MTC / REPORT / 01

REPORT NO. 38 / 2018

IFFCO

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KALOL UNIT

PLANT TURNAROUND REPORT

(SEPTEMBER - OCTOBER – 2018)

INDEX

1	**PREFACE**		I	-	VI
2	**GENERAL DETAILS**				
(a)	Equipment, Manpower & Turnaround Period Detail		VII	-	VIII
(b)	Contractor Details		IX	-	XI
	SECTION	**PLANT**	**PAGE NOS.**		
3	**MECHANICAL**	• Ammonia Plant	1	-	150
		• Urea Plant	151	-	187
		• Offsite & Utility Plant	188	-	225
		• B&MH Plant	226	-	231
4	**INSPECTION**	• Ammonia Plant	232	-	300
		• Urea Plant	301	-	364
		• Utility Plant	365	-	375
5	**INSTRUMENTATION**	• Ammonia Plant	376	-	390
		• Urea Plant	391	-	403
		• Offsites & Utility Plant	404	-	411
		• B&MH Plant	412	-	419
6	**ELECTRICAL**	• Ammonia Plant	420	-	423
		• Urea Plant	424	-	426
		• Offsites & Utility Plant	427	-	432
		• B&MH Plant	433	-	435
7	**TECHNICAL**	• Ammonia Plant	436	-	442
		• Urea Plant	443	-	444
		• Offsites & Utility Plant	445	-	447
		• B&MH Plant	448	-	-

PREFACE

Plant Turnaround for the year 2018 was taken from **17th Sep 2018** to **15th October 2018** for carrying out ESP Phase III (Energy Saving Project), Preventive maintenance jobs of Static & Rotary equipment.

After ensuring availability of all the required material for shutdown and awarding contracts for various shutdown jobs, it was decided to stop Ammonia Plant and Urea Plant on **17th Sep 2018**. This shutdown report contains details of the jobs carried out plant wise and section wise. Ammonia plant was put back in to operation on 15th **October 2018 after a shutdown period of about 28 days from production to production.**

The turnaround was carried out smoothly due to meticulous planning of all activities like planning of manpower, material and other resources. Due to exemplary efforts put in by all Personnel at all levels, turnaround jobs could be completed satisfactorily.

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

A brief details of Major jobs carried out by all sections during shutdown are as under.

MECHANICAL

❖ AMMONIA PLANT

Major Jobs carried out during Turnaround were:

- Existing LT Steam Superheat Coil, E-104 was replaced by coil of increased surface area and a De-superheater was installed in between LT Steam Superheat & HT Steam Superheat coil.
- Surface area of existing HDS-II coil was reduced by cutting top row tubes of the coil.
- Refractory of Auxiliary Boiler North & South (Burner) wall including Burner Blocks, Side walls (#10 & #12) of Coil D & E, header Box and Top Roof were replaced
- Re-Remnant Life Assessment (Re-RLA) study of Boiler No. GT-1632 was carried out during 20/09/2018 to 28/09/2018 by M/s. TCR Advanced Engineering Pvt. Ltd., Vadodara.
- Overhauling of complete Refrigeration Compressor Train i.e. Drive Turbine 105-JT, LP & HP Compressor 105-JLP & HP, Gear Box 105-JR carried out.

- Overhauling of Process Air Compressor Drive Turbine, 101-JT & HP Air Compressor, 101-JHP carried out. Rotor of 101-JHP & DE side seal was replaced.
- Overhauling of both BFW Pump Drive Turbines, 104-JT & 104-JAT were carried out.
- Hydro jetting and Hydro test of all Air Compressor Interstage coolers 129-JC, 130-JC & 131-JC were done. In 129-JC, leakage in 4 nos. tubes was found during hydro test & these tubes were plugged.
- Leakage in 3 nos. tubes was found in CO2 Stripper Gas Reboiler, 105-CA during hydro test & these tubes were plugged.
- 2 Nos. Tubes Plugged and Tube to Tube sheet seal welding of 11 nos. tube done in Intercooler of Recycle Gas Compressor, 117-J.

❖ **UREA PLANT**

- Preventive maintenance of steam turbine (Q-1801), LP Case (K-1801-1), HP case (K-1801-2) & Gear box of M-1801 of CO2 Hitachi compressor train completed.
- Preventive maintenance of Pilot valve of main steam (60 ata), extraction steam (23 ata) & induction steam control (4 ata) control valve of Hitachi compressor drive turbine was completed.
- 4 ata induction steam servo motor of Hitachi compressor drive turbine was completed.
- Major overhauling of Lube oil turbine (Q-1814) for CO2 Hitachi compressor New foundation frame for P-1408 (Melt pump) in S.S. 304.
- Preventive maintenance of Prill cooling system Inlet Air fan (K-1701) & Exhaust air fan (K-1702)
- Preventive maintenance of id fan K-1401-1/2/3& 4.
- Preventive maintenance of all conveyor system & Conveyor belt M-1403-2 was replaced.
- Auto clave V-1201 was opened for attending leakage of liner.
- HP Stripper (H-1201) was opened for Delta pressure & Eddy current testing.
- HP Condenser (H-1202) was opened for inspection of internals & Eddy current testing of the tubes.
- HP Scrubber H-1203, Top Dome was opened for inspection.
- RLA study of GT 1664 (V-1501) was carried out.
- Heat exchangers were opened for Hydro jet cleaning.
- Relief valves were opened & tested.
- LP Carbamate Condenser (H-1205) was opened for IRIS inspection of the tubes.
- Mechanical Tube cleaning of H-1207 was carried out by specialized tooling.

❖ **OFFSITE & UTILITY PLANT**

- Preventive maintenance of CW Pump P-4402, P-4401 B
- Overhauling of CW Pump P-4403.
- Preventive maintenance of Q-4403 & Q-4401 / B & Gear boxes.
- Major overhauling of CW Pump P-4401 / A.
- Preventive maintenance of Q-4411 (Elliot make) & installation of New electro hydraulic PGPL governor.
- Preventive maintenance of BFW Pump P-5111 & P-5112 Trains.
- Major overhauling of FD Fan (K-5113) Drive turbine (Q-5113).
- RLA study of GT-2068 (BHEL Boiler)
- Repairing of cooling towers.
- Refurbishing of JASH make Sluice Gate of Cooling water pump.
- Testing of Boilers Relief valves.

❖ **B&MH PLANT**

- Replaced the 800 mm wide conveyor belt of M 2121 with 1000 mm wide conveyor belt along with all structures in SS 304 material.
- Preventive maintenance of New reclaim machine. (M 2116 –A)
- Preventive maintenance of Bagging machines, Slat conveyors & stitching machines.
- Preventive maintenance of all conveyor systems, Vibrating screens & fans.

INSPECTION

❖ **AMMONIA PLANT**

- Automatic Ultrasonic scanning (AUS) of Primary Reformer tubes was carried out by M/s. PDIL. 48 nos. of tubes were observed in B grade & 288 nos. of tubes were observed in C Grade.

- Advanced NDT techniques TOFD & PAUT were introduced to assess the condition of Critical Pipelines & Equipment.

- Pulsed Eddy Current Testing (PECT) of Insulated Lines & Equipment was also introduced in this turnaround. This technique is advantageous for condition assessment of pipeline & equipment, without removing the Insulation.

- Inspection of Low Temperature Shift Converter (104-D2) was carried out from Inside as Catalyst replacement was planned in this plant turnaround. Various NDT's such as UFD, Hardness measurement, Metallography, Thickness measurement & DP test was carried out. Condition was found satisfactory.

- Inspection of Ammonia Converter loop pipelines by various NDTs such as PAUT, UFD, Radiography, Metallography, Thickness measurement & DP test.
- Thickness measurement of 144 nos. pipelines & 51 nos. Equipment was carried put.

❖ **UREA PLANT**

- Helium leak testing of Autoclave (V-1201) liner was carried out to detect leakage. Leakage was observed in 5th Compartment and the same was rectified.
- Eddy current testing of HP Stripper (H-1201) tubes was carried out.

  Max. reduction of 1.40mm. was observed in 08 nos. of tubes.
- Eddy current testing of HP Carbamate Condenser (H-1202) tubes was carried out to collect the baseline data after its Installation in ESP-III, Mar-April 2017.
- Inspection of LP Carbamate Condenser (H-1205) tubes by IRIS was carried out. One no. tube (02 nos. tube holes-being U tube) was plugged due to thickness reduction. Total 05 tubes are plugged till date.
- Radiography of 16 Nos. H.P. vent, drain & tapping installed in H.P. loop in Urea plant was carried out. Total 04 nos. tapping were observed having crevices and the same were repaired.
- Pneumatic testing in scrubber top dome liner was carried out for leak assessment. No leakage observed. However, an extra weld run was applied on ¾" nozzle as leak was suspected from this nozzle during running plant.
- Thickness measurement of 105 nos. pipelines & 22 nos. Equipment was carried out.

❖ **OFFSITE PLANT**

- Inspection of BHEL Boiler (GT 2068)
- 03 nos. U bend of Secondary super heater coils observed having leakage during Hydro-test.

  These U bends were replaced by spare ones. Radiography & DP test carried out on weld joints of replaced tubes.
- Inspection of 52" NB CW Inter connection line between New CT and P-4401 C/D sumps.
- Inspection of Cold Insulation lines connected with Ammonia Storage area. 02 nos. of lines having cold insulation were removed to assess the condition & extent of corrosion under supports.

INSTRUMENTATION

❖ AMMONIA PLANT

- Major focus area of Instrumentation jobs was to improve the reliability of plant Instrumentation. As a part of this 2oo3 trip logics were provided for several trips working on single voting logic so far. The job involved installations of additional field instruments, cabling and PLC logics development. Woodward Protech-GII over speed trip unit was installed alongwith field MPUs for 2oo3 over speed trip for Air Compressor.
- As a part of on-going drive for replacement of aged and obsolete designed instrumentation, 04 nos. more ball valves of PGR unit were replaced by new valves of contemporary design apart from 04 nos. valves replaced earlier. 04 nos. other control valves were also replaced in other process areas of Ammonia Plant.
- Highly accurate Mass Flowmeter was introduced in Ammonia Plant for the first time for measurement of cold Ammonia flow. So far conventional orifice meter was performing the duty.
- Insertion type Magnetic Flowmeter was also introduced for the first time at Kalol Unit for measurement of cooling water to surface condenser.

❖ UREA PLANT

- 2oo3 trip logics were provided for several trips actuated on single voting logic so far. The job involved installations of additional field instruments, cabling and PLC logics development.
- Bently Newada make series 3300 VMS which was in use since commissioning of Hitachi CO2 Compressor was replaced by latest series 3500 VMS as a part of modernization drive. The new system was connected with DCS via serial link for direct indications of vibration and axial displacement on DCS.
- Highly accurate Mass Flowmeter was installed for neem oil flow measurement replacing conventional rotameter and 10 nos. control valves of obsolete design were replaced by new control valves of contemporary design.

❖ UTILITY , OFFSITES & BAAGING

- 2oo3 trip logics were provided in Utilities area for several trips actuated on single voting logic so far. The job involved installations of additional field instruments, cabling and PLC logics development.
- Woodward 505-D Speed Governor was installed & commissioned for Elliot make Cooling Water Turbine.
- All control panel of bagging machines were shifted to new control room along with associated cabling. 04 Nos. panels were replaced by new ones.

ELECTRICAL

- **Critical job/ new installation**
  - Replacement of LT distribution panel of D.G.set MCC.
  - Installation , testing & commissioning of extension panel for MCC5
  - PLC installation at bagging plant and transfer tower.
  - Retrofitting of numerical Relays in 11KV substation
  - Replacement of Rotork make actuators and installation of new actuators

- **Scheduled preventive maintenance and modification work**
  - Servicing of Siemens make 11 KV HT Vacuum circuit breaker (VCB)
  - Servicing of Rotork make valve actuators
  - Maintenance of transformers
  - Overhauling of critical motors
  - Maintenance of Motor control center MCCs
  - Maintenance of 66 KV switch yard
  - Servicing of L&T make LT Air circuit breaker (ACB)
  - Servicing of Siemens make LT Air circuit breaker (ACB)
  - Checking of Rope switches in conveyors

TECHNICAL

Plant turnaround, provide opportunity to Technical Department to undertake execution of jobs related to Energy saving project, various EWRs and modification schemes which require isolation.

Piping Job of CW modification were carried out in Ammonia, Urea and Utility Plant.

EWR jobs have also been carried out during this shutdown

All modifications jobs have also resulted in tangible/ in- tangible benefits.

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

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

JGM (Maintenance)

IFFCO-Kalol

PLANT TURNAROUND SEPTEMBER - OCTOBER - 2018

GENERAL - DETAILS

SR. NO. CATEGORY QUANTITY

(A) EQUIPMENT UTILIZED :

IFFCO :

135 T	Kobelco Crane	01 No
100 T	Kobelco Crane	01 No
10 T	Escort Lift-N-Shift	01 No
14 T	Escort Lift-N-Shift	01 No
03 T	Forklift	03 Nos.
05 T	Forklift	01 No.
	Truck	02 Nos.
400 T	Liebherr Crane	01 No

(B) MANPOWER UTILIZED:

(I) IFFCO MANPOWER:

1	Mechanical	}	
2	Mechanical Services	}	Existing
3	Electrical	}	strength
4	Instrument	}	
5	Inspection	}	
6	Civil	}	

(II) HIRED - CONTRACT MANPOWER:

Sr. No.	Category	Man days
1	General Fitter	722
2	Rigger	1212
3	S.S. Rigger	2710
4	Fabricator	140
5	Grinder	221
6	Gas Cutter	114
7	HP Welder	45
8	ARC Welder	110

THE PLANT TURNAROUNDS AT A GLANCE

SR. NO.	YEAR	PERIOD FROM PRODUCTION TO PRODUCTION								REASON IF ANY
		AMMONIA PLANT				UREA PLANT				
		FROM	TO	DOWN TIME		FROM	TO	DOWN TIME		
				DAYS	HRS			DAYS	HRS	
01	1975	06-05-75	21-05-75	16.00	-	06-05-75	21-05-75	16.00	-	Planned
02	1976	26-03-76	20-04-76	26.00	-	26-03-76	20-04-76	26.00	-	Planned
03	76-77	05-12-76	22-01-77	49.00	-	05-12-76	24-02-77	51.00	-	101-JT B/D
04	1978	21-02-78	15-03-78	23.00	-	21-02-78	25-03-78	31.00	-	101-BJ B/D
05	1979	21-05-79	30-06-79	41.00	-	10-05-79	01-08-79	82.00	-	K-1101/2, 3rd Stage Cylinder
06	1981	12-04-81	10-05-81	29.00	-	08-04-81	12-05-81	35.00	-	101-B Headers Planned
07	1984	01-01-84	25-01-84	25.00	-	01-01-84	25-01-84	25.00	-	Planned
08	1986	19-03-86	03-05-86	45.00	-	04-03-86	01-05-86	59.00	-	Reformer Revamping / HP Scrubber B/D
09	1987	12-04-87	03-05-87	21.00	-	12-04-87	02-05-87	20.00	-	Planned
10	1988	18-04-88	14-05-88	27.00	-	18-04-88	13-05-88	26.00	-	Planned
11	1990	05-02-90	05-03-90	29.00	688.67	31-01-90	07-03-90	35.00	829.00	Planned
12	1991	24-02-91	13-03-91	18.00	429.08	23-02-91	14-03-91	20.00	459.25	Planned
13	1992	03-11-92	03-12-92	30.60	734.91	03-11-92	04-12-92	31.00	744.75	Planned
14	1993	12-09-93	23-10-93	42.00	986.50	12-09-93	29-10-93	47.00	1120.58	Revamp-II
15	1995	14-01-95	27-01-95	14.00	311.34	11-01-95	26-01-95	16.00	352.18	Scrubber H-1203 -B/D
16	1996	14-06-96	13-07-96	30.00	712.00	13-06-96	13-07-96	30.00	694.25	Autoclave V-1201 Leakage
17	1997	12-05-97	17-06-97	35.60	875.00	12-05-97	17-06-97	36.20	870.50	Planned
18	1998	22-04-98	19-05-98	27.50	660.00	20-04-98	19-05-98	30.00	720.00	Planned
19	1999	12-04-99	30-04-99	18.00	434.50	11-04-99	28-04-99	17.00	409.75	Planned
20	2000	03-04-00	27-04-00	24.42	586.25	03-04-00	28-04-00	25.43	610.50	Planned
21	2001	25-03-01	14-04-01	20.90	501.50	25-03-01	15-04-01	21.26	510.25	Planned
22	2002	20-03-02	22-04-02	33.40	801.58	20-03-02	23-04-02	34.31	823.50	Planned
23	2003	28-05-03	25-06-03	28.04	673.00	28-05-03	25-06-03	28.33	679.83	Planned
24	2004	20-05-04	09-06-04	20.00	495.17	20-05-04	09-06-04	20.00	480.25	Planned
25	2005	22-05-05	29-06-05	38.75	930..50	22-05-05	24-06-05	33.85	812.50	Planned
26	2006	31-03-06	06-05-06	35.93	862.42	29-03-06	06-05-06	37.06	889.50	Planned
27	2007	14-04-07	08-05-07	23.72	569.25	14-04-07	05-05-07	21.38	513.0	Planned
28	2008	24-03-08	14-04-08	20.26	486.25	24-03-08	14-04-08	20.40	489.50	Planned
29	2009	16-03-09	10-04-09	25.31	607.33	16-03-09	09-04-09	24.63	591.00	Planned
30	2010	21.03.10	05-04-10	15.07	361.50	21-03-10	05-04-10	15.25	366.00	Planned
31	2011	25-03-11	07-04-11	13.25	318.00	25-03-11	07-04-11	13.12	314.92	Planned
32	2012	28-03-12	13-04-12	16.33	392.00	28-03-12	12-04-12	15.34	368.25	Planned
33	2013	29-03-13	10-04-13	11.88	285	29-03-13	10-04-13	11.91	285.92	Planned
34	2014	26-03-14	28-04-14	33.34	800.25	26-03-14	24-04-14	28.75	689.92	Planned
35	2015	01-04-15	13-04-15	11.95	286.83	01-04-15	12-04-15	11.69	280.50	Planned
36	2016	19-03-16	05-04-16	17.36	416.75	19-03-16	05-04-16	16.97	407.25	Planned
37	2017	11-03-17	23-04-17	42.10	1010.33	11-03-17	24-04-17	43.42	1042.16	Planned-ESP III
38	**2018**	**17-09-18**	**15-10-18**	**25.79**	**662.17**	**17-09-18**	**15-10-18**	**27.81**	**667.50**	**Planned**

SHUT DOWN RELATED CONTRACTS

Sr. No.	PLANT	WO NO.	DESCRIPTION OF JOB	VENDOR'S NAME
1	MECHANICAL AMMONIA	201004181573	REPLACEMENT OF LT COIL AND MODIFICATION OF HDS-II COIL	M/s.JNK INDIA PVT LTD, THANE
2	MECHANICAL AMMONIA	201004190676	SUPPLY AND APPLICATION OF REFRACTORY OF AUXILIARY BOILER	M/s.CALDERYS INDIA REFRACTORIES LTD., NAGPUR
3	MECHANICAL AMMONIA	201004190871	REPAIRING OF WALL AND ROOF INSULATION OF PRIMARY REFORMER	M/s.UNIFRAX INDIA PVT LTD, MUMBAI
4	MECHANICAL AMMONIA	201004191114	OVERHAULING AND PREVENTIVE MAINT. OF ROTATING EQUIPMENTS IN AMMONIA PLANT	M/s.SAAD TECHNICAL SERVICES LLP, MUMBAI
5	MECHANICAL AMMONIA	201004190036	OVERHAULING OF 101-JT & 101-JHP	M/s.SAAD TECHNICAL SERVICES LLP, MUMBAI
6	MECHANICAL AMMONIA	201004191049	MAJOR OVERHAULING OF 104-JT AND PREVENTIVE MAINTENANCE OF 104-JA	M/s.SAAD TECHNICAL SERVICES LLP, MUMBAI
7	MECHANICAL AMMONIA	201004191230	OVERHAULING OF RE-CYCLE GAS COMPRESSOR, 117-J	M/s.MALHAN ENTERPRISES PVT. LTD., AHMEDABAD
8	MECHANICAL AMMONIA	201004190796	CRITICAL FABRICATION JOBS DURING SHUTDOWN 2018 IN AMMONIA PLANT	M/s. SHREE GANESH ENGG CO., AHMEDABAD
9	MECHANICAL AMMONIA	201004181223	SCAFFOLDING & BLINDING/DE-BLINDING JOBS DURING SHUT DOWN-2018	M/s.RAM BAHADUR & CO, PALI BABUGANJ, ALLAHABAD, UP
10	MECHANICAL AMMONIA	201004190939	BLINDING/DE-BLINDING, BOX-UP OF MANHOLE JOBS DURING SHUT DOWN-2018	M/s.HONESTY ENTERPRISES, SURAT
11	MECHANICAL UREA	201004181564	OVERHAULING & PREVENTIVE MAINT. OF ROTATING EQUIPMENTS	M/s.BVL POWER SYSTEMS PVT LTD, HYDERABAD

Sr. No.	PLANT	WO NO.	DESCRIPTION OF JOB	VENDOR'S NAME
12	MECHANICAL UREA	201004190849	MECHANICAL CLEANING OF "U" TUBES OF H-1207	M/s. GULACHI ENGINEERS PVT LTD,GHAZIAYABAD
13	MECHANICAL UREA	201004200281	CRITICAL NATURE FABRICATION JOBS	M/s. SHREE GANESH ENGG CO
14	MECHANICAL OFFSITE	201004161302	SERVICING/REPAIRING OF JASH MAKE SLUICE GATES	M/s. JASH ENGG. LTD
15	MECHANICAL OFFSITE	201004190302	RLA STUDY OF BOILERS	M/s. TCR ADVANCED ENGG PVT LTD
16	MECHANICAL OFFSITE	201004181564	OVERHAULING AND PREVENTIVE MAINTENANCE OF ROATING EQUIPMENTS	M/s. BVL POWER SYSTEMS PVT LTD
17	MECHANICAL OFFSITE	201004181642	SPECIALISED SERVICES FOR REPAIR OF COOLING TOWER	M/s. PAHARPUR COOLING TOWERS LIMITED
18	MECHANICAL OFFSITE	201004171816	IN - SITU OVERHAULING / REPAIRING OF GATE VALVE /CHECK VALVE	M/s. FLOTEC TECHNOSMART (INDIA) PRIVATE LIMITED
19	MECHANICAL B&MH	201004190353	DESIGN, MANUFACTURING, SUPPLY, REMOVAL & INSTALLATION OF BELT CONVEYING SYSTEM M-2121	M/s. PRAYAS ENGINEERING LIMITED
20	MECHANICAL B&MH	201004191245	SERVICES OF SKILLED ENGINEER AND TECHNICIAN FOR MAINTENANCE OF NEW RECLAIM M/C	M/s. ELECON ENGINEERING CO. LIMITED
21	INSPECTION	201004180689,	METALLOGRAPHY WORK	M/s.TCR ADVANCED ENGG, VADODARA
22	INSPECTION	201004190258,	RADIOGRAPHY WORK	M/s.SAHAJANAND TEST LAB, AHMEDABAD
23	INSPECTION	201004181158,	NDT TEAMS FOR DP TEST & THICKNESS MEASUREMENT	M/s.IXAR, MUMBAI
24	INSPECTION	201004181159,	NDT TEAM FOR ULTRASONIC FLAW DETECTION WORK	M/s.IRC ENGG. SERVECE INDIA PVT LTD, NEW DELHI
25	INSPECTION	201004181160,	NDT TEAM FOR MAGNETIC PARTICLE INSPECTION	M/s.NDT SERVICES, AHMEDABAD

Sr. No.	PLANT	WO NO.	DESCRIPTION OF JOB	VENDOR'S NAME
26	INSPECTION	201004181261,	HELIUM LEAK TESTING	M/s.GULACHI ENGRS, GHAZIABAD
27	INSPECTION	201004170499,	IRIS INSPECTION OF LPCC(H-1205)	M/s.TESTEX NDT (I) PVT. LTD, MUMBAI
28	INSPECTION	201004170587,	ECT OF HP STRIPPER	M/s.TESTEX NDT (I) PVT. LTD, MUMBAI
29	INSPECTION	201004181559,	ECT OF HP CONDENSER	M/s.TESTEX NDT (I) PVT. LTD, MUMBAI
30	INSPECTION	201004181279,	AUS OF PRIMARY REFORMER	M/s.PDIL, NOIDA
31	INSPECTION	201004190571,	PAUT/TOFD OF CRITICAL LINES/EQUIPMENT	M/s.NDT SERVICES, AHMEDABAD
32	INSPECTION	201004190632,	PECT OF INSULATED LINES	M/s.IXAR, MUMBAI
33	INSTRUMENT	2010062000384	AMC OF CONTROL VALVE	M/s. FLOWTECH INDIA PVT LTD.
34	INSTRUMENT	201004181339	MANPOWER FOR SHUTDOWN	M/s. SANTECH SYSTEM
35	ELECTRICAL	201004190746	CHARGES FOR SERVICE ENGINEER/TECHNICIAN FOR SERVICING OF CHHABI MAKE BATTERY CHARGERS	M/s. CHHABI ELECTRICALS PVT. LTD.
36	ELECTRICAL	201004190377	NUMERICAL RELAY FOR IIKV MPSS SIEMENS PANEL & TOWNSHIP HT/LT PANELS	M/s. ELCON ENGINEERS PVT LTD
37	ELECTRICAL	201004190661	LMS SYSTEM	M/s.SOFCON SYSTEMS INDIA (P) LTD
38	ELECTRICAL	201004190713	SERVICING/REPAIRING OF SIEMENS MAKE 11KV HT VACUUM CIRCUIT BREAKERS	M/s. SIEMENS LTD
39	ELECTRICAL	201004181227	DG SET MCC	M/s. INTRELEC
40	ELECTRICAL	201004180501	IQ2 SERIES ACTUATORS	M/s. ROTORK CONTROLS (INDIA) PVT LTD
41	PLANNING	201004170755	OVERHAULING & TESTING OF HP / LP RELIEF VALVES	M/s. FLOTEC TECHNOSMART (INDIA) PVT LTD, SURAT

Sr. No.	PLANT	WO NO.	DESCRIPTION OF JOB	VENDOR'S NAME
42	PLANNING	201004170773	OVERHAULING & TESTING OF VARIOUS RELIEF VALVES	M/s. FLOTEC TECHNOSMART (INDIA) PVT LTD,SURAT
43	PLANNING	201004181659	OPENING & BOXED UP OF HEAT EXCHANGERS	M/s. GENERAL ENGG WORKS , BHARUCH
44	PLANNING	201004181823	ASSISTING IFFCO DURING PLANT TURNAROUND 2018	M/s. GENERAL ENGG WORKS , BHARUCH
45	PLANNING	201004181657	HYDRO JETTING CLEANING OF HEAT EXCHANGERS TUBES	M/s. HYDRO JETTING SERVICES, AHMEDABAD
46	PLANNING	201004171471	FABRICATION JOBS IN PLANT	M/S. J & J ENGINEERING, SHERTHA
47	PLANNING	201004171470	FABRICATION JOBS IN PLANT	M/s. GENERAL ENGG WORKS , BHARUCH
48	PLANNING	201004161418	INSULATION JOBS IN PLANTS	M/s. BALAJI INSULATION, MUMBAI
49	PLANNING	201004161417	INSULATION JOBS IN PLANTS	M/s. KHANDELWAL INSULATION , MUMBAI
50	PLANNING	201004160985	PETTY MAINTENANCE JOBS IN PLANTS	M/s. J & J ENGINEERING, SHERTHA
51	PLANNING	201004171627	ON LINE SEALING JOBS IN PLANT	M/s. DYNAMIC META SEALING ENGINEERS , BHARUCH
52	PLANNING	201004180194	PAINTING JOBS IN PLANT	M/s. B CHAUHAN & CO, KALOL

MECHANICAL

AMMONIA PLANT

(MECHANICAL)

AIR COMPRESSOR TRAIN (101-J)

Overhauling and PM of Rotary equipment's was carried out by M/s. SAAD Technical Services LLP, Mumbai against WO No. 201004190036 & 201004181553.

Major overhauling of Drive Turbine (101-JT), HP Compressor (101-JHP) and Preventive Maintenance of 101-JLP & 101-JR was carried out.

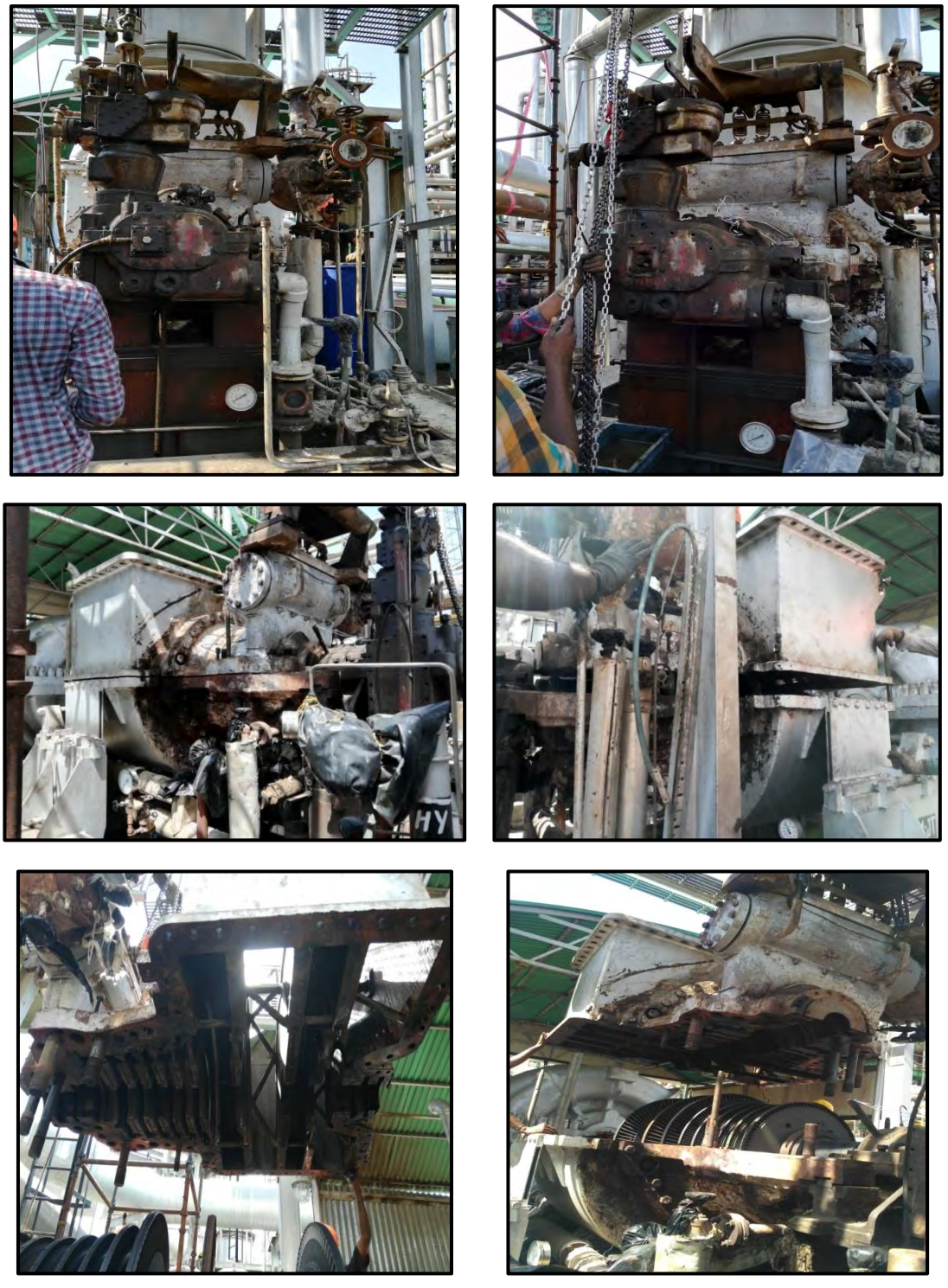
101-JT, Air Compressor Drive Turbine

Last Major overhauling of 101-JT was done during SD-2013. It was taken for major overhauling after 5-1/2 years to check the condition of internals as the superheat temperature of MP steam was 295^{0}C lower than normal 330^{0}C after ESP-III shutdown 2017.

Dismantling:

- Turbine casing was locked by changing washers of hold down bolts.
- The expansion bellow in the steam exhaust line was locked.
- Alignment of complete train was checked and readings were noted down.
- Turbine was decoupled and steam inlet & exhaust piping were removed.
- Nozzle Valve & Operating Gear Assy. link was disconnected from Speed Governor Assy.
- Disconnected Speed Governor Assy. from Governor Drive Assy., lifted using chain block and shifted on ground and placed on its support.
- The top casing half alongwith Nozzle Valve & Operating Gear Assy. and Trip Throttle Valve Assy. was lifted using crane & shifted on ground.
- Dismantled Governor Drive Assy. & Hydraulic Trip Assy. one by one.
- All internal radial as well as axial clearances between rotor assy. & bottom casing were recorded.
- Rotor assembly run-out was checked at position & recorded.
- The bearing clearances were measured and then both end Journal bearings and Thrust bearing were removed for inspection.
- The rotor assembly was lifted out of bottom casing half, shifted on ground and placed on rotor stand.
- All the interstage labyrinth rings were removed.
- The top and bottom half of diaphragms were dismantled from corresponding top & bottom casing halves. Unscrewed the countersunk bolts holding the diaphragm with top casing half for removal.

- The rotor assy. was cleaned by shot blasting after covering shaft journal area & gland sealing area.
- The top and bottom half of diaphragms were cleaned thoroughly by shot blasting.
- Cleaning of top & bottom casing halves were carried out manually. Top casing half was cleaned by hydro-jetting also.
- Emergency Governor Assy. was dismantled from the rotor assy. and cleaned.



Removal of 101-JT Top Casing Half

View of 101-JT after top casing removal

View of bottom casing half after removal of Diaphragm

Turbine Rotor

Sand Blasted Turbine Rotor

Sand Blasted Turbine Diaphragms

Observation:

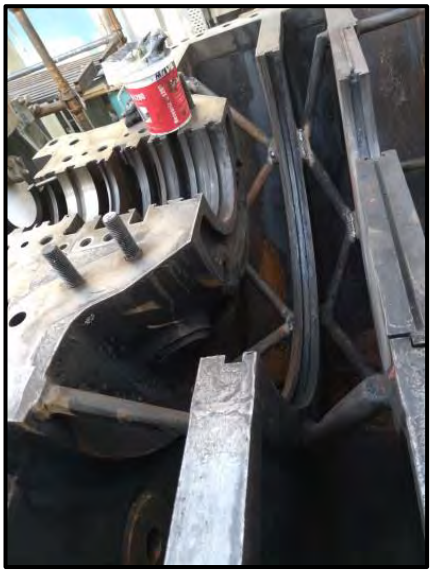
- Moisture rings fixed with the 4th, 5th & 6th diaphragms were found badly eroded.

Eroded Moisture Rings

101-JT Moisture Ring

- Heavy erosion was found at the welding joint of reinforcement rods for the diaphragm holders in the top & bottom half of casing.

Eroded Reinforcement Rod



Weld Repaired Eroded Reinforcement Rods

Deposits observed in blades

- Earthing brush was damaged and the holder of brush was touching the spacer, due to which marks were found on spacer.

101-JT Earthing Brush

Repairing & Replacement:

- 5^{th} & 6^{th} no. diaphragms with moisture rings were replaced by spare refurbished diaphragm set. Diaphragm no. 4 couldn't be replaced as it was not seating properly in the groove.

5^{th} stage Diaphragm with eroded moisture ring

Spare 5^{th} stage Diaphragm with moisture ring installed

- Eroded welding joint of reinforcement rods for the diaphragm holders in the top & bottom half of casing was repaired by welding using SS410 welding electrode (E 410).
- Loose diaphragm pin tack welded by SS410 welding electrode

Loose diaphragm pin tack welded by SS410 welding electrode

- Replaced the Oil Guard (Governor end) as edges found damaged and worn out.

Inspection

- Visual Inspection of all components was carried out.
- The Journal and Thrust bearings were visually inspected & DP test of pads were carried out. Bearings found in good condition.
- Gauss readings of the bearing pads & shaft journal area were measured and found within limits.
- Journal Bearing clearances were taken and found within the design range.
- Magnetism level of all major components i.e. shaft and casing was checked and found within limit.

Assembly

- All drain pipes were cleaned and drain valves were roused.
- All the inter stage labyrinth clearances were found OK, only springs were replaced by new one.
- The governor drive assy. end bearings and gear drives were visually inspected and found in good condition.
- The Emergency Governor Assembly was dismantled and cleaned. Movement of the OST plunger inside the shaft was checked and found to be satisfactory.

Emergency Governor Assembly (OST Assy.)

- The diaphragms were reinstalled one by one at their respective position.
- All the inter-stage labyrinth rings were fixed, only springs were replaced by new one.
- The rotor assy. was lifted and placed inside the bottom casing.
- Assembled the DE & NDE journal bearings & thrust bearing.
- The bearing clearances were measured along with rotor free float and trip plunger clearances.
- All internal radial as well as axial clearances between rotor assy. & bottom casing were measured and found to be satisfactory. Recorded these readings.
- The top casing half was lifted and placed over the bottom half after applying the gasket sealing compound (Birkosit) on the parting plane.

Rotor placed on bottom casing half

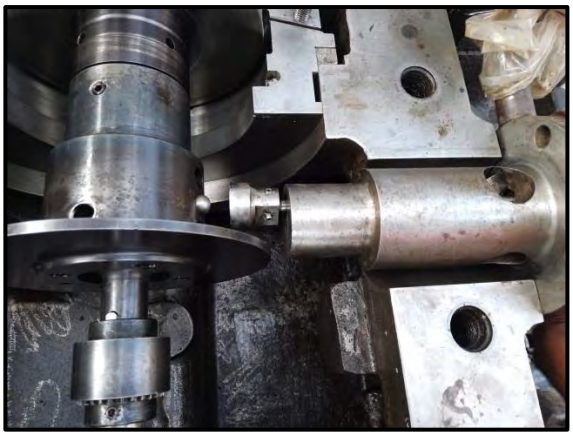
Lifted Top casing half for Assy.

Application of sealing compound on parting plane

Placement of top casing on bottom casing

- Casing bolts inserted and tightened following the bolt tightening sequence.
- Front Steam Gland Allen Bolts 2 nos. & Front Brg. Housing Bolts 4 nos. found damaged. Bolts replaced.
- The Governor was reinstalled and all linkages were greased.

View of Governor Drive Arrangement

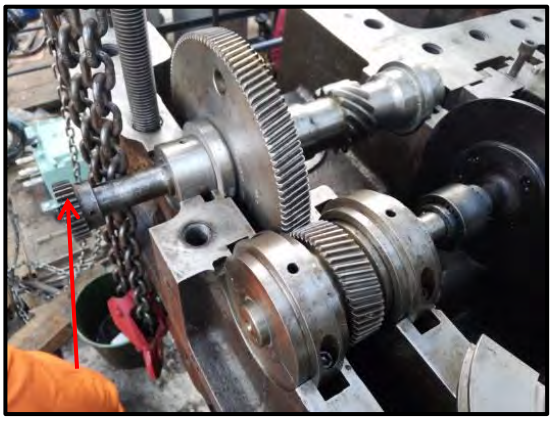


View of Hydraulic Trip Assembly

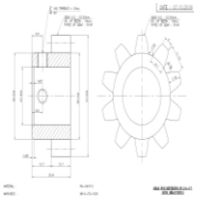
- Additional Earthing brush was installed over coupling between 101-JR & 101-JHP. Provision was made on Coupling guard top half.

Additional Earthing brush between 101-JR & 101-JHP

- Modified Spur gear for 2oo3 provision in Speed sensing.



Old Spur Gear, No. of teeth = 28



Modified Spur gear for 2oo3 provision in Speed sensing. No. of Teeth = 10 nos.

- The coupling's flexible elements were locked and the turbine was taken for OST. The turbine tripped in a single attempt at 7360 RPM. Electronic trip checked, found working ok, turbine tripped at 7168 RPM.

MAJOR OVERHAULING RECORDS: 101 - JT

Description	Position	Dwg. Ref	Design Clearance(")	Before (mm)	After (mm)
JLP End					
Journal Bearing	Mandrel	B	0.007-0.009	0.16	0.16
Oil Guard For Jr. Brg Housing	South	C	0.015-0.021	0.05	0.05
	North	G	0.058-0.097	0.05	0.05
Oil Guard For Seal Housing	---	D	0.077-0.109		
Governor End					
Journal Bearing	Mandrel	B	0.007-0.009	0.16	0.16
Oil Guard For Brg. Housing	South	---	---	---	--
	North	C	0.015-0.021		
Oil Guard For Thrust Brg.	South	A	0.002-0.04		
	North	A	0.002-0.004		
Oil Guard For Seal Housing	---	D	0.077-0.109		
Axial Thrust.	With Top Housing	---	0.008-0.012	0.43	0.41
	Without top Housing	---			
Shim thickness. Thrust adjusting	North	---	---		
	South	---	---		
Nozzle Clearance	---	---	0.055-0.065		1.32
Total Float	With Top Housing	---	0.180		
	Without Top Housing	---		3.60	4.38
	Without Non-Active Pad	-		1.68	
Shaft Diameter	Journal bearing	---	4.993	126.82	-
Trip Lever - Plunger	---	---	0.120-0.130	3.12 (without gasket)	3.25 (with 0.15 mm gasket)

JOURNAL BEARING PADS THICKNESS (MM)				
PAD	**NORTH SIDE BEARING (Rear)**		**SOUTH SIDE BEARING (Front)**	
	Before	**After**	**Before**	**After**
No 1	20.63	20.63	20.61	20.61
No 2	20.63	20.63	20.60	20.60
No 3	20.61	20.61	20.60	20.60
No 4	20.62	20.62	20.60	20.60
No 5	20.62	20.62	20.61	20.61

GAUSS RECORDS			
Description	**Position**	**Before**	**After**
Journal Bearing pads	Thrust End	0.6	0.6
	Non thrust end	1.3	1.3
Journal Bearing base ring	Thrust End	0.6	0.6
	Non thrust end	1.0	1.0
Thrust bearing pads	Active	0.7	0.7
	Inactive	1.0	1.0
Thrust Bearing base ring	Active	1.2	1.2
	Inactive	1.2	1.2
Shaft Journal	Thrust End	1.7	1.7
	Non thrust end	1.4	1.4

IFFCO - KALOL

DIAMETRICAL CLEARANCES - 101 JT

REF.	CLEARANCE (INCHES)	CLEARANCE (MM)	BETWEEN	REF.	CLEARANCE (INCHES)	CLEARANCE (MM)	BETWEEN
A	0.002 TO 0.004	0.051 TO 0.102	SEAL RING (THR. BRG.) TO SHAFT / NUT	D	0.077 TO 0.109	1.956 TO 2.769	GUARD TO SHAFT
B	0.007 TO 0.009	0.178 TO 0.229	JOURNAL BEARING TO SHAFT	E	0.013 TO 0.019	0.330 TO 0.483	LABYRINTH RING TO SHAFT
C	0.015 TO 0.021	0.381 TO 0.533	OIL GUARD TO SHAFT	G	0.058 TO 0.097	1.473 TO 2.464	OIL GUARD TO SHAFT

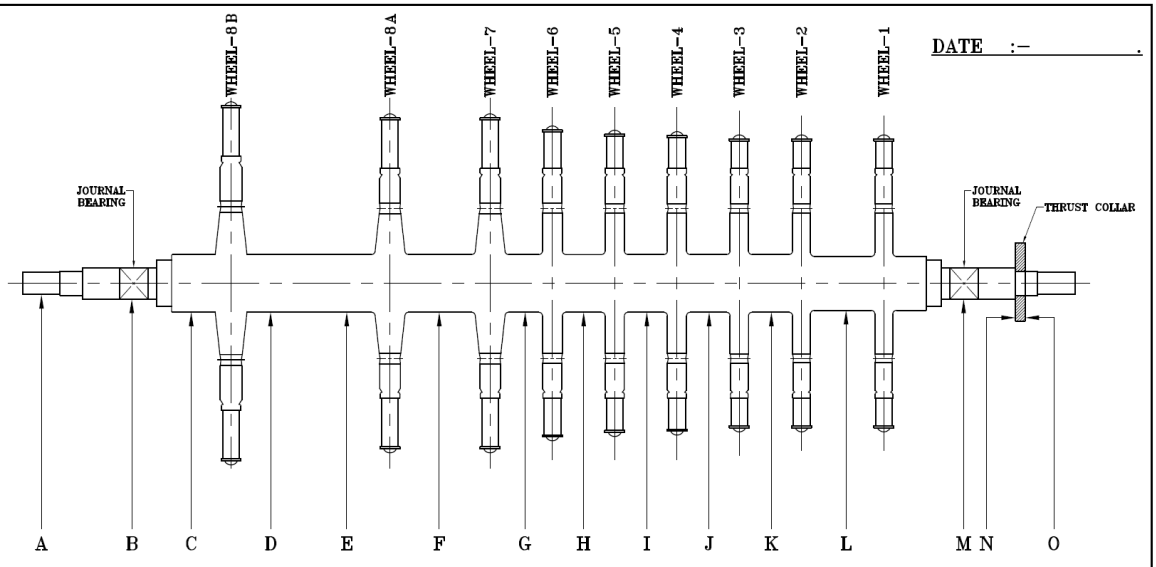
AFTER	BEFORE		BEFORE	AFTER
		OIL GUARD - A		
		THRUST BRG.		
		OIL GUARD - A		
		JR. BRG. B		
	0.08	OIL GUARD - C	0.10	
	1.00	RING - D	1.00	
0.05	0.00	E	0.60	0.60
0.10	0.10	E	0.60	0.60
0.00	0.10	E	0.60	0.60
0.10	0.00	E	0.60	0.60
0.00	0.50	E	0.10	0.60
0.00	0.55	E	0.05	0.55
		WHEEL - 1		
0.10	0.05	E	0.40	0.20
		WHEEL - 2		
0.40	0.00	E	0.35	0.00
		WHEEL - 3		
0.00	0.00	E	0.50	0.50
		WHEEL - 4		
0.35	0.65	E	0.40	0.65
		WHEEL - 5		
0.00	0.05	E	0.30	0.40
		WHEEL - 6		
0.00	0.00	E	0.20	0.20
		WHEEL - 7		
0.00	0.10	E	0.35	0.50
		WHEEL - 8 A		
0.50	0.30	E	0.65	0.50
0.30	0.50	E	0.20	0.50
		WHEEL - 8 B		
0.10	0.15	E	0.30	0.25
0.00	0.00	E	0.10	0.15
0.05	0.00	E	0.10	0.10
0.00	0.00	E	0.10	0.15
	0.60	RING - D	0.70	
	0.15	OIL GUARD - C	0.25	
		JR. BRG. B		
	0.40	OIL GUARD - G	0.25	

SOUTH (THRUST END)

NORTH (OPP. THRUST END)

COUPLING

IFFCO :-	
PARTY :-	
Date :-	

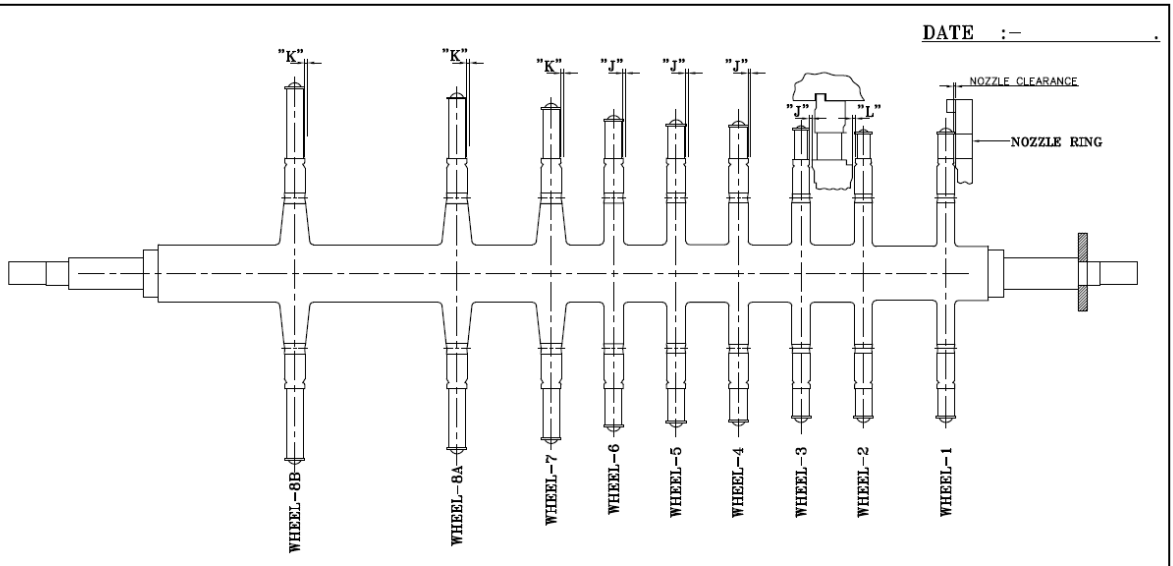


DESCRIPTION	ROTOR NO.	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
EXISTING ROTOR			0.03		0.01	0.02	0.02						0.04	0.03	0.01	0.01
IF NEW ROTOR IS INSTALLED																

IFFCO - KALOL

RUNOUT RECORD FOR 101-JT

PLANT : AMMONIA



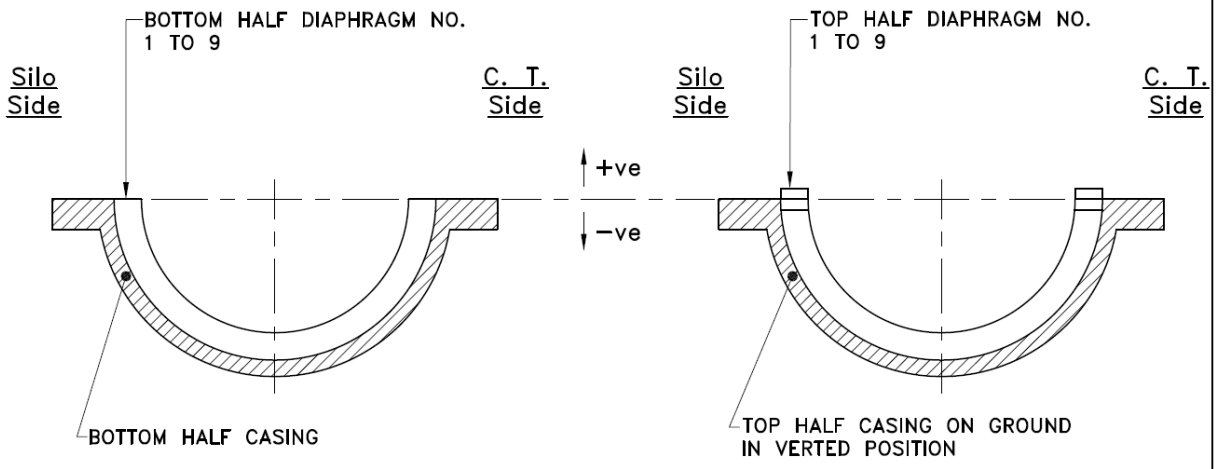
CLEARANCE		WHEEL-1	WHEEL-2		WHEEL-3	WHEEL-4	WHEEL-5	WHEEL-6	WHEEL-7	WHEEL-8A	WHEEL-8B
		NOZZLE CLEARANCE	J	L	J	J	J	J	K	K	K
DESIGN (INCH / MM)		0.055"–0.065" 1.40 – 1.65	0.055"–0.065" 1.40 – 1.65	0.115"–0.125" 2.79 – 3.18	0.055"–0.065" 1.40 – 1.65	0.055"–0.065" 1.40 – 1.65	0.055"–0.065" 1.40 – 1.65	0.055"–0.065" 1.40 – 1.65	0.110"–0.120" 2.79 – 3.05	0.110"–0.120" 2.79 – 3.05	0.110"–0.120" 2.79 – 3.05
MEASURED	SILO SIDE [WEST]	10.80	4.20	2.70	3.30	3.45	4.50	2.75	2.60	2.50	2.80
	COOLING TOWER SIDE [EAST]	10.80	4.15	2.80	3.50	3.40	4.55	2.70	2.50	2.55	2.85

IFFCO - KALOL

WHEEL TO DIAPHRAGM CLEARANCE (101-JT)

PLANT : AMMONIA

IFFCO INDIAN FARMERS FERTILISER CO-OP. LTD. KALOL



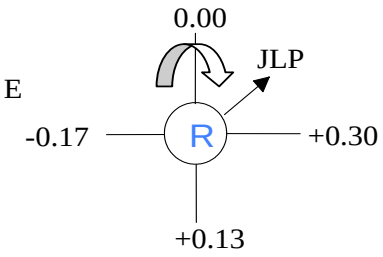
ALL DIMENSIONS ARE IN MM.

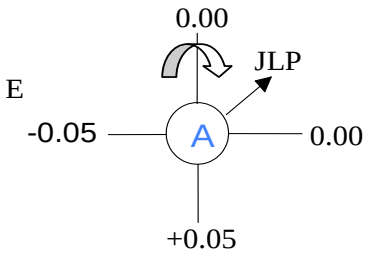
DIAPHRAGM NO. FROM GOVERNOR END		NO.:1	NO.:2	NO.:3	NO.:4	NO.:5	NO.:6	NO.:7	NO.:8	NO.:9
		BOTTOM CASING WITH BOTTOM HALF DIAPHRAGM								
SILO SIDE (X1)	BEFORE	−0.22	−1.05	−0.20	−0.83	−0.91	−1.83	−1.45	−0.65	−0.90
	AFTER	−0.50	+0.10	−0.20	−0.25	+0.02	+0.10	−0.30	−1.00	−0.30
C.T. SIDE (X2)	BEFORE	−0.32	−0.22	−0.08	−2.60	−0.70	+0.88	+1.11	−0.73	+0.32
	AFTER	−0.10	−0.00	+0.50	−1.30	+0.02	+0.00	+0.03	−0.30	−0.10
		TOP CASING WITH TOP HALF DIAPHRAGM								
SILO SIDE (X3)	BEFORE	+1.20	+0.56	−0.60	+0.60	+3.14	+0.56	+0.90	+1.15	−0.40
	AFTER	+0.40	−0.30	−0.50	+0.30	−0.40	−0.60	−0.40	+0.60	−0.40
C.T. SIDE (X4)	BEFORE	+1.20	+0.56	−0.60	+0.60	+3.15	+0.56	+0.90	+1.15	−0.40
	AFTER	+0.40	−0.30	−0.50	+0.30	−0.40	−0.60	−0.40	+0.60	−0.40
NET CLEARANCE (SUM OF ALL FOUR i.e. (X1 + X2) + (X3 + X4) with reference to parting plane)										

DRN	N.V. PANCHAL	TITLE - PP LEVEL READING OF 101−JT		EWR No.	
CHD					
APD		DRAWING No.	PLANT FROM NUMBER	SHEET OF	REV.
SCALE	N. T. S.	CODE AMM−405	P 1 E S 0 8 − − −	1 1	0

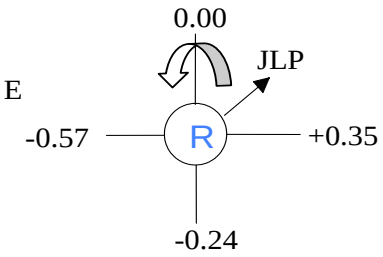
ALIGNMENT READING: 101-JT to 101-JLP

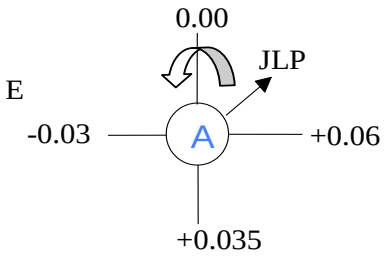
Before Preventive Maintenance





After Preventive Maintenance





101-JLP, Air Compressor

Preventive Maintenance of 101-JLP was carried out. 101-JLP was decoupled from both ends. Journal bearings and Thrust bearings were visually inspected and Dye penetration test was carried out. Gauss reading of the bearing pads and base rings were measured and found within limits. Bearing clearances were taken and found within the design range.

Journal Bearing (North Side) Pad Screw (1 No.) found damaged, hence replaced.

COUPLINGS

Description	Position	Design (Inch)	Before (mm)	After (mm)
DBSE (With Rotor at extreme ends)				
101 JT-JLP	---	10.50		
101 JLP-JR	---	8.25	210.79 (silo) 210.70 (CT)	210.90
101 JR-JHP	---	8.25		
Distance between Hub Face (With Rotor at extreme ends)				
101 JT-JLP	---	10.557		
101 JLP-JR	---	8.25	131.27	131.90
101 JR-JHP	---	8.25		

PREVENTIVE MAINTENANCE RECORDS: 101 – JLP

Description	Position	Dwg. Ref.	Design Clearances (Inch)	Before (Inch)	After (Inch)
TURBINE END					
Journal Bearing Clearance	Mandrel	D-1	0.005-0.008	0.19	0.19
	Filler / lead wire				
Shaft Dia.	Journal Bearing	------	4.493		
Oil Guard (For Journal Bearing)	North	C-1	0.013-0.015	0.10 - 0.15	0.10 - 0.15
	South	C-1	0.013-0.015		
Oil Guard (For Outer Housing)	North	A-1	0.021-0.027		
	South	A-1	0.021-0.027		
GEAR BOX END					
Journal Bearing Clearance	Mandrel	D-1	0.005-0.008	0.26	0.26
	Filler / lead wire				
Shaft Dia	Journal bearing	------	4.493		
Oil Guard (For Journal Bearing)	North	C-1	0.013-0.015		
	South	C-1	0.013-0.015		
Oil Guard (For Thrust bearing)	North	M-1	0.002-0.004		
	South	S-1	0.002-0.04		
Oil Guard (For Outer Housing)	North	A1	0.021-0.027		
	South	A1	0.021-0.027		
Axial Thrust	With Top Housing	------	0.010 - 0.015	0.20	0.20
	Without Top Housing	------			
Shim Thickness (Axial Thrust adjusting)	North	------	------		
	South	------	------		
Total Float	------	------	7.144 - 8.730		

Journal Bearing Pads Thickness (MM)				
PAD	**NORTH SIDE BEARING**		**SOUTH SIDE BEARING**	
	Before	**After**	**Before**	**After**
No 1	19.05	19.05	19.05	19.05
No 2	19.06	19.06	19.05	19.05
No 3	19.06	19.06	19.06	19.06
No 4	19.04	19.04	19.04	19.04
No 5	19.05	19.05	19.06	19.06
Thrust Bearing Pad Thickness (MM)				
Pad	**ACTIVE (Inner)**		**INACTIVE (Outer)**	
	Before	**After**	**Before**	**After**
No 1	19.80	19.80	19.81	19.81
No 2	19.80	19.80	19.80	19.80
No 3	19.81	19.81	19.80	19.80
No 4	19.81	19.81	19.81	19.81
No 5	19.79	19.79	19.80	19.80
No 6	19.79	19.79	19.81	19.81
No 7	19.79	19.79	19.80	19.80
No 8	19.80	19.80	19.81	19.81

GAUSS RECORDS: 101-JLP			
Description	**Position**	**Before**	**After**
Journal Bearing pads	Thrust End	0.8 (T) 0.9 (B)	0.8 (T) 0.9 (B)
	Non thrust end	1.4 (T) 1.0 (B)	1.4 (T) 1.0 (B)
Journal Bearing base ring	Thrust End	1.1	1.1
	Non thrust end	0.7	0.7
Thrust bearing pads	Active	1.0	1.0
	Inactive	1.3	1.3
Thrust Bearing base ring	Active	1.3	1.3
	Inactive	1.2	1.2
Shaft Journal	Thrust End	1.1	1.1
	Non thrust end	1.0	1.0

101-JR, Gear Box

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

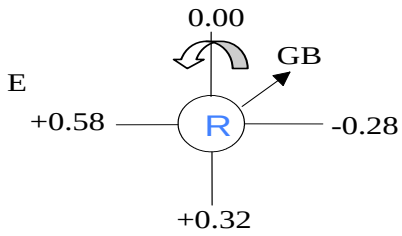
PREVENTIVE MAINTENANCE RECORDS: 101-JR

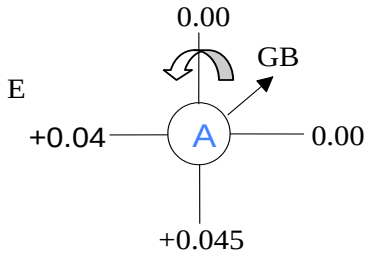
Description	**Position**	**Design Clearances (Inch)**	**Before (Inch)**	**After (Inch)**
Journal Bearing (Low Speed drive gear)	North	0.008-0.010	0.31	0.31
	South	0.008-0.010	0.31	0.31
Journal Bearing Interference (Low Speed drive gear)	North		0.02	
	South		0.05	
Axial Thrust	---	0.014-0.024	0.32	0.31
Journal Bearing (High Speed driven Pinion)	North	0.009-0.011	0.26	0.26
	South	0.009-0.011	0.24	0.24
Journal Bearing Interference (High Speed driven Pinion)	North		0.02	
	South		0.06	
Free float	---	---		
Backlash	---	---	0.36	0.36
Shaft Diameter. (High Speed driven Pinion)	North Side Bearing.	---	88.75	88.75
	South Side Bearing.	---	88.75	88.75

GAUSS RECORDS: 101-JR			
Description	**Position**	**Before (Gauss)**	**After (Gauss)**
Gear Journal Bearing	North	0.2 (T) 0.2 (B)	0.2 (T) 0.2 (B)
	South	0.5 (T) 0.4 (B)	0.5 (T) 0.4 (B)
Pinion Journal Bearing	North	0.8 (T) 0.8 (B)	0.8 (T) 0.8 (B)
	South	0.8 (T) 0.9 (B)	0.8 (T) 0.9 (B)
Thrust bearing	Active	1.0	1.0
	Inactive	1.2	1.2
Shaft Journal Pinion	Thrust End	1.3	1.3
	Non thrust end	1.2	1.2
Shaft Journal Gear	Thrust End	1.0	1.0
	Non thrust end	1.3	1.3

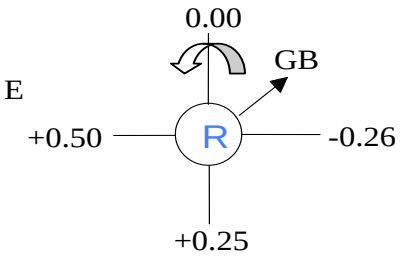
ALIGNMENT READING : 101-JLP to 101-JR

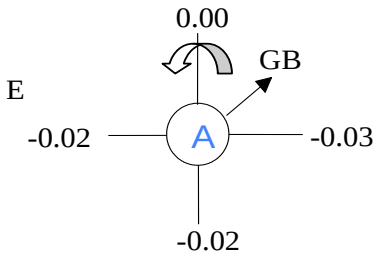
Before Preventive Maintenance





After Preventive Maintenance





101-JHP, Air Compressor

Major overhauling of 101-JHP was carried out after 3 years to attend the end seal leakage by replacement of the refurbished rotor.

Air leakage was occurring from end shaft seals since last overhauling (SD-2015) during which Integral fins of rotor was found worn out. Also, the Integral fins of spare rotor also found worn out. Hence, spare rotor was refurbished against PO 201004190333 dtd. 12/06/2018 at M/s. Siemens Works, Vadodara to maintain the clearance between the (integral fins) OD of shaft & newly procured end seals ID.

- 101-JHP was decoupled from Gear Box.
- Casing bolts were opened & compressor casing top half lifted by using crane.

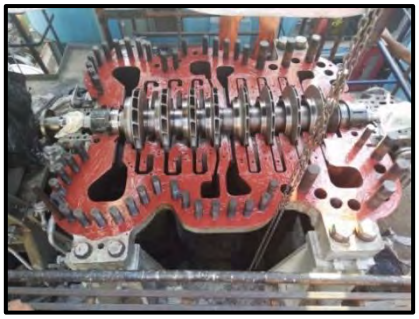
- Clearances of all internals with rotor were measured & recorded.
- Rotor was lifted out of the casing by crane.
- Rotor was replaced by spare rotor (refurbished at M/s. Siemens Works).
- Old Rotor Coupling Hub was removed by using Hydraulic Coupling removal tool.

  Expander Pressure : 24500 PSI, Pusher Pressure : 0 PSI
- Coupling hub was assembled on spare rotor by using Hydraulic Coupling installation tool after Blue checking (85%).

  Dry Fit Stand-off : 7.2mm, Wet Fit Stand-off : 7.16mm, Coupling Push required : (7.16+0.2)=7.36mm. {0.2mm Shaft overhang as measured before}.
- Coupling side gland bushing was replaced by new ones & NDE side old gland bushing was reused as per the clearance readings.
- Manual cleaning of bottom casing half & hydrojet cleaning of top casing half was carried out.
- 3 nos. damaged Casing Parting plane bolts replaced by new one.
- Placed the rotor on the bottom half of casing & again clearances of all internals with rotor checked & recorded.
- Placed the top casing half after applying Birkosit compound over the parting plane & box-up the two halves by tightening the casing bolts.
- Broken washers of Casing bolt was replaced by new ones (Size: 71 mm OD X 45 mm ID X 3 mm Thk. MOC: EN19/24).
- Journal bearings and Thrust bearing were visually inspected and Dye penetration test also carried out. Found satisfactory.
- Gauss reading of the bearing pads and base rings were measured and found within limits. Bearing clearances were taken and found within the design range.


101-JHP bottom casing half after top casing half removal

Balancing drum found corroded & eroded



101-JHP bottom casing half before final box-up

101-JHP top casing half

Balancing drum & seal found corroded & eroded

MAJOR OVERHAULING RECORDS : 101 – JHP

Description	Position		Design (Inch)	Before (mm)	After (mm)
DBSE (With Rotor at extreme ends)					
101 JT-JLP	---		10.50		
101 JLP-JR	---		8.25		
101 JR-JHP	---		8.25	210.45 (CT) 210.40 (Silo)	210.10 (L) 210.13 (R)
Distance between Hub Face (With Rotor at extreme ends)					
101 JT-JLP	---		10.557		
101 JLP-JR	---		8.25		
101 JR-JHP	---		8.25	219.10	219.30
Coupling Hub / Shaft Overhang					
101 JHP	JR End	Hub	0.00		
		Shaft	0.00	0.2	

MAJOR OVERHAULING RECORDS: 101 – JHP

Description	Position	Dwg. Ref.	Design Clearances (Inch)	Before (mm)	After (mm)
GEAR BOX END					
Journal Bearing Clearance	Mandrel	C-1	0.004-0.007	0.23	0.23
	Filler / lead wire				
Shaft Dia.	Journal Bearing	------	2.996	76.04	76.05
Oil Guard (For Journal Bearing)	North	B-1	0.013-0.016	0.15	0.10
	South	B-1	0.013-0.016	0.15	0.10
Oil Guard (For Top Housing)	North	D-1	0.015-0.022	0.68	0.50
	South	D-1	0.015-0.022	0.67	0.50

Description	Position	Dwg. Ref.	Design Clearances (Inch)	Before (mm)	After (mm)
NON DRIVE END					
Journal Bearing Clearance	Mandrel	D-1	0.015-0.022	0.23	0.23
	Filler / lead wire				
Shaft Dia	Journal bearing	------	2.996	76.04	76.05
Oil Guard (For Journal Bearing)	North	B-1	0.013-0.016	0.15	0.10
	South	B-1	0.013-0.016	0.15	0.10
Oil Guard (For Thrust bearing)	North	A-1	0.002-0.004	0.10	0.10
	South	A-1	0.002-0.04	0.10	0.10
Oil Guard (For Top Housing)	North	------	------	------	------
	South	D-1	0.015-0.022	0.20	0.20
Axial Thrust	With Top Housing	------	0.008 – 0.012	0.33	0.32
	Without Top Housing	------		0.41	0.54
Total Float	------	------	2.779 – 3.571 MM		Not possible

Journal Bearing Pads Thickness (MM)

PAD	NORTH SIDE BEARING (Rear)		SOUTH SIDE BEARING (Front)	
	Before	After	Before	After
No 1	14.27	14.27	14.25	14.27
No 2	14.25	14.25	14.27	14.25
No 3	14.26	14.26	14.26	14.26
No 4	14.27	14.27	14.27	14.27
No 5	14.26	14.26	14.26	14.26

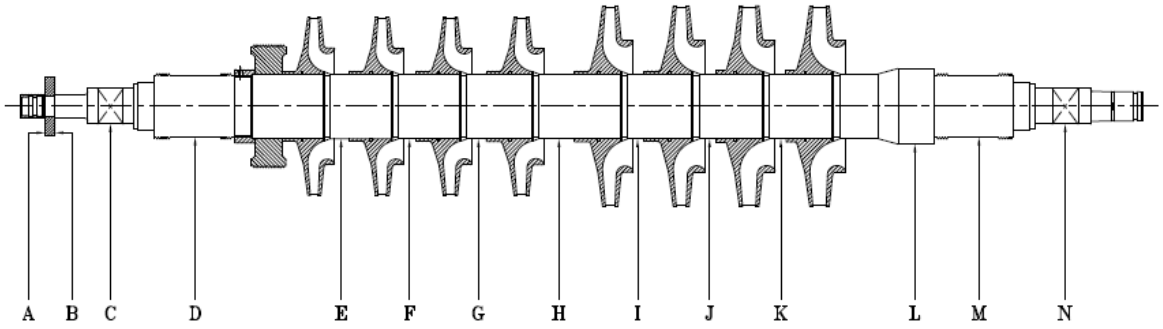
Thrust Bearing Pad Thickness (MM)

Pad	ACTIVE (Outer)		INACTIVE (Inner)	
	Before	After	Before	After
No 1	12.65	12.65	12.65	12.65
No 2	12.63	12.63	12.63	12.63
No 3	12.64	12.64	12.66	12.66
No 4	12.64	12.64	12.66	12.66
No 5	12.65	12.65	12.65	12.65
No 6	12.66	12.66	12.66	12.66

MAJOR OVERHAULING RECORDS : 101 – JHP

GAUSS RECORDS			
Description	**Position**	**Before**	**After**
Journal Bearing pads	Thrust End	0.4	0.4
	Non thrust end	0.5	0.5
Journal Bearing base ring	Thrust End	0.5 (T) 0.8 (B)	0.5 (T) 0.8 (B)
	Non thrust end	0.7 (T) 0.2 (B)	0.7 (T) 0.2 (B)
Thrust bearing pads	Active	0.3	0.3
	Inactive	0.6	0.6
Thrust Bearing base ring	Active	0.8	0.8
	Inactive	1.3	1.3
Shaft Journal	Thrust End	1.3	1.3
	Non thrust end	1.4	1.4

DATE :- _____ .

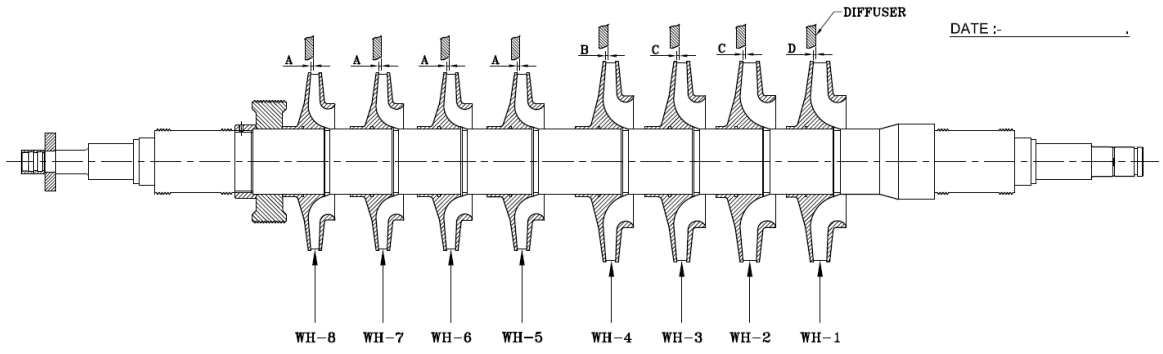


DESCRIPTION	ROTOR NO.	A	B	C	D	E	F	G	H	I	J	K	L	M	N
EXISTING ROTOR															
IF NEW ROTOR IS INSTALLED		0.03	0.01	0.00	0.00	0.03	0.00	0.00	0.06	0.04	0.03	0.03	0.03	0.00	0.00

IFFCO - KALOL

RUNOUT RECORD FOR 101-JHP

PLANT : AMMONIA



DATE :- _____ .

CLEARANCE		WH-1	WH-2	WH-3	WH-4	WH-5	WH-6	WH-7	WH-8
		D	C	C	B	A	A	A	A
DESIGN (INCH / MM)		0.125" 3.175	0.094" 2.388	0.045" 1.143	0.045" 1.143	0.030" 0.762	0.030" 0.762	0.030" 0.762	0.030" 0.762
MEASURED (SPARE ROTOR)	SILO SIDE [WEST] [L]	1.30	1.20	1.20	1.00	0.75	0.80	0.80	0.75
	COOLING TOWER SIDE [EAST] [R]	1.30	1.20	1.20	1.00	0.75	0.80	0.80	0.75
MEASURED (OLD ROTOR)	SILO SIDE [WEST] [L]	2.45	1.80	2.25	1.35	0.90	0.85	1.35	0.80
	COOLING TOWER SIDE [EAST] [R]	2.50	1.80	2.20	1.40	0.80	0.80	1.30	0.90

IFFCO - KALOL

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

PLANT : AMMONIA

IFFCO - KALOL

DIAMETRICAL CLEARANCES - 101 JHP

REF.	CLEARANCE - INCHES	CLEARANCE - MM	BETWEEN	REF.	CLEARANCE - INCHES	CLEARANCE - MM	BETWEEN
A	0.008 TO 0.012	0.203 TO 0.304	BALA. RING TO BALA. DRUM	A1	0.002 TO 0.004	0.050 TO 0.101	OIL GUARD TO SHAFT
B	0.010 TO 0.014	0.254 TO 0.355	IMPELLER TO LABYRINTH	B1	0.013 TO 0.016	0.330 TO 0.406	BEARING HOUSING TO SHAFT
C	0.010 TO 0.0125	0.254 TO 0.317	SLEEVE TO LABYRINTH	C1	0.004 TO 0.007	0.101 TO 0.177	BEARING PAD TO SHAFT
D	0.008 TO 0.012	0.203 TO 0.304	SHAFT TO RING	D1	0.015 TO 0.022	0.381 TO 0.558	OIL GUARD TO SHAFT

AFTER	BEFORE		BEFORE	AFTER
		OIL GUARD - A-1		
	0.15	THRUST BRG.	0.15	
		OIL GUARD - A-1		
0.10	0.09	B-1	0.12	0.10
		JR. BRG. C-1		
0.10	0.10	B-1	0.10	0.10
	0.15	OIL GUARD - D-1	0.15	
	0.05/0.05/0.05/0.10	RING - D	0.10/0.05/0.10/0.10	0.10/0.05/0.10/0.10 (SAME USED)
0.10 / 0.30	0.30	BALANCING DRUM A	0.25	0.10 - 0.30
0.02	0.01	WHEEL - 8 B	0.01	0.02
0.15	0.05	C	0.05	0.10
0.00	0.01	WHEEL - 7 B	0.01	0.00
0.02	0.20	C	0.05	0.20
0.00	0.01	WHEEL - 6 B	0.01	0.00
0.30	0.35	C	0.25	0.10
0.02	0.05	WHEEL - 5 B	0.01	0.02
0.15	0.40	C	0.40	0.10
0.02	0.01	WHEEL - 4 B	0.02	0.02
0.02	0.02	C	0.01	0.02
0.00	0.01	WHEEL - 3 B	0.05	0.02
0.02	0.00	C	0.03	0.02
0.02	0.05	WHEEL - 2 B	0.05	0.05
0.05	0.05	C	0.01	0.05
0.02	0.01	WHEEL - 1 B	0.05	0.05
0.15/0.10/0.08/0.10	0.22-0.40	RING - D	0.22 - 0.40	0.15/0.15/0.10/0.10 (NEW)
0.10	0.15	OIL GUARD - D-1	0.15	0.10
0.10	0.15	B-1	0.10	0.10
		JR. BRG. C-1		
0.10	0.15	B-1	0.10	0.10
0.50	0.65	OIL GUARD - D-1	0.68	0.50

NORTH

SOUTH

COUPLING

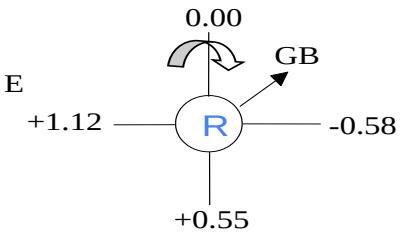
NOTE :-
* A, B, C, D AS PER REVAMPED A-1, B-1, C-1, D-1 AS PER ORIGINAL DRG.

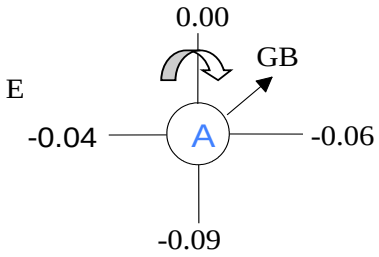
IFFCO	:-
PARTY	:-
Date	:-

MAJOR OVERHAULING RECORDS : 101 – JHP

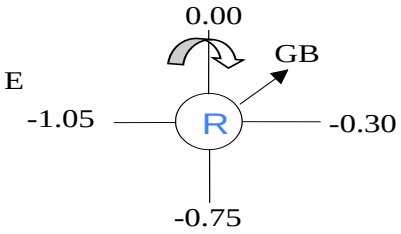
Alignment : 101-JR to 101-JHP

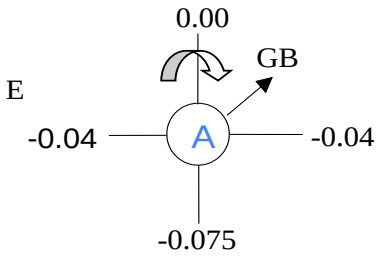
Before Preventive Maintenance





After Preventive Maintenance





SYNTHESIS GAS COMPRESSOR TRAIN, 103-J

Preventive Maintenance of Synthesis Gas Compressor, 103-JLP & 103-JHP was carried out. Drive Turbine was replaced in SD-2017; hence it was not taken for Preventive Maintenance.

103-JT, Synthesis Gas Compressor Drive Turbine

Bristles of Earthing brush installed at Coupling End bearing housing was found worn out completely. Hence, earthing brush was replaced by new one. New additional Carbon Earthing brush was supplied by M/s. Siemens India Ltd. It was installed on inboard oil seal of 103-JT Front end bearing housing.

103-JT Earthing Brush Coupling Side

New additional Carbon Earthing brush

Modified Coupling Guard between 103-JT to 103-JLP was supplied by M/s Siemens and it was replaced.

Feedback lever of ESV was not functioning properly. Hence spare ESV was sent to M/s Siemens workshop Vadodara for rectification and same was installed. The removed ESV was also sent to M/s. Siemens and rectified and kept at Store.

Following problems of HP Oil Console was attended:

- 103-JT Extraction Control Valve (CV-8104) Supply line & Drain line hose was having leakage. O-ring of hoses was replaced by new O-ring supplied by Hydac.
- 1 no. Logic cover leakage (South side) was attended by replacing complete seal kit. However after trial run, leakage was observed from middle cover. As the seal kit was not available, one O-ring (green color) was replaced with new one supplied by M/s Bhavna Rubber, Ahmedabad. O-Ring Size: 9.66mm OD X 1.85mm Cross section Dia., MOC: Viton.

Middle Logic Cover damaged seal

- COP-8503 Pump 3 micron filter element replaced as DP was high.
- COP-8503 Pump Relief Valve DB4E-01X-200S was replaced as pump was not developing pressure above 100 Kg/cm2g
- Coupling Flexible Element of all pumps i.e. COP-8501, COP-8502, COP-8503 & COP-8504 found badly damaged. Replaced all elements

Old Flexible Element of COP-8503

New Flexible Element for COP-8503 & COP-8504

New Flexible Element for COP-8501 & COP-8502

103-JLP, Synthesis Gas Compressor

The compressor was decoupled from drive turbine. The non-thrust end journal bearing was removed. On visual inspection, bottom most journal bearing pad found damaged. Hence, 1 no. bearing pad was replaced. Bearing clearance was

measured and found to be within limit. The axial thrust measured and found at 0.44 mm. Magnetism level check of the removed bearings were carried out and found to be satisfactory. Dye penetration test was performed and the result was found to be OK.

2 nos. of 0.4mm Thk. Coupling Spacer Shims added (1 no. on each side) between 103-JLP to 103-JHP coupling to make coupling stretch as per the drg. requirement.

103-JHP, Synthesis Gas Compressor

The compressor was decoupled. Coupling end Journal bearing was removed and visually inspected. 1 no. bearing pad lock screw thread of front journal bearing found damaged. Hence, 1no. bearing pad lock screw was replaced.

Thrust bearing oil ring at free end was removed and cleaned. Axial Thrust was checked and found at 0.34 mm. Magnetism level of the bearings were checked and found within limit. All the removed pads were Dye Penetration tested and found to be OK. 103-JHP Front Journal Bearing Housing both Dowel Pins new provided.

PREVENTIVE MAINTENANCE RECORDS: 103-J TRAIN

COUPLING RECORDS

Description	Position		Design (")	Before (mm)	After (mm)
DBSE (With Rotor at extreme ends)					
103 JT - JLP	---			743.40	743.40
103 JLP- JHP	---			486.50	486.50
Distance between Hub Face (With Rotor at extreme ends)					
103 JT - JLP	---			691.50	691.50
103 JLP- JHP	---			450.00	450.00
Coupling Hub / Shaft Overhang					
103 JT	JLP end	Hub		NA	NA
		Shaft		0.50	0.50
103 JLP	JT End	Hub		NA	NA
		Shaft		3.00	3.00
	JHP End	Hub		0.50	0.50
		Shaft		NA	NA
103 JHP	JLP End	Hub		1.00	1.00
		Shaft		NA	NA

CLEARANCE RECORDS : 103 – JLP

Description	Position	Dwg. Ref.	Design Clearance (")	Before (mm)	After (mm)
NON THRUST END					
Journal Bearing Clearance	Mandrel	C1	0.002"-0.004"	0.10	0.10
	Filler / lead wire			NA	NA
Oil Guard (For	North	C2	0.008"- 0.013"	0.18	0.20

Description	Position	Dwg. Ref.	Design Clearance (")	Before (mm)	After (mm)
Journal Bearing)	South	C2	0.008"- 0.013"	0.20	0.20
THRUST END					
Journal Bearing Clearance	Mandrel	C1	0.002"-0.004"	NM	NM
	Filler / lead wire			NA	NA
Oil Guard (For Journal Bearing)	North	C2	0.008"- 0.013"	0.20	0.22
	South	C2	0.008"- 0.013"	0.20	0.22
Oil Guard (For Thrust bearing)	-----	A	0.003"- 0.004"	0.10	0.10
Axial Thrust	With Top Hsg.		0.015" - 0.022"	0.44	0.44
	Without Top Hsg.			-	-

CLEARANCE RECORDS : 103 – JHP

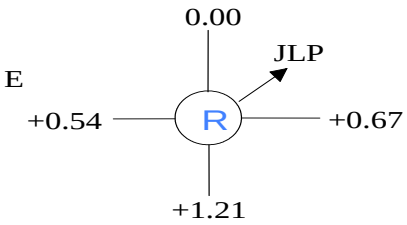
Description	Position	Dwg. Ref.	Design Clearance (")	Before (mm)	After (mm)
NON THRUST END					
Journal Bearing Clearance	Mandrel	A1	0.0023"- 0.0033"	0.13	0.13
	Filler / lead wire			NA	NA
Oil Guard (For Journal Bearing)	North	A2	0.0085"- 0.0115"	0.20	0.25
	South	A2	0.0085"- 0.0115"	0.25	0.25
THRUST END					
Journal Bearing Clearance	Mandrel	A1	0.023"-0.033"	0.15	0.15
	Filler / lead wire			NA	NA
Oil Guard (For Journal Bearing)	North	A2	0.0085"- 0.0115"	0.25	0.25
	South	A2	0.0085"- 0.0115"	0.25	0.25
Oil Guard (For Thrust bearing)	-----	F	0.0025" - 0.00375"	0.10	0.10
Axial Thrust	With Top Housing		0.015" - 0.022"	0.34	0.34
	Without Top Housing				

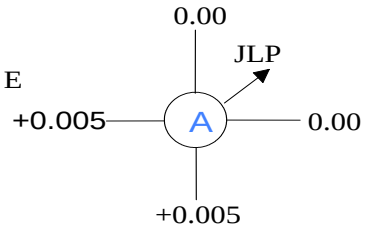
Thrust Bearing Pad Thickness (MM)				
Pad	**ACTIVE**		**INACTIVE**	
	Before	**After**	**Before**	**After**
No 1	14.25	14.25	Not Removed	Not Removed
No 2	14.25	14.25		
No 3	14.25	14.25		
No 4	14.24/14.25	14.24/14.25		
No 5	14.26	14.26		
No 6	14.26	14.26		
No 7	14.25	14.25		
No 8	14.23/14.24	14.23/14.24		

Description	Position	Before (Gauss)	After (Gauss)
GAUSS RECORDS: 103-JLP			
Journal Bearing Pads	Thrust End	-	-
	Non thrust end	0.6 (T) 0.5 (B)	0.6 (T) 0.5 (B)
Shaft Journal	Thrust End	-	-
	Non thrust end	1.0	1.0
GAUSS RECORDS: 103-JHP			
Journal Bearing Sleeve	Thrust End	-	-
	Non thrust end	1.0 (T) 0.9 (B)	1.0 (T) 0.9 (B)
Thrust bearing pads	Active	0.5	0.5
	Inactive	-	-
Thrust Bearing base ring	Active	1.0	1.0
	Inactive	-	-
Shaft Journal	Thrust End	-	-
	Non thrust end	0.5	0.5

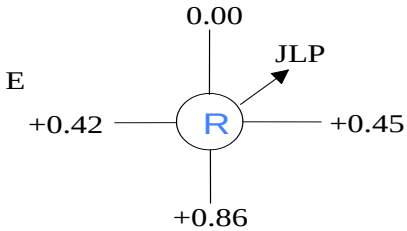
ALIGNMENT READING: 103-JT to 103-JLP

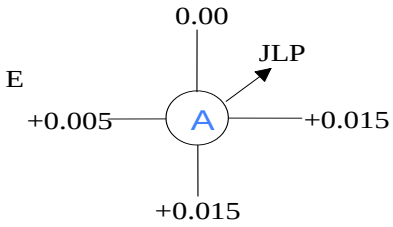
Before Preventive Maintenance





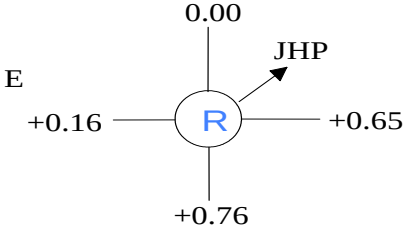
After Preventive Maintenance

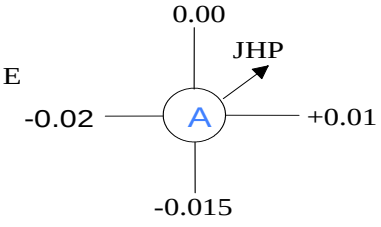




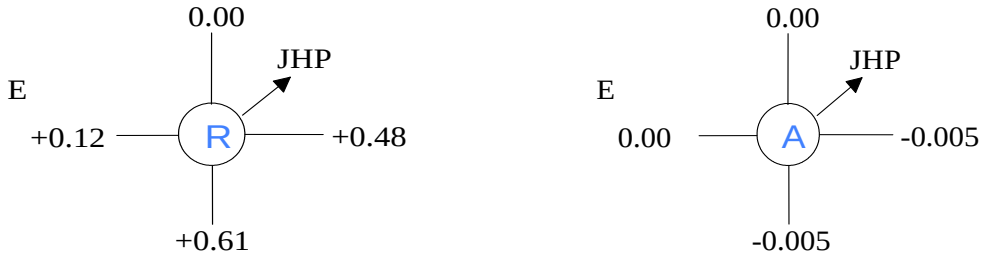
ALIGNMENT READING:103-JLP to 103-JHP

Before Preventive Maintenance





After Preventive Maintenance



Coupling Shim Calculations:

103-JT to 103-JLP

DBSE = 743.40 mm, DBFF = 691.50 mm

Spacer Length = 691.10 mm

Step = 2.00 mm

Shim available = 0.40 X 3 nos. = 1.20 mm

Coupling Pre-stretch = 691.50 - (691.10 – 2.00 + 1.20) = 1.20 mm

103-JLP to 103-JHP

DBSE = 450.00 mm

Spacer Length = 445.00 mm

Shim available = 0.40 X 5 nos. = 2.00 mm

Coupling Pre-stretch = 450.00 - (445.00 + 2.00) = 3.00 mm

Coupling Pre-stretch required as per drg. = 2.10 mm

Extra Shim required = 3.00 – 2.10 mm = 0.90 mm

Extra Shim added (0.40 X 2) = 0.80 mm

REFRIGERATION COMPRESSOR TRAIN, 105-J

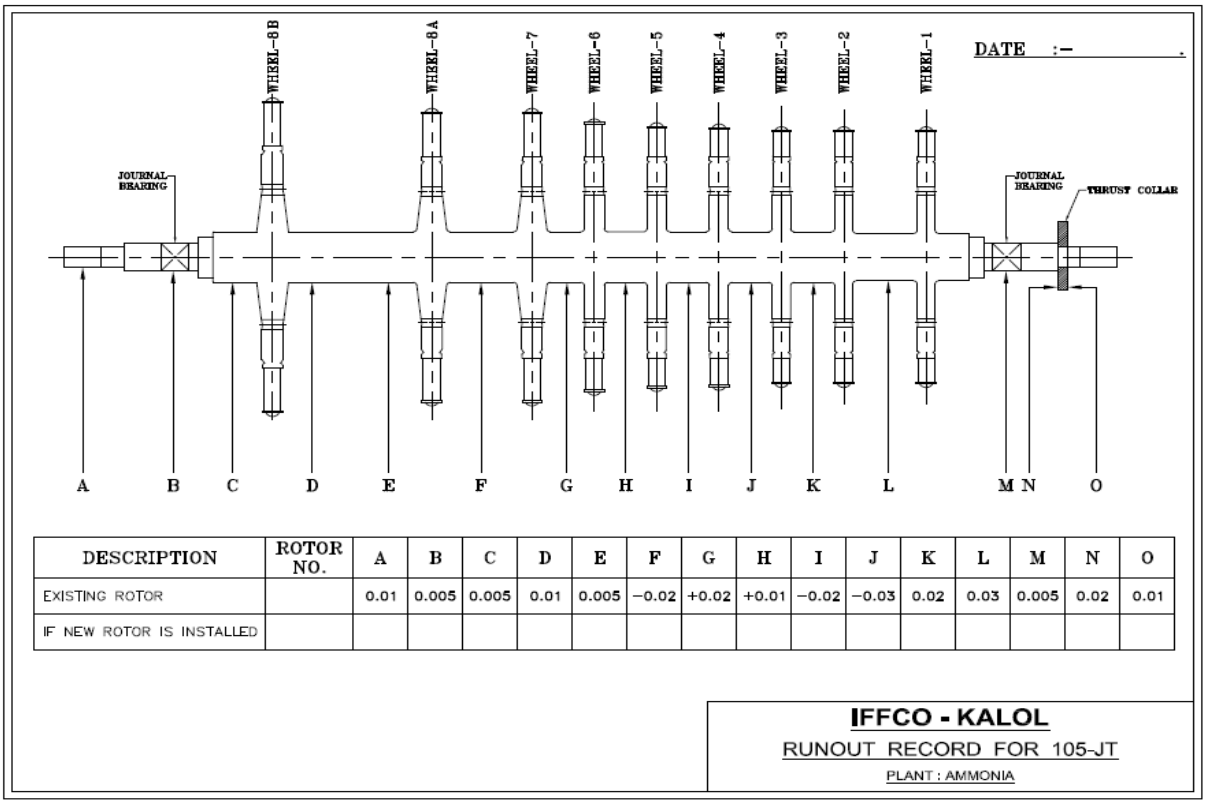
Scheduled Overhauling of complete Refrigeration Compressor train was carried out by M/s. SAAD Technical Services LLP, Mumbai against WO No. 201004181553. Last overhauling of 105-JT was carried out in SD-2009, 105-JLP in SD-2008 & 105-JHP in SD-2007.

105-JT, Refrigeration Compressor Drive Turbine

- Turbine casing was locked by changing washers of hold down bolts.
- The expansion bellow in the steam exhaust line was locked.
- Turbine was decoupled and steam inlet & exhaust piping were removed.
- The top casing was removed and all internal radial as well as axial clearances were noted.

105-JT Top Cover Removal

- Rotor run-out was checked & noted.



DESCRIPTION	ROTOR NO.	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
EXISTING ROTOR		0.01	0.005	0.005	0.01	0.005	−0.02	+0.02	+0.01	−0.02	−0.03	0.02	0.03	0.005	0.02	0.01
IF NEW ROTOR IS INSTALLED																

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RUNOUT RECORD FOR 105-JT

PLANT : AMMONIA

Initial Clearance measured before rotor removal

Bottom Casing Half after rotor removal

- The bearing clearances were measured and removed for inspection.
- The rotor was removed and cleaned by sand blasting.
- The top and bottom diaphragms were removed and cleaned by sand blasting.

Sand Blasted Rotor

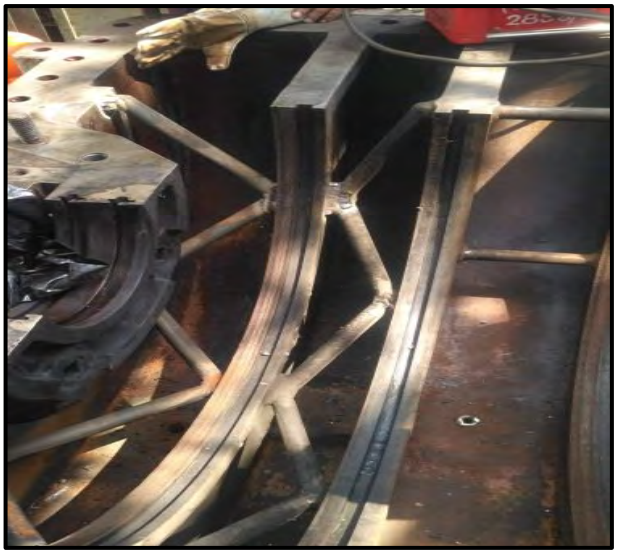
Sand Blasted Diaphragm

- Moisture rings fixed with the 4th, 5th & 6th diaphragms were found badly eroded. 5th & 6th no. diaphragms were replaced by spare refurbished diaphragm set. Diaphragm no. 4 couldn't be replaced as it was not seating properly in the groove. Also, Heavy erosion was found at the welding joint of reinforcement rods for the diaphragm holders in the top & bottom half of casing. This was repaired by welding.

105-JT Moisture Ring

Eroded Reinforcement Rod

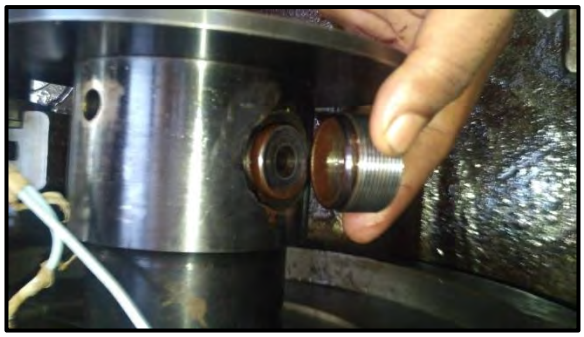
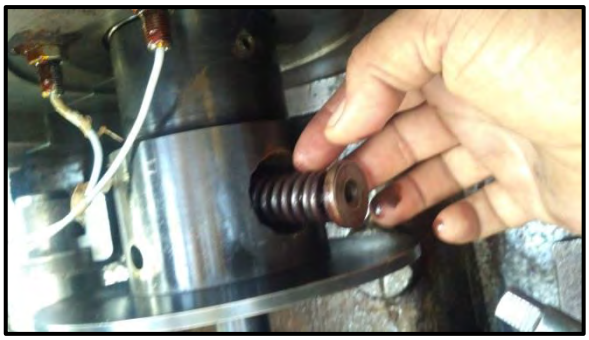
Eroded Reinforcement Rod



Weld repaired Reinforcement Rod

Replaced 5th & 6th No. Diaphragm by spare

- All the inter stage labyrinth clearances were found OK, only springs were replaced by new one.
- Both ends Journal bearings and Thrust bearings were taken for inspection.
- Magnetism level of all major components was found within limit.
- All drain pipes were cleaned and drain valve roused.
- The governor end bearings and gear drives were visually inspected and found in good condition.
- Crack was found in one no. guard HJ 588 A9, which was replaced by new one.
- The OST Plunger Assy. inside the shaft was dismantled for cleaning & inspection. After that the assy. was inserted inside the shaft & locked. The movement of the OST plunger inside the shaft was checked and found to be satisfactory.

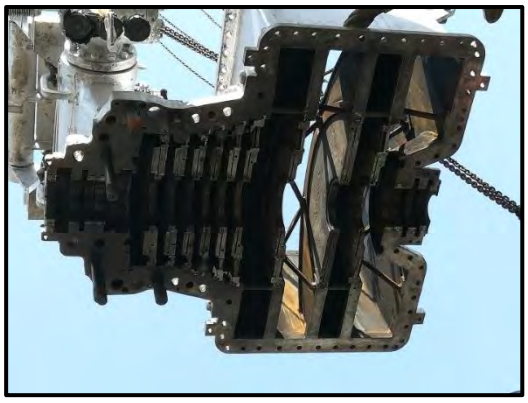



Removal of 105-JT OST assy. for cleaning & inspection

- The diaphragms were reinstalled and the rotor was placed inside the bottom casing.

Final Cleaning of bottom casing half before Assly.

Final Cleaning of Rotor before Assembly



105-JT Top Half before final assy.

105-JT Bottom Half before final assy.

105-JT Top Half before final assy.

105-JT Bottom Half before final assy.

- All internal radial as well as axial clearances were measured and found to be satisfactory.
- The top casing was reinstalled and the bearing clearances were measured along with rotor free float and trip plunger clearances.
- Front Steam Gland Allen Bolts 2 nos. & Front Brg. Housing Bolts 4 nos. found damaged. Bolts replaced.
- Complete overhauling of the 8-1/2 CM governor was carried out and all the antifriction bearings as per Drg. No.: 01-AK-08018 (i.e. Roller Brg, Sym. No: ND 5200 X 1A (315098), P.No:53 – 1 No., Ball Sep. Assy. Sym. No: ND 90025 5602 (315143), P.No:36 – 2 Nos., Single Row Angular Contact Ball Bearing, 7309 BECBJ – 2 Nos.) were replaced after cleaning & visual inspection.
- The Governor was reinstalled and all linkages were greased.
- The coupling's flexible elements were locked and the turbine was taken for OST. The turbine tripped in a single attempt at 7290 RPM.

MAJOR OVERHAULING RECORDS

CLEARANCE READINGS: 105 - JT

Description	Position	Dwg. Ref	Design Clearances (Inch)	Before (Inch)	After (Inch)
JLP End					
Journal Bearing	Mandrel	B	0.007-0.009		0.008
	Filler / lead wire				
Oil Guard	South	C	0.015-0.021		
For Jr. Brg Housing	North	G	0.058-0.097		
Oil Guard For Seal Housing	---	D	0.077-0.109		
Shaft Diameter	Jr. Brg.	---	4.993	4.993	
Governor End					
Journal Bearing	Mandrel	B	0.007-0.009		0.0078
	Filler / lead wire				
Oil Guard	South	---	---	---	--
For Brg. Housing	North	C	0.015-0.021		
Oil Guard	South	A	0.002-0.04		
For Thrust Brg.	North	A	0.002-0.004		
Oil Guard For Seal Housing	---	D	0.077-0.109		
Axial Thrust	With Top Hsg.	---	0.008-0.012	0.011	
	Without top Hsg.	---			
Shim thickness	North	---	---	15.92	
Thrust adjusting	South	---	---	2.92	
Nozzle Clearance	---	---	0.055-0.065		
Total Float	With Top Housing	---	0.180	(+) 3.50 (-) 1.20	
	Without Top Hsg.	---			
Shaft Diameter	Journal bearing	---	4.993	4.992	
Trip Lever - Plunger	---	---	0.120-0.130		3.15

Journal Bearing Pads Thickness (MM)				
PAD	NORTH SIDE BEARING		SOUTH SIDE BEARING	
	Before	After	Before	After
No 1	20.62	20.62	20.63	20.63
No 2	20.63	20.63	20.64	20.64
No 3	20.63	20.63	20.63	20.63
No 4	20.63	20.63	20.63	20.63
No 5	20.62	20.62	20.64	20.64
Thrust Bearing Pad Thickness (MM)				
Pad	ACTIVE		INACTIVE	
	Before	After	Before	After
No 1	19.06	19.06		
No 2	19.05	19.05		
No 3	19.06	19.06		
No 4	19.06	19.06		
No 5	19.06	19.06		
No 6	19.05	19.05		

GAUSS RECORDS			
Description	Position	Before	After
Journal Bearing pads	Thrust End	0.5	0.5
	Non thrust end	0.4	0.4
Journal Bearing base ring	Thrust End	0.5	0.5
	Non thrust end	0.8	0.8
Thrust bearing pads	Active	0.6	0.6
	Inactive	0.5	0.5
Thrust Bearing base ring	Active	0.8	0.8
	Inactive	0.5	0.5
Shaft Journal	Thrust End	0.4	0.4
	Non thrust end	0.5	0.5
Turbine Casing after weld repair		3.3 (max.)	3.3 (max.)

SPARES CONSUMED			
Sr. No	Item description	Store Code	Used Quantity
1.	Diaphragm 5th stage		1
2.	Diaphragm 6th stage		1
3.	Guard HJ 588 A9 (Guard KJ 588 BT)	2010112510238730	1
4.	Spring VGJ 235	2010112510252200	13
5.	Roller Brg, Sym. No: ND 5200 X 1A (315098), P.No:53, D.No:01-AK-08018, 8-1/2 CM Gov	2010112510445800	1
6.	Ball Sep. Assy. Sym. No: ND 90025 5602 (315143), P.No:36, D.No :01-AK-08018, 8-1/2 Gov	2010112510448900	2
7.	Single Row Angular Contact Ball Bearing, 7309 BECBJ	0000996030509030	2

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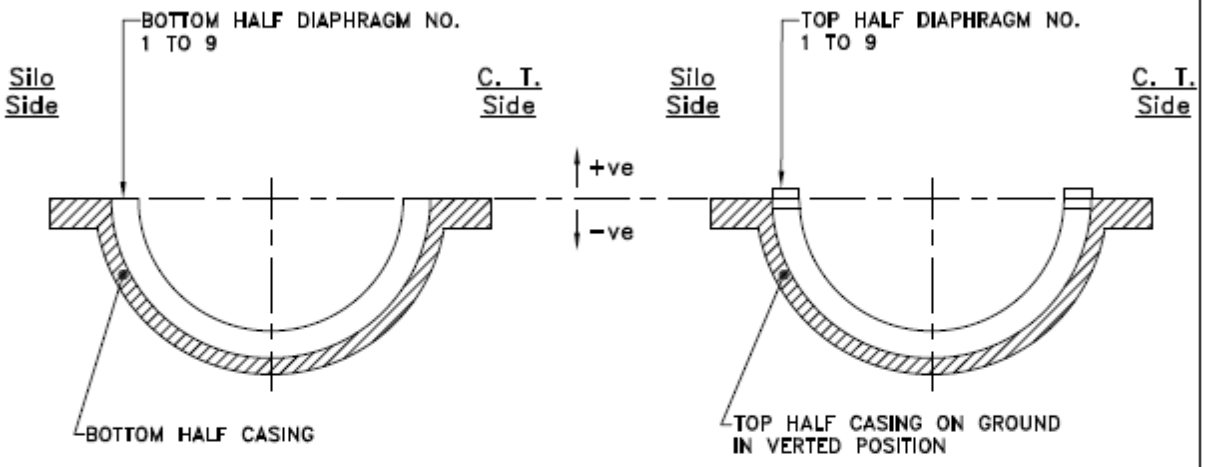
DIAMETRICAL CLEARANCES - 105 JT

REF.	CLEARANCE (INCHES)	CLEARANCE (MM)	BETWEEN	REF.	CLEARANCE (INCHES)	CLEARANCE (MM)	BETWEEN
A	0.002 TO 0.004	0.051 TO 0.102	SEAL RING (THR. BRG.) TO SHAFT / NUT	D	0.077 TO 0.109	1.956 TO 2.769	GUARD TO SHAFT
B	0.007 TO 0.009	0.178 TO 0.229	JOURNAL BEARING TO SHAFT	E	0.013 TO 0.019	0.330 TO 0.483	LABYRINTH RING TO SHAFT
C	0.015 TO 0.021	0.381 TO 0.533	OIL GUARD TO SHAFT	G	0.058 TO 0.097	1.473 TO 2.464	OIL GUARD TO SHAFT

AFTER	BEFORE		BEFORE	AFTER
		OIL GUARD - A		
		THRUST BRG.	SOUTH (THRUST END)	
		OIL GUARD - A		
		JR. BRG. B		
	0.15	OIL GUARD - C	0.10	
	0.50	RING - D	0.50	
0.01	0.00	E	0.00	0.05
0.15	0.20	E	0.15	0.15
0.15	0.05 / 0.10	E	0.15	0.15
0.15	0.15	E	0.15 / 0.20	0.20
0.20	0.25	E	0.10	0.10 / 0.15
0.35	0.30	E	0.20	0.25
0.30	0.30	WHEEL - 1 E	0.50	0.40
0.35	0.50	WHEEL - 2 E	0.25	0.25
0.30	0.20	WHEEL - 3 E	0.25	0.30
0.30	0.20	WHEEL - 4 E	0.50	0.15
0.25	0.35	WHEEL - 5 E	0.20	0.25
0.20	0.30	WHEEL - 6 E	0.25	0.30
0.20	0.25	WHEEL - 7 E	0.30	0.25
0.10	0.05	WHEEL - 8A E	0.05	0.30
0.25	0.25	E	0.20	0.20
0.05	0.05	WHEEL - 8B E	0.05	0.05
0.05	0.05	E	0.05	0.05
0.10	0.05	E	0.05	0.05
0.15	0.20	E	0.05	0.05
0.45	0.50	E	0.50	0.45
		RING - D		
		OIL GUARD - C		
		JR. BRG. B	NORTH (OPP. THRUST END)	
		OIL GUARD - G		
		COUPLING		

IFFCO :-	
PARTY :-	
Date :-	

IFFCO INDIAN FARMERS FERTILISER CO-OP. LTD. KALOL



ALL DIMENSIONS ARE IN MM.

DIAPHRAGM NO. FROM GOVERNOR END		NO.:1	NO.:2	NO.:3	NO.:4	NO.:5	NO.:6	NO.:7	NO.:8	NO.:9
		BOTTOM CASING WITH BOTTOM HALF DIAPHRAGM								
SILO SIDE (X1) L	BEFORE	+1.00	+0.40	+1.04	+1.92	+2.10	+1.60	−0.20	+2.60	+0.90
	AFTER	+0.01	+0.05	−0.01	−0.00	−0.02	−0.05	−0.01	+0.00	−0.02
C.T. SIDE (X2) R	BEFORE	−2.08	−1.68	−1.64	−2.20	−2.80	−1.60	+0.10	−2.90	−2.60
	AFTER	+0.01	+0.01	+0.01	−0.00	+0.02	+0.02	+0.01	+0.00	+0.02
		TOP CASING WITH TOP HALF DIAPHRAGM								
SILO SIDE (X3) L	BEFORE	−0.65	−0.35	+0.15	−0.68	−1.20	−0.40	−1.00	−1.50	−0.40
	AFTER	−0.45	−0.20	–	−0.04	−0.72	−0.64	−0.50	−0.60	−0.35
C.T. SIDE (X4) R	BEFORE	−0.85	−0.50	−0.05	−1.00	−1.35	−0.95	−1.80	−2.00	−0.40
	AFTER	−0.55	−0.18	−0.25	−1.70	−1.80	−1.00	+0.70	−1.80	−0.45
NET CLEARANCE (SUM OF ALL FOUR i.e. (X1 + X2) + (X3 + X4) with reference to parting plane)										

DRN	N.V. PANCHAL	TITLE - PP LEVEL READING OF 105-JT		EWR No.
CHD				
APD		DRAWING No.	PLANT / FROM / NUMBER	SHEET OF / REV.
SCALE	N. T. S.	CODE AMM-405	P 1 / E S / 0 8 - - -	1 1 / 0

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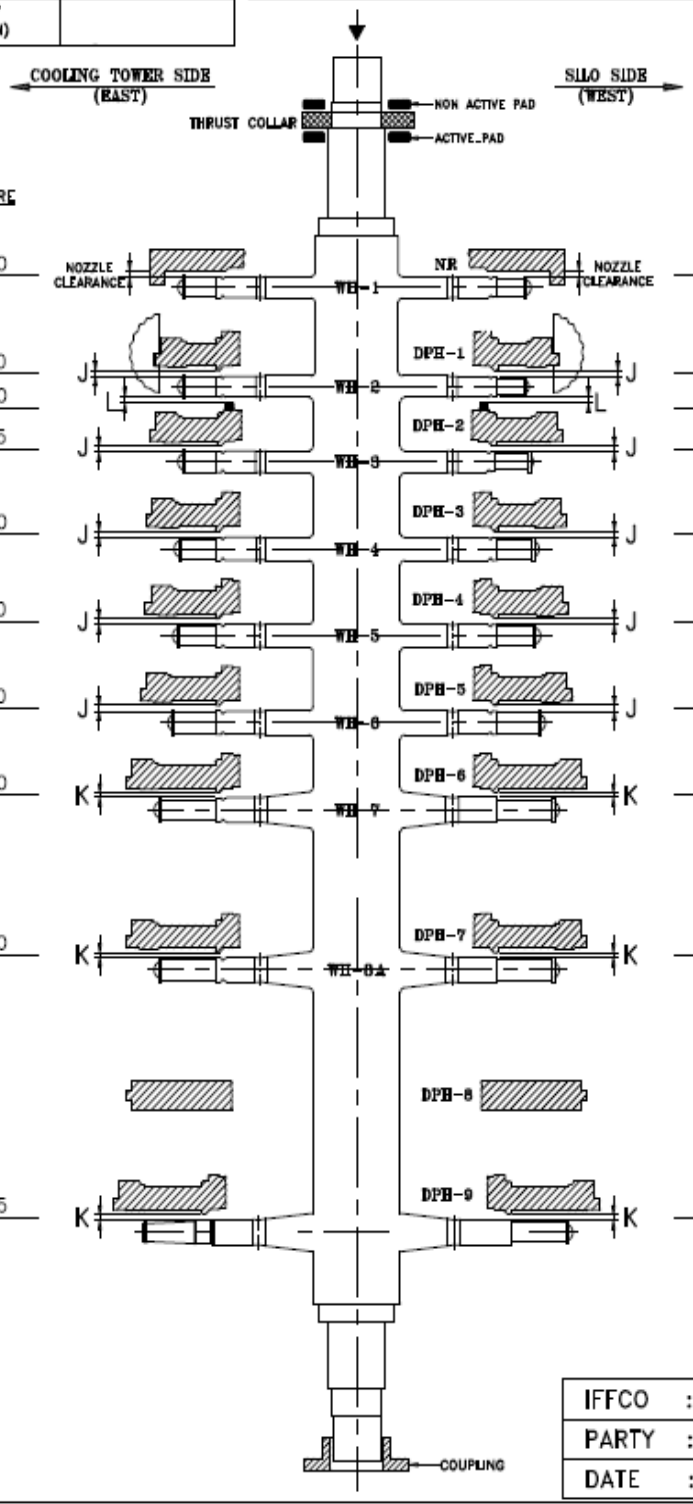
WHEEL TO DIAPHRAGM CLEARANCE (105–JT)

REF.	CLEARANCES – INCHES CLEARANCES – MM	MEASUREMENT RELEVANCE
J	0.055"–0.065" (1.375–1.625MM)	ACTIVE PADS IN POSITION & ROTOR PUSHED TOWARDS COUPLING SIDE
K	0.110"–0.120" (2.75–3.00MM)	
L	0.115"–0.125" (2.875–3.125MM)	
NOZZLE CLEARANCE	0.055"–0.065" (1.375–1.625MM)	

	TOTAL FLOAT ("WITHOUT" ACTIVE & NON ACTIVE THRUST PAD IN POSITION)	AXIL FLOAT ("WITH" ACTIVE & NON ACTIVE PAD IN POSITION)
DESIGN		0.08"–0.12" (0.2–0.3MM)
BEFORE		
AFTER		

DPH : DIAPHRAGM
WH : WHEEL
NR : NOZZLE RING



AFTER	BEFORE		BEFORE	AFTER
9.40	9.40	NOZZLE CLEARANCE	9.50	9.60
1.80	1.50	J	1.50	1.50
3.00	3.20	L	10.20	10.20
1.40	1.25	J	1.20	1.10
1.80	2.20	J	2.10	2.20
1.90	1.40	J	1.50	1.40
1.30	1.80	J	1.95	1.90
2.20	2.90	K	3.00	3.00
3.00	3.00	K	3.10	3.20
3.00	2.85	K	2.95	3.00

IFFCO	:–
PARTY	:–
DATE	:–

Refrigeration Compressor, 105-JLP

- 105-JLP was decoupled from Turbine & Gear Box.
- Casing was locked by changing washers of hold down bolts.
- Casing bolts were opened & compressor casing top half lifted by using crane.

105-JLP Bottom Casing half

105-JLP Top Casing half

Lifting of 105-JLP Top Casing half

Lifting of 105-JLP Rotor

- Clearances of all internals with rotor were measured & recorded.
- Rotor was lifted out of the casing by crane.
- Coupling Hubs were removed from Rotor by using Hydraulic Coupling removal tool.

  105-JLP to JT Coupling, Expander Pressure : 26000 PSI, Pusher Pressure : 0 PSI

  105-JLP to JR Coupling, Expander Pressure: 26000 PSI, Pusher Pressure : 0 PSI

- Blackish deposits were observed in Mech. seal area.
- Bearing assembly & Seal assembly at both ends of Rotor was dismantled.

Coupling Hub Removal & Mounting Arrangement

Thrust End Bearing Housing

Thrust End Seal Assembly.

Journal Brg. & Bush Assly

Bearing Housing Removed

Thrust End Mechanical Seal

Lock nut cut for Seal Collar removal as it was stucked

Opposite Thrust End Brg. Housing

Opposite Thrust End Seal Collar Lock Nut Removal

Opposite Thrust End Seal Collar Removal

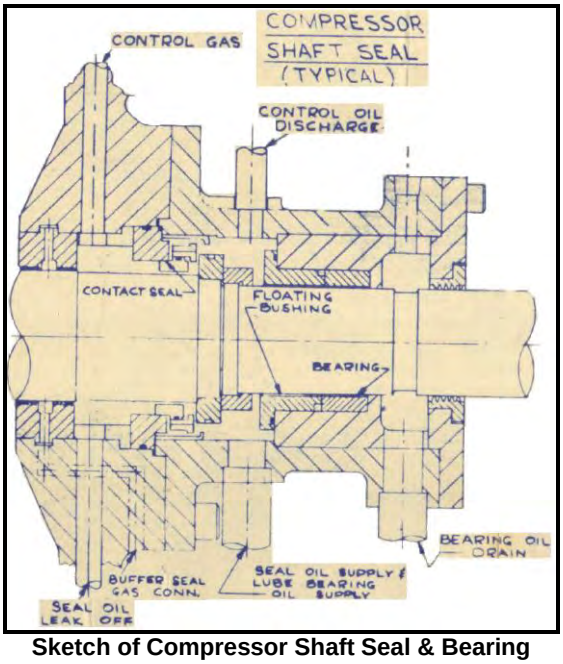
- Worn out Seal faces at both ends were replaced by new seal assembly (Part No.36 & 41), one no. seal collar locknut (Part No.39) was cut to remove as it was not opening, hence, it was replaced by new one.

Lock Nut Set screw position

Cleaned the threads

- Journal bearings and Thrust bearing were visually inspected and Dye penetration test carried out. Found OK.
- Gauss reading of the bearing pads and base rings were measured and found within limits.
- Bearing clearances were taken and found within the design range.

Journal Bearing Clearance measured at Mandrel



Sketch of Compressor Shaft Seal & Bearing Assy.

- Coupling hubs were assembled on spare rotor by using Hydraulic Coupling installation tool after Blue checking (85%).

105-JLP to JT Coupling

Dry Fit Stand-off : 17.69mm, Wet Fit Stand-off : 18.35mm, Measured Coupling hub to shaft distance = 0.96mm, Coupling Push required =17.39mm. Actual Coupling hub to shaft distance = 0.82mm

Maximum Expander Pump Pressure : 26000 PSI, Maximum Pusher Pump Pressure : 150 Kg/cm2, Pusher Pump Pressure hold up time at final pressure : 20 Minutes

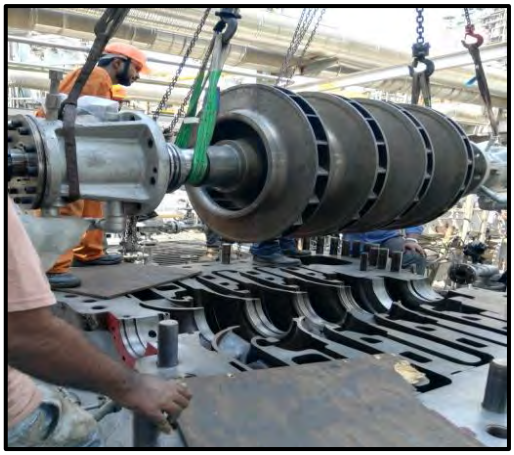
105-JLP to JR Coupling

Dry Fit Stand-off : 15.54mm, Wet Fit Stand-off : 20.53mm, Measured Coupling hub to shaft distance = 2.05mm, Coupling Push required =18.48mm. Actual Coupling hub to shaft distance = 2.07mm

Maximum Expander Pump Pressure : 24500 PSI, Maximum Pusher Pump Pressure : 170 Kg/cm2, Pusher Pump Pressure hold up time at final pressure : 20 Minutes

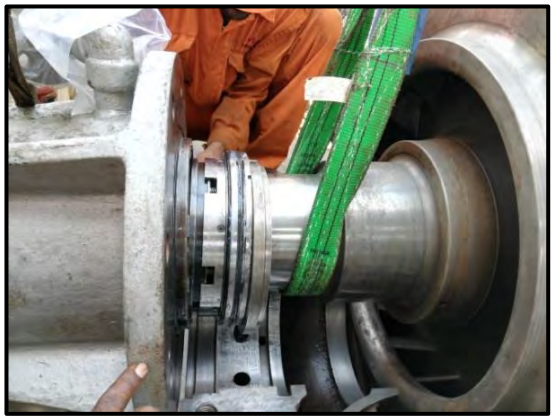
- Rotor was cleaned properly and run out was checked, found 0.02 mm max.
- Manual cleaning of bottom casing half & top casing half was carried out.
- Replaced the Oil Guard (P.No. 44) of one end as edges found damaged.
- Balance Ring Seal (Part No. 20), Case Rings (Part No. 58, 61, 65 & 86) replaced by new one as measured clearances were more than recommended.

105-JLP Bottom Casing Half before Final Assy.



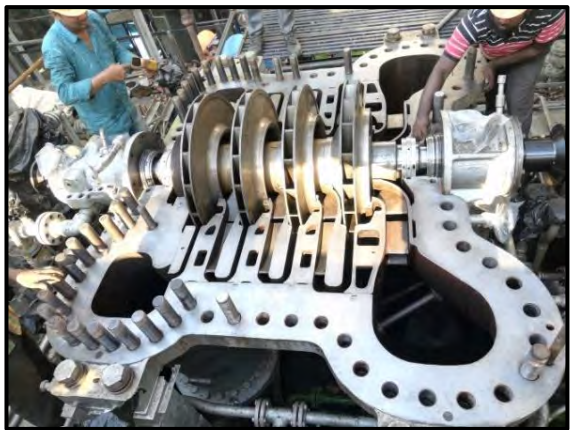
Placement of Rotor

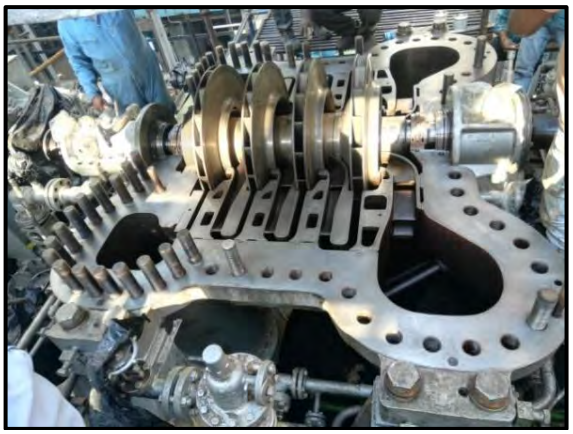
- Placed the rotor on the bottom half of casing carefully protecting seal assemblies.



Setting of Seal at ends carefully during rotor placement

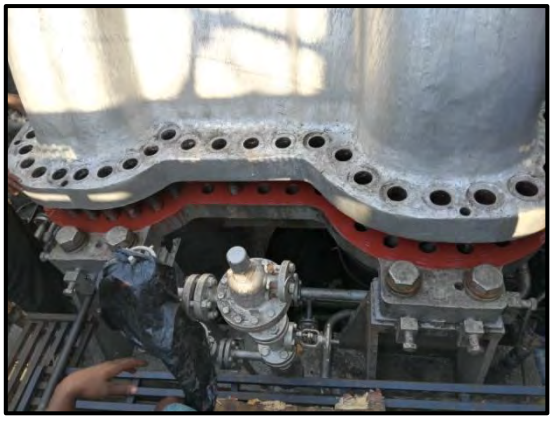
- Again clearances of all internals with rotor checked & recorded.





Clearance Measurement after Rotor placement & prepared for casing assembly

- Placed the top casing half after applying Birkosit compound over the parting plane & box-up the two halves by tightening the casing bolts.



Top casing Half placement at bottom casing half

- Sour oil Piping, Level Transmitter housing, Y strainers, Seal pot opened for inspection, found sludge, hence cleaned properly and boxed-up.

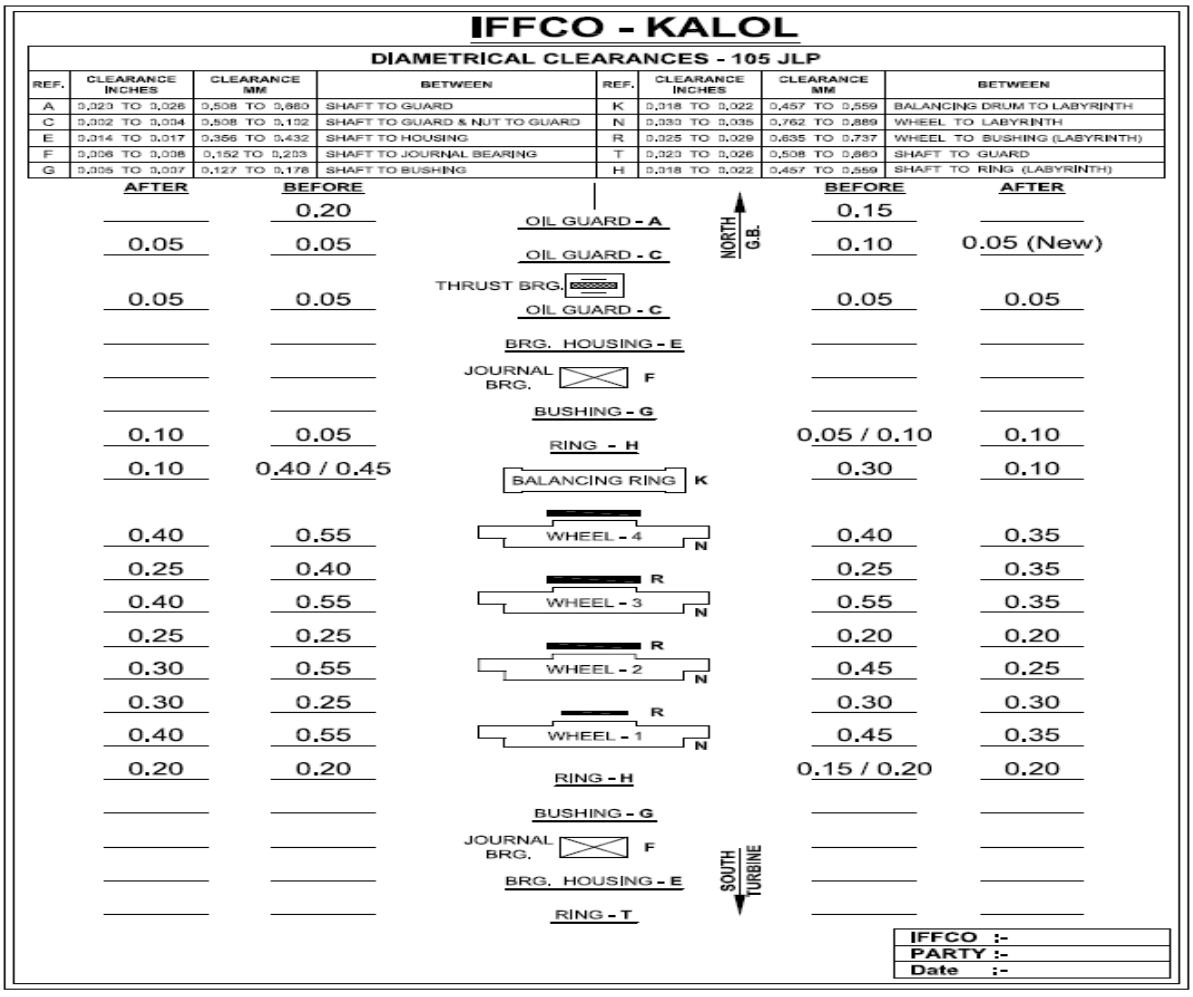
MAJOR OVERHAULING RECORDS : 105 – JLP

Description	Position	Dwg. Ref.	Design Clearances (Inch)	Before (Inch)	After (Inch)
TURBINE END					
Journal Bearing Clearance	Mandrel	F	0.006-0.008	0.0078	
	Filler / lead wire				
Shaft Dia.	Journal Bearing	----		114.15	
Bushing (For Journal bearing)	North	G	0.005-0.007	0.007	
Housing (For Journal bearing)	South	E	0.014-0.017		
Oil Guard (For Outer Housing)	------	T	0.020-0.026	0.017	0.0157
GEAR BOX END					
Journal Bearing Clearance	Mandrel	F	0.006-0.008	0.0078	
	Filler / lead wire				
Shaft Dia	Journal bearing	-----		114.15	
Bushing (For Journal bearing)	North	G	0.005-0.007	0.0055	
Housing (For Journal bearing)	South	E	0.014-0.017		
Oil Guard (For Thrust bearing)	North	C	0.002-0.004		
	South	C	0.002-0.004		
Oil Guard (For Outer Housing)	North	A	0.020-0.026		
Axial Thrust	With Top Housing	----	0.011 – 0.015	0.010	
	Without Top Housing	----			
Shim Thickness (Axial Thrust adjusting)	North	----	---		
	South	----	---		
Total Float	------	----	2.38 – 3.96	2.12-3.72	

Journal Bearing Pads thickness (MM)				
PAD	NORTH SIDE BEARING		SOUTH SIDE BEARING	
	Before	After	Before	After
No 1	19.01	19.01	19.01	19.01
No 2	19.00	19.00	19.00	19.00
No 3	19.01	19.01	19.00	19.00
No 4	19.00	19.00	19.01	19.01
No 5	19.01	19.01	19.01	19.01
Thrust Bearing Pad Thickness (MM)				
Pad	ACTIVE		INACTIVE	
	Before	After	Before	After
No 1	19.76	19.76	19.76	19.76
No 2	19.75	19.75	19.76	19.76
No 3	19.76	19.76	19.76	19.76
No 4	19.76	19.76	19.76	19.76
No 5	19.76	19.76	19.76	19.76
No 6	19.76	19.76	19.77	19.77
No 7	DP Fail	New Pad	19.76	19.76
No 8	DP Fail	New Pad	19.77	19.77

GAUSS RECORDS			
Description	Position	Before	After
Journal Bearing pads	Thrust End	1.3	1.3
	Non thrust end	0.5	0.5
Bushing	Thrust End	0.5	0.5
	Non thrust end	0.6	0.6
Journal Bearing base ring	Thrust End	0.5	0.5
	Non thrust end	0.6	0.6
Thrust bearing pads	Active	0.9	0.9
	Inactive	0.6	0.6
Thrust Bearing base ring	Active	0.6	0.6
	Inactive	0.5	0.5
Shaft Journal	Thrust End	1.8	1.8
	Non thrust end	1.2	1.2

SPARES CONSUMED			
Sr. No	**Item description**	**Store Code**	**Used Qty.**
1.	Guard Sym. No. CF-588M P.No-44, D No. F-10619 for 105-JLP	2010112050127610	1
2.	Shaft Seal Sym. No PM-2056 H, P.No. 36, Ref. Drg No. F-10619 for 105-JLP	2010112050147800	2
3.	Collar Sym. No. PM-2036E, P.No.41, Drg. No. F-10619 for 105-JLP	2010112050148001	2
4.	Nut Sym. No. CF-402 B, P.No.39, D.No. F-10619 for 105-JLP	2010112050138320	1
5.	Balance Ring Seal Sym. No. CF-2041G P.No.20, D. No. F-10619 for 105-JLP	2010112050145230	1
6.	Case Ring Sym. No. CF-4005 (CF-2083 N) P.No.58 D. No: F-10619 for 105-JLP	2010112050145240	1
7.	Case Ring Sym. No. CF-4005A (CF-2083P) P.No.61 D. No. F-10619 for 105-JLP	2010112050145250	1
8.	Case Ring Sym. No. CF-4005C (2083S) P.No-65, D. No. F-10619 for 105-JLP	2010112050145260	1
9.	Case Ring Sym. No. CF-4005R (CF-2083R) P.No.86 D. No. F-10619 for 105-JLP	2010112050145270	1
10.	LP Front & Rear Bearing Assy. Face O-Ring, 165.5 mm ID X 3.5 mm CSD		2
11.	LP Front & Rear Bearing Assy. Radial O-Ring,		2

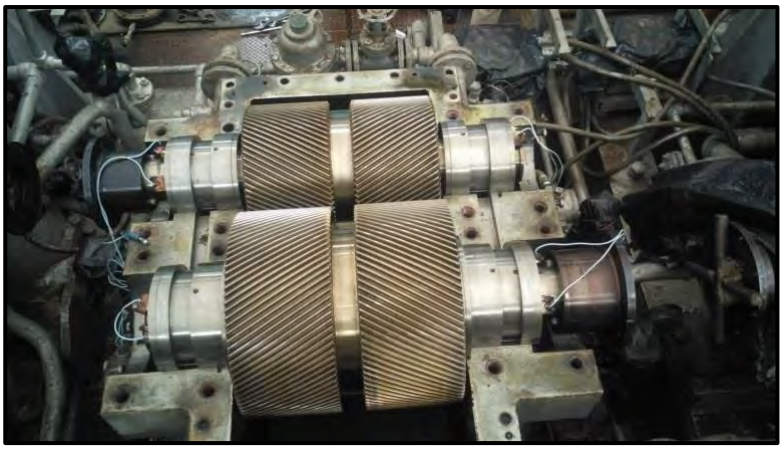


PREVENTIVE MAINTENANCE RECORDS: 105-JR

Description	Position	Design Clearances (Inch)	Before (Inch)	After (Inch)
Journal Bearing (Low Speed drive gear)	North	0.014 – 0.016	0.015”	0.0148”
	South	-- do --	0.016”	0.013”
Axial Thrust	---	0.014-0.024	0.0157”	0.0157”
Journal Bearing (High Speed driven Pinion)	North	0.013 -	0.012”	0.012”
	South	-- do --	0.012”	0.011”
Free float	---	---		
Backlash	---	---	0.48	0.48
Shaft Diameter (Low Speed drive Gear)	North Side Bearing.	---	127.16	
	South Side Bearing.	---	127.17	
Shaft Diameter. (High Speed driven Pinion)	North Side Bearing.	---	114.45	
	South Side Bearing.	---	114.45	

GAUSS: 105 - JR

Description	Position	Before (Gauss)	After (Gauss)
Gear Journal Bearing	North	0.4	0.4
	South	0.4	0.4
Pinion Journal Bearing	North	0.3	0.3
	South	0.4	0.4
Thrust bearing	Active	0.5	0.5
	Inactive	0.5	0.5
Oil Guard for Above	South		
	North		
Shaft Journal	Thrust End	0.5	0.5
	Non thrust end	0.4	0.4



105-JR after removal of Top Cover

Refrigeration Compressor, 105-JHP

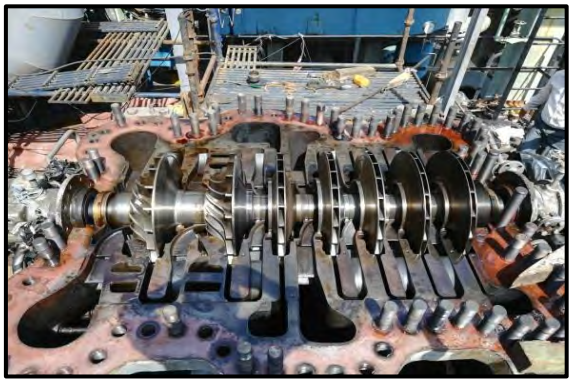
It was observed that from July 2018, there were sudden peaks in shaft vibration of 105-JHP on DE & NDE side bearings (7V, 7H, 8V & 8H). The peaks were observed on various occasions. Some of the peak readings observed is given below:

Position	Normal value (mils)	Observed on 19.07.19 (mils)	Observed on 08.08.18 (mils)	Observed on 13.08.18 (mils)
8V	0.80	**1.02**	1.25	-
8H	0.75	0.80	**1.13**	-
7V	0.65	1.34	**2.35**	1.62
7H	0.80	2.04	1.5	**2.2**

105-JHP was kept under observation. Compressor was taken for major overhauling during this Shutdown.

- Refrigeration Compressor HP case, 105-JHP was decoupled from Gear Box.
- Piping was disconnected. Casing was locked by changing washers of hold down bolts.
- Casing bolts were opened & compressor casing top half lifted by using crane.
- Clearances of all internals with rotor were measured & recorded.
- Rotor was lifted out of the casing by crane.

105-JHP Top Casing Half Removal

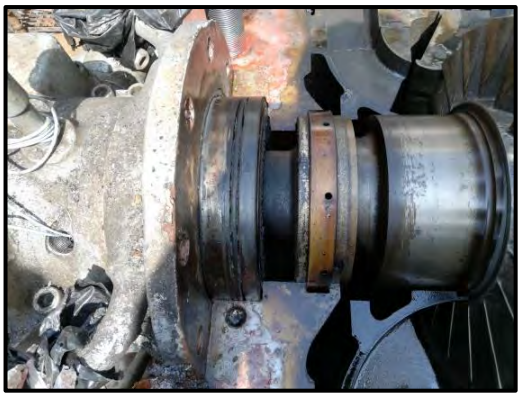


105-JHP Bottom Casing half

Removal of 105-JHP Rotor

105-JHP Rotor

- Blackish deposits were observed in Mech. seal area.



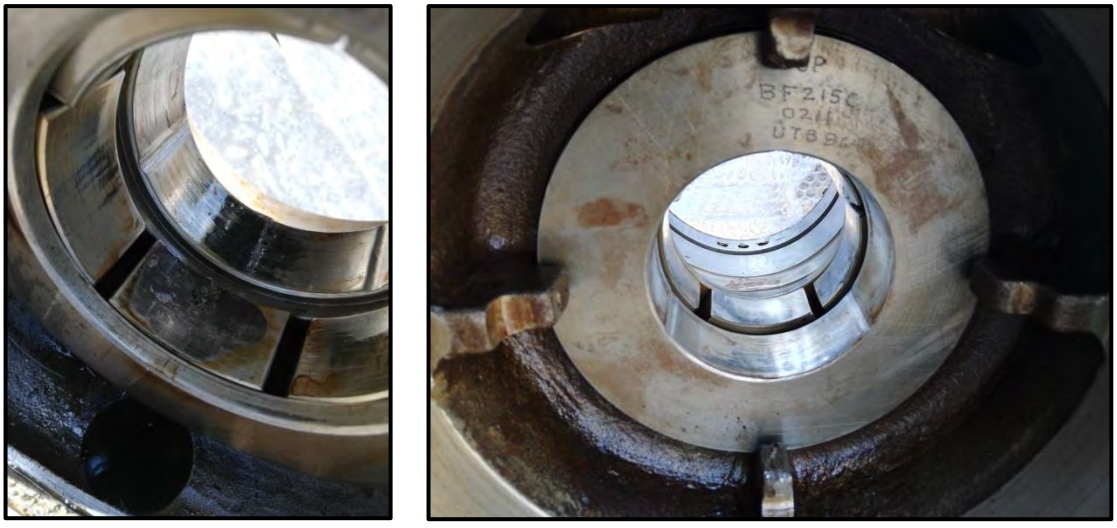
Bearing Housing and Mech. Seal Assy. at NDE

Bearing Housing and Mech. Seal Assy. at DE

- Coupling Hubs were removed from Rotor by using Hydraulic Coupling removal tool. Expander Pump Pressure : 26000 PSI, Pusher Pump Pressure : 0 PSI

Coupling Hub Removal from shaft

- Bearing assembly & Seal assembly at both ends of Rotor was dismantled.



View of NDE &DE Bearing Housing after dismantling from rotor

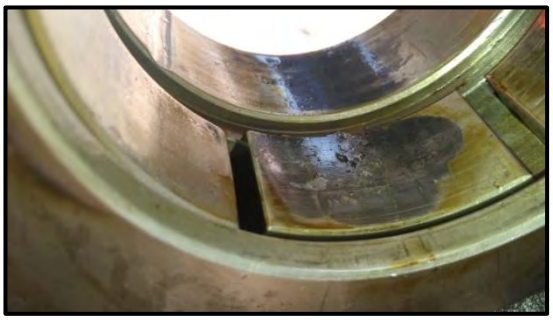
- Worn out Seal faces at both ends were replaced by new seal assembly (Part No.9 & 61), one no. old seal collar (P. No. 61) was used by reversing its face as its lock nut set screw position was not matching.

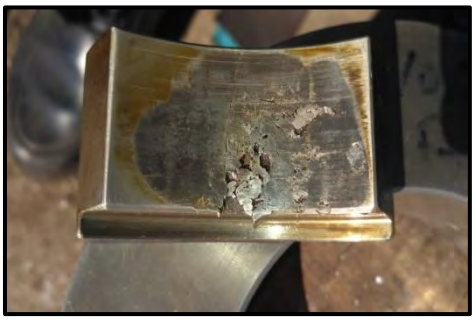
- Journal bearings and Thrust bearing were visually inspected and Dye penetration test carried out.

Journal Bearing Pads DP Check

Thrust Bearing Pads DP Check

- One no. bottom journal bearing pad of DE side bearing found damaged and hence replaced this pad.





Damaged Journal Brg. Pad

- Gauss reading of the bearing pads and base rings were measured and found within limits.
- Bearing clearances were taken and found within the design range.
- Coupling hubs were assembled on spare rotor by using Hydraulic Coupling installation tool after Blue checking (80%).

  Dry Fit Stand-off : 13.19mm, Wet Fit Stand-off : 13.82mm, Coupling Push required : (13.82-0.67)=13.15mm. {0.67mm Shaft overhang as measured before}.

  Actual Coupling Push : 13.13mm

  Maximum Expander Pump Pressure : 24500 PSI, Maximum Pusher Pump Pressure : 160 Kg/cm2, Pusher Pump Pressure hold up time at final pressure : 15 Minutes.

Blue Match checking

Reference measurement

Mounting of Coupling Hub by Expander & Pusher Pressure

- Rotor was cleaned properly and run out was checked, found 0.02 mm max.
- Manual cleaning of bottom casing half & top casing half was carried out.

Top & Bottom Casing Half after cleaning

Lifting of Rotor for Assy. into casing

- Bushings (Part No. 70, 74 – 4 nos. & 71) & Case Rings (Part No. 58, 61, 65 & 86) replaced by new one as measured clearances were more than recommended.
- Placed the rotor on the bottom half of casing carefully protecting seal assemblies & again clearances of all internals with rotor checked & recorded.

Bottom Casing Half before final assy.

Placement of Rotor

Setting of Mech. Seal during placement of Rotor

Final Clearance measurement

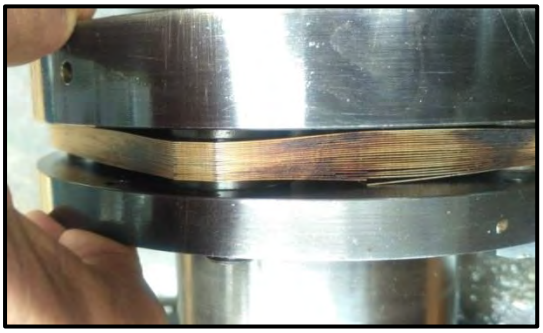

Clearance measurement & preparation for final Assy.

- Placed the top casing half after applying Birkosit compound over the parting plane & box-up the two halves by tightening the casing bolts.

Sealing Compound applied on parting plane

Placement of Top casing half for final Assy.

- Axial Thrust measured, found 0.46 mm which is more than recommended one. Hence, thrust bearing spacer shim thickness adjustment done & the Axial Thrust reduced to 0.34mm. Final shim thickness maintained, Inner spacer shim thickness=9.76mm, Outer spacer shim thickness = 9.48mm.
- HP Compressor to GB Coupling Transmission Unit shims found broken. Hence, Transmission Unit was replaced by spare one.



Broken shims of 105-JHP to GB Coupling transmission unit

Spare Transmisson unit

- Old distance piece length = 183.88mm, Spare distance piece length = 185.00mm

  Difference in lengths = 1.12mm (185-183.88)

- To accommodate spare Transmission Unit & provide 1mm pre-stretch as recommended in coupling drawing by manufacturer, pinion wheel coupling hub need to be pushed inside towards Gear box.

  Pinion wheel coupling hub pushed inside = 0.75mm

  DBFF after coupling hub pushing = 186.02mm (Both rotors in centre position)

  Pinion Float = 1.4mm & HP Rotor Thrust float = 0.34mm

- Sour oil Piping, Level Transmitter housing, Y strainers, Seal pot opened for inspection, found sludge, hence cleaned properly and boxed-up.

Choked strainer of 105-J seal oil line

MAJOR OVERHAULING RECORDS : 105 – JHP

Description	Position	Dwg. Ref.	Design Clearances (Inch)	Before (Inch)	After (Inch)
GEAR BOX END					
Journal Bearing Clearance	Mandrel	C	0.004 – 0.007	0.07	0.07
	Filler / lead wire				
Bush Clearance	Journal Bearing	---	---		
Shaft Dia.	Journal Bearing	---	---	88.80	88.80
Housing (For Journal Bearing)	South	B	0.014 - 0017		
Bushing (For Journal Bearing)	North	D	0.004 - 0.006	0.16	0.16
Oil Guard (For Top Housing)	South	A	0.018 - 0.024		
Nut	---	T	0.001 - 0.003		
NON DRIVE END					
Journal Bearing Clearance	Mandrel	C	0.004 – 0.007	0.08	0.08
	Filler / lead wire				
Housing (For Journal Bearing)	South	B	0.014 - 0017		
Bushing (For Journal Bearing)	North	D	0.004 - 0.006	0.13	0.13
Oil Guard (For Thrust bearing)	North	P	0.002 – 0.004	0.05	
	South	P	0.002 – 0.004	0.12	
Oil Guard (For Top Housing)	North	P	0.002 – 0.004		
Axial Thrust	With Top Housing	---	0.009 – 0.013	0.43	0.46 reduced to 0.34
	Without Top Housing	---			
Total Float	------	---	5.55 -7.15 mm	4.60	

Journal Bearing Pads Thickness (MM)				
PAD	**NORTH SIDE BEARING**		**SOUTH SIDE BEARING**	
	Before	**After**	**Before**	**After**
No 1	15.88	15.88	15.88	15.88
No 2	15.88	15.88	15.88	15.88
No 3	15.87	15.87	15.87(Pad Damaged)	15.86 (New)
No 4	15.87	15.87	15.88	15.88
No 5	15.88	15.88	15.88	15.88
Thrust Bearing Pad Thickness (MM)				
Pad	**ACTIVE**		**INACTIVE**	
	Before	**After**	**Before**	**After**
No 1	14.30	14.30	14.24	14.24
No 2	14.30	14.30	14.23	14.23
No 3	14.28	14.28	14.24	14.24
No 4	14.30	14.30	14.24	14.24
No 5	14.27	14.27	14.24	14.24
No 6	14.30	14.30	14.24	14.24
No 7	14.29	14.29	14.23	14.23
No 8	14.27	14.27	14.23	14.23

GAUSS RECORDS			
Description	**Position**	**Before** (Max.)	**After** (Max.)
Journal Bearing pads	Thrust End	0.5	0.5
	Non thrust end	0.4	0.4
Journal Bearing base ring	Thrust End	1.0	1.0
	Non thrust end	1.0	1.0
Bushing	Thrust End	1.0	1.0
	Non thrust end	0.6	0.6
Thrust bearing pads	Active	0.5	0.5
	Inactive	0.6	0.6
Thrust Bearing base ring	Active	1.0	1.0
	Inactive	0.9	0.9
Shaft Journal	Thrust End	2.2	2.2
	Non thrust end	**13.0**	1.8 (After Degauss)

SPARES CONSUMED				
Sr No	**Item description**	**Store Code**	**Used Qty.**	**Remarks**
1.	Brg Pad, Sym. :BF395A, D.No:H-4488 for 105-JHP	2010112050233500	1	
2.	Collar (Seal Assy.), Sym. :PM-2034 B, P.No :61, D.No:H-4488 for 105-JHP	2010112050212700	1	1 no. old collar's unused backside face used
3.	Seal, Sym.: PM-2052B, P. No: 9, D. No: H-4488 for 105-JHP	2010112050247800	2	
4.	Bushing, Sym.: BF-2056CX1, P. No. : 70, D. No. : H-4488 for 105-JHP	2010112050207300	1	
5.	Bushing, Sym.:BF-2056 BX1, P.No : 71, D.No: H-4488 for 105-JHP	2010112050207310	4	
6.	Bushing, Sym. :BF-2056B X 2, P.No :74, D.No:H-4488 for 105-JHP	2010112050207320	1	
7.	Case Ring, Sym: :BF-2083AN, P.No :72, D.No:H-4488 for 105-JHP	2010112050245260	1	
8.	Case Ring, Sym. :BF-2083AN X 1, P.No :75, D.No:H-4488 for 105-JHP	2010112050245270	1	
9.	Case Ring, Sym. :BF-2083AP X 2, P.No :76, D.No:H-4488 for 105-JHP	2010112050245280	1	
10.	Case Ring, Sym. :BF-2083AR X 3, P.No :77, D.No:H-4488 for 105-JHP	2010112050245290	1	
11.	Case Ring, Sym. :BF2083AR X 2, P.No :78, D.No:H-4488 for 105-JHP	20101120502452A0	1	
12.	Allen Headed F/T Screw for J Brg D.No. P1-ES-20010 Size: 3/4" Dia X 10 TPI X 50 MM L for 101-J LP/HP & 105-J LP/HP Case	2010112059947510	2	
13.	Transmission Unit Assy. of Coupling between 105JHP-GB	2010112050715200	1	Hub not used
14.	HP Front & Rear Bearing Assy. Radial O-Ring, 159 mm ID X 3.5 mm CSD		2	
15.	HP Front & Rear Bearing Assy. Face O-Ring, 146 mm ID X 3.5 mm CSD		2	

IFFCO - KALOL

DIAMETRICAL CLEARANCES - 105 JHP

REF.	CLEARANCE (INCHES)	CLEARANCE (MM)	BETWEEN	REF.	CLEARANCE (INCHES)	CLEARANCE (INCHES)	BETWEEN
A	0.018 TO 0.024	0.457 TO 0.610	SHAFT TO GUARD	L	0.020 TO 0.024	0.508 TO 0.610	WHEEL TO BUSH (LABYRINTH)
B	0,014 TO 0,017	0,356 TO 0,432	SHAFT TO HOUSING	M	0,020 TO 0,024	0,508 TO 0,610	BUSH (LABYRINTH) TO SHAFT
C	0.004 TO 0.007	0.102 TO 0.178	SHAFT TO BEARING	P	0.002 TO 0.004	0.051 TO 0.102	SHAFT TO GUARD, NUT TO GUARD
D	0,004 TO 0,006	0,102 TO 0,152	SHAFT TO BUSHING	S	0,013 TO 0,017	0,330 TO 0,432	BALANCE DRUM TO LABYRINTH
E	0,015 TO 0,019	0,381 TO 0,483	SHAFT TO RING (LABYRINTH)	T	0,001 TO 0,003	0,025 TO 0,076	SHAFT TO NUT
K	0.025 TO 0.029	0.635 TO 0.737	WHEEL TO RING (LABYRINTH)				

AFTER	BEFORE		BEFORE	AFTER
		OIL GUARD - A		
		BRG. HOUSING - B		
0.07 (D)	0.07 (D)	JOURNAL BRG. C	0.07 (D)	0.07 (D)
0.15 (D)	0.15 (D)	BUSHING - D	0.15 (D)	0.15 (D)
		NUT - T		
0.15	0.05	RING - E	0.10	0.10
0.15	0.15	BALANCING RING S	0.20	0.20
0.40	0.55	WHEEL - 1 K	0.45	0.45
0.30	0.30	L	0.45	0.30
0,45	0,40	WHEEL - 2 K	0,50	0,50
0,30	0,30	L	0,40	0,30
0,40	0,50	WHEEL - 3 K	0,55	0,40
0,30	0,25	L	0,45	0,30
0.50	0.45	WHEEL - 4 K	0.55	0.50
		BUSH - M		
0,30	0,25	L	0,40	0,35
0.30	0.50	WHEEL - 5 K	0.55	0.50
		BUSH - M		
0.40	0.40	L	0.50	0.45
0.95	0.80	WHEEL - 6 K	0.90	0.95
0,30	0,35	L	0,35	0,30
1,00	0,90	WHEEL - 7 K	1,00	1,00
0.10	0.10	RING - E	0.05	0.15
		NUT - T		
	0,13	BUSHING - D		
		JOURNAL BRG. C		
		BRG. HOUSING - B		
		OIL GUARD - P		
		THRUST BRG.		
		OIL GUARD - P		
		OIL GUARD - P		
		NUT - T		

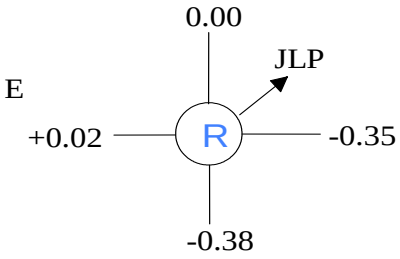
SOUTH G.B.

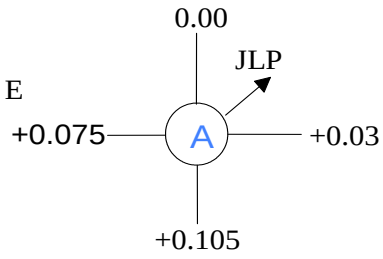
NORTH NDE

IFFCO :-
PARTY :-
Date :-

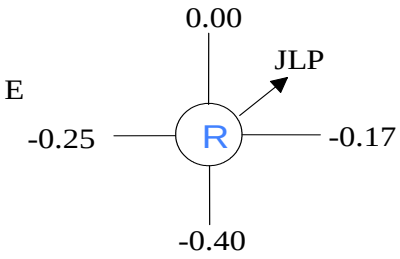
ALIGNMENT READING: 105-JT to 105-JLP

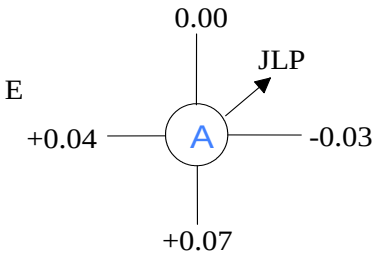
Before





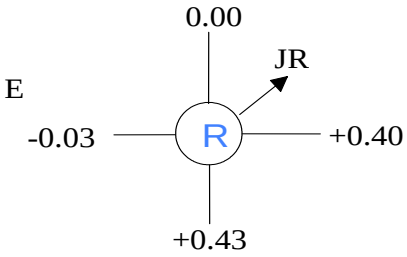
After

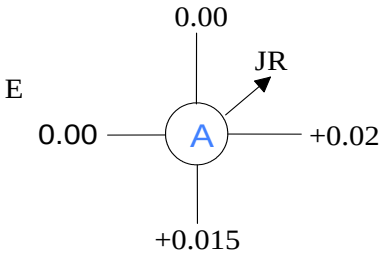




ALIGNMENT READING: 105-JLP to 105-JR

Before





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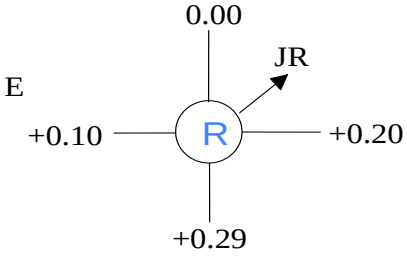
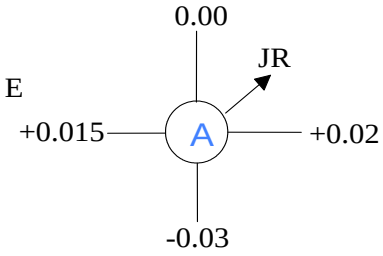
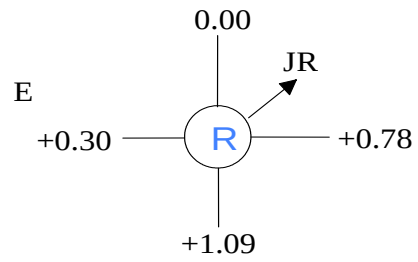
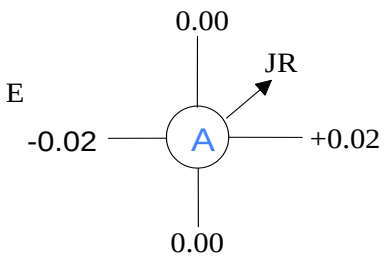




ALIGNMENT READING: 105-JR to 105-JHP

Before





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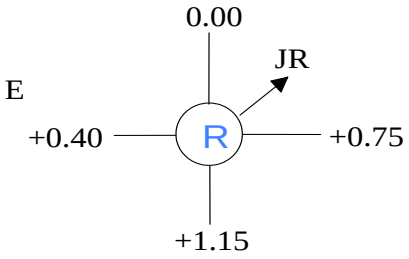
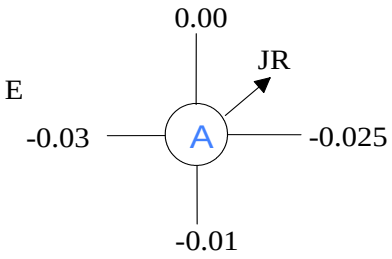




INDUCED DRAFT FAN, 101-BJ TRAIN

101- BJ Fan

Journal bearings and thrust bearings were inspected and found OK. Gauss reading was taken and found below maximum allowable limit. All the bearing pads were Dye Penetration tested and no cracks were found. Bearing clearances were taken and found within the design range. Water was circulated in bearing housing jackets & connected lines and no leakage observed.

101- BJT

Drive Turbine was taken for Preventive Maintenance. The turbine was decoupled and both ends bearing housing opened. The thrust bearing and both ends radial bearings clearance were measured and found within limit. The bearing pads were visually inspected, DP checked and found OK. The gauss measurement was taken and found within acceptable limit. The PGPL actuator drive gear was checked and oil was flushed. Actuator was tested at test bench & found ok.

101-BJR Gear box

The top cover of GB was removed. The bearings were dye penetration inspected and no defects were observed. Gauss measurement for the bearings was also carried out and found within limit. Gear backlash and bearing clearance was measured and found within limit.

During normal operation in Dec 2017, due to problem in MOP, Oil became blackish and metal particles were observed. Hence Pall filtration system was provided in support and LO was circulated through filters. Pall Filtration system was kept in line till shutdown. MOP vibration was kept under observation and found ok.

MOP mounted on GB shaft was dismantled and replaced by the spare one as the internals of pump worn out during running plant. After opening the removed MOP, it was observed that cage of ball bearings were found broken and the balls were free. The housing was worn out in some portion. Some areas of Gears were also worn out.

Pump Housing found worn out

Damaged Ball Bearing

All the Lube oil lines were flushed thoroughly to remove the worn out metallic particles. Additional AOP along with associated piping (which were removed during SD-2017) was installed back for emergency purpose (After proper flushing)

LO lines of Additional AOP was flushed

101-BJT LO console after cleaning

Provision for transmitter was made by drilling of Console wall towards Silo side. Lube Oil console was cleaned, new oil charged & filter elements replaced.

All couplings were visually inspected and found OK.

During start-up, oil leakage was observed from MOP discharge line. It was unable to stop leakage by tightening. Hence M-seal was provided and tube was connected to drain the oil directly to LO Tank.

PREVENTIVE MAINTENANCE RECORDS: 101-BJ TRAIN

COUPLINGS

Description	Position	Design (Inch)	Before (mm)	After (mm)
Coupling Float (For Gear Coupling Only)				
101 GB- BJ	---	---	5.64	5.63
DBSE (With Rotor at extreme ends)				
101 BJT-GB	---	---	150.25	150.25
101 GB- BJ	---	---	12.70	12.70

PREVENTIVE MAINTENANCE RECORDS: 101-BJT

Description	Position	Dwg. Ref	Design Clearance (mm)	Before (mm)	After (mm)
Gear Box End					
Journal Bearing	Mandrel	---		-	-
	~~Filler~~ / lead wire			0.33	0.30
Oil Guard (For Jr. Brg Housing)	CT Side	---		0.20	0.21
	SILO Side	---		0.25	0.25
Bearing Pinch	Jr. Brg.	---	---	0.03	0.03
Governor End					
Journal Bearing	Mandrel	---		-	-
	~~Filler~~ / lead wire			0.29	0.25
Oil Guard (For Jr. Brg. Housing)	CT Side	---		0.20	0.20
	SILO Side	----		-	-
Bearing Pinch	Jr. Brg.	---	---	0.03	0.03
Axial Thrust.	With Top Housing	---		0.36	0.40
	Without top Housing	---		-	-

PREVENTIVE MAINTENANCE RECORDS: 101-BJR

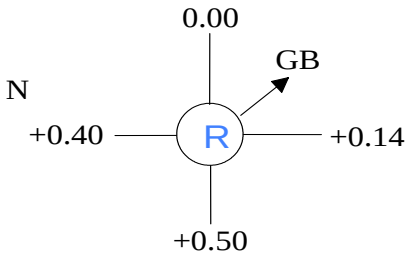
Description	Position	Design Clearance (mm)	Before (mm)	After (mm)
Journal Bearing (High Speed drive Pinion)	CT Side		0.15	0.15
	SILO Side		0.13	0.13
Bearing Pinch	CT Side		0.06	0.06
	SILO Side		0.05	0.05
Axial Thrust	Low speed High Speed		0.31	0.30
Journal Bearing (Low Speed driven Gear)	CT Side		0.20	0.20
	SILO Side		0.21	0.19
Bearing Pinch	CT Side		0.07	0.07
	SILO Side		0.06	0.06
Backlash	---		0.40	0.40
Gear Wheel Oil Guard Labyrinth clearance		0.15 mm (L) / 0.20 mm (R)		
Pinion Oil Guard Labyrinth clearance		0.15 mm (L) / 0.20 mm (R)		

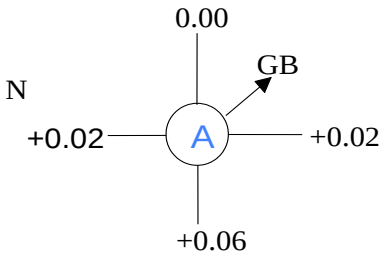
PREVENTIVE MAINTENANCE RECORDS: 101 - BJ

Description	Position	Dwg. Ref	Design Clearance (Inch)	Before (mm)	After (mm)
Gear Box End					
Journal Bearing	Mandrel	---	0.008” - 0.012”	-	-
	~~Filler~~ / lead wire			0.30	0.29
Bearing Pinch				0.06	0.06
Free End					
Journal Bearing	Mandrel	---	0.008” - 0.012”	-	-
	~~Filler~~ / lead wire			0.24	0.23
Bearing Pinch				0.06	0.06
Axial Thrust.	With Top Housing	---	---	-	-

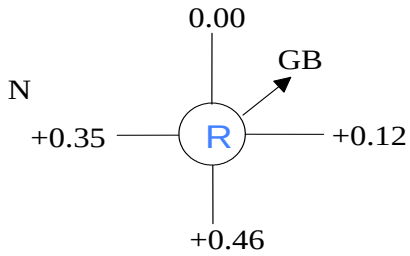
ALIGNMENT READING RECORDS: 101-BJT to 101-BJR

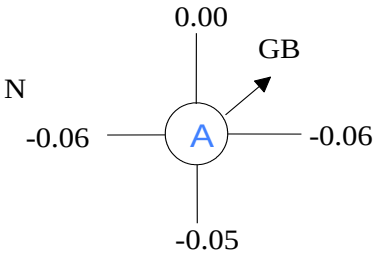
Before Preventive Maintenance





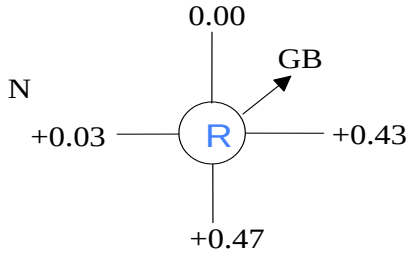
After Preventive Maintenance

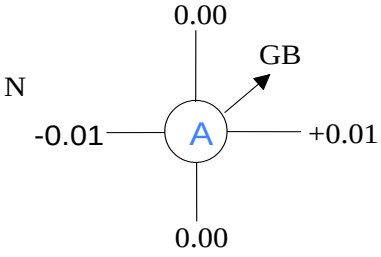




ALIGNMENT READING RECORDS: 101-BJR to 101-BJ

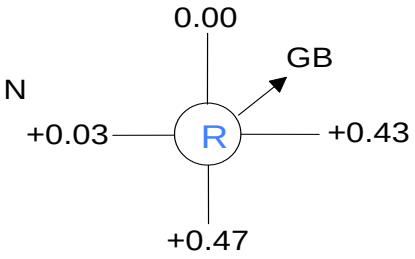
Before Preventive Maintenance

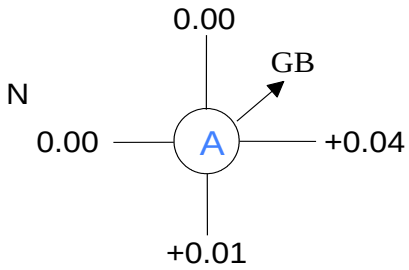




By Slip Gauge

After Preventive Maintenance





By Slip Gauge

BOILER FEED WATER PUMP DRIVE TURBINE, 104-JT

Preventive Maintenance of 104-JT Train was carried out from 11/09/2018 to 12/09/2018 before Annual Turnaround during which drive end side journal bearing of 104-JT found damaged i.e. white metal lining found worn out completely & also heavy scoring was found on shaft journal portion. At that time journal bearing was replaced & shaft was cleaned & polished. Rotor replacement was planned during Annual Turnaround.

Major overhauling of Boiler Feed Water Pump Drive Turbine, 104-JT was carried out for replacement of turbine rotor:

- Turbine was decoupled after removing Coupling Guard.
- All instruments & probes mounted over the turbine were disconnected & removed.
- Axial thrust was measured and found 0.53mm.
- Both end bearing housing and Casing bolts were opened.
- Bearing housing top halves at both ends & casing top half was removed.
- All clearances were measured and recorded. Refer chart below
- Rotor was lifted out of the casing. OST assembly was removed.
- Casing top & bottom halves were cleaned properly.
- Rotor was replaced by the spare one. New journal bearing sleeve provided on DE side.
- New Thrust bearing (Bearing No. 6310 Z – 1 No.) & OST assembly of old rotor was installed on spare rotor.
- Carbon rings clearances found increased, hence all the carbon rings (total 8 nos.) were replaced by new ones. Carbon rings clearances were measured & recorded.
- After assembly, Rotor was placed in the bottom half of the casing.
- All the clearances were measured and recorded.
- Casing top half & bearing housing top halves were placed at its position & bolts tightened.
- All the instruments & probes were mounted over the turbine and connected.
- Alignment of turbine with pump was done.

- The PGPL governor drive gear was checked and oil was flushed. Governor was tested at test bench & found ok.
- Turbine was started & trial taken. Found OK.
- Turbine OST was checked in decoupled condition (Electronic OST through Butterfly Trip Valve). Turbine tripped at 4200 RPM.
- Coupling of Turbine with pump carried out. Fixed coupling guard.

DE Journal Brg Sleeve (Before SD)

DE side Shaft Journal area (Before SD)

IFFCO - KALOL

DIAMETRICAL CLEARANCES – ELLIOT TURBINE 104–JT

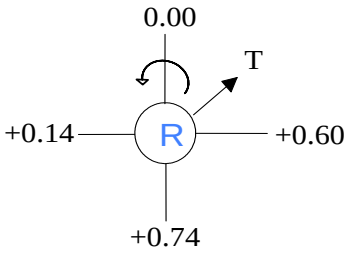
REF.	CLEARANCE – INCHES	CLEARANCE – MM	REF.	CLEARANCE – INCHES	CLEARANCE – MM
D1	0.007 TO 0.010	0.178 TO 0.254	D1	0.007 TO 0.010	0.178 TO 0.254
D2	0.004 TO 0.007	0.102 TO 0.178	D2	0.004 TO 0.007	0.102 TO 0.178
B1	0.020 TO 0.025	0.508 TO 0.635	B1	0.020 TO 0.025	0.508 TO 0.635
B2	0.005 TO 0.007	0.127 TO 0.178	B2	0.005 TO 0.007	0.127 TO 0.178

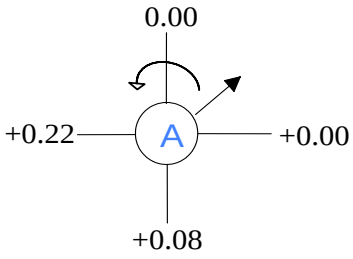
AFTER	BEFORE		BEFORE OLD ROTOR	AFTER NEW ROTOR
		STEAM FLOW ↓		
		ROTOR LOCATING BALL BEARING		
		BEARING D1	0.32	0.38
0.25		OIL GUARD		0.30
		CARBON RING–B1	0.20	0.16
		CARBON RING–B1	0.20	0.15
		CARBON RING–B1	0.25	0.16
		CARBON RING–B1	0.20	0.16
2.1		NOZZLE / WHEEL–1 (E)		1.6
3.1		DIAPHRAGM / WHEEL–2 (F)	2.5	2.5
		CARBON RING–B2	0.25	0.12
		CARBON RING–B2	0.20	0.13
		CARBON RING–B2	0.23	0.12
		CARBON RING–B2	0.21	0.14
0.40		OIL GUARD		0.45
		BEARING D2		0.45 (NEW. BRG. SLEEVE)
0.20		OIL GUARD		0.35
		COUPLING		

NEW ROTOR SHAFT JOURNAL DIA. @ NDE = 74.50mm DE = 74.47mm.

IFFCO :–
PARTY :–
Date :–

ALIGNMENT READING RECORDS : 104-JT to 104-J





Inside Micrometer

BOILER FEED WATER PUMP, 104-JA TRAIN

104-JA Boiler Feed Water Pump

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

104-JAT Drive Turbine

The turbine was taken for scheduled overhauling. Last overhauling was done in SD-2013.

- Turbine was decoupled after removing Coupling Guard.
- All instruments & probes mounted over the turbine were disconnected & removed. The exhaust piping was locked, exhaust bellow & RV was removed.
- Axial thrust & total float was measured and recorded.
- Both end bearing housing and Casing bolts were opened.
- Bearing housing top halves at both ends & casing top half was removed.
- It was observed that #2 diaphragm was found rotated slightly from position.

#1 Diaphragm was found rotated slightly from position

- Diaphragm top halves were removed.
- All clearances were measured and recorded. Refer chart below.

- Rotor run-out was checked & found OK. The bearing clearances were measured and removed for inspection. The rotor was removed from the casing and cleaned by sand blasting.
- Bottom diaphragms were removed from the casing. The top and bottom diaphragms were cleaned by sand blasting.
- Visual Inspection of Rotor & Diaphragms was carried out. Found OK.
- Both ends journal bearing pads & thrust bearing pads were visually inspected and dye penetration tested and found OK. The journal bearing clearance were measured and found within design range. Thrust pad thickness was measured & recorded. Gauss of the bearings was checked and found within desired value. The same bearings were used.
- Carbon rings clearances found increased, hence all the carbon rings (total 8 nos.) were replaced by new ones. Carbon rings clearances were measured & recorded.
- Diaphragms bottom half were installed inside the casing.
- The Rotor was placed and the nozzle clearance, total float and the end thrust were measured and found to be satisfactory.
- All the clearances were measured and recorded.
- The top diaphragms were placed inside and the top casing was installed & bolts tightened.
- Clearance between Turbine top cover & Diaphragm top halves measured. Found clearance in 2nd diaphragm is more than the other's. Hence, to avoid rotation of diaphragm during running shim was placed between Turbine top cover & 2nd Diaphragm top half. (Shim Size: 850 mm Long X 50 mm Wide X 0.07 mm Thick)
- Casing top half & bearing housing top halves were placed at its position & bolts tightened.
- All the instruments & probes were mounted over the turbine and connected.
- Exhaust bellow & RV was installed & the exhaust piping was unlocked.
- Alignment of turbine with pump was done.
- During normal operation, it was observed that there was sudden variation in Governor o/p. However, there was no variation in speed. Hence PGPL actuator was replaced with new overhauled one.
- The turbine was taken for a slow roll by opening the steam inlet bypass valve. The speed was increased by 1000 RPM and maintained for 5-10 min. Then reduced by 500 RPM and maintained for 5-10 min. This procedure ensured proper lapping of the carbon rings.
- Turbine OST was checked in decoupled condition (Electronic OST through Butterfly Trip Valve). Turbine tripped at 3799 RPM.
- Coupling of Turbine with pump was carried out. Fixed coupling guard.

OVERHAULING & PEVENTIVE MAINTENANCE RECORDS : 104-JA TRAIN COUPLINGS

Description	Position	Before (mm)	After (mm)
Distance between Hub Face (With Rotor at extreme ends)	---	128.84	128.84

OVERHAULING RECORDS : 104-JAT

Description	Position	Dwg. Ref	Design Clearances (Inch)	Before (mm)	After (mm)
Coupling end					
Journal Bearing	~~Mandrel~~				
	~~Filler~~ / lead wire			0.21	0.21
Oil Guard (For Jr. Brg Housing)	South			0.15	0.15
	North			0.15	0.20
Bearing Pinch	Jr. Brg.			0.03	0.02
Carbon Ring Clearance	From North to South	B1	0.007”-0.010”	0.41	0.20
		B1		0.41	0.18
		B1		0.41	0.19
		B1		0.46	0.18
Governor end					
Journal Bearing	~~Mandrel~~		0.005-0.007		
	~~Filler~~ / lead wire			0.20	0.20
Oil Guard (For Brg. Housing)	South			0.15	0.15
Axial Thrust.	With Top Housing		0.013	0.60	0.63
	Without top Housing			0.75	0.73
Nozzle Clearance	---			1.45	1.45
Total Float	---			2.9	2.9
Bearing Pinch	Jr. bearing			0.01	0.01
Carbon Ring Clearance	From North to South	B2	0.004”-0.007”	0.27	0.14
		B2		0.27	0.12
		B2		0.40	0.12
		B2		0.25	0.14

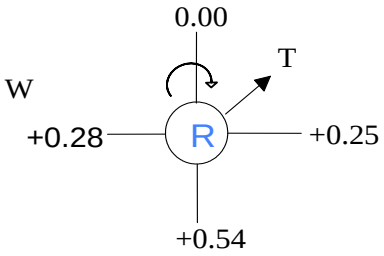
Thrust Bearing Pad Thickness (MM) : 104-JAT				
PAD	**ACTIVE**		**INACTIVE**	
	Before	**After**	**Before**	**After**
No 1	15.91	15.91	15.91	15.91
No 2	15.90	15.90	15.92	15.92
No 3	15.90	15.90	15.92	15.92
No 4	15.90	15.90	15.92	15.92
No 5	15.91	15.91	15.92	15.92

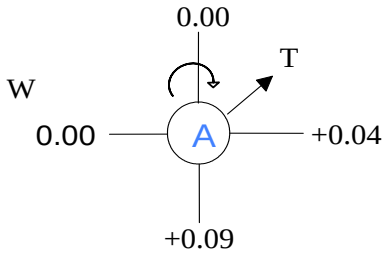
PREVENTIVE MAINTENANCE RECORDS : 104-JA

Description	Design Clearance (Inch)	Before PM (mm)	After PM (mm)
Journal bearing (Thrust end bearing)	0.006 - 0.008	0.19	0.19
Journal bearing (Opposite thrust end)	0.006 - 0.008	0.17	0.17
Axial Thrust	0.014	0.30	0.30

Thrust Bearing Pad Thickness (MM) : 104-JA				
PAD	ACTIVE		INACTIVE	
	Before	After	Before	After
No 1	25.38	25.38	25.38	25.38
No 2	25.37	25.37	25.36	25.36
No 3	25.38	25.38	25.37	25.37
No 4	25.38	25.38	25.38	25.38
No 5	25.39	25.39	25.38	25.38
No 6	25.37	25.37	25.39	25.39

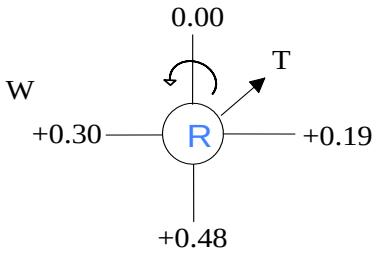
ALIGNMENT READING RECORDS : 104-JAT to 104-JA (Before PM)

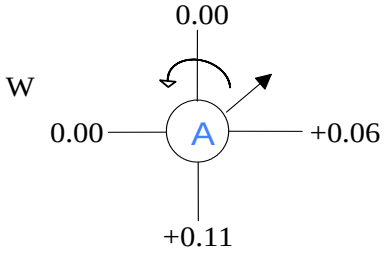




Inside Micrometer

ALIGNMENT READINGS : 104-JAT to 104-JA (After PM)

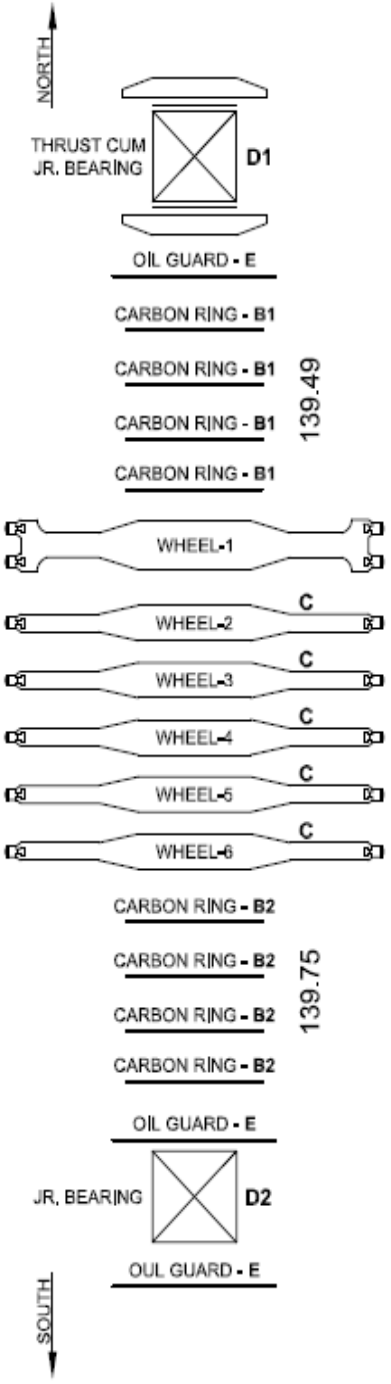




Inside Micrometer

IFFCO - KALOL

DIAMETRICAL CLEARANCES - 104-JAT			
REF.	CLEARANCE - INCHES	CLEARANCE - MM	BETWEEN
B1	0.007 TO 0.010	0.178 TO 0.254	SHAFT TO CARBON RING
B2	0.004 TO 0.007	0.102 TO 0.178	SHAFT TO CARBON RING
C	0.020 TO 0.025	0.508 TO 0.635	SLEEVE TO LABYRINTH
D	0.005 TO 0.007	0.127 TO 0.178	JOURNAL BEARING



AFTER	BEFORE	BEFORE	AFTER
	0.10 / 0.15	0.20	0.20
		0.41	0.20
		0.41	0.18
		0.41	0.19
		0.46	0.18
0.45	0.60	0.50	0.50
0.50	0.40	0.50	0.40
0.70	0.15	0.75	0.10
0.45	0.60	0.45	0.55
0.50	0.55	0.50	0.55
		0.27	0.14
		0.27	0.12
		0.40	0.12
		0.25	0.14
	0.15	0.05	
	0.05	0.20	

IFFCO :-	
PARTY :-	
Date :-	

a-MDEA PUMP 107-J Train

107-JT Drive Turbine

The turbine was decoupled. The coupling was inspected and DBSE were noted. Turbine (107-JT) front, rear bearings and thrust pads were thoroughly polished & dimensionally checked and found to be within limits. DP tests were carried out and found bonding of white metal with base metal damaged in NDE brg. Hence, NDE journal bearing replaced by spare brg. Magnetism level of all bearings was found to be within limit. Clearances were measured and found to be within limit.

107-J aMDEA Pump :

Both ends bearing housing oil flushed. Alignment between Turbine & Pump was done and final coupling of the turbine to pump done.

COUPLINGS

Description	Position	Design (Inch)	Before (mm)	After (mm)
DBSE (With Rotor at extreme ends)	---	---	180.00	180.00

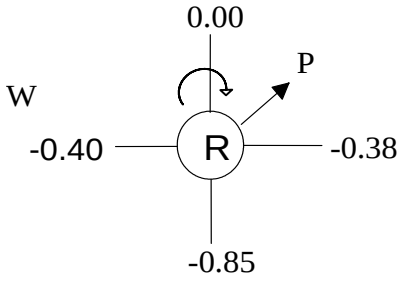
PREVENTIVE MAINTENANCE RECORDS: 107-JT (MURRAY TURBINE)

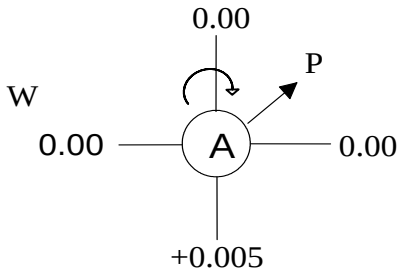
Description	Design Clearance (Inch)	Before PM (Inch)	After PM (Inch)
Journal bearing Thrust end	0.005" – 0.007"	0.29	0.21/0.26 (new)
Oil Guard Thrust end - Inboard	0.011" – 0.017"		
Oil Guard Thrust end - Outboard	0.011" – 0.017"		
Journal bearing Opposite thrust end	0.005" – 0.007"	0.31	0.18/0.20
Oil Guard Opposite thrust end - Inboard	0.011" – 0.017"	0.30/0.20 0.25/0.20	0.31/0.21 0.26/0.22
Axial Thrust	0.007" – 0.013"	0.50	0.53

GAUSS RECORDS : 107-JT			
LOCATION		**Before (Gauss)**	**After (Gauss)**
Journal bearing Governor end	Top half	0.3	0.2 (New Brg.)
	Bottom half	0.5	0.1 (New Brg.)
	Shaft	1.0	1.0
Journal bearing Coupling end	Top half	0.6	0.6
	Bottom half	0.3	0.3
	Shaft	0.6	0.6
Thrust bearing	Collar	0.8	0.8
	Pad	0.4 to 0.5	0.4 to 0.5

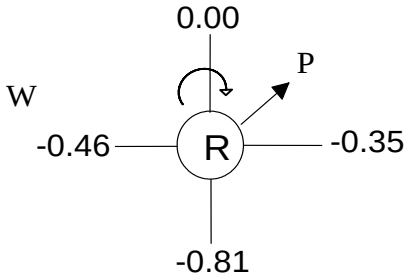
ALIGNMENT READING RECORDS: 107-J TRAIN

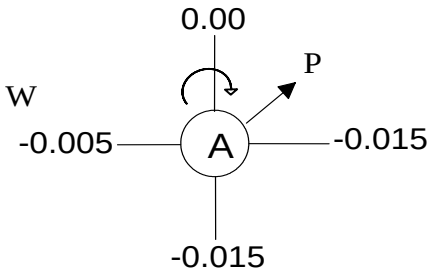
107-JT to 107-J (Before PM)





107-JT to 107-J (After PM)





PREVENTIVE MAINTENANCE RECORDS : 115-JA Train

SEMILEAN SOLUTION PUMP, 115-JA TRAIN

Preventive Maintenance of complete train was carried out.

Pump, 115-JA

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

Oil of LO console was removed, console was cleaned and filled with new oil.

Drive Turbine, 115- JAT

The turbine was decoupled and both ends bearing housing opened. The thrust bearing and both ends radial bearings clearance were measured and found within limit. The bearing pads were visually inspected and DP checked and found OK. The gauss measurement was taken and found within acceptable limit.

Actuator filter was cleaned and the actuator was flushed with oil SERVO ULTRA 40.

The condition of TB woods coupling sleeve was not good and hence replaced with new one.

Governing valve spindle was found bent. Hence it was straightened & provided, gland packing was also replaced.

Gear Box, 115-JAR

Gear Box was opened and all the bearings were inspected and found O.K. Both the gear as well as Pinion were inspected and found O.K. Gauss measurement of gear shaft and bearings carried out and found within limit. Bearing clearances and backlash were measured and found within the design range. The main oil pump drive coupling was inspected and found in good condition. The oil piping's were cleaned with air.

Hydraulic Turbine, 115-HT

The hydraulic turbine was decoupled. The thrust bearing and both ends radial bearings clearance were measured and found within limit. During visual inspection & DP check, NDE journal bearing & thrust bearing pads found OK. DE side journal bearing found damaged, hence replaced by spare one. Mechanical seal of DE side also replaced as it was having leakage. The gauss measurement was done and found within acceptable limit.

Clutch

Top cover of clutch was opened and cleaned. Sight glass was also cleaned. The hydraulic turbine to clutch alignment readings were measured and recorded. Turbine to clutch coupling was done.

Coupling Records

Coupling	DBSE (mm)
115-JAT to 115-JAR	400.12
115-JAR to 115-JA	298.39
115-JA to Clutch	360.72
Clutch to 115-HT	300.17

Coupling Hub		Measured Value (mm)
115-JA	Hub Overhang (Gear Box side)	1.3
	Hub Override (Clutch Side)	0.4
115-HT	Hub Overhang	1.0

PREVENTIVE MAINTENANCE RECORDS: 115- JAT

Description		Design Clearances (Inch)	Before (mm)	After (mm)
Coupling side bearing		0.0055-0.008	0.34	0.32
Governor side bearing		-- do --	0.23/0.24	0.23
Oil Guard Coupling side (inboard)	Radial	0.0100-0.0125	L-0.25, R-0.30	L-0.25, R-0.30
	Axial	0.040-0.050		
Oil Guard Coupling side (outboard)	Radial	0.0100-0.0125	L-0.25, R-0.30	L-0.25, R-0.30
	Axial	0.080-0.090		
Oil Guard Governor side	Radial	0.0100-0.0125	L-0.30, R-0.25	L-0.30, R-0.25
	Axial	0.030-0.040		
Axial Thrust		0.010 – 0.012	0.42	0.32

Thrust Bearing Pad Thickness (MM)				
Pad	**ACTIVE**		**INACTIVE**	
	Before	**After**	**Before**	**After**
No 1	17.47	17.47	17.44	17.44
No 2	17.47	17.47	17.44	17.44
No 3	17.47	17.47	17.44	17.44
No 4	17.44	17.44	17.47	17.47
No 5	17.47	17.47	17.47	17.47
No 6	17.47	17.47	17.44	17.44

PREVENTIVE MAINTENANCE RECORDS: 115-JAR

Description	Position	Design Clearances (Inch)	Before (mm)	After (mm)
Journal Bearing (Low Speed drive gear)	North	-	0.26	0.26
	South	-	0.25	0.25
Axial Thrust	---	-	0.59	0.59
Journal Bearing (High Speed driven Pinion)	North	-	0.26	0.25
	South	-	0.25	0.25
Free float	---	---		
Backlash	---	---	0.40	0.40

PREVENTIVE MAINTENANCE RECORDS: 115-JA

Description	Design Clearances (Inch)	Before (mm)	After (mm)
Thrust end bearing	0.005-0.0098 (0.217-0.249mm)	0.21	0.20
Opp Thrust end bearing	--- do---	0.20/0.21	0.19
Axial Thrust	0.013 – 0.015 (0.35 - 0.40 mm)	0.25	0.25

Thrust Bearing Pad Thickness (MM)				
Pad	ACTIVE		INACTIVE	
	Before	After	Before	After
No 1	31.76	31.76	31.76	31.76
No 2	31.77	31.77	31.77	31.77
No 3	31.77	31.77	31.77	31.77
No 4	31.77	31.77	31.77	31.77
No 5	31.77	31.77	31.77	31.77
No 6	31.76	31.76	31.77	31.77
No 7	31.77	31.77	31.77	31.77
No 8	31.77	31.77	31.77	31.77

PREVENTIVE MAINTENANCE RECORDS: 115-HT

CLEARANCE RECORDS			
Description	**Design Clearances (mm)**	**Before (mm)**	**After (mm)**
Thrust End Journal Bearing	0.124 – 0.148	0.16	0.16
Opp Thrust End Journal Bearing	0.124 – 0.148	0.17	0.17 (New)
Axial Thrust	0.25 – 0.30	0.33	0.35

Thrust Bearing Pad Thickness (MM)				
Pad	ACTIVE		INACTIVE	
	Before	After	Before	After
No 1	18.83	18.83	18.90	18.90
No 2	18.86	18.86	18.88	18.88
No 3	18.89	18.89	18.89	18.89
No 4	18.89	18.89	18.89	18.89
No 5	18.84	18.84	18.89	18.89
No 6	18.85	18.85	18.89	18.89

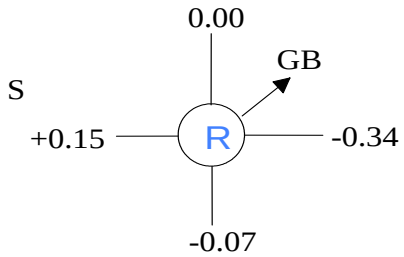
GAUSS

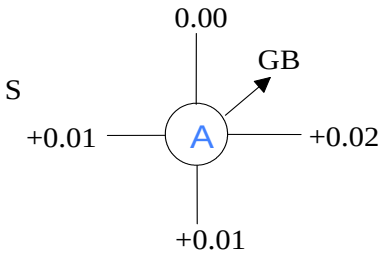
Description	Position	Before (Gauss)	After (Gauss)
115- JAT			
Journal Bearing liner	Thrust End	0.2T/0.6B	0.2T/0.6B
	Non thrust end	0.2T/0.6B	0.2T/0.6B
Thrust bearing pads	Active	1.7	1.7
	Inactive	1.7	1.7
Thrust Bearing base ring	Active	1.3	1.3
	Inactive	1.3	1.3
Shaft Journal	Thrust End	1.0	1.0
	Non thrust end	2.5	2.5
Thrust Collar	Active	1.6	1.6
	Inactive	1.6	1.6

115 - JA			
Journal Bearing Sleeve	Thrust End	0.8/0.8	0.8/0.8
	Non thrust end	0.6/0.2B	0.6/0.2B
Thrust bearing pads	Active	1.4	1.4
	Inactive	1.3	1.3
Thrust Bearing base ring	Active (OB)	0.6	0.6
	Inactive (IB)	1.7	1.7
Shaft Journal	Thrust End	1.7	1.7
	Non thrust end	2.0	2.0
Thrust Collar	Active	1.8	1.8
	Inactive	1.8	1.8
115-JR			
Gear Journal Bearing	North	0.8/1.0	0.8/1.0
	South	0.6/1.2	0.6/1.2
Pinion Journal Bearing	North	0.9/0.4	0.9/0.4
	South	0.8/1.2	0.8/1.2
Thrust bearing	Active		
	Inactive		
115 - HT			
Journal Bearing Sleeve	Thrust End	0.6/0.6	0.1/0.2 (New)
	Non thrust end	1.6/0.4	1.6/0.4
Thrust bearing pads	Active	1.3	1.3
	Inactive	1.0	1.0
Thrust Bearing base ring	Active (Out)	1.2	1.2
	Inactive (In)	1.3	1.3
Shaft Journal	Thrust End	2.0	2.0
	Non thrust end	1.8	1.8
Pinion Wheel (HS) Journal Shaft	Turbine Side		2.2
	Pump Side		2.0
Gear Wheel (LS) Journal Shaft	Turbine Side		1.6
	Pump Side		1.6

ALIGNMENT READINGS: 115-JAT to 115-GB

BEFORE





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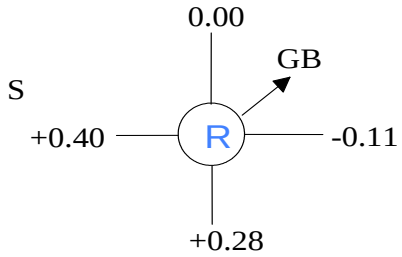
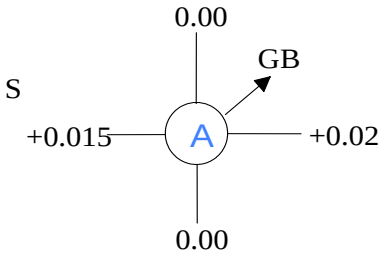
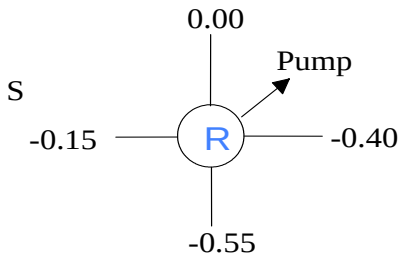
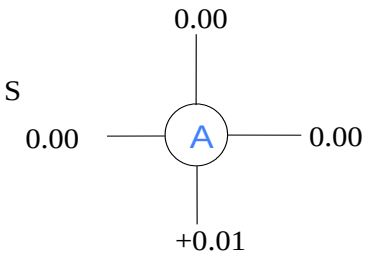




ALIGNMENT READINGS: 115-GB to 115-JA

BEFORE





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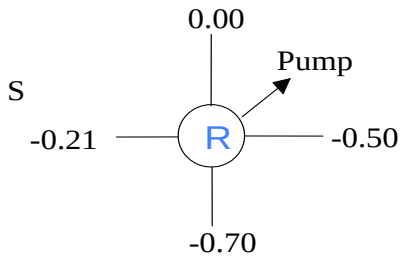

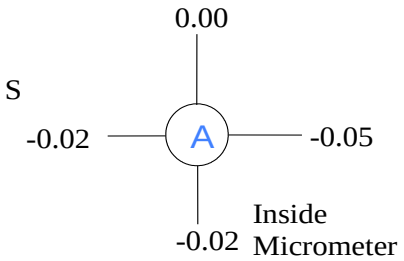

ALIGNMENT READINGS: 115-HT to 115-CLUTCH

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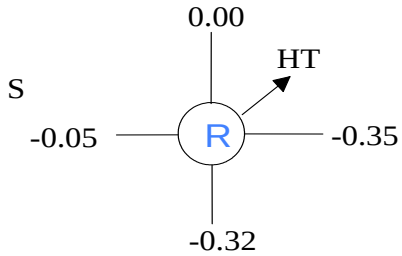

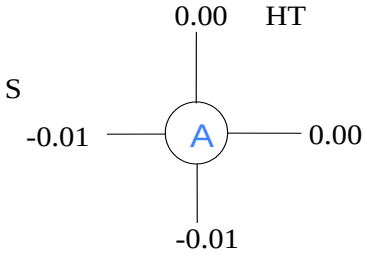

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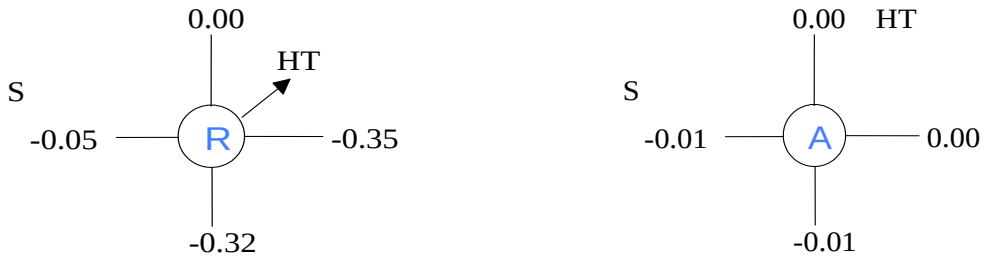

ALIGNMENT READINGS: 115-JA to 115-CLUTCH

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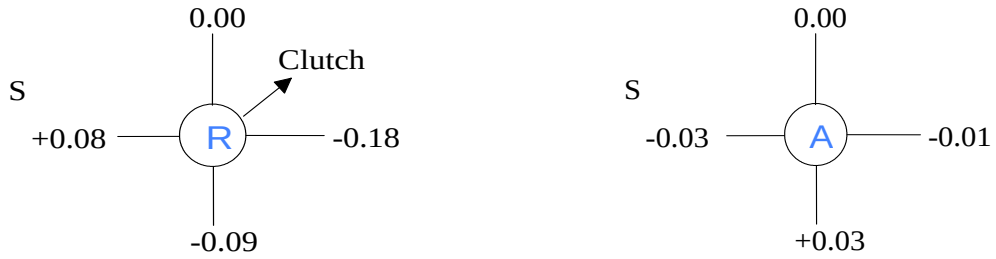

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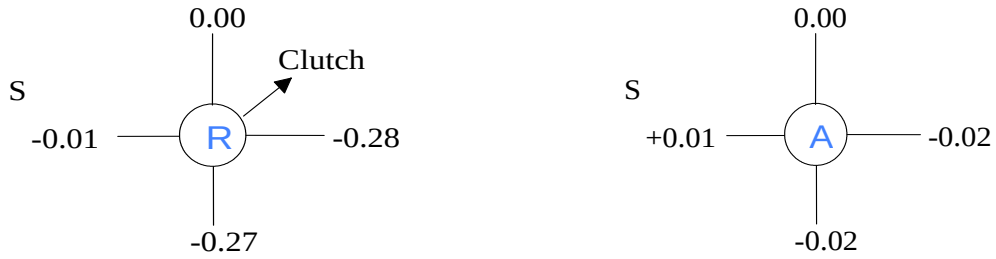


SEMILEAN SOLUTION PUMP, 115-JB TRAIN

Preventive Maintenance of complete train was carried out.

Pump, 115-JB

The pump was decoupled and both ends bearing housing opened. The thrust bearing and both ends radial bearings clearance were measured and found within limit. The bearing pads were visually inspected, DP checked and found OK. The gauss was checked and found within acceptable limit. The suction strainer was cleaned.

Oil of LO console was removed; console was cleaned and filled with new oil.

Drive Turbine, 115-JBT

The turbine was decoupled and both ends bearing housing opened. The thrust bearing and both ends radial bearings clearance were measured and found within limit. During visual & DP inspection of journal bearings & Thrust bearing pads, NDE side journal bearing & thrust bearing pad both Active & Inactive side (having RTD) found damaged, hence replaced by new one. DE journal bearing &

other thrust bearing pads were found OK. The gauss was checked and found within acceptable limit.

Actuator filter was cleaned and the actuator was flushed with oil SERVO ULTRA 40.

The condition of TB woods coupling sleeve was not good and hence replaced with new one.

Governing valve spindle was found bent. Hence it was straightened & provided, gland packing was also replaced. Actuator drive shaft was having play. Hence this was replaced.

Gear Box, 115-JBR

Gear Box was opened and all the bearings were inspected and found O.K. Both the gear as well as Pinion were inspected and found O.K. Gauss measurement of gear shaft and bearings carried out and found within limit. Bearing clearances and backlash were measured and found within the design range. The main oil pump drive coupling was inspected and found in good condition. MOP coupling sleeve was found damaged and hence replaced. The oil piping's were cleaned with air.

PREVENTIVE MAINTENANCE RECORDS 115-JB TRAIN

Coupling Records

Coupling	DBSE (mm)
115-JBT to 115-JBR	403.13
115-JBR to 115-JB	301.86

SEMILEAN SOLUTION PUMP, 115-JB

CLEARANCE RECORDS			
Description	**Design Clearances (Inch)**	**Before (MM)**	**After (MM)**
Thrust end bearing	0.005-0.0098 (0.217-0.249mm)	0.19	0.22
Opp Thrust end bearing	--- do---	0.21	0.21
Axial Thrust	0.013 – 0.015 (0.35 - 0.40 mm)	0.56	0.58

Thrust Bearing Pad Thickness (MM)				
Pad	**ACTIVE**		**INACTIVE**	
	Before	**After**	**Before**	**After**
No 1	31.75	31.75	31.75	31.75
No 2	31.74	31.74	31.76	31.76
No 3	31.75	31.75	31.75	31.75
No 4	31.75	31.75	31.75	31.75
No 5	31.74	31.74	31.74	31.74
No 6	31.74	31.74	31.74	31.74
No 7	31.75	31.75	31.75	31.75
No 8	31.75	31.75	31.75	31.75

DRIVE TURBINE, 115-JBT

Description		Design Clearances (Inch)	Before (mm)	After (mm)
Axial Thrust		0.010 – 0.012	0.58	0.45
Coupling side bearing		0.0055-0.008	0.33	0.28
Governor side bearing		-- do --	0.24 (Brg. damaged)	0.32 (New Brg.)
Oil Guard Coupling side (inboard)	Radial	0.0100-0.0125	0.25	0.30
	Axial	0.040-0.050	0.25	0.25
Oil Guard Coupling side (outboard)	Radial	0.0100-0.0125	0.25	0.30
	Axial	0.080-0.090	0.10	0.20
Oil Guard Governor side	Radial	0.0100-0.0125	0.25	0.30
	Axial	0.030-0.040	0.35	0.34

Thrust Bearing Pad Thickness (MM)				
Pad	**ACTIVE**		**INACTIVE**	
	Before	**After**	**Before**	**After**
No 1	17.46	17.47 (New Pad)	17.45	17.45
No 2	17.46	17.46	17.45	17.45
No 3	17.46	17.46	17.45	17.45
No 4	17.46	17.46	17.45	17.45
No 5	17.46	17.46	17.44	17.44
No 6	17.46	17.46	17.45	17.45

PREVENTIVE MAINTENANCE RECORDS: 115-JBR

Description	Position	Design Clearance (Inch)	Before (mm)	After (mm)
Journal Bearing (Low Speed drive gear)	North	-	0.28	0.28
	South	-	0.20	0.25
Axial Thrust	---	-	3.10	3.10
Journal Bearing (High Speed driven Pinion)	North	-	0.27	0.28
	South	-	0.27	0.28
Free float (Pinion)	---	---	1.15	1.16
Backlash	---	---	0.52	0.52

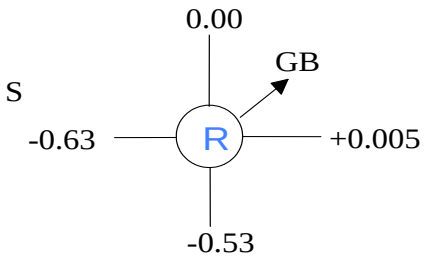
GAUSS

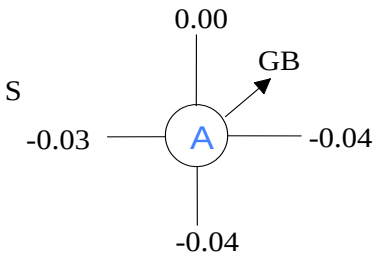
Description	Position	Before	After
115- JBT			
Journal Bearing liner	Thrust End	1.0 (T)	2.0 (T)
	Non thrust end	0.5 (T) 0.1 (B)	0.5 (T) 0.1 (B)
Thrust bearing pads	Active	0.9	0.9
	Inactive	1.3	1.3
Thrust Bearing base ring	Active	0.2	0.2
	Inactive	0.4	0.4
Shaft Journal	Thrust End	1.3	1.3
	Non thrust end	3.1	3.1

Description	Position	Before	After
115 - JB			
Journal Bearing Sleeve	Thrust End	0.6 (T) 0.6 (B)	0.6 (T) 0.6 (B)
	Non thrust end	0.6 (T) 1.0 (B)	0.6 (T) 1.0 (B)
Thrust bearing pads	Active	1.4	1.4
	Inactive	1.0	1.0
Thrust Bearing base ring	Active	0.6	0.6
	Inactive	0.8	0.8
Shaft Journal	Thrust End	0.4	0.4
	Non thrust end	0.2	0.2
115-JBR			
Gear Journal Bearing	North	0.4 (T) 0.6 (B)	0.4 (T) 0.6 (B)
	South	0.5 (T) 0.4 (B)	0.5 (T) 0.4 (B)
Pinion Journal Bearing	North	0.5	0.5
	South	0.8	0.8
Gear Wheel	Turbine Side	0.8	0.8
	Pump Side	0.5	0.5
Pinion Wheel	Turbine Side	0.8	0.8
	Pump Side	1.3	1.3

ALIGNMENT READINGS: 115-JBT to 115-JBR

BEFORE





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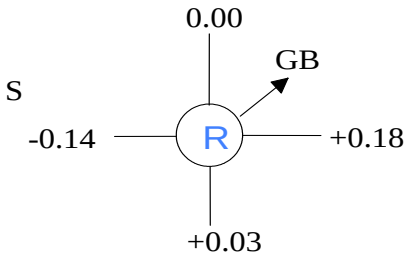
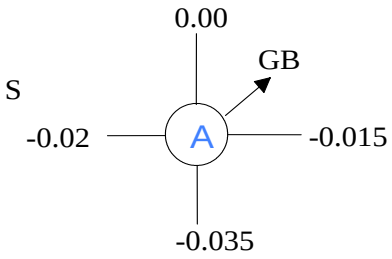
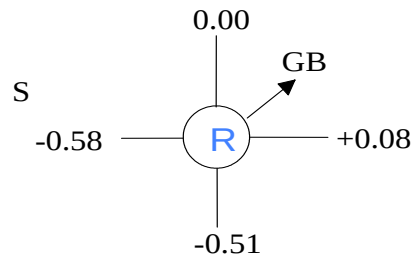
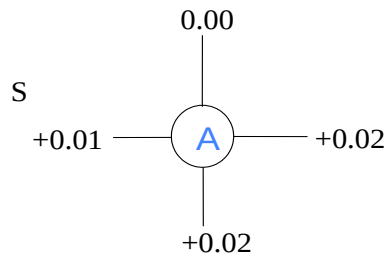




ALIGNMENT READINGS: 115-JBR to 115-JB

BEFORE





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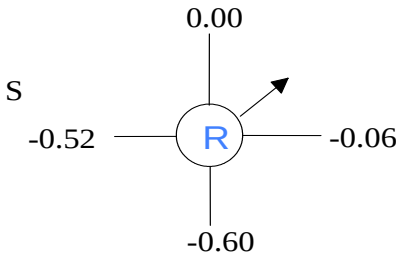
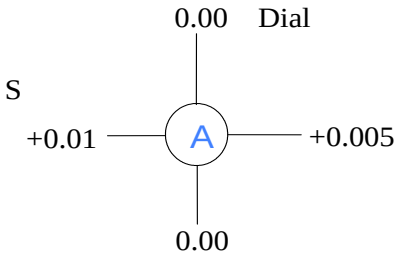




RECIPROCATING CO_2 GAS COMPRESSOR TRAIN (117-J)

Overhauling of Compressor was carried out by M/s. Malhan Enterprises Pvt. Ltd., Ahmedabad against WO No. 201004191230.

LP Cylinders Overhauling

The end clearance at TDC and BDC were measured and opened the head of both cylinders to remove the piston assembly. The cylinder liners were inspected and found OK. The piston assembly of both the cylinders was replaced. Spare refurbished gas packing assy. was installed on both the cylinders. All the suction and discharge valves were replaced by spare refurbished valves.

HP Cylinders Overhauling

The end clearance at TDC and BDC were measured and opened the head of both cylinders to remove the piston assembly. The piston rod assembly of both cylinders was replaced by new one along with gas packing assembly. Distance Piece of HP Cylinders & Urea side HP cylinder replaced. All the suction and discharge valves were replaced by spare refurbished valves.

Crank Case Assembly Overhauling

- The crank case cover was opened for the inspection of bearings & other internals.
- Clearances of all the big end bearings were found on higher side. These 5 set bearings were replaced by new ones.
- Big End bearings and Gudgeon Pin of all 4 nos. connecting rods were replaced by new one

- All the clearances were measured and recorded.
- All critical nuts were tightened at respective design torque.
- The AOP was run and oil flow inside the crank case was checked and found OK.
- The oil scrapper rings (4 nos.) were replaced by new one.

Miscellaneous jobs

- The tube bundle of inter stage cooler was pulled out & cleaned by hydro jetting.
- The LP flow dampener were checked and found OK. Gas leakage from nozzle reinforcement pad of HP flow dampener was repaired.
- The lube oil strainers were cleaned and reinstalled.

OVERHAULING RECORDS: 117-J

Description	Position		Design clearance(mm)	Before	After
Piston end clr. (Front /TDC)	LP	Urea side	2	2.00	2.30
		Ammonia side	-- do --	2.80	2.60
	HP	Urea side	-- do --	2.40	2.40
		Ammonia side	-- do --	2.90	2.70
Piston end clr. (Intermediate /BDC)	LP	Urea side	1.5	1.50	1.50
		Ammonia side	-- do --	1.80	1.70
	HP	Urea side	-- do --	1.60	1.60
		Ammonia side	-- do --	1.90	1.70
Main bearing	I	Urea side to Ammonia side	0.08-0.15 (0.3 Max)	0.22	0.20
	II		-- do --	0.23	0.20
	III		-- do --	0.22	0.21
	IV		-- do --	0.23	0.22
	V		-- do --	0.23	0.20
Big end bearing	LP	Urea side	0.07-0.13 (0.3 Max)	0.23	0.22
		Ammonia side	-- do --	0.23	0.22
	HP	Urea side	-- do --	0.22	0.22
		Ammonia side	-- do --	0.22	0.20
Small end bearing	LP	Urea side	0.05-0.10 (0.2 Max)	0.07	0.05
		Ammonia side	-- do --	0.08	0.06
	HP	Urea side	-- do --	0.07	0.06

Description	Position		Design clearance(mm)	Before	After
		Ammonia side	-- do --	0.09	0.06
Cross head guide	LP	Urea side	0.18-0.26 (0.6 Max)	0.15	0.15
		Ammonia side	-- do --	0.15	0.15
	HP	Urea side	-- do --	0.15	0.15
		Ammonia side	-- do --	0.15	0.15
Side clearance (Crank shaft)	----	Crank shaft	0.45-0.60 (0.9 Max)	0.80	0.80
Side clearance (Connecting rod big end)	LP	Urea side	0.33-0.42 (0.6 Max)	0.25	0.25
		Ammonia side	-- do --	0.25	0.25
	HP	Urea side	-- do --	0.20	0.20
		Ammonia side	-- do --	0.20	0.20

Alignment Reading between Motor & GB:

Vertical:

Offset Value = 0.09mm; Angular Value = 0.02/100mm

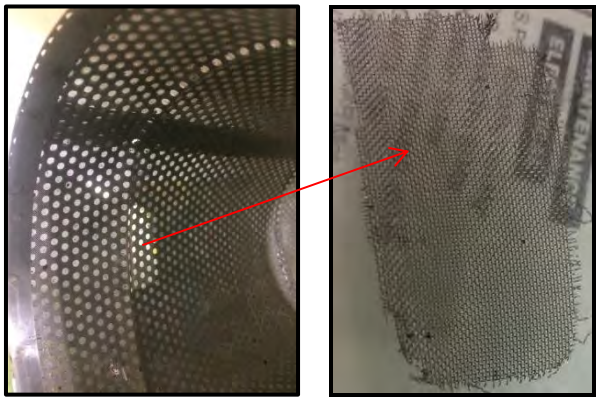
Horizontal:

Offset Value = 0.01mm; Angular Value = 0.01/100mm

<u>Drive Turbine of Lube Oil/ Seal Oil Pump for 101-J & 105-J Train, 101-JLJT</u>

- Preventive Maintenance of Turbine was carried out first time after installation.
- DE & NDE Bearing Housing's top cover was opened for bearing inspection.
- NDE side top half of journal bearing's white metal lining found in detached condition. This bearing was replaced.

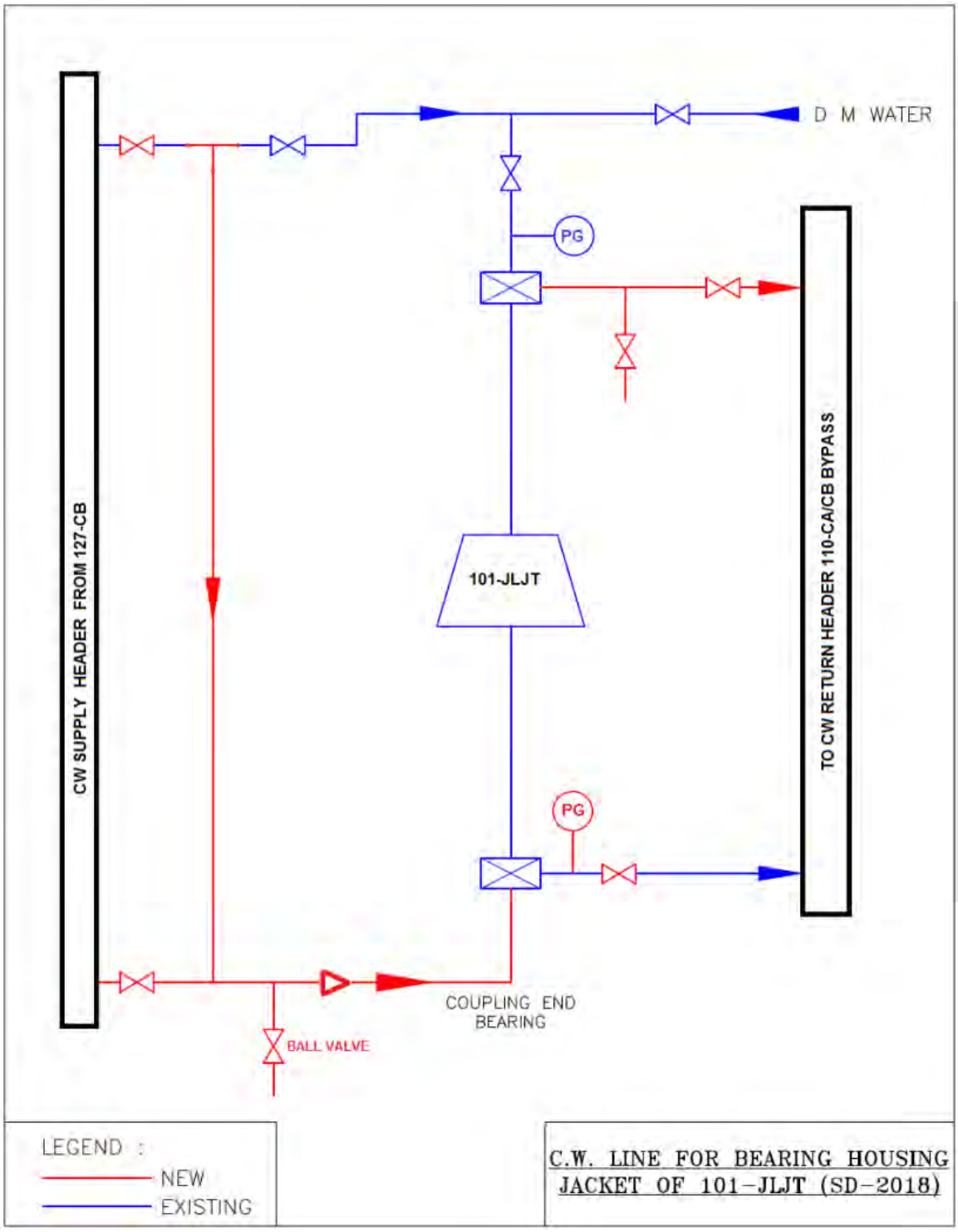
Detached White Metal Liner of NDE Bearing Top



Damaged Mesh of LO pump Strainer

- Mesh of Strainer of LO pump was damaged and the same was repaired.

- CW line for bearing housing jacket was modified for providing fresh CW for both bearings of Turbine as per the sketch given below:



Drive Turbine of Seal Oil Pump for 103-J (103-JLJAT)

The Turbine was taken for Preventive Maintenance. LO of all bearings were flushed. Actuator replace with new one as the drive shaft was having play

PRIMARY REFORMER, AUXILIARY BOILER & SECONDARY REFORMER JOBS

The Primary Reformer Radiant Zone

Burner blocks were inspected and five damaged burner blocks were replaced by Unifrax make, Model: Moldafrax BBM 15 burner blocks.

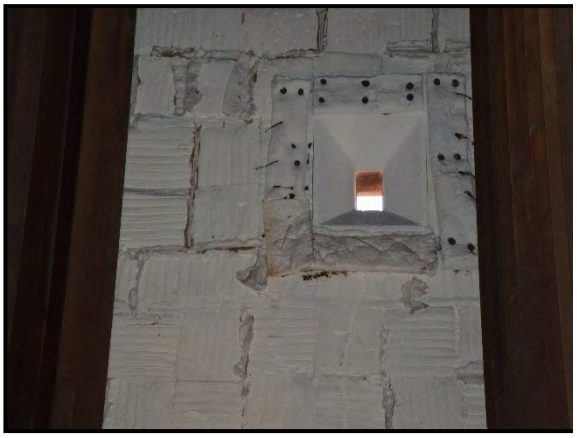
Row No.	Burner Nos.
1	Nil
2	204, 214
3	303, 305
4	406
5 to 9	Nil

The roof insulations were inspected. Damaged/dropped insulation blocks were replaced by new ones and gap was filled.

During normal operation, thermography of Reformer wall was done and it was observed that the temperature was high in some areas of side walls. This was due to gaps between the modules at various locations. Hence it was decided to fill the gaps by inserting Ceramic Fibre of suitable thickness (6mm / 12mm / 25mm) and fix with Veneer Mortar during Shutdown. Accordingly, WO No. 201004190871 dated 12/09/2018 was placed on M/s. Unifrax India Pvt. Ltd., to carry out the job.

The Z-section module of side wall near peep hole (Control room side) was fall down during normal operation and sparger was provided in this area. New modules were provided in this area.

Gap observed between blocks



Peep hole repairing done

Damaged header insulation were replaced / repaired.

Scaffolding erected & cleaning of all reformer tubes was carried out.

NDT of reformer tubes were carried out by Inspection section.

Damaged / broken tunnel slabs 13 nos. were replaced by new ones & damaged wall refractory were repaired.

All spring hangers locked for inspection & catalyst replacement & unlocked after completion of the job.

Catalyst Replacement

Complete replacement of Catalyst was done during SD-2009. There was problem of hot spot during normal operation and hence Planned the replacement of complete catalyst. All catalyst tubes (336 nos.) plugs were opened for catalyst replacement. Catalyst loading was done using dense loading method for the first time at Kalol. The advantages of dense loading include increased density & uniform loading which reduces voids and channelling. Loading time is also less compared to sock loading. All tube plugs boxed up with new gasket (Size: 3-1/2"X 600# SW with inner ring) after replacement

Catalyst loading by Dense loading method

All Inlet Manifold end covers were opened & boxed up after job completion.

All burners air resistor overhauling done.

Convection Section

Provision for additional thermocouple in Convection section

Provision for thermocouple for measuring the Flue gas temperature was provided on Convection section in the following locations. 1" pipe with Flange was welded on casing by cutting the casing Plate by Gas cutting. Refractory was removed by drilling.

- 2 nos thermocouple each at MFC outlet on North side at header end and free end
- 2 nos thermocouple each at PAC outlet on North side at header end and free end
- 2 nos thermocouple each at HT Coil outlet on North side at header end and free end
- 2 nos thermocouple at LT Coil outlet on south side at header end and free end
- 2 nos thermocouple each at BFW Coil outlet on south side at header end and free end
- 2 nos thermocouple each at NG Coil outlet on south side at header end and free end

However as the thermocouple was not available with Instrument blind was provided.

Repair of Insulation below MFC

- There was hotspot at South side wall and sparger was provided in this area. It was observed that the insulation of south side wall of MFC was damaged and plate was having hole. The support guide of MFC was removed from position.
- The damaged portion of the plate in this area was replaced and new Ceramic Fibre insulation and incoloy plate was provided. The support guides were also repaired. The castable insulation damaged near Tunnel area was also repaired.

Damaged area of insulation below MFC coil

Plate welded on side wall and guide removed from position **Supports after repair**

- Damaged plate of Duct between Reformer and convection section was repaired by providing patch plate.

Replacement of Low Temperature steam super heater coil, E-104

Introduction

During ESP-III, we have replaced the existing Air preheat coil and installed new HDS-II Coil above HT superheat coil. After start-up it was observed that the temperature at outlet of Low Temperature Steam Super Heater coil was reduced to 316^{O}C which was earlier 360^{O}C. Due to this the final steam superheat temperature was in the range 410 to 420 Deg C. The normal steam superheat temperature required was above 441 Deg C.

Also it was observed that the temperature at the HDS-II coil outlet was very high and it was exceeding the design temperature of 380 Deg C. Hence Feed preheat coil (E-106A) was bypassed to maintain the temperature (E-106 A Inlet temperature 28.4 deg C inlet and outlet temperature 291 deg C after bypassing the coil)

To resolve the problem, M/s. Casale was consulted and finally they recommended to replace the existing LT superheat coil with new one with increased surface area and also to reduce the surface area of HDS-II coil by removing the top coils as HDS-II coil it was over designed.

By carrying out these modifications, the flue gas outlet temperature will be reduced from the existing 165 Deg C.

L.T. Coil revamp contract was awarded to M/s. JNK India Pvt. Ltd. Vide PO: 6505/201004181573 for carrying out the simulation of Reformer and convection section coils and Supply and execution of LT Coil Replacement and HDS-II Coil replacement jobs. Execution of the jobs was done through sub-contractor, M/s. Neo structo Ltd., Surat.

Comparison of New and Old coils

As per API standards 530 Heating coils

Sr. no.	Description	New coil	Old Coil
1	No of tubes	96	84
2	Material	A335 Gr P-11	A335 Gr P-11
3	OD of the Tubes MM	114.3	73.3
4	MW of the Tubes	Sch 80(8.56)	7.01 mm
5	No of tubes per row	12	14
6	No of flow passes	12	42
7	Effective Tube Length	14154 mm	14300mm
8	Process Design Inlet temp	315.3^{o}C	315^{o}C
9	Process Design Outlet temp	363^{o}C	333.9^{o}C
10	Design Inlet Pressure	107.27 kg/cm^{2}	107.12 Kg/Cm^{2}
11	Design Outlet pressure	106.17 Kg/Cm^{2}	106 Kg/Cm^{2}
12	Mechanical design Temp	441^{o}C	441
13	Mechanical design pressure	120 kg/cm^{2}	120 kg/cm^{2}

Pre-shut down activities

From 6th September 2018, Pre-shutdown activities were started:

- Mobilization of material and man power was started,
- Welder test was planned. However M/s Neo has arranged shop welders who were already Pre-qualified.
- Cardboard Blasting of LT Coil module was already done from M/s Neo Structo's Works.
- Prefabrication of arrangement for blowing, Structural items required for providing temporary supports for removal of coil
- Location for placing new LT Coil, Old LT Coil and removed Panels were identified.
- Mobilisation of Crane & Load Test from 07th sept 2018 to 17th sept 2018 :

  Details of Crane- American Crane sky horse S.W.L 450Ton

  Crane was assembled with the help of kobelco 135 ton crane provided by IFFCO and load test was conducted @ 60 ton with boom radius: 23m, Boom length: 45 m. in the presence of IFFCO Inspection Section as per Crane Load chart.

American Crane sky horse S.W.L 450Ton

- Prefabrication and laying of BFW line and fabrication of supports
- Prefabrication of supports of line, Platforms and structural supports
- Erection of Scaffolding at South side and West side of Convection zone for cutting and dismantling of structure of Convection section

  Bar Chart of LT Coil replacement attached

Shut Down Activities

Ammonia Plant shut down started at 14.00 Hr on 17th September 2018, the following activities carried out during revamp of coil.

Dismantling of Old Coil

Dismantling started: 18th Sept 2018 at 17:00 hr

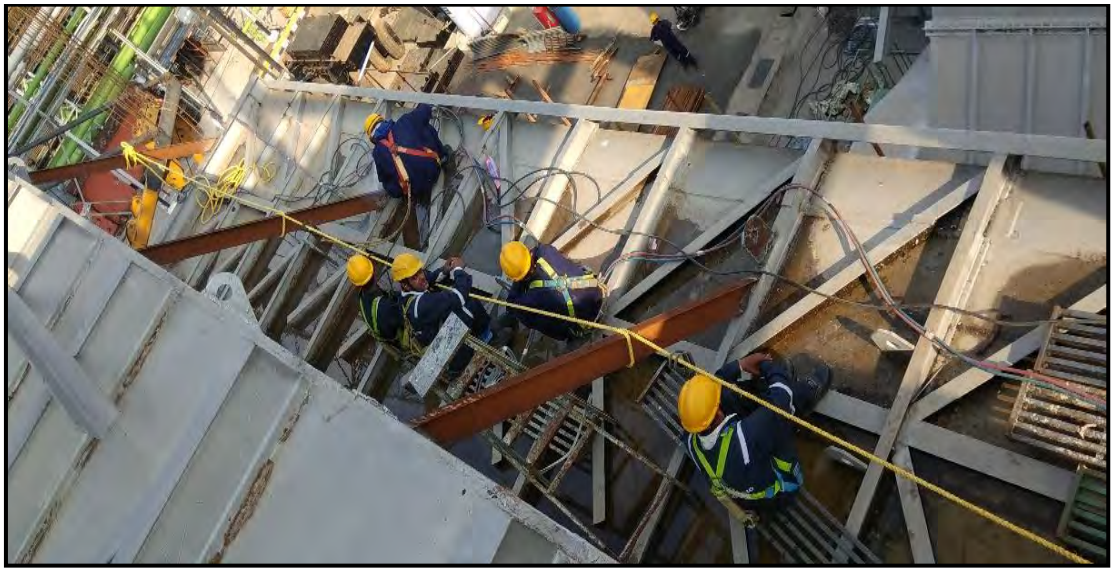
Dismantling completed: 21th Sept 2018 03:00 hrs

The following activities were carried out

- On 18thsept 2018 Ammonia production given clearance for opening of alternate bolts of header box panel & End panels of LT, BFW & HDS-II coil. Proper marking was made on Panels.
- Permission for complete opening of panel bolts and removal of end panel covers of east & west side was given at After 24 hr. given. All Panels were shifted to ground and placed by 14.00 hrs of 19/09/18.
- For LT panel cutting and removal scaffolding were constructed between H.T, L.T sections and East, West side.
- Inside baffles plates which are located between the LT and HT section were dismantled after properly marking the sequence. Then it was shifted to ground.

Baffle plates of transistion zone

- It was decided to lift LT Section roof and Transition zone wall as a single piece without cutting. Hence beams were welded between LT section Roof and transition zone.



Beams were welded between LT section Roof and transition zone.

- Incoloy sheets and blankets were removed for cutting of roof plates for lifting of roof.
- Then cutting of roof of LT panel and Transition Zone was done
- LT Panel roof with Transition zone was lifted on 19.09.18 at 19.30 hrs by crane and placed on the ground.

Lifting of LT panel with transition zone

- Steam blowing arrangement was to be made at LT Coil inlet header side. Hence space was required in this area. Hence it was decided to remove spool piece by cutting LT Inlet header to elbow joint and Pipe joint. Spool piece was shifted to ground. The free end of LT Coil inlet pipe was properly supported.
- Cutting of outlet header of LT coil header spool piece was done. Outlet header spool piece was removed and shifted to Ground.
- The Edge preparation and DP of the inlet spool piece was done. LT inlet and outlet spool piece thickness measurement & dimensions were noted.
- Cutting of Panel above LT coil at header box side & CT side was done. Cutting of Side wall towards south above LT Coil was also carried out. The Cutting of this panels/wall was done at an elevation of 8709 mm (From 0 Elevation).

South side wall above LT coil

Broken the refractory upto 600mm on bridge plate

- Broken the refractory up to 600mm on bridge plate between the LT and HT section. Then cutting of bridge wall was done for providing slings for lifting of LT Coil.
- Cutting of LT Coil “ITS bracket” on both sides was done after cutting the wall plate near ITS bracket area.
- The I-Beam below bridge plate was also cut and removed.
- The half portion of Panels below Transition zone towards Silo side and CT side were cut for easy removal of LT Coil.
- LT coil assembly along with Inlet and Outlet headers was lifted and shifted to ground by 450 MT Crane at 03.12 hrs on 21/09/2018. Weight of LT Coil – 45 MT

LT Coil removal

Ceiling arrangement for lifting LT coil

Removed LT coil

Cutting of Side walls of LT coil

Side wall removal

After removal of side walls @ 6804

- Cutting of North & south side walls of LT coil carried out at an elevation of 6804 mm. Then it was shifted to ground.
- ETS of new LT Coil was fouling the with the ETS of BFW coil. Hence the height of ETS of BFW Coil was cut by 500 mm from top and ETS of New LT Coil was cut by 75 mm from bottom.

Refractory broken at 500 mm of BFW ETS

After cutting of ETS of BFW

After strip welding

- Accordingly Header box panel cover of new LT Coil was modified to match the elevations with existing BFW coil.
- Hydro jetting of coils of LT convection zone was done (Hydro-jetting started at 11pm and completed by 17.30 hrs on 22/09/18).

Hydro jetting

After hydro jetting

- The LT Coil along with inlet and outlet header, ITS, ETS and side wall casings with castable was manufactured as a complete module.
- For placing the new LT Coil module and welding with the existing structure, 150 mm Channel was provided at the bottom of LT Coil Casing on both North and South side. On south side, the channel was welded back to back with the existing Channel. On north side there was no channel and hence and additional 150 mm channel was provided on North side wall

North side new channel welding

- The North side channel was properly levelled and then welding was done.
- Grinding of South side channel face was carried out and proper levelling was done.

South side channel after cutting

North side wall before channel welding

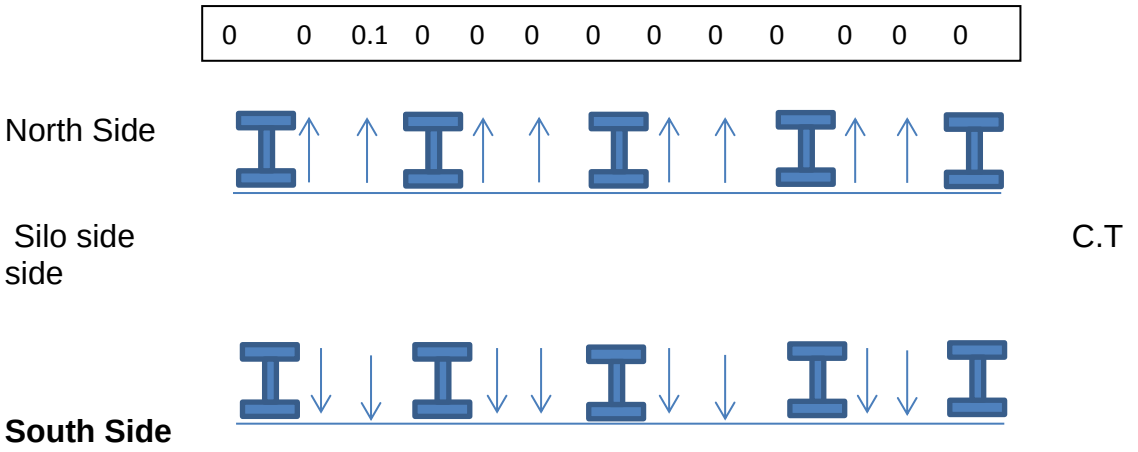
Grinding of south side channel


New Refractory on side wall of BFW coil

- Damaged refractory of North and South side walls above BFW coil was removed and new refractory was provided.

North side refractory South side refractory

- Before erection of new LT coil module, water level is checked at all the points of side wall of elevation and found as mentioned below.

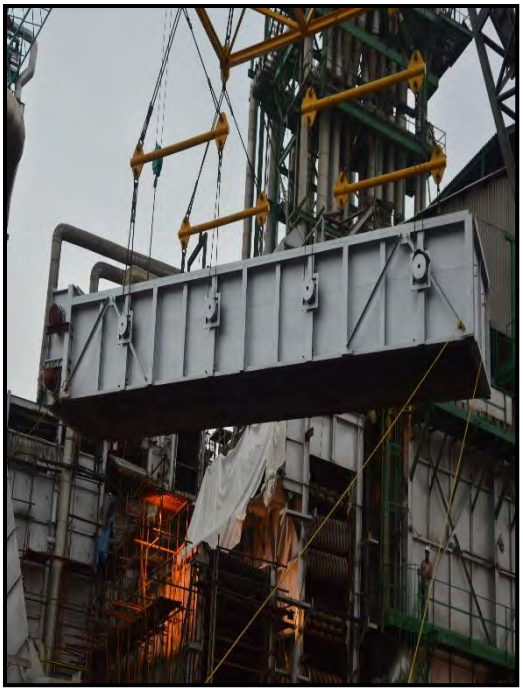


Installation of New LT coil

- New LT Coil module reached on **18/09/2018 by 18:30 hrs**. and it was unloaded near convection section.

LT Coil was unloaded near Reformer/ Convection section

- New LT coil module Inspection was carried by IFFCO inspection section and some minor damages in Refractory was observed. It was repaired by JNK.
- New LT coil module lifted on 23/09/2018 at 17.50 hrs and placed in position by 20.00 hr. 25mm Ceramic Fibre Blanket on both the side wall, New module & BFW coil as per Drawing -JNKI-027-MC-DS-282. Erection carried out with help of 450T M crane of Neo structo. Weight of LT Coil Module as per Drg No: JNKI-027-MC-DG-103- 3-R is 97690.
    - Real Load -168T Radius- 15 m
    - Hook load - 85 T Angle - 74.5

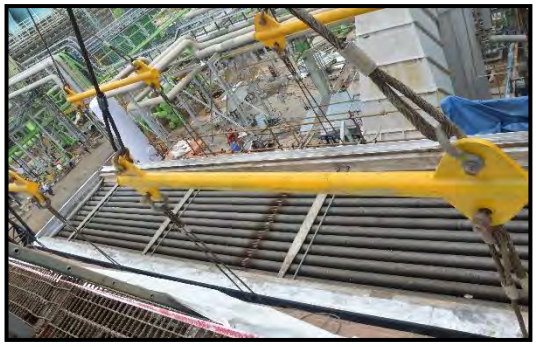


New LT coil module Erecting

While placing in position

Refractory placed b/w the modules

Postioning the module



After placing module in position

- Ceramic Fibre Blanket was provided above the Refractory to ensure that there was no gap between the refractory while placing the module. Ceramic fibre blanket was also provided on ITS and ETS bracket area.

Blankets placed towards north side wall

Blankets placed towards south side

- Module, it was held with crane and positioned above the casing.
- Then alignment and levelling was carried out.

North side channel levelling before welding

- Then started seal welding was done (of bottom portion) as per drawing No - JNKI-027-CS-DG-401. Sea welding was completed by 01/10/2018.

- South wall above LT Coil was erected in position. Stitch welding with new convection module was done from inside and full welding was done on outside of casing

South Side wall above new Lt coil module

Welding of side wall

- Weld visual and DP test conducted for all the structure parts in presence of Inspection section person.

- Welding of plate of 6mm thick plate with existing bridge plate and new coil module.

- Welding of SS V-anchors (SS304) on new plate and Bituminous paint was applied.

- Filling of Refractory (insulyte 11) over the bridge plate and doing patch over the damaged area.

Filling of refractory over the bridge plate

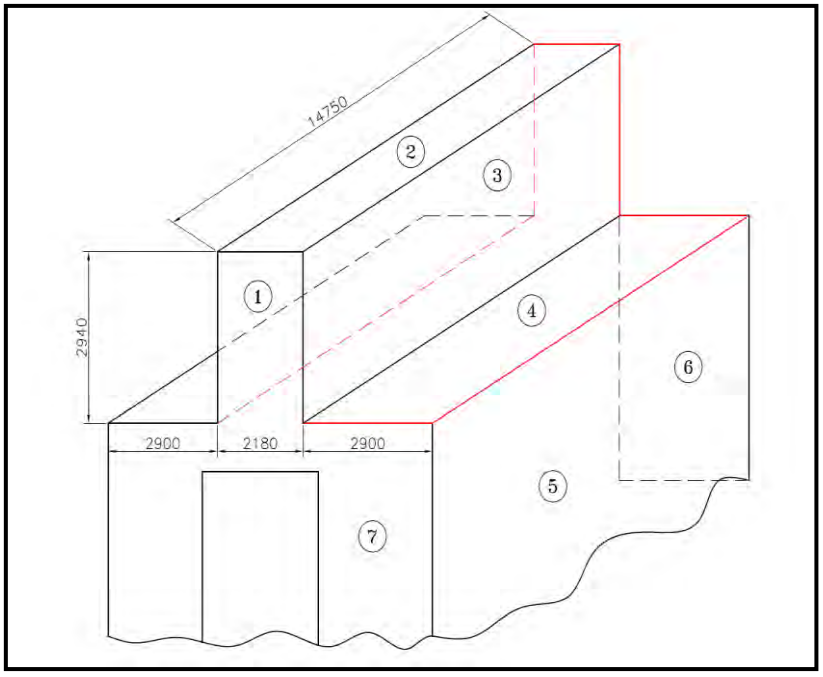
Bridge plate welding

- The transition zone was erected.

Transistion zone

- Patch plates were provided and welding was done.

- Seal welding was carried outer side of transition zone as shown in below fig (Red colored area) and inside and outside welding were carried for the LT section Top roof and provided plate support near top beams.



- Casing plate of Transition zone towards HT section was badly corroded and was having holes. So provided patch plate of size 150X 113 X 6mm of 12 qty along the length.

Damaged portion

Welding with 6 mm plate & inconel studs

- It was planned to replace the complete insulation of Transition zone and area above LT Coil. However M/s JNK had not supplied sufficient quantity of Incoloy studs and washers. Hence only repairing was carried out wherever insulation was damaged. (M/s JNK later supplied the Incoloy studs with washer).
- The damaged insulation of side wall was repaired by providing new Inconel studs and ceramic fiber blankets of required thickness and Inconel sheets of 0.5mm.
- LT coil top Panels towards silo and C.T side fixed in position and welding was carried out on both sides.
- I-beam supports under bridge plates which were removed were welded in position. (Size- I-Beam-175mm, 7 nos and 200 mm I-beam , 2 nos on each corner)
- End Panel of Mixed Feed coils was replaced as it was bent.

Old panel cover of Mixed feed coil

new blanket and panel cover

- Corbel were provided for all end panels of LT section and HT section coil.

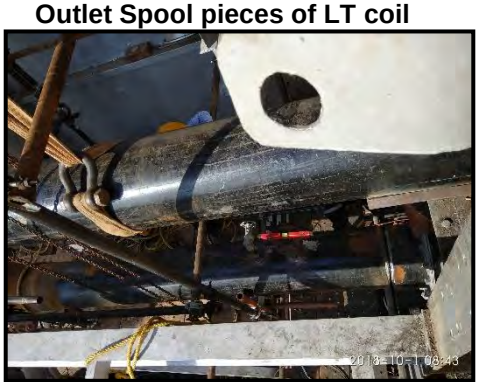
- Welding of header box of LT Coil and BFW coil was done
- Damaged refractory of BFW header box was replaced.

Repair of damaged refractory

- Supply of LT coil outlet spool piece was delayed due to non-receipt of IBR certificate of weldolet due to which IBR Hydrotest was delayed. Finally after IBR hydrotest, LT coil outlet spool pieces reached on 01/10/2019 around 01.00 hrs. and erection was started immediately.

Outlet Spool pieces of LT coil

Lifting of outlet spool piece with elbow



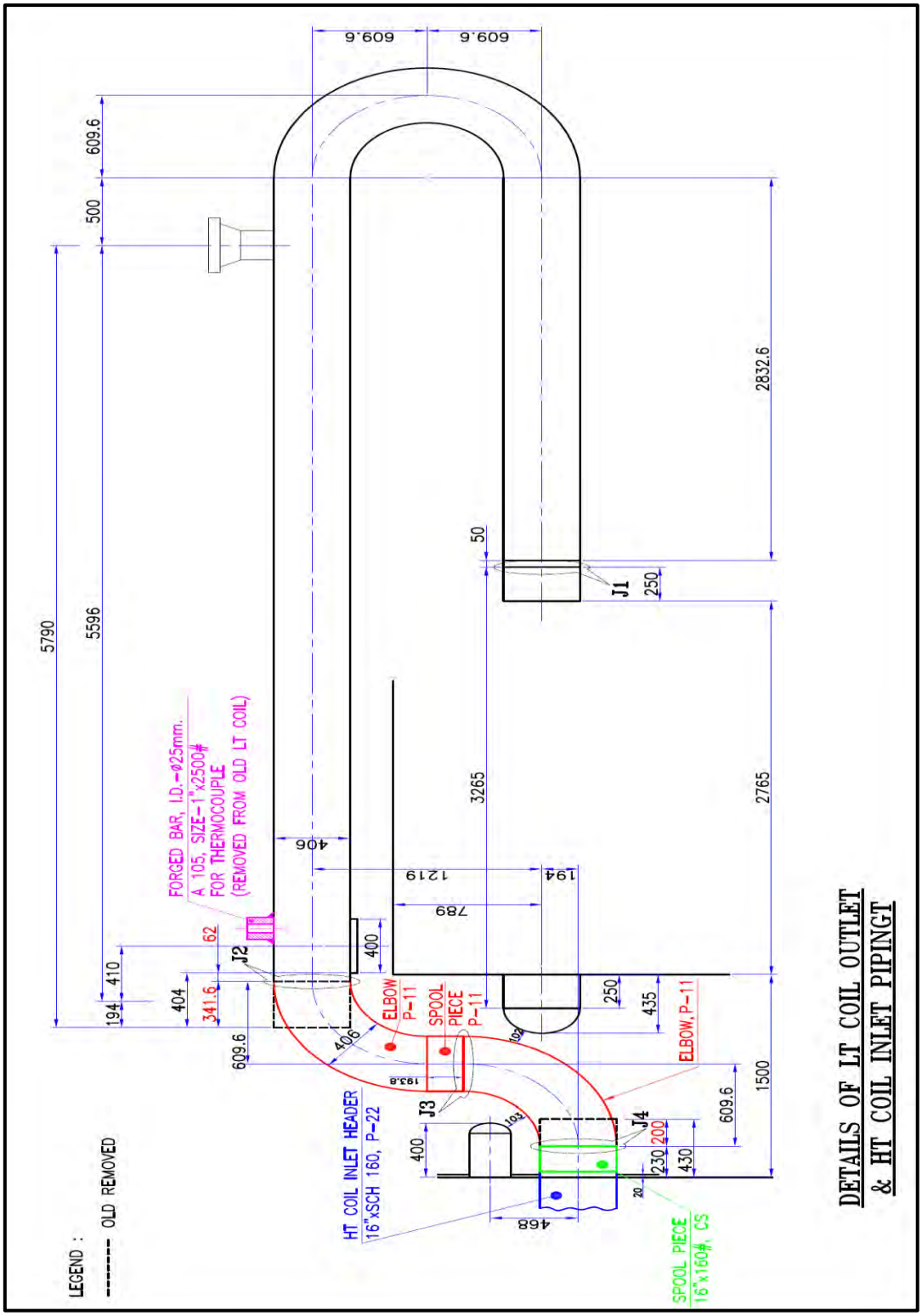
Fit up of spool piece

Outlet elbow

- After alignment, started bevel preparation and fit-up of joint J1. It was completed by 01/10/2019, 16.00 hr.
- Started pre-heating the spool piece by coil warping up to 150^{o}C and started root run @ 17.00 hrs. root, first & second hot passes completed by 19.50 hrs.
- Pre-Heated the joints @ 150^{o}C
- Root radiography was done.
- Then final welding was done. Final DP, Radiography and hardness measurement was done.
- Then fit up of elbow (supplied by JNK) at LT Coil Outlet spool piece was done. Then fit up of elbow with spool piece (supplied by JNK) was done. (Layout

drawing was made for LT-Coil To HT coil inlet Spool piece as site condition on 03/10/2018 which is attached below)

- Spool piece on HT Coil header was cut by appx 200 mm to accommodate the elbow
- **Root and final Radiography of J1 & J2 were carried out. However, the Root Radiography of J3 & J4 was not done to complete the job at the earliest.**



- There was no provision for thermocouple for measurement of temperature at LT Coil outlet after Desuperheater. Hence Pipe with Flange (Forged bar Size – 1" #1500, ID – 25 mm) which was removed from the old LT Coil outlet piece and was welded at Outlet spool piece. 25 mm dia hole was drilled in pipe by Magnetic drilling machine by W/s and welding was done.

Removed outlet spool piece

Online drilling for thermowell

Thermowell pipe was welded on 16"
Outlet spool piece after making 25 mm hole

DP after welding

- LT inlet header was not welded with inlet line. Provision for steam blowing was made by welding 16" elbow at inlet header of coil. The elbow was then welded to 16" pipe and stack was provided in the area between convection

section and Auxiliary boiler. Proper supports were also provided by taking support from Beams of Auxiliary boiler structure.

- Welding of blow stack for steam blowing of LT Coil and supports were completed by 04.50 hrs of 06/10/2019.

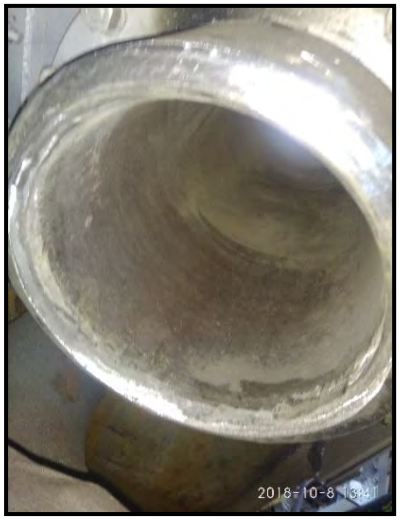
16" elbow welded to inlet header of coil for Blow stack

Target plate flange for blow stack

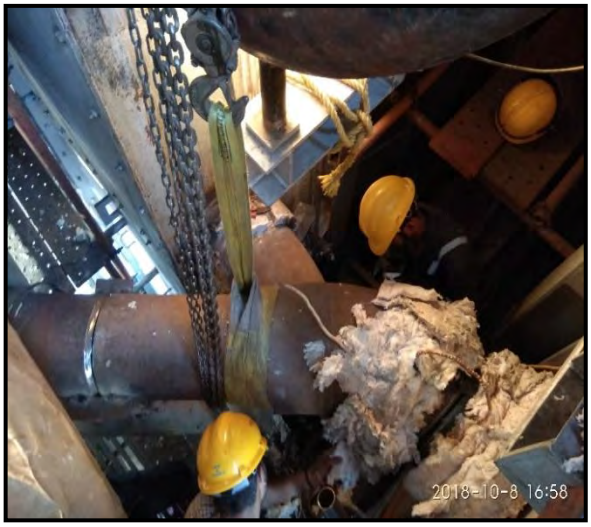
Support for blow stack

- Blowing of LT & HT Steam super heater coil loop was started at 05.00 hrs of 06/10/2018 and completed by 20.00 hrs of 07/10/2018 with no impression on the target plate. Then got the clearance for blowing arrangements removal.
- Blowing arrangement was cut and removed by 05.00 hrs of 08/10/2018.
- Size of LT coil Inlet header was 16" SCH 160, 40.46 mm thk. and the elbow was of size 16" X Sch 100, 26.19 mm thk. Hence to match ID, LT coil Inlet header ID was reduced by 15 mm.

- Fit-up was completed by 18.00 hrs on 08/10/2018, welding completed by 08.00 hrs on 09/10/2018 (J5 &J6)



ID reduced up to 15mm of LT coil inlet header



Inlet header spool pieces fit-up

- Root Radiography of J1- J4 was carried, for J5 & J6 was not done to complete the job at the earliest. Final Radiography, DP and hardness measurement was done.
- PWHT of all joints J1 to J6 was done as per the procedure given below:
- PWHT was complete by 18.00 hrs on 09/10/18

PWHT Cycle:

Loading Temperature: 350 ^{O}C

Heating rate: 100^{O}C

Soaking Temperature: 720^{O}C

Soaking time: 2 Hrs

Colling rate: 50 ^{O}C/hr

Unloading temperature: 350^{O}C

The NDT details of all the joints are given in the table below:

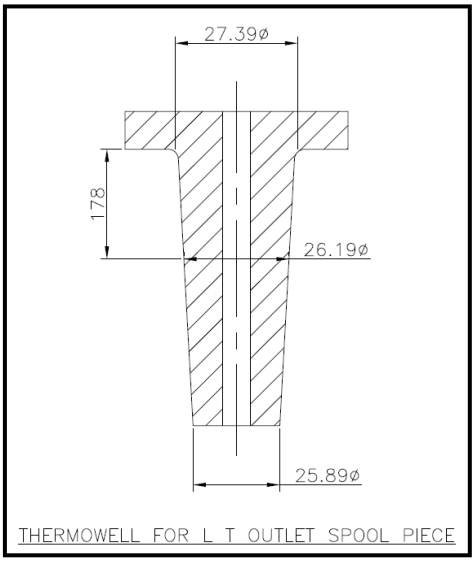
Joint No.	Date	Root & Hot pass		RT		Final		RT	PWHT
		Started (Hrs.)	Completed (Hrs.)			Started (Hrs.)	Completed (Hrs.)		
J1	01/10/18	16.48	19.07	No defects		01/10/18 24.00	18.56 02/10/18	No defects	Yes
J2	03/10/18	11.00	14.40	No defects	04/10/18	09.00	21.30 hrs	No defects	Yes
J3	03/10/18	14.26	02.00 (04/10)	No defects	04/10/18	09.00	21.30 hrs	No defects	Yes
J4	02/10/18	14.00	24.00	No defects	04/10/18	09.00	21.30 hrs	No defects	Yes
J5	08/10/10	18.00	22.00	Not done	09/10/18	23.00	08.00 hrs	No defects	Yes
J6	08/10/10	18.30	22.00	Not done	09/10/18	23.00	08.00	No defects	Yes

- Supports of inlet header and outlet header and spool piece were carried out as per drg No – JNKI-027-MC-DG-108, Minor changes were made in the position of supports for suitability at site.

- After completion of J5 & J6 joints, Hydro test Preparation for complete steam loop system was carried by providing blinds as per list blind list provided.

Sr. No.	Description
1	104-J DISCH NOZZEL FLANGE
2	104-JA DISCH NOZZEL FLANGE
3	104-J ARV-NRV U/S FLANGE
4	104-JA ARV-NRV U/S FLANGE
5	HP STEAM FIG 8 COMMON BLIND NEAR LET DOWN STATION
6	TICV-142 BFW LINE I/V U/S FLANGE
7	TICV- 60 BFW LINE D/S I/V COMMON FLANGE

- Filling of water started by 11.00hrs on 10/10/2018.
- Hydro test of complete steam loop was carried at 145kg/cm^{2}g pressure. No leakage was observed
- On 11/10/2018 again pressurised the steam loop at 145kg/cm^2 for hydro test in the presence of IBR Inspector and hold for 20mins.
- De-pressurized the loop and drained the water.
- While installation of Thermowell at LT Coil outlet (before Desuperheater) tapered portion was fouling as the ID was less. Pipe ID was 34.1 mm (1-1/2" X Sch 160 pipe) & Thermowell OD was 44 mm. After getting clearance from JNK, thermo well dia was reduced to 32 mm (root dia.) and 30 mm (tip dia.) from work shop.



- The Flexibility analysis of LT Coil, Inlet and outlet header and BFW lines were done and reports were submitted by M/s JNK. To counter check, Flexibility Analsyis was also carried out by M/s PDIL against PO No 6505 / 201004190906, Dated 20Sep2018 and it was found OK.

Installation of De-superheater and BFW line

- IBR Inspector given approval for fabrication works of BFW line for De-super heater on 18/09/18.
- Then fit up of elbows to 2-1/2" sch-180 pipes & prefabrication work was carried out.
- Pre fabrication of elbow to pipe was started on 19/09/2018, after completion of root and final welding for 5 No's elbow joints offered for Radiography test at 16.30 hrs. and test completed by 20.43 hrs. near open yard area by barricading it.
- No defects were observed in radiography films.
- On 19/09/2018 Constructed scaffoldings under BFW header line, where the tapping to be taken.
- Measured the thickness of the BFW line (8" X sch100) and found 15.03 mm at the location where the tapping was to be taken.

- Welding of joints were carried as per isometric with minor modification in root were on site suitability.
- Completed fabrication of BFW line was not done, few joint welding was not done due to delay in LT coil spool piece arrival.
- So hydro test was carried out for completed joints by providing blind.
- For remaining joints 100% radiography was carried out, for joints circled in isometric.

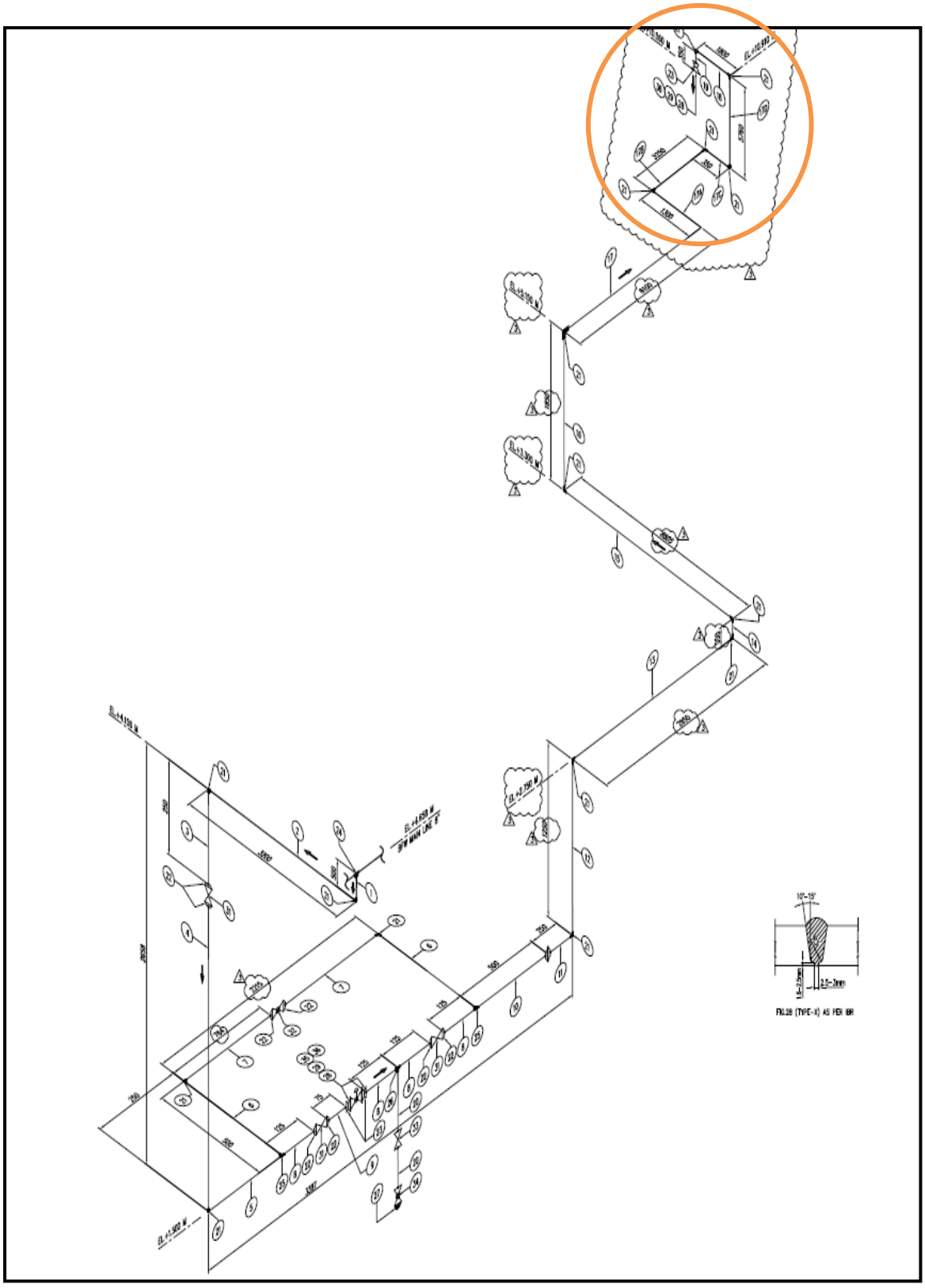
Hydro test @180 Kg/cm^{2}g

- Hydro test was conducted two types internally on 30/09/2018 and in presence of IBR Inspector on 01/10/2018, at 180 kg/cm2g and kept on hold for 20 mins but no leakage was found.

- On 09/10/18 after completion of LT coil Blowing job. Fabrication of remaining joints BFW line was rerouted for de-super heater as per site.

- Joints fit up and welding completed by evening 19.30 hrs.

- New Isometric drawing is prepared after completion of welding as per site conditions and got BR approval. (Drg No-JNKI-027-PI-DG-451 Revno:3)



- Prefabricated Platform and ladder for De-superheater platform was provided.
- Blind list for hydro test

Sr No	Description
1	104J DISCH NOZZLE FLANGE
2	104JA DISCH NOZZLE FLANGE
3	104J ARV-NRV U/S FLANGE
4	104JA ARV-NRV U/S FLANGE
5	HP STEAM FIG 8 COMMON BLIND NEAR LET DOWN STATION
6	TICV-142 BFW LINE I/V U/S FLANGE
7	TICV- 60 BFW LINE D/S I/V COMMON FLANGE
8	142CA/AB BFW OUTLET RV I/V D/S FLANGE
9	143C BFW OUTLET RV U/S FLANGE
10	123C BFW IN RV I/V D/S
11	123C BFW OUT RV I/V D/S
12	101-F 3 RV's upstream flange
13	101-F super heater RV u/s flange

Modification of HDS-II Coil

Comparison of HDS-II coils

As per API standards 530 Heating coils

Sr. No.	Description	New coil	Old Coil
1.	No of tubes	16	24
2.	Material	A335 Gr P-22	A335 Gr P-22
3.	OD of the Tubes	114.3 mm	114.3
4.	MW of the Tubes	Sch 80(8.56)	Sch 80(8.56)
5.	No of tubes per row	8	8
6.	No of flow passes	4	4
7.	Effective Tube Length	14.17 m	14.17m
8.	Process Design Inlet temp	184^{o}C	58.4^{o}C
9.	Process Design Outlet temp	377.3^{o}C	375.4^{o}C
10.	Design Inlet Pressure	38.29 kg/cm^{2}	39.61Kg/Cm^{2}
11.	Design Outlet pressure	38 Kg/Cm^{2}	39.21Kg/Cm^{2}
12.	Mechanical design Temp	441^{o}C	441 ^{o}C
13.	Mechanical design pressure	43.39 kg/cm^{2}	43.39 kg/cm^{2}

- On 18/09/2018 got the clearance for alternate bolt opening of East and West side of convection section.
- On 19/09/2018 end panel & header box panel covers were removed.
- Blinds were provided at inlet & Outlet of HDS-II Vessel and continuous steam purging was done for HDS-II coil, after 16:00 Hrs sample was collected and tested in lab.
- After result clearance was given for cutting the elbows joints of top row.
- Cutting of top row coil joints with header and elbow joints with middle row coils completed by night.

- Removal of HDS-II top row coil completed by 20/09/2018 night.

- Cleaning & bevel preparations for middle row coil & header weldolet were done.
- The elbow, spool pieces, and elbow Fittings between the header and middle row coils carried as per picture below

- All the elbow and spool pieces fittings between header and middle row coil completed by 19.30hrs of 22/09/2018.
- In the top of end tube sheet refractory is filled as per given in the drawing No:JNKI-027-MC-DG-152)

- Pre fabrications of two joints were carried & Radiography was taken on ground level, before fit-up in the position.
- On 27/09/2018 welding of 16 joints completed, radiography of joints was carried out & no repairs were found.
- After “RT” hardness of weld joints measured and noted as 230-190.
- PWHT was conducted for all 16 Nos joints at 20.30Hrs and completed by 06.00Hrs of 28/09/2018.

PWHT cycle:

PWHT Cycle:

Loading Temperature: 350 ^{O}C

Heating rate: 100^{O}C

Soaking Temperature: 720^{o}C

Soaking time: 2 Hrs

Cooling rate: 50 ^{o}C/hr

Unloading temperature: 350^{o}C

- Preparations for Hydro test were carried by considering the Feed preheat Coil with HDS II coil in a loop and maintained the pressure of 45 kg/cm^2 and hold for 30min. no leakage/ pressure drop observed.

- It was observed that the ID of HDS-II coil was having black deposits due to Carbon deposit. Hence steam blowing was carried out to clean the coil. A 6" temporary line was fabricated from PIC-14 to feed preheat coil inlet flange Size - 4"X 300#) for blowing of HDS-II coil and fixed in the position.
- After hydro test, all required blinds were removed and inlet line elbow was rotated 90^{O}, then blowing carried. After blowing inlet line rotated to position and box-upped and removed /dismantled temporary line.
- HDS-II coil East and West side header panel cover final box up done.
- Corbel was provided on Panel cover towards CT side.

SS 304 Plates were provided on ETS to cover the hole after removal of first coil.

Refractory Replacement of Auxiliary Boiler Walls

After SD-2017, hot spot was observed in Opp. Burner wall (North side) of Auxiliary boiler and East wall (CT side). It was also observed that the painting of front wall near bottom burners was also peeled off in some areas.

Hence Thermography of Auxiliary boiler was carried out and it was observed that Opp. Burner wall (North side), Front wall (South side), Side wall (East, CT side), West wall (Silo side) was having higher wall temperature in some areas.

The observations of readings of thermography done on 08/09/2018, is given below:

Sr No.	Wall No	Location	Average Temp. (°C)	Max. Temp. (°C)	Remarks
1		Opp. Burner wall (North side)	95-120	171	Max temp observed on 2nd panel from bottom
2	11	Aux Boiler Front wall (South side)	85-105 (140-175 near to burner)	370	Max Temperature around the burner port
3	10	Side wall (East, CT side)	80-105	245	Max temp observed on Top most bolted panel (East side of Coil D & E)
4	12	Side wall (West, Silo side)	80-95	110	2nd welded panel (west side of coil C)
5*		Top roof (*Thermography done on 16/03/2018)	110-150	500	Max temp observed in between area of coil A&B riser

Based on the above, it was planned to replace the refractory of these areas of Auxiliary boiler during forth coming annual turnaround Oct. 2018. Order dtd 30/08/2018 was Placed on M/s Calderys India Refractories Ltd., for supply and Application of Refractories on Auxiliary Boiler walls.

The job for removal of panels, fabrication of new panels wherever required related scaffolding and re-installation was awarded on M/s Shree Ganesh Engg Co., Ahmedabad against the WO 201004190796 dated 06/09/2018. Scaffolding jobs of side and back wall wherever possible was made as a pre shutdown activity

Complete refractory replacement job of Auxiliary boiler was planned to carry out in the below areas:

- Auxiliary Boiler Front Wall (# 11) **(Burner wall)**
- Auxiliary Boiler wall Opposite Burner (Wall # 9 lower Portion) **(South side)**
- Auxiliary Boiler Side wall (#12) & Coil C Inlet header box (West Side)
- Auxiliary Boiler Side wall (#10) & Coil C Inlet header box (East side)
- Outlet Header box of Coil C,D,E
- Aux Boiler Top roof above Coil A & B
- Side Panels at West and East ends
- Aux Boiler Refractory Brick installation

The details of Existing and New Refractory is given in the attached Table below.

Sr No	Location	Details of Existing Refractory	Ref Drg	Details of Proposed Refractory / Castable, Anchors, Mortars, Ceramic fibre and Grade by Vendor
1	Auxiliary Boiler Front Wall (# 11) Total Appx area = 27 m2	9" MK 26, 1460 Deg C (with Mortar) & 2 " Ceramic fibre back up with Inconel 601 anchors. Moisture barrier between CF and bricks.	Drg No – 214 D13, Elevation 13 D-13D & 01-BS-03131 Rev 1 Sec A	POS 1.1 Top Part – POROSINT 750 + CERAMIC FIBER BOARD 1260 GR. 320 BD (230 mm thk+ 50 mm) Brick Holder & Clit /UV type INCONEL 601 & INCONEL 601
		9" thk hot face insulating castable, 1460 Deg C with Inconel 601 Anchors & 2 " thk Insulating castable with anchors	Drg No – 214 D13, Elevation 13 D-13D & 01-BS-03131 Rev 1 Sec A	POS 1.2 Bottom Part- excluding Burner Section Bottom Part- excluding Burner Section INSULYTE HT, Thk - 280 mm thk, UV Type /INCONEL 601
		Accmon Car, 1600 Deg C / Whytheat A at Burner block area with Inconel 601 anchors & Insulyte-11, 1300 Deg C as back up	01-BS-03131 rev 1 Sec A	POS 1.3 Around Burner Around Burner- ACCMON 70M 280 mm thk, UV Type /INCONEL 601
2	Auxiliary Boiler wall Opposite Burner (Wall # 9 lower Portion) Total Appx area = 14.5 m2	Insulyte 11, 6-1/2" thk with anchors	214 D13, Elevation 13B 13B	POS 2.1 Wall Insulyte 11, 165 thk with anchors SS 310
3	Auxiliary Boiler Side wall (#12) &	Insulyte 11,1300 deg C, 6-1/2" thk with anchors	214 D13	POS 3 West side wall Insulyte 11, 165 thk with anchors SS 310
3.1	Coil C Inlet header box (West Side) Total Appx area 3 & 3.1 = 31.5 m2			POS 3.1 West Side Inlet Header Insulyte 11, 165 thk with anchors SS 310
4	Auxiliary Boiler Side wall (#10)	Insulyte 11,1300 deg C, 6-1/2" thk with anchors	214 D13, Opposite of wall # 12	POS 4 East Side wall Insulyte 11, 165 thk with anchors SS 310
4.1	Coil C Inlet header box (East side) Total Appx area 4 & 4.1 = 31.5 m2			POS 4.1 East Side Inlet Header Insulyte 11, 165 thk with anchors SS 310
5	Outlet Header box of Coil C,D,E	Insulyte 11,1300 Deg C, 2" thk with anchors	214 D15, Elevation 15A	POS 5.1 Outlet Insulyte 11, 50 thk

Sr No	Location	Details of Existing Refractory	Ref Drg	Details of Proposed Refractory / Castable, Anchors, Mortars, Ceramic fibre and Grade by Vendor
	Total Appx area = 12 m2		15 A / 15 E 15E & 214 D13	with anchors SS 310
6 6.1	Aux Boiler Top roof above Coil A & B Appx area + 17 m2	4½ " Thk Hanging bricks + 2" Plastic + 1 ½" Air space	214 D4, 214 D13, Elevation 13A 13A	POS 6.1 Roof above Coil A & B 115 Thk Hanging bricks AC 45 S (Special shape) + 2" CERAMIC FIBER BOARD 1260 GR. 320 BD + 50 mm Insulyte 11 And anchors LAH 25 & LAH 25 LX (IFFCO Drg no 01-DS-03074)
	Side Panels at West and East ends Total appx Area – 8 m 2	Insulyte 11,1300 deg C, 6-1/2" thk with anchors	214 D13, Elevation 13A 13A	POS 6.2 West and East Side Panels Insulyte 11, 165 thk with anchors SS 310
7	Aux Boiler Refractory Brick installation	Fire Bricks 9" x 6 1/2 " x 2 1/2 Bricks (with Mortar) with 2 " Ceramic fibre Deg C back up with anchors	214 D13, 215 C1	AC 45 S (Size -230 X 115 X 65)

Shutdown Activities

Ammonia plant shutdown was taken on 17/09/2018; Shift C. ID fan was kept running to cool down the auxiliary boiler temperature and parallelly scaffolding was made for top roof & back wall jobs. On 18/09/2018, Shift C, ID fan was stopped.

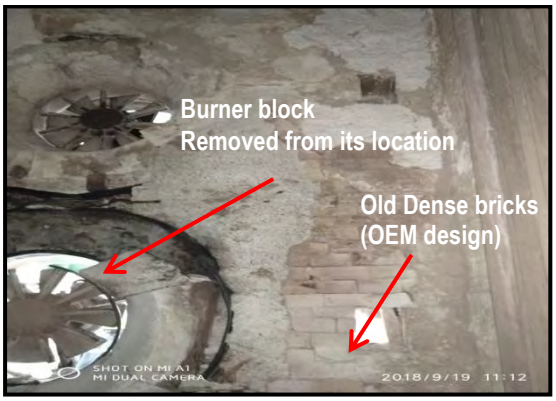
On 19/09/2018 at 8.00am, permit was given to enter Auxiliary boiler. Manhole cover was opened and insulating fire bricks were removed from its position.

After Aux Boiler entry, it was observed that the

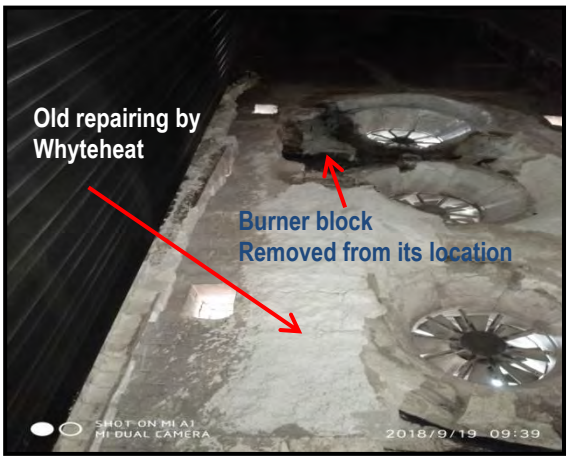
- Refractory of Burner wall was damaged badly.
- Front wall bricks had fallen from its positions i.e. area (east side) between the 4^{th} and 5^{th} burner.
- Top half of 2^{nd} burner block areas were found exposed with casing and without burner blocks.
- Below the 5^{th} burner, major area of front wall was found repaired / patch worked, which were done in previous shutdown.
- Front wall bricks (original design) were exposed in area nearby in-between the area of 2^{nd} & 3^{rd} burner.

- The arms of Burner # 1, DGN 26 was broken, the lugs was having cracks and burner housing plate was broken at bottom portion.

Damaged Refractory of front wall



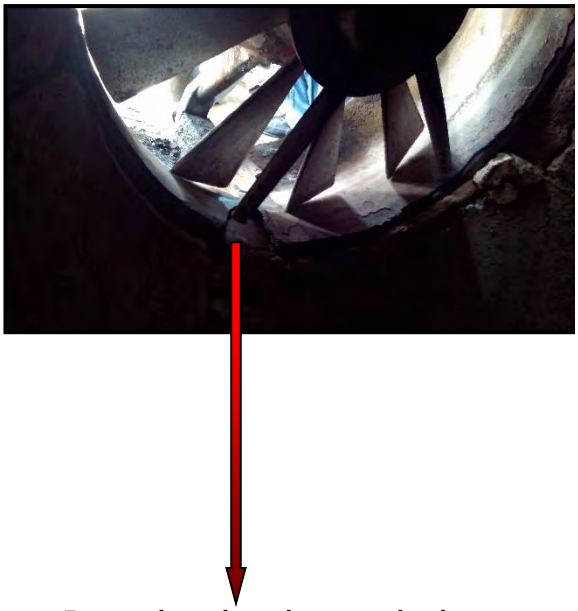
Damaged burner block



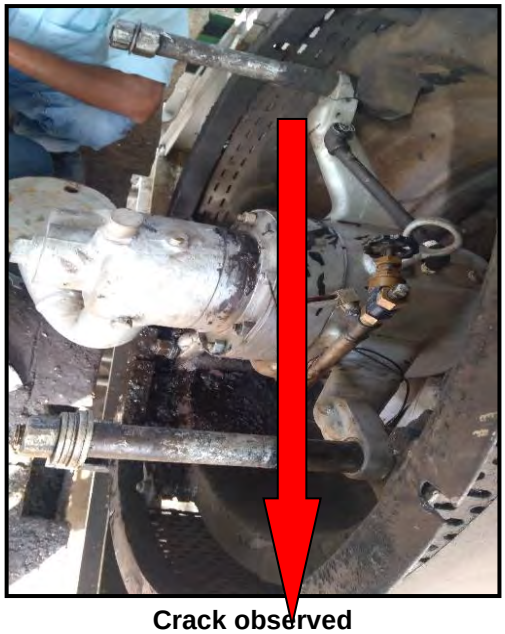
Damaged burner block

Damaged refractory of coil C header

Damaged tunnel brick (birdge wall) with back wall



Burner housing plate was broken

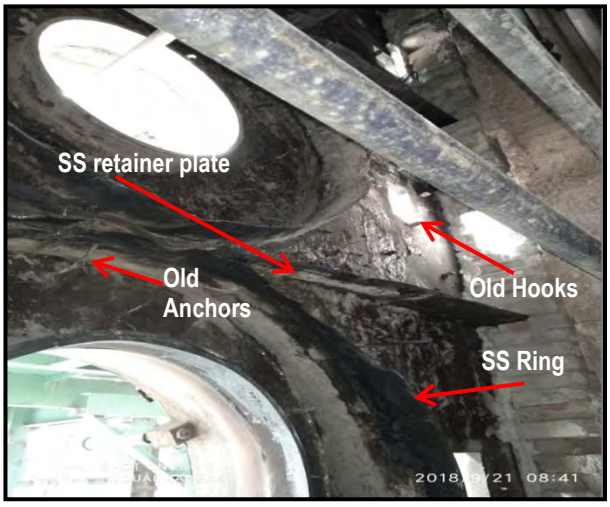


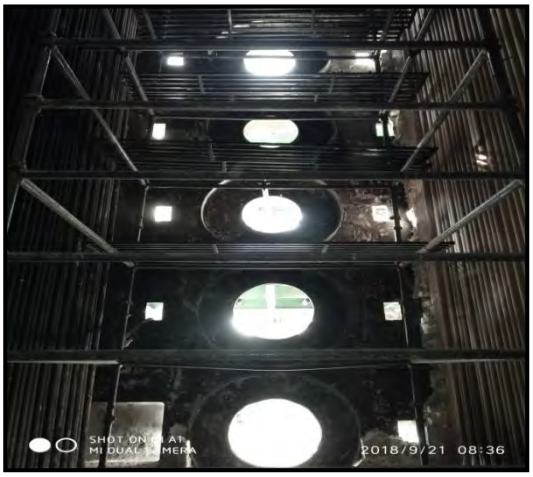
Crack observed

Refer Sr No 1 of the above Table - Auxiliary Boiler Front Wall (# 11)

Following activities were carried out

- Scaffolding were made inside the boiler for removal of complete front wall refractory
- Old bricks, casted refractory & burner blocks of complete front wall were removed from its position using breaker machine.
- 5 nos. of 14mm thick SS310 ring around the respective burners were cut using plasma cutting tool. Surface flushing was done by grinding
- 4 nos. of 5mm thick SS retainer plates welded with front wall casing were cut with help of plasma cutting tool. Surface flushing was done with help of grinding.





Old refractory removal

- Existing anchors & hooks (for brick holder pins) of front wall were removed with help of grinding tool.

- Complete cleaning of front wall was done with help of buffing tool.
- Welding of UV anchors (height 250mm, MOC : Inconel 601) with front wall CS casing were done by using 3.15mm dia electrode (E Ni Cr Fe2)
- Welding of anchors (height: 360mm, MOC: Inconel 601) with CS casing of burner port were done by using 3.15mm electrode.
- Welding of hooks (MOC : Inconel 601) for brick holder pins with front wall CS casing were done by using 3.15mm dia electrode (E Ni Cr Fe2).
- Bituminous painting was applied on complete front wall.
- Castable lining was done in each part (90mm depth) of all burner blocks by Insulyte-11 as shown in figure below**.**

New anchor welded in burner block area & Patch plate

Anchor welding in burner block area

Bitiminius painting, new anchor & & old piping (for draft measurement)

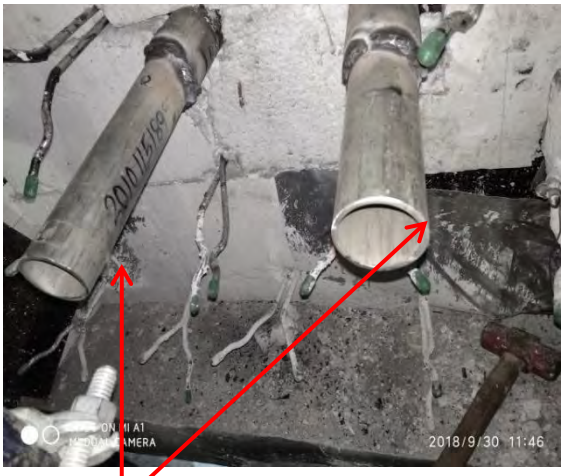
Insulyte-11 in port of burner block to match the level

- Front wall castable lining of refractory was done from bottom to top step by step.
- 50mm thick ceramic board was fixed on bottom section (Excluding Burner)
- 0.1 mm thick SS 310 foil was placed on ceramic fibre board.

- Wooden formwork was prepared for bottom half of 1st burner and casting was done by Refractory Accmon70M. Wooden formwork removed after 8 hrs of curing.
- Wooden formwork was prepared for top half of 1st burner and casting was done by Refractory Accmon70M. 3 mm thick ceramic paper was placed in between the top & bottom half of burner block before casting of top half to keep 3.0 mm expansion gap. Wooden formwork removed after 8 hrs of curing.
- After casting of 1st burner block, wooden formwork was prepared for remaining portion at east side, west side & bottom side of 1st burner. Casting was done by refractory Insulyte-HT. 12mm thick fibre blanket was placed in-between the castable lining of Accmon70M and Insulyte–HT to keep 6mm expansion gap. Wooden formwork removed after 8hrs of curing.

Wooden formwork preparation for castable burner block

Castable lining of bottom half of 1st burner (bottom most)



New Pipe (Inconel 800 , 1-1/2" x sch 40) for draft measurement

Expansion gap

- Similarly the castings of all remaining four burner blocks were done in two half by with Accmon70M and also casting of remaining portion (except burner blocks) were done by Insulyte-HT.
- Castable lining of burner wall was done by Insulyte-HT up to 8.81 meter from the bottom (1.38 meter from the top of 5th burner block) and in remaining top portion, porosint 750 bricks (230mmx115mmx75mm) were used.

- 50mm thick ceramic board was placed on casing before starting of porosint 750 bricks work.
- 75mm wide SS304 plate was welded with existing SS retainer plate and enhanced the height from 165mm to 240mm. Bottom most row of porosint bricks (230mm x 115mm x 75mm) were kept on SS retainer plate by keeping height 115mm. after that all bricks were kept keeping 75mm height as shown in figure. After each fourth row (vertically), brick holder pins were inserted on bricks & hooks. Up to 11.2 meter from bottom of burner wall, porosint 750 bricks were used as shown in figure.

From top of 5th burner – New anchor with ceramic board

New SS304 plate welded with old retainer plate & hooks for brick holder pin

Porosint 750 bricks (bottom most)

Castable refractory of Coil-C header

- Castable refractory of Coil-C header found in damaged condition which was removed by breaker machine. Old Y-type Anchors welded with header were found in satisfactory condition. Additionally two layers of new MS chain links were welded with existing anchors. Wooden forming was done for bottom half of header for approx. 1 meter and casting was done with Insulyte-11. Similarly casting of full length of bottom half of header was done in approx. 1 meter

step by step. Manually refractory was casted on top half of header. Refractory thickness was kept 75mm to provide 20mm gap with back wall.

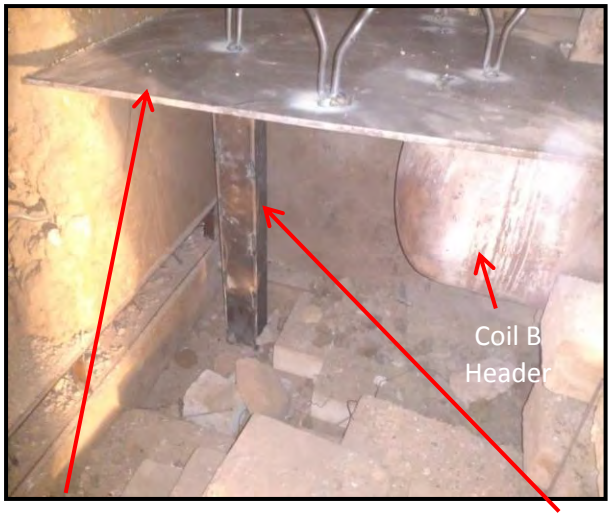
Coil C Header – new MS Mesh & Old welded anchors

Castable lining of Coil C header (Under progress)

Refer Sr No 7 of above Table- Aux Boiler Refractory Bridge installation

- **Inner most brick bridge wall** of both side (along the header of Coil A&B) and **partition brick wall** were found in damaged condition. Damaged bricks of bridge wall were replaced and the bricks of partition wall were replaced and height was made as per the MW Kellogg drawing 215-C1. Tunnel bricks & castable refractory toward north end of coil B header were also found in damaged condition. The new bridge wall in both side and partition wall were made by dense bricks. Brick tunnel with retainer plate at north end of Coil B header were observed in damaged condition. New retainer plates (6mm thick, MOC: **Inconel**) at north end of coil B header (both side) were provided to extend the tunnel of coil B header. 12mm expansion gap was kept between refractory tunnel of coil header and back wall. Retainer plate was supported on 3" square box (fabricated by 6mm thick Inconel plate), which was welded with bottom casing by using electrode (E Ni Cr Fe2). 3" square box was covered with 12mm thick ceramic fibre blanket & tightened by Inconel wire. Casting on retainer plates were done with Insulyte-11.

Retainer plate and refractory at north end of Coil B header was in damaged condition



Retainer plate for tunnel brick & castable and support

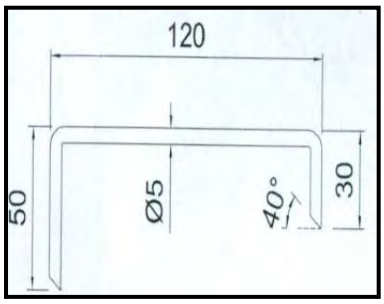
Ceramic fibre blanket and tunnel dense brick

Auxiliary Boiler Front Area after Repair

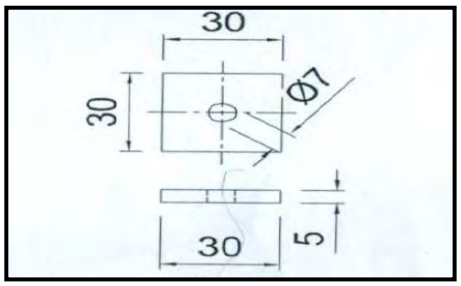
Front wall

Partition wall & bridge walls

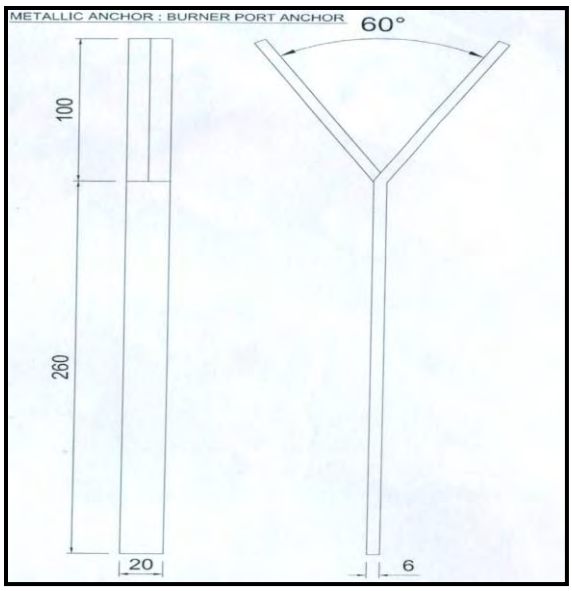
Metallic Anchor Details



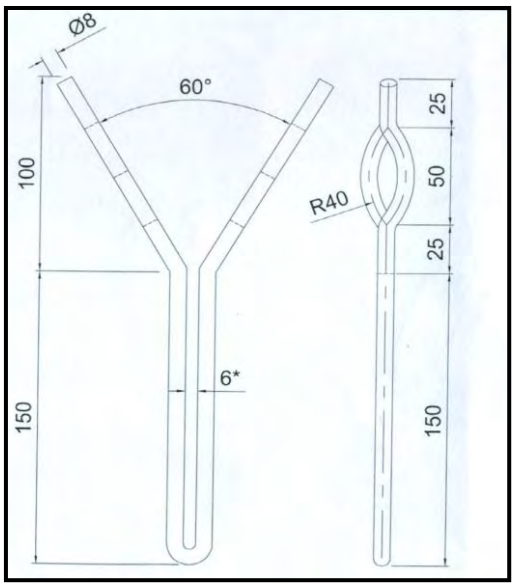
Brick holder pin (Inconel 601)



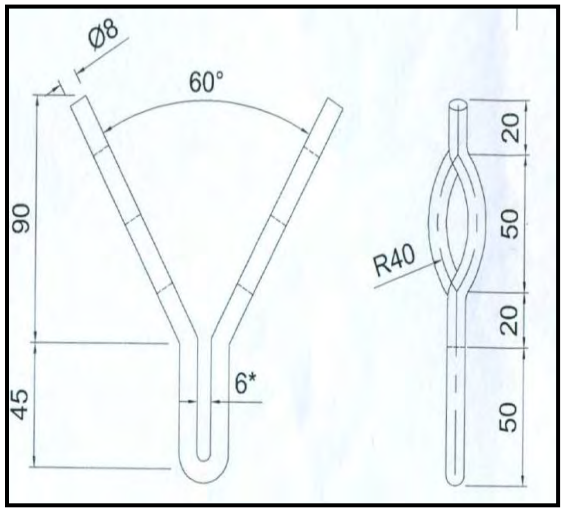
Hook for brick holder pin (Inconel 601)



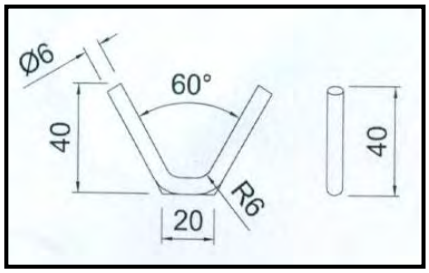
Burner Port Anchor (Inconel 601)



UV Anchor (SS310)



UV Anchor (SS310)



V Anchor (SS310)

Refer Sr no 6 of Table - Aux Boiler Top roof above Coil A & B

Following activities were carried out:

- Scaffolding was prepared near east & west side wall of auxiliary boiler to remove the side panels.

- Total 8 nos. of side panels (bolted) of top roof i.e. 4 nos. in each east and west wall were removed and lowered to the ground by Kobelco crane (Capacity – 100 ton) one by one. All panels were shifted to near NG booster sheds.

- Kobelco Crane was positioned near 101-JCB to remove the panels of both side i.e. CT side & silo side of auxiliary boiler. Crane position was not available from CT side due to occupied position of crane (capacity – 450 ton), required for LT coil replacement job.

Top roof Hanging bricks after removal

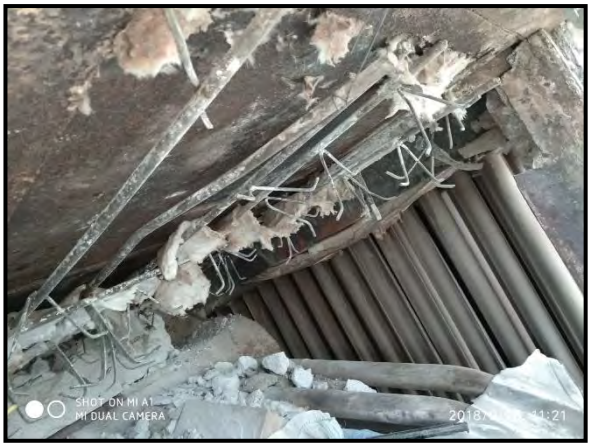
- Around 25% of total top roof area towards north side was found casted and most of the area of castable refractory was found in damaged condition. SS rods with anchors were exposed which were welded with top roof to support the old refractory casting. At some locations, hanging dense bricks were found missing from its position. Castable refractory of top outlet header of Coil A & B found in satisfactory condition.

- Welded rods & hangers were cut from top roof casing with help of grinding. Total 12 nos. of slotted channels (6 nos. from east side & 6 nos. from west side) were missing from its positions (where castable refractory were used). Channels were not available in store

- Tarpaulin sheet was placed on top of tubes of coil A & B before removing the casted refractory of top roof. Old refractory was removed by breaker & chisel.

- 12 nos. of new slotted channel (600mm long) were fabricated from 75mm CS channel.

- The fabricated slotted channels were welded with top roof by keeping the distance 330mm between two channels (at previous locations).



Top roof – 25% of top roof area was provided with castable supported with welded SS rods and hangers

New channel welded with top roof

- Old hanging dense bricks of top roof were removed from its position along with old hangers (MOC: HK 40). After that, castable layer above the old dense bricks were removed. Top roof casing was completely cleaned by buffing tools and then bituminous paintings were applied on it.
- At burner wall side, top porosint bricks were used to support the hanging dense bricks AC 45S (315mmX115mmX110mm) as shown in figure.

Top Roof Brick installation

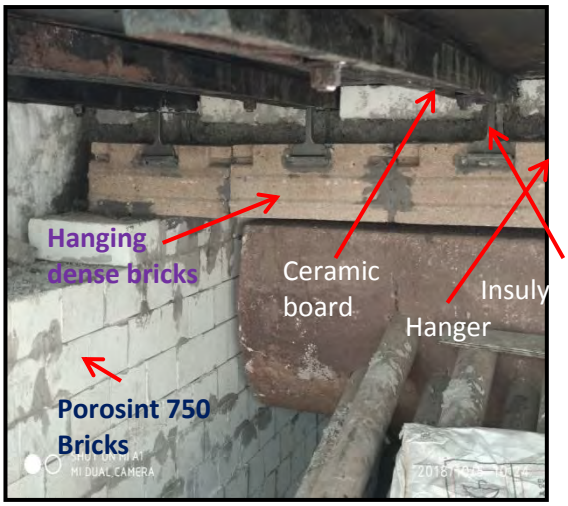
East Side

- Top roof brick lining was started at the center (above the outlet header of coil A & B) from the south side (burner wall) to north side. T-type hangers were inserted in slotted channel to hold the hanging dense bricks Dense mortars (50s) were used for bonding between dense bricks. Along with brick lining progress from south to north, 35 mm thick casting was done by insulyte-11 above the bricks and then 50mm thick ceramic board were placed above insulyte-11.

West side

- Similarly the top roof brick linings (three lining of bricks) were done from south side to north side one by one brick lining. L-type hangers were used at ends of slotted channels.
- Total 493 nos. of hanging bricks i.e. 17 nos. of brick lining row from south side to north side and total 29 nos. of brick lining row from east side to west, were used in complete brick lining of top roof.
- Around the riser header of coil A & coil B, UV type anchors (H=140mm d=8mm SS310) were welded, fiber blanket (thickness 25mm) was wrapped around the header, wooden formwork was prepared and casting was done by Accmon70M.
- Near Coil C, castable lining was done by using Accmon70M after welding of UV anchors at some portion where space for brick lining was not available.

Roof Brick installation under progress



Top roof with Burner wall

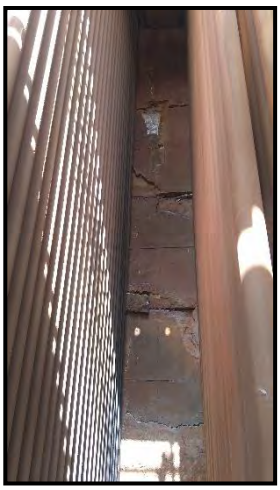
Top roof bricks (Coil C Side)

Top roof bricks

Ref Sr no 3 & 4 of table above- Auxiliary Boiler Side wall (#12) & (#10)

- Total 10 nos. of bolted panels i.e. 5nos. in each east and west wall (near Coil D & E) were removed & lowered to the ground with the help of kobelco crane one by one. Side plates of all removed bolted panels of east wall were observed in damaged and deformed condition. Old anchors of existing panels were cut by grinding. Damaged side plates of panels were completely removed by gas cutting. New side plates (5mm thick, MS plate) were welded with old panels. All deformed panels were straightened. UV-type anchors (MOC: SS310) were welded on panels by keeping 200mmx 200mm square pitch. Bituminous painting was applied on panel surface. Castings of all panels were done with Insulyte-11. All bolted panels were boxed up from bottom to top one by one with help of kobelco crane.

View of Coil C,D & E after removal of Wall #10



Damaged wall #10

Refer Sr No 6.1 - Side Panels at West and East ends below top roof

- Total 8 nos. of side panels of top roof i.e. 4 nos. in each east and west wall were removed and lowered to the ground by crane one by one. Castable Refractory of all panels was removed by breaker machine. Old anchors of existing panels were cut by grinding tool. Surface finishing was done with buffing tool. UV-type anchors (MOC: SS310) were welded on panels by keeping 200mmx 200mm square pitch. Bituminous painting was applied on panel surface. Castings of all panels were done with Insulyte-11. After completion of top roof refractory work, all bolted panels were boxed up one by one with help of kobelco crane.

Ref Sr no 2 of table above - Auxiliary Boiler wall Opposite Burner (Wall # 9 lower Portion)

- From north wall of boiler, total 7 nos. of panels were removed. Out of 7, 3 panels were bolted & remaining 4 panels were welded. Welded panels were damaged during removal by using gas cutting and bolted panels were in bulged conditions. All 7 new panels were fabricated by using 5mm thick MS plate and new C channels were fabricated with size of 150mm x 165mm for frame. Out of total 7 nos. of north wall panels, 2 panels were fabricated with provision of bolting and peep holes. UV-type anchors were welded in all

panels and C-channels. Bituminous painting was applied on panels and C channels surface and casting was done by Insulyte-11. Except bottom two panels, remaining five panels were welded at framing, fabricated by 150mm C-channel. Bolting provision were done for both bottom panels.

The area above these panels, in-situ casting was done as supports of Coil C were provided on this wall.

Damaged refractory of Wall #9

Ref Sr no 3.1 - Coil C Inlet header box (West Side) & ref Sr No 4.1 Coil C Inlet header box (East side)

- 3 nos. of panels of west wall (near coil C header) were removed by gas cutting. One bottom side panel of east wall (near coil C header) was removed by loosening the bolts and remaining 2 welded panels were removed by gas cutting. All 5 welded panels were damaged during removal by using gas cutting. New 5 nos. of panels were fabricated except bolted panel. Castings of all panels were done with Insulyte-11 after welding of UV-type anchors (MOC: SS310) and bituminous painting. All welded panels newly fabricated and boxed up at position by welding.

Ref Sr No 5 - Outlet Header box of Coil C, D, E

- Top header box cover removed & lowered to the ground with help of crane. From inside, refractory at side wall of top header box was found in damaged condition. Damaged refractory from side wall was removed. Chain link mesh also removed from the side wall with help of gas cutting. New MS chain link were welded at side walls of top header box and casting was done with Insulyte-11. Approx 10” long crack was observed on top cover. Patch plate was welded on top cover to cover the crack. Old castable refractory of top header cover were removed along with old MS chain link mesh. New V type anchors were welded on top cover by keeping 200mm pitch and then

bituminous paintings were applied. Casting on top cover was done by with Insulyte-11. And top cover boxed up with help of crane.

While installing the panels it was ensured that there was no gap by providing suitable thickness ceramic fibre insulation.

Damaged refractory of removed panel

Damaged side plate cutting from panel

Panel after cutting of side plates

Welding of side plate and retainer with old removed panel

Panel after welding of Anchors and bituminus painting

New castable Insulyte -11 in Panel

- After completion of Refractory replacement jobs, all erected Scaffolding was removed and Auxiliary boiler inside cleaning was done,
- Manhole was closed by putting bricks and ceramic blanket.

Dryout procedure for Castable refractory

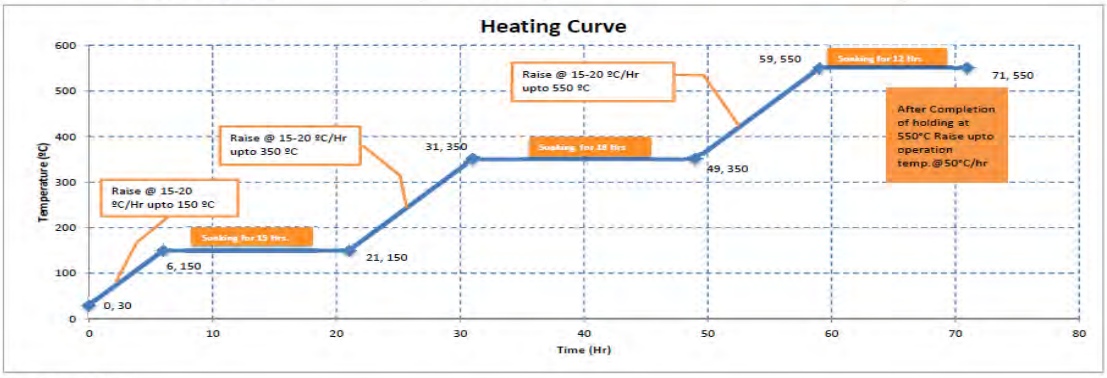
As per API STD 936 (Refractory Installation Quality Control—Inspection and Testing Monolithic Refractory Linings and Materials) Heating rate of castable lining was decided on bulk density of refractory and soaking time was decided on lining thickness. In auxiliary boiler, Accmon70M (density-2800kg/m, Insulyte HT (density 1620kg/m3), and Insulyte-11 (density-1280 kg/m3), were used as castable lining. Hence, density & lining thickness of Accmon70M was considered prominent factor for dryout schedule.

Dryout curve originally provided by supplier M/s Calderys as shown below in figure (Rev 0)

calderys

HEATING SCHEDULE		Rev
Project	Auxilary Boiler at IFFCO, Kalol	
Client	IFFCO, Kalol	0

Raise Temperature (°C) From	Raise Temperature (°C) To	Gradiant (°C/Hr)	Time (Hr)	Cumulative Time (Hrs)	Activity	Allowable Variation in Hot Gas Temp. (°C)
30	30	Hold	24	0	Hold for 24 Hrs at Ambient temp. after shuttering removal.	
30	150	20	6	6	Raise @ 15-20 ºC/Hr upto 150 ºC	±10º C
150	150	Hold	15	21		±15º C
150	350	20	10	31	Raise @ 15-20 ºC/Hr upto 350 ºC	±15º C
350	350	Hold	18	49		±25º C
350	550	20	10	59	Raise @ 15-20 ºC/Hr upto 550 ºC	±15º C
550	550	Hold	12	71		±25º C
					After Completion of holding at 550°C Raise upto operation temp.@50°C/hr	±15º C
Total Heating Duration				86 Hrs		



General Dryout Notes:

1. After removing the formwork, lining must be air dried for 24 hrs prior to start the dry out.
2. If water dripping is observed at a certain soaking temp. then the soaking period to be extended until the water dripping ceases.
3. Hot gas temp. variation is allowed as per the table above.
4. If the Furnace to be taken under operation then the External Burners to be taken out after completion of soaking at 550 °C and temperature to be increased with Pilot Burners.
5. This Heating Schedule has to be executed in one time, without any interruption.
6. In case of any interruption, the installation shall be cooled down to ambient. Re-start the Heating - Up from the beginning of this schedule.
7. Ambient temp. is considered as 30 °C, which may vary depending upon the place and season.

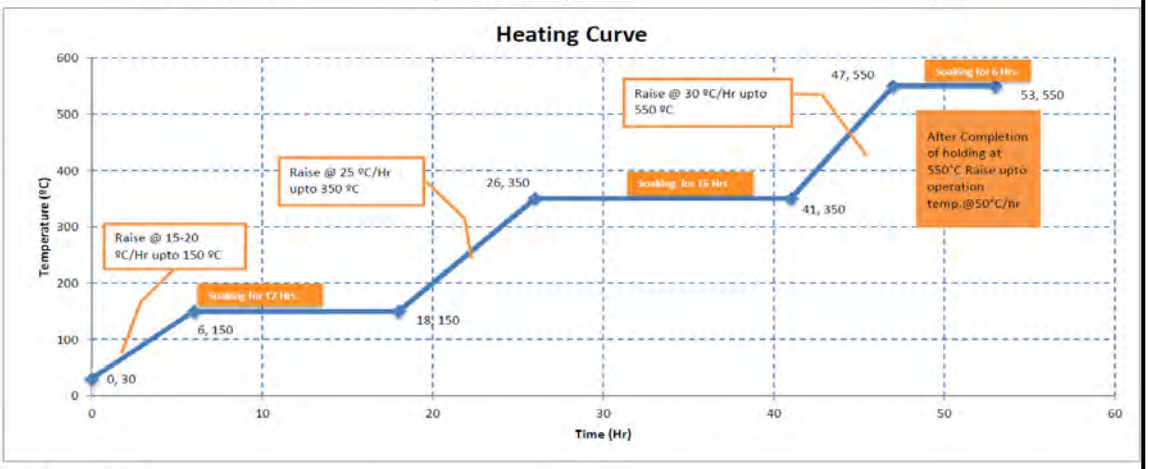
Rev. No.	Date	Prepared	Checked	Approved
0	07-09-2018	SD	RB	Choks

However the duration of the dry out period was more. Hence after discussion with the Design Department of M/s Caldrey's finally the following Dry out procedure was followed by IFFCO (Rev 3):

calderys

HEATING SCHEDULE		Rev
Project	Auxilary Boiler at IFFCO, Kalol	
Client	IFFCO, Kalol	3

Raise Temperature (°C) From	To	Gradiant (°C/Hr)	Time (Hr)	Cumulative Time (Hrs)	Activity	Allowable Variation in Hot G Temp. (°C)
30	30	Hold	24	0	Hold for 24 Hrs at Ambient temp. after shuttering removal.	
30	150	20	6	6	Raise @ 15-20 ºC/Hr upto 150 ºC	±10º C
150	150	Hold	12	18	Soaking for 12 Hrs.	±15º C
150	350	25	8	26	Raise @ 25 ºC/Hr upto 350 ºC	±15º C
350	350	Hold	15	41	Soaking for 15 Hrs	±25º C
350	550	30	6	47	Raise @ 30 ºC/Hr upto 550 ºC	±15º C
550	550	Hold	6	53	Soaking for 6 Hrs	±25º C
					After Completion of holding at 550°C Raise upto operation temp.@50°C/hr	±15º C
Total Heating Duration				53 Hrs		



General Dryout Notes:

1. After removing the formwork, lining must be air dried for 24 hrs prior to start the dry out.
2. If water dripping is observed at a certain soaking temp. then the soaking period to be extended until the water dripping ceases.
3. Hot gas temp. variation is allowed as per the table above.
4. If the Furnace to be taken under operation then the External Burners to be taken out after completion of soaking at 550 °C and temperature to be increased wi process Burners @ 50º C/Hr.
5. This Heating Schedule has to be executed in one time, without any interruption.
6. In case of any interruption, the installation shall be cooled down to ambient. Re-start the Heating - Up from the beginning of this schedule.
7. Ambient temp. is considered as 30 °C, which may vary depending upon the place and season.

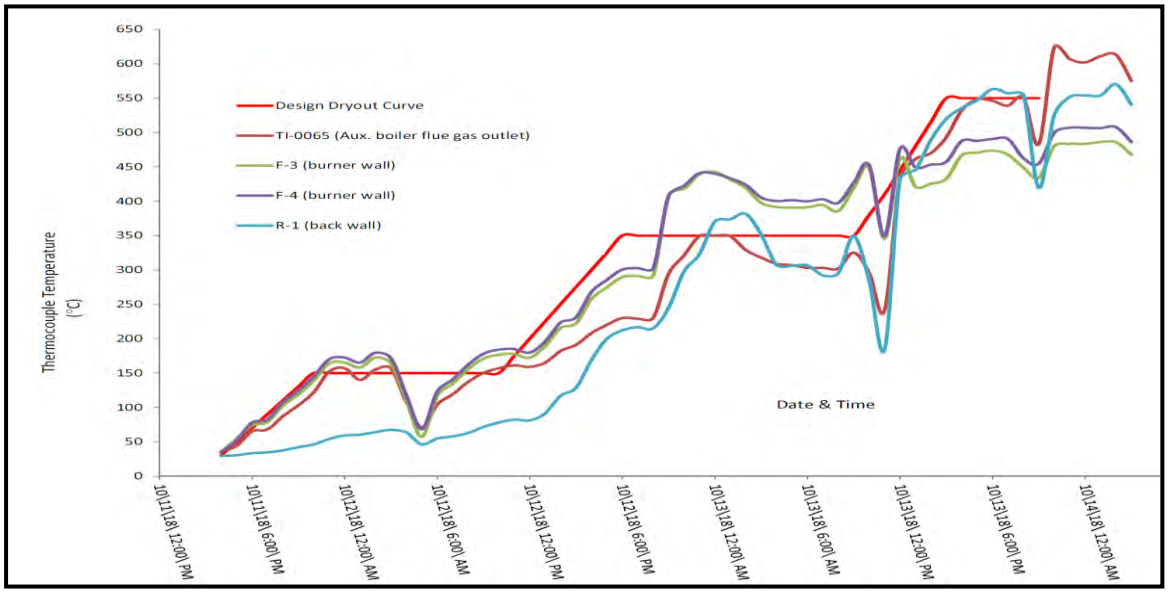
To perform the initial heating of castable lining, Primary reformer tunnel burner portable burner was installed by providing a plate in the place of 1st burner (bottom most) of auxiliary burner. A temporary pipe line of ¾" size was fabricated from PG tapping of Separator, 178-F to this Burner. PG was provided in this line. For monitoring & controlling the heating, 4 nos. of temporary thermocouples (F1, F2, F3 & F4) were installed in peepholes of front wall (burner wall) i.e. both sides of 1st & 5th burner and 2 nos. of temporary thermocouples (R1 & R2) were installed in peep holes of north wall.

Temporary Thermocouple fixed in peep hole

Temporary portable burner (primary reformer tunnel burner)

Heating of castable lining was started on 11 October 2018, 4.00 PM and finished on 13 October 2018 9.00PM after 53 hours of Dryout schedule. Actual heating curve comparative with design dryout curve is shown as below in figure. Readings of thermocouple F1 & F2 were not taken into consideration for monitoring & controlling the heating of castable lining. After 53 hours of dryout schedule, auxiliary boiler was taken in line.

On 17/10/2018, Thermography was carried out on Auxiliary Boiler Walls. Average temperatures of north, south & west wall were reduced to 85-95 °C, 75-85 °C & 75-90°C respectively and maximum temperature of south wall, east wall & top roof were reduced to 254 °C, 229 °C & 329 °C.



Actual Dryout schedule

Sr No.	Wall No	Location	Before Refractory Replacement		Remarks	After Refractory Replacement	
			Average Temp. (°C)	Max. Temp. (°C)		Average Temp. (°C)	Max. Temp. (°C)
1		Opp. Burner wall (North side)	95-120	171	Max temp observed on 2nd panel from bottom	85-95	240 (Near Sealing area)
2	11	Aux Boiler Front wall (South side)	85-105 (140-175 near to burner)	370	Max Temperature around the burner port	60-65	213 (Near Burner)
3	10	Side wall (East, CT side)	80-105	245	Max temp observed on Top most bolted panel (East side of Coil D & E)	70-75	242
4	12	Side wall (West, Silo side)	80-95	110	2nd welded panel (west side of coil C)	65-70	281
5*		Top roof (*Thermography done on 16/03/2018)	110-150	500	Max temp observed in between area of coil A&B riser	90-95	295 (Roof to riser Interface)

Other Jobs carried out in Auxiliary Boiler

- Cleaning of all Coils Coil A, B, C, D & E was carried out by Production Department. As the side walls were removed, there was full access for cleaning of Coil C, D & E. Scaffolding was made cleaning of Coils.
- PRC-23 Dampener inspection carried out, its bearings greasing done, operation of dampener checked and found OK.

103-D

- 103-D, Secondary Reformer only Bottom Dome was opened for inspection.
- It was observed that the opening of bottom brick layer was choked by Alumina Balls. These Alumina balls were removed
- Lining of 103-D to 101-CA and CB were found OK
- Damaged refractory repair was done by Civil.

103-D bottom opening was choked by Alumina Balls

Catalyst Replacement of LTS, 104-D1

- 104-D2, LT Shift Converter: Manholes were opened. Screens were removed for catalyst replacement. After removing all catalyst from the vessel, internal inspection of the vessel was carried out.
- Stiffening rod of the inlet distributor (09 out of 12) found detached at North, South & East side, repaired by welding.
- Thermowell pipe found bent and its assembly found loose at end. It was repaired.
- After filling bottom Alumina balls, Bottom floating screen was provided.
- Then Catalyst loading was done.
- Then Rasching ring was provided above catalyst.
- Then top Floating screen and grating was provided
- The bottom Floating ring mesh (Mesh size 3 X 3) and Top floating ring mesh (Mesh size 2 X 2 X 0.063" Ø & Mesh size 6 X 6 X 0.054" Ø) were replaced.
- Manhole boxed up.
- LTS Catalyst was replaced after 6 years (earlier replaced on 2012)

Unloading of Catalyst

Bottom mesh

REMNANT LIFE ASSESSMENT OF BOILER REG. NO. GT-1632:

RLA was carried out on in 2014 previously. To cater the statutory requirement of IBR Regulation 1950, Re-RLA study of Boiler No. GT-1632 was carried out during 20/09/2018 to 28/09/2018 by M/s. TCR Advanced Engineering Pvt. Ltd., Vadodara against WO No. 201004190302 dated 05/07/2018 as per scope outlined in IBR Regulation 391 (A) – (b) Table-3. Refer RLA Report for details.

The Next RLA is to be carried out in the year 2024 (After 6 years)

101-F, Steam Drum

Side Manholes were opened, tightened loose bolts and clamps of Demister Pad holding cover plate & provided new against missing one, 01 no. loose bolts tightened & 01 no. missing nut-bolt provided of north side flange near elbow in 6" BFW header. 02 nos. missing clamp bolt (1st & 2nd counting from North) provided and 3rd bent clamp replaced/straightened. On East side demister pad stiffener plate & missing fastener at 01 location at bottom side of plate was fixed. On East side, detached tack welding of 1st Stiffener plate at few locations of bottom demister pad was repaired and missing 2nd Stiffener plate provided & tack welded. 01 no. loose stud of the south side man hole tightened.

OPEN INSPECTION & HYDROTEST OF BOILERS

Open inspections as well as hydro test of the following boiler was successfully executed in presence of IBR inspector:

Sr. No.	Tag No.	Identification No.	Hydrotest Pressure (kg/cm^2)
1	101-F	Boiler No. GT-1632	146.0
2	107-C	Boiler No. GT-5217	67.5
3	1123-C	Boiler No. GT-9410 (New)	67.5

101-F open inspection was done on 24/09/2018 and hydrotest was done on 12/10/2018

HEAT EXCHANGERS AND COOLER JOBS

EQUIPMENT TAG		HYDROJETTING		HYDRO TEST	Remarks
		TUBE SIDE	SHELL SIDE (Tube bundle pull out)		
101-JCA	SURFACE CONDENSER	✓			
101-JCA	I/A COOLER	✓			
101-JCB	SURFACE CONDENSER	✓			
101-JCB	I/A COOLER	✓			
101-BJT	LUBE OIL COOLER	✓			
101-JLC1	LUBE OIL COOLER	✓			
101-JLC2	LUBE OIL COOLER	✓			
101-JT	GLAND CONDENSER	✓			
103-JLC1	LUBE OIL COOLER	✓			
103-JLC2	LUBE OIL COOLER	✓			
103-JT	GLAND CONDENSER	✓			
103-JT HPOC1	HP OIL COOLER	✓			
103-JT HPOC2	HP OIL COOLER	✓			
104-J	LUBE OIL COOLER	✓			
104-JT	LUBE OIL COOLER	✓			
104-JT	GOV OIL COOLER	✓			
104-JA	LUBE OIL COOLER	✓			
104-JAT	LUBE OIL COOLER	✓			
104-JAT	ACTUATOR OIL COOLER	✓			
105-JT	GLAND CONDENSER	✓			
105-CA	CO2 STRIPPER GAS REBOILER	✓	✓	✓	**3 Nos. Tube plugged : 105-CA** Shell Side: 40 Kg/cm2 & Tube Side : Head Pressure
105-CB	CO2 STRIPPER GAS REBOILER	✓	✓	✓	

EQUIPMENT TAG		HYDROJETTING		HYDRO TEST	Remarks
		TUBE SIDE	SHELL SIDE (Tube bundle pull out)		
107-JT	LUBE OIL COOLER	✓			
107-JAT	LUBE OIL COOLER	✓			
108-C1A	aMDEA SOLUTION COOLER	✓	✓	✓	Shell side : 8.0 Kg/cm2g. Tube side : 6.0 Kg/cm2g.
108-C2A	aMDEA SOLUTION COOLER	✓	✓	✓	
109-C1A SILO SIDE	aMDEA SOLUTION HEAT EXCH.	✓	Tube side hydro-jetting done in position	✓	Shell side : 8.0 Kg/cm2g.
109-C2A SILO SIDE	aMDEA SOLUTION HEAT EXCH.	✓		✓	Tube side : 6.0 Kg/cm2g.
109-C1B REFORMER SIDE	aMDEA SOLUTION HEAT EXCH.	✓	✓	✓	Shell side : 8.0 Kg/cm2g.
109-C2B REFORMER SIDE	aMDEA SOLUTION HEAT EXCH.	✓	✓	✓	Tube side : 6.0 Kg/cm2g.
110-CA	CO2 STRIPPER CONDENSER	✓			
110-CB	CO2 STRIPPER CONDENSER	✓			
115-C	METHANATOR EFFLUENT COOLER	✓			Shell side : 40.0 Kg/cm2g
115-JALC1	LUBE OIL COOLER	✓			
115-JALC2	LUBE OIL COOLER	✓			
115-JBLC1	LUBE OIL COOLER	✓			
115-JBLC2	LUBE OIL COOLER	✓			
116-C	SYNTHESIS GAS COMPRESSOR INTERCOOLER		✓	✓	Shell side : 8.0 Kg/cm2g
117-J	INTERCOOLER	✓	✓	✓	**2 Nos. Tubes Plugged. Tube to Tubesheet seal welding of 11 nos. Tube done**. Shell side : 15.0 Kg/cm2g
117-J	1st STAGE CYLINDER JACKET WATER COOLER	✓			

EQUIPMENT TAG		HYDROJETTING		HYDRO TEST	Remarks
		TUBE SIDE	SHELL SIDE (Tube bundle pull out)		
117-J	LO COOLER	✓			
124-C	SYNTHESIS GAS COMPRESSOR AFTER COOLER		✓	✓	Shell side : 8.0 Kg/cm2g
127-CA	REFRIGERANT CONDENSER	✓		✓	Shell side : 27.0 Kg/cm2g Strainers design modified & provision of online flushing provided
127-CB	REFRIGERANT CONDENSER	✓		✓	
128-C	REFRIGERANT COMPRESSOR INTERCOOLER	✓		✓	Shell side : 12.3 Kg/cm2g
129-JC	101-J 1ST STAGE INTERCOOLER	✓	✓	✓	**4 Nos. tubes plugged.** 6.0 Kg/cm2g In Dummy Shell
130-JC	101-J 2ND STAGE INTERCOOLER	✓	✓	✓	6.0 Kg/cm2g In Dummy Shell
131-JC	101-J 3RD STAGE INTERCOOLER	✓	✓	✓	13.0 Kg/cm2g At position
173-C	STRIPPER CONDENSATE COOLER	✓			

101-JCA/B

Deposits found after opening 101-JCA

127-CA/CB

- After opening, Deposits found after opening 127-CA & B
- Basket strainer was removed after removal of the Flushing line.
- The Flushing Valve provided on 127-CA & CB during SD-2017 by Technical was replaced as it was unable to operate during normal operation.
- Basket Strainer and Flushing line was assembled and cover was boxed up.

Deposits found after opening 127-CA & B

Strainer assembled after cleaning

<u>VESSEL INSPECTION / REPAIR JOBS</u>:

101-EA, CO2 Absorber: All Manholes were opened for inspection.

In compartment of Manhole 3, 01 no. loose Rasching ring holding clamp at south side tightened. In compartment of Manhole No. 4, Corrosion cavities and holes were observed on South most liquid distributor collector plate, located just below the liquid distributor.

In compartment of Manhole No. 5, repaired the detached Sample collector by welding.

102-EB, CO2 Stripper: Top Manhole opened & boxed up after inspection, cleaning, tightening loose U-Clamps of North-East and South-West side distribution header, repairing of following by welding:

- Replaced 01 no. nut of inlet header flange & 01 no. check nut of South-East side U-clamp observed with CS material.
- Crack was repaired by welding in South-West side U-clamp support plate weld joint.
- Missing South-West side U-clamp check nut provided.
- Tightened bolts of loose U-Clamps of North-West side distribution header.
- Crack was repaired in U-clamp tack weld with plate.
- Cracked/detached North-West side, header bottom support plate new provided.
- Repaired 75 mm long crack in the bottom of the U-clamp support plate at North-West side.
- Tightened bolts of loose North-East side distributor header U-Clamps & its missing nut provided.

103-E1, HP Flash Vessel: Top manholes were opened for inspection and then boxed up. No repairing points observed.

103-E2, LP Flash Vessel: All three manholes were opened for inspection. No repairing points observed in the compartments of top & bottom manhole.

Following repairing was carried out in the compartment of second manhole:

- Tightened loose Holding bolts of bottom annular tray & 2 nos. missing bolts provided.
- Repaired both the bubble cap tray drain line joint from top plate & support strip by welding, one was completely detached & other one was about to get sheared from top weld.
- Tightened 02 nos. loose fasteners of vertical plate segment in the East direction.
- Boxed up all the manholes after repairing.

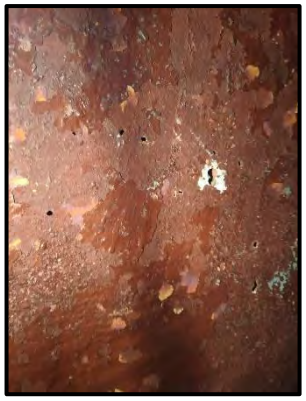
105-E, Dehydrator: Top & Bottom manholes were opened for inspection and then boxed up. No repairing points observed. Removed 01 no. Clamp and its fastener found lying at just near-below manhole.

1104-E: Top & Bottom manholes were opened for inspection. During inspection from bottom manhole, U Clamp of 10" SS Internal Pipe (Steam Inlet) was found loose. Also, the internal pipe flange fasteners were found loose. Tightening of loose clamps & flange fasteners carried out and then both manholes were boxed up.

102-F, Raw Gas Separator: Manhole opened for inspection and then boxed up after applying fresh putty against the detached one on the circumferential weld joint of manhole nozzle with shell from inside. 02 nos. lifted segments of Demister pads from its position in East Side were fixed.

Putty applied on the circumferential weld joint of manhole nozzle with shell from inside was found detached

103-F, Reflux Drum: Manhole opened for inspection and then boxed up. No repairing points observed. Cavities observed in Epoxy at scattered locations in lower half of the vessel. Epoxy coating was done inside .

Cavities observed in Epoxy at scattered locations

104-F, Synthesis Gas Compressor Suction Drum: Manhole opened & boxed up after inspection & cleaning. No repairing points observed.

105-F, Synthesis Gas Compressor 1st Stage Separator: Manhole opened & boxed up after inspection & cleaning. No repairing points observed.

106-F, Ammonia Separator: Manhole opened & boxed up after inspection & cleaning. No repairing points observed.

107-F, Primary Ammonia Separator: Manhole opened for inspection and then boxed up. No repairing points observed.

109-F, Refrigerant Receiver: Manhole opened for inspection, cleaning done and then boxed up. No repairing points observed.

110-F (1st Stage), 111-F (2nd stage), 112-F (3rd stage) Refrigerant Flash Drum: Manhole opened for inspection, cleaning done and then boxed up. No repairing points observed. In 110-F, Top plate bolts of 117-C return stand pipe found sheared and plate (approx. size of 400 mm x 400 mm) was detached and lying behind vertex plate.

SAFETY RELIEF VALVES OVERHAULING & TESTING:

Overhauling & Testing of RV's job contract i.e. WO No. 201004191247 dated 12/12/2018 was awarded to M/s. Flotec Technosmart (India) Pvt. Ltd., Surat.

The following RVs were overhauled and tested on test bench:

Sr. No.	RV Tag NO	Valve Size	Set Pressure (Kg/cm^2) g
1	RV-101-F 1	2.5" X 6" (2.545)	118.80
2	RV-101-F 2	2.5" X 6" (2.545)	117.00
3	RV-101-F 3	2.5" X 6" (2.545)	115.30
4	RV-101-B	3" X M(3.6) X 6"	111.40 (Online Floating)
5	PSV-986 (107-C)	4 L 6	45.00
6	PSV-987 (107-C)	4 L 6	46.30
7	RV-103-J (103-J Final Discharge)	3 K 4	158.93
8	RV-103-JA	3 J 4	159.00
9	RV-105-DA (103-J Recycle Line)	3 J 4	152.80
10	RV-106-F(106-F Discharge)	1.5" X 2"	157.94

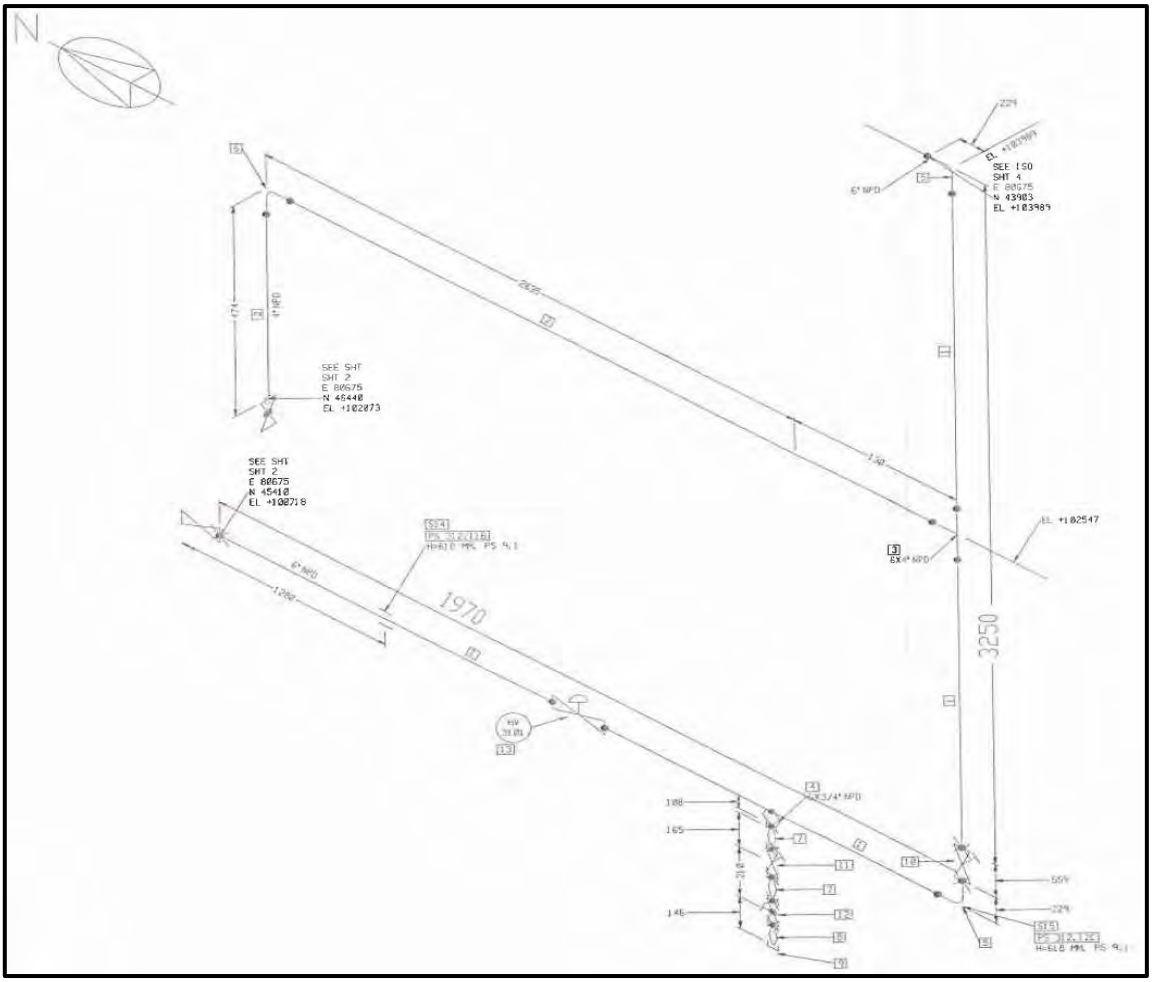
Sr. No.	RV Tag NO	Valve Size	Set Pressure (Kg/cm^2) g
11	RV-102-F	6 R 8	30.50
12	RV-123-CA	3 J 6	122.00
13	RV-123-CB	3 J 6	122.00
14	RV-MS-9 (38 Kg Steam Header)	4 P 6	42.00
15	RV-BFW-1 (Offsite Coil RV)	1-1/2 G 2-1/2	92.00
16	RV-109-F	6 Q 8	19.00
17	RV-110-F (N)	3 L 4	7.00
18	RV-110-F (S)	3 L 4	7.00
19	RV-111-F	4 P 6	6.30
20	RV-112-F	4 M 6	6.30
21	RV-104-D1	6 Q 8	35.00 (Reset:31.5)
22	RV-104-D2	1-1/2 F 2	34.10
23	RV 101-J (Air Comp. Discharge)	4 M 6	36.90
24	RV-S-7 (11 Kg Steam Header)	4 P 6	14.80
25	RV-LS-1 (LS Steam Header)	4 N 6	7.50
26	RV-129-C (103-J Interstage Cooler)	1 E 2	8.40
27	RV-PG-39 (Purge Gas to Fuel Header)	4 M 6	5.30
28	PSV-977 (Absorber Inlet)	4 P 6	32.20
29	PSV-976 (Absorber Inlet)	4” X 6”	30.60
30	RV-104-F (Syn. Gas Comp. Suction separator)	1 E 2	30.00
31	PSV-954 (115-JBT Exhaust)	8 T 10	0.70
32	PSV-951 (115-JAT Exhaust)	8 T 10	0.70
33	SV-01 (117-J)	1-1/2” H 3”	5.80
34	SV-02 (117-J)	1.5 G 2.5	15.80
35	SV-03 (117-J)	1 E 2	30.20
36	PSV-111 (Purge E4 HE Tubes)	15 X 20	57.08
37	PSV-177 (Purge Gas E1)	15 X 20	57.08
38	RV-104-JAT (Turbine Exhaust)	8 T 10	0.35
39	RV – 935 (116-JAT Exhaust RV)	3 K 4	6.10
40	RV-115-JA-01 (AOP Discharge)	1 E 2	11.00
41	RV-115-JA-02 (MOP Discharge)	1 E 2	11.00
42	RV-115-JB-01 (AOP Discharge)	1 D 2	11.00
43	RV-115-JB-02 (MOP Discharge)	1 E 2	11.00
44	RV-101-L (aMDEA filter RV)	1.5 G 3	30.94
45	PSV-3006-A	2 J2 4	43.00
46	PSV-3006-B	2 J2 4	45.00
47	RV-104-JT (Turbine Exhaust)	6 Q 8	5.27
48	PSV-502 (ARU RV)	3 K 4	20.00
49	RV-101-JT (Sealing Steam RV)	1-1/2 H 3	0.70
50	-	3 K 4	5.27
51	RV-721 (AOP Discharge of 101-BJT)	¾ X 1	8.50

Sr. No.	RV Tag NO	Valve Size	Set Pressure (Kg/cm^2) g
52	RV-720 (MOP Discharge of 101-BJT)	¾ X 1	8.50
53	RV-919	6 X 10	10.00
54	PSV-920 (LP-HP Flash Vessel)	6 X 10	10.50
55	RV-921 (LP-HP Flash Vessel)	6 X 10	10.50
56	RV-101-U (De-aerator)	4 X 6	3.50
57	RV-167	15 X 15	4.00
58	RV-172-F-A	8 X 8	+375 MMWC
59	RV-172-F-B	2 X 2	+35/-35 MMWC
60	RV-105-D (103-J Recycle Line)	3 K 4	153.00
61	RV-101-JT Sentinel RV	¾ X 1	0.35
62	RV-197	1 X 2	30.60
63	PSV-142-F-A	1 D 2	7.78
64	RV-141-F	1 D 2	7.70
65	RV-105-JT (HTS Inlet spare)	¾ X 1	0.35
66	Gail RV	3 X 6	46.00
67	PSV-181	3 X 4	6.13
68	RV-105-F (103-J 1st stage separator)	1 D 2	73.80
69	RV-983 (137-C CW line RV)	6 Q 8	7.00

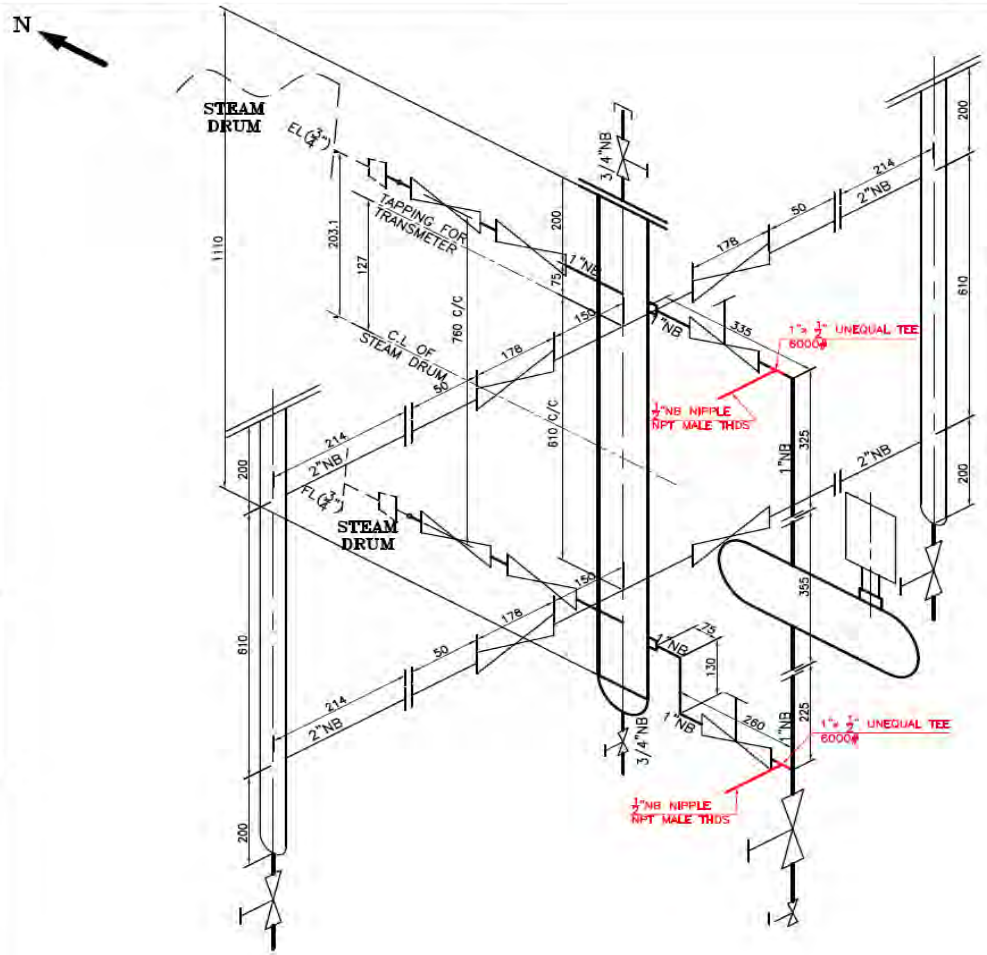
FABRICATION JOBS

Fabrication contract i.e. WO No. 201004190796 dated 24/08/2018 was placed on M/s. Shree Ganesh Engg. Co., Ahmedabad to carry out following IBR Fabrication jobs during Annual SD-2018, in addition to Auxiliary boiler repair jobs:

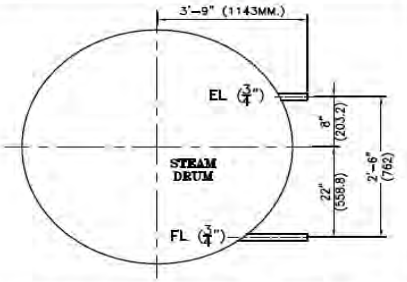
SR. NO.	IBR JOBS
1	101-F South LG Isolation Valve both (top & bottom) passing - Gate Valve: 1" X 1500#, SW - 2 Nos. replaced.
2	101-F BBD sample line I/V bonnet leak (furmanited) - Gate Valve: 3/4" X 1500#, SW - 1 No. replaced.
3	RV-BFW-1 I/V passing - Gate Valve: 1-1/2" X 1500#, SW - 1 No. replaced
4	1123-C LG Isolation Valve both (top & bottom) passing - Gate Valve: 1-1/2" X 800#, SW - 2 Nos. replaced
5	New Butterfly Valve Control Valve HICV-3101 installation on Line No. 6"-BW-0049-H24S-H, which was not installed during ESP-III – Provision made by cutting spool piece of suitable length. 2 nos. WNRTJ flange (6" X 1500#) welding done, DP, PWHT & RT carried out.
6	Modification carried out in standpipe tapping of steam drum 101-F for provision for additional pressure transmitter for 2oo3 logic as per Drg. No. P1-DS-13074 Rev.2. Unequal Tee, 1" X 1/2" SW – 2 nos. & Nipple, ½" X Sch.160 – 2 nos were provided.



Control Valve HICV-3101 was provided



BILL OF MATERIAL				
SR. NO.	DESCRIPTION	SIZE	QTY.	MATERIAL
1	PIPE	4"NB x SCH.160	1.1 MTR	ASTM A106 Gr. B
2	CAP (BW)	4"NB x SCH.160	1No.	ASTM A105
3	FLANGE (WNRTJ)	4"NB x 1500#	1No.	ASTM A105
4	FLANGE (BLIND)	4"NB x 1500#	1No.	ASTM A105
5	WELDOLET	4"NBx1"NBxSCH.160	4Nos.	ASTM A105
6	WELDOLET	4"NBx2"NBxSCH.160	4Nos.	ASTM A105
7	PIPE	2"NB x SCH.160	0.8 MTR	ASTM A106 Gr. B
8	FLANGE (WNRTJ)	2"NB x 1500#	4Nos.	ASTM A105
9	GATE VALVE (SW)	2"NB x 1500#	4Nos.	ASTM A105
10	PIPE	1"NB x SCH.160	1.0 MTR	ASTM A106 Gr. B
11	GATE VALVE (SW)	1"NB x 1500#	4Nos.	ASTM A105
12	PIPE	¾"NB x SCH.160	0.7 MTR	ASTM A106 Gr. B
13	GATE VALVE (SW)	¾"NB x 1500#	2Nos.	ASTM A105
14	WELDOLET	4"NBx¾"NBxSCH.160	1No.	ASTM A105
15	LEVEL TRANSMITTER ASSLY.	TAG NO. : LSLL–1A TAG NO. : LSLL–1B	2Nos.	MAGNETROL MAKE
16	UNEQUAL TEE (SOCKET WELD)	1"x1"x½" x 6000#	2Nos.	ASTM A105
17	NIPPLE	½"NPT THDS x 4" LG	2Nos.	ASTM A106 Gr. B
18	PIPE	1"NB x SCH 160.	0.3 MTR	ASTM A106 Gr. B



BLACK ■ EXISTING PIPING
RED ■ MODIFICATION WORK

REV.–2 : TITLE CHANGED & MODIFICATION IN S/D–2018

IFFCO INDIAN FARMERS FERTILISER CO–OP. LTD. KALOL

	NAME	DATE
DRN	N. V. Panchal	17.02.2016
CHD	Akhilesh Maurya	17.02.2016
APD	M. V. Anil	17.02.2016
SCALE	N. T. S.	

PLANT : AMMONIA | EWR No.

MODIFICATION FOR INSTALLATION OF TRANSMITTER FOR STEAM DRUM

CODE AMM–685
DRAWING NO. PLANT P1 FORM DS NUMBER 13074 SHEET OF 1 1 REV. 2

Following Fabrication jobs were carried out departmentally as well as by ARC Contractor M/s. J&J Engineers:

SR. NO.	FABRICATION JOBS CARRIED OUT DEPARTMENTALLY
1	117-J HP Suction separator (Amm. Maint. Side) Nozzle pad leak – Nozzle Pad was cut & removed. Crack was identified by DP, attended by welding and then new patch plate was welded.
2	110-CA/CB CO2 gas outlet line to 103-F Cap weld joint leakage occurred during running. Initially patch was welded to arrest the leakage. During SD, CS cap was cut, edge preparation done & new SS 304 cap (Size: 24"X Sch.40) was welded.
3	124-C CW Inlet I/V replacement – Existing valve was removed after unbolting, pipe was cut shortened to accommodate new I/V (Flanged GAV, 10" X 150#) and same flange was re-welded.
4	Pin hole leak in LP Inlet aMDEA Line weld joint – Leak attended by welding.
5	107-C steam outlet trap pinhole leak near 156-F – Steam Trap replaced
6	103-JT exhaust casing Instrument tappings to Panel pipeline was rerouted as per recommendation of M/s. Siemens.
7	105-JT steam inlet line TI tapping leak from thermowell to pipe threaded joint – Seal welding of joint done.
8	101-BJT TTV trap I/V body pin hole leakage – I/V (GAV, SW, 3/4" X 800#) replaced
9	ID fan Turbine 101-BJT TTV drain & its bypass valve both were passing – Both I/V (GAV, SW, 3/4" X 800# - 2 nos.) replaced
10	Redundant 101-BJT PAP system was dismantled & removed.
11	Rerouting of 3/4" line running above 101-BJT was carried out as it was fouling during maintenance work.
12	105-JT steam inlet trap I/v bonnet leak (furmanited) – I/V (GAV, SW, 3/4" X 800#) replaced
13	107-J discharge check valve priming line elbow drop wise leakage from weld joint was attended by welding.
14	105-JT Gland Condenser steam inlet line elbow pin hole leak from weld joint was attended by welding
15	131-JC southside condensate line Trap 2nd I/V passing & 1st I/V spindle broken – Both valves (GAV, SW, 1" X 800# - 2 Nos.) replaced.
16	PICV-14 38 ata to 11 ata letdown line drain I/V spindle was broken. Valve (GAV, SW, 3/4" X 800#) replaced.
17	HCV-12 sealing steam line I/V bonnet leak - I/V (GAV, SW, 1" X 800#) with NRV (SW, 1" X 800#) replaced
18	R1/R2 regeneration Inlet & outlet line material upgraded to SS304 from CS (4" X Sch 40) & Flanges – 8nos. replaced by WNRF Flange, 4" X 600#, SS304 for installation of Valves KV-5, 6, 7 & 8 in PGR
19	Existing 103-JT Exhaust line Butterfly I/V was removed after unbolting, pipe was cut shortened to accommodate new Butterfly I/V (36" X 125#) and same flange was re-welded. New Butterfly I/V was procured from M/s. Advance Valves Pvt. Ltd., Gr. Noida, UP against PO No. 201004181580 dated 23/02/2018.
20	Rerouting of instrument air line which was fouling with new staircase of 103-JT was carried out.
21	Installation of Davit for Superheater RV done to avoid dependency on crane for removal & installation of RV.

SR. NO.	FABRICATION JOBS CARRIED OUT DEPARTMENTALLY
22	105-JT sealing steam header redundant drain line to main MS line removed.
23	105-J Gland condenser condensate overflow pot drain line rerouting done to make it underground
24	Support structure made for new 103-JT Startup Vent Silencer. Also, proper approach was made from same structure to operate 103-JT flash box inlet line valves. However the PO No – 201004190461, dtd 04-JUL-18 for Vent Silencer placed on M/s P R ACOUSTICAL AND ENGG WORKS(P) LTD, TRICHY was cancelled as the Vendor was unable to supply the Silencer within the due date.
25	Redundant Platform & ladder near 103-JHP removed.
26	Railing support near L-001 Filter (at GAIL) removed
27	103-D damaged top platform due to jacket water leakage repaired.
28	FRC-2 I/V & new MS I/V approach platform made via Aux. Boiler Burner No.5 Platform.
29	Hand railing gap covered on 108-D platform near HCV-487
30	Rerouting of ammonia drain line of 117-C, 118-C & 119-C carried out.

VALVE GLAND REPACKING JOBS:

Gland packing of the following valves was replaced by new ones:

- All adjoining valves of 101-F (32 nos. valves), 107-C (31 nos. valves).
- 101-F CBD valve (1 no. valve).
- 101-F IBD valve (1 no. valve).
- Blowdown valves near Aux boiler (Valves - 8 nos.)
- HV-10 (1 no. valve)
- 103-J disch Pilot operated RV Ref. gas I/V (Valves - 4 nos.)
- Ammonia receiving to 109-F I/V (1 no. valve).
- Fire water injection I/V near 127-CA – packing & stud replaced (1 no. valve)
- 105-D outlet (at top) PT root I/V (1 no. valve)
- PIC- 5 Snuffing steam 1st I/V (1 no. valve)
- Auxiliary Coil IBD I/V Furmanite Plug Leak - packing replaced (1 no. valve)
- SP-152 valve at 101-E (1 no. valve)
- Gail Area (16 nos. valves)
- 107-J Rack upto Compressor area (15 nos. valves)
- 156-F area (5 nos. valves), LTS area (2 nos.)

IN-SITU OVERHAULING / RECONDITIONING OF VALVES

In-situ Overhauling / Reconditioning of Valves carried out by M/s. Moon Engineering Works against WO No. 201004190640 dtd. 06/08/2018.

- L002 filter I/V, Valve Size: 8" X 300# - 2 nos.
- LTS Guard inlet & bypass line 1st I/V, Valve Size: 20" X 300# - 2 nos.
- Old jump over NRV between new and old CW circuit, Size: 900mm X 150#
- New jump over NRV between new and old CW circuit, Size: 900mm X 150#

OTHER JOBS

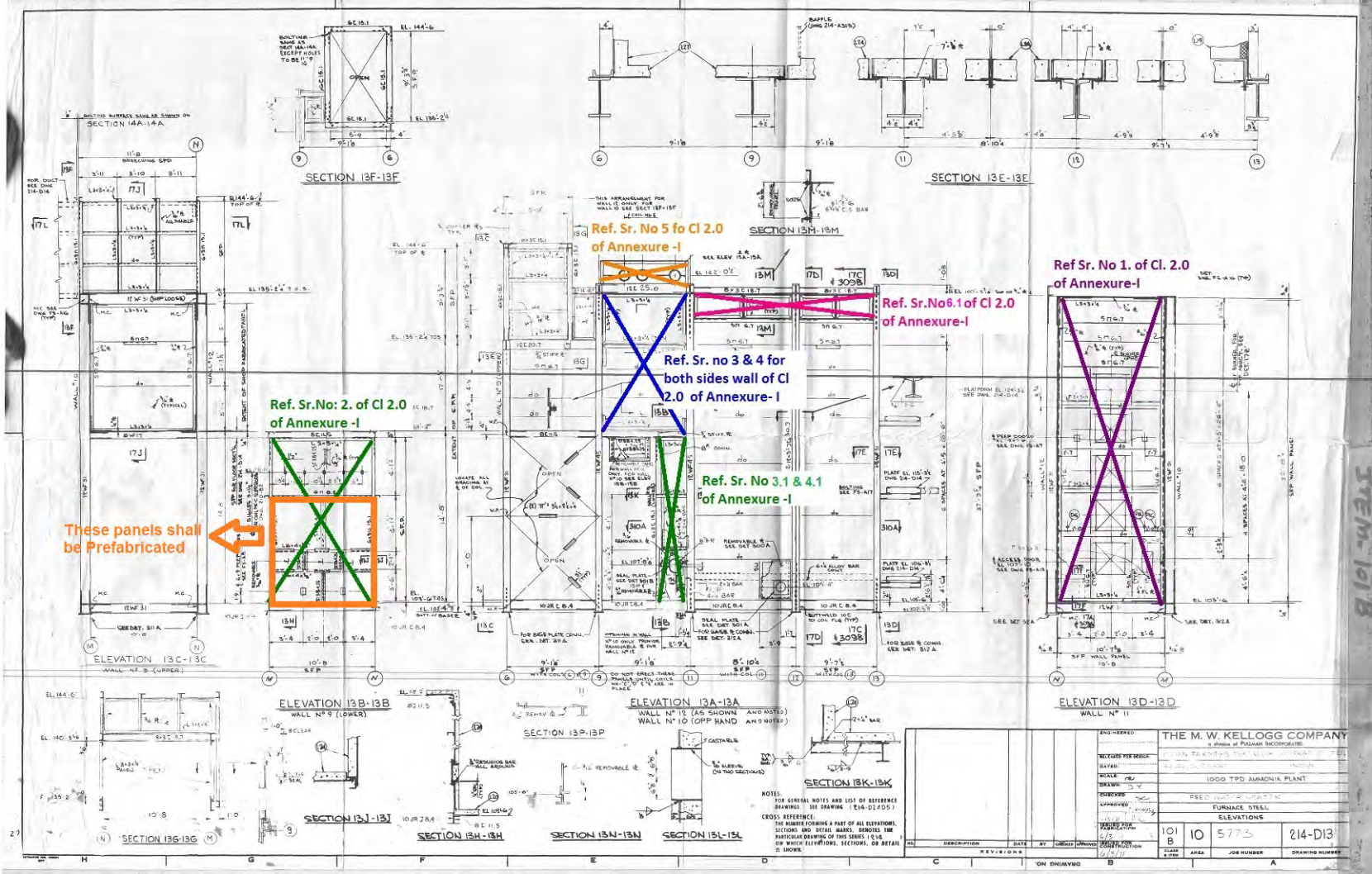
SR. NO.	JOB
	Gasket Replacement Jobs
1	116-JAT steam inlet line strainer flange leak (furmanited) – Clamp removed, flange surface cleaned, light machine cut taken. Gasket replaced & flange boxed up.
2	Leakage from 172-F manhole - Bolts tightened after spring 16 nos. & gasket (18" X 150# Spiral Wound) replacement
3	FIC-3101 U/S flange leak - Gasket (SW, 8" X 600#) replaced.
4	122-C gas outlet flange leak (Furmanited) - Gasket (RTJ Octagonal, 14" X 1500#) replaced, Studs also replaced.
5	115-JAT steam Inlet Orifice flange leak (furmanited) - Gasket (SW, 6" X 600#) replaced.
6	115-JAT steam inlet valve (6" X 600#) bonnet leak (furmanited) – Bonnet gasket (Size: 244 X 223 X 5mm) replaced.
7	1123-C silo side HP tapping flange leak (furmanited) - Gasket (SW, 1-1/2" X 600#) replaced
8	(a) HCV-10 flange leak - Gasket (SW, 10" X 900#) replaced & studs tightened at 700 PSI pressure. & (b) Threaded plug leak attended
9	Flange leak at TIC-8303 D/S I/V upstream flange (below 103-JT) - Gasket (SW, 2" X 300#) replaced.
10	101-BJT drain line flange leak (furmanited) - Gasket (SW, 3/4" X 800# - 2 nos.) replaced & threaded cap leak attended.
11	107-JT Steam Inlet line 1st I/V D/S Flange leak - Gasket (SW, 6" X 900#) replaced.
12	PIC-8303 bypass line upstream & downstream flange leak - Gasket (SW, 1-1/2" X 300#) replaced & plug leak attended.
13	180-J 38 ata steam I/V bonnet leak (furmanited) – Bonnet gasket (Size: 180 X 140 X 3 mm) replaced.
14	107-C Level transmitter (LI-485-A LP tapping) flange gasket leak (furmanited) – RTJ Gasket (R-20) replaced.
15	FIC-470 downstream flange leak - Gasket (SW, 16" X 600#) replaced.
16	101-CA north side chemical dosing flange leak (Furmanited) - Gasket replaced

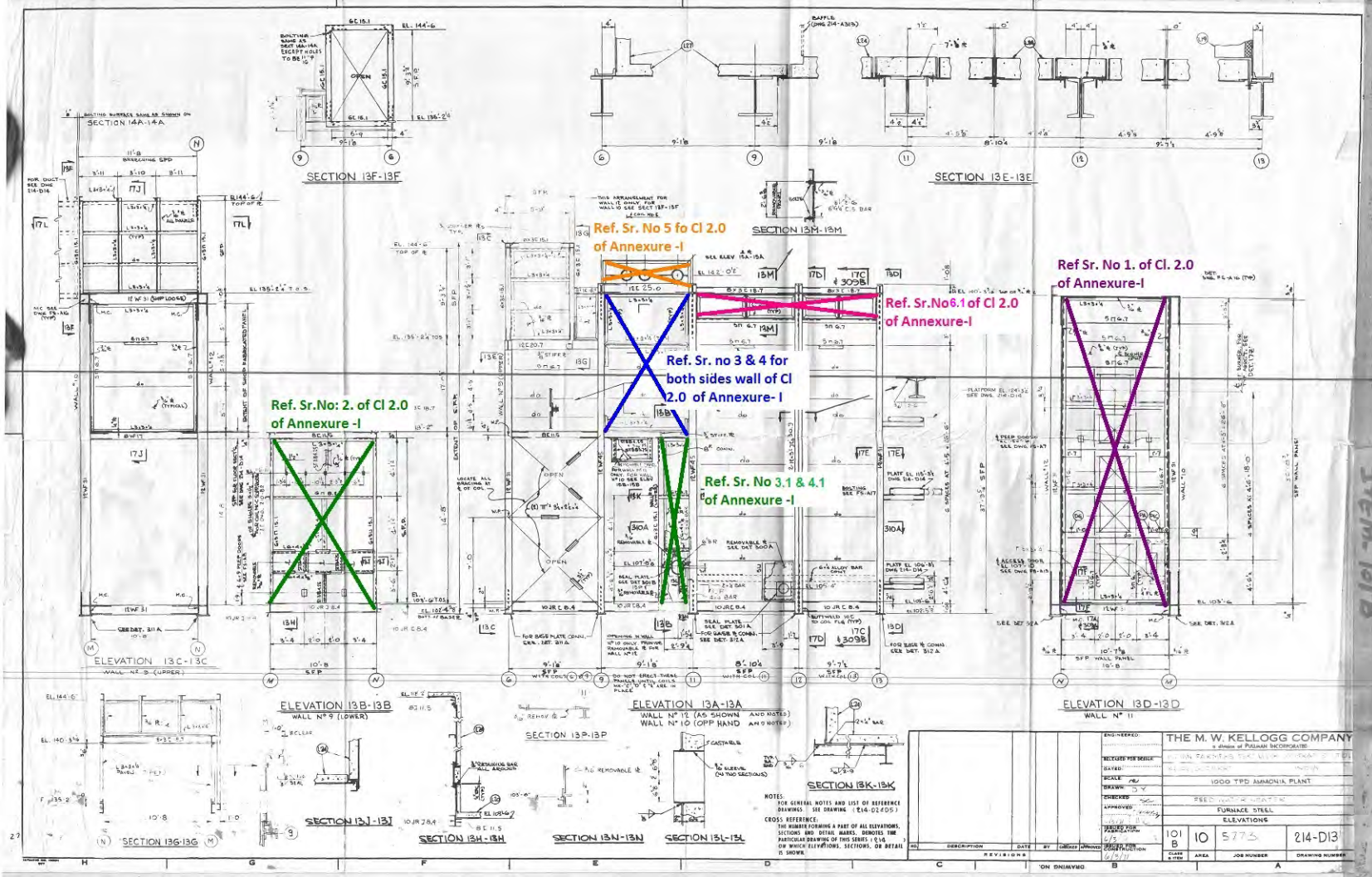
SR. NO.	JOB
	Miscellaneous Jobs
1	105-E liquid ammonia outlet to 107-F I/V (Plug valve) hard to operate – Valve roused.
2	115-JBT Sealing Steam Line Union Leak (Silo Side) attended
3	103-J HP case suction line NRV plug leak attended
4	Service water line pin hole near cooling water jump over valve attended
5	SP-1 bonnet plugs (two) thread leak (CT side) - Attended
6	HCV-11 flange leak (100% explosive) - Bolts tightened by torque tightening m/c at 3000 PSI.
7	The operation of Gear arrangement of HCV-11 was checked after removing the Gear Box. The Hex Nut stop was adjusted and operation was made OK
8	K-1 TOP L.G I/V passing - Valve seat lapping done, checked for passing & then installed with new gasket.
9	107-C LG I/v passing – Valve seat lapping done, checked for passing & then installed with new RTJ Gasket (R-20).
10	LICV-103 bypass valve bush is broken – Bush made in workshop & replaced.
11	127-CA/CB CW inlet both vent I/V not operatable – Valve replaced
12	103-J LO Filter changeover ball valve passing – complete set of valve replaced
13	Damaged / Non-working Spring supports replacement job done in 103-E1-HP & LP area, Compressor area
14	Gail Area Filters L-001 & L-002 cover opened. Filter Elements removed, cleaning done, Filter Elements inserted (New 100 nos. Elements in L-001 & Same Old Elements after cleaning by air in L-002) & Boxed up Cover with new gasket. Filter Elements Detail: L-001 – No. of Elements = 100 (50 + 50) stacked, Ceramic Type, L-002 – No. of Elements = 30, Foam Type. L-001 was removed later during SD-2019 for installation of new NG Preheater (149-C) before letdown Valve.
15	Bag filters of Air Compressor, 101-J replaced.
16	101-J Roll-o-matic filter mechanism overhauling done
17	115-JA/JB, 115-HT, 116-JA strainer cleaned
18	Provision of Isolation from oil header made in 103-J Lube Oil & Seal Oil Accumulators. Isolation Valve Size : Gate Valve, SW, 2” X 1500# (SO), Gate Valve, Flanged, 4” X 150 (LO)
19	Operation of 1123-C Inlet Control Valve, HCV-3046 B was not proper. Hence the CV was removed from position. The CV was sent to M/s Koso, Nasik for inspection & repair by Instrument. After carrying out rectification it was installed back.

INSPECTION OF NRVs

Inspection of following check valves were carried out during Annual Turnaround:

- 105-F outlet to 103-J (short loop) HP Case suction (Cover Gasket Size: 338 X 315 X 3 mm Spiral wound without Inner/Outer Ring)
- 101-J final discharge first NRV (Cover Gasket Size: 338 X 315 X 3 mm Spiral wound without Inner/Outer Ring)
- 105-J final discharge NRV (Size: 12" X 900#) (Cover Gasket Size: 440 X 360 X 3 mm Spiral wound without Inner/Outer Ring)
- 103-J final discharge u/s of SP-1
- 104-JA ARV/NRV replaced as it was passing.
- 107-J/JA Discharge NRV (Cover Gasket Size: 430 X 360 X 5 mm Spiral wound without Inner/Outer Ring)
- 116-JA Discharge NRV (Size: 6" X 150#) replaced as it was passing.
- 116-JB Discharge NRV
- Gail Station NRV flapper removed & boxed up. (Cover Gasket Size: 300 X 270 X 3 mm Spiral wound without Inner/Outer Ring)


Ref. Sr. No 5 fo Cl 2.0 of Annexure -I
Ref. Sr.No6.1 of Cl 2.0 of Annexure-I
Ref Sr. No 1. of Cl. 2.0 of Annexure-I
Ref. Sr. no 3 & 4 for both sides wall of Cl 2.0 of Annexure- I
Ref. Sr.No: 2. of Cl 2.0 of Annexure -I
Ref. Sr. No 3.1 & 4.1 of Annexure -I
These panels shall be Prefabricated
SECTION 13F-13F
SECTION 13E-13E
SECTION 13M-13M
SECTION 14A-14A
ELEVATION 13C-13C
WALL Nº 8 (UPPER)
ELEVATION 13B-13B
WALL Nº 9 (LOWER)
ELEVATION 13A-13A
WALL Nº 12 (AS SHOWN AND NOTED)
WALL Nº 10 (OPP HAND AND NOTED)
ELEVATION 13D-13D
WALL Nº 11
SECTION 13P-13P
SECTION 13K-13K
SECTION 13J-13J
SECTION 13H-13H
SECTION 13N-13N
SECTION 13L-13L
SECTION 13G-13G
NOTES:
FOR GENERAL NOTES AND LIST OF REFERENCE DRAWINGS SEE DRAWING (214-D2FDS)
CROSS REFERENCE:
THE NUMBER FORMING A PART OF ALL ELEVATIONS, SECTIONS AND DETAIL MARKS, DENOTES THE PARTICULAR DRAWING OF THIS SERIES ( ) ON WHICH ELEVATIONS, SECTIONS, OR DETAIL IS SHOWN.
THE M. W. KELLOGG COMPANY
a division of PULLMAN INCORPORATED
1000 TPD AMMONIA PLANT
FEED WATER & UTILITIES
FURNACE, STEEL
ELEVATIONS
ENGINEERED
DRAWN
CHECKED
APPROVED
DATE
REVISIONS
NO.
DESCRIPTION
DATE
BY
CHECKED
APPROVED
ISSUED FOR CONSTRUCTION
6/5
ISSUED FOR CONSTRUCTION
6/15/71
101
B
CLASS & ITEM
10
AREA
5773
JOB NUMBER
214-D13
DRAWING NUMBER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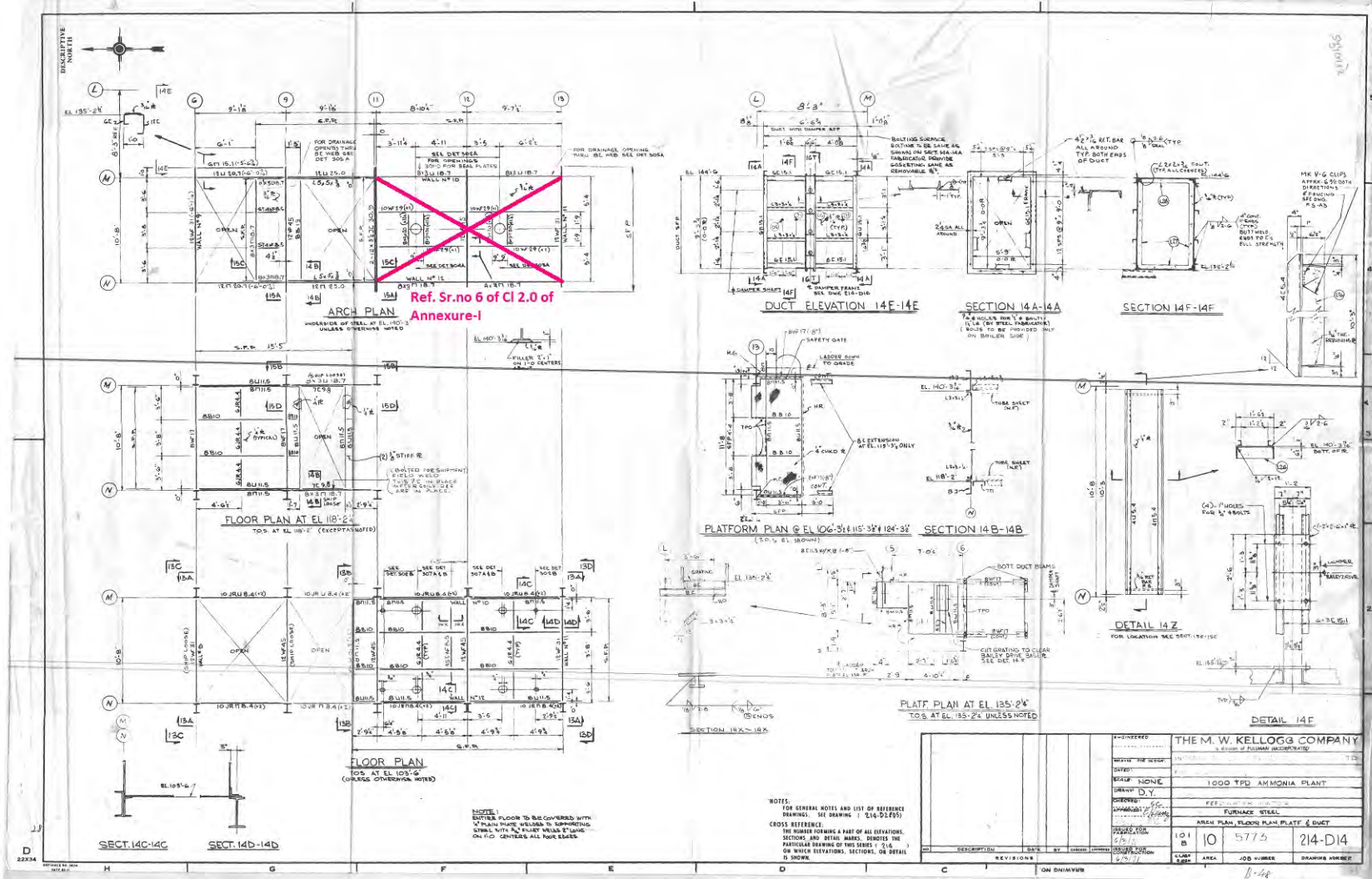
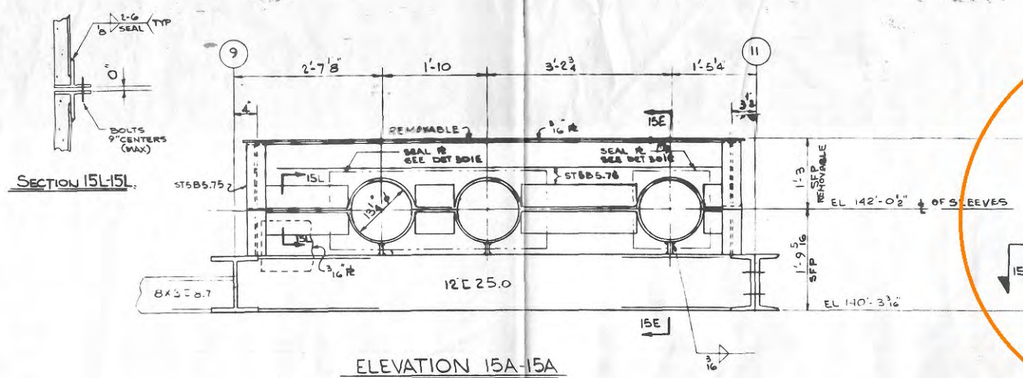
Ref. Sr.No 6.1 of Cl 2.0 of Annexure-I
Ref. Sr. no 3 & 4 for both sides wall of Cl 2.0 of Annexure- I
Ref. Sr.No: 2. of Cl 2.0 of Annexure -I
Ref. Sr. No 3.1 & 4.1 of Annexure -I
Ref Sr. No 1. of Cl. 2.0 of Annexure-I
SECTION 13F-13F
SECTION 13E-13E
SECTION 13M-13M
SECTION 14A-14A
ELEVATION 13C-13C
WALL Nº 8 (UPPER)
ELEVATION 13B-13B
WALL Nº 9 (LOWER)
ELEVATION 13A-13A
WALL Nº 12 (AS SHOWN AND NOTED)
WALL Nº 10 (OPP HAND AS NOTED)
ELEVATION 13D-13D
WALL Nº 11
SECTION 13P-13P
SECTION 13K-13K
SECTION 13J-13J
SECTION 13H-13H
SECTION 13N-13N
SECTION 13L-13L
SECTION 13G-13G
NOTES:
FOR GENERAL NOTES AND LIST OF REFERENCE DRAWINGS SEE DRAWING E14-02405
CROSS REFERENCE:
THE NUMBER FORMING A PART OF ALL ELEVATIONS, SECTIONS AND DETAIL MARKS, DENOTES THE PARTICULAR DRAWING OF THIS SERIES (E14-) ON WHICH ELEVATIONS, SECTIONS, OR DETAIL IS SHOWN.
THE M. W. KELLOGG COMPANY
a division of PULLMAN INCORPORATED
1000 TPD AMMONIA PLANT
FEED WATER HEATER
FURNACE STEEL
ELEVATIONS
101 8
10
5773
214-D13
DRAWING NUMBER
JOB NUMBER
AREA
CLASS & ITEM
REVISIONS
DESCRIPTION
DATE
BY
CHECKED
APPROVED

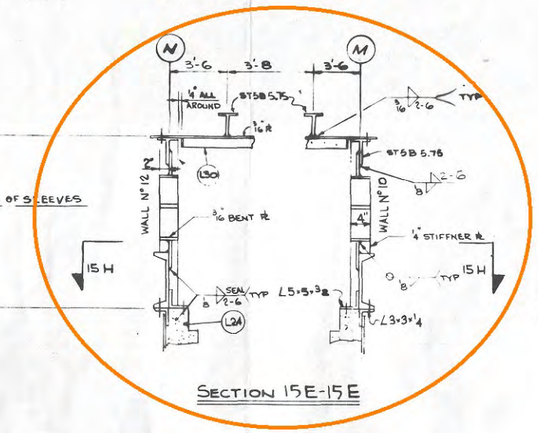

ARCH PLAN
FLOOR PLAN AT EL 118'-2"
FLOOR PLAN
DUCT ELEVATION 14E-14E
SECTION 14A-14A
SECTION 14F-14F
PLATFORM PLAN @ EL 106'-3" & 115'-3" & 124'-3"
SECTION 14B-14B
PLATF PLAN AT EL 135'-2"
DETAIL 14Z
DETAIL 14F
SECT. 14C-14C
SECT. 14D-14D
Ref. Sr.no 6 of Cl 2.0 of Annexure-I
THE M. W. KELLOGG COMPANY
1000 TPD AMMONIA PLANT
FURNACE STEEL
ARCH. PLAN, FLOOR PLAN, PLATF. & DUCT
214-D14



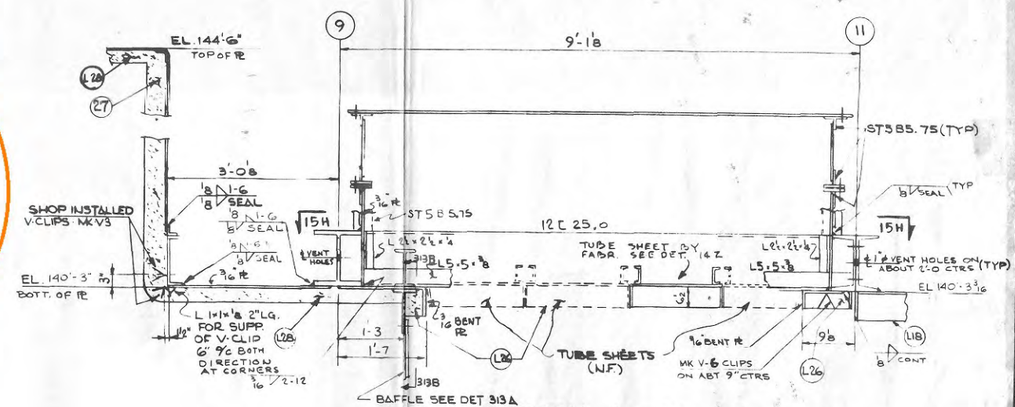
SECTION 15L-15L

ELEVATION 15A-15A

FOR LOCATION SEE DWG 214-D14
WALL N° 12 (AS SHOWN)
WALL N° 10 (OPP HAND)

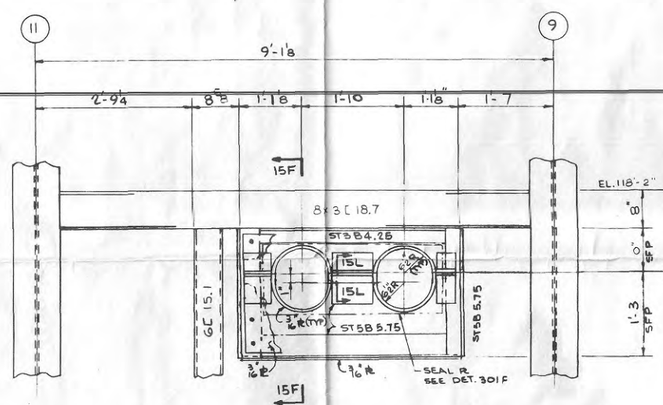


SECTION 15E-15E



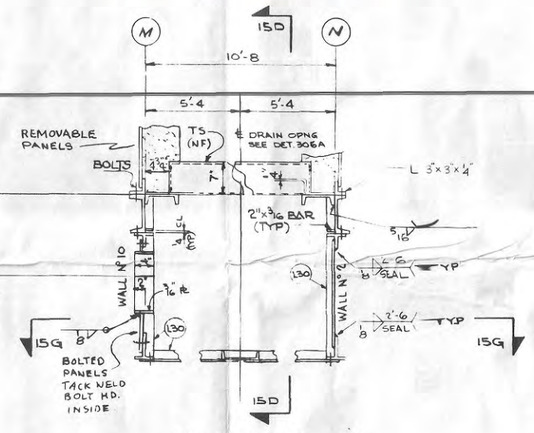
SECTION 15C-15C

FOR LOCATION SEE DWG 214-D14

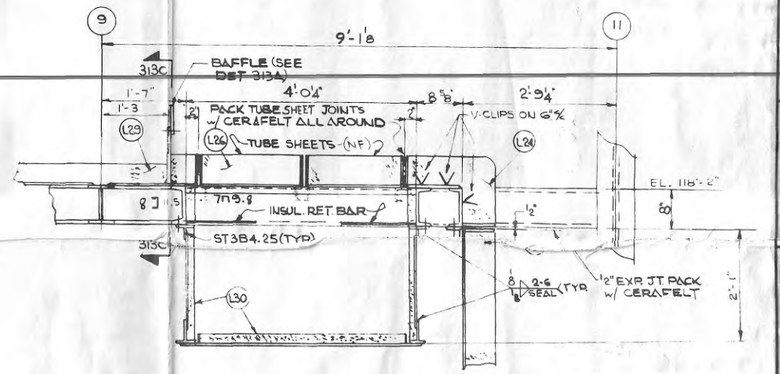


ELEVATION 15B-15B

FOR LOCATION SEE DWG 214-D14
WALL N° 10 ONLY

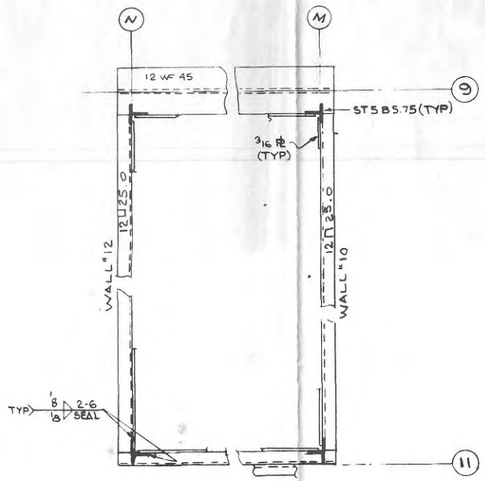


SECTION 15F-15F

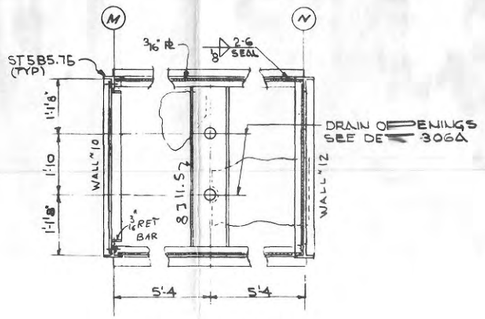


SECTION 15D-15D

FOR LOCATION SEE DWG 214-D14



SECTION 15H-15H



SECTION 15G-15G

NOTES:
FOR GENERAL NOTES AND LIST OF REFERENCE DRAWINGS, SEE DRAWING (214-D2805)

CROSS REFERENCE:
THE NUMBER FORMING PART OF ALL ELEVATIONS, SECTIONS AND DETAIL MARKS, DENOTES THE PARTICULAR DRAWING OF THIS SERIES (214) ON WHICH ELEVATIONS, SECTIONS, OR DETAILS IS SHOWN.

NO.	DESCRIPTION	DATE	BY	CHECKED	APPROVED
REVISIONS					

ENGINEERED
RELEASED FOR DESIGN
DATED:
SCALE: AS
DRAWN: D Y.
CHECKED: SC
APPROVED: Ettema
ISSUED FOR FABRICATION 6/3/71
ISSUED FOR CONSTRUCTION

THE M. W. KELLOGG COMPANY
a division of PULLMAN INCORPORATED
MEMBER TEPT LIBER INTERNATIONAL LTD.

1000 TPD AMMONIA PLANT
FEED
FURNACE STEEL
HEADER BOX ELEVATIONS & SECT'S

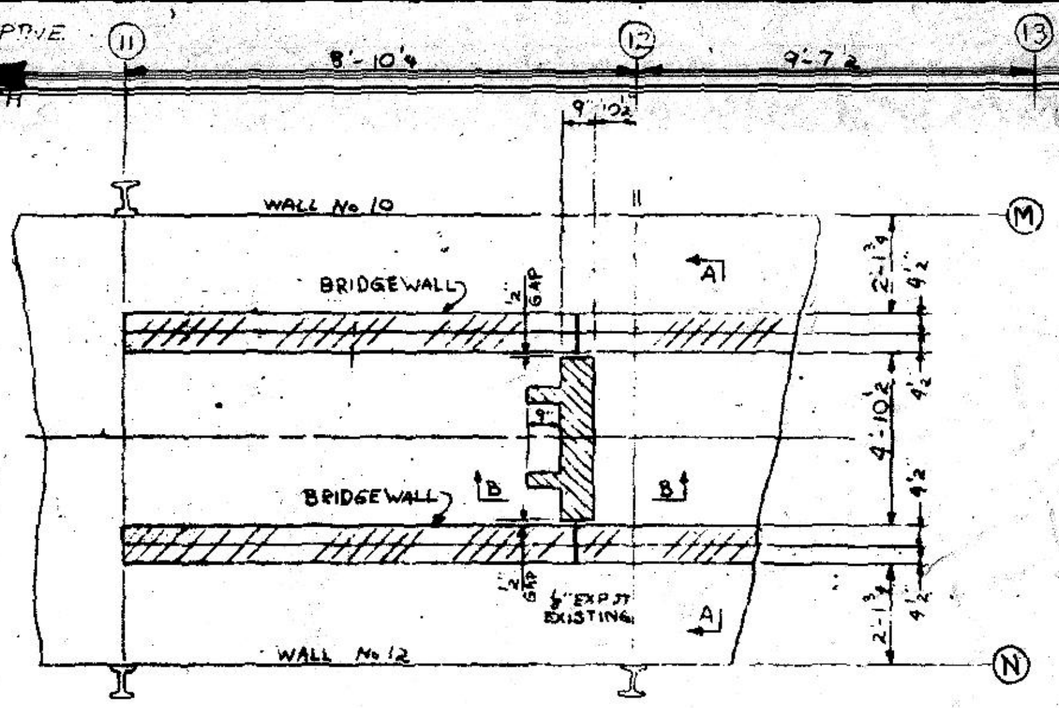
CLASS & ITEM	AREA	JOB NUMBER	DRAWING NUMBER
101 B	10	5772	214-D15

DRAWING NO

DEFIANCE NO. 187H 5977 66-11

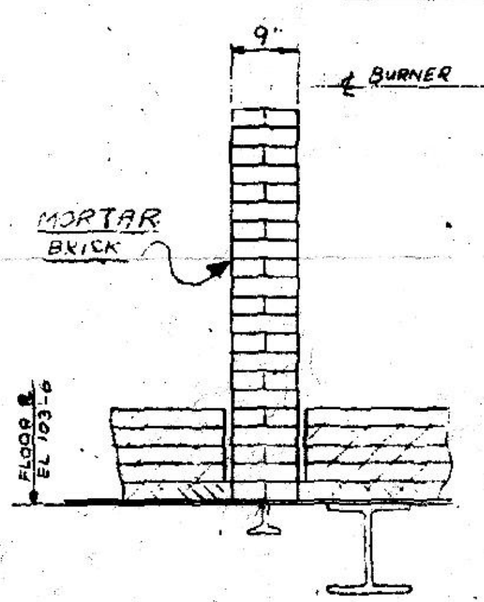
29

DESCRIPTIVE

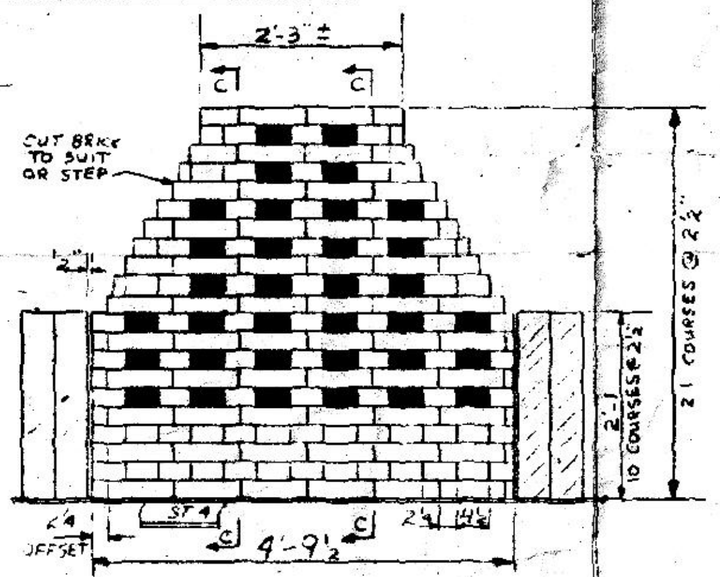


KEY PLAN (@ FLOOR)

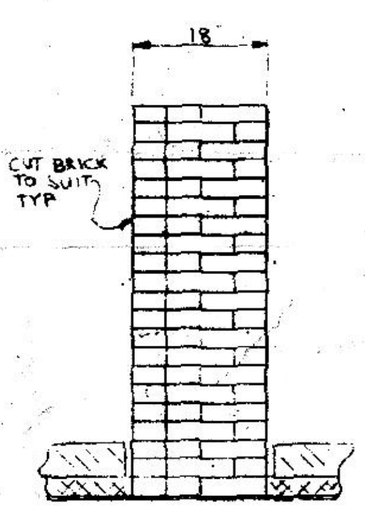
FOR ADDITIONAL INFORMATION SEE DWG 214-D17



SECTION B-B
TYP EXCEPT @ PILASTER



SECTION A-A
(34) OPENINGS INDICATED THUS ■



PILASTER
SECTION C-C

FIELD NOTES

WALL AS SHOWN. PROVIDE PILASTERS AS SHOWN. —— MORTAR BRICK

NO	REVISION DESCRIPTION	DATE	BY	CHK
ISSUED FOR FABRICATION		6/3/71		
ISSUED FOR CONSTRUCTION		6/3/71		

SCALE: *
DRAWN: M.Y.
CHECKED:
APPROVED: 6/3/71

THE M. W. KELLOGG COMPANY
a division of PULLMAN INCORPORATED

BOILER BRIDGE WALL

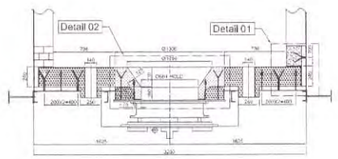
CLASS	AREA	JOB NO	DRAWING NO
1018	10	5773	215-C1

A1PLANT/ST NO-B-B

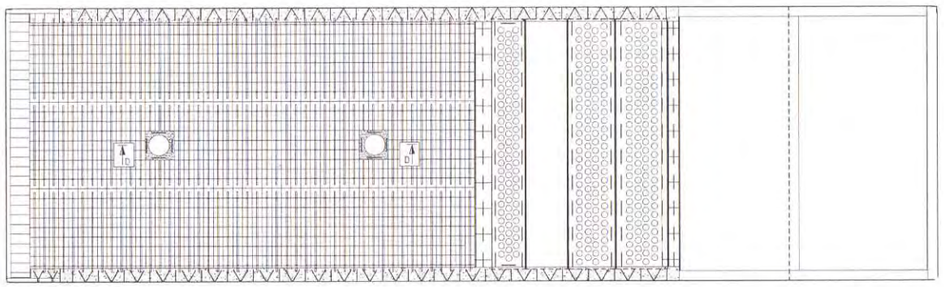
DESIGNED NO SCALE

E D C B A

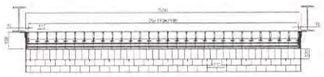
ELEVATION ON BURNER WALL

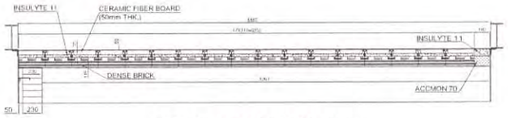


SECTION A-A

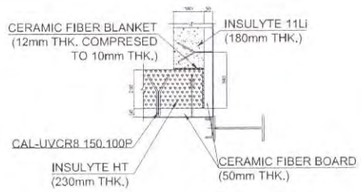


PLAN

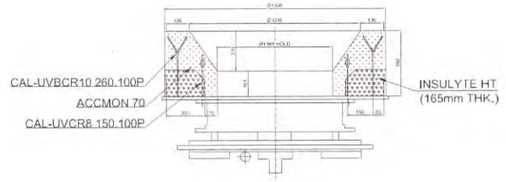




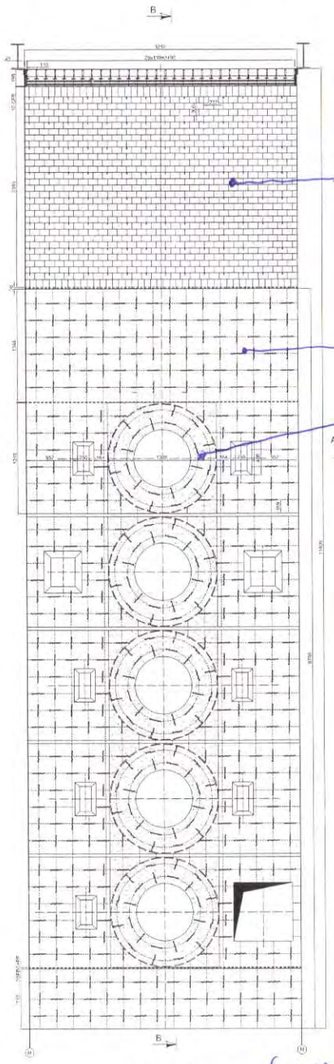
ROOF ARRANGMENT



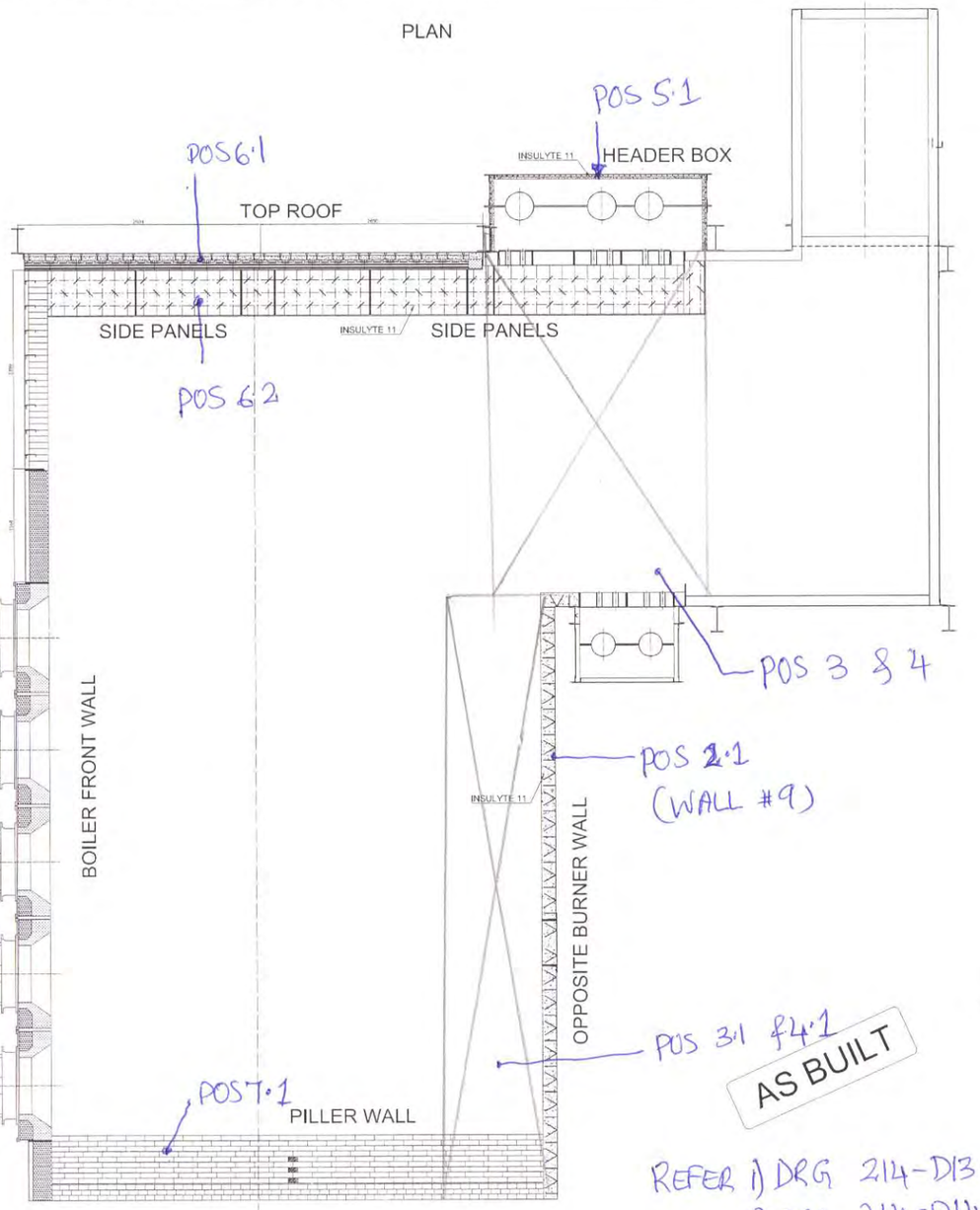
Detail 01
Scale: NTS



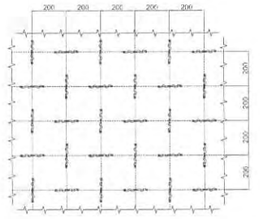
Detail 02
Scale: NTS



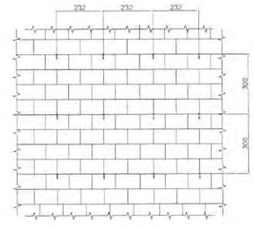
FRONT VIEW (WALL #11)



Section B - B
Scale: 1:35



TYPICAL ANCHOR PITCH DETAIL



PITCH DETAIL
TYPICAL BRICK HOLDER

REFER 1) DRG 214-D13
2) DRG 214-D14
3) LAYOUT OF LINING REV 3.0

calderys International

IMERYS

	DATE	NAME
DRAWN	14.02.2019	SHUBHAM SW
CHECKED		
THIS DRAWING IS REPLACED BY DRAWING	DATE	NAME

No.	DATE	NAME	REVISION

DRAWING TITLE: REFRACTORY ARRNG. DRAWING
AREA: AUXILIARY BOILER
CUSTOMER: IFFCO, KALOL
PLANT: KALOL
PROJECT N: PN

SIZE	SCALE	TYPE	PROJECT NUMBER	SHEET NUMBER	REVISION
A2	35		S-0718283-01.01-00		

VERSION 00

UREA PLANT

(MECHANICAL)

ROTATING EQUIPMENT

In Plant Turnaround 2018, M/s. BVL POWER SYSTEMS PVT LTD, Hyderabad carried out the following jobs in “Hitachi” compressor train, from date 18/09/2018 to 28/09/2018.

- Preventive maintenance of steam turbine (Q-1801).
- Preventive maintenance of LP case (K-1801-1).
- Preventive maintenance of HP case (K-1801-2).
- Preventive maintenance of Gear Box (M- 1801).
- Replacement of bearing of Pilot valve of main steam (60 ata), extraction steam (23 ata) & induction steam (4 ata) control valve
- 23 ata extraction steam control valve. Gland packing replacement.
- 4 ata induction steam servomotor. Seal bush replacement.

Preventive Maintenance of CO_2 Compressor drive Turbine (Q-1801)

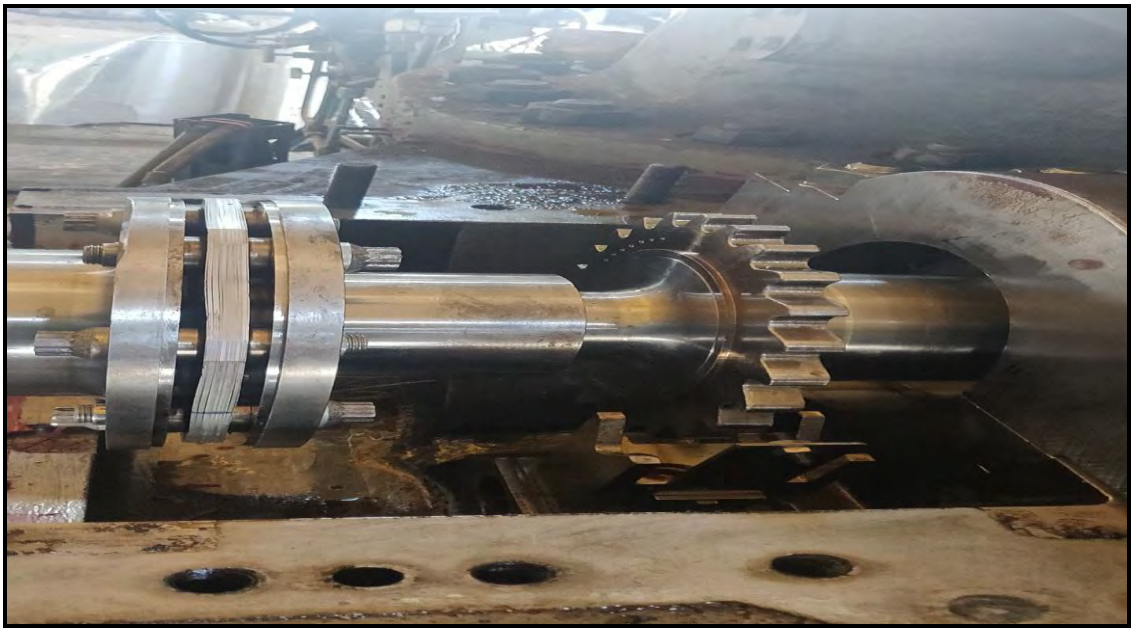
Turbine was taken for preventive maintenance. Following activities were carried out:

- Dismantled the coupling guard.
- Decoupled the Turbine from LP case.
- Alignment of Turbine and LP case was checked and found ok.
- Journal bearing assembly on free end side was opened for inspection. Found clearance values outside the acceptable limit. (Ref Table-1) and hence it was decided to replace the same with new tilting pads for maintaining the clearance values.

DRIVE END BEARING REMOVAL UNDER PROGRESS

- Journal bearing assembly on LP case side was opened for inspection. Found clearance values within acceptable limit. (Ref Table-1)
- Thrust bearing was opened for inspection. Clearances value found within acceptable limits.
- Turbine float: 0.35mm (Design float: 0.25mm to 0.35mm).
- Gauss measurement of Journal and thrust bearing pads, base rings, shaft journal, thrust collar were carried out, found within acceptable limit.

- DP testing of pads, thrust collar and journal shaft was done and the same were found acceptable.
- Final alignment readings were taken and found ok.



TURBINE BARRING GEAR & EARTHING BRUSH

Table 1-Bearing clearance for Turbine

Description	Front End - Journal bearing	Rear End - Journal Bearing
Journal diameter, mm	Ø124.80	Ø159.73
Bearing bore, mm	Ø125.08	Ø160.02
Shell bore, mm	Ø159.99	Ø204.98
Pad thickness, mm	17.45	22.488
Clearance, mm	0.28	0.29
Design Clearance, mm	0.18 to 0.31	0.24 to 0.35

RADIAL VIBRATION SPIKES IN Q-1801

In running plant, frequent spikes were observed in all the four radial probes. The amplitude of these spikes were in the range of 20-30 micron. On analysis, the Baker Hughes/GE team concluded that there was gradual increase in 1X component indication temporary bow of rotor shaft. Temporary bow of shaft may occur due to oil cocking/carburization in oil labyrinth. If due to any reason, steam leaks out from the steam gland & enters the oil seal labyrinth, oil cocking or carburization occurs. With gradual deposition of oil coke, the clearance between shaft & this hard layer of oil coke decreases and at one point shaft rubs the oil coke. On rubbing, a local thermal gradient occurs on shaft creating the bow of rotor.

OIL COKING IN THE OUTSIDE LABYRINTH OF BEARING HOUSING OIL SEAL.

The following observation were made corresponding action was taken :

- There was very high variation in opening of PICV 2119 for steam injection to gland. This might be resulting in steam escaping out of the gland and reaching the oil seals. The CV was attended by instrumentation.

- The steam/condensate outlet from the gland to surface condenser pipe line were water tested. Two leaks were observed from flange joints which were attended. This will further reduce variation in gland steam pressure.

- The oil seal labyrinth was provided with air curtaining to prevent steam ingress. It was observed that there was provision of radial steam inlet & radial steam outlet. Although the inlet port was connected to the air inlet line, the out port was plugged. This might be resulting in axial outlet of air along the shaft resulting in vacuum formation in between the labyrinth & shaft thus sucking the oil vapours from inside the bearing housing. To avoid this phenomenon, an air outlet tube with isolation valve was provided on the outlet port & vented to atmosphere.

Preventive Maintenance of CO_2 Compressor LP case (K-1801-1)

LP compressor was taken for preventive maintenance. Following activities were carried out:

- Decoupled the LP case from gearbox and Turbine.
- Alignment of LP case with gear box and turbine was checked and found ok.
- Journal bearing assembly on GB side was opened for inspection. Found clearance values within acceptable limit (Ref Table-2).
- Journal bearing assembly on Turbine side was opened for inspection. Found clearance values within acceptable limit (Ref Table-2).
- Thrust bearing assembly was opened for inspection. Clearance value found outside acceptable limits and hence the non-active side thrust pads were replaced.
- Axial thrust : 0.38 mm (design value : 0.28mm to 0.38mm)
- Gauss measurement of Journal and thrust bearing pads, base rings, shaft journal, thrust collar were carried out, found within acceptable limit.
- DP testing of thrust pads, thrust collar and shaft journal was done and the same found acceptable.
- Alignment of Turbine - LP Case and LP case – Gear Box was corrected as per protocol values. Details are given in this report.

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

Description	Turbine side Journal Bearing	Gear box side Journal Bearing
Journal diameter, mm	Ø119.99	Ø119.99
Bearing bore, mm	Ø120.12	Ø120.12
Shell bore, mm	Ø185.00	Ø185.00
Pad thickness, mm	32.44	32.44
Clearance, mm	0.13	0.13
Design Clearance, mm	0.11 to 0.15	0.11 to 0.15

LP COMPRESSOR THRUST BEARING PADS THICKNESS (MM)

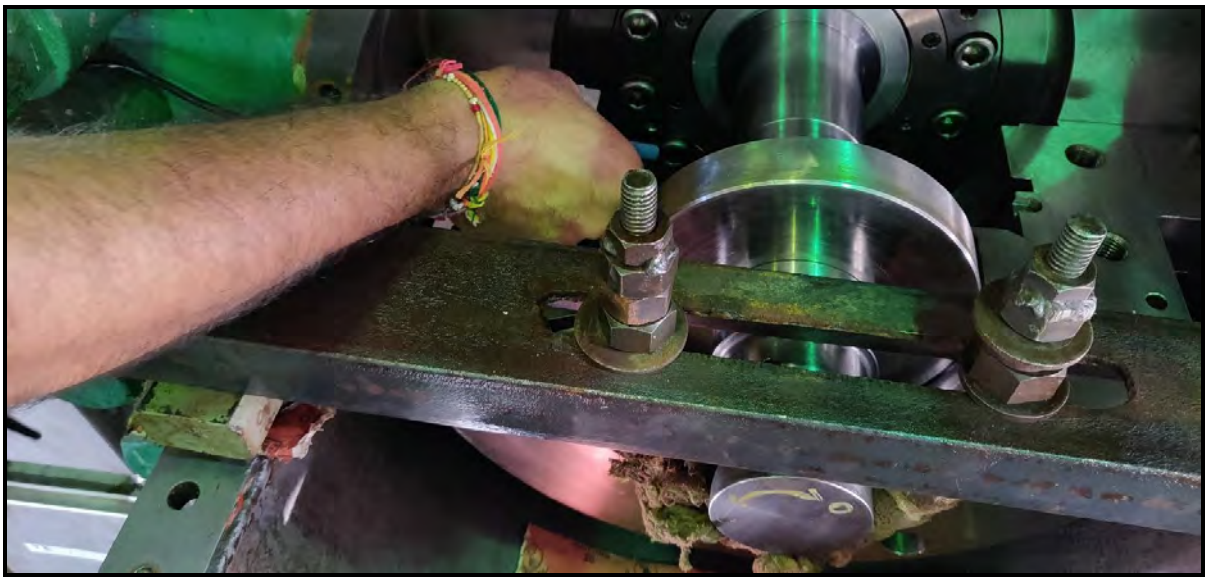
PAD NO	ACTIVE	PAD NO	NON-ACTIVE
1-1	19.82	2-1	19.83
1-2	19.82	2-2	19.82
1-3	19.81	2-3	19.83
1-4	19.83	2-4	19.82
1-5	19.82	2-5	19.82
1-6	19.82	2-6	19.84
1-7	19.83	2-7	19.82
1-8	19.82	2-8	19.82
1-9	19.82	2-9	19.83
1-10	19.83	2-10	19.82
1-11	19.80	2-11	19.83
1-12	19.82	2-12	19.82

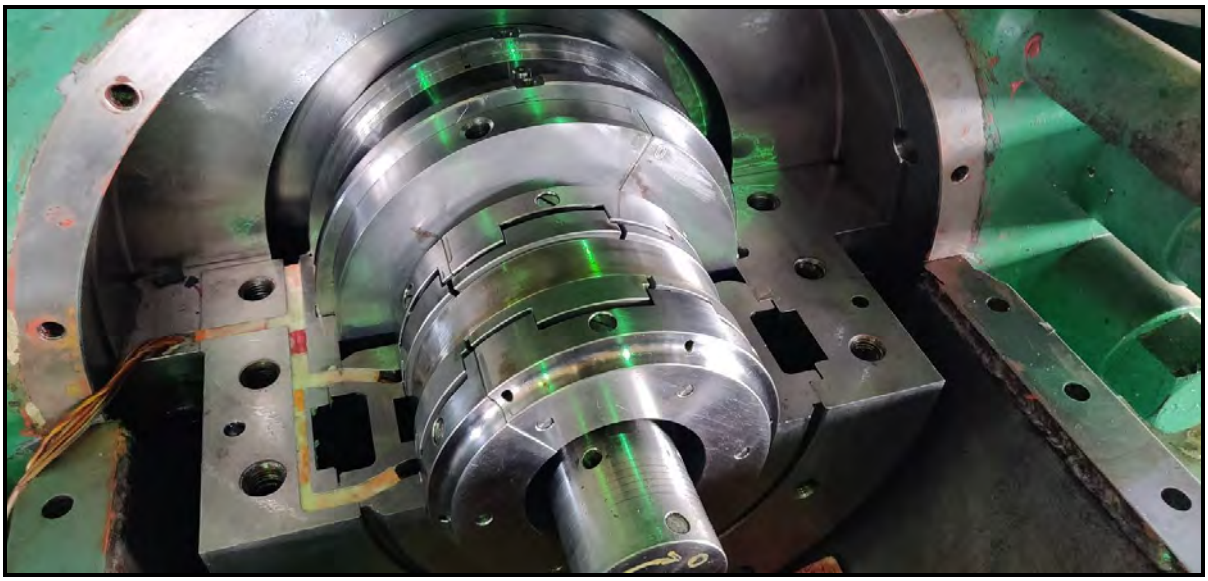
DP OF BEARINGS PADS BEING CARRIED OUT

Preventive Maintenance of CO_2 Compressor HP case (K-1801-2):

HP compressor was taken for preventive maintenance. Following activities were carried out:

- Decoupled the HP case from Gear box
- Alignment readings were checked and found ok.
- Journal bearing assembly on Gearbox side was opened for inspection. Found clearance values outside the acceptable limit (Clearance values measured are given in Table-3), hence it was decided to replace the same with new tilting pads from Store.
- Journal bearing assembly on free end side was opened for inspection. Found clearance values within acceptable limit (Clearance values measured are given in Table-3).





LP COMPRESSOR BEARING REMOVAL UNDER PROGRESS

- Thrust bearing was opened for inspection. Clearances values found within acceptable limits.
- Axial thrust: 0.31mm (design value : 0.25 to 0.35)
- Gauss measurement of Journal and thrust bearing pads, base rings, shaft journal, thrust collar were carried out, found within acceptable limit.
- DP testing of thrust pads, thrust collar and shaft journal was done and the same found acceptable.
- Alignment between HP-Gearbox was corrected as per OEM reference values. Details are given in this report.

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

Description	Gear side – Journal bearing	Rear end – Journal bearing
Journal diameter, mm	Ø79.99	Ø79.99
Bearing bore, mm	Ø80.10	Ø80.13
Shell bore, mm	Ø132.00	Ø132.00
Pad thickness, mm	25.95	25.935
Clearance, mm	0.11	0.14
Design Clearance, mm	0.11 to 0.14	0.11 to 0.14

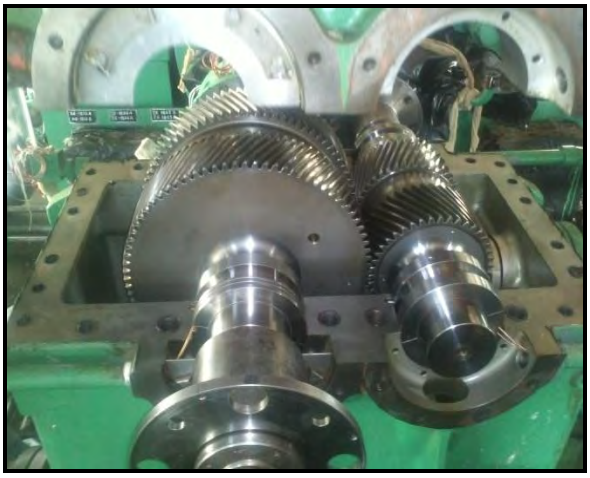
HP COMPRESSOR THRUST BEARING PADS THICKNESS (MM)

PAD NO	ACTIVE	PAD NO	NON-ACTIVE
1-1	22.19	2-1	22.19
1-2	22.18	2-2	22.19
1-3	22.18	2-3	22.18
1-4	22.19	2-4	22.18
1-5	22.20	2-5	22.17
1-6	22.18	2-6	22.19

Preventive Maintenance of GEAR BOX M-1801

Gear Box was taken up for major overhauling. Following activities were carried out:

- Decoupled the Gear box from LP case and HP case
- Alignment of Gear box with LP case and HP case was checked and found ok.




GEAR BOX VISUAL INSPECTION

Low-speed Gear Shaft and Bearings

- Both Low speed shaft bearings (Elliptical Type) were inspected and clearances values found within acceptable limit. (Clearance values measured are given in Table-4).
- Gauss measurement of pads, journal shaft, thrust collar and bearing was carried out by Inspection section and found ok.
- DP checking of thrust bearing pads, thrust collar, journal shaft and bearing was done and found satisfactory.

High-speed Pinion Shaft and Bearings

- Both Pinion shaft bearings (Offset Halves Type) were opened for inspection and found ok.
- Gauss measurement of shaft journal and bearing was carried out by Inspection section and found within acceptable limit.
- DP testing of shaft journal & bearing was done and the same was found acceptable.
- Assembly was done using the same bearings.
- Alignment between LP case – Gear box and Gear box – HP case was corrected as per protocol readings. Details are given in this report.

Table 4- Bearing clearance for Gear Box

Description		Before O/H (mm)	Design Value (mm)	After O/H (mm)
Low speed shaft	Journal bearing clearance on LP side (Front)	0.15	0.125 to 0.185	0.15
	Journal bearing clearance on HP side (Rear)	0.15	0.125 to 0.185	0.14
	Thrust bearing clearance	0.40	0.38 to 0.61	
High speed shaft	Journal bearing clearance on LP side (Front)	0.18	0.15 to 0.21	0.17
	Journal bearing clearance on HP side (Rear)	0.24	0.15 to 0.21	0.17
Gear backlash		0.47	0.383 to 0.608	0.44

COUPLINGS

- Turbine to LP coupling element (turbine side) had broken shims. The element assembly was replaced by new one. DBSE measured & found as per drawing. The same was then coupled at the required tightening torque 53.2 kgf.m (521.36 N. m).
- LP case to Gear box coupling DBSE measured & found as per drawing & coupled at required tightening torque 20 kgf.m (196 Nm).
- HP case and Gear Box coupling DBSE measured & found as per drawing & coupled at the required tightening torque 9.7 kgf.m (95.06 Nm).
- The readings are as under DBSE at outward position of each shaft :

Description	DBSE (mm)
Turbine - LP case	737.47
LP case - Gear box	674.54
Gearbox - HP	337.36

Pilot valve of main steam (60 ata), extraction steam(23 ata) and induction steam (4 ata)

Main Steam (60 ata) Pilot Valve

- The 60-ata servomotor was dis-assembled.
- The thrust bearing, was replaced with new from store.

Extraction Steam (23 ata) Pilot Valve

- Pilot valve assembly was dismantled. (Drawing no. 0-0006-1910-07).
- The thrust bearing was replaced with new from store.

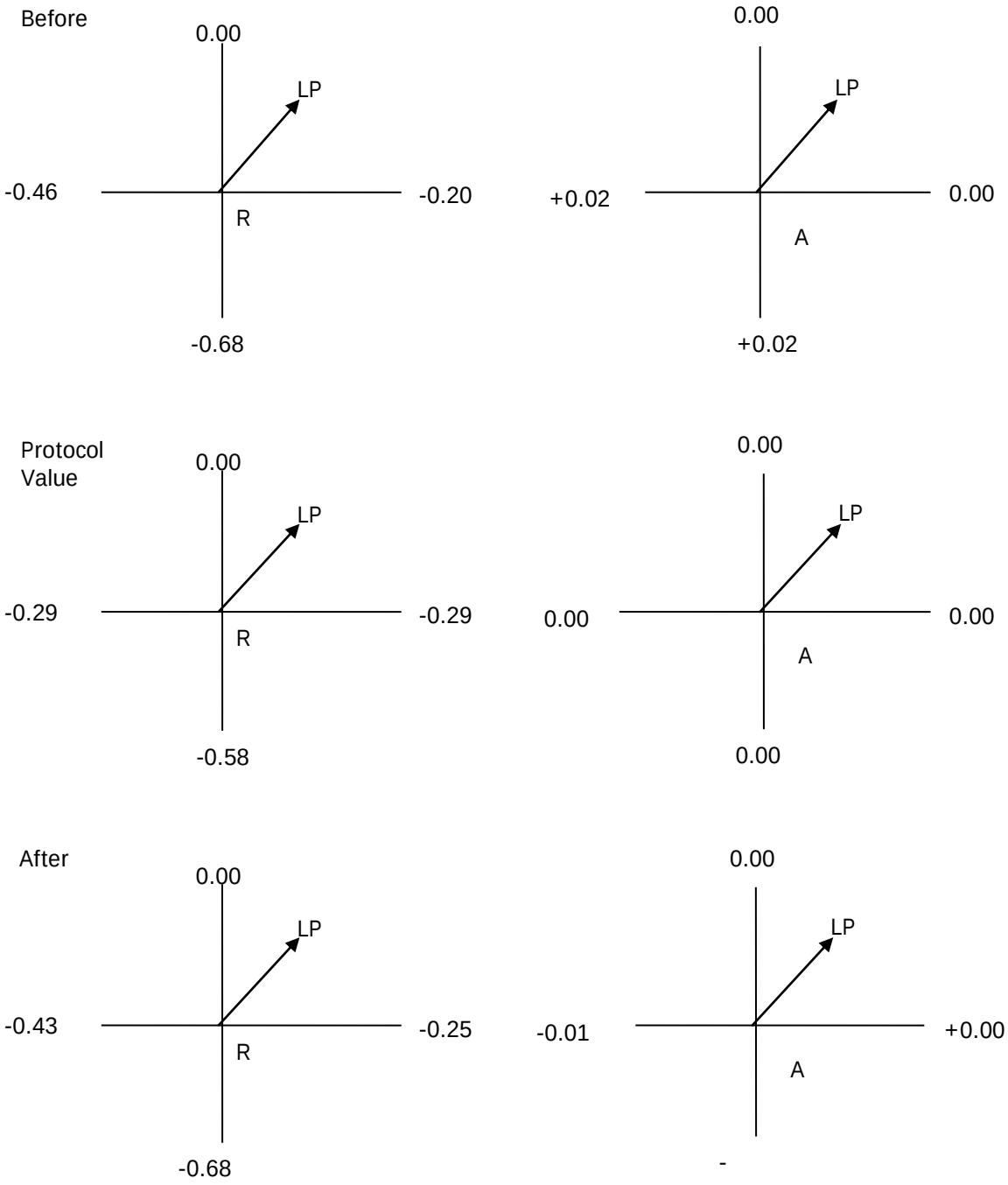
Extraction Steam (23 ata) Control Valve

- The control valve was dismantled.
- All parts were properly cleaned.
- The graphite rings were replaced with new from store. The total length of rings was 42mm i.e. 7 rings were used.

Induction Steam (4 ata) Pilot Valve

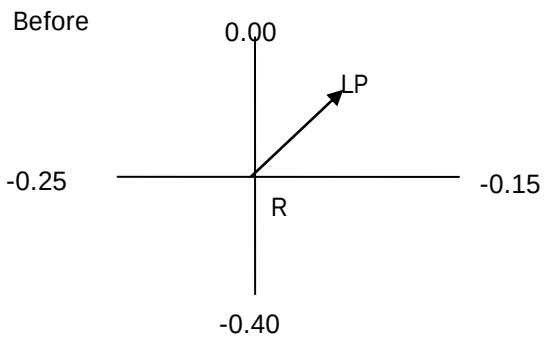
- Pilot valve assembly was dismantled.
- The thrust bearing was replaced with new one from store.
- The top was leaking oil during normal plant running so it was decided to change the shaft bush. The same was replaced during shutdown.

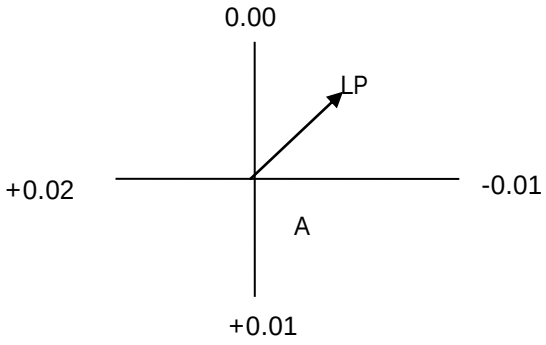
Alignment between Turbine and LP Case



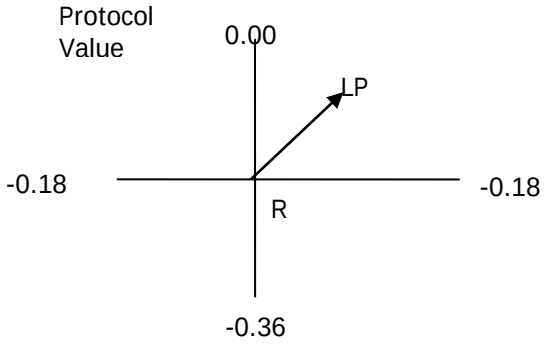
Alignment between LP Case and Gear Box

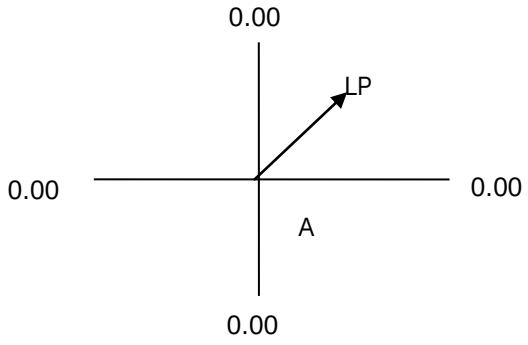
Before



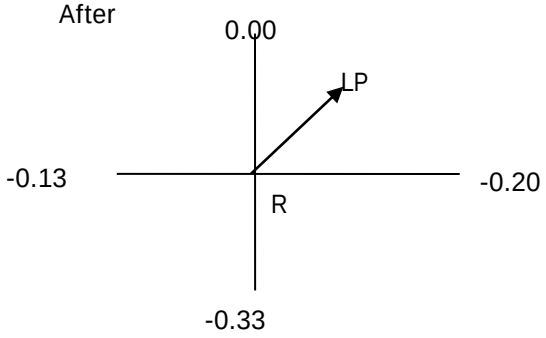


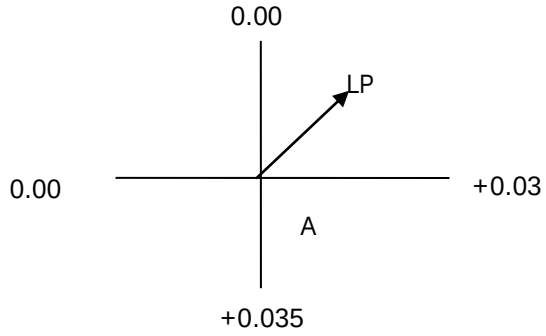
Protocol Value





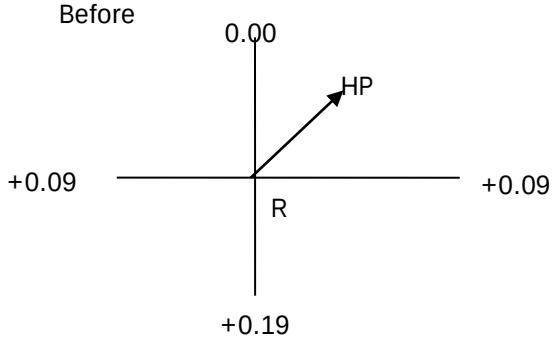
After

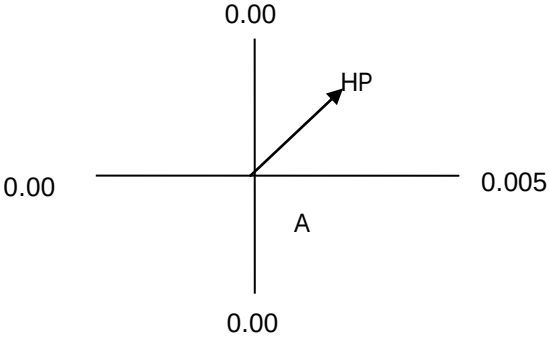


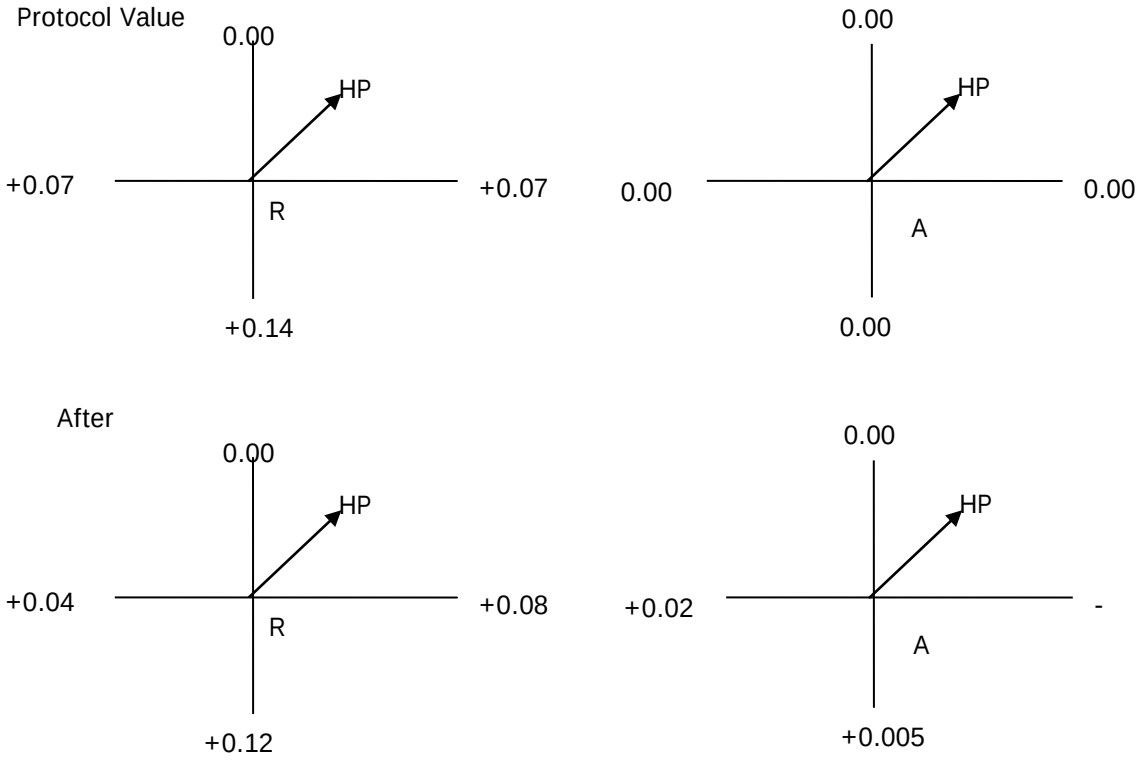


Alignment between Gear Box and HP Case

Before







Lube oil accumulator of control oil system:

Nitrogen pressure was checked in oil accumulator of control oil system of turbine. Pressure was 2 kg/cm2 g. Nitrogen was filled in accumulator bladder up to 2.7 kg/cm2 g with charging KIT.

MAJOR OVERHAULING OF LUBE OIL TURBINE (Q-1814)

The drive turbine for lube oil pump P-1814-A was taken for major overhauling as per schedule of 5 years. The last overhauling was carried out in the year 2013.

DISMANTLING OF TURBINE :

- Decoupled the turbine with pump. Measured the distance between coupling hub flange face.
- Alignment of turbine with lube oil pump was checked in cold condition & recorded.
- Delinked the Governor, trip valve & governor valve. Removed the governor. Gland housing and carbon rings were removed.
- Measured the total rotor float & nozzle clearance.
- Removed the bearing and bearing housing of both ends.
- Disassembled the casing & removed the rotor and sector.
- The OST assembly & bearings were removed from the shaft.

Q-1814 DISMANTLING UNDER PROGRESS & GOV VALVE SPINDLE STUCK IN BONNET

INSEPCTION & OBSERVATIONS

- Visual inspection & DP check of all major components was carried out.
- The governing valve spindle was found struck in open position. On dismantling the valve, the spindle was found bend.
- Non drive end gland housing was found cracked.
- The diameter of the shaft at NDE bearing area was found reduced. Clearance was observed in-between bearing & shaft.
- Governing valve had no margin to travel with governor shaft still having margin to travel.

ASSEMBLY OF TURBINE

New rotor was issued from stores. History showed the rotor was refurbished after last shutdown with new shaft. Dimension measurement, balancing check & gauss measurement was done. The rotor was found ready for use.

- The old removed OST collar assembly was installed on this rotor.
- Sector & rotor were placed inside the casing& the sector was tightened.
- Casing was installed after providing Birkosit compound in between joint planes. Both ends bearing housing were installed.
- Rotor total float & nozzle clearance was measured by providing dummy aluminum bearings. Nozzle clearance found to be 1.15 mm against design value of 1.17-1.88 mm. Hence this was increased to 1.25 mm by providing 0.1 mm shim before bearing of drive end.
- Reassembled the gland housing new carbon rings. The NDE gland housing was taken from Ammonia Mechanical w/s 112-JT rack. It was used after dimensional measurement. Leak off line tapping direction was changed in the new housing and hence the leak off lines were modified. Birkosit was provided between all joints.
- Installed both ends bearings & bearing housing cover tightened. Installed the governor mounting spool piece and reinstalled new governor. The new governor was tested on test bench before installation.
- Connected governing valve linkage & trip valve linkages. The length of connecting rod linkage in-between governor & governing valve was adjusted to keep the slight margin for governing valve opening as well as closing, with governor shaft full travel. This will prevent any compressive or tensile stress on governing valve, thus avoiding its damage.

CONDITION	GOVERNING VALVE TRAVEL
Governing valve de-linked to governor	18.8 mm
Governing valve linked to governor before link length adjustment	18.8 mm
Governing valve linked to governor after link length adjustment	15 mm 1.2 mm gap at bottom in fully closed condition 1.6 mm at top in fully open condition

- OST was done at 3545 rpm (protocol value – 3582 rpm).
- The turbine was coupled and alignment reading was checked & recorded.

BRACKET PROVIDED ON BEARING HOUSING FOR KEYPHASOR FOR SPEED MEASUREMENT

Description	Design Value	Before	After
	mm	mm	mm
Wheel runout , radial max.	0.41	0.03	0.03
Wheel runout , axial	0.1	0.1	0.1
Shaft runout , maximum	0.05	0.01	0.01
Governor coupling spider end play	0.76 - 1.52	1.0	0.9-1.0
Shaft end play	0.06 - 0.41	0.03	0.03
Shaft dia - DE		44.99	44.99
Bearing fit to shaft interference - DE	0.003	0.003 (Clearance)	-0.003 (Interference)
Shaft dia - NDE		45.05	44.99
Bearing fit to shaft - NDE	0.003	- 0.05 (Interference)	-0.002 (Interference)
Carbon Ring to shaft clearance - DE	0.06 - 0.13	0.9-0.12	0.08
Carbon Ring to shaft clearance - NDE	0.01 - 0.08	0.9-0.12	0.04
Nozzle to bucket clearance	1.17 - 1.88	1.37	1.25
Sector to bucket clearance	1.57 - 2.39	1.48	1.50
Total float	Sum of above	2.85	2.75
Roto dyanamic unbalance (max.) per plane	0.76 grams		

Lube oil pump P-1814-A & P-1814-B

There was minor leakage from the mechanical seal of P-1814-A & hence the pump was replaced by spare refurbished pump. The refurbished pump was having new mechanical seal & new bearings. The front pedestal was reused as there was crack in the pedestal of the spare pump. The pump P-1814-B's lube oil was replaced by new oil. The lube oil filter elements were replaced by new one.

P-1202-B

The old pump was of carbon steel construction. As part of upgradation, the pump P-1202-A was replaced in the year 2016. This year the pump –P-2012-B was replaced by new one. The complete base frame was replaced by new one. The suction and discharge line was modified to match the respective flanges of the pump. The suction valve was repositioned to make it safe for movement. The old motor was installed after overhauling. Alignment was done keeping the maximum misalignment values under 0.01. The suction and discharge flanges were opened & blind plates provided in-between them keeping little gap. The newly fabricated lines were flushed. DOR of the motor was checked and coupling done. The oil of the pump was flushed. Trial run of the pump was taken. The pump was found to be running normal with vibration within acceptable values.

NEW PUMP P-1202-B, SUCTION LINE, DISCHARGE LINE & BASE FRAME

P-1408

The melt solution pump had been running with higher vibration since long time. The high vibration was mostly due to the old foundation frame. This frame was of multi-level construction i.e. C-Channel on plate, plate on frame, Frame on another plate & then this plate on grouted frame. Further thread taping for the pump & motor foundation bolts was on the bottom most plate. This threads were damaged resulting in loose foundation bolts.

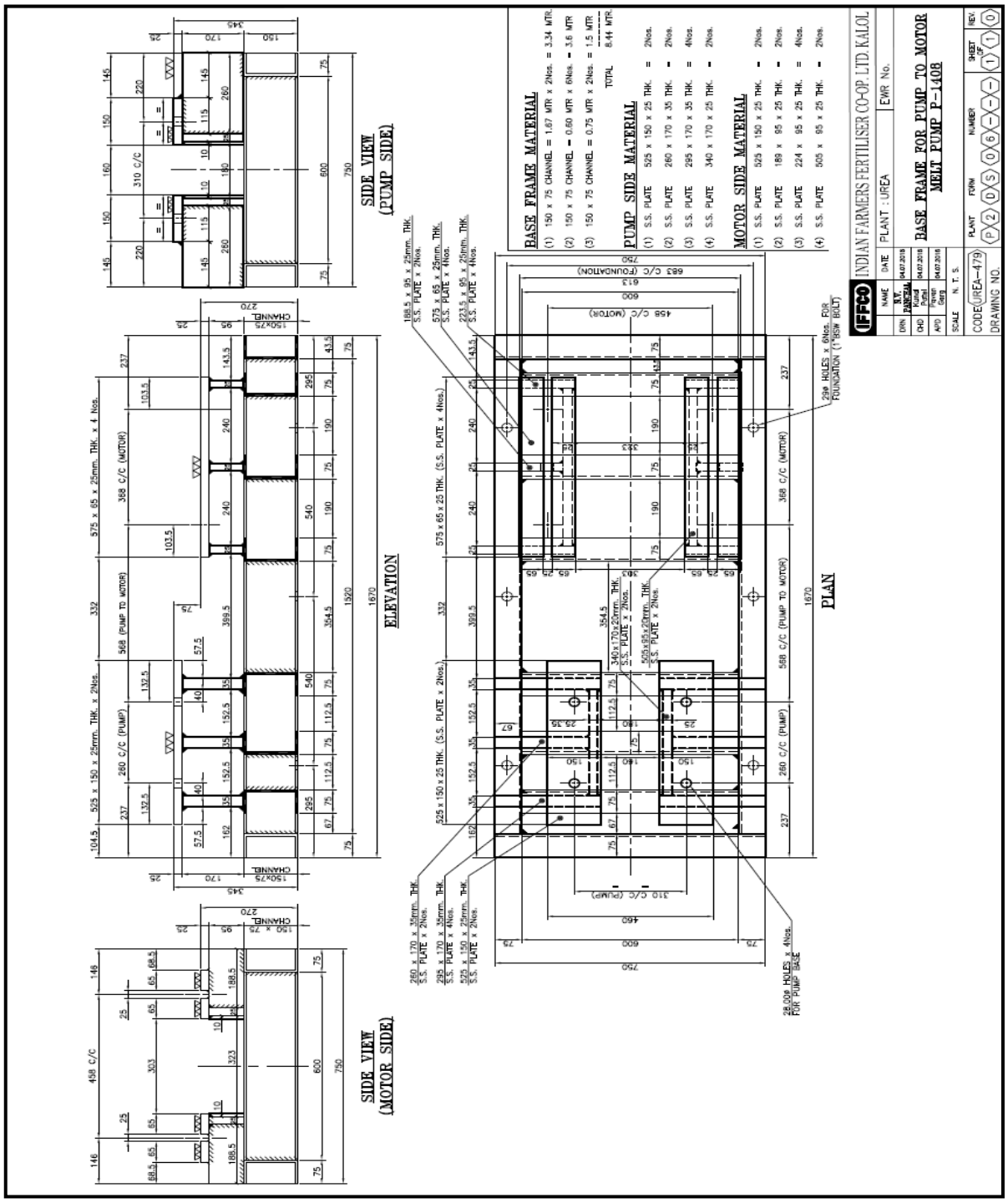
Hence new foundation frame was fabricated at workshop. The grouted portion was made of carbon steel channels & coated with stanvac epoxy paint. The portion above the grout was made of SS plates. The base plates were machined to desired height on

boring machine followed by lapping for 36 hours. Excess J-bolts received with new P-1202-A & B were used here for foundation grouting.

Spare refurbished pump was installed with new frame. Refurbished motor was installed Alignment was done. Utility steam/condensate lines were rerouted to create space for easy maintenance. Coulping was done with new pads. The pump was trial run & found to be running normal with vibration well below the acceptable limit.

VIBRATION BEFORE : Velocity 1.2 – 5.5 mm/s

VIBRATION AFTER : Velocity 0.7 – 2.0 mm/s

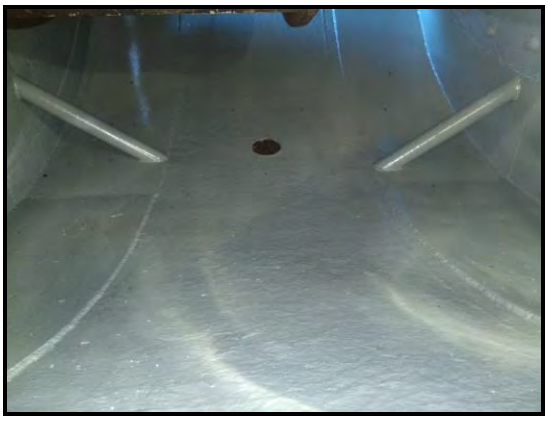


P-1408 ON NEW BASE FRAME

PRILL COOLING SYSTEM INLET AIR FAN (K-1701)

- Visual inspection of both bearing was done. Oil flushing of both bearing was done.
- Belts were replaced by new belts.
- Alignment of both pulleys was done and belt tension was checked and guard was provided.
- The casing was damaged at various location in the bottom half. Hence reinforcement of new 5 mm CS plates was provided as shown in the photograph.

K-1701 CASING BEFORE



K-1701 CASING AFTER REPAIR

PRILL COOLING SYSTEM EXHAUST AIR FAN (K-1702)

- Both ends bearing cover was opened & visual inspection was done. Oil flushing of both bearing was done.
- Belts were replaced by new belts.
- Alignment of both pulleys was done and belt tension was checked and guard was provided.

PRILL TOWER ID FAN K-1401-1/2/3/4

- Both the bearings of all the fans were checked and found o.k.
- For fan No 2 top and bottom bearing rollers were found damaged and hence replaced by new one.
- The top bearing of fan No 1 & 4 were found to be expansion type or radial type i.e. EX type. The same was converted to fixed type or thrust type i.e. GR type.
- All fans now have top bearings as fixed type and bottom bearing as expansion type.
- For fan No 3 the bearings were replaced lately and hence they were not opened.
- Greasing of all bearing was done.
- Belts of fan NO 1, 2 & 4 were replaced by new one.
- Alignment of motor and fan pulley was corrected.

CONVEYOR SYSTEM:

M-1403-1

- The bearings of head & tail pulley greasing was done.
- DP of head pulley and tail pulley shaft was checked and found ok.
- Alignment & coupling was done between gear box to motor.
- Damaged carrying rollers and return rollers were replaced.

M-1403-2

- The belt was replaced by new one
- 850 mm HR grade belt was used.
- The head pulley was replaced by new one
- The bearings of head pulley were replaced by new one.
- The bearings of tail pulley greasing was done.
- DP of tail pulley shaft was checked and found ok.
- Damaged carrying rollers and return rollers were replaced.
- Gear box oil was flushed.
- Alignment & coupling was done between gear box-motor-pulley.

M-1403-3

- Gear box oil was flushed.
- Coupling bush were checked.
- Alignment was done between gear box to motor and from gearbox to pulley.
- DP of head & tail pulley shaft was checked and found ok.

M-1419

- Damaged carrying rollers and return rollers were replaced.
- Gear box oil was flushed.
- Greasing of chain and sprocket was done.
- Damaged tie rod of tail pulley bearings was replaced.
- Greasing of tail & head pulley bearings was carried out.
- Alignment was done between gear box to motor and from gearbox to pulley.
- DP of head & tail pulley shaft was checked and found ok.
- Structures & frames were coated with stanvac metal surface corrosion prevention coating 1040 STANGARD (ST) EPOXY MASTIC ,
  718 STANGARD EGF (NV), 727 STANGARD HP – PLPU

M-1421

- Damaged carrying rollers and return rollers were replaced.
- Gear box oil was flushed.
- Greasing of chain and sprocket was done.
- Alignment was done between gear box to motor and from gearbox to pulley.
- DP of head pulley shaft was checked and found ok.
- Tail pulley and its bearings were replaced by new one.
- Structures & frames were coated with stanvac metal surface corrosion prevention coating 1040 STANGARD (ST) EPOXY MASTIC ,
  718 STANGARD EGF (NV), 727 STANGARD HP – PLPU

SCRAPER (M-1402-1/2)

- Scrapper damaged aluminum protective sheet were replaced by new one.
- Oil level was checked and found OK.
- Gear box oil was flushed.
- Both fluid couplings were replaced by new one.
- All belts were replaced by new one.

ALIGNEMENT & COUPLING OF MOTORS

Decoupling, Alignment & coupling of the following motors was carried out

- P-1814-B
- P-1802
- P-1803
- p-1815-A
- P-1815-B
- P-1150-A
- P-1150-B
- P-1151-A
- P-1151-B
- P-904-B
- P-1505-A
- P-1505-B
- P-1501
- P-1506

H.P. VESSEL

Autoclave V-1201

The autoclave was opened for attending leakage of liners. The top cover was removed after unbolting using hydraulic bolt tensioner with oil pressure maintained slightly above 700 bar. All the 11 Trays of Autoclave were opened for inspection and visual as well as helium leak test was carried out. The detail of leaks and repair carried out can be found in the inspection section.

Defect found by visual inspection are as follows

Compartment – 1

Previously repaired defects on liner at S-W direction besides long seam observed eroded & pits of 0.5 to 1 mm deep and 15mm dia approx., marked D1-1 were repaired and found satisfactory in DP test.

Compartment – 3

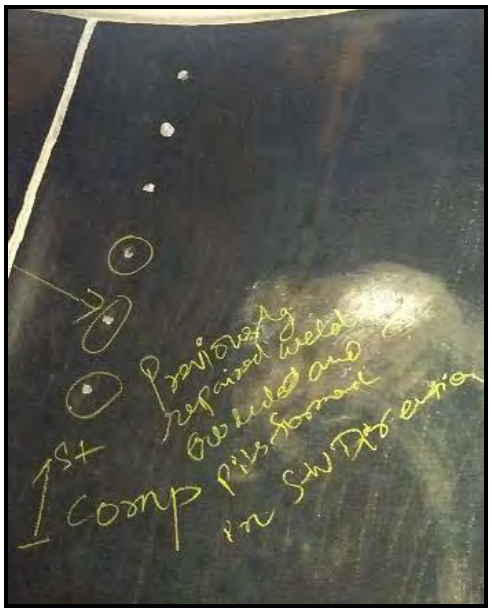
Above “C” seam in North direction near cleat Pinhole of approx 0.3 to 0.5mm & 3 to 4 mm deep, marked D3-1 were repaired and found satisfactory in DP test.

Compartment – 4

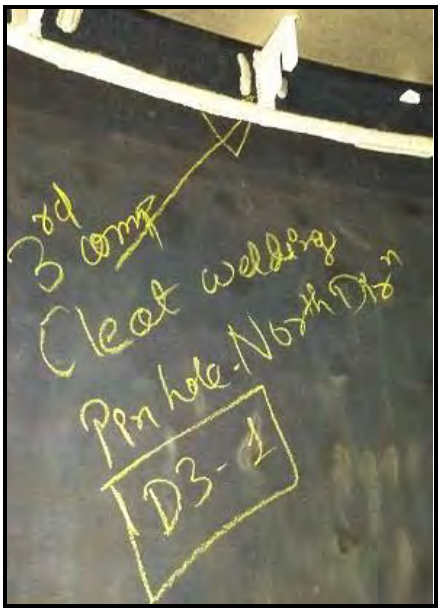
North side direction just above the “C” seam near cleat previously repaired defects found eroded & pits of 0.3-0.5 mm deep in 50mm length approx., marked D4-1 and pin hole of 1.5 -2.0 mm deep in west side “L” seam, marked D4-2 were repaired and found satisfactory in DP test.

Compartment – 5

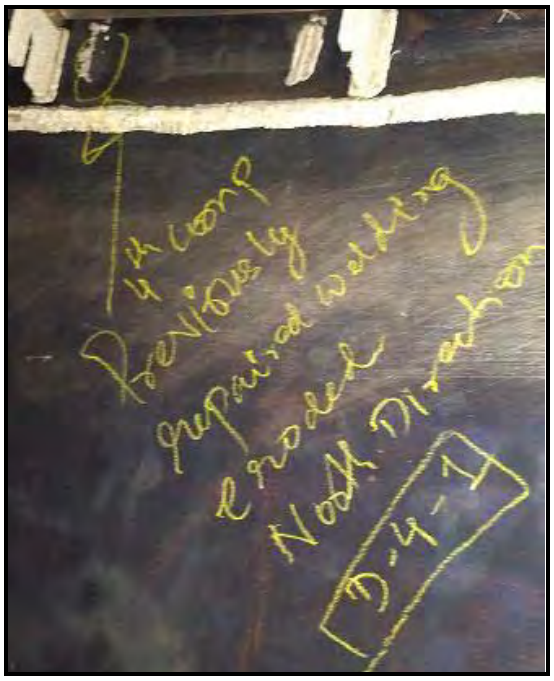
In south-west direction above” C” seam previously repaired defects having pitting of 0.5 mm deep& 10.0 mm dia, marked D5-2 and minor pinhole observed in “C” seam, marked as defect D5-3 were repaired and found satisfactory in DP test.



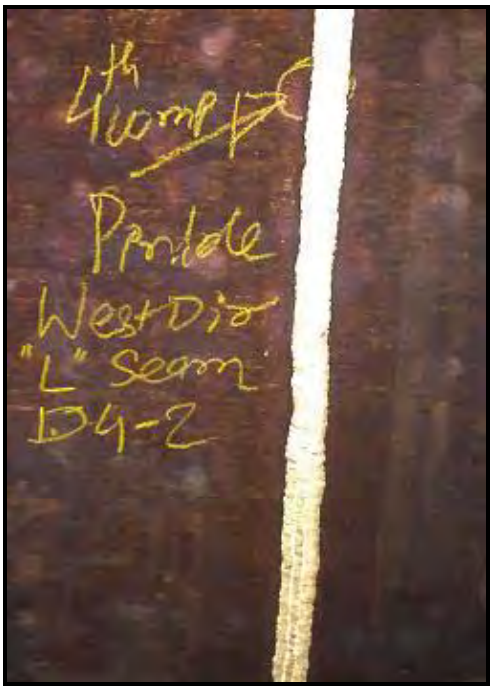
COMPARTMENT -1 South-West



COMPARTMENT -3 North

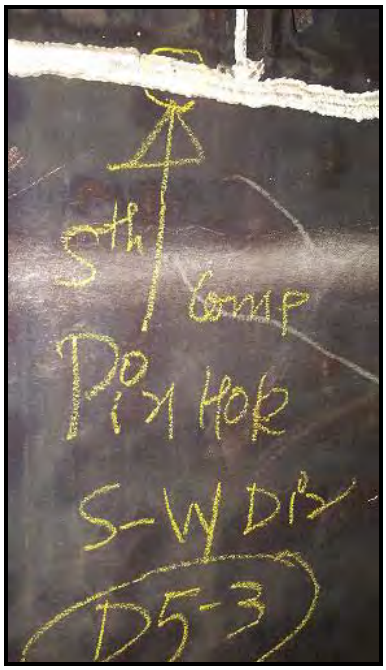


COMPARTMENT -4 North



COMPARTMENT -3 West

COMPARTMENT - 5 South west



COMPARTMENT - 5 South west

Leakages found by helium leak test is as follows

Compartment – 5

Helium leak detection carried out on 25.09.2018 with 0.26 kg/cm2 (g)pressure in shell side liner annular space (Weep hole no 4 to 15) and leakage observed in south direction at bottom of cleat welding and just above the “C” seam welding top edge which were re confirmed by liquid soap solution test. marked as D5-1. This was repaired and found satisfactory in DP test.

COMPARTMENT - 5 South (Before)

COMPARTMENT - 5 South (After)

Post repair, all trays were installed back. All bolts were reused, except few new ones at locations where bolts were removed by grinding. The top cover was boxed up and studs tightened by hydraulic tensioner.

- Tightening pressure for top cover.

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

HP Stripper (H-1201)

Bottom cover was removed using bolt tensioner at 900 kg/cm2. The bottom cover was lowered onto the wooden sleepers. After inspection, the bottom cover was boxed up. No repairs /rectifications were required to be carried out as per inspection report.

Top cover was removed using bolt tensioner at 900 kg/cm^2 and the top cover was shifted below the platform using monorail hoist and chain blocks. Ferrules were removed from position. The same were cleaned and delta pressure was checked by Production department.

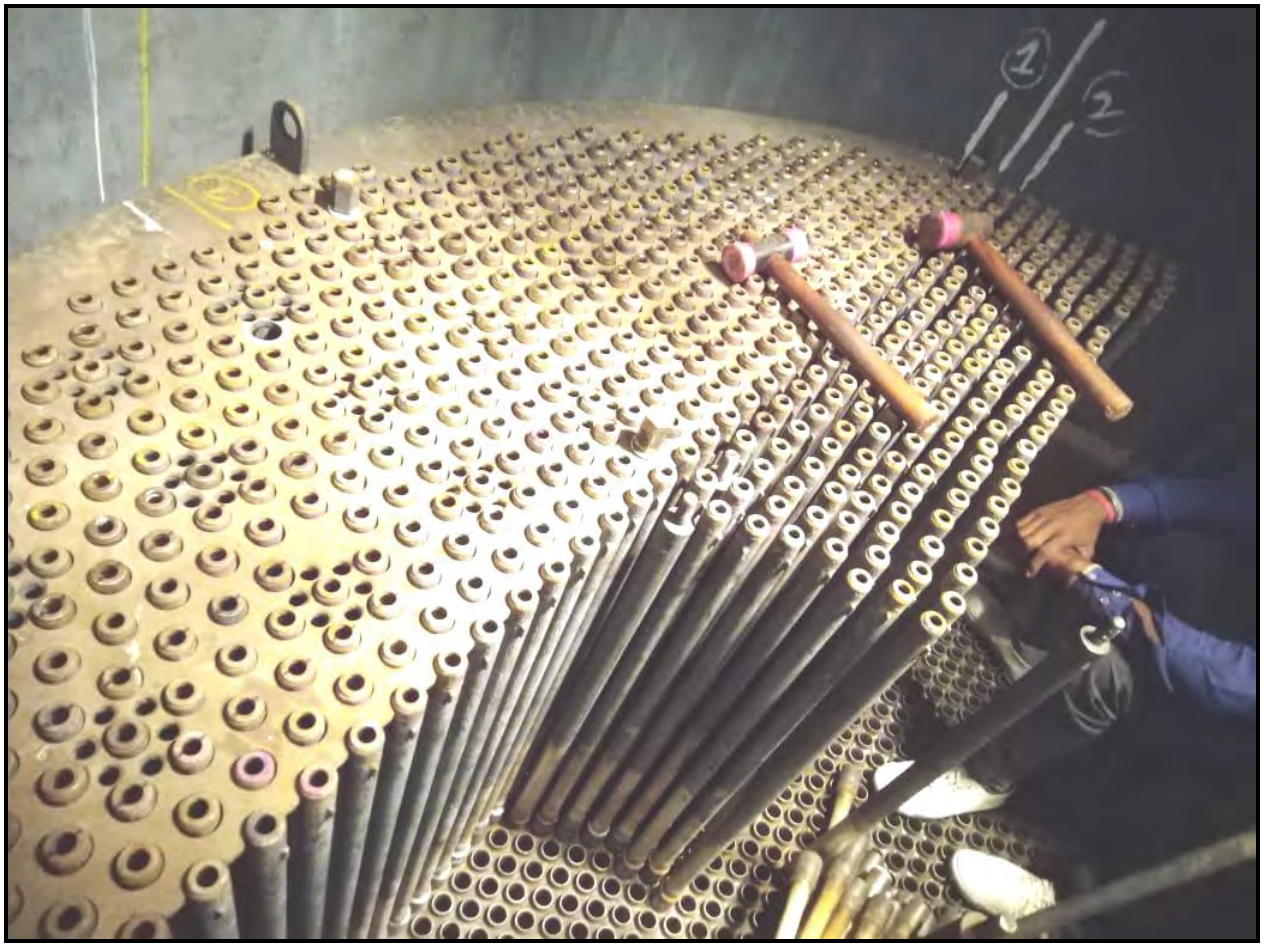
Delta pressure was found out of range for around 150 Nos. It was observed that hole size had increased & seal weld joint between gas tube & liquid divider had eroded. Hence at workshop the hole size was made 2.6 mm. The gas tube to liquid divider was re-welded.

Eddy current testing was carried out by Inspection Department. Post inspection cleaning done by production. All deposits on tube sheet was removed by stainless steel wire brush. The ferrules were fixed in position with new PTFE gaskets.

After the bottom cover was boxed up, pressure drop measurement was carried out by production department for each tube and the same was found within limit. Exchanger was thoroughly cleaned with compressed air and then with DM water.

Top and bottom cover were boxed up with new “Kempchen” gasket (839 mm OD x 800 mm ID x 4 mm thick) with new 0.5 mm thick Teflon envelope. Tightening pressure for top and bottom cover is as follows :

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



STRIPPER FERRULE INSTALLATION

HP Condenser (H-1202)

The HP condenser H-1202 was installed in the year 2017 and it was taken for visual inspection of internals as well as Eddy current testing of the tubes. During preshutdown the following activities were carried

- The bottom heavy concrete slabs on 3rd floor were removed and lightweight removable type gratings were installed to reduce time during shutdown.
- A clamp with three lugs was fabricated and provided on the channel cover as a proper rigging arrangement to lower the bottom cover.

- A frame was fabricated and positioned on 2nd floor for keeping the bottom channel cover.

LIGHT WEIGHT REMOVABLE PLATFORM

FABRICATED FRAME FOR BOTTOM COVER

CLAMP FOR BOTTOM CHANNEL FLANGE & SAFFOLDING FOR BOTTOM SCAFFOLDING

BOTTOM COVER REMOVED & PLACED ON 2nd FLOOR

- The top cover was opened using hydraulic bolt tensioner at a pressure of slightly above 800 kg/cm^2 and the top channel was handed for inspection.

- The bottom cover was opened with hydraulic bolt tensioner at a pressure of slightly above 800 kg/cm^2 the channel cover along with the gas distributer was lowered to the 2nd floor and kept on the prefabricated rack.

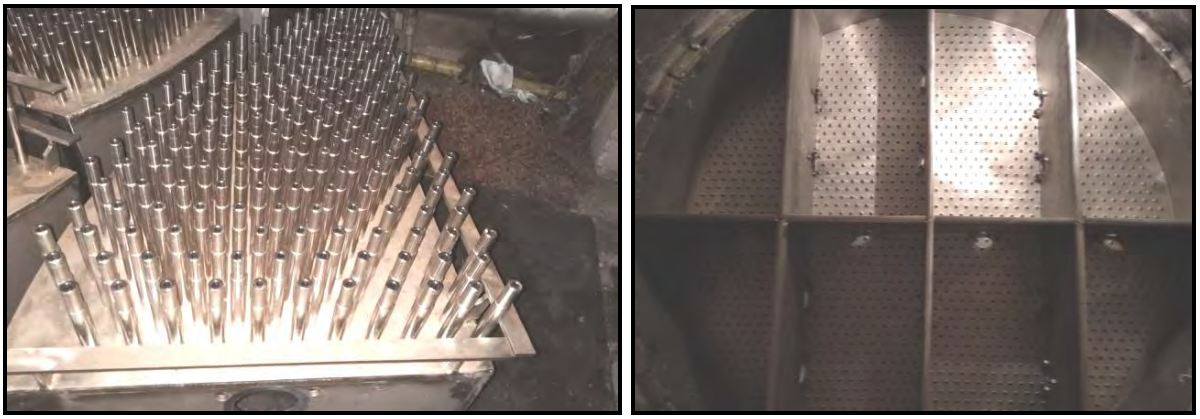
- The bottom gas distributer were removed inspected and found OK. IRIS of the tubes was carried out.
- Post inspection the internals were reinstalled. The top and the bottom cover were positioned and tightened at pressure

  1st tightening round 200 kg/cm2

  2nd tightening round 400 kg/cm2

  3rd tightening round 600 kg/cm2

  Final tightening round 800 kg/cm2



BOTTOM GAS DISTRIBUTER AFTER & BEFORE REMOVAL

HP Scrubber H-1203

Removal of top dome

- Removed the insulation for top dome lifting from following portions.
  - Off gas line flange
  - Flange of top dome and shell
  - Steam tracing line
  - Carbamate Inlet flange
  - CO_2 purging Inlet
- Prepared the scaffolding for off gas flange /steam tracing
- Placed the wooden plank on platform for safe working
- Removed the cap of stud of top dome, cleaned by rustolene and wire brush
- Marked the all process and steam line connections and disconnected.
- Disconnected the following flange of top dome

- Off gas flange (C3-3"x1500#) ** used safety belt
- Carbamate solution inlet (C6 - 3"x1500#)
- CO2 purge conn. (1"x1500, 3nos.)

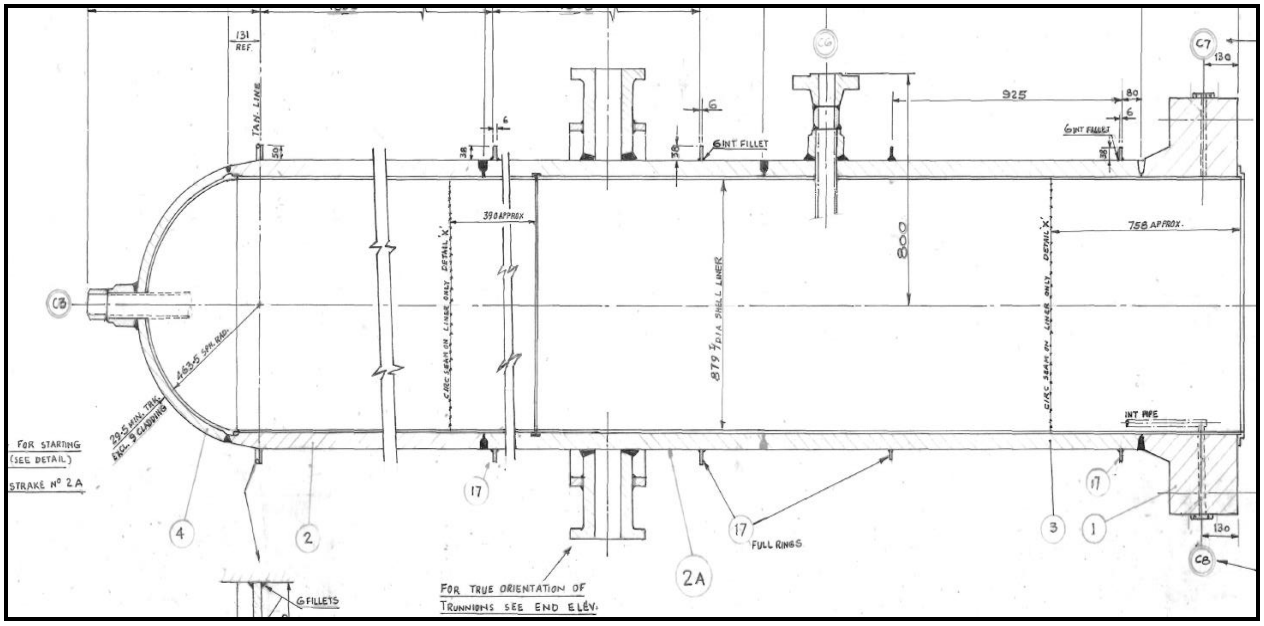
- Cut the steam tracing line
- Prepared the lifting arrangement for top dome (2 nos. of monorail, 2 nos. of 10 ton chain blocks, 2 nos. of 5 ton slings & 2 nos. of hook-chuk) . Mounted these tools on 2 nos. of trunion and tied sling with hook of chain block for safety purpose
- Loosened the nut one by one using bolt tensioner at 750 kg/cm2 g and removed all nuts.
- Disconnected the drain line flange (inside shell, 1/2") after lifting top dome.
- Shifted the top dome towards K-1403-3 , placed on wooden sleeper
- Removed the diaphragm
- Departmental inspection was carried out. Repair work was done as per report. Pneumatic test of liner weld was carried out, leak observed at blind flange weld joint with liner. The same was repaired.
- Refixed the diaphragm on its position in top dome.Installed the top dome and tightened using bolt tensioner. Tightened all flange joints. Steam tracing reconnected. New steam hose provided for flange joints.
- The studs were tightened at pressure as below :

  1st tightening round 300 kg/cm2

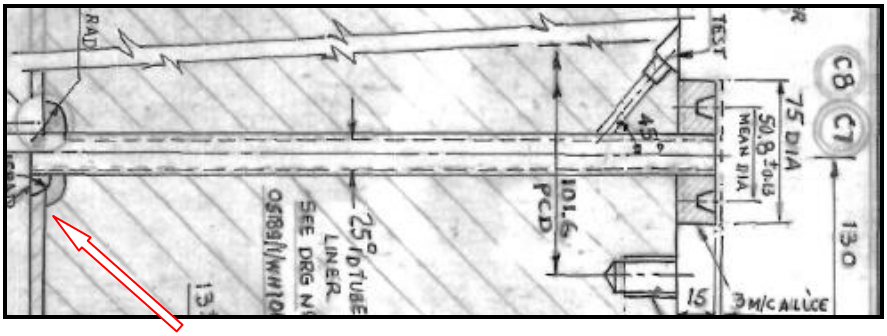
  2nd tightening round 500 kg/cm2

  3rd tightening round 700 kg/cm2

  Final tightening round /checking round 700 kg/cm2



LEAK THROUGH BLIND ON C7 NOZZLE



REPAIRED JOINT

LP Vessel

V-1501

RLA study of the steam drum was carried out as per schedule. The various NDTs and section covered under the RLA are as under:

Sr. No.	Component	VI	UT	MPI	LPI	DIM	HM	DA
1	Steam drum	Y	Y	Y	Y	Y	Y	Y
2	Downcomers piping	Y	NA	NA	Y	Y	Y	N
3	Risers piping	Y	Y	Y	Y	Y	Y	N
4	Feed water line upto 1st isolation valve	Y	N	Y	Y	Y	Y	N
5	Main steam line upto 1st isolation valve	Y	Y	Y	Y	Y	Y	N

VI – Visual inspection, DIM – Dimensional measurement (OD and thickness), PT – Liquid penetration testing, MT – Magnetic particle testing, UT – Ultrasonic testing, HM – Hardness measurement, DA- Deposit analysis

RLA OF RISER TUBES

RLA OF MAIN STEAM OUTLET LINE

The other LP vessels which were opened for inspection and repair done as per inspection report are as under:

- V-1503
- V-1423
- V-1203
- V-1207
- V-1351
- V-1811
- V-1424

V-1424 DUMMY 2RE69 SKIRT

V-1202 NOZZLE ON NEW STAND

CRITICAL VARIOUS FABRICATION JOBS

- The discharge line of P-1505 was originally of carbon steel. This line was converted to SS 304 few years back above 3rd floor only. Below 3rd floor it was having heavy thickness reduction and in running plant, a box, 2m long had already been provided near 1st floor attended leak. Hence this carbon steel line was replaced by SS 304 line from ground floor to 3rd floor. ½"to 2"branches were replaced to some extent.
- New SS 316 grade pump was installed to replace the existing carbon steel grade P-1202-B. Modification for suction & discharge line of P-1202-B was carried out. Flushing of the lines were carried out post fabrication. The suction isolation valve was reoriented as the same was obstructing the walkway.
- Carbamate pump discharge line elbow & tee on 1st floor was getting cracks frequently during the running plant. Hence the 3" SS 316L elbows and the tees were replaced. All joints were DP & RT tested. 80 & 160 SCH fittings were used for the job. Since pipe size was 80 SCH, the 160 SCH fittings edge was machined to match ID of 80 SCH pipe.

- P-1102-C recycle line valve was 1 ½" X 1500 on 2" line and this valve spindle had broken during operation. This valve was replaced by new 2" X 1500 # valve. The joints were DP tested and RT tested.
- CO_2 line to autoclave 1" line isolation valve near P-1201-A was having heavy gland leak and was furmanited during the running plant. The same was replaced by new 1"X1500# valve.
- A new 2" bypass line with isolation valve was provided for H-1301-A since this welded type PHE was having chocking
- Steam tracing line with isolation valves were replaced at various location from ground to 6th floor attended various leakages.
- Steam tracing line of V-1202 was having leakages at various location. Hence the complete steam tracing line was replaced by new one.
- Two Nos 1" joint repair were advised by inspection on HP loop line 12'' PR-0026-99-A-T near TI-1255 and 10''-PR-0019-99A-THPCC Liquid O/L to V-1201 on 3rd floor. These joints were cut and new welding was done. The same were found satisfactory in RT.
- The following angle globe valves were found heavily damaged in seat and were replaced by new one
  - Autoclave unloading valve on 3rd floor, 2", BEL make valve replaced by DOUGLAS make 2" angle globe valve.
  - HPF to ammonia line below autoclave on 3rd floor, 1", JAPAN make valve replaced by KEYTECH make 2" angle globe valve.
  - Autoclave sample line ½" BEL valve was passing and hence additional new ½" DOUGLAS make horizontal globe valve was provided on 1st floor.
  - Autoclave Sample on ground floor near P-1102-A , 1 ½" , BEL valve

DAMAGE OF AUTOCLAVE UNLOADING VALVE SEAT & VALVE

RELIEF VALVE OVERHAULING AND TESTING

Overhauling and testing of RV's were carried out through M/s Flotec Technosmart (India) Private Limited, Surat. Testing of RVs was done on test bench at Urea mechanical works.

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

Sr. No.	RV No.	Equipment Details	Set Pre. (Kg/cm2g)	Remarks
1	RV-1201 A	V-1201 off gas line	165	New PSV with HVD1 trim, modified Nozzle design & new spring was installed
2	RV-1201 B	V-1201 off gas line	165	--do--
3	RV-1201 C	V-1201 off gas line	165	--do--
4	RV-1205	P-1201 A discharge	165	
5	RV-1206	P-1201 B discharge	165	
6	RV-1208	P-1201 C discharge	165	
7	RV-1103 A	P-1102 A discharge	150	
8	RV-1103 B	P-1102 B discharge	150	
9	RV-1103 C	P-1102 C discharge	150	
10	RV-1181	K-1801 final discharge	177	
11	RV-1903	K-1801 IIIrd stage discharge	111	
12	RV-1202A	V-1202 off gas line LP System	6	
13	RV-1202B	V-1202 off gas line LP System	6	
14	RV-1202C	V-1202 off gas line LP System	6	
15	RV-1203	P-1201 A Suction line	8.5	
16	PSV-1201A	P-1201 A Suction line	8.5	
17	PSV-1201B	P-1201 B Suction line	8.5	
18	PSV-1201C	P-1201 C Suction line	8.5	
19	RV-1101A	Liquid ammonia line from H-1102 to V-1102	31	
20	RV-1101B	Liquid ammonia line from H-1102 to V-1102	31	
21	RV-1102 A	Ammonia suc. Vessel (V-1103)	31	
22	RV-1102 B	Ammonia suc. Vessel (V-1103)	31	New PSV was installed. Now both the PSV are same & interchanable.
23	RV-1108 A	Cold ammonia line from Amm storage tank to H1102	31	
24	RV-1108 B	Cold ammonia line from Amm storage tank to H1102	31	
25	RV-1106 A	Liquid amm, line from amm. Plant to amm. filter.	31	
26	RV-1106 B	Liquid amm, line from amm. Plant to amm. filter.	31	

Sr.	RV No.	Equipment Details	Set Pre.	Remarks
27	RV-1107 A	Liquid ammonia line (hot) before ammonia filter	31	
28	RV-1107 B	Liquid ammonia line (hot) before ammonia filter	31	
29	RV-1110 A	Liquid ammonia line from atm. Amm. storage tank to H-1102	31	
30	RV-1110 B	Liquid ammonia line from atm. Amm. storage tank to H-1102	31	
31	RV-1901	Ist stage discharge of K-1801.	7	
32	RV-1902	IInd stage discharge of K-1801	27	
33	RV-1503	23 ata Steam	25	
34	RV-1504	9 ata Steam Drum	12	
35	RV-1129 A	4 ata Steam Header	6	
36	RV-1129 B	4 ata Steam Header	6	
37	RV-1501 A	4 ata Steam Drum	7.5	
38	RV-1501 B	4 ata Steam Drum	7.5	
39	RV-1506	4 ata Steam Main	6	
40	RV-1209	V-1203 Vessel	10	
41	RV-1351	RV of V-1351	24	
42	RV-1352	RV of V-1352	6	
43	RV-1301	RV of V-1301	6	
44	RV-1184 (CCS-I)	H-1102 outlet NH3 outlet	6	
45	RV-1221 (CCS-II)	P-1204 disch. To H-1203	16.5	
46	RV-1913	Ejector system of Q-1801	0.2	
47	RV-1914	Ejector system of Q-1801	0.2	
48	RV-1916	23 ata Steam extraction	28	
49	RV-1917	4 ata Steam exhaust	4	
50	RV-1351 A	RV of P-1351 A	10	
51	RV-1351 B	RV of P-1351 B	10	
52	RV-1130	24 ata steam header	26	
53	RV-1904	H-1811 First stage gas cooler	7	
54	RV-1905	H-1812 Second stage gas cooler	7	
55	RV-1906	H-1813 Third stage gas cooler	7	
56	RV-1224	C.W from utilities	6	
57	RV-NH3	RV To NH3 Ammonia Plant	85	

HEAT EXCHANGER JOBS

H-1207 tube chocking due to salts deposit

The channel cover was removed & heavy salt deposits was observed. Similar deposits were observed during Annual turnaround 2017and attempts were made to clean by hydro jetting as well as chemical cleaned. But the results were not satisfactory. Hence mechanical cleaning technology was proposed and the services were hired from M/s Gulachi Engineering vide PO No 201004190849. With this new procedure, excellent

results were achieved. Post mechanical cleaning, the exchanger was also cleaned by chemical cleaning.

The exchanger was hydro tested on tube side at 6 Kg/cm and one tube leak was observed. The same was plugged.

H-1814 floating head cover leak

As routine the heat exchanger channels & connected piping were removed. The shell was along with tube bundle was lifted to ground level & tube bundle pulled out. The tube bundle was cleaned by hydro jetting & reinstalled inside the shell. Test rings were installed and the tubes hydro tested at design test pressure & no leak was observed.

FLOATING HEAD COVER JOINT LEAK

In running plant heavy leak from the cover of the floating head was observed. Hence the cover joints were inspected by DP & no defects were observed. A small grooved had formed on the sealing face, may be due to leak. This was repaired by welding. The gaskets was found to be indigenous camprofile type but without graphite layer on both sides. Hence it was decided to install camprofile gasket with graphite layer on both sides. The cover was tightened. 24 Nos new studs were installed. Test arrangement was prepared and the cover joint was tested at 35 kg/cm^2 & no leaks was observed.

H-1427 channel cover parent metal failure.

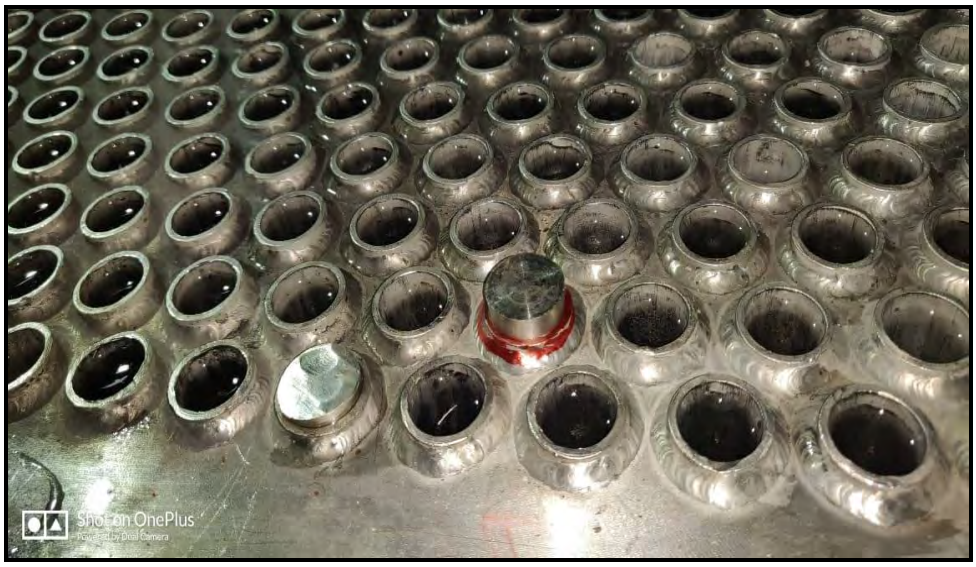
Since few years there was carbamate seepage from the parent metal of the Cooling tower side channel cover. Many attempts were made to repair this but the seepage continued. Hence new channel cover was fabricated at workshop. The same was replaced. When taken in line no seepage was observed.

H-1210

Since cooling water is on the shell side of this exchanger, and the tube bundle is welded type, there is no possibility to clean this exchanger from shell side. Hence a 6” tapping with isolation valve was provided at the bottom of the cooling water inlet line. This will help in back flushing of the exchanger.

H-1205

One tube was plugged as per IRIS inspection report



H-1205 TUBE PLUGGED HIGHLIGHTED IN RED

VAM

All the cooling water side exchangers were opened and cleaned by hydro-jetting and the same were boxed up. A 3”tapping with isolation valve was provided on the cooling water inlet line as a back-flushing arrangement.

Opening, hydrojetting & boxup of heat exchangers

The following heat exchangers were opened for hydro jetting. The same was carried out and boxed up with new gaskets.

- H-1204 (Recirculation Heater)
- H-1207 (Circulation System - Ii Water Cooler)
- H-1352 (Desorber Reflux Condenser)
- H-1419 (Pre-Evaporator Heat Exchanger)
- H-1424 (Second Stage Evaporator / Condenser)
- H-1425 (Second Stage Evaporator / First Condenser)
- H-1426 (Second Stage Evaporator / Second Condenser)
- H-1814 A/B (Lube Oil Cooler Hitachi Compressor Train)
- H-1815 (Surface Condenser For Hitachi Compressor Turbine)
- Lo Coolers Of P-1102 A/B/C
- Lo Coolers Of P-1201 A/B
- H-1811 - Tube Bundle Removal
- H-1420 (Final Condenser)
- H-1421 (Flash Tank Condenser)
- H-1422 (First Stage Evaporator / Separator)
- H-1423 (First Stage Evaporator / Condenser)
- H-1204 (Recirculation heater)
- H-1427(Circulation cooler for V-1423)
- H-1208 (Ammonia water cooler)
- H-1209
- H-1812
- H-1813

CRITICAL/HIGH PRESSURE NRV JOBS

Sr. No.	DESCRIPTION	LOCATION	VALVE DETAILS	STATUS
1.	CO2 comp. 3rd suction	Hitachi	NRV 8"X300# (Insulated valve)	Completed
2.	CO2 Comp. final dis. Line	Nr. sump	NRV (Insulated) Serviced	New internals
3.	23 ata extraction line	Comp. Deck floor	NRV (Insulated) Serviced	New bonnet gasket
4.	CO2 to Stripper Nr MOV-1201	GF	6"BEL valve type NRV Serviced	Cuttingland leakapping done
5.	P-1201 A/B/C carbamate common dis. Line to H-1203	6 th floor	BEL	Cuttingland leakapping done
6.	Ammonia to HP condenser	3.5 floor	BEL	Cuttingland leakapping done
7.	Carbamate to HP condenser	3.5 floor	BEL,	Cuttingland leakapping done
8.	Ammonia to Autoclave (PIC-1201 DOWN STREAM)	3rd floor	BEL	Cuttingland leakapping done

CONDENSATE & STEAM INJECTION LINE NRV JOBS

Sr. No.	DESCRIPTION	LOCATION	VALVE DETAILS	ACTION
1.	P-1408 suction drain condensate flushing NRV.	G	1" , non slam	Replaced with new
2.	T-1401/A to P_1401 A/B suction line sample point condensate flushing line NRV.	G	¾" , non slam	Replaced with new
3.	P-1201 A suction condensate flushing line NRV.	1ST	½" , Lift Check	Replaced
4.	P-1201-B suction condensate flushing line NRV.	1ST	½" , Lift Check	Replaced
5.	P-1201 C suction condensate flushing line NRV.	1ST	½" , Lift Check	Repaired & tested
6.	DM Water to P-1211 A/B suction line NRV.	2ND	2" , swing	Repaired & tested
7.	Melt return line condensate flushing NRV	PRILL BUCKET ROOM	1 ½" , non slam	Repaired & tested
8.	Melt return line steam flushing NRV	PRILL BUCKET ROOM	1" , non slam	Repaired & tested
9.	P-1352 A/B discharge to H-1205/H-1205A reflux condensate flushing line.	2ND	1/2" , non slam	Repaired & tested
10.	9 ata stem injection to DOWN STREAM line HICV-1208	3RD :Top V-1205	½" , Lift Check	Repaired & tested
11.	4 ata steam injection to P-1201-A Suction & discharge RV's NRV.	1ST	½" , Lift Check	Repaired & tested
12.	4 ata steam injection to P-1201-B Suction & discharge RV's NRV.	1ST	½" , Lift Check	Repaired & tested
13.	4 ata steam injection to P-1201-C Suction & discharge RV's NRV.	1ST	½" , Lift Check	Repaired & tested
14.	V-1202 (1st floor)	1ST	½" , Lift Check	Repaired & tested
15.	V-1205(3rd floor)	3RD	½" , Lift Check	Repaired & tested
16.	V-1353	Hydrolyser side 1st	½" , Lift Check	Repaired & tested
17.	V-1351 LT NRV	Hydrolyser side	½" , Lift Check	Repaired & tested

VARIOUS FLANGE LEAKS

SR NO	Job	Action	FLOOR
1.	V-1205 balancing line vessel flange leak.	Tightened	3
2.	V-1205 bottom flange leak.	Tightened	3
3.	H-1202 liquid outlet line flange leak.	Tightened	3
4.	Flange leak of V-1201 steam passivation line.	Gasket Replaced	3
5.	H-1202 liquid overflow line to V-1201 Inlet flange leakage	Gasket Replaced	3
6.	Dropwise Leakage is Observed in Suction Flange of P-1204 B	Tightened	Ground
7.	P-1202 B discharge isolation valve flange leak.	Gasket replaced	Ground
8.	4 ata steam to M-1401-A/B flange leak attended.	Gasket replaced	6
9.	Channel cover of H-1208 due to drop wise leak.	Gasket replaced	1
10.	Scrubber Overflow line, HPF line 2nd isolation valve flange leak.	Tightened	H-1203 BOTTOM
11.	Flange leak on 2nd floor on various flange joints in urea prill loop vacuum	Gaskets replaced	2

FLANGED VALVE REPLACEMENT

SR NO	DESCRIPTION	SIZE	LOCATION	ACTION
1	P-1102B suction ISOLATION VALVE	6" X 300 #	G' Floor	REPLACED
2	P-1102C suction ISOLATION VALVE	6" X 300 #	G' Floor	REPLACED
3	P-1201A Suction ISOLATION VALVE	4" X 150#	1st Floor	REPLACED
4	P-1201B Suction ISOLATION VALVE	4" X 150#	1st Floor	REPLACED
5	P-1201C Suction ISOLATION VALVE	4" x 150#	1st Floor	REPLACED
6	P-1202-B flushing fluid isolation valve	1" X 150#	GROUND	REPLACED
7	H-1814 CW backflush valve replacement	6" X 150#	GROUND (H-1814)	REPLACED
8	Isolation valve of LICV-1425 passing	2" X 150#	2nd	REPLACED

VALVE REPAIR

SR No	DESCRIPTION	SIZE	LOCATION	ACTION
1	P-1102-A suction ISOLATION VALVE	6" X 300 #	GF	Repaired
2	P-1102-B suction ISOLATION VALVE	6" X 300 #	GF	Repaired
3	P-1102-C suction ISOLATION VALVE	6" X 300 #	GF	Repaired
4	Surface condensate outlet CV bypass valve	2-1/2"	P-1815	Repaired
5	23 ata to 4 ata letdown control valve bypass valve	2" X 300 #	GF	Repaired
6	60 ata isolation valve at battery limit			Gear Box overhauled
7	Gear operated butterfly valves on cooling water lines		1st , 2nd , 3rd	Gear Box overhauled
8	LICV-1425 upstream isolation valve hard to operate, attended.			Spindle made free

VALVE GLAND REPACKING

Sr. No	DETAILS	ACTION	FLOOR
1	H-1206-A inlet isolation valve downstream drain isolation valve gland leak attended	Gland repacking done	1
2	Gland leak of P-1302-C discharge Isolation valve attended	Gland repacking done	GF
3	Attended recycle isolation valve gland leak of P-1351-B	Gland repacking done	GF
4	LICV 1425 up stream isolation valve 's gland leak attended	Gland repacking done	2
5	H-1425 condensate inlet flushing gland leak attended.	Gland repacking done	3
6	Attended main isolation valve (vessel isolation valve) gland leakage. (9 ata to V-1201)	Gland repacking done	3
7	Attended carbamate density meter , final isolation valve, gland leak ,	Gland repacking done	2
8	LI-1501 radar type level sensing bottom isolation valve gland leak	Gland repacking done	4
9	Attended 23 ata main isolation valve (to V-1503) gland leakage.	Gland repacking done	3
10	Gland leak of interconnected valve of P-1302-C/D	Gland repacking done	GF
11	Attended MOV-1811 by pass line isolation valve gland leak	Gland repacking done	Compressor
12	CO2 to V-1352 isolation valve gland leak attended	Gland repacking done	Hydrolyser
13	Attended the gland packing of P-1302-D discharge valve	Gland repacking done	GF
14	MOV-1501 isolation valve gland leak.	Gland repacking done	4
15	Attended gland leakage of 23 ata to 9 ata steam bypass isolation valve	Gland repacking done	3
16	Gland leakage of 4 ata steam tracing main isolation valve of steam tracing	Gland repacking done	3
17	LICV-1425 upstream isolation valve gland leak attended	Gland repacking done	2
18	Gland leakage of cooling water line inlet valve to H-1352.	Gland repacking done	Hydrolyser
19	4 ata header to service station line isolation valve gland leak.	Gland repacking done	2
21	P-1102-B discharge isolation valve.	Gland repacking done	GF
23	Condensate to H-1425 isolation valve gland leak attended.	Gland repacking done	3

OFFSITE & UTILITY PLANT

(MECHANICAL)

PREVENTIVE MAINTENANCE OF ROTARY EQUIPMENT

COOLING TOWER AREA

Preventive Maintenance of CW Pump, P-4402

Following activities were carried out during PM

- Coupling between the pump and motor was decoupled.
- Both the journal bearings were opened, checked & found OK.
- Bearing clearances were checked & recorded.
- During assembly correct positioning of oil splash ring in the bearing housing was ensured.
- Gland cooling water lines was opened, cleaned and boxed up
- After alignment gland was repacked with new 25MM Sq. PTFE gland packings.
- Finally new oil was filled in both bearing housings.
- Free rotation of the pump after coupling was ensured.
- Final Clearance chart is as under:

Sr. No.	Description	Design Value (MM)	Value after PM (MM)
1	Front end journal clearance (by lead wire)	0.20-0.30	0.25
2	Rear end journal bearing clearance (by lead wire)	0.2-0.30	0.20
3	Front end journal bearing interference	0.02-0.05	0.05
4	Rear end journal bearing interference	0.02-0.05	0.05

- Final alignment between pump to motor was done by laser alignment machine.

Alignment Readings				
Vertical / Horizontal	Parallel Offset	Angular Offset	Correction Required	
			Foot-1	Foot-2
Horizontal (H)	-0.07	0.00	-0.08	-0.09
Vertical (V)	0.04	0.01	0.14	0.30

Overhauling of CW Pump, P-4403

CW Pump P-4403

Observation

Pump impeller was in jammed condition. Heavy dust was found on impeller and end rings area.

Following activities were done:

- Pump top casing was opened.
- Journal Bearings & Thrust bearing were removed.
- Pump gland packing were removed.
- Bearing clearances were measured and found ok.
- Pump gland packing were replaced with new ones.
- Pump end side impeller vanes were found damaged and repaired by welding.
- Impeller was checked and it was in free condition.
- Alignment was checked between GB to Pump and found ok.

Sr. No.	Description	Design Value (MM)	Value after PM (MM)
1	Front end journal clearance (by lead wire)	0.20-0.30	0.23 – 0.24
2	Rear end journal bearing clearance (by lead wire)	0.20-0.30	0.27 – 0.34
3	Front end journal bearing interference	0.02-0.05	0.02 - 0.03
4	Rear end journal bearing interference	0.02-0.05	0.02

Turbine, Q-4403 (Triveni make)

Following activities were carried out during PM

- Coupling between the Turbine and G.B. was decoupled.
- Both sides of the turbine journal bearings were opened & cleaned.
- Bearing clearances of both sides were measured & found higher than design value. Bearing condition was found ok, therefore boxed up using same bearing.
- Axial thrust of the turbine was measured & found higher than design value. Bearing condition was found ok, therefore boxed up using same bearing.
- Complete governor removed from position and then again fixed.
- Fresh oil was charged in the governor
- Oil console was properly cleaned and charged with fresh oil.
- All connected oil pipe lines were also cleaned.
- Oil cooler was opened, cleaned and boxed up.
- Oil strainer was cleaned & replaced the oil filter.
- Gland steam leak off port and lines cleaned.

- Final alignment readings were checked with laser alignment machine.

Alignment Readings				
Vertical / Horizontal	**Parallel Offset**	**Angular Offset**	**Correction Required**	
			Foot-1	**Foot-2**
Horizontal (H)	-0.53	0.07	-1.02	-1.84
Vertical (V)	1.57	0.09	0.93	-0.13

- Trip lever functioning was corrected.
- ESV lever was serviced. ESV spring was found in broken condition. So, Spring was welded and fitted.
- Final clearance chart is as under:

Sr. No.	Description	Design Value (mm)	Value after PM (mm)	Interference
1	Axial thrust	0.25-0.30	0.33	
2	Front end journal bearing clearance (by lead wire)	0.127-0.18	0.24 – 0.26	0.03
3	Rear end journal bearing clearance (by lead wire)	0.127-0.18	0.25	0.02

Gear Box (GB-4403)

During Preventive maintenance following activities were carried out:

- Gear top cover was opened. GB internals were checked and found OK.
- Bearings of gear box was opened, cleaned, checked and found ok.
- Bearing clearances of gear box were measured & found higher than design value. Bearing condition was found ok, therefore boxed up using same bearing.
- Gear wheel thrust was measured & recorded.
- Pinion wheel float was also measured.
- All oil lines checked and cleaned.
- Duplex oil filter was replaced.
- Final clearance chart is as under

Clearance Chart

Sr. No.	Description	Design Value (MM)	Value after PM (MM)
1	Pinion front bearing clearance	0.15 - 0.20	0.20
2	Pinion rear bearing clearance	0.15 – 0.20	0.21
3	Gear wheel front end bearing clearance	0.20 – 0.30	0.23 – 0.24
4	Gear wheel rear end bearing clearance	0.20 – 0.30	0.25
5	Gear wheel axial thrust	0.50 – 0.60	0.26
6	Gear backlash	0.40 – 0.45	0.60

Preventive Maintenance of CW Pump, P-4401/B Train:

CW Pump, P-4401/B:

Following activities were carried out during PM

- Coupling between the pump and GB was decoupled.
- Both the journal bearings were opened, checked & found ok.
- Bearing clearances were checked & and recorded.
- During assembly correct positioning of oil splash ring in the bearing housing was ensured.
- Gland cooling water lines was opened, cleaned and boxed up.
- Pump gland packing were replaced by new one.
- Finally new oil was filled in both bearing housings.
- Free rotation of the pump after coupling was ensured
- Final Clearance chart is as under

Sr. No.	Description	Design Value (MM)	Value after PM (MM)
1	**Axial thrust**		0.30
2	Front end journal clearance (by lead wire)	0.20-0.30	0.30
3	Rear end journal bearing clearance (by lead wire)	0.2-0.30	0.30
4	Front end journal bearing interference	0.02-0.05	0.05
5	Rear end journal bearing interference	0.02-0.05	0.05

Turbine, Q-4401/B (Triveni make)

Following activities were carried out during PM

- Coupling between the Turbine and GB was decoupled.
- Both sides of the turbine bearings were opened, cleaned, checked, found OK and boxed up.
- Turbine Bearing Clearances were checked & found higher than design value. Bearing condition was found ok therefore boxed up using same bearing.
- Axial thrust of the Turbine was measured and recorded.
- Complete governor removed from position and then again.
- Fresh oil was filled in the governor.
- Oil console was properly cleaned and charged with fresh oil.
- All connected oil pipe lines were also cleaned.
- Oil cooler was opened, cleaned and boxed up.
- Oil strainer was cleaned & replaced the oil filter.

- Oil filter cleaned.
- Gland Steam leak off port and lines cleaned.
- ESV spring was cleaned and same and assembled.
- Final Alignment Readings were checked with laser alignment tool.
- Final Clearance chart is as under:

Sr. No.	Description	Design Value (mm)	Value after PM
1	Axial thrust	0.25-0.30	0.34
2	Front end journal bearing clearance (by lead wire)	0.127-0.18	0.20 – 0.26
3	Rear end journal bearing clearance (by lead wire)	0.127-0.18	0.24 – 0.25

Gear Box, GB-4401/B

During Preventive maintenance following activities were carried out:

- Gear top cover was opened. GB internals were checked and found OK.
- Bearings of gear box was opened, cleaned, checked and found ok.
- Bearing clearances of Gear Box was checked.
- Gear wheel thrust was measured.
- Pinion wheel float was also measured.
- All oil lines checked and cleaned.
- Duplex oil filter cleaned.
- Final clearance chart is as under

Clearance Chart

Sr. No.	Description	Design Value (MM)	Value after PM (MM)
1	Pinion front bearing clearance	0.15 - 0.20	0.16
2	Pinion rear bearing clearance	0.15 – 0.20	0.16
3	Gear wheel front end bearing clearance	0.20 – 0.30	0.28
4	Gear wheel rear end bearing clearance	0.20 – 0.30	0.26
5	Gear wheel axial thrust	0.50 – 0.60	0.20
6	Pinion axial thrust		0.82
7	Gear backlash	0.40 – 0.45	0.50

Turbine to GB

Alignment Readings				
Vertical / Horizontal	Parallel Offset	Angular Offset	Correction Required	
			Foot-1	Foot-2
Horizontal (H)	0.12	0.15	0.53	1.63
Vertical (V)	-0.25	0.13	-0.61	-1.58

GB to Pump

Alignment Readings				
Vertical / Horizontal	Parallel Offset	Angular Offset	Correction Required	
			Foot-1	Foot-2
Horizontal (H)	-0.10	0.02	-0.16	-0.31
Vertical (V)	0.04	0.02	-0.09	-0.21

CW Pump, P-4401/A Train

Major Overhauling of CW Pump, P-4401/A

Following activities were carried out:

- Coupling between the Pump and G.B. was decoupled.
- Pump top casing was opened and removed from the position.
- Top half of both sides bearing housing was removed.
- Then old gland packing rings, lantern ring and gland bush was removed.
- Rotor was removed from the bottom housing.
- Rotor assembly was shifted to workshop for dismantling. Both sides sleeve were replaced by spare one. Bearing were also replaced. Sleeve was removed by gas heating. Sleeves were locked by locknut on both sides.
- Geared coupling hub was removed from old rotor.
- New thrust bearing was fitted on rotor having SS impeller.
- Old removed coupling was fitted on rotor by oil heating
- Rotor placed in the bottom casing.
- Both the Journal Bearings were checked and found OK.
- Bearing clearances of the pump was checked and recorded as
- Both side glands of pump were repacked with 25 mm PTFE packing.
- Final clearance are as under :

Sr. No.	Description	Design Value (MM)	Value after PM (MM)
1	Front end journal clearance (by lead wire)	0.20-0.30	0.18
2	Rear end journal bearing clearance (by lead wire)	0.2-0.30	0.22 – 0.26
3	Front end journal bearing interference	0.02-0.05	0.03 – 0.05
4	Rear end journal bearing interference	0.02-0.05	0.03 -0.05

Installation of peek ring in P-4401/A

It was decided by management to replace the cast iron impeller neck ring of P-4401/A by PEEK material impeller neck ring.

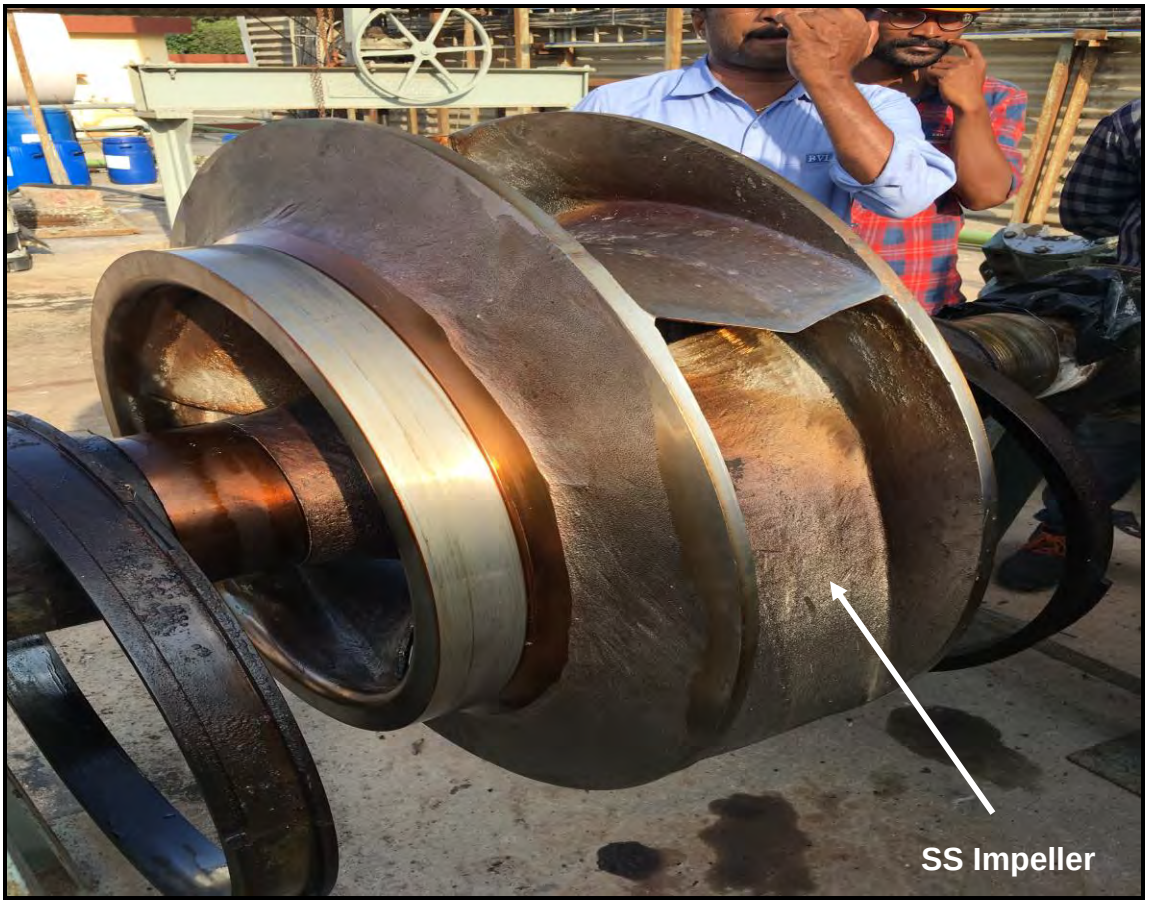
So, we have procured 02 Nos. of rings from M/s Iraa Resources Co, Vadodara against PO No. 201004190742.

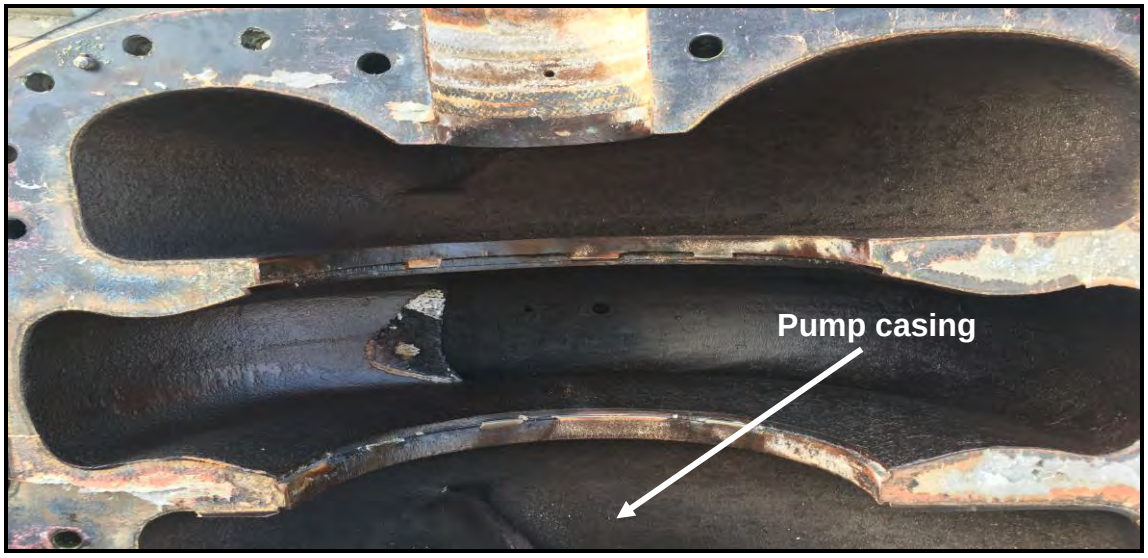
Party has agreed to supply the material on or before 04/10/2018 but party was unable to supply the material on time. So, it was decided by top management to install the cast iron neck ring and boxed up the pump so that they will be no delay in startup of plant.

We had handover the pump to production.

On 06/10/2018, party had visited our site with material and requested to install the PEEK ring. Management had decided to install the PEEK ring after meeting with production to discuss the startup activities.

We had open the pump casing and all bearing covers were removed. Casing was lifted by crane and shaft assembly was lifted by crane and rested on its stand. Old wear rings were removed and cleaning done. Measurement of impeller neck and PEEK wear ring were checked and found that there was ovality of 0.75 mm. We tried to install the PEEK wear ring and boxed up the pump but it was observed that pump was jammed. So, it was decided to replace the PEEK wear ring by cast iron wear ring and boxed up the pump. We have again install the cast iron wear ring and handover the pump to production.





Turbine, Q-4411 (Elliot make)

Following activities were carried out during PM

- Coupling between the Turbine and GB was decoupled.
- Turbine bearings were opened & cleaned
- Both turbine journal bearing clearances were measured higher than design value. Bearing condition was found ok therefore boxed up using same bearing.
- Axial thrust of turbine was measured and recorded.
- PGPL Hydro-mechanical governor was replaced with new electro-hydraulic PGPL / Driver with 505D controller.
- Drive worm gear was replaced and backlash was 0.30 mm.
- Oil console was drained, cleaned and fresh oil charged (SERVO PRESS T-32)
- Main oil pump & Auxiliary oil pump suction strainers were cleaned & boxed up.
- The surface condenser was opened. Hydro jetting was carried out & then boxed up.
- Gland steam leak off port and line cleaned.
- All oil lines cleaned and flushed.
- Oil sump cleaned.
- Oil cooler tubes cleaned by hydrojetting.
- Oil filter replaced.
- Fresh oil servo Press T-32 filled in oil sump.
- One coupling bolt of the coupling between turbine to Gear box was found damaged which was replaced from the spare coupling.
- Final Alignment readings from Turbine to Gear Box was checked with laser alignment tool and alignment report is attached.

Steam stop valve servicing done. Governing valve linkage were set. OST was checked by production. OST was 6000 RPM.

- Final clearance chart is as under:

Sr. No.	Description	Design Value (mm)	Value after PM (mm)
1	Axial thrust	0.25-0.30	0.27
2	Front end journal bearing clearance (by lead wire)	0.127-0.18	0.23
3	Rear end journal bearing clearance (by lead wire)	0.127-0.18	0.20

Gear Box, GB-4411

During Preventive maintenance following activities were carried out:

- Gear box top cover removed.
- All the bearing top half's were removed.
- Cleaning of journal on both gear wheel & pinion wheels.
- Cleaning of bearings is carried out.
- Cleaning of bearings covers is carried out.
- Bearing clearances are measured using lead wire.
- Bearings are assembled back and checked the bearing clearances which were given in below table.
- Top covers are assembled back.
- Main Oil Pump drive coupling checked and found ok.
- All oil lines were cleaned and flushed.
- Oil sump was cleaned.
- Oil cooler tubes were cleaning by hydrojetting.
- Duplex Oil Filters were cleaned.
- New Oil filled in oil sump
- Final clearance chart is as under:

Clearance Chart

Sr. No.	Description	Design Value (MM)	Value after PM (MM)
1	Pinion front bearing clearance	0.15 - 0.20	0.15 – 0.18
2	Pinion rear bearing clearance	0.15 – 0.20	0.15 – 0.18
3	Gear wheel front end bearing clearance	0.20 – 0.30	0.28 – 0.31
4	Gear wheel rear end bearing clearance	0.20 – 0.30	0.27 – 0.30
5	Gear wheel axial thrust	0.50 – 0.60	0.50
6	Pinion axial thrust		0.70
7	Gear backlash	0.40 – 0.45	0.45

- Final alignment between turbine to gear box was done by laser alignment machine.

Alignment Readings				
Vertical / Horizontal	Parallel Offset	Angular Offset	Correction Required	
			Foot-1	Foot-2
Horizontal (H)	-0.05	0.00	-0.04	-0.04
Vertical (V)	-0.05	0.00	-0.04	-0.02

- Final alignment pump to gear box was done by laser alignment machine.

Alignment Readings				
Vertical / Horizontal	Parallel Offset	Angular Offset	Correction Required	
			Foot-1	Foot-2
Horizontal (H)	-0.08	0.03	0.14	0.49
Vertical (V)	0.02	0.02	-0.09	-0.20

Pre Shutdown Jobs

Preventive Maintenance of CW Pump, P-4401/C

Following activities were carried out during PM

- Coupling between the pump and motor was decoupled.
- Both the journal bearings were opened, checked & found OK.
- Bearing clearances were checked & and recorded.
- During assembly correct positioning of oil splash ring in the bearing housing was ensured.
- Gland cooling water lines was opened, cleaned and boxed up
- Finally new oil was filled in both bearing housings.
- Free rotation of the pump after coupling was ensured.
- Final Clearance chart is as under:

Sr. No.	Description	Design Value (MM)	Value after PM (MM)
1	Front end journal clearance (by lead wire)	0.20-0.30	0.25
2	Rear end journal bearing clearance (by lead wire)	0.2-0.30	0.25 – 0.26
3	Front end journal bearing interference	0.02-0.05	0.05
4	Rear end journal bearing interference	0.02-0.05	0.05

- Final alignment pump to motor was done by laser alignment machine.

Alignment Readings				
Vertical /Horizontal	Parallel Offset	Angular Offset	Correction Required	
			Foot-1	Foot-2
Horizontal (H)	-0.09	0.05	0.28	0.88
Vertical (V)	0.09	0.01	0.05	-0.03

Pre Shutdown Job

Preventive Maintenance of CW Pump, P-4401/D

Following activities were carried out during PM

- Coupling between the pump and motor was decoupled.
- Both the journal bearings were opened, checked & found OK.
- Bearing clearances were checked & and recorded.
- During assembly correct positioning of oil splash ring in the bearing housing was ensured.
- Gland cooling water lines was opened, cleaned and boxed up
- Alignment of motor with pump was checked.
- New oil was filled in both bearing housings.
- Free rotation of the pump after coupling was ensured.
- Final Clearance chart is as under:

Sr. No.	Description	Design Value (MM)	Value after PM (MM)
1	Front end journal clearance (by lead wire)	0.20-0.30	0.22 - 0.25
2	Rear end journal bearing clearance (by lead wire)	0.20-0.30	0.22 – 0.23
3	Front end journal bearing interference	0.02-0.05	0.05
4	Rear end journal bearing interference	0.02-0.05	0.05

- Final alignment pump to motor was done by laser alignment machine.

Alignment Readings				
Vertical /Horizontal	Parallel Offset	Angular Offset	Correction Required	
			Foot-1	Foot-2
Horizontal (H)	-0.09	0.05	0.28	0.88
Vertical (V)	0.09	0.01	0.05	-0.03

PEEK wear ring installation after shutdown :

After Shutdown, it was decided to install the PEEK wear ring in P-4401/D pump. So, we had open the pump casing and all bearing covers were removed. Casing was lifted by crane and shaft assembly was lifted by crane and rested on its stand. Old wear rings were removed and cleaning done. PEEK wear ring were installed and pump was boxed up. Vibration was checked and found normal.

BOILER AREA

PREVENTIVE MAINTENANCE OF BFW PUMP, P-5111 (TURBINE DRIVEN)

BFW Pump (P-5111)

Following activities were carried out during PM

- All the oil pipe lines were disconnected.
- Both the end covers of the pump were removed

- Bearings were removed on both the sides
- Cleaning of journal on both sides of the pump was carried out.
- Cleaning of bearings and bearing covers was carried out
- DP test was conducted on all the journal bearings & thrust pads and found ok.
- Checked the bearing clearance and found ok.
- Rear side thrust bearing was removed
- Thrust pads were found ok.
- Both the sides bearings and bearing covers were assembled back
- Suction Strainer was removed, cleaned and assembled back.

Clearance Chart

Sr. No.	Description	Design/ Recommended Value (MM)	Value after PM (MM)
1	Axial thrust	0.28-0.33	0.21
2	Front journal bearing clearance	0.13-0.18	0.18
3	Rear journal bearing clearance	0.13-0.18	0.18
4	Front journal bearing interference	0.02-0.05	0.07-0.08
5	Rear journal bearing interference	0.02-0.05	0.05

- Thickness of thrust pads were also checked and recorded as

Thrust Pads Thickness (MM)

Sr. No	Active	Inactive
1	22.19	22.18
2	22.15	22.18
3	22.20	22.19
4	22.16	22.19
5	22.16	22.19
6	22.20	22.17

- Residual Magnetism (Gauss) at bearing journals and bearing were checked.
- All oil lines cleaned and flushed.
- Oil sump cleaned.
- Oil cooler tubes cleaning done.
- Oil Filters cleaned.
- Fresh oil filled in oil sump.

Drive turbine (Q-5111)

Following activities were carried out during PM:

- Decoupled the turbine
- Instruments probes were removed

- Governor top cover and Governor was removed.
- Thrust bearing & journal bearings top half's were removed.
- Cleaning of rotor shaft was carried out.
- Governing components were removed and found ok.
- Governor was replaced by spare governor during shutdown. But during start up, due to abnormal behavior od governor, old governor was tested at test bech and fitted at position.
- Checked all bearing clearances and found ok.

Sr. No.	Description	Design/ Recommended Value (MM)	Value after PM (MM)
1	Axial thrust	0.2 – 0.4	0.25
2	Front journal bearing clearance	0.12 – 0.17	0.31
3	Rear journal bearing clearance	0.12 – 0.17	0.17
4	Front journal bearing interference	0.02 – 0.05	0.05
5	Rear journal bearing interference	0.02 – 0.05	0.05

- Final alignment pump to turbine was done by laser alignment machine.

Alignment Readings				
Vertical /Horizontal	**Parallel Offset**	**Angular Offset**	**Correction Required**	
			Foot-1	**Foot-2**
Horizontal (H)	-0.23	0.09	0.03	0.69
Vertical (V)	-0.11	0.01	-0.09	-0.04

PREVENTIVE MAINTENANCE OF BFW PUMP, P-5112 (MOTOR DRIVEN)

BFW Pump, P-5112

Following activities were carried out during PM:

- All the oil pipe lines were disconnected.
- Both the end covers of the pump were removed
- Bearings were removed on both the sides
- Cleaning of journal on both sides of the pump
- Cleaning of bearings and bearing covers was carried out
- DP test was conducted on all the journal bearings & thrust pads and found ok.
- Checked the bearing clearance and found ok.
- Pump rear bearing was replaced.
- Thrust pads were found ok
- Both the sides bearings and bearing covers were assembled back.
- Strainer was removed, cleaned and assembled back.

Clearance Chart

Sr. No.	Description	Design/ Recommended Value (MM)	Value after PM (MM)
1	Axial thrust	0.28-0.33	0.25
2	Front journal bearing clearance	0.13-0.18	0.13 – 0.16
3	Rear journal bearing clearance	0.13-0.18	0.12 – 0.13
4	Front journal bearing interference	0.02-0.05	0.06
5	Rear journal bearing interference	0.02-0.05	0.05

- Thickness of thrust pads were also checked and recorded as

Thrust Pads Thickness (MM)

Sr. No	Active	Inactive
1	22.17	22.18
2	22.19	22.15
3	22.19	22.15
4	22.18	22.16
5	22.18	22.16
6	22.18	22.16

- Residual Magnetism (Gauss) at bearing journals and bearing were checked.
- All oil lines cleaned and flushed.
- Oil sump cleaned.
- Oil cooler tubes cleaning done.
- Oil Filters Cleaned.
- Fresh Oil filled in oil sump.

  Alignment readings after preventive maintenance were checked with laser alignment tool and laser alignment report is attached below

Alignment Readings				
Vertical /Horizontal	Parallel Offset	Angular Offset	Correction Required	
			Foot-1	Foot-2
Horizontal (H)	-0.23	0.09	0.03	0.69
Vertical (V)	-0.11	0.01	-0.09	-0.04

Gear Box for BFW Pump, GB-5112

Following activities were carried out during PM

- All the oil pipe lines are disconnected and oil drained from Gear Box.
- Gear Box end covers and MOP removed.
- Gear Box top cover opened and removed.
- Condition of Gear and pinion checked and found OK.
- Bearings of Gear and pinion removed, cleaned, checked and found OK.
- DP test was conducted on all the journal bearings.
- Checked the bearing clearance and found ok.

Clearance Chart

Sr. No.	Description	Recommended (MM)	Value after PM (MM)
1	Pinion, front journal bearing clearance	0.15 – 0.20	0.16-0.17
2	Pinion, rear journal bearing clearance	0.15 – 0.20	0.17 – 0.18
3	Gear wheel, front journal bearing clearance	0.15 – 0.20	0.16 – 0.18
4	Gear wheel, rear journal bearing clearance	0.15 – 0.20	0.17 – 0.18
5	Pinion, front journal bearing interference	-	0.05
6	Pinion, rear journal bearing interference	-	0.05
7	Gear wheel, front journal bearing interference	-	0.05
8	Gear wheel, rear journal bearing interference	-	0.05
9	Gear backlash	-	0.40

- DP test was conducted on all the journal bearings.
- Checked the bearing clearance and found ok.
- Residual Magnetism (Gauss) checked and recorded.
- Main Oil Pump cleaned, checked and boxed up.
- All oil lines cleaned and flushed.
- Oil sump cleaned.
- Oil cooler tubes cleaning done
- Duplex Oil Filters cleaned/Replaced.
- New Oil filled in oil sump.
- Final alignment motor to gear box was done by laser alignment machine.

Alignment Readings				
Vertical /Horizontal	**Parallel Offset**	**Angular Offset**	**Correction Required**	
			Foot-1	**Foot-2**
Horizontal (H)	-0.23	0.09	0.03	0.69
Vertical (V)	-0.11	0.01	-0.09	-0.04

F.D FAN (K-5113)

Activities carried out are

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

- Motor side plumber block cover was cracked during tightening. So, it was replaced by MASTA make plumber block. (SOFN 230 BL).
- Cracked plumber block was removed from position.
- Dimension of both blocks were checked and compared.
- New Plumber block was installed at position with gaskets.

MAJOR OVERHAULING OF FD FAN (K-5113) DRIVE TURBINE (Q-5113) F.D. Fan

Make : M/s. KKK, Germany

Model/Type: AF 4 Gs FD Fan Train

Following activities were carried out :

- Turbine was completely dismantled.
- Turbine wheel was removed & found in good condition.
- Turbine casing was removed from its position.
- All the carbon rings and chamber rings were removed.
- Stuffing box was removed and cleaned.
- Turbine casing was fixed on the position and pinion shaft on which turbine wheel is mounted fixed on the position.
- Pinion bearings found in good conditions, so bearing clearances were checked and recorded.
- After that Turbine wheel was fixed on the pinion shaft and then new reversing chamber fixed on the turbine casing.

Gear box bearing clearances

Turbine cum pinion rotor thrust float	:	0.12 mm
Pinion Front bearing	:	0.18mm
Pinion rear bearing	:	0.18mm
Gear wheel Rear bearing clearance	:	0.13mm
Gear wheel Front bearing clearance	:	0.19mm
Run out	:	0.01mm
Gear wheel float	:	0.30mm
Gear wheel backlash	:	0.25mm
Pinion Front oil seal clearances	:	0.05 – 0.10
Nozzle Gap	:	2.70-2.80
Nozzle Clearance	:	0.80
Turbine Front and Rear Journal bearing runout	:	0.00
Fan Bearing Clearance	:	0.15
Fan Rotor axial Float	:	8.85

- Oil console and all connected oil pipelines were removed, cleaned and then boxed up.
- Oil cooler was opened; cleaned by hydrojetting and then boxed up.
- Fresh oil Servo Prime 68 was charged in oil console.

Note

- Turbine rotor carbon seals were replaced by new one.
- Motor side Plummer block (SOFN 230 BL) of the fan was cracked.
- We replaced the Plummer block by MASTA make Plummer block (SOFN 230 BL).


FD Fan Turbine during overhauling


Motor side Plumber Block damaged during Assembly

Old Plumber Block

New Plumber Block

Alignment readings

Turbine to Fan

Alignment Readings				
Vertical / Horizontal	Parallel Offset	Angular Offset	Correction Required	
			Foot-1	Foot-2
Horizontal (H)	0.13	0.06	-0.73	-0.44
Vertical (V)	-0.04	0.00	0.02	0.07

Fan To Clutch

			Alignment Readings	
Vertical / Horizontal	Parallel Offset	Angular Offset	Correction Required	
			Foot-1	Foot-2
Horizontal (H)	-0.03	0.02	-0.06	-0.14
Vertical (V)	0.05	0.02	0.02	-0.06

Clutch to motor

Alignment Readings				
Vertical / Horizontal	Parallel Offset	Angular Offset	Correction Required	
			Foot-1	Foot-2
Horizontal (H)	0.04	0.03	0.18	0.33
Vertical (V)	0.08	0.01	0.12	0.17

BHEL BOILER JOBS

RLA Study of Boiler, GT-2068

DETAILS OF PRESSURE PARTS & SIZES

DETAILS OF TUBES

Sr. No	Location	No. of Tubes	Size of Tubes (In MM)	Material
2.1.1	Furnace 'D' tube	71	76.1 OD X 4.5 Thk.	SA 192
2.1.2	Furnace corner tube	33	76.1 OD X 3.2 Thk	SA 192
2.1.3	Furnace rear tube	16	76.1 OD X 4.5 Thk.	SA 192
2.1.4	Baffle wall tube	90	76.1 OD X 4.5 Thk.	SA 192

2.1.5	Boiler side wall tubes	66	76.1 OD X 4.5 Thk.	SA 192
2.1.6	Boiler shield wall tubes	34	76.1 OD X 3.2 Thk	SA 192
2.1.7	Boiler shield wall tubes	4	51.0 OD X 4.0 Thk	SA 192
2.1.8	Boiler bank tubes	1,196	51.0 OD X 4.0 Thk	SA 192
2.1.9	Furnace tubes	3	76.1 OD X 4.5 Thk.	SA 192

DETAILS OF BOILER DRUM

	Steam Drum	Water Drum
Quantity	One	One
Inside diameter (MM)	1371	914
Thickness, (MM)	97	78
Material	SA 299	SA 299

DETAILS OF SUPERHEATER HEADERS

	Primary Inlet SH Header	Primary Outlet SH Header	De - Superheater Header	Secondary Inlet SH Header	Secondary Outlet SH Header
Quantity	One	One	One	One	One
OD (MM)	273	273	273	273	273
Thickness (MM)	25	32	32	25	25
Material	SA 106 Gr.C	SA 335, P22	SA 335, P22	SA 106 Gr.C	SA 106 Gr.C

SUPER HEATER COILS

	Primary Super Heater coils	Secondary Super Heater Coils
Quantity	36	34
Outside Diameter (MM)	51	51
Thickness (MM)	7.1	5.6
Material	SA 213 T 22	SA213T22

FEED PIPE LINE

- Outside Diameter (MM) : 159
- Thickness (MM) : 10
- Material : SA 106 Gr.B

MAIN STEAM LINE

- Outside Diameter (MM) : 273
- Thickness (MM) : 25
- Material : SA 106 Gr.B

SUPER HEATER CONNECTING PIPES

- Outside Diameter (MM) : 159 & 219
- Thickness (MM) : 10 & 14.2
- Material : SA 106 Gr.B

WATER WALL TOP HEADERS

- Outside Diameter (MM) : 219
- Thickness (MM) : 25
- Material : SA 106 Gr.B

RLA study was carried out on critical components of boiler GT-2068 utility plant as per IBR regulation 391(A)-(b) (i) Table-1.

Details of boiler

Make	BHEL Tiruchirapalli
Design	IBR 1950
Rated Capacity	80TPH
Super heater outlet steam pressure	410 +-5 deg. celcius
Drum design pressure	61.5 kg/cm2
Fuel	RLNG
Year of commissioning	1982

Inspection findings component wise

Steam drum

Visual inspection from internal shell and dished end showed greyish scale. All longitudinal and circumferential weld joints are seen with even weld profile. External surface of steam drum shows reddish scale on surface. No relevant abnormalities observed.

Thickness measurements: All dimensions in mm

Component	Minimum measured Thickness	Nominal thickness
Shell	97.15	97
Dished end	76.68	72

Minimum measured thickness is adequate.

ID (Internal diameter) measurement was carried out at two locations.

Ultrasonic flaw detection was carried out on all accessible CS & LS joints of steam drum from outside. No relevant indication is observed.

Dye penetration test (DPT) was carried out on accessible shell to nozzle weld joints of steam drum from outside, no relevant discontinuity is observed.

Scale collected from steam level and water level from steam drum for EDS analysis.

In-Situ metallography was carried out at 06 spots from internal surface and Hardness test at replication spots. Results will be reported after viewing replicas at high magnification laboratory microscope.

Hardness results from internal surface are as under.

Locations	Hardness (BHN)		
	Weld	HAZ	PM
Steam drum CS-1	212-220	189-194	170-177
Steam drum CS-2	190-196	175-182	156-159
Steam drum CS-3	213-217	182-188	171-177
Steam drum LS-1	213-217	186-194	174-178
Steam drum LS-2	214-217	183-189	170-175

Hardness values are normal.

Water drum

Visual inspection from internal shell and dished end showed greyish scale. All longitudinal and circumferential weld joints are seen with even weld profile. External surface of water drum shows reddish scale on surface. No relevant abnormalities observed.

Thickness measurements: All dimensions in mm

Component	Minimum measured Thickness	Nominal thickness
Shell	80.10	78
Dished end	55.54	54

Minimum measured thickness is adequate.

ID (Internal diameter) measurement was carried out at two locations.

Ultrasonic flaw detection was carried out on all accessible CS & LS joints of water drum from outside. No relevant indication is observed.

Dye penetration test (DPT) was carried out on accessible shell to nozzle weld joints of water drum from

outside, no relevant discontinuity is observed.

Scale collected from water drum for EDS analysis.

In-Situ metallography was carried out at 02 spots from internal surface and Hardness test at replication spots. Results will be reported after viewing replicas at high magnification laboratory microscope.

Hardness measurements results from internal surface are as under.

Locations	Hardness (BHN)		
	Weld	HAZ	PM
Water drum CS-1	211-217	177-180	162-167
Water drum CS-2	190-196	187 - 189	160-168
Water drum LS-1	186-192	176-179	158-163
Water drum LS-2	182-184	171-174	149-154

Hardness values are normal.

Bottom water wall headers

Visual inspection revealed reddish scale on headers externally.

Thickness measurements: All dimensions in mm

Component	Minimum measured Thickness	Minimum acceptable / Nominal thickness
Rear water wall header	24.36	21.87/25
Front water wall header	24.23	

Acceptable thickness after considering mill tolerance of 12.5% of nominal thickness as per IBR1950, Reg53c (ii),i.e 87.5% of nominal thickness 25mm equals 21.87mm, hence minimum measured thickness is adequate.

Maximum outer diameter measured on headers was 220mm against nominal 219mm. No significant change in diameter is observed.

Ultrasonic flaw detection was carried out on all accessible butt weld metal joints of headers. No relevant indication is observed.

Dye penetration test (DPT) was carried out on accessible tube to header weld joints, no relevant discontinuity observed.

Hardness measurements was carried out on headers and values given in below table. Which is normal.

Component	**Hardness (BHN)**		
	Weld	HAZ	PM
Rear water wall headers	173-178	163-172	128-132
Front water wall headers	171-178	159-166	128-130

Top water wall headers

Visual inspection revealed reddish scale on headers externally. No significant abnormality observed in internal videoscopy inspection. Photographs with detail interpretation of videoscopy inspection submitted in the final report.

Maximum outer diameter measured on headers was 220mm against nominal 219mm. No significant change in diameter is observed.

Thickness measurements: All dimensions in mm

Component	**Minimum measured Thickness**	**Minimum acceptable/Nominal thickness**
Front water wall headers	23.5	21.87/25
Rear water wall header	23.14	

Acceptable thickness after considering mill tolerance of 12.5% of nominal thickness as per IBR1950, Reg53c (ii),i.e 87.5% of nominal thickness 25mm equals 21.87mm, hence minimum measured thickness is adequate.

Ultrasonic flaw detection was carried out on all accessible butt weld metal joints of headers. No relevant indication is observed.

Dye penetration test (DPT) was carried out on accessible tube to header weld joints, no relevant discontinuity observed.

Hardness measurements was carried out on headers and values given in below table. Which is normal.

Component	**Hardness (BHN)**		
	Weld	HAZ	PM
Front water wall headers	164-169	148-153	144-149
Rear water wall header	166-172	154-159	140-143

Water wall tubes

In visual examination tubes surface shows reddish scale with minor deposits on tube wall; no significant abnormalities observed.

Thickness measurements: All dimensions in mm

Component	Minimum measured Thickness	Nominal thickness
Furnace 'D' tube	5.05	4.5
Furnace corner tube	5.18	4.5
Furnace rear tube	5.17	4.5
Water wall tubes front	4.46	4.5
Baffle wall tube	5.15	4.5

Minimum measured thickness is adequate.

In-situ metallography was carried out on 4 locations and hardness test at metallography spots. Values of

hardness measurements given in below table. Which is normal.

Component	Hardness (BHN)
	PM
Furnace 'D' tube	135-137
Furnace corner tube	125-127
Water wall tubes front	129-131
Baffle wall tube	126-135

3 tubes are cut for destructive testing at laboratory.

Bank Tubes:

In visual examination tubes surface shows greyish coloration on tube wall; no significant abnormalities observed.

Maximum outer diameter in primary super heater tubes was measured to be 64mm against nominal of 63.5mm.

Thickness measurements: All dimensions in mm

Component	Minimum measured Thickness	Nominal thickness
Bank tubes	3.00	3.2

Minimum measured thickness is marginally less than the nominal thickness, however thickness adequacy at design parameters will be provided in final report.

Hardness measurement carried out at random locations on bank tubes. Hardness values ranges from 151 to 158BHN, which is normal.

Eco outlet to drum link pipes

Visual inspection revealed reddish scale on link piping from externally.

Maximum outer diameter measured on piping was 159.5mm against nominal 159mm.

Thickness measurements: *All dimensions in mm*

Component	Minimum measured Thickness	Minimum acceptable/Nominal thickness
Eco outlet to drum link pipes	9.15	8.75/10

Acceptable thickness after considering mill tolerance of 12.5% of nominal thickness as per IBR1950, Reg53c (ii),i.e 87.5% of nominal thickness 10mm equals 8.75mm, hence minimum measured thickness is adequate.

Hardness measurement carried out at random locations on link pipes. Hardness values ranges from 134 to 139BHN, which is normal.

Riser Pipes

Visual inspection revealed reddish scale on piping externally.

Maximum outer diameter measured on piping was 76mm against nominal 76.1mm.

Thickness measurements: All dimensions in mm

Component	Minimum measured Thickness	Minimum acceptable / Nominal thickness
Front headers to drum risers	4.10	4.5
Rear header to drum risers	4.50	

Minimum measured thickness is marginally less than the nominal thickness, however thickness adequacy at design parameters will be provided in final report.

Hardness measurement carried out at random locations on riser pipes. Hardness values ranges from 168 to 175BHN, which is normal.

Saturated steam piping

Visual inspection revealed reddish scale on piping externally.

Maximum outer diameter measured on piping was 160mm against nominal 159mm and 220mm against 219.1 mm.

Thickness measurements: All dimensions in mm

Component	Minimum measured Thickness	Minimum acceptable/Nominal thickness
Piping part-1	9.15	8.75/10
Piping part-2	13.95	12.42/14.2

Acceptable thickness after considering mill tolerance of 12.5% of nominal thickness as per IBR1950, Reg53c (ii),i.e 87.5% of nominal thickness 10mm equals 8.75mm and nominal thickness 14mm equals 12.42mm, hence minimum measured thickness is adequate.

Hardness measurements was carried out on piping and values given in below table. Which is normal.

Component	Hardness (BHN)		
	Weld	HAZ	PM
Piping part-1	192-197	173-178	142-147
Piping part-2	182-188	163-166	133-137

Primary super heater headers

Visual inspection revealed reddish scale on headers externally. No significant abnormality observed in internal videoscopy inspection. Photographs with detail interpretation of videoscopy inspection will be submitted in the final report.

Maximum outer diameter measured on headers was 274mm against nominal 273mm. No significant change in diameter is observed.

Thickness measurements: All dimensions in mm

Component	Minimum measured Thickness	Minimum acceptable/Nominal thickness
PSH inlet header	28.22	21.87/25
PSH outlet header	28.41	28/32

Acceptable thickness after considering mill tolerance of 12.5% of nominal thickness as per IBR1950, Reg53c (ii),i.e 87.5% of nominal thickness 25mm equals 21.87mm for PSH inlet header and nominal thickness of 32mm equals 28mm for PSH outlet header, hence minimum measured thickness is adequate. Ultrasonic flaw detection was carried out on all accessible butt weld metal joints of headers. No relevant indication is observed.

Dye penetration test (DPT) was carried out on accessible tube to header weld joints, no relevant discontinuity observed.

In-Situ metallography was carried out at 2 spots and Hardness test at replication spots. Results will be reported after viewing replicas at high magnification laboratory microscope. Hardness measurements values shown in table below, which is normal.

Component	Hardness (BHN)		
	Weld	HAZ	PM
PSH inlet header	-	-	180-184
PSH outlet header	191-197	162-167	155-160

Primary super heater coils

In visual examination tubes surface shows reddish coloration; no significant abnormalities observed.

Thickness measurements: *All dimensions in mm*

Component	Minimum measured Thickness	Nominal thickness
PSH coils	6.80	7.1

Minimum measured thickness is marginally less than the nominal thickness, however thickness adequacy at design parameters will be provided in final report.

Maximum outer diameter in primary super heater tubes was measured to be 51mm against nominal of 51mm. No significant change in diameter is observed.

In-situ metallography and hardness measurement carried out at random locations on tubes. Results will be reported after viewing replicas at high magnification laboratory microscope. Hardness values ranges from 150 to 170BHN, which is normal.

One tube is cut for destructive testing at laboratory.

Secondary super heater headers

Visual inspection revealed reddish scale on headers externally. No significant abnormality observed in internal videoscopy inspection. Photographs with detail interpretation of videoscopy inspection submitted in the final report.

Maximum outer diameter measured on headers was 274mm against nominal 273mm. No significant change in diameter is observed.

Thickness measurements: *All dimensions in mm*

Component	Minimum measured Thickness	Nominal thickness
SSH inlet header	27.32	25
SSH outlet header	27.89	

Minimum measured thickness is adequate.

Ultrasonic flaw detection was carried out on all accessible butt weld metal joints of headers. No relevant indication is observed.

Dye penetration test (DPT) was carried out on accessible tube to header weld joints, no relevant discontinuity observed.

In-Situ metallography was carried out at 4 spots and Hardness test at replication spots. Results will be reported after viewing replicas at high magnification laboratory microscope. Hardness values shown in table below, which is normal.

Component	Hardness (BHN)		
	Weld	HAZ	PM
SSH inlet header	201-207	172-174	152-157
SSH outlet header	170-174	140-143	131-151

Secondary super heater coils

In visual examination tubes surface shows reddish coloration; no significant abnormalities observed.

Thickness measurements: *All dimensions in mm*

Component	Minimum measured Thickness	Nominal thickness
SSH coils	5.00	5.6

Minimum measured thickness is less than the nominal thickness, however thickness adequacy at design parameters will be provided in final report.

Internal oxide scale measurements carried out on tubes and maximum measured oxide scale is 0.63mm.

Detail analysis will be submitted in final report based on destructive testing of tube sample.

Maximum outer diameter in primary super heater tubes was measured to be 51mm against nominal of 51mm. No significant change in diameter is observed.

In-situ metallography and hardness measurement carried out at random locations on tubes. Hardness values ranges from 143 to 154BHN, which is normal. In-situ metallography analysis with detail interpretation will be submit in final report.

One tube is cut for destructive testing at laboratory.

De-super heater piping

Visual inspection revealed reddish scale on pipes externally.

Maximum outer diameter measured on pipes was to be 274mm against nominal 273mm. No significant change in diameter is observed.

Thickness measurements: *All dimensions in mm*

Component	Minimum measured Thickness	Minimum acceptable/Nominal thickness
De-super heater piping	28.50	28/32

Acceptable thickness after considering mill tolerance of 12.5% of nominal thickness as per IBR1950, Reg53c (ii),i.e 87.5% of nominal thickness 32mm equals 28mm, hence minimum measured thickness is adequate.

Ultrasonic flaw detection was carried out on all accessible butt weld metal joints of link pipes. No relevant indication is observed.

Dye penetration test (DPT) was carried out on accessible pipe to pipe weld joints, no relevant discontinuity observed.

In-Situ metallography was carried out at 2 spots and Hardness test at replication spots. Results will be reported after viewing replicas at high magnification laboratory microscope.

Hardness values shown in table below, which is normal.

Component	Hardness (BHN)		
	Weld	HAZ	PM
De-super heater piping	193-197	156-170	149-157

Main steam line upto 1st isolation valve

Visual inspection revealed reddish scale on pipes externally.

Maximum outer diameter measured on pipes was to be 274mm against nominal 273mm. No significant change in diameter is observed.

Thickness measurements: All dimensions in mm

Component	Minimum measured Thickness	Minimum acceptable / Nominal thickness
Main steam line upto 1st isolation valve	23.30	21.87/25

Acceptable thickness after considering mill tolerance of 12.5% of nominal thickness as per IBR1950, Reg53c (ii),i.e 87.5% of nominal thickness 10mm equals 8.75mm, hence minimum measured thickness is adequate.

Ultrasonic flaw detection was carried out on all accessible butt weld metal joints of main steam line. No relevant indication is observed.

Dye penetration test (DPT) was carried out on accessible pipe to connection stub weld joints, no relevant discontinuity observed.

In-Situ metallography was carried out at 3 spots and Hardness test at replication spots. Results will be reported after viewing replicas at high magnification laboratory microscope. Hardness values shown in table below, which is normal.

Component	Hardness (BHN)		
	Weld	HAZ	PM
Main steam line upto 1st isolation valve	162-187	145-159	132-154

BHEL BOILER INSPECTION/HYDROTEST:

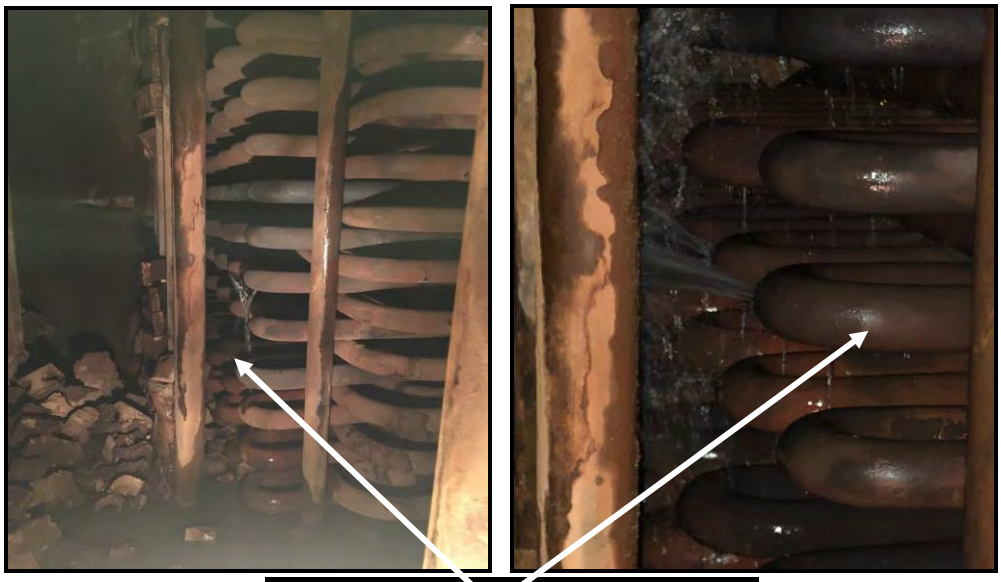
Boiler was inspected by Boiler Inspector in open condition on 23/09/2018 & Hydro test was carried out at 89.0 kg/cm2 pressure on 01.10.2018 and witnessed by Boiler Inspector.

NOTE:

Before Shutdown, it was doubt that there was leakage from BFW coil from production side. After cooling of boiler, when production performed the hydrotest of boiler, it was found that leakage was from 03 Nos. bends (4V,3H), (6V,2H), (6V,3H) of secondary super heater coil in front of bank tube.

Further, it was decided to check the leakage of other coil after plugging the secondary super heater coil header. System was pressurized by production and no leakage was observed.

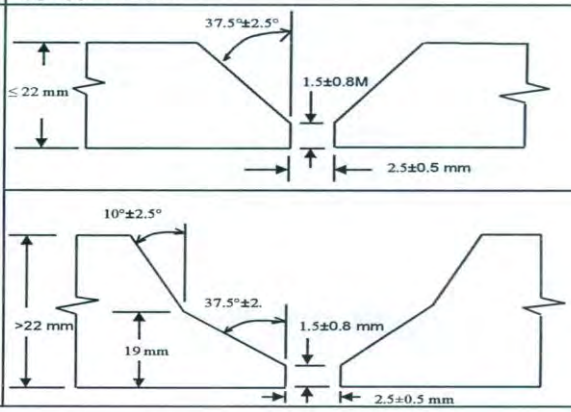
It was decided to replace the all bends by new one. The job was handed over to M/s Shri Ganesh Engineering, Ahmedabad against W.O. 201004190955. Site inspection was done and found that there was no approach from cutting and welding of tube bends. So, it was decided to cutting the front 05 Nos. bank tubes for easy approach to do the cutting, welding work.



Secondary Super heater coil Leakage

All 03 Nos. bends were replaced. DP and radiography was done and found ok.

Bend repair procedure are as :

IFFCO KALOL		WPS no: P22-P22
WELDING PROCEDURE SPECIFICATION		
(ASME BPV B31.3, ASME BPV B 31.1, ASME Section IX, IBR)		
		10/9/2006
Welding Process(es):-	Type(s): Manual	
JOINTS (QW - 402) Joint Design : As shown in Figure. Backing: No Backing Material (Type): N.A Joint Type:Single "V" Butt		
BASE METAL (QW - 403) P-No: 5A Group No: 1 to P-No: 5A Group No: 1 Specification Type & Grade: A 335 Gr.P22 to A 335 P22 Base Metal: Groove: 4.7 - 40 mm Fillet: All Other: Nil		
FILLER METALS (QW-404)	**GTAW**	**SMAW**
SFA Specification:	5.28	5.5
AWS Classification:	ER 90S B3	E 9018 B3
Filler Metal F.No.:	6	4
Weld Metal Analysis A.No	4	4
Size of Filler Metal:	1.6/2.4 mm	2.5/3.15/4.0 mm
Flux:	N.A	N.A
Other:	N.A	N.A
POSITION (QW-405) Position: 2G/5G/6G Weld Progression: Up hill Other: N.A	**PREHEAT (QW - 406)** Preheat Temp: 150°C(Min) Interpass Temp: 250°C(Max) Other: N.A	

POST WELD HEAT TREATMENT (QW-407)		GAS (QW -408)			
For thk. Greater than 13 mm			Gas(es)	% Composition	Flow Rate
Temperature:	730 +/- 20 0C	Shielding	Argon	99.99	6-12 LPM
Soaking Time:	2.5 min/mm, Min. 2.0 Hrs	Trailing	--	--	--
Heating/Cooling Rate:	100°C/Hr				
Loading/Unloading Temp.:	200°C				
Brinnel Hardness number:	241 (Max)	Backing	Argon	99.99	10-15 LPM

ELECTRICAL CHARACTERISTICS (QW-409)

Current: DC

Polarity: DCEN(GTAW), DCEP(SMAW)

Amps.: 90-160 A

TECHNIQUE (QW-410)	
String or Weave Bead:	String for Root, String/Weave for Subsequent passes
Orifice or Gas Cup Size	N.A
Initial & Inter pass cleaning :	Wire Brushing, Chippipg & Grinding
Method of Back gouging :	N.A
Oscillation:	N.A
Contact Tube to Work Distance:	N.A
Multiple or Single Pass (per side):	Multiple
Travel Speed:	Refer Table
Peening:	N.A
Other:	Nil

Weld Layer	Process	Filler Metal		Current		Volts (Range)	Minimum Travel Speed in mm/min	Remarks
		Class	Dia(mm)	Polarity	Amps(Range)			
Root & Hot Pass	GTAW	ER 90S B3	1.6/2.4	DCEN	80-150	10-15	55-80	
Fill Up	SMAW	E 9018 B3	3.15/4	DCEP	100-160	20-30	140-225	

Repairing work as per inspection report :

BHEL Boiler Furnace :

- East side refractory near to manhole refractory was found in damaged condition. So, repaired by civil department.
- Floor refractory was found damaged. So, repaired.
- Refractory around the bottom burner was found damaged. So, refractory was repaired. All nozzles of bottom burners were cleaned.
- Insulation fiber blankets placed on top of the Secondary superheater coil was found in damaged condition due to refractory fall down on it. So, it was replaced.

- Refractory found damaged and loosened above secondary super heater coil. Anchors were found missing from drum surface. So, anchors were welded with drum and refractory was repaired.
- Baffle wall refractory was repaired.

DEAERATOR:

Deaerator Head:

Spring were checked in spray nozzles.

MUD DRUM:

Blow down line (located at bottom) cover plate bolts were found loosened. So, tightening done.

Sr.	Description	Size	Qty.
1	FRC-1 down steam isolation valve bypass valve	1" X 2500#	1nos
2	FRC-1 by pass header 1st isolation valve by pass valve	1" X 2500#	1nos
3	LRCV - 30% line 1st isolation valve upstream	2-1/2" X 2500#	1nos
4	Final steam sample line 1st isolation valve (nr. conductivity meter)	1/2" x 2500#	1nos
5	Steam drum sample line 1st isolation valve	1/2" x 2500#	1nos
Rear side			
6.	Hydra state steam side 2nd isolation valve	1" X 2500#	1nos
7	Hydra state water side 1st & 2nd isolation valve	1" X 2500#	2nos
8	Drum level recorder steam side 1st isolation valve	1/2" X 2500#	1nos
9	Level impulse drum level 1st isolation valve	1/2" X 2500#	1nos
Front side			
11	Remote water level indicator 1. water side 1st isolation valve 2. steam side 1st & 2nd isolation valve	1" X 2500#	3nos
12	Direct water level indictor water side 1st isolation valve	1-1/2" X 2500#	1nos
13	Steam drum low level switch (LSLL-1) steam side isolationvalve	1" X 2500#	1nos.

- Following furmanite valves were replaced by new IBR valves.

APH

All manway covers of APH were opened. All portions of duct of flue gas and air was found satisfactory. Plates were cleaned by water nozzle spray.

OTHER BOILER JOBS:

- All inspection window glasses were checked & cleaned. Broken window glasses were replaced. Gaskets of all window glasses were also replaced.
- Opening / box up of steam / mud drum (both side)
- Opening / box up of manway cover of boiler furnace wall.

Replacement of Spring Supports :

We have done detailed inspection of boiler area spring support with M/s Procyon Techno Industry. They had recommended to replace 05 Nos of spring supports. Based on their recommendations, we had procured spring supports against PO No. 201004181359. Details are as

- It was replaced by Model no. : VS2-B-10 (Variable Spring hanger)

Before

After

- It was replaced by Model no. : VS2-B-9 (Variable Spring hanger)

Before

After

- It was replaced by Model no. : VS3-B-10 (Variable Spring hanger)

Before

After

- It was replaced by Model no. : VS1-B-9 (Variable Spring hanger)

Before

After

- It was replaced by Model no. : VS1-F-11 (Variable Spring Support)

Before

After

- <u>Insitu refurbishment of following valves were carried out :</u>

<u>Technical Details of Valves:</u>

Sr. No	Valve Details	Qty.	Remark
4	Gate Valve, Pressure Seal type Size & Rating: 6” X 1500#	02	General Overhauling and pressure seal Ring replacement
5	Globe Valve, Pressure Seal type Size & Rating: 65MM NB X 1500#	01	General Overhauling and pressure seal ring replacement

The above job was awarded to M/s Moon engineering Works, Mumbai against the WO No-6535 /201004190640 dated 06/08/2018.
Insitu refurbishment of valve done by M/s Flotec Technosmart (India) Private Limited, Surat against the contract no. 201004191073.

Details are as :

Gate Valve

Size & Rating: 150 MM NB X 1500#

Location: Turbine inlet valve

COOLING TOWER AREA JOBS :

Insitu overhauling of valves was done by M/s Moon Engineering Works, Mumbai against W.O. No. 6535 /201004190640 dated 06/08/2018.

Sr. No	Valve Details	Location	Qty.	Remark
1	Butterfly Valve, Sandwich Type Size & Rating: 900 MM NB X 150 #	Ammonia Plant	02	General Overhauling
2	Non Return Valve, Sandwich type, Size & Rating: 900 MM NB X 150 #	Utility & Ammonia Plant	02	General Overhauling
2	Gate Valve, Bolted Bonnet, Flanged End, Size & Rating: 20" NB X 300#	Ammonia Plant	02	General Overhauling
3	Gate Valve, Bolted Bonnet, Flanged End Size & Rating: 8" X 300#	Ammonia Plant	02	General Overhauling

Chlorination piping in all Cooling Tower :

Committee comprising members from Unit Head, JGM from Phulpur unit, Mech Maint, Inspection, Civil and Utility Production were made to do proper chlorination in cooling water.

Chlorine dosing system to be modified to cover maximum area of cooling water system.

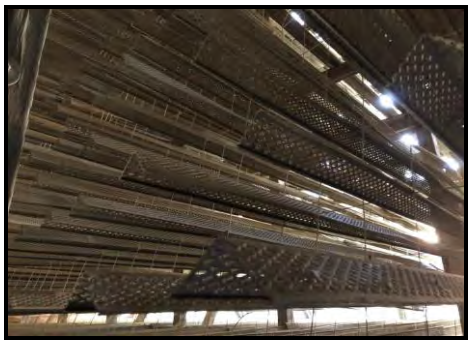
It was decided to provide 1" CPVC pipe with holes in all 14 cells of cooling tower on both sides (Admn. side & Silo side) and cap on ends.

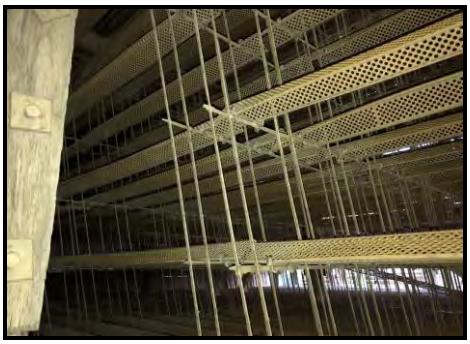
REPAIRING OF COOLING TOWER

For repairing of cooling tower except ammonia cooling tower 7&8, M/s Paharpur cooling tower, Vadodara was come at our site against the WO no. 201004181642 and repairing of ammonia cooling tower 7&8 was done by M/s Southern cooling tower, Vadodara. Based on committee recommendation, both parties had done the repairing work.

- Structural members of the cooling towers were checked and replaced the defective members.
- Corroded fasteners were replaced with new SS304 bolts with SS 304 Square washers.

- Leakages attended from end wall & louvers using mastic (STP make Tarplastic Sealant).
- Repaired stair case
- Replaced on cracked Base casting (Towards admin side) of Old Urea Cooling Tower.
- Fill area of all cooling towers were also inspected for any damage on sampling bases by providing outside scaffolding and removing louver sheet to enter in the fill area. All fill area components and structural members found in good condition.
- V-bars were found dislocated at some locations and the same were rectified.





REFURBISHING OF JASH MAKE SLUICE GATE (1/2/3/4/5/6) OF COOLING WATER PUMP SUMP

Following activities were carried out.

- Stem : cleaning & greasing
- Shutler Seat / Frame seat facing : cleaning & greasing
- Gear box were opened. Bearing were found in satisfactory condition. Gear box operation were satisfactory.
- Full operation (open / close) of all gate was checked & found satisfactory.

The above job was carried out under the supervision of OEM's Engineer (M/s Jash Engg Ltd., Indore) against the WO no. 6535/ 201004161302.

OTHER COOLING TOWER JOBS:

- Weld joint pitting of 52" NB cooling water interconnection line of P-4405 to P-4401 C/D, were repaired by using Stanvac make steel putty "Z370 steel weld" as per inspection report.
- Insitu refurbishment of following valves were carried out during shutdown:

Sr. No.	Valve Details	Plant	Qty.	Remark
1	Gate Valve Size & Rating: 900 MM NB X 150 #	P-4401-D, P-4401-BCooling Tower	02	Servicing Done
2	Check Valve Size & Rating: 900 MM NB X 150 #	P-4401-D, P-4401-B, Cooling Tower	02	Servicing Done
3	Gate Valve Size & Rating: 150 MM NB X 1500#	Turbine Outlet valve, Boiler site	01	Servicing Done

The above job was awarded to M/s Flotec Technosmart (India) Private Limited, Surat against the contract no. 201004191073.

- Recycle line of size 10" was installed in discharge line of P-4404-E.
- Main isolation valves of Pillar No. 21, 10 & 8 of steam line were replaced.
- Replacement of BFW line BFW line from Utility to Ammonia. Size: 6" X Sch 80.
- Cooling tower distribution valve overhauling job.

Installation of V-Wedge Wire Flat Panel Manual Screen with J-Basket :

We have procured 06 Nos. of V-Wedge Wire Flat Panel Manual Screen from M/s Aqseptence Group India Private Limited, Ahmedabad against PO No. 201004190797 and M/s Apollo Screens Private Limited, Chhatral against PO No. 201004190927**.**

We have Installed 06 Nos of V-Wedge Wire Flat Panel Manual Screen with J-Basket at the Bottom in the suction of all cooling water pumps.

Details of screen are as :

- Gap between V-wedge Wire: 12MM
- Effective Opening of Screen: 77-82%
- MOC of the Screen: SS-304
- Overall dimensions of Screen with Frame: 2000MM Width X 1600 MM Height

New SS-304 Screen

Installation of New 48" butterfly valve in 52" pipeline between NCT and Ammonia-7 & 8

Existing cooling water basin of all three cooling towers were interconnected and cooling water return headers of Ammonia & Urea towers were also connected.

Committee comprised of various officials of all streams was made to enhance the performance of all cooling towers, It was decided by these officials to separate the cooling water circuit of Ammonia and Urea plant with proper cooling water distribution.

For this, we have procured 48" butterfly valve for 52" pipeline from M/s Well Cast Industries, Ahmedabad against PO No. 201004190741. We have installed both the butterfly on both sides during the shutdown.

Installation of Jash make motorized Sluice Gate in new RCC wall in between Ammonia Cooling and Urea Cooling Tower cells :

Further, to enhance the performance of all cooling towers, it was decided to make a RCC wall in between Ammonia and Urea Cooling Tower. It was also decided to install the Jash make Sluice gate valve which we have procured from M/s Jash Engg. Limited, Indore against PO. No. **201004190679.**

Party had refused to deliver the sluice gate before shutdown. So, we have made a channel for the gate and CS plate with rubber lining on edges was installed it it. Whenever party will deliver the gate, we will install it same channel instead of temporary gate.

DM PLANT

RERUBBER LINING OF SBA-4 and SMB-4 UNIT

Rerubber lining of SBA-4 and SMB-4 unit were done based on the inspection report. Job was awarded to M/s Unicon Industrial Lining, Vadodara against the rate contract 201004191091.

SBA-4 was dismantled from the location and loaded in truck sent by party. Party sent the unit after relining of vessel. It was offloaded and SMB-4 was loaded in truck after dismantling of unit.

All nozzles and bellows were replaced by new one in SBA-4. Damaged side glass were replaced by new one.

All nozzles and bellows were replaced by new one in SMB-4. Side glass stud was struck in one hole. So, drilling and tapping done. Damaged side glass were replaced by new one.

IG Plant

Instrument air dryer (V-5302) inlet line:

Line of size **:** 4" X Sch 40 was replaced.

AMMONIA CRACKER, V-5504

It was observed by production that there is some leakage from ammonia cracker. So, they have checked and found that there is leakage from 07th retort tube. As shutdown was ending, it was decided to blind the 7th no. retort tube.

Moisture Separator

New moisture separator was installed in running plant for separate air compressor for Bagging plant. Various lines were connected during shutdown due to unavailability of isolation in running plant.

TESTING OF BOILER RV'S

Critical boiler RV's were removed, overhauled and then tested on test bench. RV testing readings are as under:

RV tag	Location	RV details	Set Pr. (Kg/Cm2 g)	Seat tightness test Pr. (Kg/Cm2 g)
RV-5151	40 ATA, Header	Size: 4" X 6" Make : Tyco	44	39.60
RV-F-5111-1	Steam Drum, Rear BHEL Boiler	Size : 2-1/2" X 6.0" Make : Tyco Model : HCL-56-IBR-IFN-SPL Sr. No. 201120150	72.0	64.80
RV-F-5111-2	Steam Drum, Front, BHEL Boiler	Size : 2.0" X 4.0" Make : Tyco Model : HCL-56-IBR-IFN-SPL Sr. No. 201120159	69	62.10
RV-F-5111-3	Super Heater, BHEL Boiler	Size : 1-1/2" X 3.0" Make : Dresser, BHEL Model: 1717 WD	64.5	58
RV-Q-5113,	FD Fan Turbine Exhaust	Size : 3" X 4" Make : Crosby	4.5	4
RV-Q-4411A	Elliott Turbine, Cooling Tower	Size: 1" X 1" Make: Crosby Model : 9511021-B Sr. No. : 97-2403	1.50	1.15
RV-5112	BFW Pump, Boiler	Size: 1.5" X 2" Make: Tyco Sr. No. 20140034	72.01	64.80

B & MH. PLANT
(MECHANICAL)

BAGGING BUILDING FEED CONVEYOR-M-2121

Following jobs were carried out

- Replaced Existing Conveying System of 800 mm width and Installed New 1000 mm width conveying system with SS 304 material for M-2121 within the limited space available as following Details

Executed by	: M/s Prayas Egg, Vallbhvidhyanagar
P.O. No.	: 201004190353
Conveyor Tag Number	: M-2121
Product handled	: Neem Coated Urea
Bulk density of Material	: 0.753 Ton/M3
Design Capacity	: 425 Ton Per Hour
Belt Width	: 1000 mm
Belt Speed	: 1.85 mtrs
Take-up	: VTGU
Structure	: Stringer / short support / foundation Plate, MOC: SS304
Discharge Chute	: 8 mm thk. SS 304 construction
VGTU	: Mild Steel Structure
Nuts, Bolt, Fasteners & Hardware	: SS 304
Safety devices	: Rope switch + zero speed + sway Switch

New Reclaim Machine HM–470, (M-2116-A)

- Dismantling of scraper boom and chain from position. Found 2 nos scraper blades are bend that is rectified and completed.
- Removal of buckets and chain from elevator structure and found many links are defective like broken/bent and crack condition in bracket. Replaced 10 nos link by new and other repaired by welding on site.
- Proper checking after fitting of bucket and chain completed.
- Found bucket elevator drive sprocket tooth was wearied out that is rectified by welding and grinding.
- Removed slewing gearbox from Reclaim Machine and replaced by new gearbox
- Checking of king post and slewing bearing rollers are found ok.

- Greasing of slewing bearing and rollers done manually and completed.
- Checking of luffing drum and wheel condition are ok.
- Wire rope condition found also ok.
- Overhauling of all drive motors like slewing, link conveyor, scraper and elevator are done by electrical department side.
- Alignment done of all motors and completed.
- Replacement of oil from all gearbox, thruster and fluid coupling in machine and completed.
- Link conveyor Rollers replacement job work done.
- Link conveyor belt alignment completed by adjusting return rollers and checked found ok.
- Checking of all operation like scraper, elevator, Travel, slewing and luffing working found normally.
- Load trial taken and handling 100 ton material and working of reclaim machine found normally.

Old Reclaim Machine HM–122, (M-2116)

- Removal of scraper take up unit and replaced broken cone washer and overhauling completed.
- Removal of elevator take up unit and replaced broken cone washer and overhauling completed.
- Through inspection of slewing gearbox and replacement of slewing gear pinion 12 teeth, hub and shear pin.
- Checking of luffing mechanism and wire rope condition.

  Following alignment of gear box with motor work done.
  - Main Drive
  - Luffing Drive
  - Travel Drive
  - Slewing Drive
  - Link Conveyor
- Lubrication / Greasing and overhauling of reclaim machine.

BAGGING MACHINE-M-2101 / 1, 2, 3, 4, 7, 8, 9A, 9B, 10A, 10B

Following preventive maintenance jobs were carried out

- Overhauling of gate assembly.
- Overhauling of bucket assembly.
- Overhauling of sack grip assembly.
- Servicing of all cylinders.

- Alignment of stabilizer plate.
- Calibration of packer scales.

SLAT CONVEYOR-M-2124 / 1, 2, 3, 4, 7, 8, 9A, 9B, 10A, 10B

All gearbox cleaning and oil flushing with new oil. (Servo system-460)

STITCHING MACHINE-M-2102 / 1, 2, 3, 4, 7, 8, 9A,9B, 10A, 10B

All stitching machines and spare machines were overhauled.

AIR BLOWER-K-2161

All lines were opened, checking and inspect, cleaned and boxed up.

AIR BLOWER-K-2704

- All lines were opened, checking and inspect, cleaned and boxed up
- At outlet venture flange joint work done.

CYCLONE SEPARATOR-V-2704

Separator was opened, cleaned and boxed up.

UREA SOLUTION TANK-T-2704

Tank was opened, cleaned and boxed up with new gaskets.

VIBRATING SCREEN-M-2136/ A, B, C, D

- All screens were opened and check wire mesh condition, cleaned and boxed up with new “A” section rubber gasket.
- All clamps bolts serviced and damaged bolts replaced with new bolts.

PLANT TRANSFER CONVEYOR-M-2110

Following jobs were carried out.

- Head pulley, Tail Pulley, Bend pulley, Gravity pulley and Snub pulley were inspected and greasing done.
- Provided new rubber lagging on snub pulley and head pulley
- Repairing of Tega make Tru- Trac- Trough rollers for arresting sway of conveyor belt.
- Preventive maintenance of Gear Box carried out & coupling done after proper alignment with new rubber bushes.
- Gear box oil was replaced.(Servo system-460)
- Brush pulley dismantled and repositioning after serviced.
- All damaged and noisy carrying rollers, Self alignment carrying roller frames, Self alignment return roller frames and Tracking rollers were replaced.
- Kaveri make skirt rubber opened and reposition after cleaning.

- All impact rollers serviced and damage rollers replaced with spare rollers.
- Positioned all return rollers replaced with spare rollers.
- Gear box input and output coupling bushes are replaced.

TWO WAY FEED HOPPER CHUTE-M 2111

- Servicing of two way discharge flap valve.
- Servicing of all bearings with cleaning and greasing.

FRESH UREA SHUTTLE CONVEYOR-M-2112

Following jobs were carried out.

- Preventive maintenance of Gear Box carried out & Coupling done after proper alignment with new rubber bushes.
- Gear box oil flushing and new oil provided. (Servo system-460).
- All noisy carrier, guide and return rollers serviced with oil and damage rollers replaced with spare rollers.
- Greasing done in all bearings of head pulley, tail pulley, snub pulley and gravity pulley.
- Kaveri make skirt rubber opened and reposition after cleaning.
- Gear box input and out coupling all bushes are replaced
- Brush pulley dismantled and repositioning after serviced with new brush
- Tripper Gear box oil replaced and coupled the same with motor with new Rubber bushes after alignment.
- Tripper output chain guard opened and boxed up work done after checking of chain cleaning and condition.

RECLAIM CONVEYOR-M-2117

Following jobs were carried out

- Preventive maintenance Gear Box and Coupling done after proper alignment with new rubber bushes.
- Gear box oil flushing and new oil provided. (Servo system-460).
- All noisy carrier, guide and return rollers serviced with oil and damage rollers replaced with spare rollers.
- Greasing done in all bearings of head pulley, tail pulley, snub pulley and gravity pulley.
- Rubber lagging provided on snub Pulley and gravity pulley.
- Gear box input and out coupling all bushes are replaced .
- Brush pulley dismantled and repositioning after serviced.

BAGGING BUILDING HOPPER CONVEYOR-M-2122

Following jobs were carried out

- All noisy carrier, guide and return rollers serviced with oil and damage rollers replaced with spare rollers.
- Kaveri make skirt rubber opened and reposition after cleaning.
- Greasing done in all bearings of head pulley, tail pulley, snub pulley.
- Take up studs were serviced.
- Preventive Maintenance of Gearbox carried out and Coupling done after proper alignment with new rubber bushes.

  Gear box oil flushing and new oil provided. (Servo system-460).

BAGGING BUILDING HOPPER CONVEYOR-M-2122-A1

Following jobs were carried out

- Preventive maintenance of Gear Box carried out and Coupling done after proper alignment with new rubber bushes.
- Replaced all damaged and noisy Carrying, return and guide rollers with new rollers
- Take up studs were serviced.
- Skirt rubber modified work done with we uses available skirt rubber standardization with kaveri rubbers.

BAGGING BUILDING HOPPER CONVEYOR-M-2122 A2

Following jobs were carried out

- Preventive maintenance of Gear Box carried out and Coupling done after proper alignment with new rubber bushes.
- Replaced all damaged and noisy Carrying, return and guide rollers with new rollers
- Take up studs were Serviced.
- Replaced Gearbox oil .(Servo Mesh SP-460).
- Skirt rubber modified work done with we uses available skirt rubber standardization with kaveri rubbers.

FLAT CONVEYOR BELT-M-2142

Following jobs were carried out

- Preventive maintenance of Gear Box carried out and Coupling done after proper alignment with new rubber bushes.
- Replaced all damaged and noisy Carrying and return rollers with reconditioned rollers.
- Tail pulley with gravity structure fabrication work done with extra strengthening

DUST & UREA LUMPS BELT CONVEYOR-M-2137

Following jobs were carried out

- Preventive Maintenance of conveyor belt carried out.
- Complete greasing of all bearings done.
- Preventive Maintenance of Gearbox carried out and Coupling done after proper alignment with new rubber bushes.

INSPECTION

AMMONIA PLANT
(INSPECTION)

The following major inspection activities were performed in Ammonia Plant.

- Inspection of Primary reformer, catalyst tubes and risers with various NDT Techniques. Details are given at **Annexure-1 to 5.**
- Visual inspection of equipment.
- Ultrasonic flaw detection on selected weld joints and parent metal of elbows of MP Boiler 107-C loop and other critical pipelines was carried out. Details are given at **Annexure- 6.**
- PAUT (Phased Array Ultrasonic Testing) / *TOFD* ***(****Time of Flight Diffraction Technique)* on selected weld joints of elbows and pipelines of New MP Boiler-1123-C, New Converter (S-50) & MP Boiler 107-C loop was carried out. Details are given at **Annexure- 7.**
- PECT (Pulsed Eddy Current Testing) of various Cold insulated equipment and pipe lines was carried out for Thickness measurement as well as to reveal the condition of corrosion under insulation of object without removing the insulation. Details are given at **Annexure-8.**
- Thickness measurement of various Equipment and HT/LT Convection coils of primary reformer was carried out. Details are given at **Annexure-9.**
- Thickness measurement of various pipelines was carried out. Details are given at **Annexure-10.**
- Measurement of residual magnetism at various parts of rotating equipment and de-magnetization of the same wherever required. Details are given at **Annexure-11.**
- In-situ Metallography of selected equipment and pipelines was carried out. Detailed summary of observations and microstructure analysis given at **Annexure-12.**
- Inspection of newly fabricated pipelines and fabrication jobs executed by Maintenance and Technical department.
- NDT's viz. DP, RT and UFD was carried out in the converter loop to assess the condition of weld joints & Elbow parent metal for any deterioration. The details are attached at **Annexure-13.**
- Qualification tests of welders employed by contractors.
- The detailed observations and recommendations for corrective actions required on individual equipment are given below. All the observations were recorded during inspection and were handed over to concerned Maintenance and Operation Group for necessary corrective action.

101-B, PRIMARY REFORMER

RADIANT ZONE

VISUAL INSPECTION

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

OTHER NDT ACTIVITIES

- Automatic Ultrasonic Scanning of all the 336 Catalyst tubes and 8 Riser tubes was carried out during Shutdown by PDIL. Amongst all 336 tubes, 48 tubes are placed in B grade and 288 tubes are placed in C grade. Amongst 8 risers, 5 risers are placed in B grade & 3 risers are placed in C grade. Details are attached at **Annexure-2.**

- Following additional inspection activities were also performed by M/s PDIL along with AUS this year.
- **Visual inspection of catalyst tubes for general assessment and bowing.**

  Indicate that all the tubes were almost straight. No marked bowing or sagging could be observed in any tube. Visual observation in general showed shining grayish appearance for the lower portion of the tubes whereas upper portion of some tubes were covered with red oxide distributed here and there. Generally the tubes were free from surface deposit.

- **Diametrical Growth Measurement (DGM)**

  The increase in the outside diameter of the individual reformer tubes & riser tubes were measured using digital micro Vernier caliper. The tubes diameter was checked at various places along the tube length up to approachable height. The measured values of individual tubes are within tolerable limits considering base OD value of 113.6 mm & 124.44 mm of Catalyst tubes & Riser tubes respectively.

- **Ferrite Measurement (FM)**

  Ferrite measurement were taken on the parent metal surface of Reformer tubes & Riser tubes at various places starting from bottom portion up to approachable height. The measured values of individual tubes are observed within tolerable limits. (Maximum observed values of Reformer tubes & Riser tubes are 2.5% & 1.5% respectively).

  - DP test of all riser tube to weldolet weld-joints was carried out. No service defects were revealed.

  - DP test of random catalyst tube to weldolet weld-joints was carried out. No service defects were revealed.

  - Creep measurement of all the catalyst tubes was carried out using GO-NOGO Gauge at tunnel slab level. Creep was found in the range of 0 - 0.17 % for 335 nos. In 01 no. of tube creep observed in the range of 0.17 to 0.70

%. Creep measurement of the riser tubes at tunnel slab level was also carried out using digital micrometer. Creep in all Riser tubes was observed in the range 0.33 – 1.10 %. The report is attached at **Annexure 3.**

- In-situ Metallography carried out on Catalyst tube to weldolet weld & Riser tube to weldolet weld joint. The detailed report is attached in **Annexure-12.**
- Radiography of all 08 nos. weldolet to riser weld joints was carried out. No significant defect was observed.

CONVECTION ZONE

Visual inspection of HT convection zone from bottom manhole was carried out. The observations made are as under:

101-B, H.T. CONVECTION SECTION

From Bottom Manhole

- Scaling was observed on all the tubes of Mixed Feed Coil.
- Bottom most part of Insulation covering plate was found burnt off at most of the locations. This was observed in previous inspection also.
- Rubbing on the coils observed near anchor supports, however no reduction in thickness was noticed. (Also observed in previous inspection)

- Peeling off of top layer of casting was observed on first two rows of east side anchor supports of mixed feed coils. (Also observed in previous inspection)

- 1st Mixed feed coil support (counting from West) found cracked / damaged at south end. (Also observed in previous inspection)

- Tunnel thermo well pipes were found slightly bent, scaled and eroded. Same was observed during previous inspection.
- Bottom floor refractories found loosen at some places and flooring found sagged at some location. Same was observed during previous inspection.
- Previously repaired top layer refractory was found downward sagged at West side.
- Sealing refractory found fallen between tunnel slab wall and refractory near tunnel no. 2, 5, 7 & 8.
- Top refractory found slight damaged and fall down at the end of the 4th tunnel (counting from west) towards south side.
- Minor refractory found damaged at scattered locations.
- Insulation of East, West and South wall was found satisfactory.
- Mixed Feed coil found sagged in South-West segment compared to North-East Segment. (Same was observed in previous inspection)
- Some Brick wall segments were found bent.

VESSELS & OTHER EQUIPMENT

103-D, SECONDARY REFORMER

BOTTOM DOME

- The refractory around the 101-CA/CB gas inlet nozzles (approx. half of the top circumference) was found eroded and loosened. Same was observed during previous inspection also.

101 CA Nozzle View

101 CB Nozzle View

- The liner inside the 101-CB gas inlet nozzle was slightly buckled /distorted. Condition of the thermo well was found satisfactory. Same was observed during previous inspection also.

- The liners inside the 101-CA gas inlet nozzle were found slightly buckled /distorted. Insert liner condition was found satisfactory. Condition of the thermo well was found satisfactory.

- Top Brick dome refractory condition found satisfactory.
- Allumina balls found exposed from top brick dome.
- Bottom conical refractory condition found satisfactory.

1123-C, NEW SYN LOOP BOILER

From Shell Side

- Condition of the weld joints were found satisfactory.
- Rust/ scaling observed on the weld & Dished End.
- Rust / scaling observed on the tube baffles and some of the tubes.

- Rust / scales observed lying on the shell bottom.
- South side top demister half was found upward lifted.

107-C (M.P. Boiler)

From top manhole (from outside):

- Grayish black coloration was observed inside the boiler.
- All internals were found intact in position.
- Overall condition of the vessel was found satisfactory.

104-D2 (Low Temperature Shift Converter)

- Grayish black and Brownish coloration was observed inside the vessel in top and bottom half respectively.
- Hard scattered scales and pitting were observed on the surface of entire vessel.
- Manway welding found satisfactory.
- All welding of the vessel found satisfactory.
- Catalyst found lying on the inlet distributor plate.
- Stiffening rod of the inlet distributor found detached at North, South & East side. (09 detached out of 12, Need to be attention.)
- Welding of the previous repair patch of the inlet distributor bottom plate found satisfactory.
- Catalyst found adhered on the long seam weld of top half at West side.
- Catalyst found laying on manway of side M/H at West side.
- Catalyst found adhered on dump out nozzle.
- Catalyst found adhered & water laying on 6” nozzle at North side.
- Thermowell pipe found bent and its assembly found loose at end.
- End of the Thermowell pipe found chocked with catalyst.
- Bottom screen found intact.
- Catalyst found laying at bottom around the screen plate.
- Fastener of screen clamps found loosed at few locations. (Same were marked with yellow chalk & need to be tight.)
- Catalyst impression observed in entire periphery of bottom dish end.
- Magnetic Particle test was carried out on all Circumferential and Longitudinal weld joints from inside and found satisfactory.
- Hardness measurement was carried out and observed in the range of 130 to 180 BHN.
- Ultrasonic Flaw Detection was carried out in length of 12” x 12” of all T-joints and approx. 6” area of parent metal. No significant defect was observed.
- Ultrasonic thickness measurement was carried out and found satisfactory.

107 - D ,TRANSFER LINE: (FROM OUTSIDE)

- Minor buckling/distortion of the liner was observed throughout the length of the transfer line.
- Minor damage of the refractory was observed at flange (end plug side) of the transfer line. Also End plug seating area found eroded/damaged at Top and North side. (Same was observed in previous inspection)

- Scattered cracks were observed on the end plug seat.

- Gap was observed between transfer line and End plug seat in entire periphery.

- Thermowell was found intact in its position.

101- EA, CO_2 ABSORBER

(Manhole no. counting from top of the vessel)

From Manhole- 1

- Brownish black coloration was observed on the shell.
- Bubble cap condition found satisfactory.
- Top demister pad condition found satisfactory.
- Loose oily debris particles found adhered on the shell surface.

From Manhole- 2

- Brownish black coloration was observed on the shell.
- Black coloration observed on the Inlet distributor header.
- Bubble cap bottom tray condition found satisfactory.
- Loose oily debris particles found adhered on the shell surface.
- Rectangular gas riser condition found satisfactory.

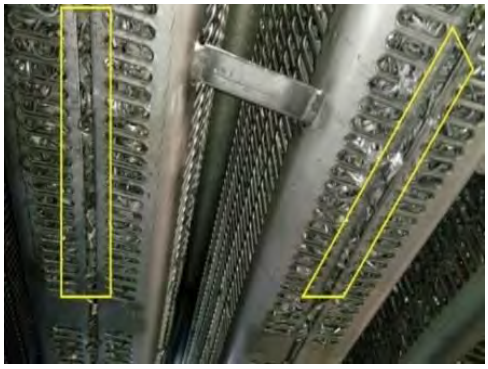
From Manhole- 3

- 01 no. Rasching ring holding clamp was found loose at south side.
  (Same was observed in previous inspection & Marked with yellow chalk)

- Brownish grey coloration was observed on the shell as well as on all the gas risers.
- Sample collectors were found intact in its position.
- Condition of the gas risers was found satisfactory.
- Loose piece of debris found between gas rising holding plate towards North.

From Manhole- 4

- Excessive gap as compared to others was observed in several rasching ring holder.(between two half of holder, Same was observed in previous inspection)

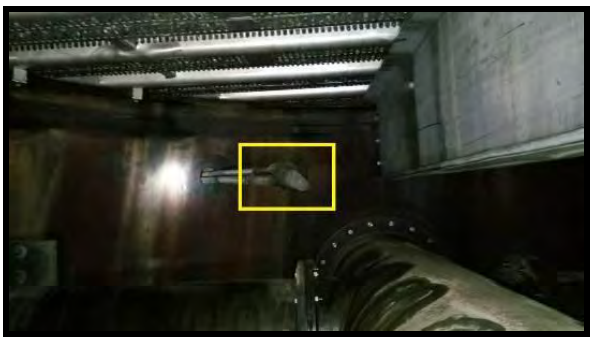


- Condition of liquid distributor was found satisfactory.
- Brownish grey coloration was observed on the shell as well as on all the fittings.
- Corrosion cavities and holes were observed on South most liquid distributor collector plate, located just below the liquid distributor. (Visible just from M/H, (Same was observed in previous inspection)

- Gas riser holding plate was found eroded/damaged from top edge at West-East side & Centre area. (Same was observed in previous inspection)



- Sample collector was found twisted. (Same was observed in previous inspection)



- Rubber piece was found lying on the gas riser holding plate at west side.

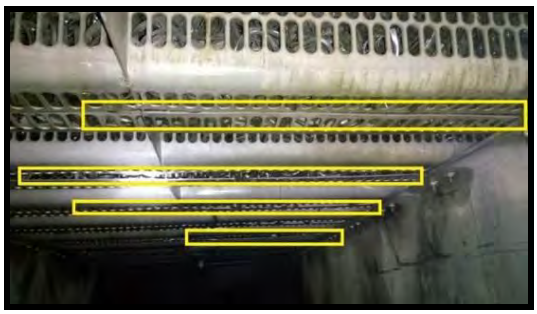
  (Same was observed in previous inspection)

- Liquid distributor bottom nozzle found eroded at bottom edge. (Visible just from M/H, Same was observed in previous inspection)

- 01 no. bolt of gas riser holding plate found loose at South side. (Marked with yellow chalk)

From Manhole- 5

- Excessive gap as compared to others was observed in several rasching ring holder. (Between two half of holder, (Same was observed in previous inspection).



- Grey coloration was observed on the shell.
- Sample collector was found missing from its location.

- Piece of rasching ring was found stuck up between shell and riser plate. (Same was observed in previous inspection)

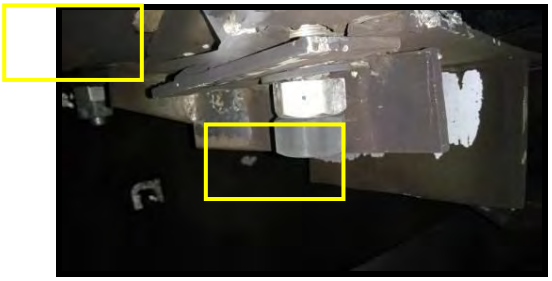
From Manhole- 6 (Inspected from outside)

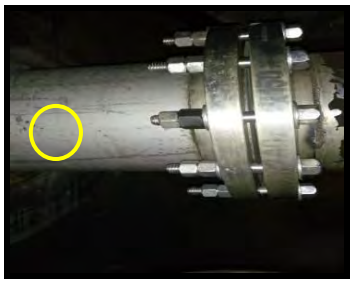
- Condition of gas distributor was found satisfactory.
- Grey coloration was observed on the shell.

102-EB, CO_2 STRIPPER

FROM TOP MANHOLE

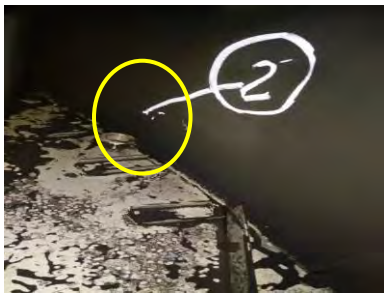
- Demister pad supporting strips were observed slightly downward bent (mostly in center portion) and supporting rods were found satisfactory.
- All the bolts of liquid inlet nozzle flange were found in position & intact.
- 01 no. nut of inlet header flange & 01 no. check nut of South-East side U-clamp observed with CS material.





- West side distributor header was found rubbing with the shell plate in S-W direction causing dent in the shell plate. Same was also observed in previous inspections.
- Crack was observed in South-West side U-clamp support plate welding. (Image no. 01)

- South-West side U-clamp check nut found missing and same was laying below the header at S-W corner. (Image no. 02)



- U-Clamps of North-West side distribution header were found loose. (Need to be tightened, Image no.03)

- Crack was observed in U-clamp tack weld with plate. (Image no. 04)

- North-West side, header bottom support plate found cracked/detached and same plate piece found laying near it. (Need to be repaired, Image no. 05)

- A crack was observed having approx length of 75 mm in the bottom of the U-clamp support plate at North-West side. (Image no.06) (Same was observed in previous inspection, Need to be repaired)

- Weld erosion observed in bottom stiffening plate of header support plate.
- North-East side distributor header U-clamp found loose & its nut found missing resulted in distributor header observed upward lifted. (Need to be attend Image no. 8 & 9)

- North-East side distributor header found rubbing with U-clamp support plate causing dent/slot of 50 mmX10 mm area in cap of header at west side. (same were marked with yellow chalk) (Image no.10)

FROM BOTTOM MANHOLE

- Blackish coloration was observed on the top half and brownish coloration observed on the bottom dish end from inside.
- White coloration was observed at the East-South direction.
- Nozzle condition was found satisfactory.
- Thermowell was found intact in its position.
- Thick scaling was observed on shell from inside.

103-E1, HP FLASH VESSEL

FROM TOP MANHOLE :

- Silverish coloration was observed at top dish end and shell coarse.
- Demister pipe found intact in position.

- Liquid distributor Main header and its distributor pipes found intact in position, color of the same was observed silver/ Gray. Supports of the main header and distribution pipes were found intact in position.

- Thin brownish scaling observed on the Liquid collectors and distributor trays segment. Gas vent rectangular risers were found intact in its position and have assumed thin brownish scales.

- Condition of the shell weld joints found satisfactory.

103-E2 (LP FLASH VESSEL)

TOP MANHOLE COMPARTMENT

- Demister pad was found intact in its position.

- Condition of bubble caps found satisfactory.

- Distributor collectors / drain pipes in West direction was found satisfactory.

- Debris/ black muck was found accumulated at many locations on the bubble cap holding plate.

- All the weld joints in the compartment were found satisfactory.

SECOND MANHOLE COMPARTMENT

- Rectangular riser box and other fittings found intact in position.

- 02 nos. of fasteners of vertical plate segment in the East direction were observed loose need to be fixed. Marked with Yellow chalk.

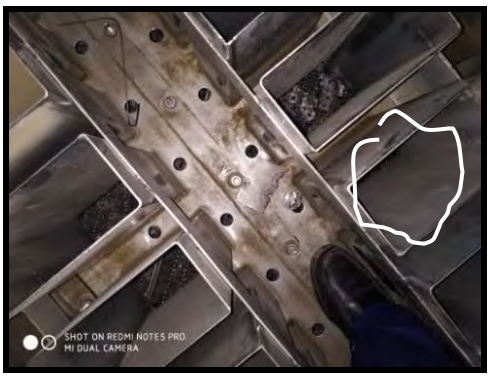
- Holding bolts of bottom Annular tray found bent at many locations. 02 nos. bolts are missing in North-West side. (Marked with yellow chalk)

- Silver coloration was observed on shell with scattered etching marks at several locations. Condition of both the tangential Nozzles & their welds were observed satisfactory.

- One of the Bubble cap tray drain line was found detached from top plate and support strip. It has been fallen on the riser boxes.

- The other Bubble cap drain line was also observed dislocated and about to get sheared from the top weld.

- 01 nos. plate segment having approx. size of 1.5”x3” found lying on the riser box holding plate. All the damaged parts of the drain pipe support, strips etc. need to be removed from the compartment.



1104-E (PROCESS CONDENSATE STRIPPER)

FROM TOP MANHOLE

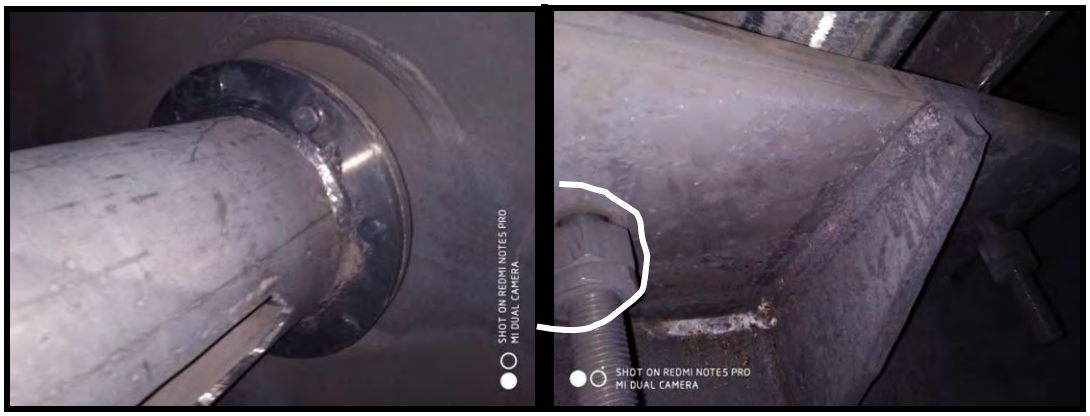
- Grayish Coloration was observed on the shell & Man-way.
- Mist eliminator was found intact in its position.
- Brownish flow marks were observed coming from the supports of the Mist eliminator.

- Grayish dust was found adhered on the top plate and internals.

- Metallic foreign particles were observed adhered to the shell near the liquid inlet nozzle & the 2” Differential pressure connection nozzle.

FROM BOTTOM MANHOLE

- Grayish Colouration was observed on the shell & Man-way.
- Bottom most tray was found intact in its position.
- ‘U’ Clamp of 10” SS Internal Pipe (Steam Inlet) was found loose. Also, the Internal pipe flange fasteners were found loosened. Need to be tightened.



- Vortex breaker in the bottom was found in satisfactory condition.

105-E ,DEHYDRATOR

FROM BOTTOM DOME:

- Bubble cap holding plate found satisfactory.
- Bubble cap surface found oily.
- Distribution header flange bolt found intact.
- Loose scaling was observed on shell surface.
- Loose scaling was observed on surface of the gas inlet distribution header.
- Brownish coloration observed inside the shell.
- Loose debris found laying on the bottom dish end.

FROM TOP DOME (From Out side)

- Bubble cap holding plate found satisfactory.
- 01 no. Clamp and its fastener found laying at just near-below manhole.
- Demister pads found intact in position, however at 03 location demister pad found upward lifted at North & West side.
- Loose scaling found at bottom of the manhole manway.
- Debris was found lying on the bubble cap plate.
- Oily surface found on bubble cap.
- Brownish coloration observed inside the shell.

STEAM DRUM (101-F):

- Grayish black coloration was observed inside the drum.
- All Cyclone Separators were found intact in position.
- Demister pads were found intact in position.
- Minor pitting of approx. 0.5 to 1.0 mm depth was observed at scattered locations. (Same was observed at previous inspection).

- One of the holes at south end of phosphate dozing line (1" NB) was found enlarged.
- Few bolts and clamps of Demister Pad holding cover plate were found loose. (Same were marked with yellow chalk & Need to be attend)
- Grill covering the Down Comers were found bent at few locations. (Same was observed at previous inspection).
- 6" BFW header found detached from center and 01 no. nut-bolt found missing and 01 no. nut-bolt found loose of the flange at north side near elbow. (Same were marked with yellow chalk & Need to be attend)
- Erosion of weld observed at top side of the 6" BFW header flange.
- In 6" BFW header, 02 nos. clamp bolt (1^{st} & 2^{nd} counting from North) found missing and 3^{rd} clamp found bent. (Need to be attend)
- 1" NB blow off line at bottom of the shell found filled with water.
- 02 nos. Demister Pad holding plate bolts found sheared at the top. (Same was observed at previous inspection).
- On East side demister pad stiffener plate fastener was found missing at 01 locations at bottom side of plate. (Same were marked with yellow chalk & Need to be attend)
- On East side, 1^{st} Stiffener plate (counting from North) tack welding of bottom demister pad was found detached at few locations. (Same were marked with yellow chalk & Need to be attend)
- On East side, 2^{nd} Stiffener plate (counting from North) found missing. (Tack welding of same were found broken in earlier inspection.)
- On East side, bottom demister pad found upward bent. (Need to be attend)
- 01 no. stud of the south side man hole found loose. (Need to be attend)
- Erosion of the weld was observed in top demister plate holding stiffener at several locations.
- Down comer no. 4,5,6,7 & 9 counting from south side found filled with water.

102-F, RAW GAS SEPARATOR

- Epoxy paint condition was found satisfactory.
- 02 segments of Demister pads were found lifted from its position at East Side.

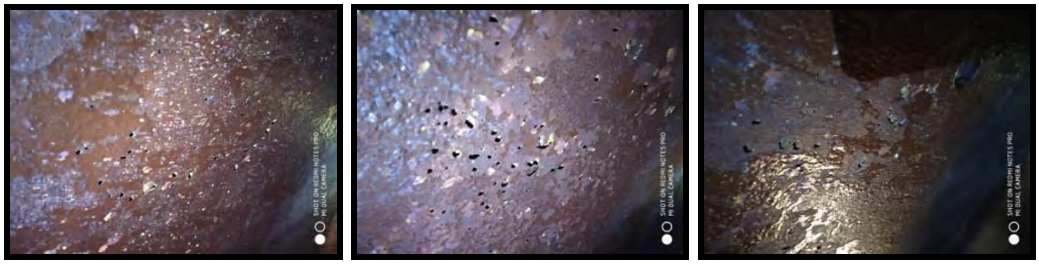

Need to be fixed.

- Putty applied on the circumferential weld joint of manhole nozzle with shell from inside was found detached approx in top half of the circumference.

- Condition of Gas inlet nozzle located at East side was found satisfactory.
- On Dished end soft blackish scales were observed, however the paint behind it was found intact.

103-F, REFLUX DRUM

- Demister pads were found intact in its position.
- Cavities observed in Epoxy at scattered locations in lower half of the vessel, more prominent up-to approx. 1.5m height from bottom dish-end.



- Nozzle condition was found satisfactory.
- Soft dry Blisters were observed in complete dish end. Manway epoxy blisters were observed filled with liquid matter.

- Epoxy layer was observed damaged on the Manway Inside Stub-end, causing corrosion. Same was observed on the manway cover.

- Hood Condition was found satisfactory.
- Vortex breaker was found satisfactory.

104-F, Synthesis Gas Compressor Suction Drum

- Grayish black coloration was observed on bottom dome, whereas brownish Coloration was observed on shell.
- Thin scales were observed on bottom dish end.
- Blackish coloration was observed inside the inlet hood baffle.
- Condition of the inlet hood baffle was found satisfactory.
- Scattered shallow pits observed on the shell course more prominent on the top course.
- Bottom vortex breaker was clear and its welds were found intact.
- Condition of demister pad was found satisfactory.
- Condition of all the nozzle weld joints was found satisfactory.

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

Visual inspection carried out from outside.

- The coloration of vessel was brownish black from inside.
- Demister pads were found intact in position.
- Scattered minor pitting were observed throughout the shell surface, the same was observed in past also.
- Entire internal surface was found oily.
- Oil was found accumulated at the bottom dished end of the vessel, need to be cleaned.
- The Overall condition of the vessel was found satisfactory.

107-F, PRIMARY AMMONIA SEPARATOR:

- Blackish brown coloration was found inside the vessel.
- Scattered thin scales were observed on the shell and dished end.
- Internal surface was found oily.
- The condition of all the weld joints of the shell, dished ends and nozzles was found satisfactory.
- Thermo well found intact in position.
- Scattered pitting was observed on entire shell surface, more prominent on bottom portion.
- Condition of target plate was found satisfactory.
- Hard scaling observed at manhole man way and same were found peeled off at scattered locations.

109-F, REFRIGERANT RECEIVER:

- Top half of the shell was having brownish coloration. Bottom half was observed oily and blackish in coloration.

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

110-F, FIRST STAGE REFRIGERANT FLASH DRUM:

- Brownish black coloration was observed inside the drum.
- Entire internal surface was found oily.
- The demister pads were found intact in position.
- Scattered scales were observed on the surface of the dish ends and shell.
- Thermowell condition found intact.
- Top plate bolts of 117-C return stand pipe found sheared and plate (approx. size of 400 mm x400 mm) was detached and lying behind vertex plate.
- Vertex plate condition found satisfactory.
- Overall condition of the vessel was found to be satisfactory.
- Ultrasonic Flaw Detection was carried out of all weld joints from inside and found satisfactory.

111-F, SECOND STAGE REFRIGERANT FLASH DRUM:

- Blackish gray coloration was observed inside the shell surface.
- Entire internal surface was found oily.
- The demister pads were found intact in position.
- Dish ends were found covered with scattered scales.
- Condition of all shell weld joints was found satisfactory.
- Thermo well found intact in position.
- Vertex plate condition found satisfactory.
- Oil found accumulated behind the make-up nozzle from 109F.
- Ultrasonic Flaw Detection was carried out of all weld joints from inside and found satisfactory.

112-F, THIRD STAGE REFRIGERANT FLASH DRUM:

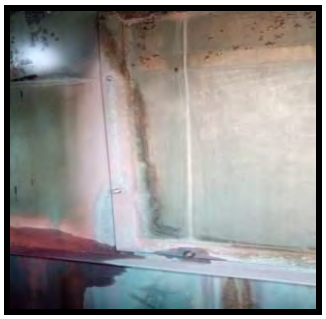
- The demister pads were found intact in position.
- The coloration of the inside surface of shell was brownish black.

- Surface of the entire vessel was found oily.
- Oil was found accumulated behind the vertex plate and 109-F make up line.
- Scattered hard scales were observed on the shell
- On East dish end thick scales with oily surface were observed.
- Condition of all the nozzles was found satisfactory.
- Condition of all the weld joints was found satisfactory.
- Overall condition of the vessel was found satisfactory.
- Thermowell condition found intact.
- Ultrasonic Flaw Detection was carried out of all weld joints from inside and found satisfactory.

101-U, DEAERATOR TOP HEAD:

(Inspected from outside)

- Redish coloration was observed inside the shell.
- Water found accumulated at bottom of the dish end.
- Water condensation particles observed adhered on shell.
- Welding condition found satisfactory.
- 01 no. stud found sheared, 01 no. stud & 01 no. nut found missing of the tray enclosure plate just in front of manhole.



- Thermowell found intact.

MISCELLANEOUS JOBS

NEW LTS COIL REPLACEMENT & REMOVAL OF 01 ROW OF HDS COIL JOBS IN 101-B CONVECTION SECTION:

- Various activities performed for replacement of LTS coil and removal of 01 row of HDS coil jobs by M/s NEO STRUCTO, sub vendor of JNK ENGINEERING COMPANY.

Viz, Final weld visual, Witness of Hardness measurement for alloy steel pipelines weld joints, review of PWHT charts, witness of PMI for Alloy Steel, Carbon Steel and Stainless steel pipelines, review of radiographs etc.

WELDER QUALIFICATION TESTS

- Performance qualification test of 23 Nos. welders offered by M/s General Engg., Bharuch (Mech. Planning) (W.O. No- 201004181283) was carried out. 08 nos. of welders were qualified during the test. These welders were allowed to perform fabrication jobs in ammonia and urea plant during Shutdown 2018.
- Performance qualification test of 20 Nos. welders offered by M/s J & J Engg., (W.O. No. 201004181048) was carried out. 08 nos. of welders were qualified during the test. These welders were allowed to perform for fabrication & erection of piping, structural and other related mechanical jobs.
- Performance qualification test of total 06 nos. welders offered by M/s SHIV ENGINEERING COMPANY LTD. (W.O. No. - 201004190882) was carried out. 04 nos. of welders were qualified during the test. These welders were allowed to perform fabrication jobs in ammonia and urea plant during Shutdown 2018.
- Performance qualification test of 11 Nos. welders offered by M/s SHREE GANESH ENGG. (W.O. No.201004190637) was carried out. 08 nos. of welders were qualified during the test. These welders were allowed to perform welding for capacity enhancement of Urea Solution Tank T-1401-A in Urea plant during Shutdown 2018.
- Performance qualification test of 08 Nos. welders offered by M/s SHREE GANESH ENGG. (W.O. No.201004190796) was carried out. 06 nos. of welders were qualified during the test. These welders were allowed to perform various fabrication job in Ammonia, Urea & Utility plant during Shutdown 2018.

D.P. TEST

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

RADIOGRAPHY

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

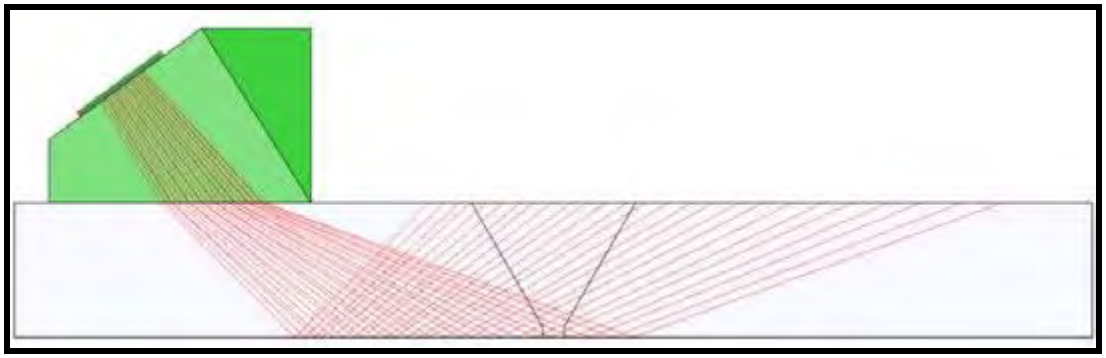
ULTRASONIC FLAW DETECTION OF WELDS

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.

The detailed list of pipeline inspected is mentioned at **Annexure-6**

PHASED ARRAY ULTRASONIC TESTING (PAUT)

Phased array ultrasonic testing is an advanced method of Pulsed echo Ultrasonic testing that has wide application and more advantage than conventional ultrasonic testing. The term PHASED refers to the timing and the term ARRAY refers to the multiple elements. PAUT is based on the principle of Constructive and destructive wave physics. Phased array ultrasonic systems utilize multi-element probes, which are individually excited under computer control. Ultrasonic beams can be constructed, steered at different angles & focused at required depths by computer controlled excitation at different time delay of different elements of PA probe. Software controls the characteristics of the ultrasonic beam.

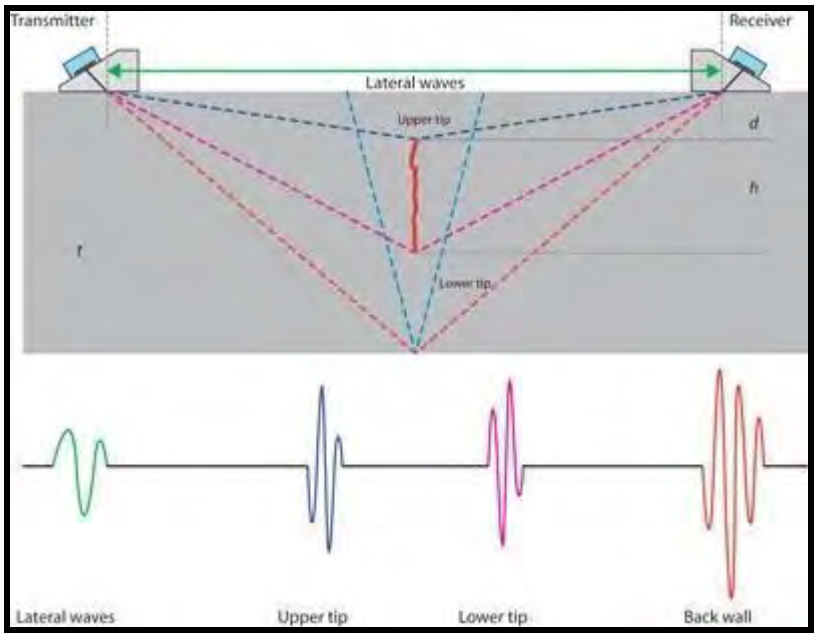


The advance software of PAUT Instrument provides the data in terms of different views that greatly helps to determine characteristics of the defect. Below are the advantages of Phased Array Ultrasonic Testing.

- High probability of defect detection than conventional UT
- Beam Focusing
- Beam Steering
- Better Visualization of flaw
- Higher sensitivity than Conventional UT
- Permanent data storage

TIME OF FLIGHT DIFFRACTION TECHNIQUE (TOFD)

Time of flight diffraction testing (TOFD) is an advanced method for testing of welds. Unlike Conventional Ultrasonic testing which is based on pulse echo, TOFD uses the time of flight of a diffracted ultrasonic pulse to determine the position & size of the reflection. As shown in image below, In a TOFD system a pair of ultrasonic probes sits on opposite sides of a weld. One of the probe acts as transmitter emits an ultrasonic pulse that is picked up by the probe on the other side, the receiver. In undamaged part of the job, the signals picked up by the receiver probe are from two waves: One that travels along the surface – Lateral Wave and one that reflects off the back wall. When a crack is present, there is a diffraction of the ultrasonic wave from the tip of the crack. Using the measured time of flight of the diffracted signal, the depth of the crack can calculated.



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.

The detailed list of pipeline inspected is mentioned at **Annexure-7**

PECT (PULSE EDDY CURRENT TESTING) OF PIPELINES AND EQUIPMENTS

Pulse Eddy Current Testing (PECT) is an inspection technique used for corrosion under insulation (CUI) screening on carbon steel structures as pipes, vessels, tanks and spherical tank legs without the need of contact with the steel surface.
PECT is a static technique able to measure spot percentage variations in steel thickness through any non-conductive and non-magnetic material between the sensor and steel surface such as air, insulation material, concrete, plastics, coatings, paint, sea water, marine growth, deposits, oil, etc.

Pulse Eddy Current Testing was carried out on various pipelines and equipment in the plant. The detailed results of inspection are attached herewith at **Annexure-8(1/2)** (For equipment) and **Annexure- 8(2/2)** (For pipelines).

ULTRASONIC THICKNESS MEASUREMENT

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 (1/2),** for equipment, **Annexure-9 (2/2)** for HT/LT Convection Coils, **Annexure-10 (1/2)** for 02 phase pipelines and **Annexure- 10 (2/2)** **f**or Other pipelines.

GAUSS MEASUREMENT, D.P TEST OF BEARINGS & COUPLING BOLTS OF HIGH SPEED TURBO MACHINARIES

Measurements of residual magnetism (gauss) on rotary and stationary parts of rotary equipment were carried out. Wherever residual magnetism was higher than

acceptable limits, same was demagnetized and brought down within acceptable limits. The detailed results of inspection are attached herewith at **Annexure-11.**
D.P. Test was carried out on all bearings to check condition of liner and its bonding and all coupling bolts of High Speed rotary equipment.

INSITU METALLOGRAPHY EXAMINATION

In order to evaluate the condition of certain critical plant equipment and pipelines operating at more than 300 deg. C temperatures, parent metal, HAZ welds , weld joints of dissimilar material, In situ metallographic examination was carried out. List of the lines/equipment checked along with observations and remarks are mentioned at **Annexure-12.**

INSTALLATION OF NEW PIPELINES

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

ANNEXURE-1

VISUAL INSPECTION REPORT

PLANT : AMMONIA

PRIMARY REFORMER RADIANT ZONE:

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

BURNER BLOCKS: Following burner blocks were found damaged:

Burner Row No.	Burner Block No.
2	4, 14
3	3, 5
4	6

BOTTOM HEADER INSULATION:

Header insulation was found damaged near following tube nos.:

Header No.	Tube no(s) where insulation found damaged
1	Near tube no. 7, 8, 24, 31 to 35, 38 to 42
2	Near tube no. 37 to 39
3	Near tube no. 17,20,21,31 to 34
4	Near tube no. 7 to 10, 23, 24
5	Near tube no. 20, 21, 23 to 26, 39 to 41
6	Near tube no.1, 2, 21, 22
7	Near tube no. 31, 32, 37 to 39
8	Near tube no. 7, 8, 23, 24, 26, 27, 35 to 37

ROOF INSULATION:

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

Row No.	Location
Burner Row No 1	Near Burner No.3, 4
Tube Row No 1	Near Tube No.40 to 42
Burner Row No 2	Near Burner No.1, 2, 4, 14
Tube Row No 2	Near Tube No.1 to 7, 21, 24, 38 to 42
Burner Row No 3	Near Burner No. 3, 4, 5, 11
Tube Row No 3	Near Tube no.19, 20, 28 to 31, 40, 41

Burner Row No 4	Near Burner no.2, 4, 6, 7, 13, 14
Tube Row No 4	Near tube no. 16 to 18, 20, 21
Burner Row No 5	Near Burner no. 2, 4, 7, 9 to 11, 14
Tube Row No 5	Near tube no. 19, 31, 32
Burner Row No 6	Near Burner no. 1, 3, 5 to 8, 14
Tube Row No 6	Near tube no. 12, 13, 19
Burner Row No 7	Near Burner no. 2, 4, 10, 14
Tube Row No 7	Near tube no. 19
Burner Row No 8	Near burner no. 1 to 3, 5, 7, 8, 13
Tube Row No 8	Near tube no. 1 to 7, 14, 17, 23, 38 to 42
Burner Row No 9	Near burner no. 8, 10

REFRACTORY / INSULATION OF WALLS:

- **East wall** **:** Found Satisfactory.
- **West wall** **:** Found satisfactory.
- **North wall**:
  Z-MODULES : Gap observed between block modules below Peep hole no. 1 and 4 (Counting from West).
- **South Wall**:
  Z-MODULES : Gap observed between block modules below Peep hole no. 4 (Counting from West)

TUNNEL SLAB: Tunnel slab found damage/broken as mentioned below.

Burner Row 4: 02 nos. towards North side.
Burner Row 6: 02 nos. towards South side.

Annexure - 2 (1/3)

GRADATION OF TUBES BY AUS CARRIED OUT BY M/s PDIL

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

Annexure - 2 (2/3)

GRADATION OF TUBES BY AUS CARRIED OUT BY M/s 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	B	2	C	23	C
3	C	24	C	3	B	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	B	9	C	30	C
10	C	31	C	10	C	31	C
11	C	32	C	11	B	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	B	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
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	B	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	B	30	C	9	C	30	C
10	C	31	C	10	B	31	C
11	C	32	B	11	C	32	C
12	C	33	C	12	C	33	B
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	B
17	C	38	C	17	C	38	C
18	C	39	C	18	C	39	C
19	B	40	C	19	C	40	C
20	C	41	C	20	C	41	C
21	C	42	C	21	C	42	B

Annexure – 2 (3/3)

GRADATION OF RISER TUBES BY AUS CARRIED OUT BY PDIL

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

Annexure – 3 (1/5)

TUBE NOS 101 TO 242

CREEP MEASUREMENT OF PRIMARY REFORMER CATALYST TUBES AT SLAB LEVEL:

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

Annexure – 3 (2/5)

TUBE NOS 301 TO 442

CREEP MEASUREMENT OF PRIMARY REFORMER CATALYST TUBES AT SLAB LEVEL:

Tube No.	Creep in Percentage			Tube No.	Creep in Percentage		
	0 – 0.17	0.17 – 0.7	0.7 – 1.55		0 – 0.17	0.17 – 0.7	0.7 – 1.55
301	X			401	X		
302	X			402	X		
303	X			403	X		
304	X			404	X		
305	X			405	X		
306	X			406	X		
307	X			407	X		
308	X			408	X		
309	X			409	X		
310	X			410	X		
311	X			411	X		
312	X			412	X		
313	X			413	X		
314	X			414	X		
315	X			415	X		
316	X			416	X		
317	X			417	X		
318	X			418	X		
319	X			419	X		
320	X			420	X		
321	X			421	X		
322	X			422	X		
323	X			423	X		
324	X			424	X		
325	X			425	X		
326	X			426	X		
327	X			427	X		
328	X			428	X		
329	X			429	X		
330	X			430	X		
331	X			431	X		
332	X			432	X		
333	X			433	X		
334	X			434	X		
335	X			435	X		
336	X			436	X		
337	X			437	X		
338	X			438	X		
339	X			439	X		
340	X			440	X		
341	X			441	X		
342	X			442	X		
Total	42	0	0	Total	42	0	0

Annexure – 3(3/5)

TUBE NOS 501 TO 642

CREEP MEASUREMENT OF PRIMARY REFORMER CATALYST TUBES AT SLAB LEVEL:

Tube No.	Creep in Percentage			Tube No.	Creep in Percentage		
	0 – 0.17	0.17 – 0.7	0.7 – 1.55		0 – 0.17	0.17 – 0.7	0.7 – 1.55
501	X			601	X		
502	X			602	X		
503	X			603	X		
504	X			604	X		
505	X			605	X		
506	X			606	X		
507	X			607	X		
508	X			608	X		
509	X			609	X		
510	X			610	X		
511	X			611	X		
512	X			612	X		
513	X			613	X		
514	X			614	X		
515	X			615	X		
516	X			616	X		
517	X			617	X		
518	X			618	X		
519	X			619	X		
520	X			620	X		
521	X			621	X		
522	X			622	X		
523	X			623	X		
524	X			624	X		
525	X			625	X		
526	X			626	X		
527	X			627	X		
528	X			628	X		
529	X			629	X		
530	X			630	X		
531	X			631	X		
532	X			632	X		
533	X			633	X		
534	X			634	X		
535	X			635	X		
536	X			636	X		
537	X			637	X		
538	X			638	X		
539		X		639	X		
540	X			640	X		
541	X			641	X		
542	X			642	X		
Total	41	01	0	Total	42	0	0

Annexure – 3(4/5)

TUBE NOS 701 TO 842

CREEP MEASUREMENT OF PRIMARY REFORMER CATALYST TUBES AT SLAB LEVEL

Tube No.	Creep in Percentage			Tube No.	Creep in Percentage		
	0 – 0.17	0.17 – 0.7	0.7 – 1.55		0 – 0.17	0.17 – 0.7	0.7 – 1.55
701	X			801	X		
702	X			802	X		
703	X			803	X		
704	X			804	X		
705	X			805	X		
706	X			806	X		
707	X			807	X		
708	X			808	X		
709	X			809	X		
710	X			810	X		
711	X			811	X		
712	X			812	X		
713	X			813	X		
714	X			814	X		
715	X			815	X		
716	X			816	X		
717	X			817	X		
718	X			818	X		
719	X			819	X		
720	X			820	X		
721	X			821	X		
722	X			822	X		
723	X			823	X		
724	X			824	X		
725	X			825	X		
726	X			826	X		
727	X			827	X		
728	X			828	X		
729	X			829	X		
730	X			830	X		
731	X			831	X		
732	X			832	X		
733	X			833	X		
734	X			834	X		
735	X			835	X		
736	X			836	X		
737	X			837	X		
738	X			838	X		
739	X			839	X		
740	X			840	X		
741	X			841	X		
742	X			842	X		
Total	42	0	0	Total	42	0	0

Annexure – 3(5/5)

CREEP MEASUREMENT OF PRIMARY REFORMER RISER TUBES AT SLAB LEVEL:

Riser No.	N- S	E- W	Creep in Percentage		
			0 – 0.33	0.33 – 1.10	1.10 – 1.44
1	125.73	125.76		X	
2	125.03	125.09		X	
3	125.53	125.54		X	
4	125.21	125.43		X	
5	125.45	125.73		X	
6	125.51	125.47		X	
7	125.26	125.31		X	
8	125.44	125.29		X	

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

Annexure – 4

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

COLD LOAD READINGS IN MM:

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

TRANSFER LINE SPRING HANGER LOAD READINGS

ROW	1	2	3	4	5	6	7
READINGS	**-30**	**-27**	**-22**	**-32**	**-36**	**-20**	**-15**

BOTTOM DRAIN READINGS

ROW	1	2	3	4	5	6	7	8
READINGS	**95**	**95**	**100**	**100**	**95**	**105**	**100**	**100**

AUXILIARY BOILER SPRING READINGS

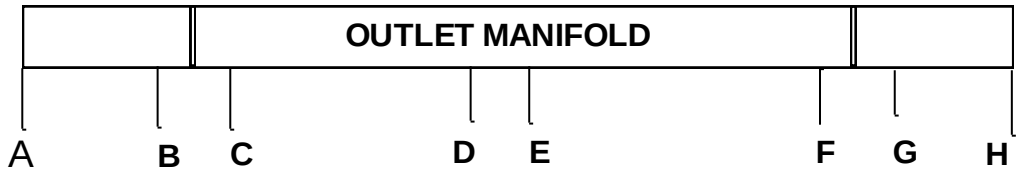
SPRING	S-E	N-E	S-W	N-W
READINGS	**60**	**65**	**60**	**60**

Annexure – 5

CLEARANCE OF OUTLET MANIFOLD FROM GROUND FLOOR IN COLD CONDITION

Header No.	Location of Measurement					
	B	C	D	E	F	G
1			*260	285		
2			*160	285		
3			265	270		
4			290	*215		
5			270	275		
6			280	*250		
7			*260	275		
8			285	*170		

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



SOUTH **NORTH**

Annexure – 6

LIST OF PIPELINES FOR ULTRASONIC FLAW DETECTION

SR NO	LINE NO	SIZE (NB)	SCH	FROM	TO	NO. OF WELD JOINTS TESTED	No. of Elbows Tested	No. of T-joints	REMARKS
1	SG-1303-11-14”	14”	140	107-C	123-C	**08**	**06**	**-**	
2	PG-12A	14”	30	105-CA	PG-26	**01**	**-**	**-**	
3	PG-12B	14”	30	105-CB	PG-26	**01**	**-**	**-**	
4	NG-11-A TO H	6”	120	NG-9	101-B	**24**	**08**	**-**	
5	NG-09-12”	12”	100	101-B	103-D	**04**	**01**	**-**	
6	SG-1303-02-14”	14”	100	121-C	SG-12-14”	**17**	**08**	**03**	
7	SG-1303-03-08”	8”	100	SG-12-14”	137-C	**07**	**02**	**-**	

Annexure – 7

LIST OF PIPELINES FOR PAUT (PHASED ARRAY ULTRASONIC TESTING)

SR NO	LINE NO	SIZE (NB)	SCH	FROM	TO	NO. OF WELD JOINTS TESTED	No. of Elbows Tested	No. of T-joints	REMARKS
1	SG-1303-08-14”	14”	120	105-D, SG-33-14	108-D Inlet (Bottom)	**06**	**03**	**-**	**No significant defect was observed.**
2	SG-1303-09-10”	10”	120	105-D, SG-1303.08-14	108-D Inlet (Bottom)	**11**	**02**	**-**	
3	SG-1303-10-14”	14”	120	108-D	107-C	**12**	**05**	**-**	
4	SG-0044-14”	14”	140	SG-1303.08-14	1123-C INLET	**11**	**-**	**-**	
5	SG-0045-14”	14”	140	1123-C OUTLET	SG-1303.08-14	**08**	**04**	**03**	
6	SG-0047-10”	10”	140	SG-0044-14”	SG-0045-14”	**08**	**-**	**-**	

Annexure – 8 (1/2)

LIST OF EQUIPMENT FOR PECT (PULSE EDDY CURRENT TESTING)

Sr. No.	Equip. No.	Equipment Description	Shell			Dish End			Channel		
			Nom./ Design	Min. Meas.	% Red.	Nom./ Design	Min. Meas.	% Red	Nom./ Design	Min. Meas.	% Red.
1	117 - C	Feed/Recycle Gas 1st Stage Chiller	11.11	10.80	2.79	11.11	10.80	2.79	63.50	-	-
2	118 - C	Feed/Recycle Gas 2nd Stage Chiller	11.11	10.80	2.79	11.11	10.90	1.89	63.50	-	-
3	119 - C	Feed/Recycle Gas 3rd Stage Chiller	12.70	12.00	5.51	12.70	12.00	5.51	-	-	-
4	120 - C	NH3 Converter Feed Gas & Recycle Gas Exchanger	24.60 65.05(ML)	23.90	2.85	-	-	-	65.08	-	-
5	129 - C	Synthesis Gas Compressor Interstage Cooler	9.53	9.10	4.51	9.53	9.10	4.51	28.50	27.00	5.26
6	126 - C	Flash Gas Chiller	8.38	8.00	4.53	-	-	-	-	-	-
7	141-C	Syn. Gas Compressor Suction Chiller	28.00	27.40	2.14	12.70	12.30	3.15	-	-	-
8	104 - F	Synthesis Gas Compressor Suction Drum	24.60	25.80	-	23.82	25.50	-	-	-	-
9	105 - F	Synthesis Gas Compressor 1st Stage Separator	47.63	48.00	-	46.03	45.60	0.93	-	-	-
10	106 - F	Secondary Ammonia Separator	104.80	103.60	1.15	53.98	55.60	-	-	-	-
11	107 - F	Primary Ammonia Separator	14.29	13.80	3.41	14.29	13.80	3.41	-	-	-
12	110 - F	1st Stage Refrigerant Flash Drum	9.52	9.10	4.41	9.52	11.60	-	-	-	-
13	111 - F	2nd Stage Refrigerant Flash Drum	9.52	9.30	2.31	19.05	22.77	-	-	-	-
14	112 - F	3rd Stage Refrigerant Flash Drum	9.52	9.10	4.41	19.05 (E)	22.70 (E) **9.2 (W)**	-	-	-	-
15	R-1	Drying Vessel	36.00	35.00	2.78	36.00	35.00	2.78	-	-	-
16	R-2	Drying Vessel	36.00	35.10	2.50	36.00	35.20	2.22	-	-	-

NOTE: All readings are in mm.

Annexure – 8 (2/2)

LIST OF PIPELINE FOR PECT (PULSE EDDY CURRENT TESTING)

SR. NO.	LINE NO.	N.B. (in.)	SCH.	NOM. THK. (mm)	MAT.	LINE DESCRIPTION		Min. Thickness Observed (mm)	% RED.
						FROM	TO		
1	HS-05	10	100	18.3	P-11	HS-4	HS-9	17.8	2.73
2	HS-09	8	100	23.01	P-11	HS-5	HS-12	22.6	1.78
3	HS-10	6	100	13	P-11	HS-5	PIC-13 A	12.5	3.85
4	HS-11	6	120	14.27	P-11	HS-9	PIC-13 B	13.8	3.29
5	HS-12	6	100	13	P-11	HS-9	MICA-22	12.6	3.08
6	NH-12	6	40	7.11	CS	111-F	NH-113	7.0	1.55
7	NH-34	6	40	7.11	CS	110-F	NH-112	6.9	2.95
8	NH-45	10	20	6.35	CS	NH-70	NH-46	5.9	7.09
9	NH-47A	6	40	7.11	CS	NH-112	117-C	7.1	0.14
10	NH-47B	6	40	7.11	CS	NH-112	117-C	6.8	4.36
11	NH-50	2	40	3.91	CS	LICV-13	107-F	3.5	10.49
12	NH-78A	10	20	6.35	CS	118-C	NH-46	6	5.51
13	NH-78B	10	20	6.35	CS	118-C	NH-46	6	5.51
14	NH-80A	16	20	7.9	CS	119-C	NH-10	7.4	6.33
15	NH-80B	16	20	7.9	CS	119-C	NH-10	7.4	6.33
16	NH-87	2	80	5.54	CS	LICV-13	NH-50	5.1	7.94
		3	80	7.6	CS	106-F	NH-87-2"	7.4	2.63
17	NH-98A	8	20	6.35	CS	117-C	NH-32	6	5.51
18	NH-98B	8	20	6.35	CS	117-C	NH-32	5.9	7.09
19	NH-112	8	20	6.35	CS	HEADER	117-C	6.3	0.79
20	NH-113	8	20	6.35	CS	HEADER	118-C	6.1	3.94
21	NH-113	3	-	-	CS	118-J/JA/JB	NH-119	5.4	-
22	NH-114	8	20	6.35	CS	HEADER	119-C	6.2	2.36
23	NH-117A	6	40	7.11	CS	NH-116	GATE	6.9	2.95
		4	40	6.02				5.9	1.99
24	NH-117B	6	40	7.11	CS	NH-116	GATE	6.8	4.36
		4	40	6.02				5.7	5.32
25	NH-117C	6	40	7.11	CS	NH-116	GATE	6.8	4.36
		4	40	6.02				5.9	1.99
26	NH-118A	3	40	5.5	CS	118-J	NH-113	5.3	3.64
27	NH-118B	3	40	5.5	CS	118-JA	NH-113	5.3	3.64
28	NH-118C	3	40	5.5	CS	118-JB	NH-113	5.4	1.82
29	SG-15	10	100	18.24	CS	117-C	118-C	18	1.32
30	SG-16	10	100	18.24	CS	118-C	SG-17	17.8	2.41
31	SG-17	14	100	23.8	CS	SG-16	119-C	23.2	2.52
32	SG-18	14	100	23.8	CS	119-C	106-F	23.2	2.52
33	SG-19	14	100	23.8	CS	106-F	120-C	23.3	2.10
34	SG-41	10	100	18.24	CS	120-C	SG-17	17.8	2.41

Annexure – 9 (1/2)

THICKNESS MEASUREMENT SUMMARY OF EQUIPMENT

Sr. No.	Equip. No.	Equipment Description	Shell			Dish End			Channel		
			Nom./ Design	Min. Meas.	% Red.	Nom./ Design	Min. Meas.	% Red	Nom./ Design	Min. Meas.	% Red.
1	102-B	Start up Heater(Shell)	6.35	6.50	-						
2	105-CA	CO2 Stripper Gas Exchanger	28.58	29.40	-	26.99	28.10	-			
3	105 - CB	CO2 Stripper Gas Exchanger	28.58	29.20	-	26.99	29.40	-			
4	106-C	Shift Effluent Feed Water Heater	6.35	6.40	-	15.08	15.70	-		19.40	
5	109-CA-1	aMDEA Solution Exchanger	12.70	12.10	4.72	12.70	14.10	-	25.00	25.20	-
6	109-CA-2	aMDEA Solution Exchanger	12.70	12.30	3.15	12.70	14.10	-	25.00	25.10	-
7	109-CB-1	aMDEA Solution Exchanger	12.70	12.20	3.94	12.70	13.40	-	25.00	23.80	4.80
8	110-CA	CO2 Stripper Condenser	12.70	16.10	-					16.10	
9	110-CB	CO2 Stripper Condenser	12.70	-						16.00	
10	115-C	Methanator Effluent Cooler		20.10						18.20	
11	122-C	NH3 Converter Interchanger	7.90	7.80	-				7.90		-
12	123-C	NH3 Converter Feed water Exchanger	82.55	-		44.00	47.60	-			
13	127-CA	Refrigerant Condenser	18.00	17.70	1.67				16.00	15.00	6.25
14	127-CB	Refrigerant Condenser	18.00	18.10	-				16.00	14.30	10.63
15	129-JC	Air Compressor Inter stage Cooler no.1	12.00	12.50	-	12.00	9.50	20.83			
16	130-JC	Air Compressor Inter stage Cooler no.2	NA	12.10		NA	8.80	-			
17	131-JC	Air Compressor Inter stage Cooler no.3	15.80	15.00	5.06	NA	9.70	-			
18	136-C	Synthesis Gas Methanator Feed Exchanger	15.80	15.10	4.43	NA	31.00	-		32.60	
19	101-JCB	Surface Condenser	NA	12.20						11.70	
20	104 - D2 (BOTTOM)	Low Temperature Shift Converter	60.32			58.74					
21	105-D	Synthesis Converter	NA	7.2 (Shell		NA	89.50(T) 89.60(B)				

Sr. No.	Equip. No.	Equipment Description	Shell			Dish End			Channel		
			Nom./ Design	Min. Meas.	% Red.	Nom./ Design	Min. Meas.	% Red	Nom./ Design	Min. Meas.	% Red.
				Jacket)							
22	107-D	Transfer Line	3.2(Liner)	3.1 (Liner)	3.12						
23	108-D	Synthesis Converter (S50)					82.10				
24	101-EA	New CO2 Absorber	M1,2,3-33 mm thk M4-50 thk M5,6-46 thk	M4-57.0 M 5,6-46.50		T-32.0 B-46.0					
25	103-E2LP	L.P. Flash Vessel		14.90							
26	157-F	Process Gas Separator	19.84	22.20	-	17.46	25.40	-			
27	172-F	Ammonia liquor Tank	12.00	11.90	0.83		12.00				
28	2005-F	New Instrument Air Receiver	8.00	12.20	-	8.00	12.60				
29	101-JLT (NEW)	Lube Oil Tank For Air / Refrigeration Compressor	NA	2.90		NA	-				
30	101-U	Deaerator	9.53	7.90	17.06	NA	12.30				
31	2005-U	Condensate Polisher	NA	14.40		NA	22.50				
32	2007-U	Resin Trap	NA	7.80		NA	9.00				
33	2008-U			16.10			19.10				
34	K-1	Washing Tower	18.00	18.20	-		18.50				
35	1115-C	TRIM HEATER		22.90			19.50			12.90	

NOTE: All readings are in mm.

Annexure – 9 (2/2)

THICKNESS MEASUREMENT SUMMARY OF HT/LT COILS.

SR NO	DESCRIPTION	DESIGN THICKNESS	MEASURED THICKNESS	% REDUCTION
Thickness Measured From East Side				
1	HT Convection Zone: New HDS Coil (4^{th} from Bottom)	8.6	9.89	-
2	HT Convection Zone: HT Steam Super Heater Coil (3^{rd} from Bottom)	8.0	7.45	6.88
3	HT Convection Zone: New SS Air-Preheater Coil (2^{nd} from Bottom)	6.1	7.3	-
4	HT Convection Zone: Mixed Feed Coil (Bottom most)	8.0	11.36	-
4	LT Convection Zone: BFW Heater Coil (Bottom most)	5.54	3.89	29.78
5	LT Convection Zone : BFW Heater Coil (2^{nd} from Bottom)	5.54	4.6	16.97
6	LT Convection Zone : BFW Heater Coil (3^{rd} from Bottom)	3.9	3.4	12.82
7	LT Convection Zone : Ammonia BFW Coil (4^{th} from Bottom)	5.54	4.72	14.80
9	Additional BFW Coil	-	6.64	-

NOTE:

1. All readings are in mm.

2 LT Steam Super Heater Coil (5^{th} from Bottom) Replaced in SD in 2018, Radiography and PWHT of field weld joints carried out and found satisfactory.

ANNEXURE- 10 (1/2)

THICKNESS MEASUREMENT OF TWO PHASE FLOW PIPELINES

SR. NO.	LINE NO.	N.B. (in.)	SCH.	NOM. THK. (mm)	MAT.	LINE DESCRIPTION		Min. Thickness Observed (mm)	% RED.
						FROM	TO		
1	BO-4	1	80	4.5	CS	BO-6H-1" (SP-7)	BO-14-3"	4.6	-
2	BO-6H	1	160	6.35	CS	103-C	BO-4-1" (SP-7)	6.3	0.79
3	BO-11H	2	XXS	11.07	CS	AUX.BOILER COIL-D	BLOW DOWN BO-9	11.2	-
4	BO-12H	2	XXS	11.07	CS	AUX.BOILER COIL-C	BLOW DOWN BO-6	11.2	-
5	aMDEA-06A	10	40S	9.27	SS	109-C1A	aMDEA-61-12"	6.0	35.28
6	aMDEA-06A	8	40S	8.18	SS	109-C1A	aMDEA-61-12"	8.2	-
7	aMDEA-06B	10	40S	9.27	SS	109-C1B	aMDEA-61-12"	5.9	36.35
8	aMDEA-06B	8	40S	8.18	SS	109C1B/ C2B	MDEA- 7-12"	8.2	-
9	aMDEA-07	10	40S	9.27	SS	aMDEA-61-12"	102-EB (aMDEA-9B-10")	9.1	1.83
10	aMDEA-24A	2.5	40	5.16	CS	108-J	aMDEA-25-3"	8.2	-
		3	40	5.5	CS	108-J	aMDEA-25-3"	5.2	5.45
11	aMDEA-24B	2.5	40	5.16	CS	108-JA	aMDEA-25-3"	6.9	-
		3	40	5.5	CS	108-JA	aMDEA-25-3"	5.2	5.45
12	aMDEA-25	3	40	5.5	CS	aMDEA-24A,B	102-EB	4.5	18.18
		2.5	40	5.16		CONT. VALVE	ASSEMBLY	4.2	18.60
13	MDEA-1212. 01	16	XS	12.7	CS	115- JA	101-EA (MDEA-1212-03) USV-933	9.6	24.41
14	MDEA-1212. 02	16	XS	12.7	CS	115- JB	101-EA (MDEA-1212-03) USV-935	9.5	25.20
15	MDEA-1212. 03	16	XS	12.7	CS	115JA/115-JB (MDEA-1212-01/02)	101-EA	9.6	24.41
16	SC-17	3	80	7.62	CS	156-F	SEWER	6.9	9.45
		2	80	5.54	CS	LC-21	CVA	3.9	29.60
17	SG-13	12	100	21.41	CS	120-C	LETDOWN VALVE (Yellow line)	16.1	24.80

ANNEXURE- 10 (2/2)

THICKNESS MEASUREMENT OF OTHER PIPELINES

SR. NO.	LINE NO.	N.B. (in.)	SCH.	NOM. THK. (mm)	MAT.	LINE DESCRIPTION		Minimum Thickness Observed (mm)	% RED.
						FROM	TO		
1	A-22	4	40	6.02	P-11	A 20 SPEC.BRK	SPEC. BRK NG-9	10.5	-
2	BF-07	6	80	10.97	CS	104-J	BF-22	7.9	27.99
3	BF-41	2"	160	8.71	CS	BF-06-8"	TRCV-142	7.4	15.04
4	BO-11	1.5	80	5.1	CS	JCT BO-G789	BO-14	4.9	3.92
5	CW-04	10	30	7.8	CS	CW-5	124-C	6.3	19.23
6	HS-02	12	100	21.41	CS	HS-2H	101-B	20.1	6.12
7	HS-2H	12	100	21.41	CS	101-F	HS-2	20.7	3.32
8	HS-04	12	100	21.41	P-11	HS-3H	HS-7	19.5	8.92
9	HS-05	10	100	18.3	P-11	HS-4	HS-9	17.5	4.37
10	HS-20-50	2	160	8.71	CS	TRCV-142 STEAM D/S LINE	-	7.4	15.04
11	HW-11	8	20	6.35	CS	116-C	HW-5	7.9	-
12	HW-26	18	20	7.92	CS	HW-27	HW-5	6.5	17.93
13	LC-16	1.5	80	5.08	CS	110-F (Level Transmitter)	-	4.9	3.54
14	LAH-115	1	80	4.55	CS	110-F (Level High Switch)	-	4.0	12.09
15	LSHH-116	1	80	4.55	CS	110-F (Level High High Switch)	-	4.1	9.89
16	LG-42	0.75	80	3.91	CS	110-F (Level Glass)	-	3.9	0.26
17	LC-18	1.5	80	5.08	CS	111-F (Level Transmitter)	-	4.8	5.51
18	LAH-117	1	80	4.55	CS	111-F (Level High Switch)	-	4.5	1.10

SR. NO.	LINE NO.	N.B. (in.)	SCH.	NOM. THK. (mm)	MAT.	LINE DESCRIPTION		Minimum Thickness Observed (mm)	% RED.
						FROM	TO		
19	LSHH-118	1	80	4.55	CS	111-F (Level High High Switch)	-	4.3	5.49
20	LG-44	0.75	80	3.91	CS	111-F (Level Glass)	-	4.2	-
21	LIC-19	1.5	80	5.08	CS	112-F (Level Transmitter)	-	4.7	7.48
22	LAH-119	1	80	4.55	CS	112-F (Level High Switch)	-	4.6	-
23	LSHH-120	1	80	4.55	CS	112-F (Level High High Switch)	-	4.2	7.69
24	LG-45	0.75	80	3.91	CS	112-F (Level Glass)	-	4	-
25	MDEA-1202.01	18	XS	12.7	CS	101- EA	MDEA-1202.02,(USV470)	10.7	15.75
26	MDEA-1202.02	18	XS	12.7	CS	MDEA-1202.01	115- HT	11.0	13.39
	MDEA-1202.02	18	10S	4.78	SS	115- HT	103-E1	11.0	-
	MDEA-1202.02	18	XS	12.7	SS	115- HT	103-E1	11.0	13.39
27	MS-17	2	80	5.5	CS	MS-2	2004-JA	5.2	5.45
28	MS-19	4	40	6.02	CS	MS-1	107-JAT	5.6	6.98
29		6	40	7.11	CS	MS-1	107-JAT	6.0	15.61
30	MS-21	6	40	7.11	CS	MS-40	105-J	6.3	11.39
31	MS-23	8	30	7	CS	MS-60	104-J	6.0	14.29
		6	40	7.11	CS			6.8	4.36
		1.5	80	5.08	CS			4.7	7.48
32	MS-24	8	30	7.04	CS	MS-60	104-JA	6.4	9.09

SR. NO.	LINE NO.	N.B. (in.)	SCH.	NOM. THK. (mm)	MAT.	LINE DESCRIPTION		Minimum Thickness Observed (mm)	% RED.
						FROM	TO		
33	MS-25	6	40	7.11	CS	MS-40	101-JT	6.7	5.77
34	NG-07	8	20	6.4	CS	101-B,NG FDPRHT COIL	NG-8	5.5	14.06
35	NG-11A	6	120	14.3	P-11	NG-9	101-B	14.1	1.40
36	NG-11B	6	120	14.3	P-11	NG-9	101-B	13.9	2.80
37	NG-11C	6	120	14.3	P-11	NG-9	101-B	14.5	-
38	NG-11D	6	120	14.3	P-11	NG-9	101-B	14.1	1.40
39	NG-11E	6	120	14.3	P-11	NG-9	101-B	13.8	3.50
40	NG-11F	6	120	14.3	P-11	NG-9	101-B	14.4	-
41	NG-11G	6	120	14.3	P-11	NG-9	101-B	13.4	6.29
42	NG-11H	6	120	14.3	P-11	NG-9	101-B	13.6	4.90
43	NG-23	6	40	7.11	CS	NG-30	NG-26	6.5	8.58
44	NG-23	8	40	8.18	CS	NG-30	NG-26	7.2	11.98
45	NG-28	2.5	40	5.2	CS	NG-27	102-B	4.2	19.23
46	NH-20	18	20	7.92	CS	105-J	NH-106 A&B	7.5	5.30
47	NH-87	2	80	5.54	CS	106-F	NH-50	8.9	-
	NH-87	3	80	7.6	CS	106-F	NH-50	9.7	-
48	NH-89	6	40	7.11	CS	121-J	CONTROL VALVE	6.2	12.80
49	NH-89	3		5.49		121-J	CONTROL VALVE	5.0	8.93
50	NH-89A	3		5.49		121-JA	NH-89	5.2	5.28
51	NH-89A	6	40	7.11	CS	121-JA	NH-89	5.7	19.83
52	NH-106A	14	20	7.9	CS	NH-20	128-C	7.8	1.27

SR. NO.	LINE NO.	N.B. (in.)	SCH.	NOM. THK. (mm)	MAT.	LINE DESCRIPTION		Minimum Thickness Observed (mm)	% RED.
						FROM	TO		
53	NH-106B	14	20	7.9	CS	NH-20	128-C	7.7	2.53
54	PG-15	14	XS	12.7	CS	102-F	101-E	7.9	37.80
55	PG-16	14	20	7.92	CS	101-E	136-C	6.2	21.72
56	PG-18	12	30	8.4	P-11	104-C	106-D	7.8	7.14
57	SC-07	2.5	80	7.01	CS	SC-42	101-JC	3.9	44.37
		1	80	4.55	CS	SC-42	101-JCA	7.8	-
58	SC-47	10	40	9.27	CS	101-JC	112-J	6.1	34.20
59	SC-47A	10	40	9.27	CS	101-JC	112-JA	5.9	36.35
60	SG-01	12	30	8.4	P-11	106-D	1114-CA (Line modified in SD-2017)	9.0	-
61	SG-05	14	20	7.92	CS	115-C	104-F	7.3	7.83
62	SG-07	10	60	12.7	CS	103-J	136-C	11.5	9.45
63	SG-08	10	40	9.27	CS	136-C	116-C	9.1	1.83
64	SG-14	10	80	15.06	CS	SG-13	117-C	18.7	-
65	SG-22	12	120	25.4	CS	SG-21	105-D	23.9	5.91
66	SG-25	8	120	18.24	CS	SG-23	CONT. VALVE	18.2	0.22
67	SG-26	6	120	14.27	CS	SG-23	105-D	13.6	4.70
68	SG-27	6	120	14.27	CS	SG-23	105-D	10.6	25.72
69	SG-28	4	120	11.13	CS	SG-23	105-D	9.8	11.95
70	SG-33	14	120	31.75	P-22	122-C	123-C	26.5	16.54
71	SG-34	14	100	23.8	P-11	123-C	121-C	24.2	-
72	SG-42	3	80	7.62	CS	CONTR.VALVE (FIC-8)	RV 103-J	6.9	9.45

SR. NO.	LINE NO.	N.B. (in.)	SCH.	NOM. THK. (mm)	MAT.	LINE DESCRIPTION		Minimum Thickness Observed (mm)	% RED.
						FROM	TO		
73	SG-0044	14	140	31.75	P22	105-D	1123-C GAS INLET	31.2	1.73
74	SG-0045	14	140	31.75	P22	1123-C GAS OUTLET	108-D	29.5	7.09
75	SG-0047	10	140	25.4	P22	SG-0044	SG-0045	22.8	10.24
76	SG-78	8	20	6.35	CS	PIC-4	V-36	6.0	5.51
77	SG-1303-02	14	100	23.8	CS	121-C	SG1303-03(121-C)	21.1	11.34
78	SG-1303-03	8	100	15.09	CS	SG-1303-02-14"(121-C)	137-C	13.9	7.89
79	SG-1303-04	8	100	15.09	CS	137-C	SG-51-8"	13.8	8.55
80	SG-1303-06	14	100	23.83	CS	121-C	124-C	20.1	15.65
81	SG-1303- 08	14	120	27.79	P 22	105- D	SG- 33	25.1	9.68
82	SG-1303- 08	10	120	21.44	P 22	SG- 1303. 08	108- D INLET (Top North)	21.0	2.05
83	SG-1303- 09	10	120	21.44	P 22	105- D	SG-1303- 08, 14"	21.0	2.05
84	SG-1303- 10	14	120	27.79	P 22	108- D	107- C	26.3	5.36
85	SG-1303- 11	14	140	31.75	P 11	107- C	123- C	28.7	9.61
86	SG-1303- 12	10	120	21.44	P 22	SG-1303- 08, 14"	108- D INLET (Top South)	21.2	1.12
87	FIC - 7	6	40	7.11	CS	103-JLP DISCH.	103-JLP SUCT.	6.9	2.95
88	FIC - 7	4	40	6.02				5.7	5.32
89	PRC - 1	6	40	7.11	CS	101/102-D INLET	VENT (SP-73)	5.1	28.27
90	PRC - 1	3	40	5.5				5.7	-
91	PRC - 1	2	80	5.54				4.9	11.55
92	PRC-6 D/S (V-27-6")	6	80	10.97	CS	V-27	V-29 (SP-75)	11.1	
93	WA-17	8	30	7.04	CS	WA-15	116-C	6.8	3.41

Annexure-11

GAUSS MEASUREMENT & DEMAGNETIZATION REPORT

DESCRIPTION	POSITION	INITIAL (Gauss)	AFTER DEGAUSSING (Gauss)
101-BJT			
Journal Bearing Sleeve	CT Side	T-0.9 B-1.7	
	SILO Side	T-0.8 B-1.4	
Shaft Journal	CT Side	1.6	
	SILO Side	1.3	
101-BJR			
LS Gear Journal Bearing Sleeve	CT Side	T-1.7 B-1.8	
	SILO Side	T-0.5 B-0.5	
LS Gear Shaft Journal	CT Side	1.5	
	SILO Side	1.4	
HS Pinion Journal Bearing Sleeve	CT Side	T-1.0 B-0.6	
	SILO Side	T-1.3 B-0.7	
HS Pinion Shaft Journal	CT Side	0.9	
	SILO Side	0.3	
101-BJ			
Journal Bearing Sleeve	CT Side	T-0.9 B-1.4	
	SILO Side	T-0.6 B-0.6	
Shaft Journal	CT Side	1.6	
	SILO Side	1.4	
101-JT			
Journal Bearing Pad	Thrust End	0.6	
	Non Thrust End	1.3	
Journal Bearing Base ring	Thrust End	0.6	
	Non Thrust End	1.0	
Thrust Bearing Pads	Active	0.7	
	Inactive	1.0	
Thrust Bearing Base ring	Active	1.2	
	Inactive	1.2	
Shaft Journal	Thrust End	1.7	
	Non Thrust End	1.4	
101-JLP			
Journal Bearing Pads	Thrust End	0.9	
	Non Thrust End	1.4	
Journal Bearing Base ring	Thrust End	1.1	
	Non Thrust End	0.7	
Thrust Bearing Pads	Active	1.0	
	Inactive	1.3	

DESCRIPTION	POSITION	INITIAL (Gauss)	AFTER DEGAUSSING (Gauss)
Thrust Bearing Base ring	Active	1.3	
	Inactive	1.2	
Shaft Journal	Thrust End	1.1	
	Non Thrust End	1.0	
101-JR			
Gear Journal Bearing (Low Speed)	North	T-0.2 B-0.2	
	South	T-0.5 B-0.4	
Pinion Journal Bearing (High Speed)	North	T-0.8 B-0.8	
	South	T-0.8 B-0.9	
Thrust Bearing (Low Speed)	Active	1.0	
	Inactive	1.2	
Shaft Journal (Low Speed)	North	1.3	
	South	1.2	
Shaft Journal (High Speed)	North	1.0	
	South	1.3	
101-JHP			
Journal Bearing Pads	Thrust End	0.4	
	Non Thrust End	0.5	
Journal Bearing Base ring	Thrust End	0.8	
	Non Thrust End	0.7	
Thrust Bearing Pads	Active	0.3	
	Inactive	0.6	
Thrust Bearing Base ring	Active	0.8	
	Inactive	1.3	
Shaft Journal	Thrust End	1.3	
	Non Thrust End	1.4	
104-JA			
Journal Bearing Sleeve	Thrust End	T-0.4 B-0.4	
	Non Thrust End	T-0.5 B-0.4	
Thrust Bearing Pads	Active	1.0	
	Inactive	0.8	
Shaft Journal	Thrust End	1.1	
	Non Thrust End	1.0	
Thrust Collar	Active	0.7	
	In Active	0.9	
104-JAT			
Journal Bearing Sleeve	Thrust End	T-0.4 B-0.6	
	Non Thrust End	T-0.4 B-0.4	
Thrust Bearing Pads	Active	0.6	
	Inactive	0.7	
Thrust Bearing Base Ring	Active	1.4	
	Inactive	0.7	

DESCRIPTION	POSITION	INITIAL (Gauss)	AFTER DEGAUSSING (Gauss)
Shaft Journal	Thrust End	1.6	
	Non Thrust End	1.4	
107-JT			
Journal Bearing Sleeve	Thrust End	T-0.3 B-0.5	**Bearing Replaced**
	Non Thrust End	T-0.6 B-0.3	
Shaft Journal	Thrust End	1.0	
	Non Thrust End	0.6	
Thrust Bearing Pads	Active	0.5	
	In Active	0.4	
Thrust Collar	Active	0.7	
	In Active	0.8	
103-JLP			
Journal Bearing Sleeve	Non Thrust End	T-0.6 B-0.5	
Shaft Journal	Non Thrust End	1.0	
103-JHP			
Journal Bearing Pads	Non Thrust End	T-1.0 B-0.9	
Thrust Bearing Pads	Active	0.5	
Thrust Bearing Base ring	Active	1.0	
Shaft Journal	Non Thrust End	0.5	
105-JT			
Journal Bearing Pad	Thrust End	0.5	
	Non Thrust End	0.4	
Journal Bearing Base ring	Thrust End	0.5	
	Non Thrust End	0.8	
Thrust Bearing Pads	Active	0.6	
	Inactive	0.5	
Thrust Bearing Base ring	Active	0.8	
	Inactive	0.5	
Shaft Journal	Thrust End	0.4	
	Non Thrust End	0.5	
105-JLP			
Journal Bearing Pads	Thrust End	1.3	
	Non Thrust End	0.5	
Journal Bearing Base ring	Thrust End	0.5	
	Non Thrust End	0.6	
Thrust Bearing Pads	Active	0.9	
	Inactive	0.6	
Thrust Bearing Base ring	Active	0.6	
	Inactive	0.5	
Shaft Journal	Thrust End	1.8	
	Non Thrust End	1.2	

DESCRIPTION	POSITION	INITIAL (Gauss)	AFTER DEGAUSSING (Gauss)
105-JR			
LS Gear Journal Bearing	North side	T-0.4 B-0.3	
	South Side	T-0.3 B-0.4	
HS Pinion Journal Bearing	North side	T-0.3 B-0.2	
	South Side	T-0.3 B-0.4	
Thrust Bearing	Active	T-0.5 B-0.3	
	Inactive	T-0.5 B-0.4	
Shaft Journal	Low Speed Gear	N-0.3 S-0.4	
	High Speed Pinion	N-0.5 S-0.4	
105-JHP			
Journal Bearing Pads	Thrust End	0.5	
	Non Thrust End	0.4	
Journal Bearing Base ring	Thrust End	1.0	
	Non Thrust End	1.0	
Thrust Bearing Pads	Active	0.5	
	Inactive	0.6	
Thrust Bearing Base ring	Active	1.0	
	Inactive	0.9	
Shaft Journal	Thrust End	2.2	
	Non Thrust End	**13.0**	1.8
115-JAT			
Journal Bearing Liner	Thrust End	T-0.2 B-0.6	
	Non Thrust End	T-0.2 B-0.6	
Thrust Bearing Pads	Active	1.7	
	Inactive	1.7	
Thrust Bearing Base ring	Active	1.3	
	Inactive	1.3	
Shaft Journal	Thrust End	1.0	
	Non Thrust End	2.5	
Thrust Collar	Active	1.6	
	Inactive	1.6	
115-JA			
Journal Bearing Sleeve	Thrust End	T-0.8 B-0.8	
	Non Thrust End	T-0.6 B-0.2	
Thrust Bearing Pads	Active	1.4	
	Inactive	1.3	
Thrust Collar	Active	1.8	
	Inactive	1.8	
Shaft Journal	Thrust End	1.7	
	Non Thrust End	2.0	
115-JR			
Gear Journal Bearing	Front (West)	T-0.8 B-1.0	

DESCRIPTION	POSITION	INITIAL (Gauss)	AFTER DEGAUSSING (Gauss)
	Rear (East)	T-0.6 B-1.2	
Pinion Journal Bearing	Front (West)	T-0.9 B-0.4	
	Rear (East)	T-0.8 B-1.2	
Gear Shaft Journal	Front (West)	1.6	
	Rear (East)	1.6	
Pinion Shaft Journal	Front (West)	2.2	
	Rear (East)	2.0	
115-HT			
Journal Bearing Sleeve	Thrust End	T-0.6 B-0.6	**DE Bearing replaced**
	Non Thrust End	T-1.6 B-0.4	
Thrust Bearing Pads	Active	1.3	
	Inactive	1.0	
Shaft Journal	Thrust End	2.0	
	Non Thrust End	1.8	
115-JBT			
Journal Bearing Liner	Thrust End	T-1.0 B-0.8	
	Non Thrust End	T-0.5 B-0.6	
Thrust Bearing Pads	Active	0.9	
	Inactive	1.3	
Thrust Bearing Base ring	Active	0.2	
	Inactive	0.4	
Shaft Journal	Thrust End	1.3	
	Non Thrust End	3.1	
115-JB			
Journal Bearing Liner	Thrust End	T-0.6 B-0.6	
	Non Thrust End	T-0.6 B-1.0	
Thrust Bearing Pads	Active	1.9	
	Inactive	1.0	
Thrust Bearing Base ring	Active	0.6	
	Inactive	0.8	
Shaft Journal	Thrust End	0.4	
	Non Thrust End	0.2	
115-JR			
Gear Journal Bearing	Front (West)	T-0.4 B-0.6	
	Rear (East)	T-0.5 B-0.4	
Pinion Journal Bearing	Front (West)	T-0.5 B-0.4	
	Rear (East)	T-0.8 B-0.3	
Gear Shaft Journal	Front (West)	0.8	
	Rear (East)	0.5	
Pinion Shaft Journal	Front (West)	0.8	
	Rear (East)	1.3	

ANNEXURE-12

DETAILS OF INSITU-METALLOGRAPHIC INSPECTION

SR. NO.	LOCATION	MOC	MICROSTRUCTURE OBSERVATION	REMARK
1	Location: 1 (Parent Metal) On parent metal of 1st elbow of NG-9-12” (101B-Mixed feed coil outlet to NG-11)	P-11	Microstructure shows essentially fine-grained ferrite and carbides. Creep voids are suspected at the grain boundaries.	Recommended to conduct SEM for detection of creep voids.
2	Location: 2 (Weld/HAZ/PM) On Weld Betn pipe & Elbow (Elbow side) ofNG-9-12” (101B-Mixed feed coil outlet to NG-11)	P-11	Weld microstructure shows dendritic structure of ferrite & bainite/carbides, HAZ shows fine-grained ferrite and pearlite/bainite structure. Parent metal microstructure shows fine & coarse-grained ferrite and pearlite/bainite structure. In-situ degradation of pearlite/bainite observed in terms of spheroidization.	Recommended to conduct SEM.
3	Location: 3 (Weld/HAZ/PM) Dissimilar weld bet” pipe piece & nozzle of header towards HAZ of P-11, NG-9-12” (101B-Mixed feed coil outlet to NG-11)	P11 to SS 304H	HAZ microstructure shows essentially coarse grains of ferrite & carbides, Parent metal microstructure shows essentially fine-grained ferrite and carbides. Onset of in-situ spheroidization of pearlite/bainite is observed. Possibilities of isolated creep cavities are observed.	Recommended to conduct SEM.
4	Location: 4 (Weld/HAZ/PM) Dissimilar weld bet” pipe piece & nozzle of header towards HAZ of SS304, NG-9-12” (101B-Mixed feed coil outlet to NG-11)	SS 304H	Microstructure at weld shows dendritic structure of ferrite pools in austenite matrix, HAZ & parent metal microstructure shows fine & coarse-grained worked austenite structure with twins and strain-induce martensite. Second phase precipitates including carbide are observed at grain boundaries.	Microstructure is free from micro crack. Monitor after 2 years of service.
5	Location: 5 (Weld/HAZ/PM) Weld bet” flange & elbow of gas inlet nozzle, PG-6-18”towards eastside of 103C	P-11	Microstructure at weld shows ferrite and carbides in dendritic form, HAZ microstructure shows fine & coarse grained ferrite with few pearlite structure. Parent metal shows fine-grained ferrite with few pearlite structure. In-situ spheroidization of pearlite is observed at the grain boundaries. Possibilities of isolated creep cavities are observed.	Recommended to conduct SEM.

SR. NO.	LOCATION	MOC	MICROSTRUCTURE OBSERVATION	REMARK
6	Location: 6 (Weld/HAZ/PM) On Weld Between BW-11H-8" & Inlet Nozzle of 103-C at bottom, towards East side.	P-11	Microstructure at weld metal shows ferrite and carbides in dendritic form, HAZ microstructure shows fine & coarse-grained ferrite and pearlite/bainite structure. Parent metal shows fine-grained ferrite and pearlite structure.	No significant degradation observed. Monitor after 2 years of service.
7	Location: 7 (Parent Metal) SG-1303-09-10" (H36) On 108-D, Converter inlet last elbow at bottom on PM	P-22	Microstructure shows fine-grained ferrite & bainite structure. In-situ spheroidization of bainite is observed.	IInd stage of creep degradations. Monitor after 2 years of service.
8	Location: 8 (Parent Metal) SG-1303, 08-14" (H36) On 108-D, Converter inlet 'Tee' on parent metal	P-22	Microstructure shows fine-grained ferrite & bainite structure. Onset of in-situ spheroidization of bainite is observed.	Initial stage of degradation, recommended to monitor after 2 years of service.
9	Location: 9 (Weld/HAZ/PM) SG-1303, 08-14" (H36) On 108-D, Converter inlet 'Tee' (Weld + HAZ of reducer)	P-22	Weld microstructure shows tempered bainite in dendrite form, HAZ microstructure shows tempered bainite & ferrite structure. Fusion is normal. Parent metal microstructure shows fine-grained ferrite & bainite structure. In-situ spheroidization of bainite is observed.	Initial stage of degradation, recommended to monitor after 2 years of service.
10	Location: 10 (Weld/HAZ/PM) SG-1303, 09-10" (H36) On 108-D, Converter inlet 'Tee' (Weld + HAZ of reducer)	P-22	Weld microstructure shows tempered bainite in dendrite form, HAZ microstructure shows fine tempered bainite & ferrite structure. Fusion is normal. Parent metal microstructure shows fine-grained ferrite & bainite structure. In-situ spheroidization of bainite is observed.	Initial stage of degradation, recommended to monitor after 2 years of service.
11	Location: 11 (Weld/HAZ/PM) SG-0047-10", On 1123-C, Converter inlet 'Tee' (Weld + HAZ of pipe)	P-22	Weld microstructure shows tempered bainite in dendrite form, HAZ microstructure shows fine tempered bainite & ferrite structure. Fusion is normal. Parent metal microstructure shows fine-grained ferrite & bainite structure. In-situ spheroidization of bainite is observed. Indication of creep cavities are suspected.	Recommended to conduct SEM.

SR. NO.	LOCATION	MOC	MICROSTRUCTURE OBSERVATION	REMARK
12	Location: 12 (Weld/HAZ/PM) (Weld+HAZ) SG-1303-10-14" (H-36) on 108-D Converter outlet nozzle	P-22	Weld microstructure shows fine tempered bainite in dendrite form, HAZ microstructure shows coarse tempered bainite & ferrite structure. Fusion is normal. Parent metal microstructure shows tempered bainite structure.	No significant degradation observed.
13	Location: 13 (Weld/HAZ/PM) (Weld + HAZ of elbow) SG-1303-10-14" (H-36) on 108-D Converter outlet nozzle & pipe at top	P-22	Weld microstructure shows tempered bainite in dendrite form, HAZ microstructure shows tempered bainite with ferrites. Fusion is normal. Parent metal microstructure shows fine-grained ferrite & bainite. Onset of in-situ spheroidization of bainite is observed.	IInd stage of creep degradations. Monitor after 2 years of service.
14	Location: 14 (Parent Metal) SG-1303-10-14" (H-36) on 108-D Converter outlet to 107-C Gas inlet elbow-01	P-22	Microstructure shows coarse tempered bainite structure.	No significant degradation observed. Monitor after 2 years of service.
15	Location: 15 (Weld/HAZ/PM) (Weld + HAZ of nozzle) SG-1303-11-14" (H-34) on 107-C Gas outlet nozzle & HAZ of nozzle	P-11	Weld microstructure shows dendritic structure of ferrite and bainite/carbides, HAZ microstructure shows fine-grained ferrite & pearlite/bainite structure. Fusion is normal. Parent metal microstructure shows fine-grained ferrite and pearlite/bainite structure. Onset of in-situ spheroidization of pearlite/bainite is observed.	IInd stage of creep degradations. Monitor after 2 years of service.
16	Location: 16 (Parent Metal) SG-1303-11-14" (H-34) on 107-C Gas outlet elbow-01	P-11	Microstructure shows fine-grained ferrite and pearlite/bainite structure.	No significant degradation observed.
17	Location: 17 (Weld/HAZ/PM) SG-26-6" MICA-16 Upstream Flange weld	Carbon steel	Microstructure at weld metal shows ferrite and carbides in dendritic form. HAZ microstructure shows fine-grained ferrite and pearlite structure. Fusion is normal. Parent metal microstructure shows fine & coarse ferrite and pearlite structure. Presence of few widmanstatten ferrite is observed.	No significant degradation observed. However the widmanstatten structure seems to be from manufacturing stage.

SR. NO.	LOCATION	MOC	MICROSTRUCTURE OBSERVATION	REMARK
18	Location: 18 (Weld/HAZ/PM) SG-27-6" MICA-14 Upstream Flange weld	Carbon steel	Microstructure at weld metal shows ferrite and carbides in dendritic form. HAZ microstructure shows fine-grained ferrite and pearlite structure. Fusion is normal. Parent metal microstructure shows fine-grained ferrite and pearlite structure.	No significant degradation observed.
19	Location: 19 (Weld/HAZ/PM) SG-28-6" MICA-13 Upstream Flange weld	Carbon steel	Microstructure at weld metal shows ferrite and carbides in dendritic form. HAZ microstructure shows coarse-grained ferrite and pearlite structure. Pearlite is observed at the prior austenite grain boundaries. Fusion is normal. Parent metal microstructure shows fine-grained ferrite and pearlite structure. Onset of in-situ spheroidization of pearlite is observed,	IInd stage of creep degradations. Monitor after 2 year of service.
20	Location: 20 (Weld/HAZ/PM) SG-25-6" MICA-15 Upstream Flange weld	Carbon steel	Microstructure at weld metal shows ferrite and carbides in dendritic form. HAZ microstructure shows fine-grained ferrite and pearlite structure. Fusion is normal. Parent metal microstructure shows fine & coarse ferrite and pearlite structure. Presence of few widmanstatten ferrite is observed.	No significant degradation observed.
21	Location: 21 (Weld/HAZ/PM) Riser No.01, Riser to weldolet weld joint	Tube-G-4852M Weldolet 800HT	Microstructure at weld shows dendritic structure of ferrite pools in austenite matrix with carbides, whereas HAZ microstructure shows coarse-grained austenite. Microstructure at parent metal shows fine & coarse austenitic grain with twins. Second phase carbide precipitations are observed within the grain & at the grain boundaries. Presence of inter-granular cracks observed at HAZ region.	Inter-granular cracks are observed at HAZ region. **Needs attention.**

SR. NO.	LOCATION	MOC	MICROSTRUCTURE OBSERVATION	REMARK
22	Location: 22 (Weld/HAZ/PM) Riser No.02, Riser to weldolet weld joint	Tube -G- 4852 M Weld olet 800H T	Microstructure at weld shows dendritic structure of ferrite pools in austenite matrix with carbides, whereas HAZ microstructure shows coarse-grained austenite. Microstructure at parent metal shows fine & coarse austenitic grain with twins. Second phase carbide precipitations are observed within the grain & at the grain boundaries. Presence of inter-granular cracks filled with scale observed at HAZ region.	Inter-granular cracks are observed at HAZ region. **Needs attention.**
23	Location: 23 (Weld/HAZ/PM) Riser No.03, Riser to weldolet weld joint	Tube -G- 4852 M Weld olet 800H T	Microstructure at weld shows dendritic structure of ferrite pools in austenite matrix with carbides, whereas HAZ microstructure shows coarse-grained austenite. Microstructure at parent metal shows fine & coarse austenitic grain with twins. Second phase carbide precipitations are observed within the grain & at the grain boundaries. Presence of inter-granular cracks filled with scale observed at HAZ region.	Inter-granular cracks are observed at HAZ region. **Needs attention.**
24	Location: 24 (Weld/HAZ/PM) Riser No.04, Riser to weldolet weld joint	Tube -G- 4852 M Weld olet 800H T	Microstructure at weld shows dendritic structure of ferrite pools in austenite matrix with carbides, whereas HAZ microstructure shows coarse-grained austenite. Microstructure at parent metal shows fine & coarse austenitic grain with twins. Second phase carbide precipitations are observed within the grain & at the grain boundaries. Presence of inter-granular cracks observed at HAZ region.	Inter-granular cracks are observed at HAZ region. **Needs attention.**
25	Location: 25 (Weld/HAZ/PM) Riser No.05, Riser to weldolet weld joint	Tube -G- 4852 M Weld olet 800H T	Microstructure at weld shows dendritic structure of ferrite pools in austenite matrix with carbides, whereas HAZ microstructure shows coarse-grained austenite. Microstructure at parent metal shows fine & coarse austenitic grain with twins. Second phase carbide precipitations are observed within the grain & at the grain boundaries. Presence of inter-granular cracks observed filled with scale at HAZ region.	Inter-granular cracks are observed at HAZ region. **Needs attention.**

SR. NO.	LOCATION	MOC	MICROSTRUCTURE OBSERVATION	REMARK
26	Location: 26 (Weld/HAZ/PM) Riser No.06, Riser to weldolet weld joint	Tube -G- 4852 M Weld olet 800H T	Microstructure at weld shows dendritic structure of ferrite pools in austenite matrix with carbides, whereas HAZ microstructure shows coarse-grained austenite. Microstructure at parent metal shows fine & coarse austenitic grain with twins. Second phase carbide precipitations are observed within the grain & at the grain boundaries. Presence of inter-granular cracks filled with scale observed at HAZ region.	Inter-granular cracks are observed at HAZ region. **Needs attention.**
27	Location: 27 (Weld/HAZ/PM) Riser No.07, Riser to weldolet weld joint	Tube -G- 4852 M Weld olet 800H T	Microstructure at weld shows dendritic structure of ferrite pools in austenite matrix with carbides, whereas HAZ microstructure shows coarse-grained austenite. Microstructure at parent metal shows fine & coarse austenitic grain with twins. Second phase carbide precipitations are observed within the grain & at the grain boundaries. Presence of inter-granular cracks observed at HAZ region.	Inter-granular cracks are observed at HAZ region. **Needs attention.**
28	Location: 28 (Weld/HAZ/PM) Riser No.08, Riser to weldolet weld joint	Tube -G- 4852 M Weld olet 800H T	Microstructure at weld shows dendritic structure of ferrite pools in austenite matrix with carbides, whereas HAZ microstructure shows coarse-grained austenite. Microstructure at parent metal shows coarse austenitic grain with twins. Second phase carbide precipitations are observed within the grain & at the grain boundaries. Presence of inter-granular micro cracks observed at HAZ region.	Inter-granular cracks are observed at HAZ region. **Needs attention.**
29	Location: 29 (Weld/HAZ/PM) Row No.01 Tube no.35, Tube to weldolet weld joint	Tube -G- 4852 M Weld olet 800H T	Microstructure at weld shows dendritic structure of ferrite pools in austenite matrix with carbides, whereas HAZ microstructure shows coarse-grained austenite. Microstructure at parent metal shows fine & coarse austenitic grain with twins. Second phase carbide precipitations are observed within the grain & at the grain boundaries.	Microstructure is free from any micro cracks. Monitor after 1 year of service.

SR. NO.	LOCATION	MOC	MICROSTRUCTURE OBSERVATION	REMARK
30	Location: 30 (Weld/HAZ/PM) Row No.06 Tube no.18, Tube to weldolet weld joint	Tube -G-4852 M Weld olet 800H T	Microstructure at weld shows dendritic structure of ferrite pools in austenite matrix with carbides, whereas HAZ microstructure shows coarse-grained austenite. Microstructure at parent metal shows coarse austenitic grain with twins. Second phase carbide precipitations are observed within the grain & at the grain boundaries. Presence of inter-granular cracks observed at HAZ region.	Inter-granular cracks are observed at HAZ region. **Needs attention.**
31	Location: 31 (Weld/HAZ/PM) Row No.07 Tube no.37, Tube to weldolet weld joint	Tube -G-4852 M Weld olet 800H T	Microstructure at weld shows dendritic structure of ferrite pools in austenite matrix with carbides, HAZ microstructure shows coarse-grained austenite. Microstructure at parent metal shows coarse austenitic grain with twins. Second phase carbide precipitations are observed within the grain & at the grain boundaries.	Microstructure is free from any micro cracks. Monitor after 2 years of service.
32	Location: 31 (Weld/HAZ/PM) Row No.03 Tube no.40, Tube to weldolet weld joint	Tube -G-4852 M Weld olet 800H T	Microstructure at weld shows dendritic structure of ferrite pools in austenite matrix with carbides, whereas HAZ microstructure shows coarse-grained austenite. Microstructure at parent metal shows fine & coarse austenitic grain with twins. Second phase carbide precipitations are observed within the grain & at the grain boundaries. Presence of inter-granular cracks observed at HAZ region.	Inter-granular cracks are observed at HAZ region. **Needs attention.**
33	Location: 33 (Weld/HAZ/PM) On dissimilar weld bet" pipe & flange of PG-12A-14", 105-CA to PG-26-18" (106-C)	SS 304 to CS	Weld metal microstructure shows dendritic structure of ferrite pools in austenite matrix, HAZ microstructure shows ferrite & pearlite structure. Ferrite is observed at prior austenite grain boundaries. Fusion is normal. Parent metal microstructure shows fine-grained ferrite and pearlite structure. In-situ spheroidization of pearlite is observed at the grain boundaries.	Microstructure is free from micro cracks. IInd stage of creep degradations. Monitor after 2 years of service.

SR. NO.	LOCATION	MOC	MICROSTRUCTURE OBSERVATION	REMARK
34	Location: 34 (Weld/HAZ/PM) On dissimilar weld bet" pipe & flange of PG-12B-14", 105-CB to PG-26-18" (106-C)	SS 304 to CS	Weld metal microstructure shows dendritic structure of ferrite pools in austenite matrix, HAZ microstructure shows fine-grained ferrite & pearlite structure. Fusion is normal. Parent metal microstructure shows fine-grained ferrite and pearlite structure.	Microstructure is free from micro cracks. No significant degradation observed. Monitor after 2 years of service.
35	Location: 35 (Parent Metal) Aux. boiler (East side) tube no.33 from south side	Carbon steel	Microstructure shows fine-grained banded ferrite and pearlite structure.	No significant degradation observed.
36	Location: 36 (Parent Metal) Aux. boiler (West side) tube no.21 from south side	Carbon steel	Microstructure shows fine-grained ferrite and pearlite structure. Few widmanstatten ferrite is observed.	No significant degradation observed. However the widmanstatten structure seems to be from manufacturing stage.

Annexure - 13

UFD & RT STATUS OF CONVERTER LOOP

JOINT NO.	2015		2016		2017		2018	
	UFD	RT	UFD	RT	UFD	RT	UFD/ PAUT	RT
FROM 108D TO 107C, LINE NO: SG-1303-10-14", SCH-120 (27.79MM NOM THICK.)								
Elbows 1 to 5	NSD	--	NSD	--	Indication observed in E4 Elbow	Confirmed by RT and found satisfactory	NSD	--
J-1	NSD	--	NSD	--	NSD	--	NSD	--
J-2	NSD	--	NSD	--	NSD	--	NSD	--
J-3	NSD	--	NSD	--	NSD	--	NSD	--
J-4	NSD	--	NSD	--	NSD	--	NSD	--
J-5	NSD	--	NSD	--	NSD	--	NSD	--
J-6	NSD	--	NSD	NSD	NSD	--	NSD	--
J-7	NSD	--	NSD	NSD	NSD	--	NSD	--
J-8	NSD	--	NSD	--	NSD	--	NSD	--
J-9	NSD	--	NSD	--	NSD	--	NSD	--
J-10	NSD	--	NSD	--	NSD	--	NSD	--
J-11	NSD	--	NSD	--	NSD	--	NSD	--
J-12	NSD	--	NSD	--	NSD	--	NSD	--
FROM 105D TO 108D, LINE NO: SG-1303-8-10" SCH-120 (21.44MM NOM THICK.), **SG-1303-8-14"** SCH 120 (27.79MM NOM THICK.), **SG-1303-9-10"** SCH-120 (21.44MM NOM THICK.) & **SG-1303-12-10**" SCH-120 (21.44 MM NOM THICK.)								
Elbows 1 to 15	NSD	--	NSD	--	NSD	E-2 Elbow replaced	PAUT of elbow 2,4,5, 6 & 7 , NSD	--
J-1	NSD	--	NSD	--	--	--		--
J-2	NSD	--	NSD	--	NSD	--		--
J-3	NSD	--	Indication observed	Confirmed by RT and found satisfactory	NSD	New joint of elbow replaced	NSD	--
J-4	NSD	--	NSD	--	NSD	New joint of elbow replaced	NSD	--
J-5	NSD	--	NSD	--	NSD	--	--	--
J-6	NSD	--	NSD	--	NSD	--	--	--

JOINT NO.	2015		2016		2017		2018	
	UFD	RT	UFD	RT	UFD	RT	UFD/ PAUT	RT
J-7	NSD	--	NSD	--	NSD	--	--	--
J-8	NSD	--	NSD	--	NSD	--	NSD	--
J-9	NSD	--	NSD	New joint,after SR ,NSD	NSD	--	NSD	--
J-9A	NSD	--	NSD	New joint,after SR ,NSD	NSD	--	NSD	--
J-9B	NSD	--	NSD	--	--	--	--	--
J-10	NSD	--	NSD	--	NSD	--	NSD	--
J-11	NSD	--	NSD	--	NSD	--	NSD	--
J-12	NSD	--	NSD	--	NSD	--	NSD	--
J-13	NSD	--	NSD	--	NSD	--	NSD	--
J-14	NSD	--	NSD	--	NSD	--	NSD	--
J-15	NSD	--	NSD	NSD	NSD	--	NSD	--
J-16	NSD	--	NSD	NSD	NSD	--	NSD	--
J-17	NSD	--	NSD	NSD	NSD	--	NSD	--
J-17B	NSD	--	NSD	NSD	NSD	--	NSD	--
J-17C	NSD	--	NSD	NSD	NSD	--	NSD	--
J-18	NSD	NSD	NSD	NSD	NSD	--	NSD	--
J-19	NSD	--	NSD	--	NSD	--	--	--
J-20	NSD	--	NSD	--	NSD	--	--	--
J-21	NSD	--	NSD	--	NSD	--	--	--
J-22	NSD	--	NSD	--	NSD	--	--	--
J-23	NSD	--	NSD	--	NSD	--	--	--
J-24	NSD	--	NSD	--	NSD	--	--	--
J-25	NSD	--	NSD	--	NSD	--	--	--
J-26	NSD	--	NSD	--	NSD	--	--	--
J-27	NSD	--	NSD	--	NSD	--	--	--
J-28	NSD	--	NSD	--	NSD	--	--	--
J-29	NSD	--	NSD	--	NSD	--	--	--
J-30	NSD	--	NSD	--	NSD	--	--	--
J-T1	NSD	--	NSD	--	NSD	New joint of Tee replaced	--	--
J-T2	NSD	--	NSD	--	NSD	New joint of Tee replaced	--	--
J-T3	NSD	--	NSD	--	NSD	New joint of	--	--

JOINT NO.	2015		2016		2017		2018	
	UFD	RT	UFD	RT	UFD	RT	UFD/ PAUT	RT
						Tee replaced		
J-T4	NSD	--	NSD	--	NSD	--	--	--
J-T5	NSD	--	NSD	--	NSD	--	--	--
J-T6	NSD	--	NSD	--	NSD	--	--	--
FROM : 107-C TO 123-C, LINE NO: SG-1303-11-14", SCH-140 (31.75MM NOM THICK.)								
Elbows 1 to 6	NSD	--	NSD	--	NSD	--	NSD	--
J-1	NSD	--	NSD	--	NSD	--	--	--
J-2	NSD	--	NSD	--	NSD	--	NSD	--
J-3	NSD	--	NSD	--	NSD	--	NSD	--
J-4	NSD	--	NSD	--	NSD	--	--	--
J-5	NSD	--	NSD	--	NSD	--	NSD	--
J-6	NSD	--	NSD	--	NSD	--	NSD	--
J-7	NSD	--	NSD	--	NSD	--	NSD	--
J-8	NSD	--	NSD	--	NSD	--	--	--
J-9	NSD	--	NSD	--	NSD	--	NSD	--
J-10	NSD	--	NSD	--	NSD	--	NSD	--
J-11	NSD	--	NSD	--	NSD	--	NSD	--
J-12	NSD	--	NSD	--	NSD	--	--	--
FROM : 105-D TO 1123-C, LINE NO: SG-0044-H-36-14", SCH-140 (31.75MM NOM THICK.)								
Elbows 1 to 5	--	--	--	--	--	--	--	--
J-1	--	--	--	--	--	NSD	--	--
J-2	--	--	--	--	--	NSD	--	--
J-3	--	--	--	--	--	NSD	--	--
J-4	--	--	--	--	--	NSD	NSD	--
J-5	--	--	--	--	--	NSD	NSD	--
J-6	--	--	--	--	--	NSD	NSD	--
J-7	--	--	--	--	--	NSD	NSD	--
J-8	--	--	--	--	--	NSD	NSD	--
J-9	--	--	--	--	--	NSD	NSD	--
J-10	--	--	--	--	--	NSD	NSD	--
J-11	--	--	--	--	--	NSD	NSD	--
J-12	--	--	--	--	--	NSD	NSD	--
J-13	--	--	--	--	--	NSD	NSD	--
J-14	--	--	--	--	--	NSD	NSD	--
FROM : 1123-C TO 108-D, LINE NO: SG-0045-H-36-14", SCH-140 (31.75MM NOM THICK.)								

JOINT NO.	2015		2016		2017		2018	
	UFD	RT	UFD	RT	UFD	RT	UFD/ PAUT	RT
Elbows 1 to 4	--	--	--	--	--	--	NSD	--
J-1	--	--	--	--	--	NSD	NSD	--
J-2	--	--	--	--	--	NSD	NSD	--
J-3	--	--	--	--	--	NSD	NSD	--
J-4	--	--	--	--	--	NSD	NSD	--
J-5	--	--	--	--	--	NSD	NSD	--
J-6	--	--	--	--	--	NSD	NSD	--
J-7	--	--	--	--	--	NSD	NSD	--
J-8	--	--	--	--	--	NSD	NSD	--
TJ-1	--	--	--	--	--	NSD	NSD	--
TJ-2	--	--	--	--	--	NSD	NSD	--
TJ-3A	--	--	--	--	--	NSD	NSD	--
TJ-4	--	--	--	--	--	NSD	--	--
TJ-5	--	--	--	--	--	NSD	--	--
T1	--	--	--	--	--	NSD	NSD	--
T2	--	--	--	--	--	NSD	--	--
FROM : SG-0044 TO SG-0045, LINE NO: SG-0047-H-36-10", SCH-140 (25.4 MM NOM THICK.)								
Elbows 1 to 4	--	--	--	--	--	--	--	--
J-1	--	--	--	--	--	NSD	--	--
J-2	--	--	--	--	--	NSD	--	--
J-3	--	--	--	--	--	NSD	NSD	--
J-4	--	--	--	--	--	NSD	NSD	--
J-5	--	--	--	--	--	NSD	NSD	--
J-6	--	--	--	--	--	NSD	NSD	--
J-7	--	--	--	--	--	NSD	NSD	--
J-8	--	--	--	--	--	NSD	NSD	--
J-9	--	--	--	--	--	NSD	NSD	--
J-10	--	--	--	--	--	NSD	NSD	--

NSD: No Significant Defect

UREA PLANT
(INSPECTION)

During Plant turnaround Sept-Oct 2018, the following major Inspection activities were performed in the Urea plant.

- Internal Inspection of High-pressure vessels viz. Autoclave (V-1201), H.P. Stripper (H-1201), H.P Condenser (H-1202), & H.P Scrubber (H-1203).
- Eddy Current Testing of H.P. Stripper (H-1201) tubes carried out by M/s TesTex NDT India Pvt. Limited.
- Eddy Current Testing of H.P. Carbamate Condenser (H-1202) tubes by M/s TesTex NDT India Pvt. Limited.
- Inspection of L.P. Carbamate Condenser (H-1205) tubes by Internal Rotating Inspection System (IRIS) technique carried out by M/s TesTex NDT India Pvt. Limited.
- Helium Leak test of Autoclave (V-1201) liner weld joints carried out by M/s Gulachi Engineers.
- Internal Inspection of other vessels.
- Ultrasonic thickness measurement of **HP Lines.** Detailed report is attached at **Annexure-1.**
- Ultrasonic thickness measurement of **SC and ST Lines.** Detailed report is attached at **Annexure-2.**
- Ultrasonic thickness measurement of various **Equipments**. Detailed report is attached at **Annexure-3.**
- Qualification test of welders employed by contractors.
- Residual magnetism measurement and demagnetization, wherever required of Hitachi Compressor (K-1801) Train. Detailed report is attached at **Annexure-4**.
- Radiography of H.P. Line tapping. List is attached at **Annexure-5.**
- Radiography & Ultrasonic flow detection of V-1103 weld joints and its connected piping weld joints.
- UFD of H.P. Ammonia Pumps discharge line weld joints carried on random basis. Details of the test is attached in **Annexure-10.**
- DPT & RT carried out during modification of Urea Solution Tank T-1401 & T-1401-A.
- The detailed observations and recommendations and corrective actions required on individual equipment are given below. All the observations were recorded during inspection and were handed over to concerned maintenance and operation group for necessary corrective action.

HIGH PRESSURE VESSELS

Following High-pressure equipment were inspected. The observations are listed below:

AUTOCLAVE (V-1201)

VISUAL INSPECTION:

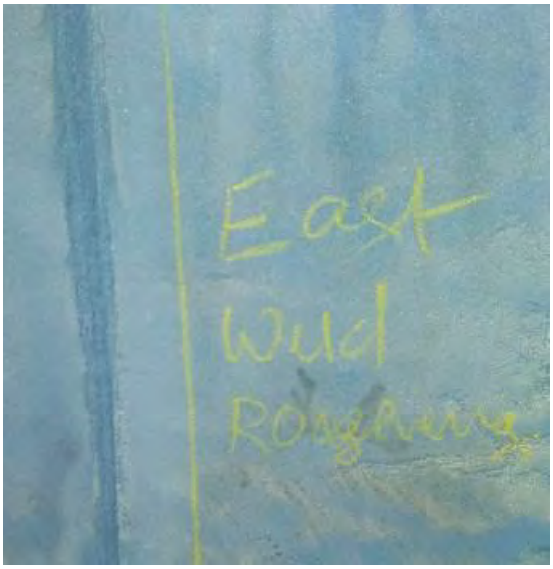
Thorough visual inspection of the liner, its welds, trays, Downcomer and internals were carried out. Observations made on each compartments are mentioned below.

Compartment No.1 (Top Compartment)

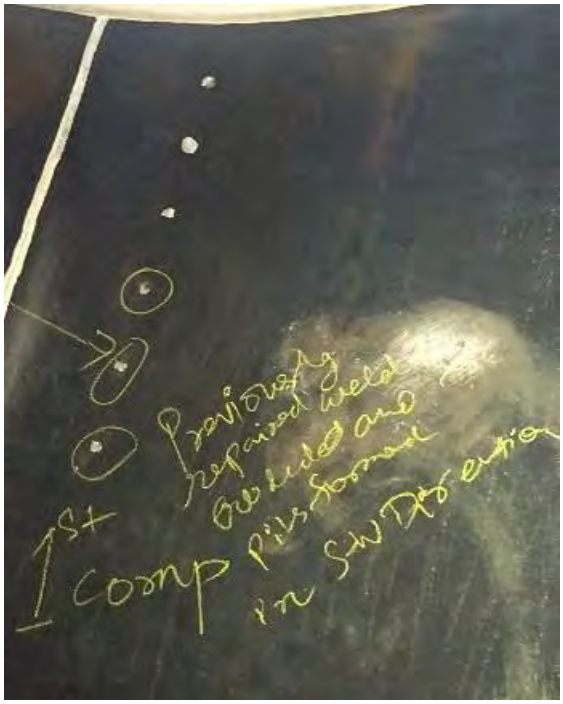
- Heavy roughening /corrosion of man way liner including its weld was observed. Man way liner “L” seam weld observed more rough/ porous in comparision to its ‘’C’’ Seam weld.

- Parent metal of man way liner observed rough / corroded / eroded at several scattered locations.

- Grayish oxide layer was observed on dome liner.
- Petal welding observed rough / porous, more prominent in East side of dome.



- Cylindrical Liner plate just below dome liner was found silver bright in colour throughout in circumference.
- Bulging of 5 to 8 mm height and 75mm width observed approx. 600 mm above tray level in South – West corner.
- Previously repaired defects on liner at S-W direction besides long seam observed eroded and pits of 0.5 to 1 mm depth and 10-15mm dia approx. were observed which were marked as D1-1 for repair. Repair was carried out by welding and found satisfactory in DP test.



- "C" Seam and "L" seam welding found satisfactory.
- 01 no. of old tray holding cleat (total – 14 nos.) was found black and severely corrosion attacked including its welding, same was observed in last inspection.
- Down-comer cone (Funnel) observed silver shiny in colour and rough in surface. Downcomer pipe observed brown in colour. Its welding was highly corroded / etched as razor sharp edges of welding observed.

Compartment No.2

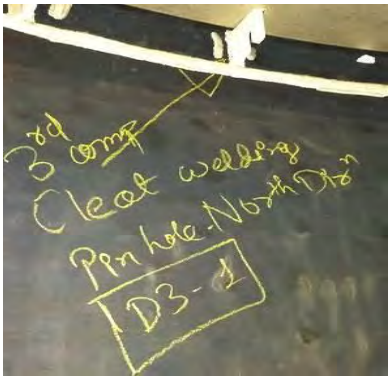
- All new cleats (Total-14 No's) and its welding observed satisfactory.
- Down comer found dark brown in colour and rough in surface.
- Welding edges observed sharp due to down comer erosion.

- Previously repaired defects found satisfactory.
- "C" Seam and "L" seam welding found satisfactory.

Compartment No.3

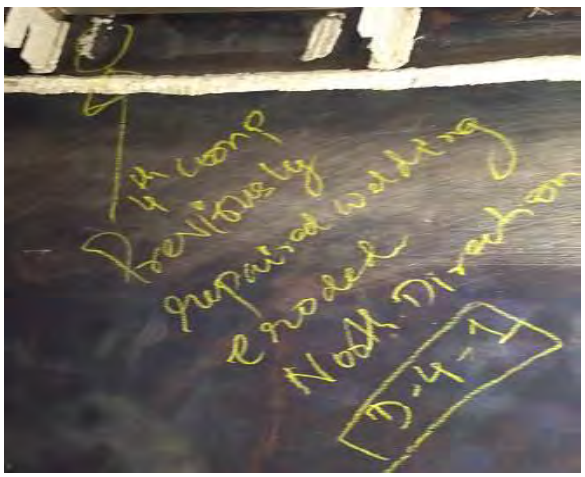
- Bulging of approx. 8mm depth and 2.5" width was observed in SW to South direction just above "C" seam near insert liner, same was observed during previous inspection.
- 03 nos. of tray holding cleats were observed blackish in color and having severe corrosion attack including its welding, same was observed in previous inspection
- Circumferentially provided Insert liner (Size 3.5Ft long x 4 Inch width approx) observed silver shiny in color.
- Previously repaired defects found satisfactory.

- “C” Seam and “L” seam welding found satisfactory.
- Half of the down comer observed brownish and half observed silver shiny in colour, sharp edges of welding observed due to erosion of down comer.
- Above “C” seam in North direction near cleat Pinhole of approx. 0.3 to 0.5mm and 3 to 4 mm depth observed, Marked as D3-1 for repair. Repair was carried out by welding and found satisfactory in DP test.

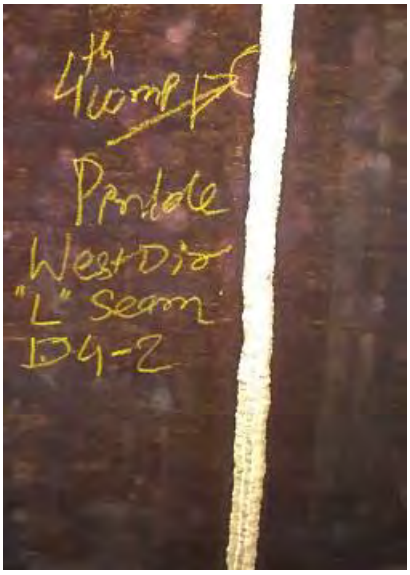


Compartment No.4

- Depression of approx. 100 mm dia. and 3 mm depth was observed at West side liner approx. 30 mm below circumferential weld. Same was observed during previous inspection.
- Convex bulging of liner plate observed just above circumferential weld by approx. 4 mm height in complete circumference. Same was observed during previous inspection.
- Concave depression of approx. 2-5 mm depth observed at approx. 200mm below the C-weld seam in approx. 80% of the periphery. Same was observed during previous inspection.
- 03 nos. of tray holding cleats (11 nos. Old + 09 nos. New) were found black and observed sever corrosion attacked including its welding, same was observed in previous inspection.
- Circumferentially provided Insert liner (Approx. 3.0 Ft long x 4 Inch width) observed silver shiny in color.
- Previously repaired defect on liner found eroded and pits of 0.3-0.5 mm depth in 50mm length approx. were formed in North side direction just above the “C” seam, marked as D4-1 for repair.



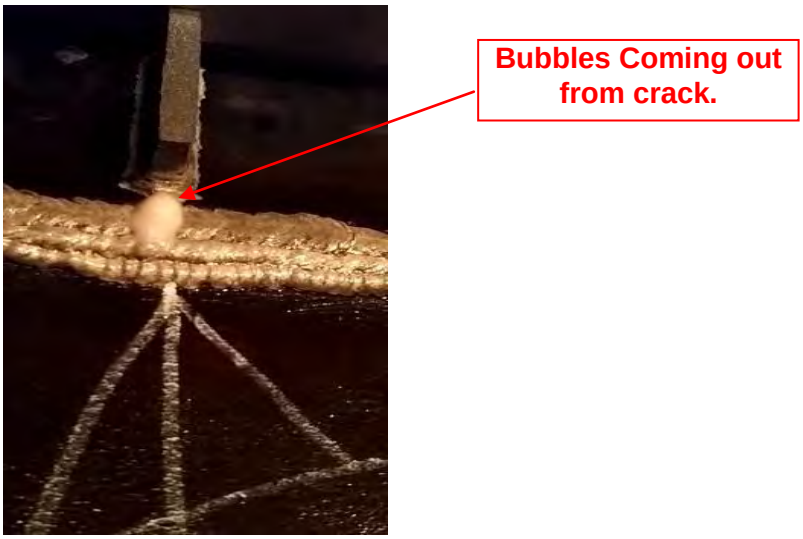
- Pin hole of 1.5 -2.0 mm depth was observed in West side “L” seam, marked as D4-2 for repair.
- Repair was carried out by welding on both defects and found satisfactory in DP test.



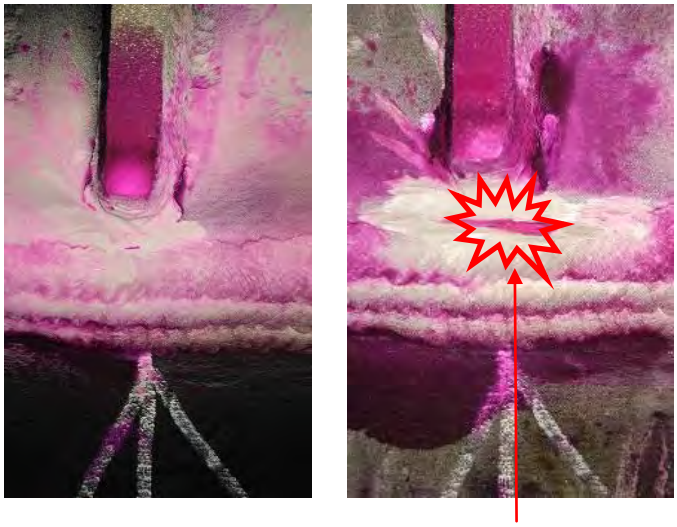
- “C” Seam and “L” seam welding found satisfactory.

Compartment No.5:

- Convex bulging of liner plate of approx. 3 to 9 mm height was observed just above the circumferential weld joint in almost complete periphery. The same was observed during last inspection.
- Concave depression of approx. 2-6 mm was observed at approx. 500 mm below the C-weld seam in full periphery. The same was observed during last inspection.
- **Helium leak** detection carried out on 25.09.2018 with 0.26 Kg/cm_2 (g)pressure in shell side liner annular space (Weep hole no 4 to 15) and leakage observed in South direction at bottom of cleat welding and just above the “C” seam welding top edge which was re confirmed by liquid soap solution test. Marked as D5-1 for repair.



- After grinding on defect location, defect opening was gradually increased in size as seen in DP test photographs.

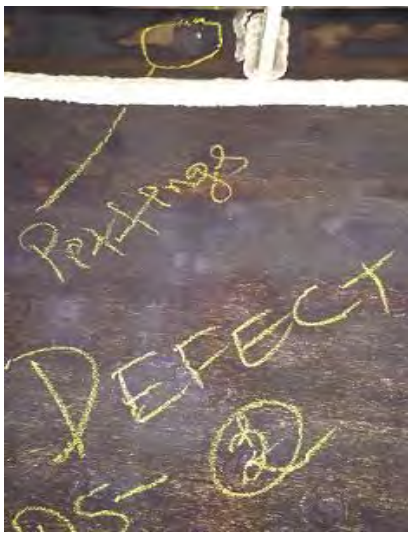


After grinding crack enlarged

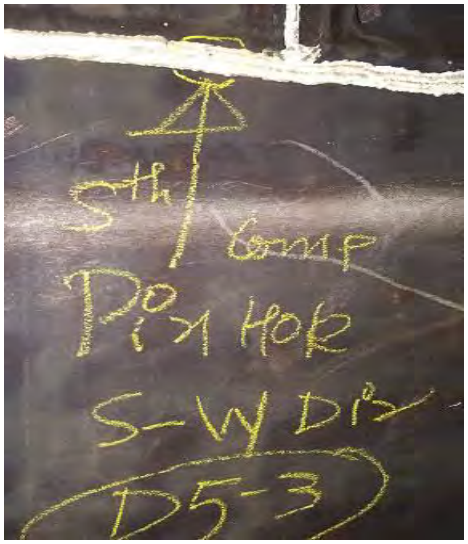
- Defect was repaired by welding & found satisfactory in D.P. test.

View of D.P. test after repair.

- Previously repaired defect locations was observed having pitting of 0.5 mm depth and 10.0 mm dia In South-West direction above “C” seam. Marked as defect D5-2 for repair.



- Adjacent to defect D5-2 minor pinhole observed in “C” seam, marked as defect D5-3 for repair.



- D5-2 and D5-3 were repaired by welding and found satisfactory in DP test.
- Condition of “C” Seam and “L” seam welding found satisfactory.

Compartment No.6:

- Convex bulging of approx. 3 to 10 mm height was observed in liner plate above the circumferential weld joint, from North-West to south-east direction in approx. Length of 4500 mm. The same was also observed during previous inspection.
- Concave depression of approx. 5 mm depth was observed from East to West side L-seam through North side of the shell at approx. one meter below “C” seam. The same was also observed during previous inspection.
- Weld capping was done on circumferential weld seam and long seam by M/s. Dowel Erectors in 2012.
- Previously repaired defects found satisfactory.
- Condition of “C” Seam and “L” seam welding found satisfactory.
- 12 nos. old cleats were observed having minor corrosion whereas 11 nos. new cleats and its welding observed satisfactory.
- Shell liner observed brownish black in colour.

- Downcomer observed brownish black in colour and due to its erosion welding edges found exposed.

Compartment No.7:

- Convex bulging of liner plate was observed above the circumferential weld joint by approx. 2-6 mm height at few locations. The same was observed during previous inspection also.
- Concave bulging of max. 5 mm. depth in approx. 60% periphery observed approx. 1200mm below C seam.
- 04 nos. of tray holding cleats were found to be blackish in coloration and having severe corrosion attack including it's welding, same observed in previous inspection.
- New welding was done on circumferential weld seam and long seam by M/s. Shree Ganesh Engg. in 2014.
- Condition of "C" Seam and "L" seam welding found satisfactory.
- Previously repaired defects were observed satisfactory.
- 11 nos. old cleats observed having minor corrosion whereas 10 nos. new cleats and its welding observed satisfactory.

Compartment No.8:

- Concave bulging of approx. 3 to 6mm. deep at the elevation of approx. 300 mm above tray was observed in complete circumference. The same was observed during previous inspection also.
- 04 nos. of tray holding cleats were found blackish in colour and having corrosion attack including its welding, same observed in previous inspection.
- Insert liner found silver shiny in color and Shell liner observed brownish black in colour.
- Weld capping was done on both long seams by M/s. Shree Ganesh Engg. in Plant S/D 2014.
- Condition of "C" Seam and "L" seam welding found satisfactory.
- Gap between tray segment and tray support ring observed due to support ring sagging.

- 04 nos. old cleats (out of 10) observed having minor corrosion whereas 10 nos. new cleats and its welding observed satisfactory.
- Down comer was observed brown in colour with corrosion in its welding.

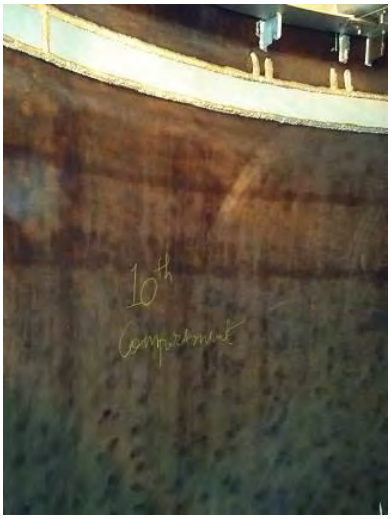
Compartment No.9:

- 02 nos. of tray holding cleats were found blackish in colour and having corrosion attack including its welding, same observed in previous inspection.
- No noticeable bulging observed in liners.
- Insert liner found silver shiny whereas Shell liner observed brownish black in colour.
- Down comer was observed brownish in colour with corrosion attack in its welding.

- New welding was done on two nos' of "C" seam and on both "L" seam of the compartment by M/S Shree Ganesh Engg. during Plant S/D 2015.
- Condition of "C" Seam and "L" seam welding found satisfactory.
- 10 nos. New and 11nos. Old cleats and its welding observed satisfactory.

Compartment No.10:

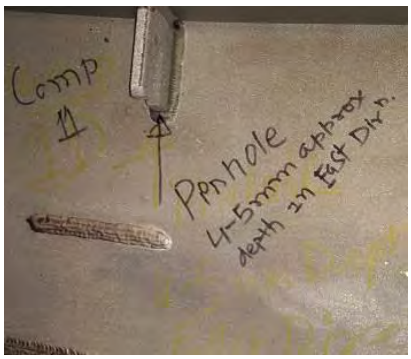
- Concave depression of approx. 7mm depth at approx. 70mm below the C-weld seam in south side of shell in approx. 100 mm dia was observed. Same was observed in previous Inspection.
- Concave depression of approx. 9 mm depth just above the C-weld seam towards the south side and adjacent to L-seam in approx. 100 mm dia. was observed. Same as last Inspection.
- Vertical bulging of approx. 2-3 mm height & 25mm wide was observed from the C-weld seam to the bottom of the compartment in north side of the shell. The same was observed during previous inspection also.
- Concave depression of about 5mm depth at approx 70mm below C seam in west side just adjacent to L seam was observed in 100 mm area. The same was observed during last inspection also.
- Pinhole of approx 1.0 mm in dia. was found in Helium leak detection test which was repaired by welding after grinding in plant S/D 2015.
- Insert liner found silver shiny.
- New welding was done on two nos. of "C" seam and on both "L" seam of the compartment by M/s Shree Ganesh Engg. In plant S/D 2015.
- Condition of "C" Seam and "L" seam welding found satisfactory.



- Shell liner observed brownish in colour.
- Previously repaired defects were observed satisfactory.
- 10 nos. New and 11 nos. Old cleats and its welding observed satisfactory.
- Down comer was observed brown in colour with corrosion in its welding.

Compartment No.11:

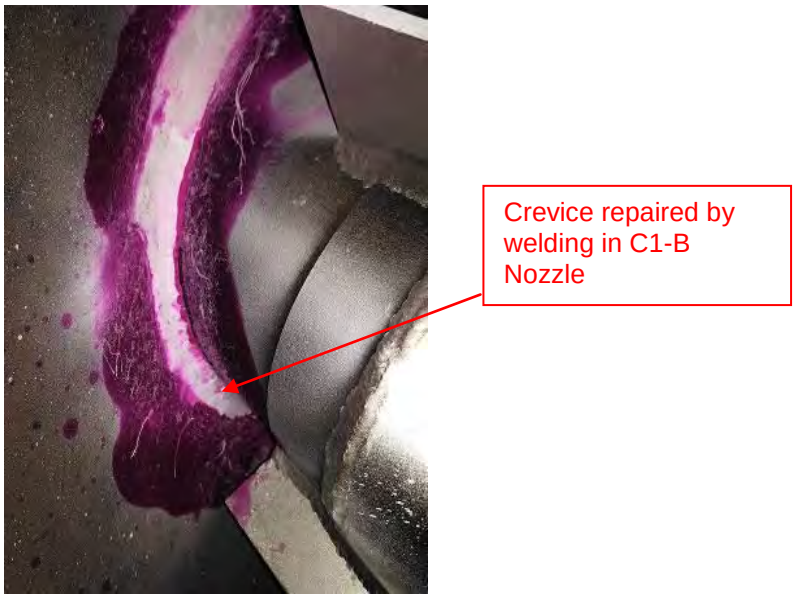
- Concave depression of approx. 10 to 12 mm depth in approx. 100mm dia. Just below circumferential weld in North-West direction was observed. The same was observed during previous inspection also.
- On insert liner segment convex bulging up to max. 5 to 8 mm height having width approx. 20-25 mm observed just above circumferential stitch welds (approx. 125 mm long). Same was observed during previous Inspection also.
- Concave depression of about 5-6 mm was observed just above and below of C-weld seam in old and Insert liner. The same was observed during last inspection also.
- Weld capping was done on both “L” seam of the compartment by M/s Shree Ganesh Engg. in plant S/D 2017.
- Insert liner and shell liner ‘’L’’ and “C’’ seam welding observed satisfactory.
- Insert liner observed silver shiny and shell liner observed dark brow in colour.
- Downcomer observed dark brown in colour & rough in surface and its welding’s sharp edges observed due to erosion.
- A pinhole of approx. 4-5 mm depth was observed in bottom of the East side cleat weld. Marked as D11-1. Same was repaired by welding followed by DP test and found satisfactory.

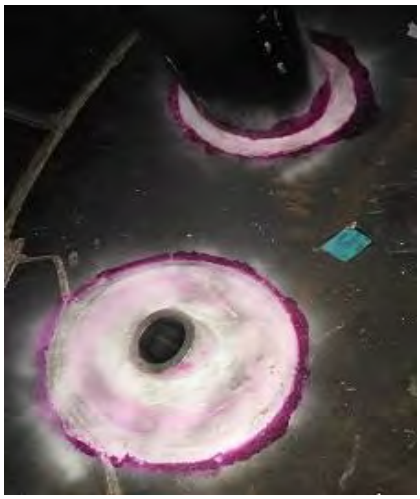


- Shell liner observed brownish black in colour.
- 11 nos. New and 11 nos. Old cleats and its welding observed satisfactory.
- Down comer was observed brown in colour with corrosion in its welding also welding sharp edges observed due to erosion.

Compartment No.12 (Bottom Compartment.):

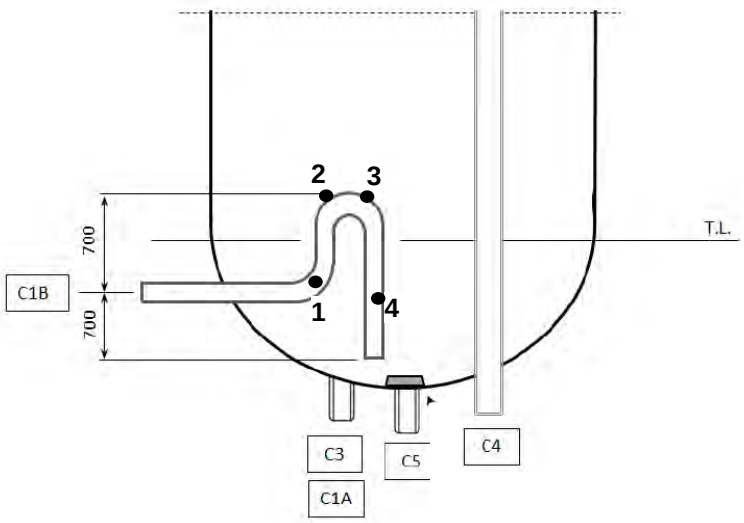
- Down comer nozzle with dish end liner weld joint edges were observed exposed. The same was observed during previous inspection also.
- Reducer of 10''x8'' observed silver shiny in colour.
- Dark brown coloration observed on dish end.
- Concave depression of approx. 2-3 mm depth and approx. 5mm width was observed at approx. 200mm above the C-weld seam in 4" dia in east and west direction of the shell respectively. The same was observed during previous inspection also.
- All old tray holding cleats (15 nos.) were found blackish in color and having corrosion attack, however all new cleats (14 nos.) and It's welding observed satisfactory.
- Tray orientation is in North - South direction.
- Two nos of long seams observed satisfactory.
- All the 12 nos. Petal weld condition observed satisfactory.
- All the Dish End to nozzle welding joints were D.P. tested at few locations indications observed which were shallow ground and found satisfactory in DP test. Carbamate inlet nozzle (C1-B) welding observed having sharp edges and crevice of approx. 2.0mm depth was observed in complete bottom half with nozzle. Same was repaired by welding followed by DP test and found satisfactory.





- Scratch mark of half round shape & approx. 0.5 mm depth and 200 mm length was observed on liner in South West direction.

- Thickness measurement on C1B nozzle (8''NB Goose neck) carried out and readings are mentioned below.



Meas. Location	Nom.Thk 8''NBX10S	North	South	East	West	Remarks
1	3.76	3.98	3.47	3.51	--	Elbow (Outer)
2	3.76	3.80	3.68	3.75	--	Elbow (Outer)
3	3.76	3.81	3.37	3.40	--	Elbow (Outer)
4	3.76	4.38	4.40	4.72	4.35	Pipe

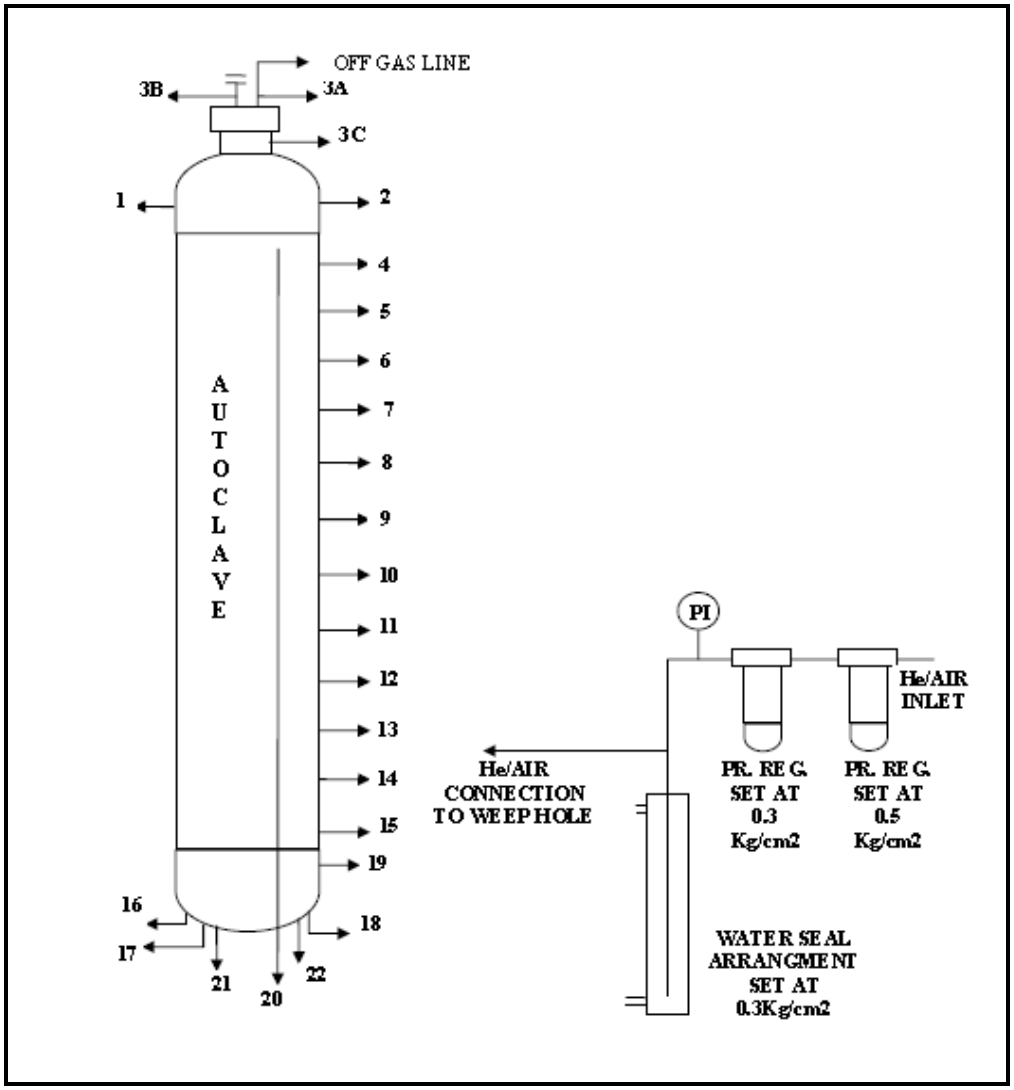
All dimensions are in MM.

HELIUM LEAK DETECTION

There are 24 nos. of weep holes provided on the vessel for leak detection. The location of all these weep holes and Helium Leak test arrangement made as shown below.

Weep hole locations and their nos. are given below:

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



ARRANGEMENTS MADE & THE PROCEDURE FOR HELIUM LEAK TEST FOR AUTOCLAVE LINER WELD JOINTS

After De-pressurization of the H.P. System and Steam purging of Autoclave following activities were performed:

- Arrangement made for pressurizing the shell liner ANNULAR space as shown in the figure.
- All the shell weep holes plugged except the 02 nos. from which
  - The Instrument Air / Helium fed (Weep Hole No 15), at 3rd floor.
  - Pressure Indicator attached (Weep hole No 4), near the G-M tube.
- All the shell TI tapping plugged after removing the TI element.
- The weld joints of the shell liner from Inside masked by Polyethene with the help of White Masking Tape including cleat welds. Welds behind the tray portion couldn't be masked due to space limitation.

WATER SEAL ARRANGMENT SET AT 0.3Kg/cm2

- Pressurized the Annular space with Instrument air up to 0.26 Kg/cm^2 and observed the pressure in the PI attached on the Top most weep hole of the shell liner.

- When the Pressure is stabilized, all the other weep hole passages checked for clearance/choking. Assured sealing of the plug joints for any leakage.
- Visually checked the Liner welds from inside the Autoclave for any leakage.

- Connection of the Helium cylinder made with the weep hole thru which the air was fed. The pressure was increased to 0.26 Kg/cm$^{2.}$
- Gave soaking time of 3 hrs. in order to accumulate the helium gas in the annular space to a concentration & permeate thru the leak. Annular space pressure maintained at 0.26 Kg/cm^2.
- Helium detector brought inside the Autoclave. A dedicated Single Phase supply for the instrument with Electrical Distribution board fitted with ELCB was provided.
- Details of Helium Leak detector used by M/s Gulachi Engineers

  Make: Adixen ASM 310, Germany

  Sr. No. HLD 1302640
- The Machine calibration was checked by Standard Leak having leakage rate value of 1.74 x 10^{-7} std. cc per second. (Calibration Piece Make: Adixen)

- Back Ground concentration of Helium checked inside the Autoclave before Starting the Leak detection and observed value was 5.0 x 10^{-6} std. cc per second.

- Punctured the polythene sheets and inserted probe inside the envelop for detection of presence of Helium gas. In case of an indication of increased helium concentration above normal background reading, removed polythene envelope from identified portion and performed scanning to locate the leak.

- Scanning of all the C-Weld seams & L-Weld seams of Compartment no 2nd to 11th carried out including Cleat weld joints with the liner starting from bottom i.e. 11th compartment. Leak observed while scanning in South direction at bottom of cleat welding and just above the "C" seam welding top edge of **5th compartment**. Scanning carried out for pin pointing the leak from C-Weld seam.

  Leak observed having leak rate of 2.3 x 10^{-4} std.cc per sec. Marked for necessary repair. Leak testing procedure submitted by M/s Gulachi Engineers, Ghaziabad is attached at **Annexure-6.**

NOTE:

- Severe etching observed on Downcomer and on its welding in almost all the compartment.
- NE-North East, SW-South West, NW-North West, SE- South East, 'L'- Long seam,
- 'C'- Circumferential seam.
- NW - SE orientation of trays- Tray No-01 From North side.
- NE - SW orientation of trays- Tray No-01 From East side.
- Helium leak detection test was carried out by M/S Gulachi Engineers in 2015 and pinhole observed in 10th compartment lower "C" seam of Insert liner.
- Helium leak detection test was carried out by M/S Gulachi Engineers in 2018 and Crack observed below cleat welding in south direction near "C" seam in 5th compartment.
- New Trays installed by M/s Ganesh Engg. & Co in 2016 and designed by Casale. These **trays are in 6 segments.**

THICKNESS MEASUREMENT

DETAILED THICKNESS REPORT OF AUTOCLAVE (V-1201)							
COMPARTMENT NO.	**LOCATION OF MEASURMENT**	**NOM. THK. (mm.)**	**OBSERVED THICKNESS (in mm.)**				**REMARK**
			EAST (1)	**WEST (2)**	**NORTH (3)**	**SOUTH (4)**	
01 TOP COMPARTMENT	Shell Liner (New)	6.5	7.27	6.53	6.64	6.60	750mm Section Replaced in Yr. 2002 by BC-05.
	Shell Liner Old (Top)	5.0	3.66	4.02	4.41	3.75	
	Shell Liner (Middle)	5.0	3.88	4.50	4.45	3.95	
	Shell Liner (Bottom)	5.0	3.74	4.40	4.33	3.83	
	Top-Dome	6.5	6.60	6.48	6.90	7.01	Replaced in Yr. 2002 by BC-05.
	Tray Segment -1	5.0	5.56	5.5	5.45	5.48	
	Tray Segment -2	5.0	5.42	5.38	5.39	5.41	
	Tray Segment -3	5.0	5.40	5.39	5.44	5.39	
	Tray Segment -4	5.0	5.31	5.27	5.24	5.28	
	Tray Segment -5	5.0	5.36	5.40	5.46	5.42	
	Tray Segment -6	5.0	5.39	5.42	5.31	5.31	
	Down Comer	10.0	4.42	4.20	4.20	3.93	Overall Min. Downcomer thickness.
	Manway Liner	6.5	6.83	6.82	6.85	6.83	Replaced in Yr. 2002 by BC-05.
02	Shell Liner (Top)	5.0	3.78	3.77	4.22	3.71	
	Shell Liner (Middle)	5.0	3.84	3.90	4.24	4.20	
	Shell Liner	5.0	4.30	3.73	4.32	3.58	

DETAILED THICKNESS REPORT OF AUTOCLAVE (V-1201)							
COMPARTMENT NO.	LOCATION OF MEASURMENT	NOM. THK. (mm.)	OBSERVED THICKNESS (in mm.)				REMARK
			EAST (1)	WEST (2)	NORTH (3)	SOUTH (4)	
	(Bottom)						
	Tray Segment-1	5.0	5.45	5.65	5.84	5.88	
	Tray Segment-2	5.0	5.15	5.27	5.22	5.18	
	Tray Segment-3	5.0	5.20	5.18	5.22	5.26	
	Tray Segment-4	5.0	5.26	5.29	5.25	5.28	
	Tray Segment-5	5.0	5.28	5.35	5.37	5.32	
	Tray Segment-6	5.0	5.18	5.27	5.32	5.30	
	Down-Comer	10.0	4.73	4.96	4.35	4.40	
03	Shell Liner (Top)	5.0	3.47	4.21	3.84	3.95	Overall Min. liner thickness.
	Shell Liner (Middle)	5.0	4.07	4.38	4.10	4.02	
	Shell Liner (Bottom)	5.0	3.75	4.60	3.97	3.83	
	Tray Segment-1	5.0	5.39	5.45	5.58	5.40	
	Tray Segment-2	5.0	5.30	5.35	5.39	5.45	
	Tray Segment-3	5.0	5.60	5.53	5.47	5.53	
	Tray Segment-4	5.0	5.43	5.40	5.41	5.40	
	Tray Segment-5	5.0	5.27	5.33	5.36	5.38	
	Tray Segment-6	5.0	5.51	5.45	5.47	5.52	
	Insert Liner	6.5	6.54	6.62	6.72	6.77	Replaced in Yr. 1997
	Down-Comer (Shiny)	10.0	8.68	8.53	8.64	8.54	
	Down-Comer	10.0	4.07	4.44	4.87	4.40	
04	Shell Liner (Top)	5.0	4.02	4.02	4.17	4.12	
	Shell Liner (Middle)	5.0	4.18	4.06	4.23	4.20	
	Shell Liner (Bottom)	5.0	4.19	4.15	4.30	4.17	
	Tray Segment-1	5.0	5.56	5.58	5.49	5.45	
	Tray Segment-2	5.0	5.36	5.38	5.37	5.39	
	Tray Segment-3	5.0	5.48	5.53	5.51	5.43	
	Tray Segment-4	5.0	5.48	5.54	5.56	5.52	
	Tray Segment-5	5.0	5.40	5.42	5.47	5.45	
	Tray Segment-6	5.0	5.55	5.56	5.57	5.39	
	Insert Liner	6.5	6.23	6.20	6.21	6.15	Replaced in Yr.1999
	Down-Comer	10.0	5.15	4.85	5.04	5.03	
05	Shell Liner (Top)	5.0	4.38	4.20	4.34	4.65	
	Shell Liner (Middle)	5.0	4.43	4.60	4.11	4.70	
	Shell Liner (Bottom)	5.0	4.46	4.50	4.35	4.62	
	Tray Segment-1	5.0	5.39	5.42	5.41	5.45	

DETAILED THICKNESS REPORT OF AUTOCLAVE (V-1201)							
COMPARTMENT NO.	LOCATION OF MEASURMENT	NOM. THK. (mm.)	OBSERVED THICKNESS (in mm.)				REMARK
			EAST (1)	WEST (2)	NORTH (3)	SOUTH (4)	
	Tray Segment-2	5.0	5.33	5.60	5.42	5.39	
	Tray Segment-3	5.0	5.38	5.44	5.35	5.38	
	Tray Segment-4	5.0	5.48	5.42	5.48	5.43	
	Tray Segment-5	5.0	5.42	5.32	5.33	5.31	
	Tray Segment-6	5.0	5.58	5.48	5.45	5.58	
	Down-Comer	10.0	5.02	5.68	5.25	5.47	
	Down-Comer (Shiny)	10.0	9.03	8.96	8.88	8.6	
06	Shell Liner (Top)	5.0	4.20	4.33	4.12	4.26	
	Shell Liner (Middle)	5.0	4.17	4.21	4.37	4.38	
	Shell Liner (Bottom)	5.0	4.23	4.30	4.02	4.41	
	Tray Segment-1	5.0	5.53	5.40	5.44	5.43	
	Tray Segment-2	5.0	5.50	5.54	5.55	5.53	
	Tray Segment-3	5.0	5.40	5.43	5.50	5.62	
	Tray Segment-4	5.0	5.46	5.33	5.43	5.50	
	Tray Segment-5	5.0	5.48	5.58	5.62	5.50	
	Tray Segment-6	5.0	5.45	5.62	5.55	5.48	
	Down-Comer	10.0	5.50	5.40	5.15	5.30	
07	Shell Liner (Top)	5.0	4.36	4.20	4.15	4.30	
	Shell Liner (Middle)	5.0	4.55	4.24	4.20	4.40	
	Shell Liner (Bottom)	5.0	4.61	4.30	4.10	4.45	
	Tray Segment-1	5.0	5.22	5.22	5.16	5.26	
	Tray Segment-2	5.0	5.12	5.18	5.20	5.16	Overall Min. tray segment thickness.
	Tray Segment-3	5.0	5.25	5.25	5.30	5.35	
	Tray Segment-4	5.0	5.26	5.52	5.46	5.40	
	Tray Segment-5	5.0	5.44	5.43	5.45	5.38	
	Tray Segment-6	5.0	5.60	5.58	5.62	5.65	
	Down-Comer	10.0	5.18	5.52	5.28	5.25	
08	Shell Liner (Top)	5.0	4.57	4.30	4.41	4.25	
	Shell Liner (Middle)	5.0	4.70	4.43	4.54	4.55	
	Shell Liner (Bottom)	5.0	4.56	4.44	4.47	4.44	
	Tray Segment-1	5.0	5.66	5.64	5.61	5.63	
	Tray Segment-2	5.0	5.58	5.56	5.60	5.61	
	Tray Segment-3	5.0	5.65	5.66	5.70	5.83	
	Tray Segment-4	5.0	5.75	5.62	5.65	5.55	
	Tray Segment-5	5.0	5.62	5.66	5.63	5.60	
	Tray Segment-6	5.0	5.70	5.17	5.70	5.65	
	Insert Liner	6.5	6.61	6.55	6.60	6.80	Replaced in

DETAILED THICKNESS REPORT OF AUTOCLAVE (V-1201)							
COMPARTMENT NO.	LOCATION OF MEASURMENT	NOM. THK. (mm.)	OBSERVED THICKNESS (in mm.)				REMARK
			EAST (1)	WEST (2)	NORTH (3)	SOUTH (4)	
							Yr. 2000
	Down-Comer	10.0	5.61	5.55	5.60	5.70	
09	Shell Liner (Top)	5.0	4.60	4.46	4.73	4.62	
	Shell Liner (Middle)	5.0	4.70	4.55	4.54	4.60	
	Shell Liner (Bottom)	5.0	4.65	4.45	4.63	4.75	
	Tray Segment-1	5.0	5.50	5.45	5.48	5.42	
	Tray Segment-2	5.0	5.49	5.50	5.55	5.51	
	Tray Segment-3	5.0	5.30	5.33	5.30	5.40	
	Tray Segment-4	5.0	5.50	5.38	5.28	5.23	
	Tray Segment-5	5.0	5.55	5.56	5.25	5.28	
	Tray Segment-6	5.0	5.35	5.30	5.48	5.38	
	Insert Liner	6.5	6.62	6.71	6.64	6.82	Replaced in Yr. 2001
	Down-Comer	10.0	6.29	6.82	6.65	6.45	
10	Shell Liner (Top)	5.0	5.03	4.90	5.38	4.80	
	Shell Liner (Middle)	5.0	4.96	5.26	5.34	5.50	
	Shell Liner (Bottom)	5.0	4.95	5.05	5.47	5.00	
	Tray Segment-1	5.0	5.49	5.58	5.60	5.7	
	Tray Segment-2	5.0	5.46	5.54	5.68	5.60	
	Tray Segment-3	5.0	5.54	5.60	5.68	5.59	
	Tray Segment-4	5.0	5.52	5.57	5.49	5.58	
	Tray Segment-5	5.0	5.52	5.40	5.48	5.47	
	Tray Segment-6	5.0	5.63	5.48	5.55	5.53	
	Insert Liner	6.5	6.55	6.64	6.66	6.57	Replaced in Yr. 2002
	Down-Comer	10.0	6.46	6.34	6.30	6.51	
11	Shell Liner (Top)	5.0	4.46	4.47	4.62	4.33	
	Shell Liner (Middle)	5.0	4.77	4.60	4.44	4.47	
	Shell Liner (Bottom)	5.0	4.63	4.62	4.63	4.54	
	Tray Segment-1	5.0	5.42	5.45	5.47	5.51	
	Tray Segment-2	5.0	5.40	5.36	5.42	5.46	
	Tray Segment-3	5.0	5.52	5.40	5.45	5.41	
	Tray Segment-4	5.0	5.62	5.57	5.51	5.52	
	Tray Segment-5	5.0	5.58	5.53	5.55	5.54	
	Tray Segment-6	5.0	5.59	5.61	5.70	5.81	
	Insert Liner	6.5	6.71	6.70	6.62	6.73	Replaced in Yr. 2002
	Down-Comer	10.0	6.82	6.75	6.85	6.90	
	Shell Liner	5.0	4.65	4.62	4.62	4.68	

DETAILED THICKNESS REPORT OF AUTOCLAVE (V-1201)							
COMPARTMENT NO.	**LOCATION OF MEASURMENT**	**NOM. THK. (mm.)**	**OBSERVED THICKNESS (in mm.)**				**REMARK**
			EAST (1)	**WEST (2)**	**NORTH (3)**	**SOUTH (4)**	
12 BOTTOM COMPARTMENT	Petal Plate	7.0	6.04	6.24	6.23	6.14	
	Bottom Dome	7.0	6.40	6.20	6.45	5.96	Replaced in Yr. 1993
	Reducer 10" X 8"	10.0	9.42	9.30	9.45	9.89	Replaced in Yr. 1997
	10" - Pipe	10.0	7.36	7.36	7.36	7.46	
	8" - Pipe (Distance Piece)	6.0	4.34	5.30	4.40	4.89	Replaced in Yr. 2000
	Nozzle-8"	6.0	3.80	3.35	3.31	3.57	

Note:

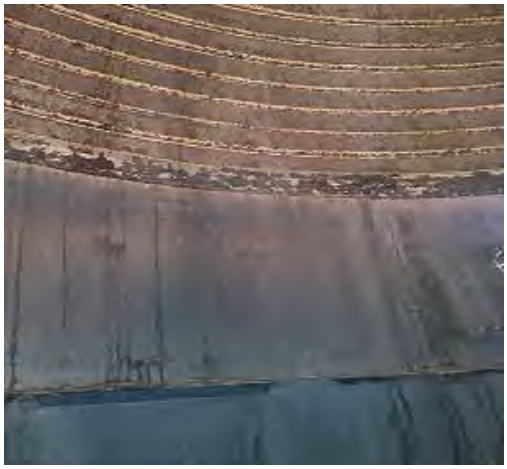
- The Complete down-comer was replaced in 1997.
- **Tray Replacement History**
  - 1997 H.E. Trays installed by L&T and Supplied by Scholler & Blackman, Germany.
  - 2016 New Trays installed by M/s Shri Ganesh Engg. & Co and Designed & Supplied by Casale Urea in all Compartments. These trays are in 6 segments. Tray Material is UNS-S31050 (25 Cr-22Ni-2Mo Alloy)

H-1201 (HP STRIPPER)

VISUAL INSPECTION

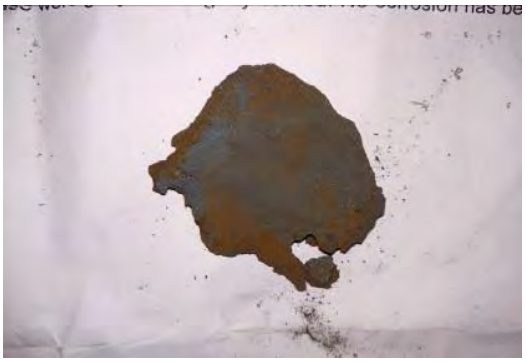
TOP CHANNEL

- The condition of sealing face was satisfactory.
- A thin blue grey oxide layer covered the overlay welding and liner in the gas phase (man way, dome and part of cylinder), except for the areas between the strip beads. The liner and liquid inlet box in the liquid phase were grey and slightly etched. No corrosion has been observed.



- The overlay welding on the tube sheet was grey and slightly etched.

- The tube welds were bright and smooth. Thick & hard oxide deposition of 3 to 5mm thickness was observed, more prominent in centre & E-W direction of tube sheet.



Scales removed from tube-sheet.

- The tubes were found smooth and brownish in colour from inside.
- Minor pittings were observed in ID of tubes 5 to 8mm from stub end edge in many tubes.
- The liner and liquid inlet box in the liquid phase are silver shiny and slightly etched. Its height from top tube sheet measured at eight locations for reference. Height (in mm) observed is shown in attached photographs below.

- Approx. 400 ferrule's seal weld were D.P tested and cracks observed in most of the ferrules seal welding, necessary corrective action taken.

- One no. New Ferrule along with 02 nos. old/used ferrules of HP Stripper were offered for Inspection. Detailed Ferrule Inspection report is attached at the end of H.P. Stripper's repot.

BOTTOM CHANNEL

- The condition of sealing face was found satisfactory.
- The overlay welds in the man way observed silver and slightly etched.
- The overlay welds in the hemi-head were silver and etched. Many patches of approx. 2”x2” size on the hemi-head overlay welds were observed which were more etched than the surrounding areas in North and East direction, same was observed in previous inspection also.
- The tube sheet was covered with a thin grey oxide layer. This layer seems to be more hard & bonded on tube-sheet to shell weld joint.

- Dark brown patches were observed at periphery of tube sheet at scattered locations, same was observed in previous inspection also.

- The tubes from inside were smooth.
- Minor pittings were observed in ID of tubes 5 to 8 mm from stub end edge in many tubes.
- The liquid outlet pipe and the gas inlet pipe were observed bright and shiny overall condition found satisfactory.

BOTTOM COVER

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

THICKNESS MEASUREMENT

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

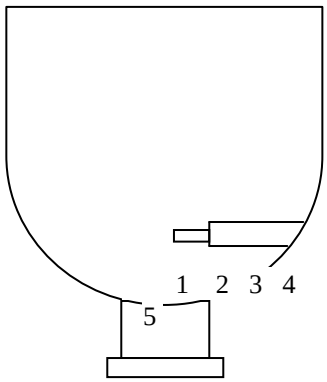
TOP DOME

	Minimum Thickness (mm)	Maximum Thickness (mm)	Design Thickness, mm (Minimum)
Man way (Overlay)	16.65	20.30	8.00
Dome area (Overlay)	11.44	13.02	8.00
Cylindrical area (Liner)-Gas phase	7.69	8.34	8.00
Cylindrical area (Liner)-Liquid phase	7.82	8.15	8.00
Tube sheet-Overlay weld	12.48 (Machined)	13.43 (Machined)	8.00

BOTTOM DOME

	Minimum Thickness (mm)	Maximum Thickness (mm)	Design Thickness, mm (Minimum)
Man way (Overlay)	18.99	21.32	8.0
Dome area (Overlay)	12.67	13.66	8.0
Cylindrical area (Liner)	8.02	8.34	8.0
Tube sheet-Overlay weld	14.68 (Machined)	15.30 (Machined)	8.0
Bottom Cover (Overlay)	16.49	17.04	8.0

RADIOACTIVE SOURCE WELL



Bottom Dish End

POINT NO.	DESIGN THK.	MEASURED THICKNESS (Minimum)
1	7.5	8.25
2	19.0	18.45
3	19.0	18.10
4	19.0	18.20
5	7.5	9.63

All measurements are in mm.

FERRITE MEASUREMENT

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

EDDY CURRENT TESTING OF TUBES

Eddy current inspection of tubes was carried out by M/TesTex NDT India Pvt. Ltd. for 2599 tubes from top tube sheet end up to a length of 4.5 meters. 01 tube was plugged before inspection. (Total no of tubes 2600)

The Results are as under:

- Wall loss: 0.86mm to 0.90 mm observed in 00 tubes
- Wall loss: 0.91mm to 0.95 mm observed in 009 tubes
- Wall loss: 0.96mm to 1.00 mm observed in 209 tubes
- Wall loss: 1.01mm to 1.05 mm observed in 233 tubes
- Wall loss: 1.06mm to 1.10 mm observed in 876 tubes
- Wall loss: 1.11mm to 1.15 mm observed in 785 tubes
- Wall loss: 1.16mm to 1.20 mm observed in 314 tubes
- Wall loss: 1.21mm to 1.25 mm observed in 145 tubes
- Wall loss: 1.26mm to 1.30 mm observed in 020 tubes
- Wall loss: 1.31mm to 1.35 mm observed in 000 tubes
- Wall loss: 1.36mm to 1.40 mm observed in 008 tubes

Result and Conclusion:

- Majority of the wall thinning was observed between 2nd to 5th baffle from top tube-sheet.
- 08 nos. of tubes were observed having Maximum Wall Loss of 1.40mm (Remaining Wall Thickness 1.9mm) (Cumulative since March-2002)
  (Tube sheet layout attached at **Annexure-7**).

INSPECTION ACTIVITIES CARRIED OUT ON FERULLES & THEIR OBSERVATIONS ARE AS UNDER

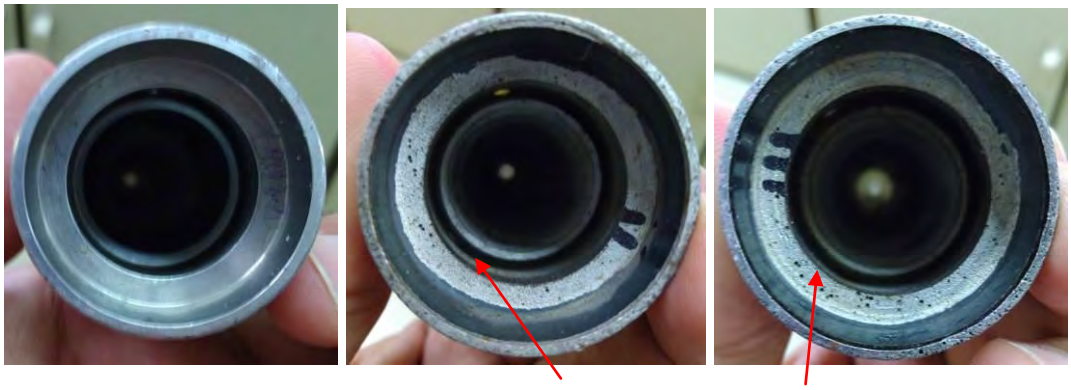
VISUAL INSPECTION

- One no. New Ferrule along with 02 nos. old/used ferrules of HP Stripper were offered for Inspection.
- New ferrule observed silver shiny in colour whereas on both old ferrules half of the length was observed having Silver coloration and the rest of the portion with dark grey hard scaling.

- Surface of new ferrule observed smooth whereas both the old ferrules observed having rough surface.

- Seal run welding of new ferrule observed smooth and uniform whereas both the old ferrule welding observed rough, non-uniform & etched. Ferrule face also observed rough and porous.

- Gradual thinning of tube ends of Old ferrules observed, viewed from I.D.
- (Images attached)



Sr No 01 New Ferrule.

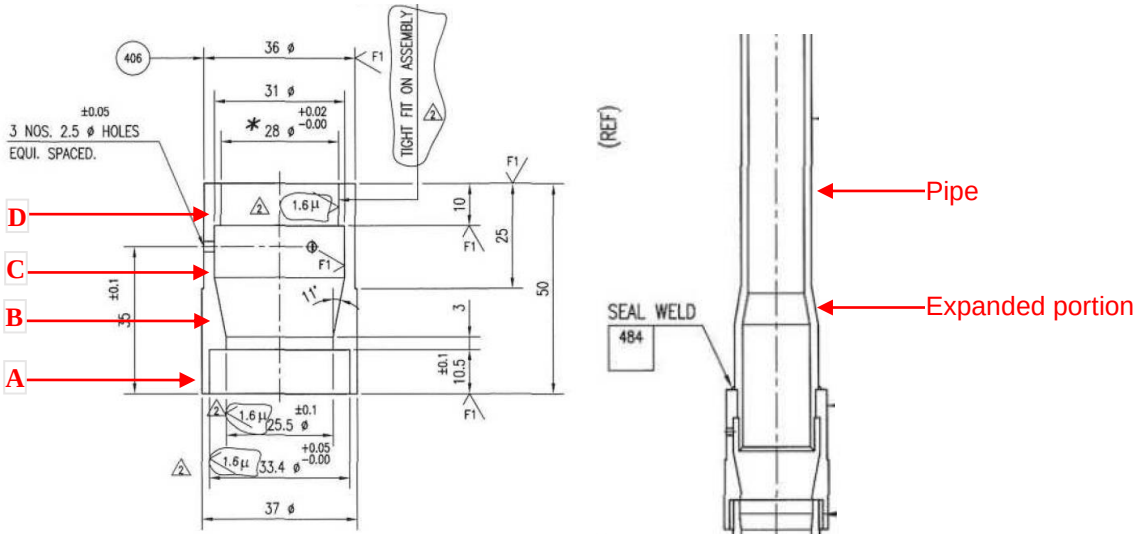
Sr No 02 and 03 Used Ferrules. Sharp tube ends observed.

DYE PENETRANT TEST

- Dye Penetrant test was carried out on seal weld and ferrule face.
- Welding of New ferrule (Sr No. 1) observed satisfactory.
- Old ferrule (Sr No. 2) face & weld observed rough and porous.
- Old ferrule (Sr No. 3) face and welding observed rough and pinholes observed on weld.

THICKNESS MEASUREMENT

- Thickness measurement carried out and readings are mentioned in table below:



Measurement Locations	Design Thk	Ferrule No. 01 (New)	Ferrule No. 02 (Old)	Ferrule No. 03 (Old)
A	1.8	1.82	1.64	1.63
B (Taper)	--	5.74,4.15	5.33,3.62	5.34,3.92
C	2.5	2.60	2.37	2.34
D	4.0	4.30	3.85	3.81
Expanded Portion	--	2.40	2.04	1.77
Pipe (Straight Length)	2.50	2.62	2.32	2.38

Note:

- All Dimensions are in M.M. Thickness measured with Ultrasonic Thickness Meter (Panamatrics MG-2 XT)."

FERRULE HOLE DIA MEASUREMENT

- Ferrule Hole dia measured with Vernier caliper and found 2.50 mm for new ferrule and 3.00 mm for both old ferrules against design dia of 2.50mm.

PMI (POSITIVE MATERIAL IDENTIFICATION)

- PMI test carried out on all three ferrules and material found matching with 2Re69.

H-1202 (H.P. CONDENSER)

VISUAL INSPECTION

TOP CHANNEL HEAD

- The man-way liner was found silver-shiny in colour. Random grinding marks were observed on the liner in SW direction.

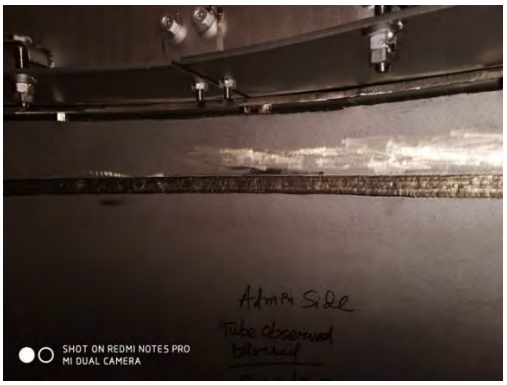
- Circumferential neck weld seam was found shiny & smooth.

- Circular single segment liner just below neck, petal liners (08 segments) & cylindrical portion liners along with their welds were found silver-shiny and free from any crevices. However, random grinding marks were observed at scattered location in the Top head Liner segments.

- Liquid collector, its weir segment and the fasteners were found intact.

- Condition of both the liquid outlet Nozzles were found satisfactory.

- Liquid collector support ring was found intact in its position.



- Tubes to tube sheet orbital welds were bright, shiny and smooth. All the welds were found in satisfactory condition. No deposition or scaling observed in the tube I.D.

- The overlaid area of the tube sheet was observed shiny & smooth.

BOTTOM CHANNEL HEAD

- The man-way liner was found silver-shiny in colour. Random grinding marks were observed on the liner.
- Circumferential neck weld seam was found shiny & smooth.
- Circular single segment liner just above the neck was found silver shiny in coloration.
- Petal liners (08 segments) & cylindrical portion liners along with their welds were found satisfactory. Coloration of the petal liner containing the Liquid Inlet nozzle observed blackish.

- Condition of the Impingement plate and its welds was observed satisfactory along with its holding cleats.
- The Cylindrical area liner just above the Liquid Inlet nozzle was observed having brownish colour patches.

- Random grinding marks were observed at scattered location in the bottom head Liner segments.

- Inlet distributor supports ring was found intact along with its fasteners.
- Tubes to tube sheet orbital welds were bright, shiny and smooth. All the welds were found in satisfactory condition. No deposition or scaling observed in the tube I.D.

- The overlaid area of the tube sheet was observed shiny & smooth.
- Condition of 08 nos. of Inlet Gas Distributor modules was found satisfactory. All the Nozzles were observed shiny and smooth.

EDDY CURRENT TESTING OF TUBES

- After new installation in SD-2017 first time ECT was carried out by M/s TesTex NDT India Pvt. Ltd.in SD-2018.
- Total 1970 tubes were tested for 12000 mm length (Full length).

Result and Conclusion:

- 01 no. of tube was observed Blocked during the Inspection. (Row # 42, Tube # 39). Same was cleaned but ECT could not be carried out.
- No significant wall loss observed in the tubes. (<20% Wall Loss observed in all 1969 tubes)
- For more details, please refer Tube Sheet Map **Annexture-8.**

H.P. SCRUBBER (H-1203)

VISUAL INSPECTION

BOTTOM COMPARTMENT

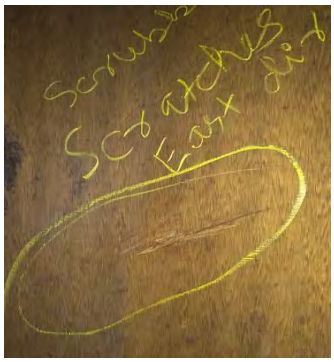
- Tube bundle was not removed from bottom compartment.

- Funnel and tubes were observed brownish black in colour.
- CO_2 inlet nozzle flange (3/4" NB) located at west side (Bottom comp.) found corroded, same was observed in previous inspection also.

TOP DOME

- Shell internal surface was found brownish in coloration and top hemi head observed silver shiny in colour.
- Condition of liquid inlet and gas outlet pipe found satisfactory.
- CO_2 Inlet line in South side was found intact.
- CO_2 inlet nozzle flange (3/4" NB) located at West side (Top Dome) found corroded same was observed in previous inspection also.
- Shell liner weld joint below the diaphragm plate found slightly rough and corroded.
- On Shell top course "T" shaped scratch/ abrasion mark of 0.5mm depth and 125mm x 125mm in length observed in West side.

- Another scratch/ abrasion mark of 0.5mm depth and 100mm length observed on Shell top course in East side.



- Shell liner "C" seams, "L" seams, Carbamate inlet nozzle, CO_2 Inlet nozzle, Dome to shell seam & Off gas line nozzle found satisfactory.
- **Pneumatic testing** of liner and all nozzle weld joints was carried out at 0.28 to 0.29 Kg/Cm^2 by applying pressure individually through all respective weep holes for minimum holding time of 10.00 min. each, but no pressure drop observed.

- However, during normal operating condition CO_2 leak was suspected from ¾''NB Nozzle (blind) weep hole in bubbler, so as a precautionary measure additional welding layer provided after grinding. DP test carried out after welding and found satisfactory.

- Thickness measurement of Shell liner carried out and readings are as under.

Course No	North	South	East	West	Design Thk.
1	5.07	4.90	5.08	4.95	5.0
2	5.11	4.98	4.95	4.93	5.0

All Dimensions are in MM

- Random ferrite measurement carried out and found within limit.

Note:

- Pneumatic testing carried out at 0.2 Kg/cm^2 and leak observed in ¾''NB Nozzle (blind) in seal welding. (North-East Direction.) This leakage was repaired by grinding, welding and found satisfactory in DP Test in SD-2017.
- Pneumatic testing of liner carried out at 0.29 Kg/cm^2 and no leak was observed in Shutdown 2018.
- Directions mentioned in report is with respect to top dome's position at rest. (After Dis-assembling it from bottom shell)

H-1205 (LP CARBAMATE CONDENSER):

Tubes were inspected by M/s TesTex NDT India Pvt. Ltd, Mumbai by Internal Rotating Inspection System (IRIS). Total No. of U-tubes are 581 Nos. (1162 tube holes), 04 nos of U-tubes (08 tube holes) were plugged during previous inspection in SD-2017.

In SD-2018 total 02 tube holes (1 U-tube) were plugged due to reduction in wall thickness (Row # 2 Tube # 17).

Total 10 tubes (5 U-tubes) were plugged till SD-2018.

Observations of IRIS are as under:

% Wall Loss	No. of Tubes (Total Inspected 1154 Holes.)
0-10	733
11-20	310
21-30	084
31-40	012
41-55	002
46-50	001
Not Interpreted	012

- Total 12 Nos. of tubes data could not be interpreted due to improper cleaning.
- Localized Baffle Fretting between 90° to 180° degree circumferences was recorded in most of the defective tubes near to bend area.
- Minimum remaining wall thickness observed during the IRIS is 1.09mm (47%) in: Row # 2 Tube # 17, same was plugged.
- Total 02 nos. of tubes were found having wall reduction 41-45%.
- Total 12 nos. of tubes were found having wall reduction 31-40%.
- Total 84 nos. of tubes were found having wall reduction 21-30%.
- Total 733 nos. of tubes were found having wall reduction 0-10%.
- Remaining wall thickness observed during inspection of all tubes are given in Tube Test Summary and color-coded format is given in Tube Sheet Map Layout.

Note:

- Row No. East to West
- Tube No. North to South

The tube sheet layout is attached at **Annexure-9.**

INSPECTION OF OTHER VESSELS / EQUIPMENT

H-1131-A (LO COOLER OF P-1102-A)

- Tube sheet condition was found satisfactory.
- Whitish scale and rusting was observed on tube sheet.
- Whitish scale was observed inside the tubes.

H-1131-B (LO COOLER OF P-1102-B)

- Tube sheet condition was found satisfactory.
- Whitish scale and rusting was observed on tube sheet.
- Whitish scale was observed inside the tubes.

H-1131-C (LO COOLER OF P-1102-C)

- Tube sheet condition was found satisfactory.
- Whitish scale and rusting was observed on tube sheet.
- Whitish scale was observed inside the tubes.

H-1231-B (LO COOLER OF P-1102-B)

- Tube sheet condition was found satisfactory.
- Whitish scale and rusting was observed on tube sheet.
- Whitish scale was observed inside the tubes.

H-1204 (RECIRCULATION HEATER):

- Brownish scaling was observed on both top and bottom tube sheet.
- Tube to tube sheet welding found satisfactory.
- Foreign particles observed lying on the top cover.
- Overall condition of the tank found satisfactory.

H-1207 (CIRCULATION SYSTEM -II COOLER)

- Pitting, Corrosion and whitish scaling was observed on the tube sheet area.
- Channel cover was found pitted / corroded from inside.
- Scaling was observed on the inside surface of tubes at many locations as per attached photograph.
- Few tubes are partially filled with water.
- Chemical cleaning carried out with help of external party of all the tubes.
- Epoxy primer may be applied inside channel cover.

H-1209 (LP ABSORBER COOLER)

- Tube to tube sheet welding was found satisfactory.
- Brownish coloration was observed inside the tubes.
- Overall condition of heat exchanger was found satisfactory.

H-1352 (REFLUX CONDENSER)

TOP TUBE SHEET

- Tube to tube sheet welding found satisfactory.
- Scaling was observed on the inside surface of all the tubes and on tube-sheet area.
- Whitish scale was observed on tube sheet.

BOTTOM TUBE SHEET

- Tube to tube sheet welding was found satisfactory on CW inlet side.
- Thick scaling was found on the CW outlet side tube sheet.
- On cooling water outlet side, scaling was observed inside the tubes and outlet line elbow. After re-hydro jetting observed satisfactory.
- Thermowell was found intact in its position.
- Overall condition of heat exchanger was found satisfactory.

H-1419 (PRE-EVAPORATOR CONDENSER):

TOP TUBESHEET:

- Tube to tube sheet weld found satisfactory.
- Minor Whitish scaling was observed inside the tubes.
- Thin scaling was observed on North half of the tube sheet area whereas the South half of the tube sheet area is free from any scaling.
- Overall condition of heat exchanger found satisfactory.

H-1421 - FLASH TANK CONDENSER

- Tube to tube sheet welding was found satisfactory.
- Minor scaling observed inside most of the tubes.
- All the tubes were found filled with water.
- Overall condition was found satisfactory.

H-1422 (FIRST STAGE EVAPORATOR):

- The shell and Dish ends observed grayish black in color.
- Colour of tube sheet observed blackish.
- Tubes to tube sheet weld joints were found satisfactory.
- Condition of impingement cone found satisfactory.
- Impingement cone to support bolts were observed bent, however they were tack welded and found satisfactory.
- Condensate flushing nozzles was found in satisfactory.
- At bottom dish end water was observed.
- Overall condition of vessel is satisfactory.

H-1423 (FIRST STAGE EVAPORATOR CONDENSER)

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

H-1424 (2ND STAGE EVAPORATOR):

- Shiny silver surface observed inside the vessel.
- Impingement cone corner was found bent in downward directions at few locations this was also observed in earlier inspection.
- Tube to tube sheet welding found satisfactory and tubes found clear from I.D.
- Circumferential sparger and its supports found bent in downward direction at many locations.
- Overall condition of vessel is satisfactory.

H-1425 (SECOND EVAPORATOR FIRST CONDENSER):

- Tube to tube sheet welding was found satisfactory.
- Whitish scale was observed inside the tubes.
- Overall condition of heat exchanger was found satisfactory.

H-1426 (SECOND EVAPORATOR SECOND CONDENSER)

- Tube to tube sheet welding was found satisfactory.
- Brownish scales were observed on the tube sheet and inside many tubes.

H-1811, 1st INTER STAGE COOLER OF HITACHI COMPRESSOR

- Condition of tubes and tube sheet was found satisfactory.
- Thin scattered scaling observed on tubes.
- Rust & observed on baffle plates and tie rods.

H-1812, 2nd INTER STAGE COOLER OF HITACHI COMPRESSOR

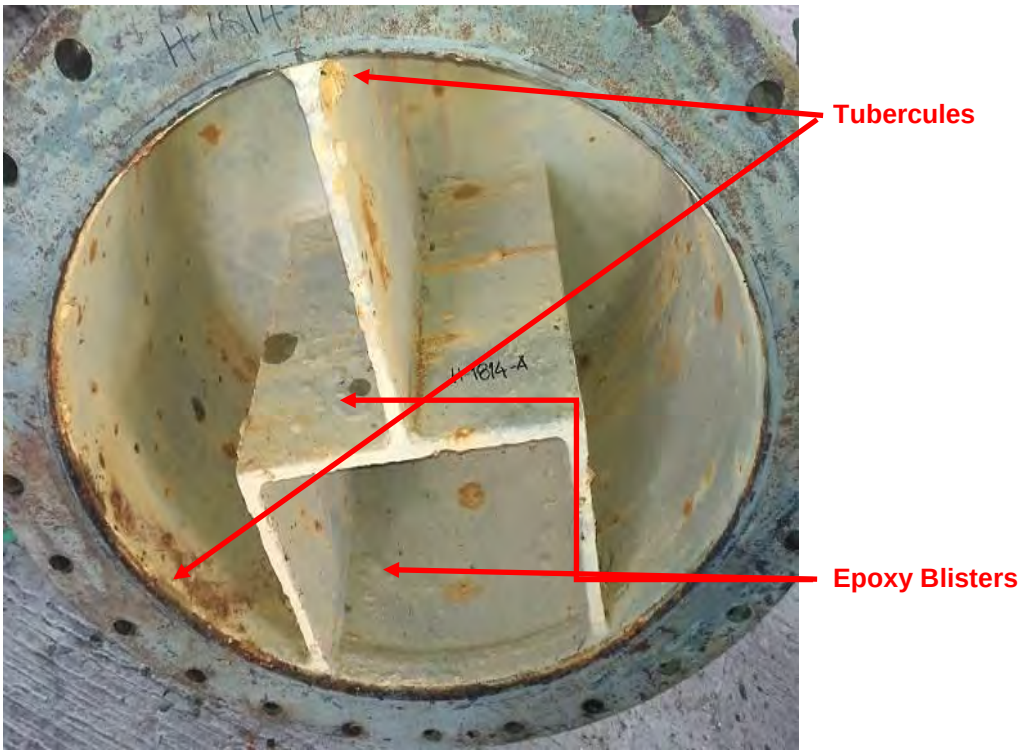
- Condition of tubes and tube sheet was found satisfactory.
- Thin scattered scaling observed on tubes OD.
- Baffle tie rods were slightly bent & rusted.

H-1813, 3rd INTER STAGE COOLER OF HITACHI COMPRESSOR

- Condition of tubes and tube sheet was found satisfactory.
- Corrosion observed on baffles.
- OD of tubes observed satisfactory.

H-1814-A, L.O. COOLER OF HITACHI COMPRESSOR

- Condition of tubes and tube sheet was found satisfactory.
- Thin white scaling observed inside the tubes.
- Few tubes observed partially filled with water.
- Channel cover observed with epoxy paint blisters and tubercules, Repainting may be carried out.



H-1814-B, L.O. COOLER OF HITACHI COMPRESSOR

- Condition of tubes and tube sheet was found satisfactory.
- White dry scaling was observed inside the tubes, found satisfactory after re-hydro jetting may be carried out on north side half from channel cover end.

- Few tubes observed partially filled with water.
- Epoxy layer was found peeled off at several locations on channel cover & partition plates.

H-1815 (SURFACE CONDENSER)

SOUTH SIDE HALF (EAST SIDE CHANNEL)

TOP HALF

- Tube sheet and tubes observed satisfactory condition.
- White thin layer observed on entire half.

- Thermowell observed covered with white colour scales.
- Few tubes observed partially filled with water.
- White dry scaling was observed inside the tubes, observed satisfactory after re-hydro jetting.

BOTTOM HALF

- Epoxy coating layer was found peeled off at several locations.

- Minor scaling / debris / rust flakes were observed at ID of few tubes.
- Few tubes observed partially filled with water.
- White dry scaling was observed inside the tubes. Found satisfactory after Re-hydro jetting.

H-1815 SOUTH SIDE HALF (WEST SIDE CHANNEL)

TOP HALF

- Tube sheet was found in satisfactory condition.
- Minor scaling was observed inside the tubes.

BOTTOM HALF

- Tube sheet was found in satisfactory condition.
- Thermo well was found intact.
- Minor damage of epoxy coating was observed.

V-1101 (CO2 KNOCK OUT DRUM)

- Epoxy paint was found peeled off from few locations in bottom dish end and shell

- Demister pads were found shifted from its position.

- Weld joint condition found satisfactory.

V-1103 (NH3 SUCTION VESSEL)

- Vessel surface from inside observed brownish.
- The condition of longitudinal and circumferential weld joints observed satisfactory.
- UFD of Top “C” seam, Mid “C” seam and Bottom course ‘’L’’ seam carried out and found satisfactory. Details mentioned in **Annexure-10.**
- RT of bottom “C” seam carried out and found satisfactory.
- Oily layer was found on the bottom dish end, shell, man way and weld joints.
- Level troll nozzles found satisfactory.
- Overall condition was found satisfactory.

V-1202 (RECTIFYING COLUMN)

FROM TOP MANHOLE

- Grey hard scales were observed on entire shell portion.

- Tray holding cleats holes observed elongated.
- Tray support / Mesh Grid support strips found satisfactory and they were covered with grayish hard scales.

FROM BOTTOM MANHOLE

- Brownish Coloration was observed on top cone.
- Shell observed reddish in colour.
- Deposition of dust / scale observed on solution inlet nozzle from H-1204.
- Rust and scaling was observed on bottom Dish ends.
- Overall condition of vessel found satisfactory.

V-1203 (L.P. ABSORBER)

FROM BOTTOM MANHOLE

- Shell observed silver shiny in colour.
- One no. of Rasching Ring tray support cleat bolt found shifted from its position and nut of two bolts were found missing.
- Depression of approx. 1" was observed on Shell opposite to the liquid inlet line, just above the circumferential weld.
- Vortex Breaker was found intact.

FROM TOP END

- Shell observed brownish in colour.
- Perforated support grid & its stool was found intact in position. However, it is not free in the shell.

V-1207 (L.P. SCRUBBER)

- Inspection carried from top cover.
- Shell portion observed brownish black from inside
- Grating condition was satisfactory. One no. holding nut was found loose.
- Condition of the top cover was found satisfactory.
- Thermowell was found intact.

V-1301 (2ND DESORBER)

TOP COMPARTMENT

- Shell Internal surface found rusty / brownish in colour.
- Nozzle found satisfactory.
- Perforated tray was found in broken condition. (in North-West side)

- Fasteners and clamp of trays observed in satisfactory condition, however one bolt observed missing and its washer and nut found lying on perforated tray.

BOTTOM COMPARTMENT

- Shell observed brownish in colour from inside.
- Nozzle condition was found satisfactory.
- Thermo well was found intact.
- 01 bolt was found in improper condition.

- Weld joint condition was found satisfactory.

V-1351 (HYDROLYSER)

TOP COMPARTMENT

- Brownish coloration was observed on Top dish end and shell.
- Trays observed reddish in color.
- Fasteners of sieve tray were found intact in position.
- Accumulated sludge / debris observed in ½'' nozzle, 3'' nozzle and ¾" nozzle in East side.

BOTTOM COMPARTMENT

- Thermowell condition found satisfactory.
- Steam inlet line flange and clamping bolt found missing.
- On Shell , Reddish coloration was observed from inside.
- Few fasteners of Middle tray clamp found missing and rest of tray clamps found satisfactory.

- End cap welding found satisfactory.

V-1352 (FIRST DESORBER)

FROM TOP MANHOLE

- Vessel inside surface observed blackish in colour.
- Fasteners were found satisfactory in its position.

- Weld joint condition was found satisfactory.
- Manhole gasket seating face observed eroded / corroded at several locations.
- Thick blackish deposition observed on M/H cover and on M/H flange.

FROM BOTTOM MANHOLE

- Brownish coloration was observed inside the vessel.
- Thin minor scaling was observed on the shell surface.
- Condition of the perforated trays found satisfactory.
- Weld joint condition was found satisfactory.

V-1423 (1st STAGE EVAPORATOR SCRUBBER)

- Reddish Brown coloration was observed inside the vessel.
- Demister pads were found slightly damaged / loosened & lifted at several locations most prominent in South-East direction.

- 02 no of bolts of bottom plate found missing.

V-1501 (4 ATA STEAM DRUM)

RLA was carried out by M/s TCR Advanced, Vadodara in this turnaround.

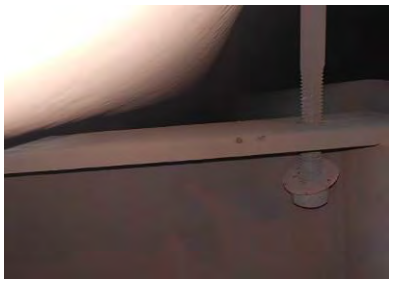
- Grayish coloration observed on Shell.
- Hard grayish scaling observed on both dished ends.
- Distribution sparger was found intact in position.
- Demister pads were found intact in its position.
- Condition of all the weld joints found satisfactory.
- Water observed lying on shell floor.
- Few bolts of Steam inlet saturation box cover were found loose which were attended.

V-1502 (23 ATA STEAM DRUM)

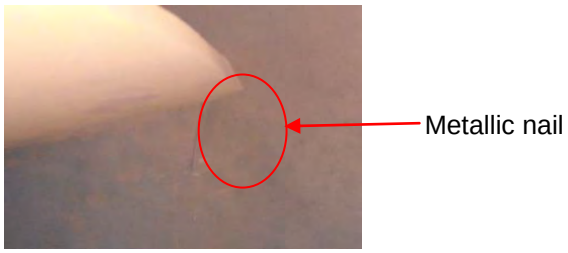
- Grayish black coloration observed inside the vessel.
- Minor scaling observed at both dished ends and shell.
- Weld joints condition found satisfactory.
- Distributor Pipe, Nozzles and Thermo Well condition found satisfactory.
- Water observed lying on shell floor.
- Overall condition found satisfactory.

V-1503 (9 ATA STEAM DRUM)

- Grayish black coloration was observed inside the vessel.
- U-clamp of the steam inlet header was found loose.



- Metal nail found between support to shell welding.



- Overall condition of the vessel was found satisfactory.

V-1811 (1ST STAGE SEPARATOR).

- Demister pads were found intact in position.
- Vessel from inside was found silver grayish in colour.
- Vortex breaker was found intact in position.

- Condition of the weld joints was found satisfactory.
- Nozzles found clear from inside.
- M/H flange seal run welding observed satisfactory.
- Overall condition of the vessel was found satisfactory.

V-1812 (2ND STAGE SEPARATOR):

- Demister pads were found intact in position.
- Vortex breaker was found intact in position.
- Condition of the weld joints was found satisfactory.
- Vessel from inside was found silver grayish in colour.
- Demister drain pipe was found intact in position.
- Nozzles found clear from inside.
- Overall condition of the vessel was found satisfactory.

V-1813 (3RD STAGE SEPARATOR): (Thru Hand Hole)

- Demister drain pipe (1" NB) observed may be detached from its weld joint and moving freely inside the vessel (in vertical condition). This was observed during previous inspections also. Vessel from inside was found silver grayish in colour.
- Inspection carried out from bottom hand hole.
- Overall condition of the vessel was found satisfactory.

T-1501 (CONDENSATE TANK).

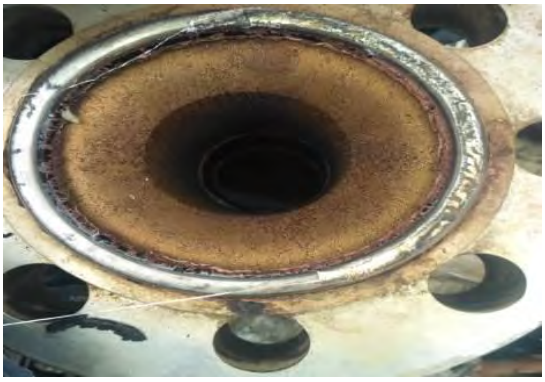
- Inside surface of tank observed reddish brown in colour.
- Weld joints condition found satisfactory.
- Supports of 6" NB (2 Nos) and 8''NB condensate inlet line found satisfactory.
- 2''NB DM water makeup line sparger observed satisfactory.
- Water observed on shell floor.
- Overall condition of the tank found satisfactory.

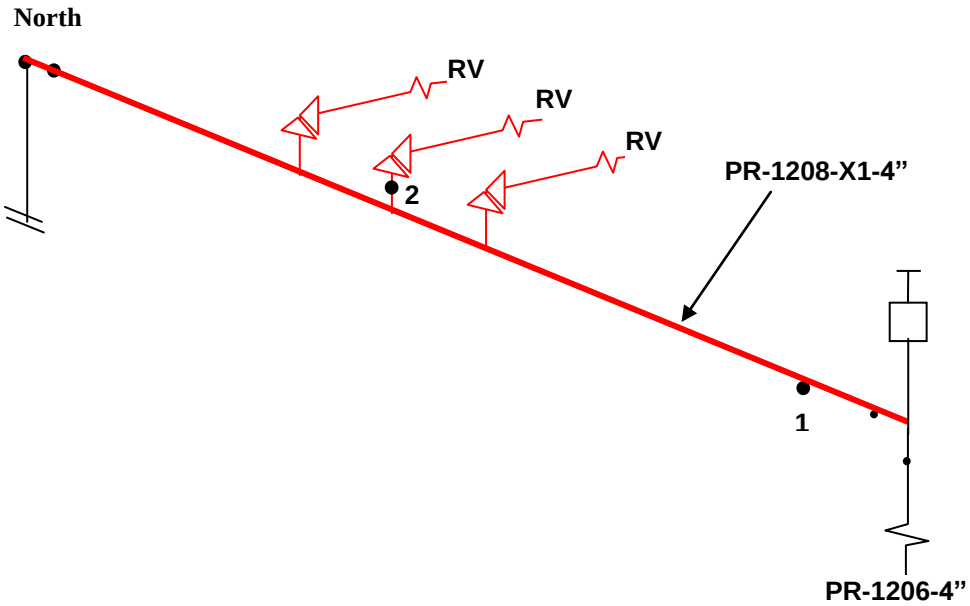
NEW AIR RECEIVER

- Bottom dish end observed satisfactory.
- Epoxy paint observed peeled off at scattered locations on shell.
- Condition of Weld joints found satisfactory.
- Nozzle's condition found satisfactory.

RV-1201 A, B, C NOZZLES

- Roughening of flange face and ID observed in all three RV Flanges.
- Brownish coloration observed inside RV Nozzles.
- Thickness measurement carried out as mentioned below. No abnormalities observed.





THICKNESS MEASUREMENT READINGS

Meas. Location	North	South	East	West	Top	Bottom	Size	Nominal Thickness
01	--	--	11.97	11.68	11.80	11.68	4”	10.41
02	11.20	10.52	10.60	11.22	--	--	3”	8.56

All Dimensions are in MM.

T-1401 and T-1401 A (UREA SOLUTION TANKS)

One shell course was added to both of the existing tanks in this turnaround.

DPT & RT was carried out on the weld joints as per the QAP.

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

MISCELLANEOUS JOBS

Various activities performed for piping fabrication and equipment erection jobs during annual shut down by various agencies of Mechanical and Technical Department etc.

Viz. Root weld / Final weld DP, Random Ferrite Measurement, PMI for Urea grade pipelines, Final weld visual, Review of Radiographs etc.

WELDER QUALIFICATION TESTS

- Performance qualification test of 23 Nos. welders offered by M/s General Engg., Bharuch (Mech. Planning) (W.O.No- 201004181823) was carried out. 10 nos. of welders were qualified during the test. These welders were allowed to perform fabrication jobs in Ammonia and Urea plant during SD-2018.
- Performance qualification test of 15 Nos. welders offered by M/s J & J Engg., (W.O. No. 201004181048) was carried out. 08 nos. of welders were qualified during the test. These welders were allowed to perform fabrication jobs in Ammonia and Urea plant during SD-2018.
- Performance qualification test of 11 Nos. welders offered by M/s SHREE GANESH ENGG. (W.O. No.201004190637) was carried out. 08 nos. of welders were qualified during the test. These welders were allowed to perform CAPACITY ENHANCEMENT WORK OF T-1401 AND T-1401-A.
- Performance qualification test of 09 Nos. welders offered by M/s SHREE GANESH ENGG. (W.O. No.201004190796) was carried out. 06 nos. of welders were qualified during the test. These welders were allowed to perform various Urea Grade Jobs in Urea plant like Carbamate Pump discharge line modification, Misc. repair work in V-1201 etc.
- Performance qualification test of 06 Nos. welders offered by M/s SHIV ENGG. (W.O. No.201004190882) was carried out. 04 nos. of welders were qualified during the test. These welders were allowed to perform various Urea Grade Jobs in Urea plant like Misc. repair, modification and new installation work.

D.P. TEST

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

D.P. test of conveyor belt pulleys shaft to disc joints carried out and necessary corrective actions taken as per requirement.

GAUSS MEASUREMENT, D.P TEST OF BEARINGS & COUPLING BOLTS OF K-1801, CO_2 COMPRESSOR

Measurement of residual magnetism (Gauss) on rotary and stationary parts of rotary equipment was carried out. Wherever residual magnetism was found higher than acceptable limits, same was demagnetized and brought down within acceptable limits. The detailed results of inspection are attached herewith at **Annexure-4.**

D.P. Test was carried out on all bearings to check condition of liner and its bonding and all coupling bolts of High Speed rotary equipment.

RADIOGRAPHY

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

ANNEXURE-1

PIPELINE THICKNESS MEASUREMENT SUMMARY OF H.P. LINES

SR. NO.	LINE NO.	NB (inch)	SCH.	NOM. THK. (MM)	LINE DESCRIPTION FROM	TO	MIN. THK. OBSERVED	%AGE RED.
1	CO-F10-2119-PP25	8	160	23.04	K-1801,III	H-1813	22.00	4.51
		4	160	13.49			13.04	3.34
		1.5	160	7.14			6.71	6.02
		0.75	160	5.54			5.15	7.04
2	CO-F10-2124	8	160	23.04	K-1801 DIS	GA-1112-6"	22.11	4.04
		4	160	13.49			12.11	10.23
		3	160	11.13			11.58	--
		0.75	160	5.54			5.00	9.75
3	CO-F10-2139	4	80	8.56	4"-CO-F10-2140 (TV-1808)	CO-E10-2122-6"	7.00	18.22
4	CO-F10-2140	4	160	13.49	CO-F10-2119-8”PP25	CO-F10-2139-4” (TV-1808)	12.04	10.75
		0.75	160	5.54			4.89	11.73
5	CO-E10-2122	6	80	10.97	H-1813	V-1813	9.57	12.76
6	GA-1112	6	F2	14.27	GA-1602-8" (K-1101-2)	GA-1201-6"	8.89	37.70
		1.5	F2 (SS)	7.14			4.00	43.98
		1	F2	6.35			6.04	4.88
7	GA-1201	8	X4	19.58	GA-1112-6"	H-1201 BOTTOM	17.36	11.34
		6	X4	15.24			13.44	11.81
		1.5	X4	5.08			5.11	--
8	GA-1202	1	F2	6.35	GA-1112-6"	GA-1203-1" (C.V.)	5.07	20.16
		0.75	F2	5.54			5.10	7.94
9	GA-1203	1	X1	4.55	GA-1202-1"	H-1203	3.20	29.67
		0.5	X1	3.73			3.49	6.43
10	GA-1204	1	X1	4.55	H-1203 (GA-1202-1")	PR-1231-X1-3"	3.45	24.18
		0.5	X1	3.73			2.85	23.59
11	GA-1602	8	F2	22.83	K-1801	GA-1112-6' (H-1201)	21.66	5.12
		4	F2	11.13			11.83	--
		0.75	F2	5.54			5.29	4.51
		0.5	F2	4.75			3.73	21.47
12	GA-1603	4	F2	11.13	GA-1602-8"-F2	GA-1604-16" (PIC-1810)	9.46	15.00
13	GA-1606	1	B3	3.38	GA-1607-0.75" (K-1801)	GA-1350-1"	2.81	16.86
14	GA-1607	0.75	B3	2.87	K-1801	GA-1606-1"	2.43	15.33
15	GA-0029	3	F2	11.13	GA-1112-6" (8"-GA-1418-F2)	8"-PR-0027-99A-T	10.12	9.07

SR. NO.	LINE NO.	NB (inch)	SCH.	NOM. THK. (MM)	LINE DESCRIPTION FROM	TO	MIN. THK. OBSERVED	%AGE RED.
16	MA-0002	4	E2/N	8.56	P-1102-A	6"-MA-0009-77A-V	11.72	--
		1.5	E2/N	5.08			4.89	3.74
		0.75	E2/N	3.91			5.49	--
		0.5	E2/N	3.73			3.36	9.92
17	MA-0003	4	E2/N	8.56	P-1102-B	6"-MA-0009-77A-V	12.64	--
		1.5	E2/N	5.08			4.88	3.94
		0.75	E2/N	3.91			5.38	--
		0.5	E2/N	3.73			3.97	--
18	MA-0006	4	E2/N	8.56	P-1102-C	6"-MA-0009-77A-V	7.32	14.49
		3	E2/N	7.62			10.68	--
		1.5	E2/N	5.08			5.48	--
		0.75	E2/N	3.91			5.40	--
19	MA-0007	4	E2/N	8.56	2"-MA-0102/0104-77A-V	V-1103	6.84	20.09
		0.75	E2/N	3.91			5.08	--
20	MA-0009	6	E2/N	14.27	4"-MA-0002-77A-V	H-1250	13.41	6.03
		1.5	E2/N	5.08			7.99	--
		1	E2/N	4.55			6.27	--
		0.5	E2/N	3.73			3.97	--
21	MA-0015	6	E2/N	14.27	H-1250	4"-PR-0016-99A-T	15.19	--
		4	E2/N	8.56			12.03	--
		1.5	E2/N	5.08			7.69	--
		0.75	E2/N	3.91			6.17	--
		0.5	E2/N	3.73			4.45	--
22	MA-0102	2	E2/N	5.54	4"-MA-0007-77A-V	4"-MA-0002-77A-V	8.12	--
		0.75	E2/N	3.91			5.13	--
23	MA-0103	2	E2/N	5.54	4"-MA-0007-77A-V	4"-MA-0003-77A-V	8.60	--
		0.5	E2/N	3.73			5.17	--
24	MA-0104	2	E2/N	5.54	4"-MA-0007-77A-V	4"-MA-0006-77A-V	6.47	--
		0.75	E2/N	3.91			3.80	2.81
25	MA-0107	6	E2/N	14.27	6"-MA-0009-77A-N	6"-MA-0015-77A-V	16.33	--
26	MA-1201	3	E2	7.62	6"-MA-0015-77A-V	V-1201	6.58	13.65
		1.5	E2	5.08			3.65	28.15
27	PR-0019	10	X1/N	24.33	H-1202 (C1B/C1C)	V-1250	23.75	2.38
		8	X1/N	19.58			18.20	7.05
28	PR-0021	4	X4	10.41	8"-PR-0020-99A-T	PR-1638-4"-X4A	11.10	--
29	PR-1201	8	X1	19.58	V-1201	HP-STRIPPER (H-1201)	14.55	25.69

SR. NO.	LINE NO.	NB (inch)	SCH.	NOM. THK. (MM)	LINE DESCRIPTION FROM	TO	MIN. THK. OBSERVED	%AGE RED.
30	PR-0020	8	X1/N	19.58	P-1250	H-1202 (C2)	21.27	--
		1.5	X1/N	5.08			4.65	8.46
31	PR-0022	4	X1/N	10.41	H-1202 (C1A)	PR-1206-4"	10.48	--
		1.5	X1/N	5.08			8.61	--
32	PR-0026	12	X1/N	28.80	H-1201 (N4)	H-1202	32.65	--
		10	X1/N	24.33			20.20	16.97
33	PR-1205	6	X1	15.24	PR-1205-8"	V-1202	10.13	33.53
		1.5	X1	5.08			4.13	18.70
		1	X1	4.55			3.39	25.49
		0.75	X1	3.91			2.89	26.09
34	PR-1205	8	X1	19.58	HP-STRIPPER (H-1201)	PR-1205-6" (V-1202)	16.42	16.14
		6	X1	15.24			11.27	26.05
		1.5	X1	5.08			4.50	11.42
35	PR-1206	4	X1	10.41	PR-1210-10"	H-1203	12.09	--
		2	X1	5.54			7.45	--
36	PR-1208	4	X1	10.41	V-1201 TOP	PR-1206-4"	10.58	--
		3	X1	8.12			11.20	--
		1.5	X1	5.08			6.44	--
37	PR-1211	1.5	X1	5.08	PR-1208-4"	PR-1212-4"	5.08	--
38	PR-1212	4	X1	10.41	H-1203	V-1201 BOTTOM	8.13	21.90
		1.5	X1	5.08			8.61	--
39	PR-1213	2	X4	5.54	PR-1201-8"	PR-1205-6"	3.94	28.88
		0.5	X4	3.73			2.86	23.32
40	PR-1224	3	X4	7.62	P-1201-B	PR-1638-4"	6.30	17.32
41	PR-1225	3	X4	7.62	P-1201-ABC (PR-1638-3")	H-1203	6.67	12.47
		1	X4	4.55			4.41	3.08
42	PR-1226	2	X4	5.54	PR-1224-3"	H-1205	4.58	17.33
43	PR-0027	8	X1/N	19.58	12"-0026-99A-T	V-1201 (C1B)	20.58	--
44	PR-1231	3	X1	8.12	H-1203	PRCV-1201	6.79	16.38
45	PR-1232 (6"-JACKET)	6	SS	3.04	PRCV-1201 (RV-1209)	ATMOS	3.40	--
46	PR-1234	4	X4	10.41	PRCV-1201 (H-1203)	V-1203	10.25	1.54
47	PR-1234	3	X4	7.62	P-1201-A	PR-1638-4"	6.08	20.21
48	PR-1637	3	X4A	9.14	P-1201-C	PR-1638-4"	7.14	21.88
49	PR-1638	4	X4A	9.14	P-1201-ABC	PR-1230-6"	11.14	--
		1.5	X4A	5.08			5.78	--
50	PR-1666	2	X4A	5.54	PR-1637-3"	PR-1226-2"	4.48	19.13
		1.5	X4A	5.08			4.13	18.70

ANNEXURE-2

PIPELINE THICKNESS MEASUREMENT SUMMARY

(STEAM CONDENSATE & STEAM LINES)

Sr. No	LINE NO.	NB (inch)	SCH	NOM. THK. (MM)	LINE DESCRIPTION		Min. Thk. Observed	%Aged.
					FROM	TO		
SC-LINES								
1	SC-1101	14	B1	9.53	H-1102	H-1206	6.00	37.01
2	SC-1101	10	10S	4.19	H-1102	H-1206	4.00	4.53
3	SC-1102	6	B1	7.11	SC-1228	SC-1101	7.00	1.55
4	SC-1102	12	B1	9.53	SC-1228	SC-1101	9.30	2.36
5	SC-1213	6	C1	7.11	H-1201	V-1502	5.90	17.02
6	SC-1228	10	B4	9.27	P-1202	H-1102	8.70	6.15
7	SC-1228	14	B4	9.53	P-1202	H-1102	9.00	5.56
8	SC-1407	3	B4	5.49	H-1422	T-1501	4.20	23.50
9	SC-1407	8	B4	8.18	H-1422	T-1501	6.20	24.21
10	SC-1409	4	B4	6.02	H-1424	T-1501	4.70	21.93
11	SC-1409	3	B4	5.49	H-1424	T-1501	4.30	21.68
12	SC-1409	1.5	B4	5.08	H-1424	T-1501	4.30	15.35
13	SC-1421	2	B4	3.90	HEADER	SC-1409	4.00	--
14	SC-1501	4	B4	6.02	T-1501	P-1501/6	5.30	11.96
15	SC-1502	3	B4	5.49	P-1501/6	V-1501	3.90	28.96
16	SC-1502	1.5	B4	3.91	P-1501/6	V-1501	4.00	--
17	SC-1503	1	B4	4.55	SC-1502	V-1503	3.30	27.47
18	SC-1504	4	B4	6.02	V-1503	V-1501	4.80	20.27
19	SC-1504	6	B4	7.11	V-1503	V-1501	5.70	19.83
20	SC-1505	2	B4	3.91	SC-1504	T-1501	3.90	0.26
21	SC-1505	6	B4	7.11	SC-1504	T-1501	5.40	24.05
22	SC-1506	3	B4	5.49	T-1501	P-1505	5.10	10.70
23	SC-1506	4	B4	6.02	T-1501	P-1505	5.00	16.94
24	SC-1509	3	B4	5.48	SC-1507	B/L	4.90	10.58
25	SC-1510	2	B4	3.91	P-1502	PCV-1501	4.10	--
26	SC-1510	1.5	B4/ SS	5.08	P-1502	PCV-1501	3.00	40.94
27	SC-1511	1.5	B4/ SS	3.68	PCV-1501	T-1501	3.60	2.17

Sr. No	LINE NO.	NB (inch)	SCH	NOM. THK. (MM)	LINE DESCRIPTION		Min. Thk. Observed	%Aged.
					FROM	TO		
28	SC-1512	4	C1	6.02	SC-1213	LCV-1501	6.20	--
29	SC-1513	4 4	B4 10S	6.02 3.05	LCV-1501	V-1503	5.00 2.20	16.94 27.04
30	SC-1514	4	B4	6.02	T-1501	SEAL POT	4.40	26.91
31	SC-1514	3	B4	5.49	T-1501	SEAL POT	4.30	21.68
32	SC-1522	2	B4	3.91	SC-1529	SC-1409	4.00	--
33	SC-1522	3	B4	5.49	SC-1529	SC-1409	5.20	5.28
34	SC-1523	3	B4	5.49	HEADER	SC-1409	5.30	3.46
35	SC-1530	3	B4	5.49	HEADER	SC-1407	4.30	21.68
ST-LINES								
1	ST-1205	12	C1	9.52	V-1502(23ata st.drum)	H-1201	7.10	25.42
2	ST-1206	8	B4	8.20	ST-1506	H-1204	7.40	9.76
3	ST-1206	10	B4	9.27	ST-1506	H-1204	6.70	27.72
4	ST-1302	6	B4 10S	7.11 3.40	ST-1504	V-1352	5.60 3.20	21.0 5.88
5	ST-1352	3	B4 10S	5.5 3.05	23 ATA HEADER	HYDROLYSER	4.80 2.60	12.5 14.7
6	ST-1409	6	B4	7.11	ST-1504	H-1424	6.20	12.80
7	ST-1502	4	B4	6.02	ST-1116	V-1503	5.00	16.94
8	ST-1502	2	B4	3.91	PICV-1502	V-1503	4.30	--
9	ST-1502	8	C1	8.20	ST-1116	PICV-1502A	7.20	12.20
10	ST-1502	3	B4	5.49	ST-1502	V-1503	5.30	3.46
11	ST-1503	3	B4	5.49	PICV-1502A	V-1503	4.80	12.57
12	ST-1503	2	B4	3.91	PICV-1502A	V-1503	4.30	--
13	ST-1503	12	B4	9.52	PICV-1502A	V-1503	9.00	5.46
14	ST-1504	2	B4	3.91	V-1503	ST-1302	3.20	18.16
15	ST-1505	14	B4	9.53	PICV-1502B	ST-1506	9.20	3.41
16	ST-1506	14	B4	9.53	V-1501	ST-1106	8.40	11.81
17	ST-1508	1.5	B4	5.08	ST-1506	PCV-1502	4.40	13.39
18	ST-1508	2	B4	3.90	ST-1506	PCV-1502	3.70	5.13
19	ST-1508	3	B4 10S	5.49 3.05	ST-1506	PCV-1502	4.80 2.80	12.5 8.19
20	ST-1525	3	B4	5.49	ST-1504	HEADER	5.00	8.93

ANNEXURE-3

UREA PLANT VESSEL THICKNESS MEASUREMENT SUMMARY

Sr. No	Equip. No.	Equip. Description	Shell			Dish End			Channel		
			Nom / Desig.	Min. / Meas	% Red.	Nom. / Desig.	Min. Meas.	% Red	Nom. / Desig.	Min./ Meas	% Red
1	H-1301/A	ADDITIONAL DESORBER HEAT EXCHANGER	8	7.2	10.0	---	---	---	---	---	---
2	H-1301/B	ADDITIONAL DESORBER HEAT EXCHANGER SHELL & TUBE TYPE	12	12.2	----	---	---	---	---	---	---
3	H-1351/A	HYDROLYSER FEED PREHEATER	12.0	12.2	----	12.0	11.7	2.5	---	---	---
4	H-1351/B	HYDROLYSER FEED PREHEATER	12.00	11.20	6.67	12.00	11.10	7.50	---	---	---
5	H-1351/C	HYDROLYSER FEED PREHEATER	12.00	10.40	13.33	12.00	10.40	13.33	12.00	12.06	---
6	H-1352	REFLUX CONDENSER	8.00	7.50	6.25	12.00	12.60	---	14.00	13.94	0.42
7	H-1424	2ND STAGE EVOPARATOR SEPARATOE	12.0/ 14.0	11.4/ 13.7	5.00/ 2.15	12.0/14	11.4/ 13.8	---	---	---	(NEW IN ESP-3)
8	T-1301	LEAN AMMONICAL WATER TANK	6.00	5.00	16.67	---	---	---	---	---	---
9	T-1301 A	STRONG AMMONICAL WATER TANK	6.00	5.30	11.67	---	---	---	---	---	---
10	T-1401	UREA SOLUTION TANK	6.00	6.00	0.00	---	---	---	---	---	---
11	T-1401 A	UREA SOLUTION TANK	6.00	5.60	6.67	---	---	---	---	---	---
12	T-1814	MAIN LO TANK FOR HITACHI COMPRESSOR	6.00	5.40	10.00	---	---	---	---	---	---
13	T-1701A	UREA DUST DISSOLVING TANK	6.00	5.60	6.67	---	---	---	---	---	---
14	T-1701B	UREA DUST DISSOLVING TANK	6.00	5.80	3.33	---	---	---	---	---	---
15	V-1102	AMMONIA FILTER	11.00	10.10	8.18	11.00	10.00	9.09	---	---	---
16	V-1103	AMMONIA SUCTION VESSEL	21.00	20.70	1.43	21.00	21.70	---	---	---	---
17	V-1203	LOW PRESSURE ABSORBER	6.00	5.50	8.33	14.00	14.00	---	---	---	---
18	V-1207	AMMONIA SCRUBBER	5.00	5.10	---	8.00	7.40	7.50	---	---	---
19	V-1418	PRE-EVAPORATOR	12.00	12.20	---	10.00	10.50	---	---	---	---
20	V-1423	1ST STAGE EVAPORATOR SCRUBBER	8.00	7.90	1.25	10.00	8.80	12.00	---	---	---
21	V-1425	1ST STAGE EVAPORATOR CONDENSER POT	8.00	8.92	---	10.00	8.90	11.00	---	---	---
22	V-1503	9 ATA STEAM DRUM	13.00	12.60	3.08	13.00	13.80	---	---	---	---

ANNEXURE-4

GAUSS MEASUREMENT & DEMAGNETIZATION REPORT

K-1801 (HITACHI COMPRESSOR)

DESCRIPTION	POSITION	INITIAL (Gauss)	AFTER DEGAUSSING (Gauss)
TURBINE (GOV END)			
Journal Bearing Pads		0.8	Within limits
Journal Bearing Base Ring	Top	0.6	”
	Bottom	0.8	
Shaft Journal		0.8	”
Thrust Collar		1.2	”
Thrust Base Ring	Top	0.4	”
	Bottom	0.6	
Thrust Bearing Pads	Active	0.8	”
	Inactive	0.4	
Collar	Active	0.6	”
	Inactive	0.4	”
TURBINE (NORTH END)			
Journal Bearing Pads	Top Half	0.7	”
	Bottom half	0.8	”
Shaft Journal		0.4	”
Journal Bearing Base Ring	Top Half	1.2	”
	Bottom half	1.7	”
L.P. CASE (TURBINE END)			
Shaft Journal		0.6	”
Journal Bearing Pads	Top	0.4	”
	Bottom	0.6	
Journal Bearing Base Ring	Top	0.6	”
	Bottom	0.5	
Shaft Journal		1.2	”
L.P. CASE (G.B. END)			
Shaft Journal		0.9	”
Journal Bearing Pads		0.7	”
Thrust Bearing Pads	Active	0.7	”
	Non active	0.8	
Thrust Collar		1.0	”
Thrust Shaft		1.4	”
GEAR BOX			
L.S. Shaft Journal Bearing L.P. Case Side	Top half	0.3	”
	Bottom half	0.4	
L.S. Shaft Journal Bearing	Top half	0.4	”

DESCRIPTION	POSITION	INITIAL (Gauss)	AFTER DEGAUSSING (Gauss)
H.P. Case Side	Bottom half	0.6	
H.S. Shaft Journal Bearing L.P. Case Side	Top half	1.3	,,
	Bottom half	1.2	
H.S. Shaft Journal Bearing H.P. Case Side	Top half	0.7	,,
	Bottom half	0.5	
Thrust Base Ring	Active Top	0.6	,,
	Active Bottom	0.8	
	Non Active Top	0.7	,,
	Non Active Bottom	0.8	
Thrust Pads	Active	0.4	,,
	Non Active	0.8	
Thrust Collar	Active	0.7	,,
	Non Active	0.8	
High Speed Shaft Journal	L.P.Side	0.6	,,
	H.P Side	0.7	,,
Low Speed Shaft Journal	L.P.Side	0.6	,,
	H.P Side	0.4	,,
H.P. CASE (FREE END SIDE)			
Shaft Journal		0.8	,,
Journal Bearing Pads	Top	0.7	,,
	Bottom	0.6	
Journal Bearing Base Ring	Top	0.6	,,
	Bottom	0.8	,,
Thrust Base Ring	Active Top	0.9	,,
	Active Bottom	0.9	
	Non Active Top	0.8	,,
	Non Active Bottom	0.6	
Thrust Pads	Active	0.6	,,
	Non Active	0.6	
Thrust Collar	Active	0.8	,,
	Non Active	0.6	
H.P. CASE (G.B.SIDE)			
Shaft Journal		1.4	,,
Journal Bearing Pads	Top	0.8	,,
	Bottom	0.6	
Journal Bearing Base Ring	Top	0.9	,,
	Bottom	0.9	,,

ANNEXURE- 5

RADIOGRAPHIC EXAMINATION OF HP LINE/HPF FITTINGS

Sr No.	Fitting Identification-No.	Line where Installed	Location		Size (OD)	Nom. Thick. (mm)	RT Result
1	TR-1206	V-1201 Offgas line	5th	Above V-1201	1.5" Sch.80	5.08	Satisfactory
2	TR-1210	H-1201 O/L Line	GF	Near Stripper Bottom	1.5" Sch.80	5.08	Satisfactory
3	2"-MA TO AMM PLANT	BET P1102A/ 1102B	G.F	--	2"	5.54	Satisfactory
4	10"-PR-0019-99A-T HPCC Liquid O/L to V-1201	HPF Drain	3rd	Nr Autoclave Bottom	1" Sch 80	4.55	Weld crevice Observed. Repair Done. Satisfactory
5	12" PR-0026-99-A-T Near TI-1255	HPF Drain	3rd	Nr HPCC Bottom (Inlet Line)	1" Sch 80	4.55	Weld crevice Observed. Repair Done. Satisfactory
6	Sample Point Nr Pillar	Nr Old Position of P-1102-C	G.F	J1 & J2	1" Sch-80	4.55	Satisfactory
7	P-1102-A Disc RV Flange Joint 01 No. Butt Joint	--	G.F	--	1.5" Sch.80	5.08	Weld crevice/ Cavity Observed. Repair Done. Satisfactory
8	P-1102-A Disc RV Flange Joint 01 No. Butt Joint	--	G.F	--	1.5" Sch.80	5.08	Satisfactory
9	P-1102-A Disc RV Flange Joint 01 No. Butt Joint	--	G.F	--	1.5" Sch.80	5.08	Satisfactory
10	V-1201 Unloading Line	Liquid Outlet from V-1201	GF	Near P-1102-C NE side	2" Sch.80	5.54	Satisfactory
11	HPF to FICV-1204	Carb. Pump Discharge to H-1203	3.5th	South/West corner of floor	1" Sch.80	4.55	Satisfactory
12	HPF to PRCV-1201	H-1203 Off gas to V-1203	6th	East side from PRCV-1201	1" Sch.80	4.55	Weld crevice/ Cavity Observed. Repair Done. Satisfactory
13	HPF to HICV-1202	V-1201 Off gas to H-1203	6th	North side from HICV 1202	1" Sch.80	4.55	Satisfactory
14	HPF Amm. To V-1201	--	3rd	---	1" Sch 80	4.55	Satisfactory (RT After Modification)
15	HPF H-1203 bottom	--	5th	---	2" Sch 80	5.54	Satisfactory
16	V-1201 Unloading Line	V-1201 (Bottom)	3rd	---	2" Sch.80	5.54	Satisfactory (After BEL V/V Replacement)

Note: After repair, weld Joints were Rechecked by Radiography and found satisfactory.

ANNEXURE- 6

PROCEDURE FOR HELIUM LEAK DETECTION SUBMITTED BY M/s GULACHI ENGINEERS

SCOPE:

This Procedure is applicable for helium leak testing of Autoclave reactor liner at IFFCO Kalol, Gujarat, India.

PURPOSE

This Procedure described the methodology and procedure adopted for detecting leakage and locating leak in Autoclave reactor liner.

TECHNIQUE:

- Testing shall be carried out by injecting helium gas under shell and liner space and monitoring any leakage on inner surface of liner using detector/sniffer probe of helium detector.
- Soaking Period: After first injection, a soaking period of 4 hours to be allowed for migrating helium gas to all areas of the liner and to accumulate leaking helium gas to a concentration which can be easily detected.
- Leak Detection: Leakage detection to be performed on inner surface of liner using sniffer/detector probe of helium detector.

REFERENCE DOCUMENT:

- ASME B & PV Code Section –V, Article-10, Appendix-IV: Detector/Sniffer Probe Technique
- SNT-TC-1A of ASNT: Training & Certification of NDT Personnel
- Autoclave Reactor Drawing

NDT PERSONNEL:

- Test procedure shall be established by NDT Level-III personnel.
- Test shall be performed and evaluated by person certified as NDT Level-II personnel.

EQUIPMENT & ACCESSORIES:

- Helium Leak Detector working on MSLD principle - Alcatel-ASM 310
- Detector Probe - Alcatel
- Standard Leak - Alcatel or equivalent for calibrating the Helium Detector
- “He” gas and arrangement for injection of helium gas
- Helium Gas – Commercial Grade
- Polythene sheet, masking tape, Aluminum Tape.

AUTOCLAVE REACTOR LINER INNER SURFACE CONDITION:

- Complete test surface shall be thoroughly cleaned to make it free from scale, paint, rust, dust or any other substance which can prevent leakage of helium gas through any leak, if present.
- Helium injection passage (space between shell and liner) shall be cleaned and dried by suitable means.

TEST MEDIUM:

Helium Gas having purity of at least 99%.

TEST TEMPERATURE:

Testing shall be conducted at ambient temperature.

HELIUM INJECTION AND PRESSURIZATION:

- Helium gas shall be injected through shell bottom most weep hole.
- Due to design limitation, helium pressure shall be maintained at 0.29 bar to avoid any deformation in liner.

CALIBRATION:

- HLD Calibration: Permeation type standard leak of the order 1.3 x 10-7 std.cc/sec fitted internally with Helium Detector shall be used to calibrate the instrument before testing and after testing and at intervals of not more than 4 hours during test
- System Calibration: Scanning speed shall be established with capillary leak.

PREPARATION:

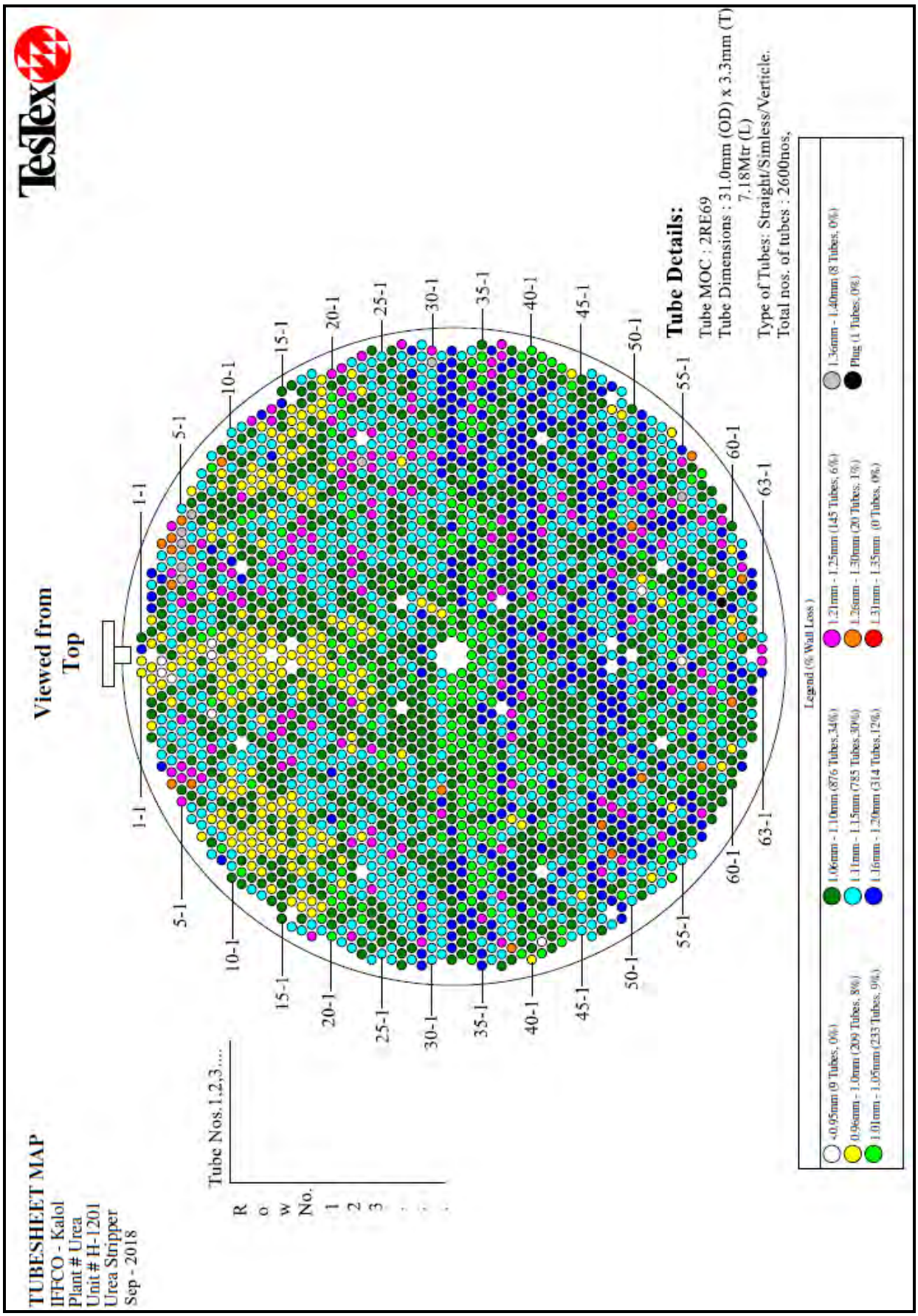
- Complete surface preparation/cleaning
- Arrange injection of helium gas into liner and shell space
- To increase the detect ability and to reduce testing time, liner inner surface shall be covered with polythene sheet in small segment. This is to be done to allow accumulation of leaking helium gas in the polythene envelope and thus easy detection by inserting the detector probe into it.
- Inject helium gas and pressurize as per design consideration of liner strength
- Hold the system under helium pressure for 4 hours.

TESTING:

- Puncture the polythene sheets and insert probe into polythene for presence of helium gas.
- In case of an indication of increased helium concentration above normal background reading, remove polythene envelope from identified portion and perform scanning to locate the leak.
- Repeat the whole process after repair of leak and scanned the repaired portion for leak tightness.

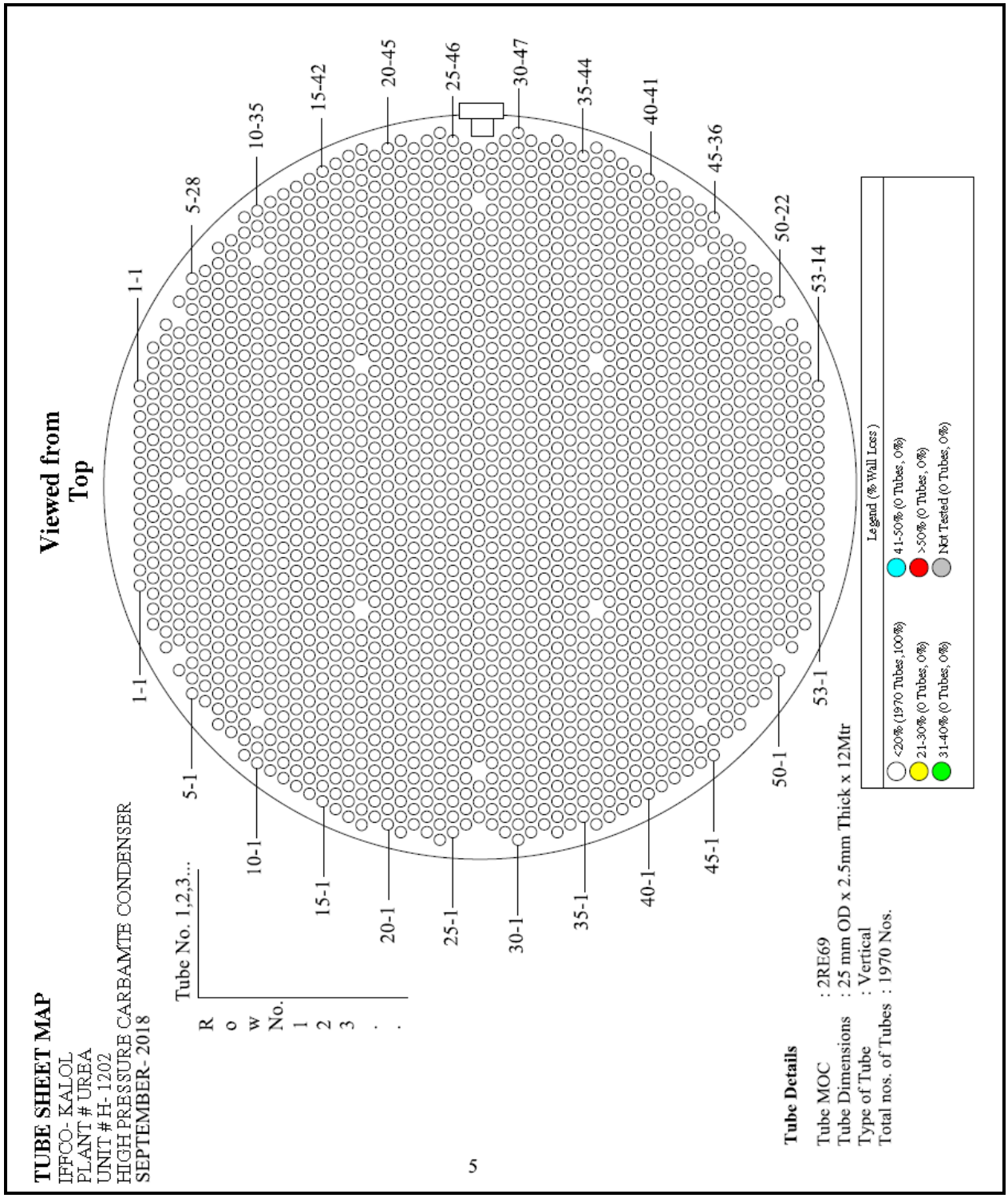
ANNEXURE- 7

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



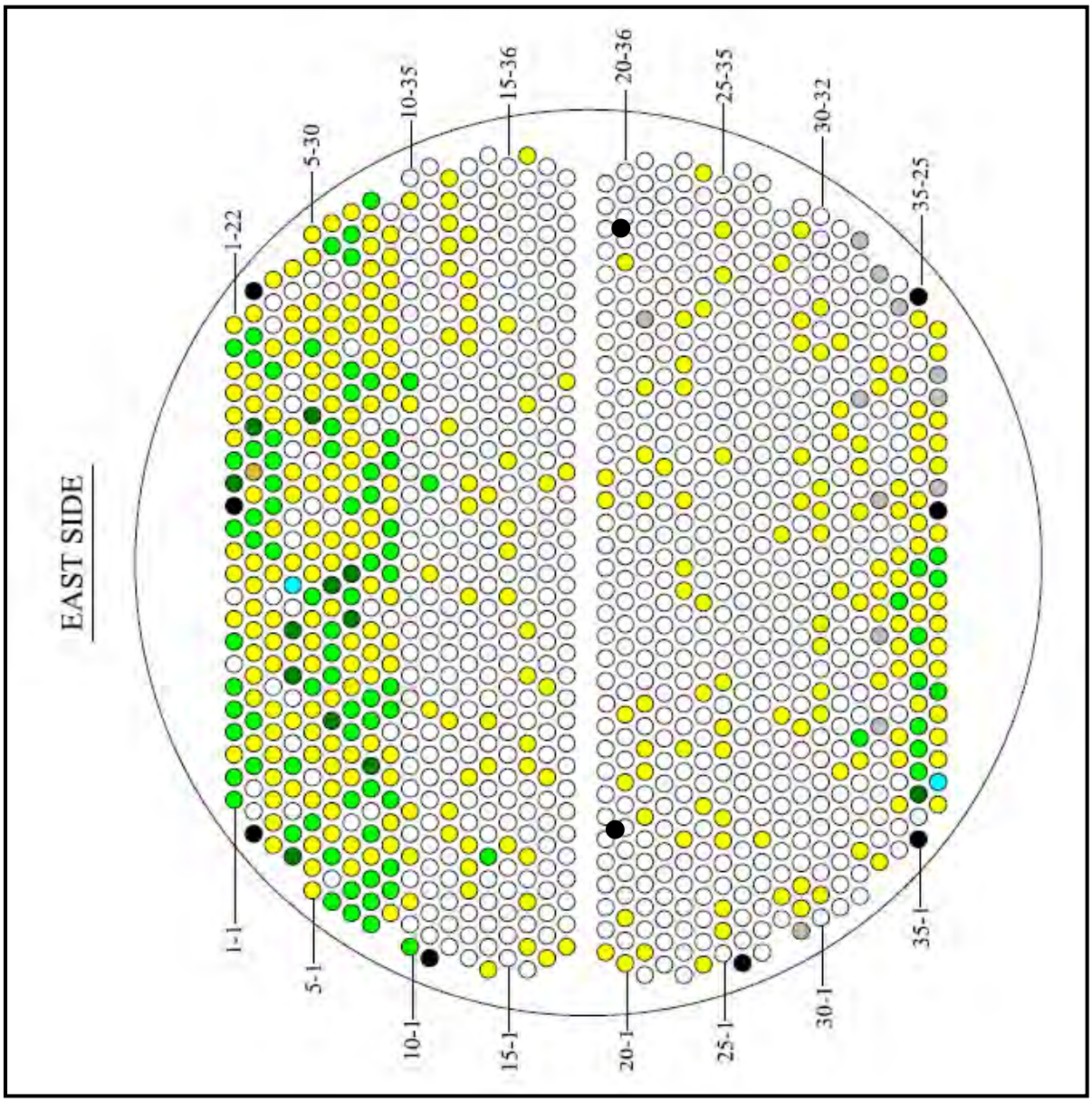
ANNEXURE- 8

TUBE SHEET LAY OUT OF H-1202 (VIEWED FROM TOP)



ANNEXURE- 9

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



Legend (% Wall Loss)			
0-10 (733 Tubes,63%)	31-40 (12 Tubes, 1%)	51-54 (0 Tubes, 0%)	Plug (10 Tubes, 1%)
11-20 (310 Tubes,27%)	41-45 (2 Tubes, 0%)	55 (0 Tubes, 0%)	Not Tested (0 Tubes, 0%)
21-30 (84 Tubes, 7%)	46-50 (1 Tubes, 0%)	>56 (0 Tubes, 0%)	UnINterpritable (12 Tubes, 1%)

ANNEXURE – 10

LIST OF PIPELINES/EQUIPMET FOR ULTRASONIC FLAW DETECTION

PIPELINES

Sr No	Line No.	Size (Nb)	Sch	From	To	No. Of Weld Joints Tested	Identification	Remarks
1	MA0002-77A-V	4''	80	P-1102-A	MA0009-77A-V	01	1st BW Joint	NSD
2	MA0003-77A-V	4''	80	P-1102-B	MA0009-77A-V	01	1st BW Joint	NSD
3	MA0006-77A-V	4''	80	P-1102-C	MA0009-77A-V	01	1st BW Joint	NSD
4	MA-1105-C2	6''	80	V-1103	MA-1105-C2	01	6''x 8'' Reducer	NSD
5	MA-1105-C2	8''	80	V-1103	MA-1105-C2	01	6''x 8'' Reducer	NSD

EQUIPMENT

Sr. No.	Equipment Name	Shell /DE Thickness	Weld Joint details	Result
1	V-1103 Ammonia Suction Vessel	21.0 mm	Top DE to Shell Circumferential Seam	NSD
			Shell to Shell Mid Circumferential Seam	
			Shell Bottom Course Longitudinal seam	

OFFSITE & UTILITY PLANT

(INSPECTION)

The following inspection activities were performed in Offsite Plant during Plant Shut-down/Turnaround, September- 2018.

- Inspection of BHEL Boiler (GT 2068)
- Inspection of 52" NB CW Inter connection line between New CT and P-4401 C/D sumps
- Inspection of VAG- B filter
- Inspection of rubber lining of S.B.A.- 4 & S.M.B.- 4 units.
- Gauss measurement of high speed rotary equipment components.
- Thickness measurement of Pipelines.
- Inspection of Cold Insulation lines connected with Ammonia Storage area.

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

BHEL BOILER (GT-2068)

Visual Inspection of following equipment was carried out during Plant turnaround. In this turnaround RLA of the complete Boiler was carried out by M/s TCR - Vadodara.

STEAM DRUM

- The internal surface of the drum observed brownish black in colour.
- All the weld joints found satisfactory.
- 01 No of fastener of bottom plate found missing. (1st bolt counting from West to East). The same was also observed during previous Inspection.
- Minor rusting observed at both dish ends.
- The tube stub ends were free from any defect.
- Overall condition of the steam drum found satisfactory.

MUD DRUM

- The internal surface of the drum observed brownish black in colour.
- The condition of the weld joints found satisfactory.
- The tube stub ends were free from any defect.
- Whitish scaling was observed in ID of some of the tubes.

- 1” NB, Phosphate dozing pipe (located at top) holding ‘’U” clamps found satisfactory.
- Blow down line (located at bottom) cover plate following bolts found loose.

  (1) Counting from West to East 1st pair north side bolt.

  (2) Counting from West to East 3rd pair north side bolt.

  These fasteners were tightened.
- Overall condition of the mud drum found satisfactory.

DEAERATOR

Deaerator Head

- Brownish coloration was observed inside the shell and dish end.
- All tray segments and angle supports were found intact in position.
- Unequal spring tension observed in spray nozzles.

- Overall condition of shell observed satisfactory.

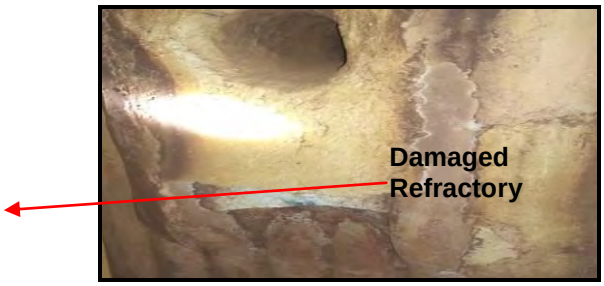
Deaerator Storage Shell

- Brownish coloration was observed on the shell and dish ends.
- Condition of the weld joints was found satisfactory.
- Minor rusting observed at both dish ends.
- Overall condition of shell observed satisfactory.

BHEL BOILER FURNACE

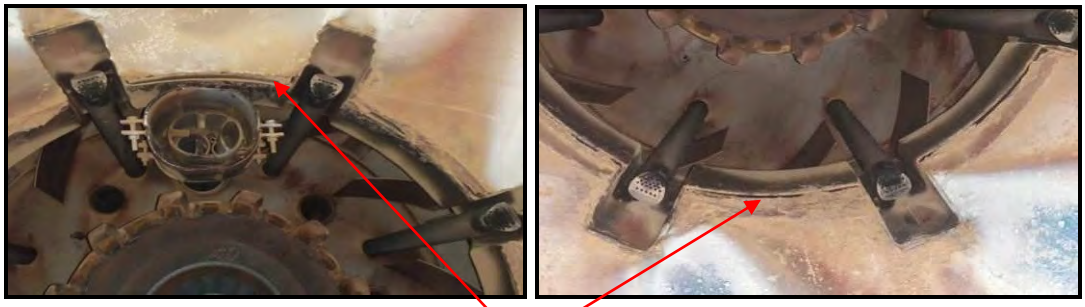
From South Wall Access Door

- Refractory near to the manhole (East side) found in damaged condition.



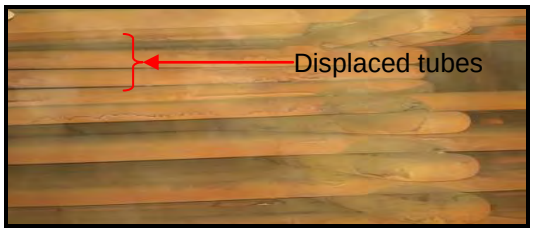
- Minor rust and scaling observed on South wall, Front panel, Rear panel, Cut corner and baffle wall tubes.
- Floor refractory was found damaged and lifted upwards, approx 6'' at centre of furnace.

- Condition of thermo-wells in cut-corner wall found satisfactory.
- Refractory around the bottom burner was found damaged, also carbon deposition observed on all its nozzles.



- Condition of refractory around the top burner was found satisfactory, however carbon deposition was observed on all its nozzles.
- Earlier repaired location of refractory near bottom burner was found damaged.

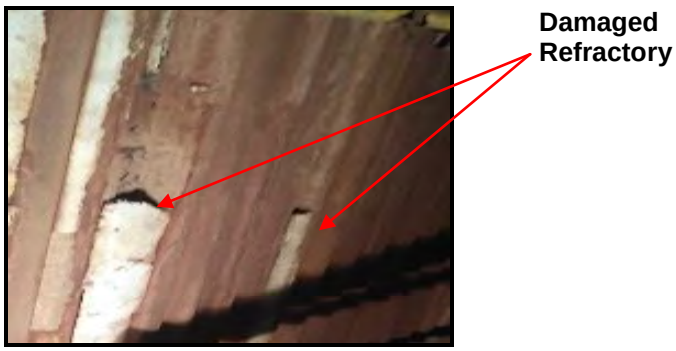
- Minor scaling was observed on Primary Super heater tubes.
- Some of the tubes of Primary super heater coil found displaced.



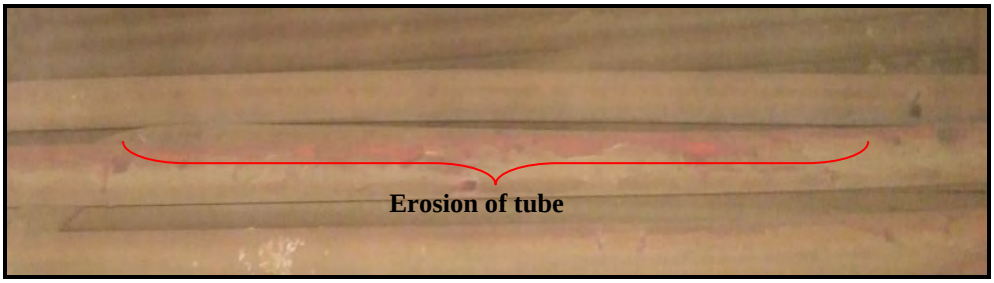
- Insulation fiber blankets placed on top of the Secondary superheater coil were found damaged as refractory from top roof fallen on it.

- Furnace roof refractory found damaged and loosened above secondary super heater coil.

- Baffle wall refractory fell down at few locations.



- Erosion observed on top tube of primary super heater coil.



From North Wall Access Door

- Leakage observed from U bends of following secondary super heater coils (SSHC) during Hydrotest :

  1. SSHC Row no.4 from bottom floor : U bend no. 3 from North Side
  2. SSHC Row no.6 from bottom floor : U bend no. 1 & 2 from North Side

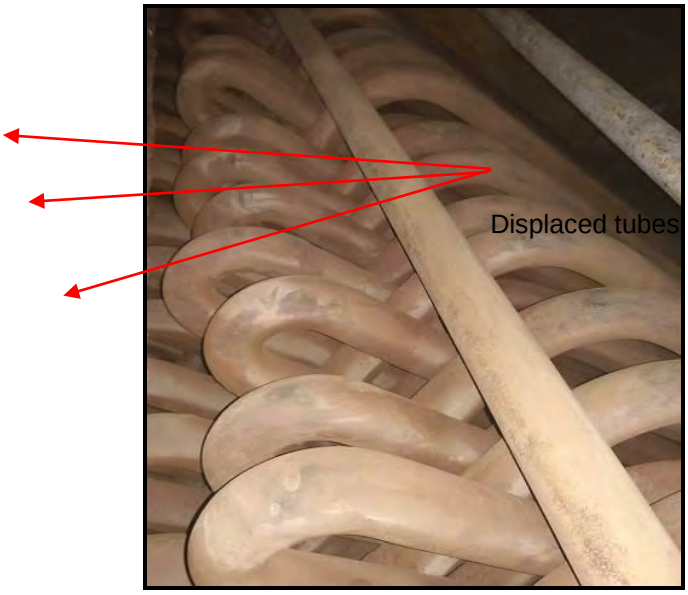
  These U bends were replaced by spare ones. Following NDT was carried out on weld joints of replaced tubes.

  - DP Test and RT of Secondary SSH coil U bend root and final weld joints. (06 joints)
  - DP Test and RT of Bank tubes root and final joint (10 joints). These tubes were cut to facilitate welding/replacement of the Sec SH U bends.

- Bank tube refractory was found damaged / detached.

Damaged Bank wall Refractory

- Refractory found satisfactory on roof just above the access door.
- Minor rust and scaling was observed on boiler bank tubes.
- Some of the Secondary super heater coils found displaced.



AIR PREHEATER (APH)

From Air Entry side (North side) Manhole

- Air Inlet duct was found in satisfactory condition.
- Condition of painting/coating was found satisfactory.
- Air Inlet flow diverter plate tack welds found satisfactory.
- Flue gas duct condition observed satisfactory.

From Air Outlet (East side) Manhole

- Air outlet duct was found in satisfactory condition, however the surface of old duct was found having Rust, scales & loose debris lying at the bottom of the duct.
- Thermowell was found intact in its position.
- Condition of SS plates was found satisfactory.

From Flue Gas Exit side (South side) Manhole

- Rust and scaling observed in middle compartment roof area & bottom surface.

- At rest of the locations the Painting / coating quality found satisfactory.
- Overall condition found satisfactory.

52" NB CW INTERCONNECTION LINE

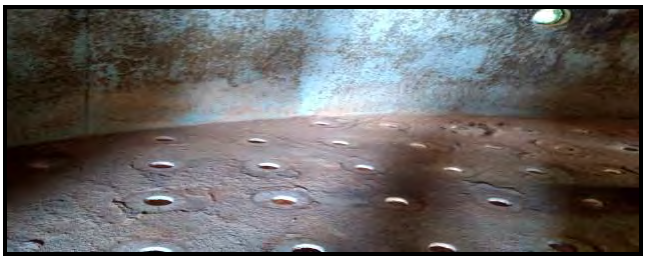
- Condition of Epoxy paint was found satisfactory, however rusting marks were observed at scattered locations.
- All circumferential and long seam welds found satisfactory.
- Rusting and blistering of paint was observed at scattered locations.

- Previously applied putty at the welding joint no. 22 (counting from P-4401 C/D Suction) found in damaged condition. The same was rectified.
- Overall condition found satisfactory.

VAG- B (VALVELESS AUTOWASH GRAVITY SAND FILTER)

- Bottom plate found bulged upward at center portion and in North direction, however bulged downwards in west side portion. Same was also observed in past
- Paint/Epoxy found peeled off from the entire shell surface.
- Scaling/Rusting observed on shell.

- Plate top surface found covered with debris/paint/oxide layers needs to be cleaned.



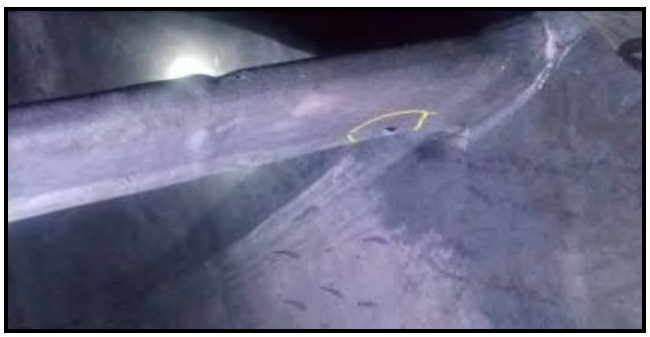
- Overall condition found satisfactory.
- Ultrasonic thickness measurement was carried out and found satisfactory.

SMB-4 (SECONDARY MIXED BED)

SMB-4 was offered for inspection of its rubber lining after new rubber lining (Carried out at vendor works). Following Inspection activities carried out at our site and the observations are as under:

Visual Inspection & Spark test

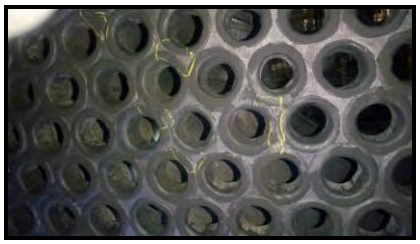
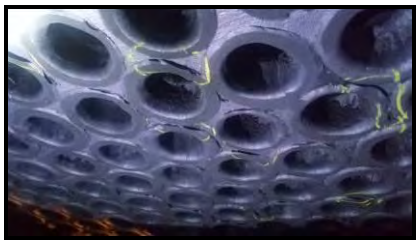
- Joint of rubber lining was found slightly opened at support of water inlet mesh holding plate. However, no leakage observed during spark test. (Marked with yellow chalk)



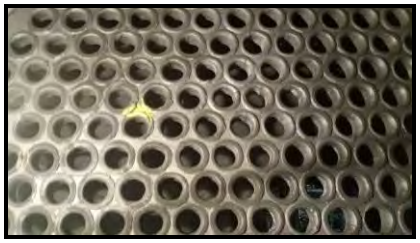
- In upper shell coarse, linear mark observed near long seam joint of rubber lining.

- 01 no. pinhole observed near manhole in bottom shell coarse. However, no leakage observed during spark test. (Marked with yellow chalk)

- Minor opening observed on sleeve joint of the nozzle bed rubber lining at few locations. (Marked with yellow chalk)

- Leakage observed at 02 nos. locations on sleeve joint of the nozzle bed rubber lining. (Marked with yellow chalk)

- Overall condition of the shell, dish end and lateral support rubber lining found satisfactory.

Hardness Measurement:

Hardness of rubber lining was checked and found as mentioned below.

Upper Shell course	:	52-58 Shore-A
Lower Shell course	:	52-58 Shore-A
Top Dish End	:	53-57 Shore-A
Bottom Dish End	:	54-58 Shore-A
Top Lateral supports	:	54-59 Shore-A
Bottom Lateral supports	:	54-59 Shore-A

SBA-4 (STRONG BASE ANION)

SBA-4 was offered for inspection of its rubber lining after new rubber lining (Carried out at vendor works). Following Inspection activities carried out at our site and the observations are as under:

Visual Inspection & Spark Test

- On 05 locations spark leakage observed. (Marked with yellow chalk)
- Fastener holes were not pierced in Rubber lining of one flange.

- Improper rubber lining and cutting observed in 4 nos. of flanges.

GAUSS MEASUREMENT

Measurement of Residual Magnetism (in Gauss) on rotary and stationary parts of BFW pump (P-5111 & P-5112) and its drive turbine bearings was carried out. Wherever residual magnetism was higher than acceptable limits, same was demagnetized and brought down within acceptable limits.

Component	Location	Initial Gauss*
BFW Turbine (Q-5111)		
Journal Bearing Coupling Side	Top	0.9
	Bottom	0.5
Journal + Thrust Bearing Governor Side	Top	0.6
	Bottom	0.8
	Thrust Face	**1.2 (Max)**
Shaft Journal	Thrust End	1.0
	Non Thrust End	**1.2 (Max)**
BFW Pump (P-5111)		
Journal Bearing Free End	Top	0.9
	Bottom	1.2
Journal Bearing Coupling side	Top	0.8
	Bottom	1.4

Thrust Bearing Pads	Active	0.6
	Inactive	0.5
Shaft Journal	**Thrust End**	**1.6 (Max)**
	Non Thrust End	1.4
BFW Pump (P-5112)		
Journal Bearing Free End	Top	0.6
	Bottom	1.1
Journal Bearing Coupling side	Top	0.5
	Bottom	1.3
Thrust Bearing Pads	Active	0.7
	Inactive	0.5
Shaft Journal	Thrust End	1.3
	Non Thrust End	**1.5 (Max)**

*At all the locations Residual Magnetism was observed within the permissible limits.

THICKNESS MEASUREMENT OF LINES

Thickness measurement of BFW Pump (P-5111 / P-5112) Discharge to BFW coil (Ammonia plant) line, BFW coil (Ammonia plant) to Steam drum of BHEL Boiler (Utility plant) line and BFW bypass line was carried out. Results are summarized as mentioned below.

Sr. No.	Line Description	Size	Design Thick.(mm)	Minimum Thick. (mm)
1	P-5111 / P-5112 Discharge to BFW coil (Ammonia plant)	6”	10.97	9.2
2	BFW coil (Ammonia plant) to Steam drum of BHEL Boiler (Utility plant)	6”	10.97	9.1
3	BFW by-pass line	6”	10.97	8.1

INSPECTION OF COLD INSULATION LINES CONNECTED WITH AMMONIA STORAGE AREA

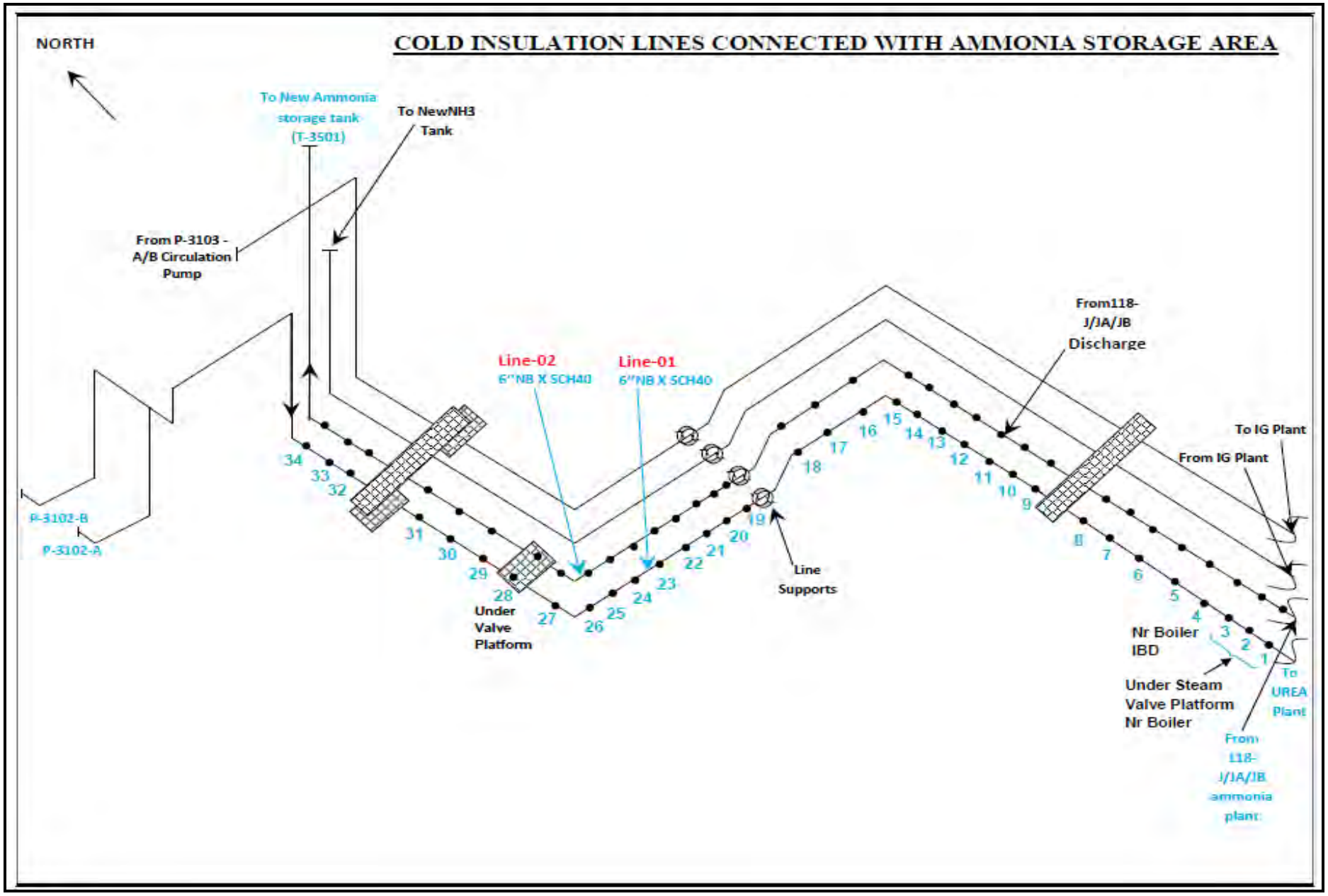
Supports of following 02 nos. of lines having cold insulation were removed to assess the condition & extent of corrosion under supports. These supports were wooden supports.

- 6” line from Discharge of P-3102-A/B to Urea Plant
- 6” line from Discharge of 118-J/JA/JB to New Ammonia Storage Tank (T-3501)

Total 34 nos. of supports were removed from each line, thickness measurement and visual inspection was carried out.

No abnormalities observed in Visual Inspection. Support no. 1 to 20 in each line were replaced by pre-cast PUF blocks & rest of the supports were overhauled and replaced with existing wooden block supports. Isometric of Pipelines showing support location is shown below.

Line No.	Description	Size	Nominal Thick. (in mm)	Measured Min. Thick. (in mm)
1	From P-3102-A/B to Urea Plant	6”	7.11	6.48
2	From 118-J/JA/JB to New Ammonia Storage Tank	6”	7.11	6.04


NORTH
COLD INSULATION LINES CONNECTED WITH AMMONIA STORAGE AREA
To New Ammonia storage tank (T-3501)
To NewNH3 Tank
From P-3103 - A/B Circulation Pump
P-3102-B
P-3102-A
Line-02
6"NB X SCH40
Line-01
6"NB X SCH40
From118-J/JA/JB Discharge
To IG Plant
From IG Plant
Line Supports
Under Valve Platform
Nr Boiler IBD
Under Steam Valve Platform Nr Boiler
To UREA Plant
From L18-J/JA/JB ammonia plant
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INSTRUMENTATION

AMMONIA PLANT

(INSTRUMENT)

Control Valve Maintenance jobs:

FICV-3008: Control valve was opened from bonnet for complete overhauling purpose. Plug & seat were inspected & found in damaged condition, so both plug & seat were replaced with new one. General cleaning of all parts of valve was done. New gland packing was provided. Finally control valve stroke was checked & found ok.

PRCV-4: Old control valve was replaced with new one. Line modification work was done by mechanical maintenance. Air supply tubing & signal cable connection work were carried out. Finally control valve stroke was checked and found ok.

FRCV-3: Control valve was opened from bonnet, trim & seat parts were checked & found in healthy condition. All parts of valve were cleaned and overhauled. Actuator diaphragm was inspected & found in good condition. New gland packing was provided. Finally stroke was checked & found ok.

LCV-490: Control valve was opened from bonnet for trim part inspection and it was found in good condition. Cleaning of trim & seat parts were carried out. Control valve was checked for tight shutoff. Actuator diaphragm was inspected & found ok. Complete overhauling of control valve was carried out. New gland

packing & body gasket had been provided. Finally stroke was checked & found ok.

KV-120-5, 6, 7 & 8: Old control valves were replaced with new control valves. Related signal cable connection & air supply tubing work were carried out. Finally control valves opening & closing were checked and found ok.

PICV-137: Control valve was dropped from line for line modification job of mechanical maintenance. Plug & seat parts were inspected & found ok. Actuator diaphragm was checked & found in good condition. General cleaning of all parts of control valve done. New gland packing had been provided. As control valve was shifted to new location, related air tubing & SOV signal cable shifting work had been done. Finally control valve stroke was checked & found ok.

PICV-11A&B: Control valves were opened from bonnet for complete overhauling purpose. Plug & seat lapping work was done for PICV-11B control valve. All trim parts were inspected & found ok. General cleaning of all parts of valve done. Seal ring, body gasket & gland packing were replaced with new one for both the valves. Finally control valve stroke was checked & found ok.

PRCV-25: Control valve was dropped from line to attend minor leakage from valve's body. Valve body was repaired by mechanical workshop & hydro-test was performed to check leakage and found ok. Plug & seat parts were inspected & found ok. General cleaning of all parts of valve done. New gland packing was provided. Finally control valve stroke was checked & found ok.

PICV-006 A&B: Control valve was opened from bonnet for trim part inspection and it was found in good condition. Cleaning of trim & seat parts were carried out. Control valve was checked for tight shutoff. Actuator diaphragm inspected & found ok. Complete overhauling of control valve was carried out. New gland packing & body gasket were provided. Finally stroke was checked & found ok.

PRCV-18: Control valve was opened from actuator for diaphragm inspection. Actuator diaphragm was found in good condition. Air filter regulator & gland packing were replaced with new one. Finally stroke was checked & found ok.

FICV-14A: Old control valve had been replaced with new one. Line modification work was done by mechanical maintenance. Air supply tubing & signal cable

connection work were carried out. Finally control valve stroke was checked and found ok.

FICV-14: Control valve was opened from bonnet, trim & seat parts were checked & found in healthy condition. All parts of valve were cleaned and overhauled. Actuator diaphragm was inspected & found in good condition. New gland packing had been provided. Finally stroke was checked & found ok.

PICV-002: Control valve was open from bonnet for trim part inspection. Plug & seat were inspected & found in damage condition, so plug, seat & cage were replaced with new one. Actuator diaphragm checked, found ok. Air filter regulator & gland packing were replaced with new one. Valve Box-up job completed & stroke was checked, found ok.

PICV-10: Control valve was open from bonnet for complete overhauling purpose. Actuator diaphragm was checked & found ok. Plug seat were inspected & found in good condition. General cleaning & checking of air regulator & valve Positioner had been done. Valve gasket was replaced with new one. Finally stroke was checked & found ok.

PCV-44: Control valve was open from bonnet for complete overhauling purpose. Plug & seat lapping work was done. All trim parts were inspected & found ok. General cleaning of all parts of valve done. Gland packing was replaced with new one. Finally control valve stroke was checked & found ok.

HICV-3101: New Control Valve was installed new one. Line modification work was done by mechanical maintenance. Air supply tubing & signal cable

connection work were carried out. Finally control valve stroke was checked and found ok.

PICV-3046A & B: Control valves were dropped from line by mechanical maintenance & both the valves were dispatched to M/S KOSO workshop at Nasik for complete overhauling purpose. Control valves were taken in line after receiving from M/S KOSO workshop, related instrument air tubing work was done. Finally stroke were checked for both the valves & found ok.

PRCV-23: Damper control valve assembly was removed to facilitate mechanical maintenance people. Overhauling work was carried out. Air filter regulator was replaced with new one. Finally stroke was checked & found ok.

TRCV-10: Control valve was opened from actuator for diaphragm inspection. Actuator diaphragm was found in good condition. Air filter regulator & gland packing were replaced with new one. Finally stroke was checked & found ok.

V-4: Control valve was opened from bonnet for trim & seat parts inspection & all parts were found in healthy condition. Actuator diaphragm was checked & found in good condition. New gland packing had been provided. Finally stroke was checked & found ok.

FICV-11: Control valve was opened from actuator for diaphragm inspection. Actuator diaphragm was found in damage condition so it was replaced with new one. Air filter regulator & gland packing were replaced with new one. Finally stroke was checked & found ok.

PCV-402: Control valves had been dropped from line for complete overhauling purpose. Plug, seat inspection work was carried out & found in good condition. Actuator diaphragm were checked & found in damage condition so it was replaced with new one. Positioner & air filter regulator were cleaned. Gland

packing were replaced with new one. Valves were taken back in line, stroke checked & found ok.

FICV-9 & 10: Actuator diaphragm was checked & found ok. General cleaning of air filter regulator was carried out. Gland packing were replaced with new one. Finally control valve stroke checked & found ok.

PICV-14: Control valve was dropped from line to attend passing problem. Plug & seat were inspected & found in damage condition, so machining work was done by mechanical workshop; also plug & seat lapping was done. Seat leakage test was performed & found no leakage. Actuator diaphragm was checked & found in good condition. Finally box-up job completed & stroke checked & found ok.

PICV-5: Actuator diaphragm had been checked & found ok. General cleaning of air filter regulator carried out. Gland packing was replaced with new one. Finally control valve stroke was checked & found ok.

PICV-251 & 252: Old control valve had been replaced with new one. Line modification work was done by mechanical maintenance. Air supply tubing & signal cable connection work were carried out. Finally control valve stroke was checked and found ok.

V-18: Control valve was opened from actuator for diaphragm inspection. Actuator diaphragm found in good condition. Air filter regulator & gland packing were replaced with new one. Finally stroke checked & found ok.

PICV-20: Control valve was opened from actuator for diaphragm inspection. Actuator diaphragm found in good condition. Air filter regulator & gland packing were replaced with new one. Finally stroke was checked & found ok.

General Maintenance & stroke checking of control valves :

Following control valves general /cleaning/ greasing were carried out. New gland packing was provided wherever required. Valve Positioner was cleaned and air header & regulators were flushed. Stroke checking was carried out:

1.	PRCV-1	8.	MICV-11	15.	MICV-61
2.	TRCV-11	9.	MICV-13	16.	V-7A
3.	V-3	10.	MICV-14	17.	LICV-13
4.	LICV-501	11.	MICV-15	18.	LICV-16
5.	LICV-503	12.	MICV-16	19.	LICV-18
6.	MICV 1 to 9	13.	MICV-17	20.	PICV-2001
7.	MICV 1A to 9A	14.	FICV-100B	21.	LICV-2001

COMPRESSOR HOUSE JOBS:

Air Compressor (101J):

Removed all radial, axial and key-phasor probes along with relevant junction boxes, speed pick-ups, bearing pad temperature thermocouple & RTD, pressure gauges and local THI to facilitate Mechanical Maintenance jobs. All Junction boxes of proximitor were cleaned. After completion of M/M jobs all instruments and probes/pick-ups were re-fixed back after cleaning & functional checking. Gap voltage adjustments for radial and axial probes were carried out.

HIC-101J: Pneumatic governor actuator was removed from its location for complete overhauling purpose. New lip seal of Piston/Cylinder was provided. Calibration of I/P Converter was carried out. New pressure gauge had been provided for I/P converter & air supply regulator. Finally governor actuator stroke was checked & found ok.

TRIP-101J: Mechanical trip feedback limit switch was overhauled and checked its operation, found ok.

VS-101J: Trip Solenoid valve was overhauled. Coil of trip solenoid valve was checked & found in good condition. Finally its operation was checked & found ok.

101J (Trip logic): Checked the setting for alarm and trip logic.

ZSH-18: Control valve open/close feedback limit switch was overhauled and checked its operation, found ok.

2003 High Speed Protech GII Trip System: 101-J High speed 2003 voting trip system was installed in shutdown. Mounting arrangement for three numbers of MPU was made with new toothed gear. MPU's were installed at proper place & MPU cables were properly terminated in dedicated junction box.

Protech GII was installed in ammonia control room & 110 V AC power supply was provided from different MCB of Power Distribution Board (PDB). Three numbers of Dedicated speed cables were laid from Protech GII to speed junction box installed in field.

Protech GII programming was done in presence of M/S SIcagen India limited, Mumbai & 110V AC power had been provided. OST was done by production person & found satisfactory response. Finally 2003 high speed Protech GII trip system was taken in line.

Ammonia Refrigeration Compressor (105J):

Removed all radial, axial and key-phasor probes along with relevant junction boxes, speed pick-ups, bearing pad temperature thermocouple & RTD, pressure gauges and local THI to facilitate Mechanical Maintenance jobs. All Junction boxes of proximitor were cleaned. After completion of M/M jobs the instruments and probes/pick-ups were re-fixed back after cleaning & functional checking. Gap voltage adjustments for radial and axial probes were carried out.

PRC-9: General cleaning and overhauling of pneumatic governor actuator was carried out. New lip seal of Piston/Cylinder was provided. New pressure gauges were provided for I/P Converter, air supply Regulator & Positioner. Calibration of I/P converter was carried out. Finally governor actuator was re-fixed back and stroke checking was performed, found ok.

TRIP-105J: Mechanical trip feedback limit switch was overhauled and its operation was checked.

VS-105J: Trip Solenoid valve was overhauled. Coil of trip solenoid valve was checked & found in good condition. Finally its operation was checked & found ok.

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

Synthesis Gas Compressor (103J):

103-J Compressor related all radial, axial and key-phasor probes along with relevant junction boxes, speed pick-ups, bearing pad temperature thermocouple & RTD, pressure gauges and local THI were removed to facilitate Mechanical Maintenance jobs. All Junction boxes of proximitor were cleaned. After completion of M/M jobs all instruments and probes/pick-ups were re-fixed back after cleaning & functional checking. Gap voltage adjustments for radial and axial probes were carried out.

PSLL-84 pressure switch of 103-J was calibrated & taken in line.

103-J turbine steam inlet trip ESV feedback limit switch and SOV wire connections were removed to facilitate M/S Siemens Person & same were re-fixed after completion of job.

Field & Control room Instrument jobs:

115-JAT: Removed & reinstalled different instruments (RTD, MPU, SV etc.) at 115-JAT to facilitate Mechanical Maintenance jobs. Checked both MPUs of electronic Governor. One RTD of 115-JA was replaced with new one as old one found in damaged condition.

101-BJT: Removed different instruments (RTD, MPU, SV etc.) at 101-BJT to facilitate Mechanical Maintenance jobs. Checked all MPUs of electronic governor. After completion of job all instruments were re-fixed back. Trip switch was relocated at new place.

104-JAT: Removed different instruments (RTD, MPU, SV etc.) at 104-JA to facilitate Mechanical Maintenance jobs. Re-routing of instrument SS tubing was done. Checked both MPUs of electronic Governor for 104-JA. After completion of job all instruments were re-fixed back.

115-JBT: Removed & reinstalled different instruments (RTD, MPU, SV etc.) at 115-JBT to facilitate Mechanical Maintenance jobs. Checked both MPUs of electronic Governor. After completion of job all instruments were re-fixed back in its location.

Following is the list of transmitters installed for 2003 logic implementation as per approved EWR. Transmitters were installed at their location, related single pair cable were laid from transmitter head to junction boxes. Proper wiring work along with ferrule was done for each transmitter at head & in marshaling cabinet end. Transmitters were re-ranged & calibration work was done. Finally transmitters were taken in line & found ok.

1.	PDSL63B	4.	PDSL66C	7.	PSH137B	10.	LSLL1C
2.	PDSL63C	5.	PSH23B	8.	PSH137C	11.	FT-3B
3.	PDSL66B	6.	PSH236B	9.	LSHH480B	12.	FT-3C

Low range pressure gauges were provided at different locations in plant as per requirement of production department for purging & maintenance purpose.

Draft point Manometer tubing had been removed & re-fixed to facilitate Mechanical. Maintenance jobs.

109-CA/CB: Thermocouples & local PI were removed from its location to facilitate M/M, after completion of job all instruments were re-fixed back in its location.

Boiler Inspection: Provided standard 10" dial size pressure gauges on steam drum 101-F, 112-C, 107-C & 1123-C. Pressure transmitter flushing and zero checking and other jobs related with Boiler inspection were carried out. After completion of inspection pressure gauges were reverted to original.

LT coil replacement job: LT coil replacement job was performed by mechanical maintenance. All thermocouples & local TI along with cables were removed from old LT coil & same were re-fixed in new one. New thermocouple TI-144 & control valve TICV-144 were installed as per P&ID, related air supply tubing & signal cable termination work had been done.

All Metal temperature thermocouples (MTI-105, MTI-106, MTI-107 & MTI-108) were removed & re-fixed to facilitate mechanical maintenance.

PT-8102A/B/C: Transmitters re-tubing work was done as per requirement of M/S Siemens persons.

FT-35A: Mass flow meter was installed to measure cold ammonia flow to ammonia storage plant; related signal & power cable wiring & termination work with proper ferruling was done.

VS-3: Air filter regulator was replaced with new one & SOV re-tubing work was done.

AR-5: Oxygen analyzer probe was removed from its location, proper cleaning & overhauling work of probe was done & same was re-fixed back at its location.

JBC-204: Junction box was shifted to new location to facilitate catalyst loading work of production person; related cable relocation work was done.

FR-97: New Magnetic flow meter was installed at cooling water line from cooling tower to 101-JCA surface condenser; related power & signal cable laying, dressing & termination work was done.

103-J LO/SO Turbine: Removed different instruments (RTD, MPU, SV etc.) at 104-JA to facilitate Mechanical Maintenance jobs. Re-routing of instrument SS tubing was done. Checked both MPUs of electronic Governor for 104-JA. After completion of job all instruments were re-fixed back.

104-JT TTV SOV was replaced with new one as old one found in damage condition.

MOV-8101: MOV start, stop command from DCS work had been done; related cable laying & termination work with proper ferrule was done. Soft button was made in DCS & operation was checked & found ok.

LCV-3/N: LCV-3/N & LIC-3B control valves split range work was done in DCS & in the field, seperate I/P convertor were provided and related air tubing & signal cable work was done. Faceplate was made in DCS & operation was checked from control room for both the valves & found ok.

PDI-102L: New transmitter was installed for measurement of DP at 101-J suction filter; related air tubing & signal cable termination in field & Marshaling cabinet work was done.

LI-101JCB: Old level switch was replaced with DP type level transmitter; related cable termination & tubing work was done.

LTS Multipoint thermocouple was removed from its location & checked its healthiness; found in good condition.

PGR Plant SOV panel main air filter regulator was replaced with new one.

PB-13, PSL-104 & PSLL-92: Old switches were removed from its location; related cables & tubing were also removed.
Old multi-pair cable between MOV JB-B junction box & PLC cabinet C-275 was replaced with new one as old one found in damage condition.

Steam Drum (101F): Following instruments of steam drum were checked:

- Level monitoring system- Level State.
- Level transmitter.
- Pressure transmitter.
- Level switches.

Following ISO related Quality/Safety affecting instruments were calibrated:

1.	PT-7	7.	TRC-12	13.	TI -0117	19.	PT-36
2.	PT-150	8.	PT-501	14.	TI-0039	20.	FT-100
3.	PT-62	9.	PT-8	15.	PT-503	21.	TRC-10
4.	PT-80	10.	PT-5	16.	PT-10	22.	TI-0036
5.	AR-1	11.	PT-9	17.	PT-4	24.	TI-0011
6.	PIC-1A	12.	FT-3	18.	PT-28		

Annual Maintenance Jobs for DCS/ESD, UPSS & Gas Analyzers:

YIL DCS:

- DCS shutdown maintenance activities were carried out as per the AMC procedure.
- The following activities were carried out in Ammonia plant.
- Before starting preventive maintenance activities, tuning parameters of all control stations were saved on Engineering station. Project back up was taken.
- Checking of System healthiness was carried out from System detail display and found Normal.
- AC/DC voltages and Battery voltages were measured wherever applicable for all
- Stations and were found within limit.
- The system was dismantled as per plant clearance and operating conditions like dust, moisture and temperature were checked. All parameters were checked and found within limit. Interior of system cabinets, Engineering station and HIS consoles were cleaned thoroughly. PCBs were inspected and inspection of data bus and connectors were done. No abnormality was observed.
- Printers were cleaned & overhauled, wherever applicable. CPU back-up battery voltage and grounding were checked and same were found within specified limit in all stations.

- Function of each component of the DCS was checked. YOKOGAWA diagnostic software was run on FCS, the results of the test Program indicated the healthiness of the system.
- Redundancy checks were performed on V net / IP Bus, CPU, Power Supply cards and AAB841 cards wherever applicable. As per redundancy feature, control transfer took place to the stand by one properly.
- HIS to HIS communication was checked by pinging and found normal. After cleaning functionality of all HIS were checked and found ok.
- TETC Board Replacement job: 16 numbers of old model TETC boards were replaced with updated version model A1BT4D; related software changes were done from DCS engineering station.
- Daily reports were modified & new tags were taken in report and also three numbers of new reports were made as per requirement of Production people.
- RAM Up-gradation work for DCS engineering station was done from 4 GB to 12 GB; related OS Up-gradation work was also done.
- Modbus communication was established between DCS engineering station & LMS system of electrical system; related ALE111 communication card was installed in FCS 0101 & mapping work for all related tags from DCS to LMS system & vice versa was done.
- Data was collected for all HIS & FCS in Project backup for reference.
- Control room dust level & temperature had been observed & found within limit.
- Cooling fan for HIS 0161, Cabinet C-101 & C-103 were replaced with new one.

Prosafe-RS ESDS:

Prosafe-RS ESD shutdown/ preventive maintenance activities were carried out as per the AMC procedure.

- Cleaning of filters, fans, cabinets were carried out for all the three SCS.
- Redundancy of all the CPU, Power Supply cards, V net / IP Buses and IO cards were checked and found ok.
- Latest Back up was taken on DVD media.

Following old logics were modified from single voting to 2003 voting tripping system:

S.No	I-Block	S.No.	I-Block
1.	IS-87	2.	I-44
3.	IS-105	4.	I-39
5.	I-43	6.	I-103G
7.	IS-101	8.	Is-101b
9.	i-47		

AMC of UPSS Battery Bank:

AMC of M/S AMCO Shaft make UPSS Battery Bank was carried out in shutdown. Cleaning & greasing work of all 175 Nos. of batteries were carried out. Electrolyte level in each battery was checked & electrolyte filled were ever required. Finally total load of UPSS was transferred to Battery bank & around 45 minute load hold by battery bank.

CAPITAL JOBS CARRIED OUT IN ANNUAL TURNAROUND

KV-120-5, 6, 7 & 8: Old control valves had been replaced with new control valves. Related signal cable connection & air supply tubing work were carried out. Finally control valves opening & closing were checked and found ok.

PICV-251 & 252: Old control valve had been replaced with new one. Line modification work was done by mechanical maintenance. Air supply tubing & signal cable connection work were carried out. Finally control valve stroke was checked and found ok.

TETC Board Replacement job: 16 numbers of old model TETC boards were replaced with updated version model A1BT4D; related software changes were done from DCS engineering station.

PRCV-4: Old control valve had been replaced with new one. Line modification work was done by mechanical maintenance. Air supply tubing & signal cable connection work were carried out. Finally control valve stroke was checked and found ok.

2003 High Speed Protech GII Trip System: 101-J High speed 2003 voting trip system was installed in shutdown. Mounting arrangement for three numbers of MPU was made with new toothed gear. MPU's were installed at proper place & MPU cables were properly terminated in dedicated junction box.

Protech GII was installed in ammonia control room & 110 V AC power supply was provided from different MCB of Power Distribution Board (PDB). Three numbers of Dedicated speed cables were laid from Protech GII to speed junction box installed in field.

Protech GII programming was done in presence of M/S SIcagen India limited, Mumbai & 110V AC power had been provided. OST was done by production person & found satisfactory response. Finally 2003 high speed Protech GII trip system was taken in line.

FT-35A: Mass flow meter was installed to measure cold ammonia flow to ammonia storage tank; related signal & power cable wiring & termination work with proper ferruling was done.

FICV-14A: Old control valve had been replaced with new one. Line modification work was done by mechanical maintenance. Air supply tubing & signal cable connection work were carried out. Finally control valve stroke was checked and found ok.

FR-97: New Magnetic flow meter was installed at cooling water line from cooling tower to 101-JCA surface condenser; related power & signal cable laying, dressing & termination work was done.

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

Following is the list of thermocouples were installed at vent headers of different vent valves of ammonia plant as per approved EWR; related thermocouple single pair cable was laid & wiring and ferruling work was done at junction box & marshaling cabinet end. All tags were defined in DCS engineering station & in respective graphic page.

S.No	Vent Control Valve	Thermocouple Tag
1.	PICV-003 & MICV-003	TI-604 A &B
2.	PICV-11A & B	TI-605 A&B
3.	PRCV-6	TI-606
4.	PRCV-4	TI-608
5.	PICV-5	TI-607
6.	PICV-3008	TI-609

FI-2004: New orifice was installed at 2004-J pump discharge line as per approved EWR; related flow transmitter was installed at its location. Single pair signal cable was laid, wiring & termination work along with proper ferruling at junction box & marshaling cabinet end. Tag was defined in DCS engineering station & in respective graphic page.

Following is the list of thermocouples & Pressure transmitter which were installed at different location of ammonia plant as per approved EWR; related thermocouple single pair cable was laid & wiring and ferruling work was done at junction box & marshaling cabinet end. All tags were defined in DCS engineering station & in respective graphic pages.

S.No	Location	Thermocouple Tag
1.	115-C Outlet Line	TI-208
2.	116-C Outlet Line	TI-209
3.	124-C Outlet Line	TI-212
4.	128-C Outlet Line	TI-213
5.	BFW Outlet of 123-C	TI-676A
6.	NG Feed Preheat coil inlet line	TI-0134A
7.	Flue gas arc burner Temperature	TI-603
8.	Flue gas arc burner Pressure	PI-603

CONTINUAL IMPROVEMENT:

KV-120-5, 6, 7 & 8: Old control valves had been replaced with new control valves. Related signal cable connection & air supply tubing work were carried out. Finally control valves opening & closing were checked and found ok.

TETC Board Replacement job: 16 numbers of old model TETC boards were replaced with updated version model A1BT4D; related software changes were done from DCS engineering station.

FR-97: New Magnetic flow meter was installed at cooling water line from cooling tower to 101-JCA surface condenser; related power & signal cable laying, dressing & termination work was done.

FT-35A: Mass flow meter was installed to measure cold ammonia flow to ammonia storage tank; related signal & power cable wiring & termination work with proper ferruling was done.

FICV-14A: Old control valve had been replaced with new one. Line modification work was done by mechanical maintenance. Air supply tubing & signal cable connection work were carried out. Finally control valve stroke was checked and found ok.

PRCV-4: Old control valve had been replaced with new one. Line modification work was done by mechanical maintenance. Air supply tubing & signal cable connection work were carried out. Finally control valve stroke was checked and found ok.

PICV-251 & 252: Old control valve had been replaced with new one. Line modification work was done by mechanical maintenance. Air supply tubing & signal cable connection work were carried out. Finally control valve stroke was checked and found ok.

UREA PLANT

(INSTRUMENT)

CONTROL VALVES :

HICV-1421: Valve was dropped from the line and replaced by spare overhauled valve with new teflon seat. Also replaced its SOV. Carried out control valve operation checking.

HICV-1201: Valve was opened from the bonnet and done compete overhauling. Cleaned and checked its body and trim parts.Boxed up the valve with new bottom guide bush, gland packing set. Carried out stroke checking and calibration of position transmitter.

LRCV-1201: Valve was dropped from the line. Cleaned and checked its body and trim parts. Foreign Material (damaged Nut) found inside seating area. Its plug and seat were found damaged, so replaced its damaged plug with new one and seat with spare (repaired) seat and boxed up the valve with new bottom guide bush, gland packing set and bonnet and seat seal rings set. Carried out stroke checking and calibration of position transmitter.

FRCV-1421: Valve was dropped from line. Replaced its plug & seat with spare machined and repaired ones .After complete overhauling boxed up valve with new bonnet gasket and gland packing & flange gaskets. Carried out valve operation and stroke checking.

PICV-1129: Valve was opened from the bonnet. Replaced its plug, cage cum seat, provided new bonnet and seat gaskets, new seal ring set and gland packing. Also, replaced its electropneumatic positioner with a new one and volume booster. Boxed up the valve and checked valve stroke and operation.

PICV-1481: Valve was dropped from the bonnet. Found its stem broken, so replaced damaged stem with new one along with spare repaired plug & new seat ring. Provided new gland packing and installed back the valve in line. Operation and stroke was checked.

PRCV-1201: Valve was dropped from the line. Replaced its plug and seat with new ones. Cleaned its internals and checked and overhauled its valve positioner. Its actuator diaphragm was replaced with a new one and complete overhauling of the actuator was carried out. Provided new gland packing & valve was installed back in line with new flange gasktes and its stroke was checked.

FICV-1281, HICV-1206, LICV-1352, HICV-1207 : Valve was dropped from the line. Overhauled the trim parts, box up the valve with new bonnet gaskets, gland packing. Control valve was installed in line with new flange gaskets and carried out valve operation and stroke checking.

LRCV-1421: Control valve was dropped from the line. Overhauled the trim parts, lapping was done over plug and cleaned other internal parts and provided new gland packing. Control valve was installed in line and carried out valve operation and stroke checking.

PICV-1979B: Control valve was dropped from the line. Overhauled its trim parts and box valve with new plug, seat, gaskets and gland packings. Diaphragm of valve was replaced with a new one with new actuator 'O' ring and complete overhauling was carried out for the actuator. Replaced its positioner with a new Eckardt make positioner. After hydro test, installed back valve in line with new flange gaskets, calibrated valve positioner and carried out stroke checking.

FICV-1351: Control valve was dropped from the bonnet. Lapping was done over its plug. Cleaned and overhauled its trim parts and other internal parts. Provided new gland packing and bonnet gaskets. Valve positioner was completely overhauled. Installed back the valve and its stroke was checked.

LICV-1201: Valve was opened from the bonnet . Lapping was done over its plug, trim parts and other internals were cleaned and overhauled. Provided new gland packing and installed back the valve in line.

PICV-1810: Control valve was dropped from the bonnet. Replaced its plug and cage with spare plug and cage (overhauled & machined). Replaced seat ring, bonnet and seat gaskets with new one and provided new gland packing and plug outer seal rings. Installed back the valve. Valve operation and stroke were checked.

HICV-1801: Control valve was dropped from the bonnet. Replaced its plug with spare plug (overhauled & machined). Replaced its cage & seat ring, bonnet and seat gaskets with new one and provided new gland packing and plug outer seal rings. Installed back the valve. Valve operation and stroke were checked.

LICV-1235: Valve was dropped from the line. Repalced its plug and seat with new ones, box up the valve with new bonnet gaskets, gland packing. Replaced its valve positioner with a new one. Control valve was installed in line after hydro testing with new flange gaskets and carried out valve operation and stroke checking.

LICV-1807: Control valve was dropped from the line. Lapping was done over its plug. Cleaned and overhauled its internal parts. Valve was assembled and installed back in line with new SS tuning. Checked the valve operation and stroke.

HICV-1205: Control valve was dropped from the line. Checked and inspected the valve internals and disc. After verification, valve was installed back in line and checked its operation and stroke.

MICV-1351B: New handjack assembly was mounted on the valve and checked the stroke and operation of the valve.

For following control valves, I to P converter was replaced by spare one.

TICV-1353, HICV-1401, PICV-1221B, HICV-1201, TRCV-1421, PICV-1181

Positioner/Electropneumatic positioner was overhauled and stroke checked for the following control valves:

PICV-1128, PICV-1181, PICV-1979A & PICV-1130

Air filter regulators were replaced for following control valves:

TRCV-1421, HICV-1422A, HICV-1422B, TRCV-1201, HICV-1221B, PICV-1202, HICV-1801, PICV-1481, PICV-1181.

General checking & stroke checking of following control valves were carried out:

FICV-1302, HICV-1385, FICV-1203, PICV-1810, HICV-1801, PICV-1979A/B, TICV-1201, HICV-1221B, TICV-1226, HICV-1211, HICV-1204, PRCV-1481. FICV-1204, HICV-1210, HICV-1424, PICV-1424, HICV-1405, PICV-1502A, PICV-1502B, PICV-1131, LICV-1502A, LICV-1501, LICV-1502B, HICV-1212, PICV-1450, PICV-1422, HICV-1423, HICV-1425, HICV-1418, PICV-1481.

COMPRESSOR HOUSE JOBS:

- All local temperature and pressure gauges were removed to facilitate mechanical jobs. All were checked and fixed back after the completion of the jobs. Faulty temperature and pressure gauges were replaced with new one.
- All bearing RTDs in turbine, HP case, LP case & gear box were removed to facilitate mechanical jobs. All were checked and reconditioned RTD termination with new lugs and soldered the wiring terminal wherever found necessary and then re-fixed on completion of mechanical maintenance jobs.

For following RTDs, the damaged cable from RTD head to Junction box were replaced with new triad cable.

TI-1813, TI-1814, TI-1815, TI-1816, TI-1827, TI-1828, TI-1829 & TI-1830

TI-1825: damaged RTD type temperature sensor were replaced with new one.

- Seven no. of new 6T (triad) cables coming from BN3500 series new vibration monitor rack were lined up at seven junction box (JBV-1 to JBV-7 with vibration system proximitor) with necessary cable glanding and wiring termination of each triad on proximitor with proper ferrules and lugging.
- All vibration probes for radial, axial and key-phasor points in turbine, HP case, LP case and gear box were removed to facilitate mechanical jobs. Physical condition of probe tips and end connector of all vibration probes were checked. Also checked extension cable and proximitor for all vibration probes. After completion of mech. maintenance jobs, all probes were re-fixed with proper gap voltage adjustments.

Following field item of vibration measurement system were replaced with new one.

- ZE-1801B physically damaged axial vibration probe of turbine was replaced with new one.
- XE-1810A physically damaged radial vibration probe of Gear box was replaced with new one.
- XE-1806A Extension cable(from proximeter to probe) was replaced with new one.
- The damaged part of conduit of ZE-1802A & ZE-1802B Axial vibration probe of LP compressor was removed and connect it with reglanding.

Following pressure switches for alarm and trip function were cleaned, checked and calibrated. Replaced the pressure switch PSLL-1801C with spare one.

PSLL-1818C, PSLL-1838C, PSHH-1839C, PSHH-1843C, PSL-1816, PSL-1812, PSL-1813, PSLL-1844

Following low level and high level switches of separators & surface condenser cleaned, checked and calibrated.

LSHH-1804, LSHH-1806, LSHH-1808, LSL-1824, LSHH-1822 & LSL- 1823

Following leveltrols for separators & surface condenser were cleaned, checked and calibrated.

LICT-1803, LICT-1805, LICT-1807 & LIC-1821

- All the limit switches for admission steam valves and barring were removed to facilitate mechanical job and re-fixed after completion the job.
- All the 3 MPUs for Woodward governor's turbine speed measurement were removed to facilitate mechanical job and re-fixed after the completion of the job.
- FI-1803 faulty DPM on Hitachi compressor local control panel (LCP) was replaced with new Rockwin make DPM and configured with range of 0 to 48000 m3/hr.
- Faulty local speed indicator near barring control panel was replaced with new DPM of Redlion make and configured with speed range of 0 to 9000 RPM.
- **PIC-1979: Turbine Sealing Steam pressure controller, Provision for dual control option, Local controller or Control from DCS.**

Earlier there are only local electronic controller with only pressure indication in DCS through retransmition output of local controller. To make dual control option Local controller or DCS control, a controller PIC-1979 configured in DCS and DCS output taken to field location by laying a single pair branch cable from JB-12 to local controller box. A two position selector switch was provided at local controller box with necessary wiring of output signal of DCS, local controller and I to P convertor of control valve.

- All the field Junction Boxes, Local Control Panel and turbine local control box were cleaned, all wiring connections terminals were tightened. Also checked all MCB fuse terminals and fuses replaced as per necessity.
- Mock up test carried out for Woodward governor for CO2 Compressor for HP and LP Valves stroke checking. Also checked the stroking for 4ata admission steam valve from DCS with necessary block of Admission steam pressure control logic scheme put in manual mode to enable the stroking from DCS.
- General cleaning & stroke checking and air filter regulators were cleaned and checked for following control valves:

HICV-1801, HICV-1802, HICV-1803, LICV-1803, LICV-1805, LICV-1807, LICV-1821A/B, PICV-1979A/B & TICV-1808.

SI-1814: Q-1814 MP oil pump turbine speed measurement.

For Q-1814 turbine speed measurement and speed indication in DCS, a proximity speed sensor mounting arrangement was done at turbine shaft coupling. A frequency to current convertor with local speed indication was mounted in a transparent cover JB near turbine. The speed indication was lined up in DCS with necessary power and signal cable arangement for F to I convertor. Configured the F to I converter for one pulse per rotation and range 0 to 4000 RPM. SI-1814 tag was assign in DCS with same range.

FIELD JOBS:

- HP Stripper's and Autoclave's pressurised as well as empty count readings for LRC-1201 & LR-1201 detectors were taken and recorded.
- Radioactive source of LR-1201 were removed from its mounting at Autoclave to facilitate mechanical maintenance jobs. After completion of mechanical maintenance jobs radioactive source was installed back.
- Empty counts reading were taken and calibrated radiac relay unit and its spare unit for LR-1201 (Autoclave level).
- Radioactive source and scintillation counter of nucleonic level gauge of HP Stripper (LRC-1201) were removed to facilitate mechanical maintenance jobs and installed back after completion of mechanical maintenance jobs.
- Berthold level measurement system for Autoclave (LR-1201) and HP stripper (LRC-1201 & LH-1201) were checked and calibrated by Berthold service engineer. Also checked set of spares for LRC-1201 & LH-1201 and updated its configuration. Backup battery cells in all online level monitoring units and spare units were replaced with new ones.
- Installed & commisioned redundant nucleonic level measurement system for Autoclave **(LR-1201B)** and checked and calibrated by Berthold service engineer. Two new berthold make scintillation detectors (length: 1500 mm & 1000 mm) were installed on Autoclave & connected them new signal cable with two new evalution unit (LB-440M & LB-440S) for monitoring level installed in new rack mounted in DCS marshalling room.
- Re-routing of branch cable for Ttransmitter of LIC-1282 & I to P convertor of

control valve HICV-1406 due to shifting of location because of capacity enhacement of Urea solution tank(T-1401) by increasing its height.

- Following HP Thermowell were removed and hydro tested.

TR-1201, TR-1205, TR-1206, TR-1207,TR-1210, TI-1209, TI-1214,TI-1250, TR-1220, TI-1101B

TI-1209 & TI-1214 : Thermowells were found damaged, replaced by new spare.

TI-1101B & TI-1250 : RTJ gaskets ,MOC: CS for were replaced with SS gaskets.

Inspection of following magnetic flow meters was done:

FICT-1203, FICT-1435, FRCT-1421, FICT-1352 & FIT-1353

Following extended pad type transmitters were checked and calibrated:

LICT-1201, LICT-1202, LIC-1421, LRCT-1481, LICT-1353, LICT-1282 and LRCT-1421

Following quality affecting instruments declared in ISO were calibrated:

PT-5303, PT-4405, PT-1121, PT-1145, PT-1802, PT-1105, PT-1201, PT-1202, PT-1421, PT-1422, SI-1401A, SI- 1401B, FR-1201, PICT-1202 & FS-1101

- Two no. of 12 inch dial pressure gauges were checked and calibrated and mounted at HPF pump discharge and at 4 ata steam drum for hydro test purpose.
- To attend leakage of different fittings of condensate distribution port at the top of 2nd evaporator (for LRCT-1421), distribution port was removed and new ball valves were provided and installed back in the field and connections done. Necessary tubings were done from pot to field connections.
- For Helium leakage test at Autoclave, blocked all TI point tappings and weep holes tappings on cylinderic portion of Autoclave vessel. Regulator setup with seal pot of 3 meter height was connected at bottom most weep hole for supply of air or helium gas. Also provide a pressure gauge with vent isolation valve arrrangement at top most weep hole of Autoclave vessel to monitor or vent the pressure.
- For operation of local controller PIC-1979 in DCS, signal cable was laid, and Local/ remote switch was mounted and wiring connections done.
- Extended diaphragm capillary type pressure transmitter for ejector, **PICT-1211**, diaphragm was found damaged. It was replaced by new transmitter.
- A Stripper ferrule testing hook up/set up with pressure gauge, rotameter and digital pressure indication was reconditioned and provided for differential pressure measurement of HP stripper ferrules.

Following metal tube rotameters with transmitter were replaced with new ones:

FICT-1281, FICT-1284 & FICT-1381.

- Cleaned the I to P convertor panel at prill bucket room and general checking

of the I to P converters and their associated tubing for leakage etc were carried out.

- Ferrules (both DCS side and field side) were replaced for all the field junction boxes in the plant areas.
- Following old and damaged junction boxes were replaced by new SS junction boxes. All wiring terminals are luged and connected with new ferrules. Also changed all branch cables with new cables.

JBS-1A (Hydrolyser area) & JBT-15 (3.5 floor)

- For implementation of **2003 Logic for HP System Trip** on high pressure, 3 no. of 2" 2500# rating extended diaphragm remote seal and capillary type transmitters, **PRCT-1201A, PRCT-1201B & PRCT-1201C** were installed and comissioned and calibrated.
- All Autoclave skin temperature thermocouples were replaced with new ones.
- Painting and earthing on all Prill Tower top control valves were done.
- The instrument air headers at all floors and in Hitachi compressor area were flushed for any foreign particles accumulation.
- PVC tube was provided as per production requirement for delta P measurement for HP Stripper and removed after the completion of jobs.
- Weep holes related tubings were removed from HPCC to facilitate mechanical maintenance jobs. Also all weep holes for HP scrubber were checked and attended and cleared the choking.
- Extended diaphragm dual capillary type level transmitter **LT-1205** (Yokogawa make) of capillary length 10 m was replaced with new ABB make transmitter (capillary length 12 m) **, 4" 2500#**. Checked and calibrated the same.
- For monitoring DP across control valve HICV-1201, extended diaphragm dual capillary type (capillary length 12 m) ABB make DP transmitter **PDI-1212 , 4" 2500#** was installed and commisioned and calibrated with lens ring gaskets. Extended diaphragm with capillary type pressure transmitter PT-1212A at upstream of HICV-1201 was removed.
- New thermo well and temperature gauge were provided for new temperature indication for H-1207 CCS-II oultlet.

Following extended diaphragm capillary type pressure transmitters were removed to facilitate mechanical maintence jobs and installed back after completeion of jobs:

PRCT-1201, PT-1210.

For modification job of Urea solution tanks, following field instruments and valves were removed and were installed back in line after completion of jobs and necessary tubings done :

LICV-1282, LICT-1282, HICV-1406, LT-1421, LT-1481.

- Pressure gauges and temperature gauges were replaced at different locations as required.

- VAM PLC pane was cleaned, checked fuse and all wiring terminals. For providing cooling air inside VAM PLC local panel mounted in field, a vortex tube panel cooler was installed and line up with necessary instrument air supply tubing. Now Panel purging is done through cold air instead of ambient instrument air.
- Flange gasket for water in carbamate density meter, ANR-1203A was replaced with new ones.
- Removal of old cables and non use tubing in different plant area.

DCS RELATED CONTROL/ MARSHALLING ROOM JOBS:

Annual shutdown preventive maintenance activities were carried out for complete CentumVP DCS System with FCS0201, FCS0202, FCS0203 all six marshalling cabinets, Operator station HIS0259 to HIS0263, SOE station HIS0258 and Engineering station EWS0264. Following activities were carried out as per AMC procudure in Urea plant.

Before starting preventive maintenance activities / AMC jobs, tuning parameters of all control stations were saved on EWS0264 and project back up was taken.

- DCS System & Panel earth resistance were checked, found within limits
- Checking of system healthiness was carried out from system details display and found normal.
- AC and DC voltages and battery voltages were measured wherever applicable for all stations and were found within limits.
- The system was dismantled; cleaned and operating conditions like dust, moisture and temperature were checked. All parameters were checked and found within limits.
- Interior of system cabinets, ENGS and HIS consoles were cleaned thoroughly. PCBs were inspected and inspection of data bus and connectors were done. No abnormality was observed.
- Printers were cleaned/overhauled, wherever applicable. CPU back-up battery voltages and grounding were checked and the same were found within specified limits in all stations.
- Function of each component of the DCS was checked. YOKOGAWA diagnostic software was run on FCS, the results of the test program indicated the healthiness of the system.
- Redundancy checks were performed on V net / IP Bus, CPUs, Power supplies and cards wherever applicable. As per redundancy feature, control transfer took place to the stand by one properly.
- HIS to HIS communication was checked by pinging and found normal. After cleaning functionality of all HIS were checked and found working ok.
- Wiring terminals of all cabinet was checked and tightened, also checked fuses in all fuse TB and changed the fuses of critical trip related IO terminals.

- Data was collected for all HIS & FCS in Project backup for reference. Latest project backup was taken on DVD media.

Bently Nevada Vibration Monitoring System Up-gradation

Existing 3300 series VMS for Hitachi CO2 Compressor was very old and obsolete. Also Spares and Service support was not available from Vendor. Considering Vibration monitoring of critical rotary machine CO2 Comp, existing 3300 Series VMS is replaced with latest 3500 Series VMS keeping compatible field item probes , Extension Cables & Proximitors existing.

3500 Series is Bently Nevada's most capable and flexible system in a traditional rack-based, modular & rugged design and represents numerous features and advantages over 3300 Series VMS. 3500 Series is software configurable with maximum reliability, self-checking features and fault tolerant design. It can be directly connected to Bently Nevada's SYSTEM 1 for enhanced diagnosis of machine.

Following jobs were carried out:

- Replaced new field cables from Junction boxes to Control room as old cables were not reliable and giving frequent problem.
- Removed field & power cables of 3300 VMS and .Removed two racks of 3300 VMS from Panel.
- Installed one rack of 3500 Series VMS after doing proper cutout in panel.
- Glanding & Termination of all new Field / Power cables to 3500 Series VMS & Junction Boxes.
- Installed Rack Configuration software in PC and Configured 3500 Rack.
- Established Modbus Configuration between DCS & 3500 VMS for Vibration reading in DCS.
- Loop Checked from Probes to 3500 VMS / DCS.
- Simulation of all vibration probes / channel with TK3 Simulator were done to check the vibration reading, Alert and Danger alarm in Rack configuration PC and in DCS. Also checked the trip logical executon with danger level execution in vibration reading.

LR-1201B Additional level Indication for Autoclave: Berthold make radiation Scintillation detector and Evolution unit.

A new rack was mounted for LR-1201B above existing rack of Berthold Evaluation unit for LR-1201 & LRC-1201. Two new evaluation units LB440-M and LB440-S were installed in rack. 110V AC UPS power provided from PDB and current output signal was connected to analog marshaling cabinet with necessary cables. Input signal coming from new set of scintillation detector installed at V-1201 Autoclave top level measurement zone were connected to both evolution units. Necessary range configuration and calibration was carried out in presence of M/s Berthold service engineer.

For **LMS (Load Management System)** connectivity with DCS, interfacing JB with media convertor was installed in DCS marshaling room. 110V AC UPS power was provided from PDB. Ethernet communication card **AE111** was installed in at Node 7 slot 7 of FCS0202 and connected with Ethernet cable to interfacing JB. Necessary IP address configuration done in DCS.

To enhance capacity of MCC/FIELD DO with discrete relays, an ELCO board Model: YAED5D-12@G and 32 no. of 24V DC relays were installed in DIC-221 with necessary wiring from relay base to field wiring terminal blocks. The ELCO board was connected with two redundant prefab cable AKB-337 to first slot of both Digital output card ADV561 installed at FCS0203 Node7 Slot 7 & 8. Also the wiring related to Start and STOP/TRIP DO of Pump P-1105A/B and Trip DO of pump P-1211A/B linking DO with MCC feeder were shifted to these DO with discrete relay.

Anti-surge Controller program and checksum were checked. Also checked cleaned checked and tightened its wiring terminal.

AUX CONSOLE for Woodward Governor**,** Annunciator and Anti-surge controller were cleaned checked all **c**able and wiring, reconditioned and tight all wiring terminals.

Annunciator wiring ferrules were changed and tight all wring terminals.

Following DCS configuration related job done.

- Removed non-use Tags and related configuration, trend and graphic assignment were deleted.
- For following new tags, tag generation, its alarm & trend assigned and with necessary range.
  - **FI-1424:** 4ata steam flow to secondary evaporator H-1424(Range:0-4600kg/Hr)
  - **SI-1814:** Speed of Turbine Q-1814 of Main oil pump P-1814(Range:0-4000 rpm)
  - **PDI-1212:** DP across control valve HIC-1201(Range: -0.500 to 1.000kg/cm^2)
  - **LIC-1150:** V-1101 Knockout vessel level control (Range: 0 to 100%)
  - **LR-1201B:** V-1201 Autoclave level (Range: 0 to 100%)
- Due to change in operation requirement following split range controller with two control output were reconfigured as two separate controllers with same input signal.

PIC-1221 to PIC-1221A and PIC-1221B

LIC-1504 to LIC-1504A and LIC-1504B

- As the control philosophy for T-1101 sump level control was changed, controller LIC-1101 was changed as indication tag LI-1101and the START & STOP interlock of sump water discharge pump were linked with LI-1101.
- To change PRCT-1201 trip input from 1 out 1 to 2 out 3 In HP Synthesis interlock (I-1), three new tags PRCT-1201A, PRCT-1201B and PRCT-1201C were assigned and updated the trip logic as 2oo3 for high pressure trip. Set the trip value at 158Kg/cm2 and tested the 2out 3 function and complete I-1 trip logic with necessary simulation.
- MODBUS mapping and alarm generation were done for all vibration tags of Hitachi make CO2 compressor vibration reading and status change.

CAPITAL JOBS

Existing old Serck make butterfly type control valve **HICV-1221B, TRCV-1201, HICV-1422A & HICV-1422B** were replaced with Mascot make butterfly type control valves procured with technical specification as per updated process data.

Existing very old Serck make control valves **LICV-1425, HICV-1208, PICV-1202, PRCV-1202, PICV-1221B & XPV-242** were replaced with Mascot make new control valves procured with new technical specifications and with updated process data.

Existing Vibration monitoring system, **3300 series,** Bently Nevada make was upgraded to **3500 monitoring series**, Bently Nevada make for CO2 Compressor in Urea Plant. New monitoring rack (3500 series) with LAN connection with dedicated PC was installed. Replaced all the cables from vibration rack to field Junction boxes. Vibration probes, extension cables and proximeters (at the field side) were same as earlier with 3300 series.

EWR JOBS:

EWR-302: New flow transmitter for 4 ata steam flow to H-1424 (tag no.: FT-1424) was installed and commisioned and calibrated with technical specifications as per process data.

EWR-311: For level indication in DCS for knock out drum , level troll with tag no.: **LIC-1150** was installed and commisioned and calibrated as per process data.

Tapping for pressure transmitter PICT-1221 was shifted to H-1207 CCS-II inlet/ outlet and new pressure transmitter was installed and commisioned and calibrated as per process data.

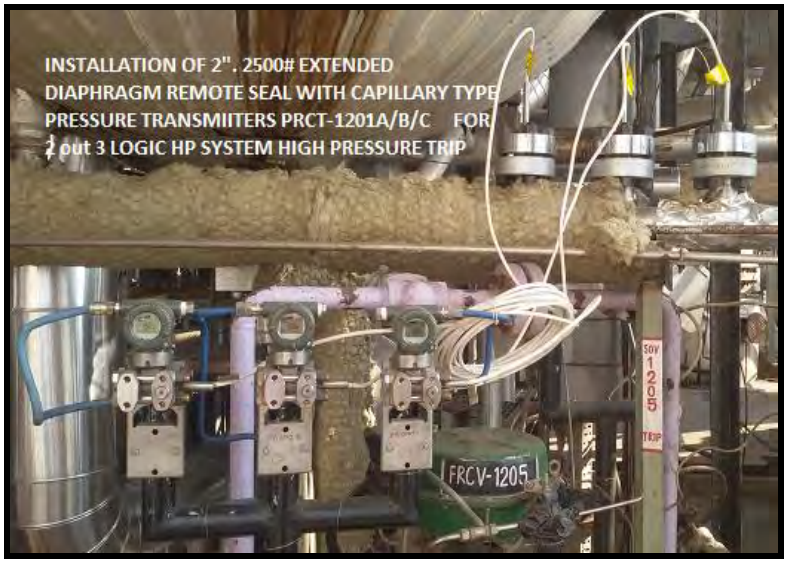
Control valve LICV-1101 was removed from the line and its cables and accessories were removed.

CONTINUOUS IMPROVEMENT

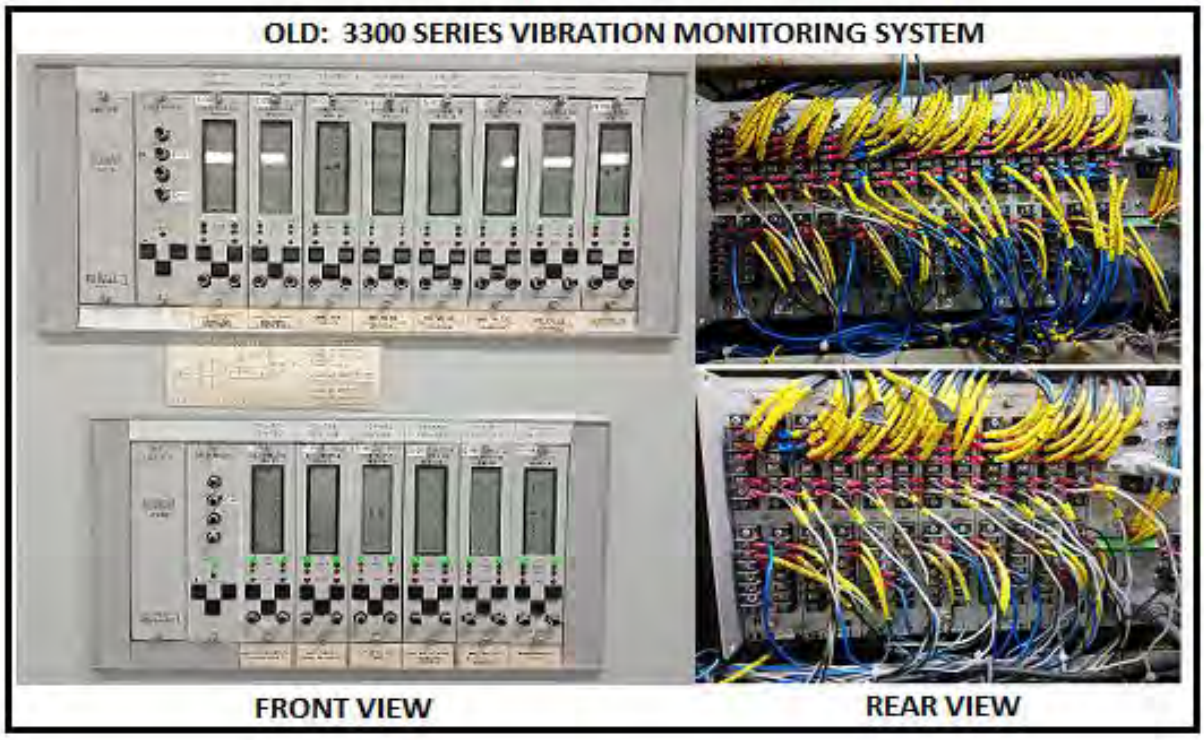
- Old and obsolete control valves were replaced with new control valve with technical specification as per updated process data

- Old and obsolete metal tube rotameter with transmitter were replaced with new rotameters with technical specification as per updated process data.

2 out 3 Logic for HP System Pressure PRCT-1201A/B/ C



Existing Bently Nevada **3300 series** Vibration monitoring system, was upgraded to BN**3500 Series Vibration monitoring system**, for CO2 Compressor in Urea Plant.



OFFSITE & UTILITY PLANT

(INSTRUMENT)

Following control valve's maintenance was carried out after removing valve from bonnet. Trim set was checked & necessary actions were taken followed by stroke checking.

Sr. No.	Tag	Description	Area	Problem	Job done
1.	PICV-5151	60-ata to 40-ata	Boiler	Passing. Plug stem found bent	Valve opened from bonnet. Bent plug stem was straightened and lapping was done for plug & seat. Blue test performed to ensure no leakage. Valve Stroke was calibrated.

Following control valve's preventive maintenance was carried out. Actuator parts, pneumatic accessories and stroke were checked and necessary action was taken.

Sr. No.	Tag	Description	Area	Problem	Job done
1	PICV-6	60-ata vent	Boiler	Hand jack gear lock nut broken	Actuator was un-mounted and taken to workshop for hand-jack repair and mounted back after that.
2	FCV-1	100% BFW flow C/V	Boiler	Diaphragm inspection	Valve actuator diaphragm cover was opened to check diaphragm which was found normal.
3	FCV-2	30% BFW C/V	Boiler	I/P converter problematic	Problematic I/P converter was replaced. New air filter regulator was provided for I/P. Valve diaphragm was inspected and found normal.
4	PCV-3	4-ata vent	Boiler	Passing	Zero & span was adjusted. Valve stroke was calibrated.
5	PIC-50	4-ata steam to De-aereator	Boiler	Air filter Regulator	Air regulator for I/P & Valve actuator were replaced.
6	LCV-4	De-aerator level control	Boiler	Zero drift	Valve opened at 3 mA. So, its zero was adjusted.
7	TCV-4	Spray water C/V	Boiler	Gland Leakage and valve operation sluggish	Actuator diaphragm was replaced and 4 gland packing were replaced.
8	PICV-25	NG pressure C/V	Boiler	Gland packing damaged	2 gland packing replaced.
9	HICV-4401	Make up water	Cooling tower	Air regulator & gland packing	Air regulator & gland 5 nos. gland packing were replaced. Needle valve for isolation was also replaced.

Following Boiler Gas/Syn gas Burner trip valves preventive maintenance was carried out. Actuator parts, pneumatic accessories and operation were checked and necessary action was taken.

Sr. No.	Tag	Description	Area	Problem	Job done
1	SGBTV-43	Syn Gas burner trip valve	Boiler	Pneumatic slider operation not smooth	Pneumatic slider removed and direct tubing done
2	SGBTV-44	Syn Gas burner trip valve	Boiler	Pneumatic slider operation not smooth	Pneumatic slider removed and direct tubing done
3	SGBTV-46	Syn Gas burner trip valve	Boiler	Pneumatic slider operation not smooth	Pneumatic slider removed and direct tubing done
4	SGBTV-47	Syn Gas burner trip valve	Boiler	Pneumatic slider operation not smooth	Pneumatic slider removed and direct tubing done
5	SGHTV-41	Syn gas header trip valve	Boiler	Overhauling	Quick exhaust was overhauled.

Following control valve's preventive maintenance was carried out. General cleaning and control valve stroke checking:

Sr. No.	Tag	Description	Area
1.	FRC-22	Main Gas Flow control	Boiler
2.	MICV-5153	40 ata Steam to Ammonia plant	Cooling Tower
3.	MICV-5154	4 ata steam Inlet	Cooling Tower
4.	HICV-4401B	Steam to Q-4402 Turbine	Cooling Tower
5.	PIC-5501	Crack Gas Pressure control	IG
6.	LCV-01	Surface Condenser Recirculation	Cooling Tower
7.	LCV-02	Surface Condensate export	Cooling Tower
8.	FICV-4502	Combine Effluent Flow control	ETP
9.	PHICV-4502	Combine Effluent pH control	ETP
10.	FCV-2201	Anion 1 outlet flow control	DM
11.	FCV-2202	Anion 2 outlet flow control	DM
12.	FCV-2203	Anion 3 outlet flow control	DM
13.	FCV-2204	Anion 4 outlet flow control	DM
14.	FCV-2205	Anion 5 outlet flow control	DM
15.	LCV-2905	DM Water Buffer tank Level control	DM
16.	PCV-3055A/B	Receiver Pressure control	Ammonia Storage
17.	PCV-3064A/B	Condenser Pressure control	Ammonia Storage
18.	LCV-3051A/B	Saturator Inlet Level control	Ammonia Storage
19.	LCV-3055A/B	Receiver Level control	Ammonia Storage
20.	LCV-3058A/B	Inter stage cooler Level control	Ammonia Storage
21.	LCV-3065A/B	Gas Separator Level control	Ammonia Storage

FIELD JOBS BOILER:

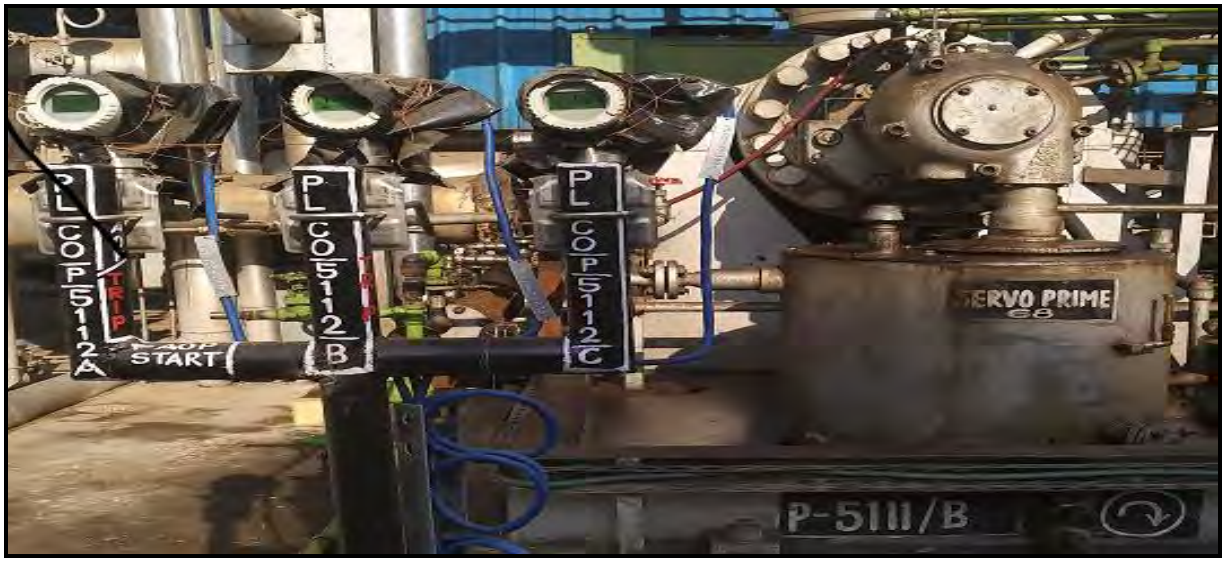
Q-5113 & P-5111: F.D. Fan turbine side & BFW pump related field instruments (Switches, probe, Temperature & pressure gauges) were removed to facilitate mechanical maintenance job and re-fixed back.

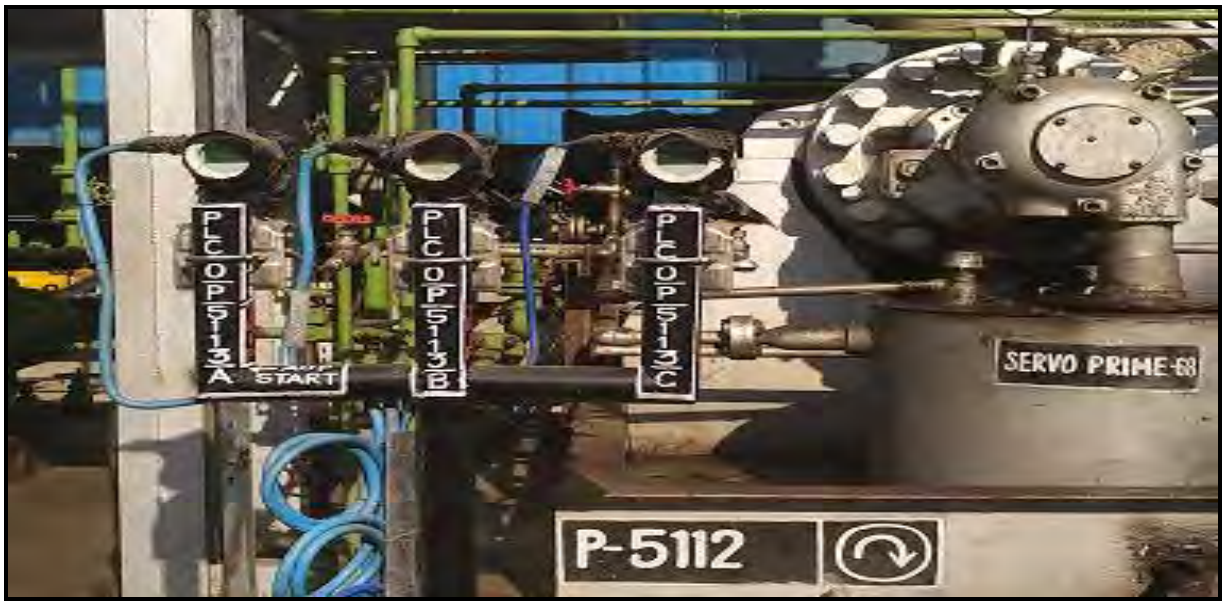
TI-13 & 13A: Boiler furnace temperature thermocouple & thermo-well replaced with a new one. Both thermocouple was provided with extra flange to reduce insertion length into the furnace as damage to element has been continuously observed every year.

2oo3 Logic implementation: Ten new Pressure transmitters were installed in Boiler area in place of pressure switches. Nine in BFW pump area and one in Boiler furnace area. Branch cables were laid from transmitters to Junction Box. Multi-pair cables were laid from junction box to DCS marshalling cabinets. All cables were terminated in Analog marshalling cabinet.

Tag	Description	Removed Switches
PLCO-Q5111A	Q-5111 Turbine side LO pressure	PAL-Q5113
PLCO-Q5111B	Q-5111 Turbine side LO pressure	PLCI-Q5112
PLCO-Q5111C	Q-5111 Turbine side LO pressure	PLCO-Q5111
PLCO-P5112A	P-5111 pump side LO pressure	PAL-P5114
PLCO-P5112B	P-5111 pump side LO pressure	PLCI-P5113
PLCO-P5112C	P-5111 pump side LO pressure	PLCO-P5112
PLCO-P5113A	P-5112 pump side LO pressure	PAL-P5115
PLCO-P5113B	P-5112 pump side LO pressure	PLCI-P5114
PLCO-P5113C	P-5112 pump side LO pressure	PLCO-P5113
PT-14	Furnace pressure	PSH-12

Old Switches were removed from the field along with their branch cables. Branch cable terminations were disconnected from Junction box and marshalling cabinet.





TI-19 for Furnace Bank Zone Temperature: New Thermo-well & K-type thermo-couple TI-19 were mounted, branch cable was laid and all terminations were completed.

O_2 Analyzer: Flue Gas O2 analyzer sensor was replaced by new spare. All other parts were inspected & found in healthy condition.

Igniter: Burner 1 & 2 both Igniter gun were taken out for inspection. General cleaning & overhauling was done.

Flame Scanner: All four flame scanner general cleaning & checking was done.

Furnace draft points were checked & cleaned properly.

Steam drum level indicator electrodes were checked, cleaned & tighten all terminals.

All pressure gauges (PI-2, PI-3, PI-4 and PI-5) were calibrated as required for boiler inspection.

Syn. Gas all BTV Air pneumatic slider was removed and tubing was done directly.

TI-30-5 Super-heater Coil Temperature: Thermocouple was checked by heating pad upto 90 degree in presence of production staff and it was found normal.

Following Critical field switches set value were checked & found ok:

1.	PSH-11	2.	PSL-24	3.	PSL-25
4.	PSN-26	5.	PSH-26	6.	LSLL-1
7.	PSL-27	8.	PSL-8	9.	PSL-30
10.	LLCI-5111	11.	LAHH-5111	12.	DPAH-5111
13.	PSL-42	14.	PSH-42	15.	LLCO-5111

Following Critical transmitters were calibrated:

1.	FT-1	2.	FT-2	3.	FT-3
4.	FT-4	5.	FT-11	6.	FT-22A
7.	FT-22B	8.	FT-42	9.	PT-1
10.	PT-3	11.	PT-4	12.	PT-5
13.	PT-6	14.	PT-7	15.	PT-15
16.	PT-22	17.	PT-42	18.	LT-1
19.	LT-2	20.	DPT-1	21.	DPT-12
22.	DPT-14				

Following ISO related Quality/Safety affecting instruments were calibrated:

1.	PI -2	2.	PI -3	3.	PI -4
4.	PI -5	5.	PT-3A	6.	TRC-5
7.	LI -2A	8.	PSH-11	9.	PSH-12(PT-14)
10.	LSLL-1	11.	LT-2A	12.	LT-4

Following BTV Limit Switches operation were checked & found ok:

1.	IGTV	2.	GHTV	3.	GBTV-1
4.	GBTV-2	5.	FCV-22	6.	SGHTV
7.	SGBTV-1	8.	SGBTV-2	9.	SGFCV-41

All air header flushed at various points.

FIELD JOBS COOLING TOWER:

Woodward Governor 505D:

Woodward Governor panel to DCS marshalling cabinet power cable & signal cable were laid & power supply was provided. New RPM indicator was mounted in the field and old one was removed. Governor panel console, all push to fit TBs

were replaced to screw fit TBs to facilitate wiring. Cable trays were laid for field cables. Five Branch cables were laid for two MPUs, actuator output, feedback & speed output to RPM indicator. All cable terminations were done at both ends.

SI-4411 Turbine speed input: Old speed probe was removed and turbine speed is now sensed by new MPUs mounted on PGPL actuator. MPU output is connected to Woodward 505-D. Old speed converter in marshalling cabinet was removed and new 4-20 mA speed readout from Woodward 505-D was connected to DCS.

Governor was powered up & it's Operation at Idle speed, rated speed and Over-speed was checked after actuator mounting completion by mechanical maintenance.

Cooling water supply & return temperature: Six new thermocouple for CW supply & Return header of Ammonia, Urea & New Cooling Towers were installed. Branch cable were laid for all thermocouples and one new JB was mounted in NCT area and multi-pair cable was laid from NCT area to Cooling tower marshalling room.

Sr. No	Service	Tag
1.	Ammonia CW supply line temp	TE-4401A
2.	Ammonia CW return line temp	TE-4401B
3.	Urea CW supply line temp	TE-4402A
4.	Urea CW return line temp	TE-4402B
5.	NCT CW supply line temp	TE-4404A
6.	NCT CW return line temp	TE-4404B

Urea CT Basin & NCT Basin level: Two new ultrasonic level transmitters were installed for Urea CT basin & NCT basin level measurement.

Sr. No	Service	Tag
1.	Urea CT basin level	LT-4402
2.	NCT basin level	LT-4403

Q-4411: Elliott Turbine all radial vibration probes, Trip SOV, speed pick-up probes; local temperature & pressure gauges were removed & reinstalled to facilitate mechanical maintenance. SV-4411 was relocated as previous mounting location was obstructed by new PGPL actuator. One vibration probe on Gear box Driving end sump side was damaged during maintenance job. So it was replaced with new one.

Q-4402 & Q-4403: Turbine side speed pick-up probes; local temperature & pressure gauges were removed & reinstalled to facilitate mechanical maintenance.
Q-4402 proxy sensor was replaced with new one.

Following Level switches of surface condenser were cleaned & calibrated:

1.11.	L LSHH-1	2.22.	LS LSAH-2
3.33.	LS LSAL-3	4.44.	PS PSH-1

Following ISO related Quality/Safety affecting instruments were checked:

1.	PI - 4401	2.	PI - 4405
3.	AR - 4401	4.	AR - 4402

Following Critical transmitters were calibrated:

1.	PT-1	2.	FT-1090
3.	FT-1091	4.	LT-01

2.26 Cleaning of control panel & tightening of all terminals inside panel was carried out.

I.G. PLANT:

Hydrogen Analyser ANR-5401 was showing faulty reading and overheating was also observed. Its sensor was replaced and calibration was done for zero & span (5%). Correct reading was observed after that.

PI-5302: New transmitter PT-5302 was installed for Air receiver pressure in IG plant. Cable was laid and all terminations were completed. Its values are used to generate Digital output for Air compressor K-5302 loading/unloading.

Following ISO related Quality/Safety affecting instruments were checked:

1.	PI - 5301	2.	PI - 5302
3.	PI - 5401		

DM PLANT:

SMB-4 Control valve air supply tube damage: Due to mechanical cutting work PVC signal tubes of BDK valves were damaged. Union was provided/new tubing was done wherever necessary.

Overhauling of inlet air regulator of SOV box of ACF-1, ACF-2, SMB-1, CATION-1 and CATION-2 was done.

Following Critical transmitters were cleaned & checked:

1.	FT-2003	2.	FT-2906	3.	FT-2005
4.	FT-2001	5.	FT-2008	6.	FT-2101
7.	FT-2102	8.	FT-2103	9.	FT-2104
10.	FT-2105	11.	FT-2201	12.	FT-2202
13.	FT-2203	14.	FT-2204	15.	FT-2205

FIELD JOBS E.T. PLANT:

AI-4500: Cleaning of sampling system and calibration of Ammonia analyzer were carried out

PHI-4502 & PHI-4502A: Combined effluent pH meter was cleaned & calibrated.

FIELD JOBS AMMONIA STORAGE AREA:

Following Critical field switches were calibrated & found ok:

1.	PSL-3053A	2.	PSL-3052B	3.	PALL-3004
4.	PAL-3055A	5.	PAL-3006	6.	PSHH-3007
7.	PSH-3063A	8.	PSH-3063B	9.	PAL-3067A
10.	PAL-3057B	11.	FSL-3050A	12.	FSL-3050B

Following Critical transmitters were calibrated:

1.	PIC-3008	2.	PT-3103	3.	PIC-3103
4.	LT-3103	5.	LT-3001		

EMV-3502 was found stuck up. Air tubing was replaced by new one and its operation was checked.

All control valves, field instruments & JB were checked, cleaning and general service was done.

FIELD JOBS NARMADA OFFTAKE POINT AREA:

Marshalling cabinet & PDB cleaning work was carried out.

B & MH. PLANT

(INSTRUMENT)

During this turn around the B & MH control room was shifted to new location. This entire job was coordinated by our section. With this opportunity, several major jobs/ modifications were taken up and completed successfully.

Bagging machines or bag filling machines are generally termed as Packer Scales (P/S). In the following matter, P/S will be used for bagging machines.

- In the place of new control room, there were several overhead cable trays passing for various purposes. These cable trays were rerouted from the outside of the control room so as to avoid any difficulty in the future.
- Control room: The new control room is designed so as to accommodate all the instrumentation panels as well as PLC-SCADA and its marshaling cabinet for conveyor belt control system, procured and maintained by Electrical section. In the earlier control room there was no false flooring. In the new control room false flooring is provided for the ease of cabling and cable replacement when needed.

- Modification of cabling and replacement of the cables:

Modification of cabling: Earlier there were 3 to 4 multicore cables of various verities (12P, 6P etc.) plus 1 Load cell cable were running from the main control panels of all the 10 machines, P/S-1, 2, 3, 4, 7, 8, 9A, 9B, 10A and10B from the control room to the field cabinets. With the modification during this turn around, only one 12P, 0.75^2 mm cable plus one 0.75^2 mm load cell cable is used.

Replacement of the cables: We replaced cable trays, cables and cable glands of P/S-1, 2, 3, 4, 7 and 8 with new 12P, 0.75^2 mm cable and one 0.75^2 mm load cell cables. For this new cable trays were laid at different location for the convenience of cable laying and replacement.

- Replacement of old Control panels with new panels: Main control panels of P/S-9A, 9B, 10A, 10B were different in construction and internal wiring than the rest of the machines. In the view to make the circuit uniform and easy to understand we replaced these panels with new panels having uniform construction and internal wiring. Out of these 4 panels 2 panels are with electrical components and without controller and interface whereas 2 panels are with electrical components, controller and interface

- Replacement of 3 Indication panels with new panels (MOC SS 304):
  - Replaced indication panel meant for P/S alarm of main control room.
  - Replaced indication panel meant for P/S alarm at hopper floor.
  - Replaced indication panel for hopper level and conveyor belt control.
  - Replaced a panel for DIV-1 operation.
- Shifting, installation and commissioning of all the control panels:

  In the new control room 10 control panels of the P/Ss, a control panel for dust extraction system and one for conveyor belt instrument logic were installed. For this MS frame was fabricated and grouted. After installation, all the 10 machines were tested for desired sequential operations before putting into practical bagging.

Field jobs in the B & MH plant:

Following activities were carried out for the Packer scale number 1, 2, 3, 4, 7, 8, 9A, 9B, 10 A &10B and Mettler-Toledo make weighing scales:

- Cleaning and tightening of terminals in local, load cell junction box and proximity Switch junction box of all the packer scales were carried out. Provided lugs in solenoid box where ever were required.
- Diverter 1 Cleaned solenoid, relay & limit switch and checked its function.

- Checked wiring terminals in the main panel, local panel, Solenoid boxes, and load cell box.
- Cleaned and checked CSC-25 relay board, fuses, and all sensors.
- Checked functioning and calibration of all Packer Scales.
- All the solenoid valves were overhauled.
- Maintenance & calibration of new reclaim machine belt was done.
- Cleaned the Dust Extraction plant panel.
- Cleaned all field instruments (Control valve, Transmitter) related to DES
- Control valve stroke checking for Dust Extraction System Area 1.
- Maintenance and functionality checking of level switches in Hopper for P/S–9A/B and P/S –10 A/B.
- Checking of level transmitter after removal from tank in Dust Extraction System Area.
- Checking and maintenance of a Level transmitter and level switches for Fiber Tank in P/S floor.
- Checked wiring terminal in the Belt Conveyor Logic panels and its related JB.
- Installation of new Electronic level transmitter in T-2163 in DES 2. Also its transmitter related power supply and wiring and termination done.
- Cleaning & Painting of all the Mettler-Toledo make weigh scale's platform was done.

- **Annual Maintenance Jobs for DCS & PLC:**
- DCS shutdown maintenance activities were carried out as per the AMC procedure. Following activities were carried out in Boiler, DM, IG/CT & Ammonia Storage, Narmada WTP, ETP & DG Set, Fire & Safety.
- Before starting preventive maintenance activities / AMC jobs, tuning parameters of all control stations were saved on Engineering station. Project back up was taken.
- Checking of System healthiness was carried out from System details display and found Normal.
- AC and DC voltages and Battery voltages were measured wherever applicable for all Stations and were found within limit.
- The system was dismantled as per plant clearance and operating conditions like dust, moisture and temperature were checked. All parameters were checked and found within limit. Interior of system cabinets, ENGS and HIS consoles were cleaned thoroughly. PCBs were inspected and inspection of data bus and connectors were done. No abnormality was observed.
- Printers were cleaned/overhauled, wherever applicable. CPU back-up battery voltage and grounding were checked and the same were found within specified limit in all stations.

- Function of each component of the DCS was checked. YOKOGAWA diagnostic software was run on FCS, the results of the test Program indicated the healthiness of the system.
- Redundancy checks were performed on V net / IP Bus, CPU, PS and AAB841 card wherever applicable. As per redundancy feature, control transfer took place to the stand-By module properly.
- HIS to HIS communication was checked by pinging and found normal. After cleaning functionality of all HIS were checked and found working ok.
- Data was collected for all HIS & FCS in Project backup for reference.
- Control room dust level & temperature had been observed & found within limit.
- Marshalling Cabinet fans were replaced wherever found faulty.
- All terminations of marshalling cabinet were checked for loose connection and tightened wherever required.
- All MCB termination in all DCS Power distribution cabinet & marshalling cabinets were checked for loose connection.
- DM Plant ACDB panel termination were also checked.
- All critical I/O related fuse were checked.
- Following tags were removed from DCS for facilitating new Transmitter Input generated 2oo3 Logic in BFW pumps & Boiler furnace. Old tags were removed from Digital input Module, Sequence tables, Logic charts & Boiler graphics. All terminations in marshalling cabinet were also disconnected.

S.No.	Tag	Description
1	PAL-Q5113	Q-5111 Turbine side LO pressure alarm
2	PLCI-Q5112	Q-5111 Turbine side LO pressure AOP start
3	PLCO-Q5111	Q-5111 Turbine side LO pressure Trip
4	PAL-P5114	P-5111 pump side LO pressure Alarm
5	PLCI-P5113	P-5111 pump side LO pressure AOP start
6	PLCO-P5112	P-5111 pump side LO pressure Trip
7	PAL-P5115	P-5112 pump side LO pressure Alarm
8	PLCI-P5114	P-5112 pump side LO pressure AOP start
9	PLCO-P5113	P-5112 pump side LO pressure Trip
10	PSH-12	Furnace pressure High Trip

- **2oo3 Logic for Q-5111 Turbine trip on De-aerator Low level:** New logic was created for Q-5111 turbine trip on De-aerator low level. Values of LI-4B, LRC-4 & LLCO-5111 have been used for the logic. LI-4B value has been taken as 0.97 meters and LRC-4 value has been taken as 22% for the low level trip. Digital output LLCO-5111TRP was generated.

- **2oo3 Logic in Steam Drum Low level trip:** LSLL-1 tag was changed to LSLL-2C for DI coming from LSLL-1 switch. New logic chart was created for steam drum low level trip. Values of LI-2A, LI-2B & LSLL-2C have been used for the logic. LI-2A & LI-2B value has been taken as 22% for the low level trip. New Digital Output LSLL-1TRP was generated and was transferred to Stardom PLC as Digital input through physical wiring.

- **2oo3 Logic in BFW pump P-5111 driver turbine Q-5111 Lube Oil pressure low Alarm / AOP Start / Trip :** Three new tags were defined for analog inputs coming from three new transmitters installed for the 2oo3 logic implementation in BFW pump turbine Q-5111 L.O pressure low trip. Digital output PLCO-Q5111TRP was generated from new logic at Pressure values mentioned below in the table. AOP start logic has been created using value of PLCO-Q5111A.

  Q-5111 Turbine L.O. Pressure Low AOP Start / Turbine Trip parameters:

Tag	Description	Trip Value	AOP Start
PLCO-Q5111A	Q-5111 Turbine side LO pressure	0.7 Kg/cm2	0.9 Kg/cm2
PLCO-Q5111B	Q-5111 Turbine side LO pressure	0.7 Kg/cm2	NA
PLCO-Q5111C	Q-5111 Turbine side LO pressure	0.7 Kg/cm2	NA

- **2oo3 Logic in BFW pump P-5111 Lube Oil pressure low Alarm / AOP Start /Trip:** Three new tags were defined for analog inputs coming from three new transmitters installed for the 2oo3 logic implementation in BFW pump P-5111 L.O pressure low trip**.** Digital output PLCO-P5112TRP was generated from new logic at Pressure values mentioned below in the table. AOP start logic has been created using value of PLCO-P5112A.

  P-5111 Pump L.O. Pressure Low AOP Start / Pump Trip parameters:

Tag	Description	Trip Value	AOP Start
PLCO-P5112A	P-5111 pump side LO pressure	0.7 Kg/cm2	0.9 Kg/cm2
PLCO-P5112B	P-5111 pump side LO pressure	0.7 Kg/cm2	NA
PLCO-P5112C	P-5111 pump side LO pressure	0.7 Kg/cm2	NA

- **2oo3 Logic in motor driven BFW pump P-5112 Lube Oil pressure low Alarm / AOP Start / Trip:** Three new tags were defined for analog inputs coming from three new transmitters installed for the 2oo3 logic implementation in BFW pump P-5112 L.O pressure low trip. Digital output PLCO-P5113TRP was generated from new logic at Pressure values

mentioned below in the table. AOP start logic has been created using value of PLCO-P5113A

P-5112 Pump L.O. Pressure Low AOP Start / Pump Trip parameters:

Tag	Description	Trip Value	AOP Start
PLCO-P5113A	P-5112 pump side LO pressure	0.7 Kg/cm2	0.9 Kg/cm2
PLCO-P5113B	P-5112 pump side LO pressure	0.7 Kg/cm2	NA
PLCO-P5113C	P-5112 pump side LO pressure	0.7 Kg/cm2	NA

- **2oo3 Logic for Boiler Furnace Pressure High Trip:** New tag PI-14 was created and linked to analog input from PT-14. New logic chart was created for Boiler Furnace High Pressure Trip. Values of PI-14, PR-15 & PI-16 have been used for the logic. Pressure value of 350 mmWC has been used in the logic to generate the DO for trip. New Digital Output PSH-12TRP was generated and was transferred to Stardom PLC as Digital input through physical wiring.

- **Woodward Governor 505-D & DCS interfacing:**

  Following inputs were taken from Woodward governor 505-D to Cooling tower DCS.

  - **SI-4411:** Analog speed readout to DCS. Existing tag was used for newly terminated speed readout from Woodward 505D.
  - **SHUTDOWN GOV:** DCS Annunciation for Governor shut-down from Woodward panel.

- Six new temperature tags were defined in Cooling Tower DCS for cooling water supply and return header from all three Cooling towers:

Tag	Description
TI-4401A	Ammonia CW Supply Temp
TI-4401B	Ammonia CW Return Temp
TI-4402A	Urea CW Supply Temp
TI-4402B	Urea CW Return Temp
TI-4404A	NCT CW Supply Temp
TI-4404B	NCT CW Return Temp

- Two new Level tags were defined in Cooling Tower DCS for newly constructed Urea CT Basin Level & NCT basin level:

Tag	Description
LI-4402	Urea CT Basin Level
LI-4403	NCT Basin Level

- **PI-5302:** New tag PI-5302 was defined for newly mounted pressure transmitter PT-5302 at the Instrument Air receiver V-5301. Its values are taken for loading/unloading operation of air compressor K-5302.

- Stardom PLC engineering station disk defragmentation done & PC operation speed has improved. One spare Engineering station is raedy for use in case of future emergency.

Annual Maintenance Jobs for UPSS SYSTEM:

EMERSON make 2 X 60 KVA

- AMC jobs for 'EMERSON' make 2 x 60 KVA UPSS and AMCO battery bank by M/S VERTIV Energy Pvt Ltd and M/s Syntech Power System respectively wascarried out.

- AC & DC Capacitor replacement job was carried out. Capacitors of following Make/Model/Rating were replaced by Vertiv Service Engineer.

Make	Model	Rating	Type	Quantity
ALCON	PG-6SR 002	10000 MFD/315 VDC	DC Capacitor	24
COMAR	CME-AS 150 300	150 MFD/300 VAC	AC Capacitor	24
EPCOS	B32341-A5092-B550	100 MFDF/550 VAC	AC Capacitor	6

- Performance of UPS was checked with draining of battery for about 45 Minutes. Redundancy Functionality of UPS checked. Load Taken on AVR for 15 minutes.

- Checked the Battery voltage/performance during charging & discharging & one battery no. was isolated due to low voltage. Battery cell no. 93 and 271 of KPH-130 were bypassed.

DB make 2 X 10 KVA UPSS NARMADA

- AMC Jobs for 2 X 10 KVA DB Make UPSS was carried out.

- All the twenty batteries of 12 VDC were replaced by new Rocket Make SMF Batteries of 12V/100AH as the old battery voltage had dropped significantly.

- Capacitors of following make/model/rating were replaced in both the UPS:

Make	Model	Rating	Type	Quantity
ALCON	PG-6SR 054	4700 UF, 350 VDC	DC Capacitor	14
EPCOS	B32341-A3042-A370	100MFD/370V AC	AC Capacitor	6

- Redundancy/functionality test carried out & found ok.

- Checked tightness of all power cables, control cables, PCB Mounting & found ok.

- Cleaning of both UPSS one by one was done with blower.

EMERSON make 2 X 10 KVA AMMONIA STORAGE

- AMC jobs for 'EMERSON' make 2 x 10 KVA UPS and AMCO battery bank was carried out by Service Engineer.
- Redundancy/functionality test carried out & found ok.
- Checked tightness of all power cables, control cables, PCB Mounting & found ok.
- Cleaning of both UPSS one by one was done with blower.
- Battery cell no. 131 and 172 of KPH-22 were bypassed.

CAPITAL JOBS CARRIED OUT IN ANNUAL TURNAROUND

Ten new transmitters were installed in Boiler area. Branch cables were laid from transmitters to Junction Box. Multi-pair cables were laid from junction box to DCS marshalling cabinets.

Tag	Description
PLCO-Q5111A	Q-5111 Turbine side LO pressure
PLCO-Q5111B	Q-5111 Turbine side LO pressure
PLCO-Q5111C	Q-5111 Turbine side LO pressure
PLCO-P5112A	P-5111 pump side LO pressure
PLCO-P5112B	P-5111 pump side LO pressure
PLCO-P5112C	P-5111 pump side LO pressure
PLCO-P5113A	P-5112 pump side LO pressure
PLCO-P5113B	P-5112 pump side LO pressure
PLCO-P5113C	P-5112 pump side LO pressure
PI-14	Furnace pressure

ELECTRICAL

AMMONIA PLANT

(ELECTRICAL)

Modification and New Installations

Installation, testing & commissioning of new actuators

Installation , testing & commissioning of extension panel for MCC5

New installation

Installation, testing & commissioning of new actuators

The existing manual operated valves are replaced with Rotork make IQ2 series latest motor operated actuators in LTS guard section in ammonia plant. The MOV was installed & commissioned successfully during ATA-18. The same was also tested for operation & indications from Local as per process requirement.

Actuator type- IQ40F25B4, Sr No: 5W480601 01, Enclosure- EXD llB T6, WD-3010-100-09 Output RPM-96 Gear box model-IBB

The picture of the new installed actuators is as below -

Also following motor operated valves are retrofitted with latest IQ series rotork make actuators .

SP-3	5W32161101	WD 3010-000	IQ70F25A	48
SP-4	5W32160601	WD 3010-000	IQ40F25A	144
SP-5	5W32160201	WD 3010-000	IQ35F16A	48
SP-156	5W32160101	WD 3010-000	IQ70F25B4	48

Some of the images of MOVs are added below for reference.

Installation, testing & commissioning of extension panel for MCC5

Extension panel is required to accommodate P-1170 JA (Condensate Stripper Feed Pump) 90 KW motor for emergency power supply source as per process requirement.

Previously P-1170 JA was fed from normal power fed from MCC-13. So after installation of extension panel and re-routing of power & control cable of P-1170 JA from MCC-13 to MCC-5 , now the motor is fed from emergency source for reliability of operation.

To install the new extension panel following jobs are carried out

- Preparation of cable trench: As per drawing prepare cable trench.
- Preparation of base frame: As per drawing prepare base frame and grouted base frame with help of L&T crew.
- Installation and commissioning work done at RHS of existing panel SYWE805.
- Coupling of new extension panel SYWE 932 with existing MCC SYWE805 is done.
- After installation and commissioning work testing of new extension panel is done and found ok.
- After completion of job MCC panel charged and motor is tested OK.

Scheduled Preventive Maintenance

Preventive maintenance of MCC: Preventive maintenance carried out on all the feeder compartments in MCC-5, MCC-16 and the job details are as under.

Common activity carried out during MCC maintenance:

- Isolation of MCC from power source.
- General cleaning of all feeders.
- Tightness checking of all power and control cable connection.
- Checking & cleaning of contactors.
- Checking of operation of breaker in test position.
- Checking continuity and IR valve of bus bar.
- Lamp test.
- Normalization of MCC.

Overhauling of critical motors: Overhauling of following motors was carried out in Ammonia plant.

Equipment Name	Description
P-2001 L J A	HYDRAZENE INJ.PUMP
P-2001 L J A	HYDRAZENE INLECTION PUMP
P-116 JB	SPLIT STREAM PUMP
104 J	AOP FOR B.F.W.PUMP MOTOR
104 JA	AOP FOR B.F.W.PUMP MOTOR
104 JT	AOP FOR B.F.W PUMP(TURBINE)
104 JTA	AOP FOR B.F.W PUMP (TURBINE)
101 BJT	AOP FOR I.D.FAN MOTOR
PC 2A	LQD AMM.PUMP MOTOR
PC-2B	LQD AMM.PUMP MOTOR
P-121 J	HOT AMM.PRODUCT PUMP
P-121 JA	HOT AMM.PRODUCT PUMP
P-107 JTA	AOP FOR MEA PUMP(TURBINE) MOTOR
115 JA	LOP FOR SEMI LEAN PUMP(STAND BY)
115 JB	LOP FOR SEMI LEAN PUMP
113 J	MEA PUMP MOTOR
P-103J SO MOTOR	SEAL OIL MOTOR
117 J	Recycle gas Compressor
AOP 117 J	AOP FOR CG COMP.

Preventive maintenance of actuators carried out for the following MOVs and tested with their interlocks:

SP1, SP70, SP151, SP152, SP 154, SP 158,101,105,8101 & SP 159.

Testing and Servicing of L&T and Siemens make Air Circuit breakers were carried out.

UREA PLANT

(ELECTRICAL)

Modification and New Installations

Installation, testing & commissioning of new actuators.

The existing manual operated valves are replaced with Rotork make IQ2 series latest motor operated actuators in MOV1801& MOV1501 train in Urea plant. The MOVs are installed & commissioned successfully during ATA-18. The same is also tested for operation & indications from Local as well as DCS as per process requirement.

Some of the images of MOVs are added below for reference.

Scheduled Preventive Maintenance

Complete overhauling of TR-17

Preventive maintenance of MCC: Preventive maintenance of the all feeder compartment in MCC 15 were carried out and the job details are as under:

- Common activity carried out during MCC maintenance**:**
- Isolation of MCC from power source.
- General cleaning of all feeders.
- Tightness checking of all power and control cable connection.
- Checking & cleaning of contactors.
- Checking of operation of breaker in test position.
- Checking continuity and IR valve of bus bar.
- Lamp test.
- Normalization of MCC.

Overhauling of critical motors: Overhauling of following motor was carried out in urea plant.

Equipment Name	Description
K-1702	FD FAN
P-1131 A	LOP
P-1131 B	LOP
P-1131 C	LOP
P-1814	MAIN LOP FOR CO2 COMP MOTOR
P-1817	EMER LOP FOR CO2 COMP MOTOR
P-1815 A	CONDEN EXTRAC PUMP MOTOR
P-1815 B	CONDEN EXTRAC PUMP MOTOR
P-1403/3	Conveyor
P-1402/2	Conveyor
P-1506	BFW PUMP
P-1501	BFW PUMP
P-1505/B	CONDENSATE PUMP MOTOR
P-1505/A	CONDENSATE PUMP MOTOR
P-1202 A	CIRCULATING CONDENSATE SYS-2 MOTOR
P-1408	MELT PUMP
K-1401/1	PT FAN
K-1401/2	PT FAN
K-1401/3	PT FAN
K-1401/4	PT FAN

Equipment Name	Description
P-904 A	Condensate Ex.Pump
P-904 B	Condensate Ex.Pump
P-905	Circu.pump fo CO2 Com.
P-1402-1	PT Scraper Motor
P-1402-2	PT Scraper Motor
P-1701	PCS FAN
P-1419	Conveyor
P-1421	Conveyor
P-1403/1	Conveyor
P-1150 A	VAM MOTOR
P-1150 B	VAM MOTOR
P-1151 A	Condensate Pump
P-1151 B	Condensate Pump

Preventive maintenance of actuator of following MOV's was carried out:

MOV 1101, 1102, 1201, 1202, 1203, 1842 ,1800 & 1811

Testing and Servicing of L&T and Siemens make Air Circuit breakers were carried.

OFFSITE & UTILITY PLANT

(ELECTRICAL)

Modification and New Installations

Installation, testing & commissioning of new actuators.

The existing manual operated valves are replaced with Rotork make IQ2 series latest motor operated actuators in MOV10, MOV11,MOV14,4401/C & 4401/D train MOV in Utility plant. The MOVs are installed & commissioned successfully during ATA-18. The same is also tested for operation & indications from Local as well as DCS as per process requirement.

Some of the images of MOVs are added below for reference

Scheduled Preventive Maintenance

Preventive maintenance of transformer: Preventive maintenance of transformer TR-, 2B, 3A, 3B, 8, 11, 12, 13, 14, 16 and 23 were carried out. Detail is given as below**:**

Common activity carried out during transformer maintenance is as under:

- Isolation of transformer from both side (LT & HT)
- Dismantling of HV & LV terminal box.
- Visual inspection about any leakage of oil from any part and any heated terminal.
- Measurement of earthing resistance, IR value, PI value and oil BDV.
- Testing of Buchholz relay about its function of tripping and alarm.
- Condition of silica gel was checked. Accordingly discharged silica gel was replaced
- Tightening of loose parts.
- Cleaning and washing.

Preventive maintenance of MCC: Preventive maintenance of the all feeder compartment in MCC 1, MCC-11 and MCC 13 were carried out and the job details are as under:

Common activity carried out during MCC maintenance**:**

- Isolation of MCC from power source.
- General cleaning of all feeders.
- Tightness checking of all power and control cable connection.
- Checking & cleaning of contactors.
- Checking of operation of breaker in test position.
- Checking continuity and IR valve of bus bar.
- Lamp test.
- Normalization of MCC.

Overhauling of critical motors: Overhauling of following motors was carried out in utility

Equipment Name	Description
P-5111 A	AOP FOR TURBINE
P-5111 B	AOP FOR TURBINE
P-5113	AOP FOR FD FAN
P-5120	
P-4411 A	Condensate Ex.Pump
P-4414 B	AOP for Q-4403
P-4413 B	AOP for Q-4401 B
K-5113	FD FAN

Servicing of following Rotork make actuators installed in utility plant was carried out.

FL2 (MAIN), FL2 (BYPASS), S2 (MAIN), S2 (BYPASS), S5, S6, P-4403(700), P-4403(900), P-4401/A, P-4401/B, P-4401/C, P-4401/D, P-4402

Testing and Servicing of L&T & Siemens make Air Circuit breakers were carried out.

Offsite Plant

Modification and new installation

Replacement of LT distribution panel of D.G.Set power control centre(PCC)

Diesel generator set is required to cater emergency power to all critical loads for emergency power supply source as per process requirement. The breakers & its feeders are becoming obsolete and their spares are not readily available. So the whole PCC is planned to replace under capital budget with latest breaker feeders with additional feeders for reliable ,safe and uninterrupted emergency power provision at plant during total power fail.

To install the new extension panel following jobs are carried out

- Preparation of cable trench: As per drawing prepare cable trench.
- Preparation of base frame: As per drawing prepare base frame and grouted base frame
- Removal of old PCC
- Installation and commissioning of new PCC
- Coupling of new panel busbar with the bus duct of DG set
- Testing of new panel is done and found ok.
- After completion of job MCC panel charged.

Scheduled Preventive Maintenance

Preventive maintenance of transformer

Preventive maintenance of transformers Tr-1A, was carried out. As per detail given below:

Common activity carried out during transformer maintenance is as under:

- Isolation of transformer from both side (LT & HT)
- Dismantling of HV & LV terminal box.
- Visual inspection about any leakage of oil from any part and any heated terminal.
- Measurement of earthing resistance, IR value, PI value and oil BDV.
- Testing of Buchholz relay about its function of tripping and alarm.
- Condition of silica gel was checked. Accordingly discharged silica gel was replaced
- Tightening of loose parts.
- Cleaning and washing.

Preventive maintenance of MCC: Preventive maintenance of all the feeder compartment of in, MCC-10& 10A was carried out and the job detail is as under**:**

Common activity carried out during MCC maintenance**:**

- Isolation of MCC from power source.
- General cleaning of all feeders.
- Tightness checking of all power and control cable connection.
- Checking & cleaning of contactors.
- Checking of operation of breaker in test position.
- Checking continuity and IR valve of bus bar.
- Lamp test.
- Normalization of MCC.

Preventive maintenance of actuators carried out for the following MOVs and tested with their interlocks (If any)

6001,6002,6003,6004,6201,6202,6203,6204,6205,6206,6207,6208, 6101 , 6102, 6103

Preventive maintenance /Servicing of 11 KV Siemens Breakers were carried at MPSS and 66KV yard as per detail given below:

Common activity carried out during maintenance:

- Visual inspection of breakers for any abnormality.
- Thorough cleaning of breakers was carried out

- Checked power & control circuit connections in the breaker for tightness.
- Gear box operation, tripping mechanism, spring charging limit switch Operation, Circlips ,Mechanical interlocks were checked.
- Mechanism was tested and lubricated.
- Insulation resistance of each breaker was measured
- Closing & Tripping time of all the Breakers was measured.
- Closing coil & Tripping coil resistance was measured.
- Contact resistance of each breaker was measured
- Adjustment of breaker damper roller gap wherever required.
- Adjustment of breaker rack out/in key position for smooth operation wherever required.

Preventive maintenance jobs were carried out in 66 KV switch Yard:

Common activity carried out during maintenance:

- All insulators of isolator, breaker and CTs and PTsare cleaned.
- Cleaned the contacts and oiling &greasing donein all isolators in yard.
- Operation of all isolator is checked & found OK.
- I R Value of all CT's and PT's are noted & found OK.
- Contact resistance of all isolator are noted

Special activity carried out during total power

- During total power shutdown in spite of routine maintenance following special maintenance are carried those are usually not available for maintenance during normal running hours and even in shutdown also.
- Checking & maintenance of bus coupler & Incomer feeders in MCC-1,2,2F,6,4,15,16 are done without feeding Emergency (DG) power to those MCC for early 3 Hrs.
- Checking & maintenance of all incomers & bus couplers in 11KV MPSS by load sharing & load management.
- Checking & maintenance of bus bars in 11KV MPSS & all MCCs incomers & bus couplers by load sharing & load management.

Preventive maintenance and servicing of 11KV MPSS, DCDB, and Capacitor bank in installed at 11 KV MPSS were carried out

- Cleaning of all incoming & bus coupler feeder of Siemens &Jyoti panels.
- Checking & cleaning of bus bars & HT cables was carried out.
- Cleaning of Jyoti breaker contacts.
- Checking of operation of breakers with all interlocks.
- Tightness checking of all control connection.

- Checking of continuity & IR value of bus by lamp test.
- Visually Inspected checked & cleaned DCDB feeders.
- Checking & cleaning of all the 4 capacitor banks done.
- Checked oil level of all capacitor banks & top-up done.

Retrofitting of numerical relay in 11 KV Substation:

- Electromagnetic relays for protection of 11 KV feeders are replaced with new advanced numerical relay.
- Modification of wiring as per scheme for new relay.
- Feeder was checked for their functionality and found ok as per scheme finalized.

B & MH. PLANT

(ELECTRICAL)

Modification and new installation

PLC installation at bagging plant and transfer tower

Initially the conveyors are operated through Mimic panel which was not reliable for operation as well as safety. So it was proposed to replace the same with latest PLC controlled panel for conveyors at both locations for reliable & safe operation with sequentially interlock logics, rope switch indication and monitoring & control of each equipment in PH plant for smooth & efficient operation of the plant.

New ABB make AC 800M series PLC based control panel with LED screen and OS has been installed at transfer tower. Pictures of OD (Operating Desk) panel, OS (Operating station) & LED Screen are shown below:

Installation of new PLC based control panel at Bagging Building:

A small PLC based was installed at Bagging building for monitoring of slat conveyor motors, P-2704/A, P-2704/B and controlling of blower K-2704/3. OS for bagging system and ES (engineering station) for complete integrated system has been installed at bagging control room. Picture are shown below:

Schedule maintenance:

Preventive maintenance of Transformer: Preventive maintenance of transformer TR-5B was carried out.

Common activity carried out during transformer maintenance is as under:

- Isolation of transformer from both side (LT & HT)
- Dismantling of HV & LV terminal box.
- Visual inspection about any leakage of oil from any part and any heated terminal.
- Measurement of earthing resistance, IR value, PI value and oil BDV.
- Testing of Buchholz relay about its function of tripping and alarm.
- Condition of silica gel was checked. Accordingly discharged silica gel was replaced
- Tightening of loose parts.
- Cleaning and washing.

Preventive maintenance of MCC:

Preventive maintenance of all the feeder compartment in MCC 4 and 4A (Old & New) was carried out.

Common activity carried out during MCC maintenance**:**

- Isolation of MCC from power source.
- General cleaning of all feeders.

- Tightness checking of all power and control cable connection.
- Checking & cleaning of contactors.
- Checking of operation of breaker in test position.
- Checking continuity and IR valve of bus bar.
- Lamp test.
- Normalization of MCC.

Overhauling of critical motors: Following motors were overhauled in B & MH plant:

Equipment Name	Description
P-2122	Conveyor
M-2110	Conveyor
M-2112	Conveyor
M-2122 A	Conveyor
M-2122 B	Conveyor
M-2137	Conveyor
M-2117	Conveyor
M-2114	Tripper Motor

Non plant

Schedule maintenance

Preventive maintenance of transformer: Preventive maintenance of, T/S-1 was carried out as per detail given below:

Common activity carried out during transformer maintenance is as under:

- Isolation of transformer from both side (LT & HT)
- Dismantling of HV & LV terminal box.
- Visual inspection about any leakage of oil from any part and any heated terminal.
- Measurement of earthing resistance, IR value, PI value and oil BDV.
- Testing of Buchholz relay about its function of tripping and alarm.
- Condition of silica gel was checked. Accordingly discharged silica gel was replaced.

TECHNICAL

AMMONIA PLANT

(TECHNICAL)

Following jobs have been carried out in Ammonia Plant

Cooling water Headers Modification Jobs :

Following cooling water header modification jobs have been carried out :

Installation of 101-JCA to 110-CA/CB 30" under ground CW header with above ground route.

Without interference to any line, line was taken over 4 newly erected column & modification in existing 4 supports. Job was completed in 11 days which otherwise could have required excavation and line laying in very intricate areas under the compressors and associated equipments.

- 110 CA / CB bypass line size increased to 20" from 12".

- CW old jump over removal & 24" Blinding at Root.
- Modification in 12" CW line interfering with 127CA/CB flushing system.

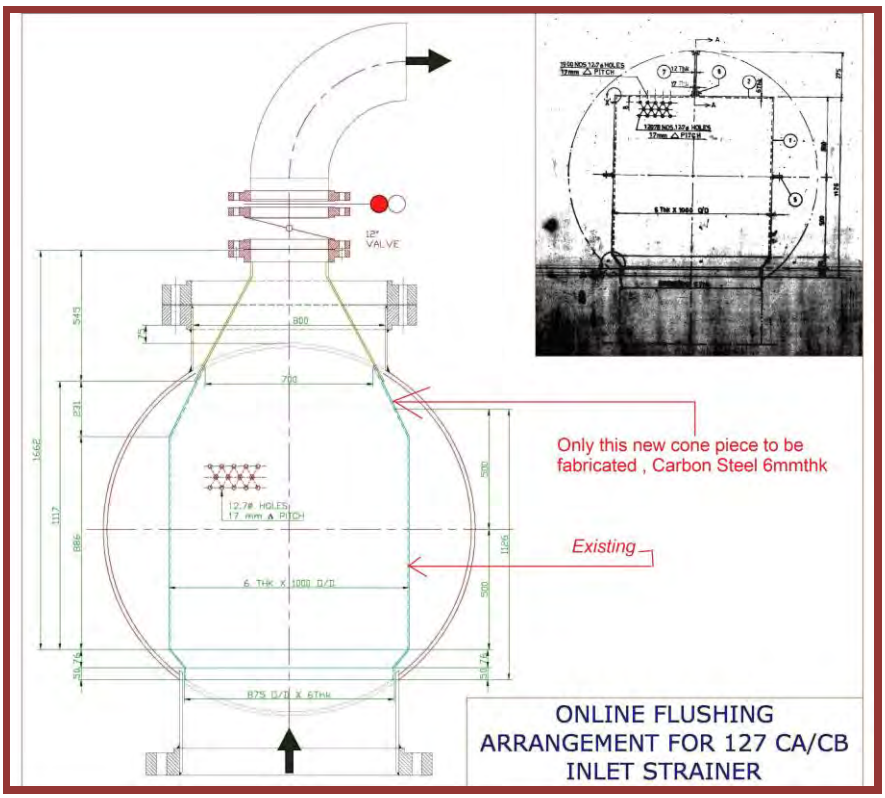
- Pump P-4401 C & D discharge line blinding at D/s of New Jump over.
- 24" Fresh Cooling Water Connection to 101 JCA with 6" u/s Drain.
- CW New Jumpover 36" Motorised Valve removal and Spool piece welding.

- CW Supply and Return of 131 JC (Air comp. 3rd stage cooler) to be routed in above Ground and size increased to 8".

- 6" bypass line with I/V in New CW Jumpover .
- Modification in 137 C Supply line for its connection with CW outlet line of 101 JCA.

- Modification in 12" size 110 CA /CB Bypass line near 101 JCA.
- Obsolete 18" CW supply line of old NG Compressor to be blinded at root.
- Obsolete 18" CW Return line of NG Compressor area to be blinded at root near 101 JCB.
- Modification in 103J /JT H P Oil Cooler CW lines for ease of movement.
- 16" Interconnection piping between 101JCA and JCB in place of existing 12".

- 101-J area Condensate Point to Overflow Pot Outlet Line replacement.
- CW Return line, 2" Vent with Isolation valves at Top and line routed to Ground with Isolation Valve for 110-CA/CB CW Return line
- Provision of online flushing of 127-CA/CB (Refrigerant condensers) inlet strainers.
- This will provide online flushing feasibility of 127-CA/CB strainers.



Installation of Liquid Nitrogen Tank (190-F)

Liquid nitrogen tank of 30000Liter capacity and 2nos of vaporisers of capacity 2000Nm^3/Hr. have been installed to create nitrogen storage facility during shutdown.

The inner shell of vessel is made of SS304 and outer shell is made of CS.

Design pressure for inner shell is 18 Bar and design temperature is -196 Deg C to 37 Deg C

Interspaced insulation is perlite under vacuum. Overall dimensions of liquid nitrogen tank are 7641mm height and 3316mm outside diameter. Overall dimensions of vaporisers are 2.1mx2.1mx5.2 m height.

- EWR A-374 : Provision of Flow Orifice of 6" size for hot liquid ammonia supply to Urea Plant . Existing 3"size line piece at discharge of 121-J/JA up to FRC-18 with new orifice meter has been replaced.
- Pump 1170-J discharge line modification job.
- EWR No. A353 : Provision of temperature indications in 101B for flue gas.
- EWR A286 : Flow orifice installation in P-2004 J Discharge line.
- EWR No. A354 : Provision of I/V along with its bypass valves across PICV-137 & PICV-139 and shifting of the above valves at a platform @ 3.0 mtr Height replacing above valves with new valves for increasing operation flexibility.
- EWR No. A364 : Installation of New PRC-4 (Syn gas compressor suction pressure CV) for increasing operation flexibility and 4" tapping with I/V as provision for H2O2 Plant.
- EWR NO. A374 : Provision of Mass Flow meter for cold ammonia flow to ammonia storage from Ammonia Plant. Mass flow meter has been installed at cold ammonia pump discharge line upstream of existing control valve (LICV-19).
- EWR No. A395 : Tappings for ONBBD water line Silica analyser for 101-F on DCS
- EWR No. A398 : Provision of 2" drain point with double isolation valve on MFPHC outlet line (P-22) to Primary reformer at lowest point.This will increase the operational flexibility of plant and safety of Primary reformer catalyst during plant start up.
- EWR No. A387 : Provision of 4" Isolation valves for PCV-44 (Tail gas vent valve)
- EWR No. A388 : Provision of isolation valves for the RV's of Tail gas and product gas in PGR Unit. 3" for PSV 181 and 1/2" for PSV 177.
- EWR No. A416 : To provide Filter and Bypass Line with Isolation valves in CW line to 101-J/105-J Lube oil coolers.

- EWR No. A335 : To provide vent valve at LTS Guard inlet bypass line.
- EWR No. A350 : To provide DP indicator at 101-J across the roll –o –matic filter for better monitoring of pressure drop and more reliable operation..
- EWR No. A358 :
- 6" CW Return header laying Aboveground and Connection to 10" Return Header Under E-W Pipe rack for users like 4"' BFW Pump / DMW Pump Area.
- 6" CW Supply header laying Aboveground from 10" Fresh Cooling Water for users like 4"' BFW Pump / DMW Pump Area
- (iii) To provide check valve at cooling water to jacket water of 101-CA/CB I/V downstream line.
- EWR No. A366 : Provision for cooling water temp. indication of 124-C & 108-C for determining heat duty across 124-C & 108-C.
- EWR No. A385 : Provision of thermocouple on 123C BFW outlet line after 123C BFW bypass line meet.
- EWR No. A 386 : Provision of thermocouple on FPHC bypass outlet line after FPHC bypass line meet.
- EWR No. A 390 : New 1" TI indication of the mixed fuel gases for arch burners of 101-B at u/s of FI-63
- EWR No. A 392 : Provision of 6" I/V's and 3" bypass valve for PICV - 10 (129-C pressure CV).
- EWR No. A 409 : To connect outlet of sample cooler C.W (Converter Area) to cooling water return header
- EWR No. A 401 : Provision of TI's at downstream piping of Process vent valve in Ammonia Plant. (6 Locations)
- EWR No. A 425 & A426 : 2 Nos , 4"- 600# gate valves welded in PICV-002 bypass line at battery limit and flapper of the check valve was removed to avoid complete stoppage of plant due to any malfunctioning.

- Reformer Structure strengthening job :
- Approx. 40 Nos , 12 thk stiffner of size 100mm x225 mm have been provided on Beams for strengthening of reformer . Cover plates of 12 thk also provided on sides of Beam.
- The Job was carried out by M/s J&J before Erection of LT coil during shutdown.
- Platform for approach to 38 ata Steam Isolation valve near Aux Boiler.

- 117-J Suction line provided with additional Globe valve.
- 110-F, 111-F & 112-F additional 1.5" HP / LP tappings on existing 1.5" tappings with Tee points for Stand pipe installation.
- LTS-11 ata line connection removed and a sample point to be provided at this cap.
- Access Platform for 103-JT Extraction line MOV(8101)
- Access Platform for 101 J Exhaust line MOV
- Access Platform for PICV-137 & PICV -139
- Reformer Structural Beams and Columns Strengthening for New LT Coil Loading.
- Installation of New Spring Supports / Spring hangers (25 Nos - for Ammonia / Urea both) replacing malfunctioning springs.
- C-2 Vent Height to be increased by about 2.5 Mtrs and outlet direction rotated.
- Erection of Walkway platform between PGR unit and 106-E Top Platform
- Access Platform for PRCV-4
- 101-J area Condensate Point to Overflow Pot Outlet Line replacement.
- CW Return line, 2" Vent with Isolation valves at Top and line routed to Ground with Isolation Valve for 110-CA/CB CW Return line
- 110-F, 111-F & 112-F additional job of line replacement as per Insp. thickness check report

UREA PLANT

(TECHNICAL)

Following jobs have been carried out in Urea Plant :

Increase in the height of Urea solution tank T-1401 & T-1401A (Total 5500 Inch Meter Cutting and 1100 Inch Meter Welding and 02 MT Structural Job)

The scheme have been implemented as under :-

- To increase capacity of urea solution tank from 175m^3 to 251m^3 , one more course of 1.8 m height has been added.
- In existing additional urea solution tank ((T-1401A) , one course of 1.8 m height has been added to increase capacity from 15 m^3 to 20 m^3 .
- Total capacity of urea solution tanks has been increased from 190 m^3 to 251m^3 i.e. 33% increase in capacity.
- With implementation of the scheme, the hold up time of urea solution tanks will increase from 2.3 to 3.0 hours @ 1780 MTPD urea production and thereby improve the operational flexibility of Urea plant.

- 20" Size Jump Over Connection with I/V between 42" Urea return header to Urea CT (CWR-4410-1050-B-13) & 30" return header to KEP CT with I/V (CW 177.01-B-20) .
- VAM supply return from New CT Supply and Return headers.
- 10" Line from VAM direct Connection with Existing 42" CW line.
- ERW No. U317 : Installation of drain with 20" Catch Pot with 6" Drain Valve in 42" CW Supply header to Urea near Hydrolyser
- EWR No. U318 : Installation of 8" I/V in CW return line of H1426.
- EWR No. U315 : HPCC Offgas 4" Line To HP Scrubber to modify with max. slope as per Casale recommendation.

- Slope of Scrubber overflow (4") to Ejector to be increased.
- PT-1201 A/B/C to be taken from D/S of NRV of Ammonia line to V-1201 for 2 of 3 logic.
- Slope at joining point of combined drain header (2") below Autoclave to be increased.
- EWR No. U288 : In HPF line to H P Scrubber , one additional I/V with drain to avoid choking on HPF line.
- 4" Nippolet & Nozzles - (2 sets) welding for DPT 1212 near Stripper (H-1201)
- EWR No. U318 : Modification in cooling water outlet line in H1423 (1st stage evaporator condenser) & H1425 (2nd stage evap. 1st condenser)

- 4" dead end Drains Welding in 20" End Flanges in Urea CW Supply and Return lines.
- EWR No. U315 : Installation of 1/2" x 1500#, Gate valves for FT 1205 & FT 1251 (02 no. valves each)
- EWR No. U285 : Provision of 1" condensate flushing sparger inside booster ejector (P-1423) for proper flushing of Ejector and therby avoid deposition of Urea polymer inside the Ejector. This will increase the operation flexibility of the evaporation section.
- EWR No. 312 : Provision of Flow Orifice in steam inlet line of H-1426
- EWR No. 320 : To provide a NRV in H-1424 steam sparger.
- Modification in P-1105 A/B discharge lines.
- Ammonia Pump-C - 6" Suction line Lowering for Eccentric Reducer (Top Flat)
- Ammonia Pump-C - Recycle Line Lowering
- Removal of CV -1101 & associated lines
- H-1250 outlet RV root I/V position to be changed towards PCS side and proper approach for easy operation to be provided.
- 6" Drain at U/s of 20 " Butterfly Valve in CW Line connected to 30" header (Existing)

OFFSITE & UTILITY PLANT

(ELECTRICAL)

Following jobs have been carried out in Utility Plant :

- Urea CT return header riser height increase by 700 mm.
- 6" & 4" dead end drains for horizontal headers of return risers in CT area
- 101 JCB to Old CT 30 " return Header (Part line- 22 mtrs) replacement in CT area.

- Installation of 48" Butterfly valves in 52" UG CW header in pit near New CT &
- 20" Manhole at d/s of valve and 4" Size Bottom Drain.
- Installation of 48" Butterfly valves in 52" UG CW header in Pit near C/D pump Sump.
- Provision for Installation of 4401E Standby Pump Installation in Pump Discharge Line:
- 28” Line connection for future provision of stand by pump at New CT area have been done and 28”butterfly valve has been installed.

EWR No. CW-108 : Replacement of sand filter with VAG filter in Urea cooling Tower :-

In urea CT there was one sand filter and no VAG filter. The existing sand filter have been replaced by new VAG filter. Foundation was ready before shutdown

and 10” tapping taken during shutdown. VAG filter and installation work was continue for few more days after completion of shutdown.

The total height of VAG tank is 4500mm and ID is 4212mm with shell and bottom plate made of SS304 material.

With new VAG filter backwashing is done automatically and problem of sand escaping to CT basins has been removed.

EWR No. CW-109 : Additional sulphuric acid system at new CT : -

As per above EWR additional sulphuric acid system (which include a buffer storage tank (T-4410), an unloading pump (P-4401), a bulk storage tank (T-4405) and a control valve (PIH-4405) for dosing have been installed for smooth control of cooling water PH.

Foundation were made ready before shutdown and job was continue after completion of shutdown being a running job.

Scouring pit for following headers have been provided:

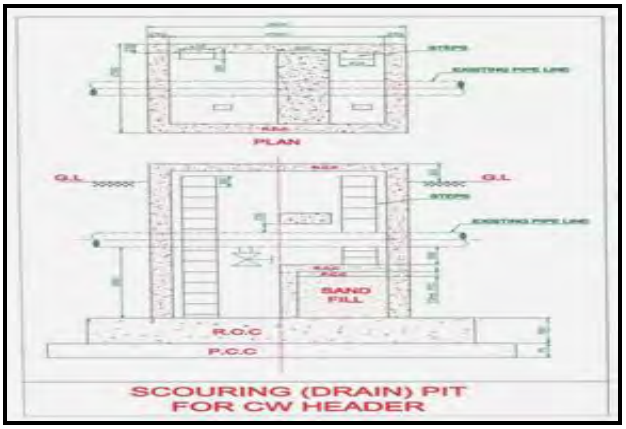
CW Pump 4401A/B discharge to Ammonia plant

Common pit for Ammonia return headers.

Pump 4401C/D discharge

Pump 4402/4403 discharge to Urea

Urea return header



- Bottom Drain and manhole in Pit for 48" Amm. Plant Supply Header .
- Bottom Drain and manhole in Pit for 48" Amm. Plant Return Header.
- Bottom Drain and manhole in Pit for 36" Pump - C / D Discharge Header to Ammonia.
- Bottom Drain and manhole in pit for CW return from 101-JCB (30"-HW-51-750)
- Installation of Air Release valves with Isolation Valve at following places for faster air removal and thus safer cooling water charging :
  - Pump C/D discharge header
  - Over jumpover in Ammonia battery limit
  - H-1425 to H-1423 CW line
  - H-1423 CW outlet line
- Magnetic Flowmeter Provision in D Pump Discharge Line near GAIL Metering Station.
- Corroded CW pipe lines near basins to be replaced with SS
- 3" Ammonia Cond. Polisher CW line with 4" SS Road Crossing for CT surface Condenser line connection.
- 3" Cooling Tower Surface Condenser line Connection to U/G Road Crossing line.
- 2" Lines at u/s of New Bottom Drains in pits to be brought above ground with additional Isolation valve for avoiding stagnation zone.
- 18" Surface Condenser Line to Return Header REROUTING to avoid interference with 30" 101 JCB return header. (Some pipe segments also observed very low in thickness)
- 14" Redundant underground header passing over 101 JCB return line removal with associated lines (sand filter connections)
- Connection of BFW Coil (APH) RV d/s line to West Side Drain.

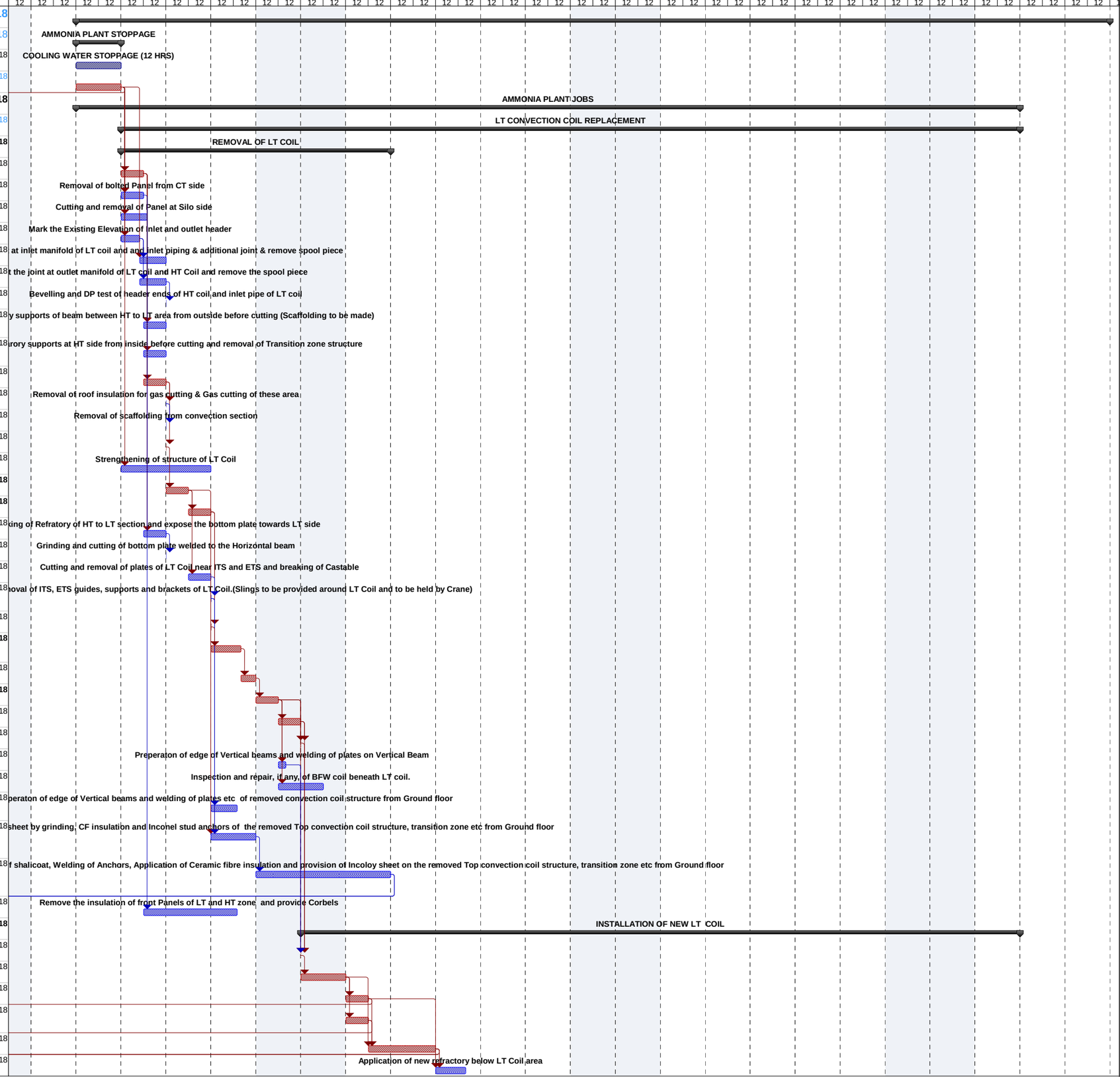
- Re-routing of all pipelines under bagging feed conveyor (M-2121)
- ¾" tapping provided in Gallery area from new Plant air line.

BAR CHART

MASTER BAR CHART OF ANNUAL TURNARROUND-2018

Date : 01.08.2018

ID	Task Name	Duration	Start	Finish
1	**SHUTDOWN JOBS 2018**	**22.88 days**	**Tue 9/18/18**	**Thu 10/11/18**
2	**AMMONIA PLANT STOPPAGE**	1 day	Tue 9/18/18	Wed 9/19/18
3	COOLING WATER STOPPAGE (12 HRS)	12 hrs	Tue 9/18/18	Tue 9/18/18
4	STEAM STOPPAGE (24 HRS)	1 day	Tue 9/18/18	Wed 9/19/18
5	**AMMONIA PLANT JOBS**	**20.46 days**	**Tue 9/18/18**	**Mon 10/8/18**
6	LT CONVECTION COIL REPLACEMENT	19.46 days	Wed 9/19/18	Mon 10/8/18
7	**REMOVAL OF LT COIL**	**5.42 days**	**Wed 9/19/18**	**Mon 9/24/18**
8	Manhole opening and entry into LT convection section	4 hrs	Wed 9/19/18	Wed 9/19/18
9	Removal of bolted Panel from CT side	4 hrs	Wed 9/19/18	Wed 9/19/18
10	Cutting and removal of Panel at Silo side	6 hrs	Wed 9/19/18	Wed 9/19/18
11	Mark the Existing Elevation of Inlet and outlet header	2 hrs	Wed 9/19/18	Wed 9/19/18
12	Cut the joint at inlet manifold of LT coil and and inlet piping & a	10 hrs	Wed 9/19/18	Wed 9/19/18
13	Cut the joint at outlet manifold of LT coil and HT Coil and remo	10 hrs	Wed 9/19/18	Wed 9/19/18
14	Bevelling and DP test of header ends of HT coil and inlet pipe	8 hrs	Wed 9/19/18	Thu 9/20/18
15	Providing temparory supports of beam between HT to LT area from outside before cutting (Scaffolding to be made)	10 hrs	Wed 9/19/18	Wed 9/19/18
16	Providing temparory supports at HT side from inside before cutting and removal of Transition zone structure	6 hrs	Wed 9/19/18	Wed 9/19/18
17	Erection of scaffolding inside convection section	8 hrs	Wed 9/19/18	Wed 9/19/18
18	Removal of roof insulation for gas cutting & Gas cutting of thes	6 hrs	Wed 9/19/18	Thu 9/20/18
19	Removal of scaffolding from convection section	6 hrs	Thu 9/20/18	Thu 9/20/18
20	Removal of bolted baffle plate and angle and shifting to ground	4 hrs	Wed 9/19/18	Thu 9/20/18
21	Strengthening of structure of LT Coil	2 days	Wed 9/19/18	Fri 9/21/18
22	**Gas cutting and removal of complete transition zone and s**	**12 hrs**	**Thu 9/20/18**	**Thu 9/20/18**
23	**Cutting and removal of roof above LT Coil and shifting to g**	**8 hrs**	**Thu 9/20/18**	**Thu 9/20/18**
24	Breaking of Refratory of HT to LT section and expose the botto	8 hrs	Wed 9/19/18	Wed 9/19/18
25	Grinding and cutting of bottom plate welded to the Horizontal b	4 hrs	Wed 9/19/18	Thu 9/20/18
26	Cutting and removal of plates of LT Coil near ITS and ETS and	10 hrs	Thu 9/20/18	Thu 9/20/18
27	Cutting and removal of ITS, ETS guides, supports and brackets of LT Coil.(Slings to be provided around LT Coil and to be held by Crane)	8 hrs	Thu 9/20/18	Fri 9/21/18
28	Cutting and removal of top roof of header box and side plate be	8 hrs	Thu 9/20/18	Fri 9/21/18
29	**Lifting of LT coil alongwith ITS ETS and Manifolds and shifting the same on the trailer for shifting.**	**12 hrs**	**Fri 9/21/18**	**Fri 9/21/18**
30	Cut the structure of both sides (South & North) of LT Coil (Vert	12 hrs	Fri 9/21/18	Sat 9/22/18
31	**Lifting of both South and North Walls of LT Coil by Crane**	**8 hrs**	**Sat 9/22/18**	**Sat 9/22/18**
32	Welding of Horizontal Channels on existing structure at the req	6 hrs	Sat 9/22/18	Sat 9/22/18
33	Welding of Horizontal Channels on existing structure at the req	6 hrs	Sat 9/22/18	Sun 9/23/18
34	Preperaton of edge of Vertical beams and welding of plates on Vertical Beam	4 hrs	Sat 9/22/18	Sat 9/22/18
35	Inspection and repair, if any, of BFW coil beneath LT coil.	24 hrs	Sat 9/22/18	Sun 9/23/18
36	Preperaton of edge of Vertical beams and welding of plates etc of removed convection coil structure from Ground floor	8 hrs	Fri 9/21/18	Fri 9/21/18
37	Removal of old Inconel sheet by grinding, CF insulation and Inconel stud anchors of the removed Top convection coil structure, transition zone etc from Ground floor	24 hrs	Fri 9/21/18	Sat 9/22/18
38	Cleaning, Applicaton of shalicoat, Welding of Anchors, Application of Ceramic fibre insulation and provision of Incoloy sheet on the removed Top convection coil structure, transition zone etc from Ground floor	60 hrs	Sat 9/22/18	Mon 9/24/18
39	Remove the insulation of front Panels of LT and HT zone and provide Corbels	50 hrs	Wed 9/19/18	Fri 9/21/18
40	**INSTALLATION OF NEW LT COIL**	**15.79 days**	**Sun 9/23/18**	**Mon 10/8/18**
41	Rigging arrangement for lifting of new coil.	4 hrs	Sun 9/23/18	Sun 9/23/18
42	**Erection of New Convection coil Module**	24 hrs	Sun 9/23/18	Mon 9/24/18
43	Alignment of Convection module by water level and Piano wire	8 hrs	Mon 9/24/18	Mon 9/24/18
44	Check the Elevation of Inlet and outlet manifold . Inlet manifold elevation shall be the same and outlet manifold as per drg	8 hrs	Mon 9/24/18	Mon 9/24/18
45	Welding of Convection module after proper levelling of comple	36 hrs	Mon 9/24/18	Wed 9/26/18
46	Application of new refractory below LT Coil area	16 hrs	Wed 9/26/18	Wed 9/26/18



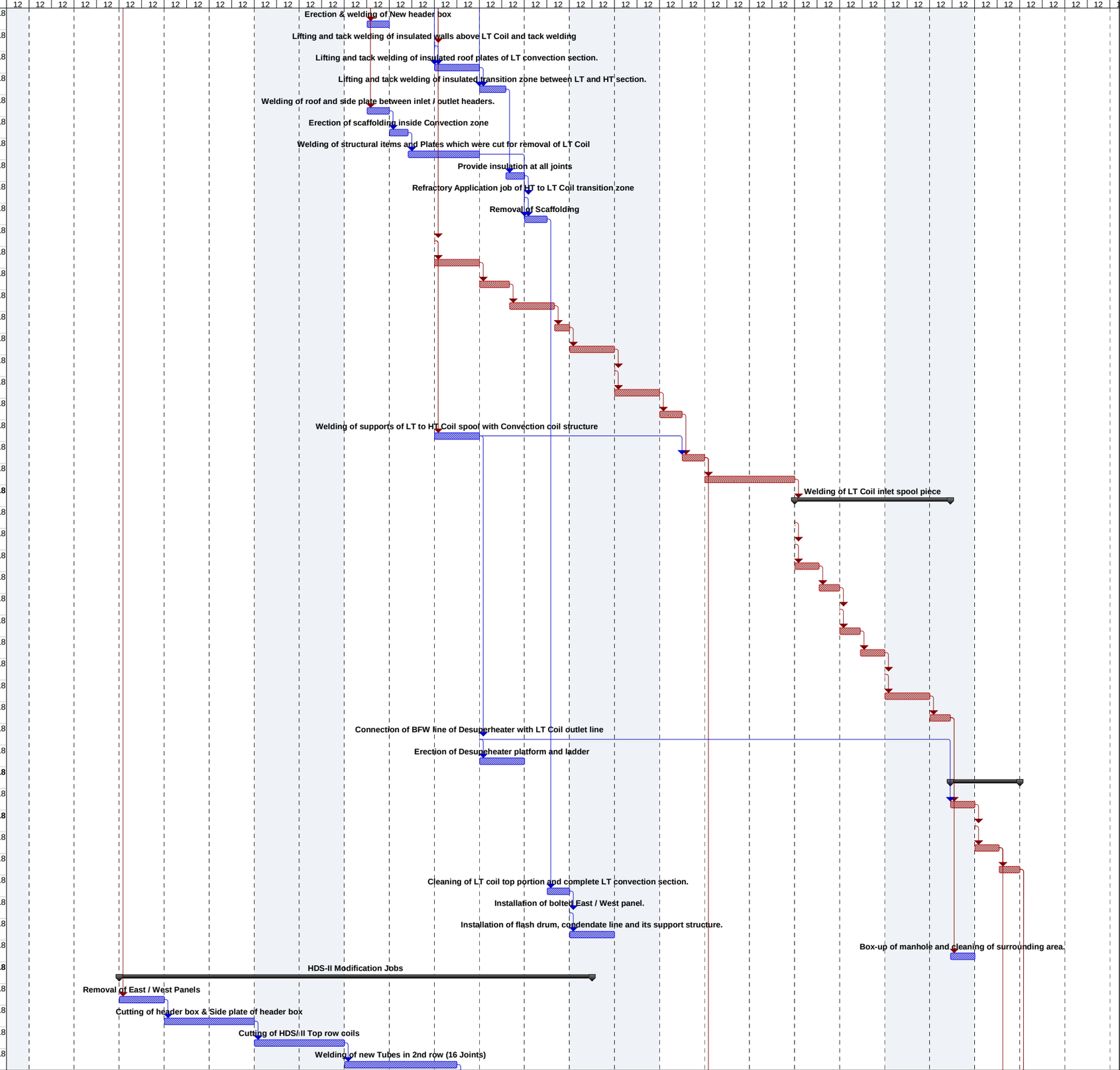
Project: 101 CA & 101CB Replacemen
Date: Fri 9/7/18

Task	Summary	Rolled Up Milestone	Project Summary	Inactive Milestone	Duration-only	Start-only	Critical Split				
Split	Rolled Up Task	Rolled Up Progress	External Milestone	Inactive Summary	Manual Summary Rollup	Finish-only	Progress				
Milestone	Rolled Up Split	External Tasks	Inactive Task	Manual Task	Manual Summary	Critical	Deadline				

MASTER BAR CHART OF ANNUAL TURNARROUND-2018

Date : 01.08.2018

ID	Task Name	Duration	Start	Finish
47	Erection & welding of New header box	12 hrs	Mon 9/24/18	Tue 9/25/18
48	Lifting and tack welding of insulated walls above LT Coil and ta	6 hrs	Wed 9/26/18	Wed 9/26/18
49	Lifting and tack welding of insulated roof plates of LT convection section.	16 hrs	Wed 9/26/18	Wed 9/26/18
50	Lifting and tack welding of insulated transition zone between LT and HT section.	16 hrs	Wed 9/26/18	Thu 9/27/18
51	Welding of roof and side plate between inlet / outlet headers.	16 hrs	Mon 9/24/18	Tue 9/25/18
52	Erection of scaffolding inside Convection zone	6 hrs	Tue 9/25/18	Tue 9/25/18
53	Welding of structural items and Plates which were cut for removal of LT Coil	36 hrs	Tue 9/25/18	Wed 9/26/18
54	Provide insulation at all joints	10 hrs	Thu 9/27/18	Fri 9/28/18
55	Refractory Application job of HT to LT Coil transition zone	6 hrs	Fri 9/28/18	Fri 9/28/18
56	Removal of Scaffolding	6 hrs	Fri 9/28/18	Fri 9/28/18
57	Fit up of Outlet manifold with prefabricated spool piece of LT to	4 hrs	Wed 9/26/18	Wed 9/26/18
58	Root run of Fit up Joints.	24 hrs	Wed 9/26/18	Thu 9/27/18
59	DP test and 100 % radiography of all root runs.	12 hrs	Thu 9/27/18	Thu 9/27/18
60	Final welding of all joints.	24 hrs	Thu 9/27/18	Fri 9/28/18
61	DP test hardness measurement and 100% radiography of all fi	12 hrs	Fri 9/28/18	Sat 9/29/18
62	Repairs in welding, if any.	16 hrs	Sat 9/29/18	Sat 9/29/18
63	Preparation for stress relieving of welded joints.	12 hrs	Sat 9/29/18	Sun 9/30/18
64	Stress Relieving of all welded joints (Reports to be submitted t	24 hrs	Sun 9/30/18	Mon 10/1/18
65	Radiography and Hardness measurement of final welds.	4 hrs	Mon 10/1/18	Mon 10/1/18
66	Welding of supports of LT to HT Coil spool with Convection coil structure	24 hrs	Wed 9/26/18	Thu 9/27/18
67	Welding of Blowing arrangemet at LT Coil inlet line and provide	6 hrs	Mon 10/1/18	Mon 10/1/18
68	**Steam Blowing after providing target plate**	48 hrs	Mon 10/1/18	Wed 10/3/18
69	**Welding of LT Coil inlet spool piece**	**3.71 days**	**Wed 10/3/18**	**Sun 10/7/18**
70	After Target plate is cleared, removal of blowing arrangeme	3 hrs	Wed 10/3/18	Wed 10/3/18
71	Fit up of spool piece at LT Coil inlet (2 joints)	4 hrs	Wed 10/3/18	Thu 10/4/18
72	Root run of Fit up Joints.	12 hrs	Thu 10/4/18	Thu 10/4/18
73	DP test and 100 % radiography of all root runs.	6 hrs	Thu 10/4/18	Thu 10/4/18
74	Final welding of all joints.	12 hrs	Thu 10/4/18	Fri 10/5/18
75	DP test hardness measurement and 100% radiography of a	4 hrs	Fri 10/5/18	Fri 10/5/18
76	Repairs in welding, if any.	12 hrs	Fri 10/5/18	Fri 10/5/18
77	Preparation for stress relieving of welded joints.	8 hrs	Fri 10/5/18	Sat 10/6/18
78	Stress Relieving of all welded joints (Reports to be submitt	24 hrs	Sat 10/6/18	Sun 10/7/18
79	Radiography and Hardness measurement of final welds.	4 hrs	Sun 10/7/18	Sun 10/7/18
80	Connection of BFW line of Desuperheater with LT Coil outlet line	4 hrs	Thu 9/27/18	Thu 9/27/18
81	Erection of Desupeheater platform and ladder	16 hrs	Thu 9/27/18	Fri 9/28/18
82	**Hydrotest of HP Loop-IBR witness**	**1.33 days**	**Sun 10/7/18**	**Mon 10/8/18**
83	DM Water filling in HP system	6 hrs	Sun 10/7/18	Sun 10/7/18
84	Pressurising the water upto 145 Kg/ Cm2(Hydrotest Pressu	**6 hrs**	**Sun 10/7/18**	**Sun 10/7/18**
85	Departmental Hydrotest	14 hrs	Sun 10/7/18	Mon 10/8/18
86	Hydrotest in presence of IBR Inspector(IBR)	6 hrs	Mon 10/8/18	Mon 10/8/18
87	Cleaning of LT coil top portion and complete LT convection sec	8 hrs	Fri 9/28/18	Fri 9/28/18
88	Installation of bolted East / West panel.	10 hrs	Fri 9/28/18	Sat 9/29/18
89	Installation of flash drum, condendate line and its support struc	24 hrs	Sat 9/29/18	Sun 9/30/18
90	Box-up of manhole and cleaning of surrounding area.	10 hrs	Sun 10/7/18	Sun 10/7/18
91	**HDS-II Modification Jobs**	**10.17 days**	**Wed 9/19/18**	**Sat 9/29/18**
92	Removal of East / West Panels	10 hrs	Wed 9/19/18	Wed 9/19/18
93	Cutting of header box & Side plate of header box	48 hrs	Wed 9/19/18	Fri 9/21/18
94	Cutting of HDS/ II Top row coils	54 hrs	Fri 9/21/18	Mon 9/24/18
95	Welding of new Tubes in 2nd row (16 Joints)	60 hrs	Mon 9/24/18	Wed 9/26/18



Project: 101 CA & 101CB Replacemen
Date: Fri 9/7/18

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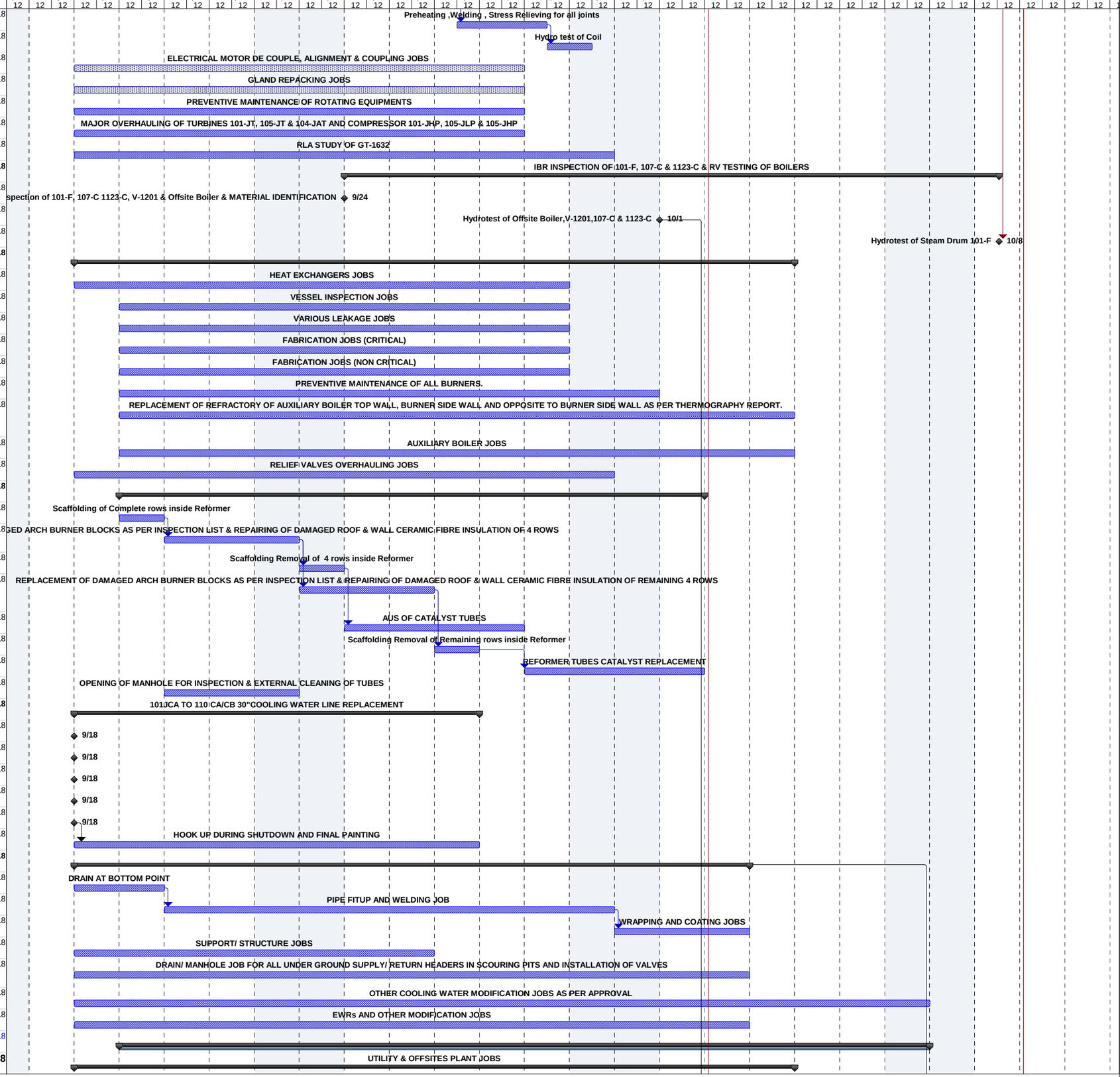
MASTER BAR CHART OF ANNUAL TURNARROUND-2018

Date : 01.08.2018

ID	Task Name	Duration	Start	Finish
96	Preheating ,Welding , Stress Relieving for all joints	48 hrs	Wed 9/26/18	Fri 9/28/18
97	Hydro test of Coil	24 hrs	Fri 9/28/18	Sat 9/29/18
98	ELECTRICAL MOTOR DE COUPLE, ALIGNMENT & COUPLING JOBS	10 days	Tue 9/18/18	Fri 9/28/18
99	GLAND REPACKING JOBS	10 days	Tue 9/18/18	Fri 9/28/18
100	PREVENTIVE MAINTENANCE OF ROTATING EQUIPMENTS	10 days	Tue 9/18/18	Fri 9/28/18
101	MAJOR OVERHAULING OF TURBINES 101-JT, 105-JT & 104-JAT AND COMPRESSOR 101-JHP, 105-JLP & 105-JHP	10 days	Tue 9/18/18	Fri 9/28/18
102	RLA STUDY OF GT-1632	12 days	Tue 9/18/18	Sun 9/30/18
103	**IBR INSPECTION OF 101-F, 107-C & 1123-C & RV TESTING OF BOILERS**	**14.21 days**	**Mon 9/24/18**	**Mon 10/8/18**
104	Open Inspection of 101-F, 107-C 1123-C, V-1201 & Offsite Boiler & MATERIAL IDENTIFICATION	0 days	Mon 9/24/18	Mon 9/24/18
105	Hydrotest of Offsite Boiler,V-1201,107-C & 1123-C	0 days	Mon 10/1/18	Mon 10/1/18
106	Hydrotest of Steam Drum 101-F	0 days	Mon 10/8/18	Mon 10/8/18
107	**OTHER JOBS IN AMMONIA PLANT**	**16 days**	**Tue 9/18/18**	**Thu 10/4/18**
108	HEAT EXCHANGERS JOBS	11 days	Tue 9/18/18	Sat 9/29/18
109	VESSEL INSPECTION JOBS	10 days	Wed 9/19/18	Sat 9/29/18
110	VARIOUS LEAKAGE JOBS	10 days	Wed 9/19/18	Sat 9/29/18
111	FABRICATION JOBS (CRITICAL)	10 days	Wed 9/19/18	Sat 9/29/18
112	FABRICATION JOBS (NON CRITICAL)	10 days	Wed 9/19/18	Sat 9/29/18
113	PREVENTIVE MAINTENANCE OF ALL BURNERS.	12 days	Wed 9/19/18	Mon 10/1/18
114	**REPLACEMENT OF REFRACTORY OF AUXILIARY BOILER TOP WALL, BURNER SIDE WALL AND OPPOSITE TO BURNER SIDE WALL AS PER THERMOGRAPHY REPORT.**	15 days	Wed 9/19/18	Thu 10/4/18
115	AUXILIARY BOILER JOBS	15 days	Wed 9/19/18	Thu 10/4/18
116	RELIEF VALVES OVERHAULING JOBS	12 days	Tue 9/18/18	Sun 9/30/18
117	**PRIMARY REFORMER RADIANT ZONE JOBS**	**13 days**	**Wed 9/19/18**	**Tue 10/2/18**
118	Scaffolding of Complete rows inside Reformer	24 hrs	Wed 9/19/18	Thu 9/20/18
119	REPLACEMENT OF DAMAGED ARCH BURNER BLOCKS AS PER INSPECTION LIST & REPAIRING OF DAMAGED ROOF & WALL CERAMIC FIBRE INSULATION OF 4 ROWS	3 days	Thu 9/20/18	Sun 9/23/18
120	Scaffolding Removal of 4 rows inside Reformer	24 hrs	Sun 9/23/18	Mon 9/24/18
121	REPLACEMENT OF DAMAGED ARCH BURNER BLOCKS AS PER INSPECTION LIST & REPAIRING OF DAMAGED ROOF & WALL CERAMIC FIBRE INSULATION OF REMAINING 4 ROWS	3 days	Sun 9/23/18	Wed 9/26/18
122	AUS OF CATALYST TUBES	4 days	Mon 9/24/18	Fri 9/28/18
123	Scaffolding Removal of Remaining rows inside Reformer	24 hrs	Wed 9/26/18	Thu 9/27/18
124	REFORMER TUBES CATALYST REPLACEMENT	4 days	Fri 9/28/18	Tue 10/2/18
125	OPENING OF MANHOLE FOR INSPECTION & EXTERNAL CLEANING OF TUBES	3 days	Thu 9/20/18	Sun 9/23/18
126	**101JCA TO 110 CA/CB 30"COOLING WATER LINE REPLACEMENT**	**9 days**	**Tue 9/18/18**	**Thu 9/27/18**
127	PIPE PREFABRICATION JOBS (PREFABRICATION JOBS)	0 days	Tue 9/18/18	Tue 9/18/18
128	GRIT BLASTING/ PRIMER PAINTING (PREFABRICATION JOBS)	0 days	Tue 9/18/18	Tue 9/18/18
129	STRUCTURE COLUMNS JOBS ON CIVIL FOUNDATION (PREFABRICATION JOBS)	0 days	Tue 9/18/18	Tue 9/18/18
130	CIVIL FOUNDATION (PREFABRICATION JOBS)	0 days	Tue 9/18/18	Tue 9/18/18
131	PIPE ERECTION EXCEPT AT END HOOK UP PARTS. (PREFABRICATION JOBS)	0 days	Tue 9/18/18	Tue 9/18/18
132	HOOK UP DURING SHUTDOWN AND FINAL PAINTING	9 days	Tue 9/18/18	Thu 9/27/18
133	**30"CW RETURN LINE PART REPLACEMENT FOR 101JCB TO OL**	**15 days**	**Tue 9/18/18**	**Wed 10/3/18**
134	DRAIN AT BOTTOM POINT	2 days	Tue 9/18/18	Thu 9/20/18
135	PIPE FITUP AND WELDING JOB	10 days	Thu 9/20/18	Sun 9/30/18
136	WRAPPING AND COATING JOBS	3 days	Sun 9/30/18	Wed 10/3/18
137	SUPPORT/ STRUCTURE JOBS	8 days	Tue 9/18/18	Wed 9/26/18
138	**DRAIN/ MANHOLE JOB FOR ALL UNDER GROUND SUPPLY/ RETURN HEADERS IN SCOURING PITS AND INSTALLATION OF VALVES**	15 days	Tue 9/18/18	Wed 10/3/18
139	**OTHER COOLING WATER MODIFICATION JOBS AS PER APPROVAL**	19 days	Tue 9/18/18	Sun 10/7/18
140	**EWRs AND OTHER MODIFICATION JOBS**	15 days	Tue 9/18/18	Wed 10/3/18
141	UREA PLANT JOBS	18 days	Wed 9/19/18	Sun 10/7/18
200	**UTILITY & OFFSITES PLANT JOBS**	**16 days**	**Tue 9/18/18**	**Thu 10/4/18**



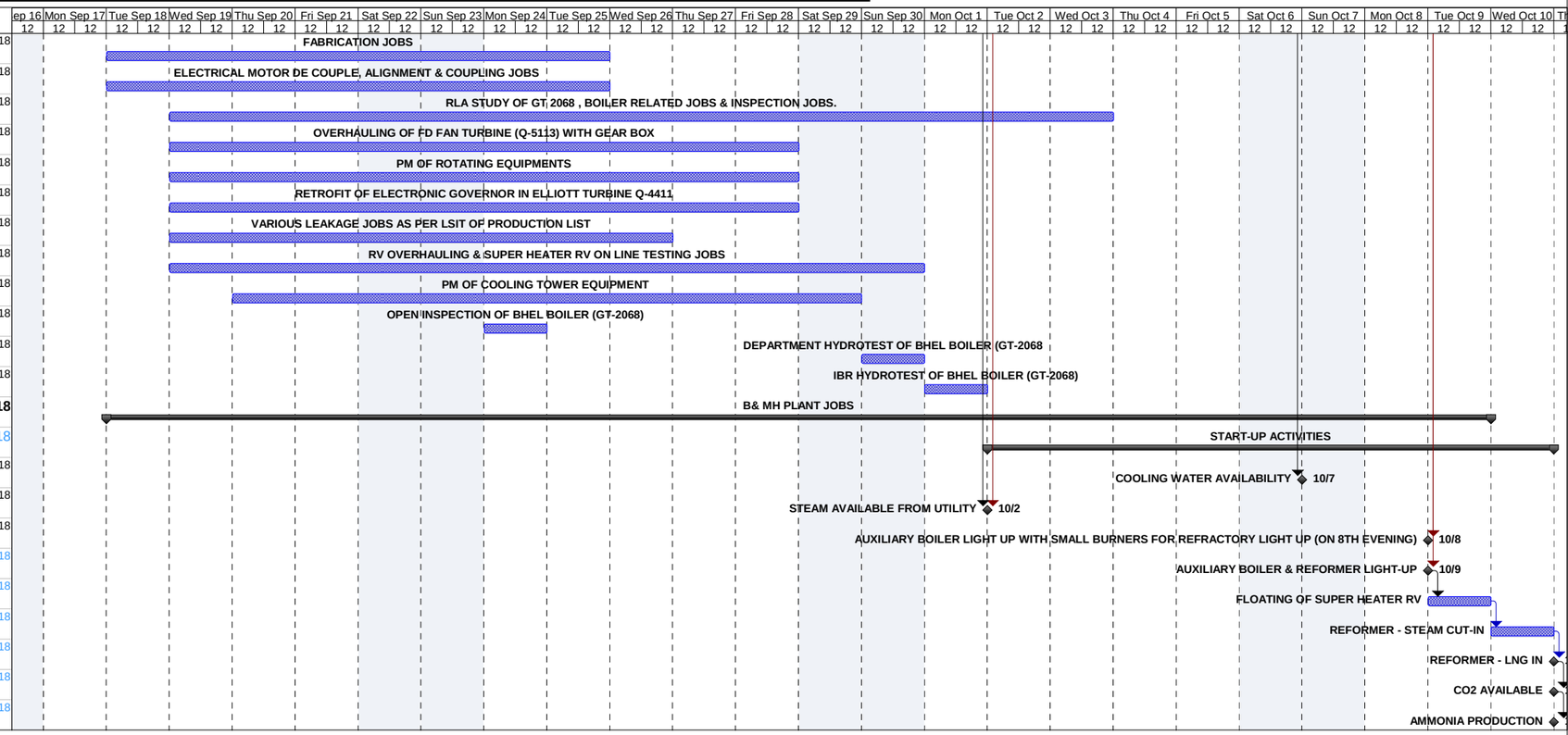
Project: 101 CA & 101CB Replacemen
Date: Fri 9/7/18

Task · Split · Milestone · Summary · Rolled Up Task · Rolled Up Split · Rolled Up Milestone · Rolled Up Progress · External Tasks · Project Summary · External Milestone · Inactive Task · Inactive Milestone · Inactive Summary · Manual Task · Duration-only · Manual Summary Rollup · Manual Summary · Start-only · Finish-only · Critical · Critical Split · Progress · Deadline

MASTER BAR CHART OF ANNUAL TURNARROUND-2018

Date : 01.08.2018

ID	Task Name	Duration	Start	Finish
201	FABRICATION JOBS	8 days	Tue 9/18/18	Wed 9/26/18
202	ELECTRICAL MOTOR DE COUPLE, ALIGNMENT & COUPLING JOBS	8 days	Tue 9/18/18	Wed 9/26/18
203	RLA STUDY OF GT 2068 , BOILER RELATED JOBS & INSPECTION JOBS.	15 days	Wed 9/19/18	Thu 10/4/18
204	OVERHAULING OF FD FAN TURBINE (Q-5113) WITH GEAR BOX	10 days	Wed 9/19/18	Sat 9/29/18
205	PM OF ROTATING EQUIPMENTS	10 days	Wed 9/19/18	Sat 9/29/18
206	RETROFIT OF ELECTRONIC GOVERNOR IN ELLIOTT TURBINE Q-4411	10 days	Wed 9/19/18	Sat 9/29/18
207	VARIOUS LEAKAGE JOBS AS PER LSIT OF PRODUCTION LIST	8 days	Wed 9/19/18	Thu 9/27/18
208	RV OVERHAULING & SUPER HEATER RV ON LINE TESTING JOBS	12 days	Wed 9/19/18	Mon 10/1/18
209	PM OF COOLING TOWER EQUIPMENT	10 days	Thu 9/20/18	Sun 9/30/18
210	OPEN INSPECTION OF BHEL BOILER (GT-2068)	1 day	Mon 9/24/18	Tue 9/25/18
211	DEPARTMENT HYDROTEST OF BHEL BOILER (GT-2068	1 day	Sun 9/30/18	Mon 10/1/18
212	IBR HYDROTEST OF BHEL BOILER (GT-2068)	0.5 days	Mon 10/1/18	Mon 10/1/18
213	**B& MH PLANT JOBS**	**22 days**	**Tue 9/18/18**	**Wed 10/10/18**
231	START-UP ACTIVITIES	8.88 days	Tue 10/2/18	Thu 10/11/18
232	COOLING WATER AVAILABILITY	0 hrs	Sun 10/7/18	Sun 10/7/18
233	STEAM AVAILABLE FROM UTILITY	0 hrs	Tue 10/2/18	Tue 10/2/18
234	AUXILIARY BOILER LIGHT UP WITH SMALL BURNERS FOR REFRACTORY LIGHT UP (ON 8TH EVENING)	0 days	Mon 10/8/18	Mon 10/8/18
235	AUXILIARY BOILER & REFORMER LIGHT-UP	0 hrs	Tue 10/9/18	Tue 10/9/18
236	FLOATING OF SUPER HEATER RV	24 hrs	Tue 10/9/18	Wed 10/10/18
237	REFORMER - STEAM CUT-IN	24 hrs	Wed 10/10/18	Thu 10/11/18
238	REFORMER - LNG IN	0 hrs	Thu 10/11/18	Thu 10/11/18
239	CO2 AVAILABLE	0 hrs	Thu 10/11/18	Thu 10/11/18
240	AMMONIA PRODUCTION	0 hrs	Thu 10/11/18	Thu 10/11/18



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Task	Summary	Rolled Up Milestone	Project Summary	Inactive Milestone	Duration-only	Start-only	Critical Split
Split	Rolled Up Task	Rolled Up Progress	External Milestone	Inactive Summary	Manual Summary Rollup	Finish-only	Progress
Milestone	Rolled Up Split	External Tasks	Inactive Task	Manual Task	Manual Summary	Critical	Deadline