MTC / REPORT / 01
REPORT NO. 31 / 2011

IFFCO

KALOL UNIT

PLANT TURNAROUND REPORT

(MARCH - APRIL - 2011)

INDIAN FARMERS FERTILISER CO - OPERATIVE LIMITED

INDEX

PREFACE

The Annual Plant Turnaround for the year 2011 was taken from 25th of March, 2011, for carrying out Preventive maintenance of Static & Rotary equipments, Statutory IBR inspection, Preventive maintenance of Electrical & Instrument systems, Civil related jobs and for attending jobs which were pending for Shut down.

After ensuring availability of all the required material for shutdown and awarding contracts for various shut down jobs, it was decided to stop Ammonia Plant and Urea Plants on 25th March, 2011. This shutdown report contains Plant wise and section wise details of the jobs carried out. Ammonia plant was restarted and regular production was lined up at 00.00 Hrs. on 7th April, 2011 .Similarly Urea plant also restarted and production was resumed at 00.00 Hrs. on 7th April, 2011.

Critical jobs like, up-gradation & integration of DCS & PLC system in Ammonia, Urea & Offsites plant. Ceramic fiber module fixing in 101-B HT convection section (bottom portion), Overhauling HP case of process air Compressor (101-JHP), overhauling of CO2 Compressor. Drive Turbine (TK-1801), Replacement of radioactive source for level measurement of Carbamate stripper, Preventive Maintenance of all Cooling Water Pumps, BFW Pumps and Turbines.

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 12 days for Ammonia Plant and Urea Plant.

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

MECHANICAL

AMMONIA:

- Major overhauling of HP Air Compressor 101-JHP was carried out.
- Major overhauling of boiler feed water pump drive turbine 104-JAT(TERRY) was carried out.
- Major overhauling of aMDEA pump 107-JA (MURRAY Turbine driven) was carried out.
- Major overhauling of Re-cycle gas compressor, 117-J was carried.
- Up-gradation of Primary Reformer HT Convection zone insulation was executed.
- New tube bundle was installed in 103-JAT/JBT gland condenser.
- Replacement of PI, TI & Drain tapping's Sockolet on the inlet and outlet piping of new Ammonia Convertor, 108-D was carried out.
- Indigenous Primary Reformer Burner Block, supplied by M/s Unifrax India Limited, Mumbai, was installed on one of the burner.

- The leaking shell of DM water tank 2002-F was repaired along the circumference at bottom.
- Boilers 101-F, 112-C & 107-C were inspected by Boiler Inspector and got approval of CIB Gujarat.
- Primary Reformer's Peep hole insulation were reinforced.
- NRV on the downstream of the FRC-2 control valve was replaced by new one.

UREA:

- Major overhauling of CO2 compressor drive turbine (Q-1801) Siemens make. Overhauling of 60 ata control valve. Overhauling of 23 ata & 4 ata servo cylinder and its pilot valves. Replaced insulation of turbine with 2 layers of ceramic fiber blanket rolls and Pyroblock insulation.

- Routine inspection of HP Condenser (H-1202) & HP Stripper (H-1201) was carried out. Eddy current testing of tubes of H-1202 and H-1201 was carried out. In HP condenser (H-1202), 1 no. tube was plugged on the basis of Eddy current testing results.

- Top half tubes (92 nos.) of 3rd inter stage cooler (H-1813) of Hitachi compressor train were replaced.

- In LP Carbamate condenser (H-1205) IRIS inspection was carried out. The tubes which were found to have thickness reduction more than 45% were plugged (21 nos. U-tubes).

- In Hydrolyser section, Chemical cleaning of Plate type heat exchanger, (H-1301 & H-1301 A) was carried out for improvement in performance.

- Replaced bottom shell of LP Absorber (V-1203) Prill tower top by Kobelco crane.

- Conveyor belt of Urea Product Conveyor – silo side (M-1403-2) was replaced.

- Loctite make Chemical resisting coating was applied on Prill Tower Fan casing and its Ducting to prevent corrosion and to minimize urea dust settlement.

- Replaced back pull assembly of CCS-I pump (P-1202 A) and both suction valve of P-1202 B.
- Routine inspection of Autoclave (V-1201), HP Condenser (H-1202) & HP Stripper (H-1201) was carried out. Flush grinding and rewelding of liner welds was performed in compartment no. 2^{nd} and 4^{th}. Repairing in V-1201 was carried out as per inspection report. Eddy current testing of tubes of H-1202 and H-1201 was also carried out and found OK.
- Shell of Flash Tank condenser, H-1421 was replaced with new one.
- M-1403-1 drive Geared Motor (M/s PBL make) was replaced with double reduction helical gear box of M/s Ingeco make.
- The fluid couplings of scraper (M/s Hansen, Belgium make) were replaced with new indigenous fluid coupling (Make-M/s Premium Energy Transmission Ltd).
- Scraper Gear box M-1402-1 was replaced with reconditioned Gear Box.

OFFSITES:

- Preventive Maintenance/Overhauling of Cooling Water Pumps, RAH, BFW Pumps and Turbines.
- Overhauling of FD fan drive turbine.
- IBR inspection of BHEL Boiler (GT-2068)
- Replacement of FD Fan discharge metallic expansion bellow.
- Removal of all soot blowers and capping of 60 ata steam line to soot blowers.
- Replacement of CW pumps discharge rubber expansion bellows
- Installation of Ceramic coated impeller in P-4401/C. (During Pre S/D Activity)
- Installation of Pump Rotor having SS impeller in P-4402.
- Installation of Peek material case wear ring in Condensate extraction pump, P-4411/A
- Complete Revamping of Urea Cooling Tower Cells (H-4402/1 to 3)

B & MH:

- Overhauling of Reclaim machine was carried out.
- All conveyor and drive gear boxes were taken for preventive maintenance.
- Preventive maintenance of all packer scales and stitching machines.
- New complete S.S. structure Flap assemblies, weighing receptacle assemblies & Sack grip assemblies replaced along with main frame in Packer Scale No. 1, 3 , 7, 10A & 10B.
- Replaced damaged conveyor belt of M 2112.

ELECTRICAL:

During this S/D period various preventive maintenance jobs and modification jobs were carried out which are illustrated as below.

- All the feeders of MCC panels were thoroughly cleaned. Burnt out/ damaged components of feeder were replaced. Tightness of connector was checked.
- Replacement of MCC-2B/2E was carried out.
- Preventive maintenance of all the transformers was carried out. Marshaling boxes were checked. Insulation resistance between HV to earth, LV to earth and Between HV and LV windings were checked and recorded. Oil having low BDV values in transformers was filtered.
- Complete Overhauling of TR-4A, TR-4B, and TR-5B was done by lifting the core. Radiators and radiators valve were replaced in TR-
- Servicing of the Siemens make HT VCBs and L&T and Siemens make LT ACBs were carried out. Closing and tripping time of all the VCBs were checked and calibrated.
- All the HT motors installed at various locations in plants were overhauled
- All the critical motors installed at various locations in plants were overhauled.
- All the MOVs were thoroughly checked in various plants.

- Actuators of following MOVs were replaced by Rotork actuators and modified control wiring accordingly.
- Preventive maintenance carried out on all rope switches installed on conveyors.

INSTRUMENTATION:

AMMONIA:

Replaced the existing obsolete DCS and ESDS were replaced with new Integrated control System from Yokogawa consisting of Centum-VP DCS and Prosafe-RS ESDS. Replaced old control valve PICV-24 with new valve.AMC services of Analyzers'/UPSS were carried out with the help of supplier's service engineers. Preventive maintenance of control valves was done .Calibration of all quality affecting instruments were carried out.

UREA:

Replaced the existing obsolete DCS and OMRON PLC were replaced with new Centum-VP DCS. Replaced the control valve make new control valve. Old source of Nucleonic gauge LRCV-1501 was replaced with new one. Instrument related jobs of Neem oil coating system were completed.

FS-1101(Old FS)- Micro motion Ammonia mass flow meter was removed and sent to EQDC, Gandhinagar for calibration. The instrument was installed back after calibration and put in line.

Servicing and overhauling of the control valves was done.Calibration of all quality affecting instruments were carried out.

UTILITY AND OFFSITE:

DCS of Boiler, DM Plant & WT plant was upgraded to New Centum-VP system. Stardom PLC system was upgraded with latest hardware and software.

FI-6001, Magnetic flow meter at Narmada water intake point was replaced with new one by service engineer from Krhone-Marshall in our presence and taken in service.

Maintenance of control valves was done.

Calibrations of all quality affecting instruments were carried out.

BAGGING PLANT:

Road Weigh Bridges and weighing machines were overhauled and calibrated.

CIVIL:

- Repairing of Refractory lining work for Primary Reformer and Auxiliary boiler in Ammonia plant
- Dismantling Brick work and PCC for laying Electrical Panel in MCC 11KV
- Fixing Pre-coated G.I Sheet at Transformer 7A & 7B and I.P. Net coating on Transformer 7A & 7B wall.

- Epoxy Nozzles grouting in scrapper floor bottom in Prill tower, I.P. Net coating in Urea plant.
- Dismantling Drain chamber and fixing valve for drain purpose in KEP-97 cooling tower.
- Chlorination “U“ PVC Pipe line extent at both side in all Cooling Towers.
- Replacement of water proofing plywood sheet on sand filter tank.
- Chlorination and Alum dosing pipe line at WTP plant.
- Acid proof brick lining in ETP tank.
- Ceramic Wall tiles fixing on wall and operator room at bagging plant 1st floor.
- Epoxy painting on wall and slab bottom at bagging 1st and 2nd floor.
- S.S. Railing in silo conveyor gallery (M-2117).
- Monolithic Plaster on Hoper floor and columns at bagging 1st floor.

TECHNICAL:

Technical Department carried out jobs related to EWRs and various modification schemes which require plant isolation.

Further, various modifications Scheme jobs were also carried out in Urea and Utility Plants in this period. These included major jobs of Scheme for Neem coated Urea, Installation of 300 m3 / Hr capacity New cooling tower, Installation of Pump with associated piping in New CT sump and a 6” dedicated DM water pipe line to boiler.

Above jobs have been completed within stipulated time because of meticulous planning, procurement of material at right time and also completion of major prefabrication work well before start of the shut down. All these jobs were executed through SOR contractors at site and no additional agency was engaged for carrying out these jobs.

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

- Neem Oil Storage tanks were fabricated in house.
- Neem oil Storage tanks were erected departmentally.
- 300 m3 / hr new Cooling Tower was designed inhouse.
- Cooling Tower Structure was so designed that only material available in in-house stocks were used and no structural steel was procured.
- More and more Piping materials and valves etc were used out of our existing stocks.
- Piping was so designed, so as to use material out of our stocks in most cases thereby minimizing Procurements, by meeting the requirements with in-house availability.
- All CT pump installation and associated piping jobs were completed with no additional procurement.

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

PLANT TURNAROUND MARCH - APRIL – 2011

GENERAL - DETAILS

EQUIPMENT UTILISED (IFFCO) :

- 135 T Kobelco Crane 01 No
- 55 T HM Crane 01 No
- 55 T TIL RT-760 Tyre mounted mobile Crane 01 No
- 15 T Coles Crane 01 No
- 18 T Tata Crane 01 No
- 10 T Escort Lift-N-Shift 01 No
- 14 T Escort Lift-N-Shift 01 No
- 03 T Forklift 03 Nos.
- 05 T Forklift 01 Nos.
- 10 T Truck 01 No
- 909 Tata (Mini Truck) 01 No

MANPOWER UTILIZED:

IFFCO MANPOWER:

- Mechanical }
- Mechanical Services } Existing
- Electrical } strength
- Instrument }

HIRED - CONTRACT MANPOWER:

Sr. No.	Category	Man days
1	General Fitter	1087
2	Rigger	1366
3	S.S. Rigger	3311
4	Fabricator	136
5	Grinder	191
6	Gas Cutter	118
7	Welder (HP)	136
8	Welder (ARC)	151
9	Carpenter	116
10	Mason	114
11	Machinist	58
12	Draftsman	-
13	Forklift Operator	-

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 B/D
06	1981	12-04-81	10-05-81	29.00	-	08-04-81	12-05-81	35.00	-	101-B Headers Planned
07	1984	01-01-84	25-01-84	25.00	-	01-01-84	25-01-84	25.00	-	Planned
08	1986	19-03-86	03-05-86	45.00	-	04-03-86	01-05-86	59.00	-	Reformer Revamping / HP Scrubber B/D
09	1987	12-04-87	03-05-87	21.00	-	12-04-87	02-05-87	20.00	-	Planned
10	1988	18-04-88	14-05-88	27.00	-	18-04-88	13-05-88	26.00	-	Planned
11	1990	05-02-90	05-03-90	29.00	688.67	31-01-90	07-03-90	35.00	829.00	Planned
12	1991	24-02-91	13-03-91	18.00	429.08	23-02-91	14-03-91	20.00	459.25	Planned
13	1992	03-11-92	03-12-92	30.60	734.91	03-11-92	04-12-92	31.00	744.75	Planned
14	1993	12-09-93	23-10-93	42.00	986.50	12-09-93	29-10-93	47.00	1120.58	Revamp-II
15	1995	14-01-95	27-01-95	14.00	311.34	11-01-95	26-01-95	16.00	352.18	Scrubber H-1203 -B/D
16	1996	14-06-96	13-07-96	30.00	712.00	13-06-96	13-07-96	30.00	694.25	Autoclave V-1201 Leakage
17	1997	12-05-97	17-06-97	35.60	875.00	12-05-97	17-06-97	36.20	870.50	Planned
18	1998	22-04-98	19-05-98	27.50	660.00	20-04-98	19-05-98	30.00	720.00	Planned
19	1999	12-04-99	30-04-99	18.00	434.50	11-04-99	28-04-99	17.00	409.75	Planned
20	2000	03-04-00	27-04-00	24.42	586.25	03-04-00	28-04-00	25.43	610.50	Planned
21	2001	25-03-01	14-04-01	20.90	501.50	25-03-01	15-04-01	21.26	510.25	Planned
22	2002	20-03-02	22-04-02	33.40	801.58	20-03-02	23-04-02	34.31	823.50	Planned
23	2003	28-05-03	25-06-03	28.04	673.00	28-05-03	25-06-03	28.33	679.83	Planned
24	2004	20-05-04	09-06-04	20.00	495.17	20-05-04	09-06-04	20.00	480.25	Planned
25	2005	22-05-05	29-06-05	38.75	930..50	22-05-05	24-06-05	33.85	812.50	Planned
26	2006	31-03-06	06-05-06	35.93	862.42	29-03-06	06-05-06	37.06	889.50	Planned
27	2007	14-04-07	08-05-07	23.72	569.25	14-04-07	05-05-07	21.38	513.0	Planned
28	2008	24-03-08	14-04-08	20.26	486.25	24-03-08	14-04-08	20.40	489.50	Planned
29	2009	16-03-09	10-04-09	25.31	607.33	16-03-09	09-04-09	24.63	591.00	Planned
30	2010	21-03-10	05-04-10	15.07	361.50	21-03-10	05-04-10	15.25	366.00	Planned
31	2011	25-03-11	07-04-11	13.25	318.00	25-03-11	07-04-11	13.12	314.92	Planned

SHUT DOWN RELATED CONTRACT

SR. NO.	PLANT	WO NO. & DATE	DESCRIPTION OF JOB	VENDOR'S NAME
1	Mech (Ammonia)	20101178 15/02/11	Major overhauling and preventive maintenance of various rotating equipment in **Ammonia**	BVL Power Systems , Hyderabad
2	Mech (Ammonia)	20101179 15/02/11	Major overhauling and preventive maintenance of various rotating equipment in **Urea and Utility** plants	Rotodyne Engineering Service , Hyderabad
3	Mech (Ammonia)	20100987 27/12/10	Services of Scaffolding & Blinding / De-blinding jobs during Annual Shutdown	Anu Engineers, Vadodara
4	Mech (Ammonia)	20101180 14/02/11	Replacement of Insulation in HT Convection Zone of Primary Reformer with Ceramic Fiber Z Section Module & Face protection	Unifrax India Limited, Mumbai
5	Mech (Ammonia)	20100859 30/11/10	Overhauling of Re-cycle gas compressor 117-J	Malhan Enterprises Pvt.Ltd.
6	Mech (Ammonia)	20101145 02/02/11	Services for Fabrication Jobs on High Pressure Lines / Steam Lines in Ammonia, Urea & Utility Plants during Annual Shut-Down	Skywin Erectors A'bad
7	Mech (Ammonia)	20101248 16/02/11	Opening & Box-up of Top Plug of Catalyst Tubes of Primary Reformer for replacement of catalyst	M/s Ram Bahadur, & Co, Allahabad
8	Mech (Urea)	20101058 13/01/11	Replacement of V-1203 shell, C3 nozzlel liner and Repairing of Weld joints of Autoclave liner	M/s Skywin Erectors, Ahmedabad
9	Mech (Urea)	20091187 02/02/10	ARC for Belt joint repairing	M/s J K Rubber Works, Ahmedabad
10	Mech (Urea)	20101235 16/02/11	INSITU RETUBING OF THIRD STAGE INTERCOOLER, (H-1813) OF UREA PLANT	M/s Emkay, Vadodara
11	Mech (Urea)	20101240 22/02/11	Spring Supports for Pipe lines in Urea & Offsites Plant	M/s Machino Engineers, West Bengal
12	Mech (O)	20090923 05/12/10	Gland re-packing of Valves	M/s Amrutha Engineering
13	Mech (O)	20101048 03/01/11	Replacement of Rubber Expansion Bellows of CW pumps disch. Line	General Engineering Works.
14	B&MH	20100887 14/12/10	Overhauling of Reclaim machine	M/s Emtici engg,VV Nagar

15	B&MH	20100517 14/08/10	Overhauling of tracking roller	M/s Hosch Equipments, Ahmedabad
16	B&MH	20100561 09/09/10	Servicing of stitching machine	M/s Gabbar Engg Ahmedabad
17	B&MH	20091187 02/02/10	Hot vulcanizing of conveyor belts	M/s J.K.Rubber works Ahmedabad
18	B&MH	20080935 22/12/08	Rubber lining of pulleys	M/s J.K.Rubber works Ahmedabad
19	Civil	20101049 22/12/10	P/A IP Net coating	M/s Krishna Conchem Products Pvt.Ltd
20	Civil	20101156 24/12/10	Repairing of Refractory lining work	M/s M.H.Detrick (India) Pvt.Ltd
21	Inspection	20091032 01/01/10	NDT Teams for carrying out Radiography work.	NDT Services, Ahmedabad.
22	Inspection	20100876 13/12/10	AUS of Reformer Tubes	PDIL, Sindri
23	Inspection	20101377 16/03/11	IRIS Inspection of LP Carbamate Condenser	Escon Technical,Chennai
24	Inspection	20091022 30/12/09	NDT Teams for carrying out Dye penetrant testing.	NDT Services, Ahmedabad
25	Inspection	20090987 21/12/09	NDT Teams for Ultrasonic thickness measurement work.	NDT Services,Ahmedabad.
26	Inspection	20090985 17/12/09	NDT Teams for carrying out Ultrasonic flaw detection.	NDT Services,Ahmedabad
27	Inspection	20091025 30/12/09	IN-Situ metallographic work	TCR Advanced Engg.,Vadodara
28	Inspection	20090836 01/12/10	Eddy current testing of HP stripper and HP Condenser Tubes.	Testex NDT, Mumbai
29	Electrical	20100911 10/12/10	Servicing of TMG make LT air circuit breakers	M/s Heatex Industries, Mumbai
30	Electrical	20100965 31/01/11	Servicing of Jyoti make 11KV vacume circuit breakers	M/s Jyoti Ltd, Vadodara
31	Electrical	20101060 10/01/11	Maintenance & Painting of transformers	M/s Unique Transformers Service, Ahmedabad
32	Electrical	20100974 12/01/11	Servicing of Rotork make MOVs	M/s Rotork Controls India, Mumbai
33	Electrical	20101277 23/02/11	Servicing of HHE make OLTC	M/s Easun MR tap changers Pvt. Ltd, Chenai
34	Electrical	20090845 29/12/09	Replacement of MCC – 2 sec A	M/s Siemens Ltd, Vadodara
35	Instrument	20090281 03/07/09	Replacement of radioactive source of Stripper.	Berthold Technologies (India) Pvt. Ltd.
36	Instrument	20101095 20/01/11	Manpower for major instrumentation jobs	A-Z Instruments Services
37	Instrument	20101318 11/03/11	Preventive maint./ checking of Ammonia Plant FUJI make UPSS	M/s Instrumentation Ltd., Kota

38	Instrument	20101327 07/03/11	AMC for servicing of ABB make Analyzers	M/s Santech System (ABB) , Ahmedabad
39	Instrument	20100580 29/9/10	Integrated Control System.	M/s Yokogawa India Ltd, Banglore
40	Instrument	20101186 5/02/11	Maintenance of Control Valves	M/s Amrutha Engineering
41	Instrument	20100563 28/09/10	Petty maintenance Jobs	M/s Saiyad & Co., Kalol
42	Mech (Plg)	20090531 29/09/09	Annual Rate Contract for supplying & application of Anti-corrosive paints in Urea & B&MH plant	M/s.Vaidehi & Co, Baroda
43	Mech (Plg)	20100493 21/08/10	Annual Rate Contractor for supplying & application of Anti-corrosive paints in Ammonia & Offsite plant	M/s B.Chauhan & Co, Kalol
44	Mech (Plg)	20101164 08/03/11	Annual Rate contract for Fabrication & Erection of piping & steel structure.	M/s.J & J Engineers – Kalol
45	Mech (Plg)	20101165 08/03/11	Annual Rate contract for Fabrication & Erection of piping & steel structure.	M/s.Smitha Engineers– Kalol
46	Mech (Plg)	20100895 22/12/10	Opening & Box-up of Heat Exchangers in Ammonia, Urea and Offsite plants.	M/s. General Engg. Bharuch
47	Mech (Plg)	20101122 01/02/11	Assisting IFFCO during Breakdown/Plant Turnaround jobs.	M/s. General Engg. Bharuch
48	Mech (Plg)	20101123 01/02/11	Assisting IFFCO during Breakdown/Plant Turnaround jobs.	M/s. J & J Engineers – Shertha
49	Mech (Plg)	20100886 13/12/10	Annual Rate Contract for Hydro jet cleaning of Heat Exchangers.	M/s.Deluxe Hydroblasting Services,Mumbai
50	Mech (Plg)	20091177 08/02/10	Rate contract for carrying out various insulation jobs.	M/s. Balaji Insulation
51	Mech (Plg)	20091179 08/02/10	Rate contract for carrying out various insulation jobs.	M/s. Khandelwal Insulation
52	Mech (Plg)	20100107	Rate contract for carrying out various Petty Maint. jobs.	M/s. J & J Engineers – Shertha
53	Mech (Plg)	20101073 07/01/11	Over hauling of Relief valves (Critical)	M/s Flotec Eng.Services, Surat
54	Mech (Plg)	20101104 30/11/10	Over hauling of Relief valves (Non-Critical)	M/s Tyco Valves & Controls India Pvt. Ltd, Vadodara

MECHANICAL

AMMONIA PLANT

AIR COMPRESSOR TRAIN (101-J)

101-JT, Air Compressor Drive Turbine:

Turbine was decoupled and both ends Journal bearings and Thrust bearings were taken for inspection. Gauss readings of the bearing pads were measured and found within limits. The pads were visually inspected as well as dye penetration tested and found OK. One of the RTD embedded thrust bearing pad was not transmitting data. The RTD was inspected by the instrument section and found not working. Hence this pad was replaced by a new pad. Bearing clearances were taken and found within the design range. The governor drive gear assembly were also inspected and found OK.

101-JLP, Air Compressor:

101-JLP, gear box end was decoupled. Journal bearings and Thrust bearings were visually inspected and dye penetration tested and found in good condition. Gauss reading of the bearing pads and base rings were measured and found within limits. Bearing clearances were taken and found within the design range. The entire bag filters as well as Roll-O-Matic filters were replaced by new one.

101-JR, Gear Box:

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

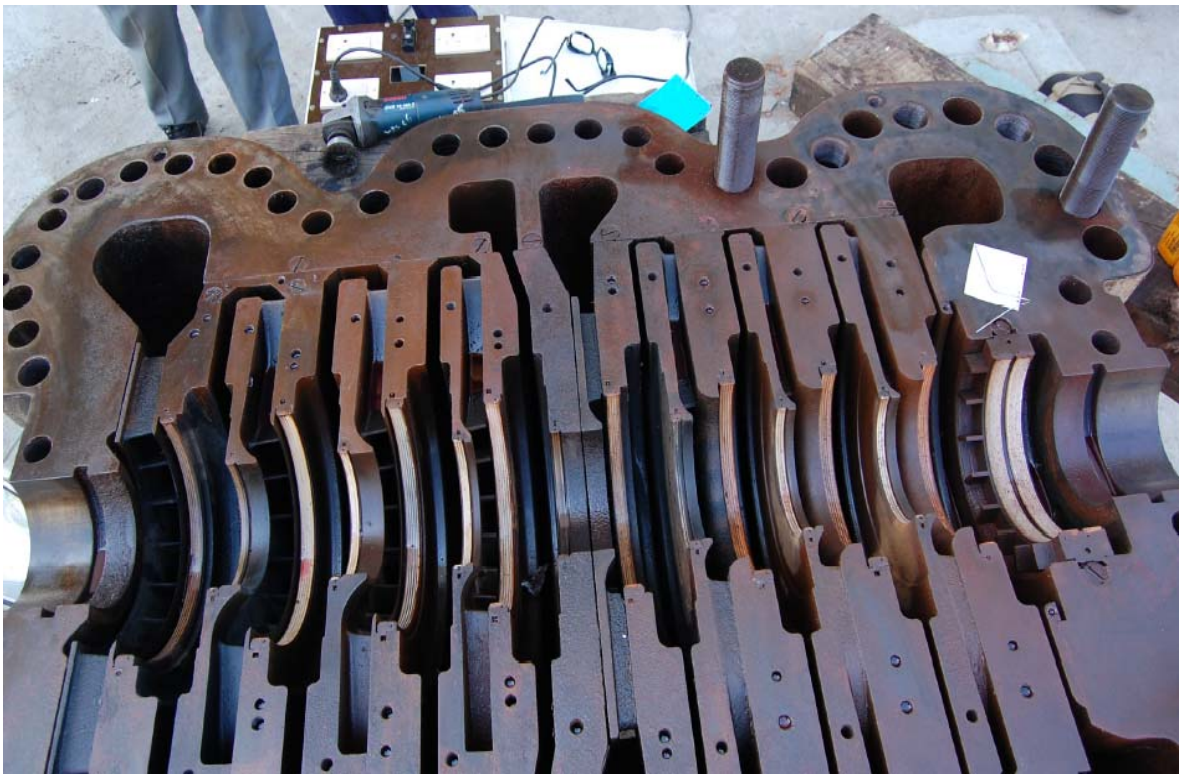
101-JHP, Air Compressor major overhauling:

The compressor was taken for major overhauling after a span of six years. The compressor was decoupled and the piping removed. The top casing was removed and various axial and diametrical clearances were measured and noted. The rotor assembly was lifted and taken for cleaning & inspection. Thick depositions were found on the vanes of the 1^{st} & 2^{nd} stage impellers. The complete rotor assembly was cleaned by hydro jetting and dye penetration test was performed and no defects were observed. The top and bottom casing were cleaned by hydro jetting followed by drying by plant air.

The journal bearing clearances were measured on mandrel and found within the design range. The journal & thrust bearing pads and their base rings were dye penetration checked and no defects were found. Gauss measurement was carried out on the complete rotor assembly as well as the bearings and the values obtained were under limit.

The rotor assembly was lifted and placed inside the bottom casing with bearing in place. The axial and diametrical clearances were measured and noted. The top casing was boxed up and the rotor end float was measured and found within limit.

REMOVED 101-JHP ROTOR ASSEMBLY INSPECTION UNDER PROGRESS



101-JHP TOP CASING CLEANING UNDER PROGRESS

<u>Couplings Inspection</u>:

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

COUPLINGS INSPECTION REPORT – 101-J TRAIN

Description	Position	Design (Inch)	Before (Inch)	After (Inch)
Distance between Hub Face (With Rotor at extreme ends)				
101 JT-JLP	---	10.557	10.556	10.556
101 JLP-JR	---	8.25	7.82	7.83
101 JR-JHP	---	8.25	8.27	8.27

CLEARANCE CHART -101-JT

Description	Position	Design Clearances (Inch)	Before (Inch)	After (Inch)
JLP End				
Journal Bearing	Mandrel	0.007-0.009	0.0065	0.0066
Oil Guard For Jr. Brg Housing	South	0.015-0.021	0.0158	0.0157
Shaft Diameter	Jr. Brg.	4.993	4.992	4.992
Governor End				
Journal Bearing	Mandrel	0.007-0.009	0.008	0.008
Axial Thrust.	With Top Housing	0.008-0.012	0.011	0.011

Journal Bearing Pads Thickness - 101 – JT

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

Thrust Bearing Pad Thickness - 101 – JT

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

Pad	ACTIVE		INACTIVE	
	Before (inch)	After (inch)	Before (inch)	After (inch)
No 3	0.938	0.938	NA	NA
No 4	0.938	0.938	NA	NA
No 5	0.938	0.938	NA	NA

CLEARANCE CHART - 101 – JLP

Description	Position	Design Clearances (Inch)	Before (Inch)	After (Inch)
101-JT END				
Journal Bearing Clearance	Mandrel	0.005-0.008	0.008	0.008
Shaft Dia.	Journal Bearing	4.493	4.491	4.491
Oil Guard (For Journal Bearing)	North	0.013-0.015	0.1014	0.014
	South	0.013-0.015	0.014	0.014
Oil Guard (For Outer Housing)	North	0.021-0.027	0.023	0.023
	South	0.021-0.027	0.023	0.023
Gear Box End.				
Journal Bearing Clearance	Mandrel	0.005-0.008	0.008	0.008
Shaft Dia	Journal bearing	4.493	4.491	4.491
Oil Guard (For Journal Bearing)	North	0.013-0.015	0.0136	0.0137
	South	0.013-0.015	0.0137	0.0137
Oil Guard (For Thrust bearing)	North	0.002-0.004	0.0019	0.0019
	South	0.002-0.04	0.0020	0.0019
Axial Thrust	With Top Housing	0.010 - 0.015	0.0115	0.0114

Journal Bearing Pads Thickness - 101 – JLP

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

Thrust Bearing Pad Thickness - 101 – JLP

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

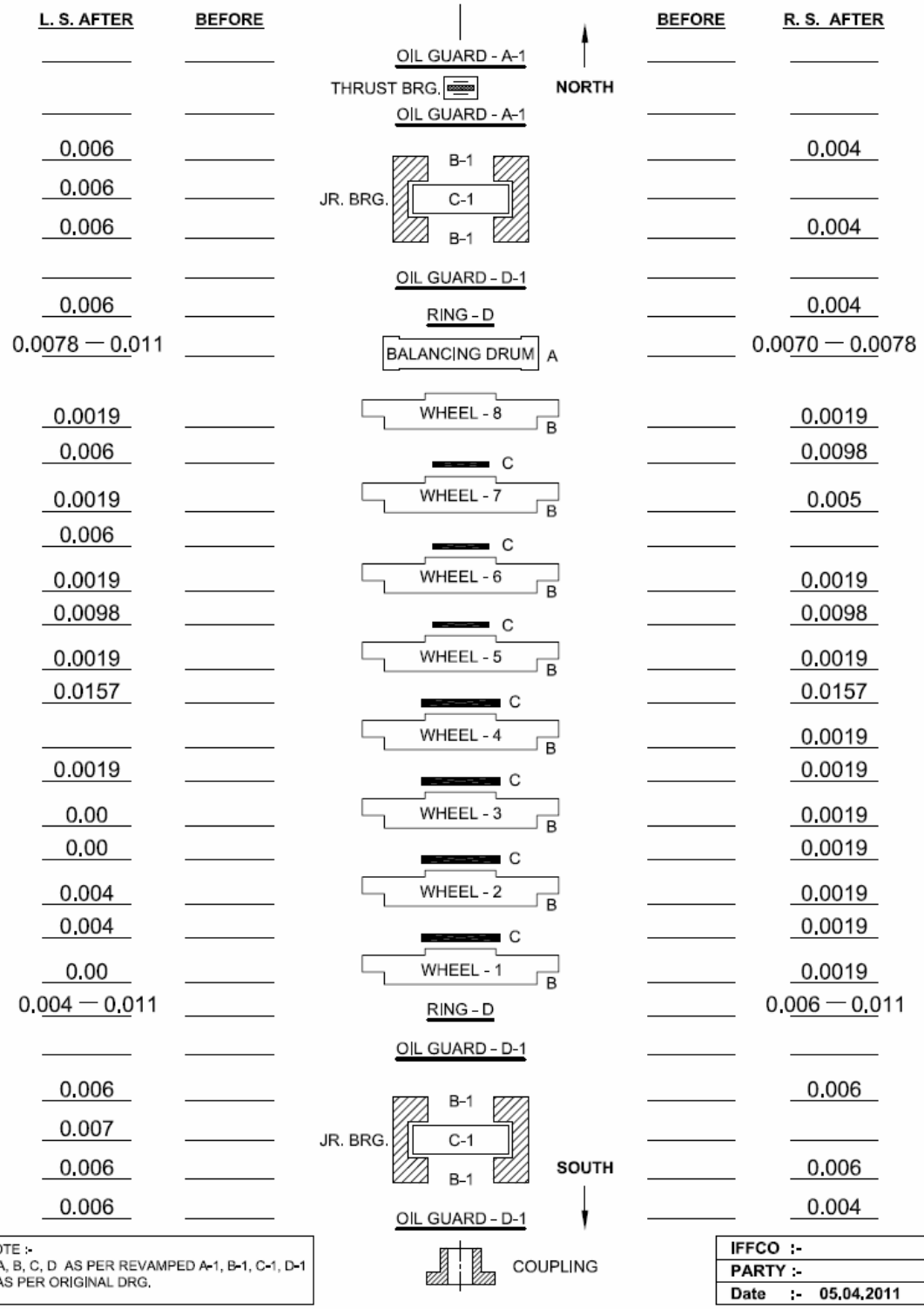
CLEARANCE CHART - 101-JR

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

IFFCO - KALOL

DIAMETRICAL CLEARANCES IN INCHES - 101 JHP

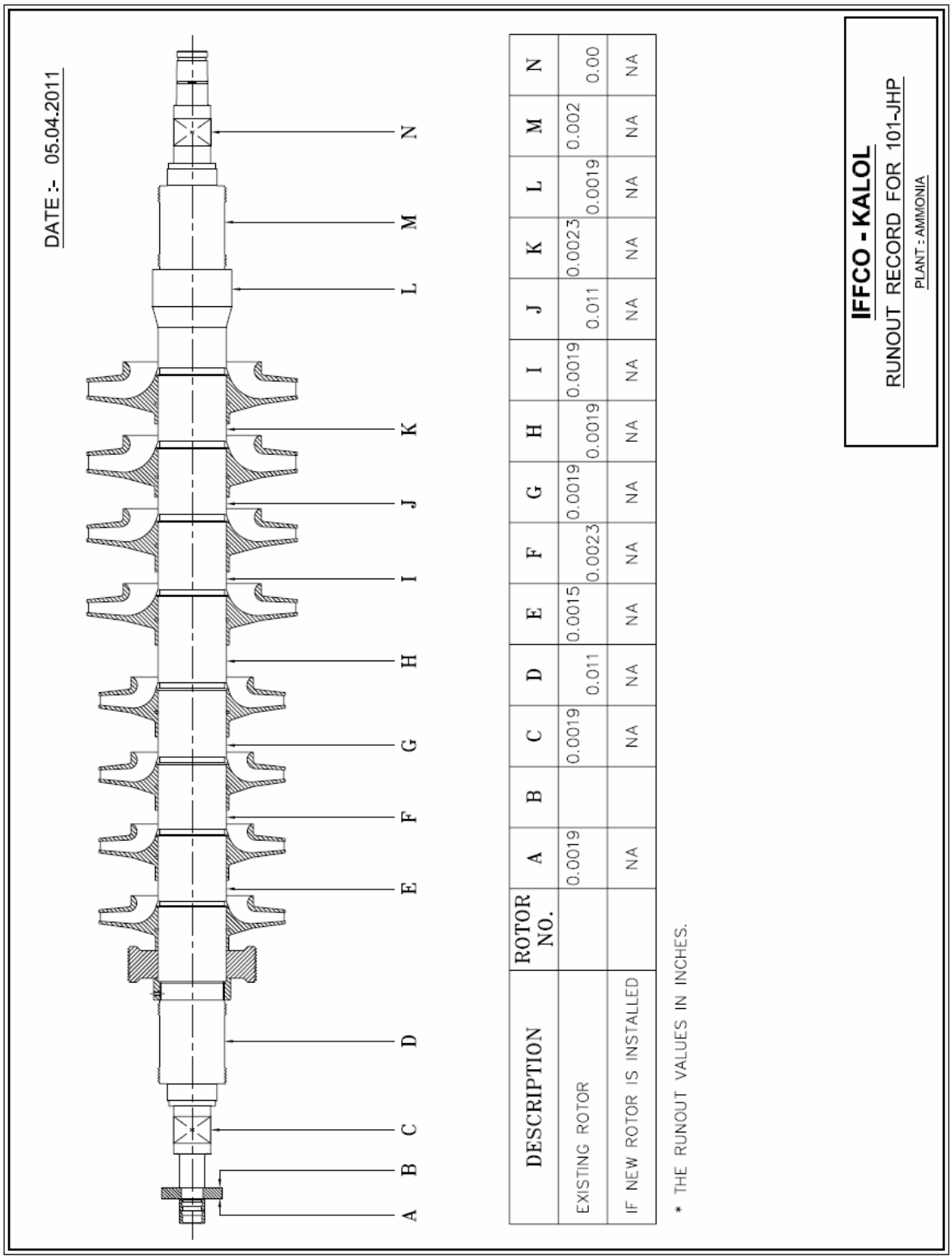
REF.	CLEARANCE - INCHES	BETWEEN	REF.	CLEARANCE - INCHES	BETWEEN
A	0.008 TO 0.012	BALA. RING TO BALA. DRUM	A1	0.002 TO 0.004	OIL GUARD TO SHAFT
B	0.010 TO 0.014	IMPELLER TO LABYRINTH	B1	0.013 TO 0.016	BEARING HOUSING TO SHAFT
C	0.010 TO 0.0125	SLEEVE TO LABYRINTH	C1	0.004 TO 0.007	BEARING PAD TO SHAFT
D	0.008 TO 0.012	SHAFT TO RING	D1	0.015 TO 0.022	OIL GUARD TO SHAFT



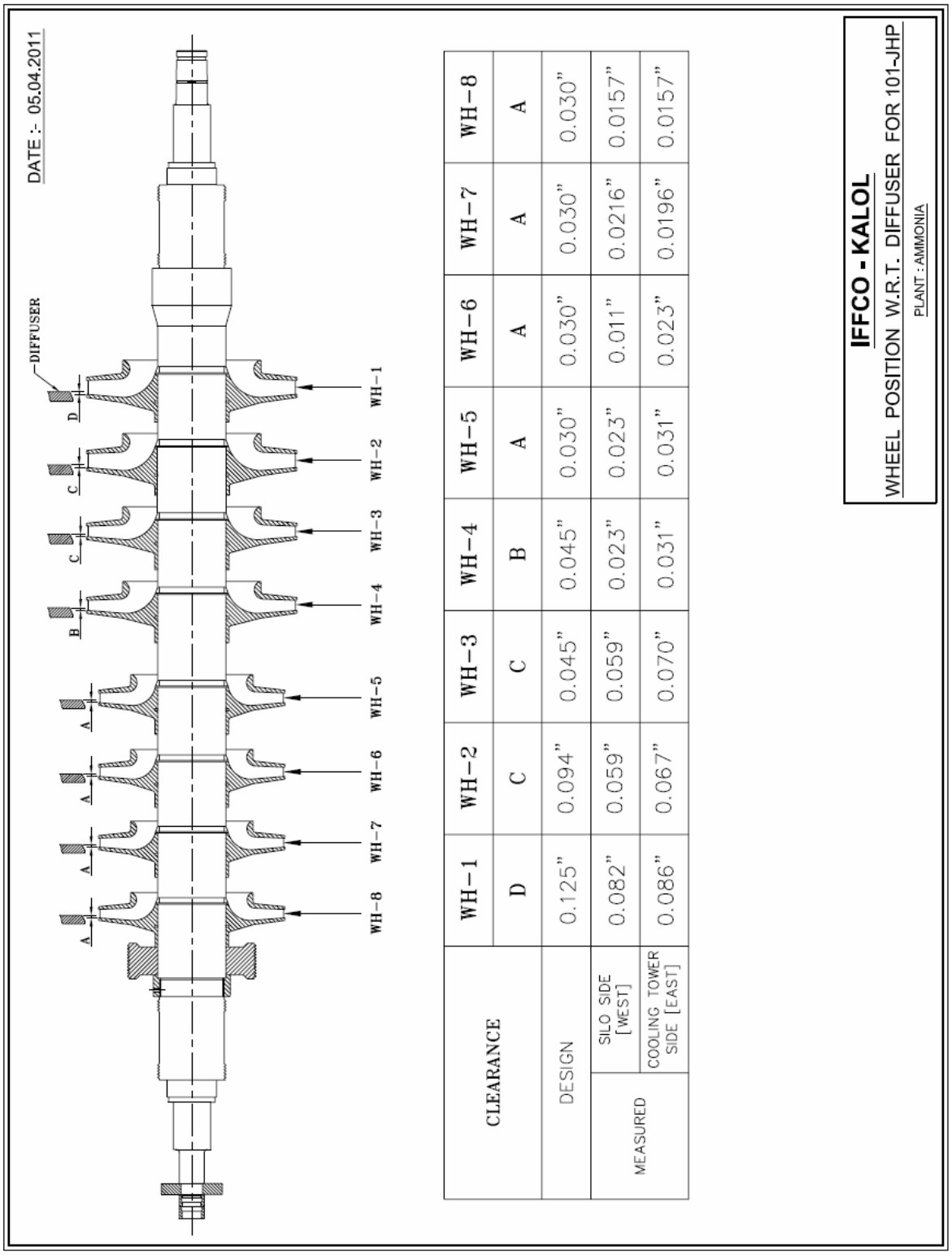
NOTE :-
* A, B, C, D AS PER REVAMPED A-1, B-1, C-1, D-1 AS PER ORIGINAL DRG.

IFFCO :-	
PARTY :-	
Date :-	05.04.2011

DIAMETRICAL CLEARANCES – 101-JHP



RUNOUT – 101-JHP ROTOR



CLEARANCE		WH-1	WH-2	WH-3	WH-4	WH-5	WH-6	WH-7	WH-8
		D	C	C	B	A	A	A	A
DESIGN		0.125"	0.094"	0.045"	0.045"	0.030"	0.030"	0.030"	0.030"
MEASURED	SILO SIDE [WEST]	0.082"	0.059"	0.059"	0.023"	0.023"	0.011"	0.0216"	0.0157"
	COOLING TOWER SIDE [EAST]	0.086"	0.067"	0.070"	0.031"	0.031"	0.023"	0.0196"	0.0157"

IFFCO - KALOL

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

PLANT : AMMONIA

AXIAL CLEARANCES – 101-JHP

CLEARANCE RECORDS – 101JHP

Description	Position	Design Clearances (Inch)	Before (Inch)	After (Inch)
GB End				
Journal Bearing Clearance	Mandrel	0.004-0.007	0.007	0.007
Shaft Dia.	Journal Bearing	2.996	3.0023	3.0023
Oil Guard (For Journal Bearing)	North	0.013-0.016	2.9948	2.9948
	South	0.013-0.016	0.0137	0.0137
Oil Guard (For Top Housing)	North	0.015-0.022	0.0157	0.0157
	South	0.015-0.022	0.0157	0.0157
Non Drive End				
Journal Bearing Clearance	Mandrel	0.004-0.007	0.0066	0.0066
Shaft Dia	Journal bearing	2.996	2.9948	2.9948
Oil Guard (For Journal Bearing)	North	0.013-0.016	0.0141	0.0141
	South	0.013-0.016	0.0141	0.0141
Oil Guard (For Thrust bearing)	North	0.002-0.004	0.1123	0.1123
	South	0.002-0.04	0.0023	0.0023
Oil Guard (For Top Housing)	North	------	------	------
	South	0.015-0.022	0.0153	0.0153
Axial Thrust	With Top Housing	0.008 - 0.012	0.0129	0.0129

Journal Bearing Pads Thickness - 101 – JHP

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

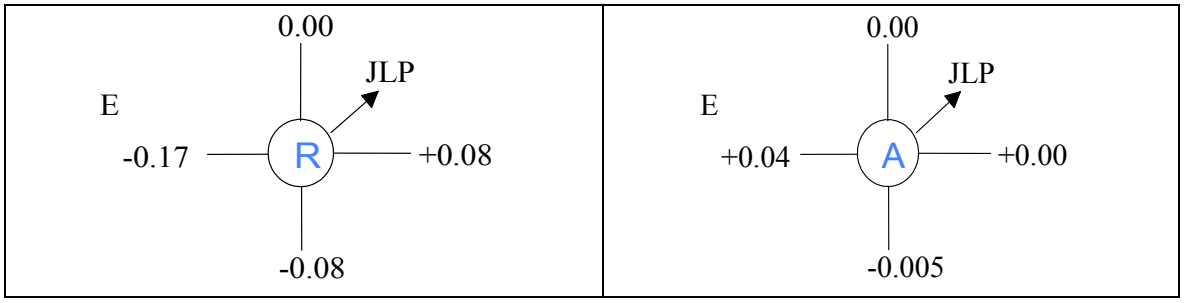
Thrust Bearing Pad Thickness - 101 – JHP

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

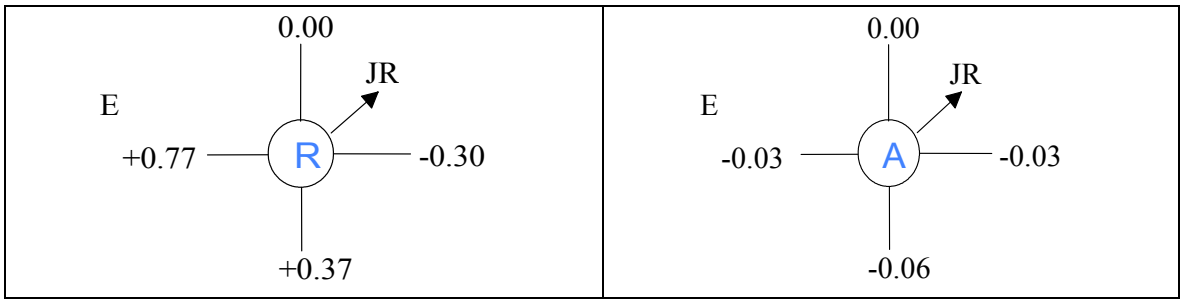
Magnetism Level Records : 101-J TRAIN

Description	Position	Before (Gauss)	After (Gauss)
101- JT			
Journal Bearing pads	Thrust End	0.7	0.7
	Non thrust end	1.5	1.5
Journal Bearing base ring	Thrust End	1.2	1.2
	Non thrust end	1.8	1.8
Thrust bearing pads	Active	2.0	2.0
	Inactive	1.2	1.2
Thrust Bearing base ring	Active	2.5	2.5
	Inactive	1.1	1.1
Shaft Journal	Thrust End	2.5	2.5
	Non thrust end	2.2	2.2
101 - JLP			
Journal Bearing pads	Thrust End	1.9	1.9
	Non thrust end	1.6	1.6
Journal Bearing base ring	Thrust End	1.8	1.8
	Non thrust end	1.6	1.6
Thrust bearing pads	Active	1.8	1.8
	Inactive	1.2	1.2
Thrust Bearing base ring	Active	2.8	2.8
	Inactive	2.4	2.4
Shaft Journal	Thrust End	2.5	2.5
	Non thrust end	1.9	1.9
101 – JR			
Gear Journal Bearing	North	1.5	1.5
	South	1.4	1.4
Pinion Journal Bearing	North	1.4	1.4
	South	1.3	1.3
Thrust bearing	Active	1.4	1.4
	Inactive	1.5	1.5
Shaft Journal	Thrust End	2.1	2.1
	Non thrust end	2.4	2.4
101 - JHP			
Journal Bearing pads	Thrust End	1.6	1.6
	Non thrust end	1.2	1.2
Journal Bearing base ring	Thrust End	1.4	1.4
	Non thrust end	1.2	1.2
Thrust bearing pads	Active	1.5	1.5
	Inactive	1.2	1.2
Thrust Bearing base ring	Active	1.6	1.6
	Inactive	1.5	1.5
Shaft Journal	Thrust End	4.8	4.8
	Non thrust end	2.5	2.5

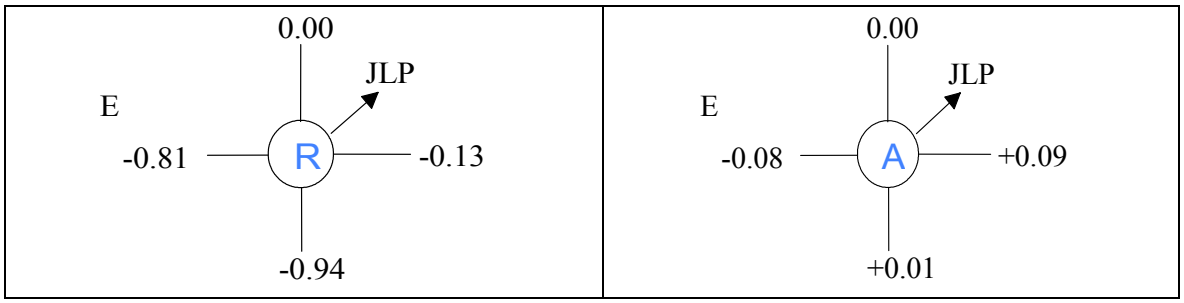
Alignment (in mm) : **101-JT to 101-JLP** After Preventive Maintenance



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



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



SYNTHESIS GAS COMPRESSOR TRAIN, 103-J:

103-JBT, Condensing turbine:

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

103-JLP, Synthesis Gas Compressor:

Journal bearings and thrust bearings which were accessible were inspected and found O.K. Gauss readings of both end journal bearing were measured and found within limit. Dye penetration test was performed on all the pads and found in good condition.

103-JHP, Synthesis Gas Compressor:

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

103-JAT, Backpressure turbine:

Turbine was decoupled and both ends Journal bearings as well as Thrust bearings were inspected and found O.K. Gauss readings of end journal bearing pad and base ring, shaft journal area, thrust bearing and thrust collar was measured and found OK. Bearing clearances were taken and found within the design range. The thrust bearing pad with RTD was found unusable since the wires were damaged. This pad was replaced by new one.
Before shutdown lot of water was observed in the oil console and hence the steam end gland housing was opened and the labyrinth packing clearance were measured which were found within limit. Simultaneously the gland condenser was opened and the tubes were found completely damaged. So it was confirmed that the reason of water in the oil console was primarily because the sealing steam was going into the bearing housing due to the leaking gland condenser. The tube bundle of this condensed was replaced by new in-house fabricated tube bundle with stress relieved U-Tubes.

DAMAGED U-TUBE BUNDLE OF 103-JAT/JBT GLAND CONDENSER

Couplings Inspection:

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

COUPLING RECORDS 103-J TRAIN

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

PREVENTIVE MAINTENANCE RECORDS: 103 – JBT

Description	Position	Clr. Chart Ref	Design Clearances (Inch)	Before (inch)	After (inch)
JAT End					
Journal Bearing	Mandrel	A	0.010-0.012	0.0105	0.0105
Oil Guard (For Jr. Brg Housing)	South	C	0.008-0.014	0.11	0.11
Oil Guard (For Seal Housing)	---	D	0.039-0.071	0.11	0.11
Bearing Pinch	Jr. Brg.			0.032	0.032
Shaft Diameter	Jr. Brg.			2.999	2.999
Governor End					
Journal Bearing	Mandrel	A	0.010-0.012	0.010	0.010
Oil Guard (For Brg. Housing	North	C	0.008-0.014	0.010	0.010
Axial Thrust.	With Top Housing		0.008-0.012	0.008	0.008

PREVENTIVE MAINTENANCE RECORDS: 103 – JBT

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

PREVENTIVE MAINTENANCE RECORDS: 103 - JAT

Description	Position	Clr. Chart Ref	Design Clearances (Inch)	Before (Inch)	After (Inch)
JLP End					
Journal Bearing	Mandrel	N	0.006-0.008	0.075	0.075
Oil Guard (For Jr. Brg Housing)	South	C	0.015-0.021	0.015	0.015
JBT End					
Journal Bearing	Mandrel	B	0.010-0.012	0.011	0.011
Oil Guard (For Brg. Housing	North	C	0.015-0.021	0.015	0.015
Axial Thrust.	With Top Housing	---	0.008-0.012	0.011	0.011
Oil Guard (For Thrust Bearing)	North	A	0.002-0.004	0.004	0.004
	South	A	0.002-0.004	0.004	0.004

PREVENTIVE MAINTENANCE RECORDS: 103 – JAT

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

PREVENTIVE MAINTENANCE RECORDS: 103 – JLP

Description	Position	Clr. Chart Ref.	Design Clearances (Inch)	Before (Inch)	After (Inch)
NON THRUST END					
Journal Bearing Clearance	Filler / lead wire	C1	0.002”-0.004”	0.004	0.004
Oil Guard (For Journal Bearing)	North	C2	0.008”- 0.013”	0.013	0.013
	South	C2	0.008”- 0.013”	0.012	0.012
THRUST END					
Journal Bearing Clearance	Filler / lead wire	C1	0.002”-0.004”	0.005	0.005
Axial Thrust	With Top Housing		0.015” - 0.022”	0.016	0.016

PREVENTIVE MAINTENANCE RECORDS: 103 – JHP

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

PREVENTIVE MAINTENANCE RECORDS : 103-J TRAIN

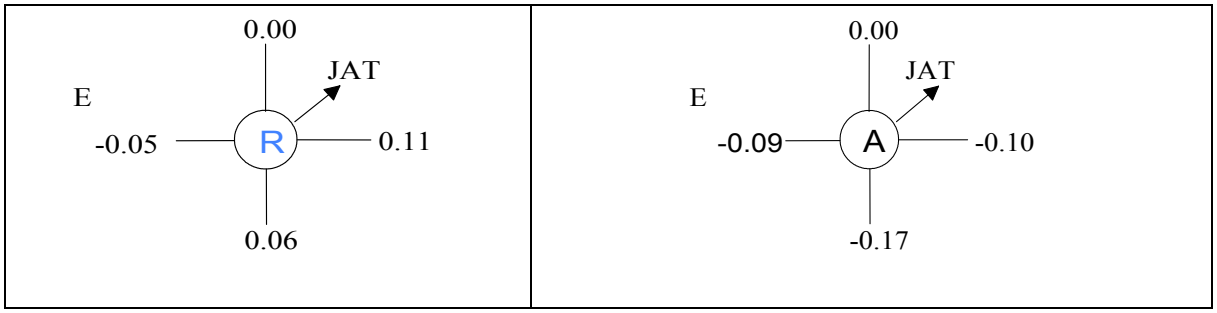
Magnetism Level Record

Description	Position	Before (Gauss)	After (Gauss)
103- JBT			
Journal Bearing Sleeve	Thrust End	1.2	1.2
	Non thrust end	2.3	2.3
Thrust bearing pads	Active	2.3	2.3
	Inactive	1.2	1.2
Thrust Bearing base ring	Active	0.9	0.9
	Inactive	1.6	1.6
Shaft Journal	Thrust End	1.3	1.3
	Non thrust end	2.5	2.5
103 - JAT			
Journal Bearing Sleeve	Thrust End	1.7	1.7
	Non thrust end	2.3	2.3
Thrust bearing pads	Active	1.7	1.7
	Inactive	1.5	1.5
Thrust Bearing base ring	Active	1.5	1.5
	Inactive	1.6	1.6
Shaft Journal	Thrust End	3.0	3.0
	Non thrust end	1.2	1.2

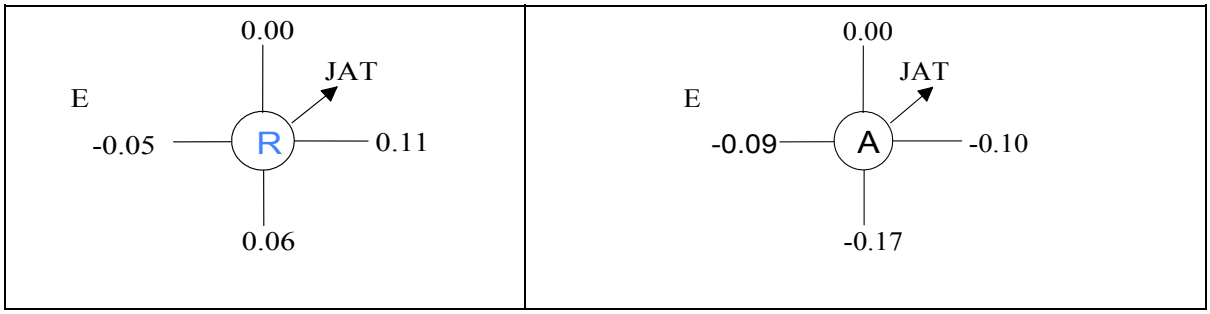
Description	Position	Before (Gauss)	After (Gauss)
Description	**Position**	**Before (Gauss)**	**After (Gauss)**
103 - JLP			
Journal Bearing Sleeve	Thrust End	1.4	1.4
	Non thrust end	1.1	1.1
Shaft Journal	Thrust End	2.2	2.2
	Non thrust end	1.6	1.6
103-JHP			
Journal Bearing Sleeve	Thrust End	0.8	0.8
	Non thrust end	0.9	0.9
Thrust bearing pads	Active	1.5	1.5
	Inactive	NA	NA
Shaft Journal	Thrust End	2.1	2.1
	Non thrust end	2.4	2.4

Alignment: 103-JBT to 103-JAT

Before Preventive Maintenance (mm)

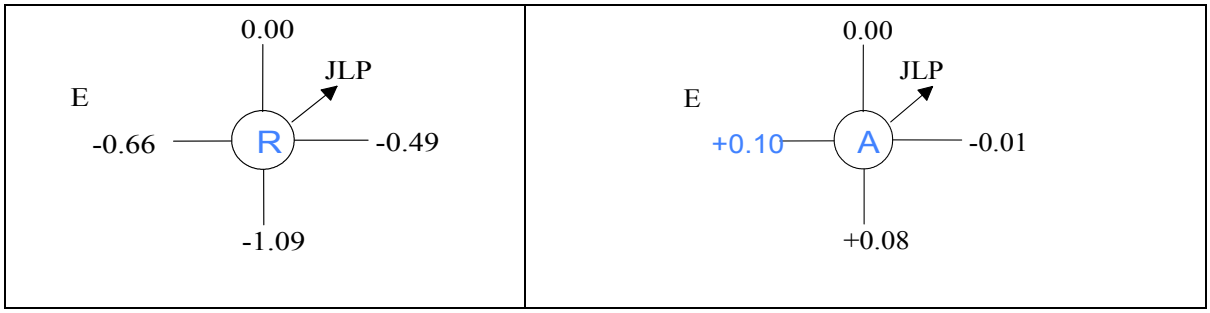


After Preventive Maintenance (mm)

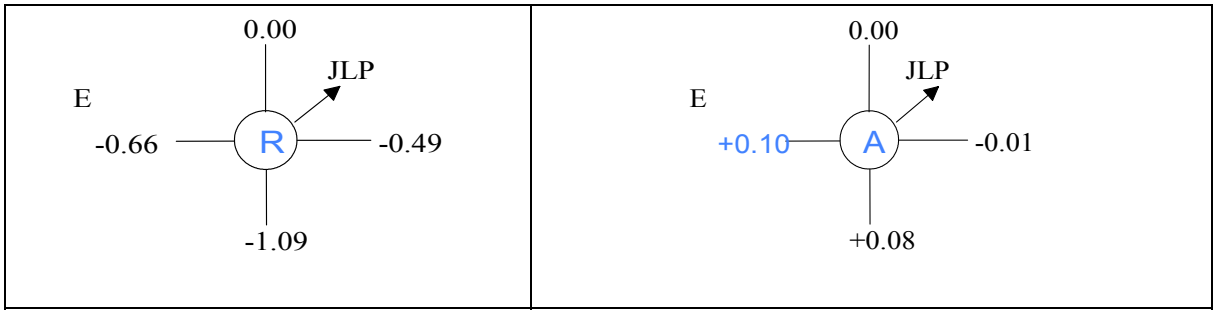


Alignment: 103-JAT to 103-JLP

Before Preventive Maintenance (mm)

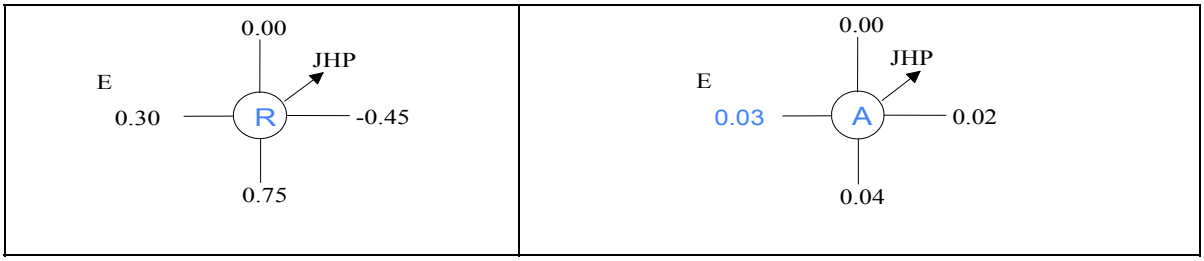


After Preventive Maintenance (mm)

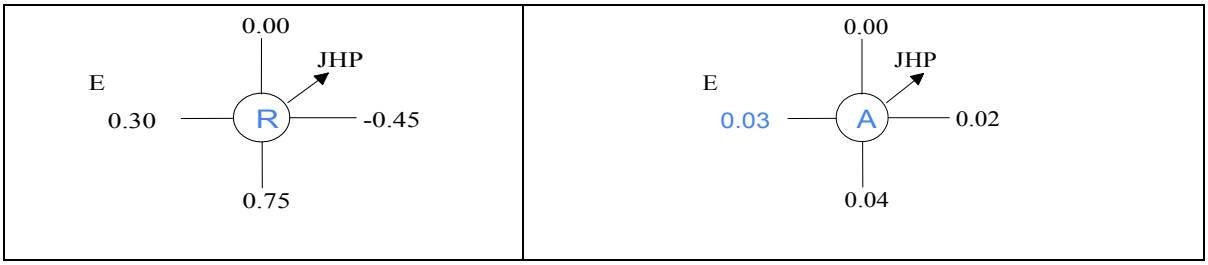


Alignment : 103-JLP to 103-JHP

Before Preventive Maintenance (mm)



After Preventive Maintenance (mm)



REFRIGERATION COMPRESSOR TRAIN 105-J:
105-JT, Refrigeration Compressor Drive Turbine:

Turbine was decoupled and both ends Journal bearings and Thrust bearings were taken for inspection. Gauss readings of the bearing pads were measured and found within limits. The pads were visually inspected as well as dye penetration tested and found OK. Bearing clearances were taken and found within the design range. The governor drive gear assembly were also inspected and found OK.

105-JLP Refrigeration Compressor:

101-JLP, gear box end was decoupled. Journal bearings and Thrust bearings were visually inspected and dye penetration tested and found in good condition. Gauss reading of the bearing pads and base rings were measured and found within limits. Bearing clearances were taken and found within the design range.

105-JR Gear Box :

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

105-JHP Refrigeration Compressor:

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

Couplings Inspection:

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

COUPLINGS RECORDS

Description	Position	Design (inch)	Before (inch)	After (inch)
Distance between Hub Face (With Rotor at extreme ends)				
105 JT-JLP	---		222.15	222.15
105 JLP-JR	---		242.17	242.17
105 JR-JHP	---		185.83	185.83

CLEARANCE CHART: 105-JT

Description	Position	Clr. Chart Ref	Design Clearances (Inch)	Before (Inch)	After (Inch)
JLP end					
Journal Bearing	Mandrel	B	0.007-0.009	0.010	0.008
Oil Guard For Jr. Brg Housing	South	C	0.015-0.021	0.015	0.020
	North	G	0.058-0.097	0.044	0.061
Oil Guard For Seal Housing	---	D	0.077-0.109	0.085	0.090
Shaft Diameter	Jr. Brg.	---	4.993	4.992	4.993
Bearing Pinch	Jr. Brg.	---	---	NA	NA
Governor End					
Journal Bearing	Mandrel	B	0.007-0.009	NA	NA
	Filler / lead wire			0.010	0.008
Oil Guard For Brg. Housing	South	---	---	---	--
	North	C	0.015-0.021	0.018	0.012
Oil Guard For Thrust Brg.	South	A	0.002-0.04	0.002	0.025
	North	A	0.002-0.004	0.003	0.005
Oil Guard For Seal Housing	---	D	0.077-0.109	0.090	0.073

Description	Position	Clr. Chart Ref	Design Clearances (Inch)	Before (Inch)	After (Inch)
Axial Thrust.	With Top Housing	---	0.008-0.012	0.014	0.011
	Without top Housing	---		NA	NA
Shim thickness. Thrust adjusting	North	---	---	NA	NA
	South	---	---	0.114	0.114
Nozzle Clearance.	---	---	0.055-0.065	0.043	0.053
Total Float	With Top Housing	---	0.180	0.20	0.19
Shaft Diameter	Journal bearing	---	4.993	4.992	4.993
Trip Lever - Plunger	---	---	0.120-0.130	0.165	0.126

Journal Bearing Pads thickness: 105 – JT

PAD	NORTH SIDE BEARING (mm)		SOUTH SIDE BEARING (mm)	
	Before	After	Before	After
No 1	**20.63**	**20.63**	**20.63**	**20.63**
No 2	**20.64**	**20.63**	**20.63**	**20.63**
No 3	**20.63**	**20.63**	**20.63**	**20.63**
No 4	**20.63**	**20.63**	**20.63**	**20.63**
No 5	**20.63**	**20.63**	**20.63**	**20.63**

Thrust Bearing Pad Thickness: 105-JT

Pad	ACTIVE (mm)		INACTIVE (mm)	
	Before	After	Before	After
No 1	**19.09**	**19.09**	**15.92(Top)**	**15.92(Top)**
No 2	**19.09**	**19.09**	**15.92(Bottom)**	**15.92(Bottom)**
No 3	**19.06**	**19.06**	**NA**	**NA**
No 4	**19.10**	**19.09**	**NA**	**NA**
No 5	**19.09**	**19.09**	**NA**	**NA**
No 6	**19.09**	**19.08**	**NA**	**NA**

CLEARANCE CHART: 105 – JLP

Description	Position	Clr. Chart Ref.	Design Clearances (Inch)	Before (Inch)	After (Inch)
TURBINE END					
Journal Bearing Clearance	By Dial Gauge	F	0.006-0.008	0.007	0.007
GEAR BOX END					
Journal Bearing Clearance	Mandrel	F	0.006 - 0.008	0.007	0.007
Shaft Dia	Journal bearing	-----		4.492	4.494
Bushing (For Journal bearing)	North	G	0.005 - 0.007	0.008	0.007
Housing (For Journal bearing)	South	E	0.014 - 0.017	0.016	0.016
Oil Guard (For Thrust bearing)	North	C	0.002 - 0.004	0.004	0.004
	South	C	0.002 - 0.004	0.004	0.005
Oil Guard (For Outer Housing)	North	A	0.020 - 0.026	0.028	0.028
Axial Thrust	With Top Housing	----	0.011 – 0.015	0.014	0.013
Shim Thickness (Axial Thrust adjusting)	North	----	---	0.372	0.372
	South	----	---	0.393	0.393

Journal Bearing Pads thickness: 105 – JLP

PAD	NORTH SIDE BEARING		SOUTH SIDE BEARING	
	Before (inch)	After (inch) (NEW PADS)	Before (inch)	After (inch)
No 1	19.02	19.05	Bearing not accessible during preventive maintenance	
No 2	19.01	19.06		
No 3	19.00	19.05		
No 4	19.01	19.05		
No 5	19.00	19.05		

Thrust Bearing Pad Thickness: 105-JLP

Pad	ACTIVE		INACTIVE	
	Before (mm)	After (mm)	Before (mm)	After (mm)
No 1	19.76	19.76	19.77	19.77
No 2	19.76	19.76	19.77	19.77
No 3	19.77	19.77	19.77	19.77
No 4	19.77	19.77	19.76	19.76
No 5	19.76	19.76	19.77	19.77
No 6	19.77	19.77	19.76	19.76
No 7	19.77	19.77	19.76	19.76
No 8	19.75	19.75	19.77	19.77

CLEARANCE CHART: 105-JR

Description	Position	Design Clearances (Inch)	Before (Inch)	After (Inch)
Journal Bearing (Low Speed drive gear)	North	0.014 – 0.016	0.016	0.016
	South	-- do --	0.016	0.016
Axial Thrust	---	0.014- 0.024	0.013	0.013
Journal Bearing (High Speed driven Pinion)	North	0.013 -	0.012	0.012
	South	-- do --	0.012	0.012
Backlash	---	---	0.009	0.009
Shaft Diameter (Low Speed drive Gear)	North Side Bearing.	---	4.992	4.992
	South Side Bearing.	---	4.992	4.992
Shaft Diameter. (High Speed driven Pinion)	North Side Bearing.	---	4.992	4.992
	South Side Bearing.	---	4.992	4.992

CLEARANCE CHART: 105 – JHP

Description	Position	Clr. Chart Ref.	Design Clearances (Inch)	Before (Inch)	After (Inch)
GEAR BOX END					
Journal Bearing Clearance	By Dial Gauge	C	0.004 – 0.007	0.006	0.006
NON DRIVE END					
Journal Bearing Clearance	Mandrel	C	0.004 – 0.007	0.006	0.006
Oil Guard (For Thrust bearing)	North	P	0.002 – 0.004	0.003	0.003
	South	P	0.002 – 0.004	0.008	0.002
Oil Guard (For Top Housing)	North	P	0.002 – 0.004	---	---
Axial Thrust	With Top Housing	---	0.009 – 0.013	0.014	0.010
Shim Thickness (Axial Thrust adjusting)	North	---	---	9.41	9.41
	South	---	---	9.72	9.72

Thrust Bearing Pad Thickness: 105-JHP

Pad	ACTIVE		INACTIVE	
	Before (mm)	After - NEW (mm)	Before (mm)	After (mm)
No 1	14.25	14.33	14.24	14.24
No 2	14.25	14.33	14.26	14.26
No 3	14.27	14.33	14.23	14.23
No 4	14.27	14.33	14.26	14.26
No 5	14.26	14.33	14.24	14.24
No 6	14.25	14.33	14.25	14.25
No 7	14.26	14.33	14.26	14.26
No 8	14.26	14.33	14.26	14.26

Magnetism Level Record: 105 – JT

Description	Position	Before (Gauss)	After (Gauss)
Journal Bearing pads	Thrust End	1.1	1.1
	Non thrust end	0.7	0.7
Journal Bearing base ring	Thrust End	1.3	1.3
	Non thrust end	1.9	1.9
Thrust bearing pads	Active	1.1	1.1
	Inactive	0.3	0.3
Thrust Bearing base ring	Active	1.7	1.7
	Inactive	1.6	1.6
Shaft Journal	Thrust End	1.3	1.3
	Non thrust end	1.3	1.3
Thrust Collar	---	1.3	1.3

Magnetism Level Record: 105 – JLP

Description	Position	Before (Gauss)	After (Gauss)
Thrust bearing pads	Active	1.4	1.4
	Inactive	1.7	1.7
Thrust Bearing base ring	Active	2.2	2.2
	Inactive	2.4	2.4
Shaft Journal	Thrust End	2.7	2.7
	Non thrust end	2.8	2.8
Thrust Collar	----	1.4	1.4

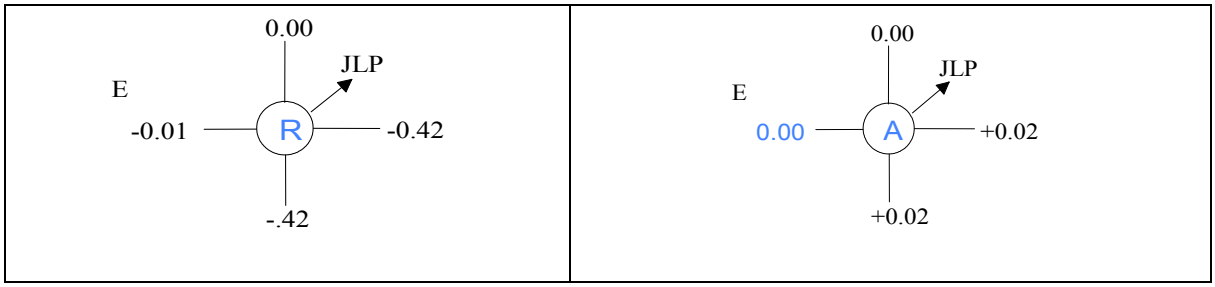
Magnetism Level Record: 105 – JR

Description	Position	Before (Gauss)	After (Gauss)
Gear Journal Bearing	North	1.6	1.6
	South	1.5	1.5
Pinion Journal Bearing	North	1.8	1.8
	South	2.2	2.2
Thrust bearing	Active	1.3	1.3
	Inactive	1.8	1.8
Oil Guard for Above	South	1.2	1.2
	North	1.4	1.4
Shaft Journal	GEAR (Both ends)	1.8-1.2	1.8-1.2
	PINION (Both ends)	1.3-2.6	1.3-2.6

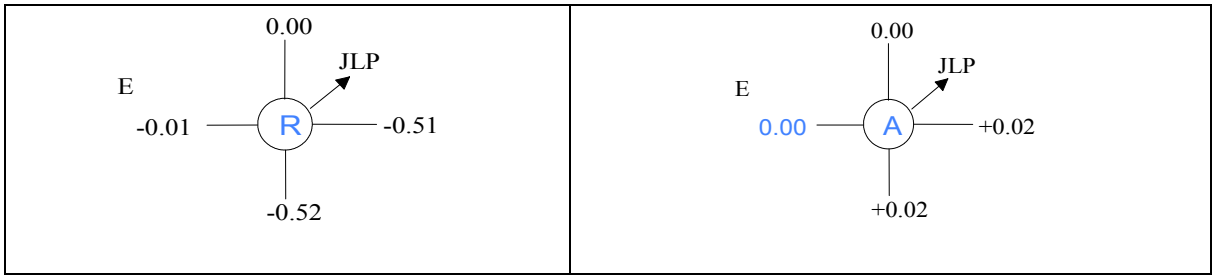
Magnetism Level Record: 105 – JHP

Description	Position	Before (Gauss)	After (Gauss)
Thrust bearing pads	Active	0.6	0.6
	Inactive	0.3	0.3
Thrust Bearing base ring	Active	1.2	1.2
	Inactive	3.5	3.5

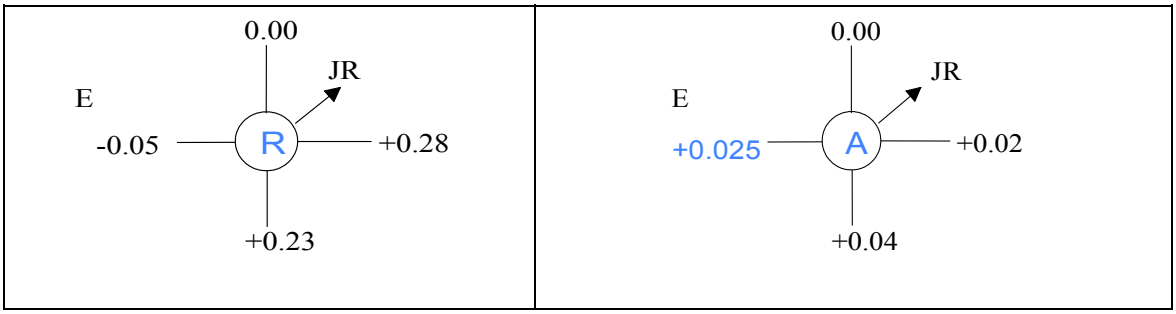
Alignment (in mm): 105-JT to JLP (Before PM)



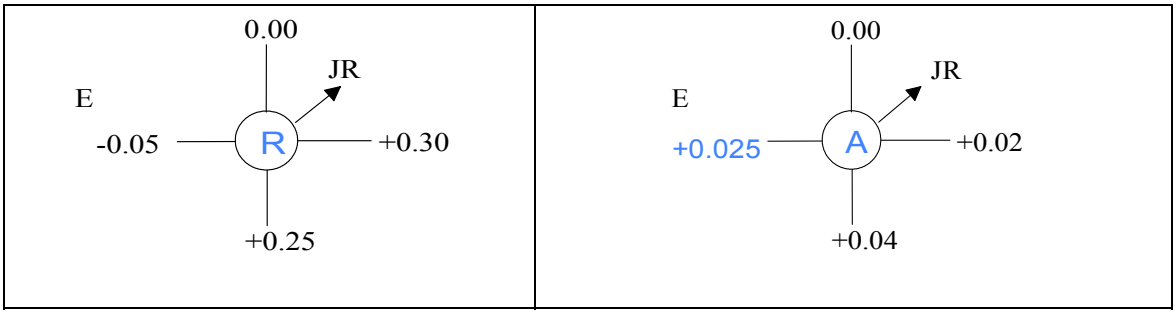
Alignment (in mm): 105-JT to JLP (After PM)



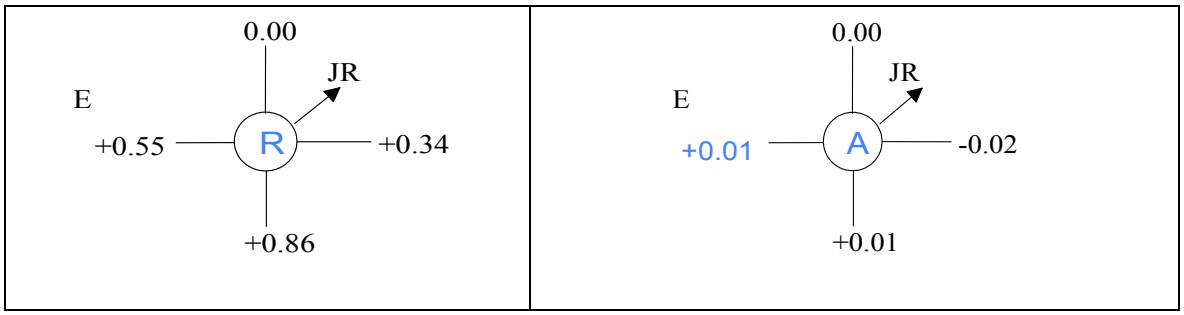
Alignment (in mm): 105 JLP to GB (Before)



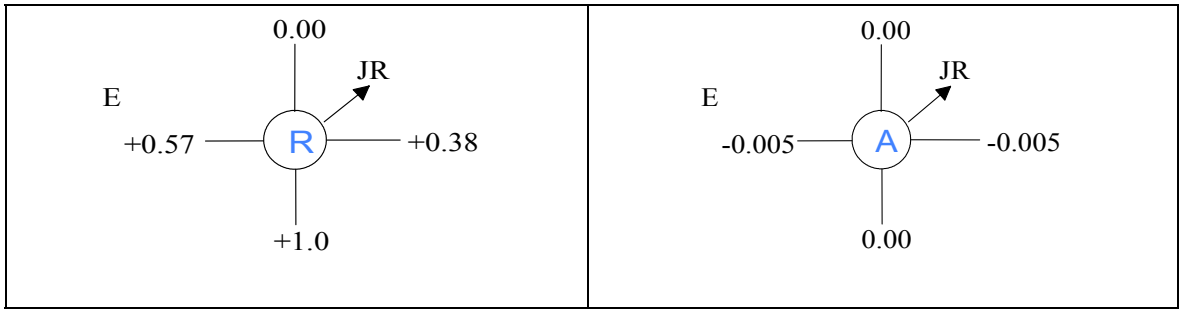
Alignment (in mm): 105 JLP to GB (After)



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



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



INDUCED DRAFT FAN TRAIN (101-BJ):

101- BJT Drive Turbine :

The turbine was decoupled and both ends bearing housing opened. The thrust bearing and both ends radial bearings clearance were measured and found within limit. The bearing pads were visually inspected and DP inspected and found OK. The gauss measurement was taken and found within acceptable limit. The PGPL actuator oil was flushed. The auxiliary lube oil cooler was showing problem of oil leakage. Hence the same was replaced by spare refurbished one.

101- BJ Fan :

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

101-BJR Gear box :

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

Couplings Inspection:

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

CLEARANCE CHART 101- BJT

Description	Position	Clr. Chart Ref	Design Clearances (Inch)	Before (Inch)	After (Inch)
Gear Box End					
Journal Bearing	Filler / lead wire	---	0.007-0.010	0.011	0.011
Oil Guard (For Jr. Brg Housing)	CT Side	---	0.015-0.0195	0.013	0.014
	SILO Side	---	0.015-0.0195	0.013	0.014
Governor End					
Journal Bearing	Filler / lead wire	---	0.006-0.009	0.011	0.011
Oil Guard (For Brg. Housing	CT Side	---	0.015-0.0195	0.014	0.014
Axial Thrust.	With Top Housing	---	0.014	NIL	NIL

101-BJR				
Description	**Position**	**Design Clearances (Inch)**	**Before (Inch)**	**After (Inch)**
Journal Bearing (High Speed drive Pinion)	CT Side	0.005-0.008	0.006	0.006
	SILO Side	0.005-0.008	0.007	0.007
Axial Thrust	---		0.024	0.024
Journal Bearing (Low Speed driven Gear)	CT Side	0.005-0.008	0.006	0.006
	SILO Side	0.005-0.008	0.007	0.007
Backlash	---	0.013-0.017	0.016	0.016
Shaft Diameter (High Speed drive Pinion)	CT Side	---	4.494	4.494
	SILO Side	---	4.494	4.494
Shaft Diameter. (Low Speed driven Gear)	CT Side	---		
	SILO Side	---	4.47	4.47

CLEARANCE CHART: 101 – BJ

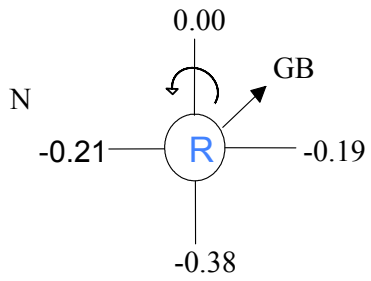
Description	Position	Clr. Chart Ref	Design Clearances (Inch)	Before (Inch)	After (Inch)
Gear Box End					
Journal Bearing	Filler / lead wire	---	0.008 - 0.012	0.012	0.012
Shaft Diameter	Jr. Brg.	---	---	6.997	6.997
Free End					
Journal Bearing	Filler / lead wire	---	0.008 - 0.012	0.012	0.012
Axial Thrust.	With Top Housing	---	---	0.029	0.019
Shaft Diameter	Journal bearing	---	---	6.997	6.997
Coupling float					
101-BJ to 101-BJR				3.3	3.3

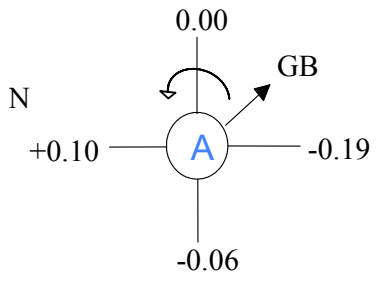
GAUSS RECORDS - 101-BJ TRAIN

Description	Position	Before (Gauss)	After (Gauss)
101- BJT			
Journal Bearing liner	CT Side	2.0	2.0
	SILO Side	1.2	1.2
Shaft Journal	CT Side	2.3	2.3
	SILO Side	2.0	2.0
101 – JR (High Speed drive Pinion)			
Journal Bearing	CT Side	1.2	1.2
	SILO Side	0.7	0.7
Shaft Journal	CT Side	2.3	2.3
	SILO Side	2.5	2.5
101 – JR (Low Speed driven Gear)			
Journal Bearing	CT Side	1.5	1.5
	SILO Side	1.3	1.3
Shaft Journal	CT Side	2.2	2.2
	SILO Side	2.5	2.5
101-BJ			
Journal Bearing	CT Side	1.7	1.7
	SILO Side	1.7	1.7
Shaft Journal	CT Side	2.3	2.3
	SILO Side	0.9	0.9

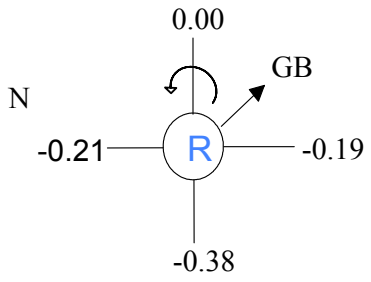
ALIGNMENT RECORDS

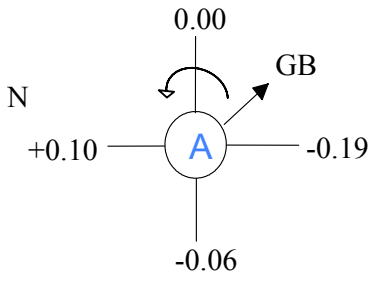
101 BJT to 101 BJR (Before PM) in mm



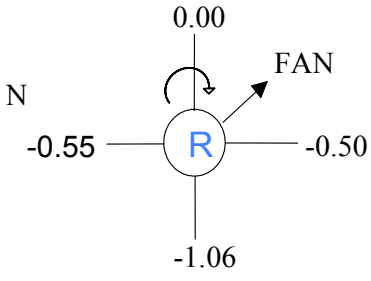


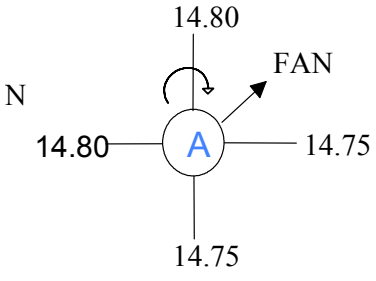
101 BJT to 101 BJR (After PM) in mm



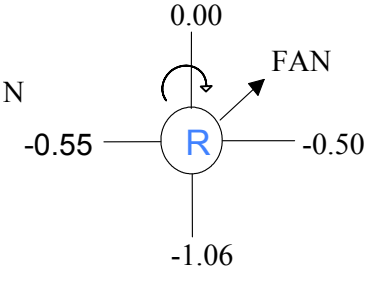


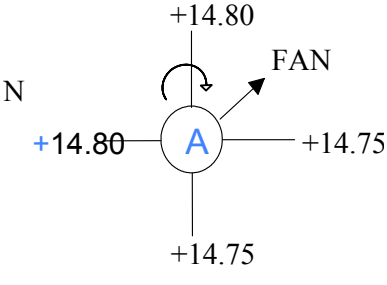
101 BJR (G/B) to 101 BJ (Before PM) in mm





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





SEMILEAN SOLUTION PUMP TRAIN (115-JA):

115-JA, Semilean Solution Pump :

The pump was decoupled and both ends bearing housing opened. The thrust bearing and both ends radial bearings clearance were measured and found within limit. The bearing pads were visually inspected and DP inspected and found OK. The gauss measurement was taken and found within acceptable limit. The suction strainer was cleaned. The mechanical seal flushing line strainer was cleaned.

115-JAT Drive Steam Turbine :

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

115-JAR Gear Box :

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

Hydraulic Turbine 115-HT:

The hydraulic coupling was decoupled and both ends bearing housing opened. The thrust bearing and both ends radial bearings clearance were measured and found within limit. The bearing pads were visually inspected and DP inspected and found OK. The gauss measurement was taken and found within acceptable limit. The suction strainer was cleaned. The mechanical seal flushing line strainer was cleaned.

CLEARANCE RECORD: 115-JA

Description	Design Clearances (Inch)	Before (Inch)	After (Inch)
Journal bearing (Thrust end)	0.005-0.0098	0.0078	0.0078
Journal bearing (Non thrust end)	0.005-0.0098	0.0066	0.0066
Axial Thrust	0.013 – 0.015 (0.35 - 0.40 mm)	0.011	0.011

Thrust Bearing Pad Thickness: 115-JA

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

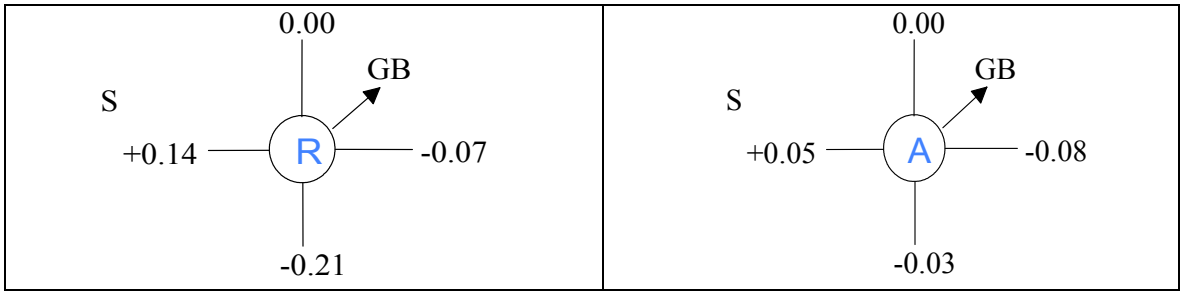
CLEARANCE CHART: 115-HT

Description	Design Clearances (Inch)	Before (Inch)	After (Inch)
Thrust end bearing	0.0048-0.0058	0.055	0.055
Opp Thrust end bearing	0.0048-0.0058	0.055	0.055
Axial Thrust	0.010-0.011	0.010	0.010

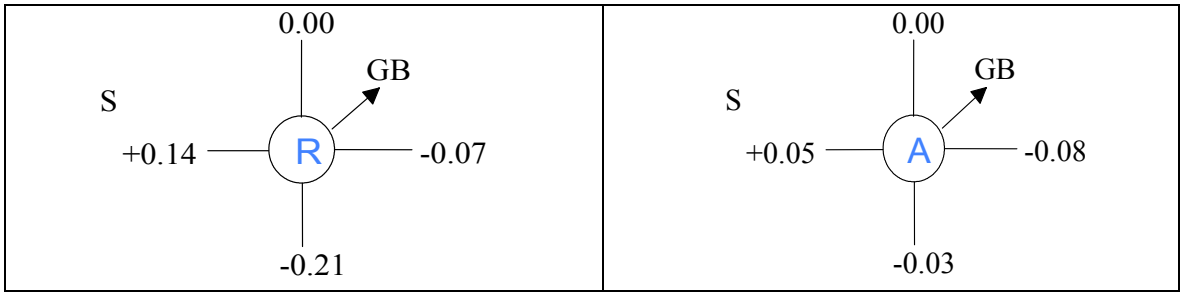
CLEARANCE CHART: 115- JAT

Description		Design Clearances (Inch)	Before (Inch)	After (Inch)
Axial Thrust		0.010 – 0.012	0.009	0.009
Coupling side bearing		0.0055-0.008	0.014	0.014
Governor side bearing		-- do --	0.010	0.010
Oil Guard Coupling side (inboard)	Radial	0.0100-0.0125	0.0118	0.0118
Oil Guard Coupling side (outboard)	Radial	0.0100-0.0125	0.010	0.010
Oil Guard Governor side	Radial	0.0100-0.0125	0.011	0.011

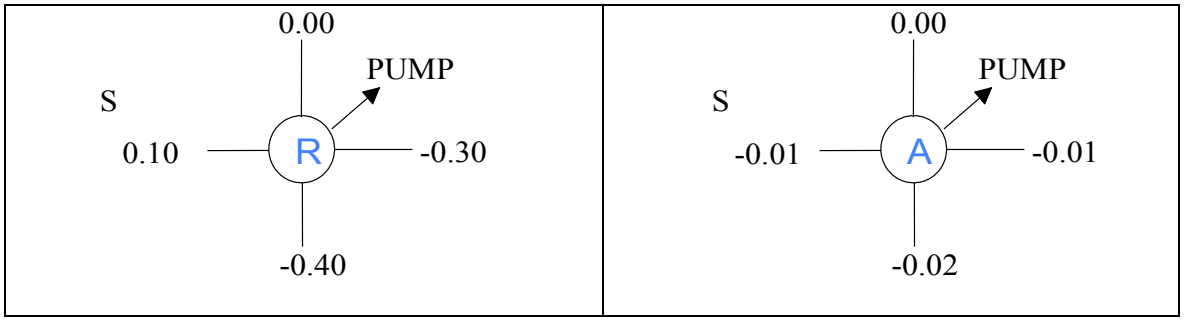
Alignment: 115-JAT to 115-GB (BEFORE) in mm



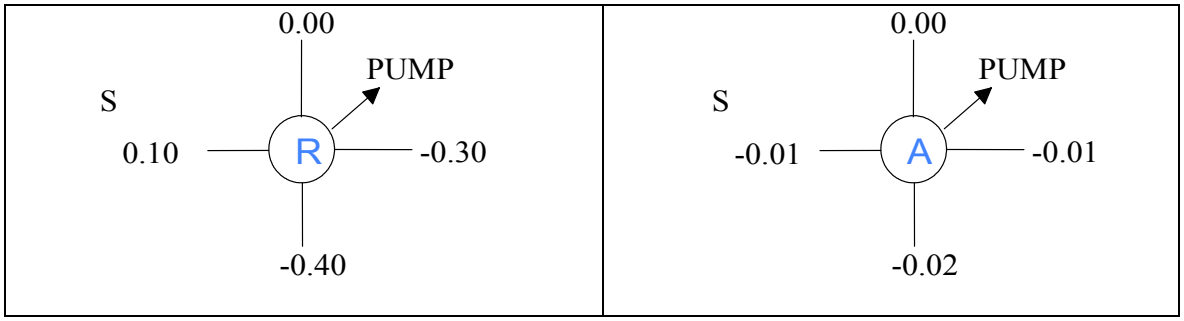
Alignment: 115-JAT to 115-GB (AFTER) in mm



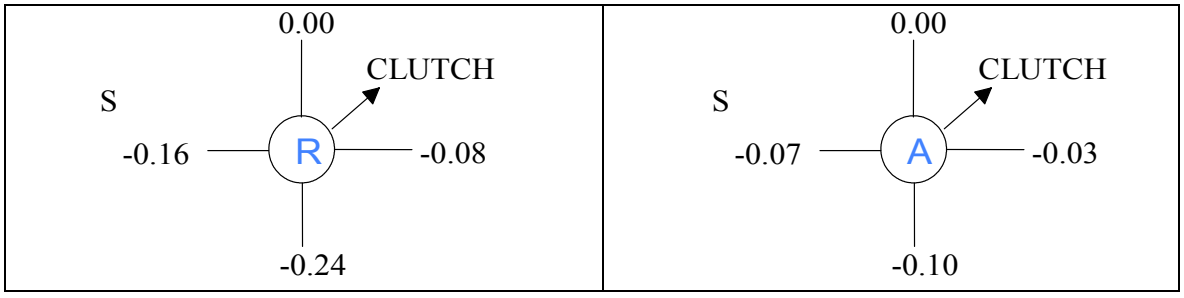
Alignment: 115-GB to 115-JA (BEFORE PM) in "mm"



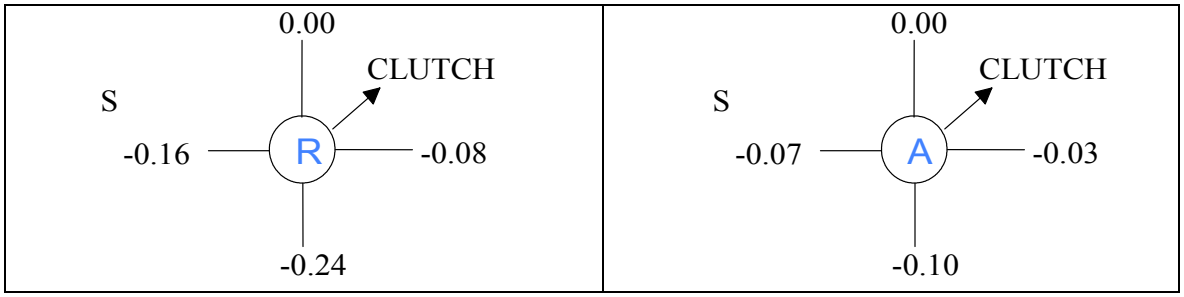
Alignment: 115-GB to 115-JA (AFTER PM) in "mm"



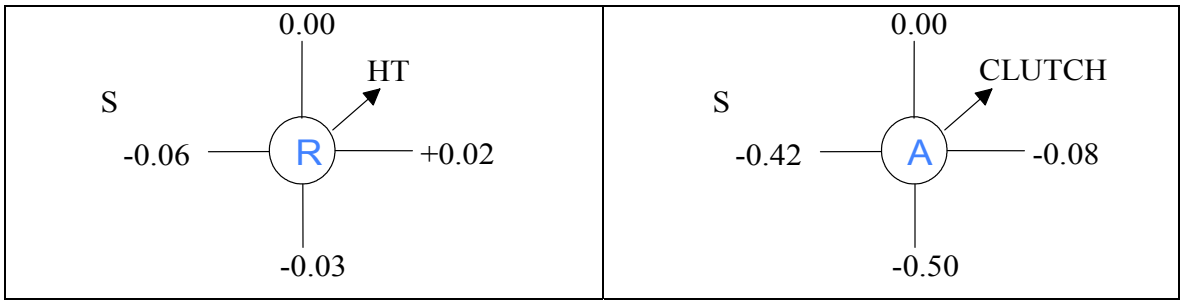
Alignment: 115-JA to CLUTCH (BEFORE PM) in "mm"



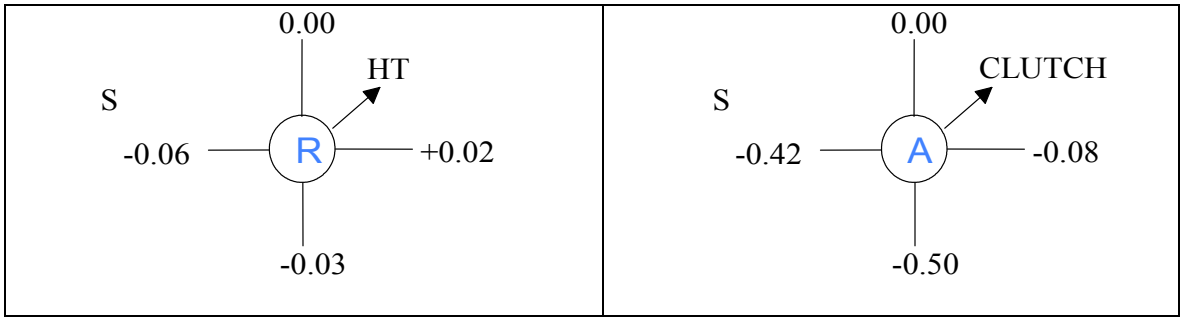
Alignment: 115-JA to CLUTCH (AFTER PM) in "mm"



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



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



BOILER FEED WATER PUMP, TRAIN 104-JA:

104-JA Boiler Feed Water Pump :

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

104-JAT Drive Turbine Overhauling:

The equipment was taken for Major overhauling. The turbine was decoupled and the exhaust pipe spring hanger was locked. After measuring the bearing clearances, the exhaust bellow was removed and the top casing was removed. The internal clearances were noted and the rotor was removed. The diaphragms were removed and the same were cleaned. The rotor was cleaned and dye penetration test was performed and no

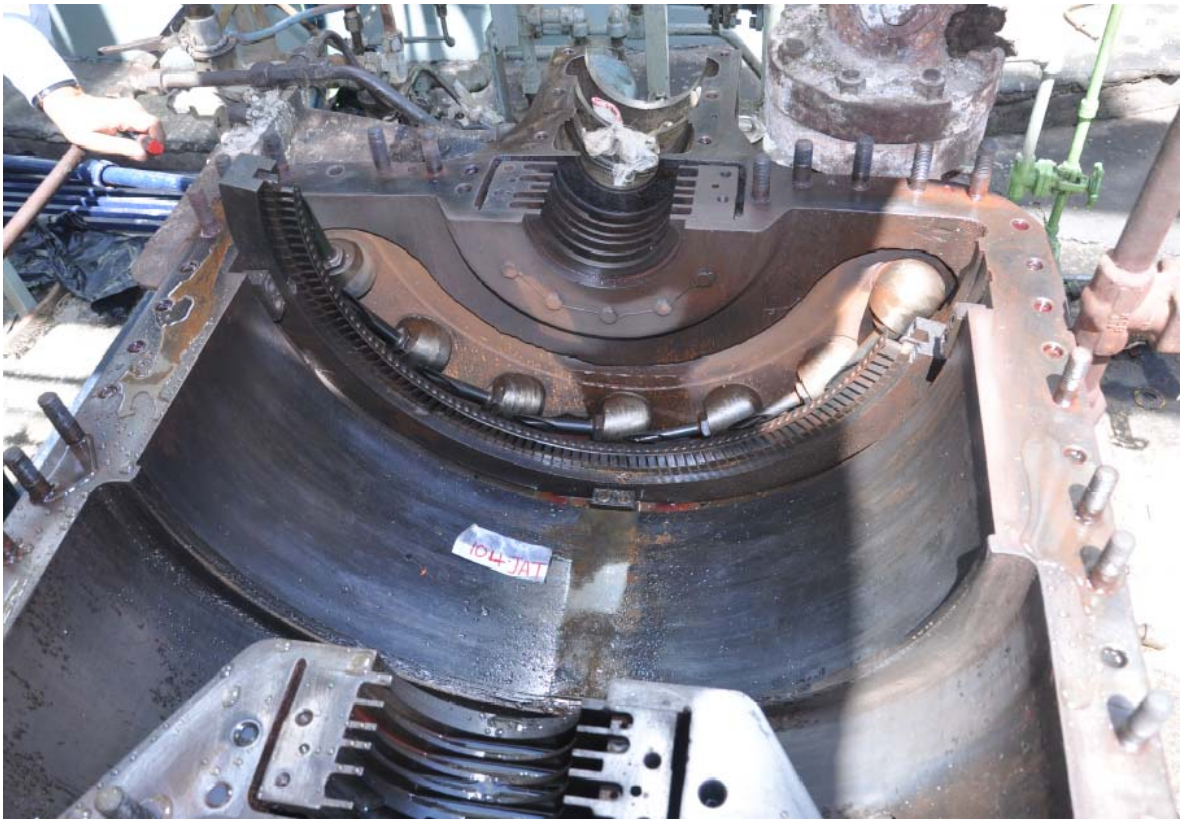
defects were observed. Both end journal bearings were inspected and the coupling end bearing was found to be having cracks. Hence this bearing was replaced by new one. The diaphragms were reinstalled and the rotor was placed inside. The carbon ring gland packings were replaced by new ones. The internals axial clearances were measured and found within limit. The journal bearing clearances and the end float were measured and found within acceptable range.
The coupling end sealing steam outlet was extended to bring its opening out of the insulation. The steam end sealing steam line was cleaned. The oil pump console was cleaned and filled with new oil. The governing valve stem carbon ring packing was replaced by new packing indigenously manufactured at Gujarat carbon.

Coupling inspection:

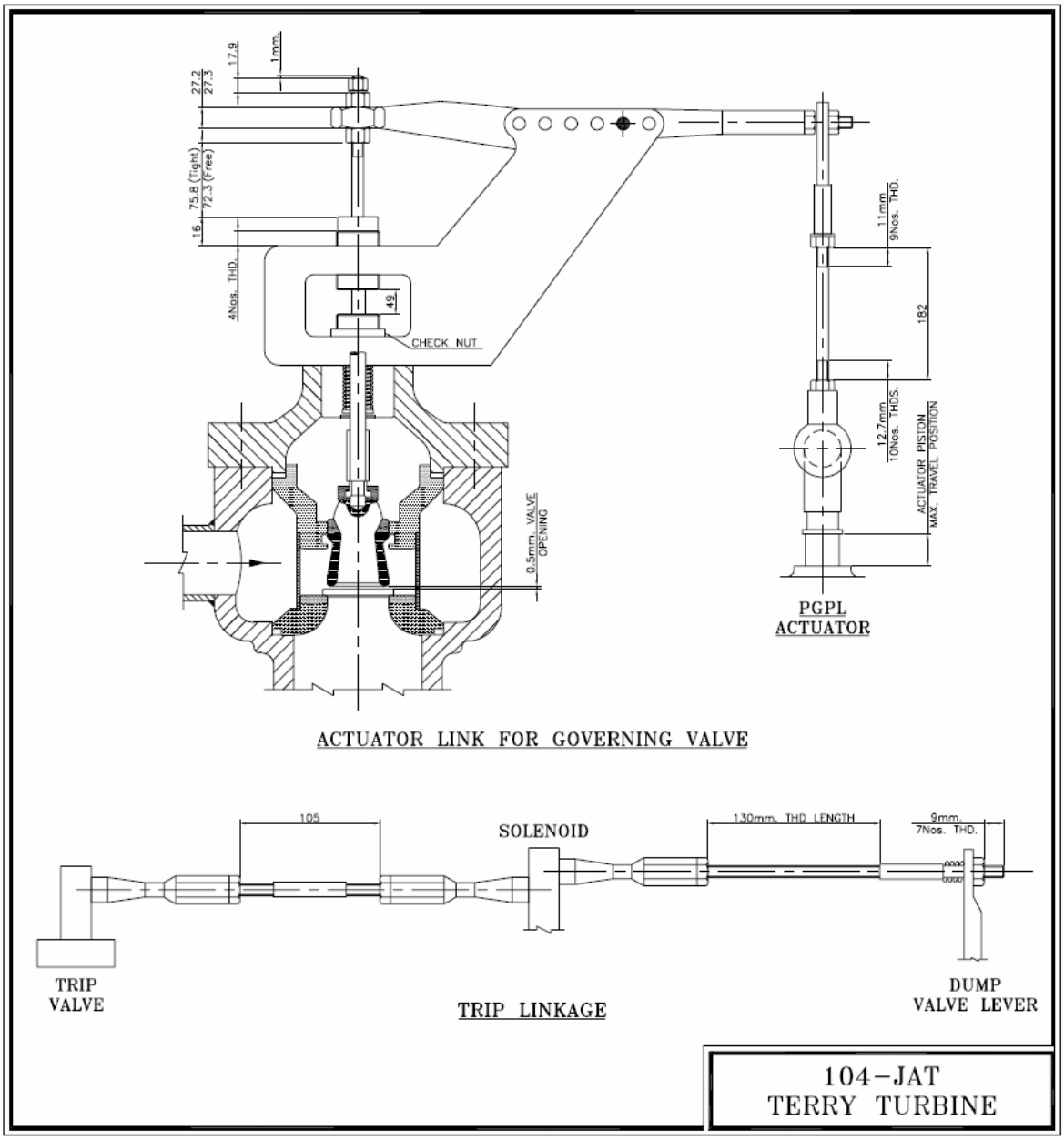
The coupling was inspected and none of the flexible element assembly was having broken shims. The DBSE and coupling hub / shaft overhang was measured and found within limit.

104-JAT ROTOR UNDER INSPECTION

104-JAT DIAPHRAGMS CLEANING & INSPECTION UNDER PROGRESS



104-JAT BOTTOM CASING CLEANING & INSPECTION UNDER PROGRESS



104-JAT GOVERNING VALVE & TRIP VALVE LINKAGES SETTINGS

IFFCO - KALOL

DIAMETRICAL CLEARANCES IN INCHES - 104-JAT		
REF.	CLEARANCE - INCHES	BETWEEN
B1	0.007 TO 0.010	SHAFT TO CARBON RING
B2	0.004 TO 0.007	SHAFT TO CARBON RING
C	0.020 TO 0.025	SLEEVE TO LABYRINTH
D	0.005 TO 0.007	JOURNAL BEARING

AFTER (INCH) (Inch)	BEFORE (INCH) (Inch)		BEFORE (INCH) (Inch)	AFTER (INCH) (Inch)
0.007	0.007	NORTH THRUST CUM JR. BEARING D1		
0.001		OIL GUARD - E		
0.007	0.010	CARBON RING - B1		
0.007	0.010	CARBON RING - B1		
0.006	0.010	CARBON RING - B1		
0.007	0.010	CARBON RING - B1		
0.007	0.010			
		WHEEL-1		
0.011	0.011		0.011	0.011
		C WHEEL-2		
0.011	0.011		0.011	0.011
		C WHEEL-3		
0.011	0.011		0.011	0.011
		C WHEEL-4		
0.011	0.011		0.011	0.011
		C WHEEL-5		
0.011	0.011		0.011	0.011
		C WHEEL-6		
0.004	0.007	CARBON RING - B2		
0.003	0.007	CARBON RING - B2		
0.004	0.007	CARBON RING - B2		
0.004	0.007	CARBON RING - B2		
0.004	0.007	OIL GUARD - E		
0.001	—			
0.004	0.004/0.005	JR. BEARING D2		
0.001		OUL GUARD - E SOUTH		

IFFCO :-	
PARTY :-	
Date :-	05/04/2011

DIAMETRICAL CLEARANCES - 104-JAT

Description	Design Clearance (Inch)	Before PM (Inch)	After PM (Inch)
104-JAT (TERRY TURBINE)			
Journal bearing (Thrust end bearing)	0.005-0.007	0.007	0.007
Journal bearing (Opposite thrust end)	0.005-0.007	0.007	0.007
Axial Thrust	0.011-0.0016	0.010	0.010
Nozzle clearance		0.062	0.062
Trip lever - Plunger		0.137	0.137

Thrust Bearing Pad Thickness : 104-JAT				
Pad	**ACTIVE**		**INACTIVE**	
	Before (Inch)	**After (Inch)**	**Before (Inch)**	**After (Inch)**
No 1	0.626	0.626	0.624	0.624
No 2	0.627	0.627	0.624	0.624
No 3	0.625	0.625	0.625	0.625
No 4	0.626	0.626	0.644	0.644
No 5	0.626	0.626	0.623	0.623
No 6	0.627	0.627	0.623	0.623

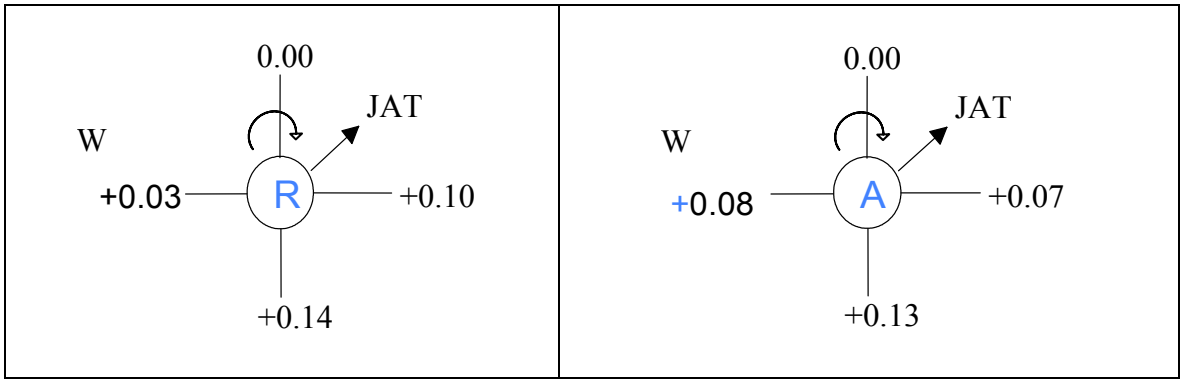
CLEARANCE CHART: 104-JA

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

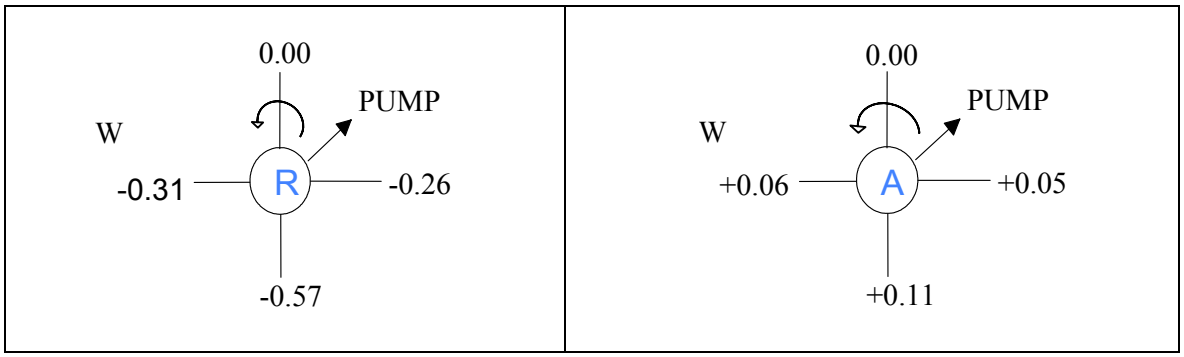
Thrust Bearing Pad Thickness : 104-JA				
Pad	**ACTIVE**		**INACTIVE**	
	Before (Inch)	**After (Inch)**	**Before (Inch)**	**After (Inch)**
No 1	**1.00**	**1.00**	**1.00**	**1.00**
No 2	**0.99**	**0.99**	**0.99**	**0.99**
No 3	**1.00**	**1.00**	**0.99**	**0.99**
No 4	**1.00**	**1.00**	**0.99**	**0.99**
No 5	**1.00**	**1.00**	**1.00**	**1.00**
No 6	**1.00**	**1.00**	**0.99**	**0.99**

The alignment readings are as follows.

104-JAT to 104-JA (Before PM) in "mm"



104-JAT to 104-JA (After PM) in "mm"



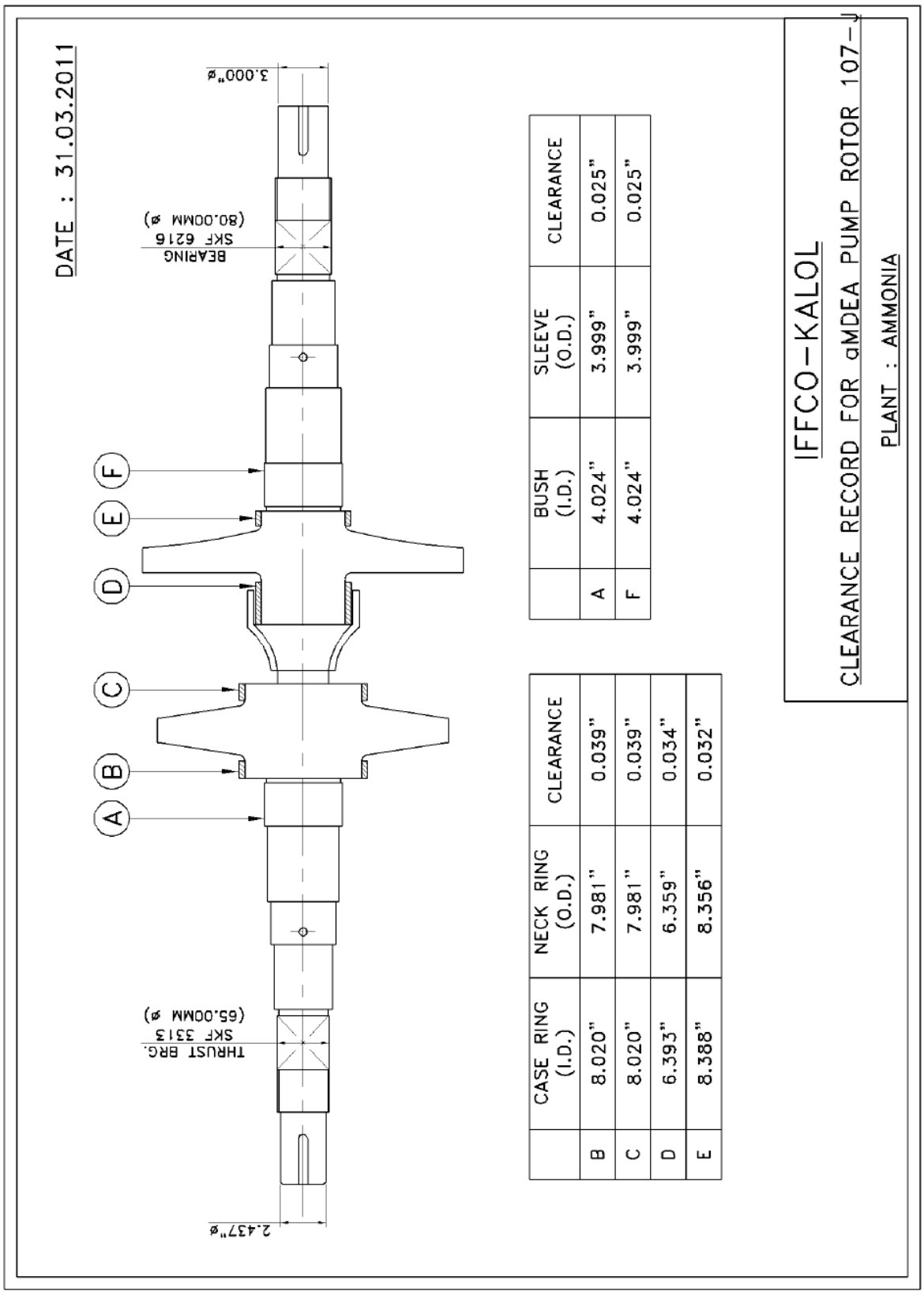
aMDEA PUMP 107-J Train:

107-JT Drive Turbine :

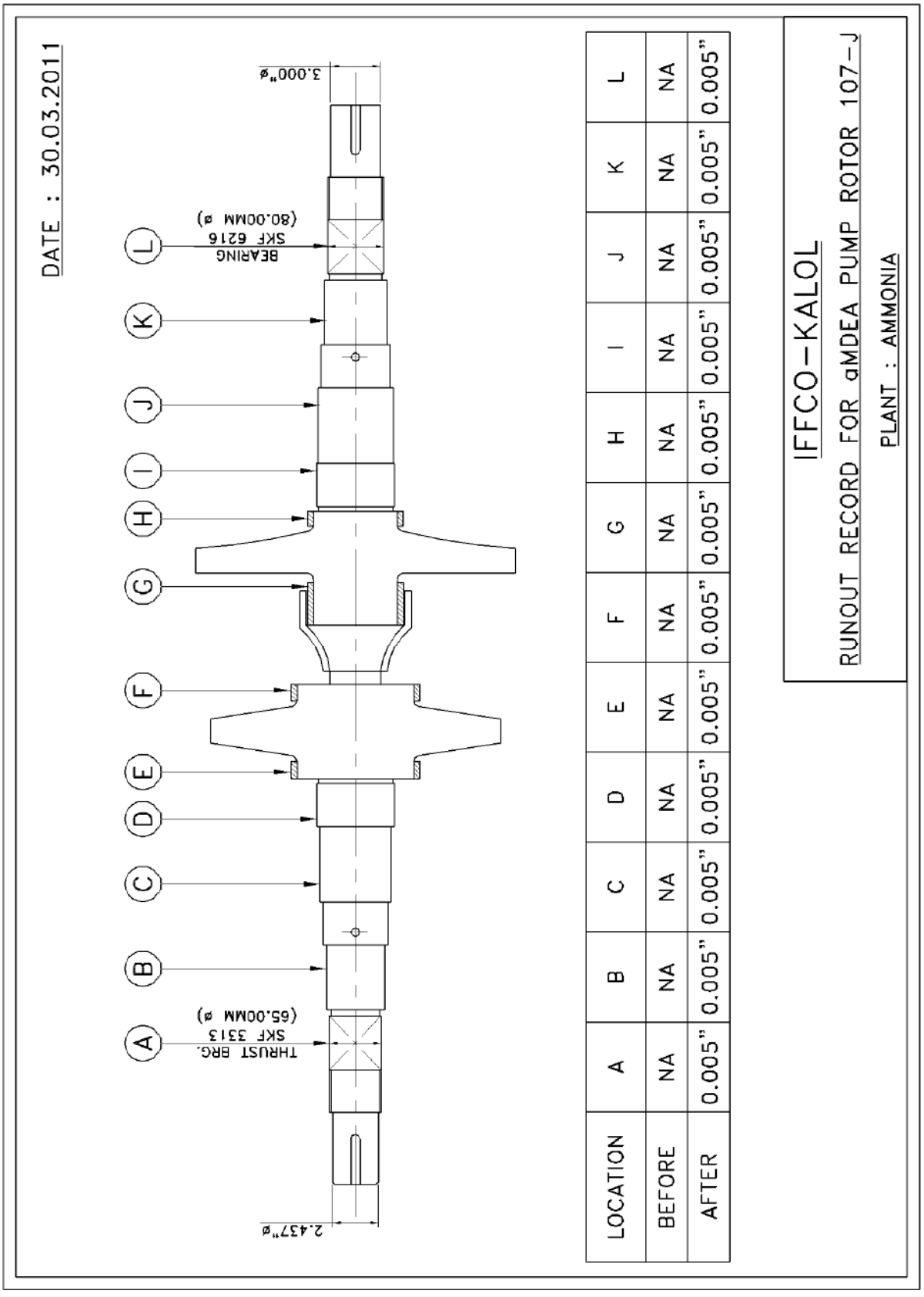
The turbine was decoupled and the coupling was inspected. The pump side flexible elements were found broken and was replaced by new assembly. Both end bearings was inspected and found in good condition. The suction strainers were cleaned. The lube oil coolers and console were cleaned. Gauss measurements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

107-J aMDEA Solution Pump Overhauling

The pump was taken for complete overhauling and to attend the casing parting plane leakage around the seal. The casing was removed after removing both ends bearings and seals. Heavy erosion of carbon steel parts like casing, wear rings etc were observed. New rotor assembly was installed. The mechanical seals were replaced by new one. The end bearings were replaced by new ones. The seal was tested using DM water and no leakages were observed.

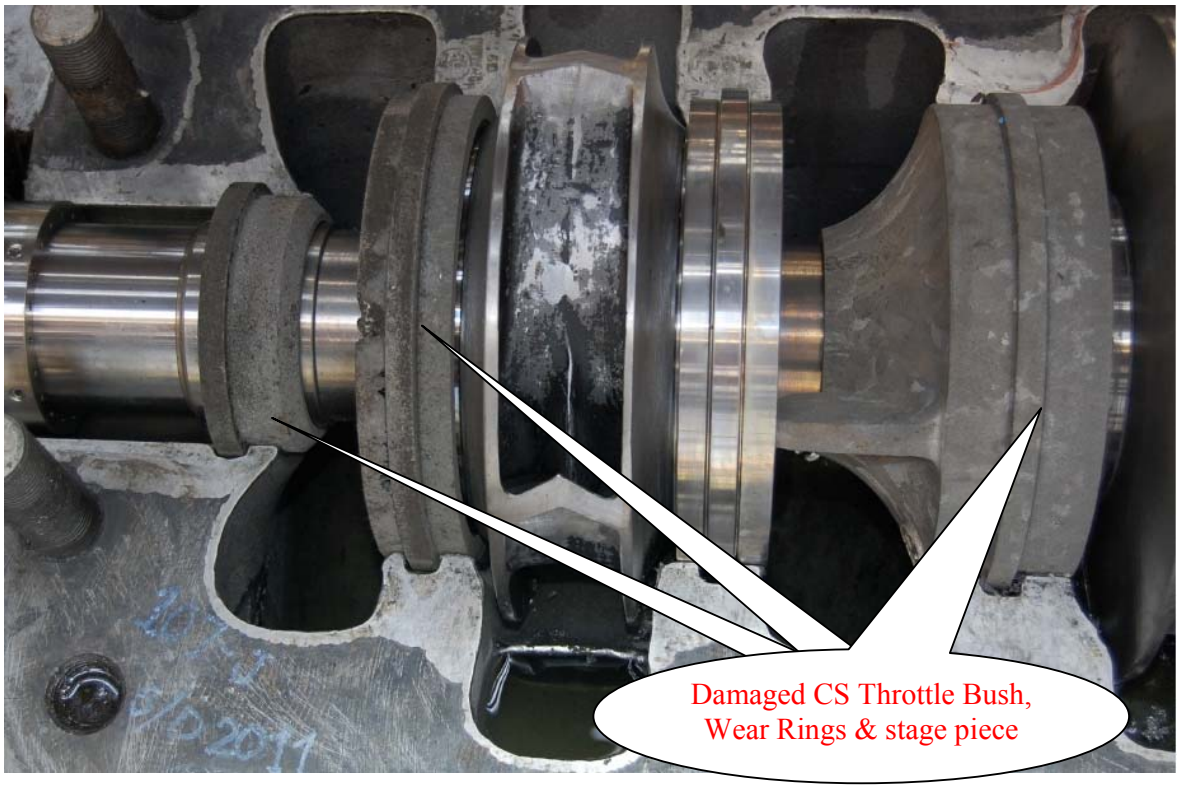


CLEARANCE CHART: 107-J



LOCATION	A	B	C	D	E	F	G	H	I	J	K	L
BEFORE	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
AFTER	0.005"	0.005"	0.005"	0.005"	0.005"	0.005"	0.005"	0.005"	0.005"	0.005"	0.005"	0.005"

RUNOUT RECORD: 107-J



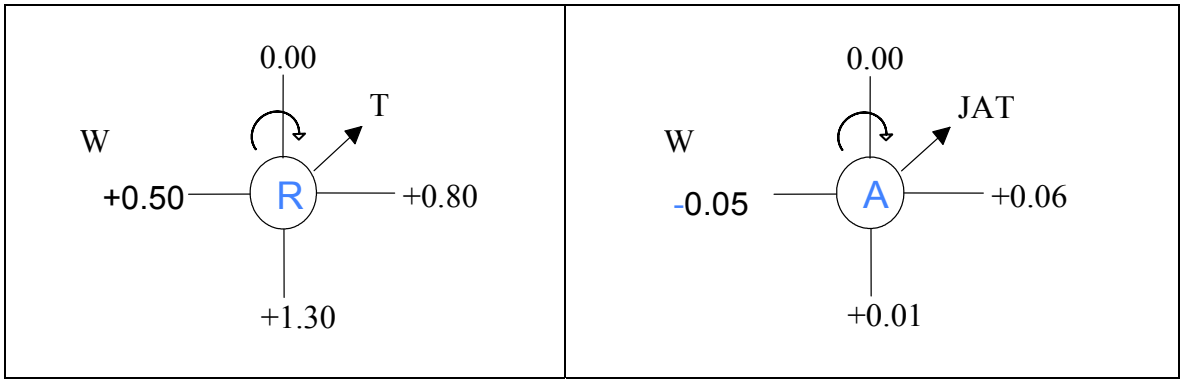
DAMAGED CARBON STEEL PARTS OF aMDEA PUMP 107-J

CLEARANCE CHART: 107-JT (MURRY TURBINE)

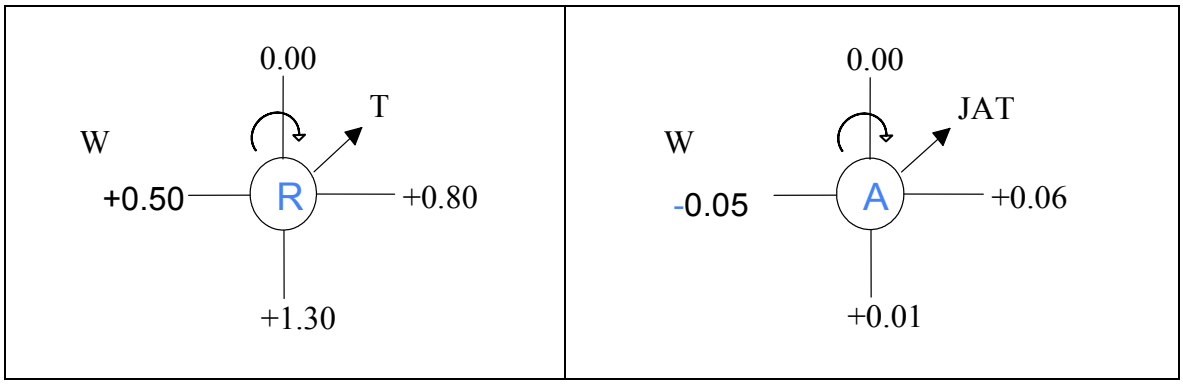
Description	Design Clearance (Inch)	Before PM (Inch)	After PM (Inch)
Journal bearing Thrust end	0.004 – 0.006	0.063	0.063
Oil Guard Thrust end - Inboard	0.011" – 0.017"	0.039	0.039
Journal bearing Opposite thrust end	0.004 – 0.006	0.007	0.007
Oil Guard Opposite thrust end - Inboard	0.011" – 0.017"	0.013	0.013
Axial Thrust	0.007 – 0.013	0.011	0.011

Magnetism Level Record			
LOCATION		**BEFORE (Gauss)**	**AFTER (Gauss)**
Journal bearing Governor end	Top half	3.0	3.0
	Bottom half	2.0	2.0
	Shaft	2.3	2.3
Journal bearing Coupling end	Top half	3.0	3.0
	Bottom half	2.3	2.3
	Shaft	2.5	2.5
Thrust bearing	Collar	1.6	1.6
	Pad -Active	2.3	2.3
	Pad –Non Active	2.0	2.0

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



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



RECIPROCATING CO_2 GAS COMPRESSOR TRAIN (117-J)

LP Cylinders Overhauling:

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

HP Cylinders Overhauling:

The end clearance at TDC and BDC were measured and opened the head of both cylinders to remove the piston assembly. The Kalol side cylinder assembly was replaced just before the shutdown; the same was reinstalled with new seal rings. New gas packing was installed for this cylinder. The Ahmedabad side piston rod assembly was replaced by new one but the same gas packing was reinstalled since the same had been replaced just before shutdown. All the suction and discharge valves were replaced by spare refurbished valves. The suction valves protection grills were replaced by new one.

Crank case assembly Overhauling:

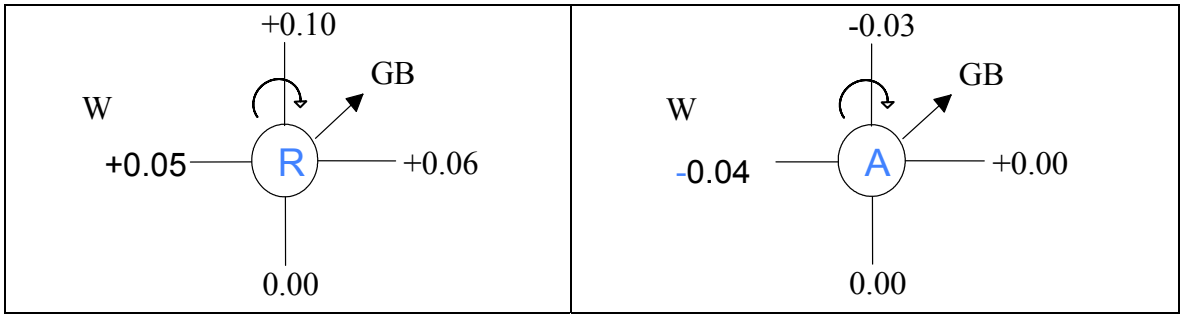
Open the crank case cover for the inspection of the bearings and other internals. Clearances of all the big end bearings were found on higher side and the white metal lining had worn out. These bearings were replaced by new ones. All other components were visually inspected and found OK. All the clearances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

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

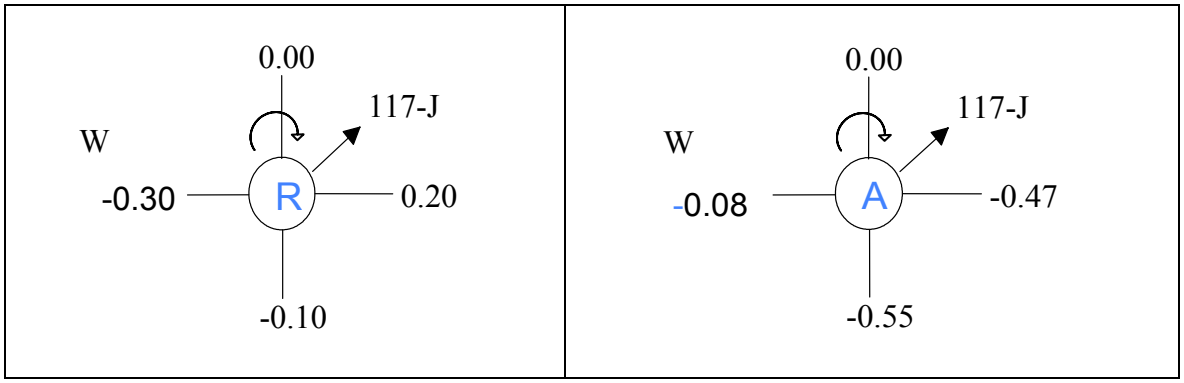
CLEARANCE CHART: 117-J TRAIN

Description	Position		Design clearance(mm)	Before (mm)	After (mm)
Piston end clr. (Front /**TDC**)	LP	Urea side	2	2.65	2.80
		Ammonia side	-- do --	2.40	2.72
	HP	Urea side	-- do --	2.50	2.49
		Ammonia side	-- do --	2.30	2.50
Piston end clr. (Intermediate /**BDC**)	LP	Urea side	1.5	1.15	1.90
		Ammonia side	-- do --	1.00	1.90
	HP	Urea side	-- do --	1.40	1.62
		Ammonia side	-- do --	1.30	1.70
Main bearing	I	Urea side to Ammonia side	0.08-0.15 (0.3 MAX)	0.16	
	II		-- do --	0.14	
	III		-- do --	0.14	
	IV		-- do --	0.15	
	V		-- do --	0.16	
Big end bearing	LP	Urea side	0.07-0.13 (0.3 MAX)		0.14
		Ammonia side	-- do --		0.15
	HP	Urea side	-- do --		0.16
		Ammonia side	-- do --		0.14
Small end bearing	LP	Urea side	0.05-0.10 (0.2 MAX)		0.08
		Ammonia side	-- do --		0.08
	HP	Urea side	-- do --		0.08
		Ammonia side	-- do --		0.08
Cross head guide	LP	Urea side	0.18-0.26 (0.6 MAX)		0.20
		Ammonia side	-- do --		0.20
	HP	Urea side	-- do --		0.20
		Ammonia side	-- do --		0.20
Side clearance (Crank shaft)	----	Crank shaft	0.45-0.60 (0.9 MAX)		0.50
Side clearance (Connecting rod big end)	LP	Urea side	0.33-0.42 (0.6 MAX)		0.35
		Ammonia side	-- do --		0.35
	HP	Urea side	-- do --		0.35
		Ammonia side	-- do --		0.35

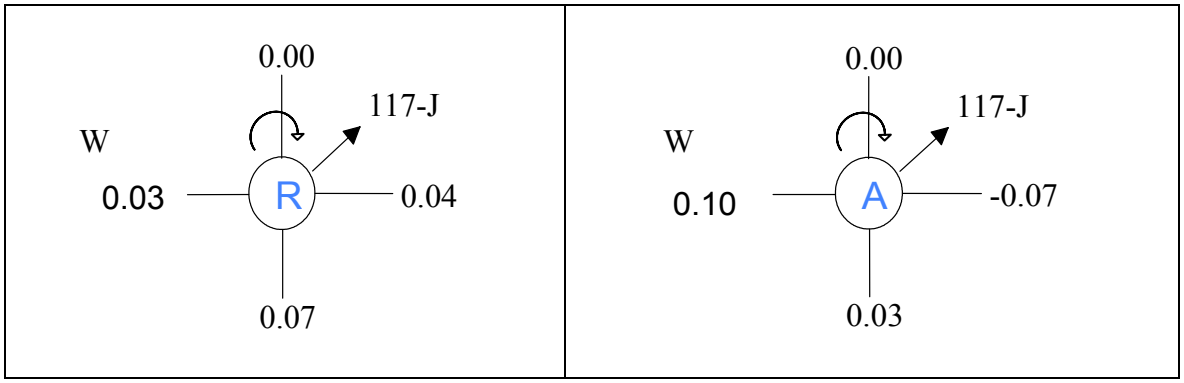
117-JM to Gear Box - (After PM) in "mm"



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



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



COPPUS TURBINES:

103-JLOPT: The lube/seal oil pump drive turbines, 103-JLOPT was taken for replacement of bearings. The radial bearing i.e. deep groove ball bearing as well as the thrust bearing i.e. angular contact ball bearing were replaced by new one. The cooling water lines were flushed. The bearing oil cooler was opened and cleaned. This cooler was of typical design and hence its drawing was prepared for future action. The trip valve spindle was made free for smooth start up of the turbine.

101/105-JLOPT: The lube oil pump drive turbines, was taken for replacement of bearings. The radial bearing i.e. deep groove ball bearing as well as the thrust bearing i.e angular contact ball bearing were replaced by new one. The cooling water lines were flushed. The bearing oil cooling water jackets were cleaned. The trip valve spindle was made free for smooth start up of the turbine.

2004-JAT: The lube oil pump drive turbines, was taken for replacement of bearings. The radial bearing i.e. deep groove ball bearing as well as the thrust bearing i.e angular contact ball bearing were replaced by new one. The cooling water lines were flushed. The bearing oil cooling water jackets were cleaned. The trip valve spindle was made free for smooth start up of the turbine.

SAFETY RELIEF VALVES OVERHAULING & SERVICING:

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

Sr. No.	RV Tag NO	Valve Size	Set Pressure (kg/cm^2 g)	Seat Tightness Test Pressure (kg/cm^2 g)
1.	RV – MS 9	4" x 6"	42.2	37.98
2.	RV – BFW 1	1.5" x 2.5"	92.0	82.8
3.	RV – 112 CA	1.5" x 3"	10.50	9.45
4.	RV – 112 CB	1.5" x 3"	10.50	9.45
5.	RV – 109 F	6" x 8"	19.0	17.1
6.	RV – 110 F-North	3" x 4"	7.0	6.3
7.	RV – 110 F - South	3" x 4"	7.0	6.3
8.	RV – 111 F	4" x 6"	6.3	5.67
9.	RV – 112 F	4" x 6"	6.3	5.67
10.	RV 101- J	4" x 6"	36.9	33.21
11.	RV – 104 D 2	1.5" x 2"	34.10	30.69
12.	RV 103-JSOP Discharge	½" X ½"	98.0	88.2
13.	PCV 103-JSOP Seal Oil Header	½" X ½"	98.0	88.2
14.	RV 107-F	3" X 4"	19.0	17.1

PILOT OPERATED RVs were overhauled and serviced and tested on test bench.

Sr. No.	RV Tag No	Valve Size	Set Pressure (kg/cm^2 g)	Seat tightness test pressure (kg/cm^2 g)
1	RV – 102 F	6" x 8"	29.50	26.50
2	RV-105-D -A	3"x 4"	152.9	137.6
3	RV – 103- JA	3" x 4"	159.00	143.0
4	RV-103-J-1	3" x 4"	158.9	143.0
5	RV-103-J-1	3" x 4"	158.9	143.0
6	RV – 106-F	1.5' x 2"	158.00	143.00

OTHER CRITICAL SERVICES RVs were overhauled and serviced and tested on test bench.

Sr. No.	RV Tag No	Valve Size	Set Pressure (kg/cm^2 g)	Seat tightness test pressure (kg/cm^2 g)
1	RV-104-D1	6" X 8"	35.0	31.50
2	123-CA	3 J 6	122.0	110.0
3	123-CB	3 J 6	122.0	110.0

HP & MP STEAM SERVICE RVs were tested on test bench:

RV-101-F-1: (Middle)

- Make: Tyco Sanmar.
- Srl.No: 97-4469.
- Model:HC-75-IBR—SPL.
- Size: 2.5" x 6".
- Service: Steam.
- Design set pressure: 118.8 $kg/cm^{2.}$
- Test bench popping pressure: 118.8 kg/cm^2
- Seat tightness test pressure: 107.00 kg/cm^2
- Locking spacer thickness : 6.70 mm

RV-101-F-2: (South)

- Make: Tyco Sanmar.
- Srl.No: 97-4468
- Model:HC-75-IBR—SPL
- Size: 2.5" x 6"
- Service: Steam
- Design set pressure: 117.0 kg/cm2
- Test bench popping pressure: 117 kg/cm2
- Seat tightness test pressure : 105.50 kg/cm2
- Locking spacer thickness : 15.0 mm

RV-101-F-3: (North)

- Make: Tyco Sanmar
- Srl.No: 97-4467
- Model:HC-75-IBR—SPL
- Size: 2.5" x 6"
- Service: Steam
- Design set pressure: 115.3 kg/cm2
- Test bench popping pressure: 115.3 kg/cm2
- Seat tightness test pressure: 103.50 kg/cm2
- Locking spacer thickness : 5.70 mm

RV-101-B (SUPER HEATER RV.):

This relief valve was steam tested after plant start-up.

- Make: Tyco Sanmar
- Sr.No: 99-8141
- Model:HC-78-IBR
- Size: 3.0" x 6.0"
- Service: Steam
- Design set pressure: 111.80 kg/cm2
- Test bench popping pressure : 111.50 kg/cm2
- Seat tightness pressure on test bench : 100.50 kg/cm2
- Set pressure achieved while floating : 112.0 kg/cm2
- Reseat pressure achieved while floating : 107.20 kg/cm2
- Blow down Percentage: 4.2 %
- Locking spacer thickness : 20.0 mm

PSV-986 MP Boiler 107-C RV:

- Make: TYCO
- Sr.No: 26 - 0991
- Model: HSJ/45 – IBR - SEL
- Size: 4 L 6
- Service: Steam
- Design set pressure: 45.0 kg/cm2
- Test bench popping pressure: 45.0 kg/cm2
- Seat tightness test pressure: 40.50 kg/cm2
- Locking spacer thickness : 14.70 mm

PSV-987 MP Boiler 107-C RV:

- Make: TYCO
- Sr.No: 26 - 0992
- Model: HSJ – 45 – IBR - SEL
- Size: 4 L 6
- Service: Steam
- Design set pressure: 46.3 kg/cm2
- Test bench popping pressure : 46.3 kg/cm2
- Seat tightness test pressure: 42.0 kg/cm2
- Locking spacer thickness : 14.20 mm

HEAT EXCHANGERS:

Tube bundle replacement:

The tube bundle of 103-JAT/JBT gland condenser was hydro tested and leakage was reported. On pulling the tube bundle out it was observed that most of the tubes had developed cracks at the U-Bend area. SS 304L tubes were available in store which were bend at heavy metal tubes and stress relieved. New tube bundle was fabricated in-house and was installed in the shell. A test ring was fabricated and the tube bundle was hydro tested and no leakage was observed.

Tube bundle pulling and cleaning:

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. NO.	QTY.	TUBE SIDE PRESSURE (kg/cm^2 g)		SHELL SIDE PRESSURE (kg/cm^2 g)		REMARKS
			DESIGN	TEST	DESIGN	TEST	
1.	**115-C**	1	29.9	----	10.6	15.8	Tube bundle not pulled out & hydro tested at position
2.	**116-C**	1	66.4	----	10.4	15.8	----
3.	**124-C**	1	158	----	17.6	26.5	----
4.	**130-JC**	1	5.27	8.1	5.27	8.1	Tube bundle pulled out & tested in a dummy shell.
5.	**129-JC**	1	2.3	----	5.29	8.1	Tube bundle not pulled out & hydro tested at position by lowering of the equipment to provide blind on shell side
6.	**131-JC**	1	11.90	----	5.27	8.1	Tube bundle not pulled out & hydro tested at position by blinding on shell side
7.	**117-J INTER COOLER**	1	----	----	8.0	8.0	----
8.	**108-C1 A**	1	5.3	8.1	5.3	8.1	Tube bundle not pulled out. Hydro tested at position along with 108-C1 A
9.	**108-C1 A**	1	5.3	8.1	5.3	8.1	-- do --
10.	**109-C1 B**	1	30.6	46.1	5.3	8.1	Tube bundle pulled out.
11.	**109-C2 B**	1	30.6	46.1	5.3	8.1	-- do --

Tube bundle cleaning by hydro jetting:

SR. NO.	EQUIP. NO.	QTY.	NO. OF TUBES	TUBE SIDE PRESSURE (kg/cm^2 g)		SHELL SIDE PRESSURE (kg/cm^2 g)		REMARKS
				DESIGN	TEST	DESIGN	TEST	
1	105-CA	1	2790	5.27	8.1	30.9	46.4	
2	105-CB	1	2790	5.27	8.1	30.9	46.4	
3	110-CA	1	763	5.60	8.1	5.27	8.1	
4	110-CB	1	763	5.60	8.1	5.27	8.1	
5	127-CA	1	3516	5.60	31.5	21.10	31.5	
6	127-CB	1	3516	5.60	31.5	21.10	31.5	
7	128-C	1	1200	5.60	NA	8.09	NA	
8	173-C	1	294	10.60	NA	5.27	NA	
9	150-C	1	98	43.6	64.5	5.2	8.1	
10	151-C	1	98	5.3	8.1	5.3	8.1	
11	137-C	1	---	7.0	10.5	155	232.5	

Lube oil coolers taken for hydro jetting:

SR. NO.	EQUIP. NO.	QTY.	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	
5	104-J/JA LOC	2	Lube oil cooler for 104-J/JA	
6	115-JA / JB LOC	4	Lube oil coolers for 115-JA / JB	

Surface and gland condensers taken for hydro jetting:

SR. NO.	EQUIP. NO.	QTY.	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	

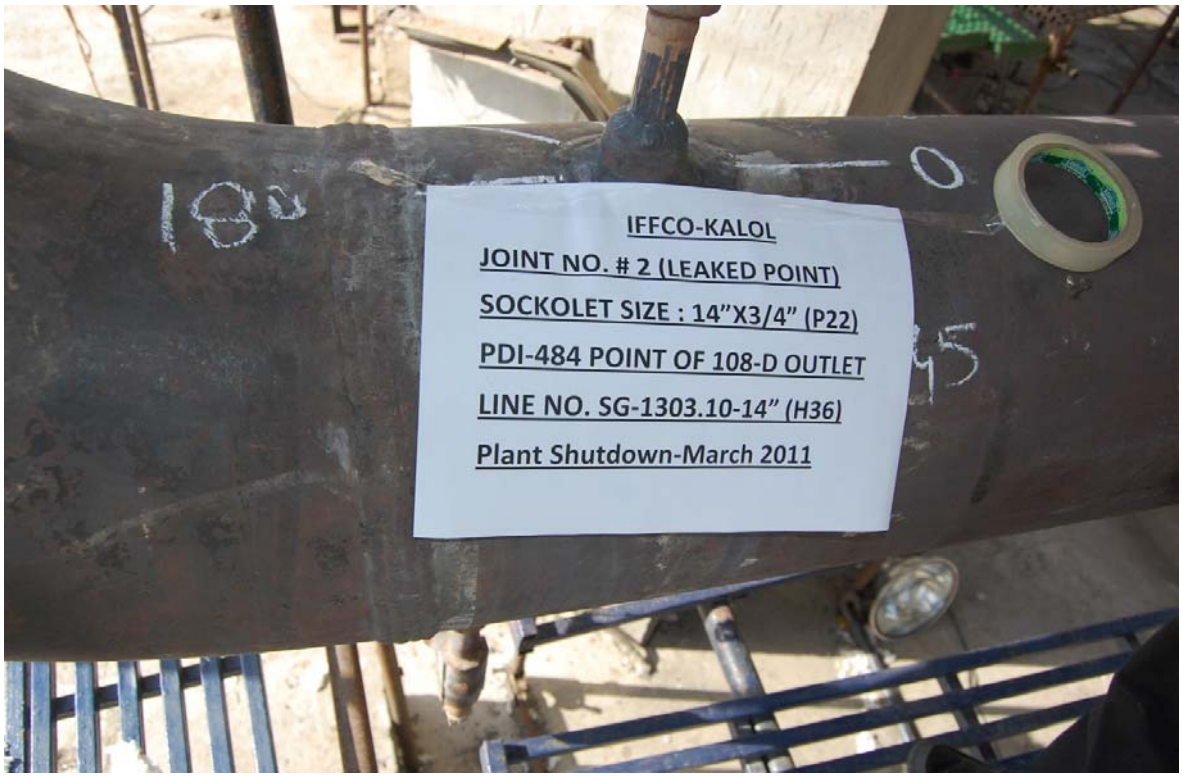
CRITICAL FABRICATION JOBS:

Replacement of sockolets of new synthesis gas convertor (108-D) & old synthesis gas convertor (105-D) loop.

During plant operations, New Synthesis Gas Convertor (108D) outlet to Synthesis gas waste heat MP boiler **PDI-484 Sockolet Point** had a developed crack in the parent metal. The crack was immediately attended by welding with a pad support after arresting gas leak. However all seven sockolets in the New Synthesis Gas Convertor (108D) & Old Synthesis Gas Convertor (105 D) loop were decided for replacement in the shutdown. The contract was awarded to M/S. Skywin Erectors vide W.O. NO. 20101145 dated 02/02/2011. The following major activities were carried out:

- Nitrogen purging was done through Nitrogen tank.
- Blinds were provided as per requirement.
- Cutting of existing sockolets
- Weld edge preparation
- Dehydrogenation of old edges. (**Dehydrogenation cycle attached)**
- Set up & welding of new elbow
- Post weld heat treatment of joints. **(Post weld heat treatment cycle attached)**
- NDT inspection (DP checking & final hardness measurement-Report is attached)
- ***Total 5 Nos. sockolets & one No. 1-½" drain valve was replaced as follows:***

  - Joint No. # 1A (Converter Loop) Sockolet Size: 14"X3/4" Drain Point OF 107-C Inlet Line No. SG-1303.10-14" (H36)
  - Joint No. # 1B (Converter Loop) DRAIN VALVE: 3/4" X1500# (P22) Drain Point of 107-C Inlet Line No. SG-1303.10-14" (H36)
  - Joint No # 2 (LEAKED POINT) SOCKOLET SIZE: 14"X3/4" (P22) PDI-484 Point of 108-D Outlet Line No. SG-1303.10-14" (H36)
  - Joint No # 3 (Converter Loop) Sockolet Size: 14"X1" (P22) Drain point of 108-D Outlet Line No. SG-1303.10-14" (H36)
  - Joint No (Converter Loop) Sockolet Size: 10"X1-1/2" (P22) Drain point of 108-D Inlet Line No.. SG-1303.09-10" (H36)
  - Joint No # 5 (Converter Loop) Sockolet Size: 14"X3/4" (P22)PDI-484 Point of 108-D Inlet Line No. SG-1303.08-14" (H36)
  - Joint No # 6 (Converter Loop) Sockolet Size: 14"X3/4" (P22) PI (AP-987) Point of 105 D TO 108-D Inlet Line No. SG-1303.08-14" (H36)



WELDING PROCEDURE SPECIFICATIONS
(FOR REPLACEMENT OF SOCKLETS ON SYN GAS LINE JOB)

1. JOINT DESIGN

Joint design : Socket weld. Welding Process : GTAW + SMAW
Type : Manual

2. BASE METAL

Specification : ASTM A 335 P22
Thickness Range : 32 mm maximum

3. WELD METALS

AWS No. (Class) : Electrode SFA/AWS A 5.5-96 (E 9018 B3)
Size of electrode : 2.5, 3.15, (Electrode) for fill up and capping
Type of electrode flux: N.A.

4. DEHYDROGENATION

First Soaking Temperature : 400 degree C
Soaking time : 20 hours
Second Soaking Temperature: 630 degree C
Soaking Time : 3 hours
Heating Rate : 100 degree C/hr
Cooling Rate : 100 degree C/hr
Loading/Unloading Temperature: 200 degree C

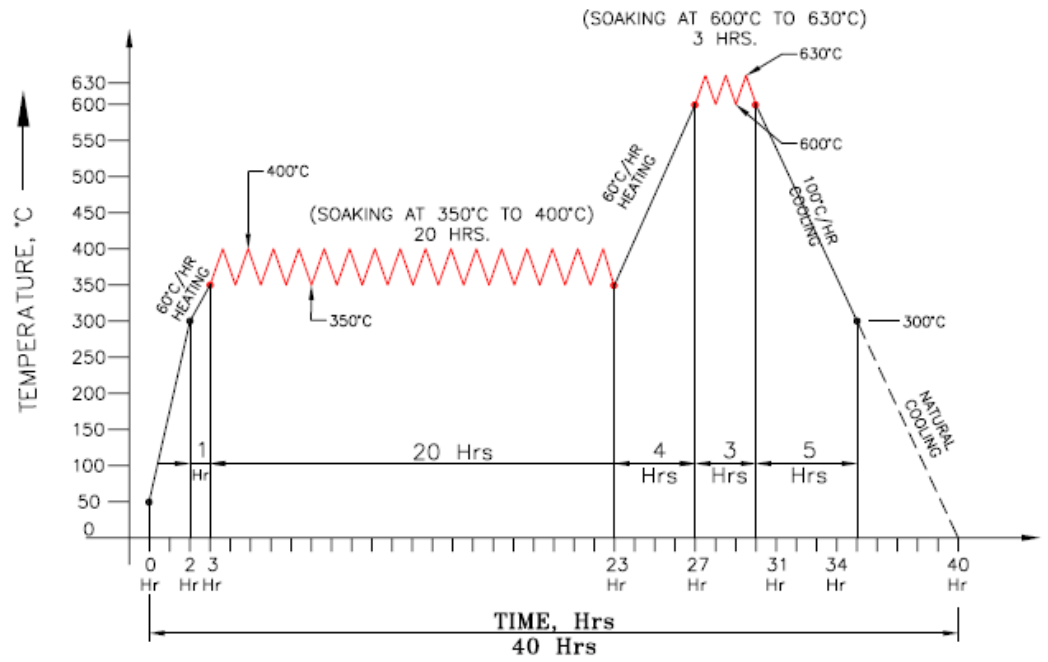
5. PREHEAT (QW - 406)

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

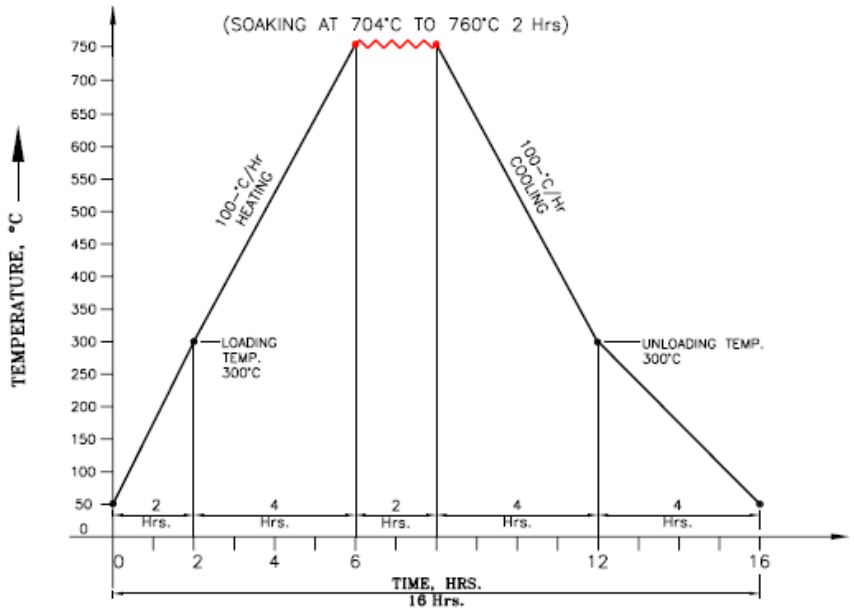
6. POST WELD HEAT TREATMENT (QW - 407)

Temperature : 704 to 760^{0}C
Soaking time: 02 Hour minimum
Heating Rate : 200^{0}C / hr. max
Cooling Rate: 200^{0}C / hr. up to 300^{0}C, then natural cooling under asbestos.
Loading : 200 degree C

IFFCO INDIAN FARMERS FERTILISER CO-OP. LTD. KALOL



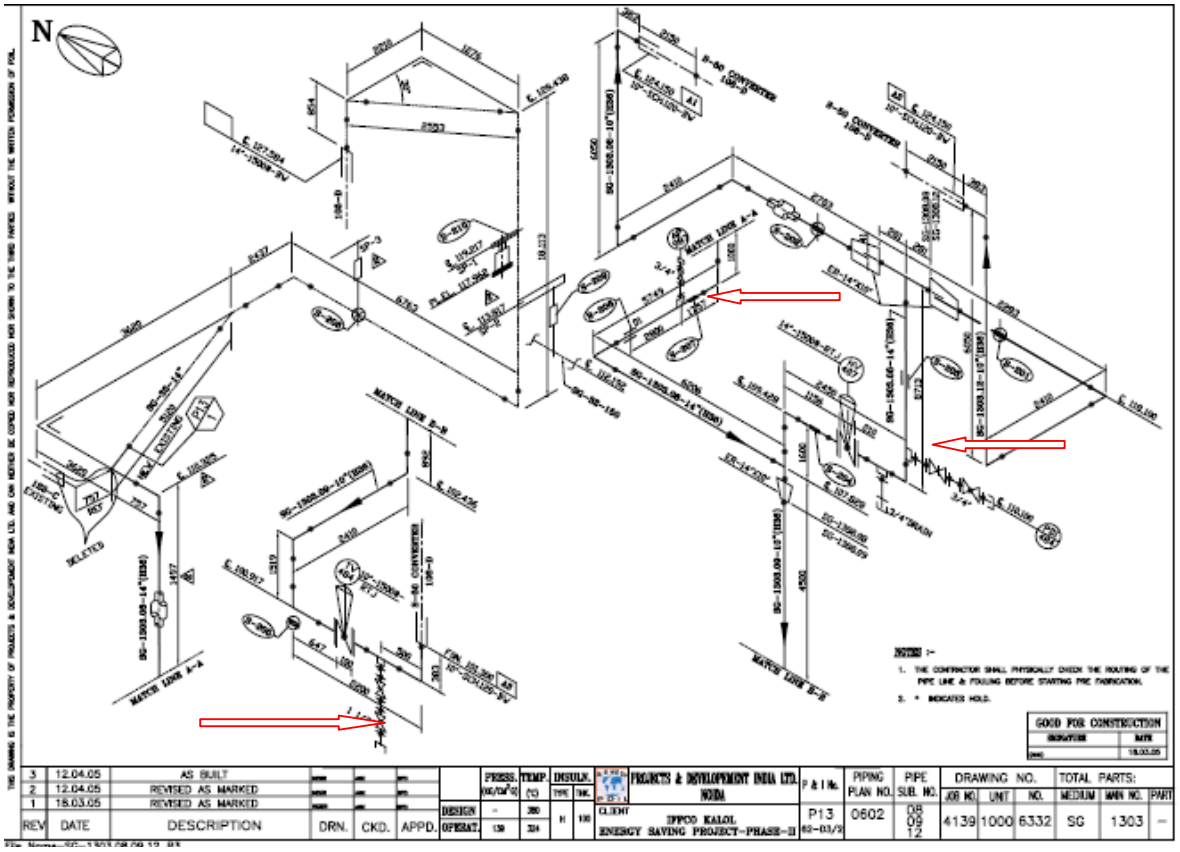
DEHYDROGENATION CURVE FOR S-50 (108-D)
INLET & OUTLET LINE (SOCKOLETS REPLACEMENT)

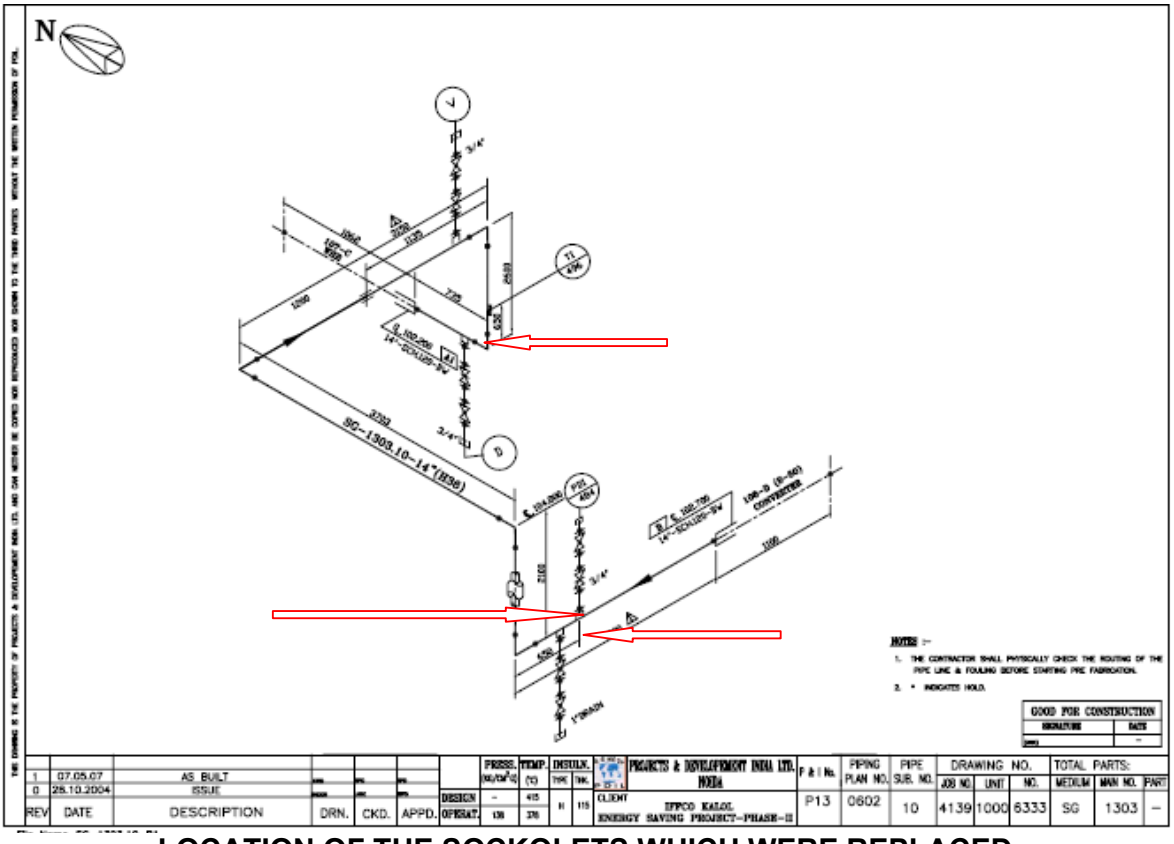


PWHT CURVE FOR S-50 (108-D)
INLET & OUTLET LINE (SOCKOLETS REPLACEMENT)

	NAME	DATE	TITLE – DEHYDROGENATION & PWHT CURVE FOR S-50 (108-D) CONVERTOR GAS INLET & OUTLET LINE SOCKOLETS REPLACEMENT 14"NB x 120 Sch., MATERIAL-WP 22	EWR No.	
DRN	N.V. PANCHAL	08.04.2011		SCALE :	
CHD			DRAWING No. CODE AMM-000	PLANT P1 FROM ES NUMBER 0----	SHEET 1 OF 1 / REV. 0
APD					

DEHYDROGENATIONS CURVES FOR 108-D SOCKOLET REPLACEMENT





LOCATION OF THE SOCKOLETS WHICH WERE REPLACED

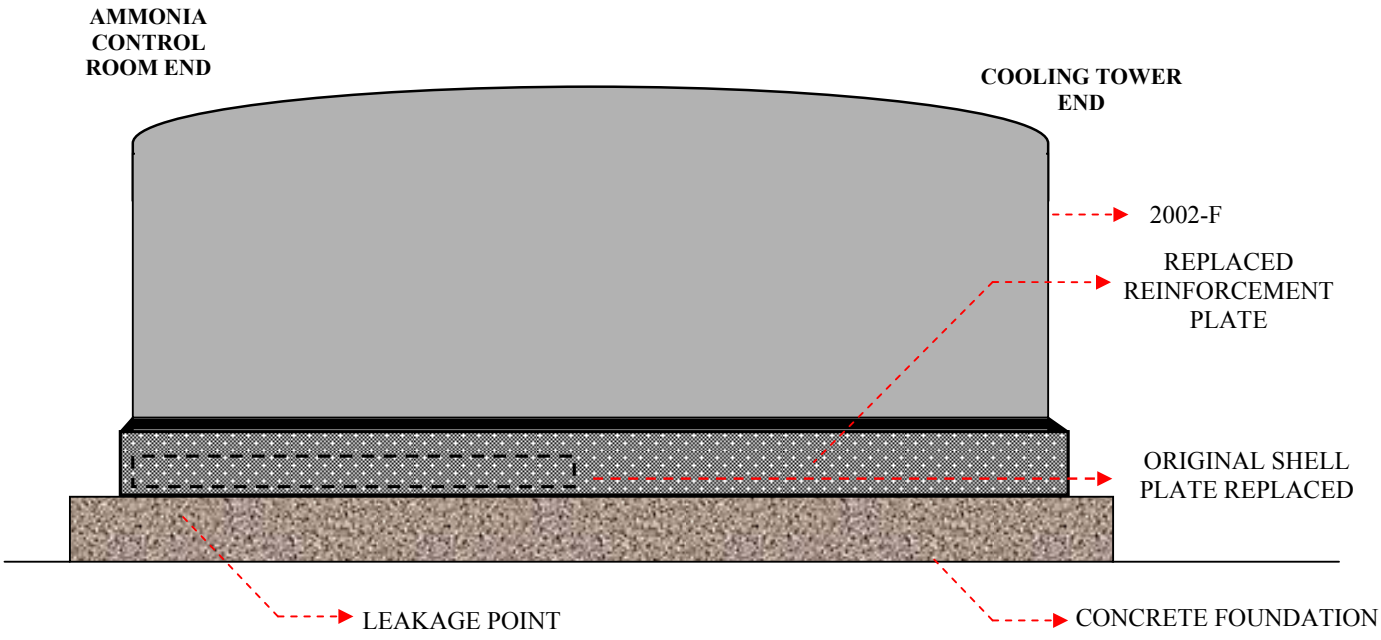
- **Repair work of DM water tank(2002-F)**

  During Shutdown March-April2011, just at the time of Ammonia plant getting startup, heavy leakage was detected at the bottom of DM Water tank in Ammonia Plant. NDT was carried out on complete circumference at the bottom of tank and found thinning at various locations. It was decided to drain the DM tank completely and attend from outside as well as from inside at the bottom of vessel along with complete circumference to avoid any such leakage during plant operation. The contract was awarded to M/S. Skywin erectors, Ahmadabad vide confirmatory work order No.20110140 Dtd.28/05/11.The following activities were carried out:

  - Marking and removing old plate by gas cutting at the leaked portion area towards control room site.
  - Edge preparation by grinding
  - Cutting & grinding of new strips (size : 2500 mm L x 300 mm W X 6 mm Thick CS plate) for complete circumference
  - Bending of plate as per tank radius
  - Welded new plate at the leaked portion approximately 5 meter along with circumference
  - Fixing up of plate at outside vessel & tack welded along complete circumference as extra patch plate.
  - Complete Welding from outside as well as inside was carried out

  The internal surface of the tank wall was coated with “STANVAC” MAKE 703 STANDARD ST PRIME and Z-1311 CORROKOTE from the bottom upto a height of 500 mm as follows:

  - The surface was cleaned with a grinding machine and wire brush.
  - One coat of 703 STANDARD ST PRIME was applied and was allowed to cure for 2 hours. The total QTY. consumed was 8 liters.
  - The first coat of 1311 CORROKOTE was applied and was allowed to cure for 8 hours.
  - The second coat of 1311 CORROKOTE was applied and was allowed to cure for 8 hours. The total QTY. consumed was 24 kilograms.



2002-F LEAKAGE REPAIR

- **FRC-2 down stream check valve replacement :**
  The NRV ***(CS, 12" X 400 #)*** was passing and hence was replaced with new one ***(CS ASTM A 216 GRADE WCB, 12" X 600 #, BW)***. The following major activities were carried out:

  - Gas cutting of existing NRV at Butt Welded end.
  - Edge preparation and DP check.
  - Flange removed from old NRV (12"x400#)
  - Flange re-welded at one end of new NRV
  - ID of new NRV machined to match Pipe ID (12" X Sch.30)
  - Fit up & butt weld joint welded.(Root TIG welded + Final Arc welded)
  - NDT inspection, root & final DP check was carried out.

4. **102-EB CO_2 stripper inlet nozzle repair.**
   The inlet nozzle ten inch pipe length was replaced by new one. The flanges on the inside of the vessel were replaced by new one and new pad was provided on the outside of the vessel. 'U' Clamps were weld repaired wherever found damaged.

NEW 10" X 150# FLANGES ON THE INLET NOZZLE INSIDE THE VESSEL

NEW REINFORCEMENT PAD ON THE INLET NOZZLE OUTSIDE THE VESSEL

NON CRITICAL FABRICATION JOBS :

- 101-Fsouth side LG drain valve was passing and hence replaced by new valve
- PIC-5 Snuffing Steam Check valve welding leakage was attended.
- 107 C North side L G Top isolation valve handle was free hence the valve was replaced by new one.
- 38 Kg/cm2 steam header line trap isolation valve towards cooling tower side had free handle and hence was replaced.
- 38 Ata header trap isolation valve near C G circulator hand wheel was free and hence replaced.
- PIC-17 steam trap line union leak & its upstream isolation valve were passing and hence replaced.

- Isolation valve was provided on 116-J mechanical seal flushing line.
- 107-JA Discharge line drain valve bush was broken and hence replaced.
- 115-JAT steam inlet line USV 934 down stream PI isolation valve bonnet was leaking and hence replaced.
- FI-935 of 115 JAT steam inlet flow transmitter HP tapping root isolation valve welding leak was repaired.
- 107-C LG inlet/outlet pipe length was reduced.
- 116-JA PI & pressure switch isolation valves were provided.
- 101-JCA inter/After condenser cooling water channel side vent valves was not operable and hence replaced
- P 201-AB Discharge NRV position was changed to make it horizontal from vertical.
- 115-JAT steam inlet PI isolation valve bonnet was leaking and hence replaced.
- 107-C vent 3rd isolation valve bonnet was leaking and hence replaced.
- FRC-465 U/S drain line valve wheel was free and hence replaced
- Various steam traps which were passing were replaced.
- 101-D drain valve 2nd isolation valve bonnet was leaking and hence was replaced.
- 2004 JAT steam inlet block valve up stream drain valve was passing and hence was replaced.
- 104 JAT steam inlet control valve up stream drain valve was passing and hence replaced.
- M S steam to 11 kg de-super heater station atomizing steam isolation valve was passing and hence replaced.
- Atomizing steam to Auxiliary boiler (bottom) header trap by pass valve hand wheel was broken and hence was replaced.
- 104-D2 LTS RV isolation valve bonnet was leaking and hence was replaced.
- 129-JC Drain line leak was repaired.

LEAKS ATTENDED

The following flange leak, valve bonnet leak & valve passing jobs were attended:

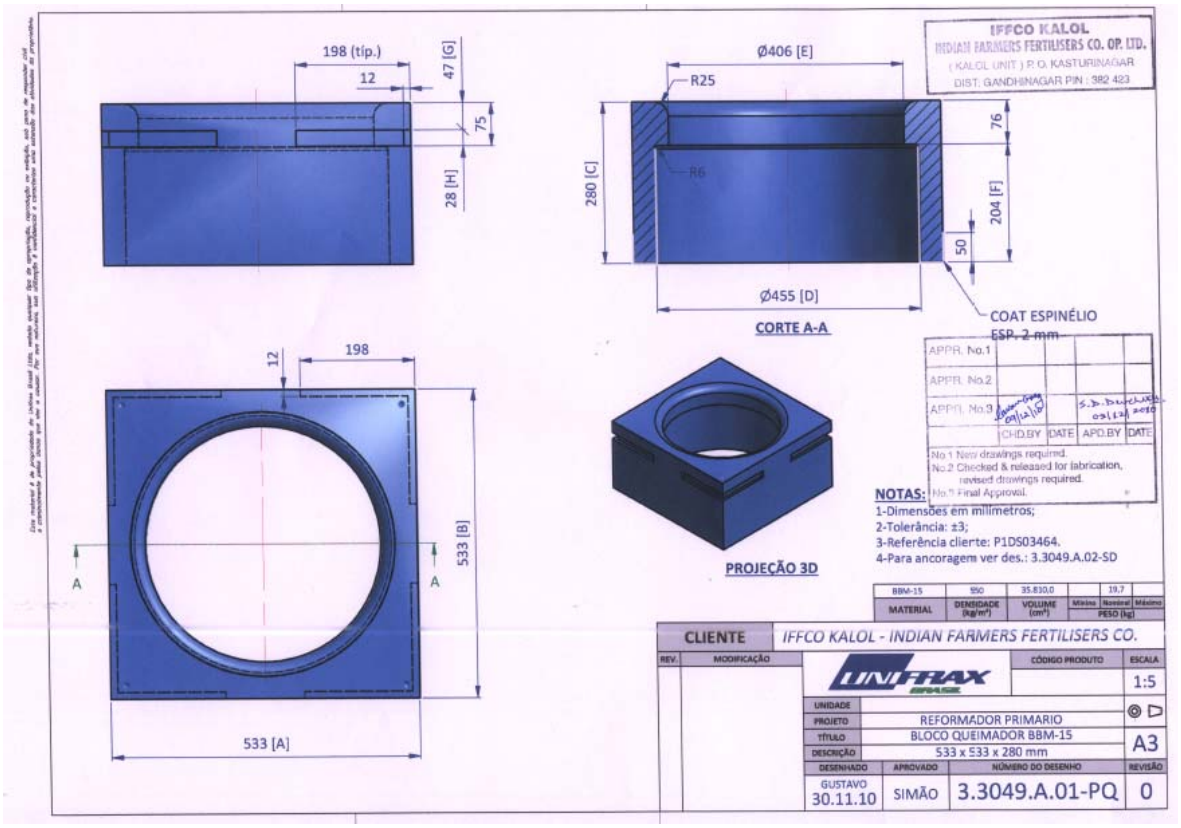
- 156 F Blow down drum drain valve passing.
- 156-F LC-21 CV bypass isolation valve passing.
- 103 JAT Steam Inlet line strainer drain line flange leak.
- PC 2 Discharge line Isolation valve bonnet leak.
- 3.5 ata steam header isolation valve above 118-J, bonnet leak.
- 107-C vent 3rd I/V bonnet leak (MIC-107-C)
- FRC-505 by pass valve bonnet leak.
- 103-JAT steam inlet main isolation valve bonnet leak.
- PIC-006 D/S flange leak.
- MIC-61 flange leak.
- N.G. to tunnel burner isolation valve(PRC-2) downstream flange leak.
- 103-JBT TTV bypass line bottom flange leak.
- PIC 14 upstream flange leak. Flange face groove repair by dropping valve.
- MIC-003 U/S flange leak.(HTS inlet valve).
- TRC-10 both side gland leak and broken bolt.

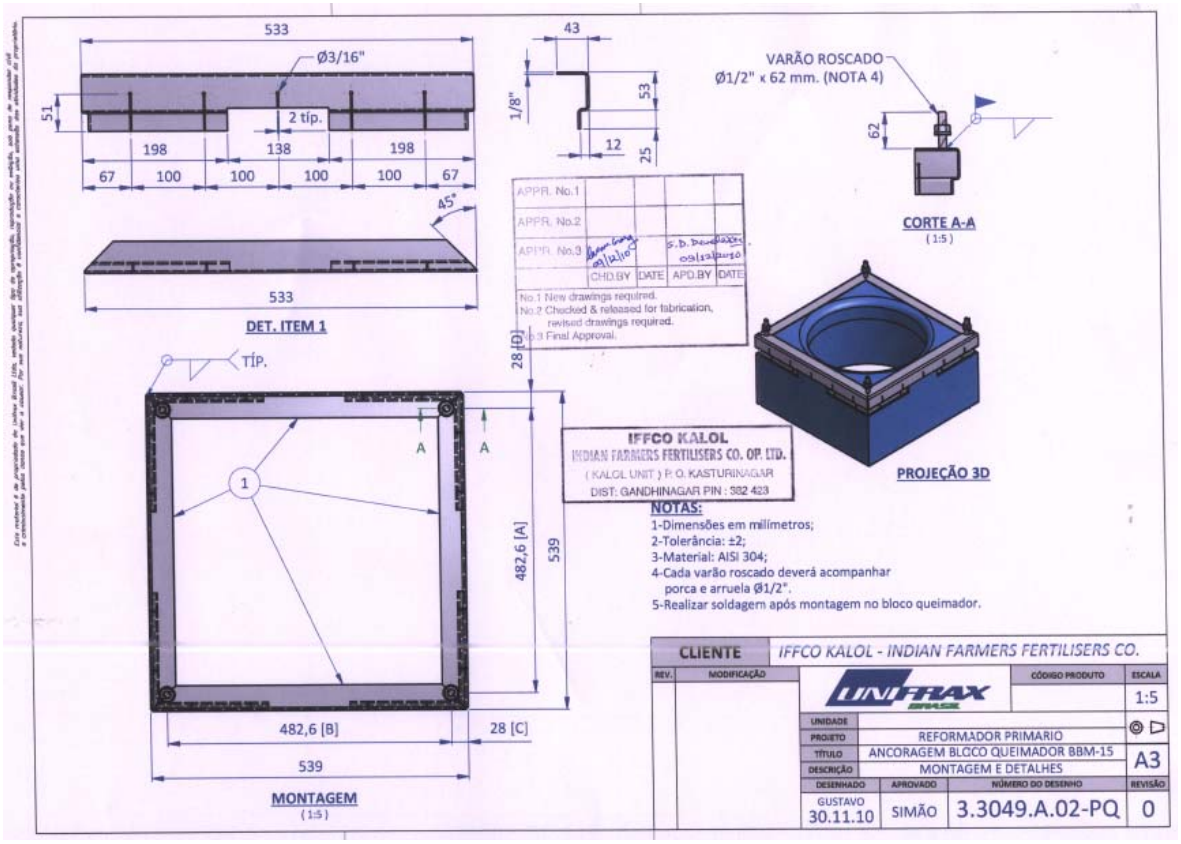
- SP-39 both side gland leak.
- 112-C steam outlet by pass drain valve gland leak.
- 101-F, steam drum connected all first and second isolation valve gland repacking.
- All rotary equipment inlet and outlet first isolation valve gland repacking.
- Auxiliary Boiler Coil C IBD isolation valve gland leak.
- Auxiliary Boiler Coil B IBD isolation valve gland leak.
- All IBD isolation valves of Auxiliary Boiler Coils to be gland packed.
- LTS Outlet vent valve (Gear Valve g)land leak.
- 101-F Steam drum vent 1st Isolation valve gland leak.
- 107-C MP boiler connected all 1st and 2nd isolation valve gland repacking.
- 112-C LP steam boiler connected all 1st and 2nd isolation valve gland repacking.
- 107-C, FRC-485 U/S and D/S isolation valve gland leak.
- SP-151 valve and its bypass valve gland leak
- HCV-12 valve gland leak.
- 107-C eye–hye top isolation valve gland leak.
- MIC-003 U/S isolation valve at HTS top platform, gland leak.
- 101 D vessel drain valve gland repacking.
- SP 4 gland leak.
- 38 kg steam from 107-C header line vent valve below 110-F platform near MIC-12 gland leak.

PRIMARY REFORMER, 101-B, RADIANT ZONE:

During this shutdown, 25% catalyst from top portion was replaced by opening the reformer tube top plugs after locking spring hangers. In the radiant section of the primary reformer, ceramic type 'Z' section modules were installed at the roof to fill the gap wherever required. Insulation around the peep holes was also reinforced by installing ceramic fiber blanket with inconel 600 studs, to cover up the gaps around the peep hole. Some damaged tunnel slabs were also replaced.

New indegenised burner block was also installed for burner number 510. This burner block was procured from M/s UNIFRAX vide purchase order No 20100767. The burner block was specially designed with stainless steel reinforcement all around the block at the top to avoid development of cracks.





NEW INDEGENOUS BURNER BLOCK OF 101-B

PRIMARY REFORMER ,101-B, CONVECTION ZONE:

In the HT convection section of the primary reformer, 5 ½" thick Ceramic Fiber blanket { 1260 Deg Grade} insulation with 0.5 mm thick Incolloy-800 H lining was provided. The region below the coils where the flue gas from the radiant section, was directly hitting, problem of buckling & burning of Incolloy-800H Sheets was encountered.

To avoid this problem, the existing insulation in these region was removed and new insulation comprising of ceramic fiber blanket and cerlock 'Z' section modules with density 160 kg/m^3, temperature 1425°C with SS 310 anchors were installed on the walls for efficient and durable insulation. Cercoat 'ZL' anti erosion coating was also applied on the face of modules to increase their life. These job was executed vide our PO No. 20101168 & WO No. 20101180.

Service Conditions :

- Service Temperature: Flue Gas Temp 1170 Degree. C (approx.)
- Flow rate of flue Gas : 2,20,000 to 2,60,000 Kg/Hr
- Flue Gas Velocity : 8 - 10 M/Sec
- Maximum ambient temperature : 45^{0}C

Old Insulation Details:

- 5 ½" thick Ceramic Fiber blanket { 1260 Deg Grade} insulation with 0.5 mm Thk Incolloy-800 H lining

New insulation details:

For Hot Face Lining

- Ceramic Fiber Z Section Modules - **150 mm thick**
- Grade : 1425 Degree C
- Density : 160 Kg / M^3
- Anchors : SS 310

For Back Up Insulation:

- Ceramic Fiber Blanket Insulation - **25 mm Thick**
- Grade : 1260 Degree C
- Density : 128 Kg / m^2

For Hot Face protection lining / coating over the face of Modules for Erosion Resistance.

- Zirconia Based Low Temperature Setting Product
- Maximum Service Temperature of Product : 1700 Degree C
- Product: Cercoat ZL of M/s Unifrax or equivalent.

BEFORE: DAMAGED INCOLLOY 800-H LINING

AFTER: NEW CERAMIC 'Z' SECTION INSULATION & CERCOAT ZL COATING

<u>AUXILIARY BOILER, ITS BURNERS JOBS</u>:

Preventive maintenance of all burners was carried out. External cleaning of tubes was done. The AG and Naphtha filter were cleaned.

UREA PLANT

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

Last major overhauling of Siemens Turbine (Q-1801) was carried out during Shutdown -2005. Hence it was taken for overhauling as per schedule after 6 years. Activities performed are as under. Following readings were recorded on 24-03-2011 (before shutdown) and 06-05-2011 (after shutdown) for reference.

Table 1: Reference Data Sheet for Q-1801

Description	**Unit**	**Before overhauling**	**After overhauling**
Date & Time		24-03-2011 & 09:05 AM	06-05-2011 & 9.00 AM
Plant Load	%	114%	104
Prilling Load	%	103%	116
Turbine (Q-1801)			
Speed	rpm	6831.9	6852
Casing Expansion	mm	5	5
Main steam pressure **PI-1941**	kg/cm2 g	63.8	63.8
Extraction steam pressure **PI-1944**	kg/cm2 g	23.1	23.1
Trip Oil pressure **PI-1971**	kg/cm2 g	9.7	9.25
Lube Oil Pressure **PI-1967**	kg/cm2 g	2.1	2.15
Secondary Oil Pressure (HP) **PI-1974**	kg/cm2 g	3.65	3.75
Secondary Oil Pressure (LP) **PI-1975**	kg/cm2 g	2.48	2.85
Control Oil Pressure **PI-1977**	kg/cm2 g	10.3	9.9
Before Stage group I **PI-1942**	kg/cm2 g	45	43
Exhaust Steam **PI-1946**	kg/cm2 g	0.875	0.875
HP Control valve opening	div	31	30
MP Control valve opening	div	8	5
LP Control valve opening	div	35	38
Air pressure for seal – Rear side	kg/cm2 g	0.3	0.5
Air pressure for seal – Front side	kg/cm2	0.9	0.5
60 ata steam temperature	°C	410	410
LP Compressor (K-1801-1)			
Bearing oil pressure – Turbine Side	kg/cm2 g	2.0	2.1
Bearing oil pressure – Free end side	kg/cm2 g	2.0	2.1
Thrust bearing oil pressure – HP side	kg/cm2 g	0.75	0.75
HP Compressor (K-1801-2)			
Bearing oil pressure – LP Side	kg/cm2 g	2.0	2.0
Bearing oil pressure – Free end side	kg/cm2 g	2.0	2.1
Thrust bearing oil pressure – Free end side	kg/cm2 g	0.35	0.35
1st Suction pressure **PI-1901**	kg/cm2 g	0.15	0.12
1st Discharge pressure **PI-1902**	kg/cm2 g	4.1	3.65
2nd Suction pressure **PI-1903**	kg/cm2 g	4.3	4.1
2nd Discharge pressure **PI-1904**	kg/cm2 g	20.4	20.0
3rd suction pressure **PI-1905**	kg/cm2 g	18.4	18
3rd discharge pressure **PI-1906**	kg/cm2 g	86	86
4th suction pressure **PI-1907**	kg/cm2 g	86	86
4th discharge pressure **PI-1908**	kg/cm2 g	145	145

Turbine was stopped at 01.30 AM on 25-03-2011 and barring gear was started. Barring gear and lube oil circulation was stopped at 10.30 AM . At the same time Insulation removal started from top of the casing. Temperature was 275 °C at 60 ata main steam inlet pressure gauge and casing expansion reduced to 4.0 mm.

Disassembly of Turbine:

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

- For decoupling the turbine with LP compressor, coupling guard with bellow was removed, and then coupling spacer was removed with the help of jack bolts.
- After removing the barring gear pipe line and instrument probe, top cover of rear bearing was lifted.
- Emergency trip gear gap measured after keeping OST pin perpendicular to the face of lever. It was 0.95 mm. (Ref 12+).

Note: refer page 12+ of Siemens Assembly Record, Document no. 0-3600-8520-40

- Earthing brush was removed by electrical department. Then top cover of front bearing pedestal was removed with help of special lifting arrangement.
- Rotor axial thrust was measured and it was 0.25mm.
- 60 ata steam servo cylinder with pilot valve removed.
- Alignment fixture was fixed with turbine coupling half and dial indicator was kept at LP case coupling half. Alignment reading between Turbine and LP Compressor was measured and recorded.
- Tightened all 6 nos. of casing locking bolts. After that steam pipe lines (23 ata steam inlet and outlet at the top of casing & 4 ata (induction steam line) connected to casing were removed.
- Both 60 ata Emergency stop valves were removed
- 23 ata servo cylinder and pilot valve were removed.
- 4 ata emergency stop valve & servo cylinder and pilot valve were removed
- Turbine front end journal bearing clearance was measured. 0.25mm thick shim was kept at bearing housing partition face. And Lead wire having 1.00 mm diameter kept at shaft. Tightened the bearing housing bolt, lead wire reading was 0.46mm. Journal bearing clearance at front side was 0.21 mm (= 0.46mm – 0.25mm). (Ref 10+)
- Turbine rear end journal bearing clearance was measured. 0.25mm thick shim was kept at bearing housing partition face. And Lead wire having 1.00 mm diameter kept at shaft. Tightened the bearing housing bolt, lead wire reading was 0.50mm. Journal bearing clearance at front side was 0.25 mm (= 0.50mm – 0.25mm). (Ref 10+)

- At front bearing pedestal, oil guard clearance was measured. (Ref 12+)

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

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

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

- End cover of thrust bearing having Allen screw size 7mm, was removed. For removing the cover, 8mm Allen key was grinded to 7mm.
- Total float of rotor was measured after removal of active and non active side thrust pads. It was 4.0mm. (Ref 9+)
- All casing bolts were removed. (Spanner Size - 50mm/ 55mm/ 60mm/ 65mm/ 75mm).
- For lifting the top casing, 2 nos. of guide bolts and 6 nos. of jack bolts were provided at front and rear side as shown in figure -1.

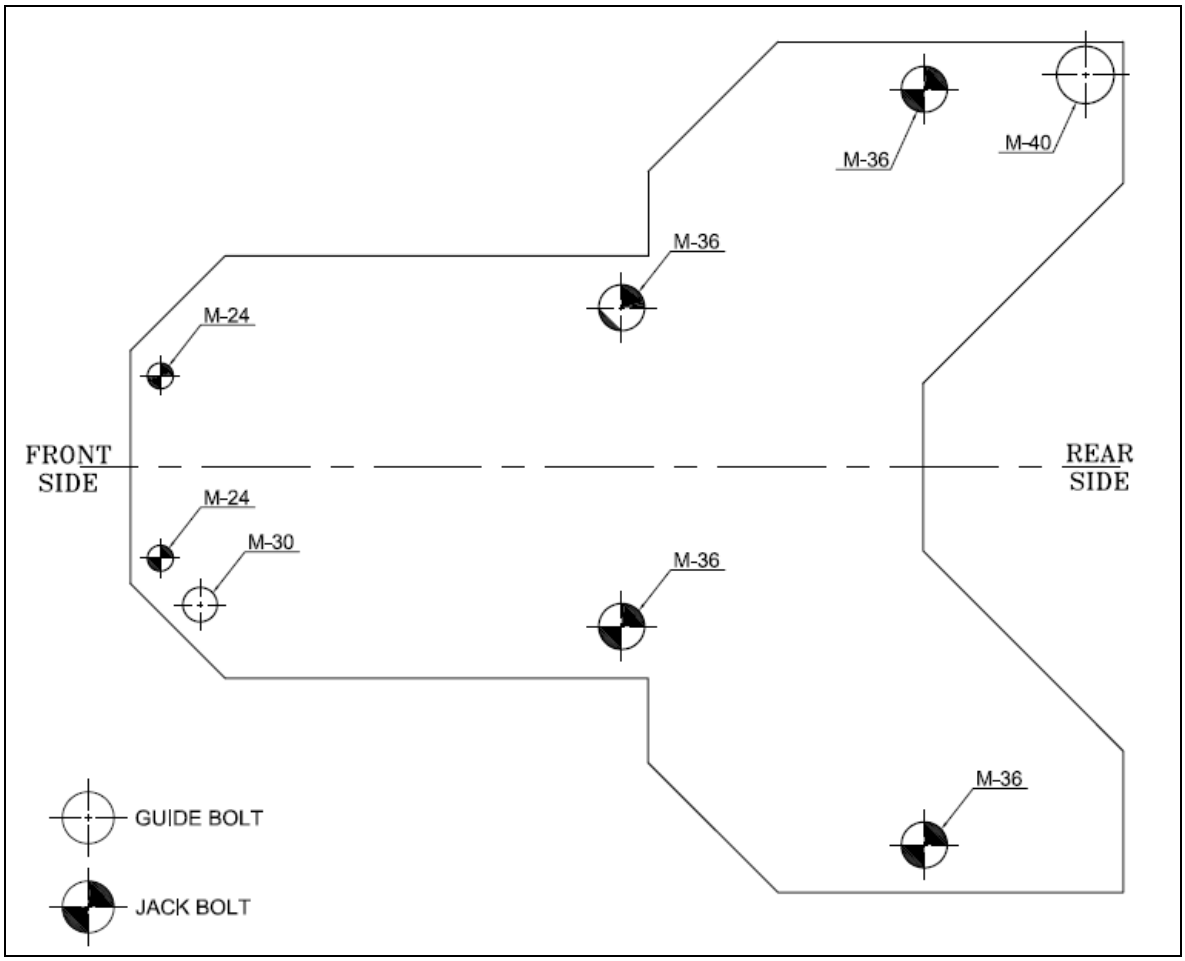


Figure -1

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

Figure -2

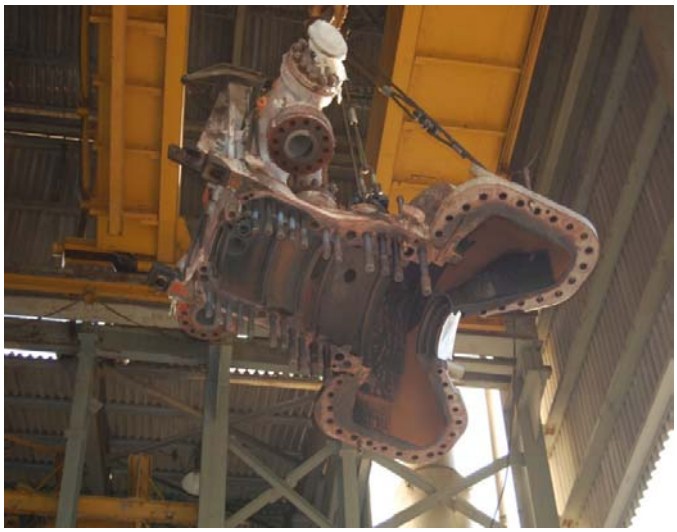


Figure -3

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

- Axial labyrinth clearances (SALE) were measured and recorded. (Ref. 27+,28+ & 29+)
- Front and rear steam gland removed
- For lifting the rotor**,** level of same was maintained by 2 nos. of bolt provided in special rigging arrangement. Rotor was lifted using 2 nos. of 3 ton web sling and shifted to ground and placed on stand as shown in Figure -4.

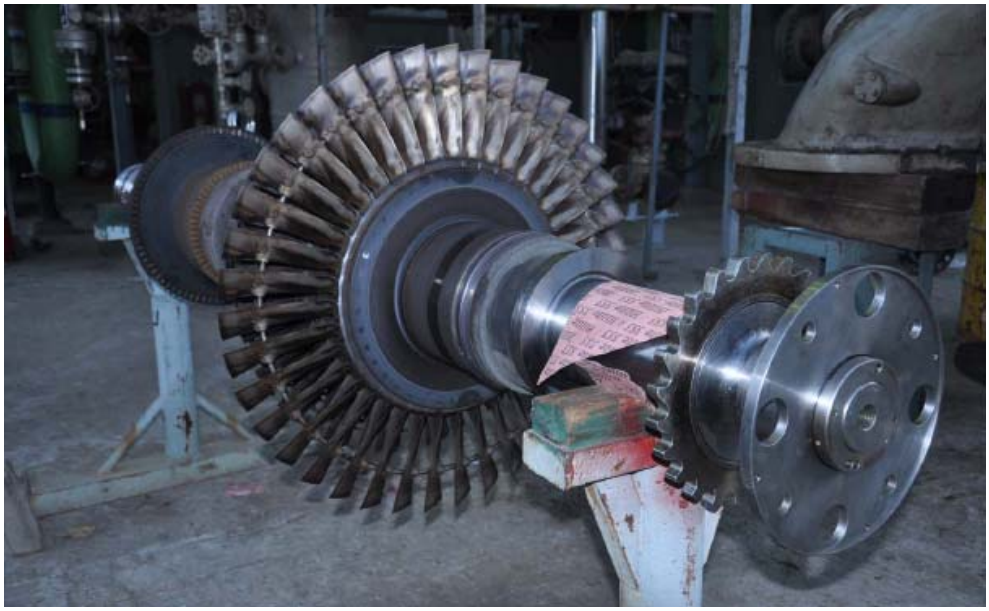
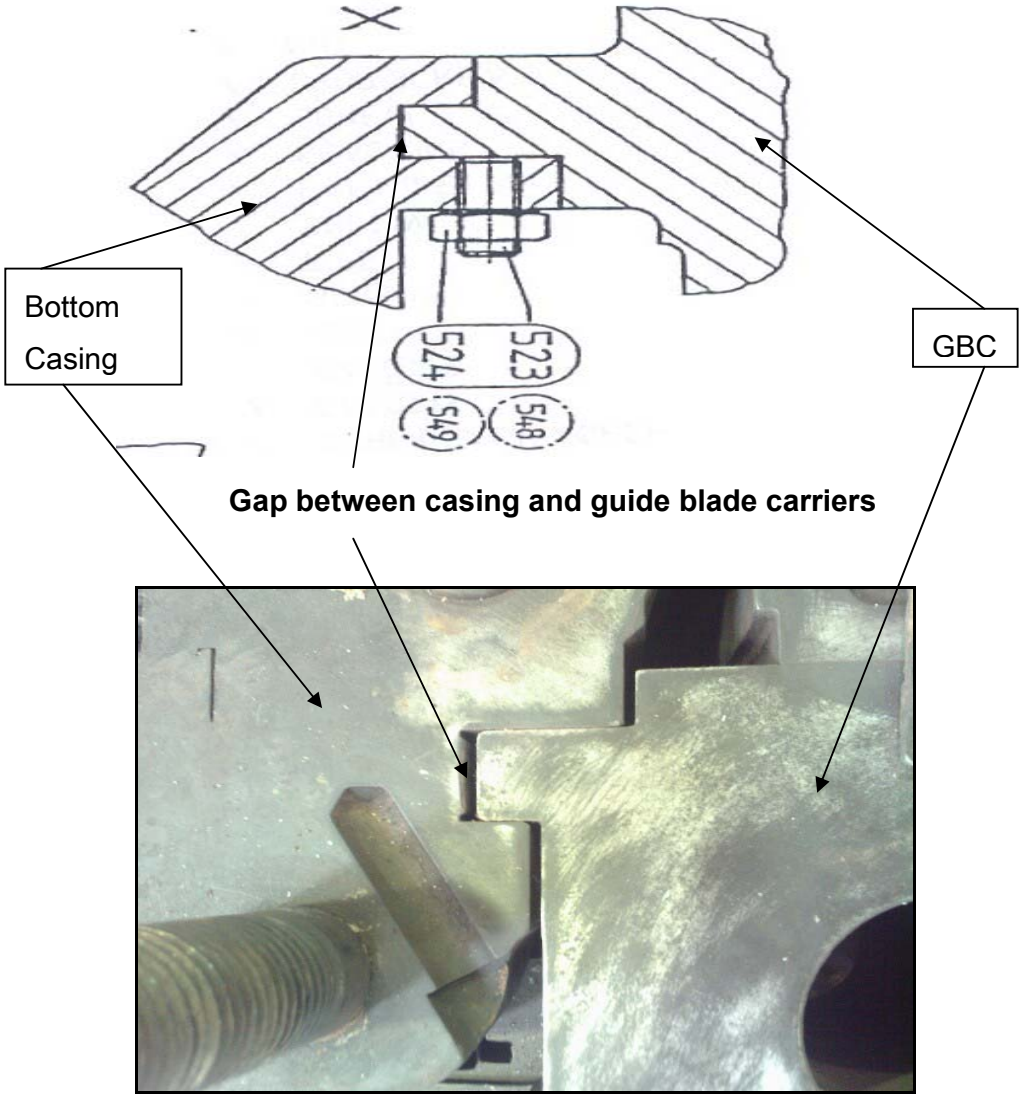


Figure -4

- Run out of rotor was checked at four point. The reading are given below:

  Front: 0.005 mm
  Rear: 0.005 mm
  Front Gland: 0.03mm
  Middle Gland: 0.02mm

- Gap between casing and guide blade carriers are measured with help of filler gauge as shown in figure -5 and recorded in table -2.



Gap between casing and guide blade carriers

Figure-5

Table – 2 : Gap between casing and guide blade cariiers

Sr. No.	Description	Left side	Right side
1	Nozzle	1.85mm	1.85mm
2	1st guide blade carrier	1.45mm	1.50mm
3	2nd guide blade carrier	1.95mm	1.90mm
4	3rd guide blade carrier	1.95mm	1.85mm
5	Inner gland	1.45mm	2.25mm

- Vertical level difference between casing and guide blade carrier (gap between spherical washer level and casing facing level as shown in figure -6) was measured and recorded. (Ref. 24+)

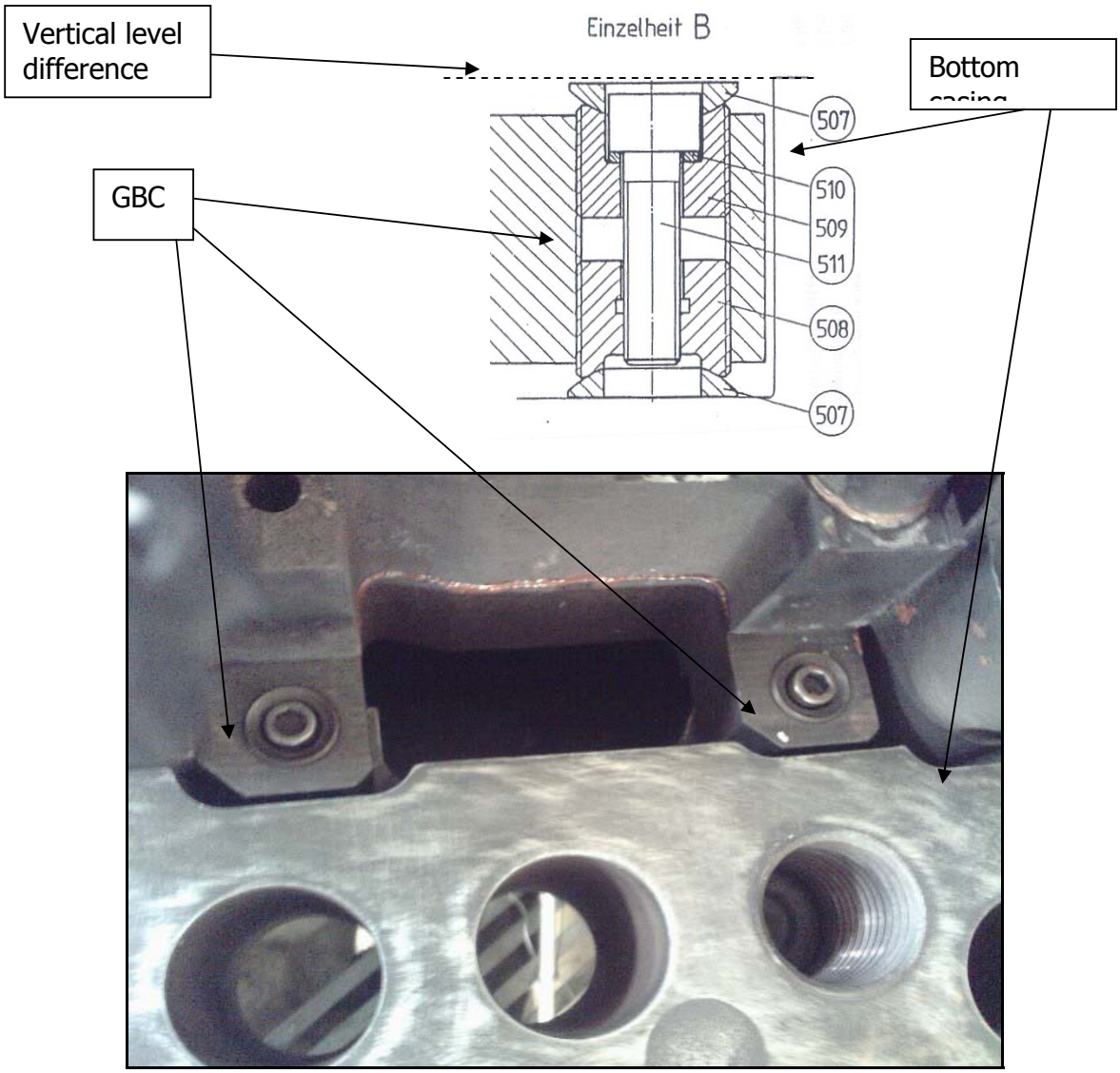


Figure -6

- Nozzle clearance was measured. It was 5.20mm left and 5.02mm right.(Ref 23+)
- Removed bottom halves of all three Guide blade carriers, steam chamber and inner gland one by one front side to rear side.

- GBC -2 was found to have minor pitting (as shown in figure-7)

Figure -7: Pitting observed on GBC-2

- Rotor, guide blade carriers, steam chamber (Nozzle block) and inner gland were cleaned by hydojetting keeping pressure 150 kg/cm2g using DM water, and then dried by pressurized air.
- DP test of rotor, all guide blade carriers, steam chamber and inner gland were done. Pin holes observe at 2 points in welding area of steam chamber. After minor grinding, pin holes were removed.

Assembly of Turbine

Following activities were carried out for assembly of Turbine.

- Bottom half of both side journal bearing were assembled. Bottom half of thrust bearing was placed.
- Kept the bottom spherical washer (POS 507) at both sides of the bottom casing. Placed the bottom half of GBC on bottom casing ensuring that washer is not displaced from position
- Assembly of bottom halves of GBC was done from LP to HP section.
- Then bottom half of nozzle block and inner gland was placed.
- Rotor was lifted from the stand after checking level with help of spirit level using leveling bolts in rigging arrangement. Placed the rotor on bottom casing.
- For centering the rotor following activities were carried out.
    - All 6 nos. of locking bolts were loosened
    - Bottom half of thrust bearing assembly was done.
    - Dial was kept at bearing pedestal shims (POS 38), as shown in figure-8 and bottom casing was kept at 0.10 mm below from bearing pedestal with shims using jack bolt.

- One dial gauge was placed at rotor free end with dial on front bearing pedestal bottom (R1), second dial gauge at bearing oil seal area, of front pedestal (R2) and third dial gauge was kept on rear bearing pedestal (R3). For position R2, a ring was made in workshop for clamping dial on front oil seal area.(Ref 8+)

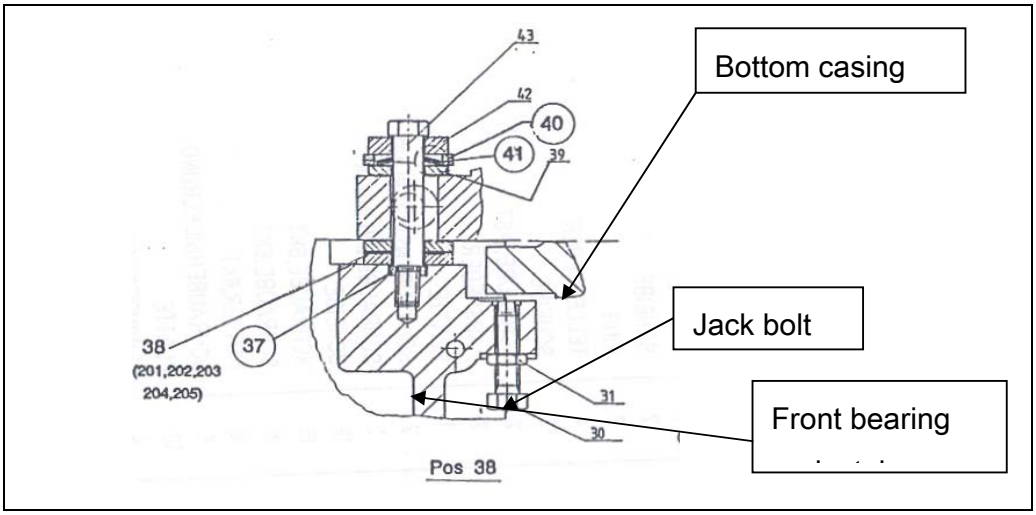


Figure -8

- Front pedestal base plate position no. is shown in figure-9.

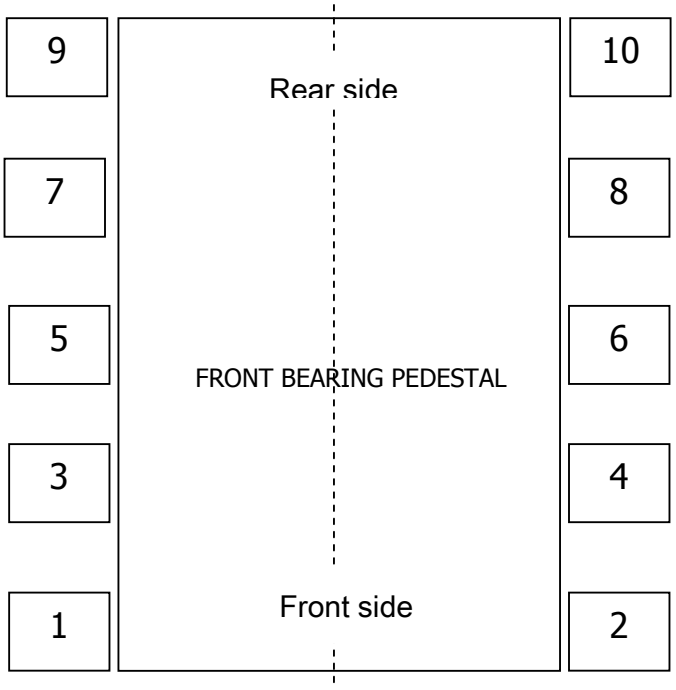
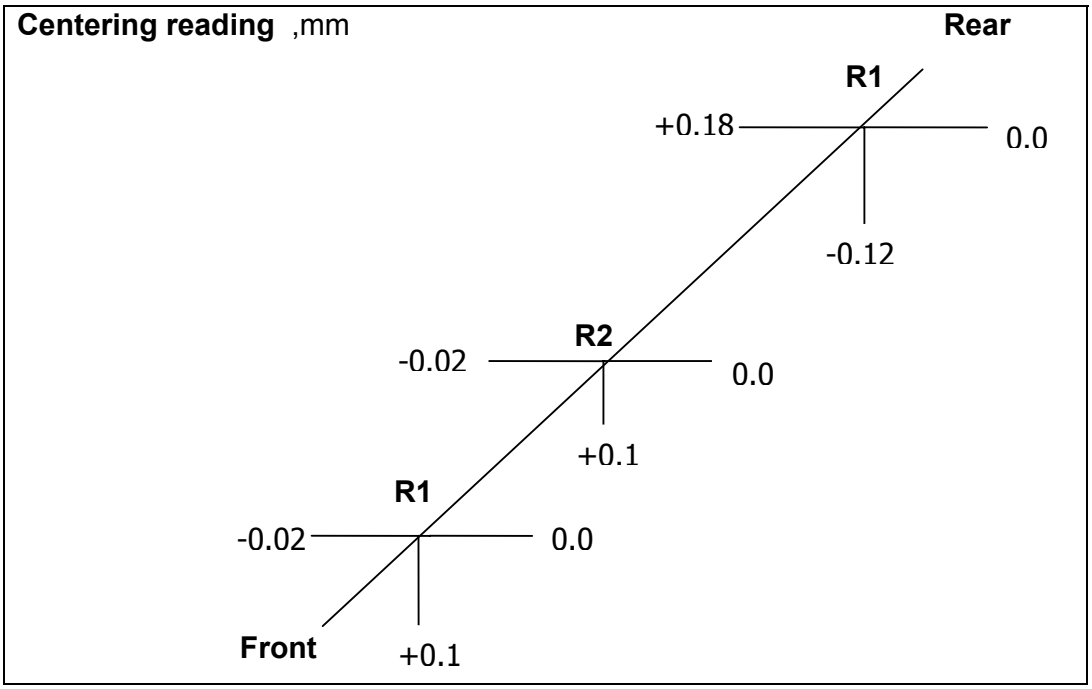
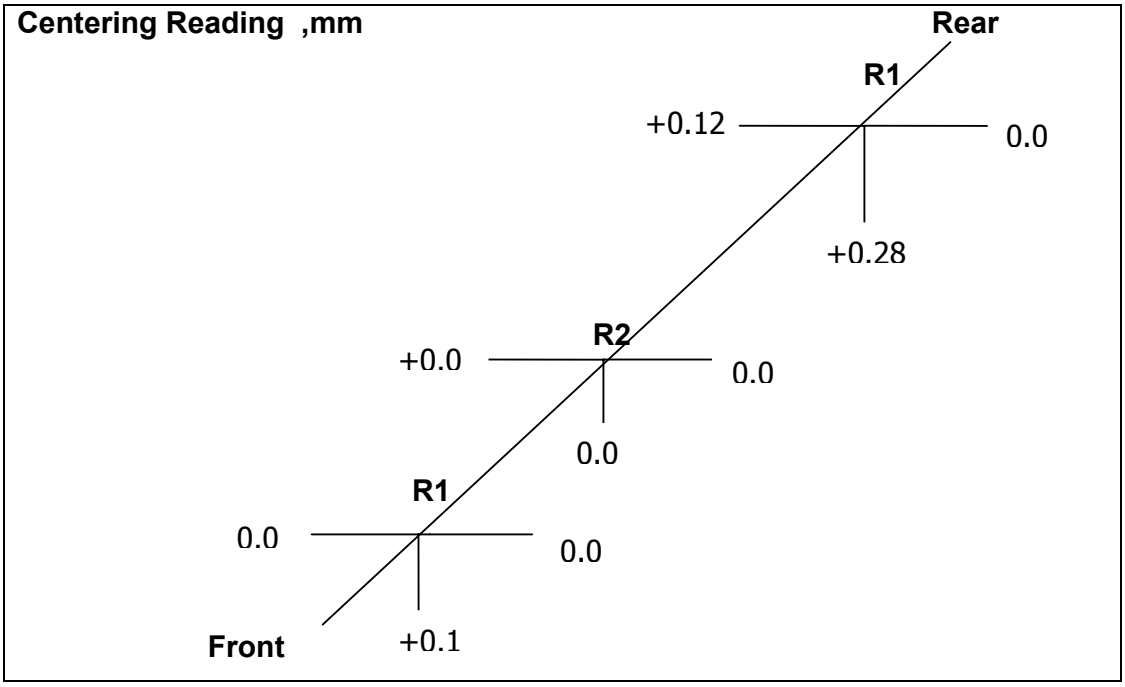


Figure -9

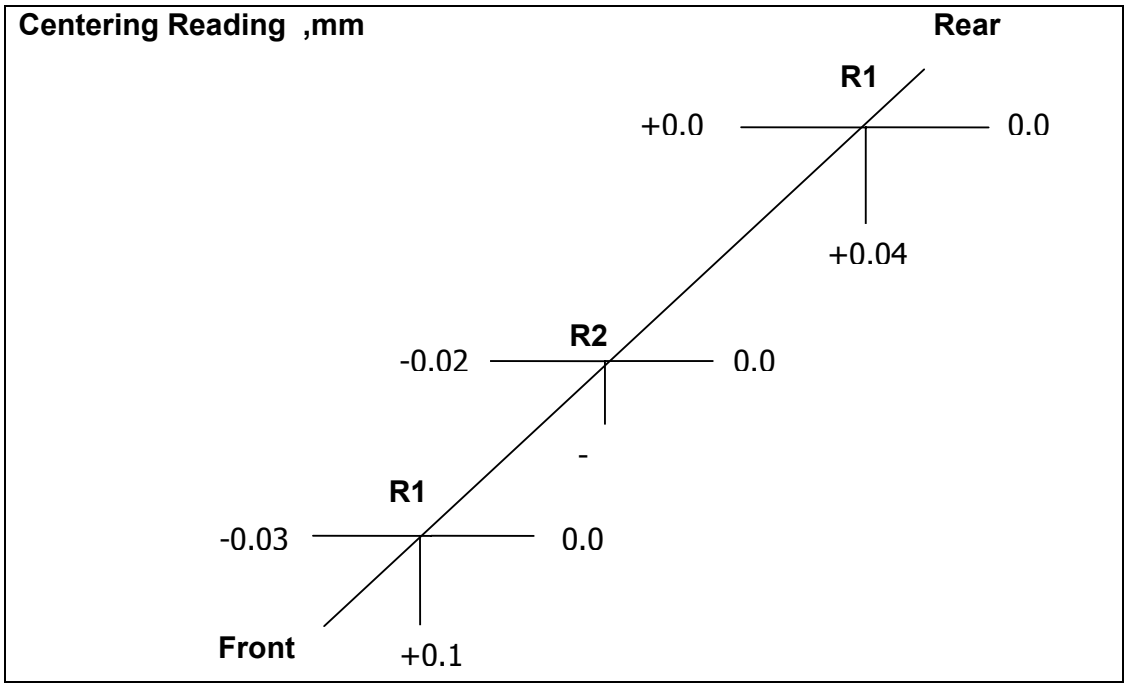
- Placed the 0.2 mm shim in front pedestal bearing base ring.



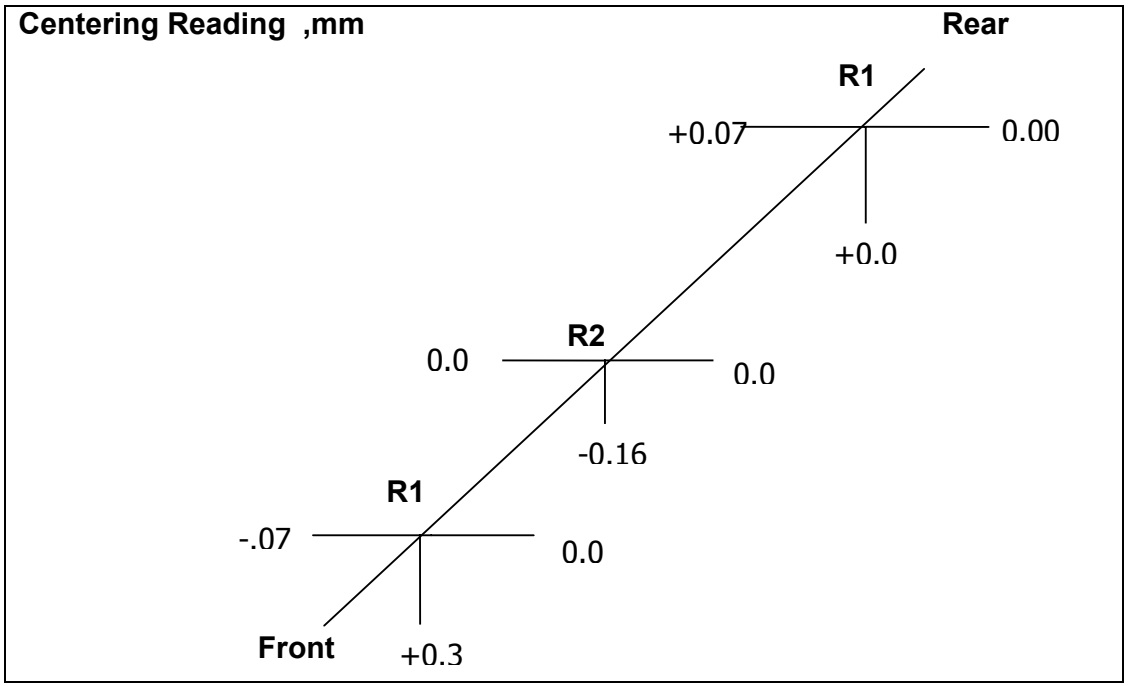
- Correction in rear bearing, remove the 0.1 shim from left side.



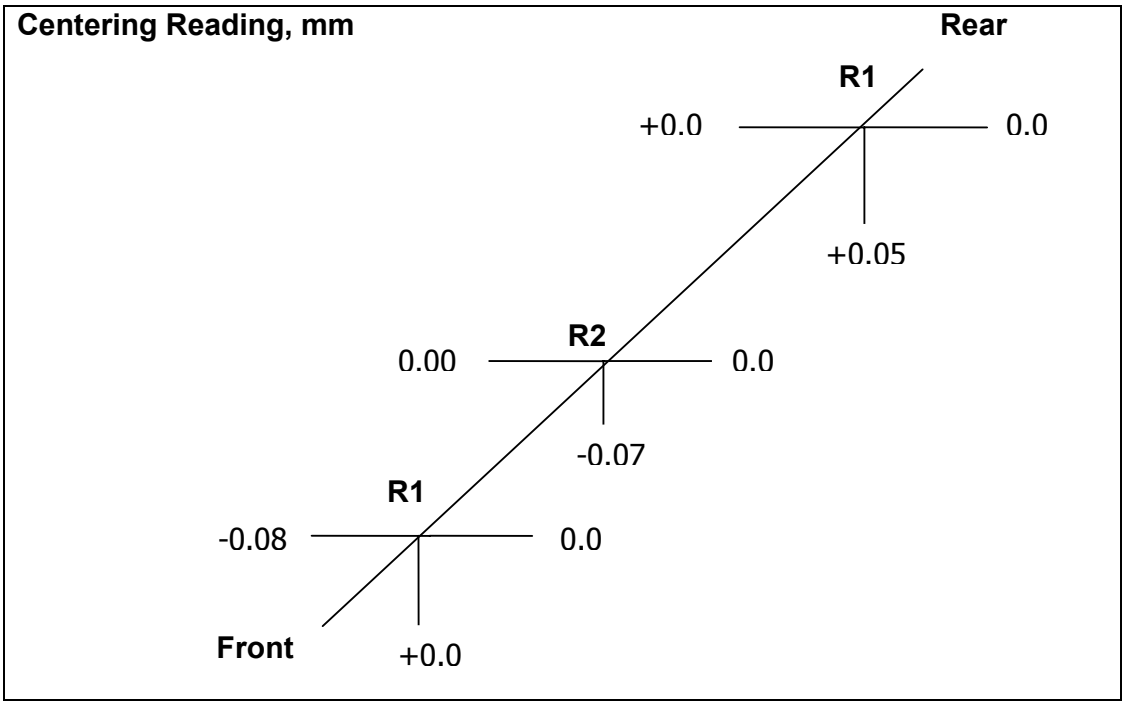
- Correction in rear bearing, removed the 0.1 mm shim from the right side.



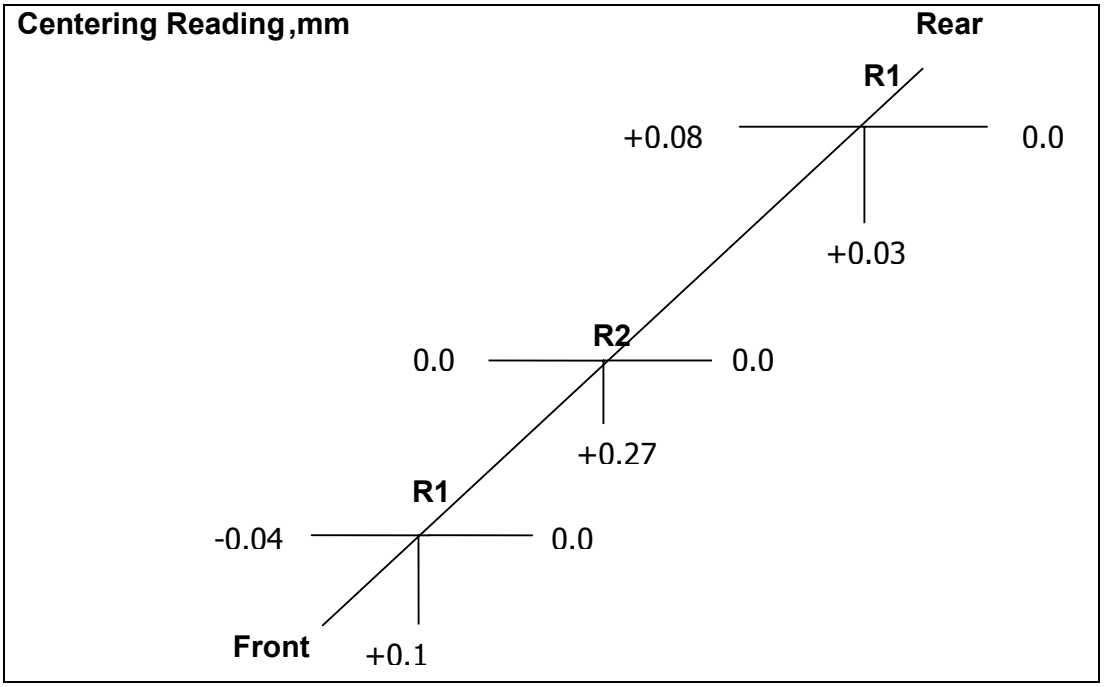
- 0.2mm shim removed from the front pedestal base plate position no. 7, 8, 9 & 10.



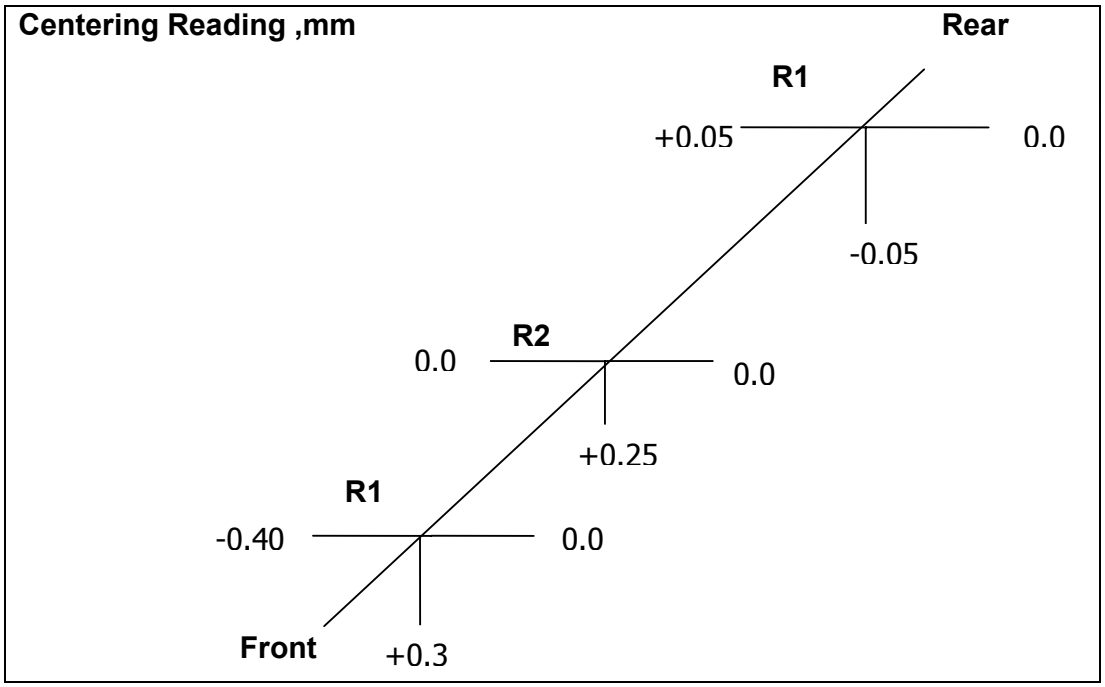
- 0.2mm shim added in front pedestal base plate position no. 9 & 10.



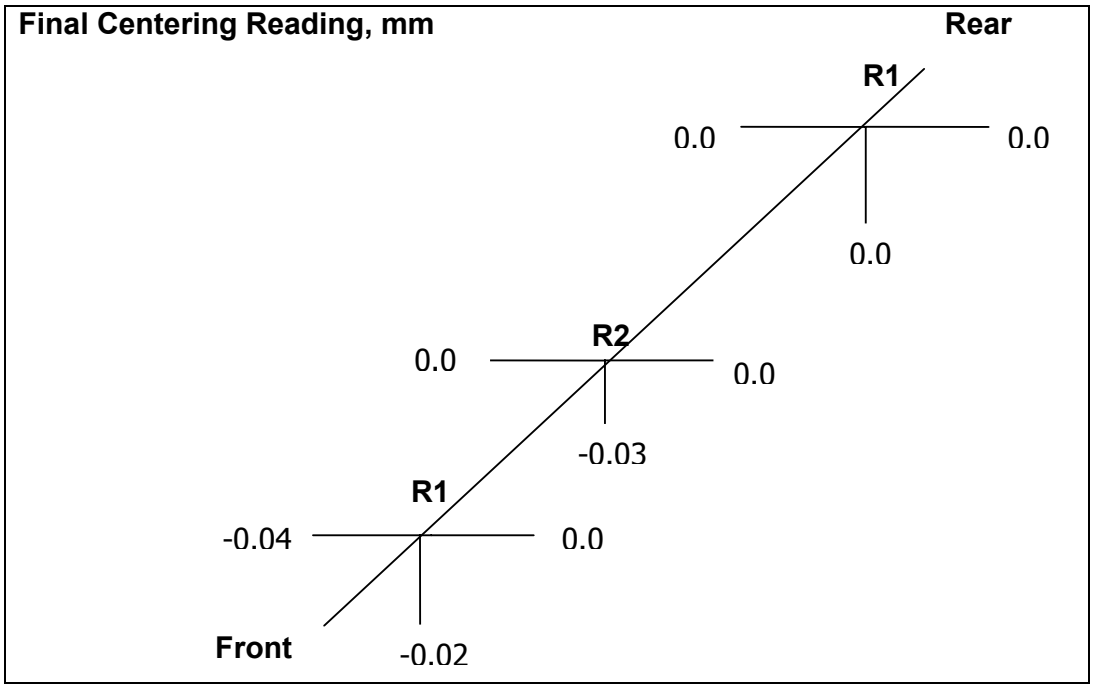
- 0.2mm thick shim removed form the front bearing base ring and 0.2 mm thick shim added in front pedestal base plate position no. 9 & 10.



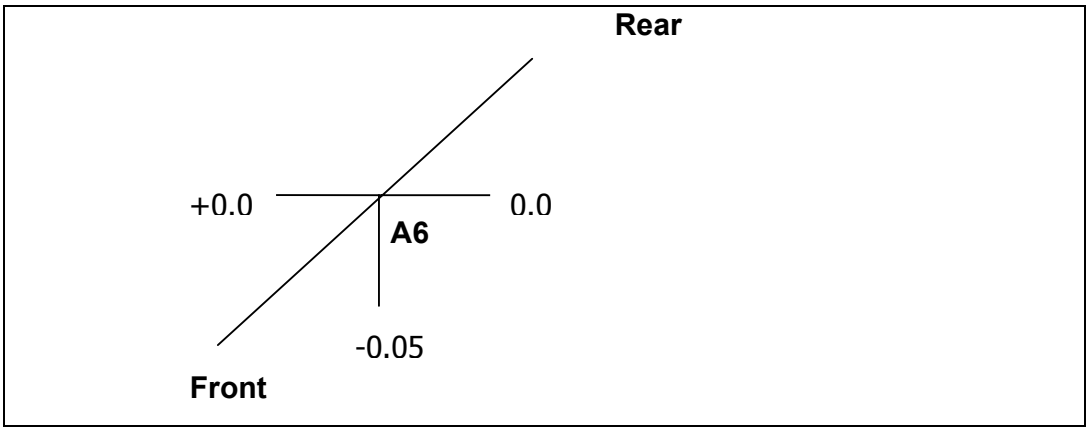
- 0.05mm shim added in bottom of rear bearing and .2 mm shim removed from front pedestal base plate position no. 1, 2, 9 & 10.



- 0.2mm thick shim provided in front pedestal base ring



- Dial gauge was placed on rotor with dial on face of housing for thrust collar (front side)



- After centering of rotor in bearing, labyrinth clearance were measured and recorded in Table -3. Also GAP between casing and GBC was measured and recorded in table -3.

Table – 3 : Gap between casing and GBC & Gap between casing and GBC

	Left side		**Right side**	
	Laby clearance (SRLA)	Gap between Casing and GBC	Laby Clearance (SRLA)	Gap between Casing and GBC
GBC-1	0.35mm	1.45mm	0.65mm	1.70mm
GBC-2	0.25mm	2.18mm	0.70mm	1.95mm
GBC-3	0.40mm	2.55mm	0.65mm	2.44mm

- It was observed that, all labyrinth clearances at right side in GBC 1 and 2 were more than at left side. Hence GBC 1 and 2 are required to shift towards left side for proper centering of rotor. Laby clearance for GBC -3 was within acceptable limit in both sides. In left side of nozzle block chamber, shaft gland clearance was 0.05mm; it also required to shift towards left side for proper centering of rotor

- Following activities were carried out for centering of bottom of GBC-1 w.r.to rotor in a horizontal plane:
  - Labyrinth clearances were 0.35mm at left side and 0.65mm at right side.
  - Lifted the Guide Blade carrier and removed the guide pin**.** The guide pin are positioned in slots as shown in figure- 10

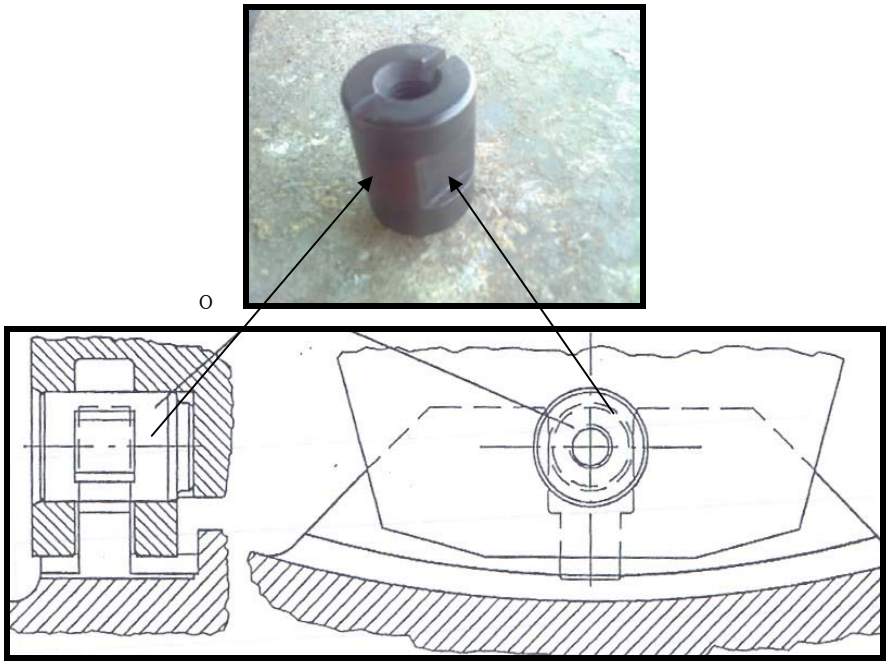


Figure -10

- For shifting the bottom of GBC towards left, tack welding was done at right side of guide pin of appx. 0.15/0.20mm height. On the slot at left side, metal was removed by grinding by same amount.
- Placed the guide blade carrier no. 1 and clearance was found OK.

- Similar procedure adopted for shifting GBC-2.
- Following activities were carried out for centering of bottom of nozzle block w.r.to rotor in a horizontal plane by adjusting eccentric guide pin and sleeve. :
  - Removed the flange from the bottom of casing (out side).
  - Locking bolt was removed from eccentric guide pin assembly.
  - Eccentric guide pin and sleeve were removed by providing jack bolts using the same flange.
  - The guide pin was slightly rotated for repositioning the bottom steam chamber and lock bolt was tightened.
  - After placing rotor, clearance was checked and found OK.

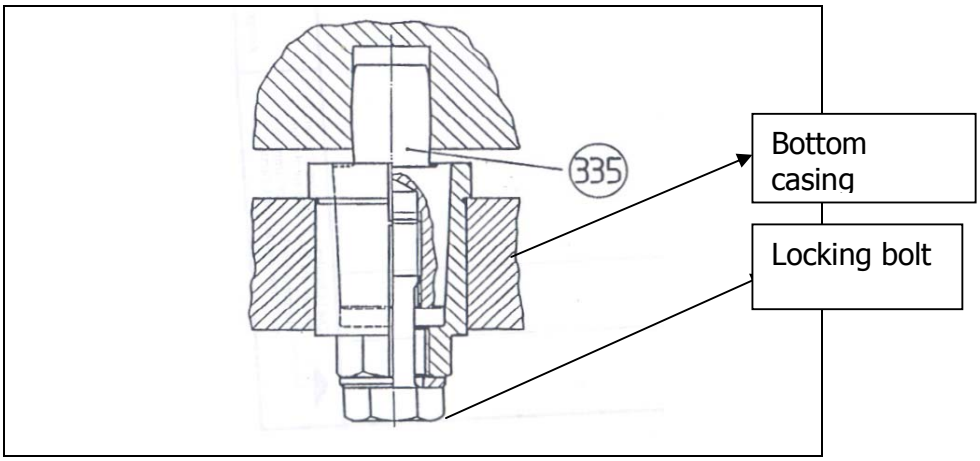


Figure- 11

Figure -12: Eccentric guide pin and sleeve in dismantled condition

Figure -13: Top view of Eccentric guide pin and sleeve in position

- Now vertical alignment of all Guide blade carriers was required to be corrected. Following activities were carried out for GBC-III.
  - Removed top calotte (POS 509), socket head screw (POS 511) , and ring (POS 510)

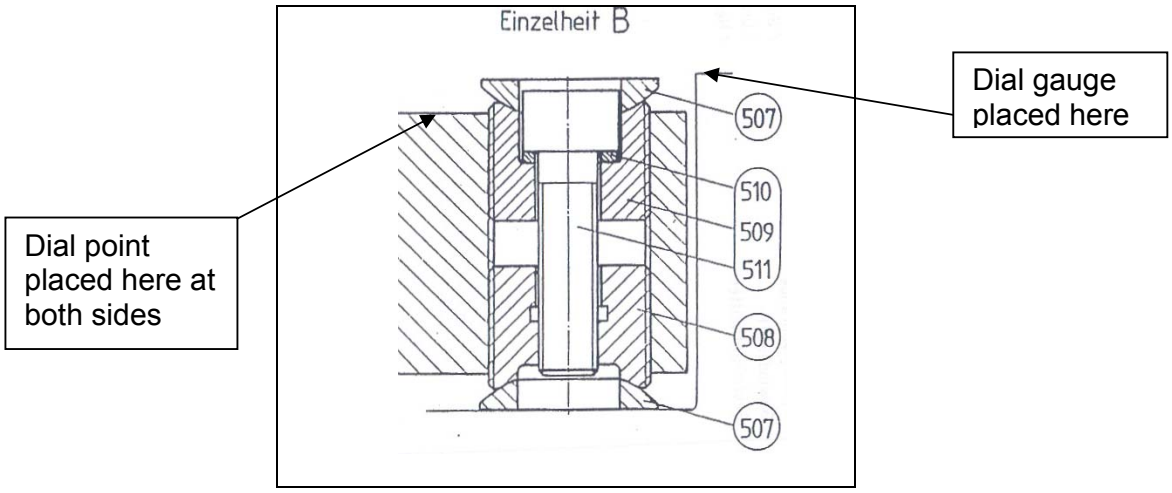


Figure -14

- Dial gauge base was placed on top face of bottom casing and dial point was placed on top of bottom half of GBC-III bottom on both sides.
- Lifting and lowering of GBC-III was done by bottom calotte (POS 508)
- By loosening the bottom calotte (POS 508), GBC-III was lowered
- Rotor was rotated manually.
- When rotation of rotor was stopped, reading of dial is as given below:

0.00

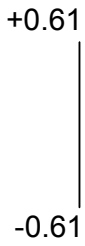
-0.45

- At the point, where rotor stopped, indicator was made “0”. Then GBC-III was lifted by tightening bottom calotte and rotor was rotated. When rotor stopped, readings are as follows.

+1.22

0.00

- For vertical alignment, GBC-III was lowered by half of top reading +1.22 i.e by 0.61 mm by bottom calotte.



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

- The same procedure was adopted for GBC-II & I. The final readings are given below:

- Top half of all guide blade carrier, steam chamber and inner gland were placed. All bolts were tightened. Tack welding of bolt done with guide blade carrier body by TIG welding using 2.5mm Dia filler wire - ER 70 S2.
- Top casing was lifted after checking the level with the help of measuring scale. Birkosit was applied on both face of casing. Top casing was placed on bottom casing using 6 nos. of guide bolts (guide bolts were not removed).
- Tightening of bolt was done sequentially as per shown in figure 15.

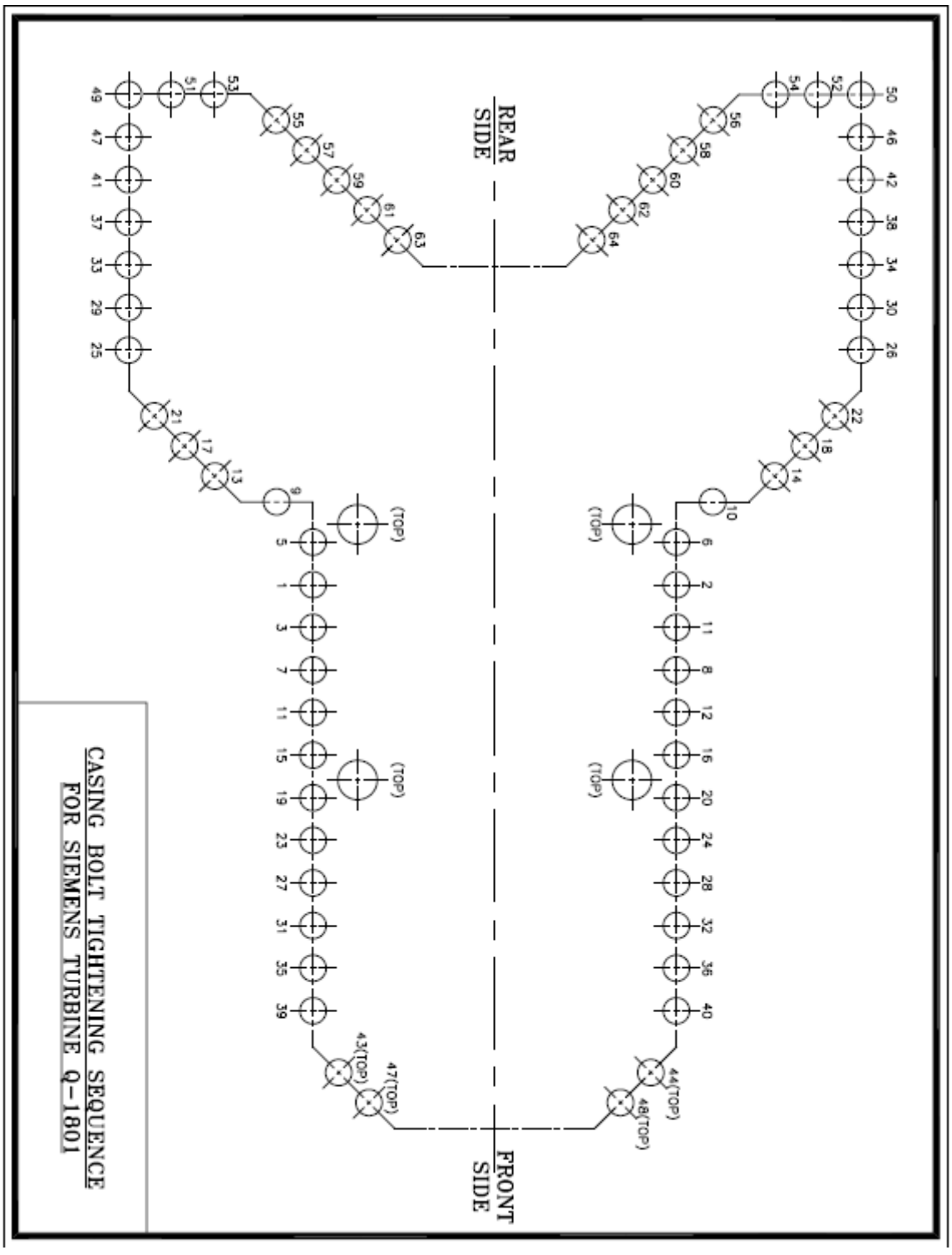


Figure -15: Tightening sequence

- Both 60 ata inlet flange was tightened using new gasket.
- Minor sound observed when rotor was rotated. Lift of rotor was checked, it was 0.30mm, and it was assumed that minor sound may be from fins of steam gland (HP side).
- Removed the OST assembly, cleaned by acetone. All parts of OST were found ok and finally boxed up the OST assembly.
- Placed the lift bar. 60 ata emergency stop valve were assembled.
- 23 ata servo cylinders with pilot valve were assembled on the position.
- All steam piping flange (4 ata induction line, 23 ata extraction line top and bottom) to casing were tightened
- 4 ata servo cylinder with pilot valve was assembled
- All locking washer of top casing were loosened.
- Alignment between turbine and LP was checked and corrected.
- Total 7 nos. of blinds in oil lines were provided for OST (LP case line – 3 nos., GB – 1no. & HP case line – 3nos.)
- Instrument probe was provided in front and rear bearing assembly.
- Axial thrust of rotor was checked and calibrated it with instrument's reading. Placed the rotor in center position.
- Box-up the front and rear vent line of turbine.
- Front end pedestal top cover of turbine was placed, boxed up.
- Existing earthing brush was provided.
- Emergency trip gear gap measurement was taken. It was 0.90mm
- Top cover of rear end pedestal bearing was placed and blind flange was provided for OST.
- AOP started, no leakage observed.
- Motor drive Lube oil pump was started.
- 60 ata and 4 ata governing valve lift was checked w.r.t secondary oil pressure, found as per protocol value shown in Table-2. 23 ata governing valve lift w.r.t secondary oil pressure corrected by loosing the adjusting screw of Pilot valve, finally found the as per protocol value as shown in Table-4.

Table -4: Governing valve lift w.r.t secondary oil pressure – Protocol value

Sr. No	WW-505 DCS out-put in %	60 ata		23 ata		4 ata	
		Secondary oil pressure	Valve Lift (Div)	Secondary oil pressure	Valve Lift (Div)	Secondary oil Pressure	Valve Lift (Div)
1	0	1.5	0	1.5	0	1.5	0
2	10	1.7	4	1.7	1	1.7	3
3	20	1.94	9.2	1.96	1.8	1.99	10
4	30	2.2	12.5	2.21	3.1	2.25	17
5	40	2.5	16	2.5	5	2.52	25.5
6	50	2.8	19.8	2.81	6.8	2.84	34.5
7	60	3.11	23.4	3.1	8.6	3.14	39
8	70	3.46	27.3	3.43	10.5	3.45	44
9	80	3.8	32	3.8	12.5	3.8	49.2
10	90	4.17	36.1	4.15	15	4.15	54
11	95	-	-	4.31	17.1	-	-
12	100	4.51	40.5	4.5	31	4.51	63.5

- Union leak at 60 ata ESV and oil line leak at 4 ata ESV observed.
- Placed the dial indicator on the top casing – front side.
- Heating of turbine started by the 60 ata main bypass valve, valve regulated slowly. Barring started and Heating was done for 2 hrs.
- Instrument speed indictor shown 2000 rpm during barring. Same was recalibrated by instrument department.
- After 4 hrs. Turbine was kept at slow roll at 2000 rpm. Casing expansion was 0.59 mm when 60 ata main steam temperature was 280 C.
- Turbine speed increased up to 4600 rpm for by passing the critical speed range. Hold it at 4600 rpm for 5 minute.
- Increased speed up to minimum governor speed 6375 rpm and hold for 30 minute. 60 ata main steam temperature was 280 C,
- Turbine speed increased to max. Governor speed 7875 rpm and over speed lock was bypassed by control room.
- Speed increased and OST done at 8620 rpm. (design valve : 8663 rpm +/- 1%)
- After doing OST, all oil line blinds were removed.
- Oil line leakage from the 60 ata and 4 ata ESV was attended.
- Removed the rear bearing pedestal top cover.
- Coupled the turbine with LP case and placed the top cover of rear end pedestal cover.
- Turbine handed over to production department.

- Turbine was started by production department; Oil spillage observed in rear bearing side. Turbine was tripped due to suction pressure of CO2.
- Flushed the rear bearing oil drain line using steam.
- After getting sufficient CO2, turbine was started. Seal air pressure at rear side was increased from 0.2 kg.cm2 to 0.5 kg/cm2g. This result, oil spillage stopped at rear bearing side.
- Bearing temperature and vibration was within acceptable limit.
- Consumed spares are shown in table -5.

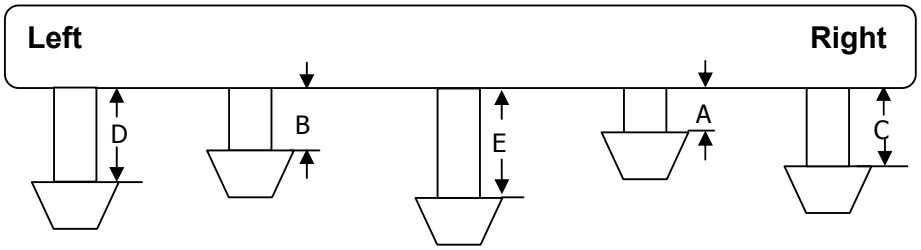
Table 5: consumed Spares

Sr. No.	Code	Description	Qty.
1	122029424740	GASKET DN 80 PN 40 POS-25,OF GASKETS FOR STEAM PIPING(POS-0601) FOR Q-1801, SIEMENS TURBINE	2
2	122029424770	GASKET DN 150 PN 160 POS-28,OF GASKETS FOR STEAM PIPING(POS-0601) FOR Q-1801, SIEMENS TURBINE	3

Overhauling of Accessories

60 ata Control valve :

- Dismantled the 60 ata stem chest valve. Following dimensions (valve cone with lift bar, required for lift bar assembly) shown in figure -16 were measured.



A: 7.00mm, B: 13.70mm, C: 17.10mm, D: 24.50mm, E: 31.40mm,

Figure - 16

- Approx 1.5 mm deep step was observed in lift bar near hole provided for stem (Ref Figure -17) . MOC was checked by Inspection (Cr 10 %,Ni 0.5%, Mo 1%). The worn out portion was built up by TIG welding using SS 410 filler wire and finished by filing.

Figure -17

- Both Stems (Store code - 122026153700) were replaced with new one made from M/s Turbo Machinery Engg. India Ltd. Hyderabad, against PO 9916673 date 29-08-2005.
- Journal bearing, POS 32 were observed in damaged condition, same was replaced with new one.
- In 60 ata and 23 ata control valve, stem gland packing were replaced with new one. Measured the packing length for both control valve, it was 42.00 mm.
- Consumed spares are shown in table- 6

Table- 6: Consumed Spares

Sr. No.	Store Code	Description	Qty
1	122023833200	JOURNAL BEARING, DI 25 X DA 32 X 30 L, POS 32, SACH-NR: 5-6685-0008-51, OF 60 ATA CONTROL VALVES DRG- 0-0006-0802-04, FOR Q-1801, SIEMENS TURBINE	1
2	**1**22026153700	STEM ASSEMBLY (VALVE SPINDLE, POS-21, INDIGENOUS), DRG. NO.: P2-DS-08053 OF 60 ATA CONTROL VALVE (POS-0038), DRG. NO.: 0-0006-0802-04, INDIGENOUS SPARE FOR Q-1801, SIEMENS TURBINE	2
4	122023326420	GLAND PACKING, FLOJET MAKE, (POS-503/504), SIZE : 19.95MM ID X 32MM OD X 6MM THICK ,OF 60 ATA CONTROL VALVE (POS-0038), DRG. NO.: 0-0006-0802-04 FOR Q-1801, SIEMENS TURBINE	10
5	122023326410	GLAND PACKING, FLOJET MAKE, (POS-503/504), SIZE : 19.95MM ID X 32MM OD X 4MM THICK ,OF 60 ATA CONTROL VALVE (POS-0038), DRG. NO.: 0-0006-0802-04 FOR Q-1801, SIEMENS TURBINE	15

60 ata servo cylinder and Pilot valve

- 60 ata servo cylinder and Pilot valve were not opened.

23 ata servo cylinder and Pilot valve

- 23 ata servo cylinder and Pilot valve were opened and cleaned.
- Approx 2mm deep step observed in return bar, POS 10 and wear observed in support roller, POS 24. Replaced the support roller with new one. The wear out portion was built up by TIG welding using SS 410 filler wire and finished by filing.

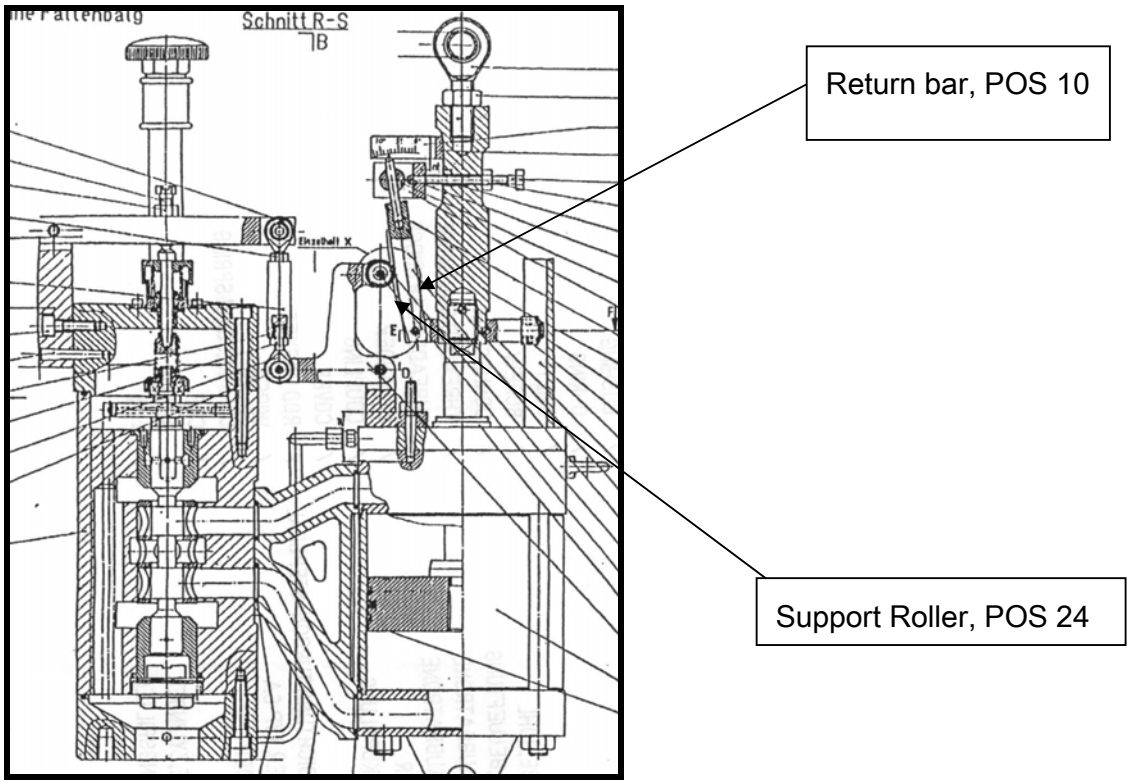


Figure – 18

- Consumed spares are shown in table -7

Table – 7: consumed Spares

Sr. No.	Store Code	Description	Qty
1	122025939510	O-RING, SACH-NR : 5-6748-2200-00,POS-16, SIZE-20X3, OF EXTRACTION (23 ATA) & INDUCTION (4 ATA) SERVO CYLINDER (POS-0050 & 0059), DRG. NO.: 0-0006-1900-08 FOR Q-1801, SIEMENS TURBINE	2
2	122025939501	O-RING, SACH-NR : 5-6748-2200-00,POS-4,SIZE-20 X 3, OF EXTRACTION (23 ATA) & INDUCTION (4 ATA) SERVO CYLINDER (POS-0050 & 0059), DRG. NO.: 0-0006-1900-08 FOR Q-1801, SIEMENS TURBINE	2
3	122025948400	PISTON SEAL RING, SACH-NR: 5-6568-2055-73,OF EXTRACTION (23 ATA) & INDUCTION (4 ATA) SERVO CYLINDER (POS-0050 & 0059), DRG. NO.: 0-0006-1900-08 FOR Q-1801, SIEMENS TURBINE	1
4	122025945700	SUPPORT ROLLER,SACH-NR : 5-6754-0001-00, POS-24,OF EXTRACTION (23 ATA) & INDUCTION (4 ATA) SERVO CYLINDER (POS-0050 & 0059), DRG. NO.: 0-0006-1900-08 FOR Q-1801, SIEMENS TURBINE	1
5	122025907310	SEALING BUSHING, SACH-NR: 5-6568-2061-00, POS-100, OF EXTRACTION (23 ATA) & INDUCTION (4 ATA) SERVO CYLINDER (POS-0050 & 0059), DRG. NO.: 0-0006-1900-08 FOR Q-1801, SIEMENS TURBINE	1

4 ata servo cylinder and Pilot valve

- 4 ata servo cylinder and Pilot valve were opened and cleaned.
- Wear observed in support roller. Replaced the same with new one.
- Support roller, POS 24 was found in damaged condition, replaced it with new one.
- Consumed spares are shown in table – 8.

Table – 8: consumed Spares

Sr. No.	Store Code	Description	Qty
1	122025939501	O-RING, SACH-NR: 5-6748-2200-00, POS-4, SIZE-20 X 3, OF EXTRACTION (23 ATA) & INDUCTION (4 ATA) SERVO CYLINDER (POS-0050 & 0059), DRG. NO.: 0-0006-1900-08 FOR Q-1801, SIEMENS TURBINE	2

Insulation of Turbine

The some of the existing insulation blankets of turbine was observed damaged. Hence it was decided to replace the damaged blankets. New blankets were made from glass cloth of 10 mil thk (temperature tolerance – 400 C) and filling it with 2 layers of Ceramic fibre blanket rolls (Size-: 7620 X 610X 25mm, Store code- 995416801010)and Pyroblock Insulation (Size 12" x 12" x 7", Store code – 995410101061).

DATA SHEET OF TURBINE, Q-1801 .SD-2011

Sr. No.	Description	Design Value (mm)	Actual Value BPM (mm)	Actual Value APM (mm)
1	Axial Float	0.25 ~ 0.35	0.25	0.30
2	Free End Bearing Clearance	0.18 ~ 0.31	0.21	
3	Coupling End Bearing Clearance	0.24 ~ 0.36	0.25	

Sr.No.		1		
Ref.Page No.		9+		
Part Name & Position		Axial displacement of rotor at the casing		
Parameter		Lower part	Lower part & upper Part	Lower part & upper Part with all internals
+ Direction	**Nominal**	2.2 - 2.8	2.2 - 2.8	2.2 - 2.8
	Actual	2.20	2.20	2.20
Measured Value	**Before overhauling**			
	After overhauling			
Sum	**Nominal**	3.90	3.90	3.90
	Actual	4.00	4.00	4.00
Measured Value	**Before overhauling**			
	After overhauling			
Remarks				

Sr No.	Ref Page No	Part Name & Position	Parameter	Ref Value	Actual Value	Measured Value		Measm. method
						Before O/H	After O/H	
2	9+	Rotor axial Position(1)	E1		98.80			2
			E2		132.20			2
			E3		304.50			2
3	10+	Journal Bearing; Tilting pad Front(1)	Journal Dia D		124.81			3
			Bearing Housing inner Dia D2		200.02			
			B1		20.003			
			B2		17.495			
			D2-D2xB1-2XB2=S	0.188 to 0.307	0.214			11
		Journal Bearing; Tilting pad Rear(5)	Journal Dia D		159.74			3
			Bearing Housing inner Dia D2		250.07			
			B1		22.506			
			B2		22.492			
			D2-D2xB1-2XB2=S	0.240 to 0.363	0.33			11
		Thrust Bearing (1)	SA	0.30 to 0.43	0.36			4
			SR1	0.70 to 1.00	0.70			1
			SR2	0.70 to 1.00	0.70			1
			SA1	0.01 to 0.055	0.025			4

Sr No.	Ref Page No	Part Name & Position	Parameter	Ref Value	Actual Value	Measured Value		Measm. method	Remarks
						Before O/H	After O/H		
4	**11+**								
	Z	Bearing Housing front(1)	S1 Front Left	≥1.3	>3.0			1	
			S1 front Right		>3.0			1	
			S1 rear left		>3.0			1	
			S1 rear right		>3.0			1	
			S2 Front Left	≥16.4	>17.0			1	
			S2 front Right		>17.0			1	
			S2 rear left		>17.0			1	
			S2 rear right		>17.0			1	
	Y		S3 front left	0.02 to 0.03	0.03			1	
			S3 front riqht						
			S3 rear left						
			S3 rear right						
			B 1 left		9.75				
			B1 riqht		9.75				
			B2 left		11.31				
			B2 right		11.31				
	X		S front left	0.08 – 0.10	0.08				
			S front right		0.08				
			S rear left		-				
			S rear right		-				
	Z		B3 left	-	19.86			3	
			B3 right	-	19.84			3	

Sr No.	Ref Page No	Part Name & Position	Parameter	Ref Value	Actual Value	Measured Value		Measm. method
						Before O/H	After O/H	
5	12+	Bearing housing front, seal ring (1)	SR	0.085 To 0.285	0.18	0.05 0.20(R)		1
			SA	1.6 to 4.0	2.00	2.24 (L) 2.24 (R)		1
		Emergency trip gear (1)	SR	0.80 to 1.00	1.00	0.95	0.90	1
				9.5 +/- 1.0	9.50			2
6	13+	Bearing housing front, seal ring (5)	SR	0.085 to 0.285	0.2	0.25 0.10(R)		1
			-SA	4.6 to 5.0	4.6	4.46(L) 4.50(R)		1
		Manual barring device(5)	-SA1	4.8 to 5.2	4.6			2
			-SA2	7.8 to 8.2	7.9			2
			-SA3	>1.5 =1.5	2.5			2
			-SA4	>1.5 =1.5	3.0			2
7	14+	Bearing housing front	SA left	0.07 to 0.09	0.08			4
			SA Right		0.08			4
8	15+	Seal ring (20)	SR	0.7 to 1.3	0.6		0.7	1
			SA	1.0 to 1.3	1.1		1	1
9	16+	Outer casing front(10)	S1	0.01 0.03	0.02			4
			S2	0.01 0.03	0.02			4
	16+	Springs fitted loaded	S1 Left	≥ 1.3	>2.5	5.2		
			S1 Right		>2.5	4.93		
			S2 Left	≥ 19.3	>19.5	17.40		
			S2 Right		>19.5	18.17		
			S3 Left	0.10 – 0.14	0.12	0.10		
			S3 Right		0.12	0.10		
			Pre Load of Spring, Left	0.7 – 0.9	0.85			11
			Pre Load of Spring,Right		0.85			11
		Dimn for checking bearing support casing	L Left (X)		31.9	29.37		3
			L Right (X)		31.82	29.74		3
			B Left (Z)		24.9	25.00		3
			B Right (Z)		24.9	25.0		3

Sr No.	Ref Page No	Part Name & Position	Parameter	Ref Value	Actual Value	Measured Value		Measm. method
						Before O/H	After O/H	
10	17+	Casing Exhaust section, rear	S(7) (Z)	0.02 0.06	0.04			4
			S1 Left (18)	0.10 – 0.14 (Y)	14			
			S1 Right (18)		0.10			1
			S2 Left (18)		0.14			1
			S2 Right(18)		0.14			1
11	18+	Angle section Ring(3)	S1 Ring No.1	0.07 0.12	0.08			4
			S1 Ring No.2		0.8			4
			S1 Ring No.3		-			
			S1 Ring No.4		0.09			4
			S1 Ring No.5		0.09			4
			S2 Ring No.1	≥ 2.6	4.1			11
			S2 Ring No.2		4.1			11
			S2 Ring No.3		4.1			11
			S2 Ring No.4		4.1			11
			S2 Ring No.5					
			S3 Ring No.1	1.9 to 2.6	2.5			11
			S3 Ring No.2		2.5			11
			S3 Ring No.3		2.5			11
			S3 Ring No.4		2.5			11
			S3 Ring No.5		-			
12	19+	Shaft gland outer / Inner	S(21.1)	0.05 to 0.14	0.07			1
			SA(21.1)	0.10 to 0.25	0.14			1
			S(15)	0.034 to 0.097	0.07			1
			SA(15)	0.080 to 0.181	0.1			1
			S(17.1)	0.06 to 0.18	0.06			1
			SA(17.1)	0.12 to 0.29	0.12			1
13	20+	Shaft gland outer	S(21.2)	0.30 to 0.44	0.3			1
			SA1(21.2)	1.70 to 2.30	1.8			1
			SA2(21.1)	2.20 to 2.80	2.2			1
			SR(17.1)	0.30 to 0.45	0.3			1

Sr No.	Ref Page No	Part Name & Position	Parameter	Ref Value	Actual Value	Measured Value		Measm. method
						Before O/H	After O/H	
14	21+	Shaft glands, inner	SR1(14.1)	0.75 to 1.20	0.75	0.45(L) 0.45 (R)	0.45(L) 0.45(R)	1
			SR2(14.1)	0.55 to 1.00	0.6			1
			SR1(14.1)	3.20 to 3.80	3.4			1
			SR2(14.1)	4.60 to 5.20	5			1
15	22+	Steam chamber	S (9)	0.02 to 0.03	0.02			4
			SA (20)	0.08 to 0.181	0.08			1
16	25+	Guide Blade carrier No.2	S=S1+S2 (8)	0.0 to 0.07	0.04			4
			S (8)	0.025 to 0.06	0.06			4
			S front left (19)	0.11 to 0.17	0.16	0.30	0.15	9
			S front right		0.16	0.30	0.15	9
			S rear left		0.16	0.2	0.15	9
			S rear right		0.15	0.35	0.15	9
17	26+	Guide Blade Carrier No.3	S=S1+S2 (8)	0 to 0.07	0.04			4
			S (8)	0.03 to 0.06	0.05			4
			S front left (19)	0.11 to 0.17	0.17	0.30		9
			S front right		0.17	0.40		9

Guide blade carrier (4) . Ref Page N0.- 27 +

Measurement Method		1											
Pos.	Version	SRLE						SRLA					
		Ref. Value	Actual Value	Measured Value				Ref. Value	Actual Value	Measured Value			
				Before O/H		After O/H				Before O/H		After O/H	
				R	L	R	L			R	L	R	L
2	A - Rad							0.80 to 1.00	0.80				
3	A	0.35 to 0.60	0.4			0.50	0.45	0.35 to 0.60	0.40			0.55	0.45
4	A					0.50	0.45		0.40			0.55	0.45
5	A					0.50	0.45		0.40			0.55	0.45
6	A					0.50	0.45		0.40			0.55	0.45
7	A					0.45	0.40		0.40			0.55	0.45
8	A					0.45	0.40		0.40			0.55	0.45

Measurement Method		1											
Pos.	Version	SALE						SALA					
		Ref. Value	Actual Value	Measured Value				Ref. Value	Actual Value	Measured Value			
				Before O/H		After O/H				Before O/H		After O/H	
				R	L	R	L			R	L	R	L
2	A -Rad	≥4.5	5.20							-	-	-	-
3	A	≥2.0	2.10		2.15	2.25	2.40	≥3.0	4.00		4.25	3.95	4.05
4	A	≥2.10	2.20		2.35	2.30	2.50	≥3.1	4.10		4.25	4.00	3.95
5	A	≥2.2	2.40		2.45	2.45	2.60	≥3.3	4.10		4.30	4.20	4.25
6	A	≥2.3	2.60		2.55	2.75	2.90	≥3.4	4.40		4.45	4.35	4.30
7	A	≥2.4	2.80		2.96	2.50	3.05	≥3.6	4.60		4.70	4.55	4.50
8	A	≥2.5	2.90		3.05	3.05	3.15						
3			E						4.50				

Guide blade carrier (4) . Ref Page N0.- 28 +

Measurement Method		1											
Pos.	Version	SRLE						SRLA					
		Ref. Value	Actual Value	Measured Value				Ref. Value	Actual Value	Measured Value			
				Before O/H		After O/H				Before O/H		After O/H	
				R	L	R	L			R	L	R	L
9	A	0.35 to 0.61	0.40			0.45	0.35	0.35 to 0.61	0.40			0.55	0.35
10	A					0.45	0.35					0.50	0.35
11	A					0.45	0.35					0.45	0.35
12	A					0.45	0.35					0.45	0.35
13	A					0.45	0.35					0.45	0.35
14	A					0.45	0.35					0.45	0.35
15	A					0.45	0.35					0.45	0.35
16	A					0.45	0.35					0.45	0.35
17	A					0.45	0.35					0.45	0.35
18	A					0.45	0.35					0.45	0.35
19	A					0.45	0.35					0.45	0.35
20	A					0.45	0.35					0.45	0.35

Guide blade carrier (4) : 28+

Measurement Method		1											
Pos.	Version	SALE						SALA					
		Ref. Value	Actual Value	Measured Value				Ref. Value	Actual Value	Measured Value			
				Before O/H		After O/H				Before O/H		After O/H	
				R	L	R	L			R	L	R	L
9	A	≥3.0	3		2.65		3.15	≥4.4			5.40	5.60	5.65
10	A	≥3.1	3.1		3.05		3.30	≥4.5	4.00		5.70	5.60	5.60
11	A	≥3.2	3.4		3.35		3.55	≥4.7	4.10		5.75	5.60	5.60
12	A	≥3.2	3.3		3.20		3.50	≥4.8	4.10		5.60	5.65	5.60
13	A	≥3.3	3.5		3.25		3.65	≥4.9	4.40		5.85	5.60	5.60
14	A	≥3.4	3.5		3.25		3.65	≥5.1	4.60		6.20	5.80	5.70
15	A	≥3.5	3.6		3.40		3.70	≥5.2			6.25	5.85	5.85
16	A	≥3.6	3.8		3.45		3.65	≥5.4			6.35	6.40	6.30
17	A	≥3.7	3.7		3.45		3.70	≥5.5	4.00		6.55	6.75	6.70
18	A	≥3.7	3.7		3.30		3.70	≥5.6	4.10		6.85	6.80	6.80
19	A	≥3.8	3.8		3.50		3.70	≥5.8	4.10		7.05	6.95	6.85
20	A	≥3.9	4.1		4.0		3.95						

Guide blade carrier (4) . Ref Page N0.- 29 +

Measurement Method		1											
Pos.	Version	SRLE						SRLA					
		Ref. Value	Actual Value	Measured Value				Ref. Value	Actual Value	Measured Value			
				Before O/H		After O/H				Before O/H		After O/H	
				R	L	R	L			R	L	R	L
21	A	0.35 to 0.61	0.40			0.60	0.70	0.35 to 0.61	0.45			0.50	0.60
22	A	0.35 to 0.61	0.40			0.60	0.70	0.40 to 0.67	0.45			0.50	0.60
23	B	0.40 to 0.67	0.40			0.60	0.70	0.40 to 0.67	0.45			0.50	0.60
24	C	0.40 to 0.67	0.40			0.60	0.70	2.55 to 3.25	2.90			0.50	
25	C	0.40 to 0.67	0.40			0.60	0.70	3.65 to 4.55	4.00				

Guide blade carrier (4) . Ref Page N0.- 29 +

Measurement Method		1											
Pos.	Version	SALE						SALA					
		Ref. Value	Actual Value	Measured Value				Ref. Value	Actual Value	Measured Value			
				Before O/H		After O/H				Before O/H		After O/H	
				R	L	R	L			R	L	R	L
21	A	≥4.0	4.3		4.35			≥6.0	6.7		7.4		
22	A	≥4.2	4.3		4.40			≥6.3	6.9		7.6		
23	B	≥4.4	4.7		4.85			≥6.5	7.6				
24	C	-	12.0						22.7				
25	C	-	10.6						-				

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

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

- Decoupled the LP case from Gear box.
- Alignment of LP case and gear box was checked and found disturbed.
- Journal bearing pads on GB side were opened for inspection. Clearance values found marginally above the design value however it was not replaced. (Ref Table-2)
- Journal bearing pads on Turbine side were opened for inspection. Clearance values found marginally above the design value however it was not replaced. (Ref Table-2).
- Thrust bearing was opened for inspection. Clearances value found within acceptable limits. (Ref Table-2).
- Gauss measurement of pads, Thrust collar, journal shaft & bearing housing were carried out by Inspection section and found within acceptable limit.
- DP testing of thrust pads, thrust collar and shaft journal was done and the same found acceptable.
- Alignment between LP Case & Gear box was corrected as per OEM reference values. Details are given in this report.
- LP case and Gear box was coupled at required tightening torque 20 kgf.m (196 Nm). Finally spacers between LP case & gearbox were assembled after alignment correction.

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

Bearing Description	Before PM (mm)	Design value (mm)	After PM (mm)
Journal bearing clearance on Turbine side	0.16	0.11 ~ 0.15	0.18
Journal bearing clearance on Gear Box side	0.16	0.11 ~ 0.15	0.16
Axial Thrust	0.34	0.28 ~ 0.38	0.35
Observations	Bearing condition was found satisfactory		

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

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

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

- Journal bearing pads on free end side were opened for inspection. Clearance values found marginally above design clearance however it was not replaced. (Clearance values measured are given in Table-3)
- Thrust bearing was opened for inspection. Thickness of the thrust pads was checked and clearances values found within acceptable limits. (Clearance values measured are given in Table-3).
- Gauss measurement of pads, Thrust collar, journal shaft & bearing housing were carried out by Inspection section and found within acceptable limit.
- DP testing of thrust pads, thrust collar and shaft journal was done and the same found acceptable.
- Alignment between HP-Gearbox was corrected as per OEM reference values. Details are given in this report.
- HP case and Gear Box was coupled at the required tightening torque 9.7 kgf.m (95.06 Nm).

Table 3- Bearing Clearance (Diametrical Clearance) Details for HP case

Description	Before PM (mm)	Design Value (mm)	After PM (mm)
Journal bearing clearance on Free end	0.15	0.11 to 0.14	0.16
Journal bearing clearance on Gear Box side	0.15	0.11 to 0.14	0.15
Thrust bearing clearance	0.30	0.25 to 0.35	0.33
Observations	Bearing condition was found satisfactory		

Following spares are consumed:

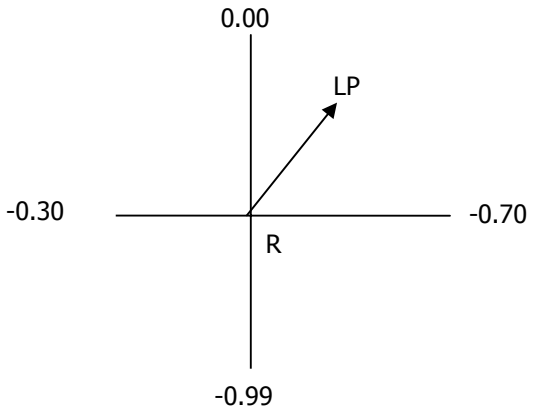
Sr. No.	Code	Description	Qty.
1	122010224770	NON ASBESTOS GASKET OF HP CASE, PART NO. : 71017, DRG. NO. : 350-012661 FOR K-1801/2,HP CASE OF HITACHI MAKE CO2 COMPRESSOR	2
2	122010224760	NON ASBESTOS GASKET OF HP CASE, PART NO. : 71016, DRG. NO. : 350-012661 FOR K-1801/2,HP CASE OF HITACHI MAKE CO2 COMPRESSOR	2
3	122010224750	NON ASBESTOS GASKET OF HP CASE, PART NO. : 71015, DRG. NO. : 350-012661 FOR K-1801/2,HP CASE OF HITACHI MAKE CO2 COMPRESSOR	2
4	122010224730	NON ASBESTOS GASKET OF HP CASE, PART NO. : 47010, DRG. NO. : 350-012661 FOR K-1801/2,HP CASE OF HITACHI MAKE CO2 COMPRESSOR	2

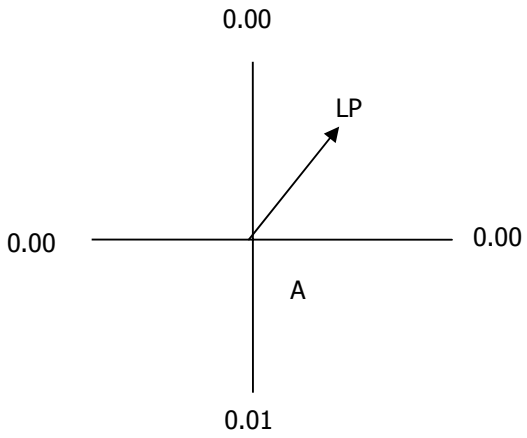
GEAR BOX M-1801

Gear Box was not taken up for overhauling since it was attended during Short Shut down Aug-2010.

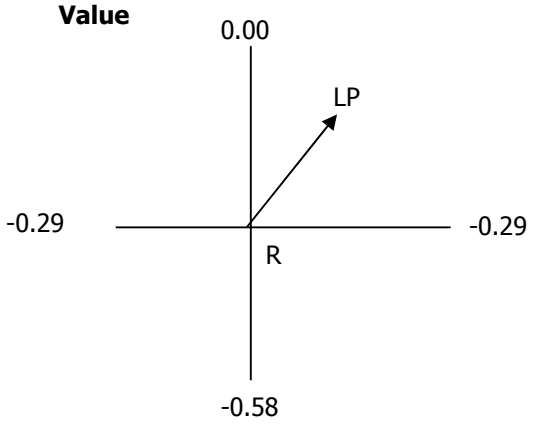
Alignment between Turbine and LP Case

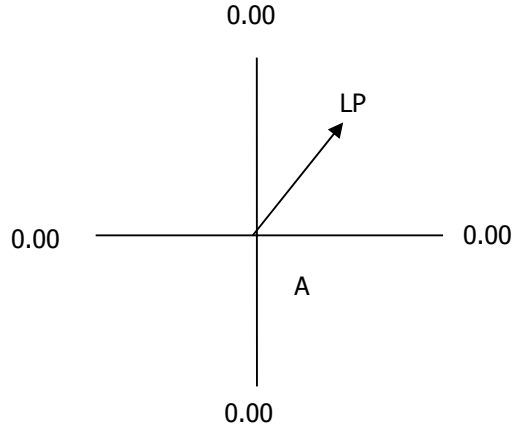
Before



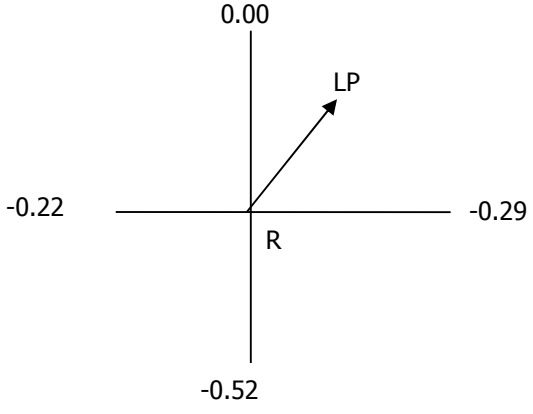


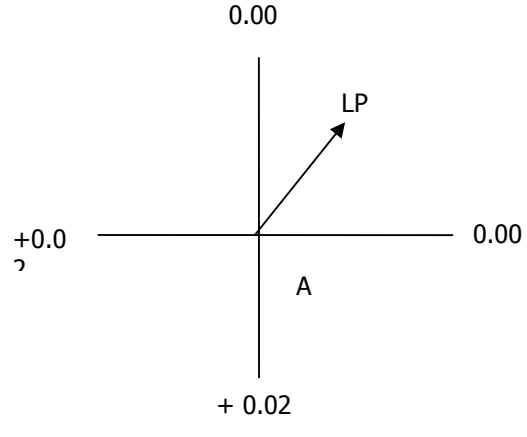
Protocol Value





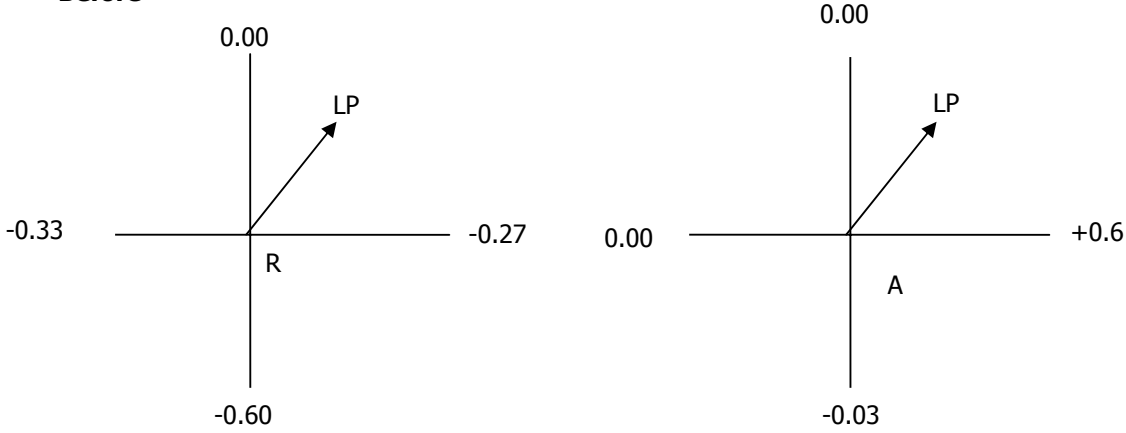
After



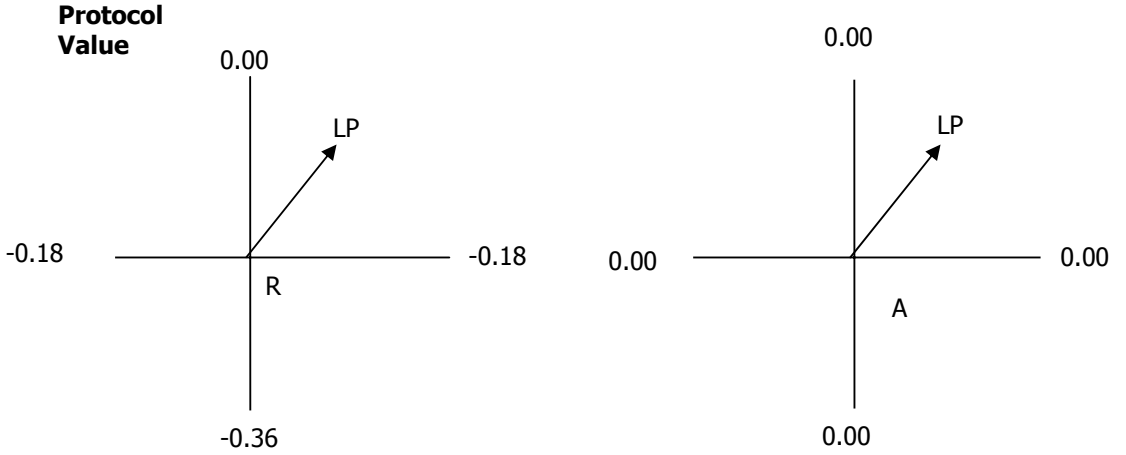


Alignment between LP Case and Gear Box

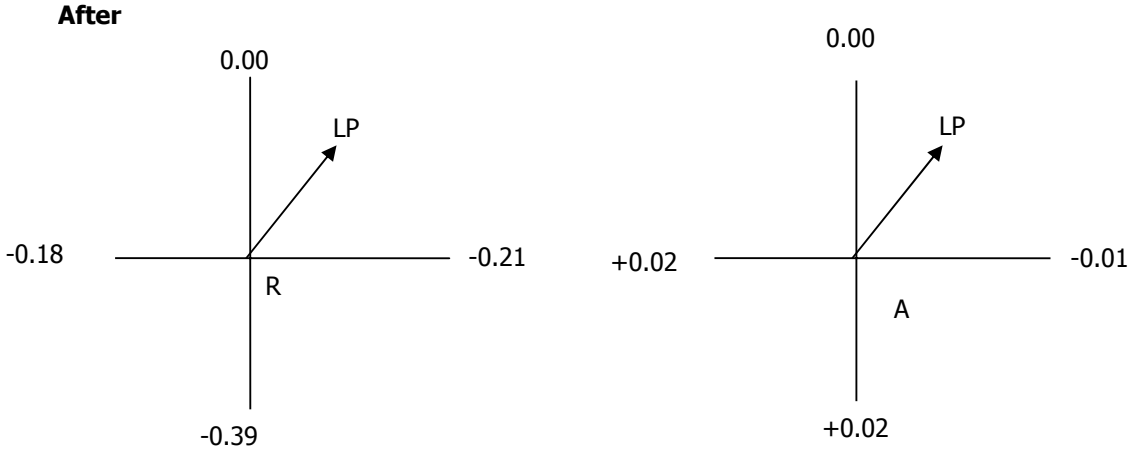
Before



Protocol Value

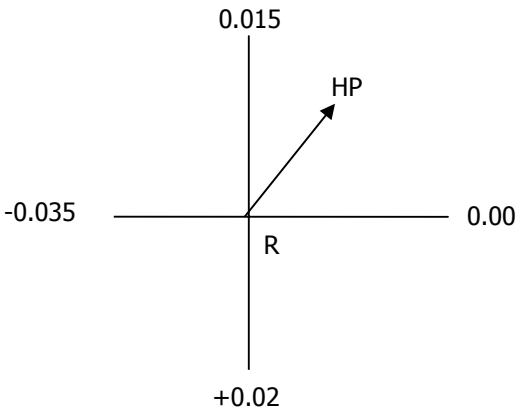


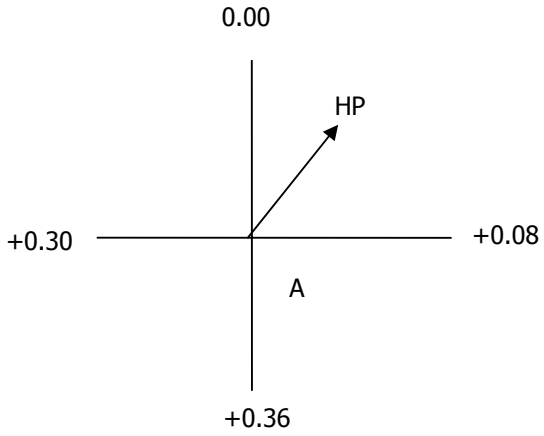
After



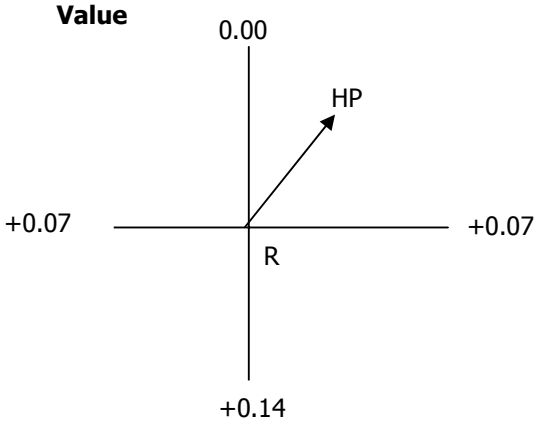
Alignment between Gear Box and HP Case

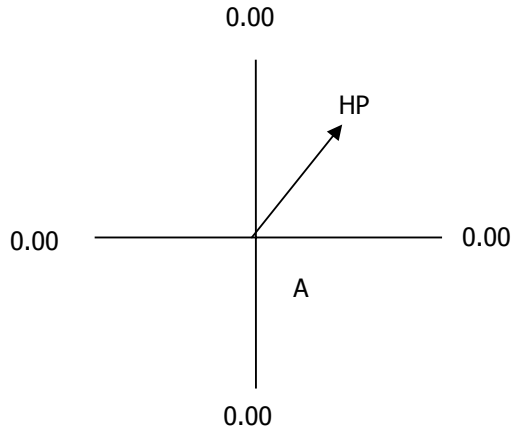
Before



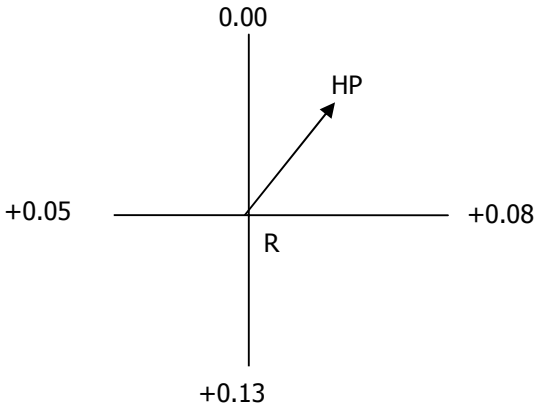


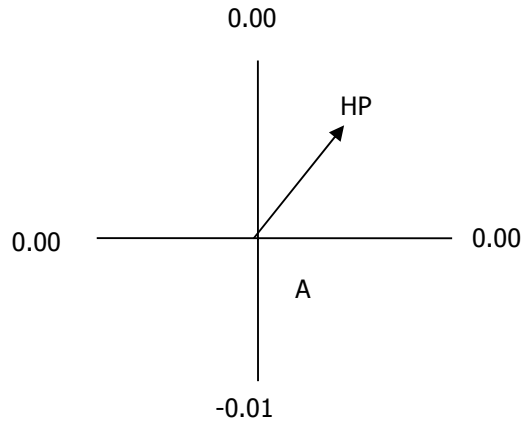
Protocol Value





After





HP VESSELS

HP Stripper (H-1201)

Bottom Dome

- Fasteners of bottom cover were loosened using bolt tensioner at 900 kg/cm^2. Bottom cover was lowered using 2 nos. of 5 ton capacity chain blocks and placed on wooden sleepers.
- After inspection, the bottom cover was boxed up.
- No repairs /rectifications were required to be carried out.

Top Dome

- Fasteners of Top cover were loosened using bolt tensioner at 900 kg/cm^2.
- The top cover was shifted below the platform using monorail hoist & 2 nos. of 5 ton chain blocks and placed on wooden sleepers.
- Ferrules were removed from position. Ferrules were thoroughly cleaned by Production department.
- Eddy current testing was carried out by Inspection Department. No repair work was required to be carried out.
- The ferrules were fixed in position with new PTFE gaskets (2700 nos) and 24 nos. of tie rods were fixed using new Teflon gasket (72 nos.)
- After the bottom cover was boxed up, pressure drop measurement was carried out by production department for each tube and the same was found within limit.
- Exchanger was thoroughly cleaned with compressed air and then with DM water.
- Top and bottom cover were boxed up with new Kempchen make gasket (839 mm OD x 800 mm ID x 4 mm thick) with new 0.5 mm thick Teflon envelope.
- Tightening pressure for top and bottom cover.

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

HP Condenser (H-1202)

- Top flange of off gas lines was opened.
- Bottom flange (H-1202 to V-1201 pipe line) was opened.
- Fasteners of Top cover and bottom cover were loosened using bolt tensioner at 700 kg/cm^2. Bottom covers were shifted using 2 nos. of 3 ton capacity chain block and top cover was shifted using 1 no. of 5 ton chain block.
- Internals from the top dome were removed.
- In last short shutdown 3 nos. bolts (1/2" UNC x 1-1/2" long) of partition plate with basket were seized. This time, basket was removed and taken to central workshop for drilling and tapping from the back side of basket.

- Eddy current testing of tubes was carried out. One tube was found having initiation of crack near top tube sheet area. The same was plugged. Tube layout drawing for showing the plugged tube location is attached in shutdown report of inspection department. The Stamicarbon and actual procedure for tube plugging in top tube sheet is given below.

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

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

Tube Plugging Sketch of HP Condenser

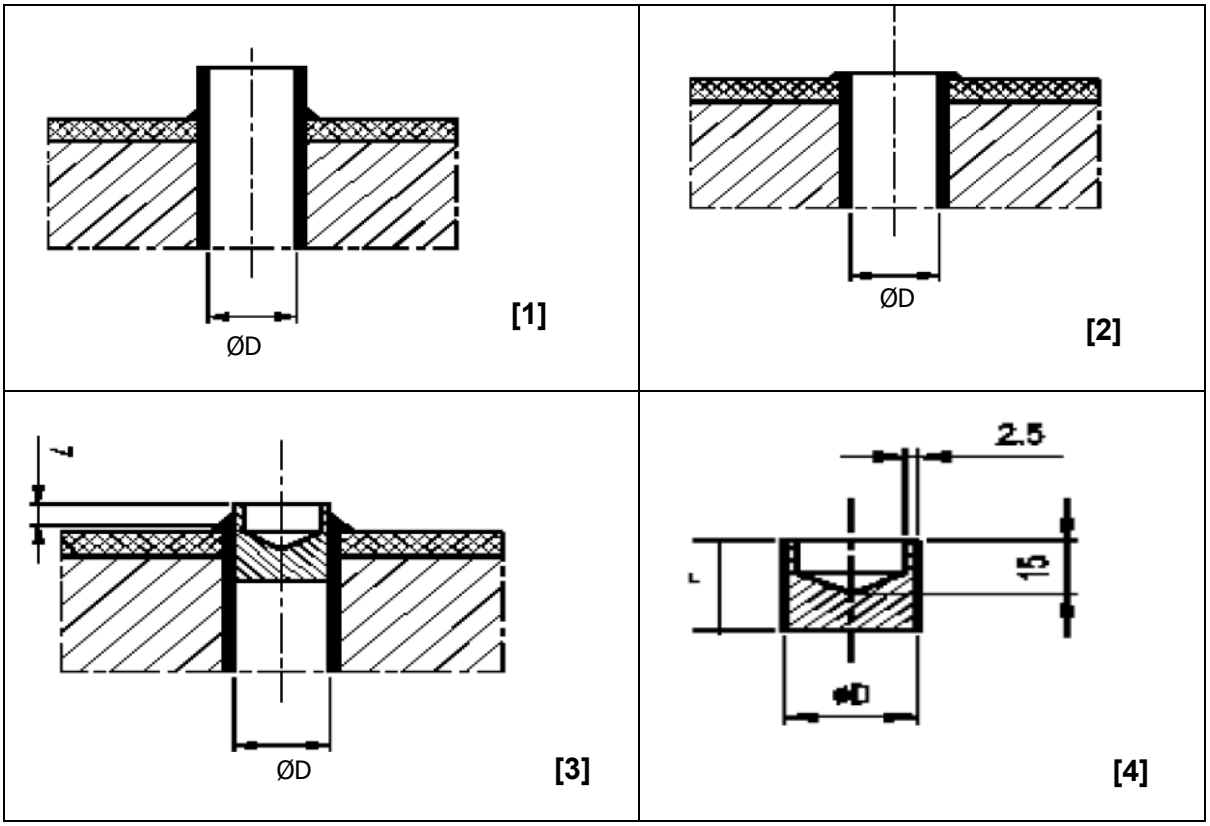


Figure – 19

- Confirmation Hydro test of Shell side was carried out at 11 kg/cm^2.
- After inspection, internals were placed on top dome. Top and bottom cover Boxed up with new Kempchen make gasket (839 mm OD x 800 mm ID x 4 mm thick) with 0.5 mm thick Teflon envelop.
- Tightening pressure for top and bottom cover

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

Autoclave V-1201

- Fasteners of Top cover were loosened using bolt tensioner at 700 kg/cm2. Top cover shifted using 1 no. of 3 ton chain block.
- Entry to Autoclave was given on 30/03/2011. (Shut down of Urea Plant was taken at 01:30 Hrs on 25/03/2011)

Replacement of sleeve of Ammonia Inlet Nozzle, C-3

3" Ammonia inlet nozzle C3 sleeve which is located at the bottom of vessel was found to have cracks at its face, OD & ID during last Annual Shutdown 2010 and the same was attended by welding. The replacement of this sleeve with new sleeve, was Planned during this shutdown. The material was procured against PO No. 20100658 dtd 04/10/10 from M/s Keytech Engg. Co., Mumbai. (Material-SS 25-22-2,Bohler Type- A 405, Drg. No.: P2-ES-05021 , Store code-125110138000)

The job was executed by M/s Skywin Erectors, Ahmedabad (WO No.: 20101058 dtd. 13/01/2011). Repairing of liner welds of Autoclave and replacement of bottom shell of V-1203 was also carried out against the above WO.

Procedure for replacement of Ammonia Inlet Nozzle is given below :

Ref. Drg. No.P2-DS-05091 sheet 1 of 1 rev.0 Nozzle C3 details of Autoclave & Drg. No.P2-ES-05103 sheet 1 of 1 rev.0 General details of Autoclave.

- Weld joint (J1) (at outside the vessel) between sleeve (#6) with elbow (#7) was cut by grinding from centre of the welding. Chain block was provided at the inlet line before cutting.
- After getting Entry permit of Autoclave, (Entry given on 30/03/2011) the following activities were carried out:
- The projected portion of C-3 nozzle sleeve was cut by grinding and flushed.
- Welding joint W1 between big pad plate (#3) with dished end liner, welding joint, W2 between big pad plate (#3) with sleeve (#6) was cut by grinding and big pad plate (#3) was removed as shown in figure – 20.
- Care was taken not to damage the dished end liner while carrying out grinding.
- Welding joint W3 between sleeve (#6) with small pad plate (#2) was cut by grinding and small pad plate (#2) was removed as shown in figure – 21.
- To make the sleeve(#6) free, the weld metal from Nozzle (#5) buffer layer and sleeve (#6) weld joint was grind and removed. DP was done for ensuring separation line between sleeve (#6) and buffer layer after each few mm grinding. Utmost care was taken not to grind buffer layer.
- It was difficult to exactly identify the separation between sleeve and welding. For removing the sleeve, at the bottom cut portion of sleeve, a plate was welded and it was hammered by rod from Autoclave bottom. The liner was got separated.
- Ferrite was checked using ferrite meter and found within limit.
- No defect was observed in buffer layer. Buffer layer thickness was measured by Dual scope and recorded .(Thickness 5.8 to 6.2 mm)
- Length of New sleeve (#6) procured was found OK.
- New sleeve (#6) was inserted from outside, maintaining the projected distance inside and was tack welded with the elbow.
- 6 mm gap was maintained between step of the sleeve (#6) and Nozzle (#5) as shown in the drawing.

- New small pad plate (#2) of 2RE69 material was made as per drawing. It was inserted from inside.
- Gap between OD of small pad plate (#2) and the dished end liner (#4) was kept as 3.5 mm. (Refer Drg. No.P2-DS-05091 sheet 1 of 1)
- SS strips was tack welded at 6 to 8 locations between the small pad plate (#2) and dished end liner (#4). This is to ensure that the loose liner does not get distorted due to heat generated during welding. Care was taken that in no case the fusion penetrates beyond 2mm thickness of the small pad plate (#2).
- ID of small pad plate was welded with the sleeve (#6) and buffer layer weld using 25.22.2 LMn filler wire, maintaining inter pass temperature below 150deg. C as shown in figure – 22.
- DP test after each welding layer of the sleeve (#6) and liner (#4) was done.
- Air test at a pressure of 0.2 Kg/cm2 for checking the weld joint was carried out , by providing air in the nozzle (#5) annular space and checking for any through passage to the weep holes of the dished end liner (#4).
- Seal weld of the sleeve (#6) was checked for leakage using soap solution. While checking, care was taken to avoid soap solution entering the gap between small pad plate (#2) and dished end liner (#4) by covering the gap with masking tape.
- After completion of the welding of the small pad plate (#2) with the sleeve (#6) and buffer layer, SS strips were removed and DP test was carried out.
- New big pad plate (#3) of 2RE69 material was made as per drawing and inserted.
- Welded new big pad plate (#3) with the sleeve (#6) at ID and dished end liner (#6) at OD using welding filler wire be 25:22:2 LMn, maintaining Inter pass temperature below 150deg. C as shown in figure – 23.
- DP test & ferrite check was carried out after completion of welding. Ferrite was 0.0 %.
- Liner joints was checked with air and soap solution test by an air pressure of 0.2 Kg/cm2 in the nozzle (#5) annular space. It was also confirmed that there was no through passage between nozzle (#5) and dish end liner (#4).
- On completion of the job, passivation of the weld joint was carried out using 10 % HNO3 solution and rinsing the same with plenty of DM water.
- Root and final welding of the sleeve (#6) with elbow (#7) was carried out using filler wire 25:22:2 LMn.
- DP check was carried out after root run and final weld and found OK.
- Radiography of the above joint was carried out after root run & final weld and found OK.

The job was completed in approx. 5 days after getting vessel entry.

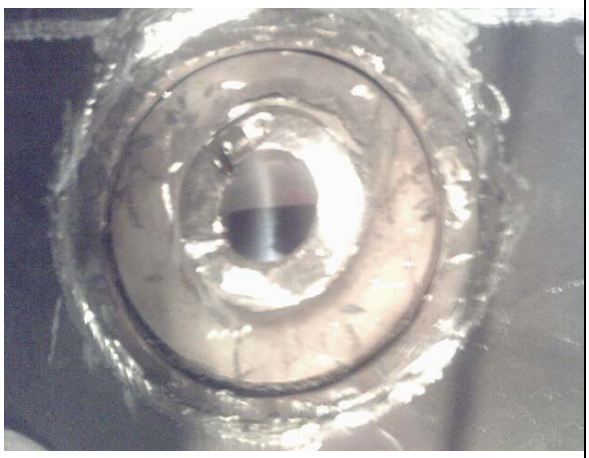


Figure – 20 : After removal of big pad plate

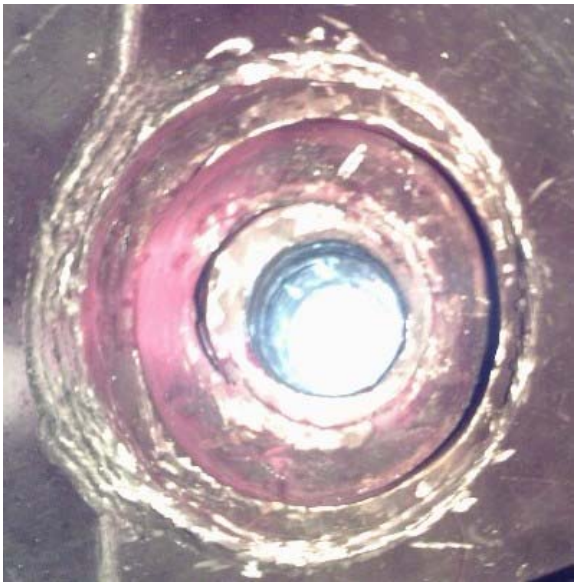


Figure – 21 : After removal of big and small pad plate

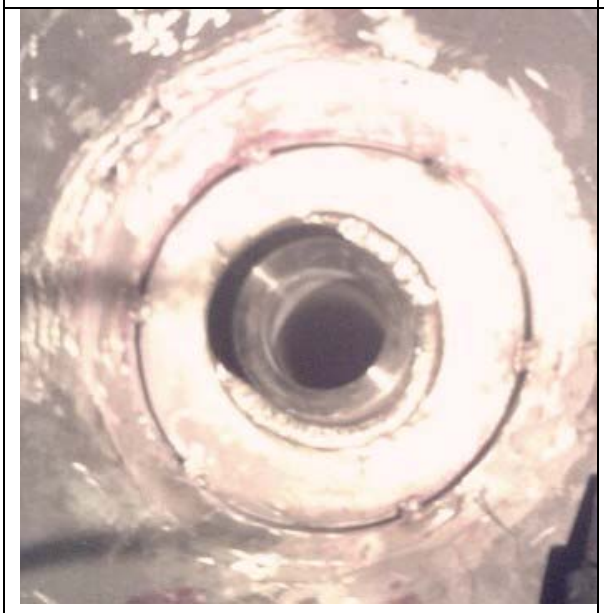


Figure – 21 : Welding of small pad plate

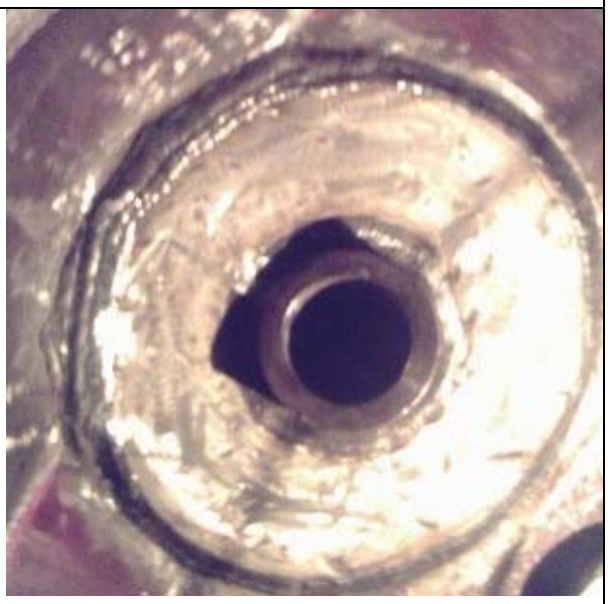


Figure – 22 : After Final Welding

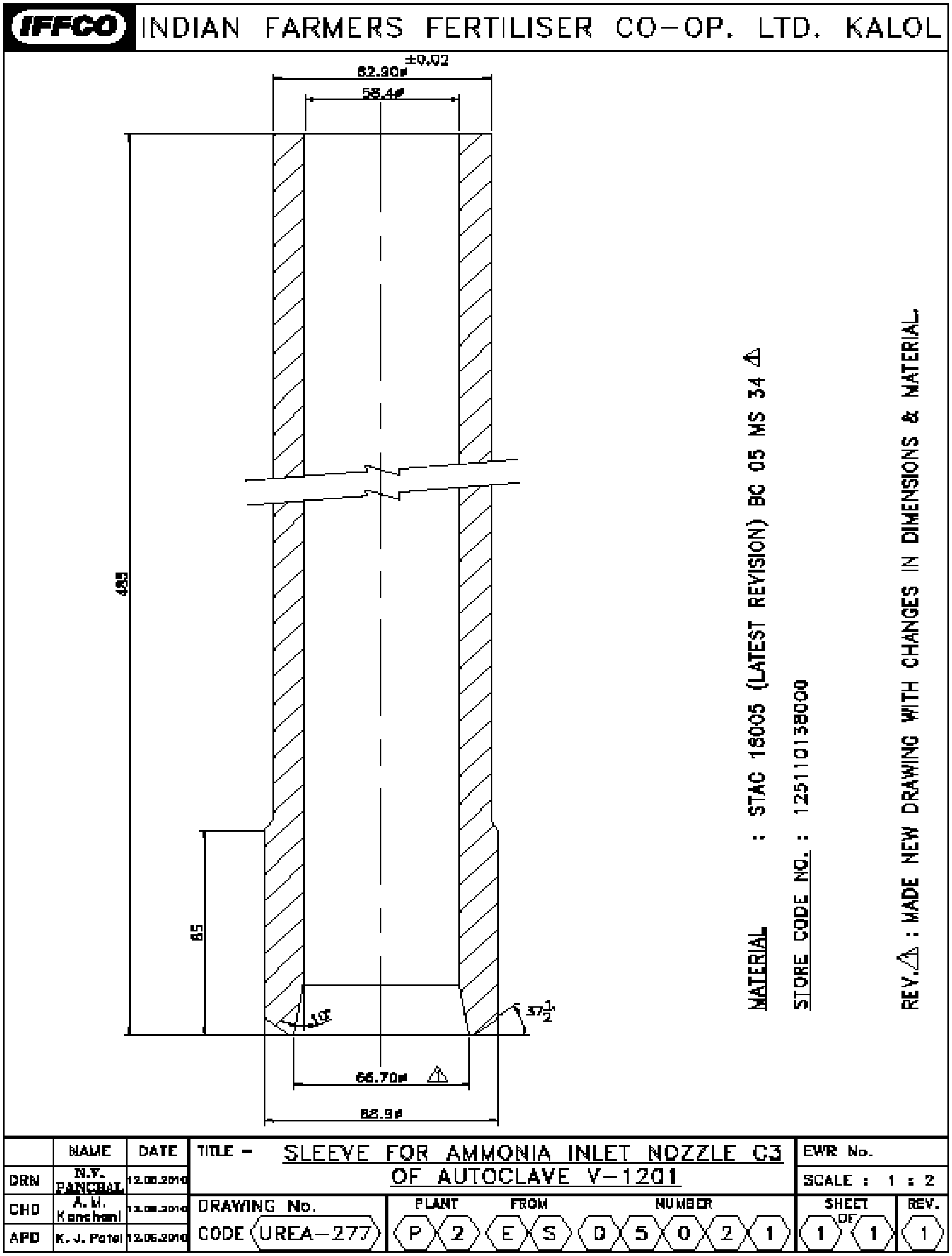

IFFCO
INDIAN FARMERS FERTILISER CO-OP. LTD. KALOL
62.90ø ±0.02
58.4ø
65
66.70ø
88.9ø
10°
$37\frac{1}{2}$°
MATERIAL : STAC 18005 (LATEST REVISION) BC 05 MS 34
STORE CODE NO. : 1251101138000
REV. 1 : MADE NEW DRAWING WITH CHANGES IN DIMENSIONS & MATERIAL.
NAME
DATE
DRN N.V. PANCHAL
CHD A. M. Kanchani
APD K. J. Patel
TITLE – SLEEVE FOR AMMONIA INLET NOZZLE C3 OF AUTOCLAVE V-1201
EWR No.
SCALE : 1 : 2
DRAWING No.
CODE UREA-277
PLANT P 2
FROM E S
NUMBER D 5 0 2 1
SHEET 1 OF 1
REV. 1

Figure – 23

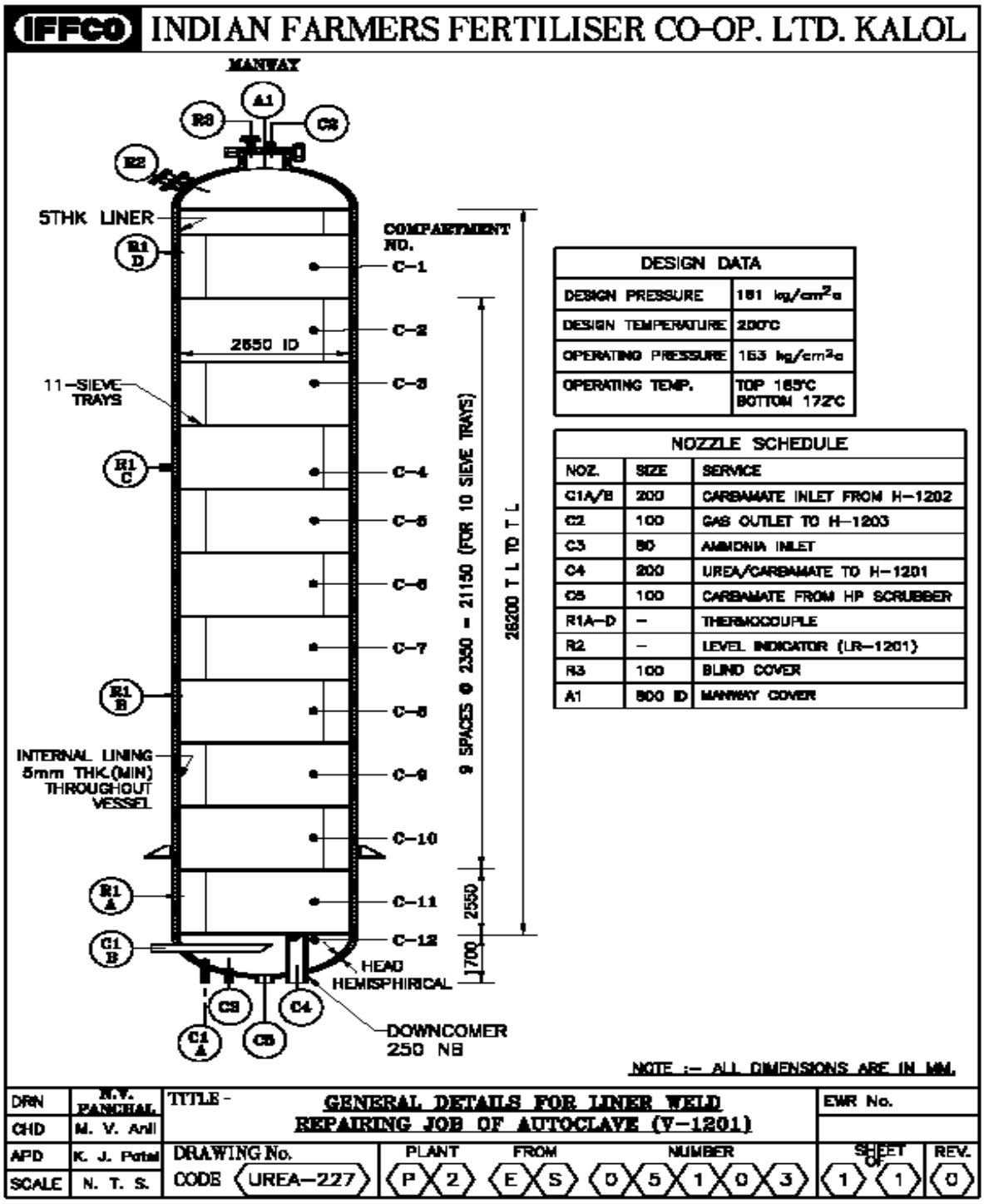

IFFCO INDIAN FARMERS FERTILISER CO-OP. LTD. KALOL
MANWAY
A1
R3
C5
R2
5THK LINER
R1 D
COMPARTMENT NO.
C-1
C-2
2550 ID
11-SIEVE TRAYS
C-3
R1 C
C-4
C-5
C-6
C-7
R1 B
C-8
INTERNAL LINING 5mm THK.(MIN) THROUGHOUT VESSEL
C-9
C-10
R1 A
C-11
C1 B
C-12
HEAD HEMISPHIRICAL
C3
C4
C1 A
C2
DOWNCOMER 250 NB
9 SPACES @ 2350 = 21150 (FOR 10 SIEVE TRAYS)
26200 T.L TO T.L
2550
1700
DESIGN DATA
DESIGN PRESSURE 161 kg/cm²a
DESIGN TEMPERATURE 200°C
OPERATING PRESSURE 153 kg/cm²a
OPERATING TEMP. TOP 165°C BOTTOM 172°C
NOZZLE SCHEDULE
NOZ. SIZE SERVICE
C1A/B 200 CARBAMATE INLET FROM H-1202
C2 100 GAS OUTLET TO H-1203
C3 80 AMMONIA INLET
C4 200 UREA/CARBAMATE TO H-1201
C5 100 CARBAMATE FROM HP SCRUBBER
R1A-D - THERMOCOUPLE
R2 - LEVEL INDICATOR (LR-1201)
R3 100 BLIND COVER
A1 500 ID MANWAY COVER
NOTE :- ALL DIMENSIONS ARE IN MM.
DRN N.V. PANCHAL
CHD M. V. Anil
APD K. J. Patel
SCALE N. T. S.
TITLE - GENERAL DETAILS FOR LINER WELD REPAIRING JOB OF AUTOCLAVE (V-1201)
EWR No.
DRAWING No.
CODE UREA-227
PLANT FROM NUMBER
P 2 E S 0 5 1 0 3
SHEET 1 OF 1
REV. 0

Figure - 24

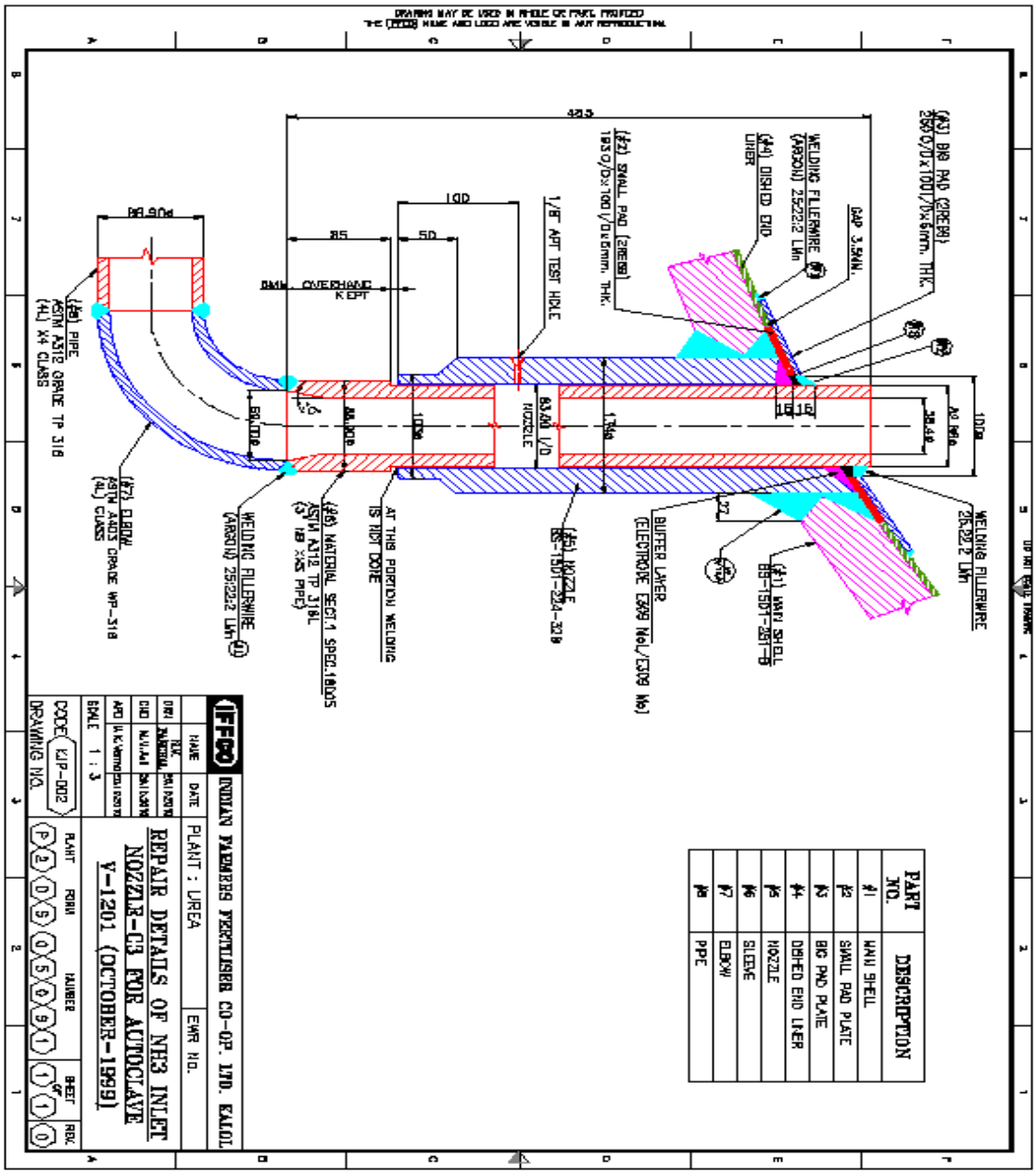


Figure – 25

Repair of Liner weld joints of Autoclave:

During Annual Turnaround- April 2009, liner welds of 1st and 3rd compartment were repaired which was most affected by corrosion. In 2010, repairing of liner welds of 2nd and 4th compartment were carried out. It was decided to carry out repair and rewelding of liner welding of 5th compartment during this shut down.

The following repair procedure was followed:

- Weld area was cleaned by SS wire brush.
- Welding joint was ground and flushed. Visible pitting / pores were removed with Grinder and surface was made smooth. It was ensured that grinding was not done deeper than 2 mm below the surface of liner.
- Corroded area of Heat Affected Zone of joints was also grinded and removed.
- DP of grinded portion was carried out. Porosity observed was removed. However if the porosity extends deeper than 2 mm below the surface of liner, it was fused while performing welding.
- Welding was done by TIG using 25-22-2LMn filler wire size -2.4 mm dia with low heat input.
- Inter pass temperature kept below 150 deg. C.
- Minimum three layer of weld was required. At some portions where the width was increased due to removal of corroded portion, an additional layer of welding was applied.
- It was ensured that no area was left ground without welding
- Final DP was carried out.
- Ferrite content was checked. It was found within acceptable limit (Max 0.6 %)
- Finally weld was cleaned and passivated by washing with 10 % HNO3 and rinsing with DM water.

<u>Repairing jobs as per Inspection Report</u>:

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

Compartment No.1 (Top Compartment):

- Overflow pipe funnel top piece longitudinal weld & its T-junction weld found eroded. It was repaired by welding.
- 02 nos. of missing fasteners of tray segment just below funnel were provided.

Compartment No.2

1 no. of missing fastener of J-bolt was provided.

Compartment No.3:

1 no. of missing fastener of J-bolt was provided.

Compartment No.4:

Crevice/corrosion cavities observed on insert liner welding was repaired.

Compartment No.6:

- NW long seam above C seam which was corroded was repaired.
- Crevice/corrosion cavity observed on N-W long seam was repaired.
- Crevice/corrosion cavity on C-weld seam of shell liner was repaired.

Compartment No.7:

Crevice/corrosion cavities were observed on shell liner welding was repaired.

Compartment No.8:

03 no. crevice/corrosion cavities observed on liner welding were repaired.

Compartment No.9:

03 nos. of crevice/corrosion cavities observed on liner welding were repaired.

Compartment No.10:

03 nos. of crevice/corrosion cavities observed on liner welding were repaired

Compartment No.12 (Bottom Compartment.):

- Downcomer Fillet weld which was having crevice cavities/undercut were repaired by welding.
- 8" NB Carbamate inlet nozzle (from East), C1B was found having 1 no. corrosion cavity. It was repaired by welding.

No repair work was required in other remaining compartments. All repairing jobs were done using TIG welding method and 25-22-2 L Mn filler wires. Repaired areas were passivated by 10% HNO3 and washed with DM water.

- After taking clearance from Production, top cover was boxed up with new Kempchen make gasket (839 mm OD x 800 mm ID x 4 mm thick) with new 0.5 mm thick Teflon envelop.
- Tightening pressure for top cover.

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

Replacement of Bottom shell of V-1203 (LP Absorber):

The minimum thickness of bottom shell of the vessel and the following nozzles measured during previous Shut downs, were found to be below design shell thickness of 6 mm. The minimum thickness (mm) is given below:

Nozzle N1	5.0
Nozzle N3	4.9
Nozzle N4	4.6
Shell S1	5.3
Shell S2	5.3

Also during Annual Shutdown-2010, bulging of appx. 30-35 mm deep was observed just opposite to gas inlet nozzle on in west side of shell above Cir. Seam near nozzle of LIC-1203.

Hence replacement of bottom shell of V-1203 was planned during Shutdown-2011. The Bottom shell of LP Absorber was procured from M/s. Texofab Engineers, Ahmedabad against Work Order no. 20100734 dtd 28/102011.

The execution of replacement was done by M/s Skywin Erectors, Ahmedabad

Detail activities which were carried out for erection of new bottom shell is given below:

Dismantling Activities of LP Absorber Bottom shell:

- Removal of Insulation of the Vessel
- Removal of safety valve (Nozzle- R2)
- Removal of inlet nozzle spool piece (Nozzle-C1) after cutting steam tracing line of jacket.
- Disconnecting the all nozzles connected to the vessel, i.e. Nozzle C-2, C3, C4,C5 etc.
- Removal of level controller (Nozzle R1 A/B) and PIC (Nozzle-R3)
- Opening and removal of both man holes (Nozzle A2B & B1, 20" NB) of bottom shell and hand hole (A2 A) of top shell
- Removal of Pall rings at top and bottom (by Prooduction)
- Removal of Gas outlet line (80 NB) from Nozzle C2. After removal the same was kept at PT top.
- Removal of spray nozzle, C4 after opening access nozzle, A1 B of bottom shell.
- Opening of flange of top and bottom shell (Nozzle A3 / A4).
- Removal of structural members & platforms, ladder and valves etc by removal of bolts / gas cutting.

- Lifting of top shell as shown in figure – 27 and figure – 28. The platform grills were removed. However structure was not removed. The top shell was kept at PT top by Kobelco Crane (Weight- approx 1.0 T). (Ref Fig -)
    - The details of crane is given below :
    - Make - Kobelco, Japan
    - Model - CKE-1350
    - Capacity – 135 MT
    - Boom length – 61 m (200') + Jib assembly of 30 m (100')
    - Rigging arrangement is shown in figure – 26.

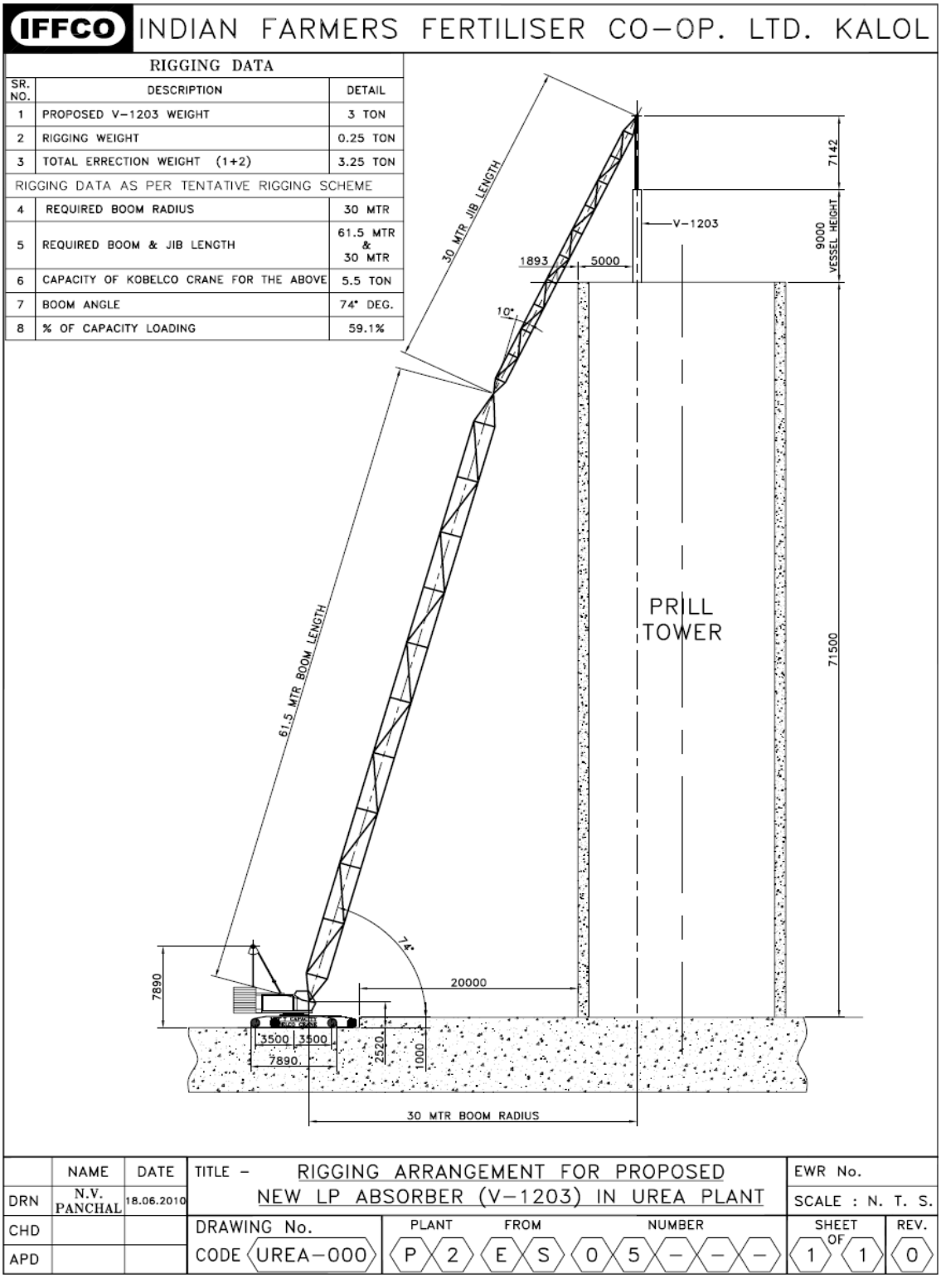

IFFCO
INDIAN FARMERS FERTILISER CO-OP. LTD. KALOL
RIGGING DATA
SR. NO. | DESCRIPTION | DETAIL
1 | PROPOSED V-1203 WEIGHT | 3 TON
2 | RIGGING WEIGHT | 0.25 TON
3 | TOTAL ERRECTION WEIGHT (1+2) | 3.25 TON
RIGGING DATA AS PER TENTATIVE RIGGING SCHEME
4 | REQUIRED BOOM RADIUS | 30 MTR
5 | REQUIRED BOOM & JIB LENGTH | 61.5 MTR & 30 MTR
6 | CAPACITY OF KOBELCO CRANE FOR THE ABOVE | 5.5 TON
7 | BOOM ANGLE | 74° DEG.
8 | % OF CAPACITY LOADING | 59.1%
30 MTR JIB LENGTH
61.5 MTR BOOM LENGTH
7142
V-1203
9000
VESSEL HEIGHT
1893
5000
10°
74°
PRILL TOWER
71500
7890
20000
3500
3500
7890
2520
1000
30 MTR BOOM RADIUS
NAME
DATE
DRN
N.V. PANCHAL
18.06.2010
CHD
APD
TITLE - RIGGING ARRANGEMENT FOR PROPOSED NEW LP ABSORBER (V-1203) IN UREA PLANT
EWR No.
SCALE : N. T. S.
DRAWING No.
CODE UREA-000
PLANT FROM NUMBER
P 2 E S 0 5 - - -
SHEET OF
1 1
REV.
0

Figure - 26

- Removal of bottom shell from support after removing the nuts of foundation bolts (Weight- 2.0 T approximately) as sown in figure – 29. Platform and structures were completely removed before lifting.

- Lowering the top shell safely on the ground. The top shell was kept on the side of road near Dry ice plant.

- Removal of packing grids and other internals of bottom shell and fixing in new bottom shell.

- Checking and comparing the dimensions of new and old bottom shell

Figure - 27 : Kobelco Crane positioned for lifting top shell

Figure – 28 : Top shell lifted by Kobelco Crane

Figure – 29 : Kobelco Crane positioned for lifting bottom shell

Erection Activities of LP Absorber Bottom shell:

- Cleaning of foundation.
- Lifting of new bottom shell and placing the same on foundation as shown in figure – 30 & figure – 31.
- Lifting of top shell and placing it on bottom shell and tightening after providing the new gaskets and bolts.(Nozzle A3/A4).
- Gas outlet line (Nozzle-C2) was lifted by crane and kept ready for installing.
- Leveling of vessel by water level and by keeping master level on top face of vessel.
- Grouting of foundation.
- Final tightening after grouting.
- Fixing of packing grids and other internals of bottom shell.
- Fixing of packing grids and other internals of top shell.
- For additional clamping of the grid was provided by welding plate at bottom of existing packing support plate and providing clamping arrangement.

- Providing platforms & ladder which were removed earlier from top shell. The top platform was modified for easy removal of Control Valve for maintenance in future.
    - Providing platforms, ladder and other structures which were removed earlier from bottom shell.
    - Installation of spray nozzle, C3 & C4 on top & bottom shell respectively.
    - Flange of C5 Nozzle connected with pipe was cut and reweld for proper alignment with nozzle. Root and final DP done.
    - Boxing up of inlet nozzle (Nozzle C1) and welding of steam tracing line of jacket.
    - Boxing up of manholes, hand holes, level control etc removed earlier. Cleaning of gasket faces of Flanges and threads of the fasteners.
    - Installation of pall rings
    - Boxing up of nozzles and pipings connected to the shell with proper gaskets.
    - Clamping on the
    - Clamping was provided in addition to the existing clamp for vertical support.
    - The existing and new clamps were provided with foundation bolts
    - Insulation of vessel.

Figure – 30 : New bottom shell lifted by Kobelco Crane

Figure – 31 : New bottom shell being kept on foundation

LP Vessels and Tanks:

LP Vessels and Tanks were opened for internal inspection during Shutdown. No repair was required in following LP vessels and tanks:

1. V-1207
2. V-1351
3. V-1502
4. T-1301 A
5. T-1401 A
6. T-1501
7. V-1202

Repair work was done in following LP vessels and tanks on the basis of inspection report.

V-1101 (CO2 Knock out Drum):

2 nos. of demister pads in west half were lifted from their position. The same were repositioned. Demister pad holding frame which was slightly bent was straightened. Epoxy paint was done at some locations.

V-1102 (NH3 Suction Filter):

Damaged filter cloth replaced with new one.

V-1301 (Second Desorber):

Loose clamp of the tray was tightened and tied with the adjacent one with wire.

V-1501 (4 ata Steam Drum):

Open inspection of Steam drum (GT-1664) by Boiler inspector was not carried out. Steam drum loop was hydraulically tested at 11 kg/cm^2 on 29/03/2011 and the same was witnessed by IBR Inspector.

V-1503 (9 ata Steam Drum):

South side U-clamp of inlet steam header support was tightened.

T-1301 (Ammonia Water Tank):

Tack weld of 2" line in East with bottom plate was repaired by welding.

T-1401 (Urea Solution Tank):

In seal pot, ¾" size nipple with cap of SS 304L material was provided as per requirement of production department for draining of seal pot. DP test carried out, found ok.

CLEANING AND HYDROJETTING OF HEAT EXCHANGERS :

The Hydrojetting job was awarded to M/s. Deluxe Hydroblasting services, Mumbai vide W.O. No. 20100886 dated 13-12-2010. Following heat exchangers were opened for cleaning by hydrojetting. After cleaning, exchangers were boxed up with new gaskets.

- Surface condenser (H-1815)
- Main lube oil coolers (H-1814-A/B)
- Condenser Pre-evaporator (H-1419)
- First Evaporator (H-1422) with DM water.
- First Evaporator condenser (H-1423)

- **Second Evaporator (H-1424)** with D.M. water

After opening, it was observed that the sparger provided for cleaning, was damaged and its support were got damaged. Repairing of sparger and support was done and provided new clamps.

- Flash Tank condenser (H-1421)
- Second Evaporator I condenser (H-1425)
- Second Evaporator II condenser (H-1426)
- First Evaporator Final condenser (H-1420)
- Recirculation heater (H-1204) with D.M. Water
- L.O. coolers of P-1102-A/B/C
- L.O. coolers of P-1201-A/B
- Reflux condenser (H-1352)
- CCS - II cooler (H-1207)

Hydrotest of LP Carbamate Condenser (H-1205):

Equipment details:

Manufacture:	Edwin Danks & Co. England
Liquid:	
Tube side – Condensate &	Shell Side – NH3, CO2 & H2O
Design Pressure:	
Tube side - 6 kg/cm2 g	Shell side - 6 kg/cm2 g
Design Temperature	Shell side – 90 °C
Tube side – 165 °C	
Hydrotest Pressure:	
Tube side – 9.0 kg/cm2 g	Shell side - 11.8 kg/cm2 g
Total Nos. of tubes	580 U Tubes
Straight Length of Tube	6000 MM
O.D. of tube	25.0 MM
I.D of Tube	20.8 MM
Thickness of tube	2.1 MM
Material of tube	SS 316 L MOD
Orientation of heat exchanger	Vertical
Type of heat exchanger	Fixed Tube Sheet

Short Shutdown of Urea Plant was taken at 07-01-2011 to attend leakage of ammonia in CCS-I loop. Even after plugging tube,(1 No U tube) leakage of Ammonia was reported after start up. Ammonia percentage was maintained around 5% by continuous condensate make up & draining of CCS-I loop.

Before Shutdown, preparation was done for lifting of tube bundle, if required. Lifting beam of H-1205 was tested at 15 Ton at Crane Yard and DP test of weld joints were done. Weight of tube bundle as per Drg no.: AP 122 207 - 10.5 Ton. Weight of water was calculated – 2 Ton max. Hence total weight of tube bundle – 12.5 Tone. Drawing for rigging arrangement was made as shown in figure – 32.

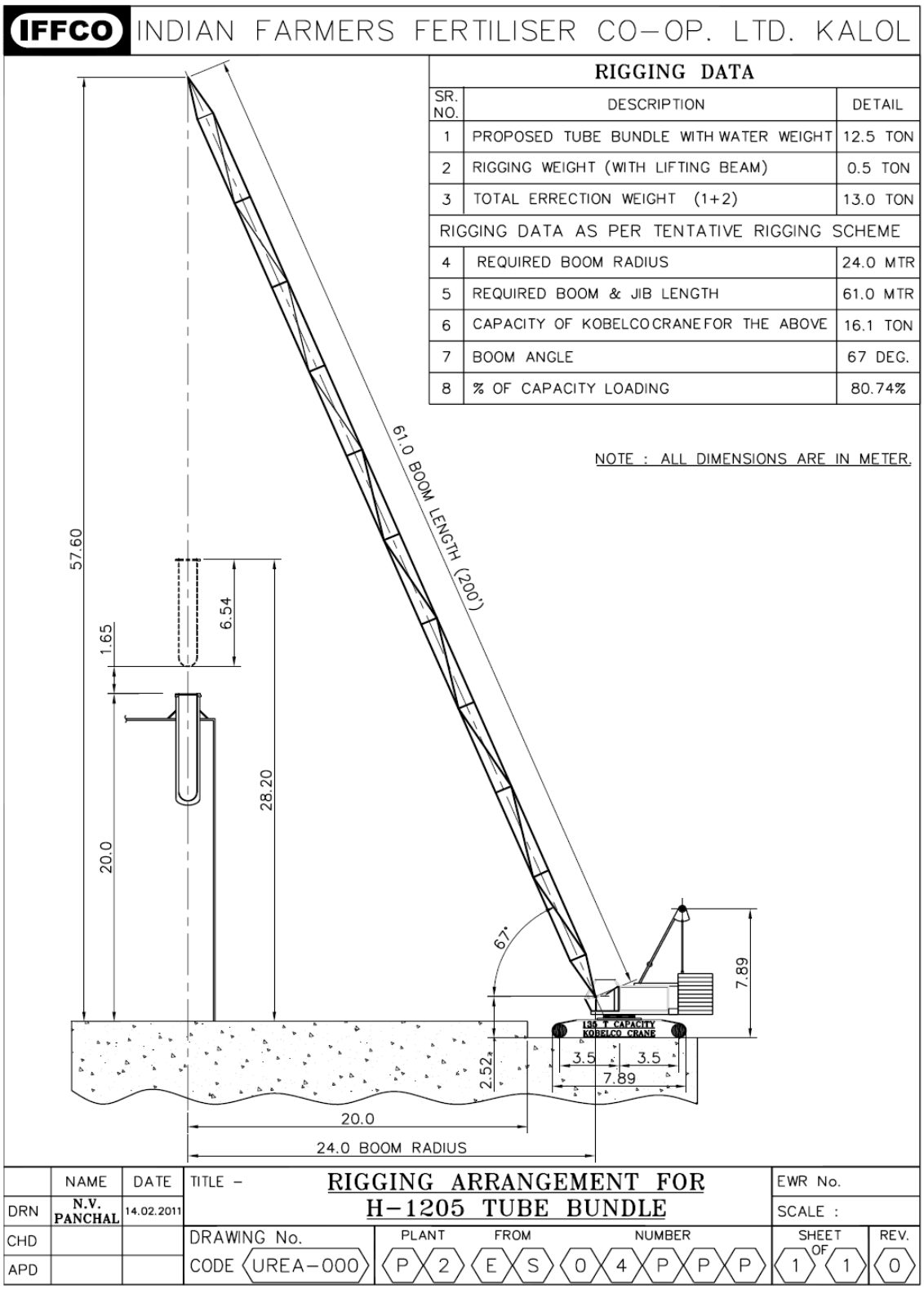

IFFCO
INDIAN FARMERS FERTILISER CO-OP. LTD. KALOL
RIGGING DATA
SR. NO. | DESCRIPTION | DETAIL
1 | PROPOSED TUBE BUNDLE WITH WATER WEIGHT | 12.5 TON
2 | RIGGING WEIGHT (WITH LIFTING BEAM) | 0.5 TON
3 | TOTAL ERRECTION WEIGHT (1+2) | 13.0 TON
RIGGING DATA AS PER TENTATIVE RIGGING SCHEME
4 | REQUIRED BOOM RADIUS | 24.0 MTR
5 | REQUIRED BOOM & JIB LENGTH | 61.0 MTR
6 | CAPACITY OF KOBELCO CRANE FOR THE ABOVE | 16.1 TON
7 | BOOM ANGLE | 67 DEG.
8 | % OF CAPACITY LOADING | 80.74%
NOTE : ALL DIMENSIONS ARE IN METER.
61.0 BOOM LENGTH (200')
57.60
6.54
1.65
28.20
20.0
67°
7.89
135 T CAPACITY KOBELCO CRANE
3.5
3.5
7.89
2.52
20.0
24.0 BOOM RADIUS
NAME
DATE
TITLE –
RIGGING ARRANGEMENT FOR H-1205 TUBE BUNDLE
EWR No.
DRN
N.V. PANCHAL
14.02.2011
SCALE :
CHD
APD
DRAWING No.
CODE UREA-000
PLANT FROM NUMBER
P 2 E S 0 4 P P P
SHEET OF
1 1
REV.
0

Figure – 32

The following activities were carried out during shutdown:

Condensate inlet and outlet lines were removed by Kobelco crane. Dome cover was removed by monorail. After opening, it was observed that one tube was empty (Due to leakage). It was marked and plugged.
The dome cover partition plate was found to have corroded. Hence 5" width plate was provided and welded. It was supported by welding pipe horizontally.

For IRIS inspection, tube cleaning is required and DM water is required as medium. Hence hydrojetting was carried out. However in some tubes, scales were not completely removed. IRIS inspection was carried out from 30/03/11 to 02/04/2011. The tubes which were found to have thickness reduction of more then 45 % were plugged (21 Nos. U Tube). Tube layout drawing for showing the plugged tubes location is attached in shutdown report of inspection department.

After tube plugging, hydrotest of H-1205 was done. Test ring was provided. Blinding of following flanges was done

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

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

Heat exchanger was boxed up after removal of test ring and de-blinding was done.

Replacement of Back pull out assembly of CCS-I Pump,P-1202 A, and both Suction valve of P-1202 B.

Impeller of the pump which was replaced during Short Shutdown, Jan-2011, was opened during normal operation and it was observed that there was heavy corrosion. Hence the impeller was applied with Loctite make Chemical Resistant coating. To assess the condition and also to replace the impeller, the pump was opened.

It was observed that corrosion rate was reduced considerably due to application of the coating. Hence it was decided to replace the existing impeller with new coated impeller. Sand blasting of new spare impeller was done and coating was applied. The casing which was corroded was also repaired by welding. Pump was assembled.

Suction I/v (Gate valve, 12" x 150#, Non Rising spindle) of P-1202 A & B, was also replaced with new valves(Gate valve, 12" x 150#, Rising spindle)procured from M/s BDK Valves, Hubli against PO No.: 20101194 dtd 14/02/2011.

RE-TUBING OF 3RD INTER STAGE COOLER OF HITACHI CO2 COMPRESSOR (H-1813)

Equipment Details:

Manufacturers	Bronswerk Heat Transfer, Holland
Liquid:	
Tube side - CO2 gas	Shell side – Cooling Water
Design Pressure:	
Tube side– 11 kg/cm2g	Shell side – 8 kg/cm2 g,
Design Temperature:	
Tube side– 250 °C	Shell side – 70 °C
Hydrotest Pressure:	
Tube side– 110 kg/cm2 g	Shell side – 12 kg/cm2 g
Tubes : Straight tube	
Total Nos. of tubes	184 nos
Length	7000mm
O.D. of tube X thk	19.05mm X 1.24 mm (min)
Material of tube	SS 304L

Following activities were carried out during Shutdown for hydrotest:

- Blinding of both shell flanges (8" x 150#, RF) of shell was done. A Pressure gauge was provided in other nozzle (provided in CW outlet).
- Removed the gas inlet/outlet channel cover and fixed the test ring
- Removed the Channel cover of floating head side
- Removed the floating head dome and split ring. Fixed the test ring and test flange with using packing asbestos rope 16mm sq. (Store Code - 993380112020)
- Pneumatic test was done at 6 Kg/cm2 pressure. No leakage was observed.
- For hydrotest, shell was filled with water and pressurized the shell at 12 kg/cm^2.
- Minor leakage was observed.
- Since the leakage was very small, for identifying the leakage, the exchanger was removed from position and kept on Ground floor in inclined position and hydrotest was done again.
- Blinding of inlet nozzle (8” x 150#) and outlet nozzle (8” x 150#) of shell side was done. 2 nos of isolation valves (3/4” x 150#) were provided in inlet and outlet nozzle for venting and pressurizing purpose.
- 5 nos. of tubes were found leaking on upper half tubes area.

In January, 2011, 3 nos. tubes were plugged, i.e total 8 nos. tubes out of 92 nos. tubes will be plugged on upper half tubes area. Hence it was decided to re-tube the complete upper half (92 nos.). Tube expansion was done through out the tube sheet length. The job was done by M/s. Emkay Construction, Baroda against WO No. 20101235 dated 16-02-2011.

After hydrotest, minor leakage was observed through tube OD. Those tubes were expanded again. Confirmation hydrotest was done. No tube leakage found. Heat exchanger was kept on the foundation & boxed up.

RELIEF VALVE OVERHAULING AND TESTING:

Following RV's were overhauled and tested on valve test bench by M/s. Tyco Valves & Controls India Pvt. Ltd; Vadodara against W. O. No. 20101104 dated 17-01-2011

Sr. No.	RV No.	Equipment Details	Set Pr (Kg/cm2 g)	Reset Pr (Kg/cm2 g)
1	RV-1101A	Liquid ammonia line from H-1102 to V-1102	31	29
2	RV-1101B	Liquid ammonia line from H-1102 to V-1102	31	29
3	RV-1102 A	Ammonia suc. Vessel	31	29
4	RV-1102 B	Ammonia suc. Vessel	31	29
5	RV-1106 A	Liquid amm, line from amm. Plant to amm. filter.	31	29
6	RV-1106 B	Liquid amm, line from amm. Plant to amm. filter.	31	29
7	RV-1107 A	Liquid ammonia line (hot) before Amm. filter	31	29
8	RV-1107 B	Liquid ammonia line (hot) before Amm. filter	31	29
9	RV-1110 A	Liquid ammonia line from atm. Amm. storage tank to H-1102	31	28
10	RV-1110 B	Liquid ammonia line from atm. Amm. storage tank to H-1102	31	28
11	RV-1130	24 ata steam header	26	22.5
12	RV-1184	H-1102 outlet NH3 outlet	6	5.5
13	RV-1202A	V-1202 off gas line LP System	6	5.5
14	RV-1202B	V-1202 off gas line LP System	5.7	5.2
15	RV-1202C	V-1202 off gas line LP System	6	5.5

16	RV-1203	P-1201 A Suction line	8.5	7.5
17	RV-1204 (PSV-1201B)	P-1201 B Suction line	8.5	7.5
18	RV-1351	RV of V-1351	24	23
19	RV-1352	RV of V-1352	6	5.4
20	RV-1501 A	4 ata Steam Drum	7.5	6.8
21	RV-1502	4 ata Steam Drum	7.5	6.6
22	RV-1503	23 ata Steam	25	23.8
23	RV-1504	9 ata Steam Drum	12	11
24	RV-1506	4 ata Steam Main	6	5.4
25	RV-1904	H-1811 First stage gas cooler	7	6
26	RV-1905	H-1812 Second stage gas cooler	7	6
27	RV-1906	H-1813 Third stage gas cooler	7	6
28	RV-1916	23 ata Steam extraction	28	26
29	RV-1917	4 ata Steam exhaust	4	3.6
30		RV for Steam drum Hydrotest	16.5	15.0

Following RV's were overhauled and tested on valve test bench by M/s. Flotec Engineering Services, Surat against W. O. No. 20101073 dated 07-01-2011.

Sr. No.	**RV No.**	**Equipment Details**	**Set Pr (Kg/cm2 g)**	**Reset Pr (Kg/cm2 g)**
1	RV-1103 A	P-1102 A discharge	150	135
2	RV-1901	Ist stage discharge of K-1801.	7	6.7
3	RV-1902	IInd stage discharge of K-1801	27	25.1
4	RV-1181	K-1801 final discharge	177	159
5	RV-1201 A	V-1201 off gas line	165	150
6	RV-1201 B	V-1201 off gas line	165	150
7	RV-1201 C	V-1201 off gas line	165	148
8	RV-1208	P-1201 C discharge- Spare RV	165	148
9	RV-1903	K-1801 IIIrd stage discharge	111	100
10	RV-NH3	RV To NH3 Ammonia Plant	85	77

The following RV's were overhauled departmentally during Preventive maintenance before Shut down:

Sr. No.	RV No.	Equipment Details	Set Pr (Kg/cm2 g)	Reset Pr (Kg/cm2 g)
1	RV-1103 B	P-1102 B discharge	150	135
2	RV-1103 C	P-1102 C discharge	150	135
3	RV-1205	P-1201 A discharge	165	148
4	RV-1206	P-1201 B discharge	165	148
5	RV-1208	P-1201 C discharge	165	148
6	RV-1207	P-1201 C Suction	8.5	7.5

Note:

- Spring of RV-1202 C, RV for V-1202 off gas line LP System was found broken. Hence new RV was installed.
- RV-1181 was found to have dust/ foreign particles in the seating portion.(Due to open exhaust pipe). All other CO2 system RV's were found in good condition.

NRV Inspection:

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

- CO_2 to H-1201
- NH_3 to H-1202
- NH_3 to V-1201
- Carbamate to H-1202
- Carbamate to H-1203
- CO_2 to H-1203
- 23 ata steam to V-1351
- NH_3 water to V-1352
- CO_2 to 1st Desorber V-1352
- Final discharge of K-1801 to H-1201

Urea Melt Pump P-1408:

Urea melt pump was having leakage through casing. Hence pump casing was opened and casing gasket replaced with new one. Bearing Greasing done. Coupling pads of pump were replaced and alignment was done.

Prill Cooling System

Inlet Air Fan (K-1701):

Loctite chemical resistant coating compound was applied on fan casing after sand blasting. Sand blasting was done by M/s Vaidehi and application of coating was done by Loctite. 2 coating of compound was applied as shown in figure – 33. Bearing oil of fan was flushed.

Figure – 32 : K-1701, After application of Chemical resistant coating

Exhaust Air Fan (K-1702):

Discharge expansion bellow which was damaged during normal operation. It was replaced with new one during shut down. The bellow was procured from M/s Urja Products Pvt. Ltd., Ahmedabad against PO No.: 20100807 dtd 16/11/2010. (Store code – 122720104510).

For proper cleaning near impeller eye of fan, additional holes were provided at the bottom of online cleaning nozzle. Bearing oil of fan was flushed.

Fluidized Bed Cooler:

Fluidized bed cooler opened for inspection. 6 nos. locking studs were provided for proper fixing of perforated plate and the same was boxed up.

Conveyor System:

Prill Tower Conveyors (M-1403-1/2/3):

M-1403-1 conveyor:

Joint of Conveyor belt was slightly opened up during operation. Hence the joint was repaired by hot vulcanizing. Damaged carrying rollers and return rollers were replaced with reconditioned one.

Ingeco make gearbox top cover opened, inspection carried out, teeth of all gears were found satisfactory. Gear box was filled with new oil (Servo system-460). New coupling bush were provided and coupled gearbox with motor. Chain and sprockets were found satisfactory. Alignment was done between gear box to motor and from gearbox to pulley.

M-1403-2 conveyor:

Joint of Conveyor belt was damaged during normal operation. Hence it was replaced with new one. Bias joint was used. Details of belt are - "Nirlon" make, 850 mm wide, N/N Rating 630/4, 4 ply, grade HRT2, 3mm top and 1.5mm bottom cover - 16.6 mtr. total length. Damaged carrying rollers and return rollers were replaced with reconditioned one. Skirt rubber replaced.

Gear box was filled with new oil (Servo system-460). Coupled the gearbox with the motor. Chain and sprockets were found satisfactory. Alignment was done between gear box to motor and from gearbox to pulley.

M-1403-3 conveyor:

Conveyor belt condition was found satisfactory. Gear box was filled with new oil (Servo system-460). Alignment was done.

Link Conveyor (M-1419):

Conveyor belt condition was found satisfactory. Damaged carrying rollers and return rollers were replaced with reconditioned one. Skirt rubber adjusted. Gear box was filled with new oil (Servo system-150). Condition of chain and sprockets were found satisfactory. New coupling bush were provided. Alignment was done.

Prill Cooling System Link Conveyor (M-1421):

Conveyor belt condition was found satisfactory. Damaged carrying rollers and return rollers were replaced with reconditioned one. Gear box was filled with new oil (Servo system-150). New coupling bush were provided. Alignment was done.

Dust Conveyor System (M-1702):

Gear box was filled with new oil (Servo system-150). Damaged carrying rollers and return rollers were replaced with reconditioned one. Alignment was done.

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

Scraper (M-1402-1/2):

Scraper oil was flushed.

Fluid Coupling:

The condition of existing indigenous fluid coupling of scraper (Model – DFP 290, Prembril , Oil – Servo Prime 46 T) which were procured from M/s Premium Energy Transmission Ltd., Ahmedabad is satisfactory. Coupling oil flushed.

Gear Box of Scraper, M-1402-1/2:

The condition of Gearbox checked, found satisfactory. Gearbox oil flushed.

Chemical cleaning of H-1301 & H-1301 A:

In Hydrolyser section, flow of ammonical water was reduced due to the chocking of both Desorber heat exchangers,H-1301 & H-1301 A (Plate Type Heat Exchanger). Back flushing of both Heat Exchangers was carried out during short Shutdown, however there was no improvement in performance. Hence the manufacturer, M/s GEA Ecoflex, Mumbai were contacted for chemical cleaning of the Exchangers.

New pipings for carrying out the Chemical cleaning was fabricated during Shutdown. The fabrication job was carried out by M/s. Smitha Engineers, Kalol. The existing pump for chemical cleaning of H-1206 / H-1206 A was used for circulation of liquid. Cleaning was carried out during start up activities.

The performance of the Exchangers was found satisfactory after cleaning.

Process jobs:

Ground Floor

- H-1201 chain valve flange gasket replaced with new one. (furmanited, Size- 6" x 300#)
- P-1202 A/B suction Gate valve which was passing was replaced with new one (12” x 150# flanged, rising spindle)supplied by M/s BDK Engg., Hubli.
- P-1302 A discharge line drain valve at ground floor replaced (3/4" x 150# Flanged)
- T-1301 drain line SS Gate valve replaced (2" x 150#)
- P-1204 A casing drain CS Gate valve replaced (1/2" x 800# SW)
- V-1201 unloading line 1st and 2nd valve body lapped and bonnet replaced (BEL Valve, 1” #1500)

2nd Floor

- 9 ata steam to PT top steam i/v discharge flange gasket replaced with new one.
- 9 ata steam line d/s i/v at 2nd floor (9 to 4 ata tracing) 3" x 150# gate valve flange gasket replaced with new one.
- P-1304 A/B to V-1207 line i/v u/s flange gasket (1-1/2" x 150#) replaced with new one (P-1211 A/B suction)

3rd Floor

- V-1201 unloading line i/v at Autoclave bottom was passing (BEL Valve). Body seat lapped, blue checked, boxed up with reconditioned bonnet.

3.5 Floor

- HPF to Carbamate to Condenser line i/v spindle (BEL Valve) was broken. Bonnet replaced.

4th Floor

- Leakage through flange of Rupture disc of H-1202 was attended by removal of dent by machining in the holder and replaced thr Rupture disc.

PT Top

- HPF to PRCV-1201 first i/v bonnet replaced (1" x 1500# BEL valve)
- Bonnet of i/v of PRCV-1201 replaced (4" BEL)
- CO2 to H-1203 FICV-1202 d/s drain valve bonnet replaced (1" x 1500# BEL valve)
- CO2 to scrubber NRV replaced with new one (1" x 1500#)
- Flange before inlet of HICV – 1202 was having leakage during start up. After depressurizing the system, opened the flange, same gasket was re used after providing Teflon tape and boxed up.

Hydrolyser:

- In Hydrolyser CS blind flange was replaced with CS flange and Teflon gasket provided. (3" x 300# SORF)
- Orifice was leaking in steam line to hydrolyser top floor. Gasket replaced (1" x 300#)
- H-1301 outlet flange leak - top side (Furmanited). Gasket replaced (4" x 300#)

Fabrication Jobs:

Following fabrication jobs were carried out by M/s. M/s Skywin Erectors, Ahmedabad against WO No.: 20101145 dtd. 02/02/2011.

- New Flange Joints were provided in Inlet Line as well as Outlet line of H-1205-A. This was done for easy removal of top cover and bottom cover during maintenance of H-1205 A. Steam tracing lines were rerouted accordingly. Details of lines are given below:

  - Inlet Line Size: 20 Inch, WNRF Flange Size: 20" x 150#, MOC: SS 316L additional support was provided..
  - Outlet Line Size : 18 inch, WNRF Flange Size : 18" x 150# MOC: SS 316L

  Root and final DP and final radiography were carried out and find OK.

- Replacement of Weldolet & Thermo well pipe above Autoclave at 5th Floor. Tag No TR-1206, Line: Autoclave off gas to H-1203 Weldolet Size: 8" x 1.5", Sch 80 Thermowell Pipe Size: 1.5" x Sch 80, Length- 85 mm.

- Replacement of Weldolet & Thermowell pipe at 1st floor near Stripper Tag No TR-1201,Line: V-1201 to H-1201 Liquid, Weldolet Size: 4" x 1.5", Sch 80, Thermowell Pipe Size: 1.5" x Sch 80. Length- 85 mm

Root and final DP and Radiography of all butt joints were carried out. Thermowell pipes were made from forged bar, material SS 25-22-2, UNSS 31050 (Bohler type A 405, Store code- 911810123010) procured against PO No. 20100735 dtd 22/10/10 from M/s Keytech Engg. Co., Mumbai.

Following fabrication jobs were carried out by M/s. Smitha Engineers, Kalol

Ground Floor

- Cooling water inlet and outlet of H-1812 was rerouted and return header was suitably modified in Hitachi compressor area for easy opening and fixing of H-1813 dome at floating head side. CW inlet and outlet line of H-1814 was also modified accordingly. Clamp and supports were also provided.
- P-1502 suction line was replaced (4"NB x sch 40)
- P-1202 A discharge line drain line was replaced (1"NB x sch 40)

1st Floor

- Spring Support for Autoclave (V-1201) to HP Condenser (H-1201) at first floor was replaced with new one. Line No. PR-1201 -8" - X 1, H & G Tag No. : BX - 381 (Variable), H & G Drg. No. 1701-L54-BX 2327 sheet 1 of 2, Machino support Model No. VS1-F-1.

- Spring Support for Rectifying Column (V-1202) to Recirculation Heater (H-1204) at first floor was replaced with new one. Line No. PR-1214 -12" - X 3, H & G Tag No. : BX - 379 (Variable), H & G Drg. No. 1701-L54-BX 2325 sheet 1 of 2, Machino support Model No. VS1-F-8. Both these spring supports were procured from M/s Machino Engrs., West Bengal against PO No.: 20101240 dtd 22/02/2011.
- A portion of 2"NB x Sch 40 condensate return line for melt pump which was having leakage was replaced
- V-1203 gas inlet line steam tracing pin hole leak at PT top was repaired.

Following fabrication jobs were carried out by M/s. J & J Engineers, Kalol:

- Cooling water inlet line tapping for H-1210 (1st Floor) was taken from bottom of CW header. This tapping was shifted to top of header. This modification was carried out to improve the cooling of H-1210. The strainer of H-1210 was removed and line was flushed. It was observed that the line was heavily choked due to dirt in this line.

Following fabrication jobs were carried out departmentally

Ground Floor

- 23 ata steam to Q-1814 line drain steam trap replaced (1/2")
- P-1102A first suction i/v, Gate valve replaced (6" BW).Root and final radiography was carried out.
- P-1408 suction line drain valve replaced with 1" size SS Ball valve

1st Floor

- V-1409 A discharge line first drain valve replaced (3/4" x 150# FE)

3rd Floor

- Vents / sampling to be provided for H-1205/H-1205A. Plugs removed and 2 nos. valves provided with nipple (1/2" x 800#)
- V-1406 flash drum steam tracing pin hole leak repaired at 3rd floor.

3.5 Floor

- Damaged portion of P-1408 discharge jacket line was replaced (3.5 Floor).

6th Floor

- Urea melt line at 6th Floor (Flanged) which was having leakage was replaced with new prefabricated line.

PT Top

- HICV – 1202 i/v valve body replaced (4" x 1500# BEL)

Hydrolyser

- In Hydrolyser 3 nos. CS valves were replaced with SS 304 material.

Gland repacking job

Gland repacking job was carried out by M/s. Amrutha Engineering, Mumbai against PO. 20090923 dtd. 05/12/2009. Repacking of glands of following valves was done.

- Carbamate pump packing i/v SW, (1" x 800#)
- 4 ata injection to carbamate pump suction RV, i/v, (1/2" x 800#, CS, SW)
- PICV-119 d/s, i/v (gland bolts replaced)
- P-1305 / P-1426 discharge i/vs (4 nos.)
- V-1409 A, suction & discharge i/vs 4 nos. (4" x 150#)
- H-1421 drain i/v (3/4" x 800#, CS)
- H-1421 off gas 4 ata injection 1st & 2nd i/vs replaced
- Tracing i/vs 4 nos. (½" x 800#) near PICV-1105
- BFW to H-1203 (middle) i/v replaced
- BFW to H-1203 (top) i/v replaced
- 23 ata steam to hydrolyser main i/v (2" x 800#)
- P-1302 / P-1305 minimum flow line valves (1-1/2" x 150# & 1" x 800#)

OFFSITE & UTILITY PLANT

- **Pre Shutdown Activities:**

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

- **Maintenance of Air Compressors:**
- K-5301, Preventive Maintenance was carried out.
- K-5302, Overhauling was carried out.
- K-5303, Preventive Maintenance was carried out.
- K-5305, Preventive Maintenance was carried out.
- K-5306, Preventive Maintenance was carried out.
- K-5401, Overhauling was carried out.
- K-5501, Minor Overhauling was carried out.

Maintenance of Cooling water pumps:

- P-4401/C, Complete Overhauling of pump was carried out in which old CS impeller was replaced with ceramic coated impeller.
- P-4401/D, Preventive maintenance of pump was carried out.
- P-4403, Preventive maintenance of pump was carried out.
- P-4401/B, Preventive maintenance of pump was carried out.
- P-4404, Preventive maintenance of pump was carried out.

Preventive Maintenance of Cooling Tower Fans:

- Preventive maintenance of All 14 Cooling tower fans were carried out.

Up gradation of Cooling tower cells, H-4401-7 & 8:

Following modification work was carried out in Ammonia cooling tower cells:

- Old ACB sheet louvers were replaced with new GRP louver.
- Old ACB sheet side wall was also replaced with new GRP corrugated sheets.
- Associated columns in side walls were also replaced.
- Old damaged load columns (04 Nos) below the motor was also replaced.
- Some damaged T & G and wooden structures were also replaced at Fan deck.
- Old 18 ft. height fan cylinders were also replaced with new 13' 9" high velocity fan cylinders.

Complete Revamping of Urea Cooling Tower Cells, H-4401/1, 2 & 3:

During revamping following major activities were carried out:

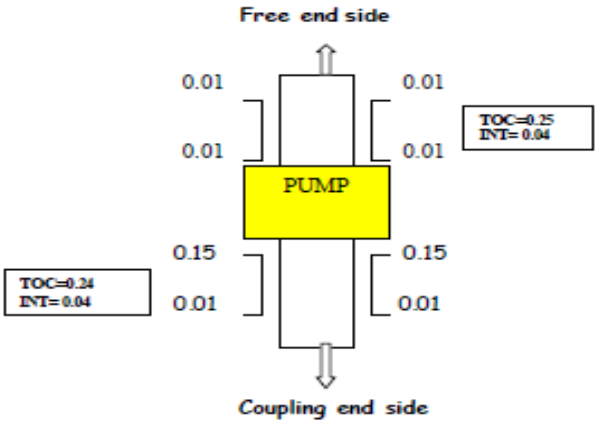
- Wooden structural load members were replaced with new one.
- ACB louver sheets and side wall (H-4401/I & 3 only)were replaced with GRP louver sheets and end wall.
- Old Grids were replaced with new GRP grids
- All PVC V bars were replaced.
- Old drift eliminators were replaced with GRP drift eliminators.
- Revamping of Cooling tower Cell, H-4401/1 was done partially before shutdown and then during shutdown.

PREVENTIVE MAINTENANCE OF ROTARY EQUIPMENTS:

COOLING WATER PUMP (P-4401/A):

Following activities were carried out:

- Coupling between the Pump and G.B. was decoupled.
- Before Preventive maintenance Pump to gearbox Alignment readings were checked.
- Both the Journal Bearings were checked and found OK.
- Bearing clearances of the pump was checked and recorded as



All readings are in mm

TOC: Top Oil Clearance (Bearing Diametrical Clearance)

INT: Interference between bearing and housing.

- Pump total float is measured and found **0.80 mm**
- Both side glands of pump were repacked with 25 mm PTFE packing up to lantern ring (02 rings on each side. Store Code: 133410126420)
- Coupling of pump with gear box was cleaned, checked and found O.K.
- After preventive maint. Alignment between pump to GB was checked
- Finally pump was coupled to GB with grease packed geared coupling.

Final Clearance Chart is as under:

Sr. No.	Description	Design Value (mm)	Value before Prev.Maint (mm)	Value after Prev.Maint (mm)
1	Total Float	-	-	0.80
2	Coupling end Journal Bearing Clearance	0.20	-	0.24
3	Front End Journal Bearing Clearance	0.20	-	0.25
4	Coupling end Journal Bearing side Clearance	-	-	0.01
5	Front end Journal Bearing side Clearance	-	-	0.01-0.15
6	Coupling end Journal Bearing Interference	-	-	0.04
7	Front end Journal Bearing Interference	-	-	0.04

- Final Alignment Readings from Gear box to pump are as under

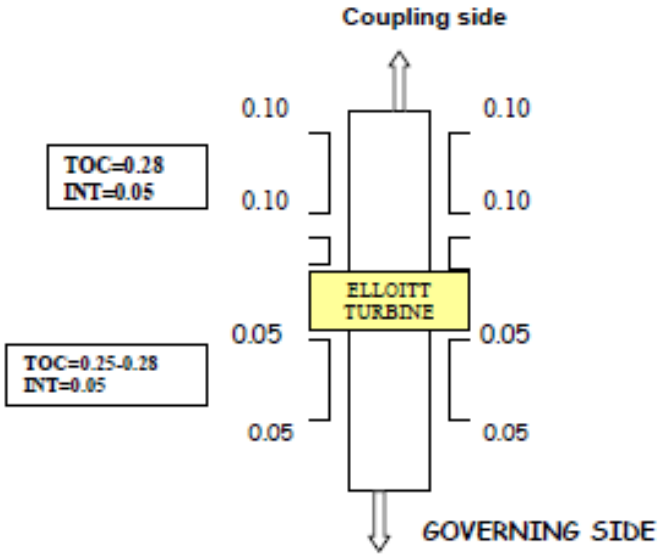
  After Preventive Maint.

  {Dial on gear box} With inside Micrometer

ELLIOTT TURBINE (Q-4411):

Following activities were carried out during PM

- Coupling between the Turbine and G.B. was decoupled.
- Turbine Bearings were opened, cleaned, checked found OK and boxed up.
- Turbine Bearing Clearances of were checked and recorded.-

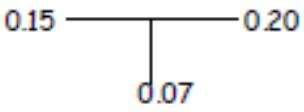


All readings are in mm

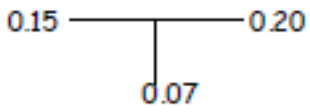
TOC: Top Oil Clearance (Bearing Diametrical Clearance)

INT: Interference between bearing and housing

- Oil gland clearances were measured and recorded (All readings are in mm):



Front Bearing Front Side



Rear Bearing Front Side

Rear Bearing Rear Side

- Thrust float of the Turbine was measured and recorded as 0.40 mm.
- Governor was replaced with new tested governor and fresh oil is filled in it.
- Governor linkages were also made free.
- Oil console was drained; cleaned and fresh oil charged (SERVO-PRIME 32)
- Main oil pump & Auxiliary oil pump suction strainers were cleaned & boxed up.
- The surface condenser was opened. Hydro jetting was carried out & then boxed up.
- Final clearance chart is as under:

Sr. No.	Description	Design Value (mm)	Value before Prev.Maint (mm)	Value after Prev.Maint (mm)
1	Thrust Float	0.25-0.30	-	0.40
2	Free Float	-	-	-
3	Coupling end Journal Bearing Clearance	0.127-0.18	-	0.28
4	Front End Journal Bearing Clearance	0.127-0.18	-	0.25 – 0.28
5	Coupling end Journal Bearing side Clearance	-	-	0.10
6	Front end Journal Bearing side Clearance	-	-	0.05
7	Coupling end Journal Bearing Interference	-	-	0.05
8	Front end Journal Bearing Interference	-	-	0.05
9	Front Bearing Front side oil gland clearance	-	-	Side- 0.15-0.20 Bott – 0.07
10	Rear Bearing Front side oil gland clearance	-	-	Side- 0.15-0.20 Bott – 0.07
11	Rear Bearing Rear side oil gland clearance	-	-	Side- 0.15-0.20 Bott – 0.07

- Final Alignment readings from Turbine to Gear Box are as under:

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

Following activities were carried out during PM

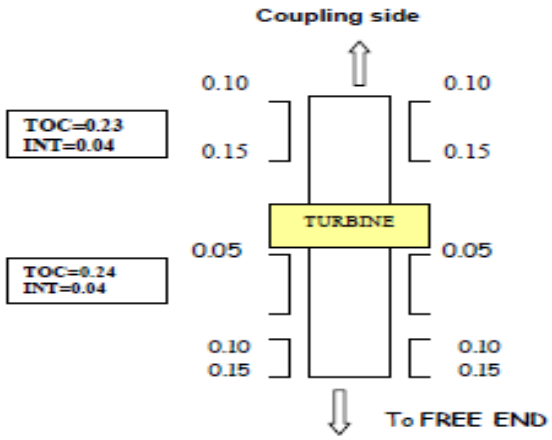
- Gear top cover was opened. GB internals were checked and found OK.
- Bearings of gear box was opened, cleaned, checked and found ok.
- Bearing clearances of Gear Box were checked and recorded.
- Final clearance chart is as under:

Sr. No.	Description	Design Value (mm)	Value before Prev.Maint (mm)	Value after Prev.Maint (mm)
1	Gear wheel pump end Journal Bearing Clearance	-	-	0.23-0.25
2	Gear wheel free end Journal Bearing Clearance	-	-	0.24-0.25
3	Pinion wheel free end Journal bearing clearance	-	-	0.17
4	Pinion wheel turbine end Journal bearing clearance	-	-	0.17

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

Following activities were carried out during PM

- Coupling between the Turbine and G.B. was decoupled.
- Both sides of the turbine bearings were opened, cleaned, checked, found OK and boxed up.
- Turbine Bearing Clearances were checked.



All readings are in mm

TOC: Top Oil Clearance (Bearing Diametrical Clearance)

INT: Interference between bearing and housing

- Thrust float of the Turbine was measured as **0.42mm**
- Turbine free end bearing cover tightening bolt hole thread (CWT sump side and turbine wheel side) was repaired with Thread repair kit.

Size: ½" BSF, 16 TPI

- Governor was replaced with old reconditioned governor.
- Both trip lever springs were replaced. (Store Code: 132011952200)
- Fresh oil SERVO PRIME 32 was filled in the governor.
- Oil console was properly cleaned and charged with fresh oil.
- All connected oil pipe lines were also cleaned.
- Oil cooler was opened, cleaned and boxed up.
- Oil strainer was cleaned & replaced the oil filter.

- Final Clearance chart is as under:

Sr. No.	Description	Design Value (mm)	Value before Prev.Maint (mm)	Value after Prev.Maint (mm)
1	Thrust Float	0.25-0.30	-	0.42
2	Free Float	-	-	-
3	Coupling end Journal Bearing Clearance	-	-	0.23
4	Front End Journal Bearing Clearance	-	-	0.24
5	Coupling end Journal Bearing side Clearance	-	-	0.10-0.15
6	Coupling end Journal Bearing side Clearance	-	-	0.10-0.15
7	Coupling end Journal Bearing Interference	-	-	0.04
8	Front end Journal Bearing Interference	-	-	0.04

- Final Alignment Readings between turbine to GB are as under:

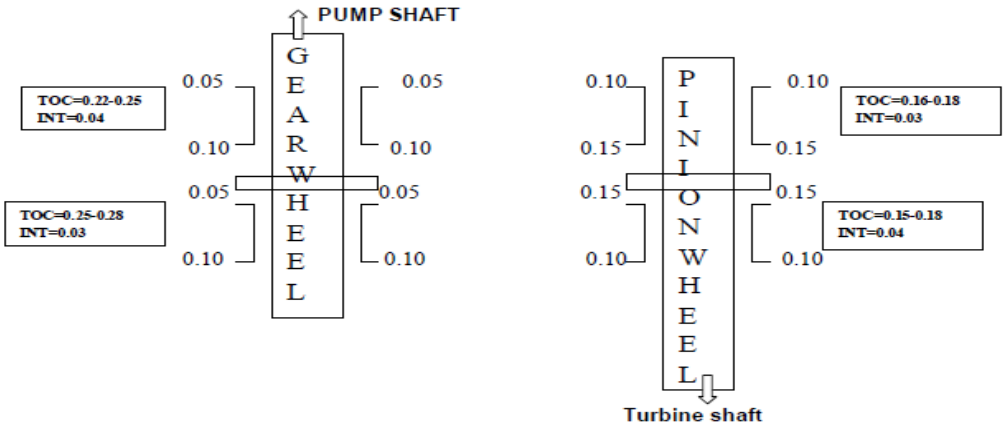
  After PM Maint:

  {Dial on gear box}

<u>GEAR BOX FOR COOLING WATER PUMP P-4401/B</u>:

Following activities were carried out during PM

- Gear top cover was opened. GB internals were checked and found OK.
- Bearings of gear box was opened, cleaned, checked and found ok.
- Bearing clearances of Gear Box was checked.



All readings are in mm

TOC: Top Oil Clearance (Bearing Diametrical Clearance)

INT: Interference between bearing and housing

- Gear wheel thrust float was measured as **0.38mm**
- Pinion wheel float was measured as **0.40mm**
- Backlash was also measured as **0.57mm**
- Final clearance chart is as under:

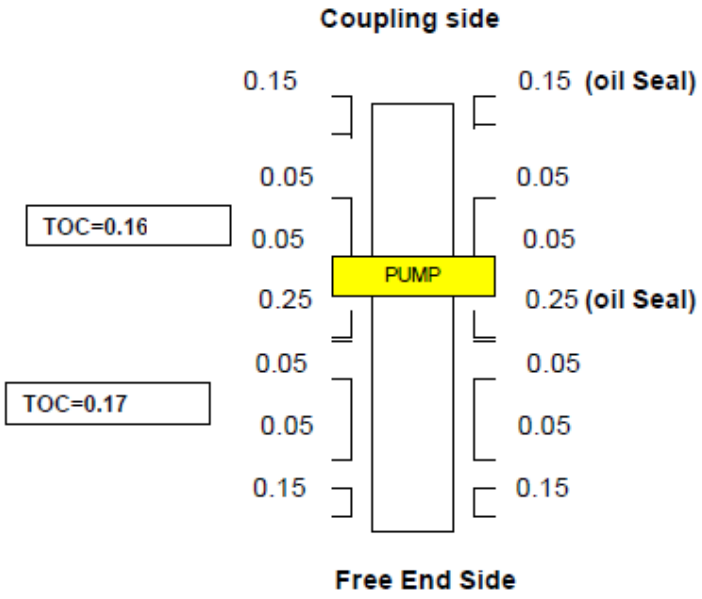
Sr. No.	Description	Design Value (mm)	Value before Prev.Maint mm	Value after Prev.Maint (mm)
1	Gear Wheel Thrust Float	-	-	0.30
2	Pinion Wheel Thrust Float	-	-	0.40
3	Gear wheel pump end Journal Bearing Clearance	-	-	0.22-0.25
4	Gear wheel free end Journal Bearing Clearance	-	-	0.25-0.28
5	Gear wheel pump End Journal Bearing side Clearance	-	-	0.05-0.10
6	Gear wheel free end Journal Bearing side Clearance	-	-	0.05-0.10
7	Gear wheel pump end Journal Bearing Interference	-	-	0.04
8	Gear wheel free end Journal Bearing Interference	-	-	0.04

9	Pinion wheel free end Journal bearing clearance	-	-	0.16-0.18
10	Pinion wheel turbine end Journal bearing clearance	-	-	0.15-01.8
11	Pinion wheel free end Journal bearing side clearance	-	-	0.10-0.15
12	Pinion wheel turbine end Journal bearing side clearance	-	-	0.10-0.15
13	Pinion wheel free end journal bearing interference	-	-	0.03
14	Pinion wheel turbine end journal bearing interference	-	-	0.04

COOLING WATER PUMP (P-4402):

Following activities were carried out during PM:

- Coupling between the pump and motor was decoupled.
- Pump casing was opened.
- Removed the old rotor assembly
- Pump side coupling half removed from old rotor and fixed on the new rotor having SS-304 impeller. Two teethes of pump side coupling half was found slightly broken at ends, so the edges of broken area was made smooth with oil stone.
- New thrust bearing SKF 6318 fixed on new rotor assembly.
- New rotor assembly having SS-410 shaft and SS-304 impeller made ready with old gland bush and impeller neck rings.
- New rotor assembly placed in bottom casing.
- Casing gasket value was determined by placing the top casing. Gasket value comes to 2.0 mm.
- Top casing tightened with new parting gasket of 2.0 mm.
- Both the journal bearings were cleaned, checked & found OK.
- Bearing clearances were checked & following are the readings:



All readings are in mm

TOC: Top Oil Clearance (Bearing Diametrical Clearance)

INT: Interference between bearing and housing

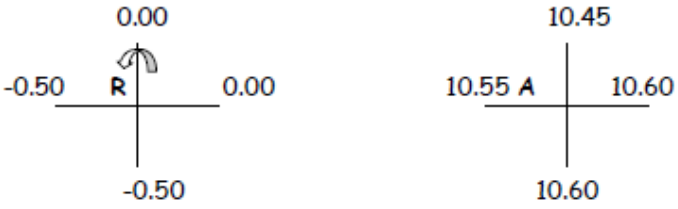
- Final Clearance chart is as under:

Sr. No.	Description	Design Value (mm)	Value before Prev.Maint (mm)	Value after Prev.Maint (mm)
1	Total Float	-	-	-
2	Coupling end Journal Bearing Clearance	0.22-0.23	-	0.17-0.20
3	Free End Journal Bearing Clearance	0.23-0.24	-	0.15-0.20
4	Coupling end Journal Bearing side Clearance	-	-	0.05
5	Free end Journal Bearing side Clearance	-	-	0.05

- Final Alignment readings are:

  After Preventive Maint :

  {Dial on Motor shaft}

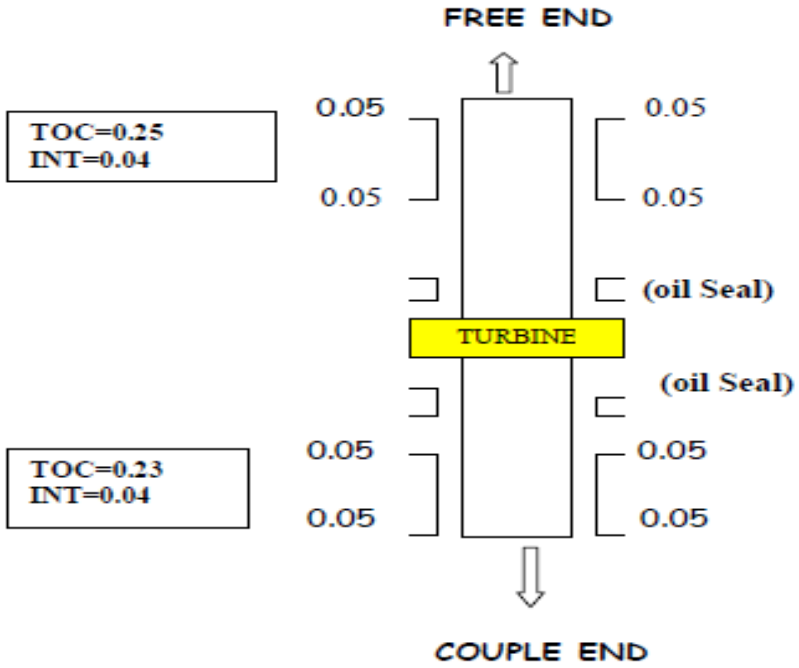


<u>BFW PUMP TURBINE (Q–5111)</u>:

Activities carried out are:-

- Coupling float of Turbine to Pump is measured & recorded.
- Coupling between Turbine to pump is decoupled.
- Before Preventive maintenance of the Q5111 Turbine to pump Alignment was checked.
- Turbine both ends bearings were opened cleaned properly and clearances were measured using lead wire.
- Clearances of Turbine Bearings were checked and recorded as Coupling End Journal bearing clearance = 0.26 mm

  Free End Journal bearing clearance = 0.25 mm



All readings are in mm

TOC: Top Oil Clearance (Bearing Diametrical Clearance)

INT: Interference between bearing and housing

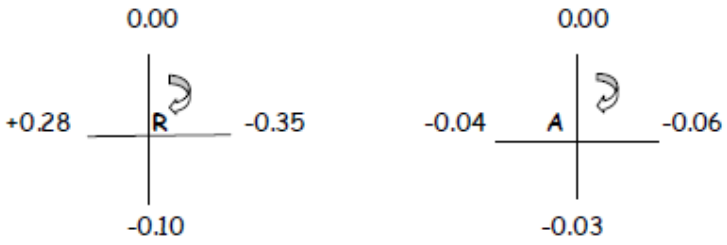
- Turbine Thrust float is measured and recorded.
- Final Clearance chart/float are as under:

Sr. No.	Description	Design Value (mm)	Value before Prev.Maint (mm)	Value after Prev.Maint (mm)
1	Coupling Float	-	10.0	9.70
2	Thrust Float	0.2-0.4	-	0.22
3	Coupling end Journal Bearing Clearance	0.12-0.17	-	0.26
4	Free End Journal Bearing Clearance	0.12-0.17	-	0.25
5	Coupling end Journal Bearing side Clearance	-	-	0.04
6	Free end Journal Bearing side Clearance	-	-	0.05
7	Coupling end Journal Bearing Interference	-	-	0.04
8	Free end Journal Bearing Interference	-	-	0.04

- Final Alignment Readings are as under:

  Before Preventive Maint:

  {Dial on Turbine}



After Preventive Maint:
{Dial on Turbine}

- Oil filters cleaned and box up.
- Oil cooler was opened & box up after hydro jetting.
- Oil from the oil sump was completely drained, cleaned properly and charged with the fresh oil. (Servo Prime-68)
- Oil leakage from governor bottom oil seal was observed, so governor was completely overhauled and during assembly following worn out parts were replaced.

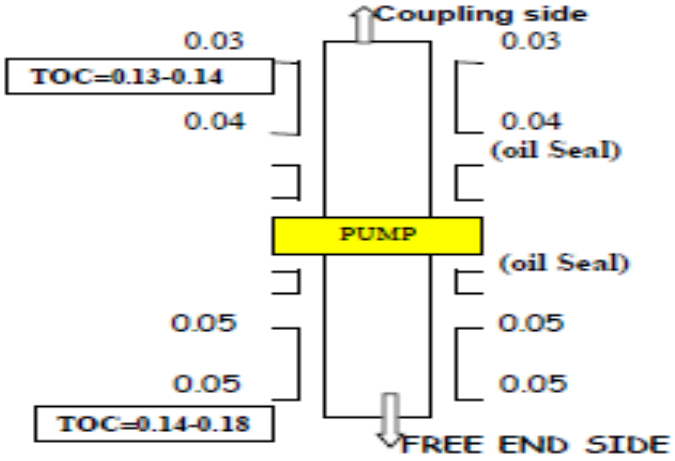
Sr. No	Store Code	Item Description	Part No.	Fig. No.	Quantity
1	142110719600	Drive Shaft	51	12	01
2	-	Oil Seal Ring	41	12	01
3	996010803020	Bearing, 6302 ZZ	50	12	01
4	142110724700	Column Cover Gasket	05	03	01
5	142110724720	Case Column Gasket	11	03	01

BFW PUMP (P- 5111):

Activities carried out are:-

- Coupling float of Turbine to pump was measured and recorded.
- Alignment between turbine to pump was checked and recorded:
- Both Bearings of pump was opened, cleaned, checked.
- Pump inboard bearing was found in good condition.
- Pump outboard bearing was found in damaged condition having rubbing marks. So it was replaced with new bearing.

- After re assembling the bearings, clearances were measured.



TOC: Top Oil Clearance (Bearing Diametrical Clearance)

INT: Interference between bearing and housing.

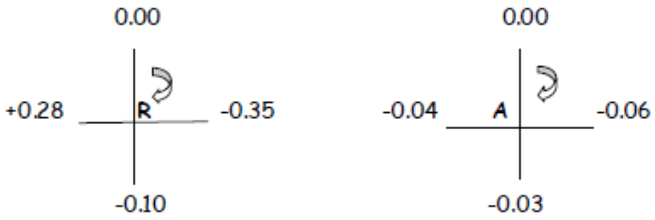
- After preventive maintenance, alignment readings between pump and turbine were again checked.
- Thrust float of the pump was recorded as **0.25** mm
- While opening the Bearing housing of free end of the pump, lot of rusting was observed on the bearings.
- Oil filters were opened, cleaned and boxed up.
- Oil sump was cleaned and charged with fresh oil.
- All connected oil pipe lines were also cleaned and checked.
- Pump coupled with turbine with packed fresh BRB-100 grease in geared coupling.

- Final Clearance chart is as under:

Sr. No.	Description	Design Value (mm)	Value before Prev.Maint (mm)	Value after Prev.Maint (mm)
1	Coupling Float (Turbine to Pump)	-	-	9.70
1	Thrust Float	0.28-0.33	-	0.25
2	Coupling end Journal Bearing Clearance	0.13-0.18		0.13-0.14
3	Free End Journal Bearing Clearance	0.13-0.18		0.14-0.18
4	Coupling end Journal Bearing side Clearance	-		0.03-0.04
5	Free end Journal Bearing side Clearance	-		0.05

Final Alignment Readings are as under:

Before Preventive Maint.

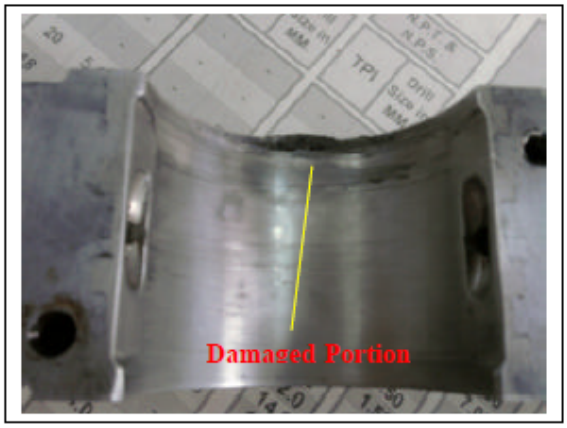


After preventive Maint:

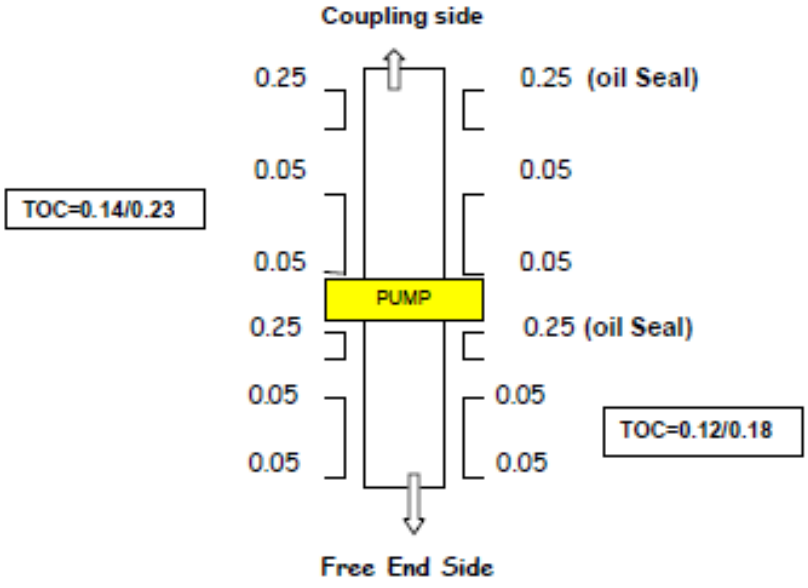
BFW PUMP MOTOR DRIVEN (P-5112):-

Activities carried out are:-

- Coupling float of motor to gear box coupling was measured and recorded as 4.50mm
- Coupling float of Pump to gear box coupling was measured & recorded as 8.30 mm.
- Motor and Pump was decoupled.
- Pump bearings were opened, cleaned & checked.
- Pump inboard was found in good condition whereas pump out board bearing was found in damaged condition.



- Pump outboard bearing was replaced with new bearing
- After re-assembly, Bearing clearances of Pump was measured and readings are as under:



All readings are in mm

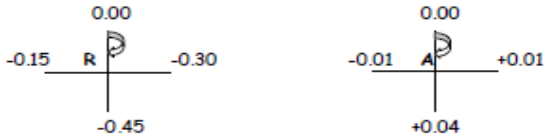
TOC: Top Oil Clearance (Bearing Diametrical Clearance)

- Motor to gearbox Alignment readings were checked.

  {Dial on gear box}

- Pump to gear box alignment readings were also checked.

  {Dial on gear box}



- Thrust float of the pump was measured and recorded as **0.30** mm
- While opening the Bearing housing of free end of the pump, lot of rusting was observed on the bearings.
- Oil cooler was opened, cleaned, hydro test and then boxed up.
- Oil sump was cleaned and charged with fresh Servo Prime-68 oil.
- Final Clearance chart is as under:

Sr. No.	Description	Design Value (mm)	Value before Prev.Maint (mm)	Value after Prev.Maint (mm)
1	Coupling Float (Motor to GB)	-	-	4.50
2	Coupling Float (GB to Pump)	-	-	8.30
3	Thrust Float	0.28-0.33	-	0.30
4	Coupling end Journal Bearing Clearance	0.13-0.18	-	0.14/0.24
5	Free End Journal Bearing Clearance	0.13-0.18	-	0.15/0.16
6	Coupling end Journal Bearing side Clearance	-	-	0.05
7	Free end Journal Bearing side Clearance	-	-	0.05

- Final alignment readings are as under:

Motor to gearbox Alignment readings were checked with Shaft Laser Alignment ToolLaser alignment report is attached below

MECHANICAL OFFSITES, IFFCO KALOL

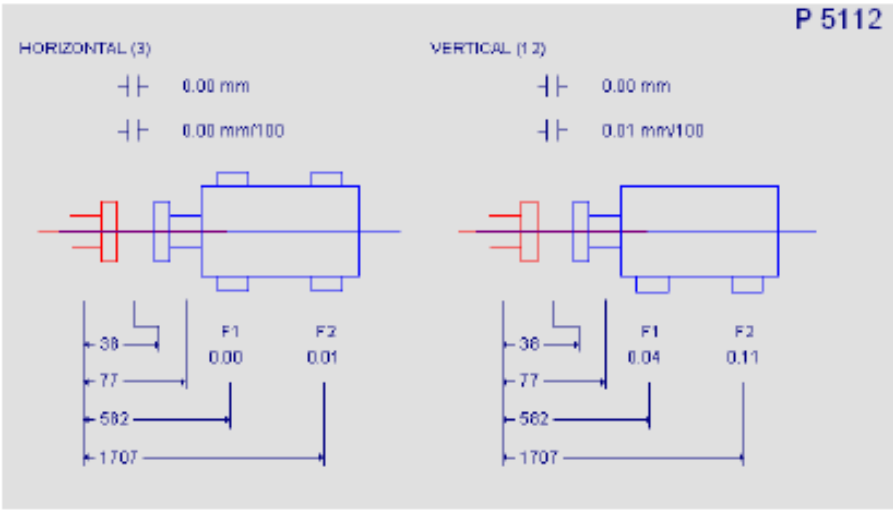
Equipment No.	P 5112 (BFW Pump)
Date:	01/04/2011
Time:	15:04
Program:	Easyturn
Unit:	mm (mm/m)
Serial:	69199 / 68864 / 68839

Alignment **Motor to Gearbox**

S-M:	77
S-Center:	38
S-Foot1:	582
S-Foot2:	1707

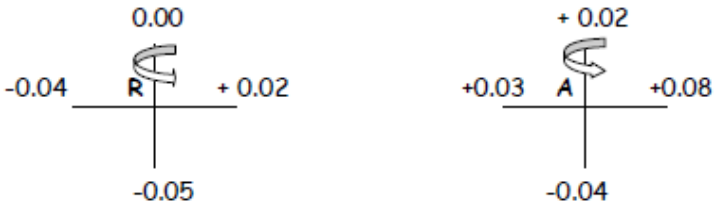
V/H	Offset	Angle	Foot1	Foot2
H	0.00	0.00	0.00	0.01
V	0.00	0.01	0.04	0.11

Comp	Offset	Angle
H	0.00	0.00
V	0.00	0.00



- Pump to gear box alignment readings were also checked.

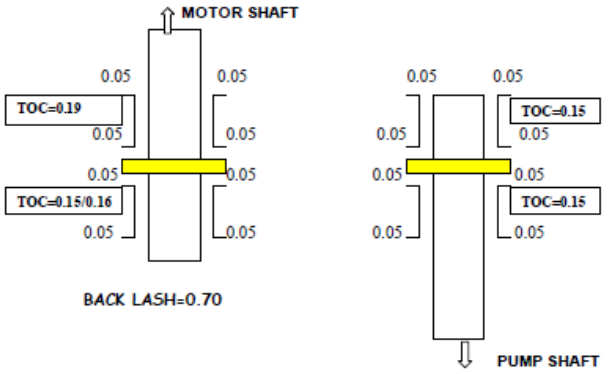
  {Dial on gear box}



<u>GEAR BOX FOR MOTOR DRIVEN BFW PUMP (P-5112)</u>:-

Activities carried out are:-

- Gear box bearings were opened, cleaned, checked.
- Bearing clearances of Gear Box were checked and recorded.



All readings are in mm

TOC: Top Oil Clearance (Bearing Diametrical Clearance)

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

- Final Clearance chart is as under:

Sr. No.	Description	Design Value (mm)	Value before Prev.Maint (mm)	Value after Prev.Maint (mm)
1	Gear wheel Motor end Journal Bearing Clearance	-	-	0.19
2	Gear wheel free end Journal Bearing Clearance	-	-	0.15/0.16
3	Gear wheel Motor end Journal Bearing side Clearance	-	-	0.05
4	Gear wheel free end Journal Bearing side Clearance	-	-	0.05
5	Pinion wheel free end Journal bearing clearance	-	-	0.15
6	Pinion wheel Pump end Journal bearing clearance	-	-	0.15
7	Pinion wheel free end Journal bearing side clearance	-	-	0.05
8	Pinion wheel Pump end Journal bearing side clearance	-	-	0.05
9	Backlash	-	-	0.70

F.D FAN (K-5113):

Activities carried out are:-

- FD fan bearing pedestal were cleaned.
- As the bearings of FD fan were checked in August-2010, hence bearings were not checked again.
- Breather filter of Clutch was cleaned.
- Oil in clutch between FD Fan & Motor was found in good condition, so it was not replaced.

FD FAN TURBINE WITH GEARBOX (Q-5113):

Complete overhauling of turbine was carried out to attend the oil leak from the turbine side end cover of gear wheel.

Activities carried out are:-

- Turbine was completely dismantled.
- Turbine wheel was found in good condition.
- Surface cracks were observed on Turbine front side reversing chamber and the same was revealed in DP test also.


- Removed the old carbon rings & chamber rings from stuffing box.
- Crack was observed on the inside surface of shaft stuffing box. Severe crack was revealed in DPT.


- All 05 nos of new carbon rings were installed in the stuffing box. Clearance of carbon rings were maintained as given below :

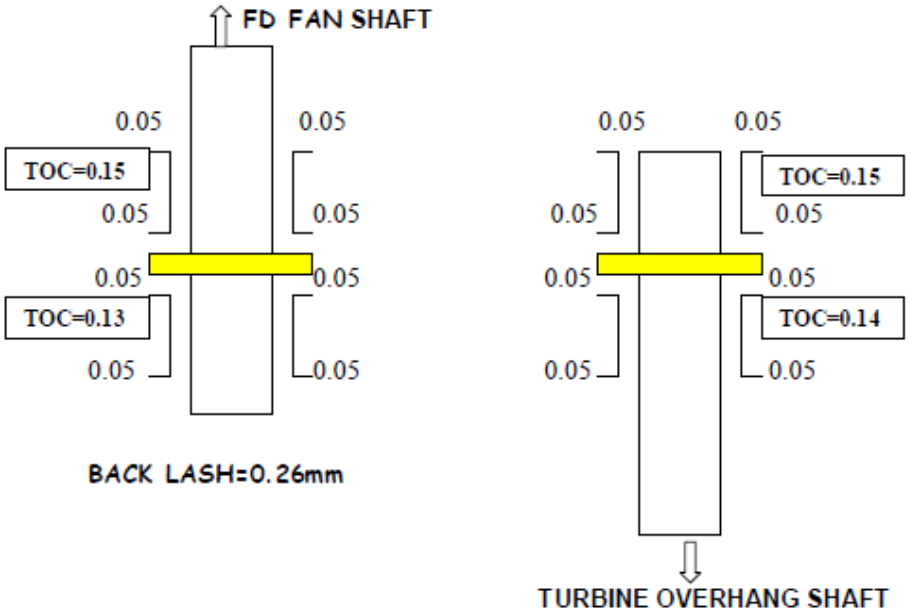
  Carbon Ring No.1 : 0.15 MM

  Carbon Ring No.2 : 0.15 MM

  Carbon Ring No.3 : 0.15 MM

  Carbon Ring No.4 : 0.20MM

  Carbon Ring No.5 : 0.20 MM
- Gear box top cover was also opened to check the internals of gear box.
- Gear box bearings were opened one by one, checked, cleaned and found OK.
    - Bearing clearances of Gear Box was checked.



All readings are in mm

TOC: Top Oil Clearance (Bearing Diametrical Clearance)

- Gear wheel turbine side end cover was opened; one no. of bolt which was found broken was removed and replaced with new one.
- Light cut was taken on the face of the end cover to remove the pittings.
- MOP of turbine was removed, cleaned and checked.
- Main oil pump coupling rubber bushes were found in damaged condition and the same were replaced with locally manufactured bushes (M/s Bhavna Enterprises)


- As the oil was leaking from the Regulating and Emergence valve, so it was completely overhauled and replaced the defective radial gasket ring (Oil Seal – 16X32X10, Part No. 430.23, Fig.430) during assembly.
- Oil was also leaking from the top oil seal (15X25X7, Part No. 390 00.12, Fig.380) of Rapid closing governor with relay and the same was also replaced.
- Gear box top cover was boxed up.
- Turbine was again assembled and during assembly following nozzle clearances were maintained:

  Turbine Reversing Chamber Nozzle Gap- Front Side: 1.10 MM

  Turbine Reversing Chamber Nozzle Gap- Front Top: 0.90 MM
- Oil console and all connected oil pipelines were removed, cleaned & then boxed up.
- Oil cooler was opened; hydrojet cleaned and then boxed up.
- Fresh oil SERVO PRIME 68 was charged in oil console.
- When turbine was started, speed of the turbine was not increasing due to decrease in the nozzle box pressure.
- So turbine exhaust side casing cover was again opened to recheck the nozzle clearance.
- During opening of Turbine front side reversing chamber, it's one end at bolting hole area gets breaked which was initially in cracked condition.
- For proper holding of reversing chamber SS plate of 5 mm thick was placed on it and tightened.

- Following clearances were maintained during reassembly

  Front top Reversing chamber & Wheel clearance = 0.90 mm

  Front top Reversing chamber nozzle clearance = 1.55 mm

  Front side Reversing chamber & Wheel clearance = 0.80 mm

  Front side Reversing chamber nozzle clearance = 1.80 mm

- Regulating and Emergence valve spindle travel was also checked and recorded as 21 mm
- Final Clearance chart is as under:

Sr. No.	Description	Design Value (mm)	Value before Prev.Maint (mm)	Value after Prev.Maint (mm)
1	Gear wheel Fan end Journal Bearing Clearance	-	-	0.15
2	Gear wheel free end Journal Bearing Clearance	-	-	0.13
5	Pinion wheel free end Journal bearing clearance	-	-	0.15
6	Pinion wheel Turbine end Journal bearing clearance	-	-	0.14
9	Backlash	-	-	0.60
10	Front top Reversing chamber & Wheel clearance	-	-	0.90
11	Front top Reversing chamber nozzle clearance	-	-	1.55
12	Front side Reversing chamber & Wheel clearance	-	-	0.80
13	Front side Reversing chamber nozzle clearance	-	-	1.80

BHEL BOILER JOBS (F-5111):

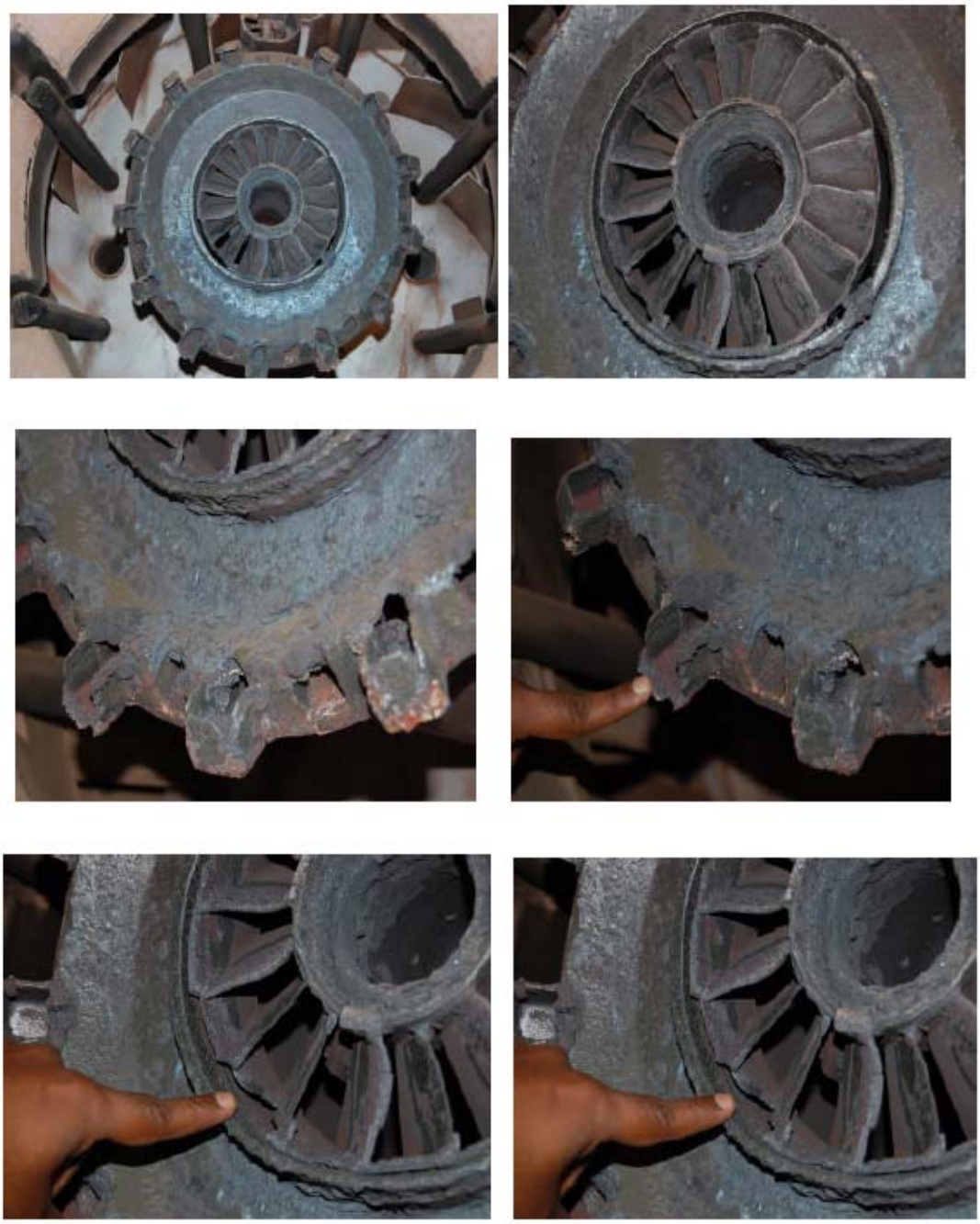
BHEL BOILER INSPECTION:

- Boiler was inspected by Boiler Inspector in open condition on 29/03/2011 & Hydrotest was carried out at 99.0 kg/cm2 pressure on 01.04.2011 and witnessed by Boiler Inspector.
- RV's were overhauled by M/s Flotec Engineering Services against WO No. 20101073 dated 07/01/2011. The nozzle seats of all three safety relief valves were found in damaged condition. Nozzle seats of Drum Rear and Superheater RV was replaced with new one whereas Nozzle seat of Drum front RV was replaced with old reconditioned seat. All the Rv's were again assembled after in-situ hand lapping and blue matching of RV seats were done.. The RVs were floated online and their readings ere as follows:

Description	Popping Pressure Kg/cm2g	Reset Pressure Kg/cm2g
Drum Rear R.V.	70.60	68.22
Drum Front R.V.	68.36	65.37
Super Heater R.V.	64.96	62.60

Blue Matching of RV seats:

- Steam drum connected all first and second isolation valves gland packing were repacked. M/s Amrutha Engineering was engaged for valve gland repacking job. (Ref: WO No 20090923 dated 05/12/2009 & Amendment dated 24/011/2010).
- All 4 nos. inspection window glasses were checked & cleaned. Two Nos of broken window glasses were replaced. Gaskets of all window glasses were also replaced.
- All dampers of air duct (FD Fan Inlet & Outlet damper, RAH Inlet, Outlet & Bypass damper) were checked and made free by greasing for smooth operation.
- Boiler furnace burners were visually inspected and burner impeller and nozzle tips of both top and bottom syn gas burners were found in burnout condition and the same was shown in the attached photographs



Removal of all Rotary and Long retraceable Soot Blowers:

- All 05 Nos of Rotary soot blowers installed in boiler furnace and RAH top and 02 Nos of Long Retracheable Soot Blowers installed in Boiler Furnace were removed along with the associated piping.
- Opening of all soot blowers was capped by welding the blind plate.

Removal and Capping of 60 Ata steam line to soot blowers:

- The 60 ata steam line goes to soot blowers was also removed as all soot blowers were removed.
- After cutting the line cap (2" Sch 80)was welded. Root DP, Final DP and Radiography of cap joint was carried out.
- Job carried out through M/s Skywin Erectors vide W.O No. 20101145, Dt 02/02/2011.

Replacement of Eye High 2nd isolation valve:

- Eye-high 2nd isolation valve (Globe Valve, Size 1" X 1500 #)in steam drum rear side was also replaced.
- Job carried out through M/s Skywin Erectors vide W.O No. 20101145, Dt 02/02/2011.

RE-GENERATIVE AIR HEATER H-5111:

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

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

- RAH Air Motor Clutch oil flushed.

Replacement of FD Fan discharge duct Bellow:

- FD Fan discharge bellow was is highly corroded condition, So it was replaced with new bellow having SS 304 convolutions procured from M/s B.D Engineers, Ahmedabad.

- Job was carried out through M/s Skywin Erectors vide W.O No. 20101145, Dt 02/02/2011 for the replacement of this bellow.
- Flushing arrangement was provided for flushing the oil coolers of P-5111, P-5112 and Q-5113.

Deaerator Inspection:

- Internal inspection of Deaerator was carried out and all the trays and internal were found in good condition.
- Thickness measurement of Down comer elbows (6" Sch 40) was carried out and thickness in two elbows (North East & North West side) was observed below the required value, So these two elbows were replaced.

COOLING TOWER AREA JOBS:

Replacement of Cooling Water pumps rubber Expansion bellows:

- Old deteriorated rubber expansion bellows installed in discharge line of Cooling water pumps – P-4401/A, P-4403, P-4402, P-4401/C and P-4401/D were replaced. (Size: 24" Dia., Store Code: 139040104510).
- Job carried out through M/s General Engg vide W.O No 20101048, Dt 03/01/2011 for the replacement of these bellows.
- The cooling tower distribution valves were attended for smooth operation.
- Inside painting of 52" CW interconnection line was carried out after applying the M-seal at the cavities of the welding joint area.

D.M. PLANT JOB:

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

Replacement of 40 Ata RV:

- The 40 Ata RV installed in the 40ata steam line over the Mech shift office was replaced with newly procured RV.
- Data sheet of new relief valve is given below:

Sr. No.	Parameter	Description
1.0	**General**	
1.1	Tag No.	RV-5151
1.2	Valve Model	HCI-46-IBR-FN - SPL
1.3	Service	Saturated Steam
1.4	Line / Vessels No.	40 ata Header
1.5	Full / Semi nozzle	Full
1.6	Con. / Bellow/ Pilot p.	Conventional
1.7	Bonnet Type	Open

2.0	**Connections**	
2.1	Size : Inlet / Outlet	4” x 6”
2.2	Orifice	P2
2.3	Flange Rating & Faces	600# (RTJ) x 150# (RF)
3.0	**Material of Construction**	
3.1	Body	ASTM A 216 Gr. WCB
3.2	Bonnet	ASTM A 216 Gr. WCB
3.3	Nozzle	ASTM A 351 Gr. CF8C
3.4	Disc	Inconel 718
3.5	Guide	S. Monel
3.6	Spring	Alloy Steel – H.T. Al. Ptd.
4.0	**Options**	
4.1	Cap	Screwed Cap
4.2	Lifting Lever	Plain
5.0	**Basis of Design**	
5.1	Code	ASME Section I
5.2	Sizing Basis	IBR
5.3	Relieves to	Atmosphere
6.0	**Input Data**	
6.1	Set Pressure	44.00 Kg/cm2 g
6.2	Operating Pressure	40.92 Kg/cm2 g
6.3	Relieving Temperature	256.20 ˚C
6.4	Allowable Overpressure	5%
6.5	Capacity Rated	90000 Kg/Hr.
6.6	Blow-down	2.5 to 5.0%

STEAM LEAK & FABRICATION JOBS:

- Replaced/repaired all steam traps which were not working as per the list given by Prod. Deptt.
- Provided 4” drain nozzle in FD fan discharge duct.
- Provide 6” tapping in FD fan discharge duct.
- Replaced saturated steam cooler CW return valve.
- Replaced 40 ata trap bypass isolation valve of Q-4403
- Replaced 40 ata main steam line bypass valve of Q-4403.

PAINTING JOBS:

- Painting of BHEL Boiler House Pipelines & Structure was carried out by M/s. Vaidehi & Company.

B&MH PLANT

RECLAIM MACHINE M-2116:

Reclaim machine was taken for Preventive maintenance / overhauling. Overhauling was carried out under the supervision of M/s EMTICI, V.V. Nagar against IFFCO WO No. 20100887 dated 14/12/2010.

The following major jobs were carried out during shutdown from 25/03/2011 to 06/04/2011.

Overhauling of Scraper Mechanism:

The following activities were carried out during inspection of complete Scraper Chain Mechanism:

- Scraper shaft assembly checked in its position and found small and big bearing housing, sleeves and shaft in good condition. Duplex chain sprocket was found damaged, replaced by new one.
- Checking of the scrapper chain, pin, washer and circlips done and replaced damaged ones.
- Replaced scraper chain tightening assembly. One set of Belleville spring washer was found damaged, replaced it. Chain was tightened and required tension was given by adjusting the Tensioning device.

Overhauling of Bucket Elevator Mechanism:

The following activities were carried out during inspection of complete Bucket Elevator Mechanism:

- Bucket elevator shaft assembly checked & found that bearing area of shaft badly damaged, replaced the shaft. Bearing housings were found damaged, replaced the same. Checking of the bucket elevator chain, pin, washer and circlips done and replaced damaged ones.
- Checked the Bucket elevator (Top) shaft with end bearings, adopter sleeve and seals as a preventive maintenance requirement. Condition of shaft was satisfactory.
- Take-up unit was overhauled.
- Checking & lubrication of bearings, shaft & sprockets was carried out.

Gear Train Assembly:

Following jobs were carried out in Gear Train assembly

- Complete overhauling of Gear train assembly carried out
- Opened the gear train cover plate, scrapper shaft gear replaced with M/s Ingeco make gears. Idler Pin found in good condition. Sufficient backlash found in gear train.

Main Drive gear box

The following activities were carried out

- Preventive maintenance of GB done .Opened the Gear box top casing, checked the bearings, and inspected the gear teeth. Condition was found satisfactory.
- Replaced Input and Output shaft oil seals
- Checked the Bearings of FC-20 coupling output shaft, found the bearings clearance more than specified clearance and therefore bearings replaced.
- Output shaft duplex chain sprocket was found damaged, so, replaced the same. Proper alignment done for Chain sprockets.
- Duplex chain was checked & found in good condition.
- Alignment of Gear Box with Motor done and coupled with new Coupling bushes.
- Fluid coupling checked, found in good condition. Replaced the oil of fluid coupling.

Traveling Gear box

The following activities were carried out

- Preventive Maintenance of Gear Box done, coupled with motor after checking alignment.
- Replaced coupling bushes.
- Chain & chain sprocket cleaned and checked, found in good condition.
- UT of Front & Rear axle done, found in good condition.

Slewing Gear box

The following activities were carried out

- Preventive Maintenance of Gear Box done. Replaced damaged oil seals of output shaft.
- Coupled the gear box after proper alignment with motor.
- Replaced coupling bushes.
- Checked output shaft pedestal bearing block, bearing, sleeve, washer, lock nut & found ok.
- Assembled with Repaired hub & pinion with new shear pins.

King Post Assembly

- Preventive maintenance of Bottom king post carrying roller base assembly done.
- Inspection of Rack pins done, found in good condition. Greasing of the same was done.

Link conveyor

The following activities were carried out

- Checked Pivot assemblies, found in good condition.
- Checked the Head end & Tail end pulley bearings, found satisfactory.
- Preventive maintenance of Gear box done, replaced the oil seals & coupled with new bushes.
- Cleaning & overhauling of carrying 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.

Hoisting Mechanism of Reclaim Machine:

The following activities were carried out

- Thruster oil replaced and brake shoes checked.
- Replaced damaged coupling bush and bolts after alignment of Gear box with motor.
- Proper cleaning & lubrication of wire rope done.

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

After completion of overhauling “no load” and “load” trial of Reclaim machine was carried out and the machine was found working satisfactorily.

SPARES CONSUMED IN RECLAIM MACHINE(HM-122)

SR. No.	Item Description	Qty. (No.)
	Scraper Mechanism	
1.	Belleville Disc washer	02
2.	Tail end bearing housing	01
3.	Idler gears bearings No. NA 4914	04
4	Idler gear for gear train (M/s Ingico make)	02
5	Taper roller bearings No. 33019	02
6	Duplex chain sprockets	set
	Bucket Elevator Mechanism	
1	Bucket elevator shaft	01
2	Bucket elevator bearing housings	02
3	Taper roller bearings No. 33019	02
4	Needle roller bearings NA 4824	04
	Slewing Mechanism	
1	Slewing Pinion (12 Teeth)	01
2	Slewing Hub	01
3	Shear Pin	04
4	Rubber Bush for coupling	06
5	Oil seal for Out put shaft 130 x 150 x 12	02
6	FC 20 out put shaft bearing No. 22224	02
	Hoist Mechanism	
1	Rubber Bush for coupling	06
	Travel Mechanism	
1	Rubber Bush for coupling	06
	Link Conveyor	
1	Input Oil seal for Gear box (50x62x7)	02
2	Output Oil seal for Gear box (130x105x16)	02

CONVEYOY BELT JOBS:

CONVEYOR M-2110:

Following jobs were carried out:

- Inspection of Head pulley was done, found satisfactory.
- Preventive maintenance of Gear Box carried out & coupling done after proper alignment.
- Replaced coupling bushes.
- Bend pulley replaced.
- All damaged and noisy Impact rollers, carrying rollers, return rollers, and guide rollers were replaced.
- All pedestal bearings of snub pulley, head pulley and gravity pulley checked and greasing done.
- Skirt rubber replaced.
- Inspection of flap valve done. Lubricate the same.
- Complete cleaning and painting done on the conveyor structure.

CONVEYOR M-2112:

Following jobs were carried out:

- Complete belt replaced as the existing belt was running from last ten years, slowly and slowly belt thickness was reduced and thickness of the top rubber and bottom rubber were found very thin.
- Preventive Maintenance of Gear Box carried out & Coupling done after proper alignment.
- Bend pulley replaced.
- All noisy and damaged Impact, Carrying, guide and return rollers replaced by reconditioned / new rollers.
- Skirt rubber replaced.
- Greasing done in all bearings of head pulley, tail pulley, snub pulley and gravity pulley.
- Preventive maintenance of Tripper system carried out.
- Realigned the gearbox with motor.
- Replaced coupling bushes.

CONVEYOR M-2117:

Following jobs were carried out

- Preventive Maintenance of Gear Box done. Coupling done after proper alignment.
- Replaced coupling bushes and damaged coupling bolts.
- All noisy and damaged carrying, guide and return rollers replaced by reconditioned / new rollers
- Greasing done in all bearings of head pulley, tail pulley, snub pulley and gravity pulley.

CONVEYOR M-2121:

Following jobs were carried out:

- Preventive Maintenance of Gear Box done. Coupling done after proper alignment.
- Complete skirt board sealing system adjusted.
- Replaced all damaged and noisy Carrying, Return, Impact and Guide rollers by reconditioned/new rollers.
- Replaced Self aligning carrying roller frames, Self aligning return roller frames which were found damaged.
- Complete greasing of all pedestal bearings done.
- Complete cleaning and painting of structure done.

CONVEYOR M - 2122:

Following jobs were carried out

- Preventive maintenance of Gear Box done. Coupling done after proper alignment.
- Replaced all damaged and noisy Carrying, Return and Guide rollers by reconditioned/new rollers.
- Skirt rubber replaced.
- Complete greasing of all pedestal bearings done.
- Complete cleaning and painting of conveyor structure done.

CONVEYOR M- 2122/A:

Following jobs were carried out

- Preventive maintenance of Gear Box carried out. Coupling done after proper alignment.
- Replaced damaged coupling bushes and bolts.
- Replaced all damaged and noisy Carrying, Return and Guide rollers by reconditioned / new rollers.
- Skirt rubber replaced.
- Cleaning and painting of complete structure done.

CONVEYOR M-2122/A2:

Following jobs were carried out

- Preventive maintenance of Gear Box carried out. Coupling done after proper alignment.
- Replaced damaged coupling bushes and bolts.
- Replaced all damaged and noisy Carrying, Return and Guide rollers by reconditioned / new rollers.
- Replaced Skirt rubber by new one.
- Cleaning and painting of complete structure done.

CONVEYOR M – 2142/1:

Following jobs were carried out

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

DUST CONVEYOR, M-2137:

Following jobs were carried out

- Replaced the damaged conveyor belt.
- Preventive maintenance of Gear Box done.
- All damaged Return rollers replaced.
- All Carrying rollers attended for free operation.
- Skirt rubber adjusted.
- Complete greasing of all bearings done.

PAY LOADER CONVEYOR, M-2113:

Following jobs were carried out

- Preventive maintenance of Gear Box carried out. Coupling done after proper alignment.
- Checking of carrying & return rollers carried out & replacement of damaged rollers done.
- Cleaning of complete structure done.

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

Following jobs were carried out on the Vibrating Screen

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

Blowers:

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

PREVENTIVE MAINTENANCE OF PACKER SCALES:

- New complete S.S. structure Flap assemblies, weighing receptacle assemblies & Sack grip assemblies replaced along with main frame in Packer Scale No. 1,3,7,10A & 10B.
- Preventive maintenance of all the assemblies of Packer scale No. 2, 4, 8, 9A & 9B carried out.
- Servicing of all Air cylinders done. Replaced the seal kits of all the Air cylinders.
- Replacement and Alignment of stabilizer plate done.
- Calibration of all packer scales done.

SLAT CONVEYOR M-2124:

Following jobs were carried out on the slat conveyors

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

STITCHING MACHINES:

All the Stitching machines were completely overhauled with the help of M/s Gabbar Engg. Co. against our Servicing Contract.

Following spares were replaced in all the stitching machines:

Needle, Looper, Pressure Foot, Throat Plate and Feed Dog, needle bar, looper holder, pressure bar, pressure bar spring regulator knob, thread Eyelet assembly, tension disk and thread cutter were also replaced in the stitching machines as per the requirements.

WAGON LOADER:

Following jobs were carried out.

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

TRUCK LOADER:

Following jobs were carried out

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

INSPECTION

AMMONIA PLANT

The following major inspection activities were performed in Ammonia Plant.

- Inspection of primary reformer, catalyst tubes and risers with various NDT Techniques including Ultrasonic Scanning by M/S PDIL. Details are given at **Annexure-1 to 5**
- Visual inspection of equipments.
- Ultrasonic flaw detection on selected weld joints and parent metal of elbows of New Converter(S-50) loop and other critical pipelines was carried out .Details are given at **Annexure-6**
- Thickness measurement of various equipment was carried out .Details are given at **Annexure-7**
- Thickness measurement of various pipelines was carried out .Details are given at **Annexure-8**
- Measurement of residual magnetism at various parts of rotating equipments and demagnetization of the same wherever required. Details are given at **Annexure-9**
- Insitu metallography of selected equipment and pipelines were carried out. Detailed summary of observations and microstructure analysis is given at **Annexure-10**
- Inspection of newly fabricated pipelines and fabrication jobs carried out departmentally by Maintenance and Technical department. 05 Nos. of sockolet were replaced in new converter 108-D pipeline loop. Details of inspection activities carried out is given at Annexure-11
- Qualification tests of welders employed by contractors.
- The detailed observations and recommendations for corrective actions required on individual equipment are given below. All the observations were recorded during inspection and were handed over to concerned Maintenance and Operation group for necessary corrective action.

PRIMARY REFORMER 101-B:

RADIANT ZONE:

VISUAL INSPECTION:

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

OTHER NDT ACTIVITIES:

- Automatic ultrasonic scanning of all the 336 Catalyst tubes and 8 Risers tubes was carried out during Shutdown by PDIL. Amongst all 336 tubes, 263 tubes are placed in B grade and 73 tubes are placed in C grade. Amongst 8 risers, 6 risers are placed in B grade & 2 risers are placed in C grade. Details are attached at **Annexure-2.**

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

- Creep measurement of all the catalyst tubes was carried out using GO-NOGO Gauge at tunnel slab level. Creep was found in the range of 0 - 0.17 % for 323 nos. of tubes and between 0.17 to 0.70 % in 13 nos. of tubes. Creep measurement of the riser tubes at tunnel slab level was also carried out using digital micrometer. Creep was found in the range of 0 – 0.33 % for 07 nos. of Riser tubes and 01 no. riser tube was found to have creep in the range of 0.33-1.1%. The report is attached at **Annexure 3.**

CONVECTION ZONE

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

H.T. CONVECTION SECTION:

From Bottom Manhole:

- Hard scaling was observed on all the tubes of mixed feed coil.
- Between H.T Convection zone and Radiant zone roof refractory was found detached and cracked from its position at few locations.
- Insulation covering plate of North wall were completely burnt off.
- Thermo well pipes were found slightly bent.
- Bottom floor was found sagged at many locations.
- Insulation of East, South and West wall is being replaced during this shutdown.

From Top Manhole:

- HT and LT super heater coils were found in satisfactory condition.
- Supports of LT/HT steam super heater coils were found in satisfactory condition.
- Extreme east side duct distribution plate was hanged down and few fasteners were found loose.
- Extreme east side insulation protection sheet was found burnt off.
- Burnt out pieces of protection sheet was found lying inside the duct.
- Welding of bottom most damper of PRC-23 was found broken

AUXILIARY BOILER:

- Gap was observed between the refractory bricks of conical portion of burner no.: 2
- A Dent mark (approx. 2-3 mm deep) was observed on 15th tube (counting from South end) of West end wall, the same was filled by welding and DP tested.

VESSELS & OTHER EQUIPMENTS
103 – D, SECONDARY REFORMER:

BOTTOM DOME:

- Erosion of refractory and scattered cracks was observed at few locations and same were found more prominent around both the gas inlet nozzles.
- Skirt liner was found dislocated from its position, downward towards primary reformer side and lifted upwards on opposite side. Need to be fixed at its position.
- Skirt liner was found slightly buckled inward(away from the shell) at scattered locations.
- Top Dome refractory was found intact except some of the refractory brick slots were found chocked with alumina balls.
- Bottom floor refractory was found loosened and eroded.

101-CA/CB GAS INLET NOZZLE:

- Slight bulging of liner of line to 101-CA and 101-CB was observed.
- Thermo well was found in satisfactory condition.

107 – D ,TRANSFER LINE (From outside)

- Minor buckling/distortion of the liner was observed at scattered locations throughout the length of the transfer line.
- Thermowell was found intact in position.
- Minor damage of the refractory was observed at flange (entry) of the transfer line

102-EB, CO2 STRIPPER:

Visual inspection of vessel from top and bottom manhole was carried out and observations are as under:

TOP MANHOLE:

- Demister pads were found slightly sagged in middle portion.
- Demister pad supporting strips and rods were found distorted in middle portion.
- All liquid inlet nozzle flange bolts were found in sheared condition.
- Upper half of Inlet flange with shell nozzle was found broken from its weld.
- U-Clamp nuts were found missing in West side distribution header.
- U-Clamp nuts were found loose in East side distribution header.
- Few fasteners of west side trays were found missing.
- Weld of Bottom support plate with East Side Distributor was found broken in North direction.
- West side distributor header was found rubbing with the shell plate in S-W direction causing dent in the shell plate. Same was observed in previous inspection also.

BOTTOM MANHOLE:

- Blackish coloration was observed from inside.
- Nozzle condition was satisfactory.
- Thick scaling was observed from inside.
- Bottom most sieve tray segment no. 2, 3 & 4 from North towards West side was found lifted upward.

101-F, STEAM DRUM:

- Grayish black coloration was observed inside the drum.
- All Cyclone Separators were found intact in position.
- Demister pads were found intact in position.
- Minor pitting of approx. 0.5 to 0.75mm depth was observed at scattered locations.
- One of the hole at south end of phosphate dozing line (1" NB) was found enlarged.
- Grill covering the Down Comers were found bent at few locations.
- Few bolts of Demister Pad holding cover plate were found sheared.
- One no. bolt of BFW distribution pipe flange was found loose.
- 5 nos. of clamps were found loose and one no. of clamp was found missing, on East side cover plate.
- 9 nos. of clamps were found loose and five no. of clamp were found missing, on West side cover plate

102-F , RAW GAS SEPARATOR:

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

103-F, REFLUX DRUM:

- Demister pads were found intact in its position.
- Epoxy paint was found peeled off from many locations at bottom half of the vessel. However epoxy primer was found intact at such location.
- Dust & loose metallic pieces were found lying at dished end of vessel.
- Over all condition of the vessel was found satisfactory.

104-F, SYN GAS COMPRESSOR SUCTION SEPARATOR:

- Demister pads were found intact in position and their condition was found satisfactory.
- Scattered hard scales were observed at bottom dish end.
- Condition of weld joints was found satisfactory.
- Grayish black coloration was observed on bottom area, where as brownish coloration was observed on remaining surface.
- Condition of the inlet hood baffle was found satisfactory.

107-F, PRIMARY AMMONIA SEPARATOR:

- Blackish brown coloration was found inside the vessel.
- Scattered thin scales were observed on the shell and dished end.
- Internal surface was found oily.
- The condition of all the weld joints of the shell, dished ends and nozzles was found satisfactory.
- Scattered pitting was observed on entire shell surface.
- Condition of target plate was found satisfactory.

109-F, REFRIGERANT RECEIVER:

- Coloration of the shell was found grayish black.
- The condition of all the weld joints of the shell, dished ends and nozzles was found satisfactory.
- Thin scales were observed on both the dished ends.
- Minor scattered pitting / scales were observed in a width of approx. 250mm throughout the length of vessel at its bottom most portions. The same was observed in past also.
- Entire Internal surface was found oily.
- Overall condition of the vessel was found satisfactory.

2002-F, DM WATER TANK:

A leakage was observed at the junction of bottom floor plate and shell plate welding at two locations. The same was repaired.

In order to check the condition of the soil side of bottom floor plate, entire bottom plate was checked by Low Frequency Electromagnetic Technique (LFET) by M/s Testex, Mumbai. No abnormality was observed.

COLD INSULATED EXCHANGERS:

External visual inspection of the following heat exchangers was carried out and the same was found in satisfactory condition.

- Feed gas recycle first stage chiller, 117-C
- Feed gas recycle second stage chiller, 118-C
- Feed gas recycle third stage chiller, 119-C
- Ammonia Converter feed/ feed and recycle gas exchanger, 120-C
- Flash gas chiller, 126-C
- Synthesis gas compressor inter stage chiller, 129-C
- Synthesis gas compressor suction chiller, 141-C
- Refrigerant cooler, E-2

MISCELLANEOUS JOBS:

WELDER QUALIFICATION TESTS:

- Performance qualification test of 18 Nos. welders offered by M/s General Engineering was carried out. 07 nos. of welders were qualified during the test. These welders were allowed to perform various miscellaneous non-critical departmental welding jobs in the plant.

- Performance qualification test of 06 Nos. welders offered by M/s Skywin Erectors Was carried out. 04 nos. of welders were qualified during the test. These welders were allowed to perform welding on BHEL boiler pipeline /fitting welding, Ammonia Converter sockolet welding, Autoclave liner weld repairing and ammonia nozzle replacement job.
- Welder qualification test of 07 Nos. welders of M/S. J & J Engg. was carried out. 06 welders were qualified. These welders were qualified for performing general purpose welding jobs.

- Welder qualification test of 03 Nos. welders of M/S. Smitha engrs. was carried out. All welders were qualified. These welders were qualified for performing Technical Department's welding jobs.

D.P. TEST:

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

RADIOGRAPHY:

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

INSITU METALLOGRAPHY EXAMINATION:

In order to evaluate the condition of certain critical plant equipment and pipelines operating at more than 300 deg. C temperatures, parent metal, HAZ and welds , weld joints of dissimilar material, Insitu metallographic examination was carried out. List of the lines/equipment checked along with observations and remarks are mentioned at **Annexure-10**

ULTRASONIC FLAW DETECTION OF WELDS:

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

ULTRASONIC THICKNESS MEASUREMENT:

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

GAUSS MEASUREMENT:

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

INSTALLATION OF NEW PIPELINES:

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

OVER SPEED TRIP TEST:

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

ANNEXURE-1

VISUAL INSPECTION REPORT OF PRIMARY REFORMER RADIANT ZONE AND CONVECTION ZONE:

RADIANT ZONE:

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

BURNER BLOCKS: Following burner blocks were found damaged:

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

BOTTOM HEADER INSULATION:

Header insulation was found damaged near following tube nos.:

Header No.	Tube nos where insulation found damaged
1	Near tube no. 1,4,13,17,20,28,34,42
2	Near tube no. 11,12,13,29
3	Near tube no. 14,17,18,23,24-28,31,32
4	Near tube no. 1,3-6,24-29
5	Near tube no. 3,8,20,26-29,42
6	Near tube no. 7-12,18-19,27,36-37
7	Near tube no. 6-14,17,37
8	Near tube no. 17,24-26,33,40

ROOF INSULATION:

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

Row No.	Location
Burner Row 1st	Burner no.1 & between burner no. 3-4
Burner Row 2nd	Burner no.1,3,6,13,14
Burner Row 3rd	Burner no. 3,4,5
Tube Row 3rd	Near tube no. 331-332
Burner Row 4th	Burner no. 3,4 and between burner no. 13-14

Burner Row 5th	Burner no. 9,between burner no. 3-4
Tube Row 5th	Near tube no. 503-506, Tube no. 519-520
Burner Row 6th	Burner No. 4,10
Burner Row 7th	Burner No. 3
Tube Row 7th	Near tube no. ,710-711 & 716-718
Burner Row 8th	Burner No. 2
Tube Row 8th	Near tube no. 817
Burner Row 9th	Burner No. 4,11

REFRACTORY WALLS:

The wall wise observations are made as under.

East Wall:

Z module insulation was found loose near manhole on south direction.

South Wall:

- Z Module insulation was found loose outwards betn peep hole no 5 & 6
- Gaps in Z-module insulation were observed at scattered locations.
- Z module insulation was found fell down surrounding all the peep hole
- except peep hole no. 1 & 2

North wall:

Z module insulation was found fell down surrounding all the peep hole.

West Wall: Found Satisfactory.

TUNNEL SLAB:

The tunnel slabs were found damaged at the following locations.

Row No.	No of slab broken
1	1
4	1
5	1
6	2

Annexure - 2 (1/5)

GRADATION OF TUBES BY AUS CARRIED OUT BY PDIL

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

Annexure – 2 (2/5)

GRADATION OF TUBES BY AUS CARRIED OUT BY PDIL

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

Annexure – 2 (3/5)

GRADATION OF TUBES BY AUS CARRIED OUT BY PDIL

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

Annexure – 2 (4/5)

GRADATION OF TUBES BY AUS CARRIED OUT BY PDIL

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

Annexure – 2 (5/5)

GRADATION OF RISER TUBES BY AUS CARRIED OUT BY PDIL

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

Annexure – 3(1/5)

TUBE NOS 101 TO 242

CREEP MEASUREMENT OF PRIMARY REFORMER CATALYST TUBES AT SLAB LEVEL

Tube No.	Creep in Percentage			Tube No.	Creep in Percentage		
	0 – 0.17	0.17 – 0.7	0.7 – 1.55		0 – 0.17	0.17 – 0.7	0.7 – 1.55
101	X			201	X		
102	X			202	X		
103	X			203	X		
104	X			204	X		
105	X			205	X		
106	X			206	X		
107	X			207	X		
108	X			208	X		
109	X			209	X		
110	X			210	X		
111	X			211	X		
112	X			212	X		
113	X			213	X		
114	X			214	X		
115	X			215	X		
116	X			216	X		
117	X			217	X		
118	X			218	X		
119	X			219	X		
120	X			220	X		
121	X			221	X		
122	X			222	X		
123	X			223	X		
124	X			224	X		
125	X			225	X		
126	X			226	X		
127	X			227	X		
128	X			228	X		
129	X			229	X		
130	X			230	X		
131	X			231	X		
132	X			232	X		
133	X			233	X		
134	X			234	X		
135	X			235	X		
136	X			236	X		
137	X			237	X		
138	X			238	X		
139	X			239	X		
140	X			240	X		
141	X			241	X		
142	X			242	X		
Total	42			Total	42		

Annexure – 3 (2/5)

TUBE NOS 301 TO 442

CREEP MEASUREMENT OF PRIMARY REFORMER CATALYST TUBES AT SLAB LEVEL

Tube No.	Creep in Percentage			Tube No.	Creep in Percentage		
	0 – 0.17	0.17 – 0.7	0.7 – 1.55		0 – 0.17	0.17 – 0.7	0.7 – 1.55
301	X			401	X		
302	X			402	X		
303	X			403	X		
304	X			404		X	
305	X			405	X		
306	X			406		X	
307	X			407	X		
308	X			408		X	
309	X			409	X		
310	X			410	X		
311	X			411	X		
312	X			412	X		
313	X			413	X		
314	X			414	X		
315	X			415	X		
316	X			416	X		
317	X			417	X		
318	X			418	X		
319	X			419	X		
320	X			420	X		
321	X			421	X		
322	X			422	X		
323	X			423	X		
324	X			424	X		
325	X			425	X		
326	X			426	X		
327	X			427	X		
328	X			428	X		
329	X			429	X		
330	X			430	X		
331	X			431	X		
332	X			432	X		
333	X			433	X		
334	X			434	X		
335	X			435	X		
336	X			436	X		
337	X			437	X		
338	X			438	X		
339	X			439	X		
340	X			440	X		
341		X		441	X		
342	X			442	X		
Total	41	01		Total	39	03	

Annexure – 3 (3/5)

TUBE NOS 501 TO 642

CREEP MEASUREMENT OF PRIMARY REFORMER CATALYST TUBES AT SLAB LEVEL

Tube No.	Creep in Percentage			Tube No.	Creep in Percentage		
	0 – 0.17	0.17 – 0.7	0.7 – 1.55		0 – 0.17	0.17 – 0.7	0.7 – 1.55
501	X			601	X		
502	X			602	X		
503	X			603	X		
504	X			604	X		
505	X			605	X		
506	X			606	X		
507	X			607	X		
508	X			608	X		
509	X			609	X		
510	X			610	X		
511	X			611	X		
512	X			612	X		
513	X			613	X		
514	X			614	X		
515	X			615	X		
516	X			616	X		
517	X			617	X		
518	X			618	X		
519	X			619	X		
520	X			620	X		
521	X			621	X		
522	X			622	X		
523	X			623	X		
524	X			624		X	
525	X			625	X		
526	X			626	X		
527	X			627	X		
528	X			628	X		
529	X			629	X		
530	X			630	X		
531	X			631	X		
532	X			632	X		
533	X			633	X		
534	X			634	X		
535	X			635	X		
536	X			636	X		
537		X		637	X		
538	X			638	X		
539		X		639	X		
540	X			640	X		
541	X			641	X		
542	X			642	X		
Total	40	02		Total	41	01	

Annexure – 3 (4/5)

TUBE NOS 701 TO 842

CREEP MEASUREMENT OF PRIMARY REFORMER CATALYST TUBES AT SLAB LEVEL

Tube No.	Creep in Percentage			Tube No.	Creep in Percentage		
	0 – 0.17	0.17 – 0.7	0.7 – 1.55		0 – 0.17	0.17 – 0.7	0.7 – 1.55
701	X			801	X		
702	X			802	X		
703	X			803	X		
704	X			804	X		
705	X			805	X		
706	X			806	X		
707	X			807		X	
708	X			808	X		
709	X			809	X		
710	X			810	X		
711	X			811	X		
712	X			812	X		
713	X			813	X		
714	X			814	X		
715	X			815	X		
716	X			816	X		
717	X			817	X		
718	X			818	X		
719	X			819	X		
720	X			820		X	
721	X			821	X		
722		X		822	X		
723	X			823	X		
724	X			824	X		
725	X			825	X		
726	X			826	X		
727	X			827	X		
728	X			828	X		
729	X			829		X	
730	X			830	X		
731	X			831		X	
732	X			832	X		
733	X			833	X		
734	X			834	X		
735	X			835		X	
736	X			836	X		
737	X			837	X		
738	X			838	X		
739	X			839	X		
740	X			840	X		
741	X			841	X		
742	X			842	X		
Total	41	01		Total	37	05	

Annexure – 3 (5/5)

RISERS

CREEP MEASUREMENT OF PRIMARY REFORMER RISER TUBES AT SLAB LEVEL

Riser No.	N- S	E- W	Creep in Percentage		
			0- 0.33	0.33- 1.10	1.10- 1.44
1	125.45	125.51	X		
2	124.99	124.93	X		
3	125.32	125.33	X		
4	125.20	125.10	X		
5	125.92	125.90		X	
6	125.30	125.31	X		
7	125.02	125.01	X		
8	125.08	125.02	X		

* Design O.D. of Riser = $124.44\ ^{+1}_{-0}$

Annexure – 4

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

COLD LOAD READINGS IN MM:

ROW	TUBE NOS. (SOUTH TO NORTH)																					
	1	2 3	4 5	6 7	8 9	10 11	12 13	14 15	16 17	18 19	20 21	22 23	24 25	26 27	28 29	30 31	32 33	34 35	36 37	38 39	40 41	42
1	0	-3	-7	-7	-8	-11	-13	-4	0	0	0	0	-4	-4	-11	-8	-8	-6	-7	0	0	-3
2	-8	-1	-2	-3	0	-1	-7	-3	-2	-3	-1	0	1	2	0	-7	-7	5	-4	0	0	-4
3	-3	0	0	-3	0	-1	0	0	0	1	2	2	3	0	-2	-4	-3	-1	0	0	4	6
4	0	1	0	0	-1	-1	0	0	3	0	8	0	0	1	0	0	0	0	0	0	3	5
5	5	2	0	-1	-3	-5	-7	-3	-3	0	0	0	0	0	0	2	2	3	2	2	4	2
6	3	5	2	0	0	-1	0	4	0	-2	0	-14	3	10	0	0	-3	-2	0	3	1	7
7	5	8	0	0	0	0	-1	-2	-2	-1	0	0	0	-3	0	0	2	-3	0	0	2	5
8	6	2	1	0	-7	0	-8	-7	0	-2	0	0	0	3	-2	0	3	2	0	-9	9	8

TRANSFER LINE SPRING HANGER LOAD READINGS

ROW	1	2	3	4	5	6	7
READINGS	-36	-30	-30	-34	-42	-20	-18

BOTTOM DRAIN READINGS

ROW	1	2	3	4	5	6	7	8
READINGS	98	100	101	96	96	99	102	101

AUXILIARY BOILER SPRING READINGS

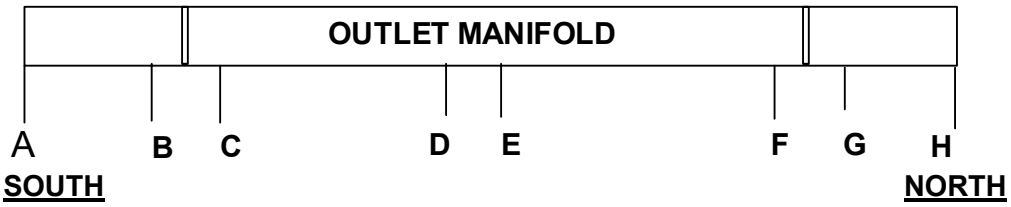
SPRING	S-E	N-E	S-W	N-W
READINGS	70	68	62	63

ANNEXURE- 5

CLEARANCE OF OUTLET MANIFOLD FROM GROUND FLOOR IN COLD CONDITION

HEADER NO.	LOCATION OF MEASUREMENT					
	B	C	D	E	F	G
1	300	300	310	310	170*	170*
2	150*	150*	300	290	220*	220*
3	280	280	280	275	290	280
4	270	270	290	290	220*	280
5	160*	160*	285	285	280	280
6	140*	140*	165*	165*	170*	170*
7	290	290	305	305	120*	120*
8	300	300	295	295	298	298

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



Annexure – 6

UFD OF WELD JOINTS OF FOLLOWING PIPELINES WAS CARRIED OUT:

SR. NO	LINE NO	SIZE (NB)	SCH	FROM	TO	NO. OF WELD JOINTS	No. of Elbows	REMARKS
1	SG-1303-08-14”	14”	120	SG-33-14” (105-D)	108-D Inlet (Bottom)	16	05	No significant defect was observed.
2	SG-1303-09-10”	10”	120	SG-1303-08-14” (105-D)	108-D Inlet (Bottom)	08	04	
3	SG-1303-08-10”	10”	120	SG-1303.08-14” (105-D)	108-D Inlet (Top North)	06	03	
4	SG-1303-12-10”	10”	120	SG-1303.08-14” (105-D)	108-D Inlet (Top South)	06	03	
5	SG-1303-10-14”	14”	120	108-D	107-C	12	05	
6	SG-1303-11-14”	14”	140	107-C	123-C	12	05	
7	SG-1303-02-14”	14”	100	121-C	137-C	10	01	
8	SG-1303-06-14”	14”	100	121-C	137-C	04	00	
09	SG-1303-04-8”	8”	100	137-C	SG-51-8	04	00	
10	SG-1303-08-14”	14”	100	121-C	124-C	06	01	
11	NG-09-12”	12”	100	Mixed feed coil	101-B	03	00	
12	NG-11-A-6	6”	120	NG-9-12	101-B	01	00	
13	NG-11-A-6	6”	80 S	NG-9-12	101-B	01	00	
14	NG-11-H-6	6”	120	NG-9-12	101-B	01	00	
13	NG-11-H-6	6”	80 S	NG-9-12	101-B	01	00	
14	SG-62 A/B-4	4”	xx	102-B	SG-32	02	00	

Annexure – 7

THICKNESS MEASUREMENT SUMMARY OF EQUIPMENT

Sl. No	Equipt No.	Equipment Description	Shell			Dish End			Channel		
			Nom./ Design	Min. Measured	% Red.	Nom./ Design	Min. Measured	% Red	Nom./ Design	Min. Measured	% Red.
1	2002-F	D.M. Water Storage Tank	4.80	4.35	9.37	4.80	4.85 (Roof)	-			
2	AF-03	After Filter of Air Drier	8.00	8.59	-	8.00	7.48	6.50			
3	PF-02	Pre Filter of Air Drier	8.00	8.44	-	8.00	7.90	1.25			
4	MS-01	Moisture Separator	8.00	8.57	-	8.00	7.88 (Top) 7.86 (Bottom)	1.75			
5	AFT	After Filter for AD-A/B	5.00	5.05	-	5.00	4.48	10.40			
6	PFT	Pre Filter for AD-A/B	5.00	4.48	10.40	5.00	4.34	13.20			
7	182-F	Natural Gas Compressor Additional Discharge Separator	35.00	36.9	-	35.0	35.21 (Top), 35.72 (Bottom)	-			
8	Separator (Phase-II)(PGR)		10.00	10.38	-	8.00	9.85 (Top), 10.36 (Bottom)	-			
9	103J/JA L.O. Cooler		8.00	7.85	1.87	8.00	7.28	9.00	8.00	7.99	-
10	103J/JB L.O. Cooler		8.00	8.05	-	8.00	6.96	13.00	8.00	7.95	-

THICKNESS MEASUREMENT SUMMARY OF HT & LT COILS.

SR NO	DESCRIPTION	DESIGN THICKNESS	MEASURED THICKNESS	% REDUCTION
1	HT STEAM SUPER HEATER COIL(HT Convection, 3rd from bottom)	8.0	7.00	12.50
2	AIR-PREHEATER COIL(HT Convection, 2nd from bottom)	6.55	6.20	5.34
3	MIXED FEED COIL(HT Convection, bottom most)	8.0	11.50	-

ANNEXURE- 8

AMMONIA PLANT PIPELINE THICKNESS MEASUREMENT SUMMARY

SR. NO.	LINE NO.	N.B. (in.)	SCH.	NOM. THK. (mm)	MAT.	LINE DESCRIPTION		Minimum Thickness Observed (mm)	% RED.
						FROM	TO		
1	A-20	10	20	6.35	C.S.	101 J	101 B	5.8	8.66
2	A-21	10	60	12.7	P-11	101 B	103 D	12.8	-
3	BO-4	1	80	4.55	CS	BO-6H	BO-14	4.5	16.60
4	BO-06	1	80	4.5	CS	BO-12H	BO-11	4.6	-
5	BO-1304.01	3	160	11.13	CS	142- CB	107- C	11	1.17
6	BO-14BH	2	160	9.53	CS	AUX.BOILER COIL-A	BLOW DOWN BO-7	10.6	-
7	BW-01H	14	100	23.8	CS	101-CA	BW-40HA,HB	26.3	-
8	BW-03H	12	100	21.44	CS	102-C	101-F	19.1	10.91
9	BW-04H	10	100	18.24	CS	101-F	102-C	17.1	6.25
10	BW-05H	14	100	23.8	CS	101-CB	BW-43 HA,HB	28.2	-
11	BW-06H	18	100	29.36	CS	101-F	101-CB	29.3	0.20
12	BW-07H	10	100	18.26	CS	BW-8H	101-F	17.3	5.26
13	BW-08H	12	100	21.44	CS	HEADER	103-C	20.9	2.52
14	BW-09H	8	100	15.06	CS	103-C	BW-8H	15	0.40
15	BW-10H	8	100	15.06	CS	103-C	BW-8H	15	0.40
16	BW-11H	8	100	15.06	CS	BW-14H	103-C	15.5	-
17	BW-12H	8	100	15.06	CS	BW-14H	103-C	15	0.40
18	BW-14H	10	100	18.24	CS	HEADER	103-C	17.2	5.70
19	BW-21H	18	100	29.36	CS	101-F	101-CA	29.1	0.89
20	BW-22H	12	100	21.41	CS	COIL-A 101-B	101-F	20.9	2.38
21	BW-23H	12	100	21.41	CS	COIL-B 101-B	101-F	20.6	3.78
22	BW-24H	12	100	21.41	CS	COIL-D 101-B	101-F	20.5	4.25
23	BW-25H	12	100	21.41	CS	COIL-E 101-B	101-F	20.8	2.85
24	BW-28H	12	100	21.41	CS	COIL-C 101-B	101-E	20.5	4.25
25	BW-30H	12	100	21.44	CS	101-F	COIL-E 101 B	20.3	5.32
26	BW-31H	10	100	18.26	CS	101-F	COIL-D 101 B	20.8	-
27	BW-32H	12	100	21.41	CS	101-F	COIL-C 101 B	21.9	-
28	BW-35H	14	100	23.83	CS	101-CA	BW-41 HA,HB	24	-
29	BW-36H	14	100	23.83	CS	101-CB	BW-45 HA,HB	23	3.48
30	BW-40HA	12	100	21.41	CS	BW-1H	101-F	22.9	-

SR. NO.	LINE NO.	N.B. (in.)	SCH.	NOM. THK. (mm)	MAT.	LINE DESCRIPTION FROM	TO	Minimum Thickness Observed (mm)	% RED.
31	BW-40HB	12	100	21.41	CS	BW-1H	101-F	23	-
32	BW-41HA	12	100	21.41	CS	BW-35H	101-F	22	-
33	BW-41HB	12	100	21.41	CS	BW-35H	101-F	21.3	0.51
34	BW-43HA	12	100	21.44	CS	BW-5H	101-F	23.1	-
35	BW-43HB	12	100	21.44	CS	BW-5H	101-F	23	-
36	BW-45HA	12	100	21.44	CS	BW-36H	101-F	21.3	0.65
37	BW-45HB	12	100	21.44	CS	BW-36H	101-F	21.7	-
38	CO-02A	18	30	11.13	CS	CO-17	110-CA	12.3	-
39	CO-02B	18	30	11.13	CS	CO-16	110-CB	12.9	-
40	CO-03A	18	30	11.13	CS	CO-17	110-CA	12.1	-
41	CO-03B	18	30	11.13	CS	CO-16	110-CB	12.8	-
42	CO-06A	18	10	4.78	SS304	110-CA	CO-7	5.1	-
43	CO-06B	18	10	4.78	SS304	110-CB	CO-7	5.3	-
44	CO-11	16	30	9.53	CS	CO-8	CO-12	13.8	-
45	CW-06	36	0.313	7.93	CS	CW-5	127-C	8	-
46	CW-06	36	0.313	7.93	CS	CW-5	127-C	7.7	2.90
47	CW-07	36	0.313	7.93	CS	CW-5	127-C	6.2	21.82
48	CW-48	6	40	7.11	CS	CW-5	173-C	5.6	21.24
49	DM-8	6	10S	3.4	SS304	2002-F	2004-J	3	11.76
50	DM-8A	6	10S	3.4	SS304	DM-8	2004-JA	2.8	17.65
51	DM-9	4	10S	3.05	SS304	2004-J	DM-2	3.5	-
52	DM-9A	4	10S	3.05	SS304	2004-JA	DM-2	3.3	-
53	HS-1304-02	8	60	10.31	CS	107- C	101- B	9.5	7.86
54	HW-12	10	30	7.8	CS	128-C	HW-41	5.6	28.21
55	HW-22	16	20	7.92	CS	108-C	HW-20	6.6	16.67
56	HW-25	10	30	6.35	CS	124-C	HW-5	5.3	16.54
57	HW-34	6	40	7.11	CS	130-JC	HW-15	5.1	28.27
58	aMDEA-01	12	30	8.38	SS-304	101-E	aMDEA-4B	9.5	-
59	aMDEA-2	4	40	6.02	SS-304	aMDEA-01	101-L	6.2	-
60	aMDEA-2	3	40	5.49	SS-305	aMDEA-02	101-L	5.9	-
61	aMDEA-3	4	40	6.02	SS-304	101-E	109C2A/C2B	5.4	10.30
62	aMDEA-06A	10	40S	9.27	SS	109-C1A	aMDEA-61	9.5	-
63	aMDEA-06A	8	40S	8.18	SS	109-C1A	aMDEA-61	8.7	-
64	aMDEA-06B	10	40S	9.27	SS	109-C1B	aMDEA-61	9.2	0.76
65	aMDEA-06B	8	40S	8.18	SS	109C1B/ C2B	MDEA- 7	8.5	-

SR. NO.	LINE NO.	N.B. (in.)	SCH.	NOM. THK. (mm)	MAT.	LINE DESCRIPTION FROM	TO	Minimum Thickness Observed (mm)	% RED.
66	aMDEA-07	12	40S	9.27	SS	aMDEA-61	aMdEA-09A 09B	9	2.91
67	aMDEA-16B	12	20	6.35	CS	108C2B	aMDEA-62	6.7	-
68	aMDEA-17	16	20	7.92	CS	aMDEA-62	aMDEA-41	7.3	7.83
69	aMDEA-24A	3	40	5.5	CS	108-J	aMDEA-25	4.8	12.73
70	aMDEA-24B	3	40	5.5	CS	108-JA	aMDEA-25	5.2	5.45
71	aMDEA-62	16	20	7.92	CS	HEADER	aMDEA-17	7.2	9.09
72	MDEA-1202.01	18	XS	12.7	CS	101- EA	MDEA-1202.02	11.1	12.60
73	MDEA-1202.02	18	XS	12.7	CS	MDEA-1202.01	115- HT	11.3	11.02
74	MDEA-1202.02	18	10S	4.78	SS	115- JT	103-E1	6.7	-
75	MDEA-1202.02	18	40S	12.7	SS	115- JT	103-E1	11.1	12.60
76	MDEA-1203.02	18	10S	4.78	SS	HV-435 (MDEA-1202.03-14")	103-E1/ E2	5.9	-
77	MDEA-1209.01	24	40	17.48	CS	103-E2LP (MDEA-1209-01-24”)	115- JA	18.4	-
78	MDEA-1209.02	24	STD	9.53	CS	103-E2LP (MDEA-1209-01-24”)	115- JA	9.9	-
79	MDEA-1209.03	24	40	17.48	CS	103-E2LP (MDEA-1209-01-24”)	115- JB	18.9	-
80	MDEA-1209.03	24	STD	9.53	CS	103-E2LP (MDEA-1209-01-24”)	115- JB	9.7	-
81	MDEA-1209.07	12	10 S	4.57	SS	103-E2LP (MDEA-1209-01-24”)	116- JB	6.4	-
82	MDEA-1209.08	12	10 S	4.57	SS	103-E2LP (MDEA-1209-01-24”)	116- JA	6	-
83	MS-01	8	30	7.04	CS	MS-2	HEADER	7.3	-
84	MS-02	12	30	8.38	CS	HEADER	MS-1	9.8	-
85	MS-06	6	40	7.11	CS	MS-1	107-JT	7.6	-
86	MS-28	3	40	5.5	CS	MS-2	FG-3	5.1	7.27
87	MS-56	2	80	5.54	CS	MS-2	SPEC. BRK.	5	9.75
88	NG-06A	8	20	8.18	CS	NG-4	150-C	7.4	9.54
89	PG-14	16	40	12.7	CS	106-C	102-F	11.1	12.60
90	PG-26	18	30	11.13	SS-304	HEADER		10.2	8.36

SR. NO.	LINE NO.	N.B. (in.)	SCH.	NOM. THK. (mm)	MAT.	LINE DESCRIPTION FROM	TO	Minimum Thickness Observed (mm)	% RED.
91	PG-1212. 01	14	10	6.35	CS	101- EA	136- C	6	5.51
92	PW-02	2	40/S	3.91	SS	SPEC.BRK.	PW-12	3.3	15.60
93	PW-02	2	40/S	3.91	SS	PW-3	LC-3	3.5	10.49
94	PW-13	6	80	10.97	CS	PW-12	SEWER	7.2	34.37
95	PW-17	4	120	11.13	CS	PW-1	170-C	11	1.17
96	PW-17	4	40	6.02	SS304	PW-1	170-C	6.2	-
97	PW-17	4	120	11.13	CS	LC-3A	104-E	11	1.17
98	PW-19	2	10S	2.77	SS	LC-3A	104-E	2.8	-
99	PW-20	6	80	10.97	CS	104-E	170-J	10.5	4.28
100	PW-20A	6	80	10.97	CS	PW-20	170 JA	8.2	25.25
101	PW-24	4	120	11.13	CS	173-C	CONTROL VALVE	10.4	6.56
102	PW-27	6	80	10.97	CS	PW-20	PW-28	10.2	7.02
103	PW-29	10	60	12.7	CS	171-C	PW-30	13	-
104	PW-29A	10	60	12.7	CS	171-C	PW-30	12.1	4.72
105	PW-31	12	40	10.31	CS	PW-30	104-E	14.2	-
106	SC-07	2.5	80	7.01	CS	SC-42	101-JC	4.5	35.60
107	SC-42	4	40	6.02	CS	CV-A	LC-2	4.5	25.25
108	SC-47	10	40	9.27	CS	101-JC	112-J	6	35.28
109	SC-47A	10	40	9.27	CS	101-JC	112-JA	6.1	34.20
110	SC-47B	10	40	9.27	CS	101-JC	112-JB	8.1	12.62
111	SG-1303-08	14	120	27.79	P 22	105- D	SG- 33	27.3	1.76
112	SG-1303-08	10	120	21.44	P 22	SG- 1303. 08	108- D INLET (Top North)	24.1	-
113	SG-1303-09	10	120	21.44	P 22	105- D	SG-1303- 08, 14"	21	2.05
114	SG-1303-10	14	120	27.79	P 22	108- D	107- C	25.1	9.68
115	SG-1303-11	14	140	31.75	P 11	107- C	123- C	27.9	12.13
116	SG-1303-12	14	120	21.44	P 22	SG-1303-08-14"	108- D INLET (Top South)	21	2.05
117	V-92	6	40	7.11	CS	101-D/102-D INLET	VENT (SP-73)(PRC-1)	5.3	25.46
118	WA-01	30	6.35	6.35	CS	101-JCA	WB-3	5.9	7.09
119	WA-34	6	40	7.11	CS	WA-23	WA-37 & WA-38	6.4	9.99
120	WA-37	4	40	6.02	CS	WA-34	105-J LO CON	6	0.33
121	WA-38	4	40	6.02	CS	WA-34	105-J LO CON	6	0.33

SR. NO.	LINE NO.	N.B. (in.)	SCH.	NOM. THK. (mm)	MAT.	LINE DESCRIPTION FROM	TO	Minimum Thickness Observed (mm)	% RED.
122	SG-42	4	80	8.56	CS	FIC-8	SG-11-10”	8.8	-
123	SG-42	4	80	8.56	CS	SG-12-12”	FIC-8	7.8	8.88
124	V-7	12	40	9.53	CS	(PIC-5) V-6-6”	V-7(SP-73), V-8-12”	8.38	12.07
125	V-6	6	40	7.11	CS	PG-18-12” (104-C)	PIC-5 (V-7-12”)	7.3	-
126	S-41	8	20	6.35	CS	11 ATA, (S-5-6”)	3.5 ATA (LS-113-6”)	8.7	-
127	S-41	6	40	7.11	CS	11 ATA, (S-5-6”)	3.5 ATA (LS-113-6”)	7.1	0.14
128	MS-34	6	40	7.11	CS	38 ATA (MS-2-12”)	11 ATA (S-7-6”- PIC-14)	6.7	5.77
129	MS-34	4	40	6.02	CS	38 ATA (MS-2-12”)	11 ATA (S-7-6”- PIC-14)	5.9	1.99
130	V-92	6	40	7.11	CS	101/102-D INLET,(NG-1-6”)	VENT (SP-73)	5.3	25.46
131	V-29	10	20	6.35	CS	V-27-6” (PRC-6)	V-29 (SP-75)	6.1	3.93
132	V-27	6	40	7.11	CS	PG-15-14”	PRC-6	6.3	11.39
133	V-34	10	40	6.25	CS	PG-10-8”	VENT	8.5	-
134	V-34	2	40	3.91	CS	PG-10-8”	VENT	3.6	-
135	A-28	4	80	8.56	CS	A-20-10”	A-21-10”	6.1	-
136	S-11	6	40	7.11	CS	S-5-6”	104D(LTS)	6.3	-
137	MS-37	3	40	5.49	CS	MS-28-3”	103D(LTS)	5.7	-
138	LS-27	3	40	5.49	CS	LS-34-12”	101B	5.4	-
139	RV-3	4	40	6.02	CS	A-20-10”	RV-102A	5.6	6.98
140	BO-17	1	80	4.55	CS	101CA	BO-20-1”	3.8	16.48
141	BO-20	1	80	4.55	CS	101CB	BO-17-1”	3.8	16.48
142	S-13	4	40	6.02	CS	S-10-4”	NG-4,5-6”	4.8	-
143	DR-24	3	40	5.49	CS	101-U	DR-8-8”	5.3	3.4
144	IA-11	1.5	80	5.08	CS	141-F	IA-7-1.5”	3.8	25
145	IA-7	1.5	80	5.08	CS	IA-11-1.5”	IA-1-1.5”	3.9	23
146	IA-1	1.5	80	5.08	CS	IA-7-1.5”	142F (2005L)	3.9	23
147	LS-78	3	40	5.49	CS	LS-75-4”	150-C	4.8	12.5
148	TG-03	4	40	6.02	CS	K-1	R-1	7.3	-
149	TG-04	4	40	6.02	CS	K-1	R-2	7.3	-
150	AG-164-01-B24	8	20	6.35	CS	VS-203(AG VALVE U/S & D/S LINE	101-B	6.2	2.36

SR. NO.	LINE NO.	N.B. (in.)	SCH.	NOM. THK. (mm)	MAT.	LINE DESCRIPTION FROM	TO	Minimum Thickness Observed (mm)	% RED.
151	SG-1303-01	14	100	23.83	CS	120-C	SG-35-12"	23.1	3.06
152	SG-1303-02	14	100	23.83	CS	121-C	SG1303-03(121-C)	22.1	7.26
153	SG-1303-03	8	100	15.09	CS	SG-1303-02-14"(121-C)	137-C	14.4	4.57
154	SG-1303-04	8	100	15.09	CS	137-C	SG-51-8"	14.1	6.56
155	SG-1303-06	14	100	23.83	CS	121-C	124-C	24	-

Annexure-9

GAUSS MEASUREMENT & DEMAGNETIZATION REPORT

DESCRIPTION	POSITION	INITIAL (Gauss)	AFTER DEGAUSSING (Gauss)
101-BJT			
Journal Bearing Liner	East Side(CT side)	2.0	
	West Side(Silo side)	1.2	
Shaft Journal	East Side	2.3	1.2
	West Side	2.0	1.5
101-BJR (High Speed Drive Pinion)			
Journal Bearing	East Side	1.2	
	West Side	0.7	
Shaft Journal	East Side	2.3	
	West Side	2.5	
101-BJR(Low Speed Driven Gear)			
Journal Bearing Liner	East Side	1.5	
	West Side	1.3	
Shaft Journal	East Side	2.2	
	West Side	2.5	
101-BJ			
Journal Bearing Liner	East Side	1.7	
	West Side	1.7	
Shaft Journal	East Side	2.3	
	West Side	0.9	
101-JT			
Journal Bearing Pad	Thrust End	0.7	
	Non Thrust End	1.5	
Journal Bearing Base ring	Thrust End	1.2	
	Non Thrust End	1.8	
Thrust Bearing Pads	Active	2.0	
	Inactive	1.2	
Thrust Bearing Base ring	Active	2.5	
	Inactive	1.1	
Shaft Journal	Thrust End	2.5	
	Non Thrust End	2.2	
101-JLP			
Journal Bearing Pads	Thrust End	1.9	
	Non Thrust End	1.6	
Journal Bearing Base ring	Thrust End	1.8	
	Non Thrust End	1.6	
Thrust Bearing Pads	Active	1.8	
	Inactive	1.2	
Thrust Bearing Base ring	Active	2.8	
	Inactive	2.4	
Shaft Journal	Thrust End	2.5	
	Non Thrust End	1.9	

DESCRIPTION	POSITION	INITIAL (Gauss)	AFTER DEGAUSSING (Gauss)
101-JR			
Gear Journal Bearing	North side	1.5	
	South Side	1.4	
Pinion Journal Bearing	North side	1.4	
	South Side	1.3	
Thrust Bearing	Active	1.4	
	Inactive	1.5	
Shaft Journal	Thrust End	2.1	
	Non Thrust End	2.4	
101-JHP			
Journal Bearing Pads	Thrust End	1.6	
	Non Thrust End	1.2	
Journal Bearing Base ring	Thrust End	1.4	
	Non Thrust End	1.2	
Thrust Bearing Pads	Active	1.5	
	Inactive	1.2	
Thrust Bearing Base ring	Active	1.6	
	Inactive	1.5	
Shaft Journal	Thrust End	2.8	
	Non Thrust End	2.5	
104-JT			
Journal Bearing Sleeve	Thrust End	0.6	
	Non Thrust End	0.6	
Thrust Bearing Pads	Active	1.2	
	Inactive	0.8	
Thrust Bearing Base ring	Active	1.8	
	Inactive	1.9	
Shaft Journal	Thrust End	0.9	
	Non Thrust End	0.9	
104-J			
Journal Bearing Sleeve	Thrust End	0.5	
	Non Thrust End	0.9	
Thrust Bearing Pads	Active	0.9	
	Inactive	0.6	
Thrust Bearing Base ring	Active	0.6	
	Inactive	0.5	
Shaft Journal	Thrust End	0.9	
	Non Thrust End	0.6	
107-JT			
Journal Bearing Governor End	Top Half	3.0	
	Bottom Half	2.0	
	Shaft	2.3	
Journal Bearing Coupling End	Top Half	3.0	
	Bottom Half	2.3	
	Shaft	2.5	
Thrust Bearing	Collar	1.6	
	Pads	2.3	

DESCRIPTION	POSITION	INITIAL (Gauss)	AFTER DEGAUSSING (Gauss)
107-JAT			
Journal Bearing Governor End	Top Half	1.2	
	Bottom Half	1.6	
	Shaft	1.9	
Journal Bearing Coupling End	Top Half	1.6	
	Bottom Half	1.8	
	Shaft	1.8	
Thrust Bearing	Collar	2.2	
	pads	2.2	
Shaft Journal	Thrust End	1.8	
	Non Thrust End	1.6	
115-JBT			
Journal Bearing Liner	Thrust End	1.7	
	Non Thrust End	1.2	
Shaft Journal	Thrust End	2.3	
	Non Thrust End	3.0	
Thrust Collar	Active	1.4	
	Inactive	1.4	
Thrust Bearing Pads	Active	3.2	1.1
	Inactive	1.8	
115-JB			
Journal bearing sleeve	Thrust End	1.8	
	Non Thrust End	1.8	
Shaft Journal	Thrust End	0.7	
	Non Thrust End	0.1	
Thrust Bearing Pads	Active	1.8	
	Inactive	0.9	
115-HT(Hydraulic Turbine)			
Shaft Journal	Thrust End	0.9	
	Non Thrust End	1.0	
Journal Bearing	Thrust End	2.3	
	Non Thrust End	1.7	
Thrust Collar	Active	2.3	
	Inactive	2.0	
Thrust Bearing Pads	Active	1.0	
	Inactive	1.3	
115-JAR (Gear Box)			
Gear,Journal Bearing	North End (DE)	2.3	
	South End (NDE)	2.0	
Pinion Journal Bearing	North End (DE)	2.3	
	South End (NDE)	1.2	
Thrust bearing	Active	3.0	
115-JA (Pump)			
Journal bearing sleeve	Thrust End	2.4	
	Non Thrust End	1.8	
Thrust Pads	Active	2.0	
	Inactive	2.5	
Thrust Bearing Base ring	Active	2.3	
	Inactive	2.2	

DESCRIPTION	POSITION	INITIAL (Gauss)	AFTER DEGAUSSING (Gauss)
115-JAT			
Journal Bearing Liner	Thrust End	2.0	
	Non Thrust End	2.0	
Shaft Journal	Thrust End	2.3	
	Non Thrust End	2.7	
Thrust Collar	Active	1.8	
	Inactive	1.8	
Thrust Bearing Pads	Active	1.6	
	Inactive	2.0	
103-JLP			
Journal Bearing sleeve	Thrust End	1.4	
	Non Thrust End	1.1	
Shaft Journal	Thrust End	2.2	
	Non Thrust End	1.6	
103-JHP			
Journal Bearing sleeve	Thrust End	0.9	
	Non Thrust End	0.9	
Shaft Journal	Thrust End	2.2	
	Non Thrust End	2.4	
103-JAT			
Journal Bearing Sleeve	Thrust End	1.7	
	Non Thrust End	2.3	
Thrust Bearing Pads	Active	1.7	
	Inactive	1.5	
Thrust Bearing Base ring	Active	1.5	
	Inactive	1.6	
Shaft Journal	Thrust End	3.0	
	Non Thrust End	1.2	
103-JBT			
Journal Bearing Sleeve	Thrust End	1.2	
	Non Thrust End	2.3	
Thrust Bearing Pads	Active	23	
	Inactive	1.2	
Thrust Bearing Base ring	Active	0.9	
	Inactive	1.6	
Shaft Journal	Thrust End	1.3	
	Non Thrust End	2.5	
105-JT			
Journal Bearing Pad	Thrust End	1.1	
	Non Thrust End	0.7	
Journal Bearing Base ring	Thrust End	1.3	
	Non Thrust End	1.9	
Thrust Bearing Pads	Active	1.1	
	Inactive	0.3	
Thrust Bearing Base ring	Active	1.7	
	Inactive	1.6	
Shaft Journal	Thrust End	1.3	
	Non Thrust End	1.3	

DESCRIPTION	POSITION	INITIAL (Gauss)	AFTER DEGAUSSING (Gauss)
105-JLP			
Thrust Bearing Pads	Active	0.6	
	Inactive	0.7	
105-JR			
Gear Journal Bearing	North side	1.2	
	South Side	1.2	
Pinion Journal Bearing	North side	0.7	
	South Side	0.7	
Shaft Journal	Thrust End	1.6	
	Non Thrust End	1.7	
105-JHP			
Thrust Bearing Pads	Active	0.6	
	Inactive	1.2	
Thrust Bearing Base ring	Active	0.7	
	Inactive	0.8	
116-JAT			
Journal Bearing Sleeve	Thrust End	0.9	
	Non Thrust End	1.4	
Shaft Journal	Thrust End	1.3	
	Non Thrust End	1.3	

ANNEXURE-10

DETAILS OF INSITU-METALLOGRAPHIC INSPECTION

SR. NO.	LOCATION	MOC	MICROSTRUCTURE OBSERVATION	REMARKS
1	Location: 3 (Parent Metal) PIC 13B inlet spool piece	Carbon Steel	Microstructure shows fine-grained ferrite and pearlite structure.	No significant degradation observed. Monitor after 2 years of service.
2	Location: 4 (Weld/HAZ) On weld bet^{n}. flange & Bend of gas inlet nozzle.PG-6 –18 towards East side of 103-C	P 11	Microstructure at weld metal shows ferrite and carbides in dendritic form. Coarse ferrite is observed in the weld region, Whereas at HAZ microstructure shows coarse-grained essentially ferrite structure. Parent metal shows fine-grained essentially ferrite and spherodization of pearlite is observed at grain boundaries.	IInd stage of creep degradations. Monitor after 2 year of service.
3	Location: 5 (Weld/HAZ) On Weld Between BW outlet Nozzle BW-11H-8'' & 103-C Shell at bottom towards East side	P-11	Microstructure at weld metal shows ferrite and carbides in dendritic form. Whereas at HAZ microstructure shows fine and coarse grained ferrite/pearlite structure. Parent metal shows fine grained ferrite and pearlite structure. Initial stage of in-situ spheroidization of pearlite is observed at grain boundaries.	IInd stage of creep degradations. Monitor after 2 year of service.
4	Location: 6 (Weld/HAZ) On Weld Between BFW outlet Nozzle BW-9H-8'' & 103-C Shell at top towards East side	Carbon Steel	Microstructure at weld metal shows ferrite and carbides in dendritic form. Whereas at HAZ microstructure shows fine and coarse grained ferrite/pearlite structure. Parent metal shows fine grained ferrite and pearlite structure. Initial stage of in-situ spheroidization of pearlite is observed at grain boundaries.	IInd stage of creep degradations Monitor after 2 year of service.
5	Location: 7 (Parent Metal) SG-1-12 On face of 1st bend of gas intlet line	P-11	Microstructure shows fine-grained ferrite and pearlite/bainite structure. Ferrite observed at prior austenite grain boundaries. In-situ spheroidization of pearlite/bainite is observed.	IInd stage of creep degradations. Monitor after 2 year of service.
6	Location: 8 (Parent Metal) SG-1-12 On face of 3rd bend of gas intlet line	P-11	Microstructure shows fine-grained ferrite and pearlite/bainite structure. Ferrite observed at prior austenite grain boundaries. In-situ spheroidization of pearlite/bainite is observed.	IInd stage of creep degradations. Monitor after 2 year of service.
7	Location: 9 (Parent Metal) On face of 1st Bend of NG-9-12" (101B-mixed feed coil outlet to NG-11)	P 11	Microstructure shows essentially fine-grained ferrite and spheroidial carbide structure.Degradation of pearlite observed in terms of spherodization. Possibilities of isolated creep cavities are observed. Microstructure shows oriented creep cavities at the grain boundaries. Initiallevel of coalescence of cavities are observed.	Approaching 3rd stage of creep damage. Monitor after 1 year of service.

SR. NO.	LOCATION	MOC	MICROSTRUCTURE OBSERVATION	REMARKS
8	Location: 10 (Weld/HAZ) On weld bet^{n}. Pipe & Elbow (elbow side) of NG-9-12" (101B-mixed feed coil outlet to NG-11)	P 11	Microstructure at weld shows ferrite and bainite in dendritic form Whereas at HAZ shows fine-grained bainite and ferrite structure. Microstructure at parent metal shows essentially fine-grained ferrite and spheroid carbide structure. Degradation of bainite is observed. Possibilities of isolated creep cavities are observed.	IInd stage of creep degradations. Monitor after 1 year of service.
9	Location: 11 (Weld/HAZ) On weld bet^{n}. Pipe & Elbow (pipe side) of NG-9-12" (101B-mixed feed coil outlet to NG-11)	P 11	Microstructure at weld shows ferrite and bainite in dendritic form Whereas at HAZ shows fine-grained bainite and ferrite structure. Microstructure at parent metal shows essentially fine-grained ferrite and spheroid carbide structure. Degradation of bainite is observed. Possibilities of isolated creep cavities are observed.	Creep cavities are present. Approaching 3rd stage of creep damage. Monitor after 1 year of service.
10	Location: 12 (Weld / HAZ of P-11) On dissimilar Weld between pipe & Nozzle of header NG-9-12" (101B-mixed feed coil outlet to NG-11)	P 11 to 304H	Microstructure at parent metal (P11) shows essentially fine-grained ferrite and spheroid carbide structure. Degradation of bainite is observed, Whereas at HAZ microstructure shows fine and coarse-grained bainite and ferrite structure. Possibility of creep damage is observed at P11 side. Weld metal microstructure shows dendritic structure of ferrite pools in austenite matrix.	Creep cavities are present. Approaching 2rd stage of creep damage. Monitor after 2 year of service.
11	Location: 13 (Weld/HAZ) On dissimilar Weld Between pipe & Nozzle of Header NG-9-12" (101B-mixed feed coil outlet to NG-11)	304H to 304H	Parent metal & HAZ microstructure (SS 304H) shows fine & coarse-grained worked austenitic grain with twins. Second phase carbide precipitations observed at grain boundaries. Weld metal shows dendritic structure of ferrite pools in austenite matrix.	Monitor after 2 years of service.
12	Location: 14 (Weld/HAZ) On dissimilar weld between pipe- flange PG-12B-14" 105CB to PG-26-18 (106C)	304H to CS	(CS side) HAZ & Parent metal microstructure shows non-uniformly distributed fine-grained ferrite and pearlite structure. Ferrite observed at prior austenite grain boundaries. In-situ spherodization of pearlite is observed.Weld metal shows dendritic structure of ferrite pools in austenite matrix.	IInd stage of creep degradations. Monitor after 1 year of service.
13	Location: 15 (Weld/HAZ) SG-1303, 10-14 (H-36) On 108D converter outlet nozzle pipe	P-22	Weld microstructure shows ferrite and carbides in dendrite form. Whereas at HAZ microstructure shows fine & coarse-grained ferrite and bainite structure. Parent metal microstructure shows ferrite and bainite structure.	No significant degradation observed. Monitor after 2 years of service.

14	Location: 16 (Weld/HAZ) SG-1303, 10-14 (H-36) On 108D converter outlet nozzle	P-22	Weld microstructure shows ferrite and carbides in dendrite form. Whereas at HAZ microstructure shows fine & coarse-grained ferrite and bainite structure. Parent metal microstructure shows ferrite and bainite structure. Bainite is observed degrading in to carbides and ferrite. However prior bainite regions are maintained.	IInd stage of creep degradations. Monitor after 2 year of service.
15	Location: 17 (Parent metal) SG-1303 10-14 On 108-D outlet to 107C Gas inlet elbow-2	P-22	Microstructure shows fine-grained ferrite-bainite structure. Initial stage of degradations in terms of carbide formation at bainite regions are observed however prior bainite regions are maintained.	IInd stage of creep damage. Monitor after 2 year of service.
16	Location: 18 (Parent metal) SG-1303 10-14 On 108-D outlet to 107C Gas inlet elbow-3	P-22	Microstructure shows coarse-grained ferrite and bainite structure. Indications of creep cavities are observed at grain boundaries.	IInd stage of creep damage. Monitor after 2 year of service.
17	Location: 19 (Parent metal) SG-1303 10-14 On 108-D outlet to 107C Gas inlet elbow-4	P-22	Microstructure shows coarse-grained ferrite and bainite structure. Indications of creep cavities are observed at grain boundaries.	IInd stage of creep damage. Monitor after 2 year of service.
18	Location: 20 (Parent metal) SG-1303 10-14 On 108-D outlet to 107C Gas inlet elbow-5	P-22	Microstructure shows coarse-grained essentially ferritic structure with few bainite. Indications of creep cavities are observed at grain boundaries.	2^{nd} stage of creep. Monitor after 1 year of service.
19	Location: 21 (Weld/HAZ) SG-28-6" MICA-16 Upstream weld	Carbon steel	Microstructure at weld metal shows ferrite and carbides in dendritic form. Whereas at HAZ microstructure shows fine-grained ferrite and pearlite structure. Parent metal microstructure shows fine-grained non-uniformly distributed ferrite and pearlite structure. In-situ spheroidization of pearlite is observed.	Monitor after 1 year of service.
20	Location: 22 (Weld/HAZ) SG-26-6" MICA-14 Upstream weld	Carbon steel	Microstructure at weld metal shows ferrite and carbides in dendritic form. Whereas at HAZ microstructure shows fine-grained ferrite and pearlite structure. Parent metal microstructure shows fine-grained non-uniformly distributed ferrite and pearlite structure with presences of few widmanstatten ferrites.	Monitor after 1 year of service.
21	Location: 23 (Weld/HAZ) SG-27-6" MICA 13 Upstream weld	Carbon steel	Microstructure at weld metal shows ferrite and carbides in dendritic form. Whereas at HAZ microstructure shows fine-grained ferrite and pearlite structure. Parent metal microstructure shows fine-grained non-uniformly distributed ferrite and pearlite structure. In-situ spheroidization of pearlite is observed.	Monitor after 1 year of service.

SR. NO.	LOCATION	MOC	MICROSTRUCTURE OBSERVATION	REMARKS
22	Location: 24 (Weld/HAZ) SG-27-6" MICA-15 Upstream weld	Carbon steel	Microstructure at weld metal shows ferrite and carbides in dendritic form. Whereas at HAZ microstructure shows fine-grained ferrite and pearlite structure. Parent metal microstructure shows fine-grained non-uniformly distributed widmanstatten ferrite and pearlite structure.	Monitor after 1 year of service.
23	Location: 25 (Weld / HAZ) On weld between pipe NG-11H	P11-Elbow SS304 H- pipe	Microstructure at weld shows dendritic structure ferrite & carbides. Whereas at HAZ microstructure shows fine-grained ferrite and pearlite structure. Parent metal microstructure shows fine-grained ferrite and pearlite structure. In-situ spherodization of pearlite is observed. Possibilities of isolated creep cavities are observed.	Creep cavities are present. 2nd stage of creep. Monitor after 2 year of service.
24	Location: 26 (Weld / HAZ) On weld between pipe NG-11H	P-11	Microstructure at weld metal shows ferrite and carbides in dendritic form. Whereas at HAZ microstructure shows fine-grained essentially ferrite structure. Parent metal microstructure shows fine-grained essentially ferrite structure. Indications of creep cavities are observed at grain boundaries.	Monitor after 2 year of service.
25	Location: 27 (Weld / HAZ) On weld between pipe NG-11A	P11-Elbow SS304 H- pipe	Microstructure at weld metal shows ferrite and carbides in dendritic form. Whereas at HAZ microstructure shows fine-grained essentially ferrite structure. Parent metal microstructure shows fine-grained essentially ferrite structure. Indications of creep cavities are observed at grain boundaries.	Creep cavities are present. 2nd stage of creep. Monitor after 2 year of service.
26	Location: 28 (Weld / HAZ) On weld between pipe NG-11A	P-11	Microstructure at weld shows dendritic structure ferrite & carbides. Whereas at HAZ microstructure shows fine-grained ferrite and pearlite structure. Parent metal microstructure shows fine-grained essentially ferrite and bainite structure. In-situ spherodization of pearlite is observed. Indications of creep cavities are observed at grain boundaries.	Monitor after 2 year of service.
27	Location: 29 (Weld/HAZ) Riser No.-8, Riser to Weldolet Weld Joint	Tube-G-4852M Weldolet 800HT	Microstructure at weld shows ferrite pools in austenite matrix with carbides, whereas HAZ microstructure shows coarse-grained austenitic grains. Microstructure at parent metal shows fine & coarse-grained austenitic grain with twins. Presence of inter-granular cracks observed at HAZ region.	Inter-granular cracks are observed at HAZ region. **Needs attention.**

SR. NO.	LOCATION	MOC	MICROSTRUCTURE OBSERVATION	REMARKS
28	Location: 30 (Parent Metal) Riser No.-8, PM	G-4852M	Microstructure shows network of primary precipitates including carbides in a cast structure. The primary and secondary precipitate seems to have coarsened within the matrix.	No significant degradation observed. Monitor after 2 years of service.
29	Location: 31 (Weld/HAZ) Riser No.-7, Riser to Weldolet Weld Joint	Tube-G-4852M Weldolet 800HT	Microstructure at weld shows ferrite pools in austenite matrix with carbides, whereas HAZ microstructure shows coarse-grained austenitic grains. Microstructure at parent metal shows fine & coarse-grained austenitic grain with twins.	No significant degradation observed. Monitor after 2 years of service.
30	Location: 32 (Weld/HAZ) Riser No.-6, Riser to Weldolet Weld Joint	Tube-G-4852M Weldolet 800HT	Microstructure at weld shows ferrite pools in austenite matrix with carbides, whereas HAZ microstructure shows coarse-grained austenitic grains. Microstructure at parent metal shows fine & coarse-grained austenitic grain with twins. Presence of inter-granular cracks observed at HAZ region.	Inter-granular cracks are observed at HAZ region. **Needs attention.**
31	Location: 33 (Weld/HAZ) Riser No.-5, Riser to Weldolet Weld Joint	Tube-G-4852M Weldolet 800HT	Microstructure at weld shows ferrite pools in austenite matrix with carbides, whereas HAZ microstructure shows coarse-grained austenitic grains. Microstructure at parent metal shows fine & coarse-grained austenitic grain with twins. Presence of inter-granular cracks observed at HAZ region.	Inter-granular cracks are observed at HAZ region. **Needs attention.**
32	Location: 34 (Weld/HAZ) Riser No.-4, Riser to Weldolet Weld Joint	Tube-G-4852M Weldolet 800HT	Microstructure at weld shows ferrite pools in austenite matrix with carbides, whereas HAZ microstructure shows coarse-grained austenitic grains. Microstructure at parent metal shows fine & coarse-grained austenitic grain with twins. Presence of inter-granular cracks observed at HAZ region.	Inter-granular cracks are observed at HAZ region. **Needs attention.**
33	Location: 35 (Weld/HAZ) Riser No.-3, Riser to Weldolet Weld Joint	Tube-G-4852M Weldolet 800HT	Microstructure at weld shows ferrite pools in austenite matrix with carbides, whereas HAZ microstructure shows coarse-grained austenitic grains. Microstructure at parent metal shows fine & coarse-grained austenitic grain with twins. Presence of inter-granular cracks observed at HAZ region.	Inter-granular cracks are observed at HAZ region. **Needs attention.**

SR. NO.	LOCATION	MOC	MICROSTRUCTURE OBSERVATION	REMARK
34	Location: 36 (Weld/HAZ) Riser No.-2, Riser to Weldolet Weld Joint	Tube-G-4852M Weldolet 800HT	Microstructure at weld shows ferrite pools in austenite matrix with carbides, whereas HAZ microstructure shows coarse-grained austenitic grains. Microstructure at parent metal shows fine & coarse-grained austenitic grain with twins. Presence of inter-granular cracks observed at HAZ region.	Inter-granular cracks are observed at HAZ region. **Needs attention.**
35	Location: 37 (Weld/HAZ) Riser No.-1, Riser to Weldolet Weld Joint	Tube-G-4852M Weldolet 800HT	Microstructure at weld shows ferrite pools in austenite matrix with carbides, whereas HAZ microstructure shows coarse-grained austenitic grains. Microstructure at parent metal shows fine & coarse-grained austenitic grain with twins. Presence of inter-granular cracks observed at HAZ region.	Inter-granular cracks are observed at HAZ region. **Needs attention.**
36	Location: 38 (Parent Metal) Riser No.-7, On PM	G-4852M	Microstructure shows network of primary precipitates including carbides in a cast structure. The primary and secondary precipitate seems to have coarsened within the matrix.	No significant degradation observed. Monitor after 2 years of service.
37	Location: 39 (Weld/HAZ) Hot spot, Raw no.-6, Tube no.6 on parent metal	Tube-G-4852M Weldolet 800HT	Microstructure shows network of primary precipitates including carbides in a cast structure. The primary and secondary precipitate seems to have coarsened within the matrix.	No significant degradation observed. Monitor after 2 years of service.
38	Location: 40 (Weld/HAZ) Raw no.-6, Tube no.18, Tube to weldolet weld joint	Tube-G-4852M Weldolet 800HT	Microstructure at weld shows ferrite pools in austenite matrix with carbides, whereas HAZ microstructure shows coarse-grained austenitic grains. Microstructure at parent metal shows fine & coarse-grained austenitic grain with twins. Presence of inter-granular cracks observed at HAZ region.	Inter-granular cracks are observed at HAZ region. **Needs attention.**
39	Location: 41 (Weld/HAZ) Raw no.-7, Tube no.37, Tube to weldolet weld joint	Tube-G-4852M Weldolet 800HT	Microstructure at weld shows ferrite pools in austenite matrix with carbides, whereas HAZ microstructure shows coarse-grained austenitic grains. Microstructure at parent metal shows fine & coarse-grained austenitic grain with twins.	No significant degradation observed. Monitor after 2 years of service.
40	Location: 42 (Weld/HAZ) Raw no.-4, Tube no.32, Tube to weldolet weld joint	Tube-G-4852M Weldolet 800HT	Microstructure shows network of primary precipitates including carbides in a cast structure. The primary and secondary precipitate seems to have coarsened within the matrix.	No significant degradation observed. Monitor after 2 years of service.
41	Location: 43 (Weld/HAZ) Raw no.-1, Tube no.35, Tube to weldolet weld joint	Tube-G-4852M Weldolet 800HT	Microstructure at weld shows ferrite pools in austenite matrix with carbides, whereas HAZ microstructure shows coarse-grained austenitic grains. Microstructure at parent metal shows fine & coarse-grained austenitic grain with twins.	No significant degradation observed. Monitor after 2 years of service.

SR. NO.	LOCATION	MOC	MICROSTRUCTURE OBSERVATION	REMARK
42	Location: 44 (Weld/HAZ) Raw no.-3, Tube no.40, Tube to weldolet weld joint	Tube-G-4852M Weldolet 800HT	Microstructure at weld shows ferrite pools in austenite matrix with carbides, whereas HAZ microstructure shows coarse-grained austenitic grains. Microstructure at parent metal shows fine & coarse-grained austenitic grain with twins.	No significant degradation observed. Monitor after 2 years of service.
43	Location: 45 (Weld/HAZ) SG-1303, 09-10 (H-36) On 108D converter inlet nozzle	P-22	Weld microstructure shows ferrite and carbides in dendrite form. Microstructure at HAZ shows fine-grained ferrite & bainite structure. Whereas at parent metal microstructure shows fine-grained ferrite and bainite structure. In-situ spheroidization of bainite is observed.	IInd stage of creep degradations. Monitor after 1 year of service.
44	Location: 46 (Weld/HAZ) SG-1303, 09-10 (H-36) On 108D converter inlet nozzle of bend at bottom	P-22	Weld microstructure shows ferrite and carbides in dendrite form. Microstructure at HAZ shows fine-grained ferrite and bainite structure. Whereas at parent metal microstructure shows non-uniformly distributed fine-grained ferrite and bainite structure. In-situ spherodization of bainite is observed.	. IInd stage of creep degradations. Monitor after 1 year of service.
45	Location: 47 (Weld/HAZ) SG-1303 11-14 (H-34) On 107C Gas outlet nozzle & HAZ of pipe	P-11	Weld microstructure shows ferrite and carbides in dendrite form. Microstructure at HAZ shows fine-grained bainite and ferrite structure. Parent metal microstructure shows in situ spherodization of ferrite and pearlite/bainite structure. Indications of isolated creep cavities are observed.	IInd stage of creep degradations. Monitor after 1 year of service.
46	Location: 48 (Weld/HAZ) SG-1303 11-14 (H-34) On 107C Gas outlet nozzle	P-11	Microstructure at weld shows dendritic structure ferrite and carbides and bainite structure. Microstructure at HAZ shows fine & coarse-grained pearlite/bainite and ferrite structure. Parent metal microstructure shows fine-grained ferrite and pearlite/bainite structure. Ferrite observed at prior austenite grain boundaries.	IInd stage of creep degradations. Monitor after 1 year of service.
47	Location: 49 (Weld/PM) SG-1303 11-14 (H-34) On 123C Gas outlet inlet nozzle	P-11	Microstructure at weld shows dendritic structure ferrite/carbides and bainite structure. Parent metal microstructure shows fine-grained ferrite and pearlite/bainite structure. Ferrite observed at prior austenite grain boundaries.	IInd stage of creep degradations. Monitor after 1 year of service.

SR. NO.	LOCATION	MOC	MICROSTRUCTURE OBSERVATION	REMARK
48	Location: 50 (Weld/HAZ) SG-1303 11-14 (H-34) On 123C Gas intlet nozzle HAZ of bend	P-11	Microstructure at weld shows dendritic structure ferrite/carbides and bainite structure. Microstructure at HAZ shows fine & coarse-grained pearlite/bainite and ferrite structure. Parent metal microstructure shows fine-grained ferrite and pearlite/bainite structure. Ferrite observed at prior austenite grain boundaries.	IInd stage of creep degradations. Monitor after 1 year of service.
49	Location: 51 (Weld/HAZ) 102B SG-62A-4" line	P-5	Weld microstructure shows dendritic structure of fine tempered bainite/martensite structure, Whereas at HAZ shows fine tempered bainite structure. Parent metal microstructure shows fine tempered bainite with few ferrites. In-situ spherodization of bainite is observed.	IInd stage of creep degradations. Monitor after 1 year of service.
50	Location: 52 (Weld/HAZ) 102B SG-62B-4" line	P-5	Weld microstructure shows dendritic structure of fine tempered bainite / martensite structure, Whereas at HAZ microstructure shows fine & coarse-grained ferrite & bainite structure. Parent metal microstructure shows fine & coarse-grained essentially ferritic structure with few pearlite. In-situ spherodization of pearlite is observed. Indications of creep cavities are observed at grain boundaries.	IInd stage of creep degradations. Monitor after 1 year of service.
51	Location: 55 (Parent Metal) MIC-22 U/S spool piece	Carbon Steel	Microstructure shows fine-grained ferrite and pearlite structure.	No significant degradation observed. Monitor after 2 years of service.
52	Location: 56 (Parent Metal) Aux. Boiler (east side) Tube no.33 from south side	106 Gr.B	Microstructure shows fine-grained banded ferrite and pearlite structure. In situ spheroidization of pearlite is observed.	IInd stage of creep degradations. Monitor after 2 year of service.
53	Location: 57 (Parent Metal) Aux. Boiler (north side) Tube no.7 from east side	106 Gr.B	Microstructure shows fine-grained ferrite and pearlite structure. In situ spheroidization of pearlite is observed at grain boundaries.	IInd stage of creep degradations. Monitor after 2 year of service.
54	Location: 58 (Parent Metal) Aux. Boiler (west side) Tube no.21 from north side	106 Gr.B	Microstructure shows fine-grained banded ferrite and pearlite structure. In situ spheroidization of pearlite is observed.	IInd stage of creep degradations. Monitor after 2 year of service.

SR. NO.	LOCATION	MOC	MICROSTRUCTURE OBSERVATION	REMARK
55	Location: 61 (Sockolet Weld Metal) 3/4" Sockolet 108D Outlet	P22	Microstructure at weld shows dendritic structure of bainite and carbides. Microstructure at HAZ shows fine-grained tempered bainite structure. Parent metal microstructure shows fine tempered bainite with few ferrites.	No significant degradation Monitor after 2 years of service.
56	Location: 62 (Parent Metal) 3/4" Sockolet 108D Outlet	P-22	Microstructure shows fine-grained bainite structure.	No significant degradation observed. Monitor after 2 years of service.

Note: Location no. 29,32,33,34,35,36,37 and 40 are recommended by M/S TCR to repair during next opportunity. However, same shall be monitored during next turnaround in detail.

Annexure-11

NDT Activities carried out during replacement of Sockolets at Convertor Loop

Description	Line No. on which Sockolet was installed	D. P. test of parent metal (after removal of old sockolet)	D. P. test of Root & Final Weld	Hardness (BHN) before Stress Relieving		Hardness (BHN) after Stress Relieving		Remarks
				Weld	HAZ	Weld	HAZ	
PDI- 484 tapping Size: 3/4" N.B.	SG- 1303. 10- 14" (H 38) (108- D outlet line).	Fissures were observed, removed by grinding.	Found satisfactory	210 to 240	305 to 425	207 to 235	170 to 222	M.O.C. of sockolets P22
Drain Size:1" N.B.	SG- 1303. 10- 14" (H 38) (108- D outlet line).	Found satisfactory	Found satisfactory	217 to 241	140 to 175	146 to 190	135 to 160	
Drain Size:3/4"" N.B.	SG- 1303. 10- 14" (H 38) (107- C inlet line).	Found satisfactory	Found satisfactory	235 to 280	140 to 177	210 to 237	135 to 158	
Drain Size:1-1/2" N.B.	SG- 1303. 08- 10" (H 36) (108- D inlet line).	Found satisfactory	Found satisfactory	185 to 250	170 to 240	164 to 223	135 to 188	
PDI- 484 tapping Size:3/4" N.B.	SG- 1303. 08- 14" (H 36) (105- D outlet)	Fissures were observed, removed by grinding	Found satisfactory	190 to 234	144 to 210	174 to 206	114 to 182	
AP- 987 tapping Size:3/4" N.B.	SG- 1303. 08- 14" (H 36) (105- D outlet).	Fissures were observed, removed by grinding	Found satisfactory	195 to 251	139 to 198	166 to 207	123 to 177	

UREA PLANT

INSPECTION JOBS:

- Internal inspection of High-pressure vessels viz Autoclave (V-1201), H.P Stripper (H-1201/A), H.P Condenser (H-1202)
- Inspection of Autoclave liner weld repair job in Compartment no.5.
- Eddy Current Testing of H.P. Stripper (H-1201/A) tubes, H.P. Condenser(H-1202) tubes by M/s TesTex NDT India Pvt. Limited.
- Inspection of L.P. Carbamate Condenser (H-1205) tubes by M/S Escon by Internal Rotating Ultrasonic Inspection System (IRIS)
- Internal inspection of other vessels in the Plant.
- Ultrasonic thickness measurement of HP lines in the Plant. Detailed report is attached at **Annexure-1.**
- Ultrasonic thickness measurement of lines (recorded more than 20% reduction during 2010 Shutdown) other than H.P lines in the plant. Detailed report is attached at **Annexure-2.**
- Ultrasonic thickness measurement of Vents and Drains of selected H.P. lines. Detailed report is attached at **Annexure-3.**
- Dye Penetrant examination and radiography of weld joints of lines fabricated, erected and offered by Mech. Maint./Technical Department as per the requirement.
- Qualification tests of welders employed by contractors.
- Insitu-Metallography at selected spots on some equipment was carried out. Summary of observations and microstructure analysis is given at **Annexure-4**.
- The detailed observations and recommendations for corrective actions required on individual equipment are given below. All the observations were recorded during inspection and were handed over to concerned maintenance and operation group for necessary corrective action.

HIGH PRESSURE VESSELS:

High-pressure equipment of the Urea Plant was inspected. Main observations are listed below:

AUTOCLAVE (V-1201)

VISUAL INSPECTION

Thorough visual inspection of the liner, its welds, trays, internals and all the nozzles at bottom dish end including its inside surface wherever possible was carried out. Observations made on each compartments are mentioned below.

Compartment No.1 (Top Compartment)

- Minor Roughening /corrosion of dome liner was observed and grayish oxide layer was observed on dome and man way surface.
- Dark brown – grayish patches observed on East side of shell liner. Liner plate piece just below dome liner was found silver bright in colour.
- Overflow pipe funnel top piece longitudinal weld & its T-junction weld found eroded and have developed crevice. **Marked as D1 & D2 for repair.**
- Bulging on petal weld East side approx. in 3" length, same was observed during previous inspection.
- 02 nos. fasteners were found missing for tray segment just below funnel.

Compartment No.2

- Minor roughening of tray holding clits and grayish brown oxide layer was observed on bottom side of trays, same was observed during previous inspection.
- Bulging in shell liner in NE direction 300mm. below C-seam, same was observed during previous inspection.
- 11 nos. of tray holding 'J' bolts were found loose and 01 no. of bolt was found missing.
- Weld joints condition was found satisfactory
- 01 no. of tray holding clit was found to be blackish in colouration and having severe corrosion attack including its welds
- Due to corrosion / erosion of trays, cavities/gaps were observed between tray and its welding with annular plate

Compartment No.3

- Bulging of approx. 8mm depth and 2.5" width was observed behind tray skirt in SW to South direction, same was observed during previous inspection.
- One no. tray holding bolt was found missing.
- 04 nos. of tray holding clits were found black and found to have severe corrosion attack including its welding.
- 07 nos. of tray holding 'J' bolts were found loose and 01 no. of bolt was found missing.
- Due to corrosion / erosion of trays, cavities/gaps were observed between tray and it's welding with annular plate.

Compartment No.4

- Approx. 30 mm below circumferential weld a depression of approx. 100 mm dia. and 3 mm depth was observed at west side liner. Same was observed during last inspection also.
- Convex bulging of liner plate observed just above circumferential weld by approx. 4 mm height in complete circumference. Same was observed during last inspection also.
- Concave depression of approx 2-5 mm depth observed at approx. 200mm below the C-seam in approx. 80% of the periphery. Same was observed during last inspection also.
- Grayish and brownish oxide layer was observed on the bottom side of trays.
- 03 nos. of tray holding clits were found black and found to have sever corrosion attack including its welding.
- Concave depression of liner plate of approx 6 mm depth was observed at approx 160mm below C seam in North West direction in approx 100 mm area. Same was observed during last inspection also.
- Due to corrosion / erosion of trays, cavities/gaps were observed between tray and it's welding with annular plate.
- Crevice/corrosion cavities were observed on insert liner welding and **marked as D-3 for repair.**
- Few fasteners of tray segments were found loose.
- 06 nos. of tray holding 'J' bolts were found loose

Compartment No.5

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

Compartment No.6

- Convex bulging of liner plate was observed above the circumferential weld joint by approx. 3 to 10 mm height, which starts from north-west to south-east direction in approx. Length of 4500 mm. The same was observed during last inspection also.
- Concave depression of approx. 5 mm depth was observed at approx. One meter below C-seam from East to West side L-seam through North side of the shell. The same was observed during last inspection also.
- NW long seam above C seam found corroded and **marked as D4 for repair**.
- 06 nos. of tray holding 'J' bolts were found loose.
- Crevice/corrosion cavity was observed on N-W long seam, **marked as D-5 for repair.**
- Crevice/corrosion cavity were on C-weld seam of shell liner welding and **marked as D-6 for repair**

Compartment No.7

- 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.
- Concave bulging 1200mm below C seam and max. 5 mm. depth in approx. 60% periphery
- 04nos. of tray holding clits were found black and having severe corrosion attack including its welding.
- Minor erosion of the tray was observed**.**
- Few fasteners of tray segments were found loose
- All tray holding 'J' bolts were found satisfactory
- Crevice/corrosion cavities were observed on shell liner welding and **marked as D-7 and D-8 for repair**

Compartment No.8

- Concave bulging at the elevation of approx. 300 mm above tray and 3 to 6mm. deep from East to South & from NE to NW. The same was observed during last inspection also.
- 03 no. crevice/corrosion cavities on liner welding. **Marked as D-09,10 & D-11 for repair.**
- Few fasteners of tray segments was found loose
- 02 nos. of tray holding 'J' bolts were found loose and 01 no. of tray segment bolt was loose
- 05 nos. of tray holding clits were found to be blackish in coloration and having corrosion attack including its welding

Compartment No.9

- 01 no. of tray holding clit was found to be blackish in coloration and having severe corrosion attack including its welding
- Few fasteners of tray segments were found loose
- All tray holding 'J' bolts were found satisfactory
- 03 nos. of crevice/corrosion cavities were observed on liner welding and **Marked as D-12 to D-13 for repair**

Compartment No.10

- Concave depression of approx 7mm depth at approx 70mm below the C-seam in south side of shell in approx. 100 mm dia was observed. The same was observed during last inspection also.
- 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. The same was observed during last inspection also.
- Vertical bulging of approx. 2-3 mm height 25mm wide was observed from the C-seam to the bottom of the compartment in north side of the shell. The same was observed during last inspection also.
- Concave depression of about 5mm depth at approx 70mm below C seam in west side just adjacent to L seam was observed in 100 mm area. The same was observed during last inspection also.
- 100mm. dia & 4 mm. concave bulging was observed in NE direction approx. 25mm. above tray. The same was observed during last inspection also.
- 03 nos. of crevice/corrosion cavities were observed on liner welding and **Marked as D-14 to D-15 for repair.**
- All fasteners of tray segments were found satisfactory.
- All tray holding 'J' bolts were found satisfactory.
- 02 nos. of tray holding clits were found to be blackish in coloration and having severe corrosion attack including its welding.

Compartment No.11

- Just below circumferential weld concave depression of approx. 4 to 6 mm depth in approx. 80mm dia. in North-West direction was observed. The same was observed during last inspection also.
- concave depression of approx. 5mm and 9mm deep in approx. 100mm dia. was observed just below the C-seam in north and west side of the shell respectively. The same was observed during last inspection also.
- 10 to 12 mm gap was observed between tray and shell liner from East to South side. The same was observed during last inspection also.

- On new liner segment convex bulging up to max. 3 mm height having width approx. 10 mm observed just above circumferential stitch welds (approx. 125 mm long). Same was observed during last Inspection also.
- Concave depression of about 5-6 mm was observed just above and below of C-weld in old and new liner. The same was observed during last inspection also.
- All tray holding 'J' bolts were found satisfactory.
- Few fasteners of tray segments were found loose.
- Weld joints condition was found satisfactory

Compartment No.12 (Bottom Compartment.)

- South side tray skirt is touching the shell liner. The same was observed during last inspection also.
- Down comer nozzle with dish end liner fillet weld joint edges were observed exposed and found to have crevice cavities/undercut. The same was **marked for repair as D-16.**
- Dark brown coloration on dish end. The same was observed during last inspection also.
- 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. The same was observed during last inspection also.
- Underside corrosion of tray bottom face has been observed at the location of Tray Segment joint. Approx. depth 1-2mm. The same was observed during last inspection also.
- 3"NB Ammonia inlet nozzle was replaced during this shutdown as it was having fissures/cracks at its ID. DP check, Ferrite measurement and Pneumatic test at 0.18 kg/cm2 was carried out and found satisfactory. The procedure followed for air test of weld joint is attached at **Annexure-5**

NOTE

- **Total 16nos. repairs D-01 to D-16 counting from top to bottom compartment were marked.**
- **Repair / welding of Long seams and Circumferential seams in compartment no. 5 from top.**
- **Severe etching observed on Downcomer in almost all the compartment.**
- **Ferrite was also measured on liner & welds, found Nil.**
- **NE-North East, SW-South West, NW-North West, SE- South East**
- **L-Longitudinal Weld Seam, C-Circumferential Weld Seam.**
- **In general, few tray holding bolts and tray segment fasteners were found loose in all the compartments hence it may be checked**

REPAIR / WELDING JOB IN COMPARTMENT NO. 5

It was decided to carry out repair and re-welding of 02 nos. Longitudinal and only Circumferential weld seam in Compartment no. 5.

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

Steps for repair of the liner weld joints:

- Removal of existing weld crowning by grinding up to the surface of the liner.
- D.P. testing the flushed area and removal of any defect if observed.
- Welding by using 25-22-2 LMn filler wire dia. 2.4mm.
- Ferrite measurement was carried out in between welding job and found NIL.
- Final D.P. test.
- Clean and passivate the weld by washing with 10% HNO_3 and rinse with plenty of DM water.

DPT OF NOZZLES IN BOTTOM DISH END OF AUTOCLAVE

Dye penetrant testing of following nozzles was carried out in bottom dome of Autoclave and the observations are mentioned below:

- C1A/B 200NB Carbamate Inlet from H-1202 : 05 nos. corrosion cavities observed. Repaired, D.P. tested and found Satisfactory
- C3 80NB Ammonia Inlet Nozzle:

  The nozzle was replaced. Inspection was carried out as per procedure attached at Annexure-
- C4 200NB Urea/Carbamate to H-1201: 02 nos. crevice cavities/undercut observed. Repaired, D.P. tested and found satisfactory
- C5 100 NB Carbamate inlet from Scrubber: 02 nos. crevice cavities/undercut observed. Removed by grinding, D.P. tested and found satisfactory

THICKNESS MEASUREMENT

Main Liner Thickness				
Location	**Min. (mm)**	**Max. (mm)**	**Remarks (Mini.Thk. observed on)**	**Design/ Installed Thk.(mm)**
Compartment 1 (Top Compartment)	3.47	4.83	East side(Top)	5.00 (old)
Compartment 1 750 mm section BC.05 – replaced in 2002	6.64	6.93	West side(Top)	6.50 (new)
Compartment 2	3.20	4.64	East side(Top)	5.00
Compartment 3	3.51	4.71	East side(Top)	5.00
Compartment 4	3.64	4.64	North side(Top)	5.00
Compartment 5	4.39	5.08	North side(Top)	5.00
Compartment 6	4.38	4.77	East side(Top)	5.00
Compartment 7	4.39	4.88	North side(Top)	5.00
Compartment 8	4.32	4.88	South side (Top)	5.00
Compartment 9	4.48	4.82	South side (Top)	5.00
Compartment 10	4.61	4.77	South side (Top)	5.00
Compartment 11	4.37	4.70	West side(Top)	5.00
Compartment 12 (Bottom Compartment)	4.51	4.65	East side(Top)	5.00

Downcomer Thickness				
Location	**Min. (mm)**	**Max. (mm)**	**Remarks**	**Design/ Installed Thk.(mm)**
Compartment 2	6.70	7.00	The Complete Down-comer was replaced in S/D 1997.	10.00
Compartment 3	6.56	7.10		10.00
Compartment 4	6.69	7.07		10.00
Compartment 5	6.77	7.16		10.00
Compartment 6	7.07	7.25		10.00
Compartment 7	7.14	7.35		10.00
Compartment 8	7.37	7.50		10.00
Compartment 9	7.63	7.85		10.00
Compartment 10	7.93	8.06		10.00
Compartment 11	8.16	8.45		10.00

Tray Thickness measurement				
Location	**Min. (mm)**	**Max. (mm)**	**Remarks**	**Design/ Installed Thk.(mm)**
Compartment 1	3.72	4.93	The Trays were replaced in S/D 1997.	8.00
Compartment 2	4.20	4.88		8.00
Compartment 3	4.02	5.08		8.00
Compartment 4	4.67	5.18		8.00
Compartment 5	4.96	5.28		8.00
Compartment 6	5.22	5.96		8.00
Compartment 7	5.40	6.07		8.00
Compartment 8	5.70	6.64		8.00
Compartment 9	6.53	7.34		8.00
Compartment 10	6.78	7.57		8.00
Compartment 11	7.26	7.89		8.00

LOCATION	**MIN.**	**MAX.**		**DESIGN.**
Man way	6.77	6.99	Replaced 2002	6.5
Top dome	6.51	6.64	Replaced 2002	6.5
Bottom Dome	6.17	6.68	Replaced 1993	7.0
Reducer 10”x 8”	9.81	9.60	Replaced 1997	10.00
Distance Piece 8”	4.55	5.09	Replaced 2000	6.00
Nozzle Pipe 8”	4.48	4.63		6.00

OTHER AREAS:

INSERT LINER

Compartment Nos.	**Min. Thickness (MM)**	**Max. Thickness (MM)**	**Installed Thickness (MM)**	**Year of Replacement**
3	6.33	6.89	-	1997
4	6.25	6.37	-	1999
8	6.40	6.70	-	2000
9	6.67	6.87	-	2001
10	5.46	6.61	-	2002
11	6.48	6.62	-	2002

HP STRIPPER (H-1201/A)

VISUAL INSPECTION

TOP CHANNEL

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

BOTTOM CHANNEL

- The condition of sealing face was found satisfactory.
- The overlay welds in the man way were grey and slightly etched.
- The overlay welds in the hemi-head were grey and etched. Many patches of approx. 2”x2” size on the hemi-head overlay welds were found more etched than the surrounding area.
- The liner in the cylindrical section was found having scattered brownish grey coloration.
- 01 no. of cavity was observed on longitudinal weld seam of cylindrical liner just above CO_2 inlet line
- The tubes from inside were smooth.
- The liquid outlet pipe and the gas inlet pipe were bright, shiny and showed no defects. Their nozzles and welds were in satisfactory condition.
- The fasteners for CO_2 inlet line flanges were found loose.

BOTTOM COVER

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

THICKNESS MEASUREMENT

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

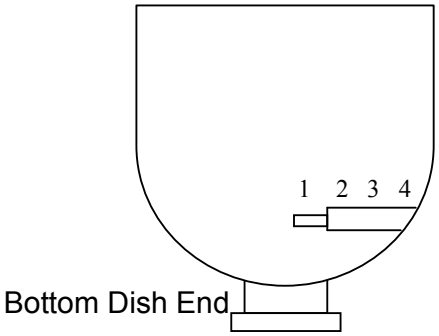
BOTTOM DOME

	Minimum Thickness (mm)	Maximum Thickness (mm	Design Thickness, mm (Minimum)
Man way (Overlay)	18.9	23.5	8.0
Dome area (Overlay)	12.5	14.32	8.0
Cylindrical area (Liner)	8.14	10.63	8.0
Tube sheet-Overlay weld	13.0 (Machined)	15.6 (Machined)	8.0
Bottom Cover (Overlay)	16.0	18.96	8.0

TOP DOME

	Minimum Thickness (mm)	Maximum Thickness (mm)	Design Thickness, mm (Minimum)
Man way (Overlay)	19.42	24.31	8.00
Dome area (Overlay)	11.8	13.88	8.00
Cylindrical area (Liner)-Gas phase	8.04	8.62	8.00
Cylindrical area (Liner)-Liquid phase	8.12	8.76	8.00
Tube sheet-Overlay weld	12.0 (Machined)	14.8 (Machined)	8.00

RADIOACTIVE SOURCE WELL



POINT NO.	DESIGN THK.	MEASURED THICKNESS			
		EAST	WEST	TOP	BOTTOM
1	7.5	8.46	8.23	8.57	8.27
2	19.0	18.52	18.29	18.64	18.58
3	19.0	18.75	18.36	18.89	18.58
4	19.0	18.72	18.38	18.77	18.46

All measurements are in mm.

FERRITE MEASUREMENT

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

EDDY CURRENT TESTING OF TUBES

Eddy current inspection of tubes was carried out by M/s TesTex NDT India Pvt. Ltd. on 2599 tubes of Urea stripper from top tube sheet end to 4.5 meters maximum. 01 tube was plugged before inspection. (Total no of tubes 2600).The Results are as under:

- Wall loss: 0.510 to 0.600 mm observed in 586 tubes
- Wall loss: 0.610 to 0.640 mm observed in 442 tubes
- Wall loss: 0.641 to 0.689 mm observed in 1415 tubes
- Wall loss: 0.690 to 0.750 mm observed in 156 tubes

Result and Conclusion: It was observed that majority of the wall thinning 2nd to 5th baffle from top tube-sheet. (Tube sheet layout attached at **Annexure-6**)

H.P. CONDENSER(H-1202)
VISUAL INSPECTION
TOP COVER

- The liner was found grey and etched.
- Liquid inlet line welds were found bright and smooth.

TOP CHANNEL HEAD

- The gasket sealing face was found satisfactory.
- The liner and welds in the man way were shiny and smooth.
- The liner and welds in the channel were shiny and slightly rough.
- The liners adjacent to the gas inlet were partly covered with a bluish grey oxide scale.
- Minor roughening was observed on the tube sheet overlay near tube sheet to channel circumferential weld joint in complete periphery. It was observed more predominant in West & South direction.
- Gas inlet line elbow was found having thick grayish passivation layer.
- The tray support clips were shiny and slightly etched.
- The tube-to-tube sheet welds were found satisfactory.
- The few tube ends were found slightly damaged.
- Condition of the patch plates were found satisfactory.
- Many tube showed burn-through at ID of tube, these were also observed in earlier inspections.

BOTTOM CHANNEL HEAD

- The sealing face was found satisfactory.
- The man way liner was dark brownish in colouration and smooth.
- In the hemi-head and cylindrical area the liner was silvery, shiny and etched.
- All liner welds and repairs were bright and smooth.
- The tube to tube sheet welds were bright shiny and smooth.
- Many tubes showed burn-through defects, these were also observed in earlier inspections.

BOTTOM COVER

- The sealing face was found satisfactory.
- The liner was shiny and slightly etched.
- The vortex breaker and welds were smooth and intact.

THICKNESS MEASUREMENT

Weld Overlay and Liner thickness measurement:

The wall thickness of the liner was measured using a Krautkramer DMS-2 thickness meter (accuracy 0.01 mm).The weld overlay thickness has been measured using a Dual Scope MP40.

BOTTOM DOME

	Minimum Thickness (mm)	Maximum Thickness (mm)	Design Thickness (mm)
Man way (Liner)	**4.18***	7.74	6.0
Dome area (Liner)	6.54	6.92	6.0
Cylindrical area (Liner)	6.39	6.92	6.0
Tube sheet-Overlay weld	8.42	11.50	8.0 (Min)
Bottom Cover (Liner)	18.94	19.20	18.0

*Near vertical seam (Thickness was observed in the same range during previous inspection also)

TOP DOME

	Minimum Thickness mm	Maximum Thickness mm	Design Thickness mm (Minimum)
Man way (Liner)	6.12	7.12	6.0
Dome area (Liner)	6.62	6.87	6.0
Cylindrical area (Liner)	6.41	6.94	6.0
Tube sheet-Overlay weld	7.42	11.49	8.0 (min)

FERRITE MEASUREMENT

- Random Ferrite measurement was carried out on welds and parent metal. No Ferrite was found.

EDDY CURRENT TESTING OF TUBES

Eddy current inspection was carried out by M/s TesTex NDT India Pvt. Ltd. Total tubes in H.P. condenser are 1970 out of which 220 tubes were tested for 12000mm tube length and 1731 tubes tested for 3000mm length. 10 tubes could not be tested due to tray support pads obstructing the probe. 09 tubes were plugged before inspection. The observations are as under:

- In Row no.22 , Tube No. 23 localised defect indication was observed within tube sheet area, showing wall loss up to 21.0 % from OD side. The same tube was plugged.
- No reduction in wall thickness or any abnormality was detected in other inspected tubes with compare to Calibration tube.

(Tube sheet layout attached at **Annexure-7**)

INSPECTION OF H.P. LINE VENT AND DRAIN TAPPINGS

- Thickness measurement of parent metal carried out.

The detailed report is attached in **Annexure-3**.

INSPECTION OF OTHER VESSELS

H-1204 (RECIRCULATION HEATER)

- Minor scaling was observed inside the tubes.
- Orifice plugs in the bottom were found intact in position.
- Brownish scaling was observed inside the plugs.

H-1205 (L.P. CARBAMATE CONDENSER)

Due to tube leakage problem faced in past, condition of all the tubes were got inspected by M/S Escon, Chennai by Internal Rotating Ultrasonic Inspection System (IRIS).

Result and Conclusion: It was observed that majority of the wall thinning was due to tube fretting under baffles. Hence total 21 nos. of tubes which had recorded thinning in the range of 45-60 % were plugged. (Tube sheet layout is attached at **Annexure-8**)

H-1207(CIRCULATION SYSTEM –II COOLER)

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

H-1352 (REFLUX CONDENSER)

TOP TUBE SHEET

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

BOTTOM TUBE SHEET

- Tube to tube sheet welding was found satisfactory on CW inlet side.
- Thick scaling was found on the CW outlet side tube sheet.
- On cooling water outlet side, hard creamy scaling was observed inside all the tubes and on the tube projections, including inside of outlet pipeline elbow. The same was observed during last inspection also.
- Paint inside the channel area was observed peeled off & thick scales were found sticking on channel and baffle plate.
- Thermo wells were found intact in position, however CW outlet side thermo well was found covered with paint/scaling. The same was observed during last inspection also.

H-1419 (PRE-EVAPORATOR CONDENSER)

TOP TUBESHEET

- Tube to tube sheet weld was found satisfactory.
- Minor whitish scaling was observed inside the tubes.
- Brownish coloration was observed on the tube sheet at scattered location.
- Overall condition of heat exchanger was found satisfactory**.**

H-1420 (FINAL CONDENSER- TOP)

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

H-1421 (FLASH TANK CONDENSER)

- Tube to tube sheet welding was found satisfactory.
- Minor scales were observed inside the some tubes.
- All tubes were found filled with water

H-1423 (FIRST STAGE EVAPORATOR CONDENSER)

- Tube to tube sheet welding was found satisfactory.
- Brownish scaling was observed on the tube to tube sheet weld joints.
- Minor scales were observed inside few tubes.
- Tube sheet was found brownish in coloration.
- All the tubes were found filled with water.
- 01 No. of tube was found chocked with hard rubber debris and the same was marked with yellow chalk for proper cleaning. This tube was cleaned by hydro jetting and found satisfactory

H-1424 (2nd STAGE EVAPORATOR)

- Bright shiny surface was observed inside the vessel.
- Sparger support no. 4,5,7 & 8 counting from M/Hole towards North direction found bent, their U-Clamps were dislocated and the nuts were missing. Marked with Yellow chalk.
- Impingement cone was found bent in downward direction at two locations, one is in north-west direction and the other is in south-west direction. This was also observed in earlier inspection.
- Thin whitish scaling was observed inside of all the tubes from approx. 2" below the tube face.
- Water and debris was found on the bottom of the dish end.
- Water was found accumulated in the impingement cone.

H-1425 (SECOND EVAPORATOR FIRST CONDENSER)

- Tube to tube sheet welding was found satisfactory.
- Whitish scales were observed inside few tubes.
- Overall condition of heat exchanger was found satisfactory.

H-1426 (SECOND EVAPORATOR SECOND CONDENSER)

- Tube to tube sheet welding was found satisfactory.
- Thick brownish scales were observed on the tube sheet.
- All the tubes were found filled with water.
- Minor scales were observed inside few tubes.

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

- Condition of tubes and tube sheet was found satisfactory.
- Thin scales were observed inside the tubes.
- Most of the epoxy coating was found peeled off in the dome covers of H-1814A/B.
- Erosion / large pits were observed on Flanged weld joint of H-1814-B dome cover (West end) from inside. The same was observed during last inspection also.
- Pits of approx. 2-3 mm depth were observed on Flanged weld joint of H-1814-B shell flange(East end) from inside.

H-1815 (SURFACE CONDENSER FOR HITACHI COMPRESSOR)
NORTH SIDE HALF (EAST SIDE COVER)

TOP HALF

- Tubes and tube sheet surface condition was found satisfactory.
- Epoxy coating was found peeled off at several locations.
- Thermo-well was found intact in position.

BOTTOM HALF

- Tubes and tube sheet surface condition was found satisfactory.
- Minor scales were observed inside the tubes.

NORTH SIDE HALF (WEST SIDE COVER)

TOP HALF

- Tubes and tube sheet surface condition found satisfactory.
- Minor scales were observed inside the tubes.

BOTTOM HALF

- Tubes and tube sheet surface condition found satisfactory.
- Minor scales were observed inside the tubes.
- Loose O-ring was found lying inside inlet pipe at bottom.

SOUTH SIDE HALF (WEST SIDE CHANNEL)
TOP HALF

- Tube sheet was found in satisfactory condition.
- Minor scaling was observed inside the tubes.
- Epoxy coating was found peeled off on baffle plate, channel & cover.
- Edges of the shell flange I.D. & Baffle plate were found eroded. This was also observed in earlier inspection in S/D 2010.

BOTTOM HALF

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

SOUTH SIDE HALF (EAST SIDE CHANNEL)

TOP HALF

- Tube sheet was found in satisfactory condition.
- Epoxy coating was found peeled off at few locations.
- Thermowell was found intact.

BOTTOM HALF

- Tube sheet was found in satisfactory condition.
- Epoxy coating was found peeled off in channel area and also from the channel cover.

T-1301 (AMMONIA WATER TANK)

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

T-1301-A (NEW AMMONIA WATER TANK)

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

T-1401 (UREA SOLUTION TANK)

- Bottom plate was having bulging upward as had been observed in the past also.
- Weld joints condition was found satisfactory.
- Dark brown coloration was observed inside the tank.
- Stiffener provided on top roof plate was found intact in position.

T-1401-A (NEW UREA SOLUTION TANK)

- Brownish gray coloration was observed inside of the shell.
- Nozzles and weld joint condition was satisfactory.
- Overall condition was found satisfactory.
- Thermo well condition was found satisfactory.

T-1501 (CONDENSATE TANK)

- Condition of weld joints was found satisfactory.
- Reddish brown coloration was observed inside the tank.
- Support of 6" condensate inlet (west most) line was found intact.
- Overall condition of the tank was found satisfactory.

V-1101 (CO_2 KNOCK OUT DRUM)

- Epoxy paint was found peeled off from few locations, need to be repaired.
- 02 nos. demister pads in West half were found lifted upward, need to be fixed.
- Demister pad holding frame found bent at one location.

V-1102 (NH_3 SUCTION FILTER)

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

V-1202 (RECTIFYING COLUMN)

FROM TOP MANHOLE

- Colouration of vessel was grayish at manhole, dome and shell portion.
- Grey hard scales were observed on the top dish end and also on the shell portion.
- Metallic matter was found lying on the tray.
- Trays were covered with grayish hard scales.
- Cleats for holding the trays have fastener holes, these holes were observed elongated downwards. This was also observed in earlier inspection.

V-1207 (L.P. SCRUBBER)

- Coloration of shell portion was observed grayish black.
- Grating condition on top was satisfactory.
- Condition of the top cover was found satisfactory.

V-1301 (SECOND DESORBER)
BOTTOM COMPARTMENT

- Brownish coloration was observed inside the vessel.
- One clamp of the tray was found loose and tied with the adjacent one with wire.
- Nozzle condition was found satisfactory.
- Thermowell was found intact.

V-1351 (HYDROLYSER)

Visual inspection of Hydrolyser was carried out (bottom compartment) and the observations are as follows

BOTTOM COMPARTMENT

- Grayish black colouration was observed from inside.
- Oily surface was observed inside the vessel.
- Condition of the trays, clamps & steam inlet pipe was found satisfactory.

V-1501 (4 ATA STEAM DRUM)

- Shell and Dish ends were found Grayish with Reddish brown coloration at scattered locations.
- Distribution sparger was found intact in position.
- Demister pads were found intact in position and condition of the same was found satisfactory.
- Water was lying at bottom of the vessel.
- Condition of all the weld joints was found satisfactory.
- Minor pitting was observed on bottom of the shell.
- Hard scaling was observed on both the dished ends.

V-1502 (23 ATA STEAM DRUM)

- Brownish black coloration was observed inside the vessel.
- Scaling was observed at both dished ends.
- Overall condition was found satisfactory.
- Condition of distributor pipe was found satisfactory.
- Condition of all welds was found satisfactory.
- Condition of all nozzles was found satisfactory
- Condition of Thermowell pipe was found satisfactory.
- A pitting of 2-3 mm depth was observed above west manhole.
- Pitting of approx. 6mm dia and 2-3 mm depth was observed at both dish end. It was also observed in past inspection.

V-1503 (9 ATA STEAM DRUM)

- Grayish black coloration was observed inside the vessel.
- Scattered scales were observed on both the dished ends.
- South side U-clamp of inlet steam header was found loose. Need to be tightened.
- I.D. of 1" bottom nozzle for Level controller in East direction at center portion of the shell was found having pitting/cavities up to 1.5mm depth.
- Overall condition of the vessel was found satisfactory.

LO COOLER OF P-1102-A

- Condition of tube to tube sheet weld was found satisfactory.
- Thick brownish scales were observed on the channel area & baffle plate.

LO COOLER OF P-1102-B

- Thin creamy scales were observed inside the tubes.
- Thick brownish scales were observed on the tube sheet, channel area & baffle plate.
- Deep cavities were observed on the tube-sheet area.

LO COOLER OF P-1102-C

- Thin creamy scales were observed inside the tubes.
- Overall condition of the cooler was found satisfactory.

LO COOLER OF P-1201- A

- Condition of tube to tube sheet weld was found satisfactory.
- Overall condition of the coolers was found satisfactory.

LO COOLER OF P-1201- B

- West side end flange sealing face ID was found corroded.
- Overall condition of the coolers was found satisfactory.

MISCELLANEOUS JOBS:

WELDER QUALIFICATION TESTS:

- Performance qualification test of 18 Nos. welders offered by M/s General Engineering was carried out. 07 nos. of welders were qualified during the test. These welders were allowed to perform various miscellaneous non-critical departmental welding jobs in the plant.
- Performance qualification test of 06 Nos. welders offered by M/s Skywin Erectors Was carried out. 04 nos. of welders were qualified during the test. These welders were allowed to perform welding on BHEL boiler pipeline /fitting welding, Ammonia Converter sockolet welding, Autoclave liner weld repairing and ammonia nozzle replacement job.
- Welder qualification test of 07 Nos. welders of M/S. J & J Engg. was carried out. 06 welders were qualified. These welders were qualified for performing general purpose welding jobs.
- Welder qualification test of 03 Nos. welders of M/S. Smitha engrs. was carried out. All welders were qualified. These welders were qualified for performing Technical Department's welding jobs.

D.P. TEST:

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

RADIOGRAPHY:

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

GAUSS MEASUREMENT:

During this shutdown measurement of residual magnetism (gauss) on rotary and stationary parts of CO2 Compressor train(K-1801) bearings was carried out. Wherever residual magnetism was higher than acceptable limits, same was demagnetized and brought down within acceptable limits.

INSTALLATION OF NEW PIPELINES:

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

OVER SPEED TRIP TEST:

Before startup, speed measurement and vibration measurement of drive turbine of K-1801 was carried out. OST was done at 8622 RPM.

ANNEXURE-1 (1/3)

PIPELINE THICKNESS MEASUREMENT SUMMARY OF HP LINES

Sr. No	LINE NO.	NB (inch)	SCH.	NOM. THK. (MM)	LINE DESCRIPTION		MIN. THK. OBSERVED	%AGE RED.
					FROM	TO		
1	CO-F10-2119-PP25	8	160	23.01	K-1801,III	H-1813	23.0	0.04
2	CO-F10-2119-PP25	1.5	160	7.14			7.6	-
3	CO-F10-2124	8	160	23.01	K-1801,DIS.	GA-1112	22.6	1.78
4	CO-F10-2140	4	160	13.49	K-1801,III	V-1813	12.9	4.37
5	CO-F10-2140	0.75	160	5.56	CO-F10-2140-PP25	DRAIN	5.9	-
6	CO-E10-2122	6	80	10.97	H-1813	V-1813	10.20	7.02
7	GA-1112	6	F2	14.27	K-1101-2	GA-1201	13.80	2.82
8	GA-1112	1.5	X1	5.08	FROM GA-1112	TO BYPASS	4.30	15.35
9	GA-1201	6	X4	13.33	GA-1112	H-1201	13.30	-
10	VENT	1.5	X4	5.54	GA-1112	H-1201	5.00	9.75
11	GA-1202	1	F2	6.35	GA-1112-6"	CVALVE(GA-1203)	5.40	14.96
12	GA-1203	1	X1	4.51	GA-1202	H-1203	3.80	15.56
13	DRAIN	0.5	X1	3.73			3.60	3.49
14	GA-1204	1	X1	4.51	H-1203	PR-1231	4.10	9.89
15	DRAIN	0.5	X1	3.73			3.40	8.85
16	GA-1602	8	F2	22.83	K-1801	GA-1112	22.70	1.35
17	GA-1603	4	F2	11.13	GA-1602	GA-1604	11.60	-
18	GA-1606	1	B3	3.38	K-1801	GA-1350	2.80	17.16
19	MA-1106-B-4	4	E2	8.56	MA-1605-6"	MA-1203-4"	7.40	13.55
20	MA-1106	4	E2	8.56	P-1102-A	MA-1605-6”	7.9	7.71
21	MA-1106	1	E2	4.55	P-1102-A	MA-1605-6”	5.1	-
19	MA-1123	4	E2	8.56	P-1102/B	MA-1605	7.5	12.38
22	MA-1201	3	E2	7.62	MA-1605-6"	MA-1202-3"	4.8	5.51
23	MA-1201	1.5	E2	5.08	MA-1605-6"	MA-1202-3"	4	27.80
24	MA-1202	3	X4	7.62	MA-1201	V-1201	6.90	9.45

ANNEXURE-1 (2/3)

Sr. No	LINE NO.	NB (inch)	SCH.	NOM. THK. (MM)	LINE DESCRIPTION		MIN. THK. OBSERVED	%AGE RED.
					FROM	TO		
25	MA-1203	4	X4	9.14	MA-1106-6"	PR-1230	9.50	-
26	MA-1603	6	C2	7.11	MA-1122-6"	P-1102 /C	5.9	17.02
27	MA-1603	4	C2	6.02	MA-1122-6"	P-1102 /C	4.6	23.59
28	MA-1603	1	C2	4.55	MA-1122-6"	P-1102 /C	4.6	-
29	MA-1603	0.75	C2	3.91	MA-1122-6"	P-1102 /C	3.80	0.03
30	MA-1604	3	E2	7.62	P-1102 /C DIS.	MA-1604-4"	6.2	18.64
31	MA-1604	1	E2	4.55	P-1102 /C DIS.	RV	5.10	-
32	MA-1604	4	E2	8.56	MA-1604-3"	MA-1605-6"	7.8	8.88
33	MA-1604	0.75	E2	3.91	MA-1604-3"	MA-1605-6"	3.1	20.72
34	MA-1605	6	E2	14.27	MA-1106	MA-1203	13.3	6.8
35	MA-1605	4	E2	8.56	MA-1106	MA-1203	7.4	13.55
36	MA-1607	4	C2	6.02	MA-1605	MA-1116	5.3	11.96
26	MA-1609	4	C2	6.02	MA-1603-6”	MA-1604-3”	6.0	0.33
27	MA-1609	1.5	C2	5.08	MA-1603-6”	MA-1604-3”	4.5	11.42
28	MA-1607	0.75	C2	3.91	DRAIN		4.2	-
29	PR-1201	8	X1	19.58	V-1201	H-1201	19.8	-
30	PR-1202	10	X1	24.33	HP-STRIPPER H-1201	HP-CONDENSER	21.20	12.86
31	PR-1203	8	X1	19.58	HP-COND H-1202	V-1201(VAPOR LINE)	18.0	8.07
32	PR-1204	8	X1	19.58	HP-CONDENSER	V-1201(LIQUID LINE)	18.6	5.01
32	PR-1205	6	X1	15.24	PR-1205-8"	RECTIFYING COLUMN	15.4	-
33	PR-1205	8	X1	19.58	STRIPPER BOTTOM	V-1202	17.50	10.26
33	PR-1205	4	X1	10.40	PR-1210	H-1203	8.50	18.27
35	PR-1208	4	X1	10.40	AUTOCLAVE TOP	PR-1206-4"	9.0	13.46
36	PR-1211	1.5	X1	5.08	PR-1208-4”	PR-1212-4"	4.6	9.45
37	PR-1212	4	X1	10.40	SCRUBBER	AUTOCLAVE BOTTOM	10.1	2.88

ANNEXURE-1 (3/3)

Sr. No	LINE NO.	NB (inch)	SCH.	NOM. THK. (MM)	LINE DESCRIPTION		MIN. THK. OBSERVED	%AGE RED.
					FROM	TO		
38	MA-1607	0.75	C2	3.91	DRAIN		4.2	-
39	PR-1201	8	X1	19.58	V-1201	H-1201	19.8	-
40	PR-1202	10	X1	24.33	HP-STRIPPER H-1201	HP-CONDENSER	21.20	12.86
41	PR-1203	8	X1	19.58	HP-COND H-1202	V-1201(VAPOR LINE)	18.0	8.07
42	PR-1204	8	X1	19.58	HP-CONDENSER	V-1201(LIQUID LINE)	18.6	5.01
43	PR-1205	6	X1	15.24	PR-1205-8"	RECTIFYING COLUMN	15.4	-
44	PR-1205	8	X1	19.58	STRIPPER BOTTOM	V-1202	17.50	10.26
45	PR-1205	4	X1	10.40	PR-1210	H-1203	8.50	18.27
46	PR-1205	0.75	X1	4.55	PR-1210	H-1203	4.6	-
47	PR-1208	4	X1	10.40	AUTOCLAVE TOP	PR-1206-4"	9.0	13.46
48	PR-1211	1.5	X1	5.08	PR-1208-4”	PR-1212-4"	4.6	9.45
49	PR-1212	4	X1	10.40	SCRUBBER	AUTOCLAVE BOTTOM	10.1	2.88
50	PR-1213	2	X4	5.54	PR-1201	PR-1205-6"	5.0	9.75
51	PR-1224	3	X4	7.62	P-1201B	PR-1638-4"	5.57	26.90
52	PR-1225	3	X4	7.62	P-1201A/B, PR1638-4"	H-1203	6.1	19.95
53	PR-1226	2	X4	5.54	PR-1224	H-1205	4.5	18.63
54	PR-1230	6	X1	15.24	MA-1203-4"	H-1202	13.3	12.73
55	PR-1230	1.5	X1	5.08	MA-1203-4"	H-1203	3.9	23.23
56	PR-1231	3	X1	8.12	H-1203	PRCV-1201	7.70	5.17
57	PR-1234	4	X4	10.41	PRC-1201(H-1203)	V-1203	9.5	7.78
58	PR-1234	3	X4	7.62	P-1201A	PR-1638-4"	6.7	12.07
59	PR-1637	4	9.14	9.14	P-1201C	PR-1638-4"	8.4	-
60	PR-1638	4	X4A	9.14	P-1201A/B/C	PR-1230-6"	12.90	4.37
61	PR-1666	2	X4A	5.54	PR-1637	PR-1226	5.20	6.14

ANNEXURE-2 (1/2)

PIPELINE THICKNESS MEASUREMENT SUMMARY (HAVING MORE THAN 20% REDUCTION)

Sr. No	LINE NO.	NB (inch)	SCH.	NOM. THK. (MM)	LINE DESCRIPTION		MIN. THK. OBSERVED	%AGE RED.
					FROM	TO		
1	CO-B22-2109	8	20	6.35	CO-B22-2115	COHA2-2109	4.80	24.41
2	CW-1118	14	B13	9.525	H-1102	H-1206	9.4	1.31
3	CW-1205	14	B13	9.525	H-1206	H-1205	8.2	13.91
4	CW-1205	8	B13	9.525	H-1206	H-1205	8.0	16.01
5	CW-1207	14	B13	9.525	H-1205	P-1202	8.2	13.91
6	CW-1207	12	B13	9.525	H-1205	P-1202	8.5	10.76
7	CW-1210	14	B13	9.525	P-1202	H-1102	8.9	6.56
8	CW-1210	10	B13	9.525	P-1202	H-1102	8.4	11.81
9	CW-1210	12	B13	9.525	P-1202	H-1102	7.3	23.36
10	CW-1210	8	B13	9.525	P-1202	H-1102	5.5	42.26
11	CW-1210	3	B13	4.85	P-1202	H-1102	4.4	9.28
12	MA-1103	4	C2	6.02	B/L	MA-1102	5.90	1.99
13	MA-1117	4	C2	6.02	RV-1103	MA-1116	5.5	8.64
14	MA-1126	4		8.56	MA-1128	MA-1116	7.6	11.21
15	PR-1214	8	X6	4.57	V-1202	H-1204	3.6	21.23
16	PR-1220	8	X3	3.76	LP SEPARATOR BOTTOM	LP CONDENSER	3.4	9.57
17	PR-1239	3	X3	3.05	V-1202	ATOM	2.3	24.59
18	PR-1259	6	X3	3.4	V-1206	P-1210 A/B	2.8	17.65
19	PR-1260	6	X3	3.4	P-1210 A/B	H-1210	2.6	23.53
20	PR-1351 (S.S.)	4	X3	3.05	V-1301	H-1301A/B/C	2.2	27.87
21	PR-1359	4	X7	3.05	P-1351A/B	H-1351C	2.3	24.59
22	PR-1373	4	X3	3.05	P-1351B DIS	PR-1361	2.9	25.46
23	PW-1603	4	B2	7.02	PW-1352	T-1301-A	5.3	24.50
24	SC-1212	10		9.27	SC-1210	SC-1209	9.1	1.83
25	SC-1240 IV FROM NE	16	B4	9.53	H-1202	V-1501	9.30	2.36

ANNEXURE-2 (2/2)

UREA PLANT PIPELINE THICKNESS MEASUREMENT SUMMARY

(HAVING MORE THAN 20% REDUCTION)

Sr. No	LINE NO.	NB (inch)	SCH.	NOM. THK. (MM)	LINE DESCRIPTION		MIN. THK. OBSERVED	%AGE RED.
					FROM	TO		
26	SC-1242 II FROM NW	16	B4	9.52	H-1202	V-1501	8.80	7.56
27	SC-1243 III FROM NW	16	B4	9.525	H-1202	V-1501	11.1	---
28	SC-1523	3	B4	5.49	HEADER	SC-1409	3.8	30.78
29	SC-1602	2	B4	3.91	SC-1603	PR-1616	3.1	20.72
30	ST-1211	2	B4	3.91	ST-1409	H-1202	2.8	28.39
31	ST-1502	3	B4	7.62	ST-1502	V-1503	6.4	-
32	ST-1502	2	B4	7.62	ST-1502	V-1503	5.4	2.53
33	ST-1614	4	B4	6.02	ST-1409	H-1424	6.2	---

ANNEXURE-3
THICKNESS MEASUREMENT SUMMARY
(H.P. LINE TAPPINGS, VENTS AND DRAINS ETC)

Sr No	Equipment	Description.	No. of vent/ drain	Size	Design Thk. (mm)	Observed Thk. (mm)
1	K-1801	PT-1810 tapping line with I/V.	1	3/4"	5.54	3.88,4.06,3.68
2	K-1801	1. Final discharge header RV U/S line vent (plugged). 2. Discharge line 3 nos. PI tapping with I/Vs at bottom of H.P. Case.	1 3	1/2" ¾"	4.75 5.54	5.48,5.23,5.46 1. 5.34,5.25,5.02 2. 4.98,4.85,5.05 3. 5.14,5.13,5.21
3	FR-1201	HP and LP tapping	2	1/2"	4.75 4.75	1. 5.38,5.32 2. 5.55,5.53
4	CO2 to H-1201	Header drain line with I/V near H-1201. Near MOV 1201	1	1"	6.35	8.42,8.51,8.44
5	CO2 to H-1203	Drain line with I/V blinded D/S of NRV.	1	½"	4.75	3.41,3.43
6	P-1102-A	1. Dish. Pressure tapping. 2. Drain with between both dish. I/Vs.	2	½" 1"	3.73 4.55	4.8,4.2,4.9,4.6 4.4,4.2,4.5,4.6
7	P-1102 B	1. Disch drain 1 No. U/s of both recycle I/Vs 2. 1 No. Between 2 Disch. I/V's 3. Disch. PI tapping with I/V	3	1" ¾" ½"	4.55 3.91 3.73	5.80,5.60,6.10 5.30,5.20,5.50,5.40 4.60,4.40,4.80,4.40
8	P-1102 C	1. Dish. RV 2. 3 No's PI tapping.	4	1.5" ¾"	4.85 3.91	4.45,4.48,4.40,4.37 1. 3.19,3.35,3.27 2. 3.52,4.04,3.80,3.2 3. 3.50,3.70,3.40,4.2
9	P-102A/B/C	1. Dish. Header (a) 2 No's vent with I/V (cap prov.) 2. PIC-1201 tapping line with I/V on First Floor.	2 1	1" ½"	4.55 3.73	1. N.A. 2. 5.10,4.60 4.50,4.40
10	PRC-1201	Sensing line tapping with I/V & drain at V-1201 bottom.	2	1/2"	3.73	3.50,3.70
11	FRCV-1201	HP & LP tapping	2	3/4"	3.91	1. 4.07,3.98 2. 4.11,4.02
12	Ammonia to H-1202	1. Vent line with I/V. 2. Blinded vent line. 3. Vent line with I/V U/S of MOV.	3	1" ¾" ¾"	4.55 3.91 3.91	5.9,5.6,5.4,5.2 4.9,5.1,4.8 6.5,6.9,6.7
13	V-1201	1. Unloading line vent line with I/V blinded at G.F. 2. Sample point tapping line with I/V at first floor.	 3	1/2" 1"	3.73 4.55	3.07,2.98,2.82,2.73 4.69,4.72,4.62
14	H-1201	Sample point tapping line with I/V at G.F.	3	1"	4.55	3.94,3.91,4.08

15	H-1203	Off-gas vent line with I/V (blinded) between PRCV-1201 & its I/V.	1	1”	4.55	3.96,4.02
16	P-1201 A/B/C	P-1201 A/B/C drain line with I/V between both dish. I/V. (PR-1638-4”X1A)	3	1”	4.55	1. 4.09,4.18,4.17 2. 4.31,4.38,4.16 3. 4.30,4.18,4.21
17	H-1201	H-1201 Sample point line. (G.F.)	1	1”-SS	3.73	4.16,4.10,4.14
18	P-1201A/B/C	Carbamate Dish. Line drain with I/V between both I/V. (F.F.)	1	½”	3.73	3.40,3.44
19	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	½ “	3.73	1. 3.60, 3.80 2. 3.90, 4.00
20	H-1203	H-1203 drain line (Bottom) drain line with I/V (2 nos.) d/s of I/V.	1	½"	3.73	2.98,2.79,2.82
21	H-1203	CO2 to H-1203 drain with I/V between both I/V. (P.T.Top)	1	½"	2.77	2.91,2.87
22	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	1” 1”	4.55 4.55	4.01,3.97 4.23,4.28
23	HPF pump	1) disch RV at Ground floor 2) Disch PI tapping at ground floor	2	3/4" 1”	4.55	1. 4.26,3.97 2. 6.65,6.52
24	P.T. Top	HPF loop P.T. Top vent with I/V	1	¾”	---	6.71,7.12

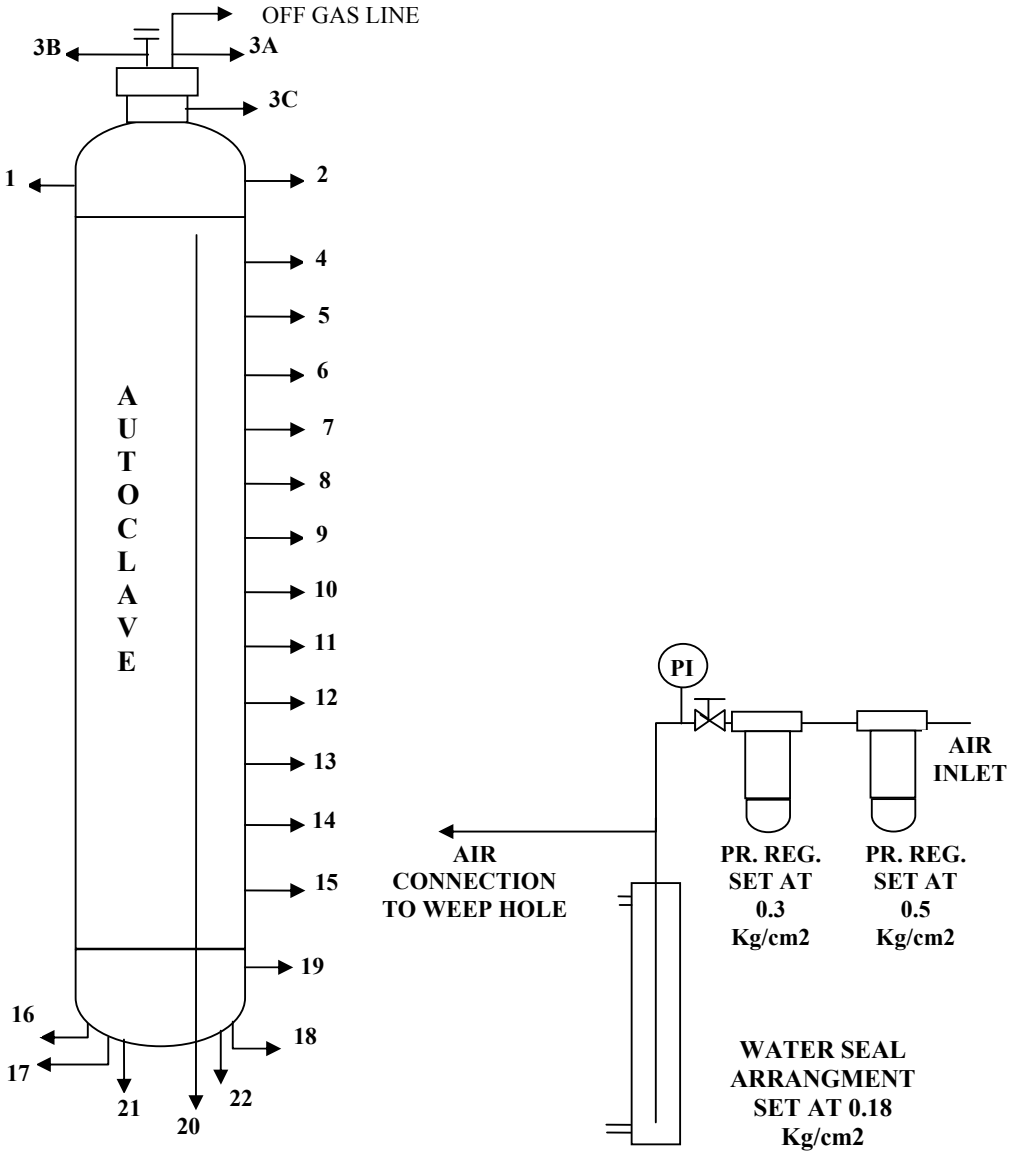
ANNEXURE- 4
DETAILS OF INSITU-METALLOGRAPHIC INSPECTION

SR.NO.	LOCATION	MOC	MICROSTRUCTURE OBSERVATION	REMARK
1.	Location: 1 (Parent Metal) **HP CONDENSER H-1202** Stub end Gas outlet bottom side	SS	Microstructure shows fine-grained worked austenitic structure with twins. Weld metal microstructure shows dendritic structure of ferrite pools in austenite matrix. Presence of weld spot is observed at PM region.	Presence of weld spot is observed at PM region. No significant degradation observed. Monitor after 1 year of service.
2.	Location:2 (Weld/HAZ) **HP STRIPPER H-1201** Stub end Liquid inlet top side	SS	Microstructure at weld shows dendritic structure of ferrite pools in austenite matrix, whereas at HAZ microstructure shows fine-grained worked austenitic structure. Microstructure at PM shows fine-grained worked austenitic structure with twins.	No significant degradation observed. Monitor after 2 years of service.

ANNEXURE-5 (1/2)

DETAILS OF AIR TEST TO BE CARRIED OUT ON AUTOCLAVE AMMONIA INLET NOZZLE WELD JOINTS

The location of weep holes no. 16, 21 and 22 were air tested. Air test arrangement made is shown below.



ANNEXURE-5 (2/2)

Weep hole locations and their nos. are given below:

Weep hole No.	Location
1	Top hemi-head (near radioactive source)
2	Top hemi-head (North side)
3A	Off gas line
3B	Blind Nozzle on Man-hole cover
3C	Man way
4 to 15	On Shell at various elevations
16	Ammonia Inlet nozzle
17	Carbamate nozzle from H-1203
18	Carbamate nozzle from H-1202
19	Gases from H-1202
20	Autoclave over-flow to Stripper
21-22	Bottom hemi head

Air test of Complete liner weld joints of bottom hemi end and Ammonia Inlet nozzle to be carried out in following steps:

- Air to be given from ammonia Inlet nozzle weep hole (16). When PI was showing 0.18 Kg/Cm2, isolation valve at up stream of PI to be closed and there should be no pressure drop. Soap solution test to be carried out from inside to check integrity of loose liner weld joint with sleeve.
- Air to be given from weep hole no. 21 and flow of air to be confirmed by connecting bubbler mounted on weep hole no.22. After confirmation weep hole no. 22 to be plugged. When PI was showing 0.18 Kg/Cm2, isolation valve at up stream of PI to be closed and there should be no pressure drop. Soap solution test to be carried out from inside to check integrity of bottom dish end liner weld joints with patch plate.

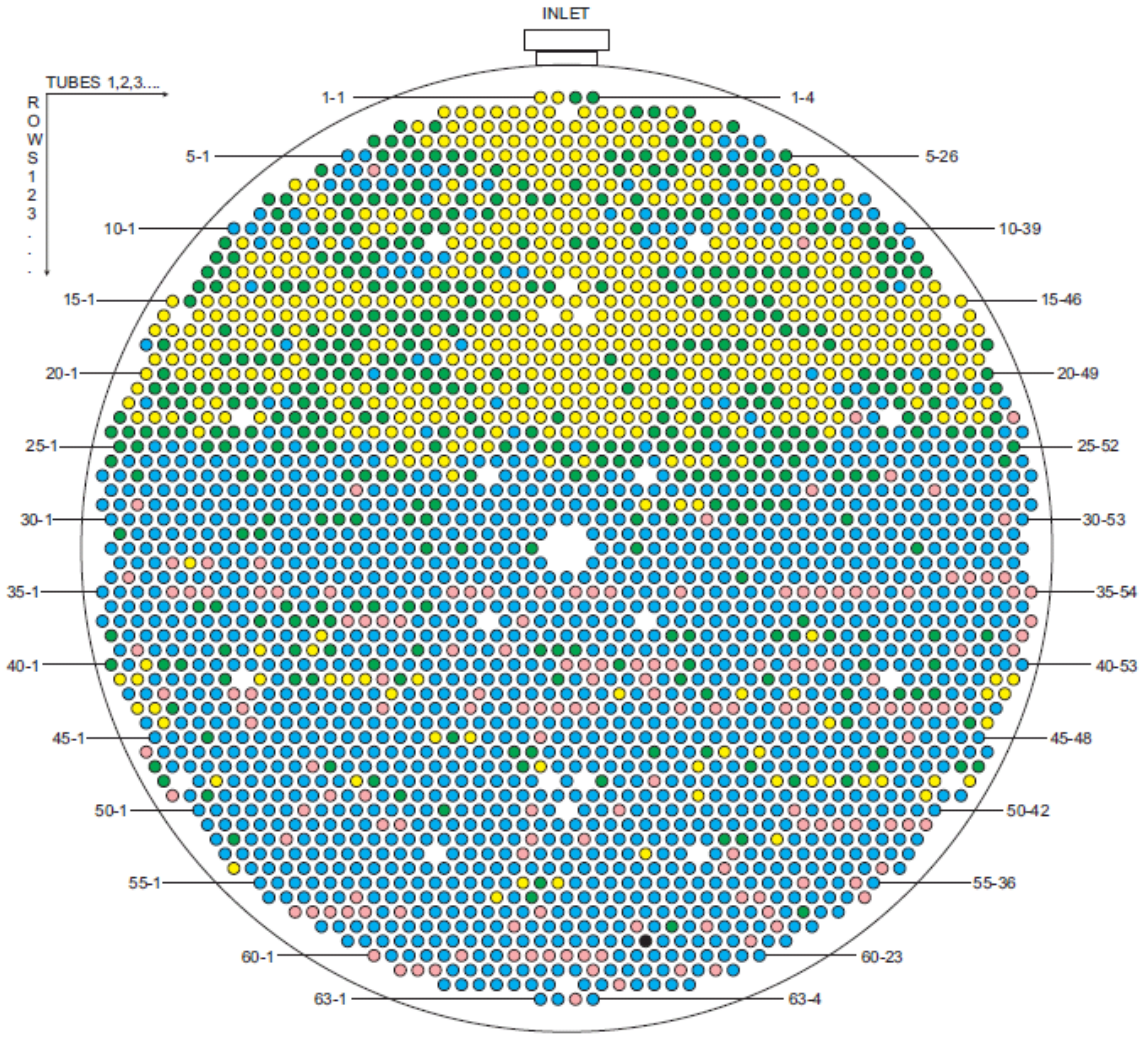
ANNEXURE- 6 (1/1)

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

IFFCO
Kalol, Gujarat.

UREA STRIPPER
H-1201/A

Viewed from Top Side



INSPECTION SUMMARY

Denotes: Wall Loss

- ○ 0.3 mm to 0.50 mm
- ● 0.51 mm to 0.60 mm
- ● Plugged
- ● 0.61 mm to 0.64 mm
- ● 0.641 mm to 0.689 mm
- ● 0.690 mm to 0.750 mm

TesTex

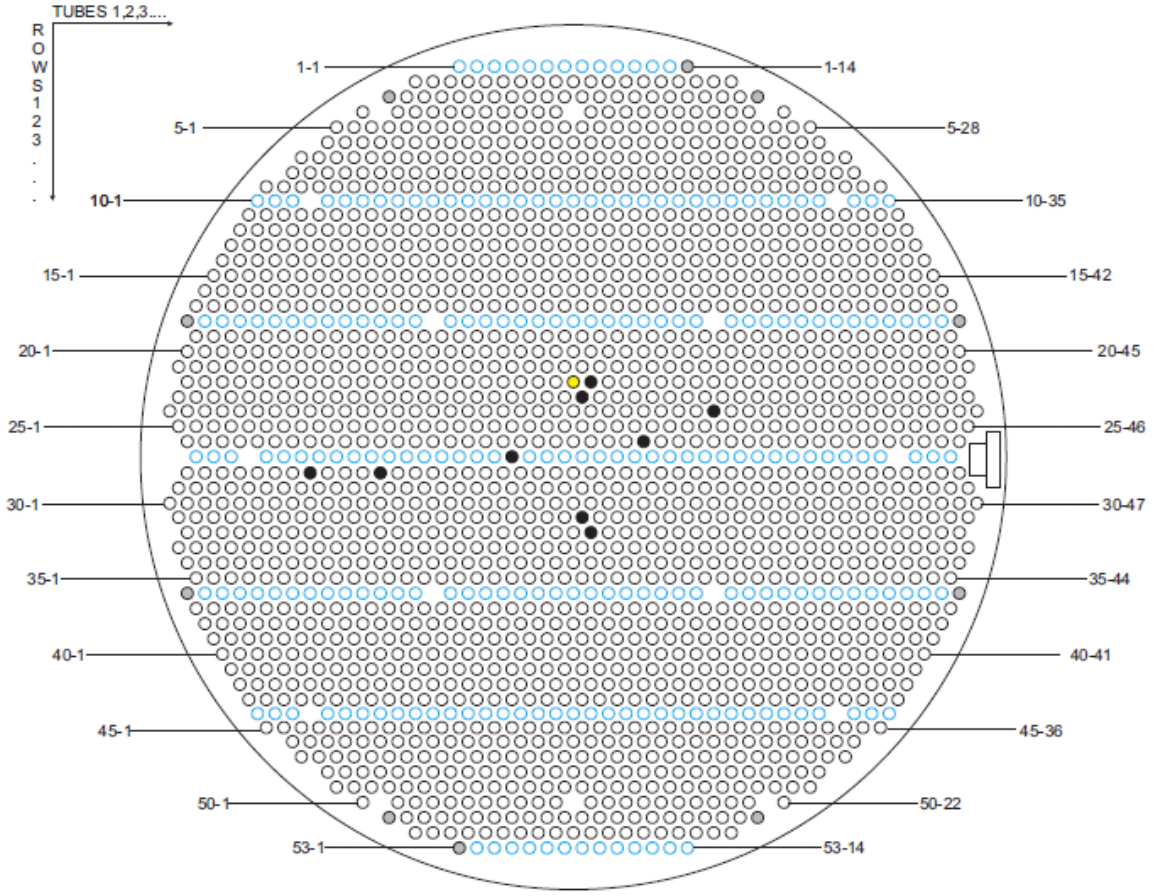
ANNEXURE- 7 (1/1)

TUBE SHEET LAY OUT OF H-1202 (VIEWED FROM TOP)

IFFCO
Kaloi,Gujarat.

HP CONDENSER
H-1202

Viewed From Top Side



Tube Sheet Drawing

Denotes:

Wall Loss 21%- 25% | Inspected up to 3000mm | Not Inspected | Plugged
Inspected up to 12000mm

TesTex

ANNEXURE- 8(1/1)

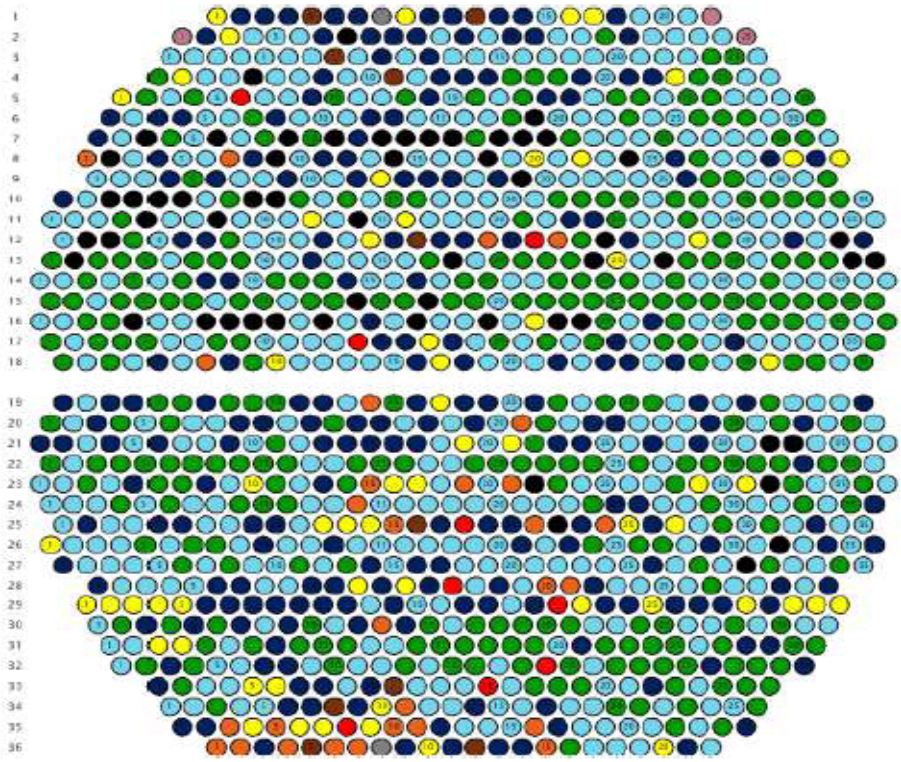
TUBE SHEET LAY OUT OF H-1205 (VIEWED FROM TOP)

ESCON

ESCON TECHNICAL SERVICES PVT. LTD.

32, Bharathy Park Cross Road 8, Coimbatore, Tamil Nadu – 641 011.
Tel: 91-422-2451263 / 2450624 Fax: 91-422-2437271
Web: www.escon-ndt.com Email: info@escon-ndt.com

IRIS Inspection on H 1205



Legend

WL <=10%	
WL 11 - 20%	
WL 21 - 30%	
WL 31 - 40%	
WL 41 - 50%	
WL 51 - 60%	
Plugged	
Blocked	
Suspected Leak	
LOS	

Summary

Un-assigned	0	0%
WL <=10%	300	26%
WL 11 - 20%	468	40%
WL 21 - 30%	222	19%
WL 31 - 40%	61	5%
WL 41 - 50%	29	2%
WL 51 - 60%	9	1%
Plugged	10	1%
Blocked	3	0%
Suspected Leak	2	0%
LOS	58	5%
Total Tubes	1162	

Note: LOS – Loss of signals

OFFSITE & UTILITY PLANT

- Inspection of BHEL boiler drums and furnace tubes.
- Inspection of Deaerator.
- Insitu Metallographic Examination of steam outlet line from boiler.

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

- **BHEL BOILER (GT-2068):**

Visual inspection of Steam Drum, Mud Drum, Furnace tubes and Super heater tubes was carried out during this shutdown. Also, Ultrasonic thickness measurement of all accessible tubes, steam drum, mud drum and super heater tubes was carried out. The following observations were made during visual examination.

- **STEAM DRUM:**

- The internal surface of the drum had assumed blackish brown coloration.
- All the weld joints were found in satisfactory condition.
- Three nos. of fastener of bottom plate just between 2^{nd} & 3^{rd} C-clamp , 5^{th} & 6^{th} C-clamp and opposite to 4^{th} C-clamp counting from west side was found loose.
- Strengthening support fastener found missing for continuous blow down line at two locations from west side.
- 5 Minimum thickness of 102.6 mm & 83.0 mm was observed on shell and dished end respectively against the nominal thickness of 97.0 mm & 77.0 mm on shell & dished end respectively.

- **MUD DRUM:**

- The shell had assumed blackish brown coloration.
- The condition of the weld joints was found satisfactory.
- Minimum thickness of 81.86 mm & 56.73 mm was observed on shell and dished end respectively against the nominal thickness of 78.0 mm & 57.0 mm on shell & dished end respectively

- **FURNACE TUBES:**

In general, the condition of the furnace tubes and super heater tubes exposed to flue gases was satisfactory. The thickness measurement of, 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: Refer Annexure- 1 showing tube layout.

Sr. No.	Description	Minimum Thickness (mm)	Design Thickness (mm)
1.	**South Manhole**		
(A)	Baffle Wall Tubes	4.51	4.5
(B)	D- Panel Tubes	4.39	4.5
(C)	Cut Corner Tubes	4.73	4.5
(D)	Rear Wall Tubes	4.67	4.5
(E)	Front Wall Tubes	4.38	4.5
2.	**North Manhole**		
(A)	Bank Tubes	3.19	3.6
(B)	North Side Wall Tubes	4.62	4.5
3.	**Primary Super heater Tubes**		
(A)	Bend of A Column	6.09	7.1
(B)	Bend of B Column	6.15	7.1
(C)	Bend of C Column	6.05	7.1
(D)	Bend of D Column	6.05	7.1
4.	**Primary Super heater Tubes**		
(A)	Bend of East wall	4.34	5.6
(B)	Bend of West wall	5.04	5.6
(C)	Bend of South wall	5.25	5.6

- **DEAERATOR:**

- **Deaerator Head:**

- 1 Two nos. pin hole was observed in top hood to dome inside welding. The same was observed during previous inspection also.
- Weld cavity observed in one no. nozzle (size-1/2") from inner side of the Deaerator. The same was observed during previous inspection also.
- Thickness measurement of condensate down comers (6" NB-04 Nos.) from head to shell was carried out. North –East & North-West elbow had shown thickness in the range of 2.7-2.8 mm against the nominal thickness of 7.11, hence both were replaced.

- **Deaerator Storage Shell:**

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

- **MISCELLANEOUS JOBS:**
- **D.P. TEST:**

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

- **RADIOGRAPHIC EXAMINATION:**

Radiographic examination of butt weld joint of cap of boiler 60 Ata line to soot blower was carried out and found satisfactory.

- **METALLOGRAPHIC EXAMINATION:**

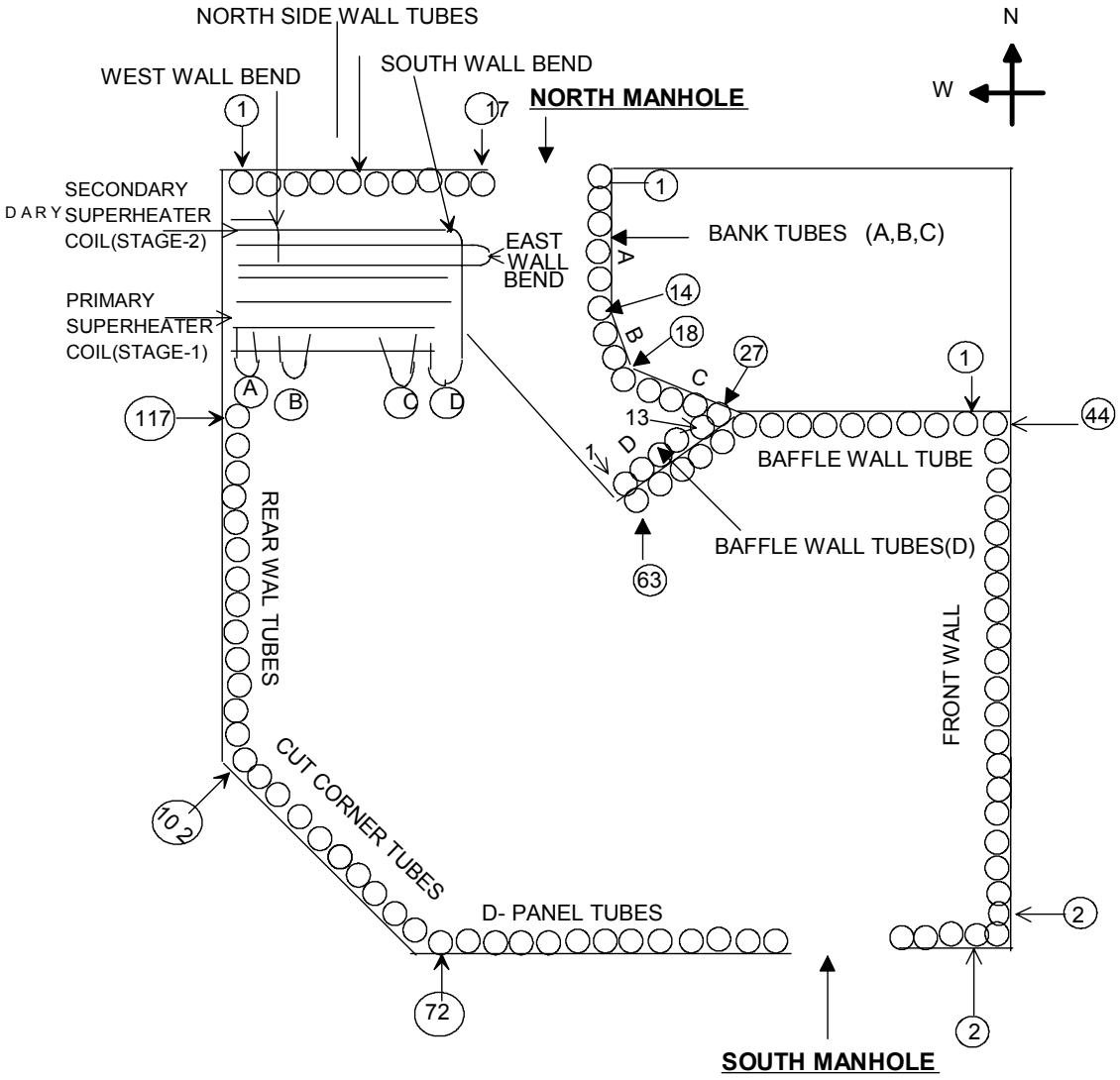
Insitu Metallographic examination of steam outlet line from boiler was carried out and observations are mentioned below.

SR.NO.	LOCATION	MOC	MICROSTRUCTURE OBSERVATION	REMARK
1	Location: 53 (Parent Metal) Boiler steam outlet elbow-1	106 Gr.B	Microstructure shows fine-grained ferrite and pearlite structure with presences of few widmanstatten ferrites.	IInd stage of creep degradations. Monitor after 2 year of service.
2	Location: 54 (Parent Metal) Boiler steam outlet elbow-2	106 Gr.B	Microstructure shows fine-grained ferrite and pearlite structure with presences of few widmanstatten ferrites.	IInd stage of creep degradations. Monitor after 2 year of service.

- **GAUSS MEASUREMENT:**

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

ANNEXURE-1



BHEL BOILER FURNACE LAYOUT
(GT-2068)

INSTRUMENTATION

AMMONIA PLANT

- **DCS / ESDS UPGRADATION:**

  Yokogawa make Centum XL DCS system was replaced by Centum Vp Vnet/IP system and HIMA make ESDS was replaced by Yokogawa make Prosafe-RS ESDS. The existing Centum CS3000 DCS system was upgraded to Centum Vp Vnet/IP system. All the systems were integrated to a common bus. The following major activities were involved in the above job.

- In Ammonia Control Room all old HIS consoles and HIMA operator stations along with Auxiliary consoles were dismantled and removed. Consoles for new Integrated Control system was installed on a newly fabricated channel base. Six new operator consoles, two new corner onsoles, two new Auxiliary consoles and one dummy Auxiliary console were installed. Centum XL Engg Station, Centum CS3000 Engg. Station, HIMA Engg. Station, HIMA ESR with printer were removed. New Centum Vp Engg. Station, Prosafe-RS Engg. Station, Colour Laser jet printer and B/W Laser jet printers were installed in control room. All operator stations, DCS Engg. Station and printers were interconnected through Cat5e Ethernet cable network via Ethernet Hub.
- Existing System cabinets (2 EFCD and 2 EFMS) were removed. Two new Centum Vp System cabinets were installed. All Pre-fab signal cables were connected to IO cards in new system cabinets. New redundant Cat5e cables laid from FCS to Engg. Station / operator stations for control bus communication via Ethernet hubs.
- Old PDB was removed. A new PDB was installed. Two new Power cables were laid from Fuji UPSS room to PDB cabinet. Power supply provided to all System cabinets, Marshalling cabinets, Operator stations, Engg. Stations from this new PDB.
- A new Remote node system cum marshalling cabinet installed for temperature inputs. All temp. inputs coming to Control room JBs were diverted to this new cabinet. All temp. inputs were terminated accordingly. Redundant Extended serial bus communication cables were laid from this cabinet to new DCS System cabinets. Power supply provided to this cabinet from new PDB cabinet.A new Temperature marshalling cabinet was installed. All temp. inputs that were coming directly to old EFMS stations were diverted to this marshalling cabinet by laying new multi-pair thermocouple cable or diverting old cables. All temp. inputs were terminated.
- All temp. loops were checked. Some analog and digital loops were also checked.
- CPU of Centum CS3000 were replaced with new Centum Vp Vnet/IP CPU CP451.
- Redundancy checks were performed on Control Bus, CPU, PS, AAB841 cards wherever applicable. As per redundancy feature, control transfer took place to the standby one properly.Redundant OFC laid for integration of Ammonia plant with Urea, Boiler, DM & WTP.
- Latest project backup was saved in HIS0158 and was taken in DVD.
- MIS connectivity established through Cisco Firewall system.

- All operator stations, Engg station, ESR printer of HIMA PLC were removed from Control room. A new ESD Engg. Station installed**.**
- Three new ESD system cabinets were installed. These stations were connected to each other and also to FCS stations, HIS, Engg. Stations through redundant Cat5e Control bus communication cables via Ethernet Hubs. Power supply provided to ESD System cabinets from new PDB cabinet. New Prefab signal cables laid from ESD system cabinets to ESD marshalling cabinets and Auxiliary consoles.
- Field terminations inside HIMA cabinets were removed. All the IO cards along with CPU were removed. New Baffle plates with terminal boards, supplied by Yokogwa were installed inside these cabinets. All the field wires were re-terminated on these baffle plates.
- Power supply provided to ESD marshalling cabinets from new PDB cabinet as well as ESD System cabinet (24V DC).
- New line monitoring networks were connected in field switches as per requirement replacing the old resistance networks.
- All loops were checked. All logic blocks were checked. Necessary corrections were incorporated in logic as well as in Graphic pages.
- Latest project backup was saved in HIS0158 and was taken in DVD.

- **<u>CONTROL VALVES</u>:**

- **FRCV- 1**: Actuator diaphragm was checked, found ok. General cleaning of positioner, air filter regulator was carried out. Gland packing was replaced. Finally control valve stroke was checked.
- **FRCV-2**: Removed from bonnet as abnormal sound was coming. Checked and found that plug bottom follower was damaged. So it was repaired by material filling and machining as per OD. Actuator diaphragm was checked, found ok. Drawing of couping block was prepared and same was made in workshop.. General cleaning of positioner, air filter regulator was carried out. Gland packing was replaced. Finally control valve was assembled, reinstalled and stroke was checked.
- **FRCV-3:** Control valve removed from bonnet, seat & plug were checked. All parts were cleaned and overhauled. Also Actuator diaphragm was opened and checked, found ok. General cleaning of valve positioner was carried out. Gland packing was replaced. Finally the stroke was checked.
- **PICV-14**: New gland packing was provided, actuator diaphragm was checked and found ok. C/V stroke was checked. During start up C/V was found stuck up. Checked and replaced air supply regulator and relay of valve positioner. After that operation of C/V was found ok.
- **PICV-24**: A new IL make butterfly control valve was installed replacing the old Masoneilan make control valve. C/V stroke was checked and found ok.
- **FICV-485**: C/V was removed from bonnet. Plug, seat and gasket were replaced with spare ones. General cleaning were carried out. Checked the valve for tight shut off & stroke was checked.
- **LCV-490**: C/V was removed from bonnet. Plug and seat were replaced with spare ones. All parts were cleaned & overhauled. Finally reinstalled, checked the stroke.

- **PICV-20**: C/V was removed from bonnet. Checked and found seat damaged so lapping was carried out. Actuator diaphragm was checked and found ok. All parts were cleaned & overhauled. Finally the stroke of C/V was checked.
- **LCV-2A**: C/V was removed from line. Plug and seat were checked. Replaced bent stem with a new stem made in workshop. General cleaning and overhauling job carried out. Finally reinstalled & stroke checked.
- **FRCV-5,5A:** Actuator diaphragm was opened and checked, found ok. Provided new gland packing. Stroke was checked.
- **TRCV- 10,11**: Actuator diaphragm was opened and checked, found ok. Provided new gland packing. Stroke was checked.
- **PRCV- 25**: C/V diaphragm was checked and found ok. Provided new gland packing. Stroke was checked.
- **PICV-13A**: Gland packing was replaced. General cleaning & greasing was carried out. Finally C/V stroke was checked.
- **PICV-13B**: Gland packing was replaced. General cleaning & greasing was carried out . Finally C/V stroke was checked.
- **MICV-22**: Gland packing was replaced. General cleaning & greasing was carried out. Finally control valve operation was checked.
- **FICV-9,10,11**: General /cleaning/ greasing were carried out. Provided new gland packings wherever required. Also valve positioner was cleaned and air header & regulator also flushed finally stroke was checked.
- **FICV-7,8:** Gland packings were replaced. Checked the stroke, found ok.
- **FICV-15**: Gland packing was replaced. Checked and found the stroke was not proper so replaced relay of double acting positioner, found ok.
- **PRCV-4:** General cleaning/greasing, replacement of gland packing, overhauling job of hand-jack assembly were carried out. C/V stroke was checked.
- **FICV-14:** C/V was opened from bonnet. Plug, seat, cage were taken out for inspection. All parts were cleaned, overhauled, gland packing was replaced finally assembled & reinstalled and checked stroke.
- **MICV-61**: Gland packing was replaced. General cleaning & greasing was carried out. Finally control valve operation was checked.
- **PICV-503**: C/V was opened from bonnet. Plug & seat were taken out for inspection. All parts were cleaned, overhauled, finally assembled & reinstalled and checked stroke.
- **PICV-137**: C/V was removed from line. Plug & seat were checked, seat and plug repaired as per required flow. All parts were cleaned, overhauled, finally assembled & reinstalled and checked stroke.
- **PICV-178**: C/V was opened from bonnet. Plug & seat were taken out for inspection. Stem was found bent so replaced with a new stem made in workshop. All parts were cleaned, overhauled, finally assembled & reinstalled and checked stroke.
- **HICV-109**: C/V was opened from bonnet. Plug & seat were taken out for inspection. Stem was found bent so replaced with a new stem made in workshop. All parts were cleaned, overhauled, finally assembled & reinstalled and checked stroke.

- **USV-400**: SOV was replaced with a spare one. C/V stroke was checked.
- **FICV-13**: Relay of valve positioner was changed. General cleaning and overhauling job carried out. C/V stroke was checked.
- **FICV-505**: Actuator diaphragm checked and found diaphragm support plate damaged so it was replaced with a new aluminium plate made in workshop as per as built drawing. General cleaning and overhauling carried out. C/V stroke was checked.
- **MICV-7:** Actuator diaphragm was replaced with a new one. C/V stroke was checked.
- **MICV-56, 57**: Removed from line and replaced with spare ones. (Aux boiler burner No. 1 & 2)
- Following important control valves general /cleaning/ greasing were carried out. Provided new gland packings wherever required. Also valve positioner was cleaned and air header & regulator also flushed finally stroke was checked.
- V-4, V-5, PRCV-11, MICV-13,14, 15 & 16.,, PICV-002 PICV-006A/B MICV 1 to 9, MICV 1A to 9A, MICV 24 to 32, LCV-15,16, 18 &19, PICV-16 and VS-18.

- **COMPRESSOR HOUSE JOBS :**

  - **Air Compressor (101J):**

    - Removed all Radial, Axial and key-phasor probes along with relevant junction boxes, speed pick-ups, T/C, pressure gauges and THIs to facilitate mechanical jobs. All proximitor JBs were cleaned. After completion of jobs the same were fixed back after cleaning/functional checking. Gap voltage adjustments for radial and axial probes were carried out.
    - HIC-101J : General cleaning and overhauling of governor positioner carried out. Checked & replaced lock out relay. Checked calibration of I to P convertor. Positioner was fixed and stroke checking was performed.
    - TRIP-101J: Mechanical trip feedback Limit switch was overhauled and checked its operation.
    - VS-101J**:** The Trip Solenoid valve was overhauled. Trip solenoid valve operation was checked.
    - 101J/105J MOP**:** Electronic governor actuator o/p signal cable & two nos of MPUs were removed to facilitate mech. maint. Jobs. After completion of jobs the same were fixed back.
    - 101J (Trip logic): Checked the setting for alarm and trip logic.
    - ZSH-18:Control valve OPEN/CLOSE Feedback Limit switch was overhauled and checked its operation.
    - HIC-101J for 101JT: Carried out general cleaning and overhauling. Replaced Air lock.
    - Checked air regulator of Governor positioner, stroke checked and overhauled.

- **Ammonia Refrigeration Compressor (105J):**

  - Removed all Radial, Axial and key phasor probes along with relevant junction boxes, speed pick-ups, T/C, pressure gauges and THIs to facilitate mechanical jobs. All Proximitor JBs were cleaned. After completion of Mech. jobs the same were fixed back after cleaning/functional checking. Gap voltage adjustments for radial and axial probes were carried out.
  - PRC-9 – General cleaning and overhauling of governor positioner carried out. Air
  - lock out relay was checked. Checked calibration of I to P converter. Positioner was fixed and stroke checking was performed.
  - TRIP-105J: Mechanical trip feedback Limit switch was overhauled and its operation was checked.
  - VS-105J: The Trip Solenoid valve was overhauled and its operation was checked.
  - 105J (Trip logic): Checked the setting for alarm and trip logic.
  - PRC-9 for 105JT: General cleaning, overhauling of governor positioner was carried out and checked stroke.

- **Synthesis Gas Compressor (103J):**

  - Removed all Radial, Axial and key-phasor probes along with relevant junction boxes, speed pick-ups, T/C, pressure gauges and THIs to facilitate mechanical jobs. All Proximitor JBs were cleaned. After completion of Mech. jobs the same were fixed back after cleaning/functional checking. All the Temp points were sealed. Gap voltage adjustments for radial and axial probes were carried out. Replaced probe of point 1V.
  - PRCV-12 (103JAT): Replaced the lip-seal of Piston/Cylinder, bottom O ring & positioner assembly with spare ones. Air lock relay was checked & found ok. Checked calibration of I to P converter. Checked air failure action and Stroke-checking was performed locally as well as from control room.
  - MIC-23 (103JBT): General cleaning and overhauling of governor positioner carried out. Checked lock out relay, cylinder leakage. Checked calibration of I to P converter. Positioner was fixed and stroke checking was performed.
  - VS-103J & VS-103: Trip solenoid valves VS-103J & VS-103 were overhauled. The coil of 103JAT Trip Solenoid Valve was checked and found ok.
  - 103J (Trip logic): Checked the setting for alarm and trip logic.
  - PRC-12 for 103JAT & MIC-23 for 103JBT: Carried out general cleaning and overhauling of Governor Positioner, stroke checked and completely overhauled.

.

- **FIELD INSTRUMENT JOBS:**

  - Removed & reinstalled different instruments (RTD, MPU, SV etc.) at 115-JA to facilitate Mech. Maint. jobs. Checked both MPUs of Peak 150 Electronic controller for 115-JA.
  - Calibration was checked of Alarm, AOP & Trip pressure switches of 115JA, 115JB
    - PAL- 432 PAL- 433
    - PSL-115JA PSL-115JB
    - PSLL-115JA PSLL- 115JB
  - Removed 115-C Gas outlet thermocouple to facilitate Mech. Maint. jobs and re fixed the same after completion of Mech. Maintenance Jobs.
  - In PGR Press. Switches PSL-122, PSL-124 and DP switch PDSL-123 were removed. Also the wirings of those switches were removed from JB. New impulse tubing for Press Tx of R1 & R2 provided.
  - 15-JA: 2 nos of bearing RTD at Turbine side were found damaged, soldering job carried out and fixed back.
  - PGR: In RTD JB new ferrules incorporated replacing old ones.
  - Various instruments were removed at 107-JAT to facilitate Mech. Maint. jobs. After completion of Mech. jobs the instruments were reinstalled.
  - Replaced Air/Filter regulator with new ones of I/P converters of the following control valves: FICV-482A/B. Trip SOV of FICV-482A was also replaced.
  - Provided low range Pressure Gauges at different locations in plant as per requirement of production staff for purging & maint. clearance purpose.
  - PI-57: Electronic Transmitter was replaced with a spare one.
  - Instrument air headers flushing were carried out at different locations.
  - LSHH-116: “Magnetrol” make switch element was replaced.
  - Boiler Inspection: Provided standard 10" dial size Pressure gauges on HP pump, steam drum, 112C and 107C. Pressure transmitter flushing and zero checking and other related work with Boiler inspection were carried out. After completion of inspection same were reverted to original.
  - 115-JA: Provided new tubing for oil coolers.
  - PGR: RTD sensors of TI-102B, TI-102G and TI-102H were replaced with spare ones.
  - Steam Drum (101F): Following instruments of steam drum were checked.
  - Level monitoring system- Level State.
  - Level transmitters.
  - Pressure Transmitters.
  - Level switches.
  - 112-C: Press Gauge of 0-16 Kg/cm^2 range was provided.

- 104-J: Calibration was checked of PSL-104J lube oil AOP switch.
- 116JA/JB: Provided new tubing for switches.
- Various instruments (MPU, PI, TI, Impulse tubing) were removed at 104-JAT to facilitate Mech. Maint. jobs. After completion of Mech. jobs the instruments were reinstalled.
- Damaged Cylinder O Ring of Aux boiler burner no 2 By-Pass Gas Trip valve was replaced.
- Unwanted instrument tubing from Burner no 1 & 2 of Auxiliary Boiler were removed.
- PRC-23: Damper was opened with Hand-jack assembly to facilitate Mech. Maint. Job**.**
- FI-63: Electronic transmitter was replaced with a spare one.
- General cleaning & Calibration were carried out of ISO & CDM related instruments.
- 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	TRC-10	30	TIC-1025
7	TRC-12	15	TI-0039	23	TI-0036		
8	PT-501	16	PT-503	24	PT-28		

- 4.26 Following CDM related instruments were calibrated:-

1.	FR-33	4.	FI-65	7.	TI-0043	10	AR-5
2.	PI-82	5.	FQI-181	8.	TI-0023	11	
3	FR-6	6	PI-676	9	TI-0065	12	

- **ANNUAL MAINTENANCE OF UPSS & GAS ANALYSER:**

  - **FUJI UPSS:**

    - Electrolyte was poured into the cells wherever required. Finally voltage readings of battery bank as well as each batteries were taken (Total no of cells: 175).
    - Load testing for the battery bank was carried out for 30 minutes.
    - Servicing of UPSS was carried out by IL service engineers. Air filters of all the cabinets were cleaned and the exhaust/cooling fans were checked. Voltage on all the test points was measured. Software data was checked by UPS loader & found ok.

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

    - Preventive maintenance of ABB make CO2 and CH_4 analyzers were carried out. CO_2 and CH_4 analyzers were checked. Condition of sample cells was good. Sensor CPU board, detector and cells were checked. Paper filters in sample system were replaced with spare ones. Sensors were cleaned.
    - Manual Calibration of CO_2 and CH_4 analyzers were performed & found ok.
    - Preventive maintenance of On line Oxygen analyzer AR-4 and Hydrogen analyzer ARC-3 was carried out. Cleaned sample path of AR-4 by flushing it with air jet. Cleaned sample conditioning system of ARC-3.
    - Manual Calibration of O_2 and H_2 analyzers were performed & found ok.

- **OTHER CONTROL ROOM JOBS:**

  - Old Annunciators were removed from control room.
  - 6.2 Levelstate and Hydrastep indicators were shifted from console to panel.
  - 6.3 Cables related to Annunciator, GE-Fanuc PLC and 102-J removed from
  - control room.

- **CONTINUOUS IMPROVEMENT:**

  - Replaced old PICV-24 control valve for better reliability & performance.

UREA PLANT

- **HITACHI (CO2) COMPRESSOR:**

  - All bearing RTDs fixed in turbine, HP case and LP case were removed to facilitate mechanical jobs. They were checked and re-fixed after the completion of the jobs.
  - Removed all Radial, Axial and key-phasor probes in turbine, HP case and LP case to facilitate mechanical jobs. After completion of the jobs, the same were re-fixed. Gap voltage adjustments for radial and axial and key-phasor probes were carried out.
  - Following Trip and Alarm Switches were cleaned, checked and calibrated:
  - PSLL-1801A, PSLL-1801B, PSLL-1801C, PSHH-1843A, PSHH-1843B, PSHH-1843C, PSHH-1839A, PSHH-1839B, PSHH-1839C, PSHH-1812, PSL-1813, PSL-1844, PSLL-1818A, PSLL-1818B, PSLL-1818C, PSL-1816, PSLL-1838A, PSLL-1838B, and PSLL-1838C.
  - Following low level and high level switches of separators were calibrated: LSHH-1804, LSHH-1806, LSHH-1808, LSL-1824, LSHH-1822, and LSL-1823.
  - Following level trolls were calibrated:
  - LICT-1803, LICT-1805, LICT-1807, LICT-1809, LT-1811, and LICT-1821.
  - Following control valves strokes were checked :
  - LICV-1803, LICV-1805, LICV-1807, and TICV-1808.
  - Following level transmitters were calibrated :
  - LT-1803, LT-1807 and LT-1805.
  - PT-1802 was calibrated.
  - Mock up test for Woodward governor 505E (HP and LP valve) was done. 4 ata admission Steam valve was also checked and found OK. Calibration of I/H converter was also done.
  - Local Control Panel and turbine local control box were cleaned, all wiring connections were tightened. All junction boxes were cleaned, terminal tightened and changed PVC cover for all Instruments.
  - Local speed indicator of turbine speed was opened and reprogrammed. After provision of rechargeable battery set in indicator the same was fixed back.

- **2.0 CONTROL/ MARSHALLING ROOM:**

  Following upgradation activities were carried out for DCS/ESD.

  - Upgradation of existing Yokogawa make Centum-CS DCS to Centum-VP DCS has been completed.
  - Existing CCC auxiliary console was replaced by new auxiliary console. Re-terminationof wires was carried out.
  - 2.3 New Centum-VP operator stations (HIS) are installed in place of Centum-CS operator stations (ICS).
  - Omron make ESD system was replaced with new Centum-VP DCS system .
  - One new system cabinet and one marshalling cabinet were provided.
  - Loop checking for Hitachi compressor logic, CCC controller, Woodward, hand switches, PB, Annuciator and key switches were carried out.
  - Provided new MCBs for additional operator station and new DCS System and marshalling cabinet.
  - 2.7 Power cables and V-net/IP cables were laid down for new DCS system.
  - 2.8 Earthing cables for system and panel were connected.

- **CAPITAL JOBS:**
  - Replaced LRCV-1501 control valve with new one.
  - Instrumentation job related to neem coating system were completed.
- **FIELD JOBS:**
  - Radio active source of LRC-1201 (Stripper level) was replaced with new one of activity 30 mili Curie and old source was kept in pit for disposal. Calibration was carried out as per new source.
  - LRC-1201 and LH-1201 detectors were removed and installed back to facilitate Mech.Maintenance jobs.
  - Autoclave source was removed and installed back to facilitate Mech. maintenance jobs.
  - 5 nos. of HP Thermowells were removed, hydro tested, and checked by inspectiondepartment. Found OK. All Thermowells were re-fixed.
  - Following level transmitters were Calibrated:
  - LIC-1421, LRC-1421, LI-1421, LI-1282, LT-1202, LIC-1353, and LT-1481.
  - Following ISO Quality affecting instruments were calibrated:
  - PT-5303, PT-4405, PT-1121, PT-1145, PT-1201, PT-1802, SI-1401A, SI- 1401B
  - FT- 1201, PICT-1202, PT-1421, and PT-1105.
  - Following level trolls were calibrated :
  - LIC-1235, LIC-1501, LIC-1502 and LIC-1203.

- Following Neem Oil Coating Project activities were carried out:
  - Cable tray installation
  - Panel preparation and installation.
  - Junction Box installation.
  - Cable laying, glanding, and termination.
  - Field instrument installation.

- Tubing for the I/P convertors of control valve LICV-1235, LRCV-1421, HICV-1206
- has been completed. Control valves strokes were checked, Found OK.
- 4.10 Minor tubing work for autoclave weep holes was carried out.
- All Plant JB's terminal were cleaned and tightened.
- 17 numbers of control valves were painted.

- **CONTROL VALVE:**

  - Following Control valves were dropped from the line, dismantled and complete overhauling was done. Provided new gland packing and bonnet gasket. Control valves were boxed-up and re-installed in the line. Stroke checked, Found OK.
  - FICV-1281, HICV-1422, PICV-1101, FICV-1204, LRCV-1235, PRCV-1202, HICV-1207, PICV-1202, PICV-1502A, HICV-1206, TICV-1353, and TRCV-1202.
  - Following control valves were removed from bonnet, dismantled and partial overhauling was done. Finally re-fixed the valve and stroke checked.

    HICV-1222B, FRCV-1421, TICV-1353, FICV-1302, HICV-1581, FWCV-1201, LICV-1201, PICV-1129, LICV-1281, FICV-1385, PRCV-1202, TICV-1701A, and TICV-1701B.
  - Preventive maintenance of the following control valves was carried out :

    LICV-1501B, PRCV-1201, HICV-1202, and LRCV-1501

OFFSITE PLANT & UTILITY

BOILER PLANT

- **CONROL ROOM JOBS:**
  - The DCS system was upgraded from Centum CS3000 to Centum-VP. Main activities involved are:
  - Replaced all three old HIS consoles with new centum-VP HIS consoles.
  - Replaced old Engineering station with new Centum-VP station with console.
  - Cable connection for all the three new HIS & ENGS Station was carried out.
  - Application project backup loaded in ENGS , FCS and all HIS .
  - Changed the Domain No. setting of the DCS System from 01 to 03 as per new system configuration.
  - V-Net IP/Vnet router installed in FCS0301 cabinet for connectivity with Urea/Ammonia DCS System. Corrections in Graphic pages were done & reports modified as per operation requirement.
  - Checked the functionality of the system and then handed over the DCS system for operation.

- Stardom PLC system was upgraded by carrying out following modifications.
  - CPU (Style 2) replaced with New CPU (Style 3) .
  - New PLC Engineering station was made ready and new PLC Software was loaded. Old Application project was converted from Ver 1.50.01 to 3.03.01. Changed the Version information in System card.
  - Downloaded the new project in CPU . Performed the online changes and Complete loop checking & logic checking were carried out.
  - OFC Cable was laid from Urea Plant to Boiler plant to provide indication of Ammonia/Urea tags in Boiler DCS. OFC Cable from Boiler/DM DCS to Narmada DCS connected at DM & Narmada plant.
  - Indication of Narmada plants were provided in Boiler DCS as per operation requirement.

    Note: Installation / commissioning of new Centum VP related work was carried out by service engr from YIL.

- **2.0 FIELD JOBS:**

  - Soot Blower related all TI & PI were removed. Also removed the impulse line of PT-6 and PIC-2.
  - MOV-12 related relay wiring checked & found o.k. from Instrument side.
  - Replaced the Emerson make transmitter of FR-22A (LNG) with Yokogawa make transmitter as zero of Emerson make trans. was drifting frequently. New transmitter. was calibrated and taken in service.
  - F.D. Fan & BFW pump turbine related field inst. were removed for mech. Maint job and installed back.
  - F.D.Fan Gov. local speed indication(digital) was given in parallal with SI – 5113 New O2 Analyzer sensor was removed from line.
  - Removed tubing & SOV connections from PICV-2 for removal of control valve Also removed fuse from 49 RZ7 of MCD-01.
  - Cleaning of 8 nos. of Furnace draft points, PSH-11& PSH-12.
  - Pressure.gauges PI-2, PI-3, PI-4 & PI-5 were calibrated w.r.t. Boiler inspection.
  - Soot Blower related inst. signal cable(PT & I/P) was removed from JBC-6 in field.
  - Signal cable of TIA-7 & PT-6 was disconnected and removed from Soot Blower panel in c/room.
  - Eye - Hye level indicator was disconnected from Soot Blower panel.
  - Shifted location of I.B.D. tank high/low level switch terminal JB. and tank level transmitter. (LT-5) to suitable location.
  - Installed new digital Pressure Switch for BFW turbine lube oil alarm.
  - RAH pneumatic motor air supply line filter lubricator was cleaned and refilled lubricator with oil.
  - Flushed air header of Boiler and DM Plant area and also checked joints for leakages.
  - TR-13 Furnace Temp. T/C was replaced with a new one.
  - Following Damper's limit switches, solenoids valves, air regulators etc were overhauled and checked its operation.
  - F.D. fan inlet damper and F.D. fan outlet damper.
  - Air heater inlet damper and Air heater outlet damper.
  - Checked instruments as per ISO calibration schedule.
  - Following field switch set value were checked :
    - PSH-11 Furnace press. high alarm switch (set at 300mmwc).
    - PSH-12 Furnace press. high trip switch (set at 400mmwc).
    - LSLL-1 of steam drum level checked and found ok .
  - EYE-HYE Electrodes were checked and tightened all the terminal.
  - High tech make steam drum level indicator electrodes were checked and tightened all the terminal.

- **<u>CONTROL VALVES</u>:**
  - Following control valves were removed from line for complete overhauling (Inspection/maint. of Seat/Plug, valve positioner, I/P Convertor, Actuator diaphragm,Gland packing, cleaning of Air supply regulator,replacement of gasket as required, c/v stroke checking etc.)
  - HICV-5154, HICV-5114, LCV-5111, HICV- 4401B .
  - Following control valves were opened from Bonnet for partial maintenance. (Inspection of Seat/Plug, valve positioner, Actuator diaphragm,Gland packing, c/v stroke checking etc.)
  - FCV-4502, TCV-4, V-5111(replaced diaph.- BFW coil bypass valve), PICV-4101, ESDV-4405.
  - Following control valve's preventive maintenance was carriedout. (General cleaning & c/v stroke checking.)
    - LRCV-4, TCV-25, FRCV-22, PICV-25, FCV-1 (100% BFW), FRCV-2 (30%),
    - PICV-5151, LCV-3

- **<u>IGNITORS:</u>**

  Cleaning & checking of both the burner's ignitor and scanner was done. [BNR#1, scanner 1A(left side) was replaced with new one as it was not working]

- **<u>D.M. WATER TREATMENT PLANT</u>:**
  - **DCS UPGRADATION JOB :**
    - Removed all three old CS 30000 HIS from DM CCR and installed new CENTUM VP HIS
    - Vnet/ETH & other Cable connection for both HIS Station was carried out.
    - Application project backup loaded in Boiler ENGS and all HIS .
    - Changed the Domain no. setting of the FCS & HIS from 01 to 03 as per new system configuration .
    - Corrections in Graphic pages were done..
    - New ETH Switch provided as existing ETH Switch failed in functioning.
    - OFC Cable between DM & Narmada DCS was lined up to provide the indication of Narmada tags in Boiler DCS.
    - Checked the functionality of the system and then handed over the DCS system for operation.

- **FIELD JOBS:**

  - FT-2003, Narmada/Raw water inlet to DM plant flow orifice and impulse line isolation valves were replaced with new one by mech. maint. FT was calibrated with new range (0-2500mmwc) and changed scale range of face plate in DCS (0-500Cu.mtr/Hr)
  - Wiring in new SOV panel for SMB/SBA-4 is completed.
  - Carried out Air supply header(1/2" SS piping with isolation valves) fabrication work for new SOV panel of SMB/SBA-4.
  - 2 x 60 KVA UPSS : AMC related work for 'EMERSON' make 2 x 60 KVA UPSS was carried out by Service engr. from EMERSON Network Power System Ltd. Performance of UPSS was checked with draining of battery for about two Hrs.
  - Cooling Tower Plant panel power was connected with 'EMERSON' make UPSS and taken in service.

- **NH3 STORAGE:**

  - Following control valves were opened from Bonnet for partial maintenance. (Inspection of Seat/Plug, valve positioner, Actuator diaphragm,Gland packing, c/v stroke checking etc.)

    LCV-3058B, LCV-3051B, LCV-3055B, PCV-3065B, PCV-3064B, PCV-3009

  - Following V-Automat make level transmitters were checked for calibration. LIC-3058A, LIC-3053A, LIC-3055A, LIC-3051A

  - Following press. switches were cleaned and checked for their set value. PSH-3063A, PSH-3057A, PSH-3060A, PSL-3071A & PSLL-3072A

- **COOLING TOWER:**

  - Q- 4411 (Elliott Turb.) All radial vibration probes , speed pick-up probe, local THI & PI were removed & reinstalled to facilitate mech. maint.
  - All the three level switches (LSAL-01, LSAH-01 & LSHH-01) of H-4411 (Surface condensor) were cleaned & calibrated.
  - Techogen. of Q-4402 & Q-4403 were cleaned, checked and fixed back.
  - Carried out general cleaning and stroke checking of LCV-01, LCV-02,
  - MICV-4401B, FCV-01, HICV-5153 & HICV-5154
  - Disconnected Ammonia UPS(FUJI) power supply from panel and connected Emerson UPS power supply (110V AC) with it.
  - Removed the old isolation transformer and fuses from control panel.
  - Fixed new MCB in panel and rerouted all the cables. Removed unwanted wires from the panel. Switched ON power from UPS.
  - Disconnected tachometer, PI/TI from P-4402 for mech. Maint. Jobs & reinstalled after mech. maint.

- HICV-5154 c/v was removed from line, lapping of plg/seat was carried out as it was passing. Provided gland packings. Valve was fixed back in line. Checked stroke.
- HICV-4401B C/V was removed from line, lapping of plg/seat was carried out as it was passing. Provided gland packings. Valve was fixed back in line. Checked stroke.
- Amm/Urea cooling water press. balancing valve was cleaned and checked operation. Inst. air supply tubing was carried out thr'o selector switch.
- Cleaning of control panel & tightening of all terminals inside panel was carried out.

- **I.G. PLANT:**

- Connected Emerson make UPS Power supply (110 V AC) to Old IG Plant inst. panel as earlier it was taken from MCC-2
- Servicing and calibration of ABB make H_2 analyzer of new I. G. Plant was carried out by Service engineer from M/s ABB in our presence.
- Attended all running jobs**.**
- **WEIGH BRIDGE (40 MT):**

  Ashbee make Weigh bridge maintenance was carried out by service engineer fro Ashbee. Calibration of weigh bridge was carried out with standard weights. Stamping of weigh bridge got done. Painting of platform was also carried out.

B&MH PLANT

- **POWER BUILD MAKE AUTOMATIC BAGGING M/C.:**
  - **<u>P/S No. : 1, 3, 7, 10 A& 10B</u>:**
    - Sack grip and bottom flapper with gate assy alongwith frame structure in all the above machines were replaced with new SS structure by mech. maint. section.
    - Carried out necessary ¼" ss tubing in all the above m/c. Checked calibration of all the m/c after mech. maint. job.
    - Cleaning & tightening of terminals in local , load cell JB & proxi s/w JB of all the p/s was carried out. Provided lugs in solenoid box where required.
    - Installed new air supply lubricators in P/S No. : 9A/9B. Carried out 3/8" SS tubing for these new air supply lubricators.
    - Carried out 3/8" SS tubing for solenoid's supply in SOV Box. of P/S No. :10A. P/S No. 9 & 10 : Hopper level s/w was cleaned and checked it's operation.
    - 10. Diverter 1 & 2 : Cleaned solenoids, relay, limit switch etc. and checked it's function.
    - 11. Checked wiring terminals in the main panel, local panel,Solenoid boxes, and load cell boxes.
    - 12. Cleaned and checked CSC-25, relay board, fuses, and all sensors.
    - Checked functioning and calibration of all Packer Scales.
    - 14. All solenoid valves were overhauled.

  - **<u>METTLER WEIGH SCALES</u>:**

    Carried out cleaning & calibration of Mettler weigh scales located at railway platform and empty bag storage area. Cleaning & painting of all Mettler weighing scale's platform was done.

  - **<u>DUST EXTRACTION SYSTEM</u>:**
    - Cleaned the Dust Extraction Panel.
    - Cleaned all field instruments (C/V,FlowTx,LevelTx etc.) related to DES.
    - Fixed receiver gauge on level transmitter output of dust dissolving tank.

  - **<u>EFFLUENT TREATMENT PLANT</u>:**
    - 1 Overhauling of SBA control valve and its valve positioner.
    - 2 Cleaning of sampling system and calibration of Ammonia analyzer.

- **NARMADA WATER TREATMENT PLANT:**

  - **DCS upgradation job:**

    - Removed old HIS (CS 3000 Software) from SSNNL CCR and installed new HIS (CENTUM VP Software) .
    - Vnet/ETH & other Cable connection for all the three new HIS & ENGS Station was carried out.
    - Application project backup loaded in ENGS and all HIS .
    - Changed the Domain no. setting of the DCS System from 02 to 04 as per new system configuration .
    - Console provided for ENGS Station. Corrections in Graphic pages were done . Checked the functionality of the system and then handed over the DCS system for operation.

- **NARMADA OFF-TAKE POINT (JASPUR) :**

  - FI-6001, Magnetic flow meter was replaced with new one by service engineer from Krhone-Marshall in our presence and taken in service.

ELECTRICAL

AMMONIA PLANT

- Preventive maintenance of transformers TR-21, TR-6, TR-22 and TR-Start-up heater was carried out and the job details are as under:
  - Inspection of primary and secondary cable boxes, end termination, checking and tightening of connections.
  - Recommended Tests & Measurement of parameters like Insulation resistance, BDV of transformer oil was carried out on each transformer.
  - Alarm & tripping contacts of Buchholz relay and MOG were checked.
  - Condition of silica gel was checked. Accordingly discharged silica gel was recharged.
  - Oil leakages from the transformers were attended and damaged gaskets were replaced.
  - Buchholz relay and flange valve gasket of startup heater transformer replaced. Buchholz valve gasket of TR 6 replaced
- Painting of TR 6 also carried out to prevent further corrosion of Transformer body from Ammonia vapors, Urea dust and humid atmosphere.
- Preventive maintenance carried out on all the feeder compartments in MCC-5, MCC-5A, MCC-5B & MCC-16 and the job details are as under:
  - Checked the tightness of cables, wiring terminals and power & control circuit connections in the feeders.
  - Thoroughly cleaned the feeder compartments.
  - Replaced damaged/ worn out contacts etc.
  - Two Lyra contacts and cable of 112J motor were found over heated. Replaced lyra contact and attended the cable.
  - One lyra contact and link cable of 2004J motor found over heated. Replaced the lyra contact and attended the cable
  - Out going cable of cooling tower fan motors K 4404/1, 2, 3 were found over heated. Re termination carried out with Aluminium lugs.
  - Replaced some portion of Aluminium bus from SFU to contactor of H4401/1 due to over heating.
  - Re lugging the power link cable of MP 4411/A due to over heating and done fresh connection by providing Bi metallic washers.
- Overhauling of following motors were carried out:

  104JA, 117J AOP, 118JB, 106J, 101BJT and 116JB
- Terminal box of lube oil pump of 103J and 101J was also checked.

- Preventive maintenance of Motor operated valve actuators SP1, SP2, SP3, SP4, SP5, SP70, SP71 SP 52, SP158 & SP159 carried out as per following job details.
    - Limit switch & torque switch setting done and indication was checked from remote as well as local.
    - Oil level checked & top up done.
    - Servicing was done & operation was checked from remote as well as local.
    - Power problem in Synchro pack assembly of SP70, fault rectified by replacing new PCB.
- Testing and calibration of power analyzer installed in MCC-16 for 117J syn-gas compressor have been carried out.
- Testing and Servicing of TMG make Air Circuit breakers were done in respective MCCs.
    - General cleaning, dust /rust/carbon removal from make-break/sliding electrical contacts. Complete overhauling of all mechanical parts and lubrication of rotating parts was done.
    - Insulation resistance between breakers pole to pole and between breaker's poles to earth was checked and recorded
    - Healthiness of the internal wiring and terminal tightness was checked.
    - The breakers contact making and breaking time, electrical as well as mechanical operation of circuit breaker, closing and tripping mechanisms were checked & recorded

UREA PLANT

- **Modification and New Installations:**
  - Installation, commissioning & testing of electrical equipments such as neem oil transfer pump motors, P-1901/A&B and lighting arrangements for operation of neem oil coating system in urea plant .
  - Provided new earthing to the newly installed vessel on PT top and new light fittings for proper illumination near the vessel.
- **Scheduled Preventive Maintenance**
- Preventive maintenance of transformers TR-17, TR-18, TR-20, and TR-7B & TR-7A was carried out and the job details are as under:
  - Inspection of primary and secondary cable boxes, end termination, checking and tightening of connections.
  - Recommended Tests & Measurement of parameters like Insulation resistance, BDV of transformer oil was carried out on each transformer.
  - Alarm & tripping contacts of Buchholz relay and MOG were checked.
  - Condition of silica gel was checked. Discharged silica gel was recharged.
  - Oil leakages from the transformers were attended and damaged gaskets were replaced.
  - Buchholz relay and gaskets of TR 7B replaced and also install new breather in transformer.
- Painting of transformers TR-7A, TR-7B & TR-17 to protect it from corrosion due to Urea dust for enhancing its life.
- Preventive maintenance of the all feeder compartment in MCC 6, MCC 14, and MCC 15 were carried out and the job details are as under:
  - Checked the tightness of cable, wiring terminals and power & control circuit connections in the feeders.
  - Thoroughly cleaned the feeder compartments.
  - Replaced damaged/ worn out contacts, etc.
  - P-1351 outgoing cable was over heated. Re tapping done after cleaning.
  - Replaced the Enercon meter of incomer 3 of MCC 15 as the same was not showing the correct readings.
  - Power & control cable of P 1114/AB, M 1122 and lube oil heaters were disconnected and removed as these equipments are removed from the plant.
  - Replaced the over heated wires of P 1505/B.

- Complete overhauling of following LT motors.

  P-1408, P-1501, P-1506, M-1402/1&2, M-1419, M-1421, M-1401/A&B, K-1401/ 2, M-1403/1, 2 & 3, P-1815/A&B, P-1817, P-1505/A&B, P-1401/B, P-1204/B.

- Preventive maintenance of MOV actuators of 1102, 1201, 1202, 1203, 1501, 1801 and 1102 carried out as per following job details,

  - Limit switch & torque switch setting done and indication was checked from remote as well as local.
  - Oil level checked & top up done.
  - Servicing was done & operation was checked from remote as well as local
  - Power problem in Synchro pack assembly of 1102 ,fault rectified by replacing new PCB .

- Preventive maintenance of LT Air circuit Breakers of TMG make, installed in MCC 6 was carried out.
  - General cleaning, dust /rust/carbon removal from make-break/sliding electrical contacts. Complete overhauling of all mechanical parts and greasing of rotating parts was done.
  - Insulation resistance between breakers pole to pole and between breaker's poles to earth was checked and recorded
  - Healthiness of the internal wiring and terminal tightness was checked.
  - The breakers contact making and breaking time, electrical as well as mechanical operation of circuit breaker, closing and tripping mechanisms were checked & recorded
- Preventive maintenance carried out of rope switches installed on following Conveyors.
  - M-1419, M-1421 & M-1403 train
- Replacement & testing of Electrical local control stations of P-1202/A & B and P-1505 A & B motors by stainless steel local control stations to enhance its life.

OFFSITE & UTILITY PLANT

- **Modification and New Installations**
- Revamping of MCC-2 sec A.
  - Removed all power and Control cables from old panel and s shifted to stores.
  - The existing panel foundation is modified according to new panel and the width of the existing cable trench has been widened for safe access to the feeder cable terminations at bottom of the panel.
  - Installation of the panel was done all the power and control cables were terminated to the new panel as per old equipment and new panel drawings.
  - The existing 1Cx800 mm² incomer power cables were terminated with clamps, which were found corrosive. These were replaced with new crimping type cable terminations.
  - The breaker panels were provided with M/s Siemens make latest numerical relays, for protection. The relay parameter settings were carried out.
  - New Energy meters were provided for the feeders feeding power to the effluent motors, as per PCB requirement.
  - After testing and commissioning, new panel was charged.
- **Scheduled Preventive Maintenance**
- Preventive maintenance of transformers TR-2A, TR-2B, TR-3A, TR-3B, TR 8, TR-11, TR-12, TR-13 TR-14, TR-16 and TR-23 was carried out and the job details are as under:
  - Inspection of primary and secondary cable boxes, end termination, checking and tightening of connections.
  - Recommended Tests & Measurement of parameters like Insulation resistance, BDV of transformer oil was carried out on each transformer.
  - Alarm & tripping contacts of Buchholz relay and MOG were checked.
  - Condition of silica gel was checked. Discharged silica gel was accordingly recharged.
  - Oil leakages from the transformers were attended and damaged gaskets were replaced.
  - Radiators of TR. 2A were replaced by new one.
  - Buchholz relay of TR 2A, TR 8, TR 12 replaced and repaired the Buchholz relay of TR 23
  - Attended oil leakage from LV bushing and replaced the gasket of LV bushing of TR 12. Flange valve gaskets replaced.

- Painting of Transformer No 2B, 3A, TR 8, TR 12, TR 14 and TR 23 also carried out to prevent the further corrosion of transformer body by Ammonia vapour, Urea dust, Acid fumes and humid atmosphere.

- Preventive maintenance of the all feeder compartments in MCC-1, MCC-2F, MCC-11 and MCC-13 was carried out and the job details are as under:

  - Checked the tightness of cables, wiring terminals and power & control circuit connections in the feeders.
  - Thoroughly cleaned the feeder compartments.
  - Replaced damaged/ worn out contacts, etc.
  - Power Contacts of K 5306 replaced as pitting was found on the existing Contacts
  - Replaced the insulator of out going bus bar of feeder No 2 (MCC-13) as the same was found broken.

- Overhauling of the following LT motors were carried out:

  P 5112/A&B, P 5120, P 5111/B, P4412, P4401/B, P 4403 and P 5113

- Preventive maintenance of MOV actuators of FL2(MAIN) ,FL2(BYPASS),S2 (MAIN),S2(BYPASS),S5,S6,4403(700) 4403(900), 4401/A, 4401/B, 4401/C, 4401/D carried out as per following job details.

  - Limit switch & torque switch setting done and indication was checked from remote as well as local
  - Oil level checked & top up done.
  - Servicing was done & operation was checked from remote as well as local.
  - Power problem in Synchro pack assembly of FL2 (Main) ,fault rectified by replacing new PCB.
  - Hand wheel O-ring of S2 (BYPASS) was damaged, O-ring was replaced with the new
  - Centre column O-ring of S5 was damaged, O-ring was replaced with the new
  - Switch mechanism of 4401/A was rectified by replacing new assembly

- Preventive maintenance of LT Air circuit Breakers of TMG make installed in MCC 2 was carried out.

  - General cleaning, dust /rust/carbon removal from make-break/sliding electrical contacts. Overhauling of all mechanical parts includes replacement of defective auxiliary switch; lubrication of rotating parts was done.
  - Insulation resistance between breakers pole to pole and between breaker's poles to earth were checked and recorded
  - Healthiness of the internal wiring and terminal tightness was checked.

- The breakers contact making and breaking time, electrical as well as mechanical operation of circuit breaker, closing and tripping mechanisms were checked & recorded

- **<u>Scheduled Preventive Maintenance</u>:**

- Preventive maintenance of transformers TR-1A, TR-1B, TR 4A, TR 4B, TR-15 and TR-DG set was carried out and the job details are as under:

  - Inspection of primary and secondary cable boxes, end termination, checking and tightening of connection.
  - Recommended Test & Measurement of parameters like Insulation resistance, BDV of transformer oil was carried out on each transformer.
  - Alarm & tripping contacts of Buchholz relay and MOG were checked.
  - Condition of silica gel was checked. Discharged silica gel was recharged.
  - Oil leakages from on the transformers were attended and damaged gaskets was replaced.
  - Buchholz relay and breather of TR 4A replaced by new one and repaired the Buchholz relay of TR 4B . Gaskets were also replaced.
  - Oil leakage from OTI and WTI of transformer 1A attended and replaced the gaskets.
  - Oil leakage from CT bushing of TR 1B attended and replaced the gasket of CT bushing.

- Servicing of HHE make On Load Tap Changer of Transformer 1A is carried out as per following job details

  - Rotary contact and rotary mechanism checked thoroughly.
  - Washed the tap changer with hot insulating oil and replaced the insulating oil of tap changer
  - Checked the operation of tap changer for all tap position from remote and local as well as by manual and by motorized operation.
  - Remote and local indication for all tap positions are also checked
  - Attended oil leakage from the tap changer by replacing the 'O' ring and gaskets

- Preventive maintenance jobs were carried out in 66 KV switch yard

  - Cleaning of insulators of all CT & PT units, bus bar supports lightning arrester, breakers, etc.
  - Insulation Resistance was measured of all the CTs
  - All the moving parts of isolators were cleaned and lubricated.
  - 11 KV VCB panels were cleaned and outgoing cable terminals were checked for its tightness and hot spots on bus bar connections.
  - Maintenance of SABARMATI feeder isolator was carried out.

- Preventive maintenance jobs were carried out in 11 KV MPSS:
    - Checked the tightness of outgoing terminals.
    - Thoroughly Cleaned the feeder compartments of both Jyoti and Siemens panel
    - Replaced damaged /worn out contacts, etc.
    - Checked power & control circuit connections in the feeders.
- Preventive maintenance of the all feeder compartment in DG MCC, MCC-10, MCC-10 A and Jaspur MCC was carried out and the job details are as under:
    - Checked the tightness of cables, wiring terminals and power & control circuit connections in the feeders.
    - Thoroughly cleaned the feeder compartments.
    - Replaced damaged/ worn out contacts, etc.
    - Out going B phase fixed contact of MP 6205 (MCC-10/AB) was damaged due to improper alignment and causing sparks. Cleaned and properly aligned.
- Preventive maintenance and servicing of HT Jyoti make Breakers installed in 11KV MPSS were carried out.
    - General cleaning, dust /rust/carbon removal from make-break/sliding electrical contacts. Complete overhauling of all mechanical parts includes replacement of defective mechanical parts, greasing of gears was done
    - Insulation resistance between breakers pole to pole and between breaker's poles to earth were checked and recorded
    - Healthiness of the Limit Switches, internal wiring and terminal tightness was checked.
    - The breakers contact making and breaking time was checked & recorded for each VCB.
    - Vacuum & breaker contact resistance of power contact were checked and recorded
    - Electrical as well as mechanical operation of circuit breaker, closing and tripping mechanisms was checked.

B&MH PLANT

- **<u>Modification/New Installation</u>:**

- Power, control and communication Cables laid and JBs installed in Silo for new reclaim machine

- **<u>Scheduled Preventive Maintenance</u>:**

- Preventive maintenance of transformers TR-5A & 5B was carried out and the job details are as under:

    - Inspection of primary and secondary cable boxes, end termination, checking and tightening of connection.
    - Recommended Testing & Measurement of parameters like Insulation resistance, BDV of transformer oil was carried out on each transformer.
    - Alarm & tripping contacts of Buchholz relay and MOG were checked. Servicing of Buchholz Relay of transformers was carried out.
    - Condition of silica gel was checked. Discharged silica gel was recharged.
    - Oil leakages from on the transformers were attended and damaged gaskets was replaced.
    - LV bushing oil leakage in TR 5A attended and replaced the LV bushing gaskets.
- Preventive maintenance of the all feeder compartments in MCC-4 and MCC 4A (New &Old) were carried out and the job details are as under:

    - Checked the tightness of cables, wiring terminals and power & control circuit connections in the feeders.
    - Thoroughly cleaned the feeder compartments.
    - Replaced damaged/ worn out contacts, etc.

- Overhauling of following LT motors was carried out:

    M 2110, M 2112, M2116/ 1 to 5, M 2117, M 2121 (old & new), M 2122 and M2122/A1 & A2

- **Non plant Areas**

- **Scheduled Preventive Maintenance:**

- Preventive maintenance of transformers TR-10A and TR-10B was carried out and the job details are as under:

    - Inspection of primary and secondary cable boxes, end termination, checking and tightening of connection.
    - Recommended Tests & Measurement of parameters like Insulation resistance, BDV of transformer oil was carried out on each transformer.
    - Alarm & tripping contacts of Buchholz relay and MOG were checked. Servicing of Buchholz Relay of transformers was carried out.
    - Condition of silica gel was checked. Discharged silica gel was recharged.
    - Oil leakages from on the transformers were attended and damaged gaskets was replaced.

CIVIL

AMMONIA PLANT

AUXILIARY BOILER

- Repairing of Refractory lining work for Primary Reformer and Auxiliary Boiler.
- Dismantling and Excavation for the repair of corroded / damaged drain pipe line near Ammonia Control room.
- Epoxy lining on D.M.Tank Foundation.
- Dismantling of Brick work and PCC for laying Electrical Panel in MCC-2E Including constructing new cable trench etc.
- Necessary civil work for installation of new DCS system in Ammonia Control room.

UREA PLANT

- Repair of Damaged doors in urea plant.
- Repair of Damaged foundation in Urea Plant by providing Epoxy plaster.
- Fixing of Pre-coated G.I. Sheet on Transformer 7A & 7B in Urea Plant.
- APP Water Proofing on Transformer Slab in Urea Plant.
- Epoxy Nozzles grouting in scrapper floor at bottom of prill tower.
- Epoxy paint in Bucket room.
- Bitumastic lining in Prill cooling system floor.
- I.P.Net coating on wall of Transformer 7A & 7B and prill cooling systems columns.
- Civil work and anchor fastener for Bucket room at Prill tower.

OFFSITES & UTILITY PLANT

OFFSITES:

- Flow Meter Valve Chamber dismantling and reconstructing and others area concreting work at Jaspur Pumping Station.
- Replacement of Chlorination and Alum dosing pipe line by providing “U” PVC at Narmada WTP Plant.
- Acid proof brick lining in ETP Tank.
- Shifting of debris in various location in plant.

UTILITY:

- Dismantling of RCC drain chamber and fixing valve for drain purpose in Urea cooling tower.
- Slab Casting on valve chamber in Urea Cooling tower.
- Repairing of plaster work on Urea and Ammonia Cooling tower basin wall.
- Chlorination “U” PVC pipe line extent at both side in all cooling tower.
- Bitumastic lining in I.G.Plant floor.
- Ammonia & Urea cooling tower basin wall cut out filling by concrete.
- Replacement of water proofing plywood sheet on sand filter tank near Ammonia Cooling Tower.
- RCC Foundation for pump in Urea Cooling Tower.
- Dismantling Brick wall inside the Ammonia & Urea Cooling Tower Basin.

B&MH PLANT

- Tiles fixing on wall and room at bagging 1st floor.
- Epoxy painting on wall and slab bottom at bagging 1st & 2nd floor.
- S.S. Railing in Silo Conveyor gallery (M-2117).
- Monolithic Plaster on Hoper floor and columns at bagging 1st floor.
- I.P.Net Coating on Conveyor gallery, columns and Slab Bottom at bagging plant.
- Plaster repairing in various location in bagging plant.
- White wash, Snowcem and Epoxy painting work inside and out side in bagging plant.

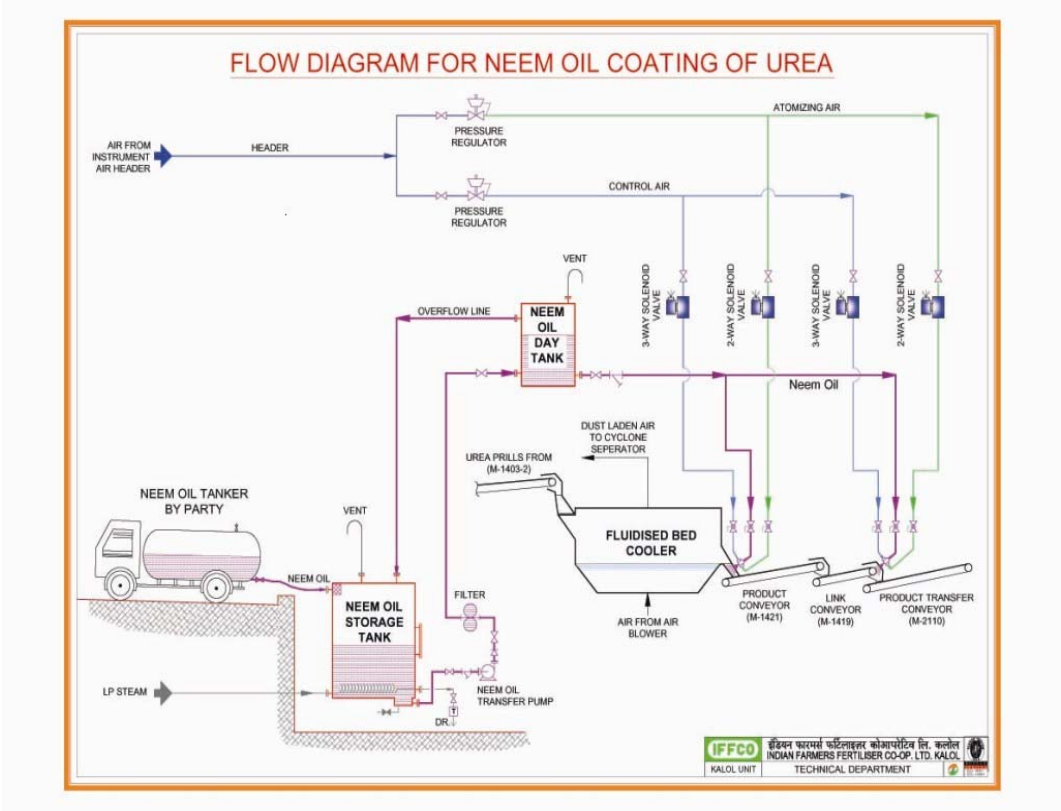
TECHNICAL

UREA PLANT

- **INASTALLATION OF SYSTEM FOR NEEM COATING ON UREA PRILLS:**

As per the Gazette notification No. S.O. 1945 (E) Dated 10.08.2010, the fertilizer (Control) order, 1985 has been amended to include the manufacture and sale of Neem coated Urea containing a minimum Benzene-soluble (Neem oil) content of 0.035% by weight in the coated Urea.

As per flow diagram enclosed below, Neem coating system mainly consist of Neem oil storage tanks with heating coil , Neem oil transfer pump, Neem oil day tank, duplex filter, air pressure regulators, solenoid valves and spray nozzles along with assoiciated piping network.



In normal process as per above flow diagram, Neem oil from storage tanks at ~70^{0}C pumped to day tank and from day tank it is fed to spray nozzles through gravity feed. Continuous overflow has been maintained from day tank to storage tanks. In spray nozzle automatic cleaning is carried out by cut off of control air and atomizing air and neem oil is fed through nozzle which is externally mixed and sprayed on urea prills coming out from fludised cooler.

- **SPECIFICATIONS OF MAIN EQUIPMENTS INSTALLED IN NEEM OIL COATING SYSTEM:**

  - **Neem Oil Storage Tanks (T – 1901 A/B):**

    Neem oil tanks have been designed and fabricated in-house from 5 mm thick SS304 plates. Plates were procured from M/s Riddi Steel (P.O. No. 20100730) and rolling of plates carried out at M/s Chaudhary, ahmedabad (W.O. No. 20100910). Steam heating coils (3/4Inch size, SS304) also fabricated in house, hydrotested and installed inside the tanks. Other details of tank are as under:

No. of tanks	: Two
Type of tank	: Horizontal Cylindrical tank
Fluid	: 100 % neem oil
Length of tank	: 8000 mm
ID of tank	: 1850 mm
Capacity	: 21 m^3
Operating temperature	: 50 – 60º C
Operating pressure	: Atmospheric
Design temp	: 100º C
Design pressure	: Full of water
MOC of tank	: SS-304

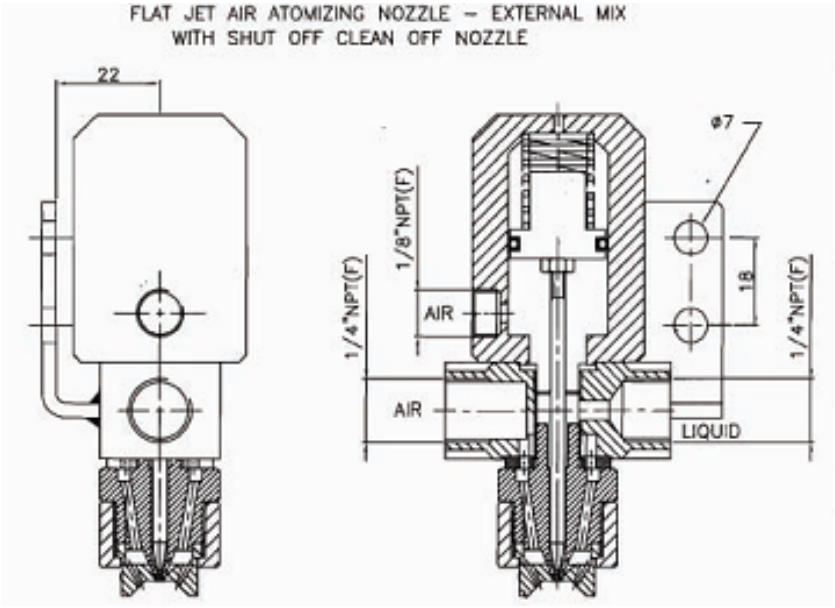
  - **Neem Oil Transfer Pumps (P-1901 A/B):**

    Neem oil transfer pumps (Gear type) have been procured from M/s Matz pump (P.O. No. 20100840).

No. of pumps	: Two (1 in operation+ 1 stand by)
Type	: Gear
Fluid	: 100 % neem oil
Density of fluid	: 0.925 @ 40 deg C
Viscosity of fluid	: 140 cp @ 40 deg C
Capacity	: 2 to 5 lpm (120 lph to 300 lph)
Suction Pressure	: Atmospheric
Suction temperature	: 50 – 60º C
Discharge pressure	: 3.5 kg/cm^2g
Design temp	: 100º C
MOC of pump (all wetted parts)	: SS 304
Total head	: 37.8 m
Suction strainer	: 40 micron
Discharge strainer	: 100 Micron

- **Spray Nozzles:**

  Spray nozzles have been procured from M/s Spray Tech. Mumbai. Nozzles have been installed with air filter cum pressure cum regulator for atomization air & control air, three way solenoid valves for control air and two way solenoid valves for atomization air for automatic control of oil and air from control room.



- **Spray Nozzles at Fluidized Bed Cooler Outlet Belt:**

  Type **:** Air atomizing, Flat pattern, External Mix Spray Nozzle with Automation (cut-off / cleaning) facility Equivalent to EF 150 of BETE or SUE 18 A of Spraying System Co. USA, or equivalent SUE 18 A Spraytech, Mumbai

No. of nozzle	: Six (6) + Six (spare)
Fluid spray	: 100 % Neem oil @ 50 – 60º C
Liquid particle size	: 100-150 microns
Capacity of nozzle	: 8 lph
Pressure at spray nozzle	: 0.7 kg/cm^{2}g
Width covered by fluid	: 400 mm
Distance of nozzle from urea	: 12” to 15” as recommended by vendor
MOC	: SS-304

- **Spray Nozzles for Link conveyor (M-1419):**

  Type **:** Air atomizing, Flat pattern, External Mix Spray Nozzle with Automation (cut-off / cleaning) facility equivalent to EF 450 of BETE or SUE 28 A of Spraying System Co. USA, or equivalent SUE 28 A Spraytech, Mumbai

No. of nozzle	: Two (2) + two (spare)
Fluid spray	: 100 % Neem oil @ 50 – 60º C
Liquid particle size	: 100-150 microns
Capacity of nozzle	: 24 lph
Pressure at spray nozzle	: 0.44 kg/cm^{2}g
Width covered by fluid	: 400 mm
Distance of nozzle from urea	: 12” to 15” as recommended by vendor
MOC	: SS-316

- **Flow Meter (FI-1901) :**

  Procured from M/s Eureca Ind Equipment vide P.O. No.20101071

Type of flow meter	: Rota-meter
Flow meter flow range	: 0 to 5 lpm (0 to 300 lph)
Operating temperature	: 50 – 60º C
Operating pressure	: 3.5 kg/cm^{2}g

- **Temperature gauges (TI-1901& TI-1902):**

Fluid	: 100 % Neem oil
Range of TI	: 0 to 100º C

- **Pressure gauge for Neem oil:**

PI-1901	: 0 to 5 kg/cm^{2}g
PI-1903 & PI-1904	: 0 to 1 kg/cm^{2}g

- **Pressure gauge (PI-1902):**

Fluid	: Instrument Air
Range of PI	: 0 to 10 kg/cm^{2}g

All the equipment erection and piping job for unloading line, steam line, pumps suction lines, Neem oil transfer line , overflow line, atomizing air line, control air line and necessary platform and ladder etc. have been carried out by M/s Smitha Engineering under a separate Work Order for the Job..

UTILITY & OFFSITE PLANT

- **Reliability improvement in DM water supply to BHEL Boiler :**

  In existing system of DM water supply to BHEL boiler and Urea Plant, two pumps of 50m^3/Hr. capacity at 47m head and 78m^3/Hr capacity at 38 m head were installed with 4'' discharge line. These pumps and line size are not adequate to supply total (100%) DM water requirement of BHEL boiler, when condensate from Urea is of Off-Spec quality and not suitable to recycle back to BHEL Boiler.

  Therefore, to improve reliability in supplying DMW to BHEL boiler following jobs have been carried out as per approved P &ID No. 03-DC-01306 :

  - Provision for new additional pump P-4203 A and new DM Water pump discharge line with increased size from 4 Inch to 6 inch up to boiler has been installed to ensure about 90m^3/hr DMW flow to BHEL boiler.
  - New bigger size (6Inch NB) SS suction line installed from DM water storage tank to DM water pumps in place of existing 4" suction line with separatetapping for each pump with isolation valve.
  - New nozzle in DM water tank has been provided for providing suction to new DM water pump.
  - New FI has been installed on DMW to SGP before hook up of line u/s of LCV-4 in BHEL boiler.

  Advantage derived out of the implementation of the above modification is more reliable system for supplying DM water to BHEL Boiler.

- **Installation of 100m^3/Hr. capacity pump (P-4101A) and associated piping in New CT sump :**

  Presently, additional surface condenser (101-JCB) is not being utilized fully due to CW limitations and problem of lower vacuum in surface condenser of Ammonia plant is faced during summer months.

  For effective utilization of the available surface area of 101-JCB and also to overcome problem of insufficient CW flow to 101-JCB to some extent, it was decided to use one of two nos. raw water pump (P-4101-A/B) and install the same in new CT at available spare suction nozzle in sump of new CT for additional CW supply of 1000 m^3/hr to 101-JCB during summer months through P-4401 C/D CW circuit.

  Accordingly, pump was installed on new foundation along with suction and discharge piping. Two tappings of 16Inch NB taken from the spare nozzle of New CT sump and from one tapping 16Inch suction line erected with valve , bellow etc. In other tapping isolation valve has been provided for future purpose. Pump discharge line of 20 Inch NB erected and hooked up with P-4401E discharge line .

The advantages envisaged with this modification are as under:

- Better vacuum in surface condensers of Ammonia plant above 670 mm Hg in summer months also and thus saving of Rs. 35 Laks annually.
- Improvement in utilization of new cooling tower, which is presently operated at 50% capacity.
- Higher CW circulation rate in new CT may also help in improving the circulating CW quality w.r.t. SRB and may help in reducing corrosion rate in new CT along with improved Cl_2 dosing system.

- **Installation of new 300 m3 / hr capacity fanless cooling tower (EWR No: X- 187):**

  During plant turnaround, all cooling towers are taken for preventive maintenance and cleaning . During this period, circulating cooling water requirement in utility plants for air compressor, IG plant and ammonia storage refrigeration compressor is met by raw water which is used once through as CW in cooling water circuit and hot returned water is drained to open channel leading to additional bulk effluent.

  Therefore to save raw water, 300m^3/hr ejector spray jet type CT has been installed with inhouse design and fabrication work near CT basin Nos. 7 & 8 which is Fan-less and Fill-less type Cooling Tower, with high end features such as consistent cooling and low maintenance. In this cooling tower, hot water comes directly into contact with ambient air and cooling is achieved by small portion of water getting converted to vapor, thus carrying away the latent heat of evaporation.

- **Following jobs have been carried out for installation of New CT :**
  - RCC basin of 6mmx6mm has been constructed on RCC columns.
  - CW return lines from compressor houe, CW return line from storage area and CW return line from CG circulator connected to new common header with I/V and taken to New CT.
  - From CT basin, common suction line provided to P-4418 A/B
  - Structure for fixing of FRP louvers has been erected by M/s Smitha Engg. and FRP lining work on the same is carried out by M/s Ionex Engg.
  - In house designed FRP louvers have been molded and supplied by M/s Ionex Engg. and spray nozzles (3/4Inch, Nylon-6) have been fixed at the top on 3Inch SS- 304 headers.

- Necessary platform on top of CT for nozzle replacement and approach has also been provided.
- **Selection of material :**
    - Structure : Made from heavy M.S.Angle /Tee /Channel sections and lined with FRP
    - Louvers : Made from NPG Based Isophthalic Resin FRP for corrosion resistance and good Mech. properties
    - Top Header and pathway Support : RCC and SS pipe
    - Water distribution headers : Made from CS - FRP lined and SS-304
    - Nozzles : Made from Nylon-6 - Capacity 1.92 m3 / Hr at 2.0 Kg/ cm2 (150Nos.)
    - Nuts & Bolts : SS
    - Sump : Concrete