

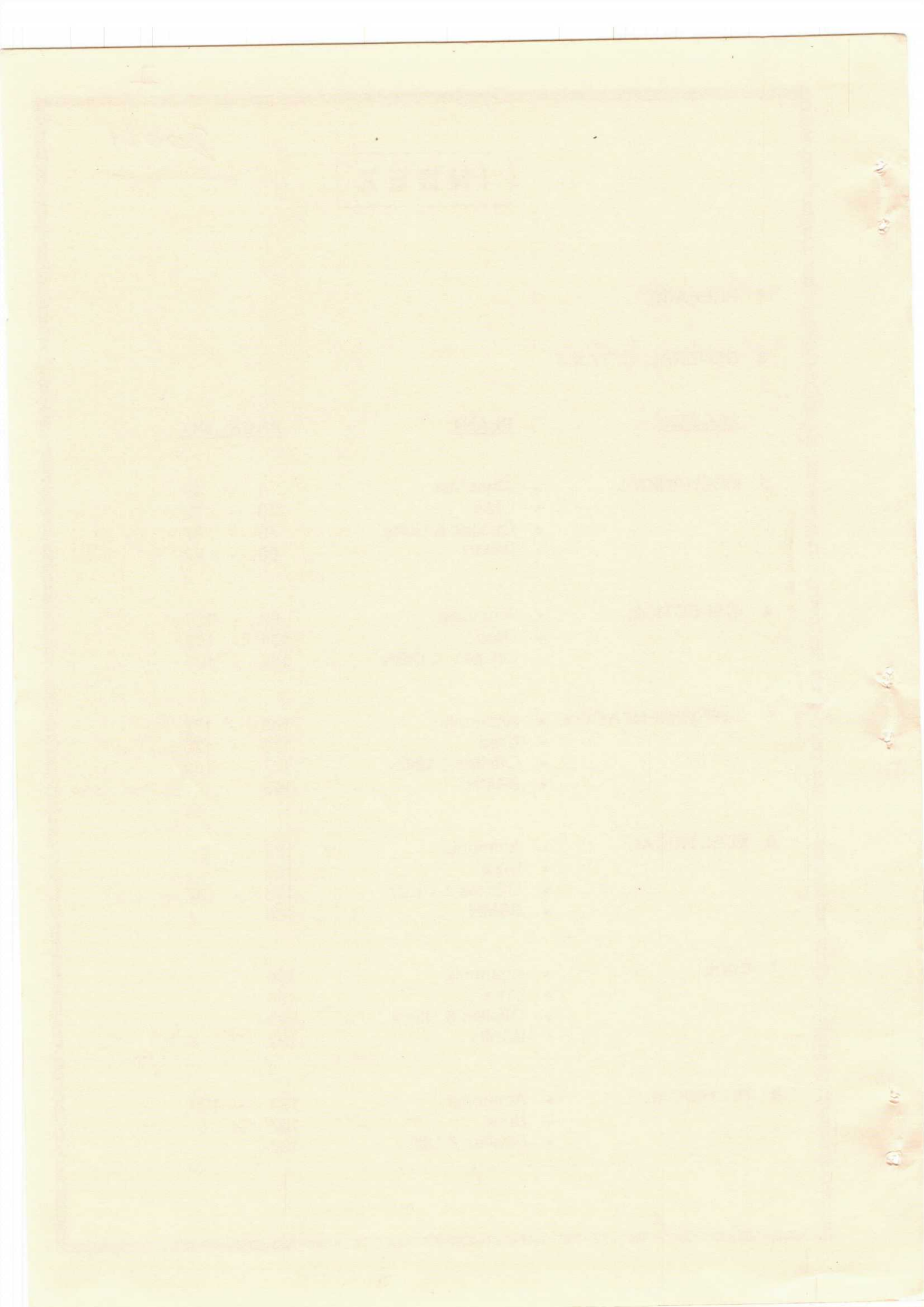
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2004

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## 2

# P R E F A C E

Plant Turnaround for the year 2004 was carried out from 20-05-2004 to 09-06-2004 for preventive maintenance of the plant equipment / miscellaneous jobs pending for the plant shutdown, including hooking up or taking tapings for the ambitious energy saving schemes of the Ammonia plant.

After ensuring availability of all the required material for shutdown as well as awarding of contracts for various shutdown jobs, it was decided to stop Ammonia and Urea plants on 20-05-2004. This Shutdown report contains details of the jobs carried out during the shutdown which are given plant wise and section wise. Plant was put back into service on 09-06-2004 after a total shutdown period of 20 days from production to production.

Main thrust for this turnaround was given on meticulous planning of all activities like planning for manpower, material and other resources. Due to the efforts put in by one and all, at all the levels, turnaround jobs could be completed within the scheduled period of 20 days.

Safety was one of the major aspects which was given top most priority during the execution of various jobs. All outsourced manpower of the contractors was given necessary training for safe working in the plant and strict vigilance was also kept by Fire & Safety Section during execution of critical jobs. As a result, the shutdown was successfully completed without a single accident.

### MECHANICAL

#### **AMMONIA PLANT**

- In addition to routine preventive maintenance jobs of various rotating equipments, Synthesis Compressor Drive Back pressure Turbine (103-JAT) and I.D Fan Drive Back pressure Turbine (101 -BJT) were taken for major overhauling.
- The new nozzles received from M/s Triveni Engineering, Bangalore were replaced in Terry turbine (104-JAT).
- Both Waste Heat Boiler(101-CA/CB) and 112-C were offered for IBR inspection.
- Ultrasonic scanning was carried out of all the reformer tubes by M/s PDIL.
- During radiographic weld examination of C-Joint of catalyst tube; cracks were found in several catalyst tubes. All 32 Nos of defectives tubes & 2 Nos of risers were salvaged in work-shop by re-welding the defective weld joints after proper heat treatment and same were welded back in position.

#### **UREA PLANT**

- Hitachi compressor K-1801 L.P Case was overhauled.
- HP scrubber H-1203 bundle was lowered down from position for inspection of the shell liner. The bundle was put back in position after NDT examination of the liner which was carried out departmentally
- Routine inspection of Autoclave liner (V-1201) was also carried out.
- HP condenser (H1202) & HP Stripper (H1201) were opened for routine inspection.
- Preventive maintenance of Prill cooling system, ID fans & scrapper was carried out.
- Routine Inspection of all L. P. Vessels were carried out.

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## OFFSITES PLANT

- All Cooling water & BFW pumps and turbines were taken for preventive maintenance. Various RV's were overhauled and tested.
- IBR inspection of BHEL boiler was carried out.

## B&MH PLANT

- Preventive maintenance of Reclaim Machine M-2116 was carried out.
- Preventive maintenance of Packer scales & all conveyors was carried out.

## INSTRUMENT

In addition to preventive maintenance following significant jobs were carried out .

## AMMONIA PLANT

- Obsolete 7200 series of M/s Bently Nevada, USA make vibration monitoring system for 101- J Air compressor was replaced by latest 3500 series system of M/s Bently Nevada, USA.
- Three nos. of obsolete pneumatic leveltrols were upgraded to electronic type by M/s Masoneilan, France make leveltrols retrofitting kits.
- DCS I/O marshalling cabinet room was suitably modified to accommodate ESP enhancement requirement.

## UREA PLANT

- Two nos. of electronic transmitter of capillary type were installed in carbamate pumps to facilitate better pump operation.

## B & MH PLANT

- Obsolete controller of Automatic Bag filling M/c no. 7 was upgraded to new machine with advance CSC model controller.

## OFFSITES PLANT

- Installed new panel in ETP plant which was departmentally designed.
- Installed new miniature PLC for compressor loading unloading and local control panel was removed.
- Installed electronic type controller in D.M.Plant.

## ELECTRICAL

### GENERAL

- Preventive maintenance for MCC Panel, transformers, motors were carried out.
- Preventive maintenance of all the transformers was carried out.
- Major overhauling of critical motors were carried out in all the plants
- Replaced all corroded local control stations of motors with FRP LCS in Urea, Offsites, Utility & B &MH plants..

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100

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**AMMONIA PLANT**

- Power and control cables of all equipment were replaced and connected with MCC-5B. Replaced SP-3 Limitorque valve actuator with Rotork make actuator.
- Provided Sohre make shaft grounding system on Syn. Gas Compressor-103 J.
- Modification carried out on 112 JB feeder compartment for providing emergency power supply.

**UREA PLANT**

- Re-commissioned actuator MOV-1201 by connecting power and control cables

**UTILITY PLANT**

- Shifted emergency power supply control from MCC-8 to new DG set MCC by laying cables and shifting of MCC-8 panels to guest house.
- Replaced EMC actuators with Rotork actuators in Boiler.
- Replaced power cables of cooling pumps motor P4402 and P-4404 from its transformer/ circuit breaker.
- Modification carried out in MCC-9 for feeding alternative power from MCC-15.

**B & MH PLANT**

- Additional rope switches installed and commissioned on dust conveyor in silo. Replaced control gear of stitching machines with FRP control gear boxes.

**CIVIL**

**UREA PLANT**

- External painting of Prill Tower was carried out by IP Net Coating for surface protection of concrete structure.
- IP Net coating was done on various concrete structure of Bagging plant building.
- Protective treatment by Epoxy Monolithic Plaster was done on Bagging plant floor area
- Concrete Apron on Railway BG plate form line No.2, 3 & 5 was done.

**TECHNICAL**

**AMMONIA PLANT**

- Fuel Gas Piping was modified to take 100% Gas i.e. LNG. for feed and fuel to ammonia plant and also for running BHEL Boiler on 100% gas.
- Mixing Tee (which mixes the two streams of process gas Line No.PG-14" and PG-2-18" from 102-C) was replaced due to degradation of its' material.
- Tapings were taken to hookup the equipment's of Energy Saving Project.
- Tapings for New Turbine exhaust line for Energy Saving Project were taken by modifying existing turbine exhaust line to 101-JCA.

**UREA PLANT**

- Provision for temperature indication on DCS panel for overhead vapors from desorber along with the vapors from LP Carbamate separator is completed.
- Flow indicators FI-96 & FI-1815 were installed.

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**PLANT TURNAROUND - MAY - JUNE - 2004**

**GENERAL - DETAILS**

**SR. NO.**                      **CATEGORY**                                              **QUANTITY**

**(A)                      EQUIPMENT UTILIZED :**

**IFFCO :**

55 T	HM Crane	01 No
55 T	TIL RT-760 Tyre mounted mobile Crane	01 No
15 T	Coles Crane	01 No
18 T	Tata Crane	01 No
10 T	ESCORT LIFT-N-SHIFT	01 No
03 T	Forklift	03 Nos.
10 T	Truck	01 No

**(B)                      MANPOWER UTILIZED :**

**(I)                      IFFCO MANPOWER :**

1	Mechanical	}	Existing strength
2	Mechanical Services	}	
3	Electrical	}	
4	Instrument	}	

**(II)                      HIRED - CONTRACT MANPOWER :**

<b><u>Sr. No.</u></b>	<b><u>Category</u></b>	<b><u>Man days</u></b>
1	Mill Wright Fitter	87
2	General Fitter	644
3	Rigger	792
4	Master Rigger	13
5	S.S. Rigger	2488
6	Fabricator	162
7	Grinder	194
8	Gas Cutter	77
9	IBR Welder	69
10	Non-IBR Welder	76
11	Carpenter	62
12	Mason	34
13	Forklift Operator	--
14	Instrument Fitter	134
15	Electrician	--
16	Machinist	26

GENERAL DETAIL

GENERAL DETAIL

QUANTITY

CATEGORY

NO.

EQUIPMENT UTILIZED

NO.

FOOD

01 No	01 T Milk Condensed
01 No	02 T Milk Sterilized
01 No	03 T Milk Evaporated
01 No	04 T Milk Sweetened
01 No	05 T Milk Unsweetened
01 No	06 T Milk Fat Free
01 No	07 T Milk Fat Reduced
01 No	08 T Milk Fat Full
01 No	09 T Milk Fat Partial
01 No	10 T Milk Fat High

MANPOWER UTILIZED

NO.

FOOD MANPOWER

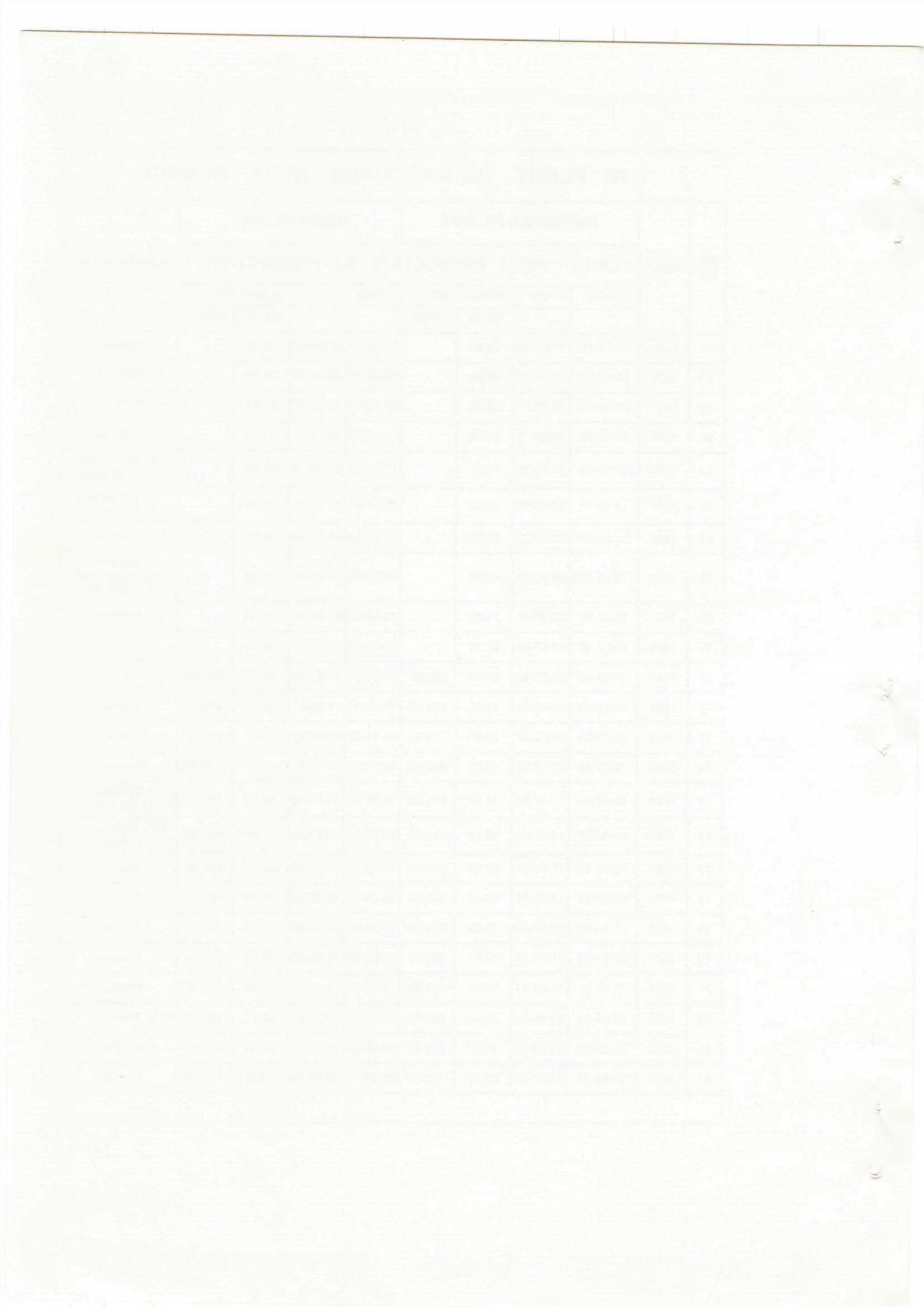
1	Food Handler
2	Food Service Worker
3	Food Inspector
4	Food Supervisor

FOOD - CONTRACT MANPOWER

01	01 T Milk Condensed
02	02 T Milk Sterilized
03	03 T Milk Evaporated
04	04 T Milk Sweetened
05	05 T Milk Unsweetened
06	06 T Milk Fat Free
07	07 T Milk Fat Reduced
08	08 T Milk Fat Full
09	09 T Milk Fat Partial
10	10 T Milk Fat High
11	11 T Milk Fat Low
12	12 T Milk Fat Medium
13	13 T Milk Fat Very Low
14	14 T Milk Fat Very High
15	15 T Milk Fat Very Medium
16	16 T Milk Fat Very Low Fat
17	17 T Milk Fat Very High Fat

## THE PLANT TURNAROUNDS AT A GLANCE

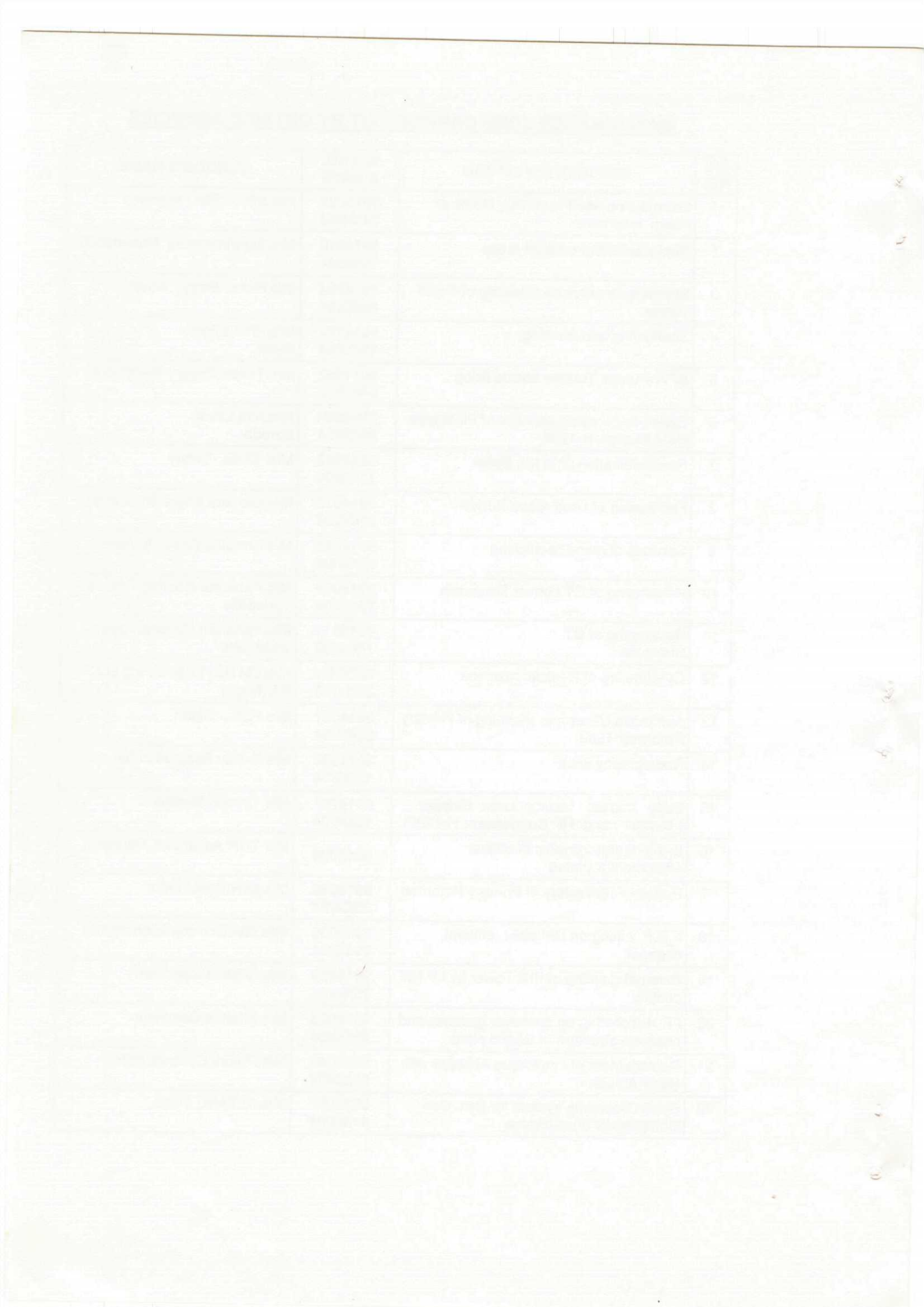
SR. NO.	YEAR	AMMONIA PLANT				UREA PLANT				REASON IF ANY
		PERIOD FROM PRODUCTION TO PRODUCTION								
		FROM	TO	DOWN TIME		FROM	TO	DOWN TIME		
				DAYS	HRS			DAYS	HRS	
01	1975	06-05-75	21-05-75	16.00	-	06-05-75	21-05-75	16.00	-	Planned
02	1976	26-03-76	20-04-76	26.00	-	26-03-76	20-04-76	26.00	-	Planned
03	76-77	05-12-76	22-01-77	49.00	-	05-12-76	24-02-77	51.00	-	101-JT B/D
04	1978	21-02-78	15-03-78	23.00	-	21-02-78	25-03-78	31.00	-	101-BJ B/D
05	1979	21-05-79	30-06-79	41.00	-	10-05-79	01-08-79	82.00	-	K-1101/2, 3rd Stage Cylinder
06	1981	12-04-81	10-05-81	29.00	-	08-04-81	12-05-81	35.00	-	101-B Headers Planned
07	1984	01-01-84	25-01-84	25.00	-	01-01-84	25-01-84	25.00	-	Planned
08	1986	19-03-86	03-05-86	45.00	-	04-03-86	01-05-86	59.00	-	Reformer Revamping / HP Scrubber B/D
09	1987	12-04-87	03-05-87	21.00	-	12-04-87	02-05-87	20.00	-	Planned
10	1988	18-04-88	14-05-88	27.00	-	18-04-88	13-05-88	26.00	-	Planned
11	1990	05-02-90	05-03-90	29.00	688.67	31-01-90	07-03-90	35.00	829.00	Planned
12	1991	24-02-91	13-03-91	18.00	429.08	23-02-91	14-03-91	20.00	459.25	Planned
13	1992	03-11-92	03-12-92	30.60	734.91	03-11-92	04-12-92	31.00	744.75	Planned
14	1993	12-09-93	23-10-93	42.00	986.50	12-09-93	29-10-93	47.00	1120.58	Revamp-II
15	1995	14-01-95	27-01-95	14.00	311.34	11-01-95	26-01-95	16.00	352.18	Scrubber H-1203 -B/D
16	1996	14-06-96	13-07-96	30.00	712.00	13-06-96	13-07-96	30.00	694.25	Autoclave V-1201 Leakage
17	1997	12-05-97	17-06-97	35.60	875.00	12-05-97	17-06-97	36.20	870.50	Planned
18	1998	22-04-98	19-05-98	27.50	660.00	20-04-98	19-05-98	30.00	720.00	Planned
19	1999	12-04-99	30-04-99	18.00	434.50	11-04-99	28-04-99	17.00	409.75	Planned
20	2000	03-04-00	27-04-00	24.42	586.25	03-04-00	28-04-00	25.43	610.50	Planned
21	2001	25-03-01	14-04-01	20.90	501.50	25-03-01	15-04-01	21.26	510.25	Planned
22	2002	20-03-02	22-04-02	33.40	801.58	20-03-02	23-04-02	34.31	823.50	Planned
23	2003	28-05-03	25-06-03	28.04	673.00	28-05-03	25-06-03	28.33	679.83	Planned
24	2004	20-05-04	09-06-04	20.00	495.17	20-05-04	09-06-04	20.00	480.25	Planned



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**MAINTENANCE JOBS CARRIED OUT BY OUTSIDE AGENCIES**

SR. NO.	DESCRIPTION OF JOB	WO NO. & DATE	VENDOR'S NAME
1	Overhauling and Preventive Maint. of rotary machines	9915022 24/04/03	M/s.SPIC -SMO Mumbai
2	Replacement of catalyst tubes	9914810 15/03/04	M/s.Skywin erector Ahmedabad
3	Supervisory services of testing of Relief Valves	9914994 15/03/04	M/s.Flotec Engg., Surat
4	Scaffolding and Blinding	9914764 15/03/04	M/s.PRV Engrs. Surat
5	BFW Pumps Turbine nozzle fixing	9911362 04/05/02	M/s.Triveni Engg., Bangalore
6	Expert supervision services of Plate type Heat Exchgr. H-1206	13/00631 06/04/04	M/s.Alfa Laval Baroda
7	Re-examination of BHEL Boiler	9914562 12/02/04	M/s. BHEL Trichy
8	Fabrication of Urea return header	9914919 22/03/04	M/s.Garcem Engrs.Ahmedabad
9	Services of gland re-packing	9915042 02/04/04	M/s.Amrutha Engg. Mumbai
10	Revamping of CT Louver Diagonals	9915068 25/03/04	M/s.Paharpur Cooling Towers Vadodara
11	Revamping of CT Structure	9913011 15/03/03	M/s.Paharpur Cooling Towers Vadodara
12	Overhauling of Reclaim machine	15/00465 24/11/03	M/s.EMTICI Engineering Ltd. V.V.Nagar
13	Automatic Ultrasonic scanning of Primary Reformer Tube	9914591 02/04/04	M/s.PDIL, Sindri
14	Radiography work	9914588 17/02/04	M/s.X-Ray Engg. Mumbai
15	Eddy current testing Urea Stripper ( H-1201 ) and HP Condenser ( H-1202)	9914767 15/04/04	M/s.Testex, Mumbai
16	In-situ Metallographic of critical equipment & piping	9915039	M/s.TCR Advanced, Baroda
17	Repair of Refractory of Primary Reformer	9915036 05/04/04	M/s.M.H.Detric India
18	F.R.P. Lining on DM plant effluent channel	9915035 29/03/04	M/s.Western corrosion control
19	External painting of Prill Tower by I.P.Net coating	9914959 25/03/04	M/s.Krishna Conchem
20	I P Net coating on conveyor galleries and concrete structure of B&MH plant.	9914963 25/03/04	M/s.Krishna Conchem
21	Replacement of Limitorque Actuator with Rotor Actuator	9915046 27/03/04	M/s.Rotork Controls (I) Ltd.
22	Shaft Grounding system for Syn. Gas Compressor drive turbine	9915067 31/03/04	M/s.ALTAIR, Pune



## MAINTENANCE JOBS CARRIED OUT BY OUTSIDE AGENCIES

23	Maint of "Siemens" LT Breaker	9915299	M/s.Siemens Ltd. Ahmedabad
24	P.M. of Ammonia and Urea plant DCS	9914363 17/01/04	M/s.Yokogawa Blue Star, Baroda
25	P.M. of Ammonia plant PLC	9912333 15/11/02	M/s.Chemtrols Engg., Mumbai
26	P.M. / Checking of Ammonia plant UPSS	9909749	M/s.Instrumentation Ltd., Kota
27	Retrofitting job of Ammonia plant Leveltrols	9912994 10/03/03	M/s.Dresser valves Mumbai
28	Replacement of 7200 series vibration monitor system with 3500 series for Process Air Compressor train (101-J)	99141341 04/11/03	M/s.Bently Nevada New Delhi
29	P.M./ Calibration of Methane / CO2 / Silica Analyzers of Ammonia plant	9915013 09/03/04	M/s.ABB Analytical Ltd., Faridabad
30	Checking and Rectification of common alarm problem in Annunciator-D	On request	M/s.IIC, Hyderabad
31	Replacement of Fuel Gas line	9914928 08/04/04	M/s.Shree Ganesh Engg. works
32	Replacement of Under ground Piping	9914924 29/03/04	M/s.Garcem Engrs. Ahmedabad
33	Modification in MCC		M/s.L & T.
34	Replacement of steam exhaust pipe	9915378 31/05/04	M/s.J & J, Sertha
35	Repair of damaged cover plywood sheet of Cooling Tower.	9914847 03/04/04	M/s.Akruti
36	Repair of damaged flooring at platform in B&MH Plant.	9914707 20/02/04	M/s.P.M.Patel

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# MECHANICAL

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MECHANICAL

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**AMMONIA PLANT**

**AIR COMPRESSOR TRAIN:**

Turbine was decoupled and both the journal bearings as well as thrust bearing were inspected and found O.K. Gauss measurement of rotor shaft and bearings carried out. Gauss reading of thrust end shaft journal (6.9 Gauss), thrust collar (6.8 Gauss), Opposite thrust journal shaft (5.2 Gauss) was higher and the same was reduced below 3 Gauss. Greasing of governor linkages was carried out.

During starting of Turbine, the steam chest valve was not opening. Steam chest valve was lifted by jacking and Turbine was started. After starting the turbine, jack was released. The jamming of steam chest valves was mainly attributed to the vacuum inside the steam chest, pulling the valves on their respective seats.

**101-JLP Air Compressor Preventive Maintenance**

Journal bearings and thrust bearings were inspected and found O.K. Gauss measurement of rotor shaft and bearings was carried out. Gauss reading of opposite thrust end journal shaft (7.9 Gauss) and pads (12.2 Gauss) was higher and the same was reduced below 3 Gauss. All the bag filters as well as Roll-O-Matic filters were replaced.

**101-JR Gearbox Preventive Maintenance**

All the bearings were inspected and found O.K. Both the gear as well as Pinion were inspected and found to be O.K. Gauss measurement of gear shaft and bearings carried out and found within limits.

**101-JHP Air compressor Preventive Maintenance**

Journal bearings as well as thrust bearings were inspected and found O.K. Gauss measurement of rotor shaft and bearings carried out and found within limits.

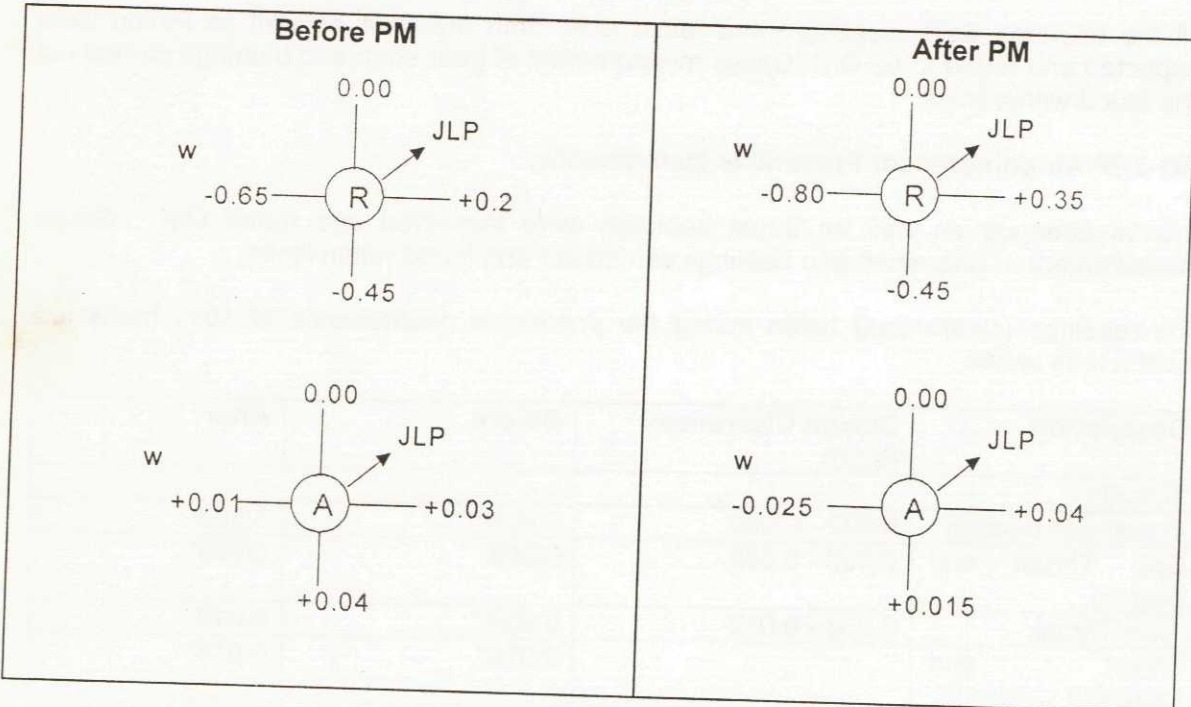
The readings (clearances) taken during the preventive maintenance of 101J trains are recorded as under:

Description	Design Clearances (Inch)	Before	After
<b>101 JT</b>			
Thrust end bearing	0.007 - 0.009	0.008 "	0.008"
Opp Thrust end bearing	0.007 - 0.009	0.008"	0.008"
Axial Thrust	0.008 - 0.012	0.009 "	0.010 "
Thrust end Labyrinth		0.018"	0.018"
Opp. Thrust end Labyrinth		0.020"	0.020"
<b>101 JLP</b>			
Thrust end bearing	0.006 - 0.008	0.008 "	0.008 "
Opp Thrust end bearing	0.006 - 0.008	0.008 "	0.008 "
Axial Thrust	0.011 - 0.015	0.010 "	0.011 "

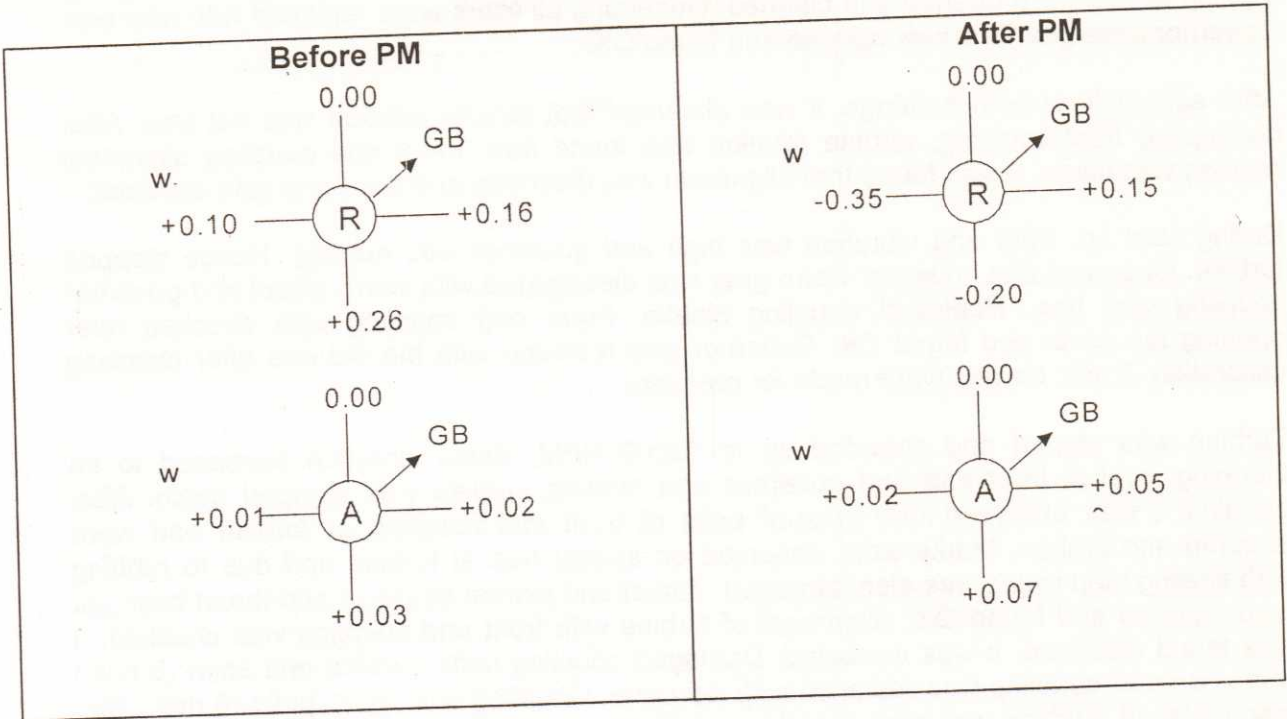
Thrust end Labyrinth		0.014 "	0.014 "
Opp. Thrust end Labyrinth		0.016 "	0.016 "
<b>101 JR</b>			
Drive gear North bearing	0.010 - 0.011	0.011 "	0.011 "
Drive gear South bearing	0.010 - 0.011	0.010 "	0.011 "
Axial Thrust	0.014 "	0.012 "	0.013 "
Pinion bearing North	0.010 - 0.012	0.011 "	0.011 "
Pinion bearing South	0.010 - 0.012	0.010 "	0.010 "
Free float		0.043 "	0.043 "
Backlash		0.0012 "	0.0012 "
<b>101 JHP</b>			
Thrust end bearing	0.004 - 0.007	0.005 "	0.005 "
Opp Thrust end bearing	0.004 - 0.007	0.005 "	0.005 "
Axial Thrust	0.008 - 0.012	0.0010 "	0.010 "

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

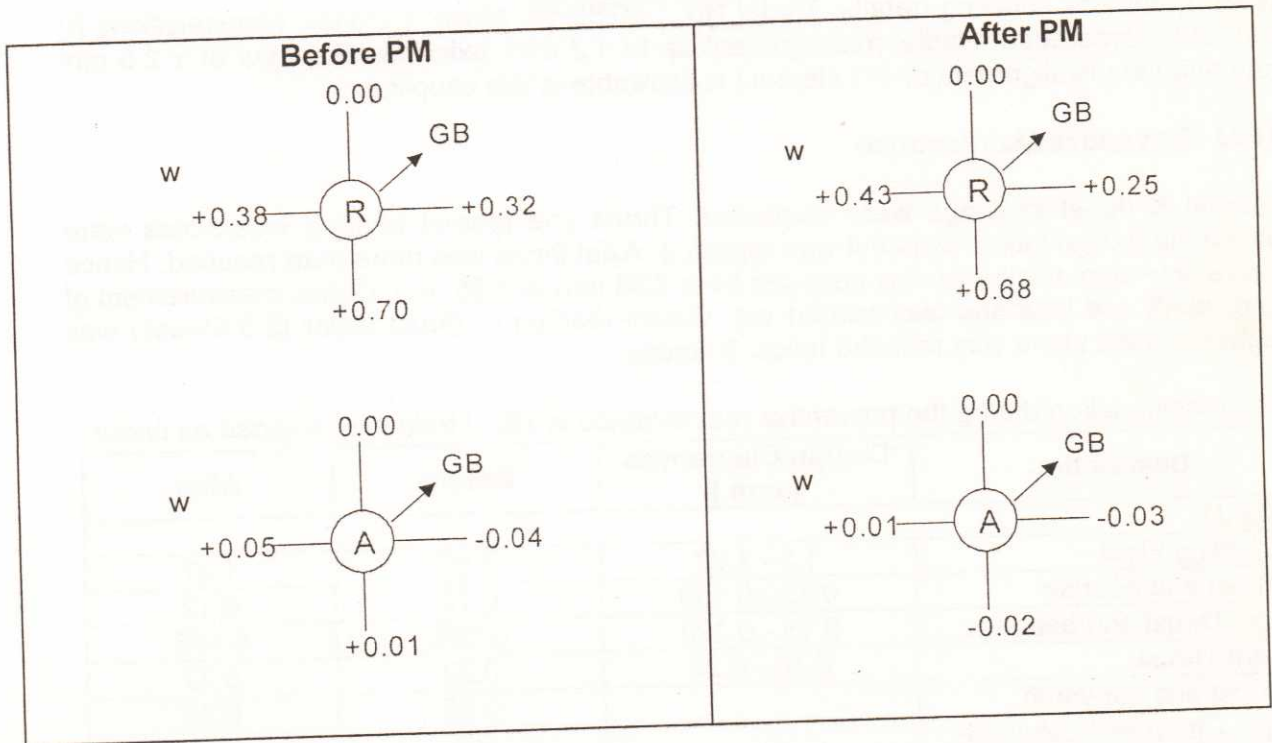
101 JT to JLP



101 JLP to GB



101 JHP to GB



N. G. COMPRESSOR TRAIN:

**102-JT Preventive Maintenance**

Turbine was decoupled and bearings were inspected and found OK. Gauss measurement of rotor shaft and bearings carried out and found OK. Coupling bolts of turbine to compressor were replaced with new one.

PG-PL Governor replaced with the repaired governor. Governor tester, hand trip valve & tripping device were opened and cleaned. Governing oil filters were replaced with new one. Governor drive gear box was opened and found OK.

After assembly of both bearings, it was observed that turbine rotation was not free. After decoupling front coupling, turbine rotation was found free. Front end coupling alignment reading was taken. It was found that alignment was disturbed and the same was corrected.

During start up, front end vibration was high and governor was hunting. Hence stopped turbine. Observed that governor worm gear was disengaged with worm wheel and governor coupling was free. Replaced coupling sleeve. Front end coupling was checked after opening top cover and found OK. Governor was replaced with the old one after checking calibration. 2 nos. dowels were made for governor.

Turbine was started and speeded up to 13500 RPM. Since vibration increased to an alarming level at front end and governor was hunting, turbine was stopped again. After opening it was observed that 2nos.of bolts of front end coupling at turbine end were sheared and broken. Marks were observed on spacer hub at turbine end due to rubbing with sealing strip which was also damaged. Thrust end journal bearings and thrust bearings were opened and found OK. Alignment of turbine with front end coupling was checked. It was found disturbed. It was corrected. Damaged coupling bolts, turbine end shim (5 nos.) and spacer of coupling was replaced with new one. Coupling hub shaft bolts (6 nos.) was also replaced. Turbine was started and found OK.

Note: Front end coupling details: Model No. : 4GBL-68, Make: Euroflex Transmissions (I) Pvt. Ltd., Hyderabad. Radial misalignment up to 1.2 mm, axial misalignment of  $\pm 2.5$  mm and angular misalignment of  $1^\circ$  / element is allowable in this coupling.

**102J Preventive Maintenance**

Journal & thrust bearings were inspected. Thrust end journal bearing clearances were above the design value. Hence it was replaced. Axial thrust was more than required. Hence active side shim thickness was changed from 2.38 mm to 2.45 mm. Gauss measurement of rotor shaft and bearings was carried out. Gauss reading of thrust collar (3.3 Gauss) was higher and the same was reduced below 3 Gauss.

The reading taken during the preventive maintenance in 102 J train are recorded as under:

Description	Design Clearances (mm)	Before	After
<b>102 JT</b>			
Coupling Float	1.2 - 1.37	1.30	1.37
Thrust end bearing	0.12 - 0.139	0.12	0.12
Opp Thrust end bearing	0.15 - 0.172	0.165	0.165
Axial Thrust	0.16 - 0.24	0.22	0.22
Thrust end Labyrinth		0.25	0.25
Opp Thrust end Labyrinth		0.3	0.3
<b>102 J</b>			
Thrust end bearing	0.07 - 0.095	0.1	0.08
Opp Thrust end bearing	0.07 - 0.093	0.09	0.090
Axial Thrust	0.25 - 0.35	0.28	0.28

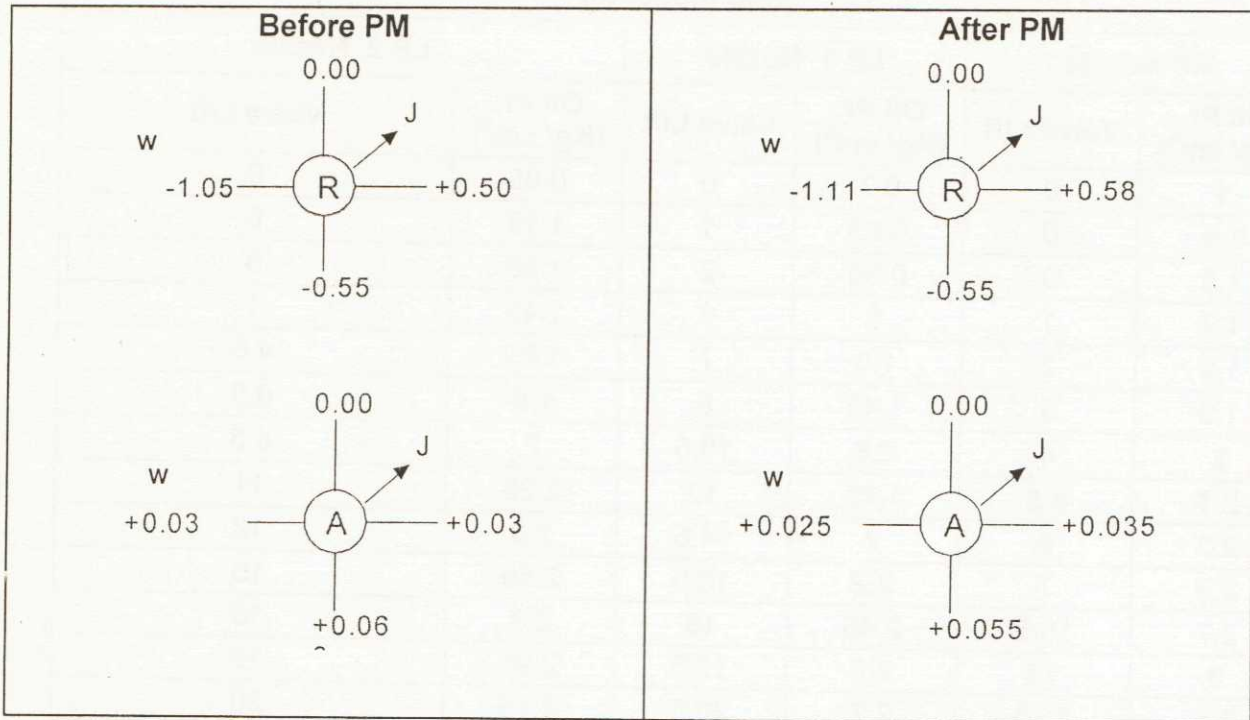
**Governing valve reading :**

Readings recorded during the stroke checking of governor valve of 102 JT:

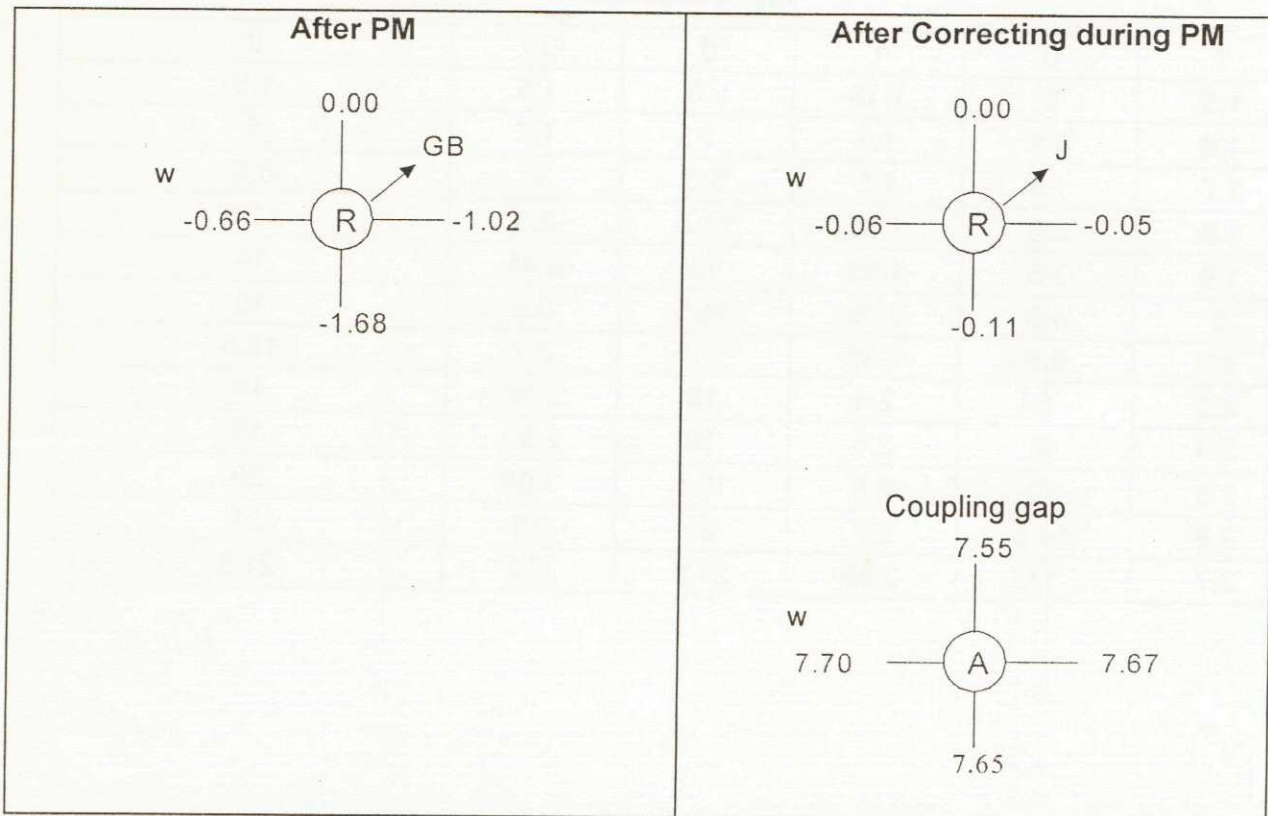
Zero Induction					
HP Nozzle		LP 1 Nozzle		LP 2 Nozzle	
Oil Pr. (Kg/ cm <sup>2</sup> )	Valve Lift	Oil Pr. (Kg/ cm <sup>2</sup> )	Valve Lift	Oil Pr. (Kg/ cm <sup>2</sup> )	Valve Lift
1	0	0.7	0	0.95	0
1.4	0	0.85	1	1.15	0
1.5	0	0.95	2	1.35	0
1.7	1	1	3	1.45	1
1.8	2	1.3	7	1.65	4.5
1.9	3	1.45	9	1.8	6.5
2	4	1.6	10.5	2	8.5
2.1	4.5	1.75	12	2.25	11
2.2	6	2	14.5	2.3	12
2.3	7	2.2	16.5	2.55	15
2.7	10.5	2.45	18	2.7	16
3	13	2.6	19.5	2.95	19
3.5	15.5	2.7	20.5	3.15	20
3.8	17.5	2.8	21	3.25	22
100 % Induction					
1	0	1	0	0.7	0
1.5	0	1.15	5.5	1.5	1.5
1.6	0.5	1.3	7	1.7	5
1.7	1.5	1.5	9.5	2	8.5
1.8	2.5	1.65	11.5	2.3	11.5
1.9	3.5	1.85	13	2.45	14
2	4.5	2.05	14.5	2.5	15
2.2	6.5	2.35	17.5	2.7	16.5
2.3	8	2.4	18	2.85	18
2.4	9	2.5	19	2.95	19
2.5	10	2.6	19.5	3.05	20
2.6	10.5	2.7	20	3.1	21
2.7	11	2.85	21.5	3.2	21.5

Alignment Readings (Dimensions are in mm)

102 JT TO 102 J

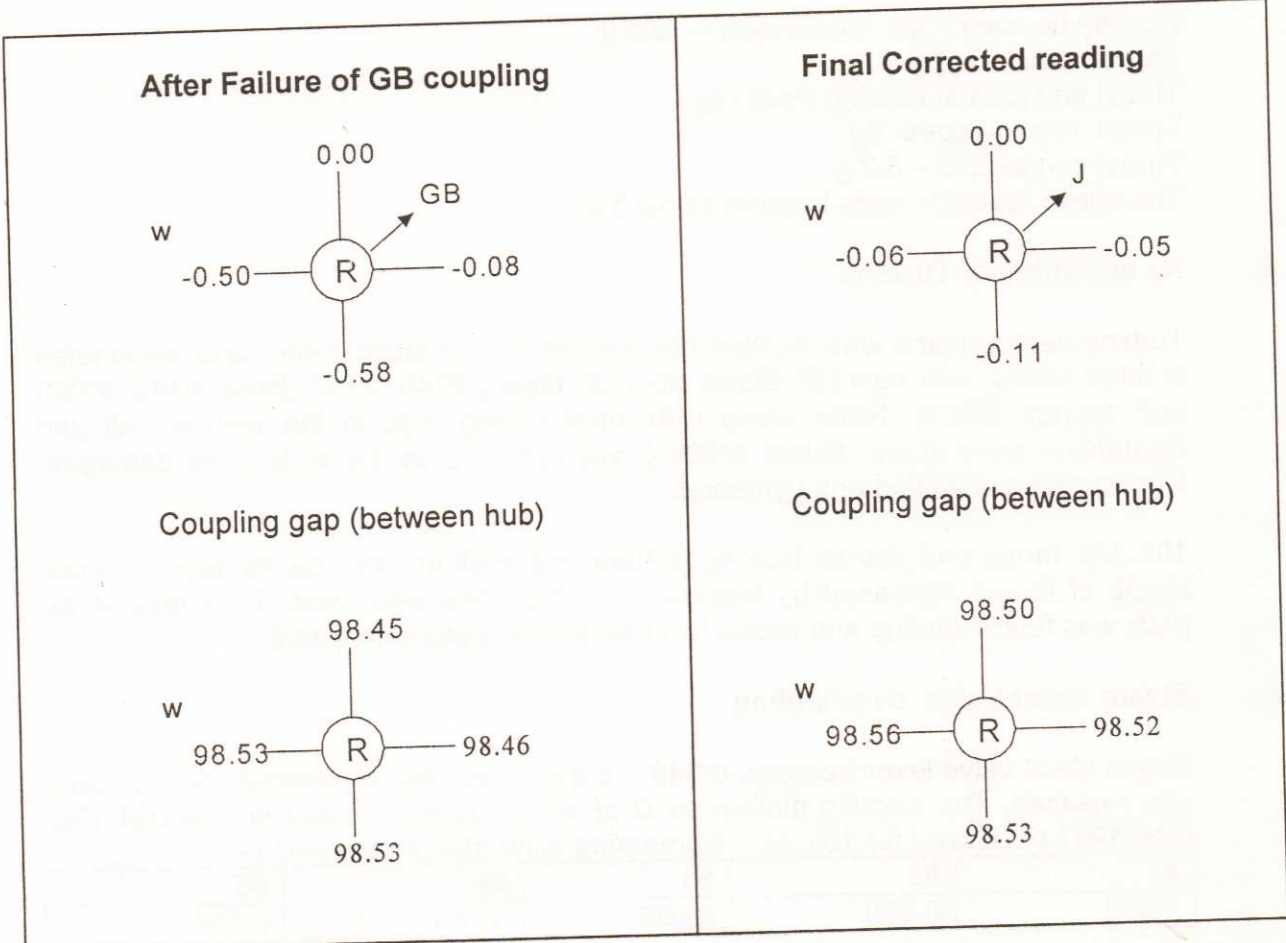


102 JT TO Governor Coupling





102 JT TO Governor Coupling



SYNTHESIS GAS COMPRESSOR TRAIN:

**103-JAT (Back Pressure Turbine) Overhauling:**

Turbine was taken for overhauling to attend steam leakage through parting plane.

Following jobs were carried out in turbine 103-JAT during the overhauling:

The turbine was handed over to Maintenance at 15:00 hrs on 20/05/2004

**1) Dismantling of Turbine**

Turbine was decoupled at both ends. Both journal bearing clearances and axial thrust was recorded and alignment readings were taken. Turbine steam outlet pipe and steam chest valve was removed. Turbine casing was removed and labyrinth clearances were noted. (Data sheet is attached). Rotor along with inner casing was removed. Then rotor was removed from inner casing. HP gland clearances were above design value.

Gauss measurement of casing, inner casing, rotor and bearings were carried out. Max. Gauss readings obtained are given below:

- Casing Bolts – 10 g
- Nozzle ring blades – 7 g
- 1<sup>st</sup> stage rotor blade – 14g
- 2<sup>nd</sup> stage rotor blade – 8g
- HP Gland - 14g
- Bearing housing (Opp. thrust end) – 10.5 g
- Thrust collar – 7.8 g
- Thrust end journal bearing Pads- 8g
- Thrust bearing pads- 8g
- Thrust end journal – 6.2 g
- The above readings were brought below 3 g
- Thrust side shaft end – 12.9
- Opp. thrust side coupling face-4g
- Opp. thrust side shaft face-4g

2) **Re assembly of Turbine**

Turbine parting plane was cleaned and polished by oil stone. Rotor was assembled in inner casing with new HP Gland labyrinth rings ( #146, #147, #148, #149, #150) and springs (#213). Rotor along with inner casing kept in the bottom half and clearances were noted. Guard (#296 ) was replaced as it's ends were damaged. Casing was assembled and tightened.

103 JAT thrust end journal bearing bottom half shell thread was damaged. Hence length of thread increased by tapping and longer bolt was used. Thickness of old pads was found varying and hence two new journal pads were used.

3) **Steam chest Valve overhauling**

Steam chest valve lever bearings (#648 – 2 nos.) were found jammed and the same was replaced. The existing dimension D of all valves were noted in inch(Ref. Drg. EDP 1997 of Delaval for 103-JAT. Numbering done from steam end ) - :

#1	#2	#3	#4	#5
1.016	0.579	0.406	0.783	0.886

4) **Installation of new Earthing brush by M/s.Terro Technology, Pune**

Two Earth brush were installed on Syn. gas compressor train. One was installed on coupling spacer of 103-JAT to JBT and the other on coupling spacer of 103-JAT to JLP.

During start up, the vibration readings of 103 JAT north bearing increased upto 3 mils (Alert) and south bearing 2.2 mils at 6000 RPM. Speed was reduced to 5000 RPM and after running for half an hour, RPM was increased and found normal. The current through earthing brush was found to be 4.0 Amp. on voltage current monitor panel.

**103-JBT (Condensing Turbine) Preventive Maintenance**

Journal & thrust bearings were opened checked and found normal. Gauss measurement of rotor shaft and bearings was carried out. Gauss reading of thrust bearing holder (7.9 gauss) and thrust bearing pads (8.9 gauss) was above limit and the same was reduced below 3 Gauss.

**103-JLP Syn. Gas Compressor Preventive Maintenance**

Journal & thrust bearings were opened and checked. Thrust ring (inner) was changed as the bearing pad holding screws were found loose. Thrust collar and bushing O-rings were

replaced. Thrust collar o-rings (2 nos.) are locally made. Size in mm-101.98 O.D. X 96.46 I.D. & 103.187 O.D. X 97.66 I.D. Gauss measurement of rotor shaft and bearings was carried out. Gauss values of thrust end journal pads (6.1 gauss), opposite thrust end journal pads (12.3 gauss) was above limit and the same was reduced below 3 Gauss.

### 103-JHP Syn. Gas Compressor Preventive Maintenance:

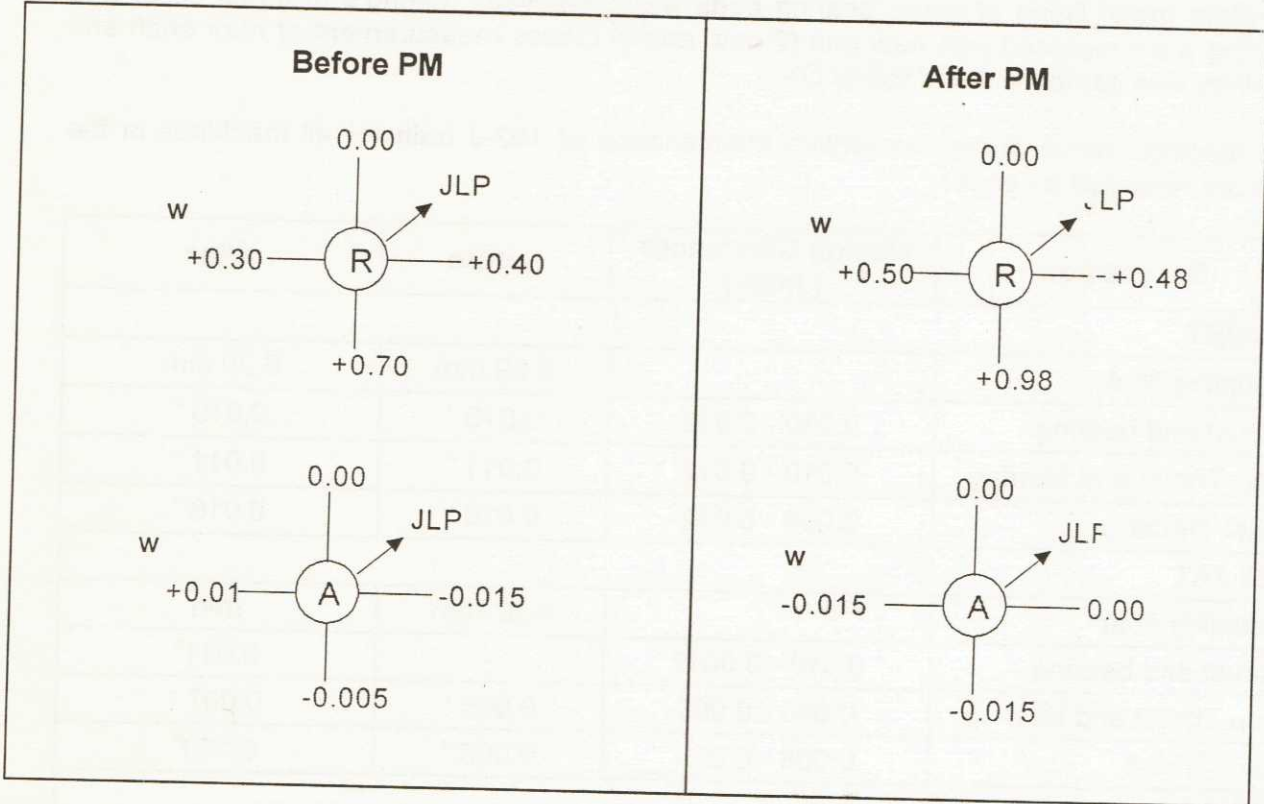
Journal & thrust bearings were opened and checked. Thrust ring (outer) was changed as the white metal lining of some bearing pads were removed. O-ring's of thrust collar and bushing were replaced with new one.(2 nos. each). Gauss measurement of rotor shaft and bearings was carried out and found OK.

The readings taken during preventive maintenance of 103-J train for all machines in the train are recorded as under.

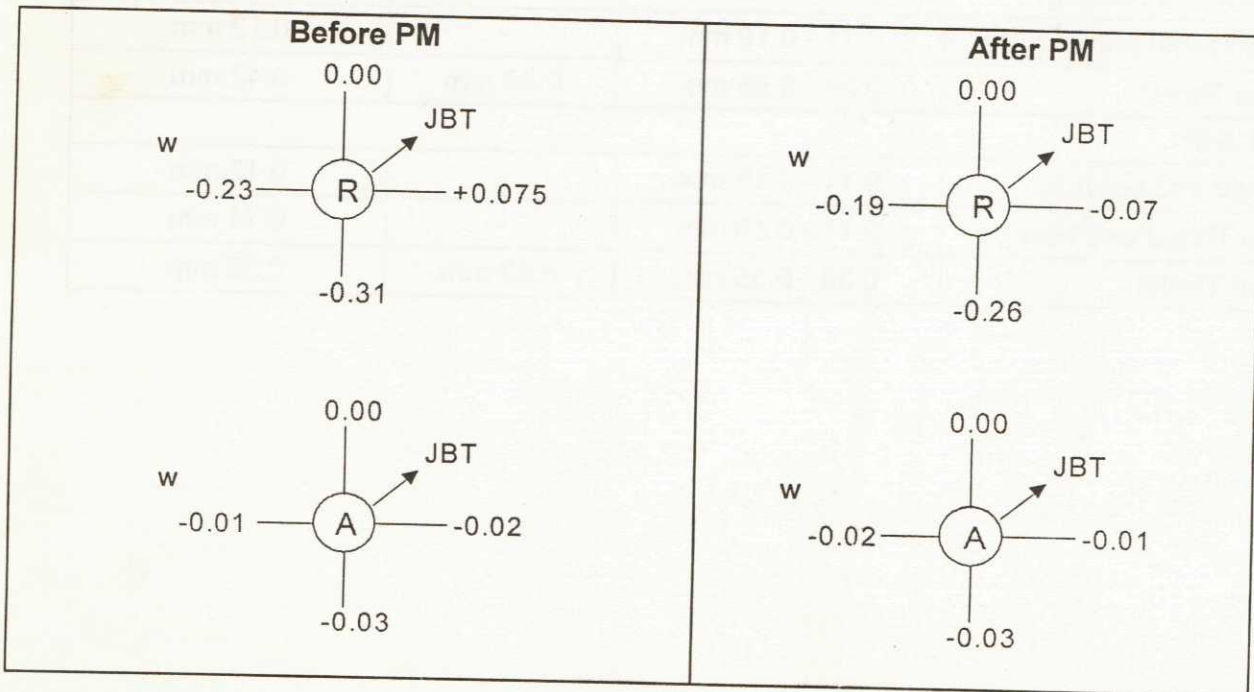
Description	Design Clearances ( Inch )	Before	After
<b>103JBT</b>			
Coupling float		6.29 mm	6.29 mm
Thrust end bearing	0.010 - 0.012	0.010 "	0.010 "
Opp Thrust end bearing	0.010 - 0.012	0.011 "	0.011 "
Axial Thrust	0.008 - 0.012	0.010 "	0.010 "
<b>103 JAT</b>			
Coupling float		4.03 mm	mm
Thrust end bearing	0.010 - 0.0012	-	0.011"
Opp Thrust end bearing	0.006 - 0.008	0.006 "	0.007 "
Axial Thrust	0.008 - 0.012	0.008 "	0.008"
<b>103 JLP</b>			
Coupling float		5.30 mm	5.30 mm
Thrust end bearing	0.11 - 0.19 mm	-	0.16
Opp Thrust end bearing	0.11 - 0.19 mm	-	0.12 mm
Axial Thrust	0.38 - 0.55 mm	0.40 mm	0.42 mm
<b>103 JHP</b>			
Thrust end bearing	0.11 - 0.19 mm	-	0.12 mm
Opp Thrust end bearing	0.11 - 0.19 mm	-	0.14 mm
Axial Thrust	0.38 - 0.55 mm	0.42 mm	0.38 mm

Alignment Reading (Dimensions are in mm)

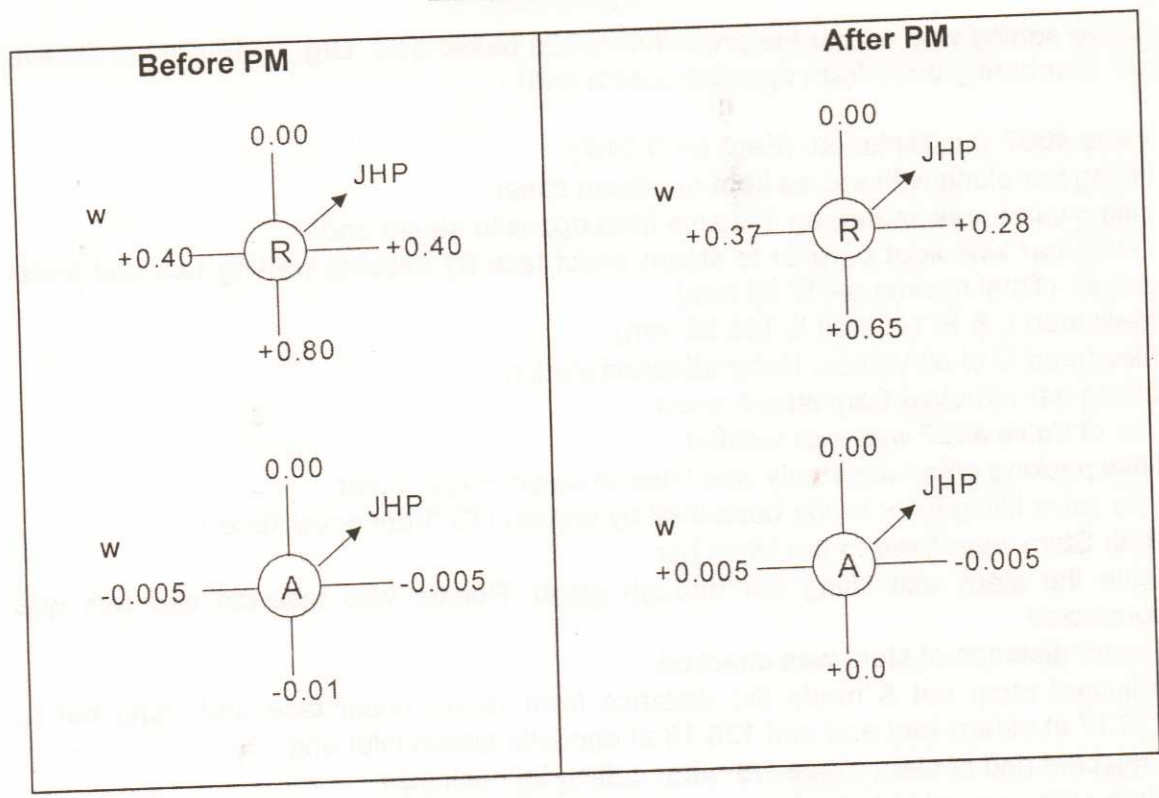
103 JAT to JLP



103 JBT to JAT



103 JLP to JHP



REFRIGERATION COMPRESSOR TRAIN:

105-JT Preventive Maintenance:

Journal & thrust bearings was opened and checked and found normal. Gauss measurement of rotor shaft and bearings was carried out and found normal. Governor drive intermediate gear (#49) was replaced since one teeth found broken.

**Steam Chest Valve**

Steam chest valve was opened to attend steam leakage through gland. After opening it was observed that both stem was having steps at the gland portion. Valve (#667- 3<sup>rd</sup> from steam inlet end), and Valve (#665) was damaged at the seating area.

Parallality of steam chest cover was checked and found to be 0.009". The existing dimension D of all valves was noted in (Ref. Drg. EDP 1997 of Delaval for 105-JT. Numbering done from opposite steam end) - :

#1	#2	#3	#4	#5
0.785	0.541	0.349	0.732	1.210

**Assembly of Steam chest valve**

Steam chest valve was assembled with new stem (#624), packing gland assembly (#625- 2 nos.), nut (# 626-2 nos.), Lock screw (#703- 2 nos.), Nut (#668 - 4 nos.), Lock screw (#669- 4 nos.), Washer (#618 - 4 nos.), valve (# 667), Nut (#621), Nut (#622), Lock screw, new copper gasket, old spacers and new pointer made from W/s. Valve (#665) was not available and hence it was not removed.

**Nozzle Valve setting**

Nozzle Valve setting was as per the procedure given below (Ref. Drg. EDP 1997 of Delaval for 105-JT Numbering done from opposite steam end) -:

- Valve #667 was replaced. (Kept D= 0.349")
- Lifting bar along with valves kept on steam chest.
- Lifting valve was seated on 1<sup>st</sup> valve from opposite steam end.
- Lifting bar was kept parallel to steam chest face by keeping parting tool and feeler gauge. (Total thickness- 32.90 mm)
- Measured L & R. (153.38 & 153.32 mm)
- Measured C of all Valves. Refer attached sketch.
- Lifting bar removed from steam chest.
- Nut of Valve #667 was tack welded.
- New packing gland assembly was fitted to steam chest cover.
- The valve lifting lever made horizontal by jacking (13 "from cover face.)
- Both Stem were fixed to the lifting bar.
- Slide the stem with lifting bar through gland. Pointer was inserted and fork was connected.
- Centre distance of stem was checked.
- Adjusted stem nut & made the distance from steam chest face and lifting bar to 136.17 at steam inlet end and 136.18 at opposite steam inlet end.
- Projected end of stem made 1/8 "after cutting by hack saw.
- Grub screw provided to both stem nuts. Nut was tack welded
- Pointer distance was adjusted to 23.495 mm.
- Steam chest assembly was kept on steam chest. (Gasket thk. - 0.8 mm)
- Lifted the valves by 0.100 "
- Final gap of pointer was 7.50 mm.
- Coupled with governor linkage.

**105-JLP Refrigeration Compressor Preventive Maintenance**

Thrust bearing was opened and cleaned. Both journal bearing clearances were recorded by dial gauge since it is single piece design. Gauss measurement of bearings and rotor was carried out and found within limits.

**105-JR Gear Box Preventive Maintenance**

All the bearings were inspected and found OK. Both the gear as well as Pinion were inspected and found to be O.K. Gauss measurement of gear shaft and bearings carried out. Gauss measurement of journal bearing input shaft (3.6 Gauss) and journal bearing output shaft (5.8 Gauss) was higher and the same was reduced below 3 Gauss.

**105-JIIP Refrigeration Compressor Preventive Maintenance**

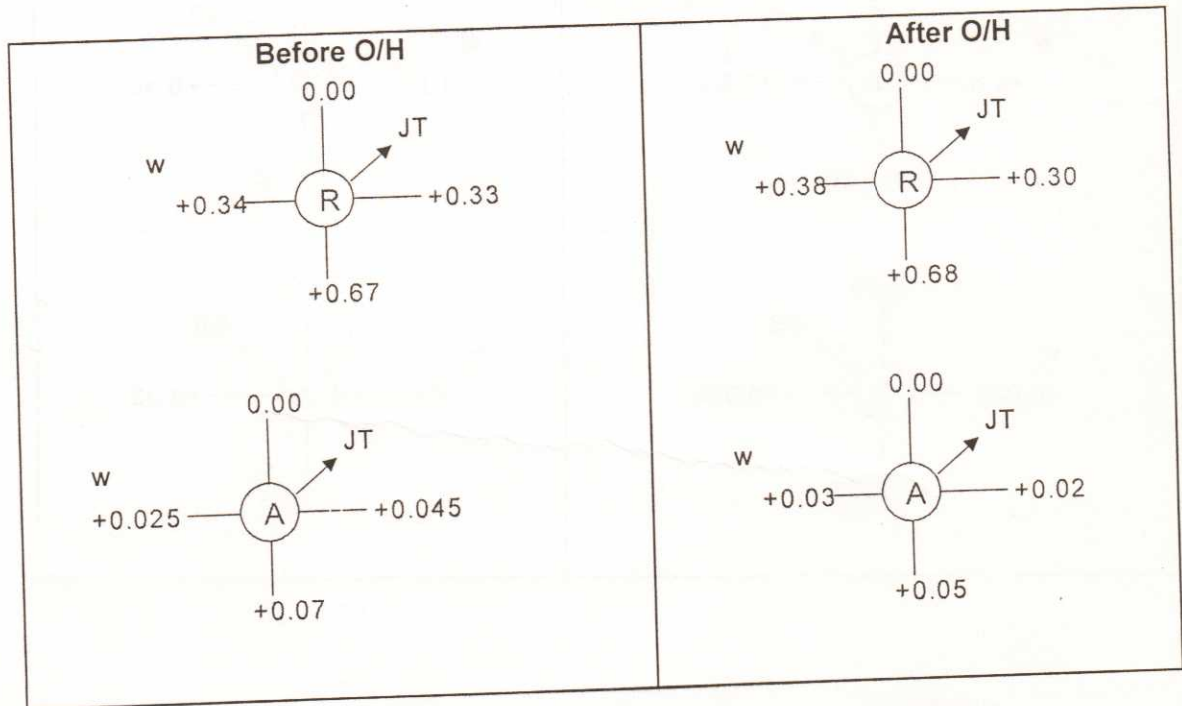
Thrust bearing was opened and cleaned. Both journal bearing clearances were recorded by dial gauge since it is single piece design. Gauss measurement of rotor and bearings was carried out and found within limits.

The reading taken during maintenance of 105 J train are recorded as under.

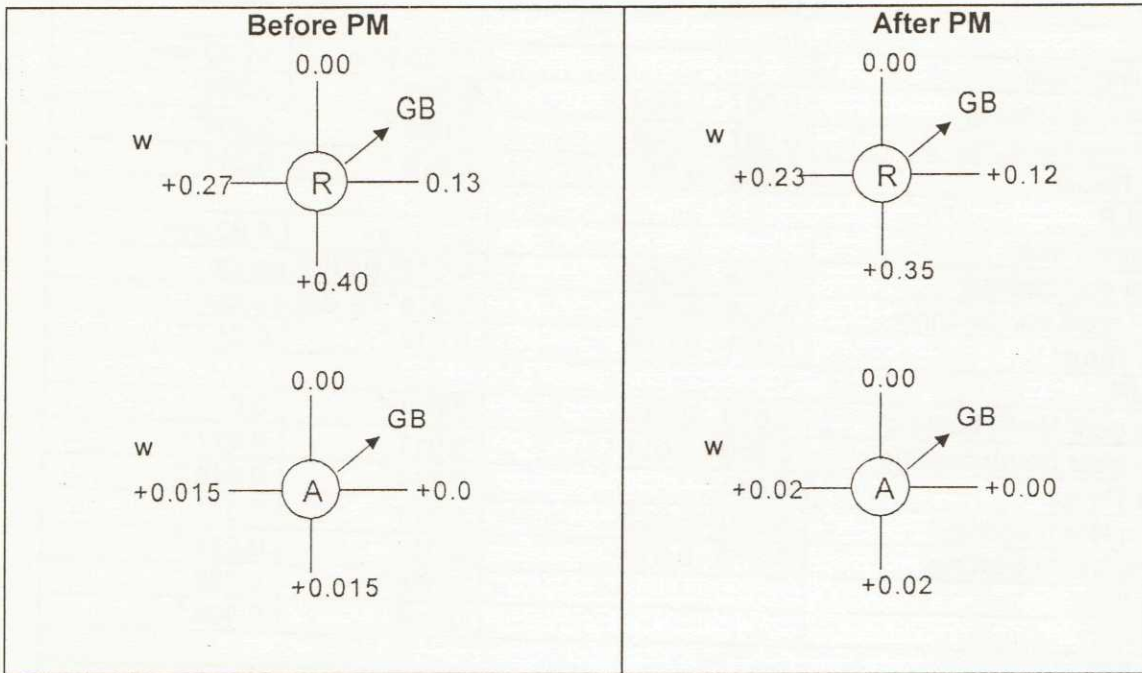
Description	Design Clearances ( Inch )	Before	After
<b>105 JT</b>			
Coupling Float		11.20 mm	11.20 mm
Thrust end bearing	0.007 - 0.009	0.009 "	0.009"
Opp Thrust end bearing	0.007 - 0.009	0.009 "	0.009"
Axial Thrust	0.008 - 0.012	0.010 "	0.011 "
<b>105 JLP</b>			
Coupling Float		8.90 mm	8.90 mm
Thrust end bearing	0.006 - 0.008	0.012" By dial gauge	
Opp Thrust end bearing	0.006 - 0.008	0.014" By dial gauge	
Axial Thrust	0.011 - 0.015	0.012 "	0.012 "
<b>105 JR</b>			
Drive gear North bearing	0.010 - 0.011	0.011 "	0.011 "
Drive gear South bearing	0.010 - 0.011	0.011 "	0.011 "
Axial Thrust	0.014 "	0.014 "	0.014 "
Pinion North bearing	0.010 - 0.012	0.011"	0.011 "
Pinion South bearing	0.010 - 0.012	0.011 "	0.011 "
Free float		0.055 "	0.055 "
Backlash		0.006 "	0.006 "
<b>105 JHP</b>			
Coupling Float		16.50 mm	16.50 mm
Thrust end bearing	0.004 - 0.007	0.005" By dial gauge	
Opp Thrust end bearing	0.004 - 0.007	0.007" By dial gauge	
Axial Thrust	0.008 - 0.012	0.011 "	0.012 "

Train Alignment Reading :

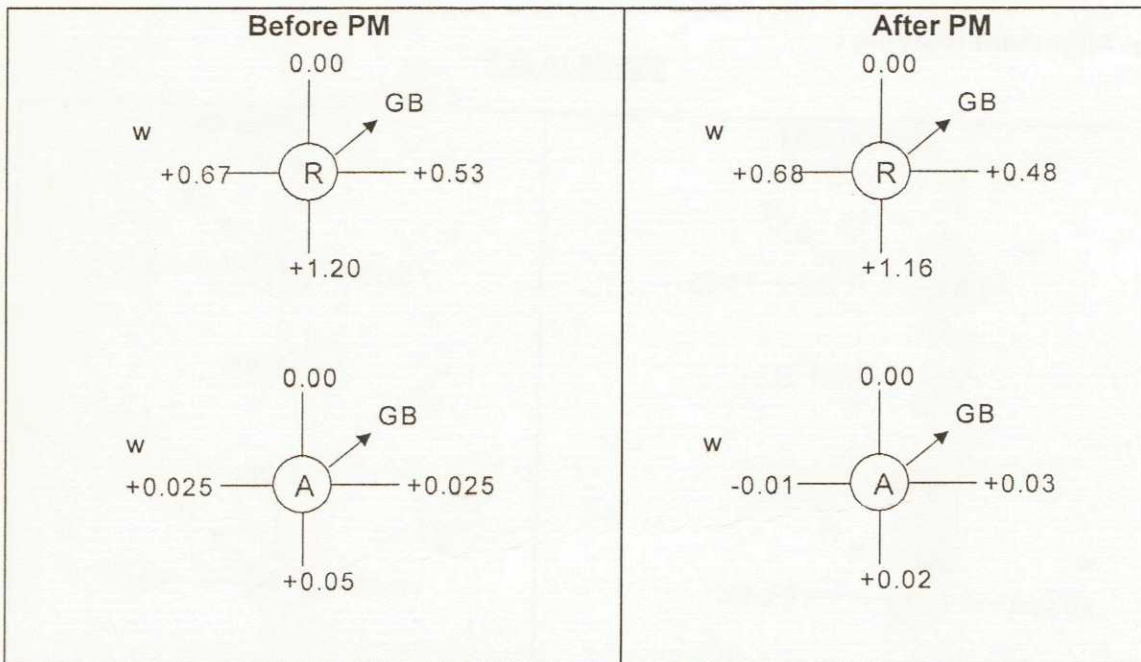
105 JT to JLP



105 JLP to GB



105 JHP to GB





## N.G. BOOSTER COMPRESSOR TRAIN:

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### **N.G Booster Compressor Drive Turbine 800-JT Preventive Maintenance**

Turbine was decoupled and Journal and thrust bearings were opened and checked. Clearances were within design limit. Gauss measurement of rotor shaft and bearings was carried out. Gauss measurement of thrust bearing housing (5.2gauss), Shim (4.4 Gauss) and opposite thrust journal bearing base ring (3.5 gauss) was above limit and the same was reduced below 3 Gauss. Servomotor Hydraulic cylinder, Pilot Valve, Governor Tester, hand trip valve, tripping device were opened and cleaned.

Both governing oil filters were cleaned. Governing valve stroke w.r.t secondary oil pressure checked from 505 Governor.

Signal %	Secondary oil Pr. (Kg/ cm <sup>2</sup> )	Valve Lift
0	1.25	0
10	1.45	0
20	1.75	2
30	1.95	6
40	2.25	9.5
50	2.6	10.5
60	2.9	11.5
70	3.2	12.5
80	3.6	13.5
90	3.95	14
100	4.3	16

### **800-J NG Booster Compressor Preventive Maintenance**

Opened both journal bearings and thrust bearing and found OK. Gauss measurement of rotor shaft and bearings was carried out. Gauss measurement of opp. thrust journal bearing base ring (4.7 gauss) was above limit and the same was reduced below 3 Gauss

### **800-J AG Compressor Preventive Maintenance**

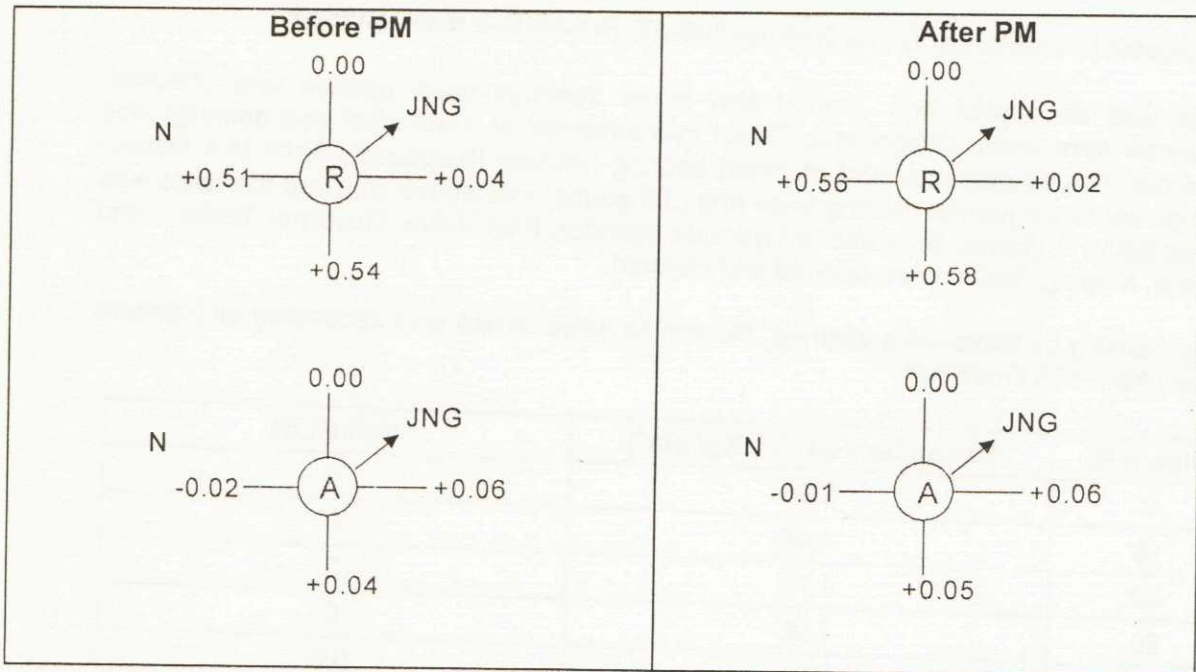
Opened both journal bearings and thrust bearing. Clearances were within the limit. Gauss measurement of rotor shaft and bearings was carried out. Gauss values of thrust pads (10 gauss), Shim (10 Gauss) was above limit and the same was reduced below 3 Gauss.

### **Train Alignment Reading:**

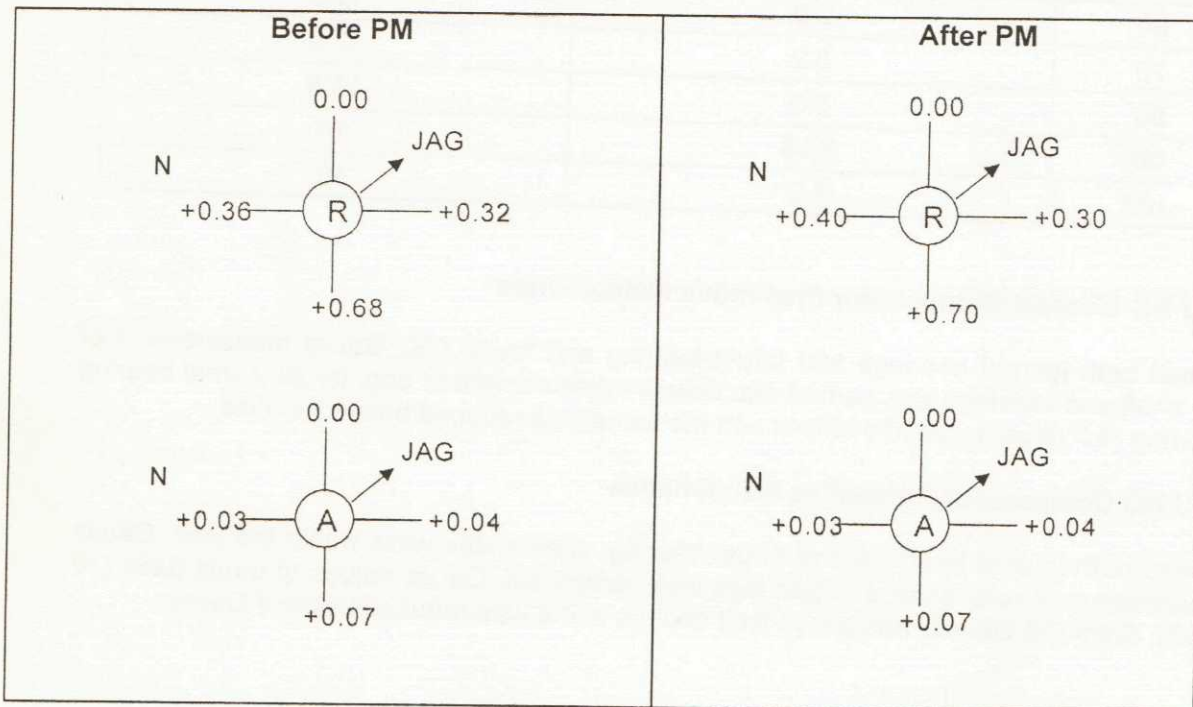
The reading taken during preventive maintenance of 800J train is recorded as under:

800 JT to JNG

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800 JNG to JAG



107-JT aMDEA Pump Drive Turbine (MURRAY) Preventive Maintenance:

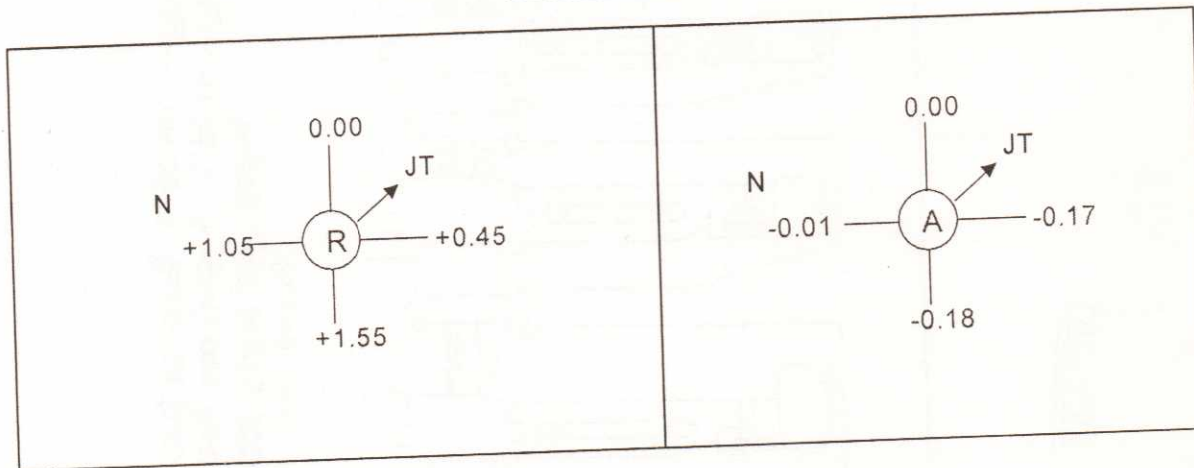
Opened both journal bearings and thrust bearing. Clearances were on the higher side. Since the spares were not available assembled with the same bearing. LO & GO cooler was cleaned. Lube oil console was cleaned and filled with new oil. LO filter was replaced with new one.

Description	Design Clearances ( Inch )	Before	After
107 JT			
Coupling Float		15 mm	15 mm
Thrust end bearing	0.004 - 0.006	0.007 "	0.007"
Opp Thrust end bearing	0.004 - 0.006	0.007 "	0.007"
Axial Thrust	0.007 - 0.013	0.013 "	0.013 "

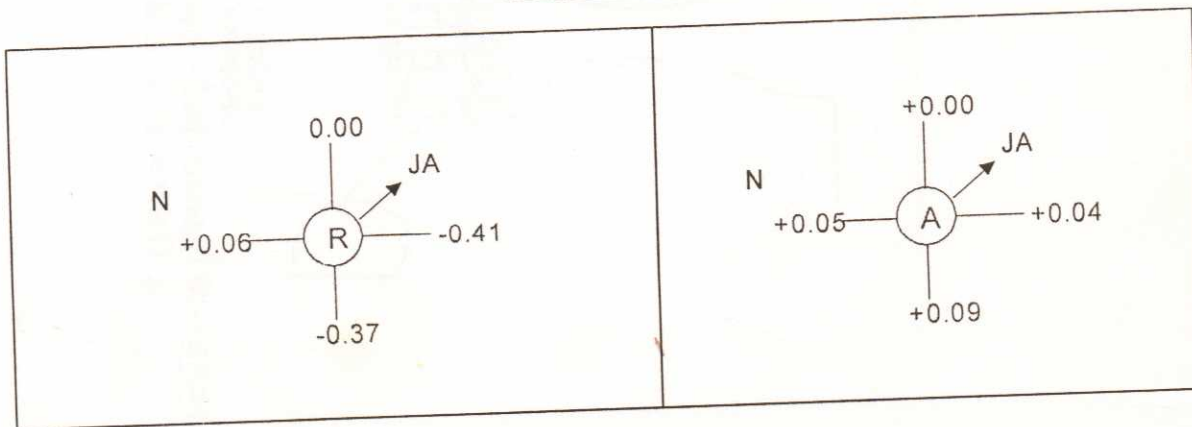
**107-JA & B aMDEA Pump Preventive maintenance**

Coupling float was taken (19 mm) and Pump was decoupled. Bearing oil was flushed.

**107 JT to JA**



**107 JA to JB**



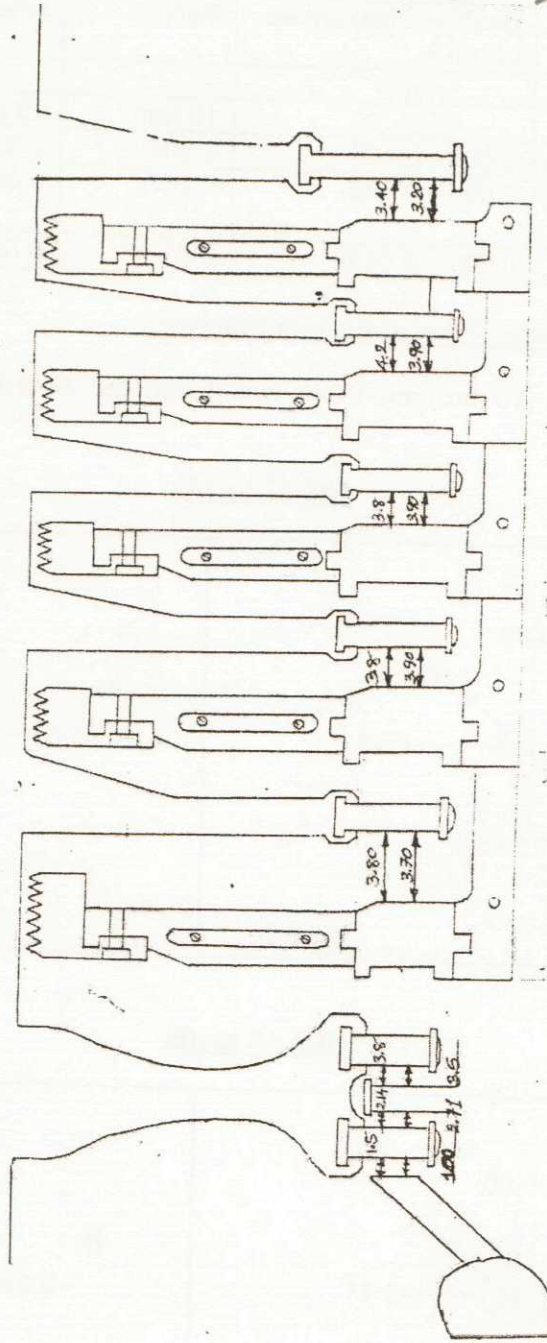
**BOILER FEED WATER PUMP AND DRIVE TURBINE (104JAT/JA/JT/J)**

**104-JAT BFW Pump Drive Turbine (Terry) Overhauling:**

Turbine was opened for changing the nozzles procured from M/s Triveni Engg., Bangalore against PO No. 12/00555/9911362, dtd. 04.05.2002. Turbine was decoupled. Exhaust bellow was removed. Journal bearing and thrust bearing clearances were checked Turbine top casing was opened and rotor was removed.

Rotor Thrust: 0.30 MM.

104-JAT



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Rotor - Eccentric side Reading  
Rotor - Eccentric side Reading  
NOTE: - Thrust Ped. In side only ~~Reading~~ Mounting: 1.70 MM - Float (outside Ped. removed)  
\* Thrust Ped. outside only. Mounting: 1.50 MM - Float (In side Ped. removed)

Rotor was replaced with new repaired rotor. New carbon rings were fitted at both glands and recorded the clearances found within design value. Nozzle clearance and diaphragm clearances were recorded. (Data sheet is attached).

Gland repacking of TTV was carried out. Governor oil was flushed and governor was tested on test bench. LO & GO cooler was cleaned. LO console was cleaned and filled with new oil. LO filter cleaned. Gland repacking of extra nozzle valves was carried out.

Turbine OST done at 4200 RPM.

Description	Design Clearances ( Inch )	Actual
<b>104 JAT (Terry)</b>		
Coupling Float		6 mm
Thrust end bearing	0.005 - 0.007	0.0065"
Opp Thrust end bearing	0.005 - 0.007	0.005"
Axial Thrust	0.011 - 0.016	0.014 "
<b>104 JA (Pacific Pump)</b>		
Thrust end bearing	0.006 - 0.008	0.008"
Opp Thrust end bearing	0.006 - 0.008	0.006"
Axial Thrust	0.014 "	0.0135 "

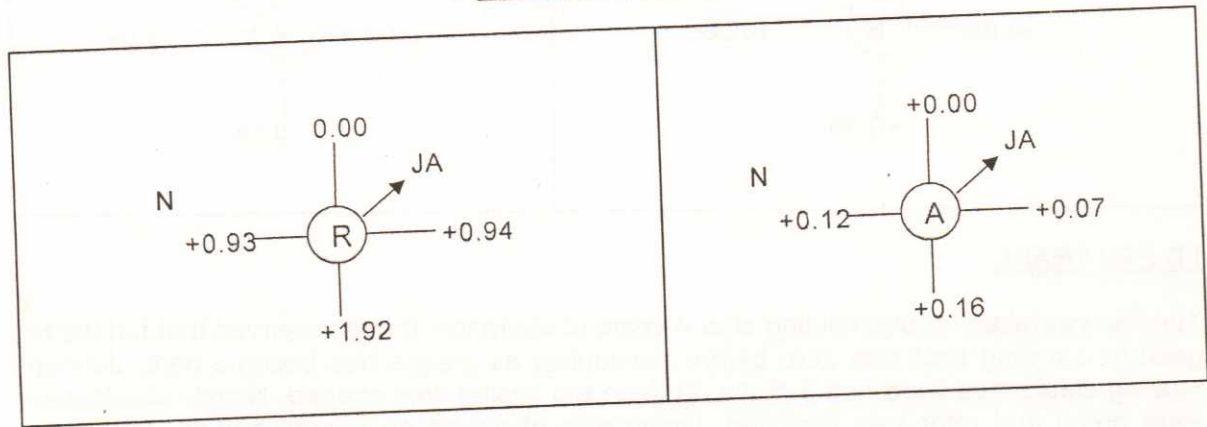
**104 -JA BFW Pump Preventive Maintenance:**

Both the journal bearings as well as thrust bearing were inspected clearances found within recommended value. Mechanical seal at free end was attended for leakage.

MOP replaced with new one. RV of MOP was replaced with new one. Pump Seal oil coolers & LO coolers were cleaned. MOP & AOP strainer and filters were cleaned. Alignment of AOP was checked. Coupled and greased the coupling.

Alignment reading:

104 JAT to 104JA



Turbine was opened for changing the rotor. Turbine was decoupled. Journal bearing clearances were noted down. Turbine top casing was opened and rotor was removed.

Governor replaced with new repaired governor. LO & GO cooler was cleaned. LO

Console was cleaned and filled with new oil. Oil filter and strainer cleaned. AOP alignment checked. Gland repacking of extra nozzle valves was carried out.

Both the journal bearings as well as thrust bearings were inspected and clearances were found within recommended value. Main oil pump drive gear replaced with new one. Pump Seal oil coolers & LO coolers were cleaned. MOP & AOP strainer and filters were cleaned. Alignment of AOP was checked. The coupling was greased .

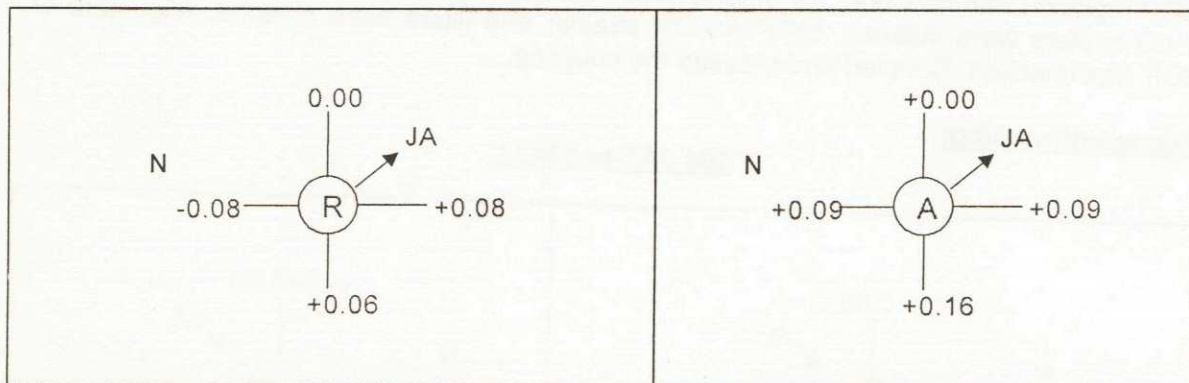
Turbine OST was done at 4210 RPM.

The reading taken during maintenance of 104J Train is recorded as under:

Description	Design Clearances ( Inch )	Actual
<b>104 JT (Elliot)</b>		
Coupling Float		mm
Thrust end bearing	0.007 - 0.010	0.010"
Opp Thrust end bearing	0.007 - 0.010	0.010"
Axial Thrust		0.016 "
<b>104 J (Pacific Pump)</b>		
Thrust end bearing	0.006 - 0.008	0.010"
Opp Thrust end bearing	0.006 - 0.008	0.011"
Axial Thrust	0.014 "	0.013 "

Alignment reading:

104 JT to 104J



I D FAN TRAIN:

Turbine was taken for overhauling after 4 years of operation. It was observed that turbine to gearbox coupling float was zero before decoupling as grease has become hard. Journal bearing clearances were noted down. Turbine top casing was opened. Nozzle clearances were noted and rotor was removed. Lining was observed on journal portion. OST was opened and cleaned. Steam inlet valve was opened. Gland (#573) was replaced with new one. Valve and stem assembly was also opened and found OK.

Turbine was assembled with new journal bearings, ball bearing (6310 Z) and Carbon rings. Governor was replaced with repaired governor after testing on test bench. LO coolers were opened and cleaned.

Tapping was taken from steam exhaust line of turbine for changing the turbine to Condensing type during next turnaround. Exhaust RV was removed and exhaust line was cleaned before start up.

During start up, the governor was not responding and hence the old one was tested at governor test bench and it was installed and found OK.

Turbine OST was carried out at 4250 RPM.

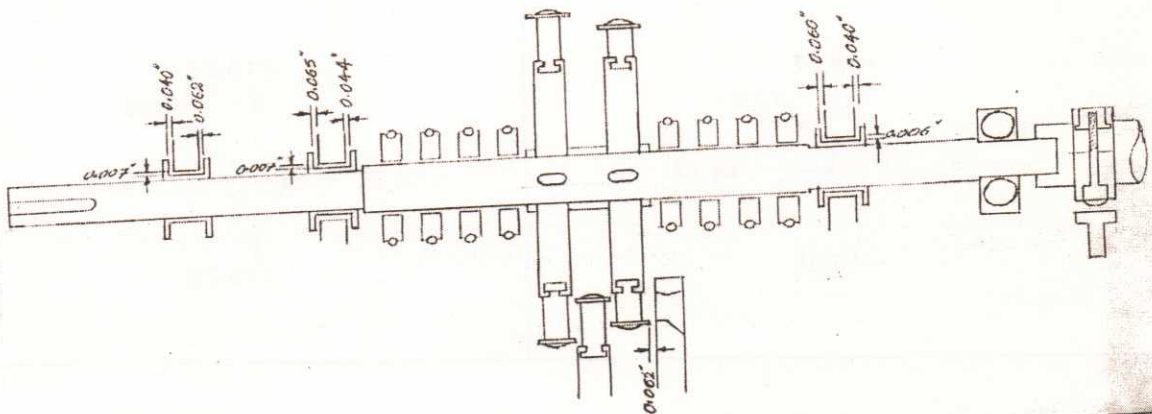
Gear box cover was removed. All bearings were inspected and their clearances were recorded. The condition of both the Gear as well as Pinion were found to be O.K. Gear box oil pump was opened. Ball bearing (6216 KC1) was replaced with new one (6216). Gear box was cleaned and filled with new oil. Oil filter was cleaned.

Both the bearings of the I.D. Fan were inspected and found to be OK. The reading taken during overhauling of I.D. Fan Train is recorded as under.

Description	Design clearances ( Inch )	Before	After
<b>101 BJT</b>			
Coupling Float		-	9.50 mm
Thrust end bearing	0.006 - 0.009	0.010"	0.009"
Opp Thrust end bearing	0.006 - 0.009	0.012"	0.009"
Axial Thrust	0.014 "	0.40 mm	0.43 mm
<b>101 BJR</b>			
Coupling Float		3.20 mm	3.20 mm
Pinion Turbine side bearing (I/P)	0.010 - 0.012	0.010"	0.010"
Pinion Fan side bearing	0.010 - 0.012	0.010"	0.010"
Free float		0.84 mm	0.84 mm
Gear Turbine side bearing (O/P)	0.010 - 0.011	0.011"	0.011"
Gear Fan side bearing	0.010 - 0.011	0.010"	0.010"
Gear Thrust		0.48 mm	0.32 mm
Back lash		0.38 mm	0.38 mm
<b>101 BJ</b>			
Thrust end bearing	0.008 - 0.012	0.012 "	0.012 "
Opp Thrust end bearing	0.008 - 0.012	0.012 "	0.012 "
Axial Thrust		0.85 mm	0.85 mm

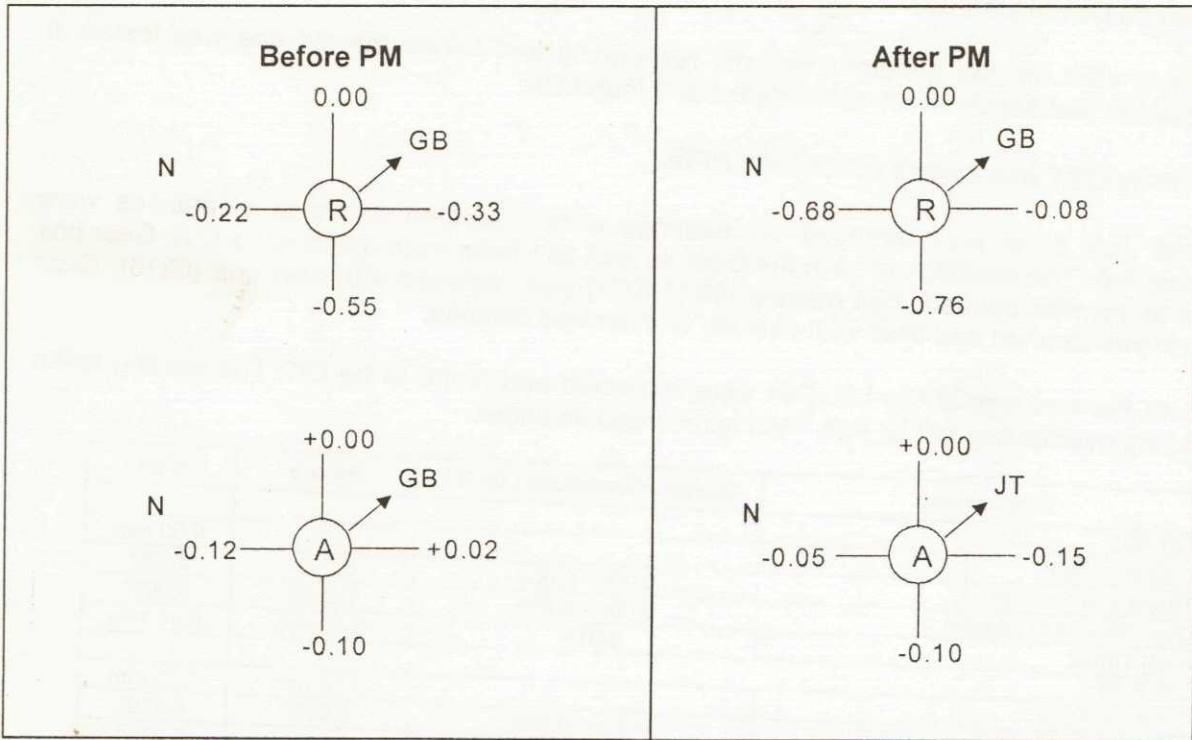
Date - 20.5.2004

ELLIOT TURBINE -  
101 BJT - I. D. FAN TURBINE

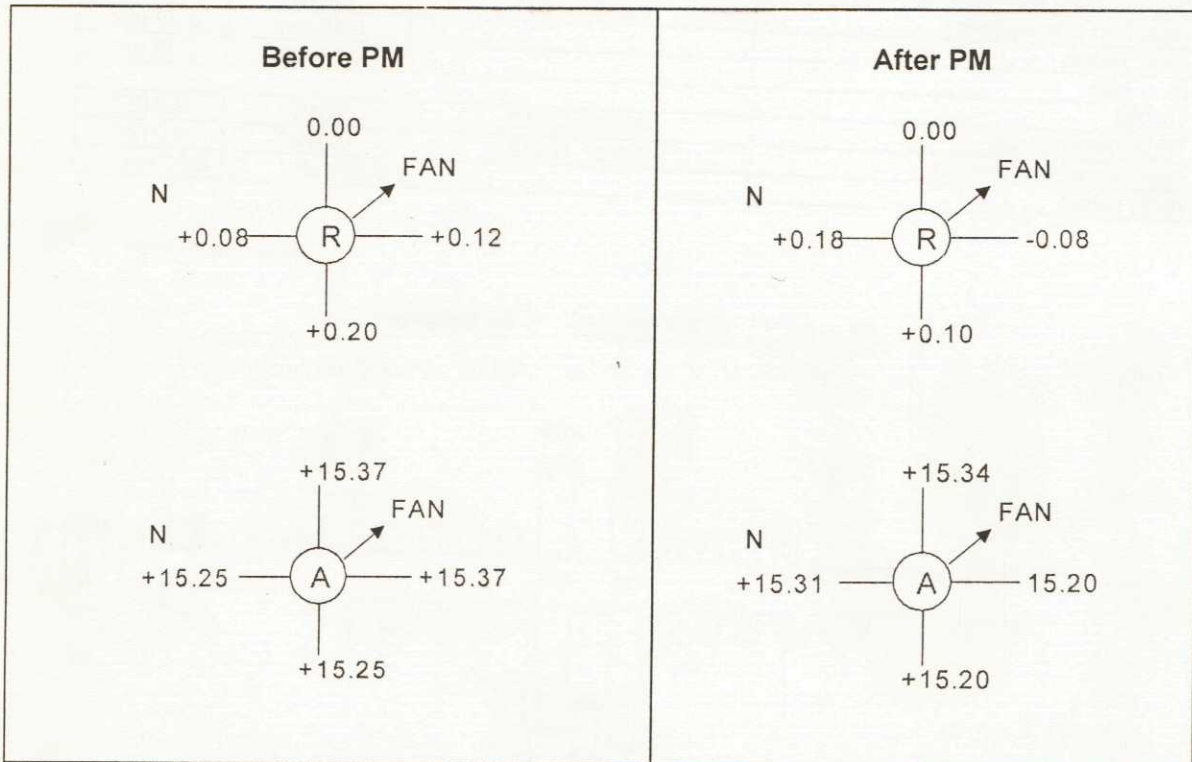


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101 BJT to GB



101 GB TO FAN





### PRIMARY REFORMER - 101-B :

During the last turn around 2003, 30 tubes and 2 risers were left as they were having minor cracks or initiation of cracks from inside of tubes at 'C' joint. It was decided to replace all these cracked tubes in this turn around 2004. Crack detected in 2 more catalyst tubes during Radiography of those tubes were having maximum frequency of Hot Bands during operation.

#### **Replacement of Catalyst Tubes:**

During shutdown 2004 in all 32 tubes were replaced. We were having 14 nos. reclaimed spare catalyst tubes and 01 no. Riser tube available in our store. Remaining 18 catalyst tubes and 01 no. Riser tube were salvaged from used tubes removed from Primary Reformer.

The tubes which were replaced are 109, 207, 215, 234, 310, 322, 335, 341, 412, 442, 512, 513, 514, 529, 539, 604, 612, 622, 623, 624, 627, 632, 633, 707, 711, 715, 719, 805, 815, 826, 839, 841. Work contract (Contact No.12/00809/9914810 dated. 15/03/2004) was awarded to M/S Skywin Erector, Ahmedabad for 32 nos. catalyst tubes replacement. The 2 riser tubes were replaced departmentally.

The procedure for replacement of catalyst tubes is as follows:

- Locked the spring hangers and removed the top plug.
- Removed the catalyst from the tubes.
- Make approach in the tunnel by removing tunnel cover tiles and tunnel wall bricks to facilitate cutting and welding.
- Cut out the tube (G4852 mod.) from the weldolet joint by grinding at outlet manifold end.
- Disconnected the spring hanger and remove the tube from the furnace one by one with the help of HM crane (120ft. boom with jib).
- Remove old weld from the weldolets (Incolloy 800 HT) edge by grinding.
- Edge preparation and welding of catalyst tubes with weldolets was carried out as per WPS of S+C Ltd., Germany. (WPS is attached):
- All the 14 reclaimed spare tubes (G 4852 mod.) inserted from top one by one with the help of HM crane.
- Fit up with 3-4 mm. gaps and welding of new tube with the weldolet by filler wire UTP 6170 Co supplied by S+C Germany. Purging was done from the top of tube using dam paper at the bottom and rubber plus gasket dam at top.
- DPT and radiography carried out for both root run and final weld.
- Following Catalyst tubes were changed with salvaged tubes (within bracket indicates tube no.s of salvaged tubes already available in stores ) in place of following tubes:

Tube No. 109(406), 234(130), 322(807), 512(704), 513(140), 514(602), 529(738), 539(736), 604(167), 612(229), 707(122), 711(508), 715(136), 719(502).

- Catalyst tubes were changed with salvaged tubes in place of the following tubes (within bracket indicates tube no.s of salvaged tubes):

Tube No. 207(529), 215(539), 310(604), 335(514), 341(513), 412(612), 442(234), 622(109), 623(623), 624(633), 627(310), 632(335), 633(207), 839(341), 841(622), 815(322), 826(624).

- Finally pigtail tubes were welded with T-11 top piece (welding rod E-8018- B2L) with preheating at 150-180 deg. C.

In addition, 18 No.s of removed tubes were salvaged at our work shop as per repair procedure given below and replaced as shown above.

#### Repair procedure adopted for salvaging the tubes:

- Cut the tube at the defective weld 'C' joint.
- Removed old weld material from the edges and DPT clearance obtained for the prepared edge.
- Carried out solution annealing in our electrical furnace available in our workshop by heating the ends upto 75 mm. length to dissolve carbides, improving ductility and weldability.

- (i) Loading of fresh tubes at 300 deg. C furnace temperature.
- (ii) Heat up rate of 150 deg. C/hour.
- (iii) Soaking temperature 1150 deg. C.
- (iv) Soaking time 2 hours.
- (v) Cooling with Forced Air.

- Cleaning of solution annealed bevel face.
- DP test of beveled face after solution annealing.
- While carrying out fit up, it was ensured that tube assembly was straight.
- Fit up with 3-4 mm. gaps.
- Root run after fit up was done DP test and selective radiography of root run.
- Welding with UTP 2535 Nb filler wire supplied by S+C Germany as per WPS.

During fill up it was ensured that inter pass temperature is less than or equal to 100° C.

#### Replacement of riser tubes in Row No. 1 & 5:

- During radiography of 'C' weld joint of riser tubes conducted in last shut down initiation of crack in 'C' weld was found in riser tubes of row no. 1 and 5. These tubes were replaced with new one (G 4852 mod.) as per the following procedure:

- Before cutting the riser, confirmed that all 42 tubes filled with catalyst and cooling water is (DM water) filled in transfer line up to the operating level.
- Unlock all spring hangers in the row corresponding to that of the riser and confirmed that the harp assembly freely suspended by spring hangers.
- Record the spring readings in mm. before cutting the riser:
- Cut out the riser from bottom by means of grinding and remove the riser through roof opening by means of the HM crane.
- Edge preparation of the weldolet and RF-10 before insertion of new riser.
- Inserted new riser by HM crane from top and supported it by clamping it with adjacent tubes and with the help of chain blocks from top.
- Checked the riser is vertically in plumb to +/- 12mm. top to bottom in both the direction and harp assembly is free from any scaffolding.
- Edge preparation and welding of Risers with weldolets and Canister RF-10 joint was carried out as per WPS of S+C Ltd., Germany. (WPS is attached here with):
- Edge DP of bottom weldolet and riser tube was done and clearance obtained. End plugs of transfer line were sealed. Dam for welding was made and purging was given from top. Fit up prepared with a gap of 4-5 mm.
- Riser welding was completed with UTP 6170 Co supplied by S+C Germany at the bottom weldolet followed by DP check and radiography for root weld and final weld.
- Record the spring readings in mm. after welding of new riser with bottom weldolet:
- The harp assembly lifted up by spring hangers to maintain a gap of 4-5 mm. at the top RF-10 joint and verticality of riser with in +/-12mm checked.
- Total load from the spring readings was calculated and this load was divided by 21. The spring hangers were set at this load.

Then dam was made for top joint welding and purging was given with the help of tube from the fit gap of 4-5mm.

Riser welding was completed with filler wire UTP 6170 Co supplied by S+C Germany at top followed by DP check and radiography of root weld and final weld.

Canister can was filled with insulation and it was welded at the top along with its bottom plate.

Finally cold balancing of harp assembly was carried out by adding riser weight of 444 kg to adjacent 3 springs from riser on both sides equally. The details are as follows:

Riser  
No. 1

Spring No.	Spring Constant	Calibrated Load	Kellogg Setting Load	Before riser cutting (From Kellogg setting)	Spring Load in Kgs	After Top Joint cutting (From Kellogg setting)	Spring Load in Kgs	After Bottom Joint cutting (From Kellogg setting)	Spring Load in Kgs	After Bottom Joint Welding (From Calibrated setting)	Spring Load in Kgs	Before top joint welding (From Calibrated setting)	Spring Load in Kgs	After Distributing Riser Weight (From Calibrated Setting)	Spring Load in Kgs
1	1.8	496	488	0	488	0	488	0	488	-14	470.8	-11	476.2	-11	476.2
2	4	937	944	-3	932	0	944	-2	936	4	953	4	953	4	953
3	4	937	944	-1	940	-2	936	-3	932	4	953	4	953	4	953
4	4	937	944	-5	924	-3	932	-3	932	4	953	4	953	4	953
5	4	937	944	-10	904	0	944	-2	936	6	961	4	953	4	953
6	4	937	944	-5	924	0	944	-1	940	6	961	4	953	4	953
7	4	937	944	-18	872	-2	936	-3	932	6	961	4	953	4	953
8	4	937	944	-25	844	0	944	0	944	6	961	4	953	4	953
9	4	937	944	-17	876	2	952	0	944	6	961	4	953	22	1025
10	4	937	944	-10	904	5	964	0	944	8	969	4	953	22	1025
11	4	937	944	-8	912	8	976	3	956	8	969	4	953	22	1025
12	4	937	944	-13	892	3	956	0	944	10	977	4	953	22	1025
13	4	937	944	-15	884	4	960	0	944	10	977	4	953	22	1025
14	4	937	944	-8	912	2	952	0	944	8	969	4	953	22	1025
15	4	937	944	-15	884	0	944	0	944	8	969	4	953	4	953
16	4	937	944	-23	852	-3	932	-2	936	6	961	4	953	4	953
17	4	937	944	0	944	0	944	0	944	6	961	4	953	4	953
18	4	937	944	-5	924	-4	928	-4	928	4	953	4	953	4	953
19	4	937	944	0	944	0	944	0	944	4	953	4	953	4	953
20	4	937	944	0	944	0	944	0	944	2	945	4	953	4	953
21	4	937	944	8	976	-2	936	-1	940	0	937	4	953	4	953
22	1.8	496	488	12	509.6	3	493.4	3	493.4	-14	470.8	-11	476.2	-11	476.2
					19185.6		19893.4		19789.4		20145.6		20012.4		20444.4

Load on Double spring hanger = 20145 / 21 = 959Kg (Corresponding Spring Setting = (959 - 937) / 4 = 6 Appx. )

Load on single spring hanger = 959 / 2 = 476.2 Kg (Corresponding Spring Setting = (476.2 - 496) / 1.8 = - 11 Appx. )

**Riser  
No. 5**

Spring No.	Spring Constant	Calibrated Load	Kellogg Setting Load	Before riser cutting (From Kellogg setting)	Spring Load in Kgs	After Top Joint cutting (From Kellogg setting)	Spring Load in Kgs	After Bottom Joint cutting (From Kellogg setting)	Spring Load in Kgs	After Bottom Joint Welding (From Calibrated setting)	Spring Load in Kgs	Before top joint welding (From Calibrated setting)	Spring Load in Kgs	After Distributing Riser Weight (From Calibrated Setting)	Spring Load in Kgs					
1	1.8	496	496	10	514	0	496	0	496	0	496	-6	485.5	-6	485.2					
2	4	937	961	9	997	0	961	0	961	0	961	8	971	8	969					
3	4	937	961	1	965	0	961	0	961	0	961	8	971	8	969					
4	4	937	961	2	969	0	961	0	961	0	961	8	971	8	969					
5	4	937	961	-8	929	0	961	0	961	1	965	8	971	8	969					
6	4	937	961	-9	925	0	961	0	961	0	961	8	971	8	969					
7	4	937	961	-15	901	0	961	0	961	2	969	8	971	8	969					
8	4	937	961	-19	885	2	969	2	969	3	973	8	971	8	969					
9	4	937	961	-15	901	2	969	3	973	5	981	8	971	26	1041					
10	4	937	961	-20	881	5	981	5	981	7	989	8	971	26	1041					
11	4	937	961	-9	925	5	981	5	981	6	985	8	971	26	1041					
12	4	937	961	-5	941	5	981	5	981	5	981	8	971	26	1041					
13	4	937	961	-9	925	3	973	3	973	4	977	8	971	26	1041					
14	4	937	961	-11	917	2	969	2	969	4	977	8	971	26	1041					
15	4	937	961	-10	921	0	961	0	961	2	969	8	971	8	969					
16	4	937	961	-15	901	0	961	0	961	1	965	8	971	8	969					
17	4	937	961	-8	929	2	969	3	973	2	969	8	971	8	969					
18	4	937	961	-1	957	-1	957	-1	957	2	969	8	971	8	969					
19	4	937	961	3	973	0	961	0	961	0	961	8	971	8	969					
20	4	937	961	1	965	0	961	0	961	0	961	8	971	8	969					
21	4	937	961	6	985	0	961	0	961	1	965	8	971	8	969					
22	1.8	496	496	9	512.2	1	497.8	1	497.8	0	496	-6	485.5	-6	485.2					
					19718.2			20313.8			20321.8			20392			20391			20782.4

Load on Double spring hanger = 20392 / 21 = 971Kg (Corresponding Spring Setting = (971 - 937) / 4 = 8 Appx. )

Load on single spring hanger = 971 / 2 = 485.5 Kg (Corresponding Spring Setting = (485.5 - 496) / 1.8 = - 6 Appx. )

### Replacement of Arch Roof Insulation :

37

Ceramic fiber modules were used for relining the roof insulation near riser no. 1 & 5.  
Insulation grade : Z (1450 deg. C)

Size	Qty.
A - 240×229×200	25 Nos.
B - 229×305×200	51 Nos.

All the above modules have special anchoring in which M-6 stud to be welded at arch roof plate and then modules are to be tightened.

### Replacement of Arch Burner Block :

During shutdown total 3 burner blocks were replaced. One near riser of row no. 1 and two nos. near riser of row no. 5. The gap around the burner blocks was filled with ceramic fiber blankets.

### Harp Assembly :

After replacement of catalyst tubes and risers new catalyst was filled in 32 tubes and partial loading of new catalyst was done in 39 tubes. All the 71 tubes were boxed up with new gaskets in the top plug. Hanger springs unlocked.

### Insulation and Refractory Work :


Wet cerafelt insulation(Store code – 461200229), procured from M/s Lloyds', Mumbai, against PO No. 12/00819/9914945, dated. 22.03.2004 was wrapped around the outlet header near the tubes and risers wherever it was required. High heat duty fire bricks, size: 228X162X63MM(Store code – 461200049), procured from M/s ACC, Ahmedabad, against PO No. 12/00845/9915316, dated. 18.05.2004 was used to repair Tunnel walls & Hollow extruded tunnel cover tiles,(Store code – 461203368), was used to replace broken tunnel cover.

### Catalyst replacement Job:

Catalyst of 71 nos. catalyst tubes were replaced (32 nos. replaced tubes and 39 nos. partially catalyst removed for radiography). Electric Hoist provided to production for catalyst loading. Plug of all the tubes were boxed up and handed over.

WPS for Catalyst Tubes:

- Catalyst Tube to Weldolet



Schmidt + Clemens GmbH + Co  
Edelstahlwerk Kaiserau  
Postfach 1140  
D-5253 Lindlar

QW-402 Welding Procedure Specification (WPS)  
No. 1795

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W 14  
.....  
G 4852 - SB-564  
catalyst tube - weldolet  
item SP-1 - item SF-1

designation see drawing KA 15320-03-2  
KA 15320-05-1  
KA 15320-06-1  
and KA 15320-00-1

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WELDING PROCEDURE SPECIFICATION NO. 1795 DATE 13.11.91 SUPPORTING PQR NO(S) P 124

REVISIONS \_\_\_\_\_ DATE \_\_\_\_\_

WELDING PROCESS (ES) GTAW TYPES manual

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<p>JOINTS (QW-402)</p> <p>Groove design <u>V-groove 70° with gap</u></p> <p>Backing <u>without strip or ring, back gas Argon</u></p> <p>Other <u>---</u></p>	<p>BASE METALS (QW-403)</p> <p>P No. <u>similar 45*</u> to P No. <u>45</u></p> <p>Thickness range <u>5 to 19 mm</u></p> <p>Other _____</p>																																
<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <th colspan="4" style="text-align: center;">FILLER METALS (QW-404)</th> </tr> <tr> <th></th> <th style="text-align: center;">root pass</th> <th style="text-align: center;">filler passes</th> <th style="text-align: center;">final pass</th> </tr> <tr> <td>F No.</td> <td style="text-align: center;">NA</td> <td style="text-align: center;">NA</td> <td style="text-align: center;">NA</td> </tr> <tr> <td>A No.</td> <td style="text-align: center;">NA</td> <td style="text-align: center;">NA</td> <td style="text-align: center;">NA</td> </tr> <tr> <td>Spec. No. (SFA, SFB)</td> <td style="text-align: center;">NA</td> <td style="text-align: center;">NA</td> <td style="text-align: center;">NA</td> </tr> <tr> <td>AWS No. (Class)</td> <td style="text-align: center;">NA</td> <td style="text-align: center;">NA</td> <td style="text-align: center;">NA</td> </tr> <tr> <td>Other</td> <td colspan="3">                     manufacturer: <u>Thyssen</u> / <u>U I P</u>                      type: <u>thermanit 2133</u> / <u>A2133Mn</u> </td> </tr> <tr> <td>Size of Electrode</td> <td style="text-align: center;">rods <u>2,4 mm</u></td> <td style="text-align: center;">rods <u>2,4 + 3,2 mm</u></td> <td style="text-align: center;">rods <u>2,4 + 3,2 mm</u></td> </tr> </table>	FILLER METALS (QW-404)					root pass	filler passes	final pass	F No.	NA	NA	NA	A No.	NA	NA	NA	Spec. No. (SFA, SFB)	NA	NA	NA	AWS No. (Class)	NA	NA	NA	Other	manufacturer: <u>Thyssen</u> / <u>U I P</u> type: <u>thermanit 2133</u> / <u>A2133Mn</u>			Size of Electrode	rods <u>2,4 mm</u>	rods <u>2,4 + 3,2 mm</u>	rods <u>2,4 + 3,2 mm</u>	<p>POSITION (QW-405)</p> <p>Position of Groove <u>5 G</u></p> <p>Welding progression <u>overhead, uphill and flat</u></p> <p>Other _____</p>
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<p>Flux Composition _____</p> <p>Particle Size _____</p> <p>Electrode Flux Composition _____</p> <p>Consumable Insert _____</p> <p>Other _____</p>	<p>PREHEAT (QW-406)</p> <p>Preheat Temp. <u>none</u></p> <p>Interpass Temp. <u>max, 200°C</u></p> <p>Preheat Maintenance <u>---</u></p> <p>Other _____</p>																																
	<p>POSTWELD HEAT TREATMENT (QW-407)</p> <p>Temperature <u>none</u></p> <p>Time Range _____</p> <p>Other _____</p>																																

QW-400 Welding Procedure Specification (WPS) (cont'd)

No. 1795

<p><b>GAS (QW-408)</b></p> <p>Shielding Gas(es) <u>Argon</u></p> <p>Percent Composition <u>99,999%</u> (mixtures)</p> <p>Flow Rate <u>8 to 10 liter/min.</u></p> <p>Gas Backing <u>Argon</u></p> <p>Trailing Shielding Gas Composition <u>99,999%</u></p> <p>Other <u>---</u></p>	<p><b>ELECTRICAL CHARACTERISTICS (QW-409)</b></p> <table border="1"> <thead> <tr> <th></th> <th>root pass</th> <th>filler passes</th> <th>final pass</th> </tr> </thead> <tbody> <tr> <td>Current (AC or DC)</td> <td>DC</td> <td>DC</td> <td>DC</td> </tr> <tr> <td>Polarity</td> <td>GTAW</td> <td>GTAW</td> <td>GTAW</td> </tr> <tr> <td>Amper (Range)</td> <td>60 - 100</td> <td>90 - 140</td> <td>90 - 130</td> </tr> <tr> <td>Volts (Range)</td> <td>--</td> <td>--</td> <td>--</td> </tr> <tr> <td>Travel Speed (Range)</td> <td>4-6cm/min.</td> <td>5-8cm/min.</td> <td>5-8cm/min.</td> </tr> </tbody> </table> <p>Other <u>---</u></p>		root pass	filler passes	final pass	Current (AC or DC)	DC	DC	DC	Polarity	GTAW	GTAW	GTAW	Amper (Range)	60 - 100	90 - 140	90 - 130	Volts (Range)	--	--	--	Travel Speed (Range)	4-6cm/min.	5-8cm/min.	5-8cm/min.
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<p><b>TECHNIQUE (QW-410)</b></p> <p>String or Weave Bead <u>string and weave beads</u></p> <p>Orifice or Gas Cup Size <u>GTAW 3/8"</u></p> <p>Initial &amp; Interpass Cleaning <u>grinding</u> (Brushing, Grinding, etc.)</p> <p>Method of Back Gauging <u>---</u></p> <p>Oscillation <u>3 to 6 mm</u></p> <p>Contact Tube to Work Distance <u>---</u></p> <p>Multipass or <u>multipasses from one side</u> Single Pass (per side)</p> <p>Single or Multiple <u>single rods</u> Electrodes</p> <p>Other <u>SCHMIDT • CLEMENS GmbH • Co</u> <u>Edelstahlwerk Kaiserau</u> <u>Schweißtechnik</u> <i>E. St. Benda</i> <u>D-5253 Lindlar</u> <u>15.11.97</u></p>	<p><b>SKETCH</b></p>																								
<p>2</p>																									

• Riser Tube to Weldolet





Schmidt + Clemens GmbH + Co  
Edelstahlwerk Kalsroo  
Postfach 1140  
D-5253 Lindlar

QW-482 Welding Procedure Specification (WPS)

No. 1796

W 15

G 4852 - SB-564  
riser tube - weldolet  
item SP-2 - item SF-2

designation see drawing KA 15320-04-1  
KA 15320-06-1  
and KA 15320-00-1

WELDING PROCEDURE SPECIFICATION NO. 1796 DATE 13.11.91 SUPPORTING PQR NO(S) P 124

REVISIONS \_\_\_\_\_ DATE \_\_\_\_\_

WELDING PROCESS(ES) GTAW TYPES manual

<p>JOINTS (QW-402)</p> <p>Groove design <u>Y-groove 75/30° with gap</u></p> <p>Backing <u>without strip or ring, back gas Argon</u></p> <p>Other <u>---</u></p>				<p>BASE METALS (QW-403)</p> <p>P No. <u>similar 45*</u> to P No. <u>45</u></p> <p>Thickness range <u>19 to 51 mm</u></p> <p>Other <u>---</u></p>																															
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<p>PREHEAT (QW-406)</p> <p>Preheat Temp. <u>none</u></p> <p>Interpass Temp. <u>max 200°C</u></p> <p>Preheat Maintenance <u>---</u></p> <p>Other <u>---</u></p>				<p>POSTWELD HEAT TREATMENT (QW-407)</p> <p>Temperature <u>none</u></p> <p>Time Range <u>---</u></p> <p>Other <u>---</u></p>																															
<p>Flux Composition <u>---</u></p> <p>Particle Size <u>---</u></p> <p>Electrode Flux Composition <u>---</u></p> <p>Consumable Insert <u>---</u></p> <p>Other <u>---</u></p>																																			

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QW-482 Welding Procedure Specification (WPS) (Cont'd)

No. 1796

**GAS (QW-408)**

Shielding Gas(es) Argon

Percent Composition 99.999%  
(mixtures)

Flow Rate 8 to 10 liter/min.

Gas Backing Argon

Trailing Shielding Gas Composition 99.999%

Other ---

**ELECTRICAL CHARACTERISTICS (QW-409)**

	root pass	filler passes	final pass
Current (AC or DC)	DC	DC	DC
Polarity	GTAW	GTAW	GTAW
Amps (Range)	60 - 100	90 - 140	90 - 130
Volts (Range)	--	--	--
Travel Speed (Range)	4-6cm/min.	5-8cm/min.	5-8cm/min.
Other	---	---	---

**TECHNIQUE (QW-410)**

String or Weave Bead string and weave beads

Orifice or Gas Cup Size GTAW 3/8"

Initial & Interpass Cleaning grinding  
(Brushing, Grinding, etc.)

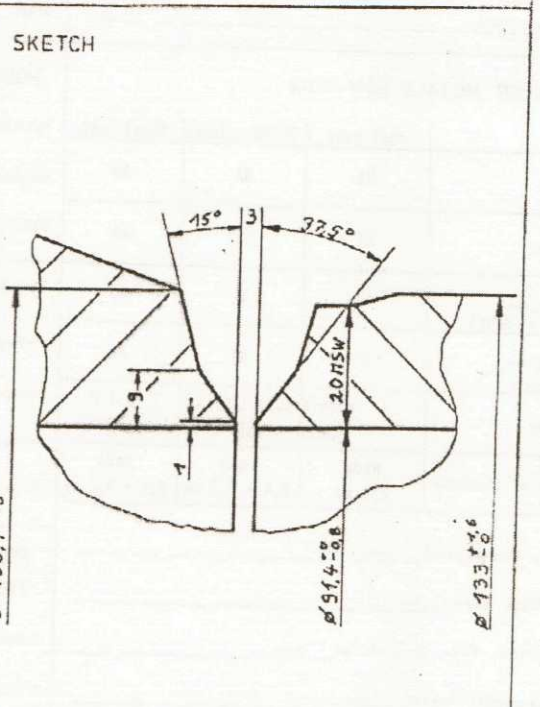
Method of Back Gauging ---

Oscillation 3 to 6 mm

Contact Tube to Work Distance ---


Multipass or multipasses from one side  
Single Pass (per side)

Single or Multiple single rods  
Electrodes



Other **SCHMIDT • CLEMENS GmbH • Co**  
**Edelstahlwerk Kaiserau**  
**Schweißtechnik** *L. A. B...*  
**D-5253 Lindlar** 15.11.97

• Catalyst Tube to Catalyst Tube Cast Section



Schmidt + Clemens GmbH + Co  
Edelstahlwerk Kaiserau  
Postfach 1140  
D-5253 Lindlar

QW-482 Welding Procedure Specification (WPS)

No. 1782

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W 1  
G 4852 - G 4852  
tube - tube  
item SP-1 - item SP-1

designation see drawing KA 15320-03-2

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WELDING PROCEDURE SPECIFICATION NO. 1782 DATE 13.11.91 SUPPORTING PQR NO(S) V 476

REVISIONS \_\_\_\_\_ DATE \_\_\_\_\_

WELDING PROCESS (ES) G T A W and S M A W TYPES manual

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<p><b>JOINTS (QW-402)</b></p> <p>Groove design <u>V-groove 70°</u> without gap _____</p> <p>Backing <u>without strip or ring, back gas Argon</u> _____</p> <p>Other <u>---</u> _____</p>	<p><b>BASE METALS (QW-403)</b></p> <p>P No. <u>similar 45 *</u> to P No. <u>the same</u> _____</p> <p>Thickness range <u>5 to 19 mm</u> _____</p> <p>Other <u>* G-X 40 NiCrNb 3525 (G 4852)</u> _____</p>																												
<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th></th> <th>root pass</th> <th>filler passes</th> <th>final pass</th> </tr> </thead> <tbody> <tr> <td>F. No.</td> <td style="text-align: center;">-</td> <td style="text-align: center;">NA</td> <td style="text-align: center;">NA</td> </tr> <tr> <td>A No.</td> <td style="text-align: center;">-</td> <td style="text-align: center;">NA</td> <td style="text-align: center;">NA</td> </tr> <tr> <td>Spec. No. (SFA, SFD)</td> <td style="text-align: center;">-</td> <td style="text-align: center;">NA</td> <td style="text-align: center;">NA</td> </tr> <tr> <td>AWS No. (Class)</td> <td style="text-align: center;">-</td> <td style="text-align: center;">NA</td> <td style="text-align: center;">NA</td> </tr> <tr> <td>Other</td> <td colspan="3">manufacturer: Thyssen / U T P type: Thermit 2535R / 2535HbSN</td> </tr> <tr> <td>Size of Electrode</td> <td>without rods</td> <td>coated electrodes 4,0 + 5,0 mm</td> <td>4,0 + 5,0 mm</td> </tr> </tbody> </table>		root pass	filler passes	final pass	F. No.	-	NA	NA	A No.	-	NA	NA	Spec. No. (SFA, SFD)	-	NA	NA	AWS No. (Class)	-	NA	NA	Other	manufacturer: Thyssen / U T P type: Thermit 2535R / 2535HbSN			Size of Electrode	without rods	coated electrodes 4,0 + 5,0 mm	4,0 + 5,0 mm	<p><b>POSITION (QW-405)</b></p> <p>Position of Groove <u>1 G, rotated</u> _____</p> <p>Welding progression <u>uphill</u> _____</p> <p>Other <u>---</u> _____</p>
	root pass	filler passes	final pass																										
F. No.	-	NA	NA																										
A No.	-	NA	NA																										
Spec. No. (SFA, SFD)	-	NA	NA																										
AWS No. (Class)	-	NA	NA																										
Other	manufacturer: Thyssen / U T P type: Thermit 2535R / 2535HbSN																												
Size of Electrode	without rods	coated electrodes 4,0 + 5,0 mm	4,0 + 5,0 mm																										
<p>Flux Composition <u>---</u> _____</p> <p>Particle Size <u>---</u> _____</p> <p>Electrode Flux Composition <u>---</u> _____</p> <p>Consumable Insert <u>---</u> _____</p> <p>Other <u>---</u> _____</p>	<p><b>PREHEAT (QW-406)</b></p> <p>Preheat Temp. <u>none</u> _____</p> <p>Interpass Temp. <u>max. 200°C</u> _____</p> <p>Preheat Maintenance <u>---</u> _____</p> <p>Other <u>---</u> _____</p>																												
<p>Flux Composition <u>---</u> _____</p> <p>Particle Size <u>---</u> _____</p> <p>Electrode Flux Composition <u>---</u> _____</p> <p>Consumable Insert <u>---</u> _____</p> <p>Other <u>---</u> _____</p>	<p><b>POSTWELD HEAT TREATMENT (QW-407)</b></p> <p>Temperature <u>none</u> _____</p> <p>Time Range <u>---</u> _____</p> <p>Other <u>---</u> _____</p>																												

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QW-482 Welding Procedure Specification (WPS) (Cont'd)

No. 1782

**GAS (QW-408)**

Shielding Gas(es) Argon

Percent Composition 99,999  
(mixtures)

Flow Rate 8 to 10 liter/min.

Gas Backing Argon

Trailing Shielding Gas Composition 99,999%

Other ---

**ELECTRICAL CHARACTERISTICS (QW-409)**

	root pass	filler passes	final pass
Current (AC or DC)	DC	DC	DC
Polarity	- GTAW	+ SMAW	+ SMAW
Amps (Range)	150 - 180	100 - 180	100 - 180
Volts (Range)	--	--	--
Travel Speed (Range)	4-8cm/min.	8-12cm/min.	8-12cm/min.
Other	---		

**TECHNIQUE (QW-410)**

String or Weave Bead string and weave beads

Orifice or Gas Cup Size GTAW 3/8"

Initial & Interpass Cleaning grinding  
(Brushing, Grinding, etc.)

Method of Back Gauging ---

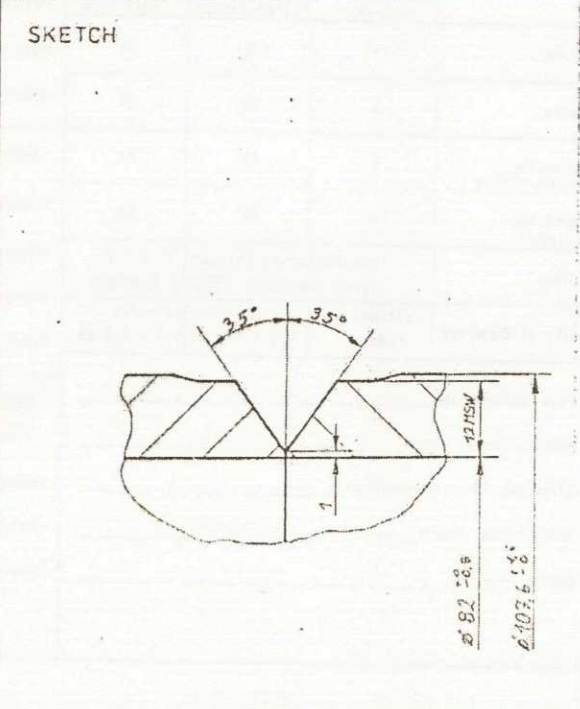
Oscillation 4 to 10 mm

Contact Tube to Work Distance ---

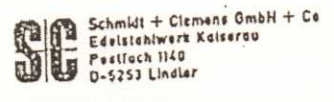
Multipass or Single Pass multipasses from one side  
(per side)

Single or Multiple Electrodes single electrodes

Other **SCHMIDT • CLEMENS GmbH • Co**  
**Edelfabrikwerk Kaiserau**  
**Schweißtechnik** *L. K. B...*  
**D-3133 Lindlar** *15.11.91*



• Riser Tube Top Piece to Transition Cone Assembly



QW-402 Welding Procedure Specification (WPS)  
No. 1798

FW 17  
SB-564 - equivalent  
riser tub top piece - riser transition assembly  
item RF-10 - item without No.  
designation see drawing KA 15320-04-1  
and KA 15320-00-1

WELDING PROCEDURE SPECIFICATION NO. 1798 DATE 13.11.91 SUPPORTING PQR NO(S) to be qualified by field manufacturer  
REVISIONS \_\_\_\_\_ DATE \_\_\_\_\_

WELDING PROCESS (ES) GMAW TYPES manual

<b>JOINTS (QW-402)</b> Groove design <u>U-groove 40° with gap</u> Backing <u>without strip or ring, back gas Argon</u> Other <u>---</u>				<b>BASE METALS (QW-403)</b> P No. <u>45</u> to P No. <u>45</u> Thickness range <u>19 to 51 mm</u> Other <u>---</u>	
<b>FILLER METALS (QW-404)</b>				<b>POSITION (QW-405)</b> Position of Groove <u>2 G</u> Welding progression <u>transverse</u> Other <u>---</u>	
F No.	NA	NA	NA	<b>PREHEAT (QW-406)</b> Preheat Temp. <u>none</u> Interpass Temp. <u>max, 200°C</u> Preheat Maintenance <u>---</u> Other <u>---</u>	
A No.	NA	NA	NA		
Spec. No. (SFA, SFB)	NA	NA	NA		
AWS No. (Class)	NA	NA	NA		
Other	manufacturer: <u>Thyssen</u> / <u>U T P</u> type: <u>Thermanit 2133</u> / <u>A2133Mn</u>				
Size of Electrode	rods 2,4 mm	rods 2,4 + 3,2 mm	rods 2,4 + 3,2 mm	<b>POSTWELD HEAT TREATMENT (QW-407)</b> Temperature <u>none</u> Time Range <u>---</u> Other <u>---</u>	
Flux Composition	<u>---</u>				
Particle Size	<u>---</u>				
Electrode Flux Composition	<u>---</u>				
Consumable Insert	<u>---</u>				
Other	<u>---</u>				

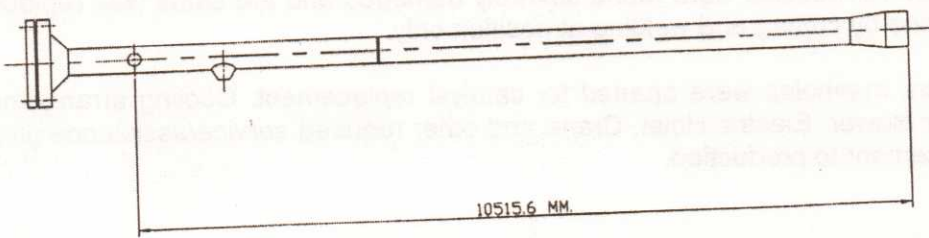
QW-482 Welding Procedure Specification (WPS) (Cont'd)

No. 1798

GAS (QW-408)	ELECTRICAL CHARACTERISTICS (QW-409)		
	root pass	filler passes	final pass
Shielding Gas(es) <u>Argon</u>	DC	DC	DC
Percent Composition <u>99.999%</u> (mixtures)	GTAW	GTAW	GTAW
Flow Rate <u>8 to 10 liter/min.</u>	60 - 100	90 - 140	90 - 130
Gas Backing <u>Argon</u>			
Trailing Shielding Gas Composition <u>99.999%</u>	4-6cm/min.	5-8cm/min.	5-8cm/min.
Other <u>---</u>			
TECHNIQUE (QW-410)	SKETCH		
String or Weave Bead <u>string and weave beads</u>			
Orifice or Gas Cup Size <u>GTAW 3/8"</u>			
Initial & Interpass Cleaning <u>grinding</u> (Brushing, Grinding, etc.)			
Method of Back Gauging <u>---</u>			
Oscillation <u>3 to 6 mm</u>			
Contact Tube to <u>---</u>			
Work Distance <u>---</u>			
Multipass or <u>multipasses from one side</u> Single Pass (per side)			
Single or Multiple <u>single rods</u>			
Electrodes <u>---</u>			
Other <u>SCHMIDT • CLEMENS GmbH • Co</u> <u>Edelstahlwerk Kaisersau</u> <u>Schweißtechnik</u> <i>E. A. Beck</i> <u>D-52333 Lindlar 15.11.91</u>			

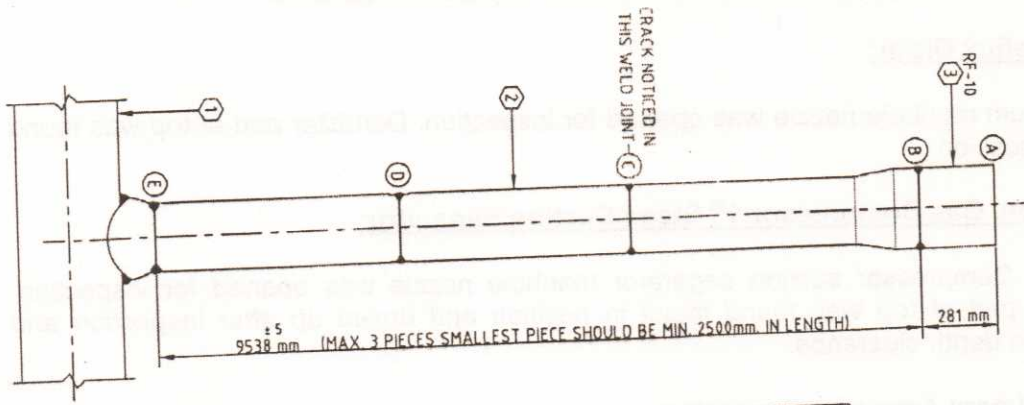
• Catalyst Tube Top Pipe

DATE : 09.06.2003



CATALYST TUBE FOR 101-B  
TRUNION DETAIL

• Riser Tube Assembly



3	RF-10 Distance piece I.D. 91.44 $\phi$ x 20.64 MW x 281 mm.	ASME SB-564	01
2	Riser Tube I.D. 91.44 $\phi$ x 16.5 MSW x 9538 mm.	G 4852 Modified	01
1	Outlet Manifold O.D. 141.3 $\phi$ x 18 MSW	G 4859	01
SR. NO.	ITEM DESCRIPTION	MATERIAL	QTY.

RISER TUBE FOR PRIMARY REFORMER (101-B)

DATE : 23.06.2003

## VESSELS AND OTHER EQUIPMENT:

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### 103-D, Secondary Reformer:

At the time of opening top manhole for catalyst unloading, the air nozzle fins were touching to the bulged liner and stuck up with the liner. Proper centering of the man hole was done and it was taken out. Liner was bulged inward in app. 20-40mm outside @ junction of transfer line inlet to 103D. The bulged portion was removed by grinding. Bottom manhole was opened for inspection. The same was boxed up after clearance from production. Air nozzles were found severely damaged and the same was replaced with repaired one by cutting and welding at position only.

Top and bottom manholes were opened for catalyst replacement. Cooling arrangement in the bottom, air blower, Electric Hoist, Crane and other required service/assistance given for catalyst replacement to production.

### 107 - D ,Transfer Line:

End plug manhole was opened for inspection and same was boxed up with new gasket after clearance from Inspection section.

### 102-F, Raw Gas Separator:

Raw Gas Separator manhole nozzle was opened for inspection. Demister pad at top was found intact in position and boxed up after inspection clearance.

### 103-F, Reflux Drum:

Reflux drum manhole nozzle was opened for inspection. Demister pad at top was found intact in position.

### 105-F, Syn. Gas Compressor 1<sup>st</sup> Stage Suction Separator:

Syn Gas Compressor suction separator manhole nozzle was opened for inspection. Demister pad at top was found intact in position and boxed up after inspection and Production deptt. clearance.

### 107-F, Primary Ammonia Separator:

Primary ammonia separator manhole nozzle was opened for inspection and boxed up after inspection and Production deptt. clearance.

### 109-F, Refrigerant Receiver :

Refrigerant Receiver manhole nozzle was opened for inspection. Cleaning was done by Production deptt. Boxed up after inspection and Production deptt. clearance.

### 112-F, Refrigerant Flash Drum:

Refrigerant Flash drum manhole nozzle was opened for inspection. Cleaning was done by Production deptt. Boxed up after inspection and Production deptt. Clearance.



**R-111, Sulpher Absorber:**

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Top, middle and bottom manholes were opened for catalyst replacement. Crane and other required service/assistance given for catalyst replacement to production.

**HEAT EXCHANGERS AND COOLERS HYDROJET CLEANING:**

- (I) Following heat exchangers were opened, pulled out the tube bundle for hydro jetting of shell / tubes. Tube bundle and channel covers were boxed up. Hydro test was carried out as mentioned below:

Sr. No.	Equip.	Qty. Nos.	No. Of Tubes	Tube side		Shell side		REMARKS
				Design	Hydrotest	Design	Hydrotest	
				kg/cm2	kg/cm2	kg/cm2	kg/cm2	
1	109	1	1.150	30.58	45.50	5.29	8.5	
2	109	1	1.150	30.58	45.50	5.29	8.5	
3	115 C	1	649 U	29.9	-	10.6	15.8	
4	116 C	1	300 U	66.4	-	10.4	15.8	
5	124 C	1	775 U	158	-	17.6	26.5	
6	130 JC	1	264	05.82	-	5.27		

- (II) Following heat exchangers were opened for hydro jetting of shell / tubes. Hydro test was carried out as mentioned below:

Sr.No.	Equip.	Qty. Nos.	No. Of Tubes	Tube side		Shell side		REMARKS
				Design	Hydrotest	Design	Hydrotest	
				kg/cm2	kg/cm2	kg/cm2	kg/cm2	
1	108 C1A	1	1415	05.27	08.5	8.00	08.5	
2	108 C1B	1	1415	05.27	08.5	8.00	08.5	
3	108 C2A	1	1415	05.27	08.5	8.00	08.5	
4	108 C2B	1	1415	05.27	08.5	8.00	08.5	One tube found leaking-Plugged it -First row, 6th nos. tube from C.T. side.
5	110-CA	1	763	05.60	-	5.27	8.10	
6	110-CB	1	2790	05.27	-	5.27	8.10	
7	127 CA	1	3516	05.60	-	21.10	31.50	
8	127 CB	1	3516	05.60	-	21.10	31.50	
9	128 C	1	1200	05.60	-	8.09	-	
10	129 JC	1	290 U	2.3	-	5.29	-	
11	131-JC	1	690	011.90	-	5.27	-	
12	173 C	1	294	010.60	-	5.27	-	
13	802 C	1	462	07.00	-	18.00	-	
14	803 C	1			-		-	

- (III) Hydro jetting in shell / tube side done on the following Lube Oil Coolers:

Sr. No.	Equipment	Quantity (Nos.)	Description	Remarks
1	101-JLC / 1-2 & 3	3	Lube oil cooler for 101 - J	
2	102-JLC/ 1 & 2	2	Lube oil cooler for 102 - J	
3	103-JLC/ 1 & 2	3	Lube oil cooler for 103 - J	
4	801-JLC/ 1 & 2	2	Lube oil cooler for 800 - J	

- (IV) Following Lube Oil Ccoolers were opened, cleaned by rod poking and boxed up:

Sr. No.	Equipment	Quantity (Nos.)	Description	Remarks
1	101-BJ Lube oil cooler	3	Lube oil cooler for 101 - BJ	
2	104-J / JA Lube oil cooler	5	Lube oil cooler for 104-J /JA	
3	107-J / JA Lube oil cooler	2	Lube oil cooler for 107- J/JA	

- (V) Following Gland Condensers & Surface Condensers were opened, cleaned by Hydrojetting and boxed up:

Sr. No.	Equipment	Quantity (No.)	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	1	Gland Condenser	
5	102-JT	1	Gland Condenser	
6	103-JBT	1	Gland Condenser	
7	105-JT	1	Gland Condenser	
8	852-J	1	Gland Condenser	
9	800-JT	1	Gland Condenser	
10	851-C	1	Gland Condenser	

- (VI) Following seal coolers were opened, cleaned and boxed up:

Sr. No.	Equipment	Quantity (Nos.)	Description	Remarks
1	104-J	2	Seal Cooler	
2	104-JA	2	Seal Cooler	
3	170-J /JA	2	Seal Cooler	

#### Retubing of 181C:

Insitu retubing of Carrier Gas Heater (181C) was carried out by M/S S.R. Engineers, Varoda. Details are ad below:

Sr. No.	Item Description	Item details
1	Drawing Referred	Drawing No. P1-BS-04105 Sheet 1 of 2, Rev '0', & P1-CS-04105 Sheet 2 of 2, Rev. '0' (Carrier Gas Heater)
2	No. of Tubes	320 Nos.
3	No. of exchanger	01 No
4	Tube material	SA179 (19.05OD X 2.3MM THK. X 2885 mm long)
5	Tube sheets material	SA105 (75 mm Thick X 776 mm OD).
6	Tube to tube sheet joint	Expanded in grooved holes & seal welded
7	Hydro test shell side	58 kg/cm2g

**RELIEF VALVES:**

Following relief valves were reconditioned and tested:

SR. NO.	RV.NO.	SET.PR. KG/CM <sup>2</sup>	RESET PR. KG/CM <sup>2</sup>	RV SIZE	DESCRIPTION	REMARK
1	101-F-1	119	116.6	2.5 X 6 (2.545)	Steam Drum RV	Steam tested
2	101-F-2	118	115.6	2.5 X 6 (2.545)	Steam Drum RV	Steam tested
3	101-F-3	117	114.6	2.5 X 6 (2.545)	Steam Drum RV	Steam tested
4	101-B	113	110.5	3 X (3.6) X 6	Super Heater RV	Steam tested
5	5RV-MS-9	42.2	37.98	4 P 6	38Kg Steam header	
8	RV-123 -C (South)	122	109.8	3 J 6	Converter outlet BFW Heat exchanger	
9	RV-123-C (North)	124		3 J 6	Converter outlet BFW Heat exchanger	
12	RV-103-JAT	660 PSIG	41.77	4 P 6	103-JAT exhaust	
14	103-JAT	660 PSIG	41.77	3/4 X (110) X 1	103-JAT cover	
16	RV 105 JLO	5.3		2 J E	3.5Kg.Steam to 111-C	
17	112-C A	10.5	9.45	1 1/2 H3	3.5Kg.Steam to 112-C	
18	112-CB	10.5	9.45	1 1/2 H3	3.5Kg.Steam to 112-C	
19	101-BJ	5.3		6 Q 8	101-BJT Exhaust	
20	109-F	19		6 Q 8	105-J Discharge	
22	RV 111-F	6.3	5.67	4 P 6	Ammonia vapor	
23	112-F	6.3	5.67	4 M 6	Liquid Ammonia	
24	RV 104-D1	35	31.5	6 Q 8	HTS Inlet	
25	RV 104-D2	34.1	30.69	1 1/2 F2	LTS Inlet	
26	RV 101-D	43.9	39.5	3 K 4	NG/LNG Gas	
27	101-J	36.9	33.21	4 M 6	Air	
28	RV-102-F Pilot operated	29.5	143	6 X R X 8	PG, Raw gas sep	
29	103-J, Recycle RV-Pilot operated	158.9 (2260 PSIG) Pilot RV	143	3 X K X 4	Synthesis Gas	
30	103-J, Discharge RV-Pilot operated	158.9 (2260 PSIG) Pilot RV	143	3 X K X 4	Synthesis Gas	
31	Desuper Heater station	42	37.8		BFW	
32	RV-103 JLP	74	66.6		Synthesis Gas	
33	RV-105-D	157.9	142.11		Synthesis Gas	
34	101 JT Sentinel RV	0.7	0.63		Air	

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

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Waste Heat Boiler was inspected by Boiler Inspector in open test condition on 29.05.2004. Hydrotest at 145 Kg/cm<sup>2</sup> pressure was done and witnessed by Boiler Inspector on 02.06.2004.

All the 4 relief safety valves of steam drum 101-F was steam tested/floated on 06.06.2004 and their readings are as follows:

	R.V. (North)	R.V. (Middle)	R.V. (South)	R.V. (Super Heater)
Popping Pr. Kg/cm <sup>2</sup> g.	116.6	118.5	119.5	113.0
Reset Pr. Kg/cm <sup>2</sup> g.	109.9	110.8	114.7	108.6

**MOV OVERHAULING JOB:**

**SP-1:** The stopper of the valve was found broken from the CI body cover, same was repaired and strengthening done.

**SP-3:** The actuator of this MOV was replaced with new Rotork make actuator.

**SP-5:** This MOV was replaced with overhauled one. Overhauling was carried out at M/S dandi valve engineering, A'bad & electrically checked at our electrical works.

**SP-71:** This MOV was replaced with existing installed one at the rack. The valve was electrically checked at our electrical works.

**Fabrication Jobs:**

Sr. No.	Item Description	Size
1	Under ground line across road near GAIL was replaced	8", sch30, SS 304
2	MIC 22 flange relocation for new control valve done	
3	P110 A/B NRV pipe line supporting done	
4	Provision for additional Isolation of 101J / 105 J Lube Oil filter and line supporting	
5	Suction line modification for installation of Y type strainer in P110 A/B and P111 A/B	
6	Stair case replacement from 103 D platform to Steam drum, partially done	
7	101J / 105J & 102J Lub oil filter cover lifting arrangement done	
8	851-J / 852-J Lifting arrangement done.	
9	101B Transfer line spring support walkway for taking reading by inspection is done.	
10	Steam trap and by pass line rerouting near 101J/105J lub oil console.	
11	107- D cover lifting arrangement done.	
12	103 J Recycle Pilot R.V. Union leakage. Union was replaced by flange joint.	

13	141-C provided platform plate.	
14	103-J Seal oil turbine C.W.line re-routing done.	
15	PICV-25 control valve platform to be extended.	
16	103-JAT turbine steam inlet TTV U/S drain flange location was changed for easy gasket replacing	
17	LCV-10 "Y" type strainer 40 mesh size was fixed.	1" x 1500 #
18	101-BJT Exhaust line drain valve was replaced	1/2"X 800#
19	FRCV-2 down stream block valve D/S bleed valve was replaced	3/4"X 800#
20	101F Blowdown sample valve near 103D Machine box at ground level was replaced	3/4"X 1500#
21	Steam line trap I/V was replaced near 156F	1/2"X 800#
22	MIS22 Jump over valve was replaced	3/4"X 1500#
23	38 Kg to ID Fan PI LP tapping root valve was replaced	1/2"X 800#
24	Offsite BFW outlet line PI 1st I/V was replaced	1/2"X 800#
25	Offsite BFW outlet line drain 2 <sup>nd</sup> I/V & Drain line to RV D/S I/V was replaced	1"X 800#
26	FRC2 HP tapping 1 <sup>st</sup> I/V G/L & its tee was replaced	1/2"X 1500#
27	MIC 22 Jump over valve(MS Side) was replaced	3/4"X 1500# 5Nos.
28	M.S steam nr Aux. Blr. Trap I/V was replaced	1/2"x 800#
29	109C D/L 1 <sup>st</sup> I/V was replaced	3/4"x800#)
30	SP 71 silencer D/L was replaced above PRC1	1 1/2"xSch40 pipe
31	FIC 13 RO U/S D/L was replaced	1"x120sch, CS
32	H-110 Naphtha outlet line was replaced	
33	Auxiliary Boiler Burner No.1 Naphtha / steam valve was replaced	
34	101-CB Shell side bottom drain valve was replaced	
35	101-CA shell side second drain valve gland leak 3.5kg to 104-E isolation valve was replaced	3/4"x800#
36	38 KG steam line I/V near 101 B step ladder was replaced	3/4"X800#
37	SR2801 discharge was connected to F 101 instead of feed fuel pump suction line	
38	107 JA/JT bearing cooling water line was connected with cooling water line in place of D.M water line	
39	101 J train platform gap to be fill up	
40	Arrangement for Super heater RV loading and Unloading with plate form was done	
41	131JC trap rerouting job was done	

**Gland Repacking of Valves:**

This job was carried out by M/S. Dandy Engineering Ahmedabad. In the given valves first old gland packing were removed and then put new gland packing.

Sr. No.	Description of Job	Size	Remarks
1	SP 4 by pass line isolation valve	2" x 1500 #	Furmenited
2	3.5 kg to 104-E isolation valve		
3	LCV-26 by pass isolation valve	2"x800#	
4	LC-26 by pass valve		
5	101F steam outlet block valve		
6	101JT steam inlet main I/V G/L	6" x 300 #	
7	173-C by pass valve gland leak	4" x 150 #	
8	SP-75 vent silencer isolation valve above post B cabin rack gland leak.	1 1/2"x 800 #	
9	101-F steam outlet block valve gland leak.		

10	101-JT steam inlet main isolation valve gland leak	6" x 300 #	
11	104-E condensate to 103-D jacket block valve gland leak	4"x150#	
12	Atomizing steam to Auxiliary Boiler Br.No.1,2 & 5 Block valve gland leak	11/2"x800#	
13	FIC-16 U/S and D/S gland leak		
14	Rich MDEA outlet corrosion test coupon line first isolation valve gland leak	3"x300#	
15	4 ata steam Urea side isolation valve gland leak	6" x 150 #	
16	PI-104 isolation valve gland lea	1"-800#	
17	Gland leak of BBD sample line first isolation valve	3/4"x1500#	
18	103-JAT steam inlet strainerd/s drain valve gland leak	3/4"X1500#	
19	PIC -4 gland leak on rack near 105-CA/CB	1"X 800#	
20	TRC-11 U/S drain valve gland leak	3/4"x 800 #	
21	101 F HP steam sample first isolation valve gland leak	1/2"x 1500#	
22	101-J lube oil turbine steam I/L line drain 1 <sup>st</sup> I/V	3/4"X800#	
23	38 Kg Steam to 800 JT C.V. D/S Pi I/V G/L	2"x300#	
24	4 ATA Steam to 104 E I/V	8"X150#	
25	104 Jt Steam Inlet Bypass Line I/V	3/4"X1500#	
26	LC-26 by pass valve G/	2"X800#	
27	127 -C Gas O/L I/V	6"X300	

#### Flange Leakage Jobs:

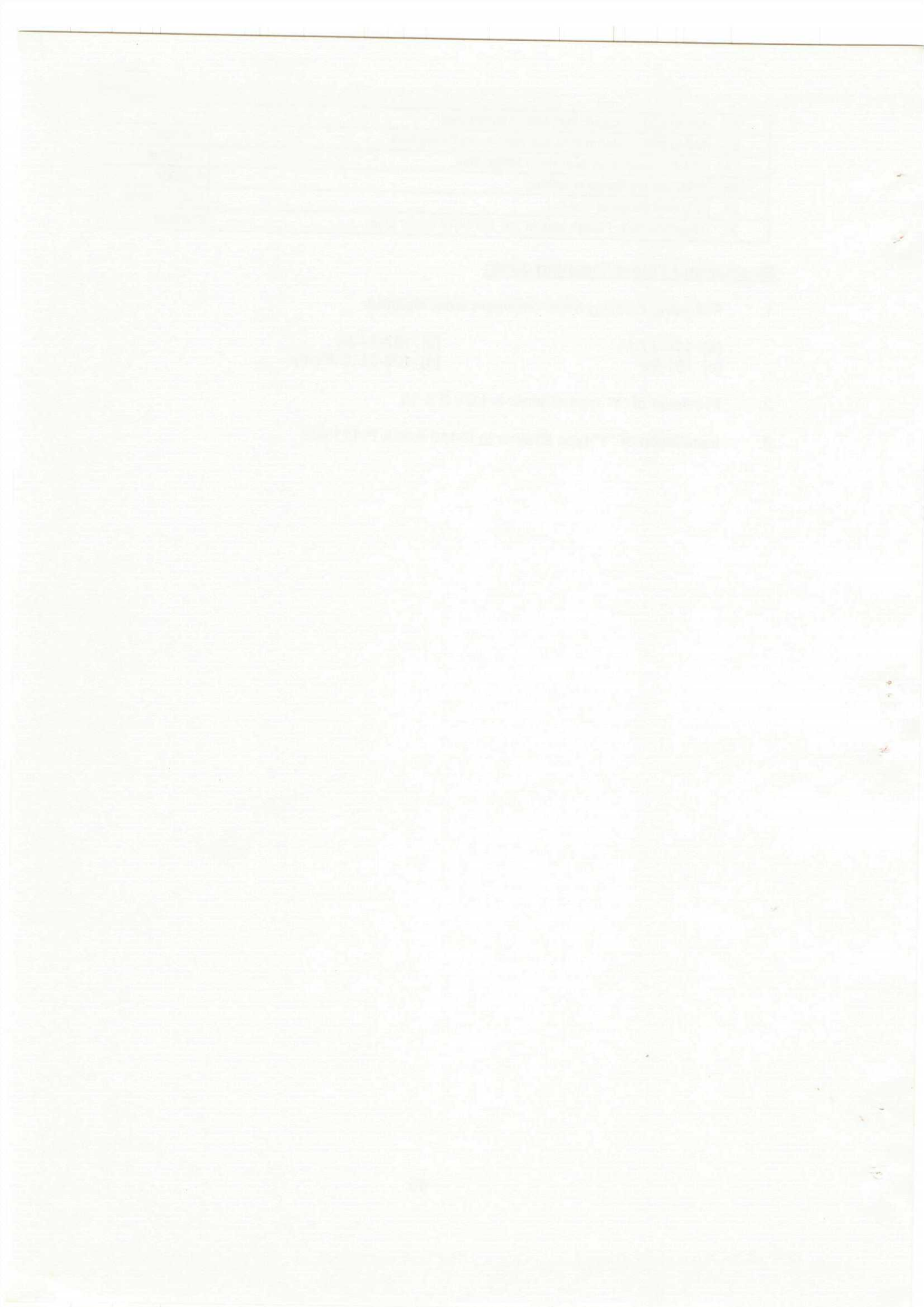
Sr. No.	Description of Job	Size
1.	156-F Blow down drum RV upstream flange leak	3"x150#
2.	FIC-13 orifice flange leak	
3.	103JAT steam inlet strainer flange leak	
4.	110-CA/CB outlet flange	
5.	102 C Inspection hole flange and 102C intermittent blow down line flange	
6.	MIC -61 U/S flange	
7.	38 kg Steam to 181 c isolation valve passing	4"x300#
8.	101CA/CB both riser & down comer flange Gkt to be replaced	14"x1500# , 18"x1500#
9.	102JT 3.5 Kg steam to 102JT PIC 202 D/S flange and strainer U/S flange	6"X 300# &8"X 300#
10.	4 ata steam Urea side I/V G/L	6"X150#
11.	HCV -12 gland leak	12"x
12.	107 JT Murray turbine stem inlet I/V bonnet leak (Pacific make G/V)	6"x 400#
13.	11 KG steam to LTS isolation valve U/S flange leak on rack	6"X 150#
14.	V-15 U/S flange leak	2"x300#
15.	157F inlet flange leak	18"x300#
16.	LTS outlet on rack above 103C F/L	16"x300#
17.	TI-1018 Thermo well (H-111) flange leak	
18.	101 F north L.G. leak	
19.	104 J disch ARV/NRV d/s flange leak.	6"x900#
20.	38 KG steam to 800 JT inlet vent valve u/s flange leak.	2"x 300#
21.	38 KG Steam to 800 JT thermocouple flange is leaking	11/2"X300#

22.	MS to 800 JT steam inlet line TI flange leak	
23.	MS to 800JT steam inlet line vent i/v u/s flange leak	1"x800#
24.	101 CA south side riser drain flange leak	1"x1500#
25.	PRC -25 u/s flange is leaking	4"x400#
26.	IBD root flange of 102 C	1 1/2"x 1500#
27.	Chemical doz. Flange leak of 101 CB BFW Outlet Line	2"x800#

### Strainer and Filters Cleaning Jobs:

1. Following Cooling water Strainers were cleaned:
 

[a] 104-J / JA	[b] 107-J / JA
[c] 101-BJ	[d] 102-J L.O.Pump
2. Provision of "Y" type strainer in LCV 8 & 10
3. Installation of "Y" type strainer in P-110 A/B & P-111 A/B





**CO<sub>2</sub> COMPRESSOR TRAIN (K-1801)****MAJOR OVERHAULING OF CO<sub>2</sub> COMPRESSOR L.P.CASE (K-1801-1)**

The Following activities were carried out during overhauling of the LP Compressor.

- The oil lines, seal lines, pressure balancing lines etc were removed to enable removal of top casing & Rotor assembly.
- The Coupling spacer between LP casing & gearbox was removed.
- Alignment between LP casing & gearbox was checked and the readings were recorded.
- The Coupling spacer between LP casing & steam turbine was removed.
- Alignment between LP casing & steam turbine was checked and the readings were recorded.
- All bearing assemblies were dismantled. Bearing condition was checked and the respective clearances were recorded.
- Demagnetizing of bearings, housings, journal pads etc was carried out.
- Top casing fixing bolts were loosened using hydraulic Wrench (available in store) and top casing was removed with the EOT crane. Prior to lifting with EOT crane, the casing was fully jacked up using four jack bolts provided in the casing. The threads of one jack bolt (control room side & towards turbine) was found damaged and hence, 1 Ton chain pulley block was provided at this corner for jacking.
- The damaged casing jacking bolt was removed in Mech. (W/S) by drilling and re-tapping was done using M42 x 4.5 mm pitch tap set.
- Labyrinth clearances were checked and readings were recorded.
- Rotor assembly was removed using soft nylon slings. Then it was placed on the properly supported stand.
- Gas labyrinths were replaced with new ones and sizes were checked.
- All inter stage labyrinths were replaced by new labyrinths.
- Balancing piston labyrinth was replaced with new labyrinth.
- Bottom casing seating surface was thoroughly cleaned using blade and compressed air.

- Rotor assembly was put back in the bottom casings and again labyrinth clearances were checked.
- Top casing seating surfaces were thoroughly cleaned using blade and compressed air.
- Top casing was positioned after application of sealant (Bircosite compound) between casing mating surfaces. Care should be taken to avoid entry of sealing fluid inside the casing and into the tapped holes.
- Top casing fixing bolts were hand tightened and final tightening was done using hydraulic wrench as per OEM bolt tightening procedure.
- Axial float of the rotor assembly was checked and recorded.
- Bearing assemblies were installed in position after thorough cleaning of the bearings & their housings. Clearances were checked & recorded.
- All oil lines, seal lines, pressure balancing lines etc were fixed back after flushing with compressed air.
- Alignment between LP casing & Steam turbine was checked and corrected as per OEM reference values.
- Alignment between LP casing & gearbox was checked and corrected as per OEM reference values.
- The coupling spacer between LP casing & Steam turbine was fixed back.
- Coupling Guards were boxed up.
- Oil circulation to the bearings was checked and minor leaks, if any, were rectified.
- Thus the Compressor train was ready for trail run and operation.

The clearance details are given bel

#### Labyrinth Clearances (Radial clearances in mm)

Sr. No.	Description	Design value (MM)	Max.	Actual value (MM)
1	Impeller eye Laby (1 <sup>st</sup> stage)	0.57-0.86	1.02	0.59 – 0.62
2	Impeller eye Laby (2 <sup>nd</sup> stage)	0.49 -0.67	0.86	0.56 – 0.60
3	Impeller eye Laby (3 <sup>rd</sup> stage)	0.48 – 0.66	0.85	0.45 – 0.52
4	Impeller eye Laby (4 <sup>th</sup> stage)	0.32 – 0.48	0.62	0.43 – 0.47
5	Impeller eye Laby (5 <sup>th</sup> stage)	0.33 – 0.48	0.63	0.37 – 0.40
6	Impeller eye Laby (6 <sup>th</sup> stage)	0.27 – 0.41	0.54	0.35 – 0.37
7	Impeller eye Laby (7 <sup>th</sup> stage)	0.26 – 0.40	0.53	0.25 – 0.30
8	Inter stage Laby (1 <sup>st</sup> stage)	0.21 – 0.52	0.62	0.215

9	Inter stage Laby (2 <sup>nd</sup> stage)	0.21 – 0.53	0.63	0.275
10	Inter stage Laby (4 <sup>th</sup> stage)	0.15 – 0.38	0.46	0.225
11	Inter stage Laby (5 <sup>th</sup> stage)	0.15 – 0.38	0.46	0.25
12	Inter stage Laby (6 <sup>th</sup> stage)	0.15 – 0.40	0.49	0.20
13	Balance Laby	0.13 – 0.43	0.52	0.28
14	Gas seal Laby.	0.13 – 0.37	0.43	0.20
15	Gas seal Laby	0.26 – 0.74	0.86	0.24
16	Oil seal Laby	0.26 – 0.70	0.82	0.23
17	Oil seal Laby	0.15 – 0.24	0.30	0.24
18	Thrust bearing	0.28 – 0.38	-	0.13
19	Radial bearing thrust end	0.11 – 0.15	-	0.13
20	Radial bearing GB side	0.11 – 0.15	-	0.17

**Observations made by M/s SPIC-SMO, the overhauling contractor:**

Deposits were observed in the 1<sup>st</sup> & 2<sup>nd</sup> stage diaphragms on Gear box side and 4<sup>th</sup> & 5<sup>th</sup> stage diaphragms on the turbine side due to oil carry over in the process gas. The reasons for this may be due to :-

- (a) Operation of the compressor with low suction pressure.
- (b) Isolation / absence of seal gas on end of the compressor.

**PREVENTIVE MAINTENANCE OF CO<sub>2</sub> COMPRESSOR HP CASE (K-1801-2)**

- Coupling guard between HP case and Gear box was removed and Decoupled from Gear Box after match marking.
- Alignment readings were taken and recorded.
- Journal bearing pads on coupling end were opened for inspection. Replaced by new one as the same were found damaged.
- Journal bearing on free end was opened for inspection and found OK.
- Thrust bearing was opened for inspection. DP testing on all the thrust pads was carried out & was found OK. Thickness of the thrust pads was checked and found within acceptable limits.
- Thrust bearing pads were thoroughly cleaned, polished and reassembled.
- The journal bearings were cleaned, polished and then reassembled back. Bearing clearances checked with lead wire.
- Gauss measurement was done by Inspection section and the readings were recorded. Found within acceptable limits.
- Final alignment readings were taken and recorded. Alignment between HP casing & gearbox was checked and corrected as per OEM reference values.
- The Coupling spacer between HP casing & gearbox was assembled.

## FINAL CLEARANCE READINGS OF HP COMPRESSOR

Sr. No.	Description	Design Value (mm)	Actual Value BPM (mm)	Actual Value APM(mm)
1	Axial Float	0.25 ~ 0.35	0.17 less due to sludge on the Bearing pads	0.32
2	Gear Box End Bearing Clearance with new one	0.11 ~ 0.14	0.14	0.14 New pads
3	Free End Bearing Clearance	0.11 ~ 0.14	0.14	0.14

PREVENTIVE MAINTENANCE OF CO<sub>2</sub> COMPRESSOR DRIVE TURBINE Q - 1801

- Coupling end bearing top cover was removed after opening all instrument lines.
- Free end bearing top cover was removed. Due care was taken to remove all the oil lines, instrument lines, side plates etc.
- Turbine float was measured and recorded.  
**Turbine float : 0.20mm**  
(Net float = Total float minus Housing play = 0.35 - 0.15)
- Free end bearing was opened and cleaned, polished and the dimensions were recorded.

Pad Thickness : **17.48 mm/17.49 mm**  
 Journal diameter : **124.80 mm**  
 Bearing housing ID : **159.93 mm**  
 Clearance was found to be : **0.17 mm**

- Thrust bearing was removed and cleaned, polished and reassembled back. The measured rotor float was as per design values.
- Free end bearing cover was boxed up after cleaning.
- Turbine coupling end bearing was removed, cleaned, polished and re-assembled back.
- Bearing dimensions were recorded as follows.

Bearing Pad Thickness : **22.47mm**  
 Journal dia is measured and found : **159.71mm/159.72mm**  
 Bearing housing ID : **204.94m**  
 Clearance was found to be : **0.34mm**

- Turbine free end and coupling end top covers were boxed up by applying Hylomer compound to the split face.

- Alignment readings were taken for LP to Turbine

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### FINAL READINGS OF TURBINE

Sr. No.	Description	Design Value (mm)	Actual Value BPM (mm)	Actual Value APM (mm)
1	Axial Float	0.25 ~ 0.35	0.31	0.20 (0.35 ~ 0.15)
2	Free End Bearing Clearance	0.18 ~ 0.31	0.17	0.17
3	Coupling End Bearing Clearance	0.24 ~ 0.36	0.32	0.34

### PREVENTIVE MAINTENANCE OF GEAR BOX M-1801 :

Since last one year, the Temperature of high speed pinion bearing of gear unit was remaining higher than permissible value of 80 ° C. Once, it even went up to 105° C and then it came down.

#### Observations: High speed Pinion Shaft and Bearings

- Both Pinion shaft bearings were inspected. Brownish discoloration and mild impressions were observed on the white metal surface of both the halves.

The Bearing white metal surface was thoroughly cleaned and polished.

#### Observations: Low speed Gear Shaft and Bearings

- Both bearings were found in good condition.
- Bearing clearances were measured and recorded. Found within design limit.
- Backlash measurement was carried out and found ok.

### BEARING CLEARANCE DATA OF GEAR BOX ASSEMBLY

SR. No.	Description	Design Value (mm)	Measured Initial value (mm)	Adequate Value(mm)	Actual value (AOH) (mm)
1	Gear Shaft - L.P. Side	0.125 -0.147	0.20	0.125-0.169	0.20
2	Gear Shaft - H.P. Side	0.125 -0.147	0.19	0.125-0.169	0.19
3	Gear shaft – Axial float	-	0.45	-	0.45
4	Pinion Shaft - L.P. Side	0.140 - 0.162	0.18	0.140-0.184 z	0.18
5	Pinion shaft - H.P. Side	0.140 - 0.162	0.19	0.140-0.184	0.19
6	Gear Backlash	-	0.47	-	0.47

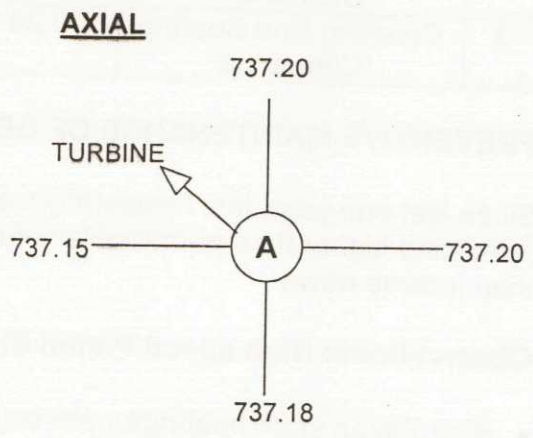
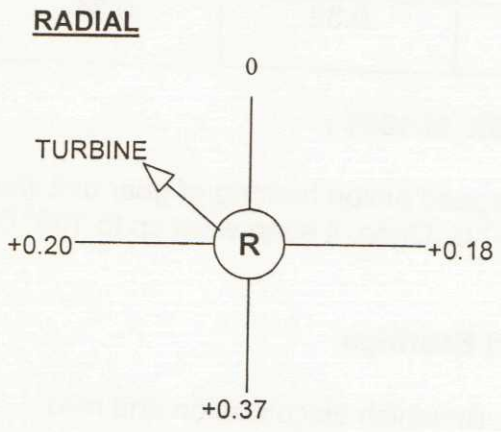
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**ALIGNMENT DATA FOR HITACHI COMPRESSOR TRAIN:**

**LP Compressor to Turbine:**

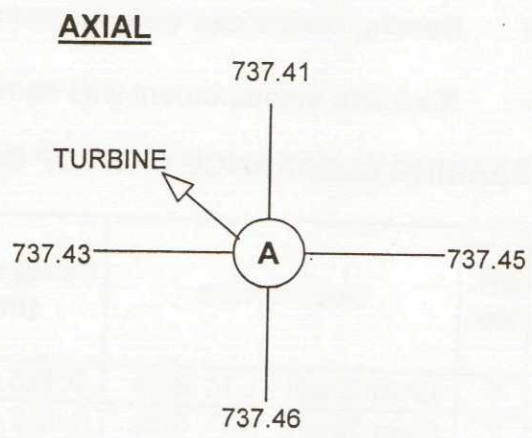
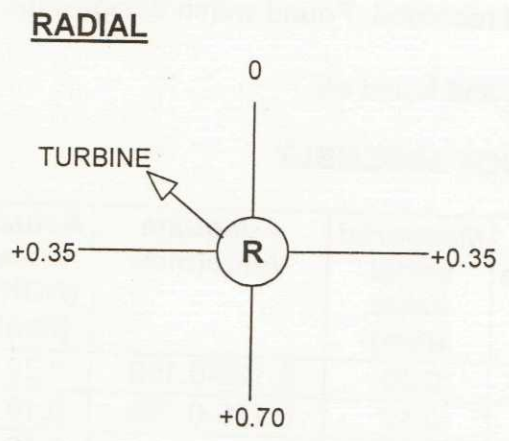
**Before Overhauling**

Dial on Turbine Coupling  
1 Div = 0.01mm



**After Overhauling**

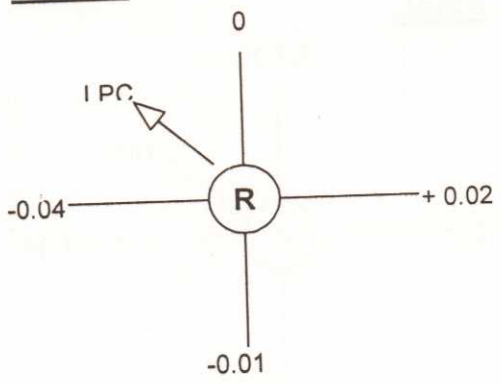
Dial on Turbine Coupling  
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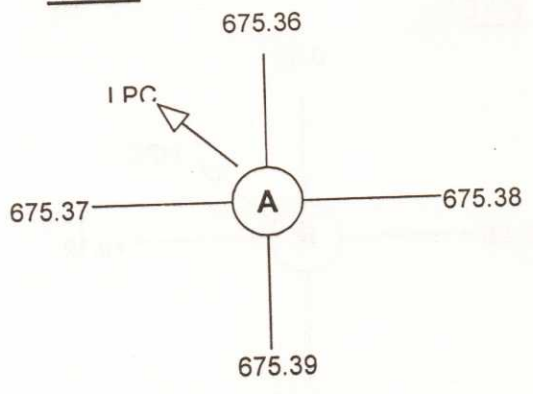
**Gear box to LP Compressor:**

**Before Overhauling**  
Dial on LP Compressor Coupling  
1 Div = 0.01mm

**RADIAL**

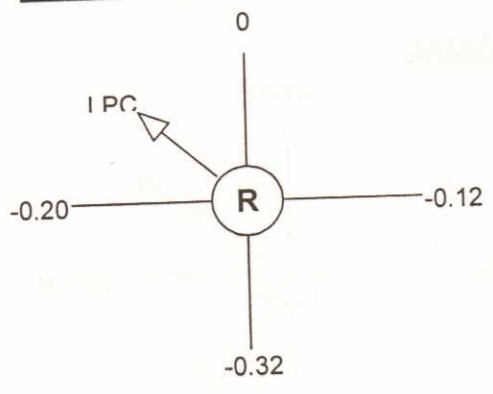


**AXIAL**

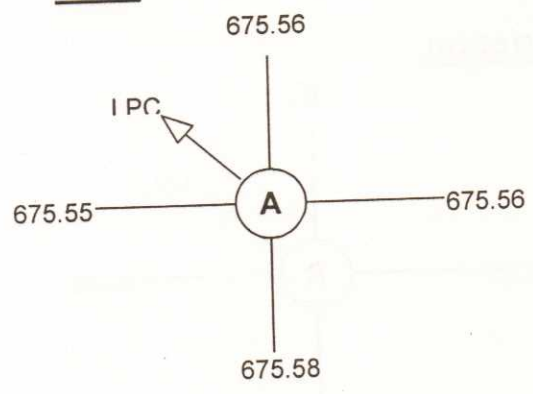


**After Overhauling**  
Dial on LP compressor Coupling  
1 Div = 0.01mm

**RADIAL**



**AXIAL**

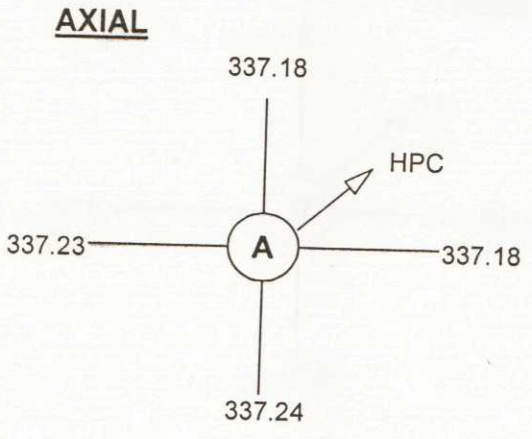
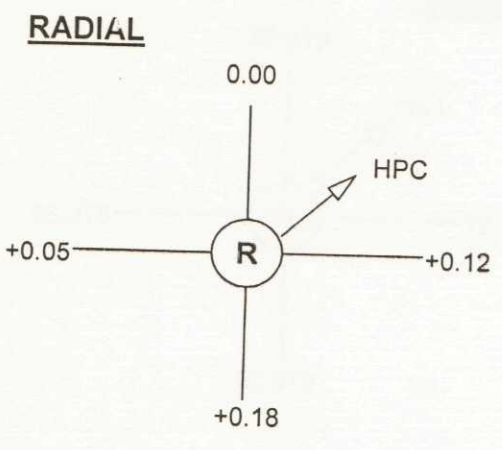


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**Gear box to HP Compressor:**

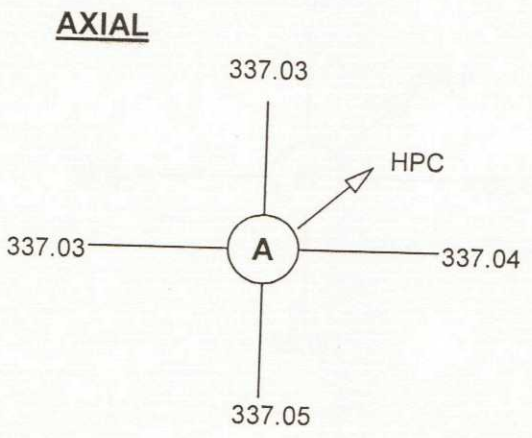
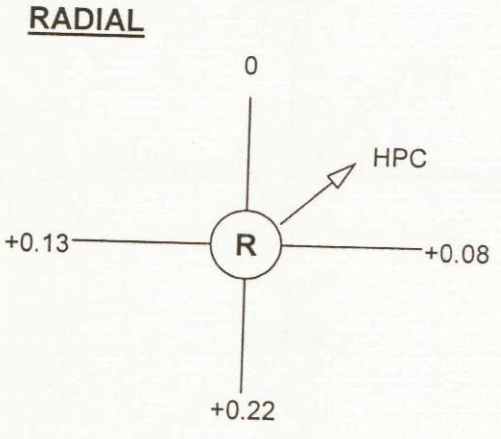
**Before Overhauling**

Dial on HP Compressor Coupling  
1 Div = 0.01mm



**After Overhauling**

Dial on HP Compressor Coupling  
1 Div = 0.01mm





**H.P. VESSEL JOBS****H-1201 – HP STRIPPER**

The top and bottom covers of the HP Stripper (H-1201) were opened using "Hydra Tight Sweeny" make bolt tensioner at hydraulic pressure of 1100kg /cm<sup>2</sup>. The top cover was shifted below the platform using monorail hoist and chain blocks. The bottom cover was lowered onto the wooden sleepers.

The top liquid barrier was opened and then all the ferrules were removed. Some oil deposits and scaling was observed between the tube ends, on the top tube sheet. The same were carefully removed using SS chisel.

The old PTFE gaskets were removed. Then all the ferrules were thoroughly cleaned by Production department. Subsequently, pressure drop measurement was carried out and 2700 nos of New PTFE gaskets were provided in the ferrules, which were found acceptable in the DP measurement.

HP Stripper vessel was thoroughly cleaned with compressed air and then with DM water. The ferrules were fixed in position and liquid barrier plates were boxed up. 72 no of new PTFE bush were used for the tie rods.

In bottom dome area, 1 no. each stud and nut were found missing in the liquid outlet line flange. New stud & nut were provided and tack welded. After inspection by production department and getting clearance, the bottom manhole was boxed up using new "Kempchen" gasket.

After the bottom manhole was boxed up, pressure drop measurement was carried out for each tube and the same was found acceptable. After clearance from Production, the top man way cover was boxed up using new "Kempchen" gasket.

**Manhole tightening pressures for top and bottom covers**

<b>1<sup>st</sup> tightening round.....</b>	<b>400kg per /cm<sup>2</sup></b>
<b>2<sup>nd</sup> tightening round.....</b>	<b>700kg per/cm<sup>2</sup></b>
<b>3<sup>rd</sup> tightening round.....</b>	<b>1000kg per/cm<sup>2</sup></b>
<b>Final tightening round/checking round</b>	<b>1000kg per/cm<sup>2</sup></b>

**H -1202 - H.P. CONDENSER**

The top flange of H-1202 (off gas line) was opened. Then the top cover was opened with bolt tensioner at 500 kg/cm<sup>2</sup> hydraulic pressure and shifted from position. The partition plates, basket, segments and rasching rings were removed.

At the bottom end, the Liquid outlet line (H-1202 to V-1201) was opened. The bottom cover was opened using bolt tensioner at 500 kg/cm<sup>2</sup> hydraulic pressure.

The vessel was thoroughly inspected by Inspection section and Eddy current testing of the tubes was carried out. After getting clearance, the segments and basket was boxed up after loading rasching rings in the basket. The partition plates on basket were boxed up. After getting clearance from production department boxed up top cover H-1202 with new "Kempchen" gasket and tightened at following hydraulic pressures.

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- 1<sup>st</sup> tightening round..... 250 kg/cm<sup>2</sup>
- 2<sup>nd</sup> tightening round..... 350 kg/cm<sup>2</sup>
- 3<sup>rd</sup> tightening round..... 450 kg/cm<sup>2</sup>
- 4<sup>th</sup>/final checking round... 450 kg/cm<sup>2</sup>

Finally the offgas line was boxed up using new ring gasket.

After inspection & clearance from production the bottom cover was taken for box up. Both gasket seats of the vessel were thoroughly cleaned. The bottom cover was lifted and put into position, provided new "Kempchen" gasket and hand tightened the nuts. The gap between two flanges of the vessel was checked and tightening was done at following hydraulic pressures.

- 1<sup>st</sup> tightening round..... 250 kg/cm<sup>2</sup>
- 2<sup>nd</sup> tightening round..... 350 kg/cm<sup>2</sup>
- 3<sup>rd</sup> tightening round..... 450 kg/cm<sup>2</sup>
- 4<sup>th</sup>/final checking round..... 450 kg/cm<sup>2</sup>

Connected liquid outlet line and tightened it.

**H.P. SCRUBBER - H-1203**

After removing insulation of H.P. scrubber and its pipe line, the pipe lines and steam tracing lines were disconnected. The threads of the studs were thoroughly cleaned. The top dome cover was opened by hydraulic bolt tensioner at 500 Kg/cm<sup>2</sup>. After pulling top dome up to length of the studs, CO<sub>2</sub> line was disconnected from the vessel. The top dome was then fully lifted from studs and shifted towards PT Fan K-1401-3. During shifting both ends of the slings hung from the chain block & monorail hoist were tied by rope to prevent dome from shock load. The monorails were operated equally in tandem. 2 nos of 10 Ton capacity chain blocks and 2 no 5 Ton capacity slings were used with top mono-rail. The platform grill on the structure was opened and the top dome was placed on the stacked wooden sleepers.

At the bottom end, all pipe lines were disconnected. The threads of the stud were cleaned thoroughly after removal of thread protection caps.

To pull down the tube bundle from the shell, the rigging arrangement was made using following tools:-

- 1. Chain block 10 Ton Capacity - 4 No
- 2. Sling 5 Ton capacity & 2.5 M Long - 4 No
- 3. 'D' shackle 8 Ton capacity - 4 No
- 4. Eye Bolt (L&T supply) - 4 No

All nuts of the tube bundle flange studs were opened except 4 nos long studs, using hydraulic bolt tensioner at hydraulic pressure of 250 kg/cm<sup>2</sup>. This was done to take load on the 4 Nos long studs. The load was transferred to the 4 Nos of chain blocks and nuts of these 4 no long studs were opened using the same bolt opening procedure. The tube bundle was slowly lowered. During pulling down gap between the shell and tube bundle flange was frequently measured by measuring tape near the chain block holding points and it was maintained equal at all times. When gap between the shell and tube bundle

flange was about 10", the tube sheet was locked as an important safety precaution using specifically designed jigs & features with aluminum gaskets. Also, guide dowel pin was locked with long studs and 4 nos of 2" dia sch 40 pipes (each welded to the length of 7.5 meter length) were provided to guide, centre and to prevent rotation of the bundle. The bundle was slowly moved down gradually by operating the chain blocks equally. After every 10 minutes, distance between the tube bundle and shell flange was maintained equal, to avoid rubbing of the baffles with the shell liner.

The tube bundle was lowered gradually till the overflow funnel top coincided with the shell bottom flange seat. This enabled removal of gasket and complete inspection of the shell liner and the tube bundle.

The equipment was handed over to inspection section for visual and other NDT inspection. A wooden round platform trolley operated manually with the help of grip hoist was provided at the top for inspection of the shell liner. The top dome, shell and tube bundle were thoroughly inspected and based on the findings repair action was taken.

3 nos. baffle plate tie rod holes indicated minor cracks. These were repaired by welding during upward pulling of the bundle. Numbering from the top, at about five baffle locations the shell liner indicated rubbing marks. These areas were polished and passivated.

The gasket seating surfaces of the tube bundle was thoroughly cleaned. New "Kempchen" gasket was provided. After inspection & clearance by the production department, the tube bundle was gradually lifted up in position. Uneven lifting was avoided by checking the gap between the shell and the tube bundle flange. Also, the CO2 line in the shell was checked frequently to avoid damage to it. When the gap between the shell and tube sheet flange was approx. 10 Inches, the jigs & fixtures removed and tube bundle load was taken on the long studs. Further tightening was carried out each time maintaining equal gap. All stud nuts were provided. After taking full hand tightening, final nut tightening was done using hydraulic bolt tensioner at following pressures.

- 1<sup>st</sup> tightening round..... 250 kg/cm2
- 2<sup>nd</sup> tightening round..... 350 kg/cm2
- 3<sup>rd</sup> tightening round..... 450 kg/cm2
- 4<sup>th</sup>/final checking round..... 450 kg/cm2

All pipe lines and steam tracing lines were boxed up.

The top dome was taken for box up after inspection & clearance from production department. The gasket seat area of both top dome and shell flange was thoroughly cleaned. The top dome was lifted and shifted in position using monorail, chain block and sling arrangement. At stud level the new "Kempchen" gasket was put into position and the CO2 line flange was boxed up using new gasket. The nuts were hand tightened after applying "antiseize" compound. The gap was checked and nut tightening was done using hydraulic bolt tensioner at following pressure.

- 1<sup>st</sup> tightening round..... 250 kg/cm2
- 2<sup>nd</sup> tightening round..... 350 kg/cm2
- 3<sup>rd</sup> tightening round..... 450 kg/cm2
- 4<sup>th</sup>/final checking round..... 450 kg/cm2

All pipe lines and tracing lines were boxed up.

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**V-1201 - AUTOCLAVE**

All the nozzles at the bottom and off gas line at the top were opened including all the steam tracing lines. The top man way over was opened using hydraulic bolt tensioner at 500 kg/cm<sup>2</sup> pressure. The over was shifted by mono-rail and chain block towards cooling tower side grating area and was put on wooden sleepers. Clearance was taken from Production that the temperature inside is suitable for vessel entry. Compressed air was provided from the bottom end and vacuum blower hose was arranged in the top compartment. Aluminium ladders & hand lamps were provided in each compartment and both the domes. Telephones were provided at the bottom end, top end and 5<sup>th</sup> compartment.

Inspection section carried out visual and NDT examination of liners and shell areas. The bulged liners were inspected for any abnormal increase. Based on the NDT examination, cracks, pin holes & weld under cuts were repaired using TIG welding method and 25-22-2 L Mn filler wires. The weld repaired areas were passivated and washed with DM water.

After getting inspection and clearance from production department the ladders, hand lamps, telephones and air hoses were removed and the top man way cover was boxed up with new "Kempchen" gasket using hydraulic bolt tensioner at following pressures.

- 1<sup>st</sup> tightening round..... 250 kg/cm<sup>2</sup>
- 2<sup>nd</sup> tightening round..... 350 kg/cm<sup>2</sup>
- 3<sup>rd</sup> tightening round..... 450 kg/cm<sup>2</sup>
- 4<sup>th</sup>/final checking round..... 450 kg/cm<sup>2</sup>

All the nozzles at the bottom end and the off gas pipe line including the steam tracing lines were boxed after taking clearance from Production.

**LOW PRESSURE VESSELS**

All LP vessels were opened and offered for visual & NDT examination by Inspection section. Based on planned repair jobs and as per observations made, the repair activities were performed.

**CO<sub>2</sub> Spray Cooler (H-1104)**

Visual inspection of top compartment was carried out.

Demister pad was found intact in position. Wood & paint debris were found collected on the liquid distributor.

Epoxy paint was found peeled off at a few locations. All debris were cleaned. One coat of epoxy primer was applied in the top compartment.

The joint of seal pot pipe with the concrete tank was repaired by Civil section using Araldite compound.

## CO<sub>2</sub> knockout drum (V-1101)

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Demister pad was found intact in position but at some locations it was found choked with yellow coloured debris.

At some locations the epoxy paint had peeled off and indicated blisters.

Brownish colour patches were observed at scattered locations on the shell surface.

The inside surface of the shell was thoroughly cleaned by power tool cleaning method and one coat of epoxy primer & two coats epoxy paint were applied.

## V-1102: AMMONIA SUCTION FILTER

New strainer element provided as the old one was damaged.

## V-1103: AMMONIA SUCTION VESSEL

The inside surface colour was brownish & black.

The condition of the welding joints was found satisfactory.

Oil layer was found in the bottom dished end. It was cleaned before box up.

## V-1202 : RECTIFYING COLUMN

Visual inspection indicated shiny & black patches in the top half whereas brownish coloration was observed in bottom half of vessel.

Hard scales were observed particularly at the top of the shell and bottom of the shell in a width of approx. 300mm

The hard scale was thoroughly cleaned by scraping, with Diesel and by hydro jetting.

Previously, Rasching rings (Size: 25 mm dia x 25 mm height x 1 mm thick) were provided in the vessel. During Annual turnaround of 2003, these rings were found extensively damaged. Technical department had contacted M/s Stamicarbon in this regard and they had suggested use of **Pall rings of 0.9 mm thickness** made from "Stamicarbon" BC-09 grade SS-316L material and also installation of bed limiter to avoid breakage & carryover of ring debris into the pipelines. Accordingly, bed limiter was fabricated as per **Drg No: O2-BF-05238 sheet 1 of 1 Rev P2** provided by technical department. The vessel was loaded with **7.647 M<sup>3</sup> of Pall rings of 25 mm dia x 25 mm height x 0.9 mm thickness** procured from M/s Hi-Pack mass Transfer Ltd, Mumbai. After getting clearance from production department the vessel manhole and all connected pipe lines were boxed up using new gaskets.

### V-1203 : LP ABSORBER

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Opened top and side manhole of V-1203

In the top half the grating was found intact in position and the shell inside surface indicated grayish black coloration.

The bottom half shell was grayish black in coloration.

In general the condition of the vessel was found quite satisfactory. The side manhole was boxed up after loading the rasching rings.

### V-1206 : LP VENT SCRUBBER

The side manhole was opened for visual inspection.

Demister pads were found intact in position. All fasteners were found intact. grayish black coloration was observed inside the vessel.

Over all the condition was satisfactory

After getting clearance from production department the vessel side manhole and all pipelines were boxed up using new gaskets.

### V-1207 : LP SCRUBBER

The top manhole was opened for visual inspection.

Blackish gray Coloration was observed in the shell top portion.

One nut of top grills found missing. However, grill was found intact in position.

Bottom supporting grill of pall ring bed found slightly bend on one side.

In general the condition of the vessel was quite satisfactory.

1 no. nut provided on top grill.

The top manhole was boxed up with new gasket, after getting clearance from Production.

### V-1301 : SECOND DESORBER

Opened top and bottom manhole for visual inspection was carried out

#### Top portion:

Brownish coloration was observed inside the vessel.

All fasteners and tray were intact in position.

Top nozzle was found satisfactory.

**Bottom portion:**

Brownish coloration was observed inside the vessel. One clamp was found missing. New clamp provided.

Nozzle condition was satisfactory.

Top and bottom manholes boxed up after getting clearance from production.

**V-1351 : HYDROLYSER**

The top and bottom man holes were opened for inspection. The overall condition of the vessel was found to be satisfactory.

**V-1352 : FIRST DESORBER**

Opened top and bottom man hole for visual inspection.

**Top portion:**

Brownish coloration was observed inside the vessel

All fasteners were found intact.

Welding joints condition was satisfactory.

**Bottom portion:**

Brownish coloration was observed inside the vessel.

One bolt of the tray was found missing. New one provided.

Overall condition of the vessel was satisfactory.

The top and bottom man holes were boxed up after getting clearance production.

**V-1421 : FLASH TANK SCRUBBER**

The side manhole was opened for the visual inspection.

Shell inside was found brownish in color.

Demister pads were found in intact condition.

Wire mesh of demister pads was found satisfactory.

The wire grill was found broken as its central position in approx. 60 % length. Necessary repairs done.

Condition of all the welds joints was found satisfactory.

The side man hole was boxed up after getting clearance of production.

### **V-1423 : FIRST EVAPORATOR SCRUBBER**

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The man hole was opened for visual inspection.

Vessel inside coloration was found brownish.

Demister pads were lifted upwards by approx. 50mm at some locations.

The condition of wire mesh of the demister pads was found satisfactory.

Demister pad frame had come out from its supporting base, at the south east and central support positions (second row counting from west side).

The vessel man hole was boxed up after necessary repairs.

### **Inter stage Separators for HITACHI compressor K-1801**

(V-1811 / V-1812 / V-1813 - 1<sup>st</sup>, 2<sup>nd</sup> and 3<sup>rd</sup> stage separators)

Demister pads were found intact position.

Vortex breaker was found intact in position.

Coloration of shell had assumed shining.

Overall condition was found satisfactory.

Man holes boxed up after getting clearance from Production.

### **H-1422 – 1<sup>ST</sup> STAGE EVAPORATOR HEATER / SEPARATOR**

Visual inspection was carried out. Found satisfactory.

### **H-1424 – 2<sup>nd</sup> STAGE EVAPORATOR HEATER**

Visual inspection was carried out. Found satisfactory.

### **V-1418 – PRE-EVAPORATOR, HOT WATER PORT**

Visual inspection was carried out. Found satisfactory.

### **H-1418 - SEPARATOR, PRE-EVAPORATOR**

Visual inspection was carried out. Found satisfactory.

### **V-1502 : 23 ATA STEAM DRUM**

Opened both manholes and visual inspection was carried out.

All fittings were found good condition.

Welded joints condition and over all condition were found satisfactory.



## V-1503 : 9 ATA STEAM DRUM

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Opened side manhole and visual inspection was carried out. Scattered scales were observed of dished end. All other internal fittings were found satisfactory. Overall conditions of the vessel were found satisfactory. Scales were removed and cleaning was carried out.

### CLEANING AND HYDROJETTING OF HEAT EXCHANGERS

Following heat exchanger were opened for cleaning by hydro jetting. After cleaning box up was done using new gaskets.

1. Surface condenser (H-1815)
2. Main lube oil coolers (H-1814-A/B)
3. Flash tank condenser (H-1421)
4. First Evaporator (H-1422) ----> (with DM water)
5. First Evaporator condenser (H-1423)
6. Second Evaporator I condenser (H-1425)
7. Second Evaporator II Condenser (H-1426)
8. First Evaporator Final condenser (H-1420)
9. Recirculation heater (H-1204) ----> (with DM water)
10. L.O. Coolers of P-1102-C
11. L.O. Coolers of P-11021-A/B/C
12. CCS - I cooler (H-1206) Plate type heat exchanger \*\*\*NOTE
13. CCS - II cooler (H-1207)
14. Reflux condenser (H-1352)
15. Pre-evaporator condenser (H-1419)
16. Hydrolyser Pre heater H-1351-C

#### \*\*\* NOTE

The total channel plates in the plate type heat exchanger H-1206 were increased to **182 Nos** (earlier 159 Nos). This modification has decreased the pressure drop across the heat exchanger and effected operation of a single pump (P-1202 A/B). Substantial amount of power saving has been achieved as earlier two pumps were operating simultaneously at part loads.

### REPAIRING OF GASKET SEAT AREA OF HEAT EXCHANGERS

The channel cover gasket seating area of some of the heat exchangers was found corroded. To prevent leakage in service, the seat areas were machined in Mech (W/S) and 1 No large cover through M/s Ahmedabad Victoria Iron Works, Ahmedabad.

The job was carried out on the following Heat Exchangers.

1. CCS - II cooler (H-1207)
2. Flash tank condenser (H-1421)
3. 1<sup>st</sup> evaporator condenser (H-1423)
4. 2<sup>nd</sup> evaporator first condenser (H-1425)

**HEAT EXCHANGER TUBE BUNDLE PULL-OUT & HYDRO JETTING :**

**H-1305 AND H-1427**

The coolers were removed from there position by HM / RT-760 crane and placed in front of GHH compressor area for tube bundle pull out. The bundle shell was locked with the concrete beam and effort was made to pull out tube bundles with 5 Ton chain block. The tube bundles were jammed inside the shell and did not come out. Therefore, chemical cleaning was tried with the help from Laboratory section. The heat exchanger was boxed up at one end and then filled with chemical on shell side, in a upright position. After soaking for 18 Hrs, pull out procedure was repeated but without any results. As a last resort, the shell was heated from outside by Oxy-acetylene flame and simultaneously load was applied using 5 ton chain block. Following this procedure, both the bundles were removed from the shell.

Lot of rust and scale was found inside the shell. The same was removed by hammering the shell and then by hydro jetting. As a precautionary measure, OD of all the baffles was reduced by 3mm with grinder to facilitate easy pull out in future. The tube bundles were cleaned by hydro jetting and boxed up with shell using new gaskets. The heat exchangers were installed at their location using HM crane.

**H-1351-C**

After removing the heat exchanger from its position, the tube bundle was removed. Cleaning of both and tube bundle was carried out by hydro jetting. Assembled with new gasket and installed at site.

**RELIEF VALVE OVERHAULING AND TESTING:**

Following RV's were removed, overhauled and tested on valve test bench by M/S. Flotec Engineering Services, Surat.

Sr No	RV No	Location	Set Pressure Kg/cm <sup>2</sup>	Reset Pressure Kg/cm <sup>2</sup>
1	RV-1202-A	V-1202 Off gas line	6	5.4
2	RV-1202-B	- do -	6	5.4
3	RV-1202-C	- do -	6	5.4
4	RV-1916	23 Ata Exhaust	28	25.2
5	RV-1301	V-1301 Exhaust	6	5.4
6	RV-1129-A	4 Ata steam header	6	5.4
7	RV-1129	- do -	6	5.4
8	RV1130	23 Ata steam header	26	23.2
9	RV-1504	V-1503 9 Ata steam drum	12	10.8
10	RV-1901	First stage discharge of Hitachi compressor	8	7.2
11	RV-1902	2 <sup>ND</sup> Stage discharge of Hitachi compressor	26.8	24
12	RV-1919	4 Ata Exhaust Hitachi Comp	3.88	3.5
13	RV-1204	P-1201-B suction	7.54	6.7

14	RV-1102	Ammonia suction vessel	30	27
15	RV-1203	P-1201-A suction	7.54	6.7
16	RV-1351	MP steam inlet to V-1351	23.5	20.7
17	RV-1503	23Ata steam drum (V-1502)	23.23	20.5
18	PSV-1201-C	P-1201-C suction	7.54	6.7
19	RV-1209	V-1203 vapour inlet	9.06	8.1
20	RV-1903	3 <sup>RD</sup> stage discharge of Hitachi compressor	110	99
21	RV-1127	K-1101-2 PB compressor 3 <sup>RD</sup> stage discharge	159.5	144.5
22	RV-1205	P-1201-A discharge	161	145
23	RV-1181	Final discharge of Hitachi compressor K-1801	176	158
24	RV-1206	P-1201-B discharge	161	145
25	RV-1128	24 Ata steam exhaust of Q-1101-2	26	23.4
26	RV-1352	Ammonia water inlet V-1352	6	5.4
27	RV-1201-A	V-1201 off gas line	165	148.5
28	RV-1201-B	- do -	165	148.5
29	RV-1201-C	- do -	165	148.5
30	RV-CCS-1	Pre Heater	10	9
31	RV-1102	Ammonia suction V-1103	31	28
32	RV-1108	Liquid Ammonia line from Ammonia storage tank to H-1102	31	28
33	RV-1106-1	Liquid Ammonia line from Ammonia plant to Ammonia filter	31	28
34	RV-1106-2	- do -	31	28
35	RV-CCS-2	P-1204 discharge to H-1203	11	10
36	RV-1107-1	Liquid Ammonia (Hot) before Ammonia filter	31	28
37	RV-1107-2	- do -	31	28
38	RV-1110-A	Liquid Ammonia line from Ammonia storage tank to H-1102	31	28
39	RV-1110-B	- do -	31	28
40	RV-1112	HP Ammonia P-1102-B discharge line	150	135
41	CCS-II(SR)	P-1204 discharge to H-1203	16	14.4

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42	RV-1904	H-1811 First stage for cooler	8	7.2
43	RV-1905	H-1812 Second stage for cooler	8	7.2
44	RV-1906	H-1813 Third stage CW outlet	8	7.2
45	RV-1911	Hitachi surface condenser CW outlet	8	7.2
46	RV-1912	- do -	8	7.2
47	RV-1224	CW from utilities	6	5.4
48	RV-1207	P-1201-C discharge	165	148.5
49	PSV-1913	Hitachi surface condenser vapour line	2.04	1.9
50	PSV-1914	- do -	0.1	0.09
51	RV-1531-C	P-1502-C discharge	185	166.5

**INSPECTION OF TANKS :**

**T-1301 / T-1301-A : AMMONIA WATER TANK**

The tank manholes were opened for visual inspection. The overall condition of all the welding joints, shell surface and nozzles was found satisfactory.

Manholes were boxed up with new gaskets after getting clearance production (urea).

**T-1302 : UNDER GROUND WASTE WATER TANK**

The top manhole was opened. Production department carried out cleaning of the tank from inside. The top manhole was boxed up with new gasket after getting clearance from production department.

**T-1401 / T-1401-A : UREA SOLUTION TANK**

The tank manholes were opened for visual inspection. The overall condition of all the welding joints, shell surface and nozzles was found satisfactory. Manholes were boxed up with new gaskets after getting clearance production.

**T-1501 : STEAM CONDENSATE TANK**

The tank manholes were opened for visual inspection.

Visual inspection was carried out.

As per inspection report the condition of shell, welding joints and nozzles was found satisfactory. The manhole was boxed up with new gasket.

**PRILL TOWER ID FANS (K-1401 / 1, 2, 3 & 4)**

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

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Both the fan bearings were opened and inspected. Found OK. Fresh grease provided and boxed.

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

Scaffolding was removed.

All internal and external surfaces were cleaned by power tool and painting was carried out using 1 coat of epoxy primer and 2 coats of epoxy paint.

The base plate of K-1401 /3 fan was found corroded and the same was replaced with new one (In-situ fabrication).

**NOTE: The fan blade was modified as per requirement of Production, to avoid deposition of Urea on the inside of Prill Tower roof.**

### **PRILL COOLING SYSTEM:**

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

**The following preventive maintenance jobs were carried out.**

- Both bearing were opened, Cleaned and checked. Found in good condition and hence boxed up.
- Fresh lube oil charged.
- Damper made operational and provided fresh grease.
- Rotor and casing of fan were cleaned.
- V belts replaced with new ones and aligned with motor.
- Alignment of fan belt checked and corrected.
- Painting of external surfaces of casing carried out.

#### **FLUIDIZED BED COOLER: H-1701**

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

### **CONVEYOR SYSTEM**

#### **M-1403 – UREA PRODUCT CONVEYOR**

- Checked gear box found OK.
- Flushed gear box oil.
- Skirt rubber replaced wherever found damaged.
- Aligned motor with gear box and after checking direction coupled with gear box by new bushes

#### **M-1419 – LINK CONVEYOR**

- Checked gear box found OK.
- Flushed gear box oil.
- Skirt rubber replaced wherever found damaged.
- Aligned motor with gear box and after checking direction coupled with gear box by new bushes

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### **M-1421 – PRILL COOLING LINK CONVEYOR**

- Replaced M-1421 gear box with new sprocket of 26 teeth and 1.5" pitch.
- Replaced bearings of head pulley (NTN – 75mm dia).
- Aligned motor (reconditioned) with gear box. New bushes provided in the coupling.
- Provided chain on head pulley to gear box sprocket and aligned.

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

**Following preventive maintenance jobs were carried out.**

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

### **SCRAPPER (M-1402 -1/2):**

**Following preventive maintenance jobs were carried out.**

- Scraper arms were inspected for tightness of nuts.
- Checked scraper floor slit plates and repaired at one location.
- Cleaned scraper surface by power tool and applied one coat of epoxy primer and two coats of epoxy paint.
- Covered the scraper surface with aluminum sheets to prevent corrosion.
- Fluid Couplings of scrapper arm was checked and found OK.
- Fluid coupling oil flushed.
- Checked condition of V belts (B 69- 4no.) and tightened the belts.
- V- belts of M-1402/1 replaced with new ones.
- Alignment checked and tightened belts.
- Checked oil level of gear box and topped up.

### **INSPECTION OF CHECK VALVES (NRV)**

**Following non-return valve (check valves) were checked and overhauled.**

1. CO2 to H-1201
2. NH3 to H-1202
3. NH3 to V-1201
4. Carbamate to H-1202
5. Carbamate to H-1203
6. CO2 to H-1203
7. 4ATA steam to V-1352
8. 23ATA steam to V-1351
9. 4ATA steam to V-1301
10. Condensate to Melt Return line.
11. P-1201 A/B steam injection to discharge Relief valve.
12. 9ATA steam injection to off gas line of V-1203/V-1207
13. 9ATA steam injection to off gas line of V-1205
14. NH3 water to V-1352
15. P-1204 A/B discharge Non-return valve.
16. P-1501/6 discharge Non-return valve.
17. P-1351 A/B discharge line.

**Note:-**  
Discharge line NRV of P-1202 A/B replaced by new (Size: 12" NB x 150# CS flanged end).

**PROCESS JOB**

**COMPRESSOR FLOOR**

1. Rectified oil leakage from the actuator NRV of 23 ata line, in Q-1801, near P-1815-B pillar.
2. Replaced gasket of F-1814-A in vent line flange.
3. Replaced valve in LT-1807 3<sup>rd</sup> separator LP tapping 1<sup>st</sup> isolation valve
4. Repacked the gland packing of two discharge isolation valves of PB compressor.

**GROUND FLOOR**

1. Re-tapping of suction strainer valve body and enlarged hole of strainer's cover.
2. Replaced 1<sup>st</sup> recycle valve of P-1102/C with reconditioned valve (4"dia\*900#)
3. Opened, checked, cleaned and boxed up the suction strainers and discharge filters of P-1201-A/B/C.
4. Replaced passing 1<sup>st</sup> recycle valve of P-1102-A (4"dia\*900#)
5. New hand wheel provided on discharge tapping isolation valve of P-1102-A.
6. Sample point on the top cover of suction strainer of P-1201-A/B was cut and plugged.
7. Urea melt pump P-1408 was replaced with reconditioned pump and aligned with serviced motor (reconditioned).

**FIRST FLOOR**

1. Cooling water outlet isolation valve of H-1206 replaced.
2. Ammonia system 3 ways isolation valve was overhauled.
3. Main isolation valve of PIC-1201 sensing line was replaced (1/2"dia\*1500#)
4. Ammonia suction filter 1<sup>st</sup> drain valve was replaced.
5. Bonnet gasket and gland packing of H-1205 drain isolation valve replaced.

**SECOND FLOOR**

Ammonical water to ANR-1203 both valve glands repacked.

**FICV-1204 FLOOR**

P-1421 vent line to vent stack pipeline pin hole weld repaired.

**PT-TOP**

RV-1201 A/B/C (3 nos.) replaced by reconditioned (RV-1201/A was passing)

**HYDROLYSER**

1. V-1351 off gas line pin hole weld repaired.
2. V-1353 level glass bottom union leak rectified and bottom up stream flange gasket replaced.

3. V-1353 off gas line steam injection line modified. New drain valve, isolation valve and NRV provided.
4. H-1352 top channel cover cooling water vent line isolation line valve replaced (1"dia\*800#).

### STEAM LEAK JOBS :

Following steam leak jobs were attended.  
Ground Floor

Sr. NO.	Description of Jobs	Material replaced
1	Replaced Service station condensate 1 <sup>st</sup> and 2 <sup>nd</sup> I/V above P-1201-A for passing	1"dia*800# SW Gate valve 4 no. CS
2	Replaced condensate Valve of 1 <sup>st</sup> station 1 <sup>st</sup> I/V	3/4"dia*800# SW gate valve 2no. CS
3	Near P-1401-B steam tracing I/V replaced (spindle and bush broken)	1/2"dia*800# SW gate valve 5no. CS
4	L.R.C.V. 1201 d/s condensate Flushing line re-routed	1/2"dia *40 sch. CS pipe 3mtrs.
5	L.I.C.V. 1204 d/s I/V valve replaced	3/4"dia*40 sch. CS pipe 4mtrs.
6	C.I.A. 1502 tapping main I/V valve replaced	1"dia*40 sch. CS pipe 3mtrs
7	P-1201C discharge line steam tracing I/V replaced	1/2"dia*40 sch. S-S 304 pipe 1mtr.
8	P-1201C dis. Line steam tracing trap replaced and line connected with return header	Elbow 1/2"dia 4no. 3/4 3no.
9	P1201C suction Dampener tracing line pin hole weld repaired	-
10	P1510 (PO <sub>4</sub> dozing pump) suction strainer down stream line replaced	Pipe SS 304 1/2 " dia sch 40
<b>PRILL COOLING SYSTEM</b>		
1	Replaced the valve of condensate Service station between (T-1701) for passing	CS 1"dia x 800# SW Gate valve - 2 No.
2	Replaced 2no. valve near K-1702 of service station	
<b>COMPRESSOR</b>		
1	Provided condensate Point near lube Oil console of Hitachi compressor	CS pipe 3/4"dia* 40 sch. 30mtrs.
2	Provided raw water line near hose station in P-B compressor	3/4"dia SW socket - 6no.
<b>FIRST FLOOR</b>		
1	PICV-1130 U/S line steam trap provided with I/V	3/4"dia*800# CS SW 4nos. gate valve.
2	Near V-1301 4ATA steam tracing line pin hole leak in return header	CS 3/4"dia*40 Sch. pipe 3mtrs.
3	Pre. Evaporator liquid o/l steam tracing pin hole leak	CS 3/4"dia*3000# coupler SW 5nos.



4	Replaced valve of CCS-II 23ATA steam injection valve	½"dia BPT steam trap SW - 5nos.
5	Replaced H-1207 condensate Line drain valve	CS ¾"dia x 800# SW Gate valve
6	Replaced 5nos. BPT steam trap	5nos. of "Spirax" BPT-21 steam traps
7	Replaced H-1206 cooling water outlet drain valve by 4"dia instead of 1"dia	4"dia*150# CS flange end gate valve
<b>SECOND FLOOR</b>		
1	Provided spool piece and removed PRCV-1501	CS ¾"dia*800# SW gate valve
2	Welded pin hole leak in down stream tapping line of PRCV-1501	CS ¾"dia*40 sch. pipe 2mtrs.
3	Replaced valve of 2 <sup>nd</sup> evaporator seal pot balancing line	
4	9 ATA Steam tracing line header drain valve replaced	
<b>THIRD FLOOR</b>		
1	Replaced valve of 9 ATA to PR-1421 1 <sup>st</sup> and 2 <sup>nd</sup> I/V	CS 1"dia*800# gate valve SW 2nos.
2	HICV-1208 d/s steam tracing pin hole weld repaired	¾"dia*800# gate valve CS SW 2nos.
3	Replaced PRCV-1202 down stream line steam tracing I/V as it was not operational	CS 1/2"dia*800# gate valve SW 1no.
4	Steam service station 1 <sup>st</sup> and 2 <sup>nd</sup> I/V were heavily passing and hence replaced.	1"dia*40 sch CS pipe 1mtr. And new valves
5	Bonnet bolt of H-1422 steam tracing I/V were broken. Replaced valve & pipe.	¾"dia*40 sch CS pipe 1mtr. And valve
<b>FICV- 1204 FLOOR (3 ½ FLOOR)</b>		
1	Carbamate to H-1202 4ATA steam tracing line pin hole weld repaired	
2	Booster ejector condensate Flushing I/V was opening suddenly and hence replaced.	
<b>FIFTH FLOOR</b>		
1	9ATA steam tracing line to P.T. top support weld repaired	
<b>PRILL TOWER TOP</b>		
1	Provided permanent line for ejector in the prilling bucket room	½"dia*800# SW CS gate valve, Qty-13Nos
2	9ATA steam I/V near hose station was not operational and hence replaced.	¾"dia*800# SW CS gate valve, Qty-4 No
3	Removed 4ATA steam line of prilling room ceiling	1"dia*800# SW CS gate valve Qty -1 No
4	Removed bucket wash tank from prilling room	½"dia *40 sch CS pipe length 6mtrs.
5	Removed unwanted material from prilling room	¾"dia *40 sch CS pipe length 4mtrs.

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6	Near K-1401-4 9ATA steam tracing line length reduced	1"dia *40 sch CS pipe length 1mtrs.
7	H – 1203 overflow line steam tracing line I/Vs replaced as these were corroded and bush was broken	CS elbow ½" dia*3000# SW Qty -14 Nos
8	H-1203 steam tracing line I/V was replaced as old one was not operational. Also the unwanted valves were removed.	CS elbow ¾" dia*3000# SW Qty - 6 Nos
9	Replaced 2nos. valve of 4ATA header below V-1203 near R.V. tail pipe	CS SW coupler 1/2"dia*3000# Qty – 12 Nos.
10	Carbamate to H-1203 steam tracing line replaced wherever pin hole leak was reported.	CS SW coupler ¾"dia*3000# QTY - 8nos.
11	R.V. -1201 A/B/C steam tracing I/V replaced	
12	9ATA to 4ATA inter connection third and fifth I/V replaced	
13	9ATA I/V under grill near HICV-1202 replaced as old one was not operational.	
14	9ATA to PRCV-1201 down stream line 5 <sup>th</sup> tapping (from HICV -1202 side) pin hole weld repaired.	
15	V-1207 9ATA injection on top flange down stream pin hole weld repaired	
16	9Ata to V-1203 I/V (near its man hole) replaced as old one was not operational.	
<b>HYDROLYSER</b>		
1	9 Ata header tapping I/V near TICV 1365 replaced	½"dia*800# CS SW gate valve Qty - 1no.
2	Steam trap I/V down stream pin hole weld repaired (near RV-1351)	¾"dia*800# CS SW gate valve Qty – 2 nos.
3	V-1352 top side steam tracing line main line replaced	1"dia*800# CS SW gate valve Qty - 1no.
4	FICV-1351 by pass line I/V replaced	CS ½"dia*3000# SW 1 No.
<b>PIPE LINE REPLACEMENT DUE TO THICKNESS REDUCTION</b>		
1	MA-1203-4" (Ammonia pump discharge line to HP condenser.) 4" dia Sch160 CS pipe and elbow changed	
2	Pipelines GA-1202 0.5" NB and 1" NB (CO2 dis. Line to H-1203 ) replaced(ground floor behind H-1201)	
3	Pipe line no. SC -1407- 6" / 8" of T-1501 on first floor 6"dia*40 sch. and 8" dia* 40 sch. elbows replaced.	

8J

	MODIFICATIONS CARRIED OUT	
1	M-1701 A/B outlet dust dissolving hopper outlet line taken from bottom to avoid frequency of choking.	
2	Suction line and suction strainer of P-1701- A/B modified to avoid frequency choking.	
3	New inspection door was provided at the dust outlet of K-1702	
4	PICV-1353 down stream I/V provided	
5	H-1420 vapor outlet line extended by 2mtrs for safety purpose.	
6	P-1102 A/B/C draining line connected and redundant line removed	
7	Ammonia oil separator redundant lines removed	
8	H-1209 inlet and outlet lines, redundant I/V, T-joints and tapping removed and connections provided as per production department (Urea )	
9	PRCV-1501 control valve removed and provided spool piece	
10	Condensate flushing I/V to H-1352 line rerouted	
11	4 " drain valve provided in place of earlier 1" valve for H-1206 CW	
12	In CCS-I H-1102 outlet down stream drain valve provided	
13	The length of Co2 vent pipe adjoining Urea control room (16"dia*40sch. CS pipe) Increased by 1mtr to avoid noise pollution and for safety purpose	
14	Hydrolyser feed pump (P-1351-A) suction pipe line re-routed to increase the NPSH availability to the pump (EWR NO. U-221 & approval ref : TM/02/1308 from technical department). Main suction pipe line tapping of P-1351-A taken after 3 <sup>rd</sup> cooling jackets of P-1351 B making all three jackets common for both the pumps	
15	23ATA exhaust of GHH compressor 2 <sup>nd</sup> I/V removed and provided spool piece.	
16	New condensate Pot (V-1430) was fabricated from old vessel removed from GHH compressor and provided for pre evaporator in urea plant near H-1418 as per EWR scheme approval from Technical deptt (Ref: TM/02/1307 dated 02-09-03 and suggestion no. SS/UREA/2403 dated 2309 2003).	

DECLARATION OF THE BOARD OF DIRECTORS

I, the undersigned, being a duly qualified and authorized officer of the above-named corporation, do hereby certify that the foregoing is a true and correct copy of the minutes of the meeting of the Board of Directors of the above-named corporation, held on the \_\_\_\_\_ day of \_\_\_\_\_, 19\_\_\_\_.

Witness my hand and the seal of the above-named corporation at \_\_\_\_\_, this \_\_\_\_\_ day of \_\_\_\_\_, 19\_\_\_\_.

\_\_\_\_\_  
Secretary

\_\_\_\_\_  
President

\_\_\_\_\_  
Treasurer

\_\_\_\_\_  
Vice President

\_\_\_\_\_  
Director

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Director

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Director

## OFFSITES & UTILITY PLANT

82

### COOLING WATER PUMP (P-4401/A):

#### PREVENTIVE MAINTENANCE OF PUMP :

Coupling between the pump and the gear box was decoupled after recording the necessary match marks.

Both the journal Bearings were checked and found okay.

The clearances were checked & following are the readings:

Sr. No.	Description	Design Value	Actual Value(BM)	Actual Value (AM)
1	Total Float of the pump	10 mm	8 mm	8 mm
2	Radial bearing Clearance coupling end	0.20 mm	0.12-0.14 mm	0.12-0.15 mm
3	Radial bearing Clearance free end	0.20 mm	0.15- 0.18 mm	0.15-0.18mm

Total Axial Float of the pump measured is 8 mm.

Coupling of pump with gear box clean, check, found O.K. Greased and box -up.

New Gland packing (25 mm) both side repacked.

### COOLING WATER PUMP ELLIOT TURBINE (Q-4401/A):

#### PREVENTIVE MAINTENANCE:

Coupling between the turbine and the gear box was decoupled after recording the necessary match marks.

Both the journal Bearings and thrust bearing were checked and found okay.

The clearances were checked & following are the readings:

Sr. No.	Description	Actual Value(BM)	Actual Value(AM)
1	Axial Float on the turbine	--	0.27 mm
2	Radial bearing Clearance coupling end	0.15- 0.17 mm	0.15 - 0.17 mm
3	Radial bearing Clearance Governor end	0.15- 0.17 mm	0.15 - 0.17 mm
4	Oil labyrinth CE	--	0.10-0.15
5	Oil Labyrinth FE	--	0.10-0.15

Governor assembly was removed, cleaned, inspected and boxed up.

Fresh oil is charged in Governor Oil (Servo 32).

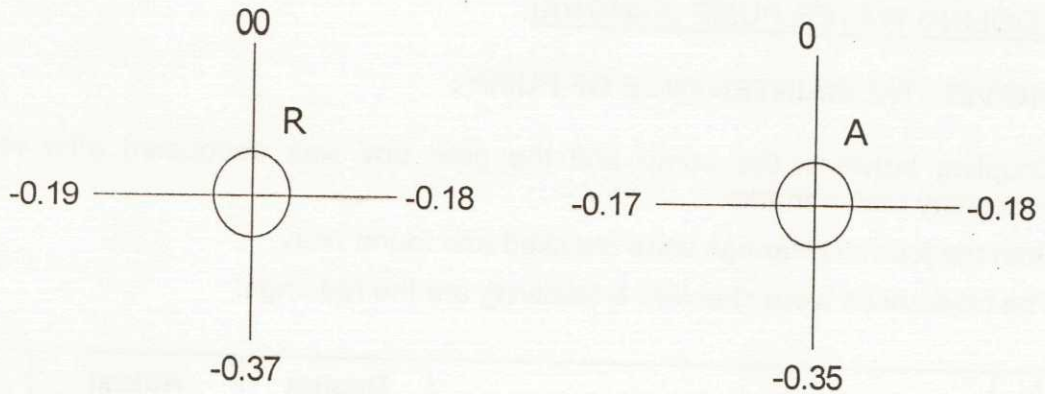
Oil console was drained, cleaned and fresh oil charged.

Main oil pump and Auxiliary oil pump suction strainer were cleaned & boxed up.

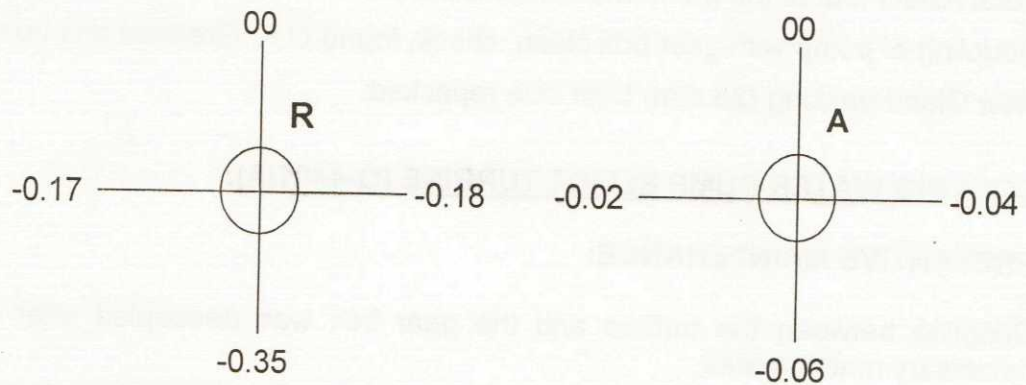
Gear box to Turbine alignment was checked.

83

Following are the readings (Before PM):



Turbine to Gear box Alignment was corrected, Following are the readings:



**COOLING WATER PUMP ( P-4402 ) :**

**PREVENTIVE MAINTENANCE OF UREA COOLING WATER PUMP :**

Coupling between the pump and motor was decoupled.

Both the journal bearings were checked & found okay.

The clearances were checked & following are the readings.  
Free end side : 0.25 mm    Coupling side : 0.18 mm

Motor was decoupled, coupling checked, new grease filled.

Both the bearing housing were flushed with oil & fresh oil servo Prime 68 charged.

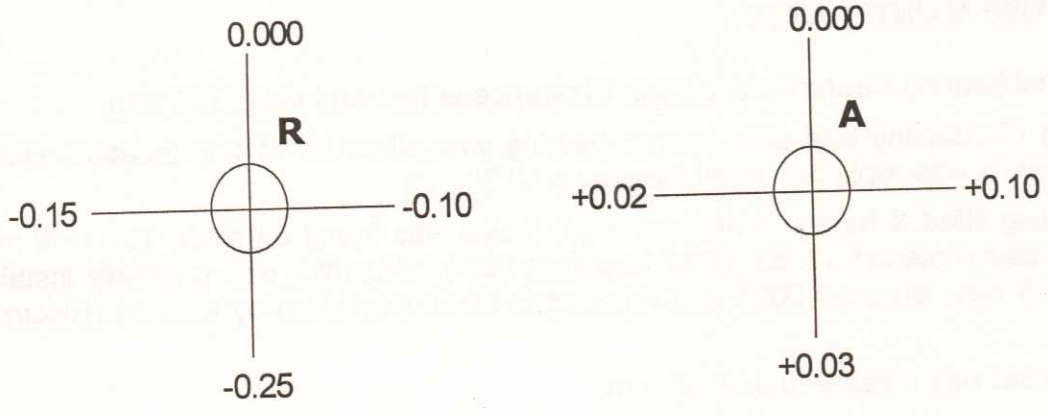
Gland packing (25 mm) both sides repacked.

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

Coupling oil paper replaced and new grease filled.

Pump with Motor alignment was checked and following are the readings:

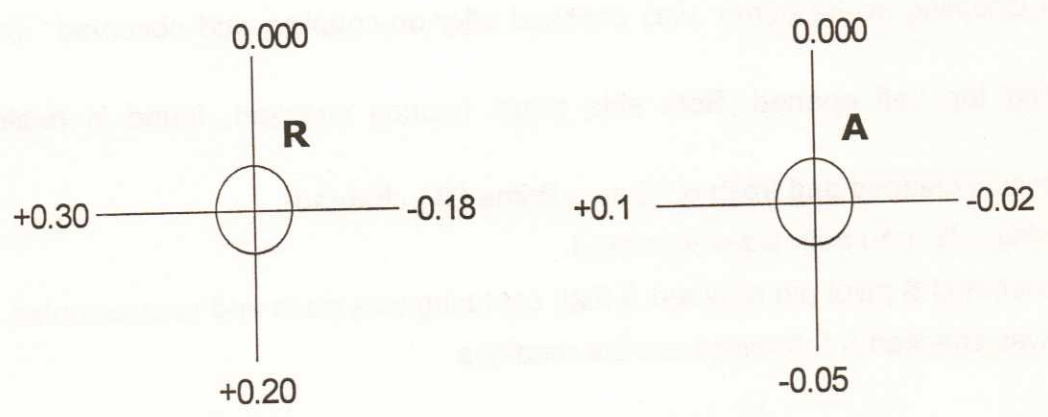
84



**COOLING WATER PUMP ( P-4401/C ) :**

**PREVENTIVE MAINTENANCE**

Both the journal Bearings were checked & found okay.  
The clearances were checked & following are the readings.  
Free end side: 0.27 mm  
Coupling side: 0.30 mm  
Both the bearing housing were flushed with oil & fresh oil servo prime 68 charged in the both bearing housing.  
Decoupled the pump coupling, cleaned & greasing done.  
Gland packing (25 mm) both sides repacked.  
Worn-out markings were found on Pump side coupling teeth upto 10 mm length.  
Bearing Housing drain valves replaced. (3/8" N.B. Gun metal valve)  
Alignment was checked & followings are the readings



### COOLING WATER PUMP (P-4401 / D):

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#### **PREVENTIVE MAINTENANCE:**

The Journal bearing clearance checked. Clearance at free end side: 0.22 mm.

The lining of coupling end side journal bearing was pilled off at one location. Hence journal bearing was replaced. Final clearance : 0.20 mm

Pump casing lifted & heavy cavitations & pin holes was found on rotor. The new rotor assembly was replaced. (333300035 Repaired Item). This rotor was originally installed in P-4402 & was removed 2003 and repaired in Mech workshop by welding (Electrode 680).

The rotor float was measured as 0.90 mm.

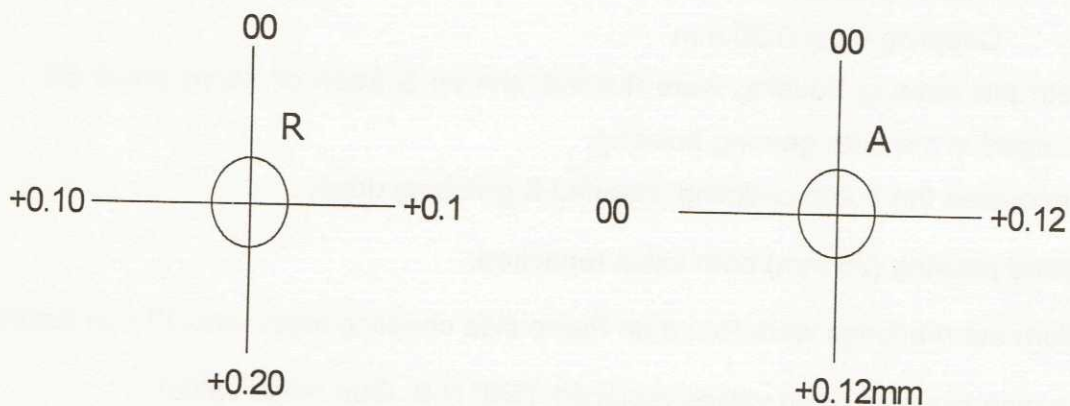
Thrust bearing was found worn out hence replaced new bearing as SKF 6318 (455001124).

Gland packing (25 mm) both sides replaced.

Bearing housing drain valves replaced. (3/8" N.B. Gun metal valve).

Cleaned & greasing done after coupling.

Pump & Motor alignment was checked. The following are the readings:



### COOLING WATER PUMP (P-4404-E):

#### **PREVENTIVE MAINTENANCE:**

Total Axial Coupling of the pump was checked after de-coupling and observed : 0.14 mm

Both bearing top half opened. Both side thrust bearing checked, found in healthy condition.

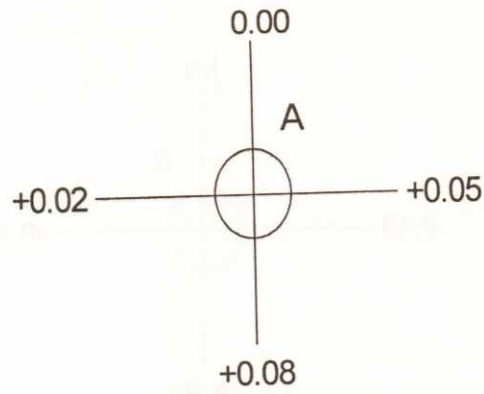
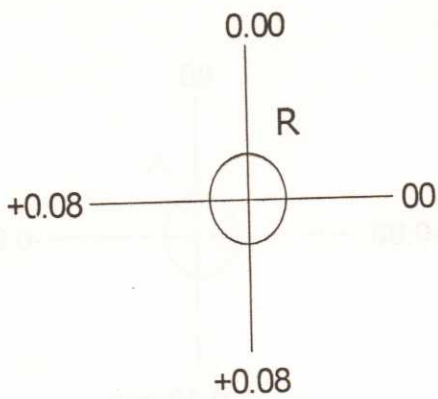
Bearing housing cleaned and fresh oil (Servo Prime 68 ) charged.

Gland packing ( 25 mm) both sides repacked.

N.R.V. opened and & pivot pin repaired & Flap centering was done and re-assembled.

Alignment was checked & followings are the readings.



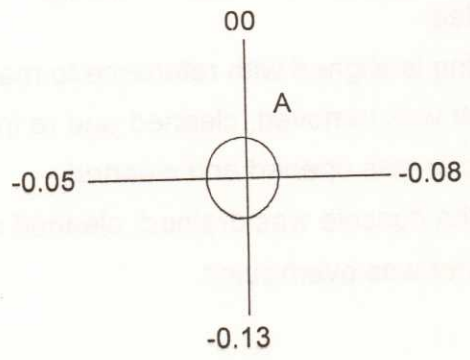
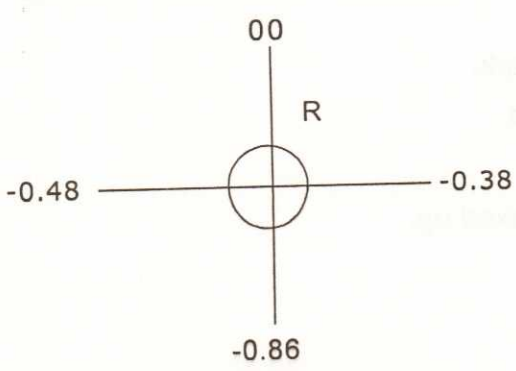


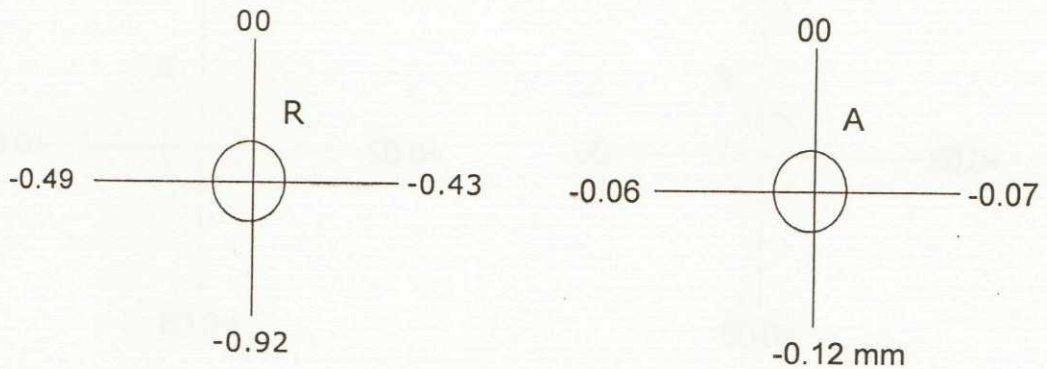
**B F W PUMP ( TURBINE DRIVEN ) P - 5111 :**

**PREVENTIVE MAINTENANCE:**

- Removal of coupling spacer - Match marks was checked.
- Checking of alignment & axial play of pump shaft.
- Removal of DE & NDE bearings top halves.
- Cleaning of Radial & Thrust bearings.
- Checking radial clearances of bearings using lead wire.
- Alignment readings and bearings clearances were checked.
- Same bearings were assembled after polishing and cleaning.
- Install coupling spacer with reference to match marks.
- Cleaning / replacing oil filters and oil in the oil console.
- Checking oil line, water line for leaks.
- Suction filter of the pump was cleaned

Alignment Readings: Pump To Turbine (Before Preventive maintenance)





**Clearance Details :**

Sr. No.	Description	Design Value	Actual Value (BM)	Actual Value
1	Axial Thrust	0.28 - 0.33	0.18 mm	0.18 mm
2	Radial bearing Clearance coupling end	0.13 - 0.18	0.15 mm	0.15 mm
3	Radial bearing Clearance free end	0.13 - 0.18	0.12 mm	0.12 mm
4	Oil Laby. clearance CE		0.20-0.25	0.12-0.15
5	Oil Laby clearance TE		0.20-0.25	0.17-0.18
6	Coupling Float			9.30 mm

**B F W PUMP TURBINE (SHIN NIPPON) Q-5111:**

Couplings between the Pump to Turbine was decoupled after recording the necessary match marks.

Initial alignment readings and axial float were measured and recorded.

Bearing top halves were removed.

Coupling end and free end bearing clearances were measured using lead wire and recorded.

Bearing pads were cleaned and polished .

Governor assembly was removed.

Bottom halves of the bearings were assembled, clearance checked and recorded.

Coupling is aligned with reference to match mark.

Oil filter was removed, cleaned and re installed.

Oil cooler was opened and cleaned.

Oil in the console was drained, cleaned and boxed up.

Governor was overhauled.

Sr. No.	Description	Actual Value(BM)	Actual Value(AM)
1	Axial Thrust	0.24 mm	0.25 mm
2	Turbine C/E Bearing Clearance	0.15 -0.17 mm	0.15 mm
3	FE Bearing Clearance	0.15-0.17 mm	0.15-0.17 mm
4	Oil Laby clearance TE	0.15-0.20	0.15-0.20
5	Oil Laby clearance CE	0.10-0.15	0.10-0.15
6	Oil Laby clearance Out Board	---	0.15 mm

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

**PREVENTIVE MAINTENANCE:**

Couplings between the Pump to Gear Box was decoupled after recording the necessary match marks.

Initial alignment readings and axial float were measured and recorded.

Bearing top halves were removed.

Coupling end and free end bearing clearances were measured using lead wire and recorded.

Bearing halves were cleaned and polished using green rouge.

Thrust collar and the bearings assembled, clearance checked and recorded.

Coupling is aligned with reference to match mark.

Oil filter was removed, cleaned and re installed.

Oil cooler was opened and cleaned.

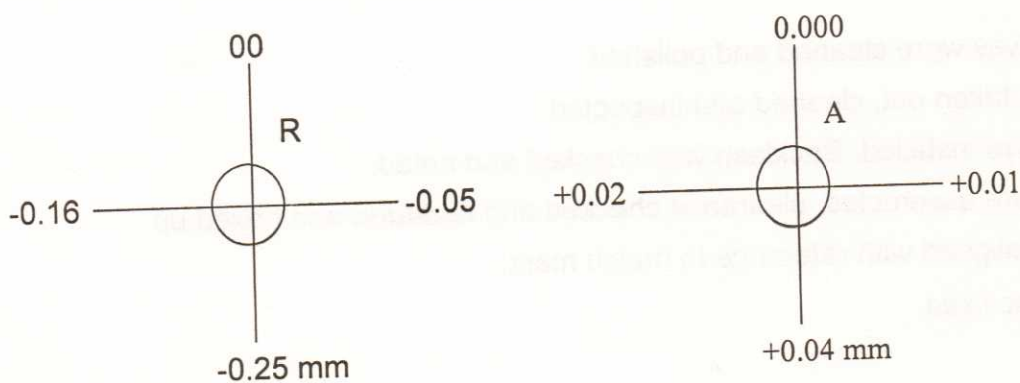
Suction filter of the pump was cleaned.

Gear Box oil was replenished with new oil.

Gearbox cooler cleaned.

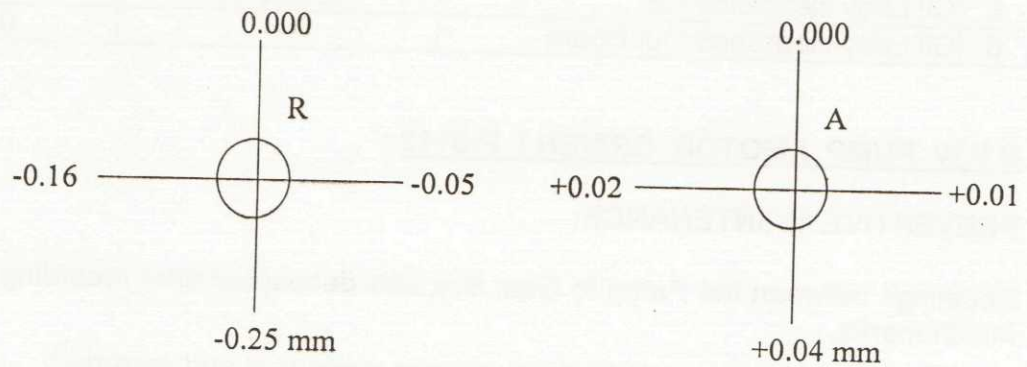
**ALIGNMENT DATA :**

**Pump to Gear Box before Preventive Maintenance:**



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**After Preventive maintenance**



**CLEARANCE DETAILS:**

All the values are in mm

Sr. No.	Description	Design Value	Actual value BPM	Actual value APM
1	Axial float on the pump side	0.28- 0.33	0.34	0.34
2	Radial bearing clearance coupling end	0.12- 0.18	0.15 - 0.16	0.15-0.16
3	Radial bearing clearance free end	0.12- 0.18	0.13-0.15	0.13-0.15

**PREVENTIVE MAINTENANCE OF GEAR BOX:**

Coupling between the Gear Box and Motor was decoupled after recording the necessary match marks.

Initial alignment readings and axial float were measured and recorded.

Bearing top halves were removed.

Coupling end and free end bearing clearances were measured using lead wire and recorded.

Bearing halves were cleaned and polished .

Gears were taken out, cleaned and inspected.

Gears were re installed. Backlash was checked and noted.

Bearings were assembled, clearance checked and recorded and boxed up.

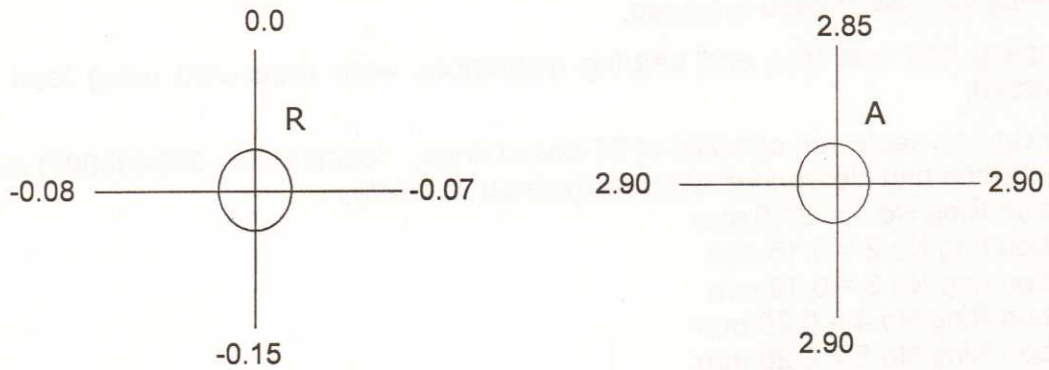
Coupling is aligned with reference to match mark.

Coupling was fixed.

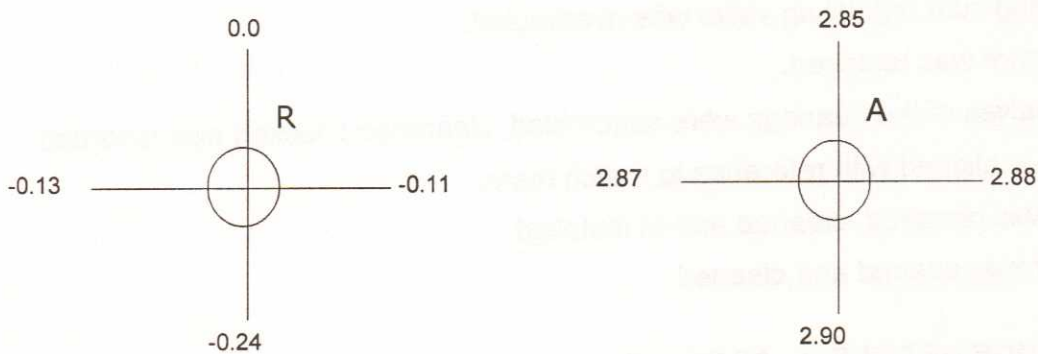
**ALIGNMENT DATA:**

90

**Gear Box to Motor: Before Preventive Maintenance:**



**After Preventive Maintenance: Dial on Motor:**



**CLEARANCE DETAILS : (All the values are in mm)**

Sr. No.	Description	Actual value (Before)	Actual value APM
1	Bull gear axial float	0.15	0.17
2	Pinion DE bearing clearance	0.15 - 0.16	0.15
3	Pinion NDE Bearing Clearance	0.15 - 0.17	0.15 - 0.17 mm
4	Bull gear D/E bearing clearance	0.13 - 0.15	0.13 - 0.15
5	Bull gear NDE bearing clearance	0.12 - 0.13	0.12 - 0.13 mm
6	Coupling float motor to GB	7.70	7.90
7	Coupling Float (Gear Box to Pump)	8.30	8.65

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

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Couplings between the Fan to Turbine was decoupled after recording the necessary match marks.

Initial alignment readings and axial float were measured and recorded.

Bearing top halves were removed.

Coupling end and free end bearing clearances were measured using lead wire and recorded.

The Carbon seals set, consists of 05 nos of rings, (store code : 335402007) replaced.

The carbon ring clearances were maintained as follows :

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 = 0.20 mm

Carbon Ring No 5 = 0.20 mm

All five carbon rings chamber and pressure springs replaced.

Turbine nozzle gap measured & recorded.

The Stuffing box was found defective and heavy corroded. The ID ovality of stuffing box was to a tune of 0.15 – 1.0 mm).

Servomotor was over hauled.

Govern ring cum regulating valve was overhauled.

Oil Governor was replaced.

Bottom halves of the bearings were assembled, clearance checked and recorded.

Coupling is aligned with reference to match mark.

Oil filter was removed, cleaned and re installed.

Oil cooler was opened and cleaned.

**CLEARANCE DETAILS: ( All the values are in mm)**

Sr. No.	Description	Actual value BOH	Actual value AOH
1	Axial float of the Turbine	---	0.22 mm
2	Turbine Nozzle Gap – Front Side	2.45	2.45
3	Turbine Nozzle gap – Front Top	1.75	1.75
4	Turbine Nozzle gap – Back Side	1.50	1.50
5	Turbine Bearing Clearance Disc side	0.12 – 0.13	0.12 – 0.14
6	Turbine Bearing Clearance TE side	0.13 – 0.15	0.12 – 0.16
7	Axial thrust Gear Box	0.18	0.19
8	Gear Backlash	0.24	0.24
9	Pinion Float	0.22	0.22
10	Bull gear CE bearing clearance	0.12 – 0.13	0.12
11	Bull gear FE Bearing Clearance	0.13 – 0.15	0.13

# PREVENTIVE MAINTENANCE OF THE FD FAN K5113

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## **JOBS CARRIED OUT:**

Couplings between the fan to Turbine was decoupled after recording the necessary match marks.

Initial alignment readings and axial float were measured and recorded.

Bearing clearances were measured using lead wire and recorded.

Coupling is aligned with reference to match mark.

Bearing housing oil removed, cleaned, oil filled up to the required level.

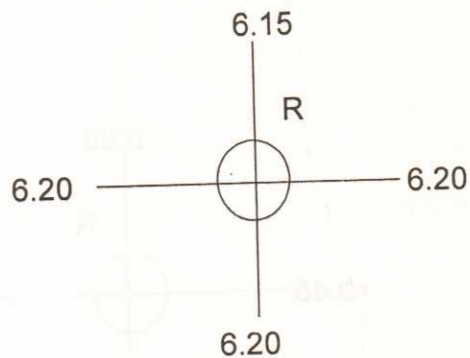
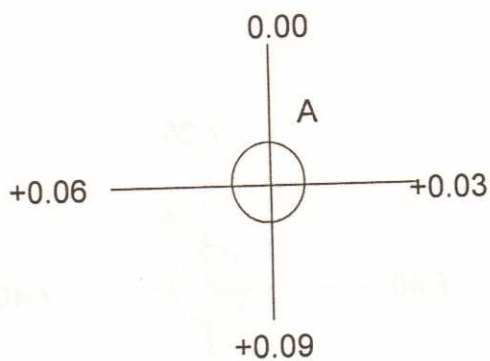
Cooling Water lines removed, cleaned, fixed.

Clutch between motor & FD Fan opened inspected and found in good condition.

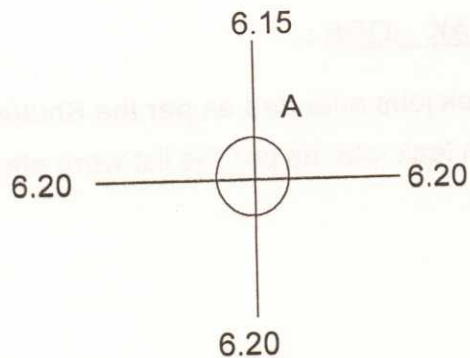
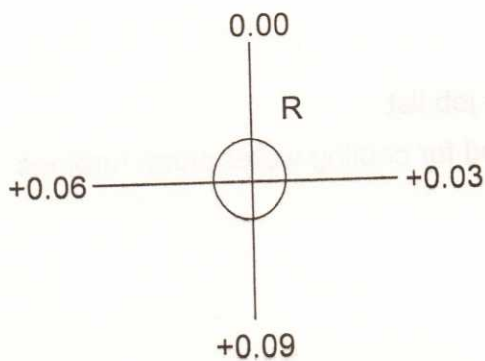
Oil filters were cleaned and boxed up and charge fresh servo Transfluid-A oil charged.

## **ALIGNMENT DATA:**

### **FD Fan to Gear box : Before Preventive Maintenance:**



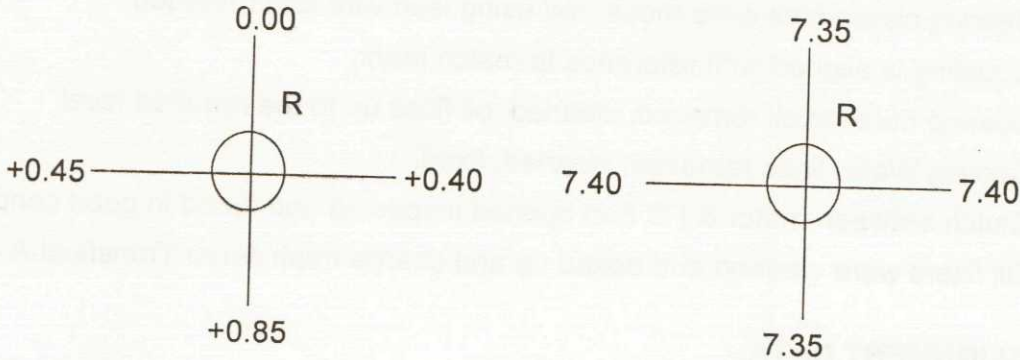
### **After Preventive Maintenance:**



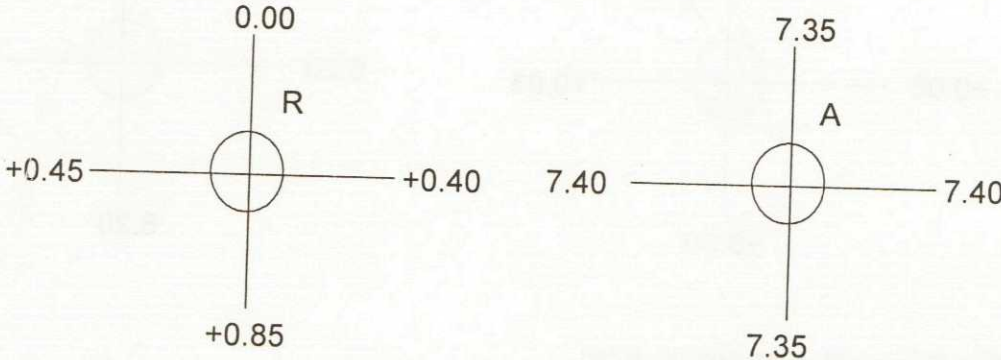
93

**ALIGNMENT DATA:**

**Clutch to FD Fan : Before Preventive Maintenance:**



**After Preventive Maintenance:**



**STEAM LEAK JOBS :**

All Steam leak jobs attended as per the Shutdown job list.  
All the steam leak jobs as per the list were attended for cooling water pump turbines.



## BHEL BOILER JOBS (F-5111) :

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### **BHEL BOILER INSPECTION :**

Boiler was inspected by Boiler Inspector in open test condition on 29.05.2004. Hydrotest at 90 Kg/cm<sup>2</sup> pressure was done and witnessed by Boiler Inspector on 02.06.2004.

All the three safety relief valves were overhauled & tested on 04-06-2004 and their readings were as follows. These valves were serviced, Disc & Nozzle lapping was carried out.

Description	Popping Pressure Kg/cm <sup>2</sup> g	Reset Pressure Kg/cm <sup>2</sup> g
Drum Rear R.V.	71.87	68.7
Drum Front R.V.	69.17	66.15
Super Heater R.V.	64.53	62.52

F.D.Fan turbine Exhaust 4 ata Header R.V. , 14 ata Automisation line R.V. And 40 ata Soot Blower Header R.V. Dearator R.V. BFW turbine exhaust 4 ata R.V. And LSHS supply pump turbine exhaust R.V .Were overhauled and tested on test bench with Nitrogen. Services of M/s Flotec engineering , Surat were taken for overhauling of Relief valves.(Ref w.o. 12/00811/KLL/ 14434BK/ 9914994 dtd 08.04.2004 )

Steam drum connected all first and second isolation valves gland packing were repacked.

Steam Drum rear side level indicator gauge glass was cut and removed for removing broken Allen bolts and replacing view glass.

"L" shaped Inconel studs @ 4 x 6 rows were welded on underside of steam drum in super heater coil area. Then ceramic insulation material & inconel covering sheet was fastened.

BFW feed water inlet line NRV was attended by replacing H. Press. sealing ring.

Re-examination of Primary Super heater line and De-super heater was carried out by M/s BHEL , Tiruchi at five locations. ( Ref : WO No 14/00537 /KLL/ 14094BK /9914562 dtd 12.02.04)

### **BHEL BOILER FURNACE AREA JOBS:**

Gas burner nozzles (top and bottom ) were inspected and found o.k.

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

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

Damper of burner made free and greasing done. All dampers were checked and made free by greasing for smooth operation.

Flue gas leakage observed from "D" tubes on the top of furnace, near to steam drum. Old casing plate was removed by gas cutting followed by castable refractory was removed and new refractory was casted & 5 mm x 350 width MS plate were tack welded.  
(Vendor: M/s Dhruv Sales, Bharuch C/o m/s ACC, A'bad)

## BHEL BOILER LONG RETRACTABLE SOOT BLOWERS (LRB'S) & ROTARY SOOT BLOWERS (RB'S) :

Both the LRB's LRB-1 & LRB 2 were overhauled.

Nozzle of Lance tube of LRB no. 1 was found damaged hence lance tube with feed pipe assembly were replaced.(code : 335810130 lance tube, 335810010 : feed pipe)

All the four RB'S were overhauled and boxed up.

## RE -GENERATIVE AIR PRE-HEATER H-5111 :

### PREVENTIVE MAINTENANCE :

General condition of Cold End baskets was found ok.

General condition of Hot End Baskets was found o.k.

Cold End Radial Two Seal was replaced with new, as the old seal was broken.

Both End Rotor Bearings (Spherical self aligning, withdrawal sleeve 22330 CCK /C3 / W 33 ) housing were open for inspection. The condition of bearings were found o.k. Boxed-up and fresh oil (C 100 5 ltrs) charged.

Drive gear box with motor was replaced. Re conditioned gearbox lying in stores was used. (Code : 335702001)

Bearings Clearances were checked by feeler gauge and this is the readings : Clearance hot end bearing : 0.012" (0.305 mm)

Clearance cold end bearing : 0.008" (0.203 mm)

Steam nozzle for swivel type soot blower of RAH unit was cleaned.

RAH Gear Box with sprocket with electric motor was replaced.

Flue gas leakages from Hot end Bearing housing were arrested by putting insulation.

Both side swivel door assembly repaired for smooth operation.

### FABRICATION JOBS :

- 1) Admn. Side Urea cooling water return header vertical portion alongwith top elbow was replaced by M/s Garcem Engineers, Ahmedabad ( W.O. 14/00561 /KLL/ 14616BK/ 9914919 dtd 22.03.2004). these pipes were supplied by M/s Engineers & Consultant, Ghaziabad )
- 2) SS 304 3.0 mm thick x 3.0 mtrs long Pad plates were provided at 03 locations on urea cooling tower return header under FC valve & SS 3.0 mm thick patch plate welded at 05 nos location at wooden support area on urea cooling water return header by M/s Garcem Engineers, Ahmedabad ( W.O. 14/00561 /KLL/ 14616BK /9914919 dtd 22.03.2004). Due to severe corrosion of distribution deck headers bottom side, welding of pad plates was very difficult. Hence it was planned to replace the complete both headers in next shut-down.
- 3) Corroded portion of 3" & 4" cooling water lines of Elliot turbines were replaced with SS 304 seamless Sch 10 pipes.
- 4) The Strainer grills of Urea & ammonia cooling towers were repaired.

- 5) The H<sub>2</sub>SO<sub>4</sub> acid lines from tank to CT Basin dosing line & valves were replaced.
- 6) The FRP portion of Raw water pump suction line inside the Raw water tank was replaced with SS 304 line and it is extended upto 500 mm from bottom so it can lift water from bottom level.
- 7) 800 mm long SS patch plate was welded at ground level on Raw water header line to DM plant.
- 8) As per steam leak job list, defective steam traps and passing isolation valves were replaced.

#### **DM PLANT JOB:**

- (1) The inlet nozzle of HCL measuring tank was replaced by new one issued from store. FRP base material was found decomposed from inside the tank. It was planned to replace the tank in next shut-down.
- (2) Pin hole was repaired near out let nozzle (suction nozzle of HCL Transfer pump) of the M-I tank.
- (3) The 250 mm diaphragm valve of DM Booster pumps suction lines were attended.
- (4) The diaphragms of all five SMB units inlet lines were replaced.

#### **INSITU REPAIR OF VALVES:**

The 40 ata steam inlet valve size : 150 mm and 04 ata steam exhaust valve size : 250 mm x 150# of of Q-4403 were insitu attended by M/s EFCO, Hydrabad. (Ref : WO No 14/00577 / KLL/15693BK/9915282 dtd 14/05/04). They brought all necessary tools for lapping of valve seat at location.

#### **PAINTING JOBS CARRIED OUT ON :**

All The Cooling Tower Fans.

Cooling water return header on the top of cooling tower (ammonia old urea and new urea).

BHEL Boiler stack, all safety valves exhaust cylinders.

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**RECLAIM MACHINE M - 2116:**

Thorough inspection of complete bucket elevator assembly for the following and it's complete overhauling.

- loose / damaged Chain links
- broken pins / lock washers / circlips
- Rubbing buckets
- Lubrication of pins
- Overhauling of the take-up unit – cone washer replacement & checking of bearings, shaft & sprockets

Thorough inspection of complete scrapper chain assembly for the following and its complete overhauling.

- Replacement of damaged scrapper blades
- Proper tightening and tack welding of nuts to avoid looseness during running.
- Chain tightening
- Sprocket inspection

Repairing of take-up unit of scrapper chain.

Pivot assembly of link conveyor replaced with new one as old pivot pin & bush found damaged.

Guide roller bracket assembly of bottom King-post inside the bunker of reclaim machine overhauled and aligned.

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

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

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

Carried out overhauling of all gear boxes like long travel, slewing, scraper and bucket elevator (main gear box) including their alignment with motor.

1<sup>st</sup> and 3<sup>rd</sup> gear of gear train replaced with new one. (1<sup>st</sup> from Drive side)

Thruster oil replaced and brake shoes checked.

Fluid coupling oil replaced.

Replaced Coupling bushes of FC-16 coupling on the output of main gear - box.

Swing gear box coupling bushes replaced.

Hub and lantern pinion assembly replaced with reconditioned one.

Slewing rack all pins checked and greasing done.

Cardium compound provided on wire rope of hoisting mechanism.

Pedestal bearings of both rear and front axle checked and greasing done.

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

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

Complete cleaning and painting of Reclaim machine carried out.

After completion of overhauling "no load" and "load" trial of Reclaim machine was carried out on 05/06/04 and 06/06/04 and the machine was found working satisfactorily.

**PREVENTIVE MAINTENANCE OF PACKER SCALES:**

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

Replacement of damaged doors.

Over hauling of coarse and fine feed gate assembly.

Over hauling of bottom flapper assembly.

Servicing of all cylinders.

Overhauling of sack grip assembly.

Alignment of stabilizer plate.

Over hauling of bucket assembly.

Calibration of packer scales.

**CONVEYOR M-2110:**

Following jobs were carried out.

M-2110 conveyor Gear Box oil-seals, coupling bolts, coupling rubber bushes and oil replaced with new one. Coupling done after proper alignment.

M--2111 diverter Flapper valve attended for proper sealing and easy operation. Greasing of bearings carried out.

Head pulley brush roller serviced.

All damaged and noisy carrier rollers and guide rollers replaced.

All pedestal bearings of snub pulley, head pulley, tail pulley and gravity pulley checked and greasing done.

Complete cleaning and painting of structure done.

Overflow pipe for transfer of material from M-2110 conveyor to M-2121 conveyor replaced with new one as the thickness of the old pipe had reduced due to corrosion.

**CONVEYOR M - 2112:**

Following jobs were carried out

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

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

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

Complete cleaning of conveyor structure done.

M-2112 conveyor Tripper Gear box overhauled and realigned with motor. Checked it's drive chain. Also one pulley bearing replaced with new one.

**CONVEYOR M-2117 :**

Following jobs were carried out

Overhauling of gearbox and replacement of oil seals, oil, coupling bolts and bushes. Coupling done after proper alignment.

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

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

**CONVEYOR M-2121 :**

Following jobs were carried out

Gear box attended for proper cleaning, alignment and coupling. Gear box oil replaced.

Diverter flapper valve of M-2121 conveyor attended for free and easy operation.

Air cylinders overhauled.

Head pulley scrapper rubber (12 mm thk.) replaced and serviced for free operation.

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

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

Complete greasing of all pedestal bearings done.

Complete cleaning and painting of structure done.

**CONVEYOR M - 2122 :**

Following jobs were carried out

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

Diverter plate of 3 and 4 hopper overhauled.

Skirt rubber with inner rubber sheet replaced.

Gear box of tripper of M-2122 conveyor overhauled.

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

Complete greasing in all bearings done.

Complete cleaning and painting of conveyor structure done.

**CONVEYOR M - 2122 A/B :**

Following jobs were carried out

Both gear boxes overhauled.

All damaged return rollers replaced with new rollers.

Skirt rubber replaced.

Cleaning and painting of complete structure.

**DUST CONVEYOR:**

Following jobs were carried out

Replacement of oil, oil-seals, coupling bolts and bushes.

All damaged return rollers overhauled.

All carrier rollers attended for free operation.

New skirt rubber with inner rubber sheet provided.

Complete greasing of all bearings done.

**SLAT CONVEYOR M-2124 ( 1 - 6 ) :**

Following jobs were carried out on all six slat conveyors

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



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All wooden slats of slat conveyor No. 4 & 8 replaced with new UHMW-PE ( Ultra High Molecular Weight Poly Ethylene ) material slats.

Preventive maintenance of Gear box done.

MPG and MHT-60 bearing servicing and greasing.

Conveyor adjusting mechanism servicing.

Cleaning and painting of all slat conveyors.

**PAY LOADER CONVEYOR M-2113:**

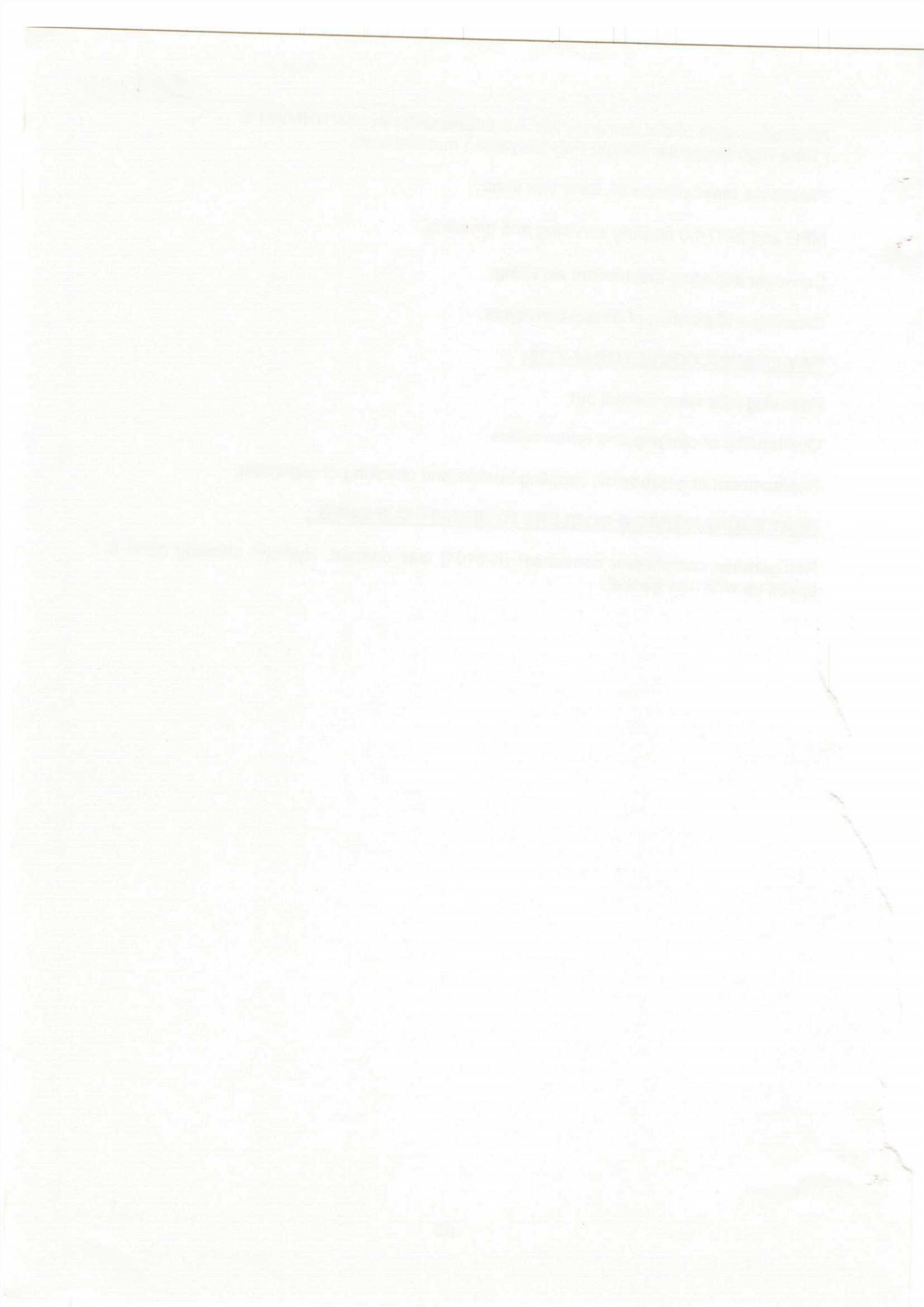
Following jobs were carried out.

Overhauling of carrying and return rollers.

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

**HEAT EXCHANGERS & COOLERS HYDROJET CLEANING :**

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



# INSPECTION

INSPECTION

**AMMONIA PLANT**

1. Inspection of existing and reclaimed reformer tubes and risers with various NDT techniques. Details are given at **Annexure-1 to 7**
2. Automatic ultrasonic scanning of all the Catalyst and Riser tubes in Reformer Furnace. Details are given at **Annexure-2**
3. Inspection of 103 D from inside after removal of catalyst.
4. Ultrasonic flaw detection on selected weld joints of critical pipelines and equipment. Details are given at **Annexure-8**
5. Thickness measurement of various equipment was carried out. Details are attached at **Annexure - 9**
6. Thickness measurement of various pipelines was carried out. Details are attached at **Annexure - 10**
7. Measurement of residual magnetism of parts of equipments and demagnetization of the same wherever the residual magnetism was found beyond limit. Details are given at **Annexure-11**
8. Insitu metallography of selected equipment and pipelines. Summary of observations and microstructure analysis is given at **Annexure - 12**
9. Inspection of newly fabricated pipelines for energy saving project and fabrication jobs carried out departmentally by maintenance department.
10. Qualification tests of welders employed by contractors.
11. Visual inspection of equipment.

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 based on the observations made.

**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.**

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## 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, 1 tube (tube no. 104) was in A grade, 15 tubes in B grade, 308 tubes in C grade, 12 tubes in D grade. Amongst 8 risers, 1 riser was in B grade, 6 risers were in C grade and 1 was not graded as it was a new riser. Details are attached at Annexure - 2.
- Radiography of C weld of 31 tubes of 8th row was carried out after removal of catalyst upto below 10 feet of C weld joints to assess the development of any weld cracks. Tube no. 815 was observed to have initiation of crack and tube no. 826 was observed to have developed a longitudinal crack in the weld. These two tubes were replaced along with other tubes which were identified to have crack/initiation of the crack during last turnaround. Remaining 29 tubes showed no indication of the crack. Further radiography was not carried out for other rows.
- Radiography of C weld of tube no. 704, 731 and 734 was carried out to see the condition of weld joints (As these tubes were reclaimed during S/D- 2003). The weld joints were found quite satisfactory after one year service in the furnace.
- Total 32 tubes were replaced, out of which 30 tubes were observed to have minor crack/initiation of crack in radiography during turnaround 2003 and 2 tubes of 8th row which showed crack this year. Details of replaced tubes are as under:  
109, 207, 215, 234, 310, 322, 335, 341, 412, 442, 512, 513, 514, 529, 539, 604, 612, 622, 623, 624, 627, 632, 633, 707, 711, 715, 719, 805, 839, 841, 815 & 826
- 2 nos. of riser (1st and 5th row) were replaced. These were observed to have crack initiation in C weld during S/D 2003 in radiography.
- Ultrasonic flaw detection of B weld of 6 tubes was carried out and found satisfactory.
- Replaced tubes were checked by DP test at root run and final run at E weld followed by radiography. Radiography of root run was done for initially 5 welded tubes.
- Outlet manifold field weld joints (16 nos.) were radiographed for all the eight rows. No service defects were observed in any joint.
- DP test of all the 16 nos. header field weld joints was carried out. DP test of riser tube to weldolet and weldolet to header weld-joints was carried out for all the risers. Also DP test of weld joints of 5 catalyst tube in each row of tube to weldolet and weldolet to outlet header joints was carried out randomly. The tubes selected were 108, 110, 116, 127, 128, 206, 214, 219, 227, 235, 309, 311, 316, 323, 328, 413, 415, 420, 427, 428, 511, 515, 528, 530, 522, 611, 613, 619, 625, 626, 708, 710, 714, 718, 721, 803, 806, 830, 838 and 840. No service defects were revealed.
- Procedure followed for reclaiming old tubes is attached at Annexure-3.

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- Creep measurement of all the catalyst tubes was carried out using GO-NOGO Gauge at tunnel slab level. No recordable Creep was found in 210 nos. of tubes, creep was upto 0.73 % in 119 nos. of tube, creep range of 0.73 % to 1.3 % was found in 3 nos. of tubes and creep range of 1.3 to 2.5 % was found in 4 tubes. The detailed report is enclosed at Annexure-4.
  - Creep measurement of Riser Tubes was also carried out. The report is attached at Annexure-5. Max. Riser O.D. was measured to be 4.9664" which corresponds to 0.53 percent creep. Riser of row no. 1 & 5 were replaced during this shutdown.
  - Clearance measurement of outlet headers from the bottom floor was carried out. The report is attached at Annexure-6.
  - Spring hanger readings of catalyst tubes in cold condition were taken. The report is attached at Annexure-7.
  - West wall header box panel segment of L.T. Convection Zone was opened for thickness measurement on Ammonia BFW Coil tubes. Minimum thickness of 4.9 mm was observed against 5.54 mm nominal thickness. No considerable reduction in thickness was observed.
  - In situ metallography of catalyst tubes and riser was done and details are recorded at Annexure-12.

#### CONVECTION ZONE:

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

- All the incolloy protection sheets of insulation were found in satisfactory condition except near dampener, where it was found bent/distorted.
- Bottom blade of damper was found bent and have crack on welding joint.
- Supports of LT & HT steam superheater coil were found satisfactory.

#### AUXILIARY BOILER :

##### FURNACE AREA :

- The bowing/bending of the tubes was observed. However this time it was on many more tubes as compared to past.
- Thickness of tubes was measured. Min. thickness observed was 6.4 mm as against design of 7.01mm.
- In-situ metallography was also carried out and observations are mentioned at Annexure-12.

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## VESSELS AND OTHER EQUIPMENT:

### 103-D, SECONDARY REFORMER:

Catalyst was removed during this shutdown. Inspection of the complete vessel was carried out for the top shell as well as bottom dome / top dome through bottom manhole.

#### **TOP DOME :**

Refractory was found slightly damaged at few locations and at one location it has sagged towards bottom by appx 20 mm max. in appx. 100 x 300 mm area.

Some of refractory brick slots found choked with alumina balls and was found more predominant at the inner two circles slots.

#### **BOTTOM DOME :**

- Erosion of refractory and scattered cracks were observed at few location and same was found more around both the gas inlet nozzles.
- Skirt liner found slightly buckled inward ( away from shell) at scattered locations. Entire surface above the skirt liner found covered with catalyst dust layer.

#### **101-CA/CB GAS INLET NOZZLE :**

- Inward bulging of appx. 20 - 40mm was observed at the ID of liner segment in scattered length but upto appx. 250mm length was maximum at the different liner segments.
- Scattered circumferential cracks were observed at the second liner plate from 103-D side at previously made repair weld.
- Catalyst dust found accumulated at both the gas inlet nozzle liner towards 103-D end and one or two alumina balls were also found inside the nozzle.
- Liner around thermocouple of 101-CA found buckled inward by appx. 50mm and gap was observed at bottom of patch plate.
- Minor outward buckling was observed at the top half of both the inlet nozzle end and at 103-D end.

#### **SHELL :**

All the three thermowell tips were bent by 30 degree to 90 degree inside the shell.

In general, superficial tight cracks were observed on the top cone and shell refractory.

Appx. 4" x 8" area of the top cone castable had spallen and resulted in exposure of metallic element.



Few holes of the bottom dome were still blocked. The dome circumference at shell had a few pores. 107

Minor bulging was observed on the transfer line liner at first row riser location.

#### **107 - D ,TRANSFER LINE:**

- Visual inspection of transfer line internals was carried out from outside through manhole. The following observations were made:
- Minor buckling of the liner was observed at scattered locations throughout the length of the transfer line.
- Minor damage of the refractory was observed at flange ( entry ) of the transfer line.

#### **102-EA, CO2 STRIPPER:**

Visual inspection of vessel top and bottom from inside was carried out. The detailed observations are given below.

- Blackish coloration was observed inside the vessel.
- Demister pad at top found intact in position.
- East side weir plates holding bolts were found missing/sheared.
- Flange joint of inlet liquid distributor found loose and all the bolts were found removed from its place. Few bolts were found sheared also.
- All trays and fasteners were found o.k.
- Scaling was observed at scattered locations on shell surface.
- Bolts of inlet flange were found loose / removed / sheared.
- Horizontal distributor header support was found cracked at two locations.
- Removable SS wear plates of east side were found loose. Few bolts were found in sheared condition.

Repairs/replacement action was taken up by Mech. Maintenance group and subsequently the vessel was re-examined and found satisfactory.

#### **102-EB, CO2 STRIPPER:**

Visual inspection of vessel top and bottom from inside was carried out. The detailed observations are given below.

- Blackish coloration was observed inside the vessel.
- Demister pad at top found intact in position.

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- All trays and fasteners were found o.k.
- Scaling was observed at scattered locations on shell surface.
- Convex bulging of approx. 30-40 mm height was observed on the 105 CB nozzle liner. Same was observed during last shutdown.
- Bolts of inlet flange were found loose / removed / sheared.
- Horizontal distribuer header support was found cracked at two locations.

Repair / replacement action was taken by mech. maintenance group and inspection was performed subsequently. Also thickness measurement was done and readings are mentioned at Annexure-9

#### 101-F, STEAM DRUM:

Visual inspection of steam drum was carried out. The following observations were made.

- Grayish black colouration was observed inside the drum.
- All cyclone separators were found intact in position.
- Demister pad was found intact in position.
- Minor pitting of approx. 0.5 to 0.75mm depth was observed at scattered locations .
- Four nos. of fastening clamps below the west side separator plate were found missing.
- One fastening bolt with clamp of west side separator plate was found missing.
- Two nos. of fastening clamps below the east side separator plate were found missing
- One fastening bolt of east side separator plate was found sheared off.
- One bolt of clamp of 6" NB distribution pipe was found loose and one bolt of another clamp was found corroded.
- Thickness measurement was carried out and readings are given at attached Annexure-9.

#### 102-F , RAW GAS SEPARATOR:

- Epoxy paint condition was found satisfactory.
- Demister pads at top were found intact in position.

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- Loose wire pieces were lying at the bottom portion of the vessel.
  - Porous surface was observed surrounding the manhole at scattered locations, having approx. depth of 2 - 3 mm.

#### **103-F, REFLUX DRUM :**

Visual inspection of the drum was carried out. The following observations were made.

- A gap of approx. 100-150 mm was observed between the central segment of demister pad at its North end. Rest of the segments were found intact. The same was observed in the past.
- Epoxy paint was found peeled off from the few small scattered locations at the bottom half of the vessel.
- Some debris was found lying on the bottom dish end.
- Weld joint condition was found satisfactory.

#### **104-F, SYN GAS COMPRESSOR SUCTION SEPARATOR:**

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

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

Visual inspection of the separator was carried out. The following observations were made

- Brownish black colouration was observed inside the vessel..
- Demister pad was found intact in position.
- Scattered minor pitting were observed throughout the shell surface.
- Overall condition of the vessel was found satisfactory.

#### **107-F, PRIMARY AMMONIA SEPARATOR:**

The vessel was offered for inspection of its internals after necessary purging. The observation were as under.

- Blackish brown colouration was observed inside the vessel.
- Scattered thin scales were observed on the shell and dish end surface.

110

- Weld joint condition was satisfactory.
- All nozzles condition was satisfactory.

**109-F, REFRIGERANT RECEIVER :**

- Grayish black surface was observed inside the vessel.
- Weld joints condition was found satisfactory.
- Thin scales were observed on both the dished ends.
- Overall condition of the vessel was found to be satisfactory.

**110-F, FIRST STAGE REFRIGERANT FLASH DRUM:**

Visual inspection of the drum was carried out. The following observations were made.

- Brownish black colouration was observed inside the drum.
- Oil layer was found on the surface of shell and sludge was found at the bottom of vessel .
- The Demister pad was found intact in position.
- Scattered mill scales were observed on the surface of the dish ends and shell.
- Overall condition of the vessel was found to be satisfactory.

**111-F, SECOND STAGE REFRIGERANT FLASH DRUM:**

The following observations were made during visual examination.

- The shell inside surface had assumed blackish gray coloration.
- Thin layer of oil was observed on the complete inside surface.
- The demister pads were found intact in position.
- Scattered scales were observed on both the dished ends.
- Two bolts of the cover plate of 12" make up line from 109 F, were found missing.

**112-F, THIRD STAGE REFRIGERANT FLASH DRUM:**

The following observations were made during visual examination.

- The demister pads were found intact in position.
- The coloration of the inside surface of shell was dark blackish.

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- Surface of the vessel was found oily.
  - Hard scales were observed in the shell which were more prominent on the dished ends.
  - All nozzles condition was found satisfactory.

#### **R-111, SULPHUR ABSORBER:**

The following observations were made during visual examination.

#### **BOTTOM COMPARTMENT:**

- Top half of the vessel found covered with some debris/dust/ loose scale and dust also found collected at the top grating supports.
- Sample point nozzle and thermocouple were found intact and in good condition.
- Bottom wire mesh was found loose and twisted upward near shell of the vessel. This requires proper fixing as alumina balls were found dropped at the bottom of the vessel through the wire mesh opening.
- Top half of the vessel assumed to be shining silver in colour whereas bottom half as grayish black.
- Overall condition of the vessel was found satisfactory.

#### **TOP COMPARTMENT:**

- Silver shining were found at scattered locations, which are loosely adhered to the shell. (can be removed easily)
- Brownish colouration was observed behind the scales wherever no scales were there.
- The condition of the wire mesh on the grating was found same as observed at the bottom of the vessel.

NOTE: Alumina balls can be loaded with due care of pressing the wire mesh with shell to avoid falling of the alumina balls from the side of wire mesh.

#### **MISCELLANEOUS JOBS:**

#### **WELDER QUALIFICATION TESTS:**

- Performance qualification test of 12 Nos. welders offered by M/s General Engg. Baroda, was carried out. 6 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 13 Nos. welders offered by M/s Ganesh Engg. was carried out. 11 nos. of welders were qualified during the test.
- Welder qualification test of 4 Nos. welders of M/S. Skywin Engrs., was carried out. 3 welders were qualified. These welders were qualified for performing welding jobs of reformer tubes.
- Performance qualification test of 9 Nos. welders offered by M/s Aneesh Engg , was carried out. 4 nos. of welders were qualified during the test.
- Performance qualification test of 12 Nos. welders offered by M/s Garcem Engg., was carried out. 7 nos. of welders were qualified during the test.
- Performance qualification test of 3 Nos. welders offered by M/s J & J Engg., was carried out. All 3 welders were qualified during the test.
- Performance qualification test of 6 Nos. welders offered by M/s Mahavir Engg., was carried out. Only 1 welder was qualified during the test.

#### **D.P. TEST:**

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

#### **RADIOGRAPHY:**

In order to ensure immediate radiography work and urgent processing of films, teams were hired on round the clock basis during entire shutdown period. Radiography was performed on the weld joints of the pipe lines fabricated by all contractors as well as departmentally . Also radiography was carried out on "C" , "B" and "D" welds of catalyst tubes and riser tube as per the requirement . Also radiography of weld joints of all the pipelines fabricated by contractors/ departmentally was carried out after root run welding and after final welding, as per 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, Insitu metallographic examination was carried out. List of the lines/equipment checked alongwith observations and remarks are mentioned at Annexure-12.

#### **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-8.

**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-9 (for equipment) and Annexure-10 (for pipelines).

**GAUSS MEASUREMENT:**

During this shutdown residual magnetism (gauss) on rotary and stationary parts of various rotary equipment were carried out. Wherever residual magnetism were higher than acceptable limits, same was demagnetised and brought down within acceptable limits. The detailed results of inspection are attached herewith at Annexure-11

**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. Radiography work was kept in the scope of Inspection Section to speed up the radiography work and the results.

**OVER SPEED TRIP TEST:**

Before startup, during over speed trip test, speed measurement and vibration measurement of BFW pump Turbine 104JAT, Air Compressor Drive Turbine 101-JT, drive turbine of LO/SO pump of 101 J/105 J, drive turbine of 103-J LOSO pump & drive turbine of aMDEA pump 107JT were carried out.

**ANNEXURE-1**

**VISUAL INSPECTION REPORT OF PRIMARY REFORMER RADIANT ZONE.**

**BURNER BLOCKS:**

Burner blocks found badly damaged:  
108,206,401,506,712

**BOTTOM HEADER INSULATION:**

**Row No. Location of header insulation damage/ partial layer damage**

- 1 Below/Between/Above tube no 1,2,10
- 2 Below/Between/Above tube no 17-20,24,32,36
- 3 Below/Between/Above tubeno 1-6,17,18,23,26-27,36-40
- 4 Below/Between/Above tube no 1-4,12,13,28,34-37
- 5 Below/Between/Above tube no 23,25,26,27,29,37-40
- 6 Below/Between/Above tube no 12,13,,34
- 7 Below/Between/Above tube no 42

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**ROOF INSULATION:**

In general, the condition of the roof insulation was found to be satisfactory. However, at few locations small segments of the fiber insulation blocks were found detached causing exposure of roof plate to the flame/flue gases. In rest of the areas, the ceramic fiber modules had got loosened which needed corrective action.

<u>TUBE ROW NO.</u>	<u>LOCATION OF DAMAGE</u>
1	Between tube no. 10-11,39-40
2	Between tube no. 22-23,29-30
5	Between tube no. 37-39
6	Between tube no. 26-27,42-North Wall
7	Between tube no. 4-5
8	Between tube no. 29-30 Near burner block 214

Canister base rings of risers found distorted/damaged of row nos. 1,3,4,5 and 7

**REFRACTORY WALLS:**

- Cerafelt was filled up wherever gap had increased between panel of bricks.
- Gap was observed between two segments of cerafelt blanket in top south west corner
- In general, condition of refractory walls was found to be satisfactory.

**ANNEXURE - 2 (1/5)**

**GRADATION OF TUBES BY AUS CARRIED OUT BY PDIL**

<u>ROW NO.1</u>				<u>ROW NO.2</u>			
<u>Tube No.</u>	<u>Aus Grade</u>	<u>Tube No.</u>	<u>Aus Grade</u>	<u>Tube No.</u>	<u>Aus Grade</u>	<u>Tube No.</u>	<u>Aus Grade</u>
1	C	22	B	1	#C	22	C
2	C	23	C	2	C	23	C
3	C	24	C	3	C	24	C
4	A	25	C	4	C	25	C
5	C	26	C	5	C	26	C
6	C	27	C	6	C	27	C
7	B	28	C	7	C	28	C
8	C	29	C	8	C	29	B
9	C	30	B	9	C	30	C
10	C	31	C	10	C	31	C
11	C	32	C	11	C	32	C
12	C	33	C	12	C	33	C



13	C	34	C	13	C	34	C
14	C	35	D	14	C	35	C
15	C	36	C	15	C	36	C
16	C	37	C	16	C	37	C
17	C	38	D	17	C	38	B
18	C	39	C	18	C	39	C
19	C	40	C	19	C	40	C
20	C	41	C	20	C	41	C
21	C	42	D	21	C	42	C

NOTE: # = BORDER LINE OF C & D GRADE

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	C	22	C	1	C	22	C
2	C	23	C	2	C	23	C
3	C	24	C	3	C	24	C
4	C	25	C	4	C	25	C
5	C	26	C	5	C	26	C
6	C	27	C	6	B	27	C
7	C	28	C	7	C	28	C
8	C	29	C	8	C	29	C
9	C	30	C	9	C	30	C
10	C	31	C	10	C	31	C
11	D	32	C	11	C	32	C
12	C	33	C	12	C	33	C
13	C	34	C	13	C	34	C
14	C	35	C	14	C	35	C
15	C	36	C	15	C	36	C
16	C	37	C	16	C	37	C
17	C	38	D	17	C	38	C
18	C	39	C	18	C	39	C
19	C	40	C	19	C	40	C
20	C	41	C	20	C	41	C
21	C	42	B	21	C	42	C

NOTE: # = BORDER LINE OF C & D GRADE

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

NOTE: # = BORDER LINE OF C &amp; D GRADE

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	C	1	C	22	C
2	D	23	C	2	C	23	C
3	C	24	C	3	C	24	C
4	C	25	C	4	C	25	C
5	C	26	C	5	C	26	C
6	C	27	C	6	B	27	C
7	C	28	C	7	B	28	D
8	C	29	C	8	B	29	C
9	C	30	C	9	B	30	D

10	C	31	C	10	C	31	B
11	C	32	C	11	#C	32	B
12	C	33	C	12	C	33	C
13	C	34	C	13	C	34	*B
14	C	35	C	14	C	35	C
15	C	36	C	15	C	36	D
16	C	37	C	16	C	37	C
17	C	38	C	17	C	38	D
18	C	39	C	18	D	39	C
19	C	40	#C	19	C	40	C
20	#C	41	C	20	C	41	C
21	C	42	C	21	C	42	D

NOTE: # = BORDER LINE OF C & D GRADE  
 \* = BORDER LINE OF B & C GRADE

ANNEXURE - 2 (5/5)

GRADATION OF RISER TUBES BY AUS CARRIED OUT BY PDIL

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

NOTE: # = BORDER LINE OF C & D GRADE  
 \* = BORDER LINE OF B & C GRADE

**ANNEXURE- 3****Procedure for reclaiming old tubes:**

- Cut the tube at "C" weld location. Ensure that no weld metal is left out. Also, ensure root of the weld is Ground Out completely, during Bevel Edge preparation.
- DP Test Bevel Edge.
- Solution annealing as per the following procedure:
  - a) Heating at 150 deg.C /hour upto 1150 deg.C. Loading of the fresh tubes at 300 deg.C furnace temperature.
  - b) Soaking at 1150 deg.C for t
  - c) Cooling by forced air.
- Cleaning of solution annealed bevel face.
- DP Test the bevelled face after solution annealing.
- While carrying out fit up ensure that tube is reasonably straight.
- Root run after fit up.
- DPT of root run. No indications are allowed.
- Selective radiography of root run.
- Fill up. Ensure interpass temperature is < 100 deg. C.
- Final DP Test.
- Final Radiography.

ANNEXURE - 4 (1/4)

CREEP MEASUREMENT OF PRIMARY REFORMER

CATALYST TUBES AT SLAB LEVEL:

TUBE NO	CREEP IN PERCENTAGE				TUBE NO.	CREEP IN PERCENTAGE			
	0	0-0.73	0.73-1.3	1.3-2.5		0	0-0.73	0.73-1.3	1.3-2.5
	0	0-0.73	0.73-1.3	1.3-2.5		0	0-0.73	0.73-1.3	1.3-2.5
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	29	13			TOTAL	35	6	1	

ANNEXURE - 4 (2/4)CREEP MEASUREMENT OF PRIMARY REFORMERCATALYST TUBES AT SLAB LEVEL:

TUBE NO	CREEP IN PERCENTAGE				TUBE NO	CREEP IN PERCENTAGE			
	0	0-0.73	0.73-1.3	1.3-2.5		0	0-0.73	0.73-1.3	1.3-2.5
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	31	11			TOTAL	38	4		

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ANNEXURE - 4 (3/4)

CREEP MEASUREMENT OF PRIMARY REFORMER

CATALYST TUBES AT SLAB LEVEL:

TUBE NO	CREEP IN PERCENTAGE				TUBE NO	CREEP IN PERCENTAGE			
	0	0-0.73	0.73-1.3	1.3-2.5		0	0-0.73	0.73-1.3	1.3-2.5
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	17	25			TOTAL	16	26		

ANNEXURE - 4 (4/4)CREEP MEASUREMENT OF PRIMARY REFORMERCATALYST TUBES AT SLAB LEVEL:

TUBE NO	CREEP IN PERCENTAGE				TUBE NO.	CREEP IN PERCENTAGE			
	0	0-0.73	0.73-1.3	1.3-2.5		0	0-0.73	0.73-1.3	1.3-2.5
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	21	18	1	2	TOTAL	23	16	1	2



ANNEXURE - 5CREEP MEASUREMENT OF RISER TUBES

RISER NO.	OUTSIDE DIAMETER		DESIGN O.D.	CREEP
	E-W	N-S	Max.	%
1	4.9423	4.9481	4.94	0.05
2	4.9466	4.946	4.94	NIL
3	4.964	4.9664	4.94	0.53
4	4.9416	4.9446	4.94	0.09
5	4.9356	4.9306	4.94	NIL
6	4.9307	4.9323	4.94	NIL
7	4.944	4.9477	4.94	0.16
8	4.9625	4.9659	4.94	0.46

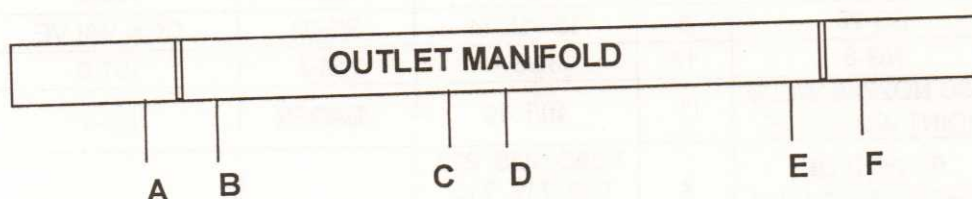
**NOTE :**

- (1) All dimensions are in Inch.  
 (2) Maximum diameter of 4.9664" was observed which corresponds to 0.53 % creep.

ANNEXURE- 6CLEARANCE OF OUTLET MANIFOLD FROM GROUND FLOOR IN COLD CONDITION

HEADER NO.	LOCATION OF MEASUREMENT					
	A	B	C	D	E	F
1	315	306	301	290	306	304
2	315	305	315	315	318	290
3	320	292	306	305	295	295
4	325	310	305	306	316	300
5	306	308	310	330	305	320
6	295	295	275	280	285	300
7	310	320	325	325	315	320
8	320	320	320	305	321	320

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



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**ANNEXURE - 7****TUBE SPRING HANGER LOAD READINGS OF PRIMARY REFORMER HARP****ASSEMBLY(101-B):****COLD LOAD READINGS IN MM :**

R O W	TUBE NOS. ( SOUTH TO NORTH )										
	1	2	4	6	8	10	12	14	16	18	20
1	0	-3	-5	-8	-10	0	-18	-20	-15	-8	-7
2	-20	4	0	0	-5	-5	-6	1	0	-10	-12
3	10	10	10	-2	-12	-10	-9	-8	-10	-15	-10
4	0	8	0	-3	-12	-10	-15	-12	-15	-10	-8
5	8	5	0	0	-7	-10	-16	-23	-15	-20	-8
6	13	2	-5	-7	-10	-20	-25	-29	-26	-20	-15
7	-2	0	2	-4	-10	-11	-22	-15	-25	-23	-15
8	-25	7	0	-2	-20	-23	-23	-22	-24	-15	-10

R O W	TUBE NOS. ( SOUTH TO NORTH )										
	22	24	26	28	30	32	34	36	38	40	42
1	-11	-13	0	-15	-25	0	-8	0	2	5	15
2	-5	-5	0	-5	0	0	0	0	0	2	-13
3	-9	-10	-10	-3	-3	0	-2	0	8	12	-20
4	-8	-7	-10	0	-12	-6	0	0	0	10	0
5	-7	-8	-10	-7	-8	-5	-2	1	0	10	8
6	-12	-20	-20	-20	-15	-15	-8	-11	-3	3	7
7	-10	-12	-18	-10	-18	-5	-4	3	2	6	7
8	-11	-15	-15	-27	-20	-20	-15	-5	10	0	3

**ANNEXURE - 8****UFD OF WELD JOINTS OF FOLLOWING PIPELINES WAS CARRIED OUT**

SR. NO.	LINE NO.	SIZE	SCHEDULE	FROM	TO	NO.OF JOINT
1	HS-5	10	160/28.58	HS-4	HS-9	1
2	MS-19	6	40/7.11	MS-1	1107-JAT	4
3	MS-19	4	40/6.02		CONTROL VALVE	2
4	MS-32	4	40/6.02	MS-38	101-BJ	3
5	MS-35	6	40/7.11	MS-11	103-J	6
6	MS-37	3	40/5.5	MS-28	104-D	1
7	MS-38	6	40/7.11	MS-29	101-B	3
8	PG-2	18	STD/9.525	102-C	PG-4	2
9	PG-6	18	0.3125/7.93	104-DTOP	103-C	2
10	PG-18	12	30/8.4	104-C	106-D	3
11	SG-1	12	30/8.4	106-D	114-C	3
12	SG-25	8	120/18.24	SG-23	CON.VALVE	2
13	NG-8	12	30/8.4	NG-7	101-B	1
14	123C NOZZLE WELD JOINT -GAS SIDE	3	40/5.49	HEADER	LS-1	1
15	B-WELD OF REFORMER TUBES	4	TUBE NOS. 622, 623, 719, 715, 707, 612			6
<b>TOTAL JOINTS</b>						<b>40</b>

ANNEXURE - 9

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THICKNESS MEASUREMENT OF EQUIPMENT DURING S/D-2004

Sr. No	Equip-ment No.	Equipment Description	Shell			D.E.			Channel		
			Nom.	Min.	Red	Nom.	Min.	Red	Nom.	Min.	Red
1	101-CB	Primary waste heat Exchanger		6.79						6.43	
2	101-E	CO2 absorber	47.63/48.41	47.7			50				
3	102-EA	CO2 stripper	9.53-T	9.93		15.9-B	20.19				
			15.9-B	16.12							
4	102-EB	CO2 stripper	9.53-T	10.03		15.9-B	19.47				
			15.9-B	16.43							
5	101-F	Steam Drum	106.40	109.40		106.40	103.90	2.34			
4	102-F	Raw gas separator	34.93	36.03		33.33	36.77				
5	103-F	CO2 stripper reflux drum	11.11	11.33		11.11	13.3				
6	104-F	Syn. gas compressor suction drum	24.6	26		23.82	25				
7	105-F	Syn. gas compressor 1 <sup>st</sup> stage separator	47.63	47.9		46.03	49.8				
8	107-F	Primary ammonia separator	14.29	14	2.02	14.29	16.7				
9	109-F	Refrigerent receiver	21.4	20.2	5.8	18.2	18.7				
10	110-F	1st stage refrigerent flash drum	9.52	10.2		9.52	14.9				
11	111-F	2nd stage refrigerent flash drum	9.52	10.1		19.5	22.4				
12	112-F	3 <sup>rd</sup> stage refrigerent flash drum	9.52	10.3		9.52	12.4				
13	2002-F	Demineralised water storage tank	4.8	4.54	5.4	4.8	4.45	7.29			
14	2005-F	New instrument air receiver	8	6.71	16.12	8	7.25	9.37			
15	101-JCA	Surface condenser		10.74						11.65	
16	101-JCB	Surface condenser		13.20						12.46	
17	101-JLC1	Lube & seal oil cooler for 101-J & 105-J	7.2	7.94			7.16				

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18	101-JLC2	Lube & seal oil cooler for 101-J & 105-J	7.2	7.53			7.08				
19	103-JLC1	Lube & seal oil cooler for 103-J		7.99			7.11				
20	103-JLC2	Lube & seal oil cooler for 103-J		7.63			6.73				
21	801-JLCA	Lube & seal oil cooler for 800-J		12.45			16.41				
22	801-JLCB	Lube & seal oil cooler for 800-J		12.40			16.24				
23	2003-L	Instrument air drier		5.73			7.34				
24	2001-LF	Hydrazine mix tank		2.86			2.67				
25	2004-LF	Mix tank		2.87			2.55				
26	2007-U	Resin trap		7.90			9.02				

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**ANNEXURE - 10**

**THICKNESS MEASUREMENT OF PLANT PIPELINES DURING S/D 2004**

Sr. No.	Line No	Nom Bore (inch)	Nom Thick (mm)	Line Description		Min Thk. Observed	% Red.
				From	To		
1	AMDEA-11	14	7.92	MEA-19 A&B	MEA-12 A&B	6.30	20.45
2	AMDEA-2	4	6.02	aMDEA-1	101-L	5.40	10.30
3	AMDEA-24A	3	5.49	108-J	MEA-25	5.20	5.28
4	AMDEA-24B	3	5.49	108-JA	MEA-25	5.10	7.10
5	AMDEA-25	3	5.49	MEA-24 A, B	108-JA	4.20	23.50
6	AMDEA-27B	18	7.92	102-EB	MEA-33B	7.20	9.09
7	AMDEA-28-A	12	6.35	MEA-33-A	105-CA	6.00	5.51
8	AMDEA-28B	12	6.35	MEA-33B	105-CB	6.00	5.51
9	AMDEA-29B	12	6.35	MEA-33B	111-CA	5.50	13.39
10	AMDEA-3	4	6.02	101-E	109 -C2A/C2B	5.00	16.94
11	AMDEA-39	3	5.49	115-F	111-J	4.60	16.21
12	AMDEA-5	4	6.02	101-E	STAND PIPE	9.60	Nil
13	AMDEA-7	10	9.27	aMDEA-61	aMDEA-9A & 9B	8.60	7.23
14	AMDEA-8	12	8.38	aMDEA-18 &19	aMDEA-20	7.70	8.11
15	AMDEA-9A-10"	10	9.27	MEA-?	CaNT . VALVE	6.90	25.57
16	AMDEA-9A-6"	6	7.11	MEA-7	CaNT . VALVE	8.30	Nil
17	AMDEA-9A-8"	8	8.18	MEA-7	CaNT . VALVE	9.00	Nil
18	AMDEA-9B-10"	10	9.27	MEA-7	102-EB	7.90	14.78
19	AMDEA-9B-6"	6	7.11	MEA-7	102-EB	8.80	Nil
20	AMDEA-9B-8"	8	8.18	MEA-?	CONT.VALVE(102)	8.70	Nil
21	BF-18	3	7.62	BF-22	114-C	6.30	17.32
22	CO-11	16	7.92	CO-8	CO-12	5.90	25.51
23	CO-12	30	12.7	CO-11	CO-13	13.30	Nil
24	CO-1A	18	11.13	102-EA	CO-17	9.40	15.54
25	cb-1A	18	11.13	102-EA	CO-17	9.40	15.54
26	MS-1	8	7.04	MS-2	Header	7.00	0.57

Sr. No.	Line No	Nom Bore (inch)	Nom Thick (mm)	Line Description		Min Thk Observed	% Red.
				From	To		
27	MS-11-14	14	9.53	103-J	MS-3	19.90	Nil
28	MS-16	2	5.54	MS-40	112-JAT	3.60	35.02
29	MS-2	12	8.38	HEADER	MS-1	7.60	9.31
30	MS-21	6	7.11	MS-40	105-J	6.50	8.58
31	MS-22	4	6.02	MS-2	MS-53	5.30	11.96
32	MS-25	6	7.11	MS-40	101-JT	6.90	2.95
33	MS-28	3	5.49	MS-2	FG-3	5.20	5.28
34	MS-28	3	5.49	MS-2	FG-3	5.20	5.28
35	MS-29	12	8.38	MS-2	NG-8	7.90	5.73
36	MS-30	3	5.49	MS-29	A-20	5.20	5.28
37	MS-37	3	5.49	MS-28	104-D	5.40	1.64
38	MS-40	8	7.04	MS-3	HEADER	6.60	6.25
39	MS-41	1.5	5.08	MS-40	102-JLO CONSOLE	2.90	42.91
40	MS-46	2	5.54	103J-EJT	ATM	5.20	6.14
41	MS-55	2	5.54	MS-2	SPECK. BREAK	5.60	Nil
42	MS-56	2	5.54	MS-2	SPEC. BRK	3.90	29.60
43	MS-60	10	7.8	MS-2	HEADER	7.30	6.41
44	NG-04	6	7.11	101-D	NG-6A	4.80	32.49
45	NG-05	6	7.11	102-D	NG-6A	5.90	17.02
46	NG-16	6	7.11	BATT. LIMIT	151-C	6.50	8.58
47	NG-23	8	8.18	NG-30	NG-26	7.90	3.42
48	NG-26-6"	6	7.11	NG-23	BURNERS	7.90	Nil
49	NG-27	2.5	5.16	NG-63	NG-28	4.90	5.04
50	NG-28	2.5	5.16	NG-27	102-B	4.90	5.04
51	NG-6A	8	8.18	NG-4	150-C	5.10	37.65
52	PG-09-2"	2	5.54	BY PASS		5.10	7.94

Sr. No.	Line No	Nom Bore (inch)	Nom Thick (IIIID)	Line Description		Min Thk Observed	% Red.
				From	To		
53	PG-10-18	18	9.53	104-D BOTTOM	PG-21	8.10	15.01
54	PG-14	16	12.7	106-C	102-F	12.20	3.94
55	PG-15	14	12.7	102-F	101-E	12.80	Nil
56	PG--16	14	7.92	101-E	136-C	6.10	22.98
57	PG-21	20	12.7	PG-10	PG-11A & B	12.40	2.36
58	PG--24	10	6.35	PG-17	PG-18	5.70	10.24
59	PG-35-20"	20	9.53	112-C	157-F	9.70	Nil
60	PW-12	16	12.7	PW-2+3	PW-13	12.70	Nil
61	PW-24	4	11.13	173-C	CONTROL VALVE	5.00	55.08
62	PW-29	10	12.7	171-C	PW-30	9.50	25.20
63	PW-29A	10	12.7	171-C	PW-30	8.90	29.92
64	RV-119	18	7.92	VE-1	RV-105-JT	9.40	Nil
65	RV-131	4	6.02	LS-1	RV-LS-1	5.90	1.99
66	SC-7	2.5	7.01	101 JCA	LC-2A	4.60	34.38
67	SG-25	8	18.24	SG-23	CONT . VALVE	17.60	3.51
68	SG-42	4	8.56	SG-51	SG-11	6.90	19.39
69	SG-47	1	4.55	104-E	CV	4.20	7.69
70	SG-5	14	7.92	115-C	104-F	6.70	15.40
71	SG-51	8	15.06	SG-13	SG-35	14.40	4.38
72	SG-52-1.5"	1.5	10.1E?	BY PASS SP-35	-----	9.90	2.56
73	SG-77	6	7.11	SG--6	SG-78	6.80	4.36
74	SG-78	8	6.35	PIC-A	V-36	6.20	2.36

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Annexure-11

**GAUSS MEASUREMENT & DEMAGNETIZATION REPORT**

Sr. No.	Component Description	Max. gauss reading	
		Before	After
<b>101-J AIR COMPRESSOR</b>			
<b>1.0</b>	<b>Turbine South Bearing</b>		
1.1	Journal bearing housing.	21.4	1.4
1.2	Journal bearing shaft	10.2	1.2
1.3	Journal bearing pads	5.2	0.9
1.4	Journal bearing base ring	5.2	0.7
1.5	Thrust collar	13.7	0.9
1.6	Thrust pads	2.0	
<b>2.0</b>	<b>Turbine North Bearing</b>		
2.1	Journal bearing shaft	4.4	0.7
2.2	Journal bearing pads	4.5	0.4
2.3	Journal bearing base ring	6.0	0.8
<b>3.0</b>	<b>H P Case South Bearing</b>		
3.1	Journal Bearing Housing	6.0	0.7
3.2	Journal Bearing Shaft	1.1	
<b>4.0</b>	<b>H P Case North Bearing</b>		
4.1	Journal Bearing Shaft	2.3	
4.2	Journal Thrust Collar	0.8	
4.3	Journal Bearing Pads	0.8	
4.4	Journal Bearing Base Ring	1.8	
<b>5.0</b>	<b>L P Case Comp. Thrust End</b>		
5.1	Journal Bearing Shaft	2.1	
5.2	Journal Bearing Pads	2.1	
5.3	Journal Bearing Base Ring	6.6	0.7
5.4	Thrust Collar	7	0.8
<b>6.0</b>	<b>Gear Box</b>		
6.1	Journal Area	2.0	
6.2	Journal Bearing	2.1	
<b>103-J SYN GAS COMPRESSOR</b>			
<b>1.0</b>	<b>JAT Thrust Bearing</b>		
1.1	Base Ring	4.2	0.4
1.2	Pads	3.5	0.2
<b>2.0</b>	<b>JAT Opposite Thrust End Radial Bearing</b>		
2.1	Base Ring	3.3	0.4
2.2	Pads	2.3	0.2
2.3	Thrust Collar	3.3	1.3
2.4	Journal Bearing Shaft	2.4	
2.5	Thrust Side Coupling End	7.1	1.3
2.6	Thrust Side Journal Area	10.1	0.9
2.7	Thrust Side Shaft End	4.5	0.8
<b>3.0</b>	<b>JBT Non Drive (Thrust End) Radial Bearing</b>		
3.1	Base Ring	13.2	1.5
3.2	Pads	1.2	



Sr. No.	Component Description	Max. gauss reading	
		Before	After
<b>4.0</b>	<b>JBT Opposite Thrust End Radial Bearing</b>		
4.1	Base Ring	6.1	0.7
4.2	Pads	1.4	
4.3	Thrust Collar	0.5	
4.4	Journal Bearing Shaft	0.4	
4.5	Thrust Side Journal Shaft Area	2.3	
4.6	Thrust Side Shaft End	9.1	0.8
<b>5.0</b>	<b>HP Thrust End</b>		
5.1	Pads	4.9	0.7
5.2	Thrust Shaft Area	1.1	
5.3	Opposite Thrust End Shaft Area	1.4	
<b>6.0</b>	<b>HP Journal Bearing</b>		
6.1	Base Ring	1.2	
6.2	Pads	2.9	
<b>7.0</b>	<b>LP Thrust End</b>		
7.1	Thrust Shaft Area	0.8	
7.2	Opposite Thrust End Shaft Area	0.5	
<b>8.0</b>	<b>LP Journal Bearing (Point No. 7)</b>		
8.1	Base Ring	1.9	
8.2	Pads	3.5	
<b>105-J, REF. GAS COMPRESSOR:</b>			
<b>1.0</b>	<b>Turbine Free End Journal Bearing</b>		
1.1	Base Ring	1.1	
1.2	Pads	1.0	
<b>2.0</b>	<b>Turbine Coupling End Journal Bearing</b>		
2.1	Rotor Journal Portion	2.3	
2.2	Thrust Journal Portion	4.0	0.7
2.3	Thrust Collar	7.2	2.0
2.4	Base Ring	5.1	1.1
2.5	Pads	3.2	0.8
<b>3.0</b>	<b>HP Case Coupling End Journal Bearing</b>		
3.1	Thrust Bearing Shaft	17.2	2.3
3.2	Thrust Bearing Pads	2.3	
3.3	Thrust Bearing Base Ring	7.1	0.8
<b>4.0</b>	<b>HP Case Free End Thrust Bearing</b>		
4.1	Thrust Bearing Shaft	10.1	1.3
4.2	Thrust Bearing Pads	1.7	
4.3	Thrust Bearing Base Ring	7.2	0.9
<b>5.0</b>	<b>LP Case Free End Thrust Bearing</b>		
5.1	Thrust Bearing Shaft	16.2	1.9
5.2	Thrust Bearing Pads	0.8	
5.3	Thrust Bearing Base Ring	2.1	
5.4	Thrust Collar	2.3	
<b>6.0</b>	<b>Gear Box</b>	2.9	

Sr. No.	Component Description	Max. gauss reading	
		Before	After
<b>102-J, N.G. COMPRESSOR:</b>			
<b>1.0</b>	<b>South Bearing</b>		
1.1	Journal Bearing Shaft	0.8	
1.2	Journal Bearing Pads	1.1	
1.3	Journal Bearing Cage	33	1.2
1.4	Thrust Collar	13	0.9
1.5	Thrust Pads	0.8	
<b>2.0</b>	<b>North Bearing</b>		
2.1	Journal Bearing Shaft	1.8	
2.2	Journal Bearing Pads	1.3	
2.3	Journal Bearing Cage	44	1.2
<b>3.0</b>	<b>Turbine Thrust End (Point No. 1)</b>		
3.1	Thrust Collar	7.9	0.9
3.2	Thrust Pads	0.8	
<b>4.0</b>	<b>Turbine Coupling End (Point No. 2)</b>		
4.1	Bearing Pads	36	0.8
4.2	Thrust Bearing Guide	8.9	0.9
<b>800-J, NG BOOSTER COMPRESSOR:</b>			
<b>1.0</b>	<b>Thrust End Journal Bearing</b>		
1.1	Thrust End Journal Bearing	52	0.4
1.2	Pads	5.2	0.8
1.3	Thrust Bearing Holder	5.4	1.3
1.4	Pads	5.2	0.8
<b>2.0</b>	<b>Turbine Thrust Bearing</b>		
2.1	Journal Bearing Area Shaft	1.5	
2.2	Turbine Rotor Thrust End	1.7	
2.3	Base Ring	3.9	0.8
2.4	Pads	3.0	0.3
<b>3.0</b>	<b>Turbine Governer End Thrust Collar</b>	<b>1.4</b>	
<b>4.0</b>	<b>Turbine Thrust End Collar Bearing</b>		
4.1	Thrust End Collar Bearing	3.2	0.6
4.2	Pads	1.2	
<b>5.0</b>	<b>Turbine Journal Bearing</b>		
5.1	Base Ring	3.3	1.0
5.2	Pads	1.2	
<b>6.0</b>	<b>NG Compressor East Bearing</b>		
6.1	Bearing Shaft	0.7	
6.2	Pads	5.6	0.8
6.3	Bearing Cage	22	2.0
6.4	Bearing Housing	6.8	0.8
<b>7.0</b>	<b>NG Compressor West Bearing</b>		
7.1	Bearing Shaft	0.2	
7.2	Pads	5.2	0.8
7.3	Bearing Cage	15.2	1
7.4	Bearing Housing	0.7	
<b>7.5</b>	<b>Thrust Collar</b>	<b>0.6</b>	

Sr. No.	Component Description	Max. gauss reading	
		Before	After
<b>107-JAB, aMDEA PUMP:</b>			
<b>1.0</b>	<b>Turbine West Bearing</b>		
1.1	Bearing Shaft	0.8	
1.2	Thrust Bearing Pads	0.9	
1.3	Bearing Cage	0.8	
1.4	Bearing Housing	3.4	
1.5	Thrust Collar	1.3	
<b>2.0</b>	<b>Turbine East Bearing</b>		
2.1	Bearing Shaft	0.9	
2.2	Bearing Cage	0.7	
2.3	Bearing Housing	1.8	

### ANNEXURE- 12

#### DETAILS OF INSITU-METALLOGRAPHIC INSPECTION

SR. NO.	LOCATION	MOC	MICROSTRUCTURE OBSERVATION	REMARK
1	(PM/HAZ) On Dissimilar joint at B-Weld of Reformer tube no 805	P11	Microstructure at HAZ shows tempered bainite structure. Parent metal shows Spheroidization of bainite/pearlite. Oriented creep cavities are observed. Initiation of micro crack observed.	2 <sup>nd</sup> stage of creep damage. Monitor after one year. Micro cracks needs to be confirmed by SEM.
2	(Weld/HAZ) On Dissimilar joint at B-Weld of Reformer tube no 805	G-4852	Microstructure at HAZ shows coarsening of primary carbides. Fine grain structure is observed near HAZ. Indication of micro-cracks is observed at HAZ. Weld metal structure shows austenite dendrites with carbides. Grain boundaries of coarse grains are present.	2 <sup>nd</sup> stage of creep damage. Monitor after six months. Micro cracks needs to be confirmed by SEM.
3	(PM/HAZ) On Dissimilar joint at B-Weld of Reformer tube no 805	G-4852	Microstructure at HAZ shows coarsening of primary carbides. Fine grain structure is observed near HAZ. Indication of micro-cracks is observed at HAZ. Parent metal structure shows coarsening of primary & secondary carbide. Oriented creep cavities are observed.	2 <sup>nd</sup> stage of creep damage. Monitor after six months. Micro cracks needs to be confirmed by SEM.
4	(Weld/HAZ) On C-weld of Reformer tube no 805	G-4852	HAZ structure shows coarsening of carbide, Initiation of micro cracks & Initiation of micro crack observed. Weld metal structure shows initiation of crack, coarsening of primary & secondary carbide is observed, presences of creep cavities are observed.	2 <sup>nd</sup> stage of creep damage. Monitor after one year. Micro cracks needs to be confirmed by SEM.
5	(Parent Metal) On C-weld of Reformer tube no 805	G-4852	Micro structure shows coarsening of primary & secondary carbide. Oriented creep cavities are observed.	2 <sup>nd</sup> stage of creep damage. Monitor after one year.

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SR. NO.	LOCATION	MOC	MICROSTRUCTURE OBSERVATION	REMARK
6	(Weld/HAZ) On C –weld of Riser tube of Row no-1 ( Before replacement)	G-4852	Weld metal coarsening of primary & secondary carbide is structure shows initiation of micro crack, observed. HAZ shows presence of micro-cracks at primary carbide region.	2 <sup>nd</sup> stage of creep damage. <b>Monitor after six months.</b> Micro cracks needs to be confirmed by SEM.If more cracks observed plan for replacement.
7	(Parent Metal) On C –weld of Riser tube of Row no-1 ( Before replacement)	G-4852	Microstructure shows coarsening of primary & secondary carbide. Oriented creep cavities are observed. Cracking along primary carbides are observed.	Approaching 3 <sup>rd</sup> stage of creep damage. <b>Monitor microstructure after six months.</b> If more cracks observed plan for replacement.
8	(Weld/HAZ) On weld at last Coil near Outlet bend of H-110	P22	HAZ structure shows essentially fine-grained ferrito-bainitic structure Grain boundary is intact & prior bainite regions are maintained. Weld microstructure shows ferrito-bainitic structure.	No significant degradation. Monitor after 2 years.
9	(Parent Metal) On last Coil near Outlet bend of H-110	P22	Microstructure shows ferrite/bainite structure, carbide formation on bainitic region, degradation of bainite has initiated.	2 <sup>nd</sup> stage of creep damage. Monitor after two year of service.
10	(Parent Metal) On Outlet Pipe near Reducer of H-110	P22	Microstructure shows ferrite/bainite structure. Disintegration of bainite is in imitation stage.	2 <sup>nd</sup> stage of creep damage. Monitor after two year of service.
11	(Weld/HAZ) On weld between Outlet Bend & Coil of H-111	SS316H	HAZ structure shows austenitic grains with twins. Presences of heavy carbide precipitations are observed along the grain boundaries as compared to old report. Weld metal structure shows ferrite pools in austenite matrix in dendritic form with heavy carbide precipitation.	Carbide precipitation would be expected under such service condition. Monitor after two years of service.
12	(Parent Metal) On Outlet Bend of H-111	SS316H	Microstructure shows austenitic grains with twins. Presences of heavy carbide precipitations are observed along the grain boundaries as compared to old report.	Carbide precipitation would be expected under such service condition. Monitor after two years of service. Ensure absence of sulfur compounds at the time of shutdown.
13	(Parent Metal) On face of inlet Bend at the top pf H-111	SS316H	Microstructure shows austenitic grains with twins. Presences of few carbide precipitations are observed along the grain boundries.Heavy strain lines are observed.	Carbide precipitation would be expected under such service condition. Monitor after two years of service.

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SR. NO.	LOCATION	MOC	MICROSTRUCTURE OBSERVATION	REMARK
14	(PM/HAZ) On Dissimilar joint at B-weld of Reformer tube no-632	P11	Normal fusion observed between dissimilar metal weld joint. Structure at HAZ towards P11 sides shows ferrite & bainite structure. Disintegration of bainite has been observed by way of carbide formation.	2 <sup>nd</sup> stage of creep damage. Monitor after two year of service.
15	(HAZ/Weld) On Dissimilar joint at B-weld of Reformer tube no-632	G-4852	Microstructure at weld shows dendritic structure of austenite and carbides. At HAZ fine presence of fine & coarse carbides are observed,	2 <sup>nd</sup> stage of creep damage. Monitor after two year of service.
16	(Weld/HAZ) On weld between top outlet bend & Flange of SG-33-14" (122C to 123C)	P22	HAZ shows ferrite grains and spheroidized carbides, prior region of bainite is maintained. Weld metal structure shows bainitic	No significant degradation. Monitor after 2-3 years of service.
17	(Parent Metal) On top outlet bend near weld with flange of SG-33-14"(122C to 123C)	P22	Microstructure shows ferrite-bainitic structure. Prior bainitic regions are observed. Carbide formation on bainitic.	No significant degradation. Monitor after 2-3 years of service.
18	(Parent Metal) On Top outlet bend of SG-33-14"(122C to 123C)	P22	Microstructure shows ferrite-bainitic structure	No significant degradation. Monitor after 2-3 years of service.
19	(Weld/HAZ) On weld between top outlet bend of SG-33-14"(122C to 123C)	P22	HAZ shows ferrite grains and spheroidized carbides, prior region of bainite is maintained. Weld metal structure shows bainitic	No significant degradation. Monitor after 2-3 years of service.
20	(Parent Metal) On pipe near weld with top outlet bend of SG-33-14"(122C to 123C)	P22	Microstructure shows ferrite-bainitic structure. Bainite disintegration observed in imitational stage.	2 <sup>nd</sup> stage of creep damage. Monitor after two year of service.
21	(Parent Metal) On pipe near weld with outlet bend of SG-33-14"(122C to 123C)	P11	Microstructure shows ferrite-bainitic structure. Prior bainite region are maintained. Degradation of bainite is observed in initial stage. Creep cavities observed.	2 <sup>nd</sup> stage of creep damage. Monitor after two year of service.
22	(Weld/HAZ) On weld between pipe & outlet bend of SG-33-14"(122C to 123C)	P11	HAZ shows fine grain of ferrite-bainitic structure. Bainite disintegration observed by carbide formation.	2 <sup>nd</sup> stage of creep damage. Monitor after two year of service.
23	(Parent Metal) On outlet bend of SG-33-14"(122C to 123C)	P11	Microstructure shows ferrite-bainitic structure. Prior bainite region are maintained. Initial stage of spheroidization observed.	2 <sup>nd</sup> stage of creep damage. Monitor after two year of service.
24	(Weld/HAZ) On weld between bend of SG-32-6"(SG-62-A & B to SG-25) & reducer at top.	P5	Structure shows fine-grained ferrite & carbide structure. Initial stage of spheroidization observed at HAZ. Weld structure ferrite/bainite/carbides	Monitor after two year of service.

SR. NO.	LOCATION	MOC	MICROSTRUCTURE OBSERVATION	REMARK
25	(Parent Metal) On bend of SG-32-6"(SG-62-A & B to SG-25) near weld with reducer	P5	Structure shows fine-grained ferrite & carbide structure	Monitor after two year of service.
26	(Parent Metal) On vertical pipe near weld with bend of SG-25-8"(SG-23 to 105D)	-	Microstructure shows ferrite/pearlite structure	No significant damage. Monitor after 2 years of service.
27	(Weld/HAZ) On weld between vertical pipe & bend of SG-25-8"(SG-23 to 105D)	-	HAZ Microstructure shows fine-grained ferrite/pearlite structure. Weld metal structure shows ferrite-bainitic structure with widmanstatten ferrite.	No significant damage. Monitor after 2 years of service.
28	(Parent Metal) On face of bend of SG-25-8"(SG-23 to 105D)	-	Microstructure shows fine-grained ferrite/pearlite structure. Effect of decarburization observed.	Monitor after one year of service.
29	(Weld/HAZ) On weld between horizontal pipe & bend of SG-5-8" (SG-23 to 105D)	-	HAZ Microstructure shows fine-grained ferrite/pearlite structure. Weld metal structure shows ferrite & carbide in dendritic form.	Monitor after two years of service.
30	(Parent Metal) On horizontal pipe near weld with bend of SG-25-8" (SG-23 to 105D)	-	Microstructure shows ferrite/pearlite structure. Effect of decarburization observed.	Monitor after one year of service.
31	(Parent Metal) On Pipe of HS-10-6"(HS-5 to PIC-13A)	P11	Microstructure shows ferrite/pearlite structure	No significant damage. Monitor after 2 years.
32	(Parent Metal) On Pipe of HS-11-6"(HS-9 to PIC-13B)	P11	Microstructure shows ferrite/pearlite structure	No significant damage. Monitor after 2-3 years of service.
33	( Weld/HAZ) On weld between pipe & flange of HS-11-6"(HS-9 to PIC 13B)	P11	HAZ shows fine-grained ferrite/pearlite structure with carbides.	No significant damage. Monitor after 2 years of service.
34	(Parent Metal) On pipe near weld with flange of HS-12-6"(HS-9 to MICA-22)	P11	Microstructure shows ferrite/pearlite structure	No significant damage. Monitor after 2-3 years of service.
35	(Weld/HAZ) On weld between pipe & flange of HS-12-6"(HS-9 to MICA-22)	P11	HAZ shows fine-grained ferrite/pearlite structure with carbides. Weld metal shows dendritic form of ferrite & bainite	No significant damage. Monitor after 2-3 years of service.
36	(Weld/HAZ) On weld between nozzle & 90 degree bend of 123 gas inlet nozzle joint.	P22	Microstructure at welds shows ferrite-bainitic structure	No significant damage. Monitor after 2-3 years of service.
37	(Parent Metal) On 90 degree bend near weld with nozzle of 123 gas inlet nozzle joint.	P22	Microstructure shows ferrite-bainite structure	No significant damage. Monitor after 2-3 years of service.
38	(Weld/HAZ) On weld between 90 bend & 45 degree bend of 123 gas inlet nozzle joint.	P22	Microstructure shows ferrite-bainite structure at weld.	No significant damage. Monitor after 2-3 years of service.

SR. NO.	LOCATION	MOC	MICROSTRUCTURE OBSERVATION	REMARK
39	(Parent Metal) On 45 degree bend near weld with 90 degree bend near weld with nozzle of 123 gas inlet nozzle joint.	P22	Microstructure at bend shows ferrite/pearlite structure. Deformation bands are observed in ferrite structure.	Monitor for restriction in expansion (Stress analysis is recommended) No temp. related degradation observed. Monitor after 2 years.
40	(Parent Metal) On face of bend of SG-1-12"(106D to 114C)	P22	Microstructure shows ferrite/pearlite structure	Monitor after 2 years of service.
41	(Weld/HAZ) On weld between bend & bend of SG-1-12"(106D to 114C)	P11	Structure at parent metal shows ferrite/pearlite/bainite structure. Carbide formation observed at grain boundaries after disintegration of pearlite/bainite. At weld structure shows carbide formation in the bainite regions. However prior bainite regions are maintained.	2 <sup>nd</sup> stage of creep damage. Monitor after 1 year of service.
42	(Parent Metal) On bend near weld with bend of SG-1-12"(106D to 114C)	P11	Microstructure shows essentially ferrite grains.	Needs to be grounded up to 200-300 microns and study the microstructure.
43	(Parent Metal) On face of bend of PG-6-18"(104D to 103C)	P11	Microstructure shows ferrite/pearlite structure. The disintegration of bainite is observed. Presence of deformation bands observed in ferrite grains.	Monitor for restriction in expansion (Stress analysis is recommended) 2 <sup>nd</sup> stage of creep damage. Monitor after 1 year.
44	(Parent Metal) On face of bend of PG-6-18"(104D to 103C) <b>(AFTER GRINDING)</b>	P11	Microstructure shows ferrite/pearlite structure. The disintegration of bainite is observed. Presence of deformation bands observed in ferrite grains.	Monitor for restriction in expansion (Stress analysis is recommended) 2 <sup>nd</sup> stage of creep damage. Monitor after 1 year.
45	(Weld/HAZ) On weld between bend & pipe of PG-6-18"(104D to 103C)	P11	<b>Weld Microstructure shows bainite structure.</b> The disintegration of bainite is observed in initial stage. Fine-grained ferrite/pearlite/bainite structure observed at HAZ.	<b>2<sup>nd</sup> stage of creep damage.</b> Monitor after 2 years of service.
46	(Parent Metal) On pipe near weld with bend of PG-6-18"(104D to 103C)	P11	Microstructure shows Fine-grained ferrite/pearlite/bainite structure observed	Monitor after 1 year of service.
47	(Weld/HAZ) On weld between Bend & pipe of BF-17-3"(114C to BF-3H)	CS	Microstructure at weld shows dendritic ferrite and carbides. Fine-grained HAZ observed.	No significant damage. Monitor after 2 years of service.
48	(HAZ/PM) On pipe near weld with bend of BF-17-3"(114C to BF-3H)	CS	Microstructure shows Fine-grained ferrite/pearlite structure. ferrite/pearlite distribution is not uniform. Initial stage of spheroidization observed.	2 <sup>nd</sup> stage of creep damage. Monitor after 2 years of service.

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SR. NO.	LOCATION	MOC	MICROSTRUCTURE OBSERVATION	REMARK
49	(Parent Metal) On face of bend of NG-9-12"(101B mixed feed coil to NG-11)	P11	Microstructure shows essentially ferrite structure. Carbide observed at grain boundaries. Presences of creep cavities observed.	2 <sup>nd</sup> stage of creep damage. Monitor after 1 year of service. Creep cavities may be confirmed by SEM.
50	(Weld/HAZ) On weld between Pipe & bend of NG-9-12"(101B mixed feed coil to NG-11)	P11	Microstructure at weld shows ferrito-bainitic structure in dendritic form. HAZ structure shows ferrite & bainite. Degradation of bainite observed at parent metal.	2 <sup>nd</sup> stage of creep damage. Monitor after 1 year of service. Creep cavities may be confirmed by SEM.
51	(Parent Metal) On Pipe near weld with bend of NG-9-12"(101B mixed feed coil to NG-11)	P11	Microstructure shows essentially ferrite structure. Carbide observed at grain boundaries. Presences of creep cavities observed.	2 <sup>nd</sup> stage of creep damage. Monitor after 1 year of service. Creep cavities may be confirmed by SEM.
52	(Parent Metal) On tube no 60 at 4" height from floor towards East side in Auxiliary Boiler tube.	CS	Microstructure shows Fine – grained ferrite/pearlite structure observed	No significant damage. No significant degradation.
53	(Parent Metal) On tube no 55 at 4" height from floor towards West side in Auxiliary Boiler tube.	CS	Microstructure shows ferrite/pearlite structure. Pearlite is found at the grain boundaries.	Tube seems to have got heat affected. Recommended to replace.
54	(Parent Metal) On tube no 12 at 5" height from floor towards North side in Auxiliary Boiler tube.	CS	Microstructure shows Fine – grained ferrite/pearlite structure.	No significant degradation.
55	(Parent Metal) On bend of 5 <sup>th</sup> row from North of LT Steam Superheater Coil.	P11	Microstructure shows essentially ferrite structure. Pearlite seems to have degraded to carbides.	Recommended to go for further grinding up to 100-200 microns in next opportunity to confirm the observation.
56	(Weld/HAZ) On weld between Pipe & bend of 5 <sup>th</sup> row from North of LT Steam Super heater Coil	P11	Microstructure at weld shows ferrite & carbides & few bainite in dendritic form. HAZ macrostructure shows fine-grained ferrite/pearlite structure.	No significant damage. Monitor after 2 years of service.
57	(Parent Metal) On pipe near weld with bend of 5 <sup>th</sup> row from North of LT Steam Super heater Coil	P11	Microstructure shows ferrite/pearlite structure.	No significant damage. Monitor after 2 years of service.
58	(Parent Metal) On bend of 5 <sup>th</sup> row from South of LT Steam Super heater Coil	P11	Microstructure shows Fine – grained ferrite/pearlite structure. Disintegration of pearlite observed. Creep cavities observed.	2 <sup>nd</sup> stage of creep damage. Monitor after 1 year of service. Creep cavities may be confirmed by SEM.
59	(Weld/HAZ) On weld between Pipe & bend of 5 <sup>th</sup> row from South of LT Steam Super heater Coil	P11	Weld microstructure shows ferrito-bainitic structure. HAZ shows fine-grained ferrite/bainite & pearlite structure.	No significant damage. Monitor after 2 years of service.



SR. NO.	LOCATION	MOC	MICROSTRUCTURE OBSERVATION	REMARK
60	(Parent Metal) On pipe near weld with bend of 5 <sup>th</sup> row from South of LT Steam Super heater Coil	P11	Microstructure shows essentially ferrite structure with few pearlitic. Accumulations of creep damage in form of thickening of grain boundaries observed.	SEM analysis is recommended to judge between creep cracks to find out level of degradation. However it needs to be monitored after 1 year of service.
61	(Weld/HAZ) On weld between header of 6 <sup>th</sup> row & flange towards north side of Reformer Inlet Header.	A335Gr. P11	Microstructure at weld shows ferrite & carbides. prior bainite regions are maintained. At HAZ microstructure shows fine-grained ferrite/pearlite structure.	No significant damage. Monitor after 2 years of service.
62	(Parent Metal) On header of 6 <sup>th</sup> row near weld with flange towards north side of Reformer Inlet Header.	A335Gr. P11	Microstructure shows essentially ferrite structure with few pearlitic. Accumulations of creep damage in form of thickening of grain boundaries observed.	SEM analysis is recommended to judge between creep cracks to find out level of degradation. However it needs to be monitored after 1 year of service.
63	(Parent Metal) On 14" pipe near Old mixing tee.	-	Microstructure shows fine-grained ferrite pearlite structure. in-situ spheroidization of pearlite observed	2 <sup>nd</sup> stage of creep damage. Monitor after 1 year of service.
64	(Parent Metal) On inner side of flange near Old mixing tee.	-	Microstructure shows fine-grained ferrite pearlite structure. in-situ spheroidization of pearlite observed.	2 <sup>nd</sup> stage of creep damage. Monitor after 1 year of service.
65	(Parent Metal) On pipe near weld with bend of PG-1101-01-F34(H110 to R-110)	P11	Microstructure shows ferrite/pearlite structure.	No significant damage. Monitor after 2 years of service.
66	(Weld/HAZ) On weld between pipe & bend of PG-1101-01-F34(H110 to R-110)	P11	Microstructure at weld shows ferrite-bainitic structure. HAZ shows bainite structure.	No significant degradation. Monitor after 2 years of service.
67	(Parent Metal) On face of bend of PG-1101-01-F34(H110 to R-110)	P11	Microstructure shows essentially ferrite structure with few pearlitic. Accumulations of creep damage in form of thickening of grain boundaries observed.	SEM analysis is recommended to judge between creep cracks to find out level of degradation. However it needs to be monitored after 1 year of service.
68	(Weld/HAZ) On weld between pipe & Flange of MIC-22 downstream steam flange joint.	P11	Microstructure at weld shows ferrite/pearlite structure.	Weld metal seems to have undergone heat treatment. Monitor after 1 year of service.
69	(Parent Metal) On Pipe near weld with flange of MIC-22 downstream steam flange joint.	P11	Microstructure shows ferrite pearlite structure. In-situ spheroidization of pearlite observed.	2 <sup>nd</sup> stage of creep damage. Monitor after 1 year of service.

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SR. NO.	LOCATION	MOC	MICROSTRUCTURE OBSERVATION	REMARK
70	(Weld/HAZ) On weld at Reformer Outlet header of 8 <sup>th</sup> row, between 27 <sup>th</sup> & 28 <sup>th</sup> tube.	G-4859	Microstructure at weld shows ferrite pools in austenite matrix with carbides.	No significant degradation. Monitor after 2 years of service.
71	(Parent Metal) On weld at Reformer Outlet header of 8 <sup>th</sup> row, between 27 <sup>th</sup> & 28 <sup>th</sup> tube.	G-4859	Microstructure shows primary & secondary carbides in austenite matrix in cast form.	No significant degradation. Monitor after 2 years of service.
72	(Weld/HAZ) On weld between shell plates at leakage towards south of RO water tank.	SS-304	Microstructure shows austenite grains with presence of twins at HAZ. Weld metal microstructure shows carbide precipitation at inter-dendritic region. General microstructure at weld shows ferrite pools in austenite matrix.	Weld metal microstructure is susceptible for inter-granular corrosion. Parent metal microstructure is acceptable.
73	(Parent Metal) On shell near weld at leakage towards south of RO water tank.	SS-304	Microstructure shows austenite grains with presence of twins.	Microstructure is acceptable.

## UREA PLANT

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- Internal inspection of all the four High pressure vessels.
- Eddy current testing of tubes of H.P.Stripper (H-1201) and H.P. Condenser (H -1202).
- Internal inspection and ultrasonic thickness measurement of other vessels in the Plant.
- Ultrasonic thickness measurement of various pipelines including HP lines in the Plant. Detailed report is attached at **Annexure-A**. A small segment of pipeline SC-1407-8" (from H-1422 to T-1501) was replaced as 55.99 % reduction in thickness was observed.
- Ultrasonic thickness measurement of various equipment was carried out. Detailed report is attached at **Annexure-B**.
- Dye penetrant examination and radiography of weld joints of lines fabricated ,erected and offered by Mech. Maint. / Technical Department as per the requirement. A small loop of Ammonia pump discharge line to H.P.Condenser(MA-1203-4") was replaced as 27.8 % reduction in thickness was observed as compared to nominal thickness.
- Qualification tests of welders employed by contractors.
- Insitu Metallography of V-1421(Flash drum Scrubber).
- Residual magnetism measurement of Hitachi compressor rotor and various parts was carried out and wherever required the same were demagnetized. Detailed report is attached at **Annexure-C**

The detailed observations and recommendations for corrective actions required on individual equipments are given below. All the observations were recorded during inspection and were handed over to concerned maintenance and operation group for necessary corrective action based on the observations made.

### HIGH PRESSURE VESSELS:

#### AUTOCLAVE (V-1201):

#### VISUAL INSPECTION:

Thorough visual inspection of the liner and its welds, trays and internals was carried out. Observations made on each compartments are mentioned below. Repairing on marked locations was carried out and inspected by D.P. test followed by ferrite content checking.

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**Compartment No.1 (Top Compartment):**

Roughening /corrosion of spot welds (which are in existence since long) which are located on both sides of south west longitudinal weld was observed below the surface of main liner. These spots were repaired.

**Compartment No.2:**

Minor roughening of tray holding cleats was observed.

**Compartment No.3 :**

- Very minor roughening was observed on insert liner.
- Just above the circumferential weld depression by amount of approx. less than 5 mm was observed in liner in approx. 1 mtr. Length and 3-4 inch width at North-East side. This was also observed during last inspection.
- Cluster of dent marks was observed on the North side just above tray no 3 on an area of 10"x 10" approx. This was also observed during last inspection.
- Min. thickness of 4.6 mm was observed.(Thickness of 3.9 to 4.1 mm observed at location just above circumferential seam near 3rd support cleat from man way towards south in Shutdown-2003, however the same spot could not be located during this Shutdown.)

**Compartment No.4:**

- Slight roughening of insert liner plate and tray holding cleats was observed.
- Approx. 30 mm below from circumferential weld a depression of approx. 100 mm dia. and 3 mm depth observed at West side liner. Same was observed during last inspection also.
- Undercut was observed at the bottom side of circumferential weld seam at the East-North side. Repairing was carried out.
- Convex bulging of liner plate observed just above circumferential weld by approx. less than 4 mm height from North to West side along the circumference.

**Compartment No.5:**

- Convex bulging of liner plate was observed just above the circumferential weld joint by approx. 3 to 9 mm height starting from North to South direction. DP test on the bulged liner was carried out, no service defects were observed. The same was observed during last inspection also.
- Concave depression of max. 4 to 5 mm was observed at approx. 500 mm below circumferential length. The same was observed during last inspection also.

**Compartment No.6:**

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- 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 less than 5 mm depth was observed at approx. one meter below circumferential weld in area of approx. 750 X 70 mm at east side of shell. The same was observed during last inspection also.
- Two nos. of undercuts observed at circumferential weld joint, which were repaired.

**Compartment No.7:**

- Convex bulging of liner plate was observed above the circumferential weld joint by approx. less than 5 mm height in approx. 2 mtr. circumference from South-East to West side. The same was observed during last inspection also.
- One no. undercut was observed on circumferential weld joint, the same was repaired.

**Compartment No.8:**

Cavity of approx. 1 mm depth was observed at the location of old cleats at two places. The same were repaired.

**Compartment No.9:**

Found satisfactory.

**Compartment No.10:**

Found satisfactory.

**Compartment No.11:**

- Just below circumferential weld concave depression of approx. 4 to 6 inch dia. was observed. The same was observed during last inspection also.
- 10 to 12mm. gap was observed between tray and shell liner from East to South side.
- On new liner segment, (approx. 125 mm long) convex bulging up to max. 3 mm height having width approx. 10 mm observed just above circumferential stitch welds on complete circumference.

**Compartment No.12 (Bottom Compartment.):**

- Weld joints of all nozzles, petal plates, crown plates and the circumferential weld of the bottom dished end liner DP tested. 13 nos. defects were marked from A to M and were got repaired.
- Tray holding cleats have shown no sign of corrosion.

In all total 18 nos. defects were repaired, DP tested and final passivation with DM water was done.

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**THICKNESS MEASUREMENT:**

Ultrasonic thickness measurement was carried out on liner. The readings are summarized as below:

**MAIN LINER THICKNESS:**

Compartment No.	Min.Thk. (mm)	Max.Thk (mm)	Remarks
Man way	6.8	6.9	Replaced with 2 RE69 in April-02, with 6.5 mm thick liner plate.
Dome area	6.4	6.9	Replaced with 2 RE69 in April-02, with 6.5 mm thick liner plate.
Compartment 1 (New liner)	6.9	7.0	Replaced with 2 RE69 in April-02, with 6.5 mm thick liner plate.
Compartment 1 (Old liner)	4.2	4.7	Installed thickness 5 mm.
Compartment 2	4.3	4.9	Installed thickness 5 mm.
Compartment 3	4.6	4.8	Installed thickness 5 mm.
Compartment 4	4.3	4.7	Installed thickness 5 mm.
Compartment 5	4.8	5.4	Installed thickness 5 mm.
Compartment 6	4.7	5.0	Installed thickness 5 mm.
Compartment 7	4.8	4.9	Installed thickness 5 mm.
Compartment 8	4.7	4.9	Installed thickness 5 mm.
Compartment 9	4.9	5.0	Installed thickness 5 mm.
Compartment 10	4.9	5.0	Installed thickness 5 mm
Compartment 11 old liner	4.6	4.7	Installed thickness 5 mm
Compartment 11 New(Partial )	6.6	6.7	Replaced with 2 RE69 in April-02 with 6.7 mm thick liner plate.
Compartment 12 Shell liner	4.7	4.7	Installed thickness 5 mm
Compartment 12 Dome liner	6.4	6.8	Fabricated from 7 mm thick 2RE69 plate.

**INSERT LINER:**

Min. thickness of 6.6mm, 6.3mm, 6.5mm, 6.8 mm and 6.7 was observed on insert liner in compartment no. 3,4,8,9 & 10 respectively.

**DOWN COMER AND TRAYS:**

Compartment No.	Downcomer thickness (mm)		Tray thickness(mm)	
	Design thk.	Min.	Design thk.	Min.
1	10.0	--	8.0	6.6
2	10.0	9.1	8.0	6.7
3	10.0	9.2	8.0	6.5
4	10.0	9.4	8.0	6.9
5	10.0	10.3	8.0	7.0
6	10.0	9.4	8.0	6.9
7	10.0	9.4	8.0	7.3
8	10.0	9.5	8.0	7.4
9	10.0	9.5	8.0	7.9
10	10.0	10.2	8.0	7.9
11	10.0	10.1	8.0	8.5
12(10"NB)	10.0	10.2		
12(8" NB)	6.0	5.7		

**HP STRIPPER (H-1201):**

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**BOTTOM DOME:**

The following inspection activities were performed.

Visual Inspection of tubes b. Thickness measurement

The observations on above inspections are as under. :

**VISUAL INSPECTION:**

- Two nos bolts of urea solution outlet line were found missing.
- Two nos. Nuts and one bolt of another flange of urea solution outlet line were observed blackish compared to other bolts.
- One of the washer of square plate of CO<sub>2</sub> inlet line near tube sheet was found missing.
- Tube to tube sheet seal welds as well as shell to tube sheet overlay welds were found in satisfactory condition and observed to be covered with the oxide layer.
- Previously repaired area was found in satisfactory condition.
- Ferrite was measured and no ferrite was observed.

Overlay weld and Liner thickness measurement was carried out and details are as under:

Description	Minimum Thickness mm	Maximum Thickness mm	Design Thickness mm(Minimum)
Man way (Overlay)	19.32	24.35	8.0
Dome area (Overlay)	12.08	14.12	8.0
Cylindrical area (Liner)	8.3	8.4	8.0
Tube sheet-Overlay weld	20.15	24.2	8.0

**TOP DOME:**

The following inspection activities were performed.

a. Visual Inspection b. Thickness measurement

The observations on above inspections are as under. :

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**VISUAL INSPECTION:**

- Conditions of weld joints were found satisfactory.
- Thin oxide layer was observed on top half portion where as shiny surface was observed on bottom area of shell.
- Ferrite was measured and no ferrite was observed.
- Overall condition was found satisfactory.

Overlay weld and Liner thickness measurement was carried out and details are as under:

Description	Minimum Thicknessmm	Maximum Thickness mm	Design Thickness, mm(Minimum)
Man way (Overlay)	19.4	23.7	8.0
Dome area (Overlay)	11.56	13.85	8.0
Cylindrical area (Liner)	8.1	8.4	8.0
Tube sheet-Overlay weld	13.55	18.5	8.0

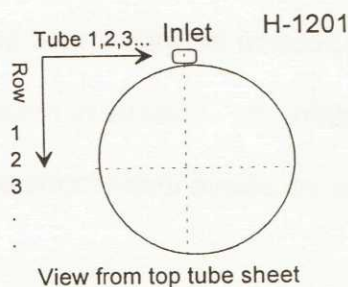
**EDDY CURRENT TESTING OF TUBES:**

Inspection of HP Stripper tubes was carried out using TesTex make TX 2000 4 x 2 Eddy Current System by Differential, Absolute and Multi frequency method for determination of tube thickness and detection of flaws in the heat exchanger tubes.

**Results:** All 2600 tubes were inspected from top tube sheet. Inspection was performed on tube length of 4500 mm from top tube sheet. 15 nos. tubes were showing 5 % to 10 % (0.162 to 0.325 mm) wall loss and remaining 2585 tubes were showing wall loss less than 5 % (0.162 mm). No other flaws were observed in the tubes. The majority of the wall losses were observed between 2nd to 4th baffle plates from top tube sheet. Following 15 tubes were showing 5 to 10 % wall loss.

Row 9 Tube 9, Row 14 Tube 4, Row 18 Tube 7, Row 21 Tube 50, Row 22 Tube 34, Row 23 Tube 5, Row 24 Tube 10, Row 24 Tube 25, Row 24 Tube 38, Row 24 Tube 43, Row 26 Tube 13, Row 27 Tube 50, Row 36 Tube 35, Row 41 Tube 42, Row 41 Tube 44 .

Tube Numbering System:





## H.P. CONDENSER H-1202:

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The following inspection activities were performed.

- a. Visual Inspection                      b. Thickness measurement                      c. Eddy current testing

The observations on above inspections are as under. :

### **VISUAL INSPECTION:**

Top Cover & Bottom Cover Sealing face was found satisfactory. Liner & welds were found smooth.

#### **Top Channel Head:**

- The colouration of internal surface found to be silver shiny with light brownish band of approx. 75-80 mm width at approx. 300 mm above the tube sheet. Grayish passivation layer was found at very few scattered locations.
- Minor roughening of dome and cylindrical area liner was observed where as man way liner was found smooth.
- Minor roughening of all the circumferential and longitudinal welds was observed which were found more predominant on the fillet welds of patch plate.
- Tube to tube sheet weld had shown no sign of corrosion/ roughening and were found smooth.
- Ferrite content was checked on randomly selected spots at welds and parent metal. No ferrite was found.
- Thickness measurement of liner segments was carried out.

#### **Bottom Channel Head:**

- No sign of corrosion/ roughening observed on entire bottom dome area. All welding joints and liner surface found smooth.
- Roughening of bottom cover weld neck flange inside surface was observed.
- Thickness measurement of liner segments was carried out.

#### **Overlay weld and Liner thickness measurement:**

##### **Top Section:**

Description	Minimum Thickness, mm	Maximum Thickness, mm
Cover(Liner)	19.7	19.8
Man way (Liner)	6.2	7.3
Dome area (Liner)	6.7	7.3
Cylindrical area (Liner)	6.4	7.3
Tube sheet-Overlay weld	10.6	13.6

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**Bottom Section:**

Description	Minimum Thickness, mm	Maximum Thickness, mm
Cover(Liner)	19.6	19.8
Man way (Liner)	4.6*	6.9
Dome area (Liner)	6.5	7.0
Cylindrical area (Liner)	6.3	7.0
Tube sheet-Overlay weld	10.4	18.3

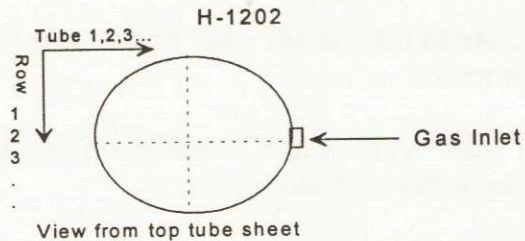
\* Observed at left side of longitudinal weld at west side.

**EDDY CURRENT TESTING OF TUBES:**

Tube inspection of HP Condenser tubes was carried out using TesTex make TX 2000 4 x 2 Eddy current System by Differential, Absolute and Multi frequency method for determination of tube thickness and detection of flaws in the heat exchanger tubes.

**Results:** Out of 1970 tubes, full length of 220 tubes were inspected from top tube sheet. All the tubes were showing less than 5 % ( 0.125 mm) wall loss. No other flaws were observed in the tubes

Tube Numbering System:



**HP SCRUBBER H-1203**

**VISUAL INSPECTION OF TUBE BUNDLE:**

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

- Coloration of tubes external surface assumed to be dull golden.
- Second baffle plate from bottom found corroded/eroded at the location of North/East side tierod. Tie rod is exposed at this location. Repair of baffle plate was suggested.
- Third baffle plate from bottom found corroded/eroded at the location of South/West side tie rod. Tie rod is exposed at this location. Repair of baffle plate at this location was recommended.
- Few nos. of tie rods spacers between baffle were found loose.
- Mechanical abrasion/impact mark seen on the two tubes just above the topmost baffle plate at North side. Size of mark on one tube is approx. 50x10x(0.75-0.9mm deep) and that on other tube is having depth of approx. 0.1 to 0.2mm.

Tube nos. counting from North side	East (mm)	West (mm)	Bend (mm)	Design thk(mm)
1	3.3	3.3	2.9	3.6
2	3.3	3.3	3.0	3.6
3	3.3	3.3	-	3.6
4	3.3	3.3	3.1	3.6
5	3.3	3.3	3.2	3.6

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

**VISUAL INSPECTION OF TOP SHELL:**

- Shell internal surface was found brownish black in coloration.
- CO<sub>2</sub> inlet nozzle flange (3/4"NB) located at west side found corroded along with its fillet weld. This requires repair/replacement.
- Condition of liquid inlet and gas outlet pipe found satisfactory.
- Tack welding of 2 nos of bolt head surrounding liquid inlet line found cracked.
- Thickness measurement of bottom half of shell liner carried out and was found in range of 4.6 to 4.9mm against design thickness of 5 mm .

**VISUAL INSPECTION OF BOTTOM SHELL:**

- Abrasion marks due to the lowering of tube bundle were observed at scattered locations on the liner including those caused in the past.
- DPT of liquid overflow basket welds, pipe support cleat fillet welds and top circumferential weld i.e. liner to top flange cladding was carried out. No significant defect was observed.
- Thickness measurement of liner was also carried out as under:

Course No	North	South	East	West	Design thk(mm)
1	5.4	5.4	5.3	5.3	5.0
2	5.5	5.3	5.5	5.5	5.0
3	5.2	5.3	5.2	5.2	5.0

**Note:** Course nos. are counted from top to bottom

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### **INSPECTION OF OTHER VESSELS:**

#### **H-1113 A/B (Main L.O.Cooler for K-1101/1 ):**

- Tube and Tube sheet observed in satisfactory condition.
- Epoxy coating is seen to be in satisfactory condition at North end channel center but has been peeled off at inside of South end channel at few locations resulting in corrosion attack.
- Thickness measurement was carried out.

#### **1204 (Recirculation Heater):**

- Tube to tube sheet weld found in good condition.
- Orifice plugs at bottom of tube sheet found intact in position however, urea/water was observed accumulated around O.D. of few orifice plugs.
- Brownish deposits observed inside some of the tube holes.

#### **H-1301 A/B/C ( Desorber heat exchanger):**

- Tube to tube sheet seal welding was found satisfactory for H-1301 A/B where as pinholes were observed on tube seal welding of H-1301 C.

#### **H-1305 (Lean carbamate cooler):**

- Flange faces and their welding were found corroded at scattered locations.
- Scattered pitting up to the depth of approx. 2-3mm were observed from inside and outside.
- A cavity of approx. 5mm depth was observed on the periphery of 1"NB. nozzle of cover from inside.
- Baffle plates and their tie rods were found corroded at many locations.
- Repainting is required.

#### **H-1419 (Pre-evaporator Condenser) :**

##### **BOTTOM TUBESHEET.**

- Tube to tube sheet weld found satisfactory.
- Three nos of tube holes were found partially choked with wooden piece/scale debris.

##### **TOP TUBESHEET.**

- Tube to tube sheet weld found satisfactory.
- Overall condition of vessel found satisfactory.

### H-1422 (1st Stage Evaporator):

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Visual inspections of shell and dish end were carried out as mentioned below.

- The shell and dish ends have assumed brownish black in coloration.
- Tube to tube sheet weld found satisfactory. Scales and deposits were observed inside the tubes.
- Lot of urea lumps were found accumulated on the inside surface of distributor at the top and at the bottom dished end.
- Impingement cone and condensate distributor were found satisfactory.

### H-1424 ( 2 nd Stage Evaporator):

Visual inspection of the equipment was carried out. The following observations were made.

- Vessel inside was found grayish black in coloration.
- Tube to tube sheet weld joints were found satisfactory.
- Urea lumps were found adhered at top dished end and bottom dished end.
- White thin deposits were found at the scattered location of the shell.
- Impingement cone found intact however it's drain found chocked with urea lumps.

### H-1427 (Circulation cooler for V-1423):

- Pitting up to depth of approx. 2mm was observed at scattered locations from inside on entire shell surface.
- Flange faces and its welding were found corroded.
- Severe pitting up to the depth of 3-4mm in area of approx. 100mm dia were observed at a distance of approx. 2 feet from one end on outside surface of shell. Also scattered pitting up to depth of approx. 2mm were observed on rest of the outside surface.
- One baffle plate of tube bundle was found corroded up to the depth of approx. 10mm. Also corrosion was observed on other baffles as well as their tie rods.
- Flange face of the cover was found corroded at one location in approx. 30mm length and approx. 3mm depth.
- Scattered pitting were observed inside the cover. Repainting is required on outside surface.

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**H-1814-A (L.O. Cooler of Hitachi Compressor):**

- Tubes and tube sheet were found satisfactory.
- Epoxy coating has got peeled off at various locations on channel cover inside both east and west cover particularly predominant on west side. Marked for recoating
- Blind channel cover flange also observed to have epoxy peeled off causing pits on the inside surface.

**H-1814-B (L.O. Cooler of Hitachi Compressor):**

- Tubes and tube sheet were found satisfactory.
- Epoxy coating has got peeled off at various locations on channel cover inside both east and west cover particularly predominant on west side. Marked for recoating
- Blind channel cover flange also observed to have epoxy peeled off causing pits on the inside surface.

**H-1815 (Surface Condenser for Hitachi Compressor):**

**SOUTH SIDE HALF (West side channel)**

- Bottom half found satisfactory.
- Top half Scales were observed inside almost all the tubes of bottom half.

**SOUTH SIDE HALF (East side channel)**

- Bottom half Found satisfactory except few tubes were found to have scales inside.
- Top half Seven nos. of tubes were found to have rust mark at its joint with tube sheet and also in these tubes, tube sheet was found to have impact/notch mark at the junction of tube sheet hole in a circumferential length of approx. 5 to 20 mm. This was observed in south half of the tube sheet.

Minor scaling were observed inside the tubes.

New epoxy paint applied on east & west side was found to have oxide/corrosion debris below the paint at few scattered locations.

**North side partition (East side cover):**

- Scaling was observed at the inside surface of the tubes.
- Tubes and tube sheet surface condition was found satisfactory.

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- Corrosion scales were observed on the bottom end corner of the channel. This was marked for proper cleaning and application of epoxy paint. Same was also observed during shutdown 2003 inspection.
  - Epoxy coating was found peeled off at seven locations from channel cover.

**North side partition (West side cover):**

- Scaling was observed at the inside surface of the tubes.
- Tubes and tube sheet surface condition found satisfactory.
- Epoxy coating found peeled off at many locations at the top half of channel shell, this was marked for proper cleaning and application of epoxy paint.
- Epoxy coating was found peeled off at four locations from channel cover.

**T-1301 (Ammonia Water Tank):**

- Brownish coloration on bottom plate and bottom half of shell and silver bright coloration on top half of shell was observed.
- Bottom plate was found bulged up-side at different locations. Same has been observed in past.
- Weld joints and nozzle condition was found to be satisfactory.

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

- Brown coloration on bottom plate and bottom half of shell and silver bright coloration on top half of the shell was observed.
- All weld joints and nozzle condition was found satisfactory.

**T-1401 (Urea Solution Tank):**

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

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

- Brownish gray coloration was observed on bottom half and bright silver coloration was observed on top half.
- Nozzles and weld joint condition was satisfactory.

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#### **T-1501 (Condensate Tank):**

Visual inspection of the tank from inside was carried out and observations made are as under.

- Brownish black coloration was observed inside the tank.
- Weld joint condition was satisfactory.
- All nozzle condition was found satisfactory.
- Support of 6" dia condensate line from V-1503 was found bent, rest of the supports were satisfactory.

#### **V-1101 (CO2 Knock Out Drum):**

- Epoxy paint was found peeled off from few locations. Also blisters of epoxy paint were observed at few locations.
- Demister pads were found intact in position. At few locations it was found choked (covered) with yellow colour debris.
- Brownish colour patches were observed at scattered locations on shell surface.

#### **V-1103 (NH3 Suction Vessel):**

Visual inspection of the vessel internals was carried out. The observations were as follows.

- Coloration of vessel inside was brownish black.
- The condition of longitudinal and circumferential weld joints was satisfactory.
- Oil layer was found on the bottom dished end.
- In general condition of the vessel was found satisfactory.

#### **V-1104 (CO<sub>2</sub> Spray Cooler):**

Visual inspection of top compartment was carried out.

- Demister pads were found intact in position.
- Wood and paint debris were found collected on liquid distributor.
- Epoxy paint found peeled off from few location.



**V-1202 (Rectifying Column):**

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**From Bottom manhole:**

- Coloration of top cone was silver with black patches where as brownish coloration was found on bottom dished end.
- Hard scales were observed particularly at the top of the shell and bottom of the shell in a width of approx. 300 mm

**V-1203 (L. P. ABSORBER):**

**From Top End:**

- Shell observed grayish black in coloration.
- Grating was found intact in position.

**From Bottom End:**

- Shell observed grayish black in coloration.
- In general condition of vessel found satisfactory.

**V-1206 (Atmospheric Vent Scrubber):**

Visual inspection of the vessel internals was carried out. The observations were as follows.

- Demister pads were found intact in position.
- All fasteners were found intact.
- Grayish black coloration was observed inside the vessel.
- Overall condition was satisfactory.

**V-1207 (L. P. Scrubber):**

Visual inspection of the vessel internals was carried out from top manhole. The observations were as follows.

- Coloration of shell top portion found blackish grey.
- One no nut of top grill was found missing, however grill was found intact in position.
- Bottom supporting grill of pall ring bed found slightly bent at one side.
- In general condition of vessel found satisfactory.

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**V-1301 (2ND Desorber):**

Visual inspection of vessel was carried out from bottom and top manhole. The observations were as follows.

**Bottom Compartment:**

- Brownish coloration was observed inside the vessel.
- One clamp was found loose.
- Nozzle condition was found satisfactory.

**Top Compartment:**

- Brownish coloration was observed inside the vessel.
- All fasteners and tray were intact in position.
- Top nozzle was found satisfactory

**V-1352 (First Desorber):**

Visual inspection was carried out from top and bottom manhole.

**Top Manhole:**

- Brownish coloration was observed inside the vessel.
- All fasteners were found intact
- Weld joint condition was found satisfactory.

**Bottom Manhole:**

- Brownish coloration was observed inside the vessel.
- One bolt of the tray was found missing.
- Overall condition was satisfactory.

**V-1418 (Pre Evaporator Separator):**

- Condition of the cone and weld joints was found satisfactory.
- Minor scaling was observed inside the tubes.
- Tube to tube sheet weld found in good condition.
- Minor scaling was observed inside the tubes.

**V-1421 (Flash Drum Scrubber):**

- Shell inside was found brownish in colour.
- Demister pads condition was found satisfactory.
- Weld joint condition was found satisfactory.
- Previously repaired welding was found satisfactory.
- Insitu-Metallography was carried out from outside on a crack observed on parent below the manhole.

**V-1423 (1 ST Stage Evaporator Scrubber):**

Visual inspection was carried out from top manhole.

- Dark brown coloration was observed.
- Demister pads condition was found satisfactory.
- All fasteners were found intact.
- Overall condition of the vessel was satisfactory.

**V-1502 (23 ATA Steam Drum):**

- Brownish black coloration was observed inside the vessel.
- All the internal fittings were found in good condition.
- Weld joints condition was found satisfactory
- Overall condition was found satisfactory.

**V-1503 (9 ATA Steam Drum):**

- Grayish black coloration was observed on the bottom half and brownish gray coloration was observed on top half portion of the drum.
- Scattered scales were observed on both the dished ends.
- All other internal fittings were found satisfactory.
- Overall condition was found satisfactory.

**V-1811 (1st Stage Separator):**

- Demister pads found intact in position.
- Vortex breaker found intact in position.
- Coloration of shell had assumed shiny.
- Overall condition of the vessel found satisfactory.

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**V-1812 (IInd Stage Separator):**

- Demister pads found intact in position.
- Vortex breaker found intact in position.
- Coloration of shell had assumed shiny.
- Overall condition of the vessel found satisfactory.

**V-1813 (IIIrd Stage Separator):**

As seen from the manhole no abnormality observed.

**P-1201-A/B (L.O Cooler):**

**CHANNEL COVER END:**

- Rusting and corrosion observed on inside surface of channel cover.
- Minor pitting and cavities were observed on tube sheet face.

**HEAD END:**

Minor pitting and corrosion cavities were observed.

**P-1102-C (L.O Cooler):**

- Tube sheet found satisfactory at both sides.
- Gasket at C.W inlet found covering approx. 50% holes of one row at bottom half.

**PIPE LINES THICKNESS MEASUREMENT:**

During this shutdown, a large nos. of pipe lines were examined for thickness. The detailed report on thickness measurement is attached herewith at **Annexure - A**.

**THICKNESS MEASUREMENT OF EQUIPMENT:**

Thickness measurement of selected heat exchangers and vessels was also carried out. The details are summarized at the **Annexure - B**

**GAUSS MEASUREMENT:**

Residual magnetism in different components of Hitachi Compressor was measured and wherever it was found 3 Gauss, the component was demagnetized and residual magnetism level was brought down to below 3 Gauss. Detailed report is attached at **Annexure-C**.

**INSITU-METALLOGRAPHY:**

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In situ Metallography of V-1421(Flash drum Scrubber) was carried out on the crack on parent metal. Worked austenite grains with twins and presence of transgranular crack is observed.

**ANNEXURE – A****THICKNESS MEASUREMENT OF PLANT PIPELINES DURING S/D - 2004**

Sr. No.	Line No	Nom Bore (inch)	Nom Thick (mm)	Line Description		Min Thk Observed	% Red.
				From	To		
1	CO-E-10-2139	4	8.56	TV-1808	CO-E10-2112-6"	6.90	19.39
2	CO-E10-2122	6	10.97	H-1813	V-1813	9.70	11.58
3	CO-E10-2123	6	10.97	V-1813	K-1801 IV SUCTI	9.80	10.67
4	CO-F10-2119	8	23.01	K-1801	H-1813	20.10	12.65
5	CO-FIO-2140	4	13.49	CO-FIO-2119-8"	TV-1808	11.50	14.75
6	GA-1112	6	14.27	K-II01-2	GA-1201	12.30	13.81
7	GA-1201	6	13.33	GA-1112	H-1201	14.20	Nil
8	GA-1202	1	6.35	GA-1112	GA-1203	5.20	18.11
9	GA-1202	1	6.35	GA-1112	GA-1203	5.20	18.11
10	GA-1602	8	23.01	K-1801	GA-1602-8"	21.90	4.82
11	MA-II04	3	5.49	V-II02	V-II03	5.60	Nil
12	MA-1104-6"	6	7.11	V-II02	V-II03	6.60	7.17
13	MA-II05	6	7.11	V-II03	P-II02	6.60	7.17
14	MA-II06	4	8.56	MA-1203-4"	MA-1605-6"	7.00	18.22
15	MA-II06-4"	4	8.56	P-II02-A	MA-1605-6"	7.80	8.88
16	MA-1128	4	8.56	P-II02/B	MA-1605	7.40	13.55
17	MA-1202	3	7.62	MA-1201	V-1201	7.00	8.14
18	MA-1203	4	9.14	MA-II06	PR-1230	7.40	19.04
19	MA-1603	4	6.02	MA-1603-6"	P-II02/C suc.	5.10	15.28
20	MA-1603-6"	6	7.11	MA-1122-6"	MA-1603-4"	6.50	8.58
21	MA-1604-3"	3	7.62	1102-C	MA-1604-4"	6.30	17.32
22	MA-1604-4"	4	8.56	MA-1604-3"	MA-1605-6"	8.00	6.54
23	MA-1605	6	14.27	MA-II06	MA-1203	13.30	6.80
24	PR-1201	8	19.58	V-1201	H-1201	16.20	17.26

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Sr. No.	Line No	Nom Bore (inch)	Nom Thick (mm)	Line Description		Min Thk Observed	% Red.
				From	To		
25	PR-1202	10	24.33	H-1201	HP CONDENSER	23.50	3.41
26	PR-1203	8	19.58	H-1202	V-1201	18.20	7.05
27	PR-1204	8	19.58	HP-CONDENSER {E	V-1201	18.00	8.07
28	PR-1205-6"	6	15.24	PR-1205-8"	V-1202	13.30	12.73
29	PR-1205-8"	8	19.58	STRIPPER BOTTO	V-1202	19.60	Nil
30	PR-1207	6	3.4	PR-1206	V-1406	3.30	2.94
31	PR-1207-14"	14	4.78	LICV-1201	V-1406	5.00	Nil
32	PR-1208	4	10.4	AUTOCLAVE TOP	SCRUBBER	9.50	8.65
33	PR-1211-1.5"	1.5	5.08	PR-1208-4"	PR-1212-4"	4.00	21.26
34	PR-1212	4	10.4	SCRUBBER	AUTOCLAVE BOTTC	9.90	4.81
35	PR-1212	4	10.4	SCRUBBER	AUTOCLAVE BOTTC	9.90	4.81
36	PR-1213	2	5.54	PR-1201	PR-1205	4.30	22.38
37	PR-1213	2	5.54	PR-1201	PR-1205	4.30	22.38
38	PR-1214	12	4.57	V-1202	H-1204	3.50	23.41
39	PR-1215	16	4.78	H-1204	V-1202	5.20	Nil
40	PR-1220	8	3.76	V-1205	H-1205	3.20	14.89
41	PR-1223	4	3.05	V-1205	P-1201	2.50	18.03
42	PR-1223	4	3.05	V-1205	P-1201	2.50	18.03
43	PR-1224	3	7.62	P-1201/B	PR-1638-4"	6.00	21.26
44	PR-1226	2	5.54	PR-1224	LP CONDENSER	5.00	9.75
45	PR-1230	6	15.24	MA-1203-4"	H-1202	13.70	10.10
46	PR-1231	3	8.12	H-1203	PRCV-1201	6.20	23.65
47	PR-1232	4	10.4	PRCV-1201	ATOMS	10.20	1.92
48	PR-1234-3"	3	7.62	H-1203	V-1203	6.50	14.70
49	PR-1237	3	3.05	H-1203	V-1203	2.90	4.92
50	PR-1305	3	3.05	H-1301	V-1301	2.50	18.03
51	PR-1311	4	3.05	PR-1625- 6"	1302-A/B	2.80	8.20
52	PR-1333-2"	2	2.77	P-1305 A/B	H-1304	2.40	13.36
53	PR-1356	3	3.05	V-1351	V-1352	2.50	18.03
54	PR-1359-4"	4	3.05	P-1351 A/B	H-1351/C	2.50	18.03

Sr. No.	Line No	Nom Bore (inch)	Nom Thick (mm)	Line Description		Min Thk Observed	% Red.
				From	To		
55	PR-1362-4"	4	3.05	V-1351	H-1351/A	2.80	8.20
56	PR-1367-3"	3	3.05	V-1353	P-1352 A/B	2.50	18.03
57	PR-1447-3"	3	3.05	V-1421	PR-1330	2.90	4.92
58	PR-1608	2	2.77	H-1421	V-1200	2.20	20.58
59	PR-1625-6"	6	3.4	T-1301/A	PR-1311-4"	3.10	8.82
60	PR-1632	2	2.77	LICV-1281	H-1201 A	2.60	6.14
61	PR-1637	4	9.14	P-1201 C	PR-1638-4"	8.30	9.19
62	PR-1638-4"	4	9.14	P-1201 A/B/C	MA-1230-6"	13.80	Nil
63	PR-1646	2	2.77	H-1205	PR-1365-6"	2.60	6.14
64	PW-1101	3	3.05	V-1101	SEAL POT	2.20	27.87
65	PW-1351-4"	4	3.05	H-1301	V-1301	2.80	8.20
66	PW-1512	4	3.05	H-1502	LICV-5111	2.50	18.03
67	PW-5152	4	3.05	P-4202/3	H-1502	2.50	18.03
68	SC-1209	10	9.27	H-1207	H-1203	8.20	11.54
69	SC-1210-10	10	9.27	P-1204-A/B	H-1207	8.00	13.70
70	SC-1211-10	10	9.27	H-1203	P-1204	7.60	18.02
71	SC-1212-4	4	6.02	SC-1210	SC-1209	7.50	Nil
72	SC-1212-8	8	8.18	SC-1210	SC-1209	8.10	0.98
73	SC-1213	6	7.11	H-1201	V-1502	6.60	7.17
74	SC-1222	14	9.52	H-1205	P-1202 A/B	8.50	10.71
75	SC-1227	14	9.52	SC-1101	SC-1220	8.30	12.82
76	SC-1228-10	10	9.27	P-1202	H-1102	8.00	13.70
77	SC-1242	16	9.52	H-1202	V-1501	10.10	Nil
78	SC-1407-3	3	5.49	H-1422	T-1501	5.20	5.28
79	SC-1407-8	8	8.18	H-1422	T-1501	7.20	11.98
80	ST-1123-20	20	9.52	PICV-1129	ST-1106	8.10	14.92
81	ST-1124	6	10.97	ST-1104	PICV-1128	10.10	7.93
82	ST-1125-10	10	9.27	ST-1116	PICV-1129	8.10	12.62
83	ST-1503-3	3	5.49	PICV-1502A	V-1503	5.40	1.64

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**ANNEXURE-B****THICKNESS MEASUREMENT OF UREA PLANT EQUIPMENT DURING THE SHUTDOWN-2004**

SL. NO.	EQUIPMENT NUMBER	EQUIPMENT DESCRIPTION	SHELL THICKNESS IN MM			DISH END THICKNESS IN MM			CHANNEL THICKNESS IN MM		
			DGN	MEASD MINI.	RED. %	DGN	MEASD MINI.	RED. %	DGN	MEASD MINI.	RED.%
1	H-1113-A	MAIN LUB OIL TANK FOR K-1101-1 & K-	N.A	10.3	-	-	8.1	-	-	-	-
2	H-1113-B	MAIN LUB OIL TANK FOR K-1101-1 & K-	N.A	9.8	-	-	9.0	-	-	-	-
3	H-1114	SURFACE CONDENSER	N.A	10.1	-	-			-	9.8	-
4	H-1123	CRANK CASE LUB OIL COOLER FOR	N.A	9.8	-	-	18.0	-	-	20.4	-
5	H-1205	LP CARBAMATE CONDENSER	8.0	7.4	7.50	10.0	12.4	-	-	-	-
6	H-1207-A	CCS II SURAFCE CONDENSER	10	7.8	22.00				8.0	12.4	-
7	H-1209	LP ABSORBER	10.0	8.9	11.00	7.5	7.9	-	6.0	6.8	-
8	H-1301-A	ADDITIONAL DESORBER	9.5	10.2	-	-	-	-	-	-	-
9	H-1301-B	DESORBER HEAT EXCHANGER	7.92	6.80	14.14	5.0	5.2		5.0	5.0	-
10	H-1301-C	DESORBER HEAT EXCHANGER	7.92	7.10	10.35	5	5.20		5.0	5.20	-
11	H-1303	EFFLUENT COOLER	10.0	9.5	5.0	12.0	10.4	13.33		10.0	
12	H-1305	FEED COOLER FOR V-1203	9.1	9.6	-	-	-	-	-	-	-
13	H-1351-A	HYDROLYSER FEED PREHEATER	12	12.2	-	12.0	11.2	6.7			-
14	H-1351-B	HYDROLYSER FEED PREHEATER	12	12.2	-	12	11.2	6.7	-	-	-
15	H-1351-C	HYDROLYSER FEED PREHEATER	12	12.1	-	12	11.4		12.0		
16	H-1352	REFLUX CONDENSER	8.0	7.7	3.75	-	-	-	14.0	14.2	-



ANNEXURE-C

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GAUSS MEASUREMENT & DEMAGNETIZATION REPORT

Sr. No.	Component Description	Max. gauss reading	
		Before	After
<b>K-1801, CO2 COMPRESSOR</b>			
<b>1.0</b>	<b>Turbine South Bearing</b>		
1.1	Journal bearing shaft	0.6	
1.2	Journal bearing pads	1.7	
1.3	Journal bearing base ring	1.1	
1.4	Thrust bearing base ring	1.9	
1.5	Thrust collar	2.7	
1.6	Thrust pads	1.5	
1.7	Thrust Bearing Case	1.9	
<b>2.0</b>	<b>Turbine North Bearing</b>		
2.1	Journal bearing shaft	1.3	
2.2	Journal bearing pads	2.1	
2.3	Journal bearing base ring	2.4	
<b>3.0</b>	<b>H P Case South Bearing</b>		
3.1	Journal Bearing Shaft	1.1	
3.2	Bearing Pads	0.8	
3.3	Bearing base ring	2.5	
<b>4.0</b>	<b>H P Case North Bearing</b>		
4.1	Journal Bearing Shaft	1.4	
4.2	Journal Thrust Collar	2.9	
4.3	Thrust Pads	1.6	
4.4	Journal Bearing Pads	1.6	
4.5	Journal Bearing Base Ring	5.7	1.1
<b>5.0</b>	<b>L P Case South Bearing</b>		
5.1	Journal Shaft Portion	1.2	
5.2	Journal Bearing Pads	1.8	
5.3	Journal Bearing Base Ring	2.8	
<b>6.0</b>	<b>LP Case North Bearing</b>		
6.1	Journal shaft Portion	1.8	
6.2	Journal Bearing Pads	2.1	
6.3	Journal Bearing Base Ring	2.5	
6.4	Thrust Collar	1.0	
6.5	Thrust Pads	0.8	
<b>7.0</b>	<b>Gear Box</b>		
7.1	HP Pinion Shaft	1.0	
7.2	HP Bearing	1.3	
7.3	LP Pinion Shaft	1.0	
7.4	LP Bearing	0.9	

APPENDIX

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- Inspection of BHEL boiler drums and furnace tubes.
- Inspection of deaerator.
- Inspection of newly fabricated pipelines viz. Segment of cooling water return header for Urea plant and cooling water line for Q-4401/A cooling water pump turbine carried out departmentally by Maintenance Department.
- Visual inspection of H<sub>2</sub>SO<sub>4</sub> tank.

The detailed observations on individual equipment are given below.

**BHEL BOILER ( GT-2068 ):**

Visual inspection of Steam Drum, Mud Drum, Furnace tubes and Super heater tubes was carried out during this shutdown. Also, ultrasonic thickness measurement of all accessible tubes, steam drum, mud drum and super heater tubes was carried out. The following observations were made during visual examination.

**STEAM DRUM:**

- The internal surface of the drum had assumed blackish coloration.
- All the weld joints were found in good condition and free from any corrosion attack.
- The separator cover plate at the bottom of west end was found to have crack at one location in length of approx. 250 mm and one of its fastener was found missing. All other internal fittings were found intact.
- Overall condition of the steam drum was found to be satisfactory.

Ultrasonic thickness measurement was carried out. Min. thickness was observed to be 99.7 mm against nominal specified thickness of 97 mm in cylindrical shell area and 78.4 mm on dished end against nominal specified thickness of 77 mm.

Detailed report is attached at **Annexure- 1**

**MUD DRUM:**

- The shell had assumed blackish coloration.
- The condition of the weld joints was found satisfactory.
- The tube stub ends were free from any defect.
- In general, the overall condition of the mud drum was found satisfactory.

Ultrasonic thickness measurement was carried out. Min. thickness was observed to be 82.0 mm in cylindrical shell area against nominal specified thickness of 78 mm and 58.3 mm on dished end against nominal specified thickness of 57 mm. Detailed report is attached at **Annexure - 2**

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**DEAERATOR:**

Inspection of the deaerator head and the storage shell was carried out. Observations are as under.

**Deaerator Head :**

- Two nos. of valves were found leaking.
- Middle segment of 5th tray layer(Bottom most tray) was found lifted upward by approx. 25-30 mm and its tack welding with the surrounding segments as well as with the supporting frame were found broken, the same was repaired by Mech. Maint. Crew.

**Deaerator Storage Shell:**

- Brownish coloration was observed inside the shell.
- Condition of the weld joint was found satisfactory.

**FURNACE TUBES:**

In general, the condition of the furnace tubes and super heater tubes exposed to flue gases was satisfactory. The thickness measurement of Stage-I & Stage-II Primary and Secondary Super heater tubes, Bank tubes, Sidewall tubes, Baffle wall tubes, D-Panel tubes, Cut corner tubes, Rear wall tubes and Front wall tubes was carried out. The Summary indicating the thickness of individual type of the tubes is given below:

SL. NO.	DESCRIPTION	MIN. THK. (MM)	DESIGN THK. (MM)	% RED.	REFER ANNEXURE
<b>1</b>	<b>SOUTH MANHOLE:</b>				
(A)	BAFFLE WALL TUBES	4.8	4.5	-	Annexure - 3,7
(B)	D-PANEL TUBES	4.6	4.5	-	Annexure - 3,7
(C)	CUT CORNER TUBES	4.7	4.5	-	Annexure - 3,7
(D)	REAR WALL TUBES	4.8	4.5	-	Annexure - 3,7
(E)	FRONT WALL TUBES	4.6	4.5	-	Annexure - 3,7
<b>2</b>	<b>NORTH MANHOLE:</b>				
(A)	BANK TUBES	3.5	3.6	2.78	Annexure - 4,7
(B)	BAFFLE TUBES	5.1	4.5	-	Annexure - 4,7
(C)	NORTH SIDE WALL TUBES	4.8	4.5	-	Annexure - 4,7
<b>3</b>	PRIMARY SUPERHEATER TUBES INSIDE FURNACE(STAGE-I)	6.3	7.1	11.27	Annexure - 5,7
<b>4</b>	SECONDARY SUPERHEATER TUBES INSIDE FURNACE (STAGE-II)	5	5.6	10.71	Annexure - 6,7

## COOLING TOWER AREA:

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### H<sub>2</sub>SO<sub>4</sub> Storage Tank :

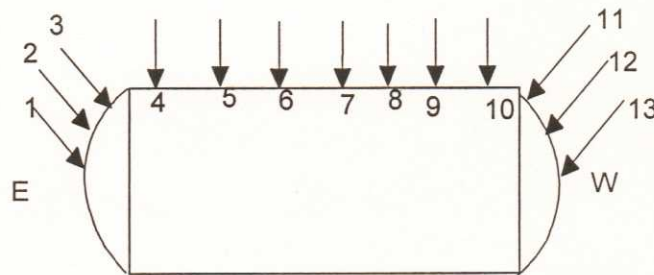
- Tank internal surface was covered with white / yellow loose deposits all around.
- 2" N.B. Nozzle at south cover was found choked partially.

A segment of East Side cooling water return header of Urea Plant near cooling tower was replaced by M/s Garcem Engineers. Its weld joints were D.P. Tested at the various stages of fabrication and defects observed were got rectified.

## ANNEXURE -1

### THICKNESS MEASUREMENT REPORT OF STEAM DRUM

SHELL	Design Thickness : 97 mm			
POINT NO.	TOP	BOTTOM	NORTH	SOUTH
4	100.8	101.4	100.2	101.4
5	-	-	99.9	99.9
6	-	-	100.1	100.4
7	-	-	101.5	100.3
8	-	-	101.4	101.0
9	-	-	100.3	101.9
10	99.7	101.3	100.6	100.8
DISH END	Design Thickness : 77 mm			
POINT NO.	TOP	BOTTOM	NORTH	SOUTH
1(E)	79.3	79.4	78.4	79.2
2(E)	79	79.2	79.2	79.6
3(E)	85.1	84.8	85.6	84.8
11(W)	84.8	83.4	80.1	84.2
12(W)	80.1	78.5	81.8	80.3
13(W)	78.4	79.9	78.9	78.9

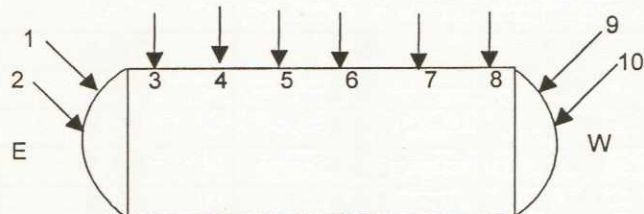


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**ANNEXURE -2**

**THICKNESS MEASUREMENT REPORT OF MUD DRUM**

SHELL:		Design Thickness : 78 mm		
POINT NO.	TOP	BOTTOM	NORTH	SOUTH
3	82.3	82.4	82	82.2
4	82.6	82.5	82.1	82.3
5	82.5	82.6	82.3	82.4
6	82.8	83.1	82.4	82.7
7	82.6	82.5	82.9	82.7
8	82.4	82.7	82.8	82.8
DISH END		Design Thickness : 57 mm		
POINT NO.	TOP	BOTTOM	NORTH	SOUTH
1(E)	58.6	58.4	58.5	56
2(E)	58.7	58.3	58.4	59
9(W)	58.3	58.6	58.3	56.2
10(W)	58.5	58.7	58.9	58.4



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**ANNEXURE -3**

**THICKNESS MEASUREMENT REPORT OF D-PANEL TUBES , CUT CORNER TUBES, REAR WALL TUBES, FRONT WALL TUBES AND BAFFLE WALL TUBES:**

D-PANEL TUBES			FRONT WALL TUBES:		
TUBE NO.	TOP	BOTTOM	SL. NO.	TOP	BOTTOM
2	4.9	4.9	2	4.7	4.8
8	4.6	4.8	8	4.7	4.7
14	4.9	4.8	14	4.7	4.8
20	4.9	4.7	20	4.5	4.7
26	4.9	4.7	26	4.7	4.6
32	4.9	5	32	4.7	4.8
38	4.9	5.1	38	4.9	4.7
44	4.8	4.8	48	4.9	4.8
50	4.9	4.9			
56	4.7	4.8	<b>BAFFLE WALL TUBES:</b>		
62	5	5	SL. NO.	TOP	BOTTOM
68	4.8	4.9	1	4.9	4.9
			7	5	4.9
<b>CUT CORNER TUBES:</b>			13	4.9	4.8
TUBE NO.	TOP	BOTTOM	19	5	4.8
73	5	4.7	25	4.9	5
78	4.9	4.9	31	5.1	5
84	5	4.8	37	5.1	4.9
90	5	4.9	43	4.9	4.8
96	5	4.8	49	5.1	4.9
102	5.1	5	55	4.9	4.9
			61	5	5
<b>REAR WALL TUBES:</b>					
TUBE NO.	TOP	BOTTOM			
108	5	4.9			
114	4.8	5			

Note:

1. All readings are in MM
2. Refer annexure-7 showing tube layout & numbers identifying the individual tubes.
3. Design thickness of tubes: 4.5 mm

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**ANNEXURE -4****THICKNESS MEASUREMENT REPORT OF BANK TUBES, BAFFLE WALL TUBES AND SIDE WALL TUBES:**

<b>BANK TUBES "A" WALL (Design Thickness : 3.6 mm)</b>		
<b>TUBE NO.</b>	<b>TOP</b>	<b>BOTTOM</b>
6	3.7	3.8
11	3.5	3.6
14	3.6	3.6
<b>BANK TUBES "B" WALL (Design Thickness : 3.6 mm)</b>		
<b>TUBE NO.</b>	<b>TOP</b>	<b>BOTTOM</b>
16	3.6	3.6
17	3.7	3.7
<b>BANK TUBES "C" WALL (Design Thickness : 3.6 mm)</b>		
<b>TUBE NO.</b>	<b>TOP</b>	<b>BOTTOM</b>
22	3.7	3.8
27	3.8	3.6
<b>BAFFLE ("D") WALL TUBES (Design Thickness : 4.5 mm)</b>		
<b>TUBE NO.</b>	<b>TOP</b>	<b>BOTTOM</b>
1	5.1	5.3
6	5.5	5.2
11	5.4	5.1
<b>NORTH SIDE WALL TUBES: (Design Thickness : 4.5 mm)</b>		
<b>TUBE NO.</b>	<b>TOP</b>	<b>BOTTOM</b>
2	5	4.9
8	5	5
14	5	4.8
26	4.8	5

**Note:** 1. All readings are in MM

2. Refer annexure-7 showing tube layout &amp; numbers identifying the individual tubes.



**ANNEXURE -5**

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**THICKNESS MEASUREMENT REPORT OF PRIMARY SUPERHEATER TUBES (STAGE-1):**

<b>BEND-A</b>		
<b>TUBE NO.</b>	<b>TOP</b>	<b>BOTTOM</b>
2	6.8	6.5
7	6.9	6.7
15	6.8	6.7
21	6.6	6.7
27	6.7	6.8
34	6.6	6.5
<b>BEND-B</b>		
<b>TUBE NO.</b>	<b>TOP</b>	<b>BOTTOM</b>
3	6.9	6.8
9	6.9	6.9
10	6.9	6.8
22	7	7
28	7.2	7
34	6.9	6.9
40	7	6.9
<b>BEND -C:</b>		
<b>TUBE NO.</b>	<b>TOP</b>	<b>BOTTOM</b>
1	6.3	6.4
7	6.5	6.4
13	6.9	6.8
19	6.4	6.4
25	6.6	6.6
31	6.7	6.6
37	6.4	6.9
<b>BEND-D</b>		
<b>TUBE NO.</b>	<b>TOP</b>	<b>BOTTOM</b>
2	6.3	6.4
8	6.5	6.4
15	6.5	6.4
21	6.4	6.4
27	6.4	6.3
33	6.5	6.4
39	6.5	6.4

**Note:-**

1. All readings are in MM
2. Refer annexure-7 showing tube layout & numbers identifying the individual tubes.
3. Design thickness of tubes : 7.1 mm

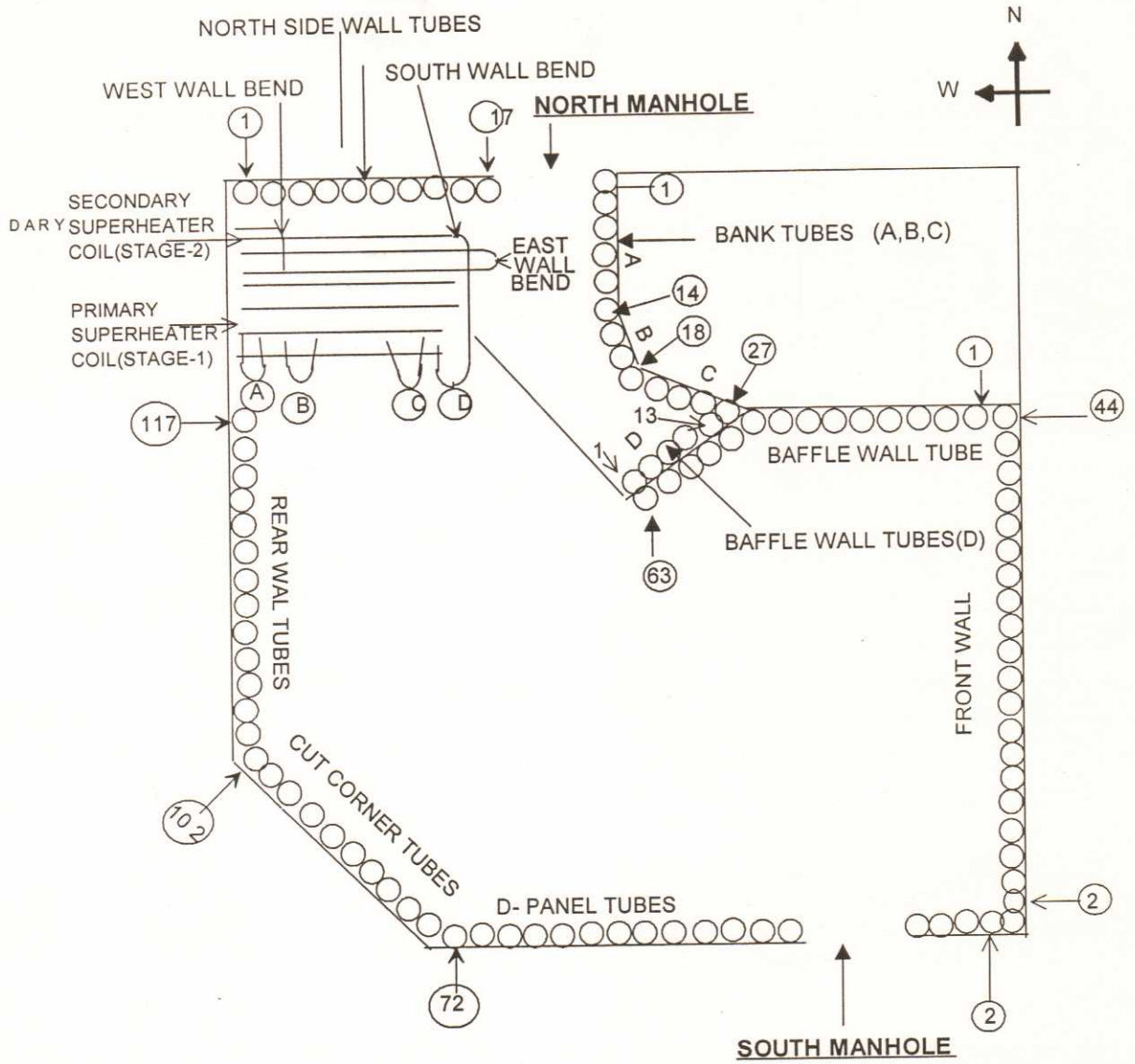
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**ANNEXURE -6****THICKNESS MEASUREMENT REPORT OF SECONDARY SUPERHEATER TUBES  
(STAGE-2):**

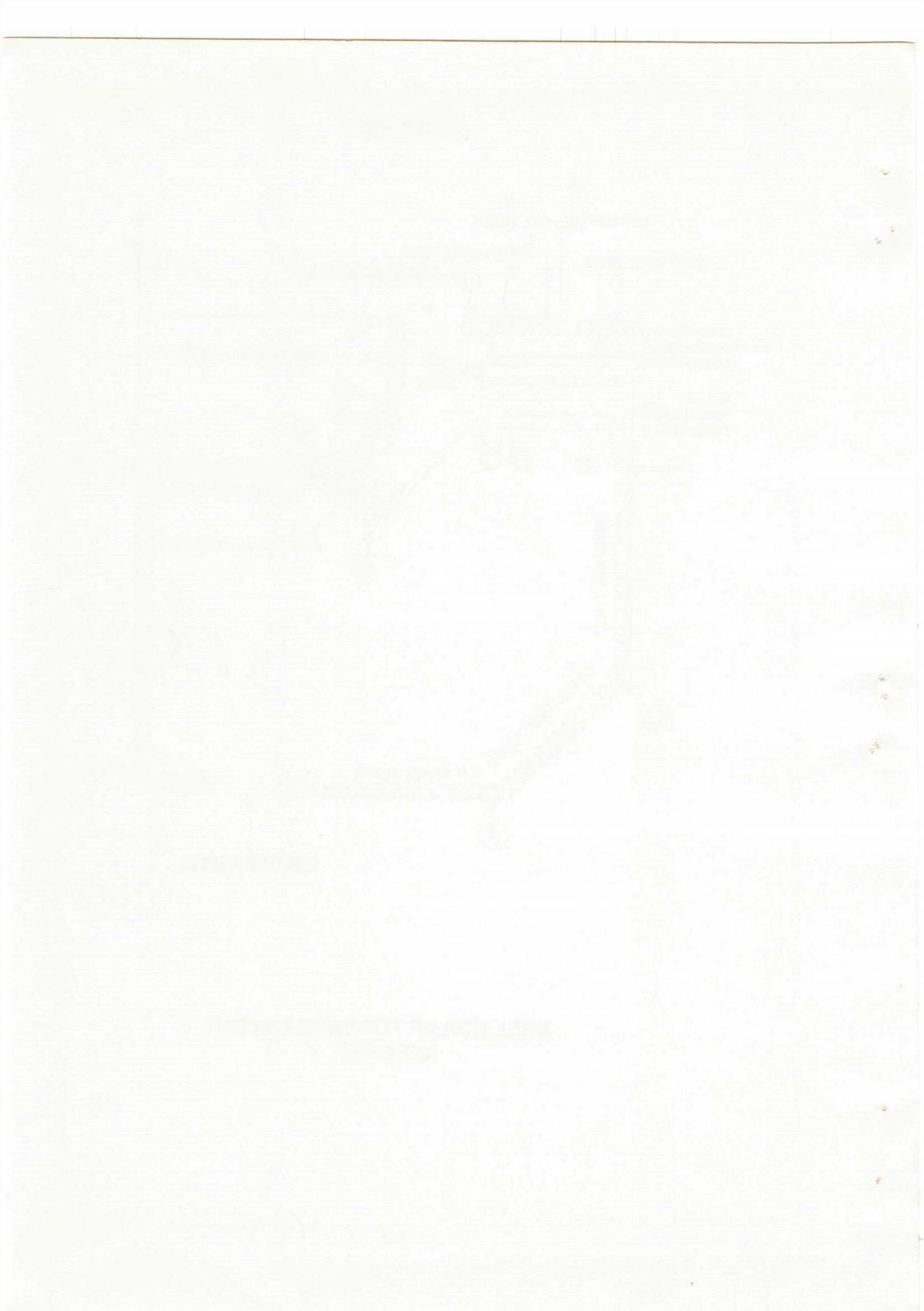
<b>WEST WALL BEND</b>		
<b>TUBE NO.</b>	<b>TOP</b>	<b>BOTTOM</b>
2	5.5	5.6
8	5.6	5.7
14	5.7	5.7
20	5.8	5.9
26	5.8	5.8
32	5.5	5.6
<b>SOUTH WALL BEND</b>		
<b>TUBE NO.</b>	<b>TOP</b>	<b>BOTTOM</b>
2	5.9	5.6
8	5.5	5.4
14	5.6	5.5
20	5.4	5.5
26	5.9	5.6
32	5.5	5.5
<b>EAST WALL BEND</b>		
<b>TUBE NO.</b>	<b>TOP</b>	<b>BOTTOM</b>
2	5.2	5.3
8	5.3	5.3
14	5.4	5.2
20	5.1	5.3
26	5.2	5.2
32	5.2	5

Note :-

1. All readings are in MM
2. Refer annexure-7 showing tube layout & numbers identifying the individual tubes.
3. Design thickness of tubes: 5.6 mm



**BHEL BOILER FURNACE LAYOUT  
(GT-2068)**



# INSTRUMENTATION

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WITIA (V. MUSSTIA)

**CONTROL VALVE: MAINTENANCE JOBS**

**LCV - 8 -** C/V was dropped from bonnet. Removed seat from body. Plug and seat were machined and lapped. All parts were cleaned and valve overhauled. C/V assembled and C/V stroke was checked.

**FRCV - 3 -** C/V was opened from bonnet & from bottom flange. All parts were cleaned and overhauled. Plug and seat were lapped. Replaced diaphragm. C/V assembled & C/V stroke was checked.

**FRCV - 1 -** C/V diaphragm was opened and checked found to be good, same was refixed. Quick exhaust provided for faster action. Bottom flange was opened, cleaned and refixed it. C/V stroke was checked.

**PRCV-6(V-27) -** C/V was opened from bonnet. . All parts were cleaned and valve actuator and hand jack assemble were overhauled. New modified plug with linear characteristics and soft seat were provided. Two bearings were replaced in hand jack assemble. C/V stroke was checked.

**V-7 -** C/V was dropped from body line and disassembled. All parts were cleaned and overhauled. Plug and seat lapped. C/V assembled and replaced studs and nuts. Provided new gland packings. Pressure test was done upto 40 kg/cm<sup>2</sup> to check passing. C/V stroke was checked. All copper tubing was replaced by S.S. tubing with S.S. Fittings.

**PICV-14 -** C/V was dropped from bonnet and disassembled. All parts were cleaned and overhauled. The body step for seat was found damaged. After Machining work seat was fixed in body. Seat ring part coming out from flange level was cut down. Pressure test was done upto 40 kg/cm<sup>2</sup> to check passing. .Replaced three V/P gauges. C/v stroke was checked.

**FICV - 14 -** C/V valve positioner was replaced by new one as it was not working properly. C/V was cleaned and stroke was checked

**LCV- 15 -** C/V was opened from bonnet. Machining was done on plug- stem. All parts were cleaned and overhauled. C/v stroke was checked.

**PRCV - 25 -** C/V, actuator was removed for maintenance. Diaphragm was replaced by new one and all parts were cleaned and overhauled. Copper tubing was replaced by S.S. tubing with S.S. fittings. C/v stroke was checked.

**USV - 1117 A AND USV - 1117 B-** New pneumatic 5 port slider valve was provided and S.S. tubing with S.S. fitting was done so that at a time one c/v will open and other c/v will close and vice versa.

**USV -1106 A AND USV -1106 B -** New pneumatic 5 port slider valve was provided and S.S. tubing with S.S. Fitting was done so that at a time one c/v will open and other c/v will close and vice versa.

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**LCV- 2B** - C/V was opened. Machining work was done on seating portion of plug and seat. New v/p with I/P (make valflo) was fixed On c/v. C/v stroke was adjusted from 4 m.a. To 8 m.a. (split range) LY- 2B tag was generated in DCS and necessary panel wiring done. A New signal cable was laid from JBC-35 to LCV-2B. c/v stroke was checked from C/R . Did S.S. tubing with S.S. fitting for the C/V .

**MICV -22** - Old valve with hydraulic actuator was replaced by new Masonelin make valve with pneumatic actuator. New matching flanges were welded in line. Mounted Limit switch on c/v for c/v open -close indication. C/V stroke was checked.

**MICV - 30** - C/V was dropped from bonnet . Machining was done on plug & stem. All parts of C/V were cleaned and overhauled. V/P was replaced .C/V stroke was checked.

**MICV - 28** - Positioner by pass switch of v/p was replaced . c/v was cleaned and preventive maintenance was done. C/V stroke was checked.

**TRCV - 142** - C/V was dropped from bonnet and disassembled. Machining was done On plug and seat ring to increase the Cv of the valve . C/v stroke was checked.

**PICV - 13 A**- C/V was cleaned and c/v preventive Maintenance was done. C/V stroke was checked

**PICV -13 B** - C/V was cleaned and c/v preventive Maintenance was done. C/V stroke was checked.

**PIA -81** - Impulse tapping related with PICV -14 was leaking. This was checked and found 1/2" S.S tube from union to mech. Main valve was damaged. It was replaced by 1/2" S.S. tubing and made it alright .

**PICV -005** - C/V was not working properly in range 50 % to 100 % for split range. Checked and found v/p air regulator was faulty. It was replaced by new one and made it alright .

**FIC-10** : C/V opened from line flange to check passing. Found alright. Preventive maintenance was carried out. C/V stroke was checked.

**FIC-9&11** : C/V opened from line flange to check passing. Passing observed. Machining was done On plug and seat. Preventive maintenance was carried out. C/V stroke was checked.

Following were cleaned and preventive maintenance was carried out. Also v/p cleaned and related air header & regulator also flushed. C/V stroke was checked.

- (1) FICV- 7 (2) FICV - 8 (3) MICV -24 (4) MICV -25 (5) MICV -26 (6) MICV -29
- (7) MICV -31 (8) MICV -32 (9) PRCV -4 (10) PRCV -28 (11) V - 150 (12) FICV-200
- (13) PICV -4805 (14) PV -801 (15) V1 (16) FRCV - 5 (17) PRCV -2 (18) FRCV - 1

Copper tubing of following C/V was replaced by S.S. tubing .

- (1) PICV - 20 (2) THICV - 60 (3) PICV - 14 (4) MICV - 11 (5) V27 (6) V7
- (7) MICV - 13 (8) MICV - 14 (9) MICV - 15 (10) MICV - 16 (11) PICV - 137
- (12) FRCV - 5



New c/v gland packings were provided for following control valves.

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(1) PICV -13A (2) PICV-13B (3) PICV-20 (4) LCV - 5 (5) TICV-142B (6) PICV -17  
(7) PICV-5 (8) TRCV-11 (9) VS-203 (10) PRCV - 1(11) LCV-20 (12) LCV - 25  
(13) FICV-8 (14) FICV-7 (15) PRCV-4 (16) FICV-14 (17)FICV -12 (18) MICV-61  
(19) FRCV -2

General maintenance were carried out for following control valves. c/v cleaned, hand jack checked, did greasing on necessary parts, checked c/v gland, flushed air headers & regulators and finally c/v colour painting work was done.

(1) MICV -13 (2) MICV -14 (3) MICV-16 (4) MICV -15 (5) PRCV -1 (6) LCV -12  
(7) V-6 (8) V-4 (9) TRCV -11 (10) LCV -27 (11) TRCV-12 (12) LCV - 5  
(13) PICV -17 (14) V-18 (15) V-1 (16) PV -801

### COMPRESSOR HOUSE JOBS :

#### **NGBC/AGBC Compressor (800J):-**

- Removed all radial , axial and key-phasor probes along with relevant junction boxes, speed pick-ups, RTDs, pressure gauges and THIs to facilitate mechanical jobs. After completion of jobs the same were fixed back after cleaning/functional checking of RTDs and gap voltage adjustments for radial and axial probes.
- Replaced proximeter of NG comp radial probe and two cable hose of NG radial probes.
- Replaced 4 new RTD element of point no. 817,824,825&826
- Woodward governor was checked and also GE fanuc PLC functional checking was performed with respect to governor.
- All the RTDs of NG and AG compressors were checked. Checked Temp.trip contacts going to GE fanuc PLC.
- All the relays in local panel were checked and tightening of terminations was carried out.
- Attended cable glands of various vibration signal junction boxes.
- Relay No. R-76, R-88, R-72 corresponding to VAHH-801, ZAHH-801,TAHH-827 respectively were replaced by new one in local panel. Functional checking of relays were performed.
- TAHH-827 checked for getting continuous faulty alarm in C/R and found wiring was not proper .Corrected wiring and made the TAHH-827 alright
- Checked RTD no. 818 as it was opened and showing faulty reading . Attended and same was terminated in monitor no3, channel no2

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### **Air Compressor (101J) :-**

Following jobs were carried out for installation and commissioning of 3500 series vibration monitoring system for Air Compressor :

- Removed all old 7200 series BNC radial vibration , axial displacement, acceleration, speed and key-phasor probes and all proximities alongwith relevant junction boxes and extension cables.
- 7200 Series monitor Rack in control room was removed and new 3500 series monitor rack was installed alongwith face mount display. Necessary cabling for powering up the rack and display and for earthing was done.
- New 3500 series proximities were mounted in junction boxes and JBs were installed at respective locations. Installation of new compatible probes for axial displacement, radial vibration, acceleration and speed alongwith extension cables and proximities was carried out in field.
- Individual loops were checked for continuity between field and control room. Probe characteristics were verified using TK-3 kit and gap voltages were set for all the installed probes.
- Software for rack configuration ,data acquisition and operator display was loaded in operator display PC in control room. Rack monitors were configured as per operational requirement. Functional checking of modules was performed.
- One new TDX-connex was installed from available stock and one existing TDX-connex was upgraded to TDX-net for interfacing with DM-2K computer. Necessary configuration was done in DM-2K software for capturing static and dynamic data from monitoring rack via TDX-net and TDX-connex.

Removed speed pick-ups, pressure gauges and THI's to facilitate mechanical jobs. After completion of jobs the same were fixed back after cleaning/functional checking .

General cleaning and overhauling of governor positioner carried out , replaced it's gauges, attended it's regulator, checked lock out relay, cylinder leakage . Positioner was fixed and stroke checking was performed.

### **N.G. Compressor (102J):-**

- Removed all radial and axial probes, bearing T/Cs PIs and THIs to facilitate mechanical jobs. After completion of jobs the same were fixed back after cleaning/functional checking of T/Cs and gap voltage adjustments for radial and axial probes were carried out.
- Beacon make digital speed indicator magnetic pick-up probe was removed and installed back after clearance from Mech.
- Checked compressor general and thrust bearing's T/C one element was found opened resoldered it on bearing pad.
- PIC-315: Removed connection and fixed back all fittings and checked the stroke.

### Synthesis Gas Compressor (103J) :-

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- Removed all radial , axial and key-phasor probes alongwith relevant junction boxes, speed pick-ups,T/C, pressure gauges and THIs to facilitate mechanical jobs. After completion of jobs the same were fixed back after cleaning/functional checking and gap voltage adjustments for radial and axial probes were carried out.
- Removed 38 kg/cm2 steam pressure tubing near HP turbine.
- PRCV-12 general cleaning, overhauling and functional checking was performed. Its piston/cylinder were lubricated. It's air regulator, gauges was replaced. Checked air failure function. Stroke-checking from control room was performed.
- Governor positioner MIC-23 cleaning/checking was done and its stroke checking was performed.

### Ammonia Refrigeration Compressor (105J):-

- Removed all radial , axial and key-phasor probes alongwith relevant junction boxes, speed pick-ups,T/C, pressure gauges and THIs to facilitate mechanical jobs. After completion of jobs the same were fixed back after cleaning/functional checking and gap voltage adjustments for radial and axial probes were carried out.
- Governor positioner PRC-9 pneumatic actuator cylinder, fittings and tubing's were checked. Its stroke and lock-out relay functional checking was also performed.
- Replaced damaged probe connector of 4H and extension cable of 8V,8H.
- Replaced probe no. 7H,5V,5H and adjusted the gap voltage.

### FIELD INSTRUMENTS JOBS:

- Auxiliary Burner no. 1& 2: Did SS tubing from solenoid valve to cylinder actuator for all Naphtha, steam and gas valves. Cleaned all Gas, neptha and steam valves of both burners. Checked valve operation and open-close indication in Ammonia control room. Changed the micro switch of steam valve of burner 2 as it was faulty.
- SI-103J: Did direct wiring from local Beacon indicator to DCS as earlier it was coming through Beacon frequency to current converter mounted in DCS cabinet room.
- PRC-23: Provided flexible hose tube from power cylinder to actuator in place of copper tubing. Did general cleaning and stroke checking
- JBC-01: Replaced the damaged multicore cable from JB to C/R and did connections.
- 104J BFW pump: Removed inst. Panel and associated tubing's and fixed back after completion of mach. Work. Replaced S/V coil as old coil was burnt.
- Eye- Hye: Checked the electrodes and flushed the chamber.
- 109 CA, CB: Inlet/outlet T/C provided and made connections.

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- Laid seven 12 pair signal cable for JBC-02,JBC-04,JBC-06,JBC-07,JBS-02,JBS-07 and JBS-21 to replace damaged cable from JB to C/R. Did respective connection with ferruling of each pair of the cable.
- Removed Old pipe and JB's from 103J,105J,101J compressor area.
- Calibrated LTS PI-105 and PI-106 .
- Removed all T/C from 103D secondary reformer to facilitate mechanical jobs and fixed back after completion of job.
- Removed FR-4 TX. from mounting and fixed back after getting clearance.
- Disconnected 172-C CW flow orifice tapings and connect after getting clearance.
- Removed 2 T/c from 108 C2 A, 108 C2 B and fixed back after completion of Mech. Job.
- Removed old MIC-22 controller with old tubing's.
- FIC-9, FI-62 checked calibration.
- FR-32 impulse line disconnected and connected after mech. job.
- Igniters and solenoids valves of start-up heater were cleaned and functionally checked.
- In reformer area TI-98 and O2 analyser alongwith calibration panel , D.G points tubing were removed and refixed after completion of mech. work.
- Naphtha pre-reformer were (H-110, H-111): All the igniters/gas gun were cleaned and functionally checked.
- LIC-1 leveltrol transmitter flapper/nozzle cleaned and relay was checked. Relay to nozzle tube was cleaned and functional checking of transmitter was performed. Also flushed the troll in startup.
- Instrument air headers flushing were carried out in different areas.
- 111-F local PI isolation valve was replaced by new valve.
- PRC-18 impulse line was disconnected and connects after completion of mech. work.
- Provided Manual loader for ID fan OST and removed after completion of work.
- Provided PI on 118-C and 102J Lube oil line.
- Replaced solenoid valve coil of V-203 and V-203A and checked logic.
- Checked and attended TI-650 & TI-651 for wrong indication.

- LC-23 leveltrol transmitter flapper/nozzle cleaned and relay was checked. Relay to nozzle tube was cleaned and functional checking of transmitter was performed. Also flushed the troll .
- Provided 0-6 kg/cm2 PI and 0-100 °C THI at 104-J.
- Dressed properly all PDR tubing's.
- Duplicated the following signal and did necessary wiring and configuration in DCS so that both indications will have to be available in AMMONIA and UREA plant.  
FR-1101 CO2 flow (Urea plant)  
FR-18 Ammonia flow(Ammonia plant)
- General cleaning and checking of all the level trolls of 104F, 105F, 106F, and 108F were carried out.
- Provided Pressure gauges on HP pump and steam drum, 102C, Pressure transmitter flushing and zero checking and other related work with Boiler Inspection were carried out.
- Trip circuits of the all compressors were checked with production people and adjusted switches as per requirement and design trip value.
- LC-13, LC-14: Level troll brought to DCS.
- FIC-9 Pitot venture was removed, adjusted the immersion length and fixed back in line.
- Following ISO related quality affecting instruments (total 31) were calibrated .

PT-7, PT-8, PT-10, PT-28, PT-150, PT-5, PT-4 , PT-80, PT-62, PT-9, PT-36, FT-1, FT-2, FT-3, FT-100, TI-104E, AR-1, PT-1027, FT-1006, FT-1005, PIC-1A,, TI -0117, TI-0007, TI-0011, TI-0026, TI-0039, TI-0036, TIC-1025, PT-501, PT503, PT-27

**CONTROL ROOM JOBS :**

- R-1-45 lamp indication in auxiliary console was configured in PLC.
- Replaced CRT of PLC operator stations and ESR of HIMA PLC to TFT monitors.
- I-16 block logic modified as per the requirement of production people against MWO: 4979 dt:28/11/03 and checked the modified logic in presence production people.
- Checked all console push button ,indicating ,limit switch lamps and tightened the connection .
- DCS shift report was modified with addition of new instrument tags as per requirement of production department.
- Complete logic for sequential operation of air dryer was checked in DCS after shifting of the dryer to new location.

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**Technical dept. Jobs :**

- Dryer shifting: Three T/C cable and one 12 pair cable laid from old installation to the new installation. Installed one new JB at old dryer location and made connections.
- Following New flow ,pressure and temp tags were added in DCS for R-LNG and for other modifications.

FI-002 LNG supply from GSPL  
FI-004 NG fuel to plant  
PT-001 LNG supply from GSPL  
PI-002 RLNG Pr.at down stream of PIC-002  
PI-004 NG Fuel to plant  
PIC-004 Ng fuel pressure  
PI-65 NG to Aux. boiler  
TI-091 AG to 101-B  
TI-65 NG to aux. boiler  
TI-004 NG to plant

- Reranged FR-32 and FI-63 due to change of existing orifice to new enhance orifice.
- Configured V-203A in PLC block I-46 and checked modified logic.

**ANNUAL MAINTENANCE OF UPSS, DCS AND PLC :**

**UPSS**

- The preventive maintenance of UPSS was carried by M/s IL, Jaipur against the AMC. General cleaning, servicing and configuration of parameter checking were done.
- UPSS to AVR Auto changeover was checked, found OK. Battery performance was checked by switching off input supply. Conditions of the battery were checked by voltage reading before and after discharging of batteries and found in good condition.

**YBL DCS**

- The preventive maintenance of DCS was carried by M/s YBL as per the AMC. All EFCD, EOPS, HIS ,EFMS and Engineering stations circuit PCB cards were removed from cabinet/panel and cleaned. Overhauled the fans, cleaned the filter, panels and cabinets.
- All the jobs related with AMC were attended. Checked the redundancy for CPUs, MAC2 cards, power supplies and HF buses. Taken the latest backup of complete DCS in magnetic tape .

**HIMA PLC :**

- The preventive maintenance of HIMA PLC was carried out. Cleaning of filters, fans, cabinets etc. was carried out for all the four PLC stations.
- Checked the redundancy of all the four PLC at card ,CPU and power supply level. Checked Error code by removing every card and redundant card(If applicable),fuse etc. and correct the discrepancy found at any level. The whole system is checked in presence of PLC representative for fault diagnostic measure.
- Created holes in the existing cable trays of PLC3 for proper cooling of cards. Provided /Fixed two fans of 12V rating in series on the PLC doors for extra cooling of cards in PLC2 & PLC3.
- Replaced analog cards F-6214 at locations 1301,1303,2401 in PLC-1, 1305,1302,2402 in PLC-2 & 2402 in PLC-3
- 5.Checked Earth continuity and 24Vdc power supply through CRO.

**GE-Fanuc PLC**

- The preventive maintenance of GE-FANUC PLC was carried out. Cleaning of cards, filters, fans, cabinets etc. was carried out .PLC was completely tested for redundancy at CPU and bus level from A to B change over and vice versa.
- 2.Checked and tightened all terminal strip connection in cabinet and replaced one faulty terminal strip.

**ABB CO2 and CH4 Analyser**

- The preventive maintenance of ABB make CO2 and CH4 analyser were carried out. Replaced all filters in sample line and optical alignment of the sensor was performed. Checked electronic circuits and calibration of both analyser were carried out .

**CAPITAL JOBS CARRIED OUT IN ANNUAL TURNAROUND**

- LIC-27,LIC-12,LIC-15:Replaced pneumatic head assemble by electronic head assemble. Laid single pair cables from level troll and I/P of the respective valve to JB's.Configured the level trolls in DCS. Did calibration and checked stroke.
- Replaced 7200 series vibration system to 3500 series vibration system for air compressor.

**PREVENTIVE MAINTENANCE JOBS (As per the ISO 9001:2000 list)**

- Preventive maintenance of following control valves, as per the list, were carried out by general cleaning, greasing, positioner & I/P checking, gland replacement / tightening, stroke checking.

FRCV-1, FRCV-2, FRCV-3, V-18, PRC13A/B, MIC-22, FICV-12, FICV-14, PRCV-25 LCV-13, FICV-7, FICV-8, FICV-9, FICV-10, FICV-11, FICV-15

- HIC-101J for 101JT: Carried out general cleaning and overhauling. Changed air regulator of Governor positioner, stroke checked and overhauled.
- MIC-23 for 103JBT : Carried out general cleaning and overhauling. Changed air regulator of Governor positioner, stroke checked and completely overhauled.
- PRC-12 for 103JAT : Carried out general cleaning and overhauling. Stroke checked and completely overhauled.
- PRC-9 for 105JT : General cleaning, overhauling of governor positioner was carried out and checked stroke.
- The preventive maintenance of UPSS was carried by M/s I/L, Jaipur. The general cleaning, servicing and configuration and parameter checking were done as per AMC. The trip setting noted down using the hand held configurator. Battery back up test carried out. Redundancy test for the UPS1 and 2 checked.
- The preventive maintenance of DCS was carried by M/s YBL as per the AMC. All EFCD, EOPS, EFMS and Engineering station cards were removed from cabinet / panel and cleaned. Overhauled the fans, cleaned the filter, panels and cabinets. Checked the redundancy for CPUs, MAC2 cards, power supply and HF buses. Engineering station and EOPS healthiness checked through software.
- The preventive maintenance of HIMA PLC were carried out by M/s Chemtrol Ltd.as per the AMC. Cleaned filters, fans, cabinet and physical inspection were carried out. Checked the redundancy for CPU, input and output cards, power supply cards and HIMA buses.
- The preventive maintenance of GE-FANUC PLC were carried out. PLC was completely tested for redundancy at CPU and bus levels and the changeover from A to B and vice versa were checked.



## UREA PLANT

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### HITACHI (CO<sub>2</sub>) COMPRESSOR

- All vibration probes extension cables and Proximeter were removed and checked and installed back to facilitate Mech. Maintenance jobs.
- All RTDs and Thermocouples were removed to facilitate Mech. Maintenance, checked and installed back. In TE-1814 lug were soldered.
- Worked with Mech. Maint. in instrument related job for the compressor.
- Followings Trip and Alarm Switches were cleaned, checked and calibrated :-  
PSLL-1801A/B/C, PSLL-1818A/B/C, PSLL-1844, PSL-1838A/B/C, PSL-1813, PSHH-1839A/B/C, LAHH-1804, LAHH-1806, LAHH-1808 & LAH-1802.
- Local Control Panel and TLC Box were cleaned, all wiring connection were tightened.
- Followings transmitters were cleaned and calibrated:-  
LICT-1805, LICT-1807, LICT-1821, LICT-1803, PI-1802, PI-1809, LT-1809, PT-1836
- Speed probes SE-1801, SE-1802 and SE-1803 were checked.  
Key phasors probes KE-1801, KE-1802 and KE-1803 were checked.
- All junction boxes were cleaned, terminal tightened and terminal details were noted.
- All I/H converters calibrated
- Redundancy of OMRON PLC (CPU) and Cx programmer software checked.

### OLD CENTRIFUGAL AND PB COMPRESSOR :

- Panel was cleaned and all wiring connections were tightened.
- Following trip and alarm switches were calibrated :-  
PHCO-1133, PHA-1133, PLCO-1101, PHCO-1127, PLCO-1124, PLCO-1145, PHCO-1126, PHCO-1132, PLCO-1166, LHCO-1123, PLCO-1153, PLCO-1167, PLCO-1160,

### CONTROL/ MARSHALLING ROOM :

- DCS, ACDB, PDB, Vibration cabinet, PLC Panel were cleaned, all terminals were tightened.
- Radiac Relay unit for LR-1201 was calibrated. One spare unit was also calibrated.

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- Annual preventive maintenance of DCS, like cleaning of Cards, Software backup of FCS and all ICS, Batteries Voltage of all ICS and FCS were taken and found to be O.K. Functionality checking of FCS and all ICS by diagnostic software was carried out, by Yokogawa representatives and found to be O.K.
- Battery Voltage of both CPU of OMRON PLC was checked and found O.K.

#### **OTHER PLANT JOBS :**

- Following ISO Quality affecting instruments were calibrated:-  
PT-5303, PT-4405, PT-1121, PT-1145, PT-1201, PT-1202, PT-1422, PT-1421, PT-1105, PT-1802, SI-1401A, SI-1401B, FT-1201
- All Plant J. B.s terminal were tightened.
- LRC-1201 and LH-1201 detectors were removed to facilitate Mech. Maintenance.
- 8 nos. HP Thermowell removed and hydrottested. One thermowell TR-1209 gases in let to HP condensor was replaced with new one due to bad condition of the Thermowell.
- Preventive maintenance of turbine flow meter for cooling water was carried out.
- PT-14-21, PT-1422, PT-1481 and LRC-1421 transmitters were calibrated.
- Following alarm and trip switches were calibrated-  
PAHH-1194, PAH-1193, PHCO-1363A&B, PLCO-1102A, PLCO-1201A, PALL-1195, PLCO-1102B, PSL-1101, LSL-1357
- Coordinated with Production/ Maintenance persons for miscellaneous plant Jobs.
- Trip switch PL-1104A & PLCO-1104A switches were replaced by single switch for removing obstruction of junction box on Ammonia pump A.
- Painting of instrument supports carried out.
- Shifted PI Gauge of circulation pump discharge.
- Provided new pressure Transmitter on P-1201 A and B

#### **WEEP HOLE CHECKING OF HP VESSELS:**

Coordinated with production persons for inst. Air/ clearing weep holes & tubing.

#### **CONTROL VALVES :**

- HICV-1801 and PICV-1810 Control valve were opened from bonnet and trim parts including plug, seat and carbon seal rings were replaced by spare once. Boxed up the valve and calibration carried out.

- LRCV-1201 – Dropped from line and following jobs carried out. Diaphragm changed with new one, Plug & Seat and gland packing replaced. Calibration carried out after refixing the valve in line.
- HICV-1201 The valve was dropped from line, over all maintenance was carried out including 1..diaphragm changed with new one, 2..Plug & Seat inspected and slight machining was done on seat at lens ring gasket portion and 3.. Internal cavitations in the body at gland packing collar was made up with welding and machining carried out. Fixed it back and calibration carried out.
- PICV-1129 – : Control valve dropped from line ,body cavitations at seat collar rectified by machining, provided new gaskets and gland packing and refixed after satisfactory hydro test at 30kg/cm<sup>2</sup>.
- PICV-1181 – Control valve was opened from bonnet checked plug and seat. Found alright.In place of damaged graphoil ring, provided new graphoile rope & box up.
- LICV-1351 - New Electronic positioner and regulator provided and overhauled.
- LICV-1235 - Diaphragm and positioner changed and overhauled.
- LICV-1430 New control valve & transmitter installed on pre evapreator condensate port.
- FICV- 1351 Control valve was opened from line Diaphragm and trim inspected, found alright.
- FRCV-1201 Additional gland packing provided and calibrated.
- MICV-1101 Plug & seat were replaced by repaired ones torectify the passing problem.
- HICV-1207 opened from line, Completely serviced the valve and refixed.Only actuator diaphragm needed replacing with new one.
- FICV-1302 Control valve seat found damaged & made from teflon by Hitech, Baroda.
- PICV-1979 A & B control valve are open from bonnet, Checked the trim and actuator diaphragm.Found in good condition.
- HICV-1221 A & B control valve were opened from line & checked condition of the baffle found it ok. Actuator also overhualled.
- N/C Ratio meter monoblock valve was overhauled.
- PICV-1130 control valve removed from line & send to Hitech work shop at Vadodara for the passing problem. modified the top seat as per requirement. Hydrottested it at our workshop, found no passing at 5Kg/cm<sup>2</sup> test pressure. Refixed in line.
- Prill Divert three-way valve replaced with spare one.

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- HICV-1424 control valve was changed with new one.
- General external overhauling of the following control valves was carried out :-  
TICV-1421 , FICV-1352, PICV-1502A, LICV-1353, LICV-1420, FICV-1204, FRCV-1421, FICV-1303, PICV-4801, FICV-1351, HICV-1581, PICV-1481, TRCV-1201, TRCV-1202, HICV-1221B, FICV-1302, HICV-1222B, HICV-1221A, HICV-1222A, HICV-1208, LICV-1422, LICV-1301, LICV-1502A, PICV-1221, LICV-1351.
- Painting and stroke-checking of Control valves carried out.
- Carried out shifting of all the I/P Converters of all the Control Valves of Prill Tower to Junction box in closed Chamber.

## OFFSITES-UTILITY PLANT

### BOILER PLANT

#### **CONTROL ROOM PANEL INSTRUMENTS:**

- Following pneumatic Receiver/Recorders were cleaned & checked the calibration. (General cleaning, Cleaning of Orifices, Flapper Nozzle, and seal checking was done).  
PR1/PR2, PRC5, PR15, PRC 22, PIC5151, FR2, FR3/FR4, TRC4, TRC5, LRC2, LRC3 , LRC 4, FRC1, FRC11/PR15, FRC22, FRC21/FR 22 .
- Following Set point Tx. were cleaned and checked the calibration.  
FR3/FR4, TRC4, TRC5, LRC3, FRC1, LRC2, PRC5, FRC11, FRC21, FRC22, PIC5151, PIC (Gas pressure controller)
- Following Controllers were cleaned and Synchronised.  
(Cleaning of Orifices, Flapper Nozzle)  
TRC4, TRC5, LRC3, FRC1, LRC2, PRC5, PIC 22, FRC11, FRC21, PIC5151
- Following Receiver switch set value were checked  
PSL-2, PSL-6, PSL-7, PSL-8, PAL-4, LAL-3, LAH-4  
FSL-2, FSL-4, FSL-11, FSL-5111, PSL 41.
- Following Temp. Indicator / Recorder were cleaned and checked.  
TIA-6, TIA-7, TI-11, TI-12, TI 14 TI-21 & TR 13.
- Both air regulators for main Control Panel were cleaned , overhauled.
- Following Square Root Extractor 's relay, flapper - Nozzle were cleaned.  
FSQ 1, 2, 3, 4, 11, 21, 22,
- TRC-4/TRC-5: checked its Temp. to Current converters, I/P Coverter and related wiring, tubing and complete loop operation.
- All wiring terminals of BMS Panel & Main Control Panel were checked, cleaned and tighten.
- Replaced the pneumatic local loop of PIC-50 into remote electronic loop using Yokogawa make UT 350e Electronic controller and Rosemount make SMART transmitter. and brought control on main panel.

#### **UPSS SYSTEM (Performance and reliability check)**

- Checked the reliability performance M/s IL make stand by UPS System.
- Checked the performance of batteries for M/s IL make UPS System by taking 10 minutes to 2 Hrs. load on batteries. Changed Battery No. 13 of Bank B as it was found weak.
- M/s Keltron make UPS System is disconnected and removed from UPSS room.

## FIELD JOBS :

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Following field switch set value were checked

- LSL-1, LSL-2, LSL-3 of steam drum.level  
( LSL-2 & LSL-3 Replaced the new micro switch with assembly)
- LLCO-5111, LAL-5111 and LAH-5111 of Deareator.
- LAL-5171 and LAH-5171of LSHS day tank.
- PSL-1 F.D. Fan lube oil pressure low AOP START.
- PSL-11,PSH-12 of Furnace pressure.
- PSL-24, PSL-25, PSL-26 & PSL-27 of Ignition and fuel gas line.
- PSL-28 and PSL-29f atomising steam line
- PSL-21 ,PSL-22 & PSL-23 fuel oil header
- PSH-42 of soot blower steam line.

Checked set value of following lube oil system switches of motor and turbine Driven BFW pump.

- PAL-5114, PLCI-5113, PLCO-5112 for P-5111
- PAL-5113, PLCI-5112, PLCO-5111 for Q-5111
- PAL-5115, PLCI-5114, PLCO-5113 for P-5112
- PLCI-5115 M-5112 AOP

### LIMIT SWITCHES.

- Burner no 1 & 2 main gun engagement limit switches replaced with new one.
- All BTV's limit switches( BTV1-1, 1-2,1-3,BTV 2-1,2-2,2-3) were cleaned and checked.
- HOHTV, IGTV, CCV21,CCV22 limit switches were cleaned and checked it's operation.
- All Manual Main Gun Oil/Atomising Valve limit switch were cleaned and checked the operation.

### DAMPERS:

Following dampers overhauling and checked its operation.  
(Checked/overhauled limit switches, solenoids, air regulators etc.)  
Changed copper tube connection to air cylinder by flexible rubber hose and checked operation.

- Fuel Air Damper ;Overhauled the positioner, limit switches, air regulator & solenoid. Checked performance.
- F.D. fan inlet damper and F.D. fan outlet damper.
- Air heater inlet damper and Air heater outlet damper.

## STEAM DRUM:

- EYE-HYE Electrodes were checked and changed electrode No. 4 as it was found damage. All the terminal wire lugs were replaced by new ones.

Removed old O2 Analyzer and blocked its tapping with blind flange. Checked new O2 Analyzer and calibrated it with air in single point calibration mode. Also checked new spare zirconia sensor by actually line up it in O2 analyzer.

Field Controllers: Cleaning and synchronisation of the following field controllers was carried out: DPC-1, LRC-3, LRC-4, PCV-2.

Following transmitters and air regulators were cleaned and checked the calibration of Tx / Receiver gauge.

- FT 1, FT-2, FT 3, FT11, FT 13, DPT 1, DPT 14, DPT 12.
- PT 1, PT 2, PT 4, PT 5, PT-6, PT-7, PT-21, PT-22, PT-41, PT-50, DPI-1, DPT-12.
- LT 1, LRC 2, LRC 4, LT-3, LT-5

Pressure gauges PI-2, PI-3, PI-4 & PI-5 were calibrated for production requirement.

## CONTROL VALVES

Following control valves & its positioner were cleaned and checked the stroke.

- FCV 1(100% BFW), PCV 2, LCV 4, PCV 1, TCV 1, PCV 50.
- BTV 1-1, BTV 1-2, BTV 1-3, BTV 2-1, 2-2, 2-3,, CCV 22, HORV, HOHTV, GHTV, IGTV.

\* Lined up new control valve (Fisher-Xomox make) CCV-21 at fuel oil line.

IGNITORS Both Burner's ignitor gun, spark plug, and gas & Oil flame scanners were cleaned and checked.

All furnace draft impulse lines were flushed with 7.0 kg/cm<sup>2</sup> air.

BFW Turbine and FD Fan turbine governor oil TRIP solenoid valves were cleaned and checked operation.

Furnace Temp. t/c with t/w was replaced with new one as it was found burnt.

Carried out all instrument jobs as per mech. requirement. BFW pump (Motor/Turbine driven) pressure switches, techo generator, THI & PI where removed and installed back.

## D.M. WATER PLANT:

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- Control valve's positioner were cleaned and checked the stroke of Control valve V3 of Anion-I, II, III & IV, Control valve for Degasor level, D.M. Buffer tank level, CTMU sump level, Raw water header pressure, and CTMU flow Line up new control valve at Anion-V1 V3.
- Following Flow Tx. were checked and calibrated.  
Cation I, II, III, IV, V Tx, Anion I, II, III, IV, V Tx,

Raw Water to DM Plant, Cooling Tower make up, Decation water flow, NH<sub>4</sub>OH prep. Water, Liq. NH<sub>3</sub> flow for NH<sub>4</sub>OH Preparation, B.F.W. To D.M. Tank (NH<sub>3</sub>plant).

- Cleaned sampling system and measuring chamber of Silica Analyser and also calibrated it.
- Cleaned and tightened all wiring terminals behind the Control panel.
- Converted the pneumatic local loop of Degasser level control into remote electronic loop using Yokogawa make UT 350e Electronic controller and Fuji make SMART transmitter.

## NH<sub>3</sub> STORAGE

- Removed old local control panel of old compressor.  
Line up new OMRON make PLC in old panel of control room for load/unload system of old compressor. Mounted a pressure transmitter for old ammonia tank vapour pressure and a Indicator for same. Also mounted solenoid valve with required tubing.
- Servicing and checking of Endraft make level indicator of T-3001 by Toshbro service Engr.
- PIC 3103 Local Controller were cleaned and synchronized.
- Controller and control valves of LSHS Tank A, B and C were overhauled and checked.
- LIC 3101 & LIC 3101 cleaned & checked both leveltrol and c/v operation.
- All electrical & RTD JB were cleaned and tightened all wiring terminals.
- All SLPC indicators/controllers/recorders were cleaned & checked its Battery.
- Cleaned, checked and tightened all terminals inside old, new & PLC panel.



## COOLING TOWER :

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Following Flow/Pressure/Level Tx. were cleaned / overhauled and calibrated

- Raw Water Inlet Flow Tx., C.T. Basin level Tx,
  - Q-4401A/B Steam Flow To Turb. Tx (FT 1090).
  - Q-4403 Steam Flow to Turb
  - Raw Water Tank to C.T.Flow Tx
  - FT 1091 Condensate flow
  - Surface condenser Level Tx.
- \* **Relocated FT 1090 with new impulse line tubing.**

Following Level Switch were cleaned and checked the set value.  
Surface cond. High,Low, High-High level switch.

Q- 4401 Turb. North and south side radial vib probes , speed pick-up unit was removed & installed to facilitate mech. maint.

Modified the mounting of annubar type primary element of Raw water tank inlet flow transmitter. to Provided a ball valve for isolation of impulse.

Overhauling and stroke checking of control valve

- MICV-4401B
- LCV-01
- LCV-02
- PICV-5153 \*
- PICV-5154 Removed the c/v from line, after removing plug & seat of c/v Control valve plug was found damaged. Weld the plug and necessary machining was done by mech w/s. then Overhauled the valve positioner installed the control valve back in line and checked stroke.

Changed AIRPAX make speed indicating transmitter of Q-4401.

Modified mounting of sensor for ultrasonic level indicator of H2SO4 tank.

Checked and tightened all wiring terminals of control panel.

### I.G. Plant:

Attended all running jobs.

- \* Servicing and calibration of ABB make H2 analyzer of new I. G. Plant.  
(Service engineer From M/s ABB has completed this work.)

### EFFLUENT TREATMENT PLANT:

Line up new Console type control panel with all electronic instruments.  
For this also changed related pneumatic field instrument by electronic instruments.

- Two Digital Indicator and Two Digital Indicating Totalizer.
- Two Digital Indicating controller
- One 6 Channel hybrid recorder and one annaunciator.

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Overhauling of SBA control valve and its valve positioner.

Cleaning of sampling system and calibration of Ammonia analyzer.

**WEIGH BRIDGE (MAIN GATE):**

Following jobs has been done .

(Service engineer From M/s Ashbee Systems Pvt Ltd was came to attend the job)

- Removed the platform and cleaned the whole weigh bridge.
- Painted the weigh bridge after scrubbing it.(inside as well as outside)
- Overhauled the load cell mounting assembly and checked the alignment of load cell.
- Cleaned the digital indicator/Computer .
- Calibrated the weigh Bridge with standard weights. (upto 33 tones)

**PACKER SCALES NO. P/S 1,2,3,4 and 8**

- Checked wiring terminals in the main panel, local panel, Solenoid boxes, and load cell boxes.
- Cleaned and checked RIC Card, Data Pond, all relays, fuses, and checked all sensor.
- Packer scale No. 7 and line-up new panel with CSC-25 weighing scale controller.
- Checked all function and calibration of all Packer Scales.

**COMPUTPAK PANELS.**

- All PCB's inside the computpak panels were removed and cleaned.
- Relocation of Solenoid valves of UBM 9A and 9B.
- Calibrated the Both UBM 9A, UBM 9B

**AUTO BAG PLACERS (Machine No. 9&10).**

- Cleaned/checked the all sensors of both auto bag placers.
- Cleaned the local panels, PLC Panels.
- Tighten the all wiring terminals ofv local panels, PLC Panels for both auto bag placers.

**WEIGHING SCALES (Mettler -Toledo/Libra make)**

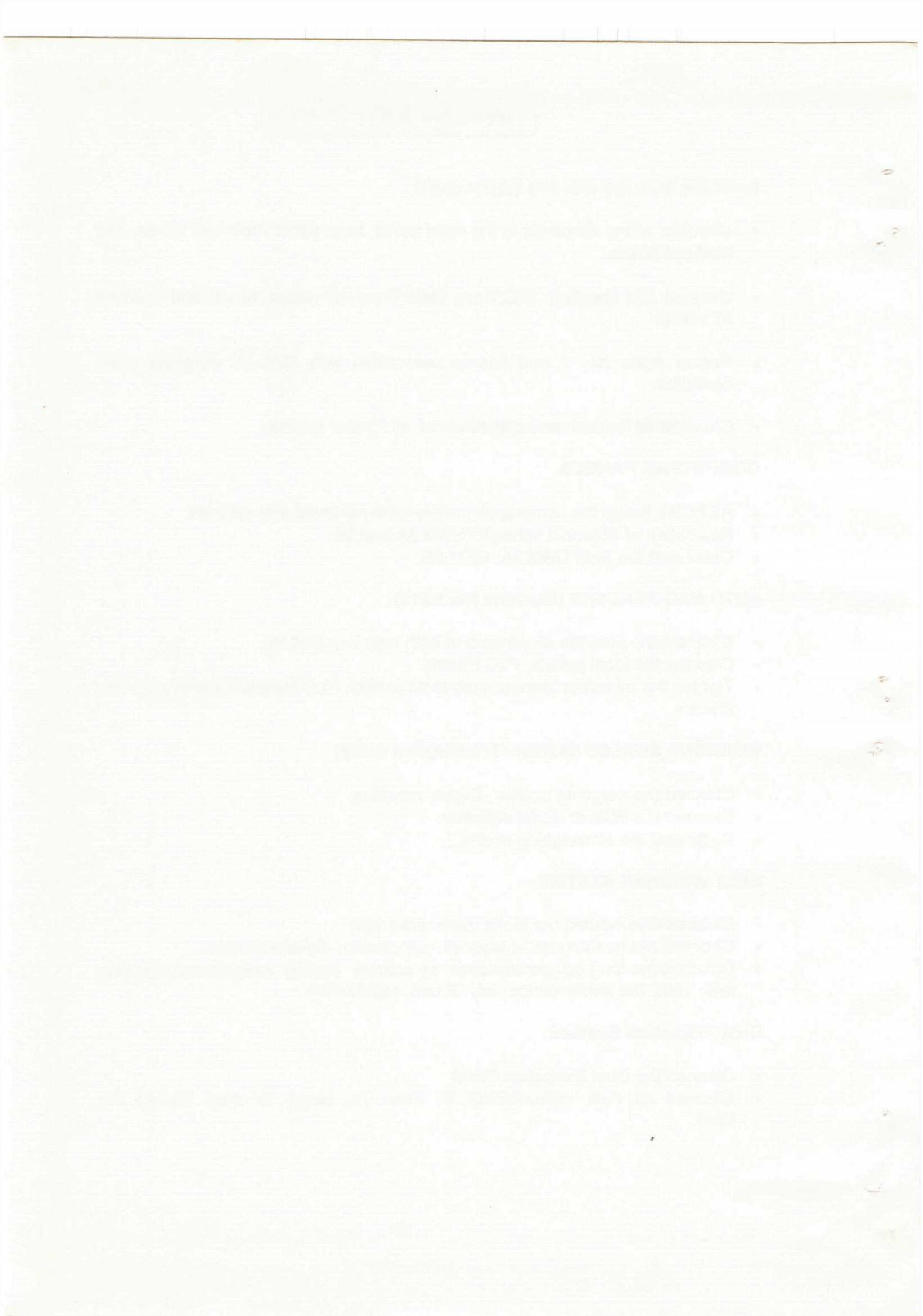
- Cleaned the weighing scales , Digital Indicators
- Cleaned the PCB of digital indicator.
- Calibrated the all weighing scales.

**BELT WEIGHER SYSTEM.**

- Cleaned/Overhauled the techo meter assembly
- Checked the healthiness of loadcell, techometer, digital indicator.
- Checked the load cell performance by actually putting weights and checking milli volts, the performance was found satisfactory.

**Dust Extraction System.**

- Cleaned the Dust Extraction Panel
- Cleaned all field instruments(C/V, Flow Tx, Level Tx etc.) related the DES.



# **ELECTRICAL**

LABORER

**AMMONIA PLANT**

- Replaced power and control cables of all equipment connected with MCC-5B.
- Preventive maintenance carried out on all feeder compartments in MCC-5, MCC-5A, MCC-5B and MCC 16 and replaced damaged / burnt out parts.
- Preventive maintenance carried out on Siemens and L&T LT air circuit breaker, installed in MCCs and replaced damaged/ burnt out parts.
- Overhauled following motors:  
  
101J, 101BJT, Seal oil pump of 102 J, LOP of 102J, , 104 J, 104 JA, 104 JT, 106 J, P1, P2, 118J, 118JA, 118JB, 111J, 104JTB, 172J &172JA
- Preventive maintenance carried out on all MOVs and checked its local control panels.
- Replaced SP-3 Limitorque valve actuator with Rotork make actuator
- Provided Sohre make shaft grounding system on Syn. Gas Compressor - 103 J
- Modification carried out on 112 JB feeder compartment for providing emergency power supply
- Checked terminal boxes for loose connections, burning cables, terminals of the motors above 20 HP rating.

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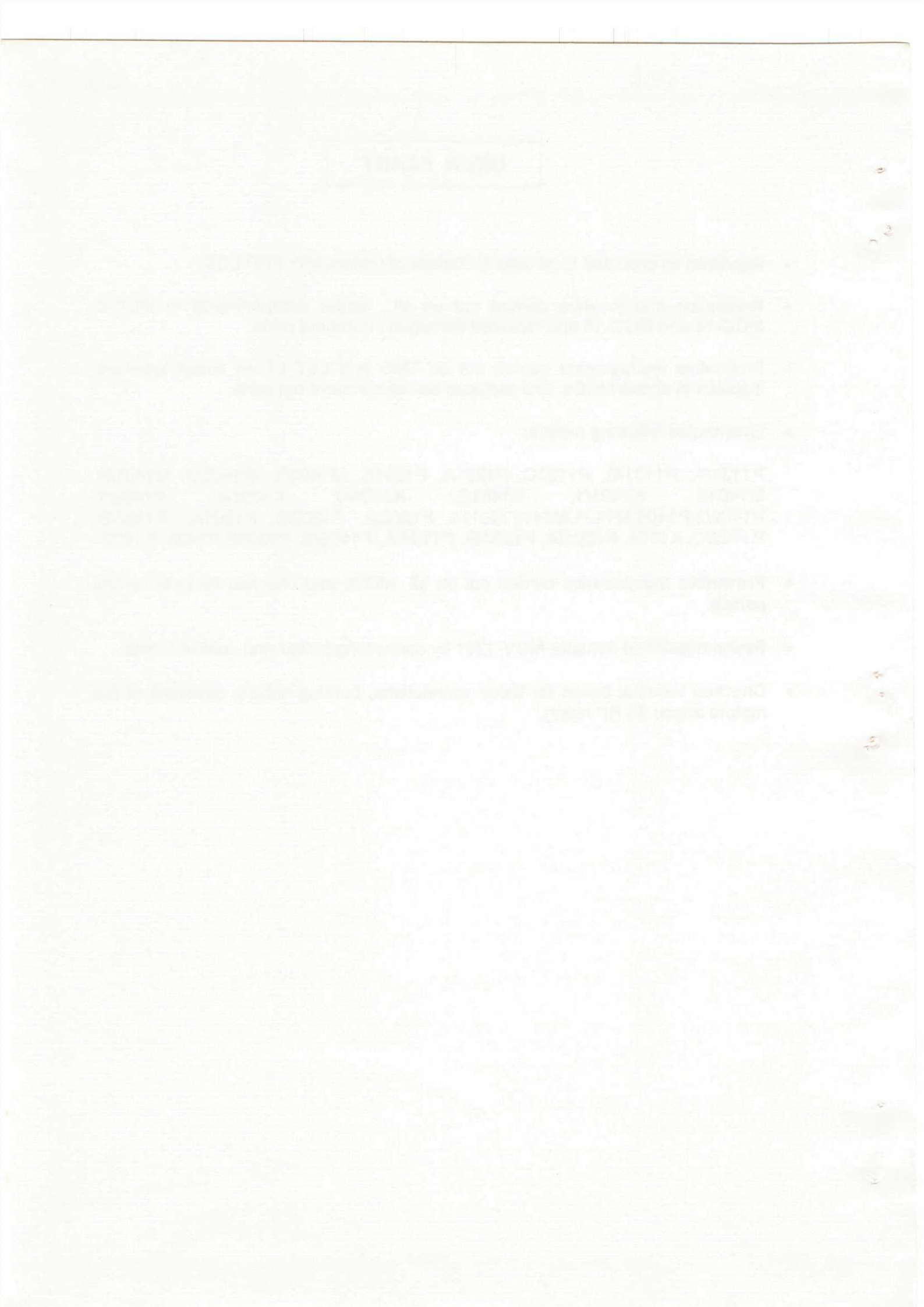
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<b>UREA PLANT</b>
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- Replaced all corroded local control stations of motors with FRP LCS.
- Preventive maintenance carried out on all feeder compartments in MCC-6, MCC-14 and MCC-15 and replaced damaged / burnt out parts.
- Preventive maintenance carried out on TMG and L&T LT air circuit breakers, installed in above MCCs and replaced damaged/ burnt out parts.
- Overhauled following motors:  
  
P1131/A, P1131/B, P1131C, P1231A, P1231B, M1403/1, M1403/2, M1401/A, M1401B, K1401/1, K1401/2, K1401/3, K1401/4, P1402/1, P1402/2, P1408, M1421, M1419, M2114, P1202/A, P1202/B, P1201/C, P1102/B, P1102/C, K1701, P1204/A, P1204/B, P1106/A, P1106/B, P1305B, P1426, P1402
- Preventive maintenance carried out on all MOVs and checked its local control panels.
- Recommissioned actuator MOV-1201 by connecting power and control cables
- Checked terminal boxes for loose connections, burning cables, terminals of the motors above 20 HP rating.



## UTILITY PLANT

- Replaced all corroded local control stations of motors with FRP LCS.
- Preventive maintenance carried out on all feeder compartments in MCC-1, MCC-2, MCC-2A, MCC-2B/E, MCC-2F, MCC-11 and replaced damaged / burnt out parts.
- Preventive maintenance carried out on Siemens & TMG LT air circuit breakers, installed in above MCCs and replaced damaged / burnt out parts.
- Overhauled following motors:  
 P4412, H5111, P5111A, P5111B, P5112/A, P5112/B, P4401, P4403, 4103/B, K5502, K5503, K5401
- Preventive maintenance jobs carried out in 66 KV switch yard.:  
 Cleaned insulators of all the CT & PT units, bus bar supports, lightning arresters, breakers, etc.  
 Cleaned and lubricating of all the moving parts of isolators.  
 Cleaned 11KV VCB panels and checked tightness of outgoing cable terminals.  
 Cleaning and operational checking of out door breakers.  
 Measured insulation resistance value of all the CT units.
- Shifted controls of VCBs to CRP panel.
- Preventive maintenance carried out of 11 KV sub station which includes checking, cleaning of Siemens panel and Jyoti .
- Checked terminal boxes for loose connections, burning cables, terminals of the motors above 20 HP rating.
- Shifted emergency power supply control from MCC-8 to new DG set MCC by laying cables and shifting of MCC-8 panels to guest house.
- Replaced EMC actuators with Rotork actuators in Boiler.
- Replaced power cables of cooling pumps motor No. P4402 and P-4404 from its transformer/ circuit breaker.
- Modification carried out in MCC-9 for feeding alternative power from MCC-15.

QUALITY PLAN

1. The purpose of this Quality Plan is to ensure that the project is completed on time, within budget, and to the satisfaction of the client. This plan will define the quality standards, the roles and responsibilities of the project team, and the processes for monitoring and controlling quality.

2. The project manager is responsible for the overall quality of the project. The project manager will ensure that the project team understands the quality requirements and that the project is managed in accordance with this Quality Plan.

3. The project team will be responsible for the day-to-day quality management activities. This includes identifying quality risks, implementing quality control measures, and reporting quality issues to the project manager.

4. The quality management process will be integrated into the project management process. This includes identifying quality requirements, defining quality standards, and implementing quality control measures.

5. The project team will use a variety of quality management tools and techniques to ensure the quality of the project. This includes quality planning, quality control, and quality assurance.

6. The project team will monitor and control quality throughout the project. This includes identifying quality risks, implementing quality control measures, and reporting quality issues to the project manager.

7. The project team will ensure that the quality of the project is maintained throughout the project. This includes identifying quality risks, implementing quality control measures, and reporting quality issues to the project manager.

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10. The project team will ensure that the quality of the project is maintained throughout the project. This includes identifying quality risks, implementing quality control measures, and reporting quality issues to the project manager.

MTC / REPORT / 01  
REPORT NO. 24 / 2004

**IFFCO**  
**KALOL UNIT**

**REPORT**  
**ON**  
**PLANT TURNAROUND**  
**(MAY - JUNE - 2004)**

**INDIAN FARMERS FERTILISER CO-OPERATIVE LIMITED**

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<b>OFFSITES PLANT</b>
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- Replaced all corroded local control stations of motors with FRP LCS.
- Preventive maintenance carried out on feeder compartments in MCC-3 , DG set MCC and replaced damaged / burnt out parts.
- Preventive maintenance carried out on Siemens and TMG LT air circuit breakers installed in above MCCs and replaced damaged/ burnt out parts.
- Overhauled following motors:  
P3303A, P3303B, P3201B, P3304A, P3304B, P3706A, P3706B, F1 & F2.
- Checked terminal boxes for loose connections, burning cables, terminals of the motors above 20 HP rating.

OFFICE PLANT

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<b>B &amp; MH PLANT</b>
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- Replaced all corroded local control stations of motors with FRP LCS.
- 2. Preventive maintenance carried out on all feeder compartments in MCC-4, MCC-9, MCC-4A and replaced damaged / burnt out parts.
- Preventive maintenance carried out on Siemens & TMG LT air circuit breakers, installed in above MCCs and replaced damaged/ burnt out parts.
- Overhauled following motors::  
  
Dust Conveyor motor, M2110, M2112, M2116/3, M2117, M2121, M2122, M2122/A1, M2122/A2, M2123, M2142/1, M2124/1, M2124/3, M2124/7, M 2116/1-5
- Relocated and replaced rope switches of M2112 conveyor by laying new cables
- Additional rope switches installed and commissioned on dust conveyor in silo.
- Preventive maintenance carried out on all rope switches of conveyors M 1419, 2110, 2117, 2121 & 2122
- Replaced control gear of stitching machines with FRP control gear boxes.
- Checked terminal boxes for loose connections, burning cables, terminals of the motors above 20 HP rating.

ANNALS OF THE ENTOMOLOGICAL SOCIETY OF AMERICA

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1954  
VOLUME 46, PART 1

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2. The Biology of the Mosquitoes of the Genus *Culiseta* in the State of Texas

3. The Biology of the Mosquitoes of the Genus *Aedes* in the State of Texas  
4. The Biology of the Mosquitoes of the Genus *Culex* in the State of Texas

5. The Biology of the Mosquitoes of the Genus *Wyeomyia* in the State of Texas  
6. The Biology of the Mosquitoes of the Genus *Coquillettidia* in the State of Texas

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# CIVIL

CIVIL

## AMMONIA PLANT

### AUXILIARY BOILER:

- Replacement of burner block for burners No. 1
- Replacing of burner block for burner No. 3 and 4.
- Replacing of Header and other refractory work in side auxiliary boiler.

### PRIMARY REFORMER:

Patch work of insulation brick along with back up insulation was carried out after removed of old damaged refractory.

### SECONDARY REFORMER:

Repairing of cracks developed inside the secondary reformer.

ANNEXURE I

ANNEXURE I

1. Department of Culture, Government of Karnataka

2. Department of Culture, Government of Karnataka

3. Department of Culture, Government of Karnataka

ANNEXURE I

4. Department of Culture, Government of Karnataka

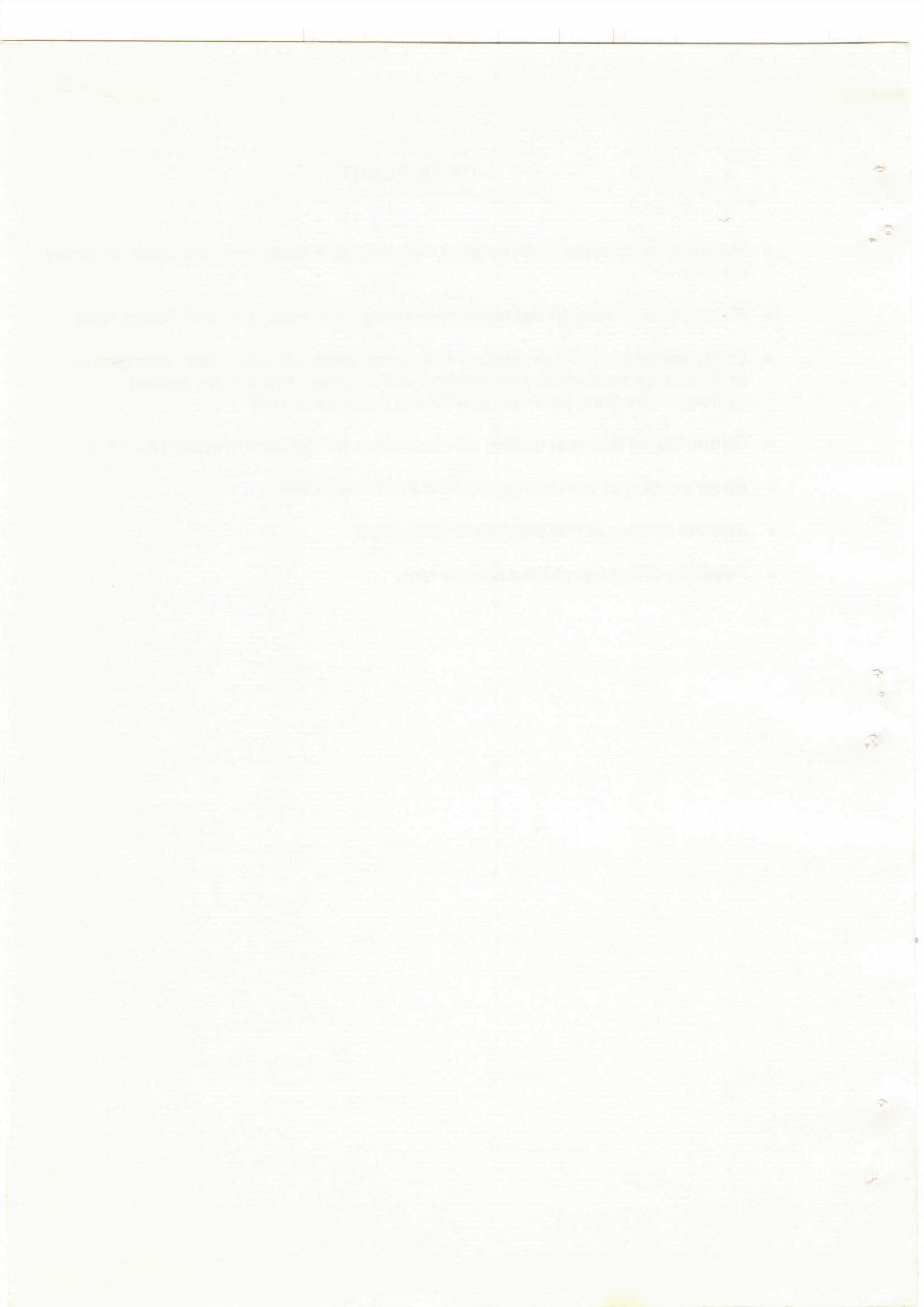
5. Department of Culture, Government of Karnataka

ANNEXURE I

6. Department of Culture, Government of Karnataka

## UREA PLANT

- Repairing of scrapper floor by filling the joints of existing tiles and vatas by epoxy system.
- Providing and laying IP Net protective painting on outside surface of bucket room.
- Epoxy painting of RCC structure of Prill bucket room, Lift cabin room, stair case at Prill tower top level inside scrapper floor of Prill tower , Prill Cooling system, hydrolyser structure, pipe rack column and transformer area.
- Dismantling of floor and making new foundation for Prill cooling system duct line.
- Epoxy painting of conveyor gantry from Prill tower to Silo.
- External painting of Prill tower by IP Net system.
- Repairing of leakage of Urea solution tank.





**OFFSITES & UTILITY PLANT****WATER TREATMENT PLANT:**

- Repairing of acid proof brick linings in strong effluent tank no. A & B.
- Repairing of acid proof brick lining of top & side wall of weak effluent sump.
- Repairing of supports for pipeline in Water treatment plant & floor of H<sub>2</sub>SO<sub>4</sub> tank near cooling tower sump side.
- Repairing of floor by bitumastic lining in the acid unloading area surrounding of equipments of DM plant.
- Maintenance of strong and weak effluent channel and repairing of strong as well as weak effluent chambers in water treatment plant upto effluent tank.
- FRV lining work for strong effluent channel and open channel near lagoon phase B area.
- Repairing of leaking CT sump tank in DM Plant.
- Epoxy grouting of nozzle in raw water stroage tank.

**BOILER HOUSE :**

Repairing of casting refractory for burners side, floor and superheated zone inside BHEL boiler.

STATE OF TEXAS

County of \_\_\_\_\_

Know all men by these presents, that \_\_\_\_\_

do hereby certify that \_\_\_\_\_

is the true and correct copy of \_\_\_\_\_

as the same appears by \_\_\_\_\_

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**B & MH PLANT**

Following jobs were carried out during plant turn around 2004.

- Repairing of Walk way for conveyor belt inside the Silo by epoxy monolithic plaster.
- Epoxy painting of Transfer tower and conveyor gantry from Silo to B & MH.
- Repairing of Hopper floor / Packer scale floor with the use of epoxy monolithic plaster.
- Epoxy painting of RCC columns, ceiling, slab, beams and other RCC structure in Bagging plant at Ground Floor, First Floor and Second Floor.
- IP Net painting for the external surface of conveyor gantry from Silo to B & MH plant and screen house, platform (Ground floor)
- Concrete Apron for Platform line No.3,4 & 5.
- Ironite flooring for platform area No. 3 & 4.



# TECHNICAL

JACOBUS

**AMMONIA PLANT**

**MECHANICAL JOBS**

**COMMISSIONING OF FUEL GAS SYSTEM:**

Following modifications has been carried out for commissioning of LNG as Fuel & Feed System

**HOOK UP OF LNG LINE:**

300 mm NB CS line from GSPL'S battery limit hooked up with NG-800-10" line & new PICV-002 & FICV-002 has been installed to provide as feed through NGBC (800-J). Gate valve of size 10"x300# is installed in NG booster compressor suction line. LNG to NG line of size 100 mm NB x Sch.40 with control valve (PICV-002A) has been provided to use LNG as fuel. To provide LNG directly as feed i.e. Bypassing NGBC & NG compressor , line of size 150 mm NB x Sch. 40 has been installed from PRC-1A U/S to existing desulphuriser inlet NG line. Approx. Length:40 Mtr., Material : A106Gr.B, Ref. Drg No.:-01-CL-13490(3 Sheets)

**REPLACEMENT OF NG-22-8" LINE FROM 176-F TO 151-C**

Existing 200 mm NB AG line from 176 - F to 151-C has been replaced with 300 mm NB & 350mm NB line size . 350 mm NB is approx. 30 Mtr. & 300 NB line is approx. 75 Mtr. & material is A106 Gr. B. Ref. Drg. No.01-BL-13494

**REPLACEMENT OF 178-F OUTLET LINE (NG-66-8")**

AG to utility separator outlet line was replaced with 8" size and hooked up with old ammonia vapour line to supply NG/AG to utility boiler & NG -22-6" line going to NG-30-24" with VS 203 A to send AG/NG to auxiliary boiler burners. One check valve & gate valve has been provide. Approx. Length : 56 Mtr. For 8 inch size, Approx. Length :100 Mtr. For 6" size, Ref. Drg. No.03-BL-13571 (2 Sheets)

**MODIFICATION FOR FUEL TO PRIMARY REFORMER BURNER**

PRC-2 downstream line was replaced with 12"x Sch. 40 line & new header at north side (line no. FG-3A-8") has been provided . From this header 9 nos. Tappings of size 100 mm NB size (Line no. FG-4 A1 to 4H1) has been taken & hooked up with existing headers (Line no. FG-5A-4" to 5H-4"). To bifurcate gas 9 NOS. Gate valves were provided in middle of the existing headers. Line from 151-C to PRC-2 were changed with 250 mm NB size & bypass line of 151-C was provided. Approx. Length : 300 mm NB size is 33 Mtr. & 8" size is 38 Mtr., Ref. Drg. No.01-BL-13481 (2Sheets)

**REPLACEMENT OF MIXING TEE :-**

Mixing Tee was replaced as recommended by PDIL inspection agency due to deterioration of micro-structure & mechanical properties of material of old Mixing Tee . New Mixing Tee is fabricated & supplied by M/s Mabel Engineers Pvt. Ltd., Chennai (Vendor's drawing No. : MEPL-A2-IFFCO-035, Rev-3 ). Mixing Tee mixes the two streams of process gas ( Line No. PG-5-14" & PG-2-18") from 102-C. After mixing process gas passes to HT Shift Converter (104-D) through Line No. PG-3-18". Ref Drawing No. 01-DL-13433, Sheet 1 of 1, Rev-1 & 610-E1-B162, Material : Pipe - A 335 Gr.P11, Fittings - A234 Gr. WP11, Flange - A 182 Gr.F11.

The job was carried out by M/s Garcem Engineers Pvt. Ltd., Ahmedabad.

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**RE-ROUTING OF VARIOUS UNDER GROUND COOLING WATER PIPE LINES IN AMMONIA PLANT :-**

Existing underground cooling water lines ( Line No. WA-8-30" & WB-1-30" ) were rerouted as they were fouling the foundations of equipments to be installed for Shift Conversion Section in Energy Saving Project (ESP) . Old underground cooling water lines ( Line No. WA-8-30" & WB-1-30" ) approx. 28 meters were removed. These lines were rerouted as per Drg. No. 01-DL-13479, Sheet 1 of 1, Rev-P1. Approx. length of rerouted under-ground cooling water lines ( Line No. WA-8-30" & WB-1-30" ) is 59 mtrs., Material : CS EFW (SAW) Pipes 10 mm thk. as per IS 3589.

Ref Drawing No. 01-DL-13479, Sheet 1 of 1, Rev-P1

The job was carried out by M/s Garcem Engineers Pvt. Ltd., Ahmedabad.

**TAPPINGS FOR ENERGY SAVING PROJECT IN AMMONIA PLANT:-**

Following tappings were taken for Energy Saving Project ( ESP )

- Tie-in Point No. P6/1 for Line No. PG-1201.01-20"-D24 from 112-C gas outlet line PG-35-20" to LT Guard Bed 103-D3, Material : Fittings - A 234 WPB, Flanges - A105, Valve Body - A 216 Gr. WCB, Valve Size & Rating : 20"x 300#. The job was carried out by M/s Garcem Engineers Pvt. Ltd., Ahmedabad.
- Tie-in Point No. P6/2 for Line No. PG-1204.01-20"-D24 from 142-CA/CB gas outlet line PG-35-20" to LT 157-F gas inlet PG-35-20", Material : Fittings - A 234 WPB, Flanges - A105, Valve Body - A 216 Gr. WCB, Valve Size & Rating : 20"x 300#. The job was carried out by M/s Garcem Engineers Pvt. Ltd., Ahmedabad.
- Tie-in Point No. P6/8 for Line No. NI-1201.01-10"-D24 from CG circulator discharge (to LTS ) line CG-5-10" to LT Guard 104-D3 gas inlet line PG-1202.01-20"-D24, Material : Fittings - A 234 WPB, Flanges - A105, Valve Body - A 216 Gr. WCB, Valve Size & Rating : 10"x 150#. The job was carried out by M/s J&J Engineers, Gandhinagar.
- Tie-in Point No. P6/9 for Line No. NI-1202.01-10"-D24 from LT Guard 104-D3 gas outlet line PG-1203.01-20"-D24 to LTS outlet line to C Circulator CG-1-10", Material : Fittings - A 234 WPB, Flanges - A105, Valve Body - A 216 Gr. WCB, Valve Size & Rating : 10"x 300#. The job was carried out by M/s J&J Engineers, Gandhinagar.
- Tie-in Point No. P6/7 for Line No. SG-1201.01-1"-D24 from SG from 104-F to LTS line SG-46-1" (3P10) to NI-1201.01-10"-D24 line to LT Guard 104-D3, Material : Fittings - A 105, Flanges - A105, Valve Body - A 105, Valve Size & Rating : 1"x 800#, SW. The job was carried out by M/s J&J Engineers, Gandhinagar.
- Tie-in Point No. P8/5 for Line No. MS-1201.01-4"-F24S from MS to 107-JT/JAT header MS-1-8" to 115- JTA/JTB & 116-JAT, Material : Fittings - A 234 WPB, Flanges - A105, Valve Body - A 216 Gr. WCB, Valve Size & Rating : 8"x 600# (IBR) .The job was carried out by M/s Shree Ganesh Engineers.



- Tie-in Point No. P6/4 for Line No. MS-1211.03-3"-F24 from Spit Stream Pump Turbine 116-JAT to LS-1-12" header, Material : Fittings - A 234 WPB, Flanges - A105, Valve Body - A 216 Gr. WCB, Valve Size & Rating : 3"x 150#. The job was carried out by M/s Shree Ganesh Engineers.
- Tie-in Point No. P7/5 for Line No. CW-1201.01-2"-B20 from 4" CW tapping from 108-C CW inlet header to 144-C & L.O. Coolers for CO2 Removal system pumps, Material : Fittings - A 234 WPB, Flanges - A105, Valve Body - A 216 Gr. WCB, Valve Size & Rating : 4"x 150#. The job was carried out by M/s J&J Engineers, Gandhinagar.
- Tie-in Point No. P7/6 for Line No. CW-1202.01-2"-B20 from 4" CW tapping from 108-C CW outlet header ( For 144-C & L.O. Coolers for CO2 Removal system to 108-C CW outlet header. Material : Fittings - A 234 WPB, Flanges - A105, Valve Body - A 216 Gr. WCB, Valve Size & Rating : 4"x 150#. The job was carried out by M/s J&J Engineers, Gandhinagar.

One 18" Isolation Valve ( Gate valve 18" NB x 300# ) was provided in Line No. PG-35-20" ( 112-C outlet ) between two tappings. A portion of PG-35-20" was replaced with 2 Nos. 20" tapping & Isolation valve in between as per Dwg. No. 01-DL-13480-Sheet 2 of 2, Rev- P.

**TAPPINGS FOR NEW TURBINE EXHAUST LINES FOR ENERGY SAVING PROJECT  
MODIFYING EXISTING TURBINE EXHAUST LINES TO 101-JCA :-**

Turbine exhaust line from 104-JTA to 101-JCA was modified to connect the turbine exhaust lines of 115-JTA/JTB, 116-JTA and ID fan turbine ( 101-BJT) steam exhaust line to be installed to Energy Saving Project.

For this, approx. 55 mtr of 24"NB x 10 mm thk old steam exhaust line was dismantled and 42"NB x 12 mm thk. ( approx. 18.5 Mtr. ), 36"NB x 10 mm thk. ( approx. 32.5 Mtr. ), 30"NB x 10 mm thk. ( approx. 5 Mtr. ) was fabricated & erected.

24" NB tapping for 116-JTA & 12" NB tapping for and ID fan turbine exhaust line was taken.

Plate Material of Welded Pipe : IS 2062

Ref Drg. No. 01-CL-13486, Sheet 1 of 1, Rev-1 & 01-CL-13487, Sheet 1 of 1, Rev-0.

The job was carried out by M/s J&J Engineers, Gandhinagar.

**INSTALLATION BY-PASS LINE TO 120-C :-**

By-pass line ( Size ; 4" NB x Sch-120 ) with Plug Valve ( Size & Rating : 4 " NB x 1500 #, RTJ End ) was installed connecting line No. SG -13-12" and Line No. SG-41-10".

Material : A106 Gr.B

The job was carried out by M/s Shree Ganesh Engineering, Ahmedabad.

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**INSTALLATION OF ISOLATION VALVE TO CONTROL VALVE PIC-5 :**

A gate valve was provided for isolating control valve PIC-5.  
Material : Flange - A182 Gr.F11, Valve body : A217 Gr.WC6.  
Size & Rating : 6" NB x 300#.

The job was carried out by M/s Garcem Engineers Pvt. Ltd., Ahmedabad.

**SHIFTING OF INSTRUMENT AIR DRYER & INSTRUMENT AIR RECEIVER AT NEW LOCATION :-**

Instrument Air Dryer & Instrument Air Receiver were dismantled from existing location and were shifted to new location ( south side of Dry ice plant ).

The job was carried out by M/s Garcem Engineers Pvt. Ltd., Ahmedabad.

**INSTRUMENTATION JOBS :**

As per **EWR NO. A-233** for providing new duplex thermocouple on flue gas stack of H-110 in pre-reformer unit, structural work for laying thermocouple extension cable from stack to nearest junction box is completed. total work was not completed as material was not received.

**UREA PLANT**

**MECHANICAL JOBS**

**BIGGER SIZE VENT LINE FOR UREA SOLUTION TANK ( T-1401 A ):-**

The size of Vent line for Urea Solution Tank (T-1401A) was increased from 4" NB to 12" NB.

Ref. Drawing No. : 02-DD-13440, Sheet 1 of 1, revamp

Material : Pipe -A 358 Gr. 304L, Col., Fittings - A 403 WP 304L.

**4 ATA STEAM ISOLATION WAS RELICATED FROM FIRST FLOW TO 3RD FLOW FOR ONE OF OPERATION:-**

The job was carried out by Ms Gram Engineers Pvt. Ltd., Ahmedabad.

**INSTRUMENTATION JOBS :**

As per **EWR NO. U-218** provision for temperature indication on DCS panel for overhead vapors from desorber along with the vapors from LP Carbamate Separator is completed.

100

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## OFFSITES & UTILITY PLANT

### MECHANICAL JOBS :

Mechanical jobs were done to install two Flow Indicators FI-96 and FI-1815.

### INSTRUMENTATION JOBS :

As per **EWR No. A-204** provision of following two turbine flow indicators with their indication in cooling tower control room was completed :-

Sr.No	1	2
Instrument Tag No.	FI - 96	FI-1815
Range of the Instrument	0 to 14000 meter <sup>3</sup> / hr.	0 to 3500 meter <sup>3</sup> / hr
Location	Common header at discharge of turbine driven pumps (P-4401 A&B and Q-4403) before joining jump over.	On C.W. Supply line to surface condenser (H-1815) of Hitachi CO <sub>2</sub> compressor in Urea Plant

Old pneumatic instruments for FI-96 & FI-1815 which were near GAIL Metering Station & in cooling tower area are removed & cleared the site.

MICV on 40 ata steam line of cooling water pump turbine Q-4401-B which was removed from line for full servicing & plug seat lapping. After completion of the work in workshop, it was installed in line.

Ultrasonic level indicator for horizontally installed Sulphuric acid tank in cooling tower area which was giving slow response was attended and made it O.K.

Additional pipe inside the tank was cut under the Ultrasonic Level Sensor which was restricting the ultrasonic rays ; due to which response was slow. calibration & response of the instrument was checked while acid tanker was unloading the acid in the tank, found O.K.

### OFFSITE PLANT

#### INSTRUMENTATION JOBS :

As per **EWR NO. ET-81** the old control valve LCV- 4511 of storm water sump level control which is removed from the old system along with its level transmitter , level controller & other accessories & installed it for bulk effluent tank level control.

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1873