MTC / REPORT / 01

REPORT NO. 35 / 2015

IFFCO

Wholly owned by Cooperatives

KALOL UNIT

PLANT TURNAROUND REPORT

(MARCH – APRIL – 2015)

INDIAN FARMERS FERTILISER CO – OPERATIVE LIMITED

INDEX

PREFACE

The Annual Plant Turnaround for the year 2015 was taken from 01st of April, 2015 to 12th of April, 2015. In addition to routine Preventive maintenance jobs of Static & Rotary equipments, Statutory IBR inspection, maintenance of Electrical & Instrument systems, Civil related jobs, several major Retrofitting and Replacement jobs in plant were carried out during shutdown.

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 01st April 2015. This shutdown report contains Plant wise and section wise details of the jobs carried out. Ammonia plant was re started and regular production was lined up at 15.30 Hrs. on 12th April, 2015. Similarly Urea plant was restarted and production was resumed at 21.50 Hrs. on 12th April, 2015.

Major jobs like overhauling of 101-J Air compressor HP case, 103-JAT Turbine, 115-JB pump , 115-JBT Pump drive Turbine, 107-J/JT and preventive maintenance of other rotary equipment was carried out in Ammonia Plant. Heat exchanger 101-CA Tube Bundle was replaced. In Urea plant preventive Maintenance of Hitachi compressor train was carried out. In LP Carbamate condenser (H-1205) IRIS inspection was carried out, Baffle locking arrangement is provided to arrest flow induced vibrations resulting in tube leakages and leaky tubes were plugged. In Offsite/Utility plants, IBR inspection of BHEL Boiler (GT-2068) was done.

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 before the scheduled period for Ammonia Plant and Urea Plant.

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

Major jobs carried out during shutdown are as under.

MECHANICAL

❖ AMMONIA

- Major overhauling of Syn gas compressor drive turbine 103 JAT
- Major overhauling of Semi lean solution pump drive turbine and Pump (115- JBT & 115-JB)
- Major Overhauling of 101-JHP Air compressor
- Replacement of tube bundle of 101-CA Waste heat boiler.
- Replacement of common minimum flow line of semi lean solution pumps, 115 J & 115 JA and split stream solution pumps, 116 J & 116 JA.
- Major overhauling of Re-cycle gas compressor, 117-J.
- Auxiliary boiler West side wall refractory replaced.

❖ UREA

- Preventive maintenance of LP Case (K-1801-1), HP case (K-1801-2), drive turbine (Q-1801) & Gear box (M-1801) were carried out
- Overhauling of Pilot valve of main steam (60 ata), extraction steam (23 ata) and induction steam (4 ata) and NRV (23 ata).
- Major overhauling of lube oil turbine (Q-1814)
- Replacement of shaft of exhaust air fan, K-1702
- Helium leak detection and repairing of Autoclave V-1201 was carried out.
- Eddy current testing of tubes of H-1201.
- Air testing and Eddy current testing of HP Condenser H-1202 was carried out.
- IRIS inspection of LP Carbamate condenser (H-1205) tubes & Baffle locking.
- Replacement of steam Condensate lines (up to elevation of 75.0 mtr.) in Urea Plant.
- Replacement of existing corroded CS steam tracing lines of High Pressure Lines.
- Replacement and modification in CCS-I line at First Floor.
- Modification in Ammonia Supply Line Loop at 1st Floor.
- Modification in Off Gas RV Platform and Platform behind the HP Scrubber.
- Replacement of both bearing of Prill tower ID Fan (K-1401/1, K-1401/2 and K-1401/4).
- IBR inspection of 4 ata steam drum V-1501.
- LP Vessels inspection was carried out and necessary repairs were undertaken as per inspection findings.

❖ OFFSITE & UTILITY

- Preventive Maintenance of Cooling Water Pumps and Turbines, BFW Pumps and Turbines.
- Preventive Maintenance of FD Fan (K-5113) Train
- Checking & overhauling of FD Fan Dampers.
- IBR inspection of BHEL Boiler (GT-2068)
- Overhauling of 900 MM Discharge I/V of P-4403 and P-4401/C.
- Overhauling of all cooling tower distribution valves.
- Inspection & Repairing of 52'' inch CW interconnection tunnel.
- Overhauling of check valve for cooling water pump, P-4411 E
- Insitu refurbishment of gate valve, 900mm NB x 150#, at Pump P-4403 common discharge line (towards Urea plant) and gate valve, 700mm NB x 150#, at Pump P-4403 common discharge line (towards ammonia plant)
- Replacement of Sintex make partition wall in Ammonia 4-5 & 5-6 cooling tower cells.
- Repairing of structural members of cooling towers.
- Welding of SS304 Patch Plate on Jump over line of CW supply header to ammonia CW circuit
- Rerubber lining of stripped process condensate (SPC) unit

❖ **B&MH**

Following jobs were carried out in B&MH.

- Replaced the Complete length of conveyor belt with new oil & heat resistance Conveyor belt in M 2121.
- Installation of tru trac trough rollers for arresting off centering of conveyor belt in M-2110 and M-2112 conveyor.
- Preventive maintenance of all the conveyor gear boxes, weighing machines, packer scales, stitching machines & New Reclaim machine.

INSTRUMENTATION

❖ **AMMONIA**

- Major Instrumentation jobs were carried out for MCC-5 replacement. Junction boxes were installed inside MCC-5, Multi-pair cables were laid & terminated with lugging & ferruling from MCC to DCS Marshalling cabinet & contactor box. Finally checking with operation of Motors was done from Control Room & was found functionally ok.
- Two new transmitters PT-79B & PT-79C were installed with new impulse line tapping to provide 2oo3 Low surface condenser vacuum turbine trip logic for 101-J/103-J/105-J. Trip logic was modified as per requirement.
- Replaced old control valves MICV-10, TRCV-142A, LCV-16, LCV-18, LCV-19, FICV-20, HICV-435A & VS-203A with new control valves of contemporary design.
- AMC service of DCS/PLC/UPSS and UPSS Batteries were carried out with the help of suppliers' service engineers. Preventive maintenance of CH_4, CO_2 NDIR Analyzer, and H2 Analyzer was done. Preventive maintenance of control valves and calibration of all quality affecting instruments was carried out.

❖ **UREA**

- Plug and seat of Control valve LICV-1201 having MOC Safurex was replaced with that of MOC HVD1.
- Motor Current Indications were provided on DCS for Scrapper motor M-1402-1 and M-1402-2 and Conveyer motor M-1403-1 as per EWR U-257. Necessary current to current convertors were installed in a Junction Box in MCC-6 and same were connected with DCS with multi-pair signal cable.
- AMC Services of DCS and Nucleonic Level gauges were carried out with the help of supplier's service engineers.
- Calibration of FS-1101 (Ammonia Mass flow meter) was carried out at EQDC, Gandhinagar, as per ISO & CDM requirement.
- Servicing & overhauling of the control valves was done. FICV-1202, FICV-1435 and PICV-1502B control valves were replaced with new control valves of contemporary design. Calibration of all quality affecting instruments was carried out.

❖ **UTILITY AND OFFSITE**

- Major Instrumentation jobs were carried out in Boiler plant for replacement of old MCC interface relay box with new one.
- Liquid Ammonia flow to Rail Gantry line control valve FICV-3101 was installed in Ammonia storage area as a part of EWR / Suggestions implementation.
- Replaced old control valves LCV-01, LCV-02, pHICV-4401& pHICV-4402 (Cooling Tower Plant), BTV-1-4A & BTV-1-4B (Boiler Plant), PICV-5401, MICV-5501 & MICV-5502 (IG Plant) with new control valves of contemporary design.
- AMC service of DCS/PLC/UPSS and UPSS Batteries were carried out with the help of supplier's service engineers. Preventive maintenance of control valves was done. Calibration of all quality affecting instruments was carried out.

❖ **BAGGING PLANT**

❖ Road Weigh Bridges and weighing machines were overhauled and calibrated.

ELECTRICAL

- **Critical job/ new installation**
  - Replacement of MCC-5
  - Replacement of DG set Battery
  - Replacement of busbar chamber in MCC-4

- **Scheduled preventive maintenance and modification work**
  - Servicing of Jyoti make 11 KV HT Vacuum circuit breaker (VCB) (Total: Nos 30)
  - Testing of protective relays in plant & township
  - Servicing of Chhabi make battery charger
  - Servicing of Rotork make valve actuators(Total: Nos 47)
  - Maintenance of transformers(Total: Nos 32)
  - Overhauling of critical motors (Total: Nos78)
  - Maintenance of Motor control centre MCCs
  - Maintenance of 66 KV switch yard
  - Servicing of TMG make LT Air circuit breaker (ACB)
  - Provision of emergency power to actuators in urea plant
  - Provision of current indication at DCS for M-1402/1&2 and M-1403/1
  - PGR heater replacement and checking
  - Installation of emergency stop PB in M-1402/1 &2 motor
  - Maintenance of VFD panels
  - Checking of Rope switches in conveyors

CIVIL

❖ AMMONIA PLANT

- Refractory repairing jobs in primary reformer, Secondary reformer & Primary waste heat exchanger. The casting of auxiliary boiler side panels was carried out.

❖ UREA PLANT

- Rehabilitation of Lift room (outside) & stair case at prill tower top by providing elastomeric lining.
- Repairing of prill tower top floor by providing elastomeric lining & replacing acid/ alkali proof bricks carried out.
- Demolishing job of floor behind urea plant for crane approach was carried out to replace LPCC in urea plant.
- Retrofitting of the existing foundations and construction of the additional supports on Ammonia pump line in urea plant.

❖ OFFSITES & UTILITY PLANT

- Replacement of marine plywood sheet in cooling tower deck
- Damaged plywood sheets of the cooling tower deck were replaced with new marine plywood sheets.
- The cooling tower basin outside walls are badly damage and prone to seepage. The outside brickwork & plaster was carried out during the shutdown.
- Excavation of cooling tower header for wrapping & coating of the pipe lines & backfilling including PCC of the header.

❖ B & MH PLANT

- IP Net coating was provided as a rehabilitation measures in Silo, transfer tower & reclaim conveyor gallery (M-2117).
- Rehabilitation of wagon floor (beams, columns & soffit) & dust dissolving tank area of B & MH plant by providing elastomeric lining
- Job of providing Kota stone in transfer tower floors in B& MH after removing old bitumastic lining was carried out.

TECHNICAL

The annual turnaround of about 12 days, provide opportunity to Technical Department to undertake execution of jobs related to EWRs and various modification schemes which require isolation.

Various modification jobs were carried out by Technical Department in Ammonia, Urea and Utility Plants in Annual Turnaround-2015.

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 shut down.

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

PLANT TURNAROUND APRIL - 2015

GENERAL - DETAILS

SR. NO.	CATEGORY	QUANTITY
(A)	**EQUIPMENT UTILIZED :**	
	IFFCO :	
	135 T Kobelco	01 No
	100 T Kobelco	01 No
	55 T TIL RT-760 Tyre mounted mobile 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.
	909 Tata (Mini Truck)	01 No
(B)	**MANPOWER UTILIZED :**	
	(I) IFFCO MANPOWER :	
	1 Mechanical }	
	2 Mechanical Services }	Existing
	3 Electrical }	strength
	4 Instrument }	
	5 Inspection }	
	6 Civil }	
	7 Kandla (Crane Operator) }	2 Person

(II) HIRED - CONTRACT MANPOWER :

Sr. No.	Category	Man days
1	General Fitter	611
3	Rigger	741
4	S.S. Rigger	1548
5	Fabricator	87
6	Grinder	122
7	Gas Cutter	75
8	IBR Welder	20
9	Non-IBR Welder	88
10	Carpenter	44
11	Mason	44

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**

SHUT DOWN RELATED CONTRACTS

SR. NO	PLANT	WO NO. & DATE	DESCRIPTION OF JOB	VENDOR'S NAME
1	Mechanical Ammonia	201004151427 10/03/2015	Overhauling and Preventive Maintenance of Rotating Equipments	M/s. Ovl Power Systems Pvt. Ltd, Hyderabad
2	Mechanical Ammonia	201004151148 05/01/2015	Overhauling of Re-cycle Gas compressor, 117-J	M/s. Malhan Enterprises Pvt. Ltd., Ahmedabad
3	Mechanical Ammonia	201004151471 10/03/2015	Critical Fabrication jobs in Ammonia and Offsite Plant	M/s. J&J Engineers, Shertha
4	Mechanical Ammonia	201004151375 26/02/2015	Scaffolding & Blinding/De-blinding jobs during Shut Down-2015	M/s. Shiv Engineering, Vadodara
5	Mechanical Urea	201004151419 07/03/2015	Various Fabricarion Jobs during Shutdown	M/s Shree Ganesh Engg
6	Mechanical Urea	201004151418 05/03/2015	Overhauling and Reconditioning of Gate/Globe Valves	M/s Flotec Techno smart
7	Mechanical Urea	201004150965 08/12/2014	Specialised Painting on Structures of Urea Plant	M/s Mohan Paints
8	Mechanical Offsite	201004150938 29/11/2014	Removal of Old Rubber Lining & Making New Rubber Lining	M/s Conveyor Rubber Industries, Ahmedabad
9	Mechanical Offsite	20100415279 03/02/2015	Services for In-situ gland re-packing of valves during annual shutdown-2015	M/s Amrutha Engineering, Mumbai
10	Mechanical Offsite	201004151202 28/01/2015	Insitu Overhauling/ Repairing of Gate Valve.	M/s Flotec Technosmart (India) Pvt. Ltd., Surat
11	Mechanical Offsite	201004151204 02/02/2015	Specialised services for Repair & Maintenance of "PAHARPUR" make Cooling Towers	M/s Paharpur Cooling Towers Ltd. Vadodara
12	Mechanical Offsite	201004150939 02/12/2014	Supply and installation of Sintex Make PVC Panel in Cooling Tower Partition wall	M/s Abhay Fabricators, Kalol
13	Mechanical Offsite	201004151080 27/12/2014	Servicing/Repairing of Jash make Sluice Gates	M/s Jash Engg Ltd, Indore
14	Mechanical B&MH	201004141314 04.03.2014	ARC for overhauling of Gabbar make stitching machines	M/s Gabbar Engineering Works, Ahmedabad
15	Mechanical B&MH	201004151289 04.02.2015	Splising and vulcanizing of conveyor belts	M/s J.K.Ruuber works, Ahmedabad
16	Mechanical B&MH	201004150761 31.10.2014	Requirement of skilled Engineer and Technician for Reclaim machine	M/s Elecon EPC Projects Ltd., Vadodara
17	Mechanical B&MH	201004150817 14.11.2014	ARC for providing rubber lining on belt conveyor pulleys	M/s J.K.Ruuber Works, Ahmedabad
18	Inspection	201004150853 14-11-14	ECT of HP Stripper and HP Condenser	M/s Testex NDT(I) Pvt. Ltd., Mumbai

SR. NO	PLANT	WO NO. & DATE	DESCRIPTION OF JOB	VENDOR'S NAME
19	Inspection	201004150874 15-11-14	Insitu-Metallography Work during S/D and as and when required	M/s TCR advanced Engg., Vadodara
20	Inspection	201004130578 15-09-12	Radiography work	M/s NDT Services, Ahmmedabad
21	Inspection	201004140590 11-09-13	NDT Teams for DP Test	M/s S.R. Technical Services, Mumbai
22	Inspection	201004140794 19-10-13	NDT Teams for Thickness Measurement	M/s S.R. Technical Services, Mumbai
23	Inspection	201004140793 18-10-13	NDT Team for Ultrasonic Flaw Detection work	M/s S.R. Technical Services, Mumbai
24	Inspection	201004140767 12-10-13	NDT Team for Magnetic Particle Inspection	M/s NDT Services, Ahmmedabad
25	Inspection	201004160018 15-04-15	ARTIS Inspection of Primary Reformer Tubes	M/s TCR advanced Engg., Vadodara
26	Inspection	201004150877 25-11-14	IRIS Inspection of LPCC(H-1205)	M/s Testex NDT(I) Pvt. Ltd., Mumbai
27	Inspection	201004116011 3 28-04-15	Helium Leak Testing of Autoclave Liner and its weldjoints	M/s Gulachi Engrs, Gaziabad
28	Instrument	201004151185 09/01/2015	Maintenance of Control Valves	M/s Flotec Technosmart (India) Private Limited, Surat
29	Instrument	201004140992 02/12/2013	Hiring of Skilled Instrument manpower for shutdown.	A-Z Instruments Services, Vadodara
37	Electrical Ammonia	201004150920	Installation of MCC-5	M/s A N Electrical
38	Electrical	201004151159	Servicing of Jyoti VCB	M/S Jyoti
39	Electrical	201004150942	Servicing of TMG ACB	M/S Heatex
40	Electrical	201004150954	Servicing of rotork MOV	M/S Rotork
41	Electrical	201004151172	Servicing of chhabi battery charger	M/S Chhabi
42	Electrical 66kv Yard	201004151186	Maint. Of 66KV Yard/11KV SS/	M/S Akron
43	Electrical	201004151477	Relay Testing	M/S Elcon
44	Electrical	201004151173	Maint. Of Transformer	M/S Unique Transformer
45	Electrical	201004140891	Overhauling of LT motors	M/S A N Electrical
46	Electrical	201004150852	Replacement of DG set Battery	M/S Amco shaft
47	Electrical B&MH	201004151271	Installation of Vibro screen	M/s PARIKH ELECTRIC
48	Planning	201004151497 19/03/2015	Assisting IFFCO during plant turnaround / Breakdown jobs	M/s General engg works Bharuch
49	Planning	201004151438 05/03/2015	Opening & Boxed up of heat exchangers	M/s General engg works Bharuch
50	Planning	201004151474 11/03/2015	Hydrojetting Cleaning of Heat Exchangers tubes	M/s Hydro jetting services Ahmedabad
51	Planning	201004151133	Overhauling & Testing of	M/s Flotec technosmart

SR. NO	PLANT	WO NO. & DATE	DESCRIPTION OF JOB	VENDOR'S NAME
		29/01/2015	Safety valves/Relief valves/Pilot operated valves	(india) private limited Surat
52	Planning	201004141309 13/02/2014	Arc for on line leak Sealilng Job.	M/s Dynamic meta sealing engineers, Thane
53	Planning	201004150549 08/09/2014	Arc for Painting Jobs.	M/s B chauhan & co Kalol
54	Planning	201004141171 24/JAN/2014	Arc for Carrying out Various hot & cold Insulation Jobs	M/s Khandelwal Insulations Pvt ltd Mumbai - 400083
55	Planning	201004141170 24/01/2014	Arc for Carrying out Various Hot & cold Insulation Jobs	M/s Balaji Insulation India Pvt ltd Thane-west - 400607
56	Planning	201004151074 20/12/2014	Arc For Various Fabrication Work In Plant	M/s Aneesh engineers Kalol
57	Planning	201004151075 20/12/2014	Arc For Various Fabrication Work In Plant	M/s J&J engineers Shertha
58	Planning	201004131192 25/01/2013	Arc for Petty Maint. Jobs.	M/s J&J engineers Shertha
59	Civil Urea plant	201004141515 27/03/2014	Repairing of the scrapper floor of prill-tower by providing elastomeric lining and replacement of acid / alkali proof bricks.	M/s Greensboro Polychem Pvt Ltd.
60	Civil B & MH Plant	201004141517 27/03/2014	Repairing of damaged RCC structure of B & MH plant .	M/s Greensboro Polychem Pvt Ltd.
61	Civil B & MH Plant	201004141486 24/03/2014	Providing and applying IP net protective coating on RCC structures of Silo, B & MH plant area, Conveyor Gallery, Prill-Tower and others area in plant	M/s Krishna Conchem Products Pvt Ltd.
62	Civil Utility Plant	201004141512 27/03/2014	Maintenance of damaged water proof plywood sheet in cooling tower deck .	M/s Sudama Furniture Products Pvt. Ltd
63	Civil	201004141397 15/03/2014	Miscellaneous Civil work in plant during shutdown 2014-15	M/s Rakesh S. Prajapati
64	Civil Urea & Offsite	201004141363 13-02-2014	Fixing charges of HILTI made anchor fastners for the strengthening of platform in urea plant .	M/s Nine Projects Pvt. Ltd.
65	Technical	201004151348 16/02/2015	Supply and installation of Urea feeding system in Silo	M/s Thermal Alliance
66	Technical	201004151494 13/03/2015	Erection of vibrating screens and Fabrication job of structure & Piping	M/s Shiv Engg

MECHANICAL

AMMONIA PLANT

(MECHANICAL)

AIR COMPRESSOR TRAIN (101-J)

101-JT, Air Compressor Drive Turbine

Turbine was decoupled and both end Journal bearings and Thrust bearing were removed for inspection. The bearings were visually inspected & found in good condition. Gauss readings of the bearing pads & shaft journal were measured and found within limits. Bearing clearances were taken and found within the design range.

Governor of 101 JT was remaining hot during normal operation. Governor was opened for overhauling. It was observed that the bearing (No 7309 BECBJ, #2) was rubbing with Governor Valve Body (#5) due to which groove was found in Governor valve body. The new bearings were assembled as per drawing. Governor Valve Body was also replaced with new one.

Turbine hydraulic trip assembly was opened and cleaned. O-ring (#21) was replaced. Linkage of Governing valve was opened and overhauled. Bushing of Governing valve lever was replaced with new one.

Parts replaced in 101 JT				
Sr. No.	Part No.	Part Name	Qty.	Store Code
1	2	ND Ball bearing (7309 BECBJ) Bottom bearing	1	2010112510402600
2	5	GOVERNER BODY HC.250LX3 P.NO 5, D.NO:01-AK-08018, 8-1/2 CM GOV OF 101-JT	1	2010112510405400
3	21	O-RING, SYM. NO:11 021(329328) , P.NO :21,D.NO : F-10761, FOR HYDRAULIC TRIP ASSY, FOR 101-JT	1	2010112510739500
4	687	BUSHING, SYM. NO.HJ-215E NOZZLE VALVE AND OPERATING GEAR ASSY	2	2010112510307340

101-JLP, Air Compressor

101-JLP was decoupled from both ends. Journal bearings and Thrust bearings were visually inspected and Dye penetration was also 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. The entire bag filters as well as Roll-O-Matic filters were replaced by new one during start up.

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 to be O.K. Gauss measurement of gear shaft and bearings carried out and found within limit. Bearing clearances were taken and found within the design range.

101-JHP ,Air Compressor Major overhauling

The compressor was taken for major overhauling due to air leakage from both ends. The compressor was decoupled and the piping removed. The top casing was removed and all axial and diametrical clearances were measured and noted. The rotor assembly was lifted and taken for cleaning & inspection. Thick deposits were observed on both end seals.

The complete rotor assembly was cleaned by hydro jetting and dye penetration test was performed and no defects were observed. The top and bottom casing were cleaned by hydro jetting followed by drying by plant air. The diaphragms were not removed.

Clearance of both shaft end seals and one no. diaphragm seal of intermediate discharge end (4^{th} wheel) were higher and hence replaced with new one.

After removal of Top half of casing

End seal at coupling end

101 JHP Compressor rotor after cleaning

Parts replaced in 105 JHP			
Sr. No.	**Store Code**	**Description**	**Qty**
1	2010112010247800	CASE SEAL,P.NO:11,SYM. NO:AF 2041-CZ, FOR 101 JHP(MODIFIED)	1
2	2010112010247810	CASE SEAL.P.NO 12,SYM. NO: AF 2041 CS, FOR 101 JHP(MODIFIED)	1
3	2010112010247831	DIAPHRAGM SHAFT SEAL, P.NO : 15, SYMBOL NO CG 4006 E ,FOR 101 JHP COMP. (MODIFIED,AF-4004-R)	1

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

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

Couplings Inspection

All the couplings were visually inspected. Wherever coupling hub locknuts have been provided, the nuts were found intact. The flexible elements were also found to be in good condition.

CLEARANCE CHART -101-JT

Description	Position	Dwg. Ref	Design Clearances (Inch)	Before (Inch)	After (mm)
JLP End					
Journal Bearing	Mandrel	B	0.007-0.009		0.19
	Filler / lead wire				
Oil Guard (For Jr. Brg Housing)	South	C	0.015-0.021		0.40
	North	G	0.058-0.097		0.40
Oil Guard (For Seal Housing)	---	D	0.077-0.109		0.20
Shaft Diameter	Jr. Brg.	---	4.993		-
Bearing Pinch	Jr. Brg.	---	---		0.02
Governor End					
Journal Bearing	Mandrel	B	0.007-0.009		0.19
	Filler / lead wire				
Oil Guard (For Brg. Housing	South	---	---	---	--
	North	C	0.015-0.021		0.20
Axial Thrust.	With Top Housing	---	0.008-0.012	0.36	0.36
	Without top Housing	---			
Bearing Pinch	Jr. bearing	---	---		0.01

Journal Bearing Pads Thickness - 101 – JT

PAD	NORTH SIDE BEARING	SOUTH SIDE BEARING
No 1	0.8113	0.8138
No 2	0.8114	0.8138
No 3	0.8114	0.8146
No 4	0.8114	0.8146
No 5	0.8114	0.8134

Thrust Bearing Pad Thickness - 101 – JT

Pad	ACTIVE	INACTIVE
No 1	0.498	0.916
No 2	0.5004	0.913
No 3	-	0.914
No 4	-	0.911
No 5	-	0.916

CLEARANCE CHART - 101 – JLP

Description	Position	Design Clearances (Inch)	Before (Inch)	After (mm)
101-JT END				
Journal Bearing Clearance	Mandrel	0.005-0.008		0.19
Bearing Pinch				0.01
Oil Guard (For Journal Bearing)	North	0.013-0.015		0.20
	South	0.013-0.015		0.20
Oil Guard (For Outer Housing)	North	0.021-0.027		-
	South	0.021-0.027		-
Gear Box End				
Journal Bearing Clearance	Mandrel	0.005-0.008		0.28
Oil Guard (For Journal Bearing)	North	0.013-0.015		0.20
	South	0.013-0.015		0.20
Oil Guard (For Thrust bearing)	North	0.002-0.004		0.10
	South	0.002-0.04		0.10
Axial Thrust	With Top Housing	0.010 - 0.015		0.45

Journal Bearing Pads Thickness - 101 – JLP

Pad	NORTH SIDE BEARING	SOUTH SIDE BEARING
No 1	0.751	0.750
No 2	0.752	0.751
No 3	0.752	0.750
No 4	0.752	0.751
No 5	0.752	0.750

Thrust Bearing Pad Thickness - 101 – JLP

Pad	ACTIVE	INACTIVE
No 1	0.781	0.781
No 2	0.781	0.781
No 3	0.782	0.781
No 4	0.781	0.781
No 5	0.783	0.781
No 6	0.781	0.781
No 7	0.781	0.781
No 8	0.781	0.781

CLEARANCE CHART - 101-JR

Description	Position	Design Clearances (Inch)	Before (mm)	After (mm)
Journal Bearing (Low Speed drive gear)	North	0.008-0.010		0.27
	South	0.008-0.010		0.27
Axial Thrust	---	0.014-0.024	0.35	0.32
Journal Bearing (High Speed driven Pinion)	North	0.009-0.011		0.26
	South	0.009-0.011		0.24
Backlash	---	---	0.50	0.50
Shaft Diameter (Low Speed drive Gear)	---	---		114.10
Shaft Diameter (High Speed drive Gear)				88.74

CLEARANCE RECORDS – 101JHP-

Description	Position	Design Clearances (Inch)	Before (mm)	After (mm)
GB End				
Journal Bearing Clearance	Mandrel	0.004-0.007		0.21
Bearing Pinch				0.02
Shaft Dia.	Journal Bearing	2.996		76.0
Oil Guard (For Journal Bearing)	North	0.013-0.016	0.15	0.15
	South	0.013-0.016	0.10	0.10
Oil Guard (For Top Housing)	North	0.015-0.022		-
	South	0.015-0.022		-
Non Drive End				
Journal Bearing Clearance	Mandrel	0.004-0.007	0.17	0.17
Bearing Pinch				0.02
Shaft Dia	Journal bearing	2.996	76.0	76.0
Oil Guard (For Journal Bearing)	North	0.013-0.016	0.20	0.20
	South	0.013-0.016	0.15	0.15
Oil Guard (For Thrust bearing)	North	0.002-0.004		
	South	0.002-0.04		
Oil Guard (For Top Housing)	North	------		
	South	0.015-0.022		
Axial Thrust	With Top Housing	0.008 - 0.012	0.32	0.32
Total Float		2.779-3.571		2.859”

Journal Bearing Pads Thickness - 101 – JHP

PAD	NORTH SIDE BEARING (inch)	SOUTH SIDE BEARING (inch)
No 1	0.5614	0.5614
No 2	0.5614	0.5614
No 3	0.5614	0.5614
No 4	0.5614	0.5614
No 5	0.5614	0.5614

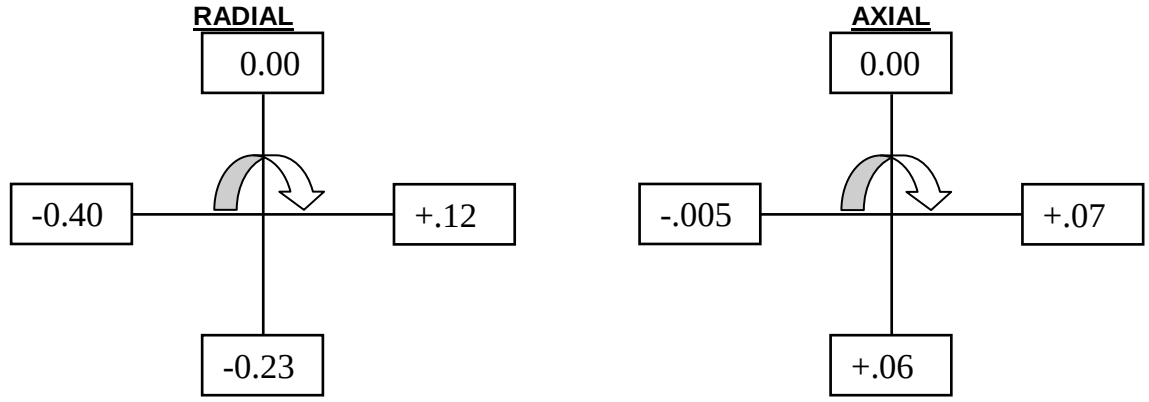
Thrust Bearing Pad Thickness - 101 – JHP

Pad	ACTIVE	INACTIVE
No 1	0.499	0.498
No 2	0.500	0.496
No 3	0.499	0.498
No 4	0.498	0.498
No 5	0.500	0.498
No 6	0.500	0.498

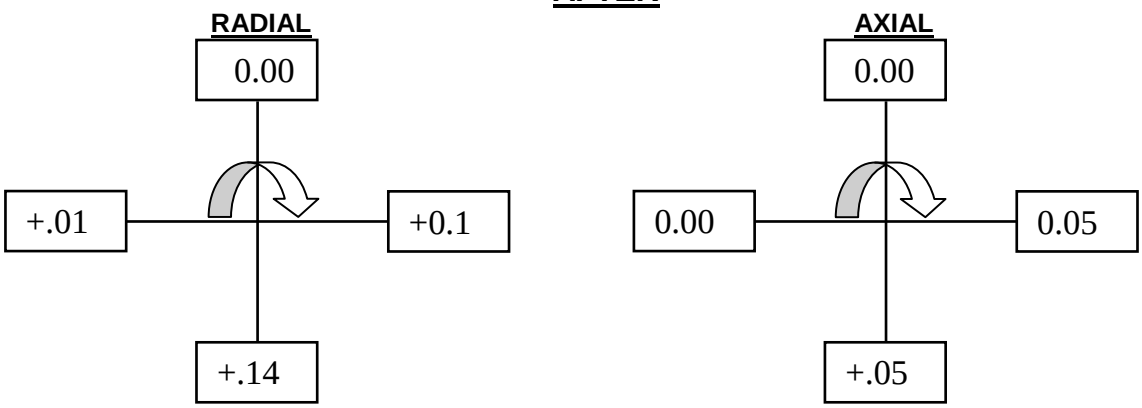
101-JT TO 101-JLP

BEFORE

Silo side CT



AFTER

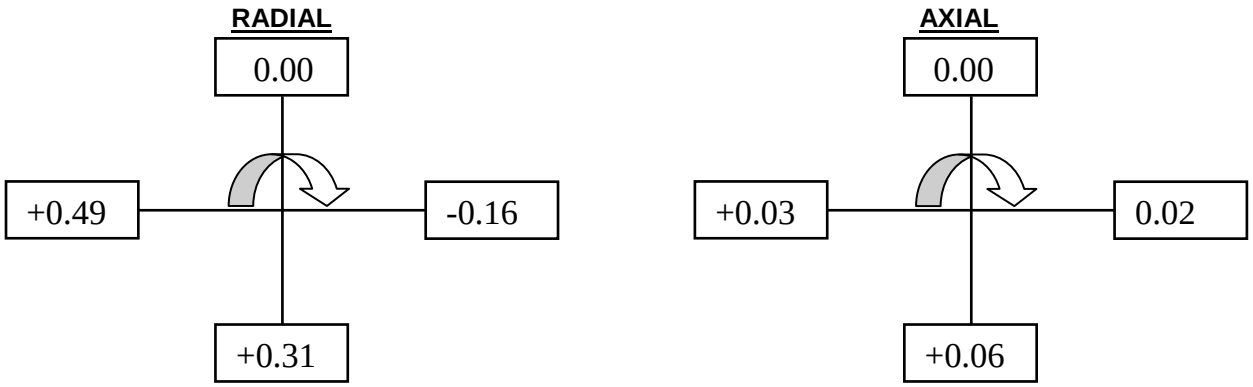


NOTE : Fixture mounted on JT, Dial reading on JLP, All Readings are in mm.

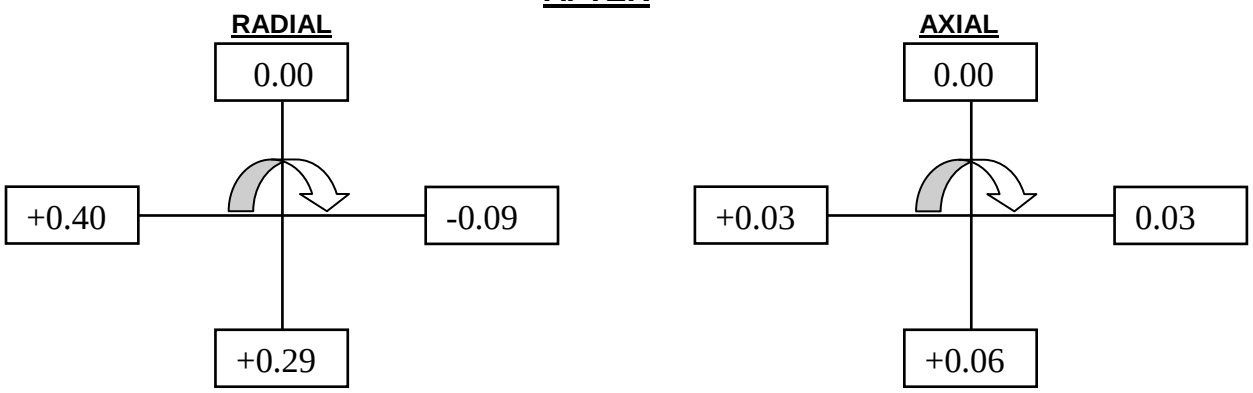
101-JLP TO 101-JR

BEFORE

Silo side CT



AFTER

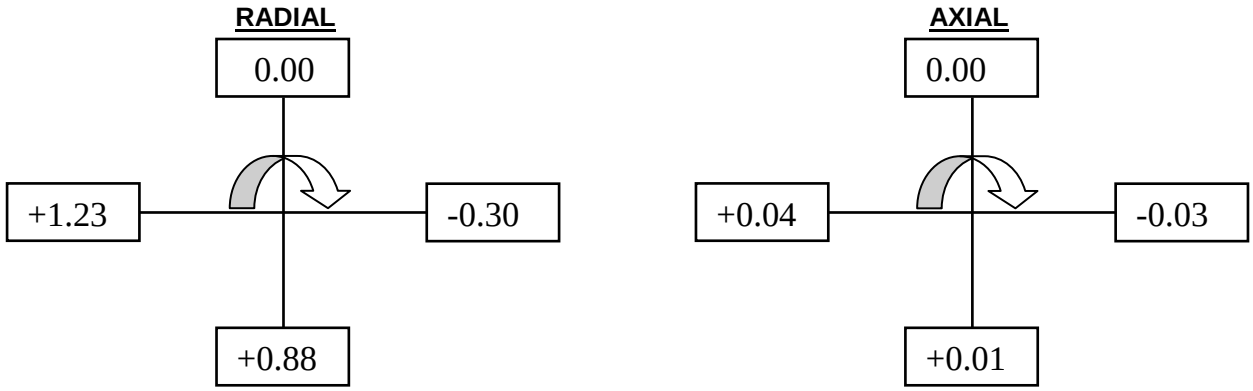


NOTE: Fixture mounted on JLP, Dial reading on Gearbox, All Readings in mm.

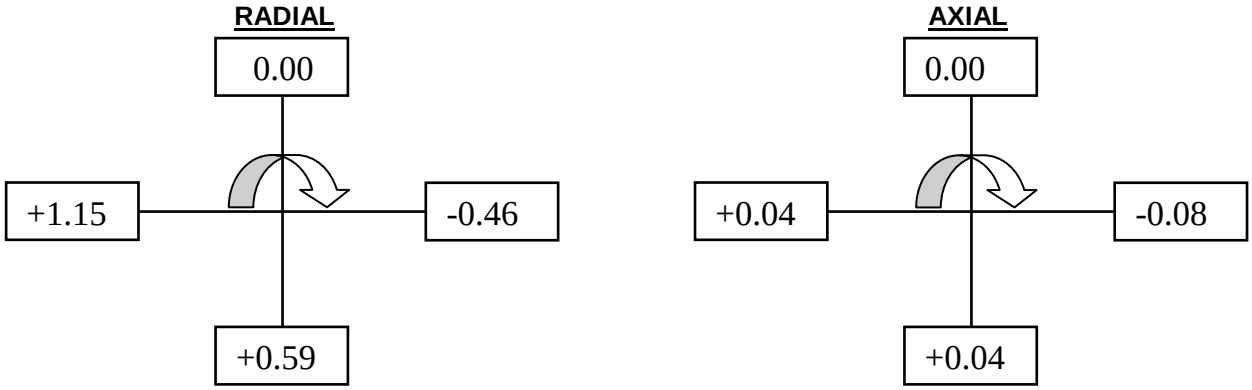
101-JR TO 101-JHP

BEFORE

Silo side CT



AFTER



NOTE : Fixture mounted on JHP, Dial reading on Gearbox, All Readings in mm.

SYNTHESIS GAS COMPRESSOR TRAIN, 103-J

103-JBT, Condensing turbine

The turbine was decoupled. Thrust bearing and both end Journal bearing were visually inspected and found O.K. Magnetism level of both end journal bearing pad and base ring, shaft journal area, thrust bearing and thrust collar was measured and found within limit. All pads were Dye Penetration tested and no cracks were found. The governor linkages were greased.

103-JLP, Synthesis Gas Compressor

The non thrust end journal bearing was removed and the clearance was measured and found to be within limit.
The axial thrust measured and found at 0.26 mm. Magnetism level check of the removed bearings was carried out and found to be satisfactory. Dye penetration test was performed and the result was found to be OK.

103-JHP, Synthesis Gas Compressor

The compressor was decoupled. Coupling end Journal bearing was removed and visually inspected and found O.K. Thrust bearing ring at Free end was removed and cleaned. Thrust was checked. 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-JAT (Back Pressure Turbine) Overhauling

Turbine was taken for overhauling as per schedule. There was also leakage through steam chest cover which was also to be attended.

Dismantling of Turbine

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

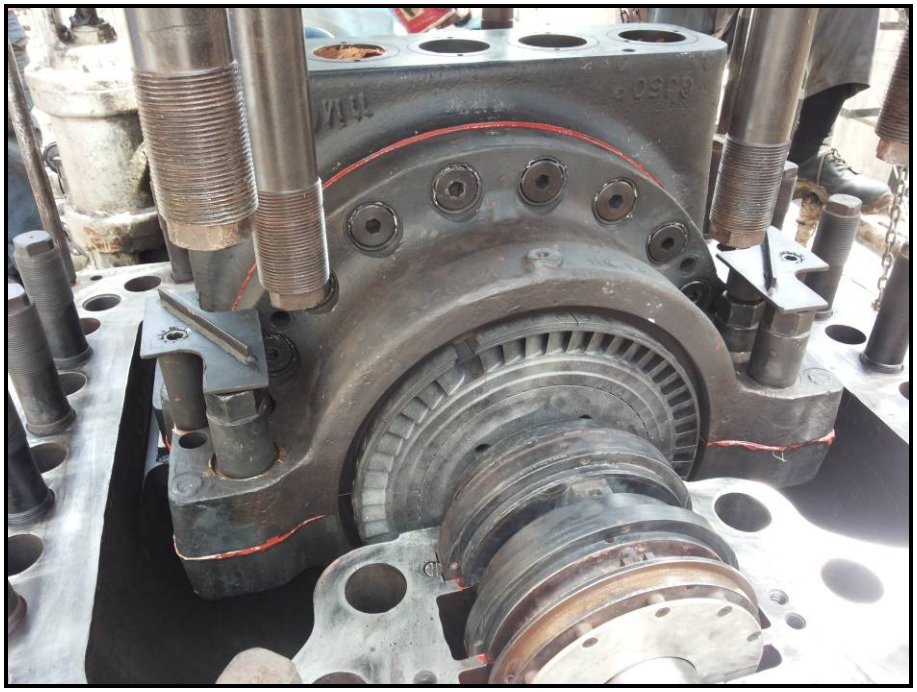
Re assembly of Turbine

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

Steam chest Valve

Steam chest valve was opened to attend leakage through cover. Steam chest cover and flange was cleaned, and then Blue match was checked by assembling. It was found OK.

Both Bearing (2 nos) and end plates (4 nos) of Governing valve lever was replaced with new one.



Assembly of top casing

Parts replaced in 103 JAT			
Sr. No.	**Store Code**	**Description**	**Qty**
1	2010112540204100	SHOES (SET OF 6) ,SYM. NO:PM-1031AB, FOR103-JAT	1
2	2010112540234200	LABY.RING SYM.NO: GJ-141 AZ X1,P. NO:146, FOR 103-JAT	1
3	2010112540234220	LABY.RING SYM.NO: GJ-141 AZ X 3,P. NO:148, FOR 103-JAT	1
4	2010112540234230	LABY.RING SYM.NO: GJ-141 AZ X 4,,P. NO:149, FOR 103-JAT	1
5	2010112540245240	RING BEARING GJ-1189P,P.NO:288 FOR 103-JAT	1

6	2010112540403400	BRG, P.NO:648 SYMBOL 315519 FOR 103-JAT	2
7	2010112540407320	BUSHING, SYM.:KJ-215E,P.NO :646 D.NO :F-9162,FOR NOZ VALVE & OPT GEAR ASSY 103-JAT	4
8	2010112540624710	GASKET ANNEALED COPPER PLAIN RING GASKET OD :342MM, ID:307MM X THK.:1.5MM , SPARES FOR STRAINER OF 103-JAT	1
9	2010112549947530	ALLEN HEADED F/T BOLT FOR THURST & J BRG D.NO. P1-ES-20010, 3/4" DIA X 10 TPI X 58 L FOR 103 JAT	10
10	2010112549947530	ALLEN HEADED F/T BOLT FOR THURST & J BRG D.NO. P1-ES-20010, 3/4" DIA X 10 TPI X 58 L FOR 103 JAT	10

PREVENTIVE MAINTENANCE RECORDS: 103 – JBT

Description	Position	Clr. Chart Ref	Design Clearances (Inch)	Actual (inch)
JAT End				
Journal Bearing	Lead Wire	A	0.010-0.012	0.01102
Oil Guard (For Jr. Brg Housing)	South	C	0.008-0.014	0.00590
Bearing Pinch	Journal Brg.			0.00078
Governor End				
Journal Bearing	Lead Wire	A	0.010-0.012	0.00984
Oil Guard (For Brg. Housing)	North	C	0.008-0.014	0.00590
Axial Thrust.	With Top Housing		0.008-0.012	0.00984
Bearing Pinch	Journal Brg.			0.00039

THRUST BEARING PAD THICKNESS

DESCRIPTION	ACTIVE	NON-ACTIVE
PAD NO. 1	0.624	0.500
PAD NO. 2	0.625	0.500
PAD NO. 3	0.624	0.500
PAD NO. 4	0.625	0.500
PAD NO. 5	0.625	0.500

PREVENTIVE MAINTENANCE RECORDS: 103 - JAT

Description	Position	Clr. Chart Ref	Design Clearances (Inch)	After (Inch)
JLP End				
Journal Bearing	Lead Wire	N	0.006-0.008	0.00669
Oil Guard (For Jr. Brg Housing)	South	C	0.015-0.021	0.00590
	North			0.00393
Bearing Pinch	Journal Brg.			0.00078
JBT End				
Journal Bearing	Lead Wire	B	0.010-0.012	0.0098
Oil Guard (For Brg. Housing)	North	C	0.015-0.021	***
Axial Thrust.	Without Top Housing	---	0.008-0.012	0.0118
Total Float				0.1811
Bearing Pinch	Journal Brg.			0.00078
Oil Guard (For Thrust Bearing)	North	A	0.002-0.004	***
	South	A	0.002-0.004	***

THRUST BEARING PAD THICKNESS

DESCRIPTION	ACTIVE	NON-ACTIVE
PAD NO. 1	0.998	0.624
PAD NO. 2	0.998	0.624
PAD NO. 3	0.997	0.624
PAD NO. 4	0.997	0.624
PAD NO. 5	0.998	0.624
PAD NO. 6	0.998	0.624

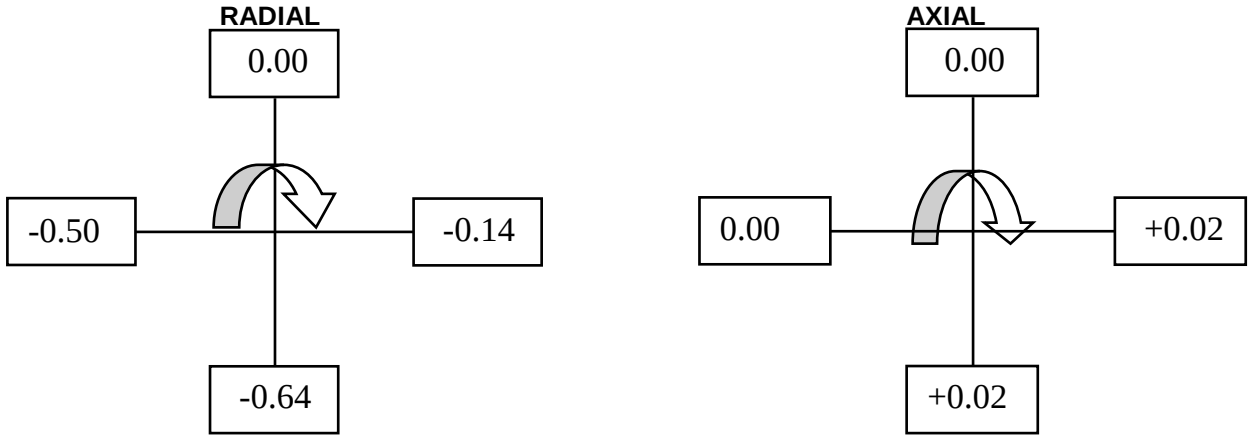
PREVENTIVE MAINTENANCE RECORDS: 103 – JLP

Description	Position	Clr. Chart Ref.	Design Clearances (Inch)	Before (Inch)	After (mm)
NON THRUST END					
Journal Bearing Clearance	Mandrill	C1	0.002”-0.004”		0.08
Oil Guard (For Journal Bearing)	North	C2	0.008”- 0.013”		
	South	C2	0.008”- 0.013”		
THRUST END					
Journal Bearing Clearance	Mandrill	C1	0.002”-0.004”		
Axial Thrust	With Top Housing		0.015”-0.022”	0.25	0.25

PREVENTIVE MAINTENANCE RECORDS: 103 – JHP

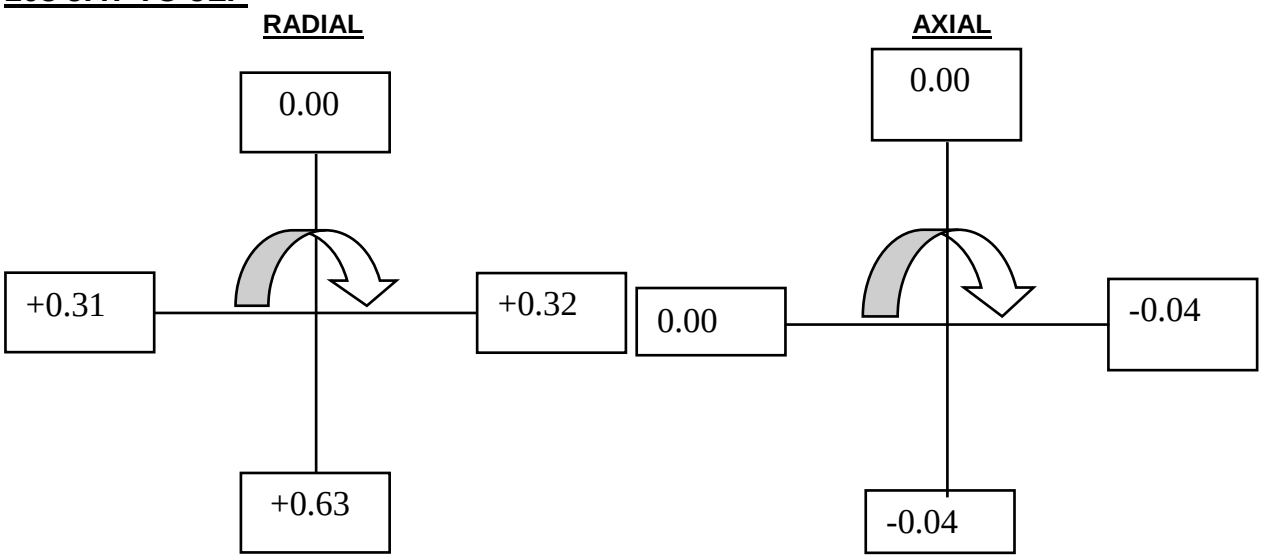
Description	Position	Clr. Chart Ref.	Design Clearances (Inch)	Before (Inch)	After (mm)
NON THRUST END					
Journal Bearing Clearance	Mandrill	A1	0.0023”-0.0033”		0.09
Oil Guard (For Journal Bearing)	North	A2	0.0085”- 0.0115”		
	South	A2	0.0085”- 0.0115”		
THRUST END					
Journal Bearing Clearance	Mandrill	A1	0.0023”-0.0033”		
Axial Thrust	With Top Housing		0.015” - 0.022”	0.40	0.40

ALIGNMENT VALUE 103 JBT TO 103 JAT



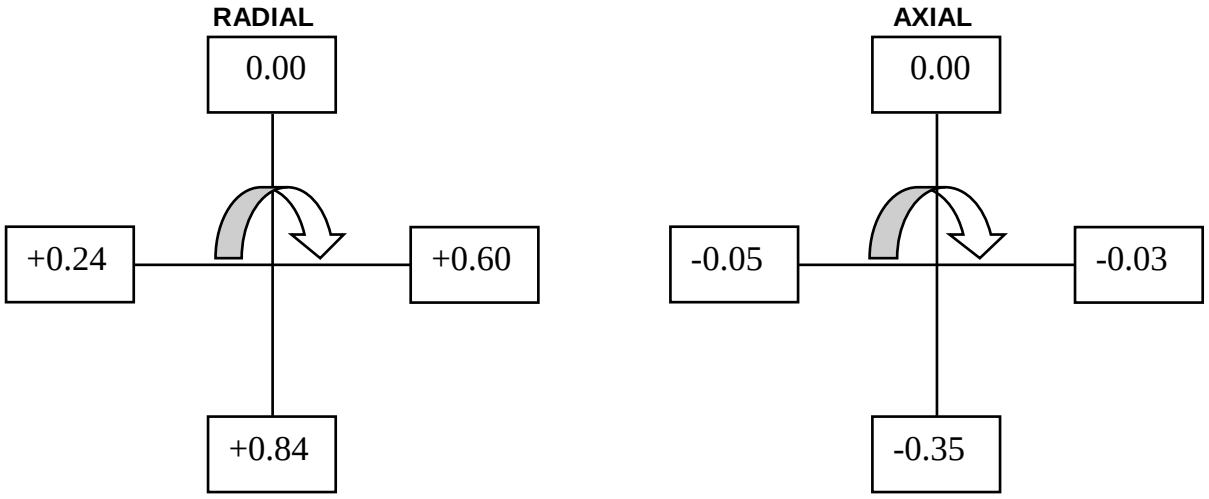
Note: Fixture mounted on JBT, Dial mounted on JAT, All Readings are in mm.

103 JAT TO JLP



Note: Fixture mounted on JAT, Dial mounted on JLP, All Readings are in mm.

103 JLP TO JHP



Note: Fixture mounted on JLP, Dial reading on JHP, All Readings are in mm.

REFRIGERATION COMPRESSOR TRAIN 105-J

105-JT, Refrigeration Compressor Drive Turbine Preventive Maintenence

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

105-JLP Refrigeration Compressor

105-JLP, gear box end was decoupled. Axial thrust was measured (0.27 mm) and found within limit.

105-JR Gear Box

After decoupling the top cover was removed. All the bearings were inspected and found in good condition. Both the gear as well as Pinion were inspected and found to be O.K. Magnetism level of gear/pinion shaft and their bearings was carried out and found within limit. Bearing clearances were taken and found within the design range.

105-JHP Refrigeration Compressor Preventive Maintenance

105-JHP, gear box end was decoupled. Axial thrust was measured (0.46 mm).

All couplings were visually inspected. No damage in flexible elements was observed all the hubs were found to be in their position intact.

105-JT CLEARANCES

Description	Position	Design clearance	Actual Clearance
JLP End			
Journal Bearing	Lead wire	0.007”-0.009”	0.0094”
Oil Guard (For Jr. Brg Housing**)**	South	0.015”-0.021”	0.0039”
	North	0.058”-0.097”	0.0039”

Oil Guard (For Seal Housing**)**	***	0.077”-0.109”	
Governor End			
Journal Bearing	Lead wire	0.007”-0.009”	0.0086”
Oil Guard (For Seal Housing**)**	***	0.077”-0.109”	0.0059”
Axial thrust	With Top Housing	0.008”-0.012”	0.011”

Journal Bearing Pad Thickness

Pad	North Side Brg.	South Side Brg.
No.1	0.811811”	0.811811”
No.2	0.811023”	0.811417”
No.3	0.811417”	0.811023”
No.4	0.811811”	0.811811”
No.5	0.811811”	0.811417”

Thrust Bearing Pad Thickness

Pad	Active	Inactive
No.1	0.7511”	0.62755”
No.2	0.7511”	0.62716”
No.3	0.7507”	0.62716”
No.4	0.7507”	0.62755”
No.5	0.7818”	0.62716”
No.6	0.7507”	0.62716”

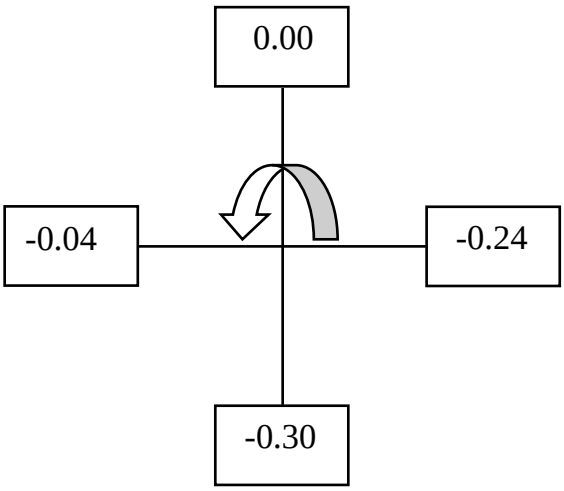
105-JR CLEARANCES

Description	Position	Design clearance	Actual Clearance
Journal Bearing	North	0.014”-0.016”	0.0133”
	South	-do-	0.0133”
Axial thrust		0.014”-0.024”	0.0153”
Journal Bearing	North	0.013”	0.0165”
	South	-do-	0.0165”
Free Float		--	0.059”
Backlash		--	0.49/0.50mm
Shaft diameter	North	--	4.9921”
	South	--	4.9921”
Shaft diameter	North	--	4.4937”
	South	--	4.4937”
Thrust Float.		--	

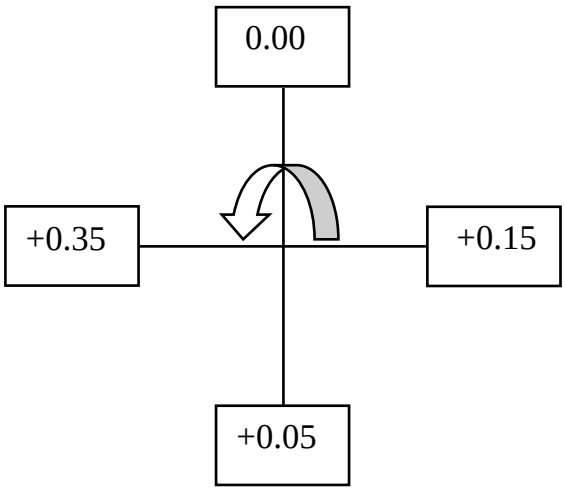
ALIGNMENT VALUES – 105-JT TO 105-JLP

BEFORE

RADIAL

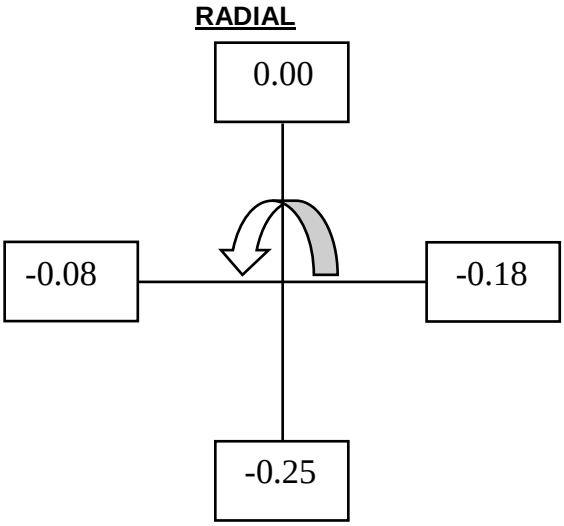


AXIAL

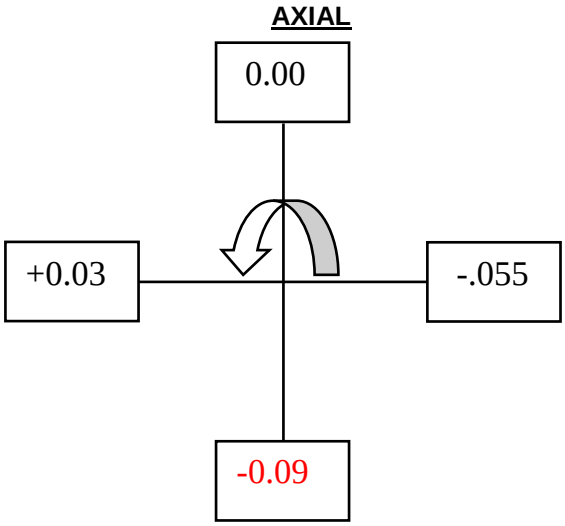


AFTER

RADIAL



AXIAL

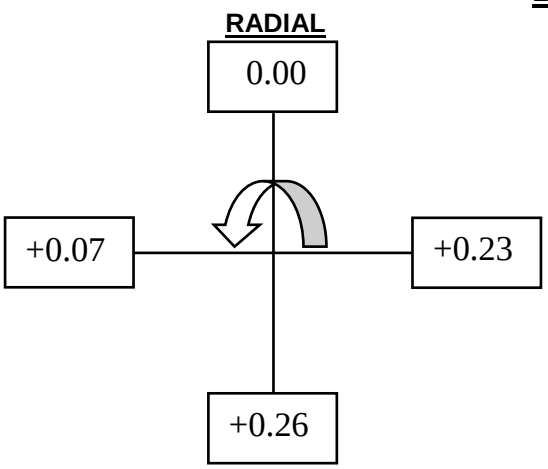


Note: Fixture mounted on Turbine Rotor, Dial reading on JLP, All Readings are in mm.

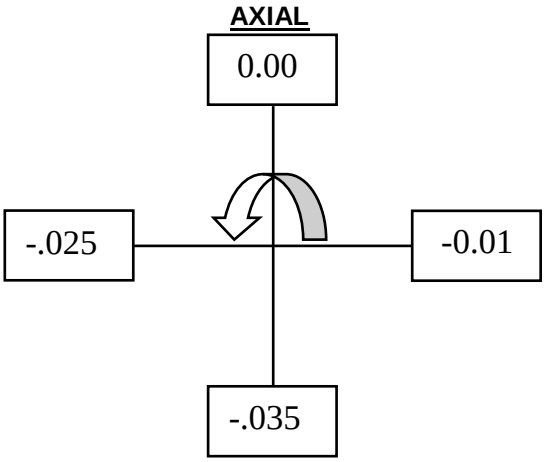
105-JLP TO 105-JR

BEFORE

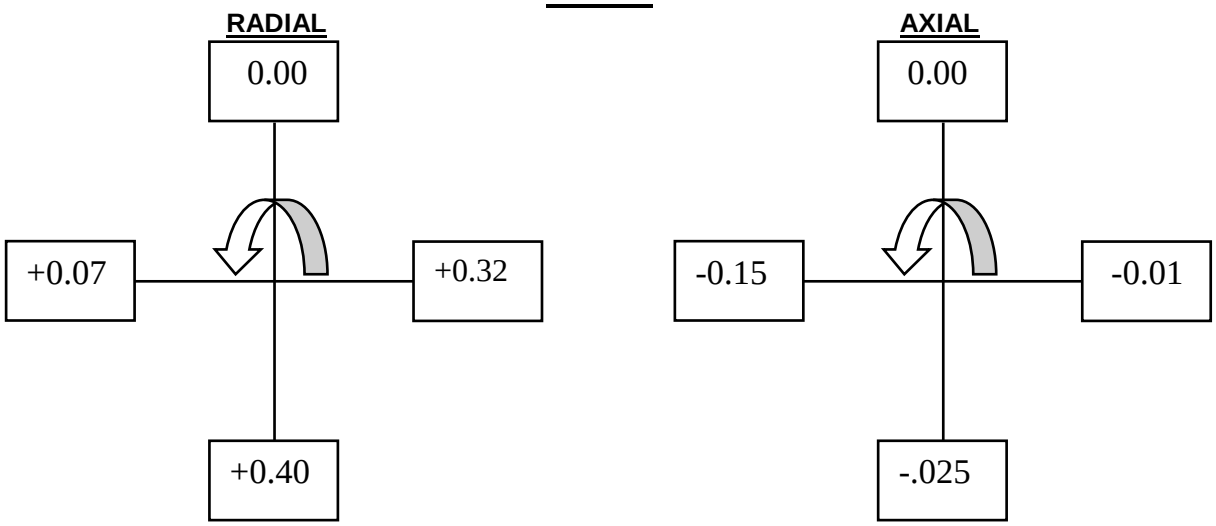
RADIAL



AXIAL



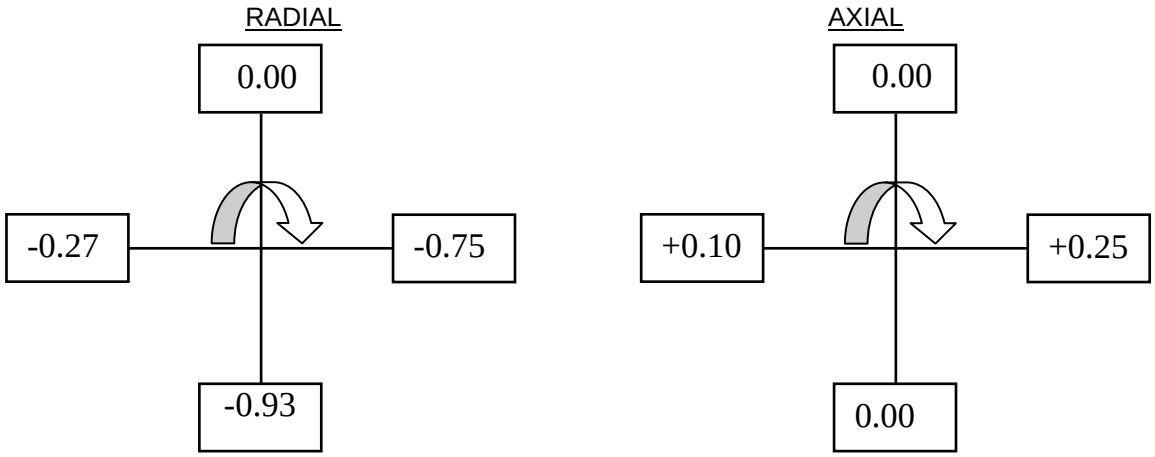
AFTER



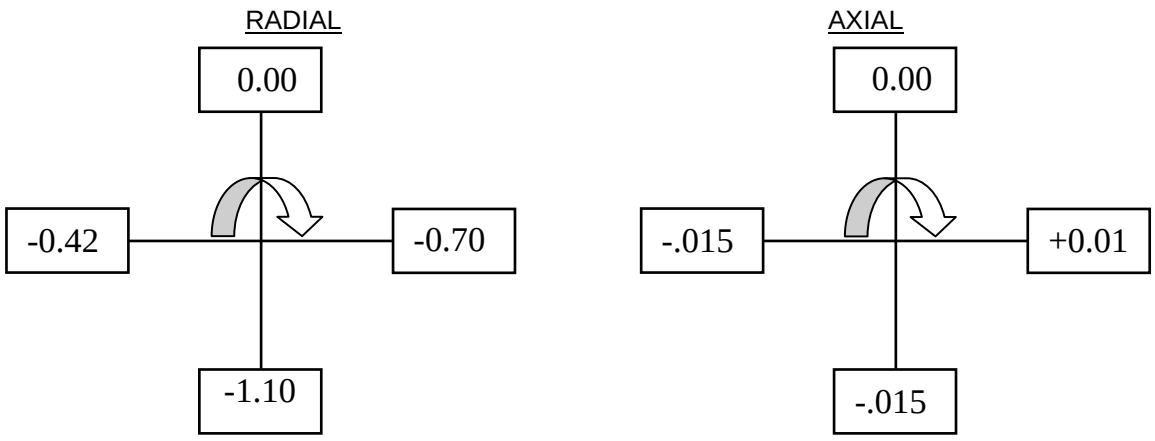
Note: Fixture mounted on LP Rotor, Dial reading on JR, All Readings are in mm.

105-JR TO 101-JHP

BEFORE



AFTER



Note : Fixture mounted on JR, Dial reading JHP, All Readings are in mm.

INDUCED DRAFT FAN 101-BJ TRAIN

101- BJ Fan

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

101- BJT

101 BJT and Gear box were taken for PM for the first time after installation. The turbine was decoupled and both ends bearing housing opened. The thrust bearing and both ends radial bearings clearance were measured and found within limit. The bearing pads were visually inspected and DP inspected and found OK. The gauss measurement was taken and found within acceptable limit. The PGPL actuator drive gear was checked and oil was flushed.

101-BJR Gear box

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

All couplings were visually inspected and found OK.

Removal of MOP

MOP on Gear box was damaged in May 2014 during normal operation of the Plant and the pump was in operation with failure condition. MOP was removed and it was observed that the internals were broken and pump was worn out badly.

M/s KEPL had supplied new pump on Free of Cost basis. Lock washer was installed on back cover of the new pump to prevent loosening of bolts and it was installed in GB. The pipe lines which were provided for additional motor driven pump during May 2014 was removed and piping was installed as per the original installation. Additional motor driven pump was isolated. Spring in the existing NRV at suction of MOP was removed as per recommendation of M/s KEPL.

However during start up on 11.04.2015 with AOP in line, MOP was getting heated up (Turbine speed – 1000 RPM appx) and the pump was not developing the required Pressure . Temporary tubing was provided from PG tapping at discharge of MOP to LO Tank and the temperature of MOP came down to normal. (AOP Dis Pr – 7.5 Kg/cm2).

Since the operation of MOP was not reliable, it was decided to remove the MOP after stopping turbine. Additional motor driven pump was taken inline and the piping connections were installed back as per requirement.

After start up, abnormal sound was observed from Turbine coupling end bearing. Hence this bearing was opened during this opportunity. It was checked and found OK.

101 BJ Train was again started and found OK.

Damaged internal of MOP

BEARING CLEARANCES : 101-BJT

Description	Position	Design clearance	Clearance After (mm)
GB End			
Journal Bearing	Lead wire	0.18 – 0.25	0.30
Oil Guard (For Jr. Brg Housing)	CT side	0.25 – 0.37	0.15
	Silo side	0.25 – 0.37	0.15
Bearing Pinch	***	***	0.01/0.02
Governor End			
Journal Bearing	Lead wire	0.18 – 0.25	0.25
Oil Guard (For Jr. Brg Housing)	CT side	0.25 – 0.37	0.15
Axial Thrust	w/o top hsg		0.31
Bearing Pinch	***	***	0.01/0.02

Journal Bearing Liner Thickness

Liner	CT Side Brg.	Silo Side Brg.
Top	3.18 mm	3.18 mm
Bottom	3.18 mm	3.18 mm

101-BJR CLEARANCES

Description	Position	Design clearance	Actual Clearance
Journal Bearing (High Speed Shaft)	CT side	0.10-0.14	0.13
	Silo side		0.12

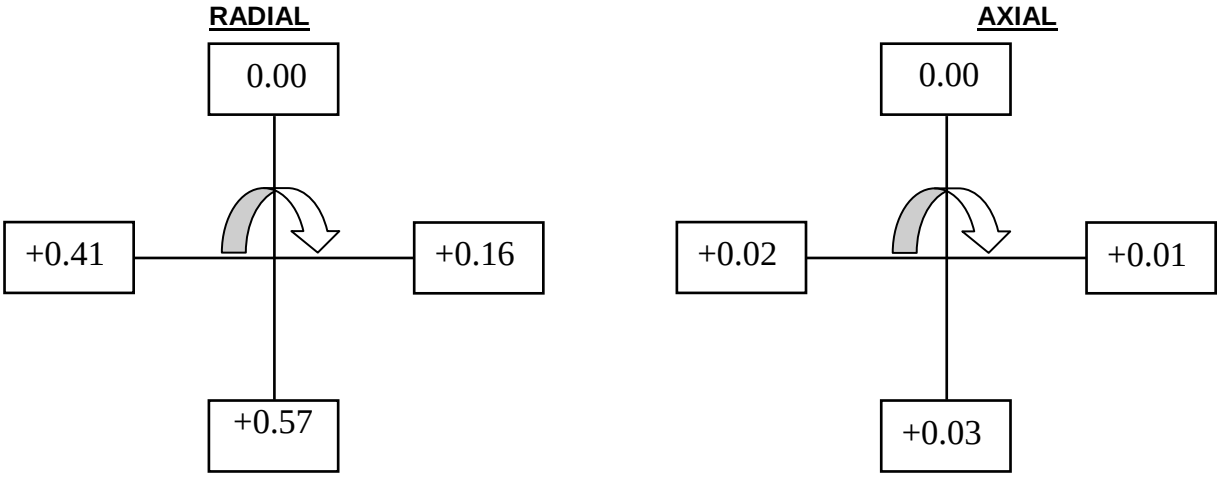
Axial thrust (Low Speed Shaft)		0.20-0.28	0.28
Journal Bearing (Low Speed Shaft)	CT side	0.14-0.19	0.19
	Silo side		0.17
Free Float		--	0.060”
Backlash		0.30-0.50	0.35
Shaft diameter (High Speed drive pinion)	CT side	--	99.93
	Silo side	--	99.90

BEARING CLEARANCES : 101-BJ

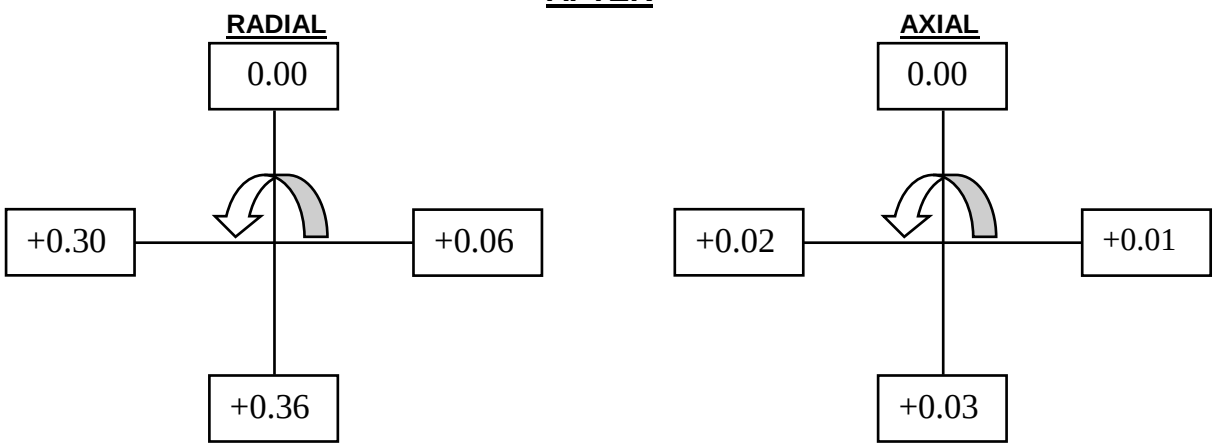
Description	Position	Design clearance	Actual Clearance mm
Gear Box End-BJ			
Journal Bearing	Lead wire	0.008”-0.012”	0.35
Free End-BJ			
Journal Bearing	Lead wire	0.008”-0.012”	0.30

ALIGNMENT VALUES – 101-BJT TO 101-BJR

BEFORE



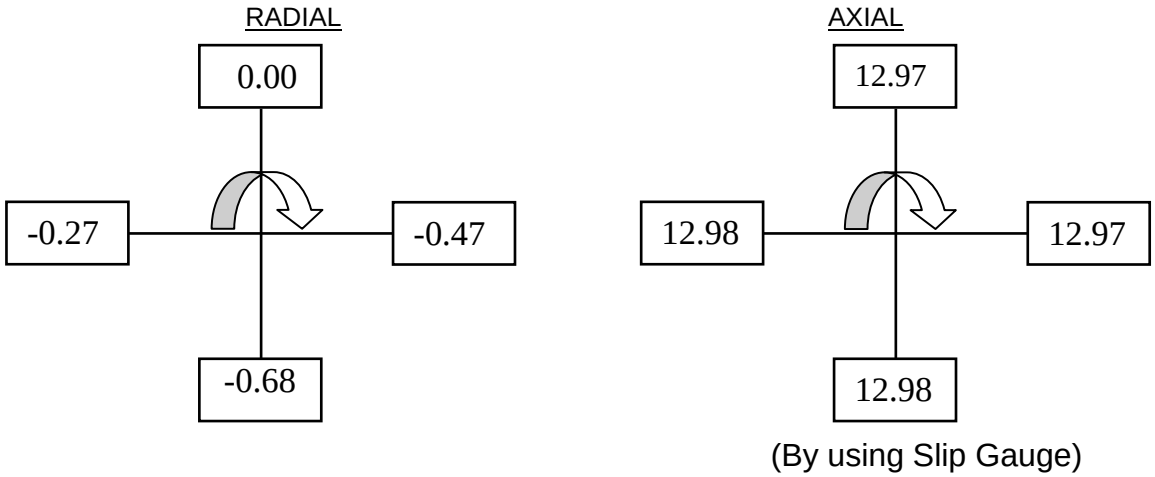
AFTER



Note: Fixture mounted on Turbine Rotor, Dial reading on GB, All Readings are in mm.

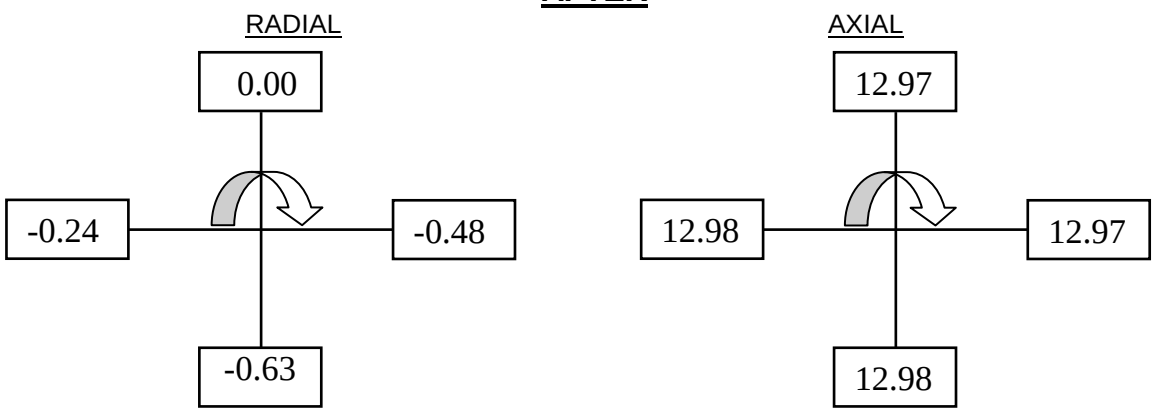
101-BJR TO 101-BJ

BEFORE



(By using Slip Gauge)

AFTER



(By using Slip Gauge)

Note : Fixture mounted on GB, Dial reading on Fan, All Readings are in mm.

SEMILEAN SOLUTION PUMP115-JA TRAIN

115-JA Semilean Solution Pump

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

Oil of LO console was removed and filled with new oil as bearing shell & housing were found to be having rust.

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 inspected and found OK. The gauss measurement was taken and found within acceptable limit.

The turbine was having problem of speed variation during normal operation. Service Engineer from M/s KEPL was called for attending the problem. Governing valve was opened. The Valve stem was bent (Runout - 0.3 mm) which was straightened and

provided as there was no spare available. Packings were replaced with new one. Actuator filter was cleaned and the actuator was flushed with oil SERVO ULTRA 40. As per KEPL, greasing is to be done only on rod end bearings and greasing is not required to be done on linkages as the turbine is in open area.

The condition of TB woods coupling sleeve was not good and hence replaced with new one issued from Stores. The condition of the existing coupling sleeve of 115 JBT was good and it was reused. The following differences were observed in the coupling sleeves:

Parameter	115 JAT existing sleeve & new sleeve's issued from store	115 JBT
OD(mm)	48	50.5
Width (mm)	25.5	27
Hardness Shore A	80	65

115-JAR Gear Box

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 to be O.K. Gauss measurement of gear shaft and bearings carried out and found within limit. Bearing clearances and backlash were measured and found within the design range. The main oil pump drive coupling was inspected and found in good condition. The oil pipings 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. The bearing pads were visually inspected and DP inspected and found OK. The gauss measurement was taken 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.

COLD CLEARANCE TOLERANCES – 115-JAT

Sr. No	DESCRIPTION			DESIGN (INCH)		ACTUAL (INCH)	
				MIN	MAX		
1	CARBON RING DIAMETRAL			.0070	0.0085	STM. END	EXT. END
						0.007	0.007
2	JOURNAL BEARING DIAMETRAL			.0035	.0080	STM. END	EXT. END
						0.0098	0.0094
3	OIL GLAND COUPLING SIDE	Inboard	Radial	0.0100	0.0125	0.0047 / 0.0047	
4			Axial	0.040	0.050	0.0748 / 0.0669	
5		Outboard	Radial	0.0100	0.0125	0.0059 / 0.0059	
6			Axial	0.080	0.090	0.1614 / 0.1496	
7	OIL GLAND GOVERNING SIDE	Radial		0.0100	0.0125	0.0059 / 0.0047	
8		Axial		0.030	0.040	0.0346 / 0.0503	
9	END THRUST			0.010	0.012	0.009	

Journal Bearing Pads Liner Thickness 115-JAT

PAD	NORTH SIDE (Inch)	SOUTH SIDE (Inch)
Upper	0.1157	0.1141
Lower	0.1141	0.1141

Thrust Bearing Pad Thickness: 115-JAT

Pad No.	Active (Inch)	Inactive (Inch)
No. 1	0.687	0.688
No. 2	0.686	0.686
No. 3	0.687	0.687
No. 4	0.687	0.687
No. 5	0.686	0.686
No. 6	0.687	0.687

CLEARANCE RECORD: 115-JA

Description	Design Clearances (Inch)	Actual Clearances (Inch)
Journal bearing (Thrust end)	0.005-0.0098	0.0070
Journal bearing (Non thrust end)	0.005-0.0098	0.0066
Axial Thrust	0.013 – 0.015	0.011

Thrust Bearing Pad Thickness: 115-JA

Pad No.	Active (Inch)	Inactive (Inch)
No. 1	1.2500	1.2500
No. 2	1.2503	1.2496
No. 3	1.2403	1.2492
No. 4	1.2411	1.2496
No. 5	1.2500	1.2500
No. 6	1.2500	1.2500
No. 7	1.2503	1.2496
No. 8	1.2507	1.2500

CLEARANCE CHART: 115-HT

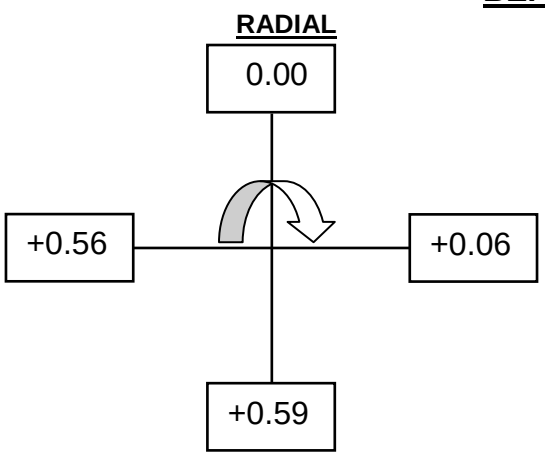
Description	Design Clearances (Inch)	Actual Clearances (Inch)
Thrust end bearing	0.0048-0.0058	0.0051
Opp Thrust end bearing	0.0048-0.0058	0.0062
Axial Thrust	0.010-0.011	0.011

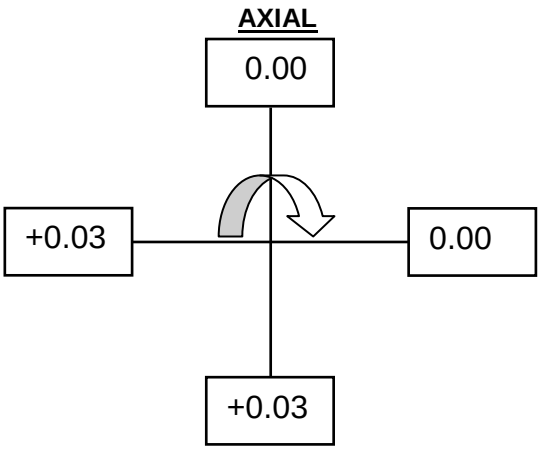
Thrust Bearing Pad Thickness: 115-HT

Pad No.	Active (Inch)	Inactive (Inch)
No. 1	0.742	0.744
No. 2	0.742	0.743
No. 3	0.743	0.743
No. 4	0.742	0.743
No. 5	0.741	0.744
No. 6	0.741	0.743

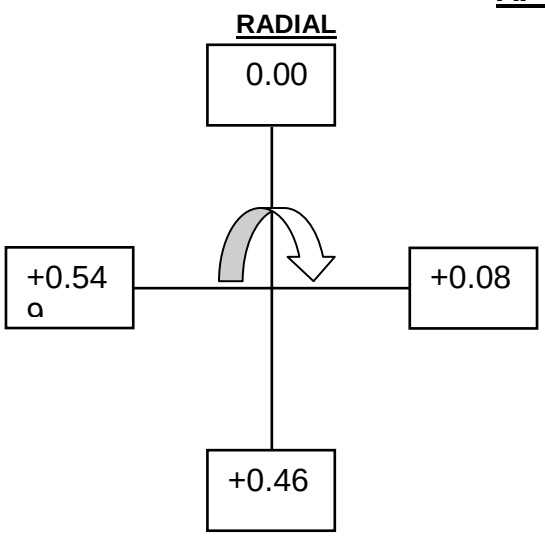
115-JAT TO 115-GB

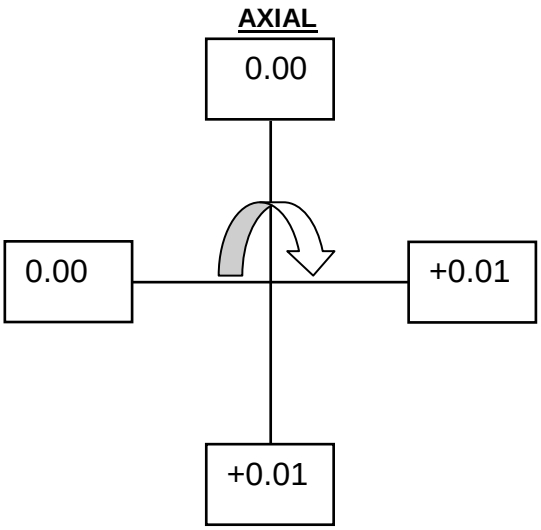
BEFORE





AFTER

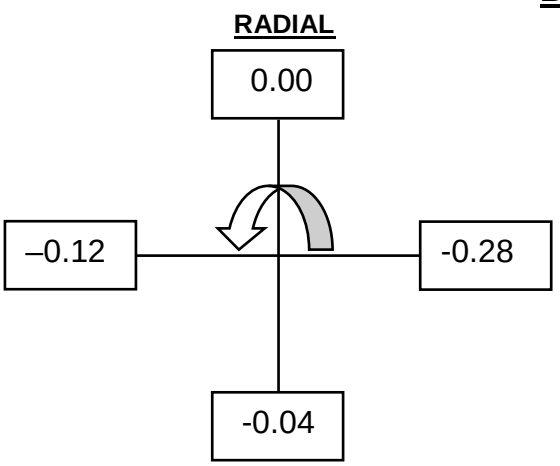


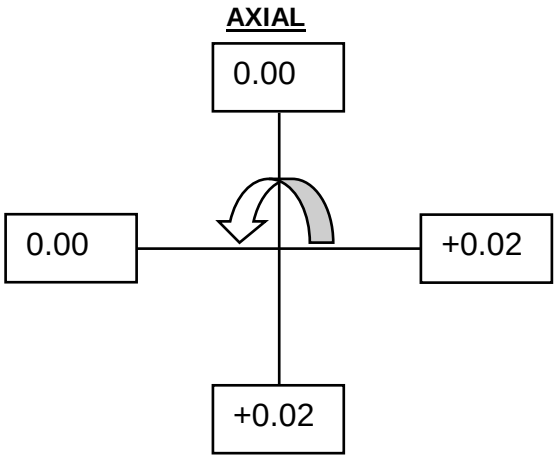


Note : Fixture mounted on Turbine, Dial reading on Gear box, All Readings are in mm.

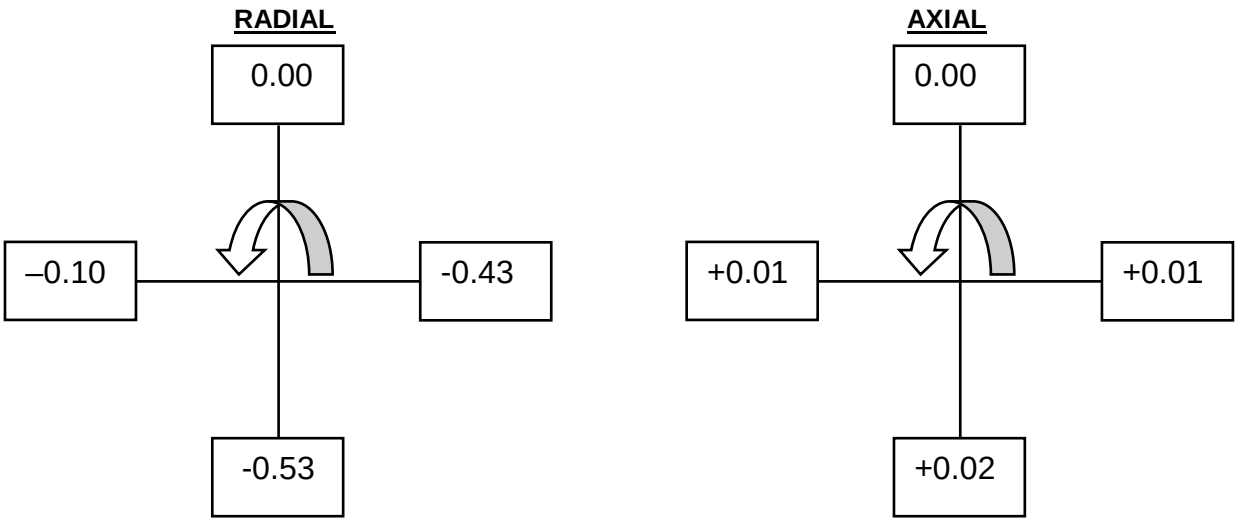
115-GB TO 115-JA

BEFORE





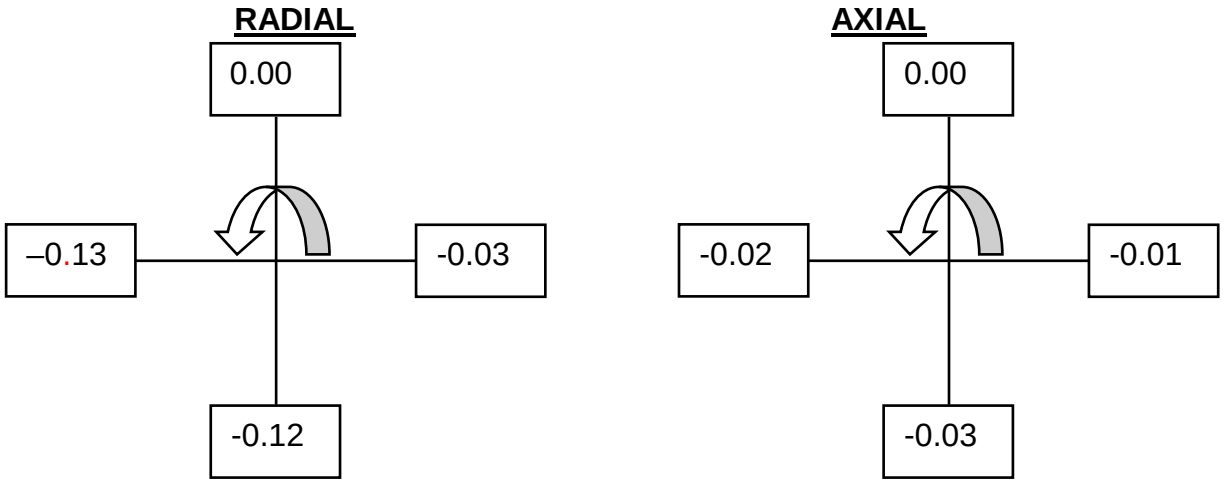
AFTER



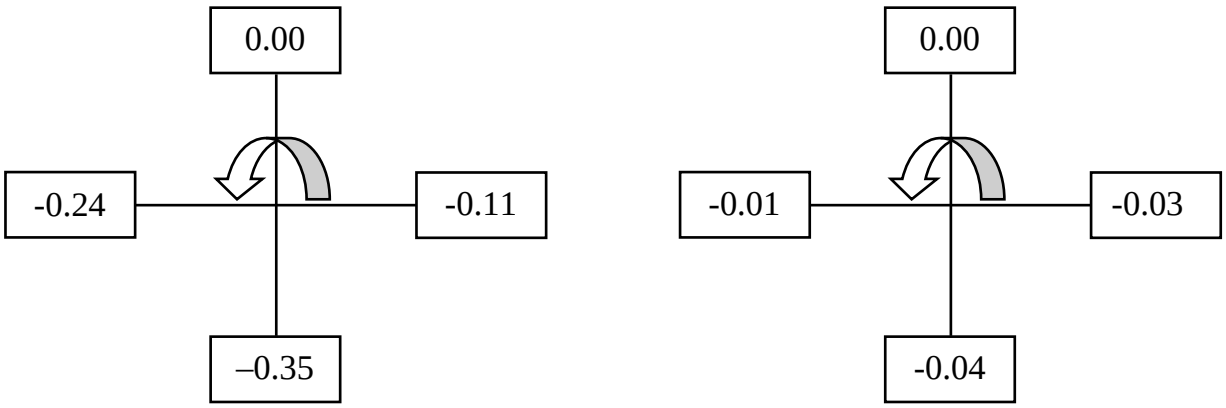
Note: Fixture mounted on Pump, Dial reading on GB, All Readings are in mm.

115-HT TO CLUTCH:

BEFORE



AFTER



Note: Fixture mounted on pump, Dial reading on Clutch, All Readings are in mm.

SEMILEAN SOLUTION PUMP115-JB TRAIN

Major Overhauling of SEMILEAN PUMP 115-JB

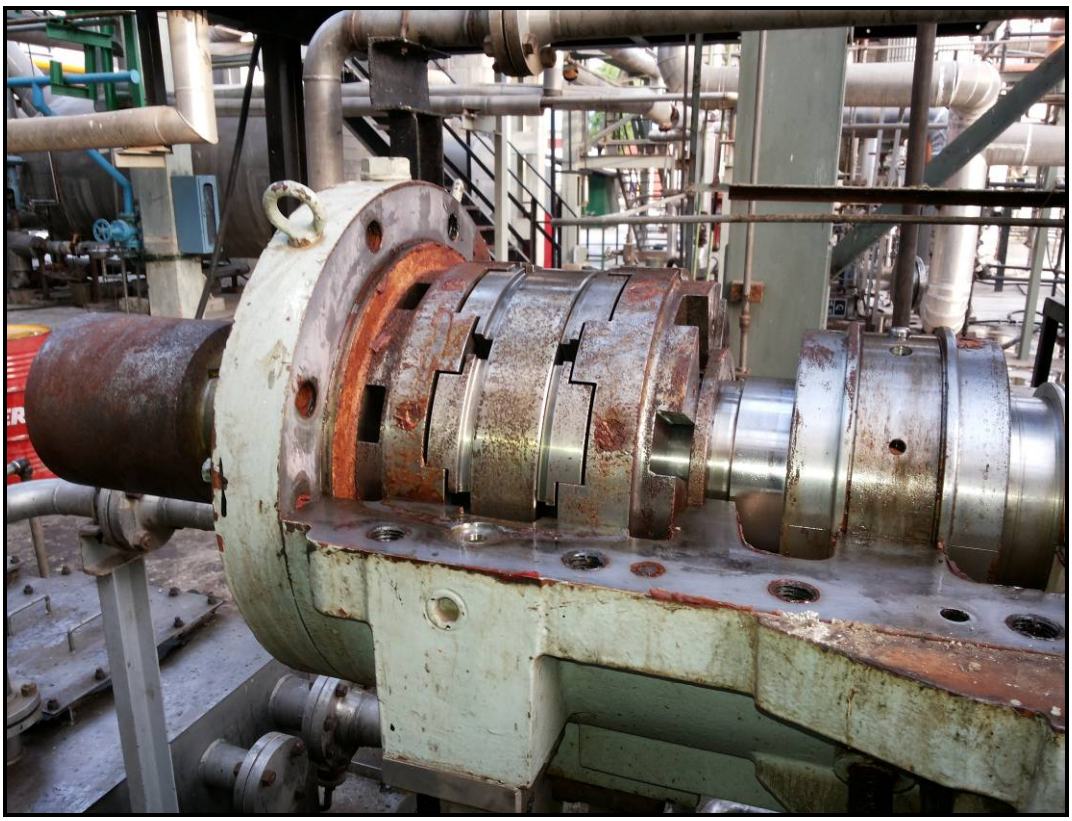
The 115 JB was taken for major overhauling for the first time after its installation on May 2005. The turbine was decoupled and both ends bearing housing opened and bearing clearances measured for records. Both end bearings were removed along with the housing. Both ends mechanical seals were locked and removed. The casing was unbolted and the top casing removed. The bearing shell & housing were found to be having rust. Hence the oil console was cleaned and filled with new oil.

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

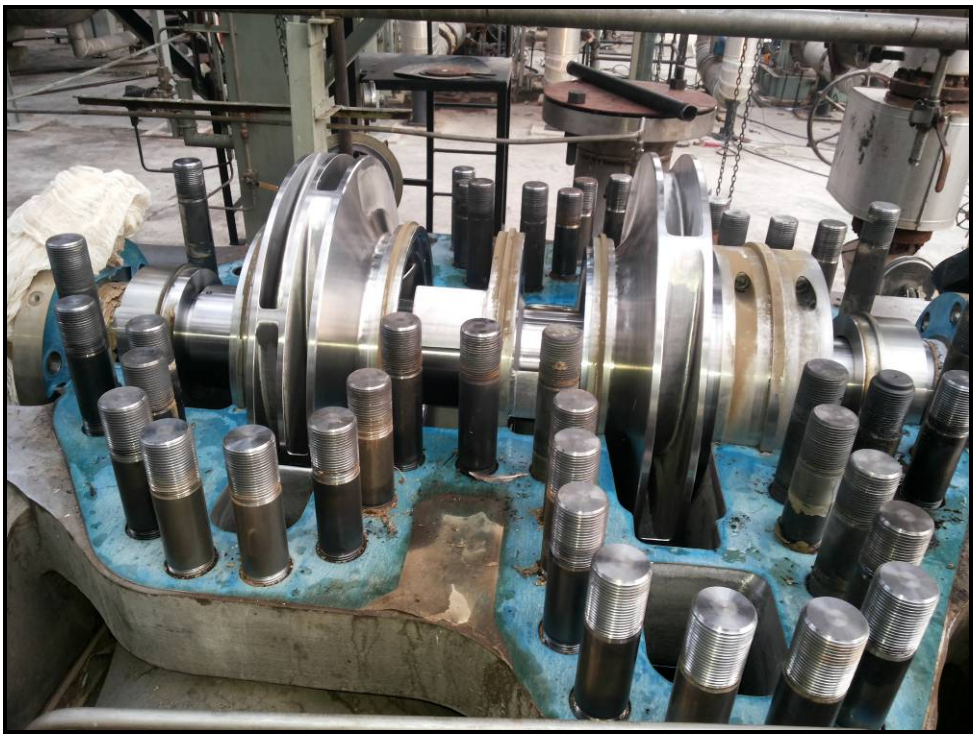
The wear rings and throat bush clearances were measured. The throat bush clearances as well as DE & NDE wear ring clearances were found OK.

The rotor was placed inside the casing. The casing was lowered and a new parting plane gasket was provided. While cutting of gasket care was taken to keep gasket end portion (in contact with mechanical seal & around it) was kept extended by around 5 mm. The casing was tightened and this extended portion of gaskets at both ends was cut using a blade. Both ends new refurbished mechanical seals installed. The mating faces o ring/u cup were available in two materials i.e. duraflon & viton. It was observed that on installation duraflon seal, the mechanical seals were leaking while being tested in workshop using testing tool. Hence the mechanical seals were assembled with viton seals. The seal were tested using DM water and no leakage was observed.

Both end bearing housing along with housings were also installed. The bearing clearances were measured and noted. The pump to GB alignment readings were measured and recorded.



The bearing shell & housing of pump were found to be having rust



115-JB after removal of top casing

115- JBT Major overhauling

The turbine was taken for major overhauling for the first time after its installation on May 2005. Turbine was decoupled and exhaust line was removed. The top casing was removed and all axial as well as radial clearances were measured. The bearings were removed for inspection. Rotor assembly was taken out and it was observed that the 5th stage blades was having deposits and it was choked badly. Sand blasting of rotor was carried out by M/s B Chauhan. All diaphragms were taken out for cleaning. All inter-stage labyrinths were also taken out and new labyrinths were installed. (Procured from M/s Prabhu Engineering, Hyderabad)

The rotor was reinstalled & all axial as well as radial clearances were measured. New carbon rings installed. The bearing clearance of free end side was on higher side and hence replaced with new one. Bearing liner of coupling end was visually inspected and DP check carried out and found satisfactory. The magnetism level of the bearings and rotor assembly was checked and found within acceptable limit.

An additional flange joint was provided in the Exhaust line of turbine (Fabrication done by M/s J & J Engg.) for easy removal during Overhauling.

Steam inlet pipe, exhaust pipe and all other related piping were boxed up.

Oil of TG13 E actuator was flushed. Coupling sleeve of governor was found in good condition and hence re used.

The turbine was taken for a slow roll . The speed was increased by 1000 RPM , maintained for 5-10 min. Then reduced by 500 RPM and maintained for 5-10 min. Proper care to be taken to speed up the turbine in the range of critical speed. This procedure ensured proper lapping of the carbon rings. The turbine tripped at 5881 RPM.

After removal of casing

5th stage blades was having deposits and it was choked badly

115 JBT rotor after sand blasting

Parts replaced in 115 JBT			
Sr. No.	**Part Name**	**Qty.**	**Store Code**
1	CARBON RING, # 28 CAT NO-604900-49 FOR TURBINE 115 JAT/JBT	10	2010113560109400
2	DIAFRAM SEALS CAT-NO-GY0771-5 T.NO-30,DRG NO ELLIOT:TURBINE-1000177 115 JAT/JBT	5	2010113560117800
3	DIAFRAM SEALS CAT-NO-GY0771-5 T.NO-30,DRG NO ELLIOT:TURBINE-1000177 115 JAT/JBT	1	2010113560117800

4	BEARING LINER BOTTOM , CAT NO.-603360-23, ITEM.NO:60 ,D.NO: WC-00001000177, FOR DRIVE TURBINE (115-JT)	1	2010113560135201
5	BEARING LINER TOP , CAT NO.-603360-42, ITEM.NO:61 , TYPE:ELLIOT-MYR, D.NO : WC-000001000177 FOR DRIVE TURBINE (115-JT)	1	2010113560135211
6	COUPLING SURE-FLEX COUPLING NO 3 J , BORE 1/2 INCH FOR TURBINE TO ACTUATOR Note – for 115 JAT	1	2010113566115000

115-JBR Gear Box

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

CLEARANCE RECORDS – 115-JB

Description	Design Clearances (Inch)	Before (Inch)	After (Inch)
Thrust end bearing	0.005-0.0098	0.0082	0.0082
Opp Thrust end bearing	--- do---	0.0074	0.0074
Axial Thrust	0.013 – 0.015	0.0177	0.0177

CLEARANCE RECORDS – 115-JBT

Description		Design Clearances (Inch)	Before (Inch)	After (Inch)
Axial Thrust		0.010 – 0.012	0.0122	0.0110
Coupling side bearing		0.0055-0.008	0.0122	0.0122
Governor side bearing		-- do --	0.0122	0.0122
Oil Guard Coupling side (inboard)	Radial	0.0100-0.0125	0.0047/0.0047	
	Axial	0.040-0.050	0.0425/0.0425	
Oil Guard Coupling side (outboard)	Radial	0.0100-0.0125	0.0059/0.00511	
	Axial	0.080-0.090	0.07283/0.06889	
Oil Guard Governor side	Radial	0.0100-0.0125	0.00059/0.00393	
	Axial	0.030-0.040	0.003149/0.03149	

Journal Bearing Pads Liner Thickness 115-JBT

PAD	NORTH SIDE	SOUTH SIDE
Upper	0.1153	0.1145
Lower	0.1141	0.1141

Thrust Bearing Pad Thickness: 115-JBT

Pad No.	Active	Inactive
No. 1	0.6866	0.6874
No. 2	0.6870	0.6874
No. 3	0.6874	0.6874
No. 4	0.6874	0.6877
No. 5	0.6870	0.6874
No. 6	0.6874	0.6874

COLD CLEARANCE TOLERANCES					
Sr. No.	**DESCRIPTION**	**DESIGN**		**ACTUAL**	
		MIN	MAX		
1.	DIAMETRAL SHAFT SLEEVE SEALS	.0100	0.0125		
2.	RADIAL DIAFRAM SEAL	.0148	0.0165		
3.	CARBON RING DIAMETRAL	.0070	0.0085	STM. END	EXT. END
				0.0066	0.0066
4.	JOURNAL BEARING DIAMETRAL	.0035	.0080	STM. END	EXT. END
				0.0145/0.0010	0.0122
5.	TRIP PIN/ PLUNGER	.0620	.0650		
6.	AXIAL BEARING HOUSING SEAL, STEAM END	.0300	.0400		
7.	AXIAL BEARING HOUSING SEAL, EXHAUST END INBOARD	.0400	.0500		
8.	AXIAL BEARING HOUSING SEAL, EXHAUST END OUTBOARD	.0800	.0900		
9.	NOZZLE RING, AXIAL	.0500	.0720	0.0669	0.0649
10.	BUCKET HOLDER, AXIAL (INLET)	.0500	.0900	0.0669	0.0669
11.	BUCKET HOLDER , AXIAL (OUTLET)	.0700	.1050	0.0925	0.0925
12.	RADIAL , DISK	.0580	.0680		
13.	DIAFRAM , AXIAL (ROW 6)	.0840	.1140	0.0708	0.0708
14.	DIAFRAM , AXIAL (ROW 2)	.0520	.0820	0.0708	0.0708
15.	DIAFRAM , AXIAL (ROW 3)	.0520	.0820	0.0708	0.0708
16.	DIAFRAM , AXIAL (ROW 4)	.0520	.0820	0.0787	0.0787
17.	DIAFRAM , AXIAL (ROW 5)	.0520	.0820		
18.	MAGNETIC IMPULSE SPEED PICK – UP AIR GAP	.0200	.0250		

Thrust Bearing Pad Thickness: 115-JB

Pad No.	Active	Inactive
No. 1	1.2511	1.2492
No. 2	1.2503	1.2496
No. 3	1.2499	1.2492
No. 4	1.2496	1.2496
No. 5	1.2496	1.2499
No. 6	1.2503	1.2496
No. 7	1.2503	1.2496
No. 8	1.2499	1.2499

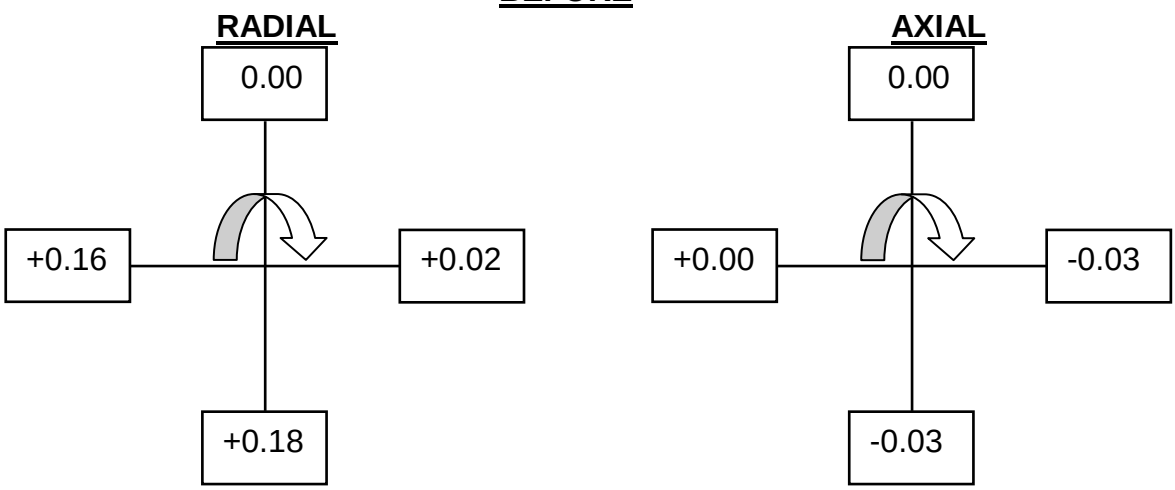
ALIGNMENT READINGS

Distance Between Flange Faces

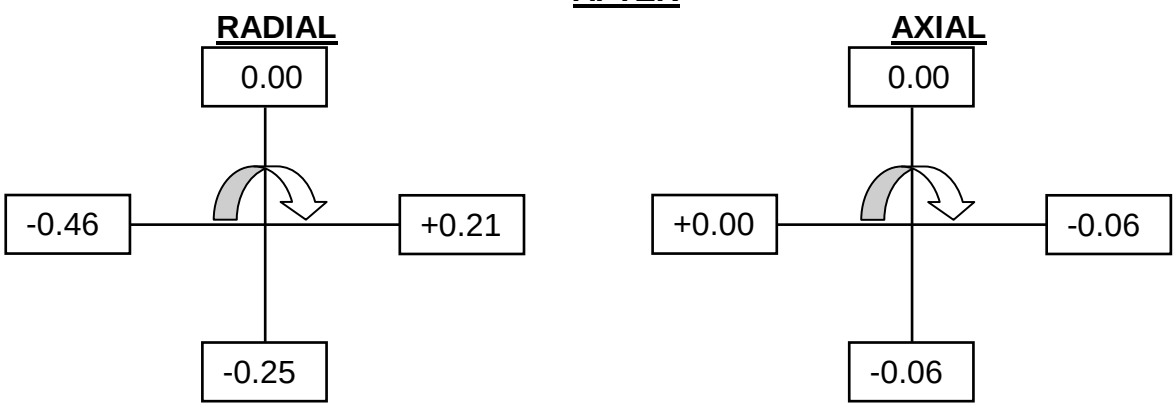
115-JBT to 115-JR = 15.902” & 115-JR to 115-JB = 11.881”

115-JBT TO 115-JR

BEFORE



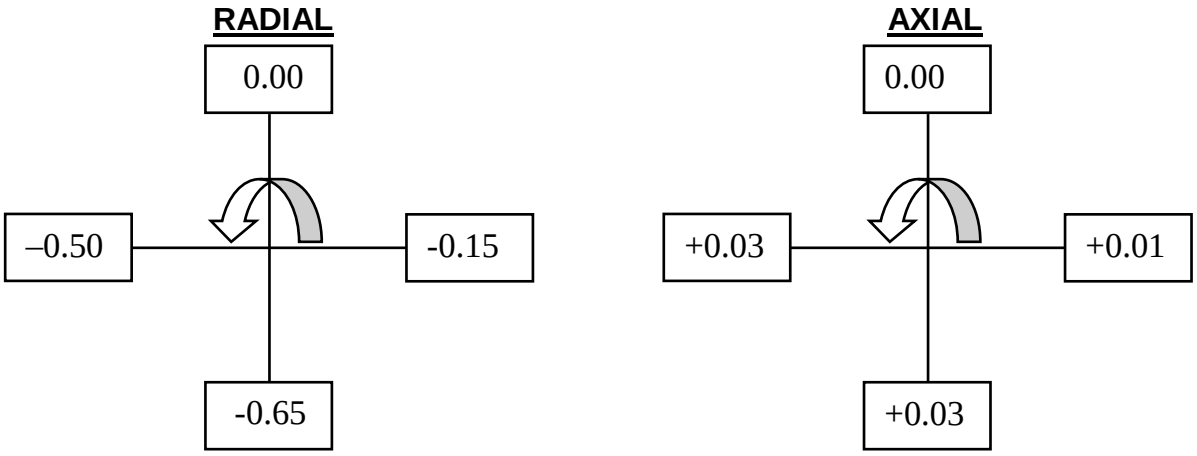
AFTER



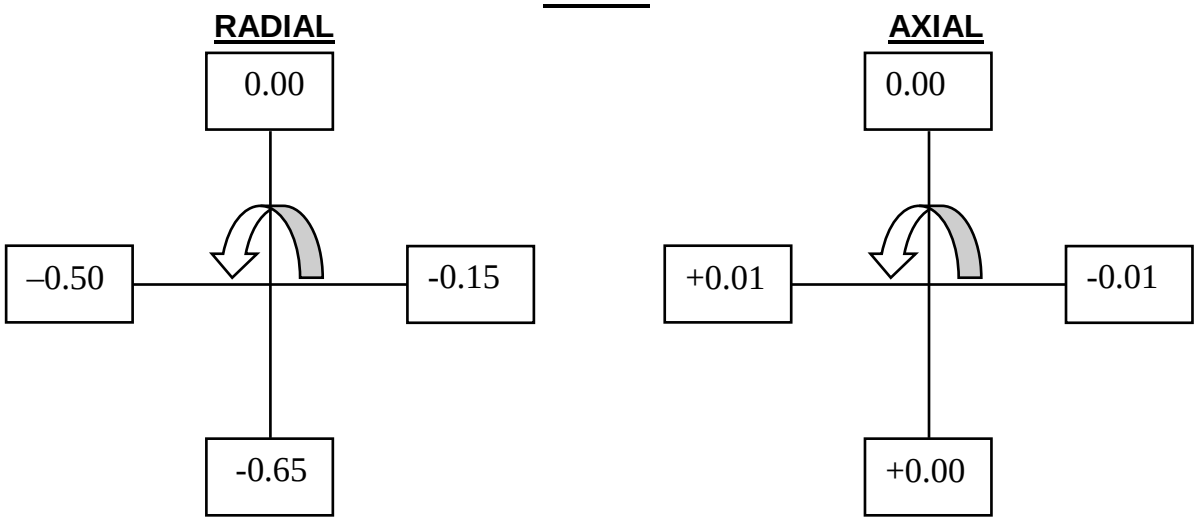
Note: Fixture mounted on Turbine, Dial reading on Gear Box, All Readings in mm.

115-JR TO 115-JB

BEFORE



AFTER



Note: Fixture mounted on Gear box, Dial reading on Pump, All Readings are in mm.

BOILER FEED WATER PUMP, TRAIN 104-JA

104-JA Boiler Feed Water Pump

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

104-JAT Drive Turbine

The turbine was taken for preventive maintenance.

CLEARANCE CHART: 104-JAT

Description		Design Clearance (Inch)	Before PM (Inch)	After PM (Inch)
Coupling end				
Journal bearing		0.005 – 0.007	0.0059	0.0059
Oil Guard (For Journal Brg. Housing)	**South**		0.0059	0.0059
	North		0.0039	0.0039
Bearing Pinch			0.00078/0.0011	0.00078/0.0011
Governor End				
Journal bearing		0.005 – 0.007	0.0066/0.0078	0.0066/0.0078
Oil Guard (For Journal Brg. Housing)	**South**		0.0098/0.0059	0.0098/0.0059
Axial Thrust (With Top Housing)		0.011 – 0.016	0.022	0.0216
Total Float				0.0551
Bearing Pinch				0.00039/0.00078

Journal Bearing Sleeve Thickness 104-JAT

PAD	NORTH SIDE (Inch)	SOUTH SIDE (Inch)
Upper	0.3980	0.3996
Lower	0.4051	0.3988

Thrust Bearing Pad Thickness: 104-JAT

Pad No.	Active (Inch)	Inactive (Inch)
No. 1	0.6228	0.6297
No. 2	0.6236	0.6297
No. 3	0.6232	0.6255
No. 4	0.6228	0.6259
No. 5	0.6240	0.6263

CLEARANCE CHART: 104-JA

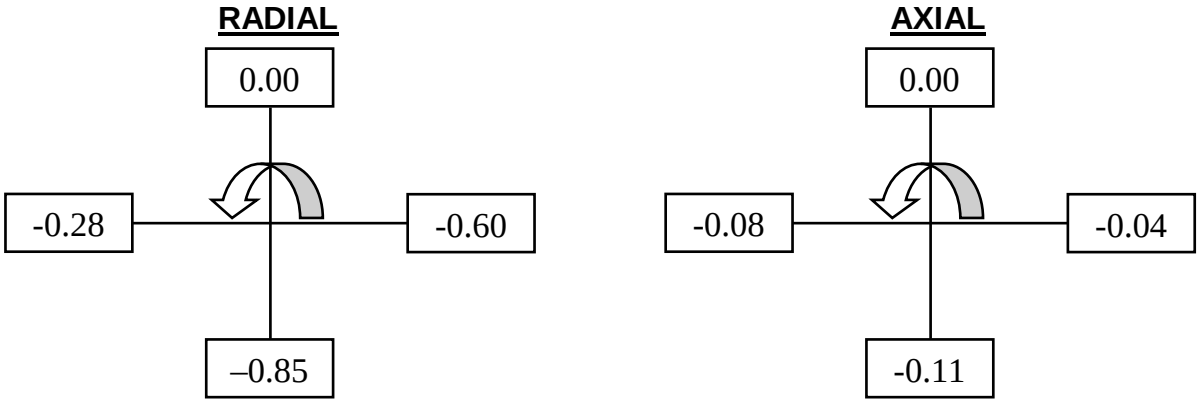
Description	Design Clearance (Inch)	Before PM (Inch)	After PM (Inch)
104 JA			
Journal bearing (Thrust end bearing)	0.006 - 0.008	0.00748	0.00748
Journal bearing (Opposite thrust end)	0.006 - 0.008	0.00826	0.00826
Axial Thrust	0.014	0.0145	0.0125

Thrust Bearing Pad Thickness: 104-JA

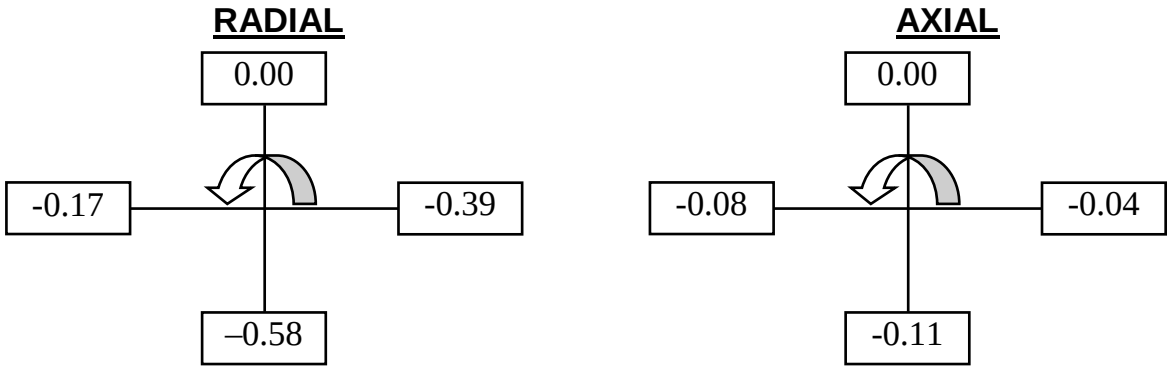
Pad No.	Active (Inch)	Inactive (Inch)
No. 1	0.9992	0.9996
No. 2	0.9984	0.9992
No. 3	0.9992	0.9992
No. 4	0.9988	0.9992
No. 5	0.9992	0.9992
No. 6	0.9984	0.9998

ALIGNMENT : 104-JAT to 104-JA

BEFORE



AFTER



Note: Fixture mounted on pump, Dial reading on Turbine, All Readings are in mm. View from Turbine Rear side

a-MDEA PUMP 107-J Train

107-J aMDEA Pump

Both DE & NDE side bearing housing oil flushed.

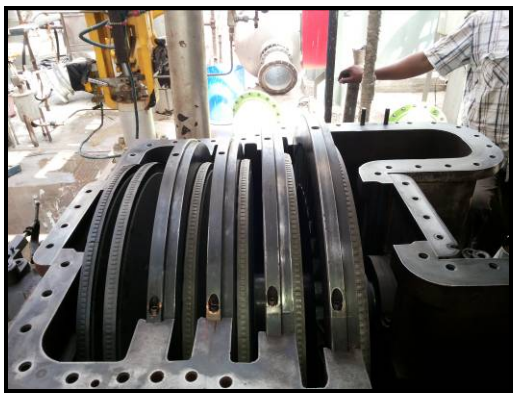
Major Overhauling of 107-J Drive Turbine, 107-JT

All the pipings were disconnected. The turbine was decoupled and 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 no damages found. Magnetism level of all bearings was found to be within limit. Clearances were measured and found to be within limit.

Turbine Casing Parting Plane bolts removed & top casing half lifted from position. The steam inlet strainer was found damaged and some portions of blades was having minor damages. The damages were rectified. Top casing half was cleaned properly by hydrojetting. Diaphragm parting plane bolts removed & top portion lifted out of turbine. Turbine Rotor was lifted from bottom casing after recording all internal clearances. Turbine rotor was thoroughly cleaned by sand blasting. Turbine Rotor was placed in bottom casing & all the readings were recorded.

All Carbon Rings i.e. Front & Rear Steam gland & Interstage replaced & clearances made as per design requirement. Turbine Casing final box-up done after ensuring drain passage clean. Lube oil filter cleaned & filter element replaced. Lube oil filter was cleaned by hydrojetting. Alignment between Turbine & Pump was done and final coupling of the turbine to pump done. All the pipings were connected.

Some portions of rotor blades was having minor damages



Ready for keeping top casing

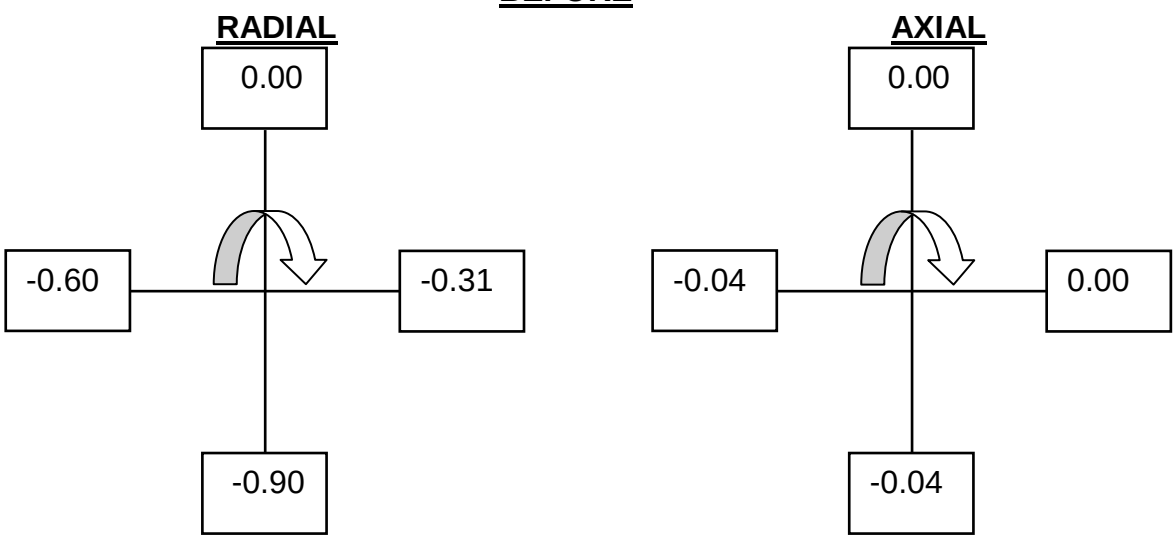
CLEARANCE CHART: 107-JT (MURRY TURBINE)

Description	Design Clearance (Inch)	Before PM (Inch)	After PM (Inch)
Journal bearing Thrust end	0.004 – 0.006	0.0062-0.0070	0.0062-0.0070
Oil Guard Thrust end – Inboard & Outboard	0.011” – 0.017”	0.0059	0.0059
Journal bearing Opposite thrust end	0.004 – 0.006	0.0062-0.0070	0.0062-0.0070
Oil Guard Opposite thrust end - Inboard	0.011” – 0.017”	0.0066-0.0059	0.0066-0.0059
Axial Thrust	0.007 – 0.013	0.0145	0.01338
Nozzle Clearance	0.0625	0.0728-0.0846	0.0728-0.0846

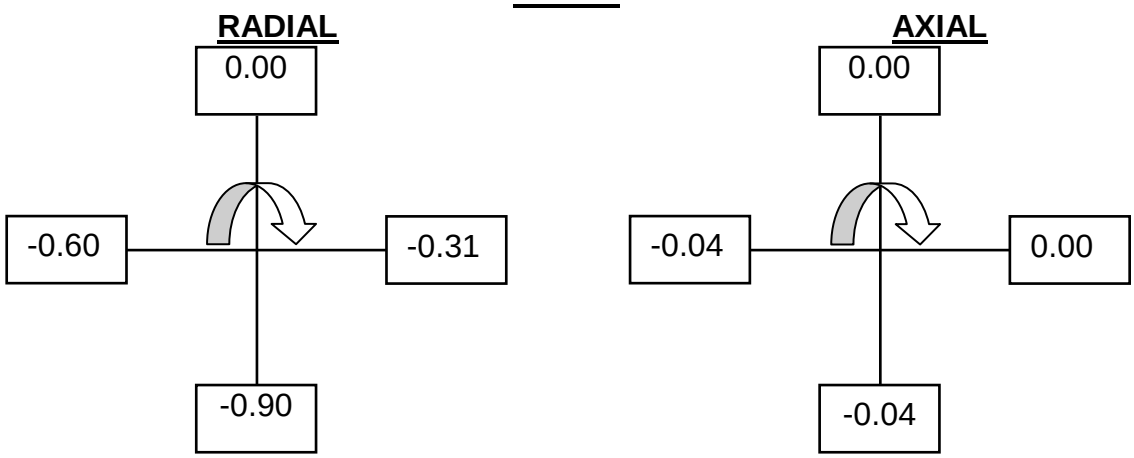
Sr. No.	DESCRIPTION	DESIGN (Inch)	BEFORE (Inch)	AFTER (Inch)
1	Thrust Bearing	0.007-0.0013	0.0145	0.01338
2	Front Bearing	0.004-0.006		0.0062/0.0070
3	Carbon Ring	0.0075-0.0010	0.75-0.81mm	0.0059/0.0078
4	Nozzle to Wheel1	0.0625		0.0728/0.0846
5	Wheel1 to Sector			0.0590
6	Sector to Wheel2			0.098/0.0787
7	Wheel3	0.012-0.016		0.0944/0.0964
8	Wheel4	0.012		0.0944/0.0964
9	Wheel5	0.012		0.0944/0.0964
10	Wheel6	0.012		0.1377/0.1417
11	Carbon Ring	0.0044-0.007	0.75-0.81mm	0.003/0.0051
12	Rear Bearing	0.004-0.006		0.0062/0.0074

ALIGNMENT READINGS: 107-JT to 107-J

BEFORE



AFTER



Note: Fixture mounted on Turbine, Dial reading on Pump, All Readings are in mm.

However after Overhauling and during start up high vibration was observed in 107-JT. The sequence of activities carried out during overhaulin and after observing the Vibration problems are tabulated and given below:

SEQUENCE OF ACTIVITIES OF 107-JT HIGH VIBRATION PROBLEM

Sr . No.	Date	Vib mm/s at 1H	Activities	Remarks
1	1-10 April 2015		Major overhauling of 107-JT done during SD-April 2015. Gland and Interstage Carbon ring were replaced with new one. Bearings were not replaced	
2			Thrust - 0.40 mm,Cplg end Brg Cl- 0.25, Gov End - 0.25. Nozzle ring Clearence -1.85, Diaphragm cl - 2.4 mm min, Carbon ring cl- 0.20 mm, Interstage carbon -0.35	
3			Turbine started in sequence for proper lapping of Carbon ring. OST at 4100 RPM.	
4		5.7	During Start up (while carrying out OST) the vibration at 1H was slightly on higher side.	Normal at 1H -3 mm/s
5	12.04.15	14.3 & reduced to 8	After coupling and taking in line, Vib at 1H increased upto 14.3 mm/s and after running for about an hour, It reduced to 8 mm/s, but still on higher side.	Cyclic Vib. observed
6	12.04.15		Decided to check MOP. The following activites done-	
7	13.04.15		Observed black deposits in MOP and bearings. MOP replaced with spare, Worm wheel replaced, All bearings were replaced.	
8	13.04.15	19.9	Turbine started. On coupled condition, High vibration observed. At 3370 RPM, 1H 19.9 mm/s	Cyclic Vib. observed
9	13.04.15		Decided to check bearings. The following activites done-	
10			Blue match of both bearings checked. Found OK (80%)	
11			However Free end bearing replaced with new one to reduce brg clearence. Clearence reduced from 0.25 to 0.18 mm. Blue match checked.OK	
12			Coupling end brg not replaced. Clearence-0.25	

13			Thrust collar face R/o checked by keeping two dials. Found OK	
14			New thrust brg pads pads provided. Thrust reduced from 0.4 to 0.30 mm	
15	14.04.15	26.4	High vibration at 3350 RPM in coupled condition at 3350 RPM	Cyclic Vib. observed
16		32.2	Thrust increased to 0.45 mm. However Vibration increased upto 32.2 at 3300 RPM in coupled condition. Turbine stopped	
17	15.04.15		MOP decoupled and turbine was started.Vibration found to be 5.7 mm/s at 3450 RPM in coupled condition However after 1 hr of running vibration incresed upto 40.6 mm/s. Turbine stopped	
18			Original MOP, old worm shaft and new bearings installed back and turbine was run with MOP coupled. No improvement found	
19	16.04.15		Decided to open turbine and check rotor. Observed that 3rd, 4th & 5th stage diaphragm partition plane bolts (Control Room side) found loose	
20	to		New steam end carbon rings and old interstage carbon rings provided. Tapping of threads of partition plane bolt hole done. Strainer replaced with new one.	
21			Rotor Runout checked and found ok	
22			Carbon ring clearence, steam end -0.2, Exh end-0.11, Interstage - 0.35, Axial thrust-0.45	
23			J Brg, free end - 0.17,Cplg end - 0.22, New MOP installed back.	
24	18.04.15		Nozzle clearence -1.9 mm, Diaphragm cle- 2.1 mm min	
25			Turbine started for OST. At 3300 RPM 1H - 11 mm/s Vibration increased upto 37.5 mm/s at3450 RPM, Speed reduced upto 2500 RPM. Support adjusted and vib reduced upto 12 mm/s. OST done at 4367 RPM.	Cyclic Vibration NOT observed
26			Coupled and run. At 2500 RPM 1 H- 12mm/s. Reduced upto 7.5 mm/s may be due to support adjustments. Pump changed over. Vibration was continously increasing above 2900 RPM. Turbine was Stopped when vibration reached 32 mm/s.	
27	20.04.15		Flexibility analysis of steam inlet line done by M/s Tech Emerging Engg. Services,Hyderabad.One no fixed support on inlet line replaced by spring support and othe support adjusted as per their suggestion	No significant improveme nt observed
28			Steaminlet line flange disconnected and observed offset by 6 mm. Support adjusted and offset removed and connected again. Turbine run. Vibration measured at 2700 rpm, 1H=6.47mm/sec, 3450 rpm 1H 5.5 mm/sec	No significant improveme nt observed
29	21.04.15		Vibration measured in couple condition in load at 3450 rpm 1H=33.1 mm/sec	
30	22.04.15		Vibration measured in decouple condition at 3400 rpm, 1H= 6.14 mm/sec	

31	24.04.15	4.5	Top Hand nozzle valve which was unable to operate (Valve was in open condition) was removed and closed by providing Plug(Made from W/s).Turbine run. On load at 3530 RPM 1H -4.5	Valve seat was not found
32		28	However after running for 1 hr, vibration was continuously increasing. Turbine was Stopped when vibration reached 28 mm/s at 3500 rpm	
33	25.04.15		Due to seal leak of 107 JA, Plant load was reduced and 107 J was taken on line at 07.30 hrs	
34		4.5	At 2940 RPM (Flow 220 M3/hr) 1H - 7.5mm/s. Vibrtion increased upto 10.5 mm/s and then reduced to 4.5 mm/s. Turbine was run at 2850 RPM in low load upto 12 hrs. Vibraton was constant at 1H-4.5mm/s.	2856 RPM, 190.4 m3/hr, 23.62 Kg/cm2 dis Pr, PRC-4.18 kg/cm2
35		13.4	After attending seal leakage of 107-JA, load on 107-J was increased. Vibration started to increase at 3150 RPM and vibration was continuously increasing. Turbine was Stopped when vibration reached 13.4 mm/s.	3150 RPM, 200 m3/hr, 26.7 Kg/cm2 dis Pr
36	27.04.15		Decided to open turbine and replace with spare refurbished rotor. Observed that all stage diaphragm partition plane bolts OK	
37	to		Same carbon rings and interstage carbon rings were reused	
38	01.05.15		Rotor R/o checked and found ok. 3rd and 4th stage diaphragm machining was done and button was welded at other end for maintaining the clearance	
39			Carbon ring clearence, steam end -0.2, Exh end-0.11, Interstage - 0.35, Axial thrust-0.30. Turbine side Coupling hub Overhang -4.57 mm	
40			J Brg, free end - 0.23,Cplg end - 0.20	
41			Nozzle clearence -1.79 mm, Diaphragm cle- 1.92 mm min	
42			Bottom Hand nozzle valve which was operatable was opened and found that Valve seat is not provided. It was closed by providing Plug(Made from W/s).Turbine run. On load at 3530 RPM 1H -4.5	Valve seat was not found
43			Turbine started for OST.OST at 4315 RPM. (Spare OST assbly provided) vibration in decouple condition at 3000 rpm , 1H 6.5mm/sec and at 3450 rpm 5.9mm/sec	
44	02.05.15	18.7	After starting coupling Vib at 1H increased upto 18.7 mm/s	
45	04.05.15		Thrust increase to 0.45 mm	
46	TO		Decided to carry out insitu balancing at operating speed. 2 nos M6 X 16 mm bolts provided on coupling hub (At jack bolt). Trial wt 3 g. After trial run, 1.8 g correction wt was provided. Vibration on no load reduced to 3.8 mm/s from 4.5mm/s	No significant improvement on load

47		3.8	Oil inlet temp to brg was increase by reducing the CW flow to oil cooler.Oil temp at HE I/l increased upto 48.5 Deg C (Brg I/l - 44.5) 1H- 3.8 at 3200 RPM. Lube Oil - Servo Prime 68 Normal operation - Oil temp at HE inlet- 40 deg C. At brg i/l - 36 deg C	
48	05.05.15		Oil temp at HE I/l increased upto 48.5 Deg C (Brg I/l - 44.5) 1H- 3.8 at 3200 RPM. (Later CW I/l Valve opened)	No significant improvement on load
49	06.05.15		One tie rod of Expansion bellow was not free. Hence one adjustable tie rod made. On reducing the length of the adjustable tie rod the other two are unable to rotate. Hence Screw jack provided and lifted. All tie rods made free. Exhuast line lifted by 5 mm. Vibration measured in decoupled condition at 3430 rpm, 1H vibration was 4.16 mm/sec. In coupled condition vibration measured at 3400 rpm at low load condition, vibration levels were stable around 5 mm/sec, but after pump change over, vibration level started increasing and reached upto 30 mm/sec . Pump stopped.Later screw jack removed.	No significant improvement on load
50	07.05.15		Brg Lube Oil inlet line is under tension. It was removed by providing flexible SS hose.	
51			LO Cooler inlet and outlet line were under tension. It was cut and welded for removing it	
52	08.05.15	6.5	Turbine started in decoupled condition. Max vibration increased to 14 mm/s at 2400-2600 RPM and then reduced.At 3450 RPM, 1 H 6.5 mm/s.	
53		6	Horizontal supports with Jacking arrangement provided at free end Bearing housing. These supports loaded by tightening.	No significant improvement on load
54	Note		Inlet line and exhaust lines were checked and adjusted for reducing the Vibration. However no significant improvement observed.	
55	10.05.15 to 12.05.15		Free end bearing clearance increase from 0.18 to 0.25/0.33 mm by scraping	OD shaft 101.47, ID of bearng 101.80/101.65 mm
56	13.05.15		Alignment correction done. Pump kept ---- towards Control room side	
57	14.05.15 to		NDE bearing bluematching done and scraping done to improve contact	
58	15.05.15		Ejector opened. Found corroded. Made new one a per drawing of 104 JT ejector and provided in position	
59	16.05.15		Alignment done	

60	18.05.15	2.5-3.55	Run in decoupled condition, Vibration max upto 3.22. In Load Condition, Vibration levels at 1H were maintained between 3.5 to 4.0 mm/sec for 1 Hr. and reduced to min. level of 2.9 mm/sec.Then vibration starts increasing at 1.00 PM, increased up-to 15.0 mm/sec and then reduced even to the lowest value of 1.48 mm/sec. Vibration were cyclic in nature. However, Vibration levels were not increased above 9.0 mm/sec, till the stoppage of machine at 04.30 PM	
61	19.05.15 to 20.05.15	2-7.0	107 JT DE bearing checked ??. Run incoupled condition After changeover, vibration was 3.8 mm/s at 15.30 Hrson 19.05.15, which reduced to around 2.5-3.0 mm/s within 1 hour. Turbine kept in line. Vibration stable at 2.5-3.0 mm/s. On 20.05.15, 15.00 hrs, Cyclic Vibration at 1H observed from 2.00 mm/sec To 7.20 mm/sec.	
62	21.05.15	0.9-6.8	Vibration levels are maintained as earlier set of readings. Cyclic Vibration at 1H observed from 0.9 mm/sec To 6.8 mm/sec. NDE side bearing replaced.Thrust decreased. DE brg checked NDE brg - 0.2 mm, Thrust 0.29, **DE brg -0.14 to 0.17 (0.15 shim for pinch)**	
63	22.05.15	21.5	At full load, Vibration levels at 1H increased up to 21.5 mm/sec. NDE side brg increased. Thrust increased NDE brg - 0.27 - 0.34 mm Thrust 0.42	
64	23.05.15		NDE side brg clearance checked. NDE clearence 0.26-.035 mm pinch 0.05. Shim provided	
65	25.05.15	10-14.2	Front turbine Journal bearing clearances were increased in the range of 0.26 to 0.30 mm & Thrust maintained at 0.29mm Vibration levels at 1H maintained at 5.0 to 5.7mm/sec for 2.50 hrs. At 11.45 AM cyclic nature of vibration observed. Vibrn levels were observed in the range of 6-13.0mm/sec then 8-14.0mm/sec & finally 10-15.0 mm/sec. Back Pressure reduced to 25.8 Kg/cm2, Flow reduced to 322 M3/hr & RPM reduced to 3410 but at 16.30 hrs 1H vibration were cyclic in the range of 10-14.2 mm/sec.	Damaged thread of NDE brg repaired, Blue match of NDE brg checked.
66	26.05.15		NDE journal brg increased **NDE clearence 0.27-.034 mm pinch. Shim provided Axial thrust 0.42**	
67	27.05.15		Turbine run in coupled condition. Vibration increased upto 14 mm/s	
68	28.05.15		DE brg opened. Shim changed. Blue match OK. NDE opened and checked OK. New oil provided in console.(Exhaust BV broken) DE brg -0.14 to 0.17 (0.05 shim for pinch)	
69	29.05.15	4-8 mm/s	Turbine run in decoupled condition. Cyclic Vibration observed. Vibration varying between 4 to 8 mm/s	

70	01.06.15 to 02.06.15		Readings between top & bottom Tie rod support clits measured: Ammonia Maint. side Tie rod - 594mm CT side Tie rod- 592mm Urea side Tie rod - 591mm Steam exhaust line lifted by hydraulic jack to make tie rods free.	
71	03.06.15		Turbine decoupled. Steam exhaust line lifted by hydraulic jack to make tie rods free. Readings between top & bottom Tie rod support clits: Ammonia Maint. side Tie rod - 596mm CT side Tie rod- 595mm Urea side Tie rod - 593mm Turbine run for 30 minutes in decoupled condition at 3430 RPM. Vibration at 1H 5.13 mm/s. & reduced to 1.9mm/s. Additional supports were made to lift the Exhaust line.	
72	04.06.15	3.7 mm/s	Turbine decoupled. One no. tie rod found tight. Hence, Steam exhaust line lifted by hydraulic jack to make it free. Readings between top & bottom Tie rod support clits: Ammonia Maint. side Tie rod - 598mm CT side Tie rod- 597mm Urea side Tie rod - 593mm Turbine run in decoupled condition. Vibration at 1H 2.6 mm/s. & increased to 5.0 mm/s Turbine was stopped & again started after removing condensate from casing & line. Vibration at 1H 3.5 - 4.0 mm/s. & increased to 6.5 mm/s. Considering the condensate formation due to low quantity of steam entering into turbine, it is decided to couple the turbine. Turbine coupled & run on full load. Turbine vibration measured after 15 to 20 min running in coupled condition. 1 H vibration reduced to 2.71 mm/sec from initial reading of 4.1 mm/sec. Further continuous monitoring carried out till 8.30 PM. and vibration value at 1H location found in the range of 3.5 to 3.7 mm/sec.	
73	05.06.15	3.7 mm/s	80.5 mm packing on both sides of steam exhust pipe inserted to maintain the lift position & removed the hydraulic jacks.	
74	06.06.15	3.8 mm/s	Vibration levels are maintained as earlier set of readings. At 1H observed 3.8 mm/sec.	

RECIPROCATING CO_2 GAS COMPRESSOR TRAIN (117-J)

LP Cylinders Overhauling

The end clearance at TDC and BDC were measured and opened the head of both cylinders to remove the piston assembly. The cylinder liners were inspected and

found OK. The piston assembly of both the cylinders was replaced. Spare refurbished gas packings were reinstalled on both the cylinders. All the valve assemblies were reconditioned.

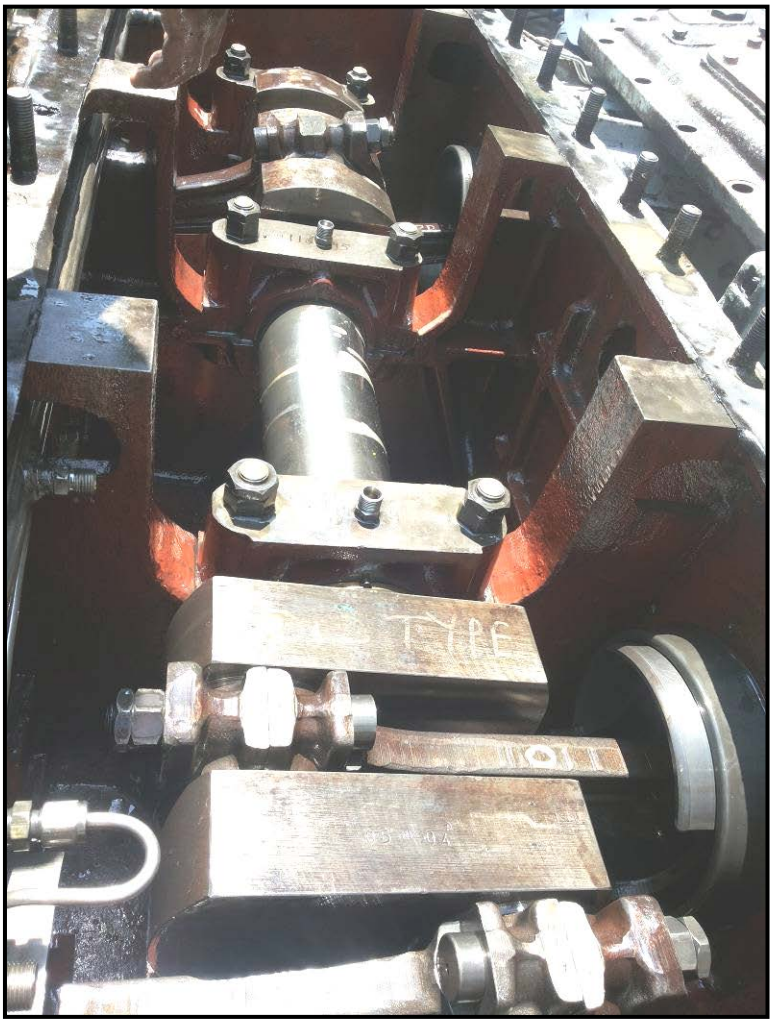
HP Cylinders Overhauling

The end clearance at TDC and BDC were measured and opened the head of both cylinders to remove the piston assembly. The piston rod assembly of both cylinders was replaced by new one with new gas packing. All the suction and discharge valves were replaced by spare refurbished valves.

Crank case assembly Overhauling

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

The tube bundle of the inter stage cooler was pulled out and cleaned by hydro jetting. The LP and HP flow dampener were checked and found OK. The lube oil strainers were cleaned and reinstalled.

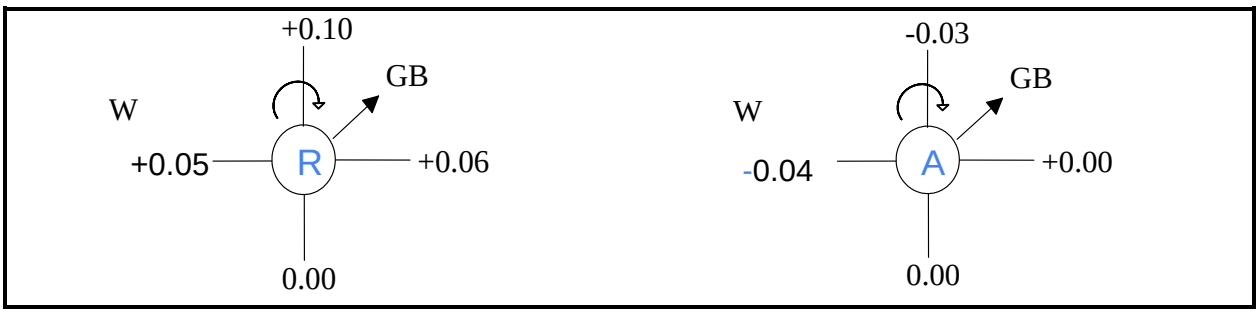


Crank case opened

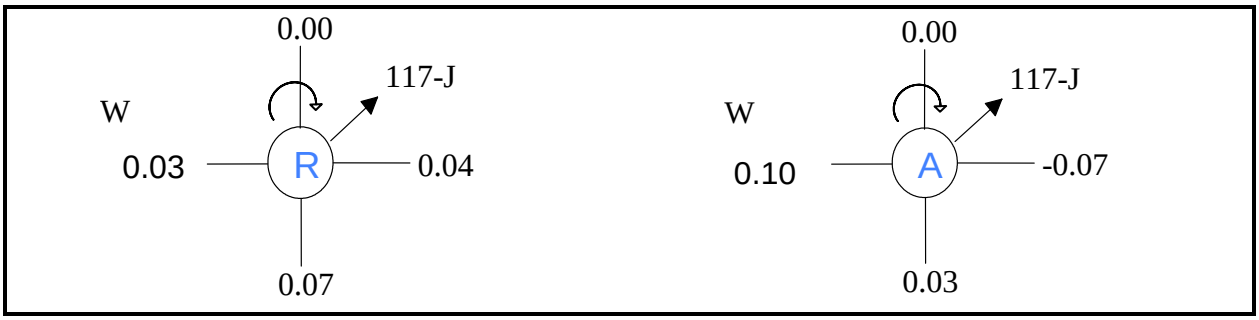
CLEARANCE CHART : 117-J TRAIN

Description	Position		Design clearance(mm)	Before (mm)	After (mm)
Piston end clr. (Front /**TDC**)	LP	Urea side	2	2.64	2.78
		Ammonia side	-- do --	2.40	2.7
	HP	Urea side	-- do --	2.40	2.41
		Ammonia side	-- do --	2.30	2.40
Piston end clr. (Intermediate /**BDC**)	LP	Urea side	1.5	1.12	1.91
		Ammonia side	-- do --	1.00	1.90
	HP	Urea side	-- do --	1.40	1.60
		Ammonia side	-- do --	1.30	1.71
Main bearing	I	Urea side to Ammonia side	0.08-0.15 (0.3 MAX)		0.14
	II		-- do --		0.14
	III		-- do --		0.15
	IV		-- do --		0.14
	V		-- do --		0.16
Big end bearing	LP	Urea side	0.07-0.13 (0.3 MAX)		0.13
		Ammonia side	-- do --		0.14
	HP	Urea side	-- do --		0.14
		Ammonia side	-- do --		0.14
Small end bearing	LP	Urea side	0.05-0.10 (0.2 MAX)		0.08
		Ammonia side	-- do --		0.08
	HP	Urea side	-- do --		0.08
		Ammonia side	-- do --		0.08
Cross head guide	LP	Urea side	0.18-0.26 (0.6 MAX)		0.20
		Ammonia side	-- do --		0.20
	HP	Urea side	-- do --		0.20
		Ammonia side	-- do --		0.20
Side clearance (Crank shaft)	----	Crank shaft	0.45-0.60 (0.9 MAX)		0.50
Side clearance (Connecting rod big end)	LP	Urea side	0.33-0.42 (0.6 MAX)		0.35
		Ammonia side	-- do --		0.35
	HP	Urea side	-- do --		0.35
		Ammonia side	-- do --		0.35

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



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



COPPUS TURBINES

101 / 105-JLOT

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

PRIMARY REFORMER, SECONDARY REFORMER & AUXILIARY BOILER JOBS

The Primary Reformer Radiant Zone

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

Row No.	Burner Nos.
1	110, 112
2	203, 211, 212
3	Nil
4	405, 414
5	501, 513, 514
6	602
7	703, 708, 709, 710
8	807, 812
9	908, 912

The roof insulations were inspected and damaged / dropped ones were replaced by new ones & gaps were filled.

Gaps in side wall Z-module were observed at peephole elevation and the same was repaired. However, side wall insulation at other locations were intact & in satisfactory condition.

Damaged bottom header insulation were replaced / repaired.

AUS and other NDT of reformer tubes were carried out by M/s TCR Vadodara.(Refer Inspecton section Report)

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

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

All burners air resistor overhauling done.

The Primary Reformer Convection Zone

Refractory which was having crack were repaired & fallen ones were replaced at the ceiling after providing new holding clits against burnt off clits at such locations. Insulation of East, West & South wall was found satisfactory.

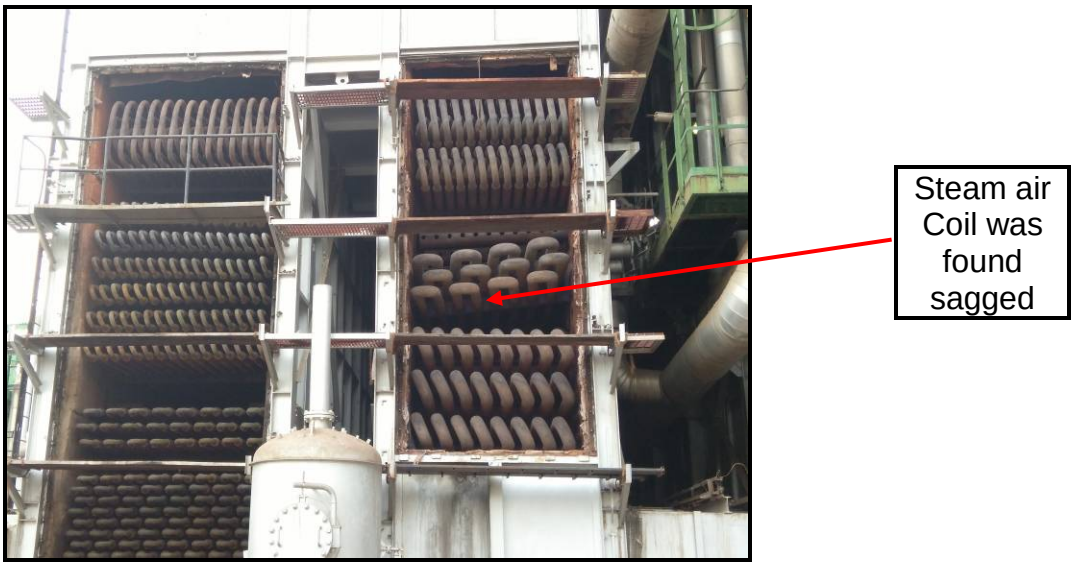
The LT and HT end panel walls were opened for external cleaning of the coils. External scaling of all HT coils & LT coils was cleaned by hydrojetting except BFW coil in the duct.

Steam Air coil was found sagged up to 300 mm downward direction at south side.

Coil was lifted up & support fabricated from SS310H plate Material inserted & welded.

HT & LT panels were boxed up with new gasket.

The transfer line end cover was opened for inspection and then boxed up.

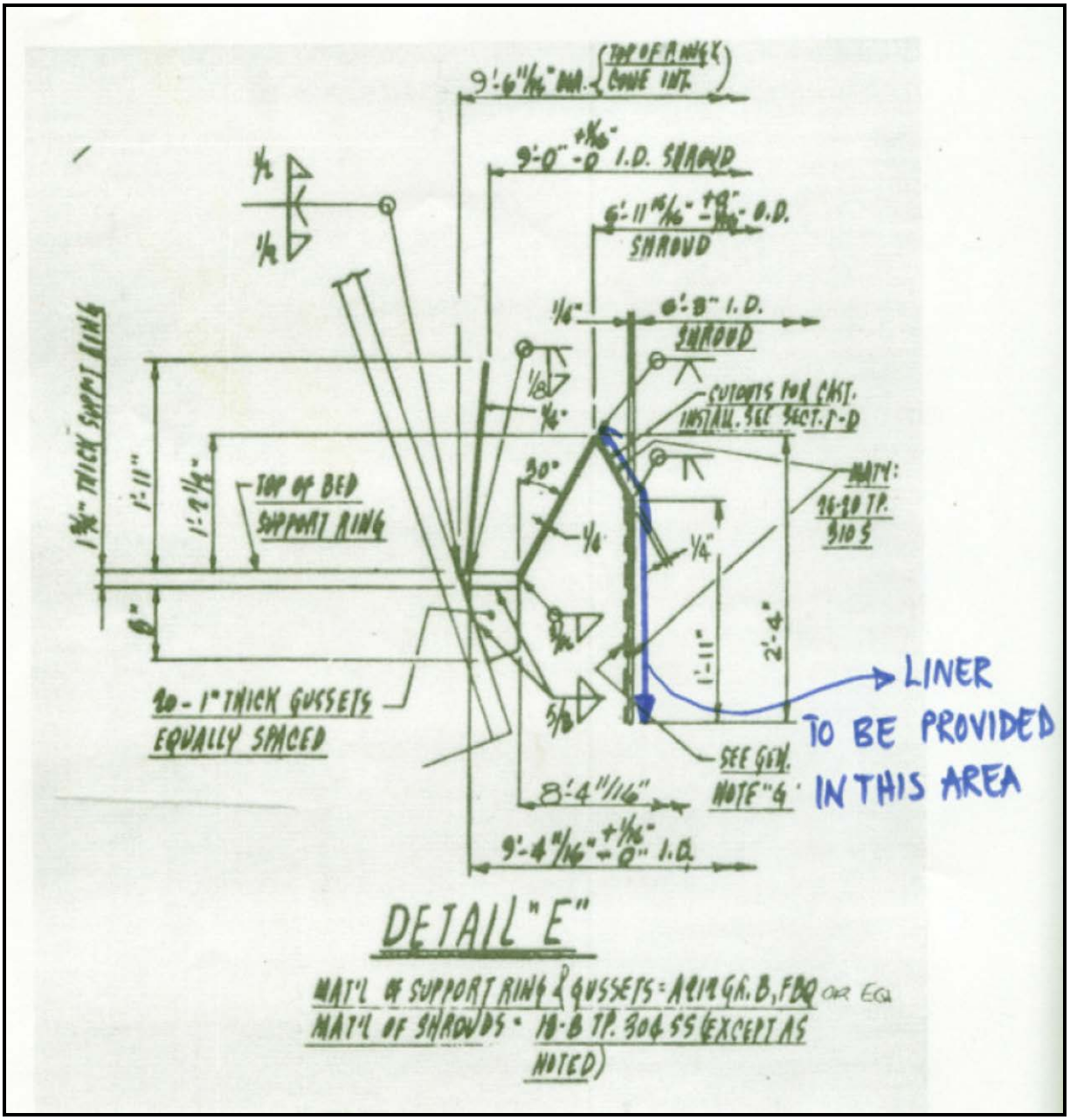


LT and HT end panel walls were opened for external cleaning

The Secondary Reformer

Top cover with Air distributer & Bottom cover were opened for inspection.

Before Shutdown it was decided to provide a sleeve of 6’3” ID and approx. 2’4” height of Incoloy 800 H material inside the circumference of 103-D below Bed support dome. (Ref IFFCO drawing 01-BN-03003 and attached sketch-Detail E below).



Accordingly WO 201004151471 dated 10/03/2015 was placed on M/s. J & J Engineers for carrying out this job along with other fabrication jobs. Prefabrication of the sleeves was made as per IFFCO drawing no.01-BS-03045 for carrying out the job.

After opening of bottom cover, inspection was done. The refractory was found intact and its condition was good. Hence it was decided not to provide the sleeve.

The prefabricated sleeve was returned to store. Top cover with Air distributer & Bottom cover were boxed up with new gasket.

Auxiliary Boiler

Replacement of Refractory of West Side Wall

During operation hot spot was observed on the west side wall panels of Auxiliary Boiler. Hence, it was decided to repair the refractory in this area. The side panels of the Auxiliary Boiler are of bolted construction and have less clearance between the

water wall and the refractory wall (about 6"). Therefore, to carry out refractory repair work panels were removed with the help of crane.

Removed damaged refractory from panels, cleaned it properly, Y-type anchors (SS 304) welded on panels at square pitch length of 140 mm & then 165 mm thick refractory (Insulyte-11) casting done.

Panels fixed back to their respective position with the help of crane after ensuring refractory setting.

Bulged & damaged liner near PRC-23 repaired.
Manhole was closed after putting bricks and ceramic blanket.

HEAT EXCHANGERS AND COOLER JOBS

101-CA, Waste Heat Boiler

Replacement of Outer & Inner Tube bundle Assembly carried out by the help of KOBELCO Crane.We have replaced the Tube bundle of 101 CA during last shutdown SD-2014 after it was damaged due to failure of chain block. The tube bundle installed in 2014 was in service for over a long period and hence it was decided to replace the Tube bundle during this Shutdown SD-2015.

The overhead trolley which was used for shifting of tube bundle by Chain block was removed. The Beam on which the overhead trolley was positioned, was fouling with the crane boom, hence it was also cut and removed. The rigging was carried out by Kobelco Crane

After getting clearance from Production, all steam side flanges i.e. Downcomer flange, T1; Top Channel Cover flange, F1; Riser Flanges, T2A & T2B & gas side flange i.e. Outer Tube Sheet to Shell Flange, F3 were disconnected by opening respective studs.

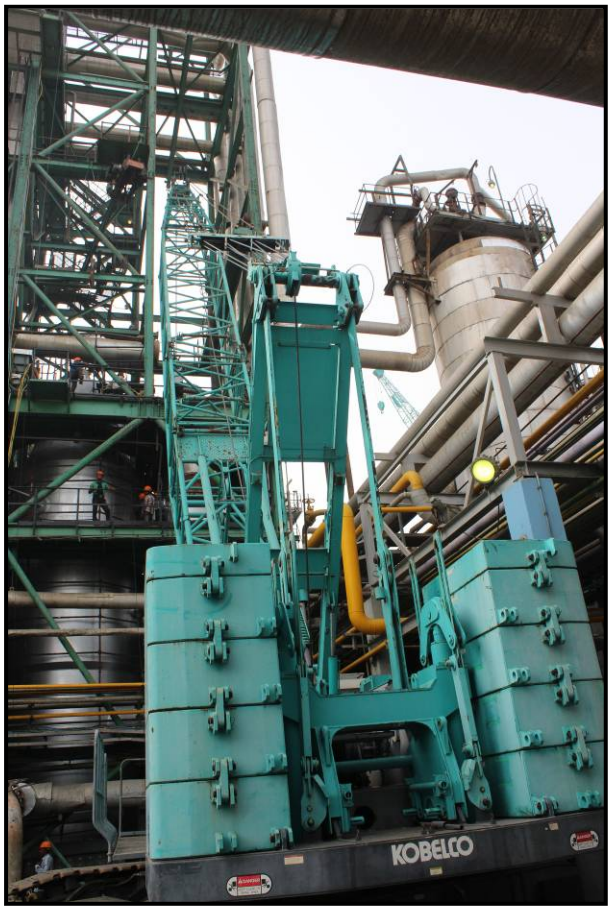
Down comer elbow of 101 CB and CA was removed from top by Kobelco crane. For fast removal of water from the bundle, 3 nos 1/2 " transparent hose was connected from vacuum blower header and given to Production. Lifting cover was taken to the top by the help of crane & placed over the Top Channel Cover flange, F1 of 101 CA & tightened all the studs.

Tube bundle Assy. was replaced by KOBELCO (135 T) crane with 95 ft boom length & 16.5 Mtr. Boom Radius with 5' sheave assembly.

All flange joint connections boxed up after providing new gaskets & bolts tightened as per respective specified torque values.

The exchanger was boxed up with spare Tube bundle No-2 (Sr. No. 1-72-04-31387-73), which was repaired by M/s. Anup Engineering against WO No.201004150078 dated 23/05/2014.

Tube bundle was lifted and installed by Kobelco crane



The overhead trolley and beam was removed rto remove fouling

114-C North side channel cover leak

North side channel cover was opened & removed. Channel cover & shell gasket seating area were cleaned properly and boxed up with new gasket.

115-C tube leakage

115-C was reported to be having tube leakage during normal operation. Helium Test was conducted by M/s. Gulachi Engineers to detect leakage. Channel cover was opened. Blinds fixed on shell side inlet & outlet nozzles. The whole tubesheet face was covered by Tape. Shell was pressurized by air at 3.0 Kg/cm2g & then Helium Gas was injected & shell side pressure was raised to 5.0 kg/cm2g. Removed the tape & Helium gas was checked by Helium detector & marked the leaky area successively.It was observed that there was leakage through tube to tube sheet weld joint. Hence, it was repaired by welding.

OTHER EXCHANGERS

EQP TAG		HYDROJETTING		HYDRO TEST	Remarks
		TUBE SIDE	SHELL SIDE (Tube bundle pull out)		
101-JCA		✓			
101-JCA	I/A COOLER	✓			
101-JCB		✓			
101-JCB	I/A COOLER	✓			
101-JLC1	LUBE OIL COOLER	✓			
101-JLC2	LUBE OIL COOLER	✓			
103-JLC1	LUBE OIL COOLER	✓			
103-JLC2	LUBE OIL COOLER	✓			
103-JBT	GLAND CONDENSER	✓			
104-J	LUBE OIL COOLER	✓			Cleaning done before shutdown
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		✓			
105-CB		✓			
107-JT	LUBE OIL COOLER	✓			
107-JAT	LUBE OIL COOLER	✓			Cleaning done before shutdown
108-C1A		✓		✓	Shell side : 8.0 Kg/cm2g Tube side : 8.0 Kg/cm2g
108-C2A		✓		✓	
109-C1A	SILO SIDE	✓	✓	✓	
109-C2A	SILO SIDE	✓	✓	✓	
110-CA		✓			
110-CB		✓			
114-C					North Side Channel cover Gasket replaced
115-C			✓	✓	Shell side: 2004-J Discharge pressure. Tube to tube sheet welding done
115-JALC1	LUBE OIL COOLER	✓			

EQP TAG		HYDROJETTING		HYDRO TEST	Remarks
		TUBE SIDE	SHELL SIDE (Tube bundle pull out)		
115-JALC2	LUBE OIL COOLER	✓			
115-JBLC1	LUBE OIL COOLER	✓			
115-JBLC2	LUBE OIL COOLER	✓			
116-C			✓		Shell side : 8.0 Kg/cm2g
117-J	INTERCOOLER	✓	✓	✓	
117-J	1st STAGE COOLER	✓			
124-C			✓	✓	Shell side : 8.0 Kg/cm2g
127-CA		✓		✓	Shell side : 26.0 Kg/cm2g
127-CB		✓		✓	Shell side : 26.0 Kg/cm2g
128-C		✓			
129-JC	101-J INTERCOOLER	✓			
130-JC	101-J INTERCOOLER	✓			
131-JC	101-J INTERCOOLER	✓			
150-C		✓			
151-C					
173-C		✓			
HE-2	PGR	✓			
HE-4	PGR	✓			

VESSEL INSPECTION / REPAIR JOBS

- 101-EA, CO2 Absorber: 6 nos. Manholes opened, inspection carried out. Loose Raschig ring holding clamps tightened & then boxed up.
- 102-EB, CO2 Stripper: Top Manhole opened, cleaning done, tightening of loose East-North & West-South side U-Clamps of East/West side distribution header done & weld repair of cracked distributor header support plates at marked locations carried out & then boxed up top manhole after inspection.
- 103-E1, HP Flash Vessel: Top manhole opened for inspection and then boxed up. No repair was carried out.
- 103-E2, LP Flash Vessel: In Second from Top Manhole compartment, North-West side 3" line which was found broken and lying on the rectangular riser box repaired by welding. Welded broken End plate of same 3" line which was found lying on the bottom tray. Loose holding bolts of bottom tray tightened.
- 105-E, Dehydrator: Top & bottom Manholes opened & boxed up after inspection. No damage / looseness were observed.

- 101-F, Steam Drum: Side Manholes opened, tightened loose bolts and clamps of Demister Pad holding cover plate & provided new against missing one, 02 nos. loose bolts tightened in flange joint of 6" BFW header. Side Manholes boxed up.
- 102-F, Raw Gas Separator & 103-F, Reflux Drum manholes were opened. Inspection carried out in which. Manholes boxed up.
- 104-F, Synthesis Gas Compressor Suction Drum: Manhole opened & boxed up after inspection & cleaning. No repairing was required.
- 105-F, Synthesis Gas Compressor 1st stage separator: Manhole opened for inspection and then boxed up. No damage / looseness were observed.
- 110-F (1st Stage), 111-F (2nd stage), 112-F (3rd stage) Refrigerant Flash Drum**:** Manholes opened for inspection, cleaning done and then boxed up. No damage / looseness were observed.

OPEN INSPECTION & HYDROTEST OF BOILERS:

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

Sr. No.	Tag No.	Identification No.	Hydrotest Pressure (kg/cm^2)
1	112-C	Boiler NO GT-1631	15.0
2	101-F	Boiler No. GT-1632	146.0
3	107-C	Boiler No.GT-5217	67.5

RELIEF VALVES OVERHAULING

SAFETY RELIEF VALVES OVERHAULING & SERVICING

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

Sr. No.	RV Tag NO	Valve Size	Set Pressure (kg/cm^2) g
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 (3.6) X 6"	111.70
5	PSV-986 (107-C)	4 L 6	45.00
6	PSV-987 (107-C)	4 L 6	46.30
7	RV-104-D1	6 Q 8	35.00
8	RV-103-J	3 K 4	159.00
9	RV-103-JA	3 J 4	158.90
10	RV-105-D	3 K 4	153.00
11	RV-105-D-A	3 J 4	152.90
12	RV-106-F	1.5" X 2"	157.90

Sr. No.	RV Tag NO	Valve Size	Set Pressure (kg/cm^2) g
13	RV-102-F	6 R 8	30.50
14	RV-123-CA	3 J 6	122.00
15	RV-123-CB	3 J 6	122.00
16	RV-MS-9 (Spare)	4 P 6	42.20
17	RV-BFW-1	1-1/2 G 2-1/2	92.00
18	RV-112-CA	1-1/2 H 3	10.50
19	RV-112-CB	1-1/2 H 3	10.50
20	RV-109-F	6 Q 8	19.00
21	RV-110-F (N)	3 L 4	7.00
22	RV-110-F (S)	3 L 4	7.00
23	RV-111-F	4 P 6	6.30
24	RV-112-F	4 M 6	6.30
25	RV-104-D2	1-1/2 F 2	34.10
26	RV 101-J	4 M 6	36.90

IN-SITU VALVE REPAIRING JOB:

In-situ valve repairing of Isolation valves of PIC-13A & PIC-13B (Valve Size: 6" X 1500#) were carried out by M/s. Flotech Technosmart (India) Pvt. Ltd. against CPA No. 201004151418 dated 05/03/2015.

- Dismantled bonnet assembly.
- Visual inspection of dismantled parts carried out.
- Lapping of seat & seat ring, Cleaning and polishing of bushings, Replacement of gland packing & Cleaning / greasing of all internals carried out.
- Blue matching of trim parts checked.
- Assembly of valves done.

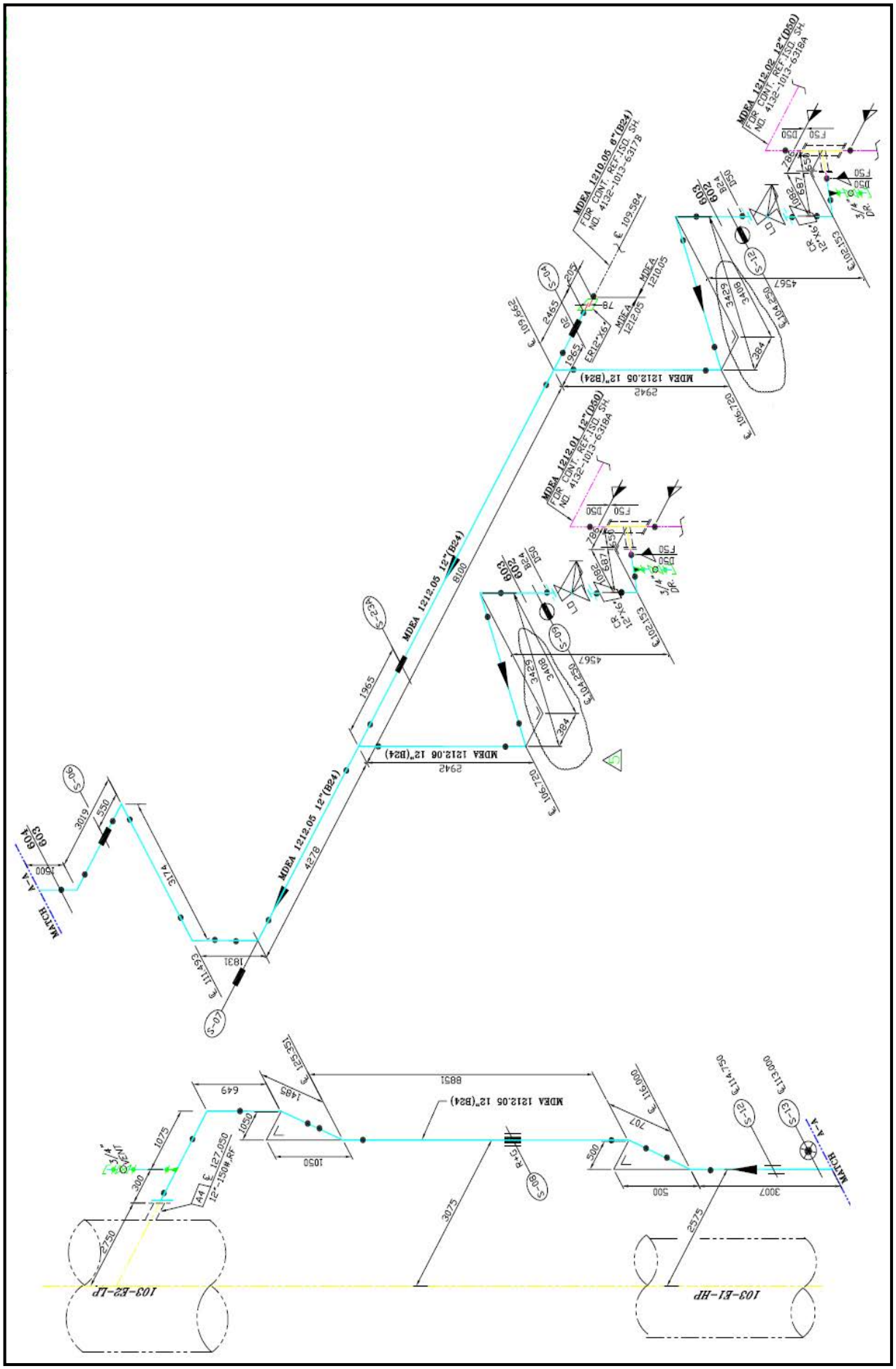
Flange of PIC 13 B was having leakage which was furmanited during normal operation of Plant. Dents observed in flange face was built up by welding and was boxed up.

FABRICATION JOBS:

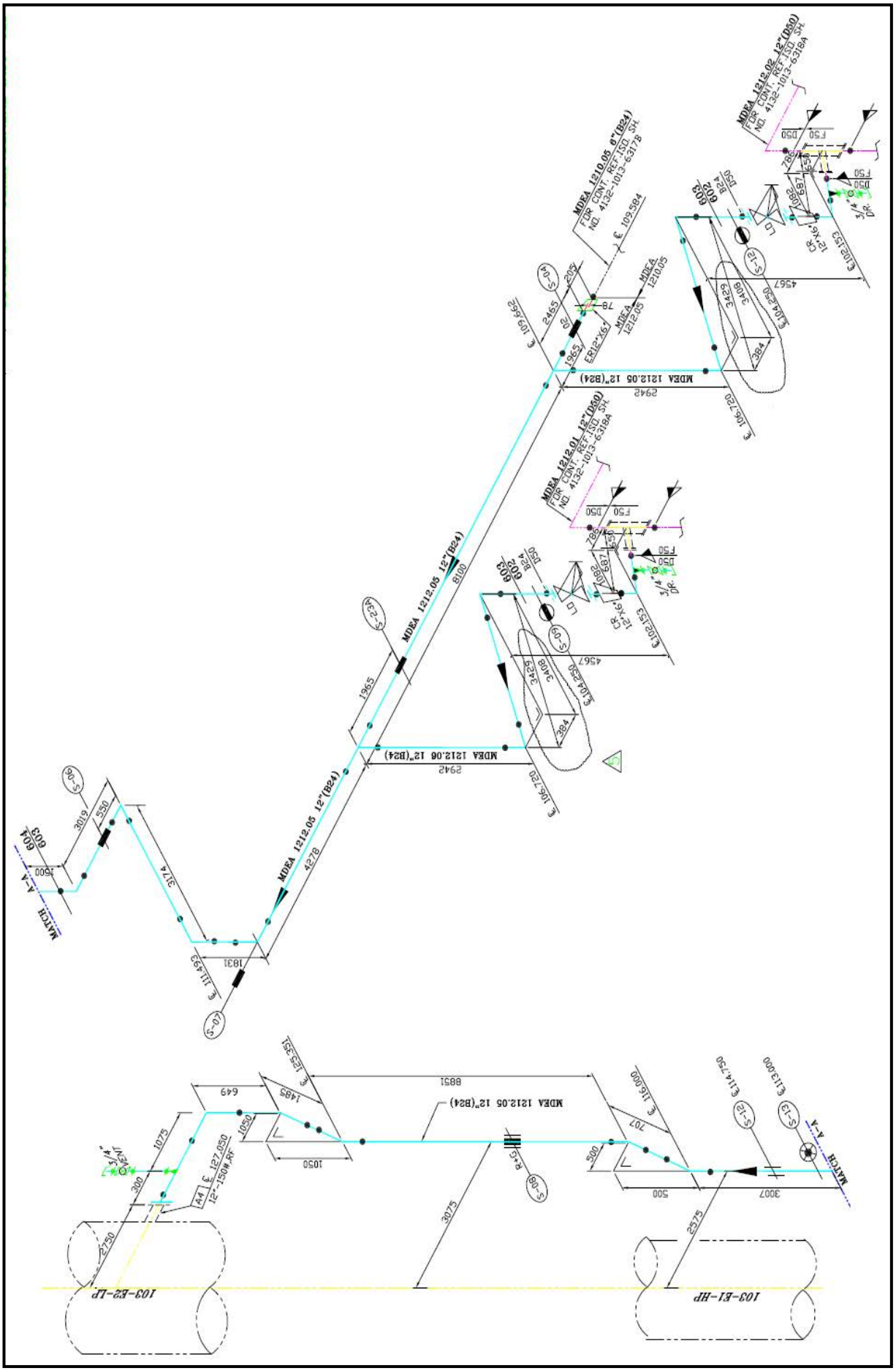
WO 201004151471 dated 10/03/2015 was placed on M/s. J & J Engineers to carry out following jobs:

- **Replacement of common minimum flow line of semi lean solution pumps, 115-JA & 115-JB and split stream solution pumps, 116-J & 116-JA**

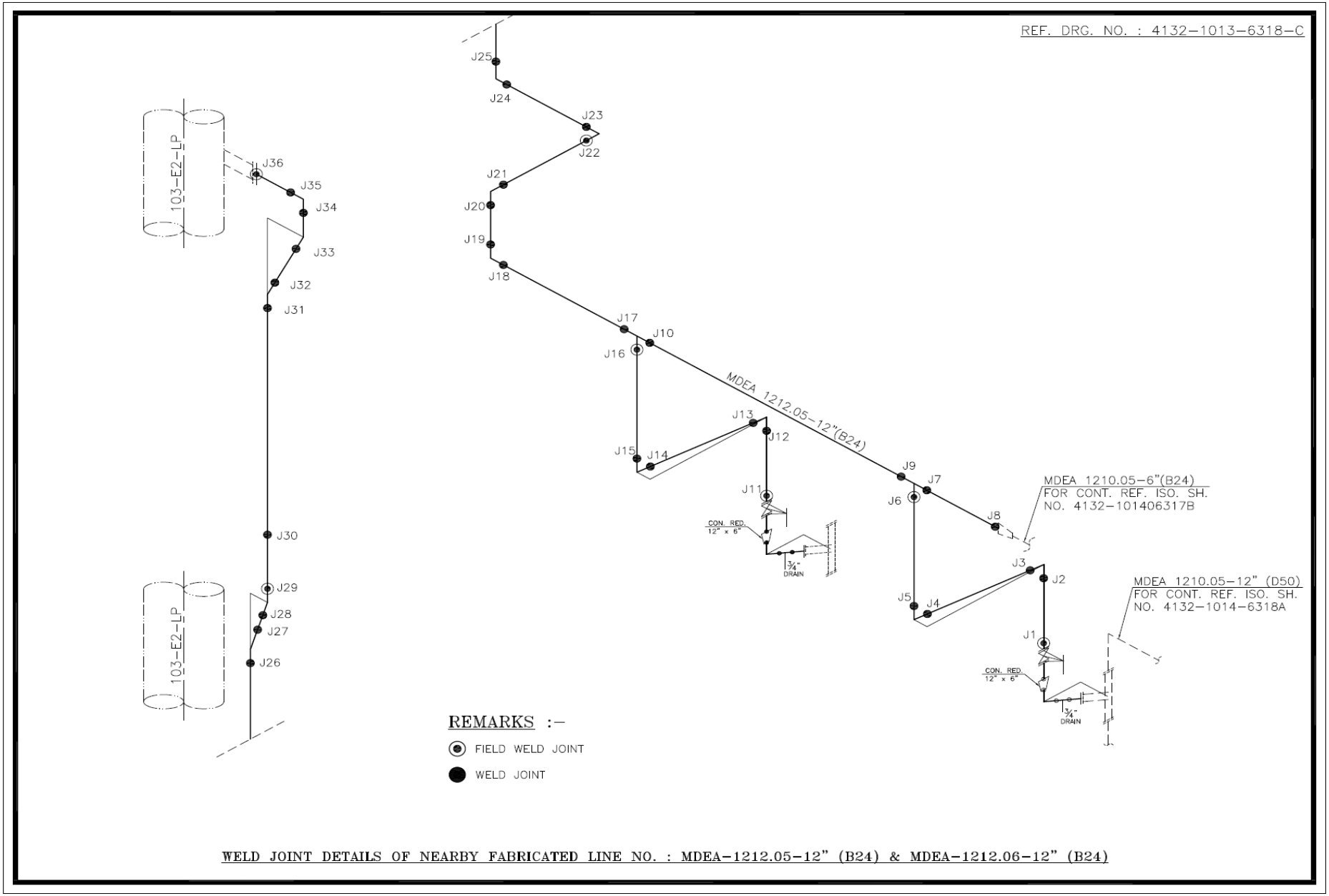
  In recent past, frequent aMDEA leakage problem occurred in common minimum flow line of semi lean solution pumps, 115-JA & 115-JB and split stream solution pumps, 116-J & 116-JA where patch plates were welded to arrest the leakage but leakage still persist. Therefore, it was decided to replace the complete line i.e. Line Nos. MDEA 1210.05 6", MDEA 1210.06 6", MDEA 1212.05 12" & MDEA 1212.06 12" by SS304 material.



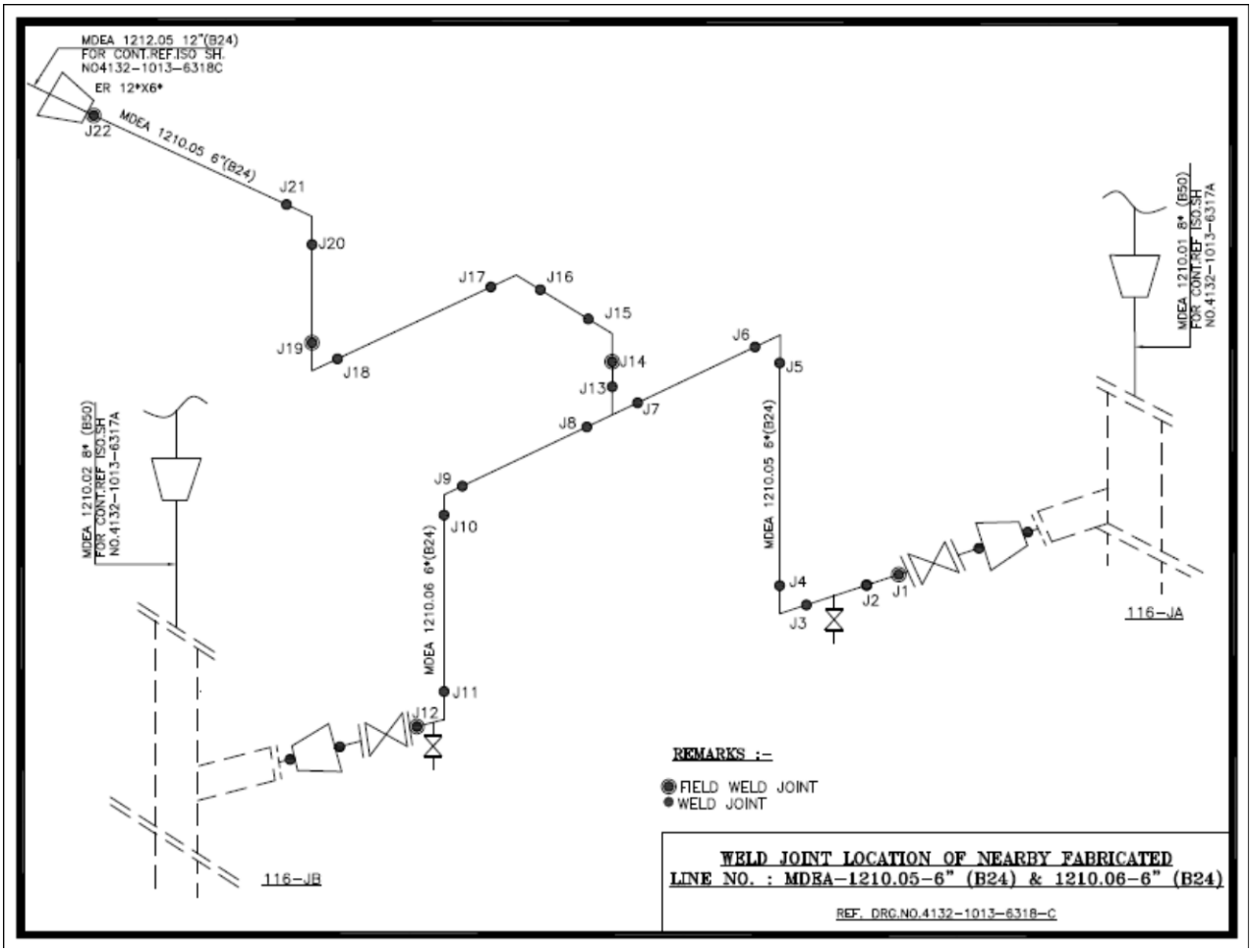
Isometric Drawing of Line No. : MDEA-1212.05-12” (B24) & MDEA-1212.06-12” (B-24)



Isometric Drawing of Line No. : MDEA-1210.05-6” (B24) & MDEA-1210.06-6” (B-24)



WELD JOINT DETAILS OF NEARBY FABRICATED LINE NO. : MDEA-1212.05-12" (B24) & MDEA-1212.06-12" (B24)



The approximate quantity and material used for fabrication is given in the table below:

SR. NO.	ITEM CODE	STORE DESCRIPTION	UOM	QTY. CONSUMED	TOTAL RATE
1	0000991030118B10	PIPE - SS SEAMLESS ASTM A 312 TP 304 12" NB (300 MM) SCH - 10 PLAIN END (PE)	Meter	46.49	546350
2	0000991030115B20	PIPE - SS SEAMLESS ASTM A 312 TP 304 6" NB (150 MM) SCH - 10 BUTT WELD (BW)	Meter	20	70352
3	0000991041218E20	PIPE - SS ERW / WELDED ASTM A 358 GRADE 304 12" NB (300 MM) SCH-40 BUTT WELD (BW)	Meter	5.45	45407
4	0000991190718B20	ELBOW - SEAMLESS, 90 DEG., LONG RADIUS, ASTM A 182 F304, 12" NB (300 MM) SCH - 10, BUTT WELD (BW)	NO.	9	178092
5	0000991170718B60	ELBOW - SEAMLESS, 45 DEG. LONG RADIUS, ASTM A 182 F304, 12" NB (300 MM) SCH - 10, BEVEL ENDS CONFIRMING TO ANSI B 16.9	NO.	4	44676

SR. NO.	ITEM CODE	STORE DESCRIPTION	UOM	QTY. CONSUMED	TOTAL RATE
6	000991192315B20	ELBOW - SEAMLESS, 90 DEG., LONG RADIUS, ASTM A 182 F304, 6" NB (150 MM) SCH - 10, BUTT WELD (BW)	NO.	3	6945.07
7	0000891192315B20	ELBOW - SEAMLESS, 90 DEG., LONG RADIUS, ASTM A 182 F304, 6" NB (150 MM) SCH - 10, BUTT WELD (BW)	NO.	5	15504
8	0000991702252C20	REDUCER CONCENTRIC, ASTM A 403 WP304, 12" X 6" SCH 40 X SCH 40, BUTT WELD (BW)	NO.	1	7097.21
9	0000991562315B20	TEE EQUAL - SEAMLESS ASTM A 182 F304L 6" NB (300 MM) SCH - 10 BUTT WELD (BW)	NO.	1	5906
10	0000991560718B20	TEE EQUAL - SEAMLESS ASTM A 182 F304 12" NB (300 MM) SCH - 10 BUTT WELD (BW)	NO.	2	48756
11	0000991400718470	FLANGE - SLIP ON (RF) ASTM A 182 F30412" NB (300 MM) 300 # SLIP-ON (SO)	NO.	2	22440
12	00009914008182A0	FLANGE - SLIP ON (RF) ASTM A 182 F304L 12" NB (300 MM) 150 # SLIP-ON (SO)	NO.	1	9412.12
13	00009914008152A0	FLANGE - SLIP ON (RF) ASTM A 182 F304 6" NB (150 MM) 300 # SLIP-ON (SO)	NO.	2	7202.24
14	0000992190805G20	GATE VALVE ASTM A 182 F 304, 3/4" NB (20 MM) 800 # SCOKET WELD (SW)	NO.	3	15593.3
15	0000991922115E10	NIPPLE - LONG / SHORT ASTM A 312 TP 304L 3/4" X 4" LONG SCH - 40 PLAIN END (PE)	NO.	3	450
16	2010912541102010	FILLER WIRE AWS/DIN ER 308L D&H SIZE : 2.5 MM	KG	26	13809.6
17	2010912523003010	WELDING ELECTRODE AWS TYPE AWS E308L-16 (FOR SS 304L) 3.15MM STANDARD	NO.	300	6398.46
18	2010912523002010	WELDING ELECTRODE AWS TYPE AWS E308L-16 (FOR SS 304 L) 2.5MM MAKE : D&H	NO.	480	7775.38
19	2010912510303010	PARTY'S ARGON GAS CYLINDER	NO.	25	14350
20	2010912510303020	IFFCO'S ARGON GAS CYLINDERS	NO.	15	8086.22
Total: Rs.					1074603

- **Replacement of passing PDR tapping Root valves of 101-CA/CB downcomers and risers.**
  - Valves were cut and removed.
  - 2 nos. New Isolation valves (Gate Valve: 3/4" X 1500#, SW) with threaded Nipple & Tee provided at each & every PDR tapping Root valves of 2 nos. downcomers (each having 2 root valves) and 4 nos. risers (each having 1 root valve). (Total 16 Nos valves).
  - All Socket Weld joints were DP tested.
- **Provision of drain on risers of 101-CA & 101-CB.**
  - Unbolted & removed blind flange from all risers.
  - Hole drilled at centre to accommodate ¾" X Sch 160 pipe.
  - Pipe with 2 nos. new Isolation valves (Gate Valve: 3/4" X 1500#, SW) provided on all risers (Total 4 nos). (Total 8 Nos valves)
  - Fixed flange at their respective positions.
  - ¾" X Sch 80 pipe welded at d/s of valves. All riser drain lines connected & routed upto ground floor drain pot.
  - All Socket Weld joints were DP tested.

SR. NO.	FABRICATION JOBS
1	104-JAT steam inlet I/V with counter flanges & bypass valve replaced (Flanged Gate Valve: 8"X 900# , 1-1/2" X 1500#)
2	Extra Flange provision (SORF, Size: 24" X 150# - 2 nos.) made in 115-JBT Exhaust line for easy removal of exhaust line & turbine top casing to carry out turbine overhauling.
3	103-JAT steam Inlet bypass valve gland leak (furmanited) (Globe Valve, SW, Size: 1" X #2500)
4	101-CA/CB DM Water inlet 1st I/V (SW Gate Valve, 3/4" X 1500#) replaced.
5	111-J discharge to 109-C passing I/V (Gate Valve Size: 2" X 800#) replaced.
6	I/V (SS, SW Gate Valve, Size: 3/4" X 800#) provided in seal flushing line of both pumps, 116-JA/JB
7	HE-1C shell side drain valve replaced
8	Steam inlet to C2 PI root I/V replaced
9	SR-2 outlet Ammonia line FT orifice by-pass valve replaced.
10	BFW to utility line drain valve between both I/V replaced
11	2 nos. valve provided in BFW to utility (FIC-20) bypass line
12	HCV-12 Sealing steam line I/V (3/4"X800# - 1no. SW Gate Valve) replaced
13	THIC 60 bypass valves (3/4"X1500# - 2nos. SW Gate Valve) replaced.
14	103-JBT steam inlet line Trap I/V bonnet leak – valve replaced
15	101-BJT steam inlet vent line valve replaced.
16	I.D. Fan steam inlet TTV drain line elbow leak – Line fabricated & replaced.
17	108-D Platform repaired.

18	Rerouting of instrument air line & RV exhaust line carried out which was fouling during HP cylinder dismantling of 117-J.
19	105-JT Exhaust RV pipe pin hole leak repaired by patch plate welding.
20	115-JB LO Cooler outlet line to filter R.O. Weld joint crack repaired.
21	Provision for transmitter on 101-JCA made by taking 2 nos. ½" tapping on shell top.
22	Blind provided in BFW line near 123-J Pump
23	Sample point tappings taken from all 4 nos. vents of CW jacket of Transfer line 107-D & extended upto the Arch burner floor level.
24	131-JC shell side drain line elbow thickness reduced to 2.0mm. Elbow replaced by new one.
25	Reduction in thickness observed in Line No. A-22-4". As the line is redundant, it was disconnected from Line No. A-20-10" by cutting & blind plate welding done.
26	Reduction in thickness observed in Vent of 130-JC i.e. Line No. A-32-6". Pipe portion with reduced thickness was cut & new pipe piece welded.
27	LP Steam header corroded line with i/v replaced.
28	MP Steam header corroded drain line with I/V & trap at pillar near FSH4 replaced.
29	Plugs of 1" and 1/2" provided in Naphtha line near auxiliary boiler.
30	Provision of vent line with I/V made at 101 BJT LO Cooler inlet line and outlet line
31	Rerouting of 103-J SO pump (Turbine driven) discharge line carried out to make it separate from standby pump (Motor driven) discharge line.
32	Repaired leakage of 103-D TI near FR-33 root I/V.
33	Shed installed over 103-J LO/SO skid.

VALVE GLAND REPACKING JOBS:

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

- All adjoining valves of 101-F & 107-C
- HCV-12 Sealing steam inlet I/V
- FICV-482 bypass valve.
- PT-12 I/V.
- LP steam to 153-C 2nd I/V
- 101-F Blowdown valves near Aux. Boiler (10 nos.)
- 181-C Main I/V. Gland bolts also replaced.
- 112-JAT Steam Inlet I/V.
- PIC-13A & 13B
- SP-5 & its bypass valve
- SP-39
- All adjoining valves of 112-C.

GASKET / VALVE REPLACEMENT & MISCELLENEOUS JOBS:

SR. NO.	JOB
GASKET REPLACEMENT	
1	PIC-13B upstream flange leak (furmanited) – Groove repaired by weld deposition & filing. Gasket (Size: 6” X1500# SW) & Studs (Size: 1-3/8” X 265mm Long) replaced.
2	SP-39 valve flange leak - Gasket (Size: 18” X 300# SW – 2 nos.) replaced.
3	SP-5 valve upstream flange (furmanited) & valve bonnet leak - Groove on flange repaired by weld deposition & filing. Flange gasket (Size: 8” X300# SW) & valve bonnet gasket replaced.
4	103-JAT Steam Inlet Strainer flange leak – Copper Gasket (Size: 342 mm OD X 307 mm ID X 1.5 mm Thk. – 1 no.) replaced.(Store Code: 112540624710)
5	PRCV-25 u/s i/v u/s flange leakage (Furmanited) - Flange gasket (Size: 4” X 400# SW) replaced.
6	107-C South Side LG Top I/V Bonnet Leak – Valve Bonnet gasket replaced.
7	MP Steam to 103-J LO AND SO Turbine Header End Flange Leak – Gasket (Size: 6” X 600# SW – 2 nos.) replaced
8	103-JAT Leak-off line RV u/s flange leak - Flange gasket (Size: 3” X150# SW) replaced.
9	FIC-20 2ND I/V Bonnet Leak(Furmanited) - Valve (Size: 3” X 1500#) bonnet gasket replaced.
10	101-BJT leak-off line flange leak - Groove on flange repaired by weld deposition & filing. Flange gasket (Size: 3/4” X300# SW) replaced.
11	181-C steam inlet I/V bonnet leak - Valve (Size: 4” X 300#) bonnet gasket replaced.
12	103-D air inlet NRV passing – New gasket seat ring made in w/s & new gasket provided.
VALVE REPLACEMENT	
1	105-E Level Gauge I/V (Size: 1-1/2” X 600# - 2 nos.) & drain line 1st & 2nd I/V (Size: 3” X 600# - 2 nos.) passing – Replaced Ball valves.
2	121-JA NRV passing – NRV (Size: 6” X 300#) replaced.
3	CW supply to CG Circulator LO system I/V corroded - Gate Valve (Size: 2” X 150#) replaced.
4	RV-141-F with I/V installed .
5	103-J Lube oil coolers cooling water outlet valve non operatable – New Sandwich type Butterfly valve (Size: 4” X 150# - 2 nos.) provided.

MISCELLENEOUS JOBS	
1	115-JA and 115-HT Flushing Fluid Line PCV Bottom Plug Leak - Attended
2	105-CA tube outlet elbow vent line union leak - Attended
3	101-BJT Leak Off Line both union Leak - Attended
4	AMERAL Charging Pot Drain Line Plug Valve leak – Greasing done
5	LPFV 5^{th} & 6^{th} LG (from bottom) bottom & top I/V not operatable. 1 no. LG to be fixed at any one point. – Valves made operatable & 1 no. new LG fixed.
6	103- J Lube oil coolers cooling water outlet valve to be make operatable – New Butterfly valve (Size: 4” X 150# - 2 nos.) provided.
7	124-C cooling water inlet I/V (non-operatable) – Valve roused & greasing done.
8	115-JA/JB, 115-HT, 116-JA strainers cleaned.
9	115-HT strainer drain cap leak - Attended
10	ID Fan Overhead Tank Drain Line threaded joints leak - Attended
11	104-JA inboard bearing side seal water line to seal cooler ferrule leak – New ferrule joint made.
12	103-J LO & SO pump filters replaced.
13	115-JA & 115-JB ARV/NRV Overhauling carried out. All O-rings replaced.
14	116-JA ARV/NRV replaced by spare one.
15	C-1 Vessel Drain Valve Wheel Free – Valve bonnet replaced.

UREA PLANT

(MECHANICAL)

ROTATING EQUIPMENT

Hitachi Compressor Train (Q-1801/K-1801):

The following jobs were carried out during the Annual Turnaround 2015.

M/s. BVL Power, H'bad was engaged with our own maintenance group from date 02/04/2014 to 10/04/2014 to complete the job in time.

- 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).
- Overhauling of Pilot valve of main steam (60 ata), extraction steam (23 ata) & (4 ata) induction steam.
- Overhauling of 23 ata extraction check valve (NRV).

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

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

- 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 within acceptable limit. (Ref Table-1).

- 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. Clearance values were found within acceptable limits.
- **Turbine float: 0.21mm; Net float = Total float – Housing play = 0.33mm - 0.12mm (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 corrected as per protocol readings. Details are given in report.




- LP case and Turbine was coupled at the required tightening torque 53.2 kgf.m **(521.36 N. m).** The Coupling spacer between LP casing & Turbine was assembled.

Bearing clearance for Turbine

Description	Front End - Journal bearing	Rear End - Journal Bearing
Journal diameter, mm	Ø124.81	Ø159.73
Bearing bore, mm	Ø125.08	Ø160.02
Shell bore, mm	Ø160.00	Ø204.98
Pad thickness, mm	17.46	**22.47**
Clearance, mm	**0.25**	**0.34**
Design Clearance, mm	0.18 to 0.31	0.24 to 0.35
Interference, mm	0.02	0.01

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 limits (Ref Table-2).
- Journal bearing assembly on Turbine side was opened for inspection. Found clearance values within acceptable limits (Ref Table-2).
- Thrust bearing assembly was opened for inspection. Clearances value found within acceptable limits.
- Axial thrust : **0.36 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 limits.
- 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 the report.
- LP case with Gear box was coupled at required tightening torque 20 kgf.m (196 Nm) and with turbine was coupled at the required tightening torque 53.2 kgf.m (521.36 N. m). Finally spacers between Turbine - LP case and LP case - Gear box were assembled after alignment correction.

Bearing Clearances Data Sheet of K-1801-1

Description	Turbine side - Journal Bearing	Gear box side - Journal Bearing
Journal diameter, mm	Ø119.98	Ø119.98
Bearing bore, mm	Ø120.12	Ø120.13
Shell bore, mm	Ø185.00	Ø185.01
Pad thickness, mm	**32.44**	**32.44**
Clearance, mm	**0.14**	**0.15**
Design Clearance, mm	0.11 to 0.15	0.11 to 0.15
Interference, mm	0.07	0.11

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 within acceptable limit (Clearance values measured are given in** Table-3).
- 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).**

- Thrust bearing was opened for inspection. Clearance values found within acceptable limits.
- Axial thrust: **0.32mm** (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.
- HP case and Gear Box was coupled at the required tightening torque 9.7 kgf.m (95.06 Nm).

Bearing Clearance (Diametrical Clearance) Details for HP case

Description	Gear side – Journal bearing	Rear end – Journal bearing
Journal diameter, mm	Ø79.99	Ø132.00
Bearing bore, mm	Ø80.12	Ø131.87
Shell bore, mm	Ø132.00	Ø132.00
Pad thickness, mm	25.94	25.94
Clearance, mm	**0.15**	**0.13**
Design Clearance, mm	0.11 to 0.14	0.11 to 0.14
Interference, mm	0.10	0.06

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.**

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 limits.
- 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.
- Gear Box with HP case was coupled at the required tightening torque 9.7 kgf.m (95.06 Nm) and with LP case was coupled at required tightening torque 20 kgf.m (196 Nm)

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	**0.20**
	Journal bearing clearance on HP side (Rear)	0.24	0.15 to 0.21	**0.20**
Gear backlash		0.47	0.383 to 0.608	**0.43**

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

Main Steam (60 ata) Pilot Valve

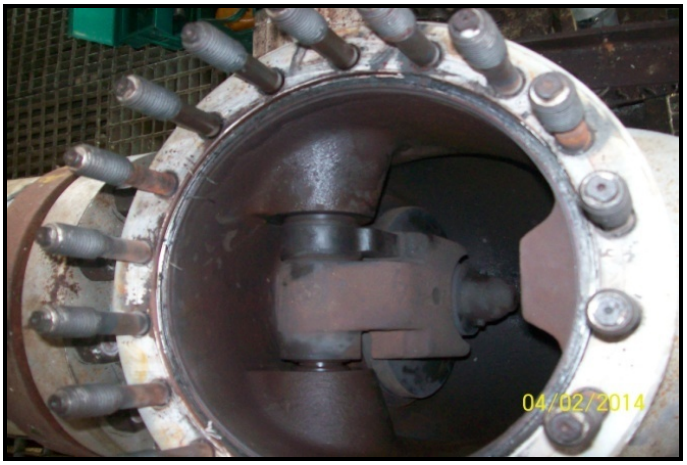
- Pilot assembly was dismantled
- All parts were thoroughly cleaned
- Boxed up the pilot valve assembly using new sealing set

Extraction Steam (23 ata) Pilot Valve

- Pilot valve assembly was dismantled. (Drawing no. 0-0006-1910-07)
- All parts were thoroughly cleaned.
- Boxed up the pilot valve assembly using new sealing set.

Extraction Steam (23 ata) NRV

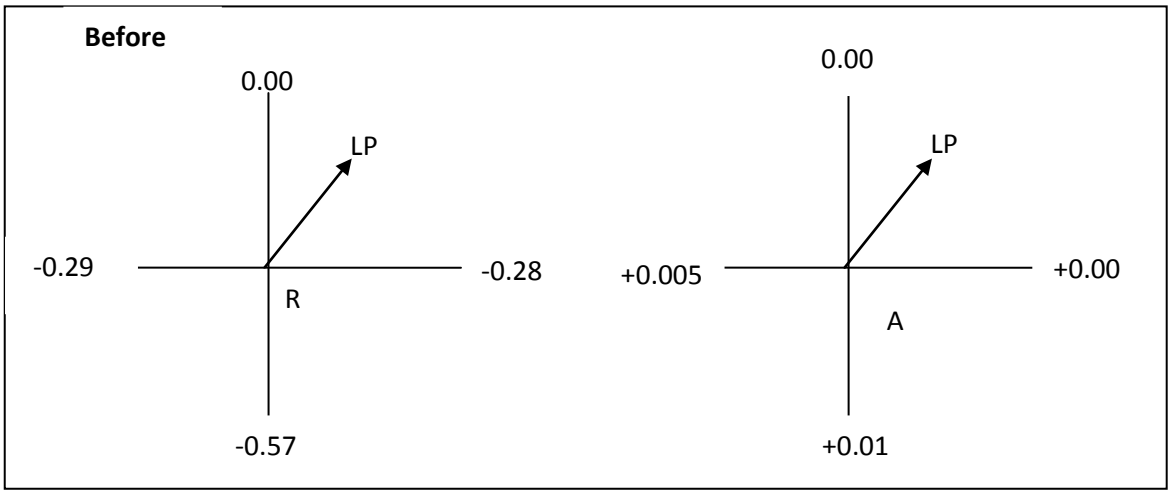
- Top cover of NRV was removed. (Drawing no. 0-0006-2352-04)
- NRV flap (jointing disc) blue matching was checked with seating area. Found satisfactory.
- NRV Condition was checked and found ok.
- All parts were thoroughly cleaned
- Top Cover was boxed up with new serrated gasket.

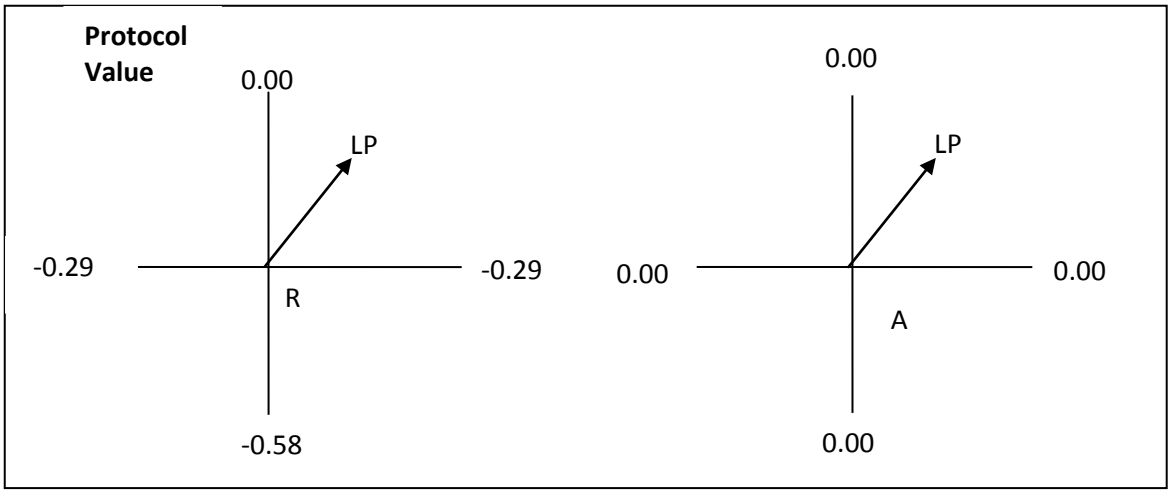


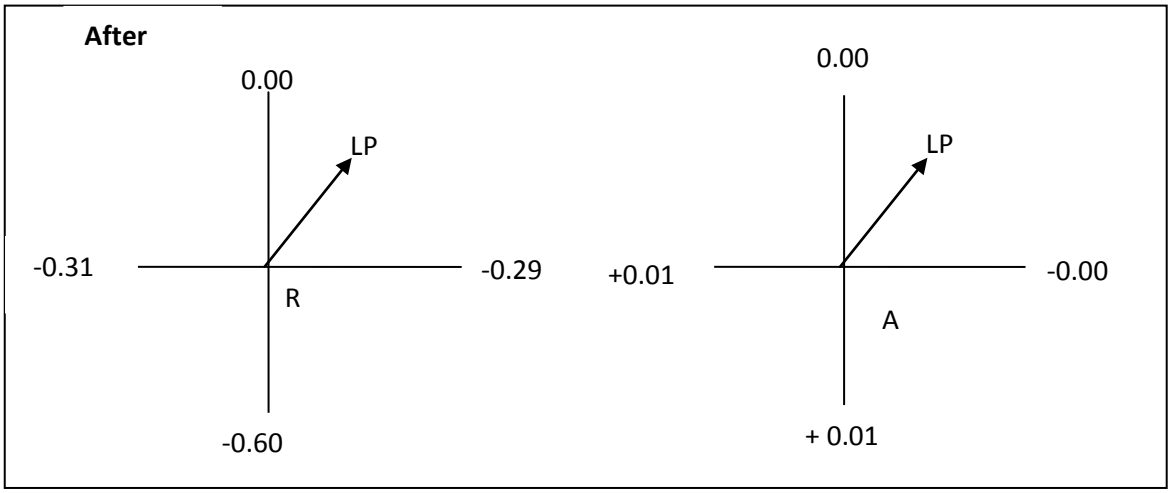
Induction Steam (4 ata) Pilot Valve

- Pilot valve assembly was dismantled.
- All parts were thoroughly cleaned
- Boxed up the pilot valve assembly using new sealing set.

Alignment between Turbine and LP Case

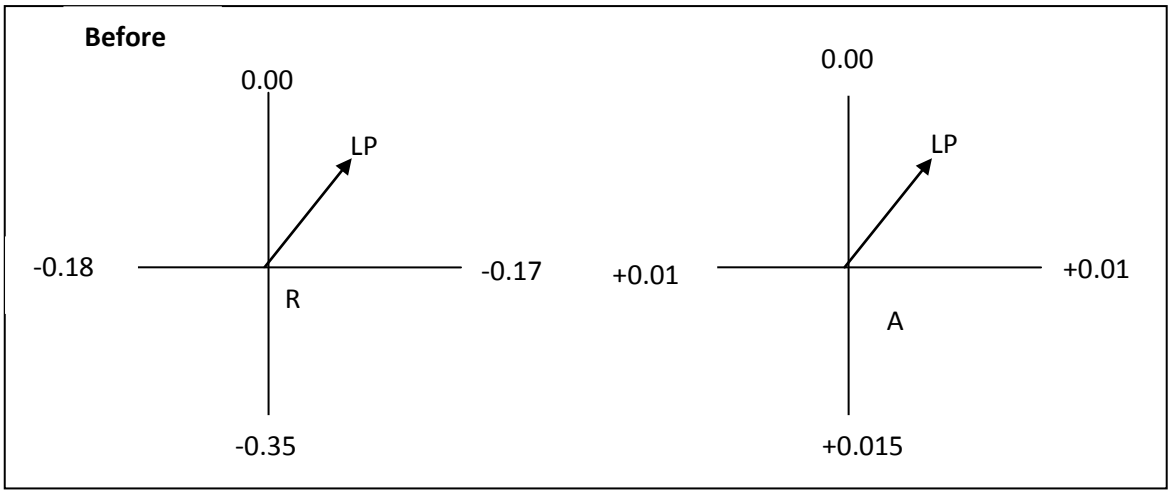


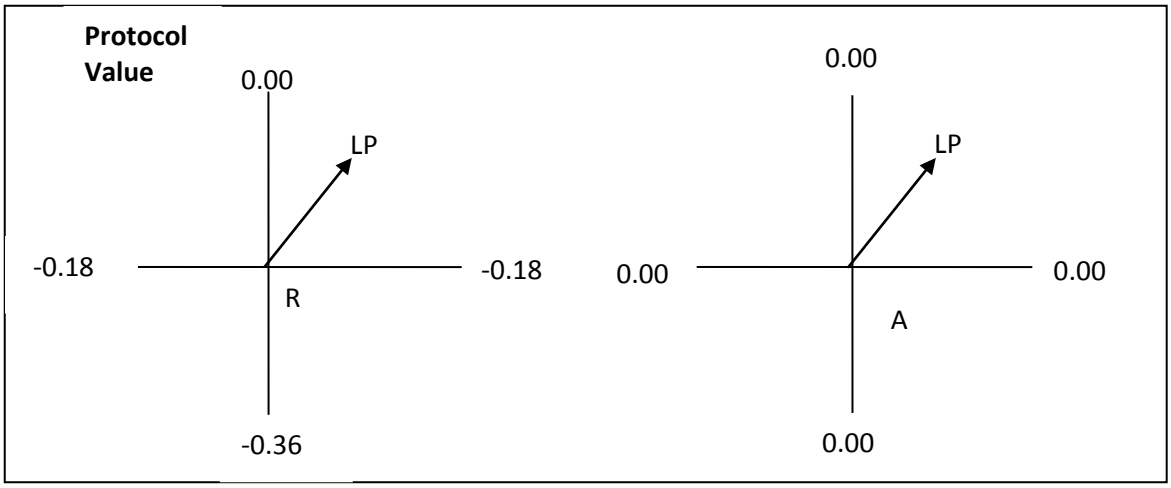


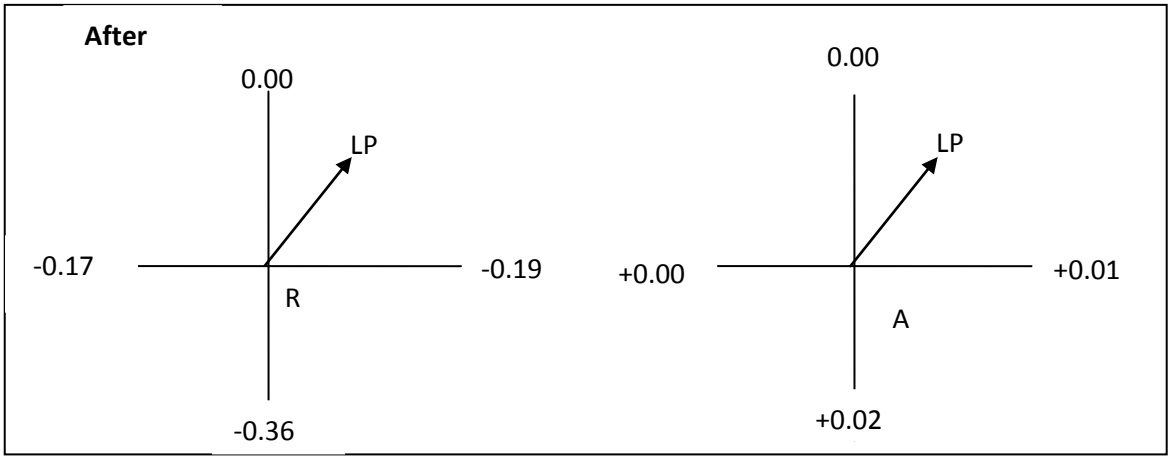


(Correction : 0.05 sim was added to LP Base)

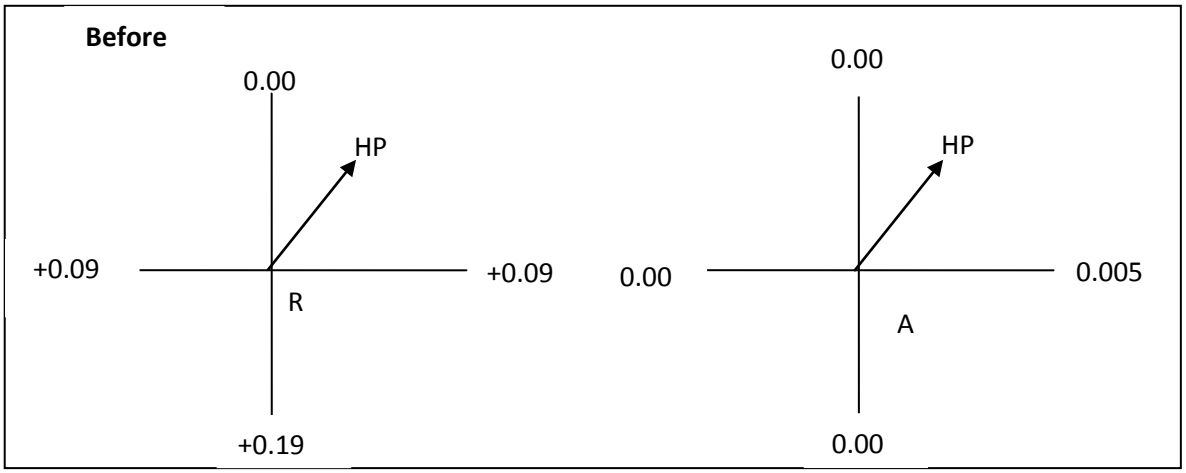
Alignment between LP Case and Gear Box

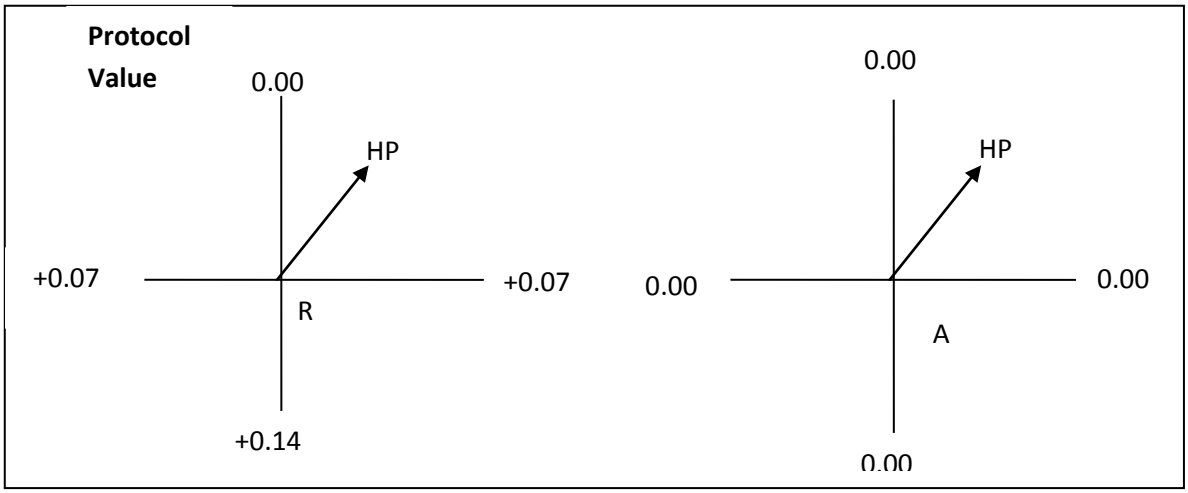


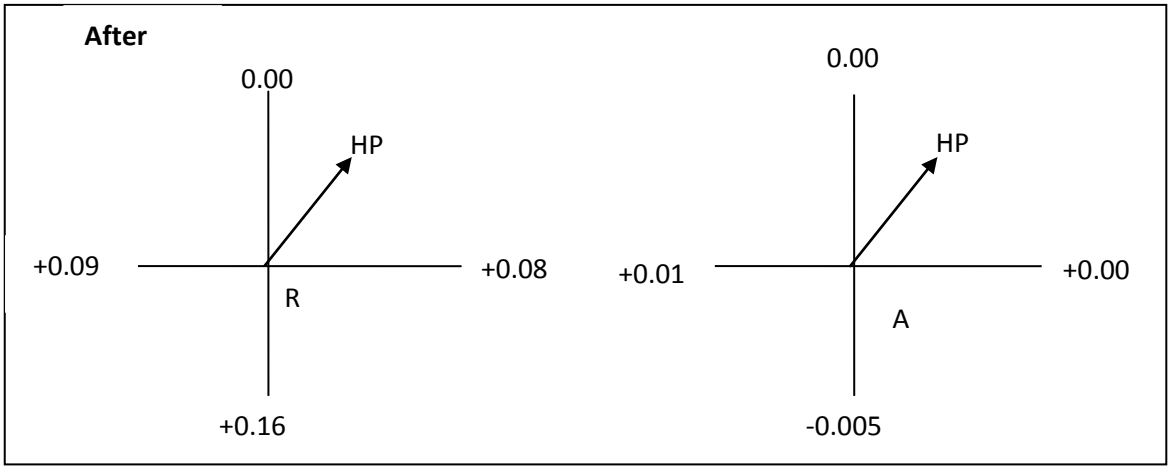




Alignment between Gear Box and HP Case







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

Calibration of control valve lift w.r.t secondary oil pressure

After assembly of governing system, calibration of control valve lift for 60 ata, 23 ata & 4 ata steam was done with variation of secondary oil pressure respectively in the presence of production and instrument departments.

Sr. No.	WW-505 DCS out-put in %	60 ata		23 ata		4 ata		
		Secondary oil pressure	Valve Lift (Div)	Secondary oil pressure	Valve Lift (Div)	Secondary oil Pressure	Valve Lift (Div)	Milli Ampere MA
1	0	1.5	0	1.5	0	1.5	0	4
2	10	1.7	4	1.7	1			
3	20	1.94	9	1.94	1.8			
4	30	2.2	12.5	2.2	3	2.15	14.5	8
5	40	2.5	16	2.5	5			
6	50	2.8	19.8	2.8	6.8	2.9	33.5	12

7	60	3.11	23.4	3.11	8.6			
8	70	3.5	28	3.46	10.2			
9	80	3.9	33	3.8	13	3.7	46	16
10	90	4.2	36.5	4.17	15			
11	95	-	-	4.31	17			
12	100	4.6	41	4.51	31	4.58	63	20

Pre - charging of Nitrogen in 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 the help of Kit supplied by OEM.

MAJOR OVERHAULING OF LUBE OIL TURBINE (Q-1814)

Lube oil turbine was in service for the last 04 years after major overhauling in 2010. So, it was taken up for major overhauling in 2015 shutdown. Details of turbine are given below:

Make : Coppus
Model No. : RLA 16E,
Sr. No. : 96T2398
Power : 75 KW,
Speed : 2960 rpm
OST : 3582 rpm

Governor Details

Make : Woodward
Model : TG-13
Part No. : F8516-039
Serial No. : 11910153
Speed Range : 2400-4000 RPM
Direction : CW

(Note: This governor is interchangeable with the governor of 2004 JT)
Following activities were carried out:

Dismantling of Turbine

- Decoupled the turbine with pump. Measured the distance between coupling halves and it was **137.88mm (DBSE: 141.58mm).**
- Alignment of turbine with lube oil pump was checked in cold condition **and found disturbed with reference to protocol values.**
- Disassembled the Governor & Stop valve assembly and removed the OST assembly.
- Bearing and Gland housing of governor end were removed. Carbon rings were found in good condition.
- Opened the casing and measured the position of sector from casing face & recorded the readings. (Ref. Table 5).
- Removed the bearing and gland housing of coupling end. Carbon rings were found hard.

- Removed the rotor **and sector and found good in condition.**
- **Cleaning of old rotor was carried out with emery paper and Corium Z-97.**

View of rotor of turbine

Assembly of Turbine

- Rotor was fitted into casing.
- Sector was placed between the two rows of blades on the wheels of rotor and rotor along with sector was slide into casing.
- Sector cap screws were tightened after ensuring that sector was solidly seated against the casing shoulder.
- Reassembled the gland assembly at coupling end with new carbon ring (Ref. Table 6). Grafoil was provided between gland housing and casing.
- Reinstalled the coupling end bearing 6309 C3 (new bearing) and associated components.
- Reassembled Casing cover with grafoil and bolts of casing were tightened.
- Reinstalled the governor end gland assembly with new carbon rings. (Ref. Table 6). Grafoil was provided between gland housing and casing cover.
- Reinstalled the governor end old bearing, and associated components. Reinstalled mounting housing. Connected the connecting rod to the trip latch. Reinstalled the over speed trip collar assembly and governor. New governor cover was fitted as old one have cracks in its body.
- After final assembly of turbine checked the alignment between turbine and pump and corrected as per protocol value.
- Coupled the turbine with pump. OST was done at **3545** rpm (protocol value – 3582 rpm).

NOTE:

At the time of installation of NEW bearings in housing, it was found that NEW bearing no. 6309 C3 was loosened in housing on both sides (Coupling and Governor side). So, it was decided to do knurling the bearing seating (housing) area as per requirement in workshop. Still, there was problem of looseness in coupling side bearing. So, Old bearing was installed on coupling side and new bearing was installed on Governor side.

Table 6- Clearance Data Sheet of Q-1814

Sr. No.	Description	Required Value	Actual value (Before O/H)	Actual value (after O/H)
1	Carbon Ring to shaft clearance – governor end	0.0025” - 0.005”		**0.003” 0.003” 0.0025” 0.0025”**
2	Carbon Ring to shaft clearance – coupling end	0.0005” - 0.003”		**0.0015” 0.0015” 0.001” 0.001”**
3	Position of sector from the face of casing	-	**7.80 mm**	**7.80 mm**

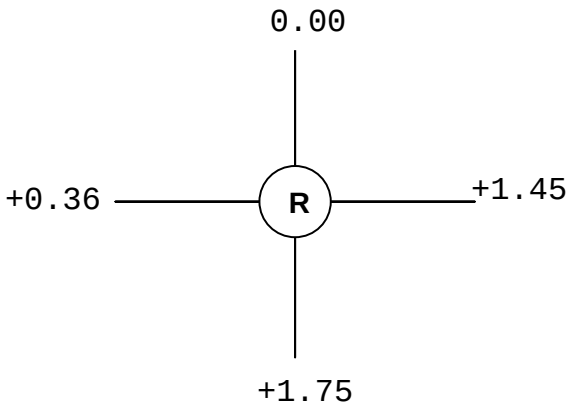
ALIGNMENT READINGS: TURBINE TO PUMP

Dial on Turbine Coupling

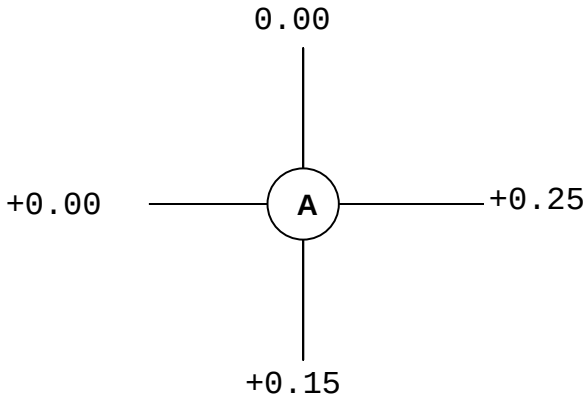
All values are in mm

Before O/H

RADIAL

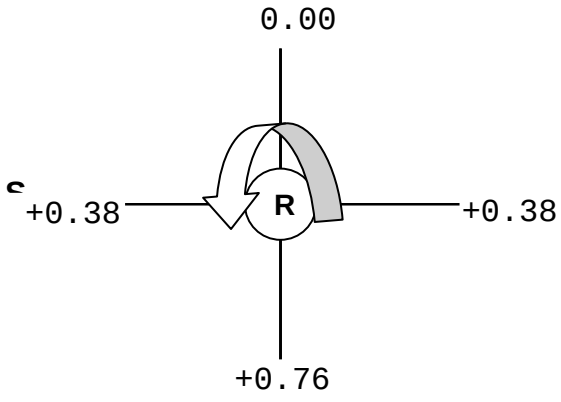


AXIAL

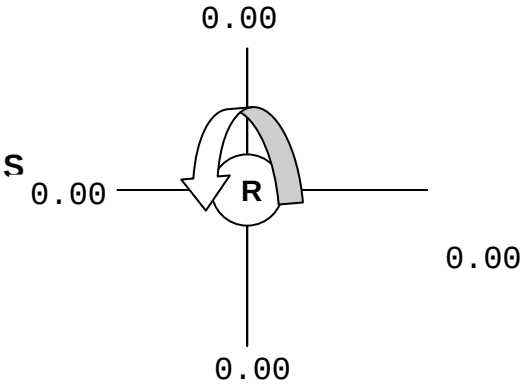


Protocol Value

RADIAL

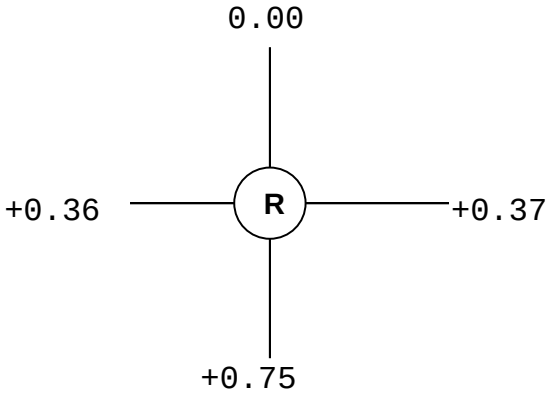


AXIAL

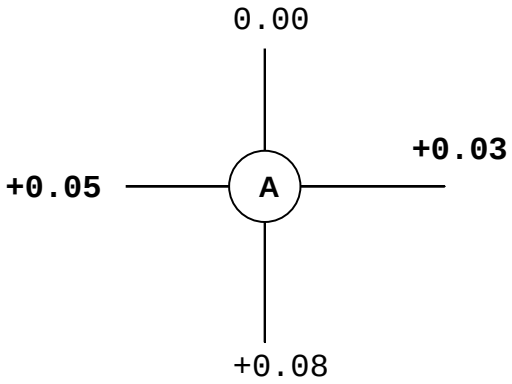


After O/H

RADIAL



AXIAL



REPLACEMENT OF SHAFT OF EXHAUST AIR FAN, K-1702

Frequent failures of Fan Drive End bearing were occurred in the month of Feb & March-2015 and all these failures are mainly due to looseness of Bearing adapter sleeve on the fan shaft. OD of shaft at the bearing portion is damaged and became undersize due to scoring on the shaft surface. (See pictures below)

So it was decided to replace the fan shaft in the shutdown.

For the removal of fan shaft, first it was tried to remove the fan shaft by jacking it towards the derive end side, and for that pulley and drive end side bearing was removed and fan impeller was locked in the casing. Even after heating the fan hub by gas cutting and hydraulic jacking the shaft, it could not moved. So finally it was decided, to lift the complete rotor by removing the fan top casing half and exhaust hood.

So fan exhaust hood and top casing half was removed by lifting with the kobelco crane.

For the easy lifting/removal of Fan rotor, a top segment of suction cone was also cut which was re-welded after positioning of fan rotor which is shown in attached photograph.

After removal of Fan rotor, it was sent to the works of OEM M/s C.B Doctor, Vatva , Ahmedabad for the fixing of new shaft in the rotor and final balancing.

Removal of old damaged fan shaft, fixing of new spare fan shaft, final balancing & polishing of the fan rotor was carried out at M/s C.B Doctor works.

Refurbished rotor of fan was again positioned in the bottom casing and then top casing half and exhaust fan hood was again bolted in the position. Painting of exhaust hood and top casing was done before reinstallation.

During final assembly of Fan rotor drive end side bearing housing, both ends Bearings SKF 22328 CCK C3 W33 along with its adapter sleeve H2328 were replaced.

After assembly of bearings, final clearance was maintained as 0.10-.012 MM.

After assembly of bearing and bearing housing centering of bearing housing and bearings were also carried out with help of dial gauge.

Finally pulley was positioned and alignment was carried out with new installed belts.

Provison for removal of bearing housing back cover bolts was done by cutting the C-sector plate and then fix it at the position by bolts & nuts for its easy removal, which creates sufficient space in the back side of bearing for opening the bearing cover bolts.

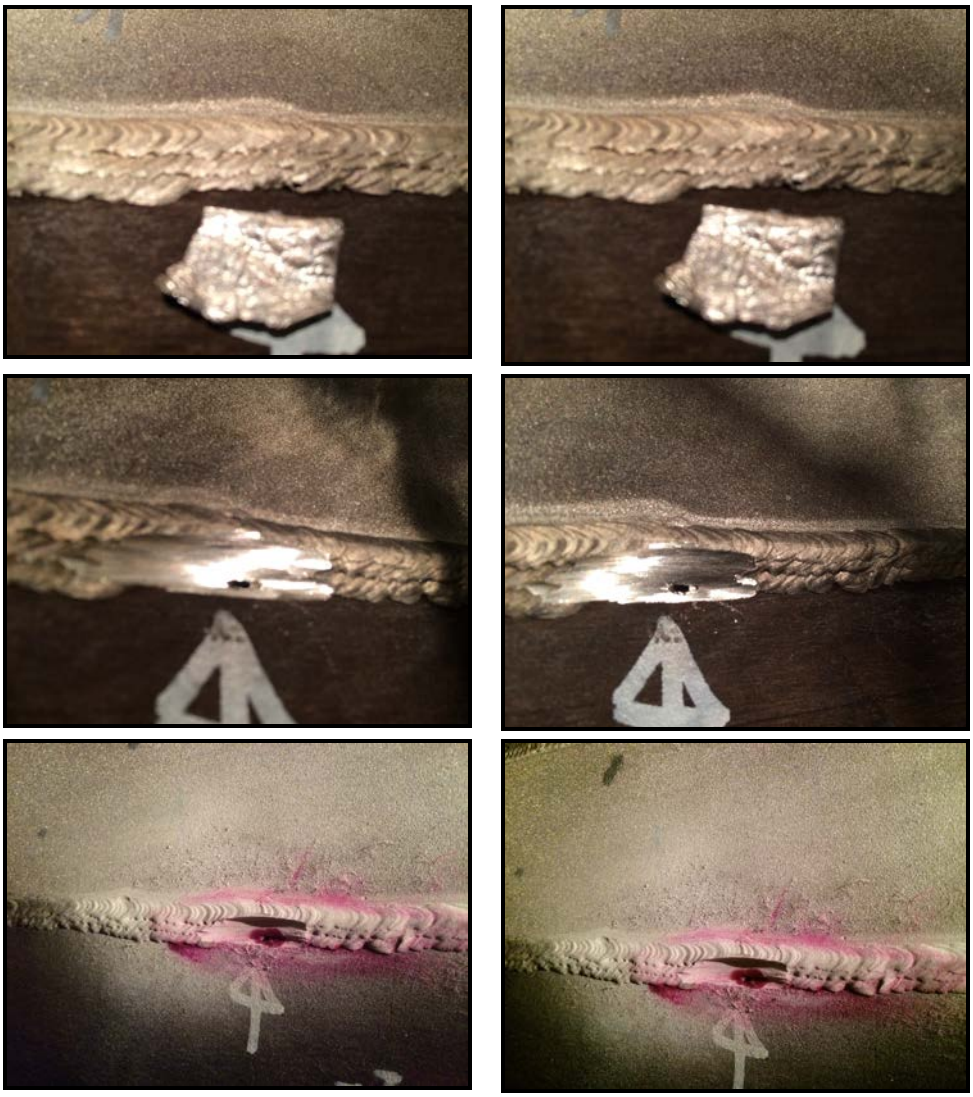
HP VESSEL

Autoclave V-1201

Helium Leak detection and repairing

Leak was suspected in Autoclave before shutdown and for the identification of that suspected leak, Helium leak detection method was used.

Observation: In Helium leak detection, a pinhole leak was observed in bottom C-seam of insert liner in the 10^{th} compartment. See photographs below:



Repairing of Pin Hole Leak

Pin Hole was grinded locally and then DP Tested and then repaired by following procedure:

- DP of grinded portion was carried out.
- Welding was done by TIG using 25 -22-2LMn filler wire size - 2.4 mm dia with low heat input.
- Inter pass temperature kept below 150 deg. C.
- It was ensured that no area was left ground without welding
- Final DP was carried out.
- Ferrite content was checked. It was found within acceptable limit (Max 0.6 %) Finally weld was cleaned and passivated by washing with 10 % HNO3 and rinsing with DM water

Repair of Liner weld joints of Autoclave

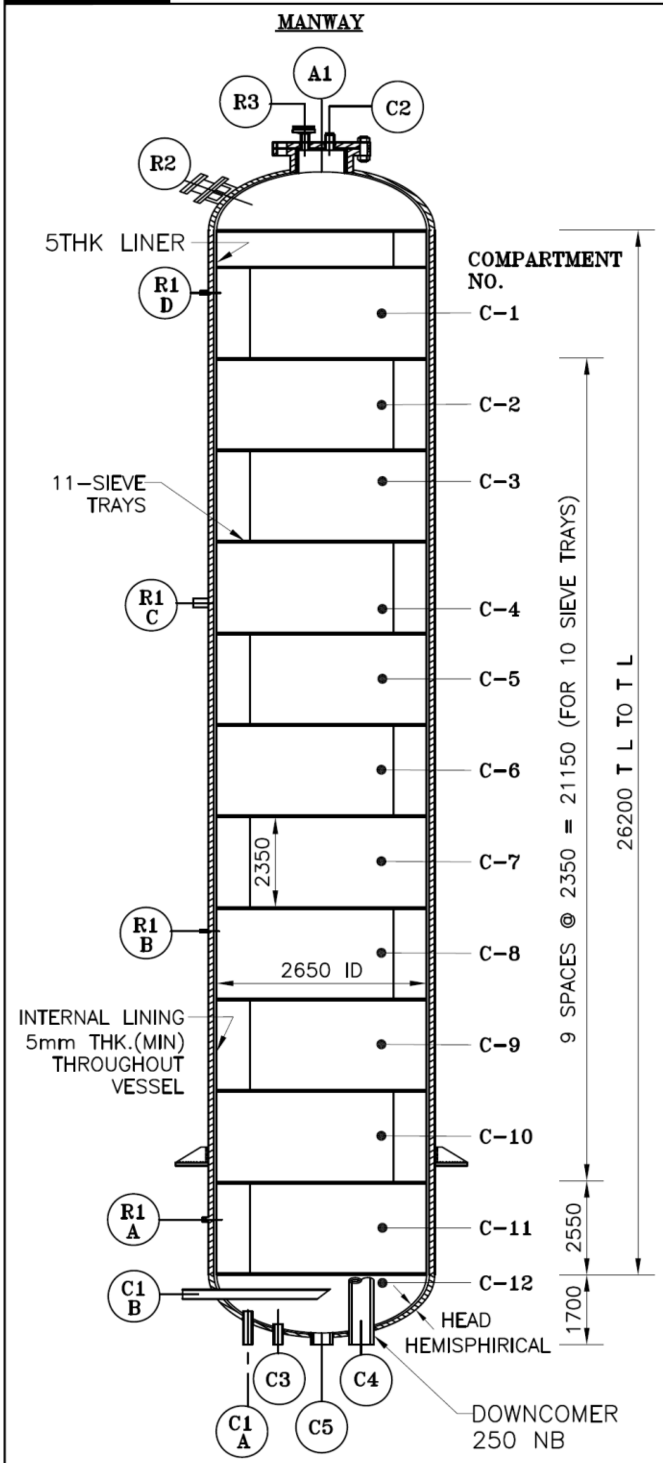
Liner welds of each compartment of V-1201 were most affected by corrosion. It was decided to repair liner weld one by one during shutdown.

- During shutdown 2009 liner welds of 1st and 3rd compartment were repaired
- During shutdown 2010, liner welds of 2nd and 4th compartment were repaired
- During shutdown 2011, liner welds of 5th compartment were repaired.

- During shutdown 2012, liner welds of 6th compartment were repaired.
- During shutdown 2014, liner welds of 7th and 8th compartment were repaired.

During shutdown 2015, repairing of liner weld of 9th & 10th compartment was carried out. M/s Shree Ganesh Engineering, Ahmedabad (CPA 201004151419) was engaged along with our own fabrication and inspection group for above job.

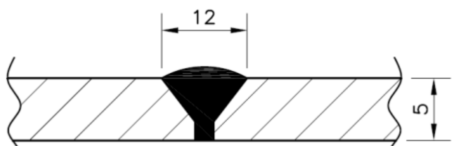
IFFCO INDIAN FARMERS FERTILISER CO-OP. LTD. KALOL



DESIGN DATA	
DESIGN PRESSURE	161 kg/cm^{2}a
DESIGN TEMPERATURE	200°C
OPERATING PRESSURE	153 kg/cm^{2}a
OPERATING TEMP.	TOP 185°C BOTTOM 172°C

NOZZLE SCHEDULE

NOZ.	SIZE	SERVICE
C1A/B	200	CARBAMATE INLET FROM H-1202
C2	100	GAS OUTLET TO H-1203
C3	80	AMMONIA INLET
C4	200	UREA/CARBAMATE TO H-1201
C5	100	CARBAMATE FROM HP SCRUBBER
R1A-D	-	THERMOCOUPLE
R2	-	LEVEL INDICATOR (LR-1201)
R3	100	BLIND COVER
A1	800 ID	MANWAY COVER



LINER WELD DETAIL

NOTE :- ALL DIMENSIONS ARE IN MM.

DRN	N.V. PANCHAL	TITLE - **GENERAL DETAILS FOR LINER WELD REPAIRING JOB OF AUTOCLAVE (V-1201)**	EWR No.
CHD	M. V. Anil		
APD	K. J. Patel	DRAWING No. CODE UREA-227 / PLANT P 2 / FROM E S / NUMBER 0 5 1 0 3	SHEET 1 OF 1 / REV. 0
SCALE	N. T. S.		

The following repair procedure was followed:

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

Repairing jobs as per Inspection Report

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

Compartment No.1 (Top Compartment)

- 1no of missing “J” bolt was provided just near down comer funnel at north side.
- There are few defects which are marked as **D1,D2 and D3** were repaired
- **D1**- In Shell liner South-West side, besides ‘’L’’ Seam Pits/Localized erosion of 1 to1 .5 mm depth, 10-12 mm in Dia .
- **D2** –another localized pit besides D1.
- **D3** – In East direction near stairs localized pit 5 to 6.0 mm in Dia and 1 to 1.5 mm in depth.

Compartment No.2

- Few nos. of tray holding ‘J’ bolts, tray segment loose fasteners were tightened
- There are few defects which are marked as **D1 & D2** were repaired.
- **D1** – Noth – West side just above “C” Seam near clit welding localized pit/ erosion of 2’’ long and 1.0-1.5 mm in depth observed.
- **D2 –** In Other side of same clit localized pitting / erosion of 2’’ long and 1.0-1.5 mm in depth observed..

Compartment No.3

- There are few defects which are marked as **D1, D2 and D3** were repaired.
- **D1 -** North side just above “C” Seam near clit welding localized pit/ erosion of 2’’ long and 1.0-1.5 mm in depth observed.
- **D2 –** Besides D1 defect in west direction near clit welding localized pit/ erosion of 1.5’’ long and 1.0-1.5 mm in depth observed.
- **D3 –** In North –West direction one no old clit is not properly removed and its welding has developed crevices with shell liner which is required to be ground / re welded.

Compartment No.4

- There are few defects which are marked as **D1, D2,D3 and D4** were repaired:
- **D1 –** North-West side just above “C” Seam near clit welding crevices developed along the clit length.
- **D2 –** In East direction besides clit welding localized pit/ erosion of 1.5’’ long and 1.0-1.5 mm in depth observed.
- **D3 –** In South –West direction near “C” Seam in welding cavity / porosity observed which is required to be ground / re welded.
- **D4 –** In south direction just above “C” Seam near clit welding localized Pits / Erosion observed along the clit length.

Compartment No.5

- There are few defects which are marked as **D1, D2 and D3 were repaired:**
- **D1 –** North side just above “C” Seam near clit welding pits & weld cavity observed.
- **D2 –** In East direction besides clit welding weld cavity and at bottom side of “C” seam under cuts / crevices observed with liner 1.5’’ long observed.
- **D3 –** In North –West direction near “C” Seam in Clit welding localized Pits / erosion observed which is required to be ground / re welded.

Compartment No.6

- There are few defects which are marked as **D1, D2 were repaired:**
- **D1 –** North side just above “C” Seam near clit one side welding was flushed out (Missing)..
- **D2 –** In west direction long seam in old welding porosity / pinhole observed.

Compartment No.7

- There was a defects which was marked as **D1 was repaired.**
- **D1 –** In South – West direction approx 1’’ below “C” Seam localized pitting / erosion of 1’’ in length and 1 to 1.5 mm depth observed.

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

During removal of ladder and lightening arrangement from the V-1201, all tray segment bolts were tightened. After taking clearance from Production, top cover was boxed up with new Kempchen make gasket (839 mm OD x 800 mm ID x 4 mm thick) with new 0.5 mm thick Teflon envelop.

- Tightening pressure for top cover.

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

HP Stripper (H-1201)

Bottom Dome

- 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.

Top Dome

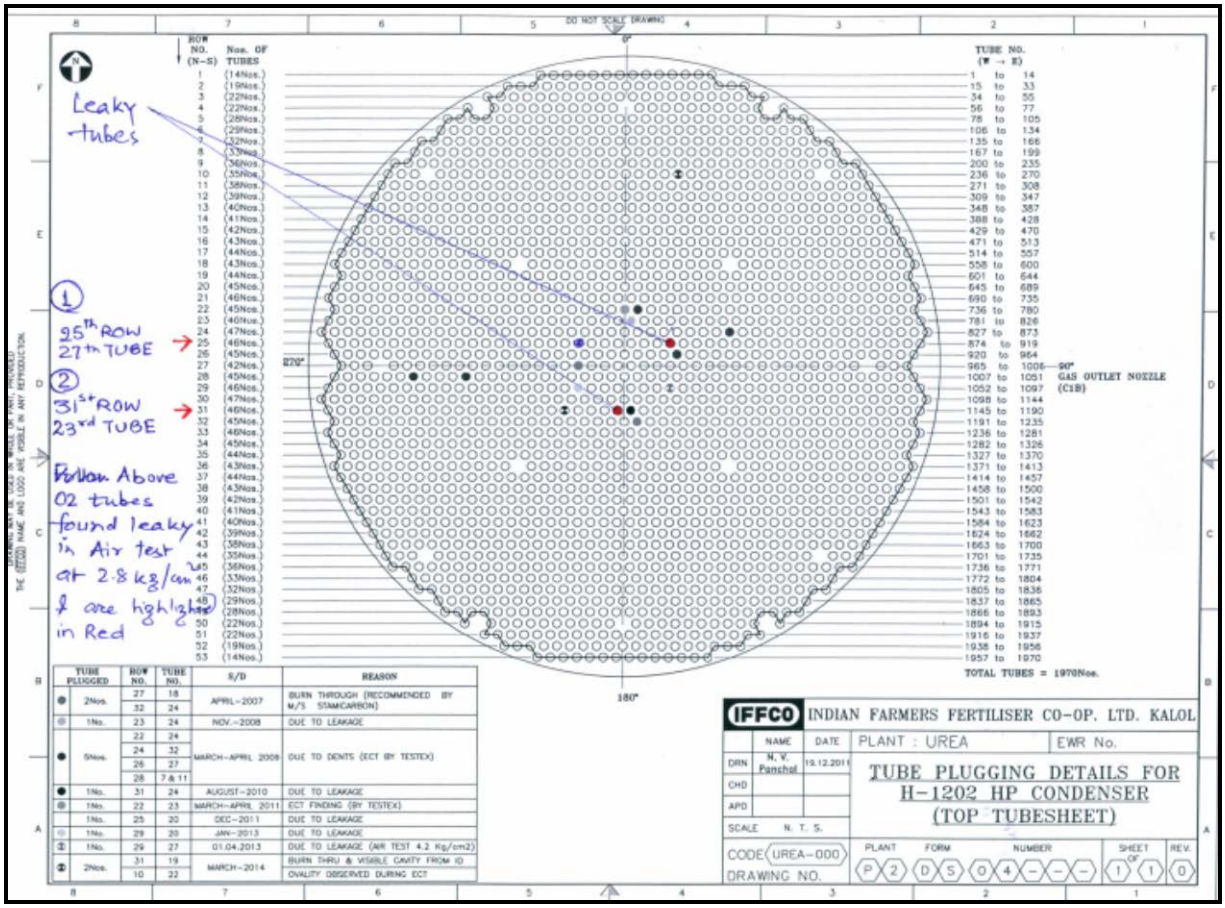
- Top cover was removed using bolt tensioner at 900 kg/cm2.
- The top cover was shifted below the platform using monorail hoist and chain blocks.
- Ferrules were removed from position. Ferrules were thoroughly cleaned by Production department.
- Eddy current testing was carried out by Inspection Department. No repair work was required to be carried out.
- The ferrules were fixed in position with new PTFE gaskets (2600 nos).
- After the bottom cover was boxed up, pressure drop measurement was carried out by production department for each tube and the same was found within limit.
- Exchanger was thoroughly cleaned with compressed air and then with DM water.
- Top and bottom cover were boxed up with new “Kempchen” gasket (839 mm OD x 800 mm ID x 4 mm thick) with new 0.5 mm thick Teflon envelope.
- Tightening pressure for top and bottom cover.

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

HP Condenser (H-1202)

- Top flange of off gas lines was opened.
- Bottom flange (H-1202 to V-1201 pipe line) was opened.
- Fasteners of Top cover and bottom cover were loosened using bolt tensioner at 700 kg/cm^2. Bottom covers were shifted using 2 nos. of 3 ton capacity chain block and top cover was shifted using 1 no. of 5 ton chain block.
- Internals from the top dome were removed.

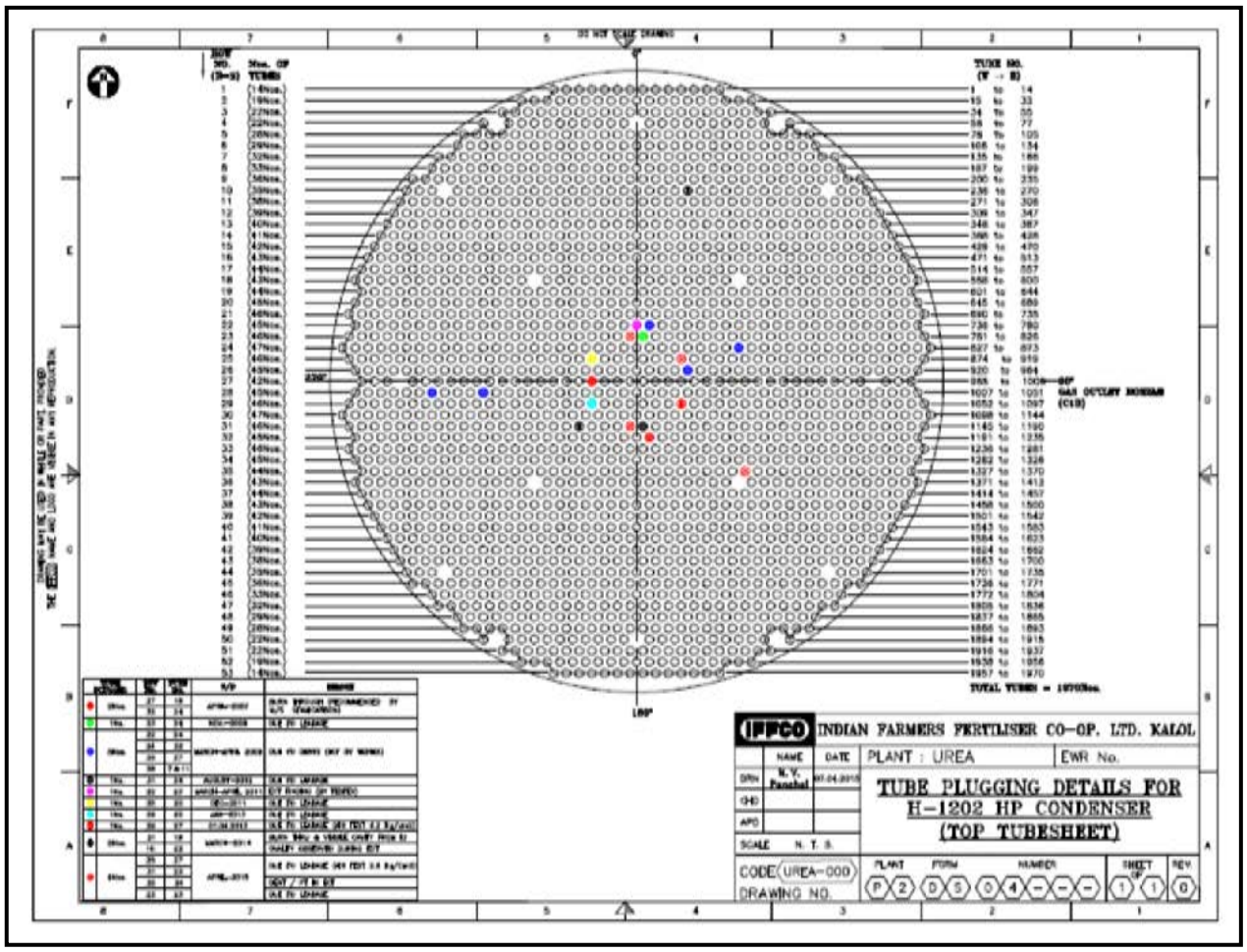
- Leakage was suspected in HPCC before shutdown, so air test was carried out after removing the internals 2.8 kg/cm2 and in air test following 02 tubes was found leaky.
  (1) Row No. 25, tube No. 27
  (2) Row No. 31, tube No. 23



- After that Eddy current testing of tubes was carried out and based on its finding Tube No.31 of Row No. 35 was plugged. In ECT wall loss of 31-40% was observed and internal pitting was also confirmed in boroscopic inspection.
- Based on visual inspection following repairs were also carried out.
  - 06 Nos of Marked crevice cavity in top channel head.
  - Approx 1.5mm deep dent was observed on shell liner just above the dome to shell liner weld joint in North-West direction in bottom channel head, marked with Yellow chalk, which is shown in below Photograph.

  - 02 nos of Crevice/Cavity observed in the I.D. of Gas Outlet Nozzle to elbow weld were repaired.

- Hydrotest of HPCC shell side was carried out at 11 Kg/cm2 and one tube was found leaked (Row No. 23, Tube No. 23) which was plugged.
- Hence total 04 tubes were plugged shown in below picture

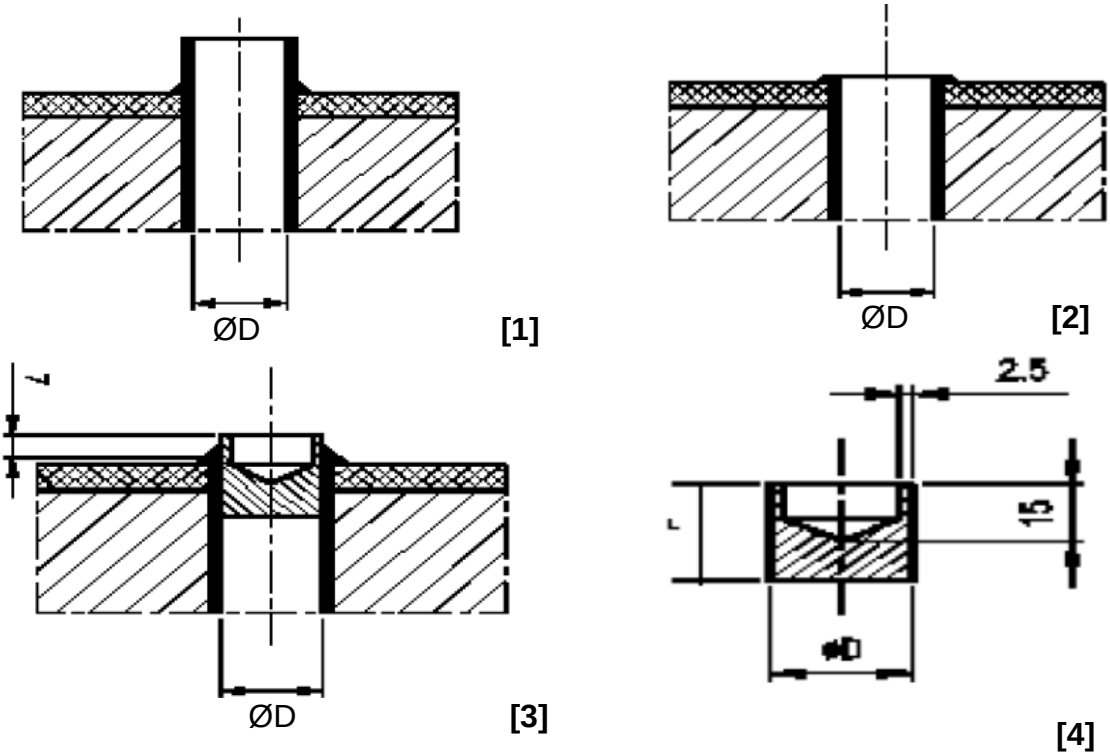


- Tube layout drawing for showing the plugged tube location is attached in shutdown report of inspection department. The Stamicarbon and actual procedure for tube plugging in top tube sheet is given below.

Sr. No.	Stamicarbon procedure	Actual procedure for Plugging in top tube sheet
1	Puncture the tube. Confirm by DP test. (At top or bottom end)	Punctured at the top end of tube (approx 60mm from the tube end) and marked its location in bottom tube sheet also using wire.
2	Grind and remove the tube end down until 50% of the tube to tube sheet weld metal is removed.	Grinding of tube end was done until 50% of tube using barring cutter in flexible grinder machine.
3	Clean the tube inside by reaming or by grinding at the location where the plug will be positioned.	Cleaning of tube inside was done using barring cutter in flexible grinder machine.
4	Determine the inner tube diameter	Inner tube diameter was 20.00mm
5	Machine the plugs, material quality equal to material of heat exchanger tube. Dimension shall be maintained as per the sketch given below. L= 25 mm.	Machine the plug as show in figure – 19[4]. Dimension ØD was kept 20.00mm and L was 25.00mm
6	Clean and degrease the plug and the	Cleaned the plug and inner tube hole

Sr. No.	Stamicarbon procedure	Actual procedure for Plugging in top tube sheet
	inner tube hole	by acetone
7	Insert the plug	Punched at 7mm from the end of plug in four direction of plug to hold it at tube. Refer figure- 19[3].
8	Protect the surrounding tube ends very carefully with help of the old PTFE bushing.	
9	Weld the plug in two layers, GTAW (material quality filler wire equal to material of heat exchanger tube; rod diameter 1.2 mm to 2.0 mm); start / stop points staggered to each other After each layer of welding perform a penetrate test and a ferrite check	Root welding was done using TIG welding (filler wire 25 22 2 LMn, 2.0mm dia.). DP check and ferrite check of root welding done. Found satisfactory. Further 2 run of welding was done. DP and ferrite check was done, found ok. Passivation was done using 10 %HNO3 solution and rinsing with DM water After welding

Tube Plugging Sketch of HP Condenser



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

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

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

HP Scrubber (H-1203)

Top dome of HP scrubber was lifted and shifted to check the chocking of gas inlet line. For the lifting of top dome cover of HP Scrubber following activities were carried out:

- 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
  - CO2 purging Inlet
- Cleaned monorail for top dome and applied grease
- Prepared the scaffolding for offgas 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
  - Offgas flange (C3-3"x1500#) ** used safety belt
  - Carbamate solution inlet (C6 - 3"x1500#)
  - CO2 purg conn. (1"x1500,3nos.)
- Cut the steam tracing lines wherever required.
- 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 the 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 upto stud using chain block place sleeper in between studs for safey of flange seating area of shell.

- Shifted the top dome towards K-1403-3 , placed on wooden sleeper .


- Removed the diaphragm for checking the dome internals.




- Departmental inspection was carried out. No repair work was done.
- Refixed the diaphragm on its position in top dome.
- Shifted the top dome and kept it upto the studs to tighten the inside drain flange.
- Kept the top dome on its position with new kempchen make serrated ring gasket with Teflon envelop.
- Tightened the nut as per procedure (In 4 steps at 300 kg/cm2 g, 500 kg/cm2 g, 700 kg/cm2 g pressure and final check round at 700 kg/cm2 g using hydraulic bolt tensioner as per sequence)
- Connected the all flange and welded the steam tracing line flange and Insulation was done.

LP Vessel

Repairing was done in following equipments after manhole opening

V-1101 (CO_2 Knock Out Drum)

New epoxy paint inside of the shell was done. 03 nos. of loosened segments of demister pads were tightened.

V-1423 (1st Stage Evaporator Scrubber)

- Demister pads were found slightly damaged, loosened & lifted at several locations which are rectified.
- Support channels and outer ring of demister pads were found lifted in East, direction, tied by metallic wires which are broken and the same are rectified.

V-1811 (1ST STAGE SEPARATOR)

- Demister drain pipe bottom tack weld found broken, which was again tack welded.

Low Pressure Carbamate Condenser, LPCC (H-1205)

Removal of Tube Bundle Assembly and providing the tube bundle baffle locking

The new LP carbamate condenser (H-1205) was procured from M/s Gansons Limited, Nagpur against the PO 201004131373 dated 14 / 03 / 2014 and was installed in Annual shutdown-2014.

Leakage in 01 no of U-tube (R-2,T-25 & R35, T-25) was observed in Oct-2014 and the leaky tube was plugged. It was decided to lift the tube bundle assembly in the shutdown to know the nature of failure i.e tube fretting due to vibration of tube bundle in the bi-phase condition.

It was also decided to make the provision of locking the tube baffles by jack bolts to minimize the vibration in tube bundle.

Before removing the tube bundle assembly, IRIS inspection of tubes were carried out after hydrojetting of tubes.

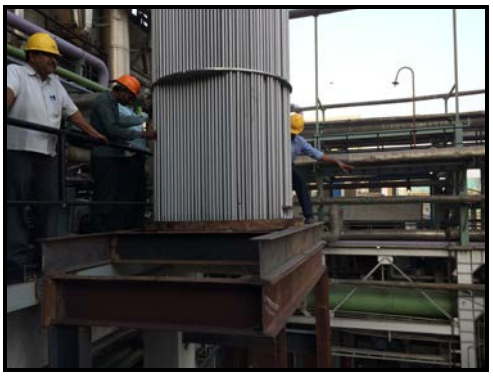
Based on the result of IRIS inspection following tubes were recommended for plugging.

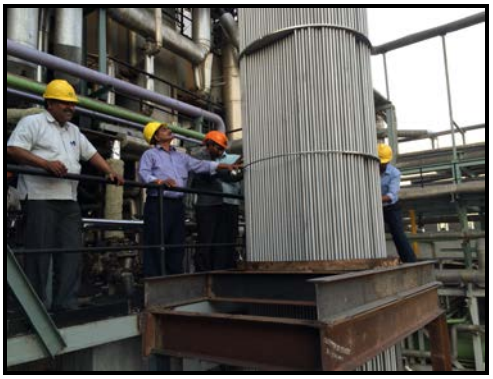
- **Row-2/Tube-1, Row-35/Tube-1 (57% Reduction)**
- **Row-1/Tube-14, Row-36/Tube-14 (33% Reduction)**

Activities involved in Removing the tube bundle assembly

- To remove the tube bundle assembly, all connected pipe lines and steam tracing lines were removed and cut from suitable locations.
- Top dish end removed from position.
- Platform above LPCC was also removed.
- Specially lifting fixture was fixed in the eye bolt hole of tube bundle to lift it upto the height of 1 feet and the tube bundle was then wooden sleepers was placed under the tube sheet to enable to weld the special lugs to lifting fixture to transfer the load from eyebolt hole threads to fixtures for safe lifting of tube bundle. (See attached photograps)

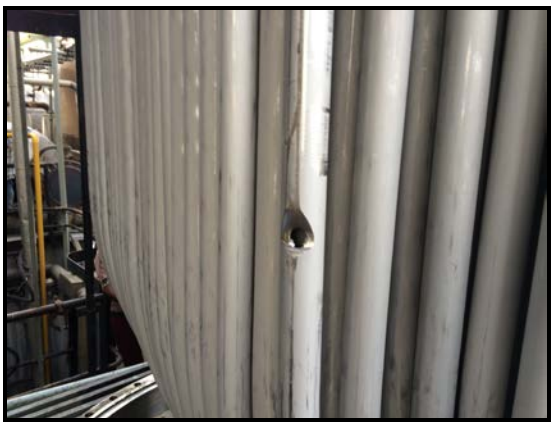
- The approx weight of tube bundle was 18 Tonnes.
- Finally tube bundle was lifted and placed on prefabricated stand as shown in attached photographs.



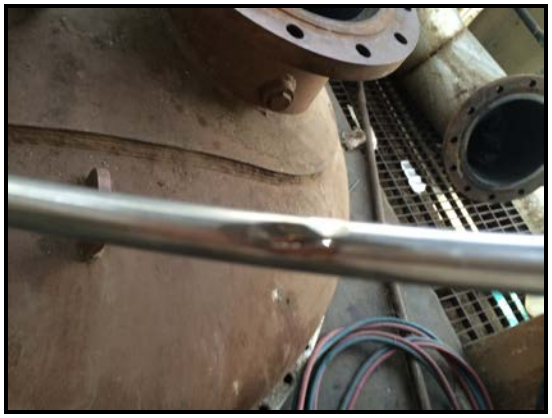
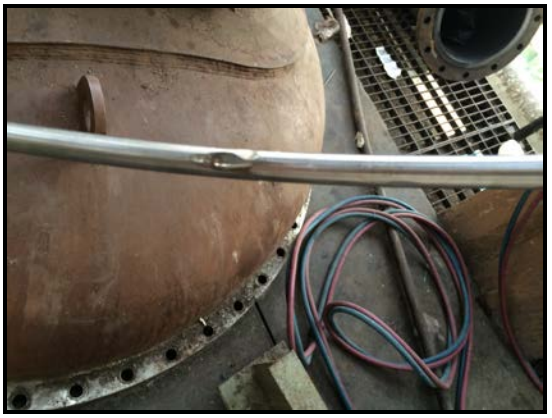



During removal of tube bundle it was observed that 12 mm dia ring welded with baffle plate was found rubbed with the tubes and one of the ring attached to bottom most baffle was found broken also.

Due to rubbing of this ring and tubes severe thinning on some tubes were observed and this was the prominent reason for the failure on one U-tube during Oct-2014. See the below attached photographs.

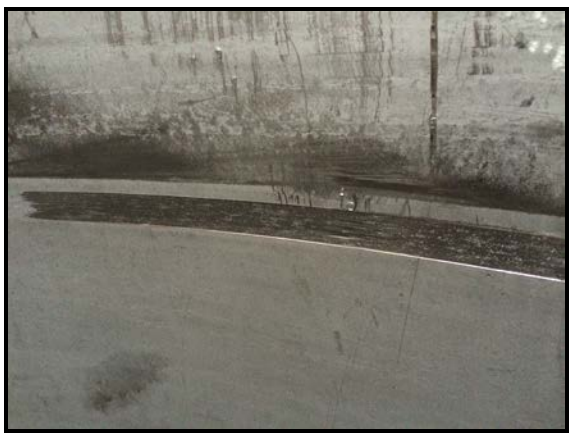


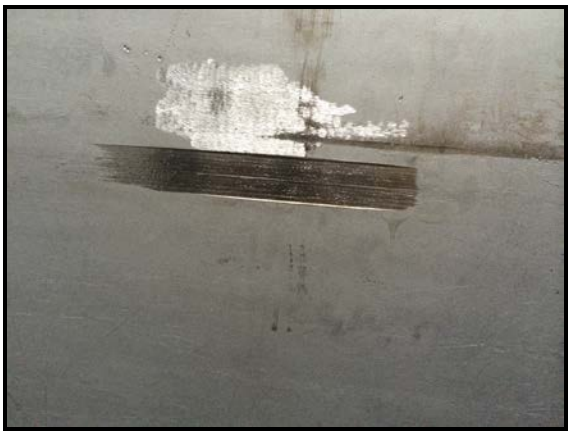

Photographs of Damaged ring are attached below:

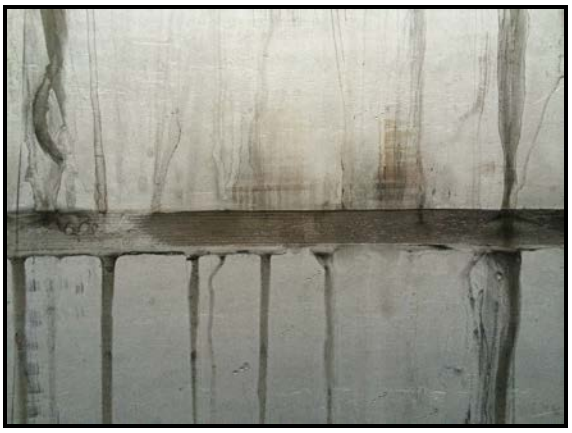



One no. of ring was found broken and lying inside the shell. (See attached photographs below)

After removal of tube bundle internal shell was inspected and various rubbing marks of tube baffle and shell were observed. See the below attached pictures:

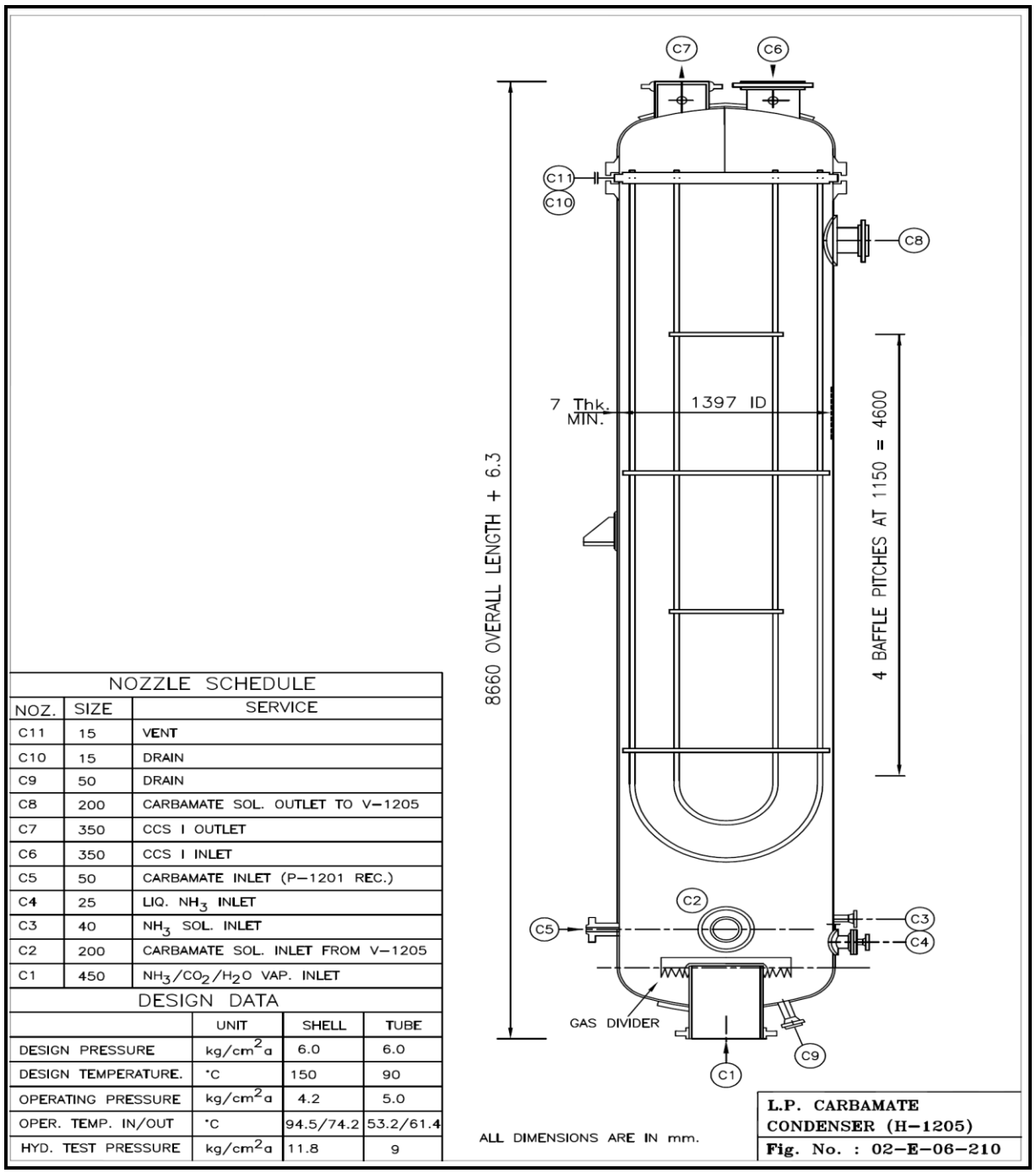






After the visual inspection of tube bundle at stand one more U-tube

Row-11 / Tube-1, Row-26 / Tube-1 (50% reduction due to abraision / rub) Was recommended for plugging.



NOZZLE SCHEDULE		
NOZ.	SIZE	SERVICE
C11	15	VENT
C10	15	DRAIN
C9	50	DRAIN
C8	200	CARBAMATE SOL. OUTLET TO V-1205
C7	350	CCS I OUTLET
C6	350	CCS I INLET
C5	50	CARBAMATE INLET (P-1201 REC.)
C4	25	LIQ. NH_3 INLET
C3	40	NH_3 SOL. INLET
C2	200	CARBAMATE SOL. INLET FROM V-1205
C1	450	$NH_3/CO_2/H_2O$ VAP. INLET

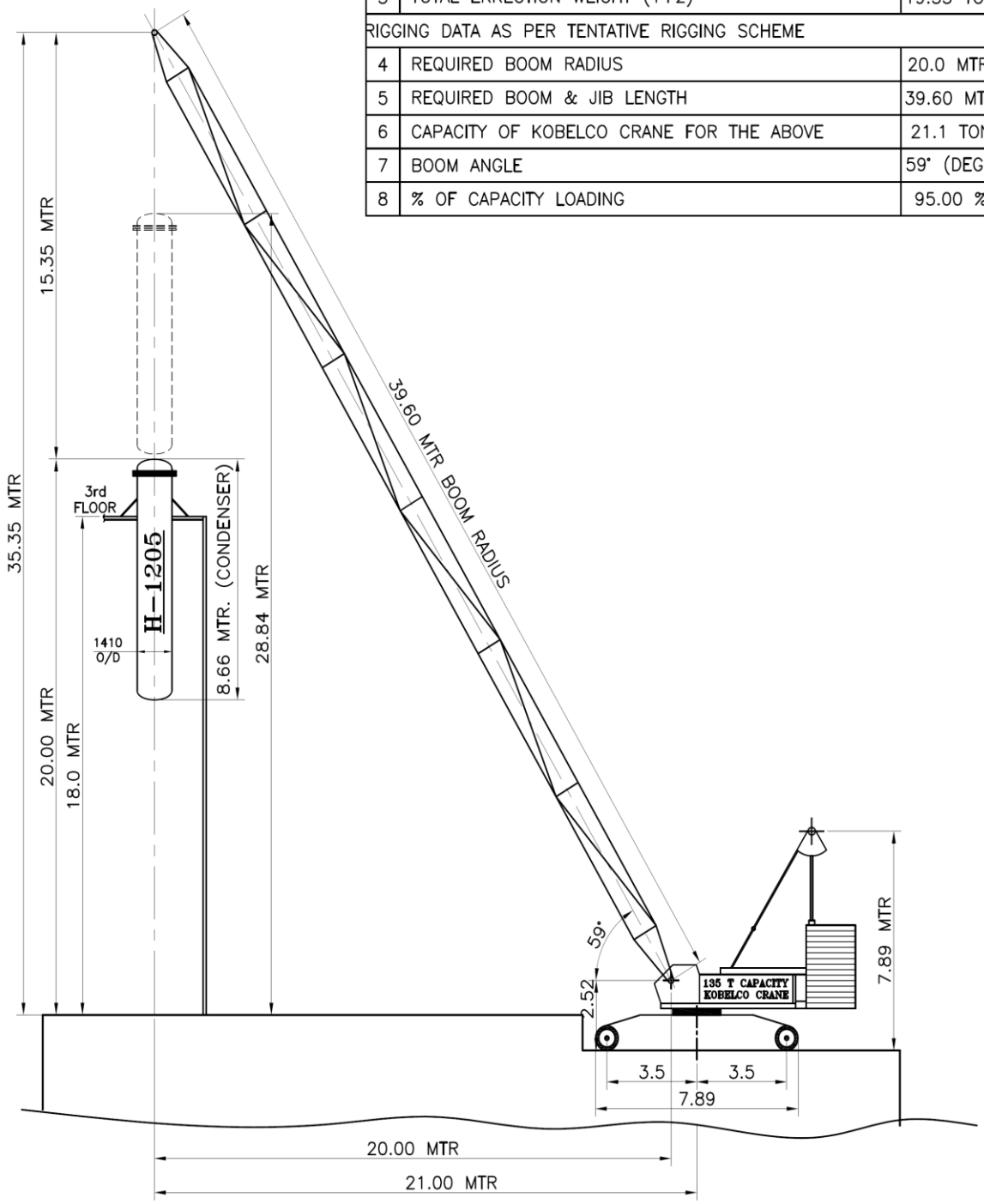
DESIGN DATA			
	UNIT	SHELL	TUBE
DESIGN PRESSURE	kg/cm^2a	6.0	6.0
DESIGN TEMPERATURE.	°C	150	90
OPERATING PRESSURE	kg/cm^2a	4.2	5.0
OPER. TEMP. IN/OUT	°C	94.5/74.2	53.2/61.4
HYD. TEST PRESSURE	kg/cm^2a	11.8	9

Final rigging arrangement is attached for reference.

IFFCO INDIAN FARMERS FERTILISER CO-OP. LTD. KALOL

RIGGING DATA

SR. NO.	DESCRIPTION	DETAIL
1	PROPOSED CONDENSER (H-1205) WITH WATER WEIGHT	17.3 TON
2	RIGGING + SPREADER WEIGHT	2.25 TON
3	TOTAL ERRECTION WEIGHT (1+2)	19.55 TON
RIGGING DATA AS PER TENTATIVE RIGGING SCHEME		
4	REQUIRED BOOM RADIUS	20.0 MTR.
5	REQUIRED BOOM & JIB LENGTH	39.60 MTR
6	CAPACITY OF KOBELCO CRANE FOR THE ABOVE	21.1 TON
7	BOOM ANGLE	59° (DEG.)
8	% OF CAPACITY LOADING	95.00 %



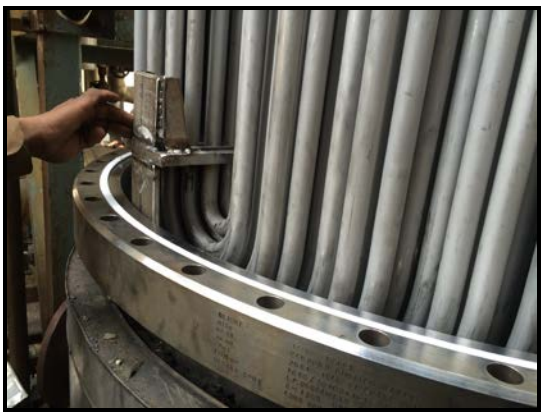
	NAME	DATE	TITLE – RIGGING ARRANGEMENT FOR H-1205	EWR No.
DRN	N.V. PANCHAL	09.07.2013		SCALE : N. T. S.
CHD			DRAWING No.	PLANT FROM NUMBER / SHEET OF / REV.
APD			CODE UREA-354	P 2 E S 0 4 - - - / 1 OF 1 / 0

To arrest the tube bundle vibration and to stop further failure of tubes, following two steps were taken,

- Removed the 12 MM dia ring attached to all baffles, which was the dominant reason for the premature tube failure.

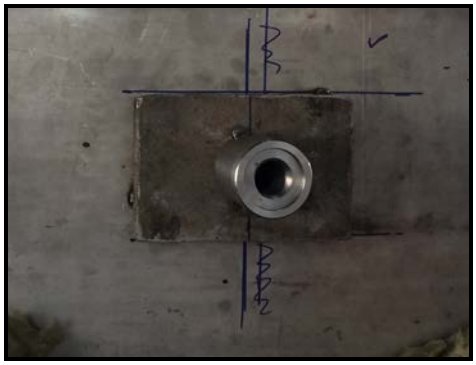
- Tube Baffle locking arrangement was made which restricts the movement of baffle inside the shell.

For this 03 Nos of support plate / lugs were welded on each tube baffle plates and this type of arrangement was done in 03 bottom most tube baffle plates. (See attached photograph)



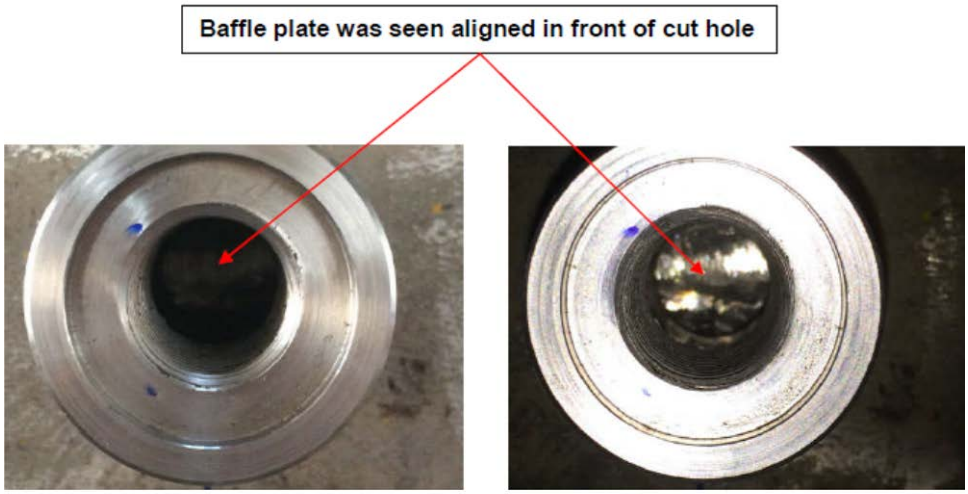
Similarly socket and stud locking arrangement was made in shell by drilling the holes at 9 location at exactly 03 baffle elevations and then a patch plate with hole and threaded socket was welded on shell at cut hole position.. (03 bottom most baffles).

Ellipitical hole cut in the shell plate at baffle location



Pad plate will threaded socket tack welded will shell place from out side

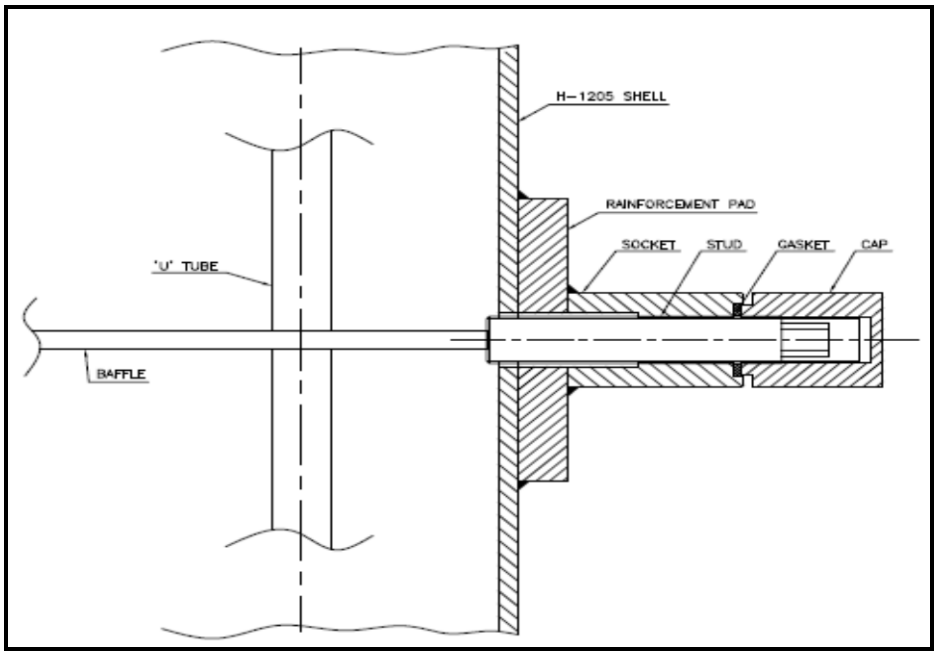
Then tube bundle was again inserted in the shell and checked the alignment of hole of shell with that of tube baffle plate that baffle plate was just in front of cut holes in shell.



After confirming the alignment of pad plate and socket hole with baffle plates, all 09 nos of pad plates with threaded sockets were welded and DP tested.

Finally baffles were locked by tightening the threaded stud in sockets and the secured by tightening of caps with Teflon gasket to made the joint leak proof. (See attached photographs)

Schematic arrangement of baffle locking arrangement is shown below:



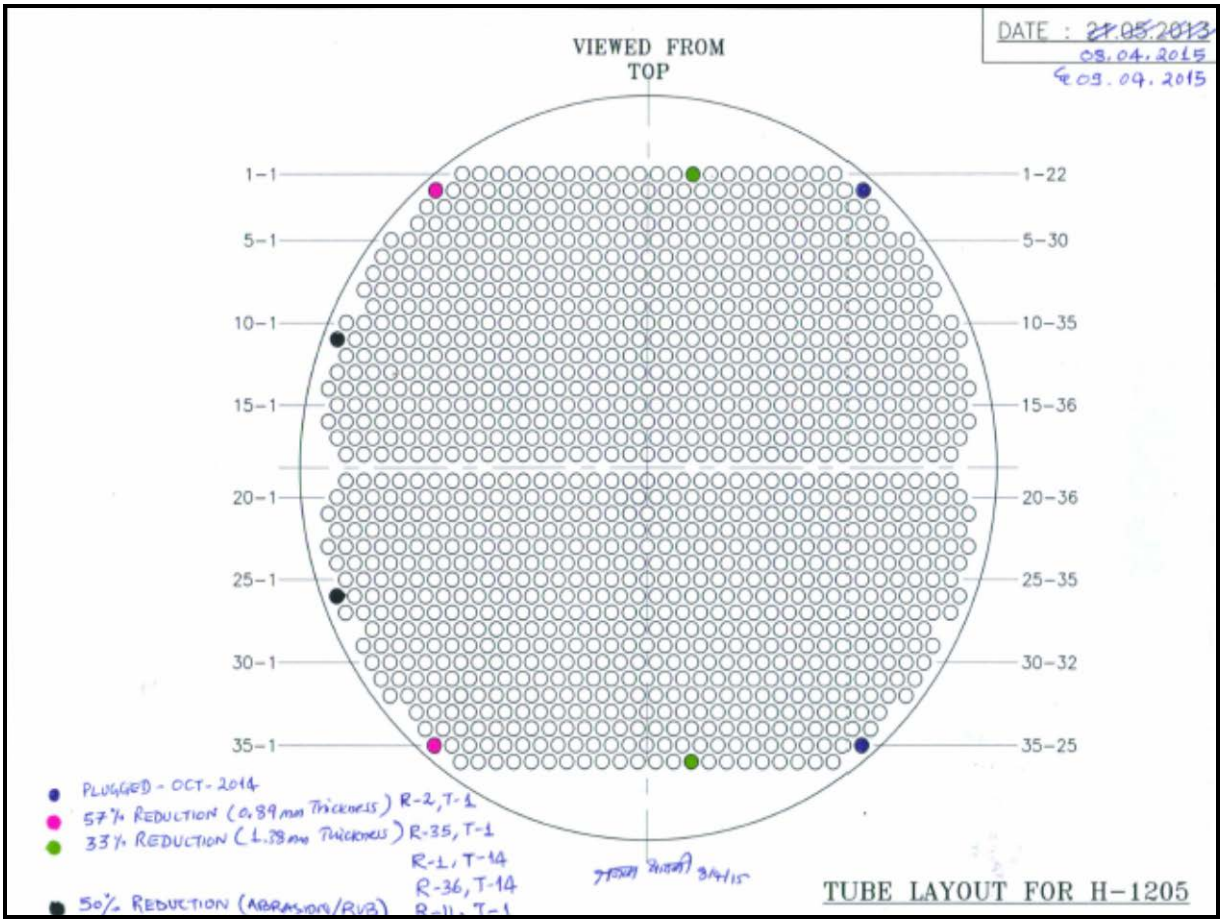
Attach dimensional drawing of each component

Before taking the hydrotest of tube bundle, following 03 U-tubes were plugged

Row-2/Tube-1, Row-35/Tube-1 (57% Reduction)

Row-1/Tube-14, Row-36/Tube-14 (33% Reduction)

Row-11/Tube-1, Row-26/Tube-1 (50% reduction due to abraision/rub)



Finally hydrotest was carried out at 11 Kg/cm2 and and found OK.
Then top dish end and all connected pipe line, other tracing lines and platform which were removed for lifting the tube bundle were fixed/welded and all blinds provided for hydrotest were removed.

VARIOUS FABRICATION JOBS

Following fabrication jobs were carried out during shutdown:

Replacement of Bottom Elbow (Size: 18" X Sch.10) of H-1205

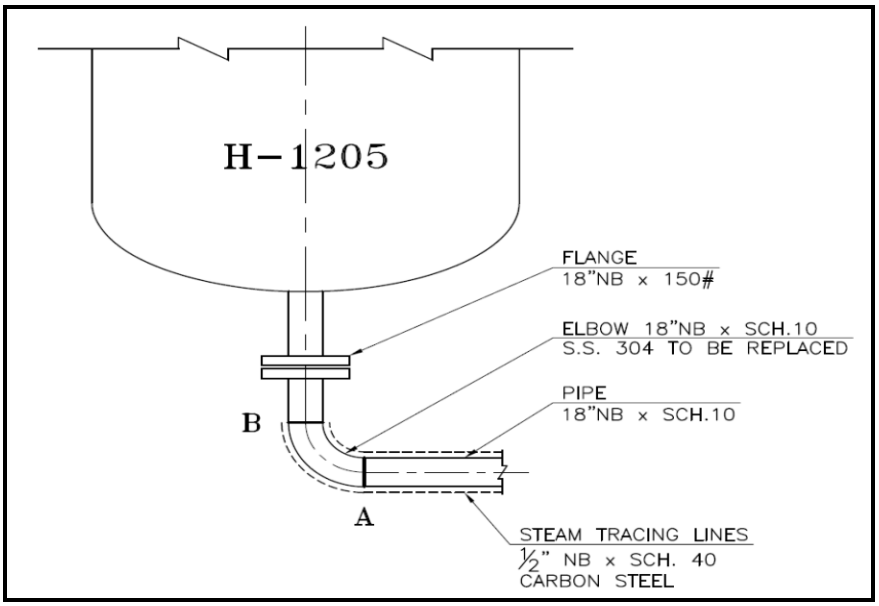
Bottom elbow of H-1205 was leaking due to various pin holes in the elbow area so it was replace in Shutdown-2015.

Ref.: Below Attached drawing

Material of pipe and fittings: SS-304/SS-304L

Joints Involved:

18" NB X sch.10 :– 02 Joints in position



Following activities were carried out

- Cutting of ½" NB X Sch.40 steam tracing lines.
- Cutting of existing 18" NB X Sch.10 Elbow by grinding at marked locations A & B as shown in above sketch.
- Removal of existing 18" NB X Sch.10 Elbow
- Opening of Bottom flange of H-1205 (18" X 150#)
- Removal of 18" Flange with spool piece.
- Weld edge preparation.
- Fitment of New Flange with Spool Piece and elbow in position.
- Root and final welding by GTAW.
- Inspection including Root weld & final weld DP.
- Welding of Steam tracing lines.
- Final tightening of Bottom flange of H-1205 (18" X 150#) with new gasket.

Replacement of steam Condensate lines (up to elevation of 75.0 mtr.) in Urea Plant

Various steam condensate lines near prill tower which were of carbon steel and are leaking frequently were replaced with SS-304 material.

Piping Material: ASTM A312 Gr 304 Sch.10

Size: 3" NB, 2" NB, 1-1/2" NB

Inch Dia welding involved: 300 Inch Dia

Following activities were carried out;

- Cutting and removal of existing pipe lines by grinding.
- Prefabrication, Fabrication and erection of New SS-304 pipe line in the position.
- Weld edge preparation and fitment of New SS-304 pipe lines.
- Root & final welding by GTAW.
- Inspection including Root weld & final weld DP by IFFCO.

Replacement of existing corroded CS steam tracing lines of High Pressure Lines

- Various corroded steam tracing lines along with valves and traps were replaced with new CS lines.
- Various steam tracing lines were replaced near HP Scrubber.

Steam Tracing Line details:

Seamless Pipe: ½"x Sch 40, Carbon Steel ASTM A106 Grade B

Coupling (Socket weld): ½" x 3000#

Gate Valve: ½" x 800#

Steam Trap: ½' x 800#

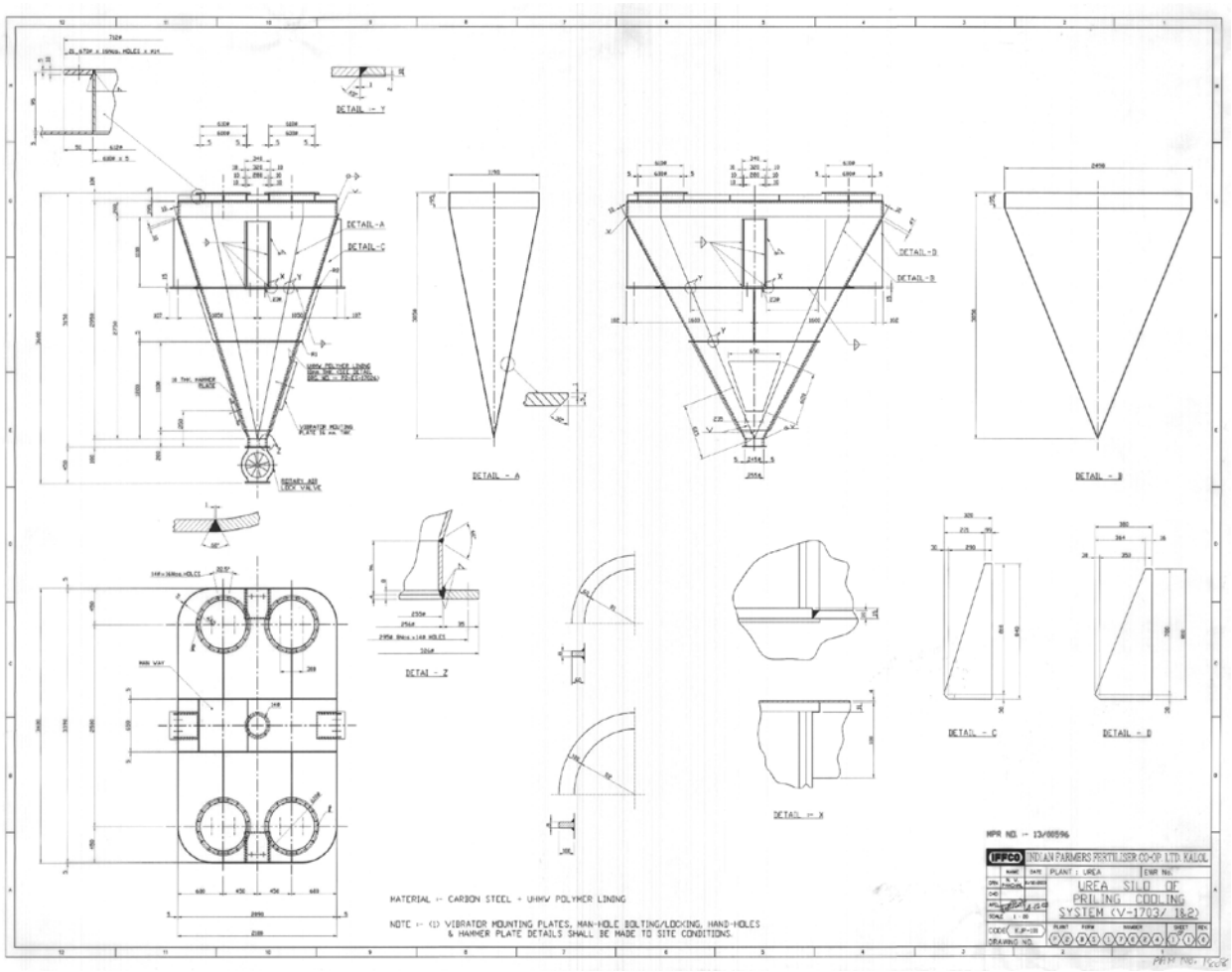
Fabrication and welding of SS-316L liner plate in Dust Silo.

Ref.: IFFCO Drg. No. P2-BS-17024 & P2-BS-17025 (V-1703)

Material of Plate/Liner: SS 316L, Thickness:2 MM

The following activities were carried out during replacement;

- Opening of Dust Silo and removal of old UHD Liner.
- Cutting off SS-316L plates in the required shape and size as per the requirement.
- Fit up and welding of SS-316L plates by arc welding followed by DP Test.



Replacement of valves in Ammonia Lines

Two nos of old flanged globe valves of 4" X 900# rating in Ammonia Pump P-1102/B discharge line and P-1102/C recycle line were replaced by new flanged globe valves of 4" X 1500 rating.

Material of Pipe Line: ASTM A106 Gr.B

Material of Flange: ASTM A 105

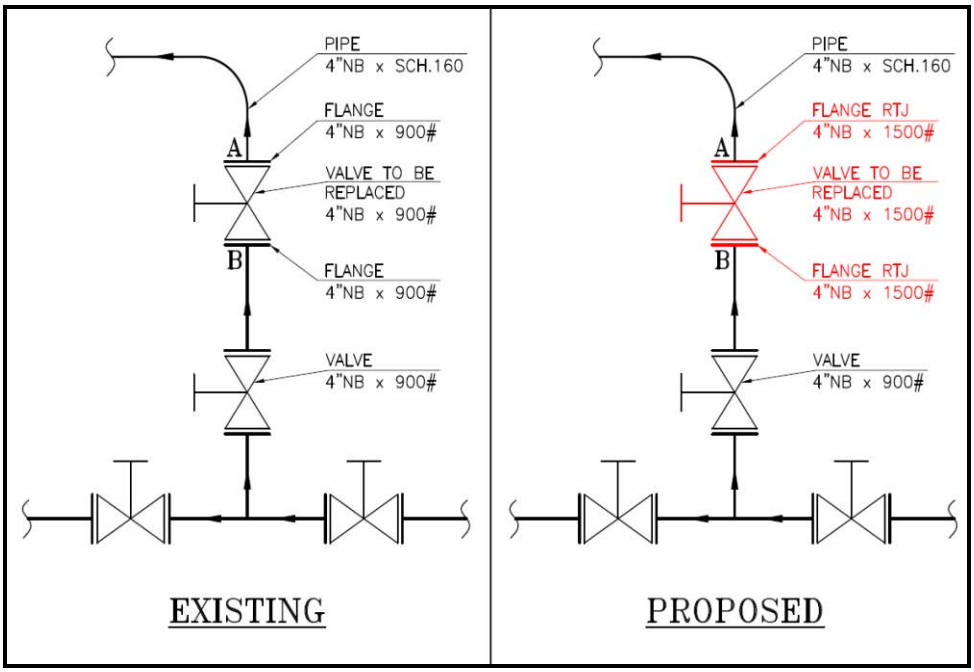
Size of New Flange: 4" NB X 1500#. Sch.160

Sketch of valves replaced in P-1102/C recycle line is attached below.

The following activities were carried out;

- Opening and removal of existing 4" NB X 900# flanged valve.
- Cutting of Existing 4"NB X 900# flanges (A & B as shown in the fig.)
- Weld edge preparation and fitment of New 4" NB X 1500# flanges in position considering flange to flange distance of new valve.
- Root welding of New flanges by TIG Welding followed by Root DP and radiography.
- Fill up and final welding by Tig followed by Root DP and Radiography.

Sketch and photograph of valves replaced in P-1102/C recycle line and P-1102/B discharge line is attached below.



P-1102/C Recycle Line Valve

P-1102/B Disch. Line Valve

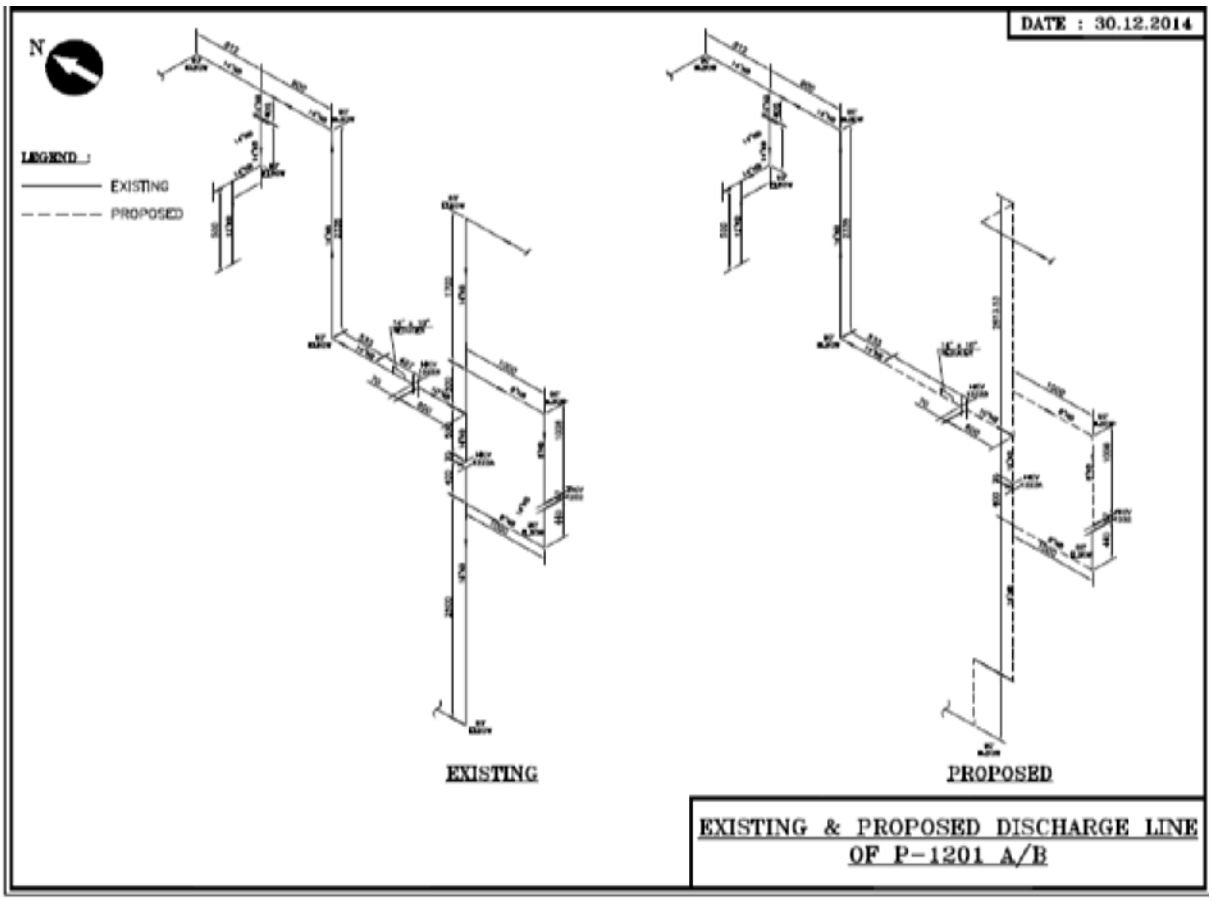
Replacement and modification in CCS-I line at First Floor

Complete Existing loop of CCS-I line is of carbon steel. In last year we have faced a leakage problem in CCS-I line at first floor and the reparing of that leak was very difficult due to space problem. So it was decided to replace and modify the existing CS loop at first floor with SS-304 material.

Size of Line: 14” NB, 12” NB, 10” NB and 8” NB, Sch.10

MOC: ASTM A 312 TP 304

Refer: Attached Sketch



CCS-1 Modified line at first floor

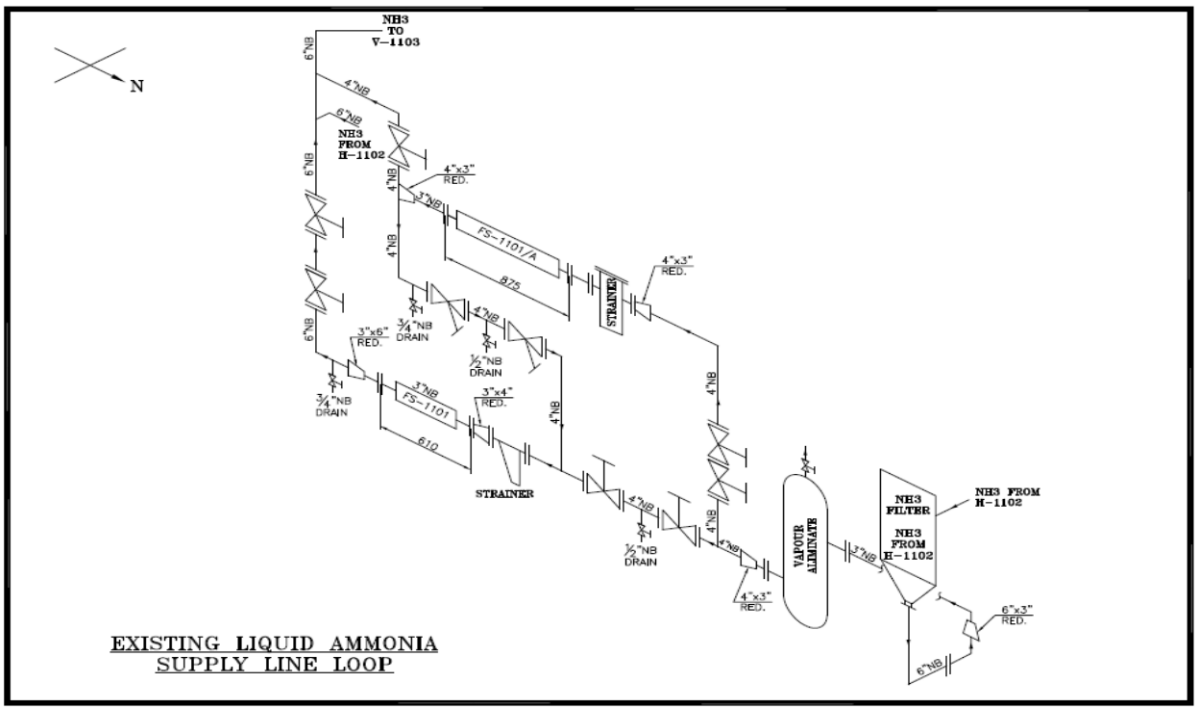
CCS-1 Modified line at first floor

The following activities were carried out;

- Removal of existing CS, CCS-1 line.
- Fabrication and Erection of new SS-304, CCS-1 line at 1st Floor in Urea Plant
- Inspection including final weld DP by IFFCO.

Modification in Ammonia Supply Line Loop at 1st Floor

Liquid Ammonia is suppled at a pressure of 14-16 Kg/cm2 from Ammonia plant to Urea Plant battery limit. The pressure drop in Ammonia supply system was around 1.5-2.0 kg/cm2. Due to this pressure drop vaporization of Liquid ammonia may occur at pump suction which is causing the knocking sound in P-1102/C. So a EWR was raised to study and simplify the Ammonia supply loop at 1st floor. Based on the study following sketch of existing and modified sketch was prepared and the line was modified as per modified sketch.



In final modification scheme, following components were removed:

- Vapour Eliminator
- Suction strainers provided at upstream of mass flow meters.
- Only one mass flow meter will remain in line.

The scheme for the EWR U-268 was approved vide note dated 27/03/2015 by competent authority to reduce the pressure drop in Ammonia Supply System of Urea Plant The scheme was implemented in April 2015 Plant turn around as per the details given below:

- Vapor eliminator was removed from ammonia supply system.
- Strainers provided at upstream of ammonia mass flow meters were removed.
- Associated pipes & fittings were also removed.
- New mass flow meter (FS-1101A) was removed and only one old mass flow meter (FS-1101) is kept for operation.

Process parameters (before and after modification)

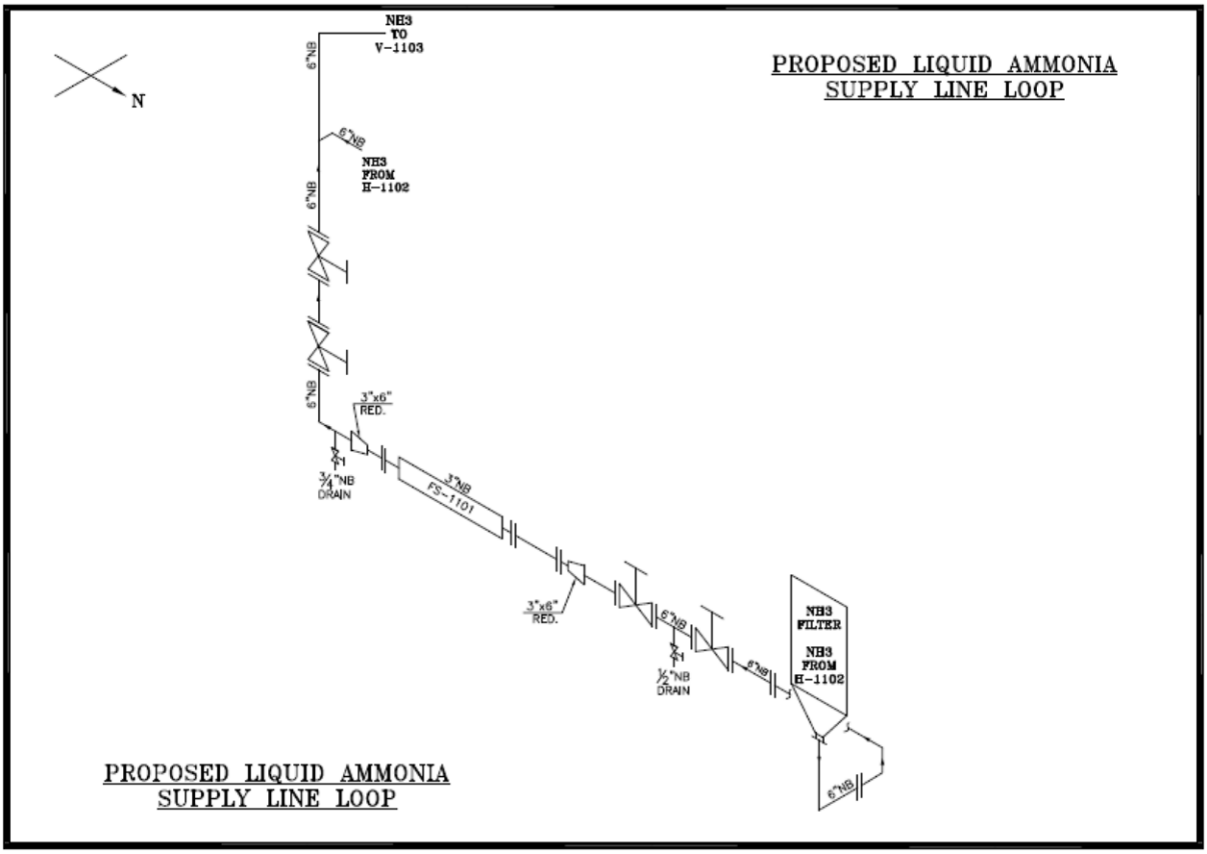
After the plant turn around 2015, Urea production has started on 12/04/2015 and plant is under stabilization.

Process parameters before and after modification are given below.

Sr. No.	Description	Unit	Before Modification	After Modification (16/04/2015)
1	Ammonia draw as per mass flow meter	t/h	42.5	42.6
2	Ammonia supply temperature at Urea Plant	Deg C	28	27
3	Ammonia supply pressure at Urea Plant Battery Limit	kg/cm2g	17.4	17.5
4	Ammonia supply pressure at suction vessel	kg/cm2g	15.6	16.4
5	Pressure drop in the ammonia supply system	kg/cm2	1.8	1.1
6	Reduction of pressure drop	kg/cm2	**0.7**	

With implementation of above modification, the pressure drop in ammonia supply system in urea plant has reduced by about 0.7 kg/cm2.

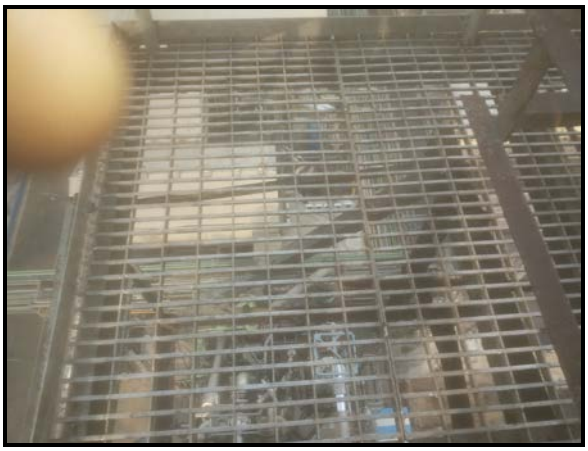
Final modified and implemented scheme is attached below:



Modification in Off Gas RV Platform and Platform behind the HP Scrubber

Existing platform at Off gas RV's (RV-1201 A/B/C) was of CS structure and is very congested and was very unsafe also. So this RV platform was modified with SS Material I,e with SS 304 railing pipes and gratings and also size of platform was increased for easy in mechanical jobs at RV station.

Photographs of new modified SS platform are attached below:

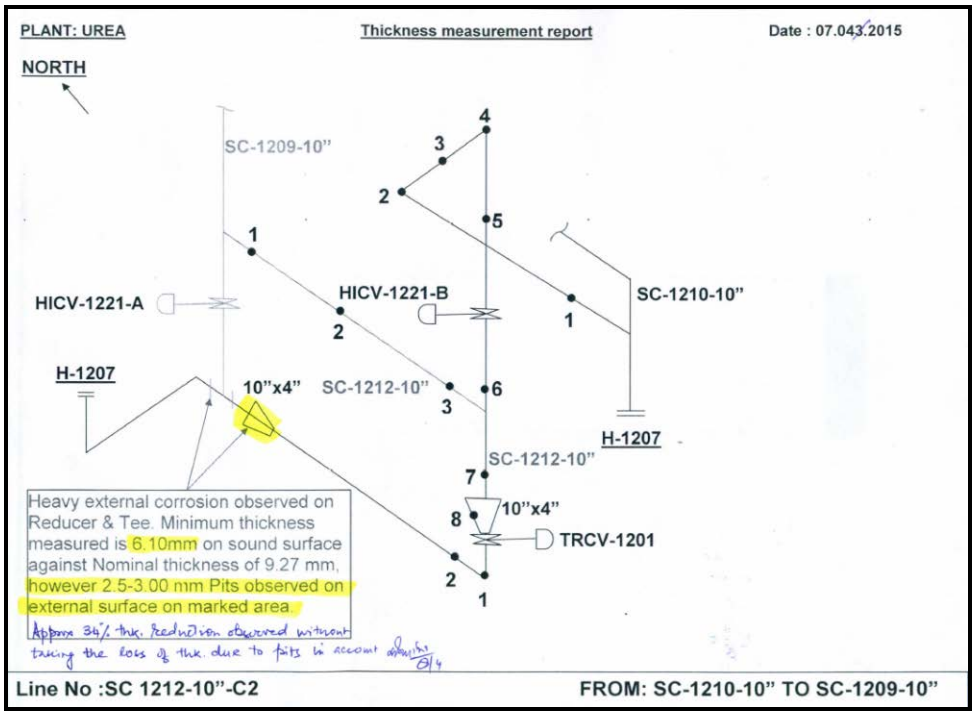


In addition to that the ms checkered plates in platform of HP scrubber was also replaced with SS-304 gratings.

Fabrication jobs based on thickness report by inspection section:

Replacement of some portion of Line No. SC-1212-10”-C2

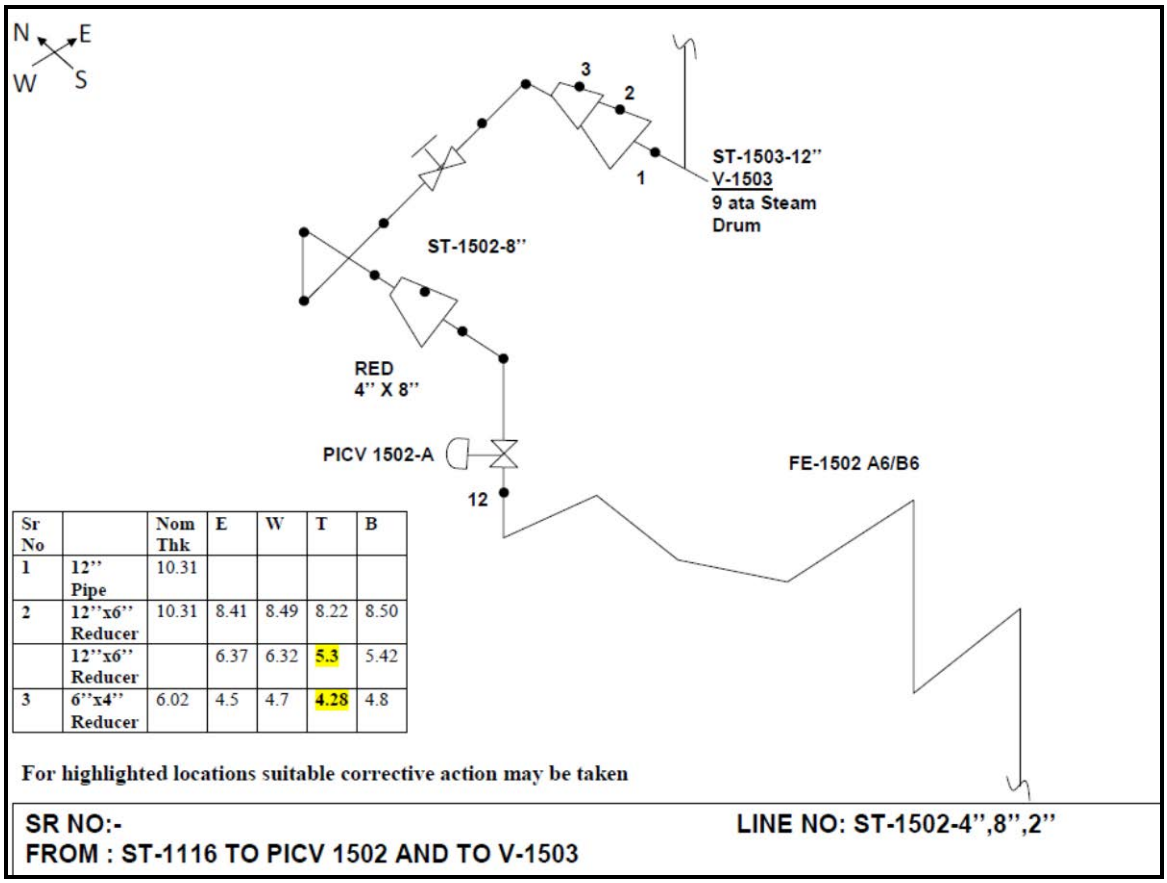
During thickness survey of line no. SC-1212-10”-C2, thickness loss was observed on some locations as marked in the attached sketch.



So the line portion from Equal tee of 10”X10” (Connected to HICV-1221A) to TRCV bottom flange was replaced with new one as shown in attached photofraph.

Thickness loss in Reducer of Line No. **ST-1502-4’’,8’’,2’’**

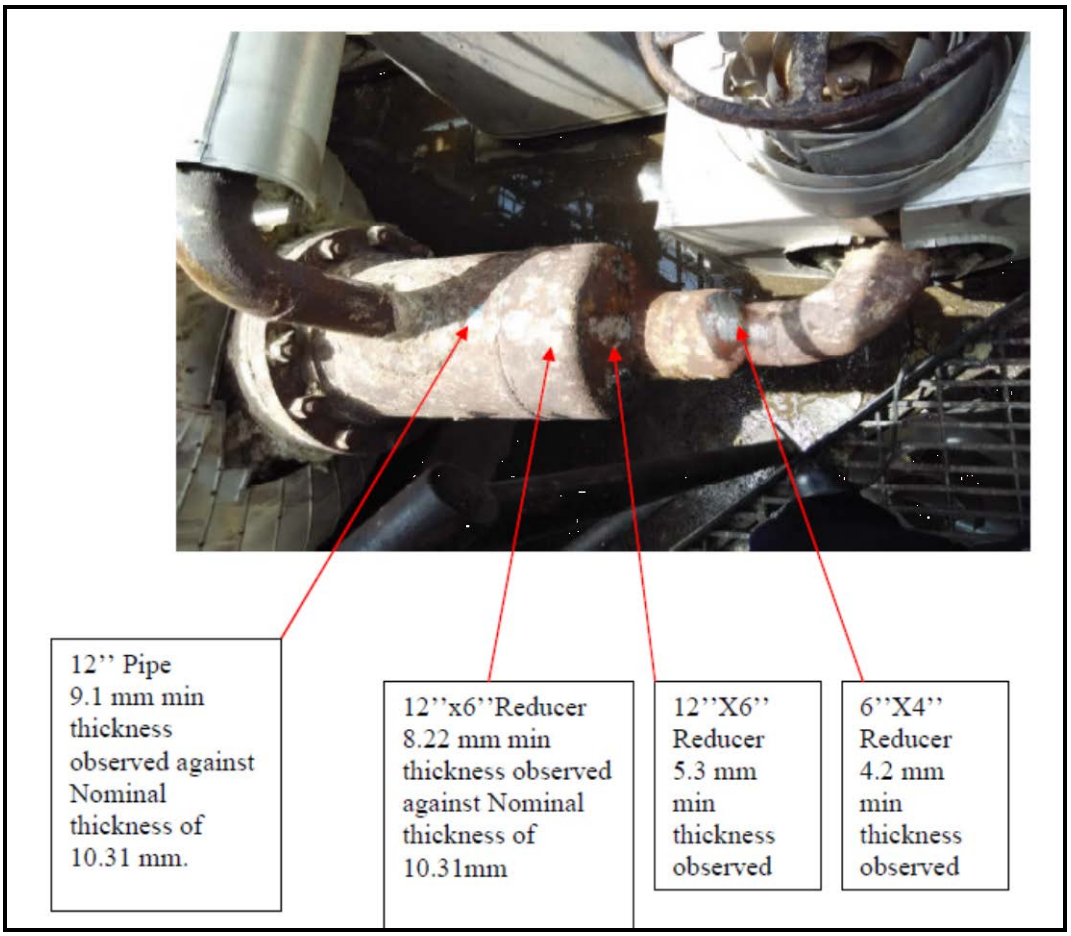
Thickness loss in Eccentric reducer of 12” X 6” and 6” X 4” was observed in line No. ST-1502-4’’,8’’,2’’ i.e line from ST-1116 TO PICV 1502 AND TO V-1503 as shown in the attached report and pictures.



Sr No		Nom Thk	E	W	T	B
1	12’’ Pipe	10.31				
2	12’’x6’’ Reducer	10.31	8.41	8.49	8.22	8.50
	12’’x6’’ Reducer		6.37	6.32	5.3	5.42
3	6’’x4’’ Reducer	6.02	4.5	4.7	4.28	4.8

For highlighted locations suitable corrective action may be taken

SR NO:- **LINE NO: ST-1502-4’’,8’’,2’’**
FROM : ST-1116 TO PICV 1502 AND TO V-1503



Since the major thickness loss was observed on the top half portion of 12"x6" and 6"X4" reducers and also new reducers of required sizes were not available with us , so patch plate in top half of both the reducers was welded.

Fabrication Jobs related to Instrumentation Section

TAG No. FRCV-1202 (CO2 to HP Scrubber)

Existing angel type control valve replaced with new valve of same size, type n rating. (1" X 1500 #, SS-316L)

TAG No. FI-1204 (Carbamate Solution Flow to P-1201 A/B/C suction at 2nd Floor

Prill Cooling System

Inlet Air Fan (K-1701)

- Visual inspection of both bearing was done. Oil flushing of both bearing was done.
- Alignment of both pulleys was done, Belt replaced by new one and guard was provided.
- Casing and structure of Fan was painted with M/s Mohan Paints on trial basis.

Conveyor System

Prill Tower Conveyors (M-1403-12/3)

M-1403-1 conveyor

- All damaged carrying rollers and return rollers were replaced.
- Alignment was done between gear box to motor and from gearbox to pulley.

M-1403-2 conveyor

- All damaged carrying rollers and return rollers were replaced.
- Gear box oil was flushed. Coupling bush were checked. Greasing of chain and sprocket was done.
- Alignment was done between gear box to motor and from gearbox to pulley.

M-1403-3 conveyor

- All damaged carrying rollers and return rollers were replaced.
- Gear box oil was flushed.
- Coupling bush were checked.
- Alignment was done between gear box to motor and from gearbox to pulley.

Link Conveyor (M-1419)

- All 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.

Prill Cooling System Link Conveyor (M-1421):

- All 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.

Dust Conveyor System (M-1702):

- 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.

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

Scraper (M-1402)

Scraper oil was flushed.

Fluid Coupling

- Oil of both fluid coupling M-1402-1/2 was flushed.
- Alignment of motor and coupling was done.

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

- Oil flushed.

Prill Tower ID Fan K-1401-1/2/3/4

K-1401-1/2/3/4

- Both fixed and free end bearings of M/s Cooper make were replaced in K-1401/1, K-1402/2 and K-1401/4.
- Belts were replaced in K-1401/2 and K-1401/4

- Alignment of motor and fan pulley was corrected.

V-1501 (4 ATA STEAM DRUM) (GT-1664)

On 09-04-2014, Hydrotest of V-1501 was carried out at 11.10 Kg/Cm2g in presence of Boiler Inspector.

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: It was jointly decide by production and maintenance that only critical RV's shall be overhauled every year and non-critical RV's shall be overhauled and tested once in 4 years.

Sr. No.	RV No.	Description	Test Medium	Set Pressure Kg/cm2 g	Reset Pressure Kg/cm2 g
1	RV-1201 A	V-1201 off gas line	Nitrogen	165	150
2	RV-1201 B	V-1201 off gas line	Nitrogen	165	150
3	RV-1201 C	V-1201 off gas line	Nitrogen	165	148
4	RV-1205	P-1201 A discharge	Water	165	148
5	RV-1206	P-1201 B discharge	Water	165	148
6	RV-1208	P-1201 C discharge	Water	170	148
7	RV-1103 A	P-1102 A discharge	Water	150	135
8	RV-1103 B	P-1102 B discharge	Water	150	135
9	RV-1103 C	P-1102 C discharge	Water	150	135
10	RV-1181	K-1801 final discharge	Nitrogen	177	159
11	RV-1903	K-1801 3rd stage discharge	Nitrogen	111	100
12	RV-1202A	V-1202 off gas line LP System	Nitrogen	6	5.5
13	RV-1202B	V-1202 off gas line LP System	Nitrogen	6	5.5
14	RV-1202C	V-1202 off gas line LP System	Nitrogen	6	5.5
15	PSV-1201A	P-1201 A Suction line	Water	8.5	7.5
16	PSV-1201B	P-1201 B Suction line	Water	8.5	7.5
17	PSV-1201C	P-1201 C Suction line	Water	8.5	7.5
18	RV-1102 A	Ammonia Suc. Vessel (V-1103)	Water	31	29
19	RV-1901	1st stage discharge of K-1801.	Nitrogen	7	6.7
20	RV-1902	2nd stage discharge of K-1801	Nitrogen	27	25.1
21	RV-1501	4 ata Steam Drum	Nitrogen	7.5	6.8
22	RV-1502	4 ata Steam Drum	Nitrogen	7.5	6.6
23	RV-1506	4 ata Steam Main	Nitrogen	6	5.4
24	RV-1221 (CCS-II)	P-1204 disch. To H-1203	Water	16.5	15
25	RV-1916	23 ata Steam extraction	Nitrogen	28	26
26	RV-1917	4 ata Steam exhaust	Nitrogen	4	3.6
27	RV-1130	24 ata steam header	Nitrogen	26	22.5

CLEANING AND HYDROJETTING OF HEAT EXCHANGERS

The Hydrojetting job was awarded to M/s. Hydrojetting Services, Following heat exchangers were opened for cleaning by hydrojetting. After cleaning, exchangers were boxed up with new gaskets.

- Surface Condenser (H-1815)
- Main Lube Oil Coolers (H-1814-A/B)
- Condenser Pre-evaporator (H-1419)
- Flash Tank Condenser (H-1421)
- First Evaporator (H-1422) with DM water.
- First Evaporator Condenser (H-1423)
- Second Evaporator (H-1424) with D.M. water
- Second Evaporator I Condenser (H-1425)
- Second Evaporator II Condenser (H-1426)
- First Evaporator Final Condenser (H-1420)
- Recirculation Heater (H-1204) with D.M. Water
- L.O. Coolers of P-1102-A/B/C
- L.O. Coolers of P-1201-A/B
- Reflux Condenser (H-1352)
- CCS - II cooler (H-1207)
- Hitachi Compressor First stage Intercooler (H-1811)
- Hitachi Compressor Second stage Intercooler (H-1812)
- Hitachi Compressor Third stage Intercooler (H-1813)

NRV Inspection

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

- CO_2 to H-1201
- NH_3 to H-1202
- NH_3 to V-1201
- Carbamate to H-1202
- Carbamate to H-1203
- CO_2 to H-1203
- 4 ata steam to V-1352
- 23 ata steam to V-1351
- 4 ata steam to V-1301
- Condensate to melt return line
- P-1201 A/B steam injection to discharge RV
- 9 ata steam injection to offgas line of V-1203/V-1207
- 9 ata steam injection to off gas line of V-1205
- NH_3 water to V-1352
- CO_2 to 1^{st} Desorber V-1352
- P-1351 A/B discharge
- Final discharge of K-1801 to H-1201
- NH3 water to V-1203 top
- NH3 water to V-1207

Process and Steam leak Jobs

Process Jobs

Sr. No.	JOB DESCRIPTION	TAG NO	REMARKS
COMPRESSOR			
1	MOV-1201 1st I/V D/S Drain line 1st fermanited -To be replaced	1	1 “X1500# Globe Valve Replaced
2	CO2 to H-1201 HPF drain I/V passing Near FIC-1202 Transmitter	2	1” BEL valve bonnet replaced
3	LIC-1807 U/S I/V gland leak	3	1 “X1500# Globe Valve Replaced
4	FR-1201 HP Tapping I/V to be replaced	31	1/2 “X1500# Globe Valve Replaced
GROUND FLOOR			
1	P-1204B suction flange gasket to be replaced as it was damaged	4	10” X 150# gasket replaced
2	P-1352B dis. Drain I/V wheel to be replaced for broken	5	¾” X 150# flanged valve replaced
3	P-1352 A suction I/V and its cond. Flushing I/V to be attended for passing	6,7	Valve Replaced
4	H-1201 sample poin both I/Vs are passing to be attended	8,9	BEL Valve cutting and lapping done
5	P-1102C 1st Discharge I/V gland is leaking , when it is open/close condition	10	Valve replaced
6	P-1102B 1st Dishcharge Valve to be attende as it was fermanited	11	Valve Replace with 4” X 1500 #
7	P-1102C 1st recycle valve to be serviced /reconditioned	12	Valve reconditioned
8	P-1102B recyle line close darin I/V bush broken to be attended	13	Valve replaced
9	P-1102B 1st suction I/V defectctive locking screw to be replaced & valve	14	Valve reconditioned
	to be reconditioned/serviced		
10	P-1401 A/B both discharge I/V is hard to operate	15,16	Valve reconditioned
11	P-1305 B discharge I/V bush broken	17	Valve replaced
12	P-1302D Dis. Bypass of H-1208 I/V to be replaced for bush broken	18	Valve replaced
13	P-1302C discharge interconnection I/v is hard to operate	19	Valve replaced
14	P-1351A/B dis. Drain I/V wheel to be replaced for broken	20,21	Valve Wheel replaced
15	H-1301 B Steam IV Flange gaskets Fermanited- To be replaced	22	Valve replaced
16	P-1201A Suction line drain i/v	52	Valve replaced
17	P-1201B suction line drain i/v	53	Valve replaced
FIRST FLOOR			
1	H-1205 -gas inlet line pin hole leakages	23	Bottom Elbow replaced
2	P-1201A 2nd Dis. I/V is passing and suction	24,25	

Sr. No.	JOB DESCRIPTION	TAG NO	REMARKS
	I/V is hard to operate		
3	N/C ratio meter sample 1st I/V is not operable(its bush welded)	26	BEL Valve bonnet replaced
4	H-1204 hydro jetting to be carried out		Hydrojetting done
5	V-1409 A/B drain I/Vs gland / bonnet leaking and poor performance	32	Valve replaced
	of its cond. Flushing ball valve ,to be replaced	27	Bonnet gasket replaced
6	V-1202 bottom steam tracing trap fermanited to be replaced	33	Trap replced
7	LIC-1282 U/S drain I/V hard to operate and gland leak	34	Gland repacked
8	Pre-Evapor outlet to T-1401A I/V is hard to operate	35	Ball valve and handle provided
10	Condensate to P-1304 C/D suction line I/V gland leak & hard to operate	36,37	Valve Replaced
11	P-1305 A/B to H-1205A I/V gland leak	38,39	Gland attended
12	V-1201 sample point darin & U/S of Monoblock valve of N/C ratiometer all three valves to be replaced for hard to operate & passing		BEL valve Bonnet replaced
13	MOV -1101 D/S I/V is hard to operate	40	Valve reconditioned
14	P-1102A/B/C,C.W sprinkler individual I/Vs behind N/C ratiometer hard to oper	41,42,43	BEL valve reconditioned
15	P1210 A/B both dis. & cooler bypass I/V gland leak	44-47	Gland Attended
16	P-1201A 2nd Dis. I/V is passing and suction I/V is hard to operate	48-49	Valve attended
17	P-1201A/C dishcharge RV's gland leak		
18	F-1206 B IN I/V is not properly operable (valve flapper probl.)	50	Valve reconditioned
19	D water to bagging plant 1st I/V hard to operate		
20	V-1409B suction / discharge both main and their drain I/V 's gland leak	28-29	Valve Replaced
21	V-1409A 1st discharge drain I/V gland leak	30	Bonnet gasket replaced
22	V-1201 sample point drain both I/V s are passing to be replaced		Instrument Job
23	P-904A casing leaks ,when it was put on cond. Flushing		Instrument Job
24	N/C ratio density transducer inlet RV is passing (inside cabin)		Instrument Job
25	P-1210B suction I/V to be relocated for obstacle	54	Valve orientation changed
26	V-1301 LG Bottom IV is Not operable	55	Valve replaced
27	F-1206 A/B I/V bush broken	51	Valve replaced

Sr. No.	JOB DESCRIPTION	TAG NO	REMARKS
SECOND FLOOR			
1	H-1207 Shell drain I/V is passing	56	Valve replaced
2	DM to P-1211 root I/V bush broken (above H-1502)	58	Valve Replaced
3	PCV -1502 U/S I/V gland leak	60	Valve replaced
4	H-1421 to P-1305 I/V flange leak	59	Flange gasket replaced
5	P-1352 to H-1205A I/V gland leak	61	Valve replaced
6	P-1211 DM inlet I/V wheel is free&valve bush broken(above H-1502)	57	Valve replaced
7	H-1421 Leg I/V flange leak	62	Valve replaced
8	LIC-1203 D/S drain I/V is passing (dropwise)	63	Valve replaced
THIRD FLOOR &3 1/2 floor			
1	V-1201 steam passivation 2nd I/V bonnet leak (bonnet lock welding done at bottom of autoclave)	64	Valve reconditioned
2			
3	V-1201 1st unloading valve bonnet leaking	65	Valve reconditioned
4	H-1205 CCS-I outlet flange gsaket to be replaced as it was damaged	67	Gasket replaced
5	Pre-Evapor.Drain I/V gland leaking (LIC-1282 U/S)	34	
6	H-1424 manhole to be opened for removal depositions/inspection	68	
7	FIC-1204 U/S I/V hard to operate & passing	77-78	Valve reconditioned
8	V-1201 top unloding I/V bonnet leak		
9	V-1201 both passivation or seal fill up I/Vs bonnet /gland leak (welded temp)	69	Valve reconditioned
10	PICV -1201 D/S 2nd I/V hard to operate	70	Valve reconditioned
11	PRC-1201 Pressure sensing root I/V bonnet leak	71	Valve reconditioned
12	NH3 to H-1202 start up by pass I/V of FRC-1201 to be replaced (wheel is welded)	76	
13	NH3 to V-1201 D/S 1st & 2nd inbetween both HPF I/Vs are not operable	72-74	Valve bonnet replaced
14	To Re-route Pre-evporator bleeder control Valve (HICV-1481) vent direction	75	
15	V-1201 i/v gland leak	66	Gland repacked
FOURTH FLOOR			
1	LIC-1501 D/S I/V is passing & hard to operate , to be reconditioned / replaced	80	Valve reconditioned
2	4 ata sample point at V-1501 top I/V hard to operate	79	Valve replaced
FIFTH FLOOR			
1	Scrubber drain both I/V s are hard to operate, to be serviced/reconditioned	81,83	Valve bonnet replaced

Sr. No.	JOB DESCRIPTION	TAG NO	REMARKS
SIXTH FLOOR			
1	V-1207 , LIC-1235 bypass I/V gland leak and hard to operate	82	Valve replaced
2	CO2 to Scrubber drain I/V hard to operate	84	Valve reconditioned
3	PT top HPF bleeder drain I/V hard to operate		Wheel replaced
4	Prill bucket rotating assembly is very hard to operate, to be checked		Greasing done
HYDROLISER			
1	H-1303 by pass I/V hard to operate Nr. Control room staircase	91	Valve replaced
2	P-1351A/B dis. I/V bottom flange leak	90	Flange gasket replaced
3	H-1352 C.W inlet I/V hard to operate	89	Valve replaced
4	FIC-1351 U/S & D/S I/V hard to operate	87-88	Valve replaced
5	FIC-1352 D/S and by pass I/V gland leaking	86	Calve replaced
6	H-1301 bypass I/V not proper closed	22	Valve replaced
PCS/NEEM OIL			
1	P-1901 A/B is poor pumping to be attended or replaced		Pump replaced
2	Silo No : 1 base bolts are looseness and correded to be replaced	94	Bolts replaced
3	T-1901 A Recycle IV to be replaced	92-93	Globe valve replaced
4	K-1702 Duct Drain Ivs to be replaced	95-96	Valve replaced
5	To Repair FCS bed for missing bolts and damages		Bolts replaced/provided

Steam / Condensate Jobs

Sr. No.	DESCRIPTION	TAG NO	REMARK
1	Density meter condensate flushing 2nd I/V gland leak	107	Gland replaced
3	TRC-1201 U/S drain I/V is hard to operate	109	Gate valve replaced
3	Steam tracing lines corroded/leak Nr Piller Beside F-1206 at 1st flr	99	Line replaced
4	Melt pump jacket Steam header to PT top inlet I/V and its drain I/V is hard to operate at 3rd floor.	113	Gate valve replaced
5	Melt pump dis .line jacket inlet steam I/V hard to operate at 2nd flr	106	Gate valve replaced
6	FT-1502 root I/V pin hole leaking to be replaced(23 to 9 ata)	108	Gate valve replaced
7	HICV-1422A steam tracing leak (insulation to be removed)	103	Gasket replaced

Sr. No.	DESCRIPTION	TAG NO	REMARK
8	V-1200 off gas line steam tracing to be provided for choking	105	Steam tracing tube provided
9	Pre evaporator outlet to T-1401 steam tracing is not working	102	Steam trap and gate valve replaced
10	Melt returns to T-1401 steam tracing is not working	101	Steam trap replaced
11	P-1352 A/B suction line cond. Flushing I/V passing & hard to operate	7,97	Valve replaced
12	4 ata steam to rectifying column offgas both I/Vs are passing & HTO	120	Valve replaced
13	TRC-1422 D/S I/V gland leak and hard to operate (HTO)	121	Gland replaced
14	TRC-1421 U/S I/V gland leak and hard to operate	122	Gland replaced
15	4 ata to H-1301 A/B back flushing both I/V s gland &flange leak	22	Valve replaced
16	Bucket room steam trap is not working ,its line corroded and I/V to be replaced as not operable	128-130	Valve and trap replaced
17	H-1203 bottom steam tracing pin hole leak Nr. Hand railing	133	Valve and trap replaced
18	4 ata drum B/D I/V to be replaced as it was fermanited Nr C.R	127	Valve replaced
19	4 ata steam Tracing main I/V is passing Nr HICV-1210	126	Valve replaced
20	4 ata steam tracing Main I/V is passing Nr. FR-1504(piller side)	112	Valve replaced
21	P-1425 (II nd Evapor. Final Ejector) vent drain to be extended to floor	111	Line extended
22	TIC-1481 U/S darin I/V whell is free	110	Valve replaced
23	V-1202 bottom trap fermanite repaired-To be replaced	100	Valve, line and steam trap replaced
24	23 ata to Hydrolyser	98	Valve replaced
25	V-1430 Cond pot LG leak	104	Gasket replaced

PREVENTIVE MAINTENANCE OF ROTARY EQUIPMENTS

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 & 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
- After alignment gland was repacked with new 25 MM 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	0.22 – 0.24
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 between pump to motor was done by laser alignment machine. Readings are as under

Alignment between **Pump to Motor, P-4402**

Position	Parallel Offset	Angular Offset	Correction Required	
			Foot-1	Foot-2
Horizaontal (H)	0.01	0.01/100	0.07	0.15
Vertical (V)	-0.01	0.01/100	-0.02	-0.10
All readings are in MM.				

Preventive Maintenance of CW Pump, P-4403 Train

CW Pump P-4403

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
- After alignment gland was repacked with new 25 MM Sq PTFE gland packings.
- 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 – 0.23
2	Rear end journal bearing clearance (by lead wire)	0.20-0.30	0.25 – 0.28
3	Front end journal bearing interference	0.02-0.05	0.05
4	Rear end journal bearing interference	0.02-0.05	0.06

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 after complete overhauling.
- 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.
- Oil filter cleaned.
- Gland steam leak off port and lines cleaned.
- Final alignment readings were checked with laser alignment machine.
- Final clearance chart is as under:

Sr. No.	Description	Design Value (mm)	Value after PM
1	Axial thrust	0.25-0.30	0.35
2	Front end journal bearing clearance (by lead wire)	0.127-0.18	0.20 – 0.25
3	Rear end journal bearing clearance (by lead wire)	0.127-0.18	0.23 – 0.24

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 cleaned.
- Final clearance chart is as under

Sr. No.	Description	Design Value (MM)	Value after PM (MM)
1	Pinion front bearing clearance	0.15 - 0.20	0.22 – 0.24
2	Pinion rear bearing clearance	0.15 – 0.20	0.21 – 0.23
3	Gear wheel front end bearing clearance	0.20 – 0.30	0.22 – 0.24
4	Gear wheel rear end bearing clearance	0.20 – 0.30	0.24 – 0.25
5	Gear wheel axial thrust	0.50 – 0.60	0.20
6	Gear backlash	0.40 – 0.45	0.42

- Final alignment between turbine to gear box was done by dial gauge. Readings are as under

Turbine to Gear Box

Dial on Gear Box

View from turbine front

All readings are in mm

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.
- After alignment gland was repacked with new 25 MM 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	**Axial thrust**		0.30
2	Front end journal clearance (by lead wire)	0.20-0.30	0.21 – 0.22
3	Rear end journal bearing clearance (by lead wire)	0.2-0.30	0.20 – 0.23
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)

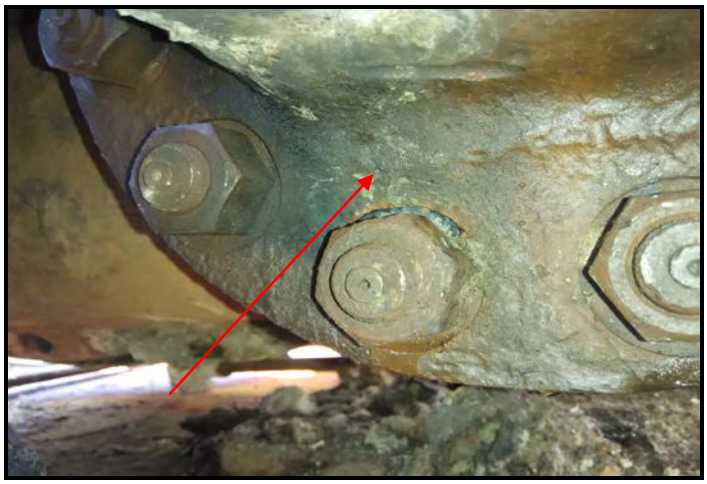
Following activities were carried out during PM

- 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 fixed after complete overhauling.
- 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.

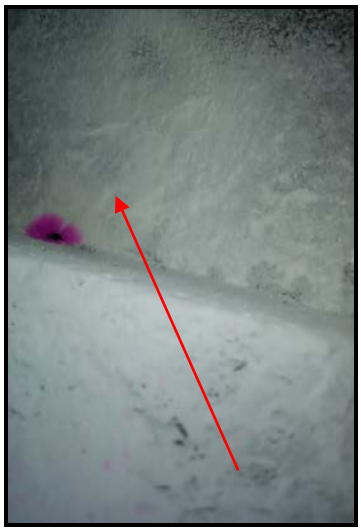
- Final Alignment Readings were checked with laser alignment tool.
- Final Clearance chart is as under:

Sr. No.	Description	Design Value (mm)	Value after PM
1	Axial thrust	0.25-0.30	0.39
2	Front end journal bearing clearance (by lead wire)	0.127-0.18	0.25 – 0.26
3	Rear end journal bearing clearance (by lead wire)	0.127-0.18	0.24 – 0.25

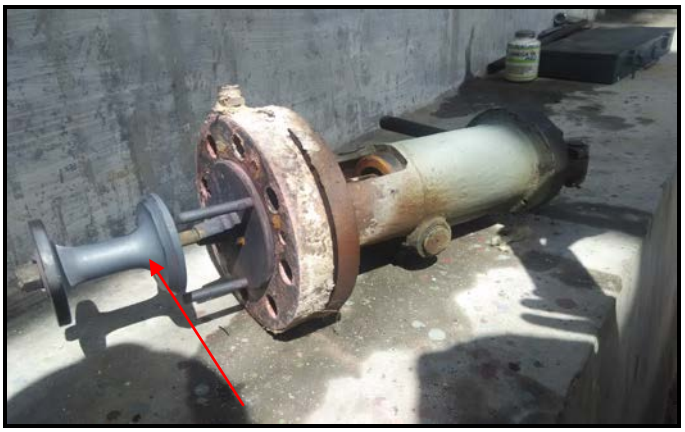
During start-up of turbine, leakage was observed from the one no. of bolt of steam chest flange to turbine (shown in figure below). Nut of same bolt was removed with the help of pneumatic tool. Copper washer was provided and bolt was tightened using pneumatic tools. Steam was charged in turbine, no leakage observed from the bolt, but there was heavy leakage from the steam chest body through the pin hole. To attend the leakage from the steam chest body, assembly of governor, quick shut-up & isolation valve were removed. Both flange bolts of steam chest were loosened using pneumatic tool. Connecting steam drain line was removed from its position. Steam chest was lifted using kobelco crane and shifted to workshop. Grinding was done in chest body throughout the pin hole. DP test was done to check the extent of pinhole. Pinhole repaired by TIG welding using 70S2 filler wire. Finally boxed up the dismantled assembly. Turbine was checked by steam charging no leakage was found.



Steam lekage through the bolt



Pinhole in steam chest body



Quick shut-off valve assembly

Governor valve assembly

Isolation valve

Gear Box, GB-4401/B

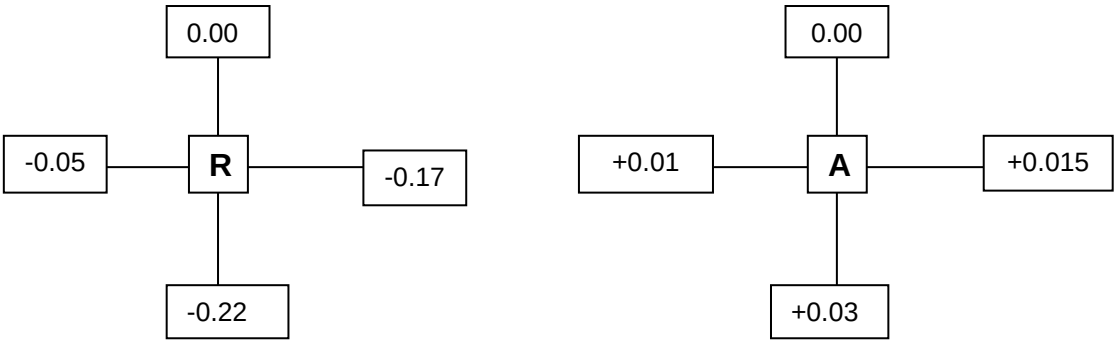
During Preventive maintenance following activities were carried out:

- 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

Sr. No.	Description	Design Value (MM)	Value after PM (MM)
1	Pinion front bearing clearance	0.15 - 0.20	0.13 – 0.14
2	Pinion rear bearing clearance	0.15 – 0.20	0.13 – 0.25
3	Gear wheel front end bearing clearance	0.20 – 0.30	0.24 – 0.25
4	Gear wheel rear end bearing clearance	0.20 – 0.30	0.24 – 0.25
5	Gear wheel axial thrust	0.50 – 0.60	0.20
6	Pinion axial thrust		0.82
7	Gear backlash	0.40 – 0.45	0.44

- Final alignment between turbine to gear box was done by dial gauge. Readings are as under

Turbine to Gear Box



Dial on Gear Box
View from turbine front
All readings are in mm

Preventive Maintenance of CW Pump, P-4401/A Train

CW Pump, P-4401/A

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
- After alignment gland was repacked with new 25 MM 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	0.15 – 0.16
2	Rear end journal bearing clearance (by lead wire)	0.2-0.30	0.20 – 0.25
3	Front end journal bearing interference	0.02-0.05	0.06
4	Rear end journal bearing interference	0.02-0.05	0.06

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.
- Governor was cleaned, checked and fresh oil is filled in it.

- Governor linkages were also made free.
- 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 below:
- Final clearance chart is as under:

Sr. No.	Description	Design Value (mm)	Value after PM
1	Axial thrust	0.25-0.30	0.41
2	Front end journal bearing clearance (by lead wire)	0.127-0.18	0.25 – 0.28
3	Rear end journal bearing clearance (by lead wire)	0.127-0.18	0.24 – 0.25

Gear Box, GB-4411

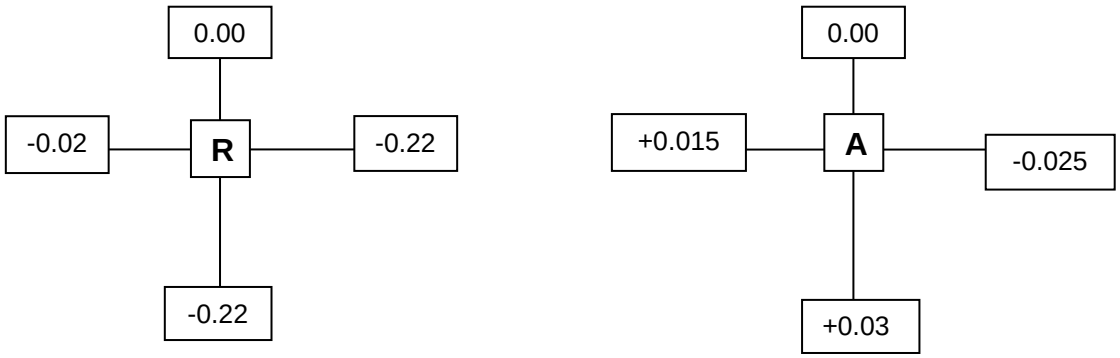
During Preventive maintenance following activities were carried out:

- 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:

Sr. No.	Description	Design Value (MM)	Value after PM (MM)
1	Pinion front bearing clearance	0.15 - 0.20	0.16 – 0.20
2	Pinion rear bearing clearance	0.15 – 0.20	0.20 – 0.21
3	Gear wheel front end bearing clearance	0.20 – 0.30	0.27 – 0.30
4	Gear wheel rear end bearing clearance	0.20 – 0.30	0.28 – 0.30
5	Gear wheel axial thrust	0.50 – 0.60	0.54
6	Pinion axial thrust		0.70
7	Gear backlash	0.40 – 0.45	0.48

- Final alignment between turbine to gear box was done by dial gauge. Readings are as under

Turbine to Gear Box



Dial on Gear Box

View from turbine front

All readings are in mm

- Final alignment pump to gear box was done by laser alignment machine. Readings are as under

Pump to Gear box				
Position	Parallel offset	Angular offset	Correction required	
			Foot-1	Foot-2
Horizontal (H)	0.00	0.03/100	0.09	0.16
Vertical (V)	0.01	0.04/100	0.11	0.20
All readings are in mm.				

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
- After alignment gland was repacked with new 25 MM 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	0.25 – 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. Readings are as under

Pump to Motor				
Position	Parallel offset	Angular offset	Correction required	
			Foot-1	Foot-2
Horizontal (H)	-0.05	0.01/100	0.00	0.11
Vertical (V)	-0.05	0.01/100	0.02	0.14
All readings are in mm				

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. Pump level was found 3.0mm down with reference to motor level (without shims). Pump was lifted by 5.00mm using 10 ton hydraulic jack. 5.00 mm SS304 plate was provided in pump foundation. Again alignment was checked and corrected.

Lifting pump using hydraulic jack

- After alignment gland was repacked with new 25 MM Sq PTFE gland packings.
- 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. Readings are as under

Pump to Motor				
Position	**Parallel offset**	**Angular offset**	**Correction required**	
			Foot-1	**Foot-2**
Horizontal (H)	0.01	0.00/100	0.03	0.05
Vertical (V)	-0.03	0.01/100	-0.07	-0.13
All readings are in mm				

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
- Strainer was removed, cleaned and assembled back.

Sr. No.	Description	Design/ Recommended Value (MM)	Value after PM (MM)
1	Axial thrust	0.28-0.33	0.18
2	Front journal bearing clearance	0.13-0.18	0.14
3	Rear journal bearing clearance	0.13-0.18	0.13
4	Front journal bearing interference	0.02-0.05	0.05
5	Rear journal bearing interference	0.02-0.05	0.05

- Thickness of thrust pads were also checked and recorded as

Thrust Pads thickness

Sr. No	Active	Inactive
1	22.16	22.19
2	22.16	22.19
3	22.19	22.22
4	22.19	22.18
5	22.19	22.18
6	22.20	22.19

- 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 giver or are removed
- Thrust bearing & journal bearings top half's were removed.
- Cleaning of rotor shaft was carried out.
- Governing components were removed and found ok.
- Checked all bearing clearances and found ok.

Sr. No.	Description	Design/ Recommended Value (MM)	Value after PM (MM)
1	Axial thrust	-	0.27
2	Front journal bearing clearance	-	0.14
3	Rear journal bearing clearance	-	0.15
4	Front journal bearing interference	-	0.05
5	Rear journal bearing interference	-	0.05

- Final alignment pump to turbine was done by laser alignment machine. Readings are as under

Turbine to pump				
Position	**Parallel offset**	**Angular offset**	**Correction required**	
			Foot-1	**Foot-2**
Horizontal (H)	-0.22	0.08/100	-0.90	-1.35
Vertical (V)	0.12	0.01/100	0.23	0.30
All readings are in mm				

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.
- Rear side thrust bearing was removed
- Thrust pads were found ok
- Both the sides bearings and bearing covers were assembled back.
- Strainer was removed, cleaned and assembled back.

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	0.14
3	Rear journal bearing clearance	0.13-0.18	0.15
4	Front journal bearing interference	0.02-0.05	0.05
5	Rear journal bearing interference	0.02-0.05	0.05

- Thickness of thrust pads were also checked and recorded as

Thrust Pads thickness

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

- 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

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.

Sr. No.	Description	Recommended	Value after PM (MM)
1	Pinion, front journal bearing clearance	0.15 – 0.20	0.17
2	Pinion, rear journal bearing clearance	0.15 – 0.20	0.16
3	Gear wheel, front journal bearing clearance	0.15 – 0.20	0.17
4	Gear wheel, rear journal bearing clearance	0.15 – 0.20	0.17
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	-	0.20

- 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. Readings are as under

Motor to Gear Box				
Position	**Parallel offset**	**Angular offset**	**Correction required**	
			Foot-1	**Foot-2**
Horizontal (H)	-0.01	0.03/100	0.17	0.54
Vertical (V)	0.05	0.00/100	0.07	0.12
All readings are in mm				

PREVENTIVE MAINTENANCE OF FD FAN (K-5113) / DRIVE TURBINE (Q-5113)

Following activities were carried out during PM :

- Decoupled the turbine
- Decoupled Fan from Turbine
- Removed oil lines & Governor
- Gearbox cover was opened and checked the condition of Gears. The same was cleaned; DP test was carried out and assembled back.
- Backlash between gear wheel to pinion was checked.
- Cleaned the Radial bearings.
- Dimensional Inspection, DP test & Gauss measurement of Journal bearings were done. Results were found satisfactory.
- Main oil console was cleaned and recharged with new oil (SERVO PRIME 68).
- MOP was removed from its position & cleaned. Coupling Bush of MOP was replaced.
- Oil cooler was opened and cleaned by Hydro jetting.
- Cleaned Duplex oil filter & replaced O-ring.
- The air dampers were attended for proper working. The Fan inlet air mesh screen was changed.
- Sentinel valve was passing during operating condition. The same was replaced with new one.
- Between turbine and fan coupling rubber pads were replaced
- The clutch oil (Servo Trans fluid-A) was replaced.
- The clearances were checked & following are the readings

Sentinel valve

- Final alignment motor to clutch was done by laser alignment machine. Readings are as under

Motor to Clutch				
Position	**Parallel offset**	**Angular offset**	**Correction required**	
			Foot-1	**Foot-2**
Horizontal (H)	-0.36	0.03/100	-0.23	-0.08
Vertical (V)	1.68	0.18/100	2.36	3.18
All readings are in mm				

- Final alignment fan to clutch was done by laser alignment machine. Readings are as under

Fan to clutch				
Position	**Parallel offset**	**Angular offset**	**Correction required**	
			Foot-1	**Foot-2**
Horizontal (H)	-0.09	0.02/100	-0.07	0.03
Vertical (V)	-0.20	0.06/100	-0.14	0.08
All readings are in mm				

- Final alignment gear box to clutch was done by laser alignment machine. Readings are as under

Gear box to clutch				
Position	**Parallel offset**	**Angular offset**	**Correction required**	
			Foot-1	**Foot-2**
Horizontal (H)	0.09	0.05/100	0.19	0.39
Vertical (V)	0.13	0.01/100	0.16	0.21
All readings are in mm				

BHEL BOILER JOBS

BHEL BOILER INSPECTION/HYDROTEST

Boiler was inspected by Boiler Inspector in open condition on 05/04/2015 & Hydro test was carried out at 89.0 kg/cm2 pressure on 09.04.2015 and witnessed by Boiler Inspector

TESTING OF BOILER RV'S

Critical boiler RV's were removed, overhauled and then tested on test bench.
RV testing readings are as under:

Description		Set pressure (Kg/cm2g)	Reset pressure (Kg/cm2g)	Seat tightness test pressure (Kg/cm2 g)	Remarks
Boiler Drum Front RV Tag no. RV-F-5111-2 Make : Crosby Model : HCL-56-IBR-IFN-SPL Size : 2" x J x 4"	On Valve testing Machine	69.00	----------	62.10	
Boiler Drum Rear RV Tag no. RV-F-5111-1 Make : Crosby Model : HCL-56-IBR-IFN-SPL Size : 2.5" x K x 6"	On Valve testing Machine	72.00	----------	64.80	
Boiler Super Heater RV Tag no. RV-16126 Size : 1.5" X 3" Model: 1717 WD	On Valve testing Machine	64.60	----------	58.14	Seat insert & nozzle ring locking screw replaced
	Online Floating	64.70	62.20	----------	
Tag no. RV-Q-5111 Size : 4" x 6" Model : SL-131	On Valve testing Machine	5.00	----------	4.50	
Tag no. RV-Q-5111 Size : 3" x 4" Model : 3SL-131	On Valve testing Machine	4.50	----------	4.00	

STEAM DRUM

One no. of U-clamp of feed water inlet header (4") was found in damaged condition. The same was repaired shown in below figure. Two nos. of clamps of phosphate dozing line (1") were also found in damaged. New clamps were welded with pipe line and tightened it with fasteners.

Repaired U-Clamp

DEAERATOR

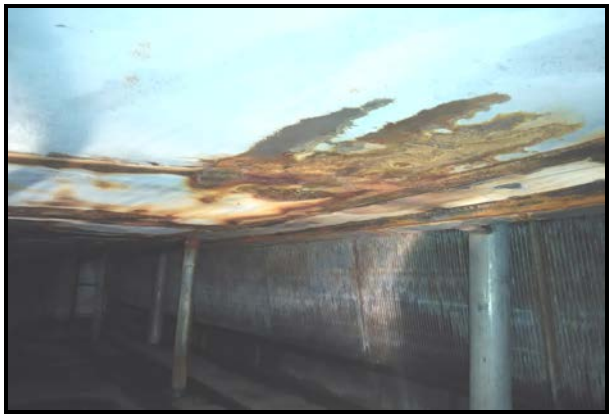
Bottom two tray segments were found displaced from its position. All tray segments were removed one by one from the top by cutting tack welding. From bottom, each tray segment was placed its position one by one. Tack welding of fasteners of each tray was also done for strengthening.

Tray position inside dearator

APH

All manway covers of APH were opened. Some portion of Flue gas outlet chamber was found rusted and corroded. Rusting was cleaned by power tools and 2 coat of epoxy coating was applied after primer. Remaining portion of duct of flue gas and air was found satisfactory. Plates were cleaned by water nozzle spray.

Light leak detection was carried out to check welding. At two portions, pinhole leak was detected. The same was repaired by weld filling. After getting clearance from production department all manway covers were box-up



Corrosion and rusting area in flue gas outlet chamber

FIXING OF CAP ON TOP PILOT BURNER

During previous shutdown-2014, a fabricated cap with clamp type arrangement was provided on bottom burner tip to prevent the direct impinging of air. After satisfactory performance of this modification, similar cap with clamp type arrangement was fabricated and provided on top burner tip.

Top burner from outside

Top burner - After removal from its position

Cap with clamping arrangement

Cap fixed on top burner at its position

OTHER BOILER JOBS

- All inspection window glasses were checked & cleaned. Broken window glasses were replaced. Gaskets of all window glasses were also replaced.
- SSH top coil (no. 36) Old Ceramic fiber blanket got replaced by new one
- Insulation replaced at several place based on thermography survey report.
- PSH & SSH header drain 2nd isolation valve (Globe valve, 1" x 1500#, IBR) was passing. The same was replaced with new one.
- Steam drum rear side Hydrastate 1st steam side (Fermanited) valve (Globe valve , 1" x 2500#, IBR) got replaced with new one.
- Opening / box up of steam / mud drum (both side)
- Opening / box up of manway cover of boiler furnace wall.

COOLING TOWER AREA JOBS

Welding of SS304 Patch Plate on Jump over line of CW supply header to ammonia CW circuit

SS 304 patch plate was welded on u/p & d/s line of NRV of CW supply header to ammonia CW circuit

Header size: 36" NB Sch. STD, MOC: CS

Patch Plate: SS 304, 3 mm Thick X 1500 MM Aprrox.

This job involves:

- Excavation work in u/s and d/s of NRV was done by civil section
- Removing the wrapping coating with gas burning upto approx 1 mtr depth.
- Cutting of SS-304 patch plate in required quantity and sizes to suit the profile of the pipe.
- Welding of patch plate upto 1 mtr depth on CW headers.
- Inspection including final weld DP.
- Wrapping coating of exposed CS pipe surface of CW header.
- Spark testing of wrapping coating.

SS 304 Patch plate

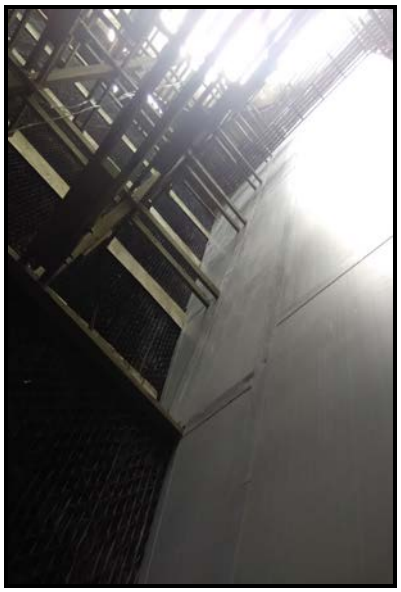
INSTALLATION OF SINTEX MAKE PARTITION PANEL IN AMMONIA COOLING TOWER

During previous shutdown-2014, old wooden damaged partition panels of old ammonia cooling tower cells A1-A2, A2-A3 and A3-A4 were replaced by new sintex make PVC section partition panels. After finding satisfactory performance of new PVC partition panel, during shutdown 2015, existing wooden partition panels of remaining cooling tower cells A4-A5 & A5-A6 were also replaced with the same.

In addition of above job, all wooden doors of old ammonia cooling tower, urea cooling tower and new cooling tower were replaced with PVC panels.

Job was awarded to M/s Abhay Fabricators, Kalol against the WO 6535/ 201004150939 & dated 02-DEC-14.

New PVC partition panel installation-1



New PVC partition panel installation-2

New PVC partition panel installation-3

Old wooden door

New PVC door

REPAIRING OF COOLING TOWER

- Committee comprising members from Mech Maint, Inspection, Civil and Utility Production inspected all the cooling towers and recommended the necessary repairs.
- Based on the committee recommendations, 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, however some PVC V-bars are found dislocated and the same was rectified

Timber block missing

Repairing of water distribution of box-1

Leakage from end wall

Damaged deck ply

Repairing of water distribution of box-2

Repairing of water distribution of box-3

- Above Job was carried out through M/s Paharpur cooling tower against the WO no. 201004151204 dated 09/01/2015 for the repairing of cooling towers

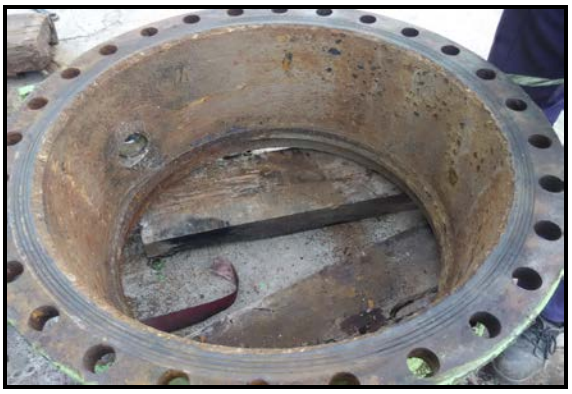
During preventive maintenance of CT fan K-4401-7, both side drift eliminator of CT was found damaged in condition. The same was repaired by M/s Paharpur cooling tower, Vadodara.

Damaged drift Eliniminator

OVERHAULING OF CHECK VALVE FOR COOLING WATER PUMP, P-4411 E

During running condition, check valve (Size: 28" x 150#) of cooling water pump, P-4411E was found passing. Job was awarded to M/s Flotec Technosmart (India) Private Limited, Surat against the contract no. 6535 /201004151202, dated 28/01/2015.

Check valve was dismantled. Corrosion & pitting observed along the disc seat portion, which seems unable to refurbishing. Body seat of valve is having heavy corrosion & pitting. Finally check valve was boxed up after using new gland packing and it is decided to procure new valve to replace existing one during next shutdown-2016.



Check valve parts after dismantling

REPLACEMENT OF CS COVER OF COOLING WATER SUMP INTO SS 304

CS covers (6 nos.) of cooling water sump basin were found corroded condition. All new SS304 covers were fabricated and provided on its position.

SS304 Cover

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
- Gate no.1: Gear box was opened. Bearing was found in satisfactory condition. Small wear marks observed in gear teeth. Gear box operation was satisfactory.
- Gate no.3: Bottom wedge block was not found.
- Gate no. 4: Bottom wedge block was found in damaged condition.
- Full operation (open / close) of all gate was checked & found satisfactory.

Jash make Sluice Gate

The above job was carried out under the supervision of OEM's Engineer (M/s Jash Engg Ltd., Indore) against the WO no. 6535/ 201004151080 dated 26/12/2014.

OTHER COOLING TOWER JOBS:

- Raw water to cooling tower line (8" x 20 sch, CS) was punctured at two points. Clamp with gland packing was provided on the same to reduce leakage during operating condition. Total 80 meter long pipe covering both punctured points, was removed from its position by gas cutting. Prefabrication was done for replacement of existing pipe before shutdown. Only three field weld joints were done after installation of new pipe with the help of Kobelco crane (100 ton).
- Drain valve (Gate valve, 12" x 150#) of ammonia cooing tower sump basin was passing. The same was replaced with one.
- Narmada header to new IG header , a new interconnection line with valve (gate valve, 4" x 150#) was provided
- I/V (Gate valve, 4" x 150#) of interconnection line from raw water header to cooling tower, was passing. The same was replaced with new one.
- Seal ejector line of Q-4411 (Elliot turbine) was creating hurdle near platform. As the safety of personnel, the same was rerouted.
- 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".
- Insitu refurbishment of following gate valve was carried out due to passing
  - Gate valve, 900mm NB x 150#, at Pump P-4403 common discharge line (towards Urea plant)
  - Gate valve, 700mm NB x 150#, at Pump P-4403 common discharge line (towards ammonia plant)

The above job was awarded to M/s Flotec Technosmart (India) Private Limited, Surat against the contract no. 6535 /201004151202, dated 28/01/2015.

- Cooling tower to distribution valve overhauling job.

DM PLANT

RERUBBER LINING OF STRIPPED PROCESS CONDENSATE (SPC) UNIT

Rerubber lining of SPC unit was done based on the inspection report. Job was awarded to M/s Conveyor Rubber Industries, Ahmedabad against the rate contract 6535/ 201004150938 dated 24/11/2014.

Following activities were carried out to execute the job

- Manhole cover opening / connected flange loosened / Resin unloading
- Lifting of vessel from its position and placing at rollers
- Removal of old rubber lining / scrapping
- Cleaning by shot blasting
- Visual inspection of bare surface & repair , if any
- Primer application
- New rubber lining
- Steaming for curing
- Inspection (Visual / Spark test / Hardness test) & repair , if any
- Re-installation of vessel on its position.
- box - up / Resin loading

To check the leakage, resin was filled up to bottom manhole and the water was filled from the top manhole. Resin was found on drain due to leakage between slit nozzle and perforated hole. Again resin was removed, All slit nozzle was removed from the its position. New Teflon threaded bushes were provided in the place of loosed PVC threaded bush. Araldite compound was applied in gap between all loosed threaded bushes and respected perforated holes. Again leakage was tested similar way. No resin was found in drain

Finally job handed over to production department.

Before rerubber lining

New rubber lining on perforated plate

Steam curing after new rubber lining

Other DM Plant Jobs:

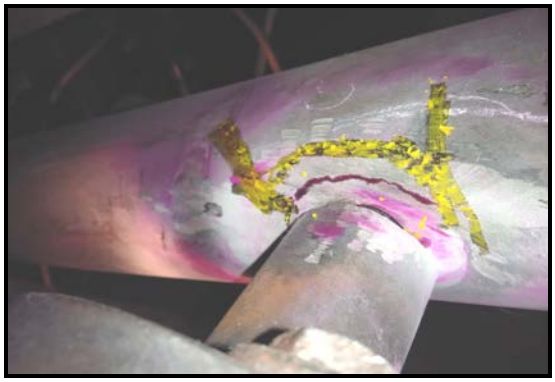
- All existing FRP open channel with drain pit were replaced by fabricated SS304 open channel and drain pit. Job was executed by workshop department. To prevent the chloride corrosion, in three nos. of drain pit a special corrosion resistance coating (Valancy 314) were applied on trial basis.

Corrosion Resistance Coating (Valancy 314)

- I/V (Gate valve, 1-1/2" x 800#) was provided on main instrument header to DM control room.

I G Plant

- In new IG cracker, fire observed under the retort no.1 flange joint (from K-5301 towards offsite maint office side). The same was attended by replacing gasket with new one after IG purging. Again fire observed on same joint & DP test was carried out. A crack was observed in weld joint of crack gas inlet line to header (to combustion chamber). The same was repaired after grinding and welding.



Cracked area

- DM water to polisher unit (Ammonia plant) lifted by 6" to facilitate the flooring work by civil section.

Narmada Plant

In Clariforculator sump, 8 nos. of bottom rubber scrapper were found in damaged condition. The same were replaced with one. Bottom bush of paddle-B was also found corroded condition. New bush was provided

Bottom rubber scrapper

Bottom bush

B & MH PLANT
(MECHANICAL)

PLANT TRANSFER CONVEYOR - M-2110

Following jobs were carried out.

- Repairing of damaged vulcanized joint of conveyor belt.
- Head pulley, Tail Pulley, Bend pulley, Gravity pulley and Snub pulley were inspected and greasing done.
- Provided new rubber lagging on Gravity pulley, Tail pulley and Snub pulley.
- Two Nos of new Tega make Tru- Trac- Trough rollers were installed 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 was serviced.
- All damaged and noisy carrying rollers, Return rollers, Self alignment carrying roller frames, Self alignment return roller frames and Tracking rollers were replaced.
- New Kaveri make skirt rubber were provided.

TWO WAY FEED HOPPER CHUTE - M 2111

- Servicing of two way discharge flap valve.
- Greasing of bearings

FRESH UREA SHUTTLE CONVEYOR - M-2112

Following jobs was carried out.

- Modified inlet chute of M-2112 conveyor and provided new kaveri make skirt rubbers.
- Rubber lagging done in both bend pulley and snub pulley.
- Preventive maintenance of Gear Box carried out & Coupling done after proper alignment with new rubber bushes.
- Gear box oil was replaced.(Servo system-460)
- All noisy and damaged carrier, guide and return rollers replaced with new rollers.
- Greasing done in all bearings of head pulley, tail pulley, snub pulley and gravity pulley.
- Tripper Gear box oil replaced.
- New Three Nos Tega make tru Track Trough rollers provided on carrying side for arresting sway of conveyor belt

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 was replaced.(Servo Mesh SP-320)
- All noisy and damaged carrying, guide and return rollers were replaced with new rollers.
- Greasing done in all bearings of head pulley, tail pulley, snub pulley and gravity pulley.
- Rubber lagging done in snub pulley & both bend pulley.

BAGGING BUILDING FEED CONVEYOR - M-2121

Following jobs were carried out

- Replaced the complete length of conveyor belt with new oil and Heat resistance conveyor belt NN630/800 mm width (M/s Sempertrans Nirlon make)
- Preventive maintenance of Gear Box carried out and Coupling done after proper alignment with new rubber bushes.
- Complete skirt board sealing system skirt blocks were replaced with new one.
- Replaced all damaged and noisy Carrying, Return, Impact and guide rollers with new rollers.
- Complete greasing of all pedestal bearings done.
- New rubber lagging provided on Bend pulley, Tail pulley, Snub pulley and Gravity pulley.
- Rubber lagging done in snub pulley pulley.
- New bend pulley (2 Nos) provided with new bearings.

BAGGING BUILDING HOPPER CONVEYOR - M-2122

Following jobs were carried out

- Replaced all damaged and noisy Carrying, return and guide rollers with new rollers.
- New Kaveri make skirt rubber were provided.
- Complete greasing in all pedestal bearings done.
- Take up studs were serviced.
- Replaced complete Gearbox with another overhauled Gearbox and Coupling done after proper alignment with new rubber bushes.
- Rubber lagging done in tail pulley.

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
- Rubber lagging done in Snub pulley.
- Take up studs were serviced.

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.

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.

DUST & UREA LUMPS BELT CONVEYOR - M-2137

Following jobs were carried out

- Reduce the length of conveyor as per requirement of Technical department for commissioning of new vibrating screens.
- Complete greasing of all bearings done.
- Replaced Tail end pedestal bearing 75 mm dia.
- Coupling done after proper alignment with new rubber bushes.

BAGGING MACHINE - M-2101/1, 2, 3, 4, 7, 8, 9A, 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, 9, 10A, 10B

- All gearbox oil was replaced.(Servo system-460)

STITCHING MACHINE - M-2102 /1, 2, 3, 4, 7, 8, 9, 10A, 10B

- All stitching machines and spare machines were overhauled with M/s gabber engg.

AIR BLOWER - K-2161

- All lines were removed, cleaned and boxed up.

AIR BLOWER - K-2704

- All lines were removed, cleaned and boxed up.

CYCLONE SEPARATOR - V-2704

- Separator was opened, cleaned and boxed up.

UREA SOLUTION TANK - T-2704

- Tank was opened, cleaned and boxed up.

VIBRATING SCREEN - M-2136/A, B, C, D

- All screens were removed, cleaned and boxed up.
- Replaced screen of M-2136 A , as it was found in damaged condition.

RECLAIM MACHINE - M-2116 A

Following jobs were done

- Preventive maintenance of Scrapper and Bucket elevator mechanism.
- Checking of complete slewing ring mechanism.
- Checking of upper and lower kingpost.
- Inspection of Tie Rod, Tie Rope and Pivot assembly.
- Checking of complete central Greasing mechanism.
- Complete Greasing of reclaim machine
- Replacement of lubricating oil of all Gearboxes (Servo mesh SP-320)
- Checking of Thruster and break shoes

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 including Automatic Reformer Tube Inspection System (**ARTIS**) by M/s TCR ADVANCED ENGINEERING LTD. 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 New Converter(S-50) loop and other critical pipelines was carried out .Details are given at **Annexure- 6.**
- Thickness measurement of various equipment and HT/LT Convection coils of primary reformer were carried out .Details are given at **Annexure-7.**
- Thickness measurement of various pipelines was carried out. Details are given at **Annexure-8.**
- Measurement of residual magnetism at various parts of rotating equipment and de - magnetization of the same wherever required. Details are given at **Annexure-9.**
- In-situ Metallography of selected equipment and pipelines were carried out. Detailed summary of observations and microstructure analysis is given at **Annexure-10.**
- Inspection of newly fabricated pipelines and fabrication jobs carried out departmentally by Maintenance and Technical department.
- 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-11.**
- Qualification tests of welders employed by contractors.
- The detailed observations and recommendations for corrective actions required on individual equipment are given below. All the observations were recorded during inspection and were handed over to concerned Maintenance and Operation group for necessary corrective action.

PRIMARY REFORMER 101-B

RADIANT ZONE

VISUAL INSPECTION

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

OTHER NDT ACTIVITIES

Automatic Ultrasonic Scanning of 194 Catalyst tubes out of 336 and 8 Riser tubes were carried out during ARTIS by TCR. All 194 tubes & All 8 Risers are placed in grade II. Details are attached at **Annexure-2.**

Following inspection activities includes in the ARTIS.

- Visual inspection of catalyst tubes for general assessment and bowing.

  In general all the tubes are found with grayish brown coloration with some of them showing reddish coloration. All the tubes appear straight and free from any significant abnormalities.

  Bowing:

  No apparent bowing is observed on any of tubes visually; the value as measured by ARTIS system was found less than 5mm for most of the tubes, however 03 tubes had recorded it as 7.6mm, 28.3 mm and 31.5 mm.

  Baldness:

  Surface of most of the tubes appear to be rough. However few tubes showing smoothening tendency (baldness) as listed as under:

  - Row-1 tube no. 19, 26, 28
  - Row-2 tube no. 12, 15, 18, 21, 22
  - Row-3 tube no. 15, 27, 42
  - Row-5 tube no. 1, 31
  - Row-6 tube no. 23
  - Row-7 tube no. 36
  - Row-8 tube no. 5, 6, 21, 36

- Dye penetration testing of bottom 1st weld joints of 04 catalyst tubes & 16 nos. weldolet to catalyst tube weld joints.

  Tube to weldolet joint:

  - Row-1 tube no. 15, 27
  - Row-2 tube no. 16, 28
  - Row-3 tube no. 15, 27
  - Row-4 tube no. 16, 28
  - Row-5 tube no. 15, 27
  - Row-6 tube no. 16, 28
  - Row-7 tube no. 15, 27
  - Row-8 tube no. 16, 28

  Tube to tube 1st weld joint from bottom:

  - Row-1 tube no. 21
  - Row-1 tube no. 22
  - Row-1 tube no. 22
  - Row-1 tube no. 21

  No significant discontinuity observed with respect to area tested in DPT.

- OD measurement by manual method at about 2 meter height from bottom.

  Manual diameter measurement was carried out on tubes at 2 meter height from bottom Minimum and maximum diameter observed in 114 mm and 116 mm, respectively against the design value of 113.6-115.2 mm. Maximum creep was found to be 1.39% considering average diameter of 114.4 mm.

- Magnetic permeability measurements at about 2 meter height from bottom.

  Permeability measurement has been carried out on catalyst tubes and riser tubes at 2 meter height from bottom. Minimum and maximum values observed are 1.18 – 1.57 u for catalyst tubes and 1.05 – 1.49 u for riser tubes respectively.

- Microstructural examination by replication Metallography on 16 nos. catalyst tubes and 4 nos. of riser tubes was carried out along with hardness measurements on all Metallography spots.

  Observations:

  No indication of micro cracks and creep fissures is observed anywhere. Microstructural condition was found satisfactory.

  Hardness was found in the range of 151-181 BHN and 159-175 BHN for catalyst tube and riser tube respectively.

- Ultrasonic attenuation and OD measurement carried out by ARTIS and detailed report is attached in annexure 2 and grades marked as per following guidelines:

Grade class: Attenuation (dB)	**Condition of tube**
New Material Grade I : 30 – 55	New tubes (Variation depends on chemical composition, casting process leading to difference in ration of equiaxed to dendritic structures)
Grade II : 45 – 62	Tubes put in operation, without any significant creep voids, but likely carbide coarsening.
Grade III : 62 – 70	Probability of tube affected with creep void and requires to be correlated with microstructural examination and OD measurements. Tube may be subjected to radiographic examination for evaluation on creep.
Grade IV : >70	Indication of aligned creep cavities. To be correlated with microstructural examination and increase in OD. Tube may be removed for further destructive tests for remnant life assessment (RLA) study.

- Ultrasonic thickness measurements at one location on tubes at about 2 meter height from bottom.

  Thickness of the catalyst tubes and risers tubes was measured by ultrasonic A-scans technique by specially fabricated shoe. Minimum and maximum thickness observed was 12.2 mm and 13.6 mm respectively for catalyst tubes against minimum required thickness of 11.0 mm.

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. of tubes and between 0.17 to 0.70 % in 01 nos. of tubes. Creep measurement of the riser tubes at tunnel slab level was also carried out using digital micrometer. Creep was found of Riser tube in the range 0.33 – 1.10 % in 06 nos. tubes & 1.10 – 1.44 %. In 02 nos. of Riser tube. The report is attached at **Annexure 3.**

In-situ Metallography on Catalyst tube parent metal, Riser tube parent metal, Catalyst tube to weldolet weld & Riser tube to weldolet weld joint. The detailed report is attached in **Annexure-10.**

Radiography of all 08 nos. weldolet to riser weld joints was carried out. No significant defect was observed.

CONVECTION ZONE

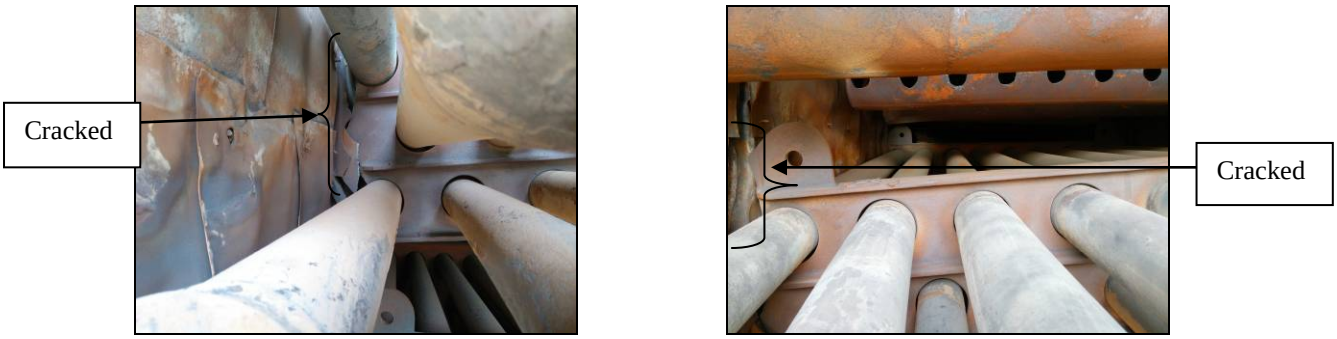
Visual inspection of HT convection zone from top and bottom manhole and Auxiliary boiler furnace was carried out. The observations made are as under:

H.T. CONVECTION SECTION

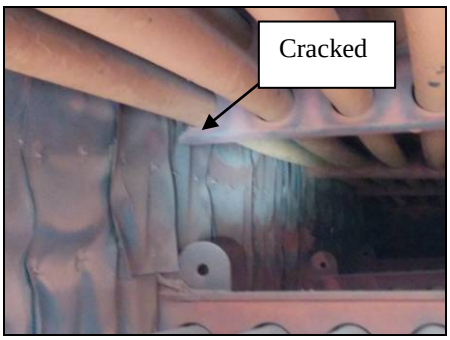
From Top Manhole:

- Air pre heater coil was found sagged up to 300 mm downward direction at south side.

- South side all support found cracked/damaged. (1st support from of East side)



- South side 01no. Support found cracked/damaged. (2nd support from of East side)



- HT and LT super heater coils were found in satisfactory condition.
- Supports of LT/HT steam super heater coils were found in satisfactory Condition.
- 6" to 8" gap found between insulation protection sheets at East side just above partition wall.
- HT steam super heater top coil tube fins found damaged in approx. 100 mm length for 02 nos. of tube at East end.
- 02 nos. of thermo well near damper of PRC-23 found bent downward.
- Insulation covering sheet found distorted and bounding with wire.

From Bottom Manhole

- Hard 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.
- Refractory at the ceiling found superficially cracked at few locations.
- Peeling off of top layer of casting was observed on first two rows of east side anchor supports of mixed feed coils. Refer attached photographs.

- Tunnel thermo well pipes were found slightly bent, scaled and eroded. Same was observed during previous inspection.
- Bottom floor refractory found loosens at some places and flooring found sagged at some location. Same was observed during previous inspection.
- Insulation of East, West and South wall was found satisfactory.
- Mixed Feed coil found sagged in South-West segment compared to North-East Segment.
- Some Brick walls were found bent and some of the top layer of bricks of brick walls were found loose.

VESSELS & OTHER EQUIPMENT

PRIMARY WASTE HEAT BOILER (101-CA) SHELL

Visual inspection of Primary Waste Heat Boiler shell liner was carried out after removal of its tube bundle. Following observations were made:

1st Liner Piece from top

- 1st course was found satisfactory except metal dusting was observed at scattered locations which have resulted in pitting of 1-1.5 mm depth at few locations. This was also observed during previous inspection.
- Superficial abrasion marks were observed on liner segments.
- Gas outlet nozzle liner was found in satisfactory condition, however a fine crack of approx. 400 mm was observed at its weld junction with shell liner. Same was observed during previous inspection also. Refractory behind it was found intact as seen through gap.
- 2nd course was found to have metal dusting attack resulted in approx. 1-3 mm deep pitting in approx. 40 % surface area of liner segment and erosion of its longitudinal weld seam by approx. 2-3 mm in its complete length below the liner surface. Its circumferential weld was found slightly eroded in approx. 80% of its length. This was also observed during previous inspection also.
- Uniform gap was observed between the 1st & 2nd pieces of the liners.

2nd Liner Piece from top

- Surface Abrasion marks were observed approx in 150mm circumferential length in South-East side due to rubbing of the tube bundle.

- Minor metal dusting attack observed on shell liner resulted in pitting of approx.1.0 mm depth at few locations in approx. 5 % of the liner surface area. This was also observed during previous inspection.
- Inward bulging of approx. 300 mm was observed at South-West and South-East side.
- Long seam weld was found slightly eroded in approx. 250 mm length.
- A gap of approx. 10mm to 60mm observed east side between loose liner and 3rd shell liner piece in entire circumference, causing exposure of refractory. However, condition of the refractory exposed in between seems to-be intact and observed to same as during previous inspection.

3rd Liner Piece from top

- Uneven gap observed on expansion joint. East half has 2-4 mm gap between liner segments where as 15-20 mm gap was observed in remaining half. The same was also observed in previous inspection also.
- Inward bulging approx 3"X3" observed at West side of the shell.

4thLiner Piece from top

- Circumferential weld joint just at the level of the gas distributor bulged and cracked in approx. 60% of its length.

Gas Distributor

- Gas distributor was found deformed inwards from both the sides.
- Gas distributor header found chocked by alumina bolls at few perforated holes.

115-C, METHANATOR EFFLUENT COOLER

- Helium leak detection of tube sheet area was carried out by M/s. Gulachi Engg to find out the leak.
- Details of Helium Leak detector used by M/s Gulachi Engineers

  Make: Adixen ASM 310, Germany.

  Sr. No. HLD 1302640

- Complete tubesheet weld joints were masked by Aluminum Tape.

Tube sheet masking by Aluminum tape.

- Initially shell side was pressurized by air at 3.0 kg/cm2 and then helium was injected till the pressure reached at 5.0 kg/cm2.
- Leak detection was carried out by puncturing the Masking tape and checked by Sniffer to locate the point of leakage.

Leak detection in progress.

- Total 88 nos. tube sheet welding were found defective in helium leak testing. The same were repaired by grinding and welding.

103-D, SECONDARY REFORMER

TOP AIR AND GAS ENTRY:

Visual inspection was carried out from outside and observations are as under:

- Appx 1” Gap was observed between shift liners of top shell to transfer line in complete circumference.
- Crack observed on the weld joint of patch liner to transfer line liner in approx. 4” length.

- Bulging of shift liner of top shell in appx 1 ‘ height was observed at appx 1 mt from bottom .

BOTTOM DOME :

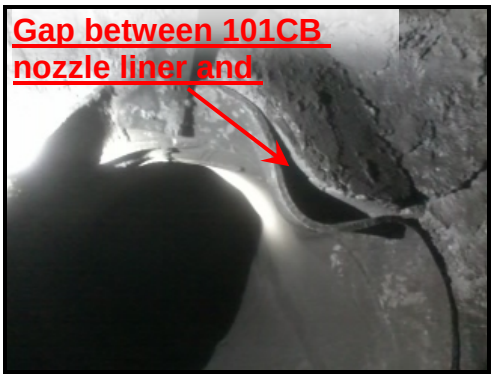
- The refractory around the 101-CA/CB gas inlet nozzles (approx half of the top circumference) was found eroded and loosened.

101 CA Nozzle View

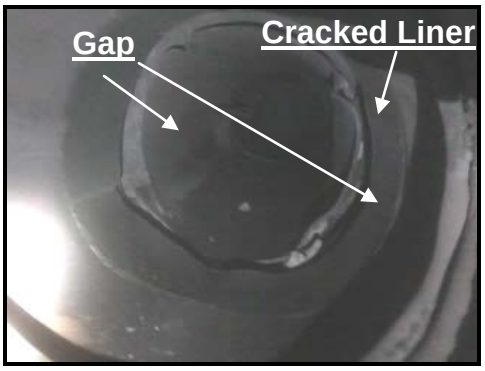
101 CB Nozzle View

- Gap was observed between the 101-CA/CB gas inlet nozzle liner and the shell refractory joint. Gap of approx 2” was observed towards the 101-CB nozzle.

  The same was observed in previous inspection also.



- The liners inside the 101-CB gas inlet nozzle were slightly buckled /distorted. Condition of the thermo-wells was satisfactory. The same was observed in previous inspection also.
- Longitudinal weld of one of the liner pieces of 101 CA gas inlet nozzle was found opened hence exposing the refractory as shown in the attached fig.



AIR MIXTRURE of 103-D

- Scattered cracks were observed at refractory around nozzle holes.
- Straightening vanes and its support ring found slightly distorted.
- Refractory found fallen around the nozzle.

- Some Partition plate of nozzle holes found partially burnt and some found with crack at its centre & end welds.

- Insulation cover weld with top cover liner found eroded.

- Circumferential crack was observed at the top cover liner welding.

- 02 nos. cracks of approx 15mm length were observed on conical surface as shown below.

101- EA ,CO_2 Absorber
(Manhole no. counting from top of the vessel)

From Manhole- 1

- Demister pad was found intact in its position.
- Bubble caps as well as all the fittings were found satisfactory.
- Brownish black coloration was observed in shell where as dish end was found grey in colour with yellow patches over it.
- Black deposits were found in dished end area.
- Weld joints were found satisfactory.
- aMDEA liquid was lying on the bubble cap tray.

From Manhole- 3

- 01 no. Rasching ring holding clamp was found loose at south side

- 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.

From Manhole- 4

- Excessive gap as compared to others was observed in several rasching ring holder.(between two half of holder)
- 01 no. rasching ring holding clamp was found loose at west side.
- 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)

- Gas riser holding plate was found eroded/damaged from top edge at west side.

- Sample collector was found twisted.

- Debris was found lying on the gas riser holding plate.

From Manhole- 5

- Excessive gap as compared to others was observed in several rasching ring holder. (Between two half of holder).
- Grey coloration was observed on the shell.
- Sample collectors were found intact in its position.

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 pads were found slightly shifted in middle portion.
- Demister pad supporting strips and rods were found satisfactory.
- All the bolts of liquid inlet nozzle flange were found in position & intact.
- 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.
- U-Clamps of East-North and West-South side distribution header were found loose.
- West-North side distributor header support found cracked.
- West-South side distributor header found rubbing with U-clamp support causing dent in cap of header.
- East-South side distributor header support plate found cracked/detached from shell in approx length of 8".
- East-North side distributor header found rubbing with U-clamp support plate causing dent/slot of 100 mmX20 mm area in cap of header. At same location U-clamp support & header support plate found cracked.

PRIMARY WASTE HEAT BOILER (101-CA) SHELL

Visual inspection of Primary Waste Heat Boiler shell liner was carried out after removal of its tube bundle. Following observations were made:

1st Liner Piece from top

- 1st course was found satisfactory except metal dusting was observed at scattered locations which have resulted in pitting of 1-1.5 mm depth at few locations. This was also observed during previous inspection.
- Superficial abrasion marks were observed on liner segments.
- Gas outlet nozzle liner was found in satisfactory condition, however a fine crack of approx. 400 mm was observed at its weld junction with shell liner. Same was observed during previous inspection also. Refractory behind it was found intact as seen through gap.
- 2nd course was found to have metal dusting attack resulted in approx. 1-3 mm deep pitting in approx. 40 % surface area of liner segment and erosion of its longitudinal weld seam by approx. 2-3 mm in its complete length below the liner

surface. Its circumferential weld was found slightly eroded in approx. 80% of its length. This was also observed during previous inspection also.

- Uniform gap was observed between the 1st & 2nd pieces of the liners.

2nd Liner Piece from top

- Surface Abrasion marks were observed approx in 150mm circumferential length in South-East side due to rubbing of the tube bundle.
- Minor metal dusting attack observed on shell liner resulted in pitting of approx.1.0 mm depth at few locations in approx. 5 % of the liner surface area. This was also observed during previous inspection.
- Inward bulging of approx. 300 mm was observed at South-West and South-East side.
- Long seam weld was found slightly eroded in approx. 250 mm length.
- A gap of approx. 10mm to 60mm observed east side between loose liner and 3rd shell liner piece in entire circumference, causing exposure of refractory. However, condition of the refractory exposed in between seems to-be intact and observed to same as during previous inspection.

3rd Liner Piece from top

- Uneven gap observed on expansion joint. East half has 2-4 mm gap between liner segments where as 15-20 mm gap was observed in remaining half. The same was also observed in previous inspection also.
- Inward bulging approx 3"X3" observed at West side of the shell.

4thLiner Piece from top

- Circumferential weld joint just at the level of the gas distributor bulged and cracked in approx. 60% of its length.

Gas Distributor

- Gas distributor was found deformed inwards from both the sides.
- Gas distributor header found chocked by alumina bolls at few perforated holes.

103-E2 LP, LP FLASH VESSEL

SECOND MANHOLE COMPARTMENT (FROM TOP)

- Rectangular riser box and other fittings found intact in position.
- Holding bolts of bottom tray found loose and bent at many locations. 02 nos. bolts are missing from at north side.

- Silver coloration observed at scattered locations. Weld joints observed as if etching has occurred resulting in slightly differing color in comparison to adjacent shell surface.
- 01. no. 3” bubble cap tray drain line was found broken at North-West side and same was lying on the rectangular riser box. End plate of same 3” line was broken and found lying on the bottom tray.



- 01. no. 3” bubble cap tray drain line was found having crack in the 75% of the circumference weld.

BOTTOM MANHOLE COMPARTMENT (FROM OUTSIDE)

- Vortex plate of the header found intact in position.
- Silver coloration observed at scattered locations.

105-E,DEHYDRATOR (FROM OUTSIDE)

FROM BOTTOM DOME

- Bubble cap holding plate found satisfactory.
- Bubble cap surface found oily.
- Distribution header flange bolt found intact.

FROM TOP DOME

- Bubble cap holding plate found satisfactory.
- Demister pads found intact in position.
- 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.
- 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/missing.
- Grill covering the Down Comers were found bent at few locations.
- 6" BFW header found bent from centre and nut-bolts found missing at the same location.
- 02 nos. bolts found loose at flange joint of 6" BFW header.
- 01 no. cap nut chocked in 1" blow off line at bottom of the shell.

102-F , RAW GAS SEPARATOR

- Epoxy paint found peeled off/cracked on few locations at north side of shell.
- Epoxy paint found peeled off on vertex plate of condensate outlet.
- Demister pads were found intact in position.
- Putty applied on the circumferential weld joint of manhole nozzle with shell from inside was found detached at one location in East side.
- Condition of Gas inlet nozzle located at East side was found satisfactory.

103-F, REFLUX DRUM

- Demister pads were found intact in its position.
- Epoxy paint/primer was found peeled off from the few small scattered locations at the dish end and bottom half of the vessel.
- Scales of epoxy paint were found sticking with Mesh of Demister pads.

104-F, SYNTHESIS GAS COMPRESSOR SUCTION DRUM

- Grayish black coloration was observed on bottom area, whereas brownish Coloration was observed on remaining surface.
- Condition of weld joints was found satisfactory.
- Thin scales were observed at bottom dish end.
- Condition of demister pad was found satisfactory.
- Blackish coloration was observed inside the inlet hood baffle.
- Condition of the inlet hood baffle was found satisfactory.
- Condition of the nozzle weld joints was satisfactory.
- Bottom vortex breaker was clear and its welds were found intact.

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

- The coloration of vessel was brownish black from inside.
- Demister pads were found intact in position.

- Scattered minor pitting were observed throughout the shell surface, the same was observed in past also.
- The 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.
- Overall condition of the vessel was found to be satisfactory.
- Thermowell condition found intact.
- Liquid outlet line weld and vertex plate condition found satisfactory.
- White and yellow colored liquid was found sticky behind liquid inlet line.

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, where as one bolt was found missing from middle support of the demister pad (observed in past also).
- Dish ends were found covered with scattered scales.
- Condition of all shell weld joints was 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.
- 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.

MISCELLANEOUS JOBS

WELDER QUALIFICATION TESTS

- Performance qualification test of 22 Nos. welders offered by M/s General Engineering, Bharuch (W.O.No- 201004151497) was carried out. 12 nos. of welders were qualified during the test. These welders were allowed to perform various miscellaneous non-critical & Technical Departments' welding jobs.
- Performance qualification test of 04 Nos. welders offered by M/s J&J Engineering (W.O. No.201004151471) was carried out. 02 nos. of welders were qualified

during the test. These welders were allowed to perform welding for replacement of common minimum flow line of semi lean solution pumps, 115-J & 115-JA and split stream solution pumps, 116-J & 116-JA.

- Performance qualification test of 04 Nos. welders offered by M/s Shiv Engineering was carried out. 04 nos. of welders were qualified during the test. These welders were allowed to perform Vibrating Screen Jobs, Misc CS/SS Jobs, and valve replacement Jobs & Technical Departments' welding jobs.

D.P. TEST

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

RADIOGRAPHY

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

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**

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-7** (For equipment) and **Annexure- 8** (For 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-9.** 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-10.**

INSTALLATION OF NEW PIPELINES

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

OVER SPEED TRIP TEST

- OST of following Machines was carried out/witnessed:

  115-JT : 5840 RPM

  107- JT : 4315 RPM

ANNEXURE-1

VISUAL INSPECTION REPORT:

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 is as under:

BURNER BLOCKS: Following burner blocks were found damaged:

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

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. 1,3,4,9,10,11,15,18 to 21,23 to 27,28 to 42
2	Near tube no. 5 to 20, 24 to 42
3	Near tube no. 7 to 14, 16 to 21,23,24, 30 to 36,38,39
4	Near tube no. 7,8,16,17,20,21,22,26,27,30 to 40
5	Near tube no. 1 to 16, 26 to 42
6	Near tube no. 3 to 15,25,26, 29 to 40
7	Near tube no. 1 to 16, 29 to 42
8	Near tube no. 14,18,19,20,25,26, 30 to 42

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 2,8,9
Tube Row No 1	16,18,19, 23,24,33,34
Burner Row No 2	Near Burner No.13,14
Tube Row No 2	Near Tube No.12,13,24
Burner Row No 3	Near Burner No. 2,3,4
Tube Row No 3	Near Tube No.16,28,29,30,31,32
Burner Row No 4	Near Burner No 4,8
Tube Row No 4	Near tube no. 12,17,19,20,33,34
Burner Row No 5	Around Burner No. 1,4,6,11,14
Tube Row No 5	Near tube no. 7,8,16,19,31,32,37,38
Burner Row No 6	Around Burner No. 2,3,4,5,13
Tube Row No 6	Near tube no. 19,30
Burner Row No 7	Around Burner No. 2,3,4,6
Tube Row No 7	Near tube no. 6,15,16-20,,23,32,33
Burner Row No 8	Near burner 3,4,6,8,11,12,13,14
Tube Row No 8	Near tube no. 1,6,7,13,15,31,32,38
Burner Row No 9	Near burner 10,13,14

REFRACTORY / INSULATION OF WALLS:

- **East wall** : Found Satisfactory.
- **West wall** : Found satisfactory.
- **North wall** :

  Z-MODULES : Between West wall and Tube Row No.1: Gap below Peep Hole.

REFRACTORY WALLS UPTO TUNNEL SLAB LEVEL

Loose refractory found up to 1 ft above tunnel slab.

- **South Wall** :

  Z-MODULES : Found satisfactory.

Annexure - 2 (1/3)

GRADATION OF TUBES BY ARTIS CARRIED OUT BY M/s TCR

ROW NO.1			ROW NO.2		
Tube No.	**AUS Grade**	**OD Range**	**Tube No.**	**AUS Grade**	**OD Range**
3	II	114.92 - 115.02	1	II	115.01 - 115.25
5	II	114.65 - 114.98	2	II	114.77 - 115.08
6	II	115.07 - 115.80	9	II	116.01 - 116.44
9	II	114.81 - 115.02	16	II	114.80 - 114.98
10	II	114.51 - 114.90	18	II	114.50 - 114.60
15	II	115.88 - 116.12	19	II	114.71 - 114.91
27	II	115.75 - 115.91	21	II	114.90 - 114.98
28	II	114.98 - 115.12	23	II	115.34 - 115.64
30	II	114.87 - 115-14	25	II	114.85 - 115.07
31	II	114.85 - 115.05	26	II	114.37 - 115.00
32	II	115.84 - 115.97	28	II	114.78 - 115.00
34	II	114.78 - 115.01	29	II	114.12 - 114.35
35	II	115.64 - 115.85	32	II	114.91 - 115.94
38	II	114.51 - 114.80	33	II	114.80 - 115.00
40	II	114.81 - 115.11	35	II	115.60 - 115.80
42	II	113.50 - 114.61	37	II	115.78 - 115.97
-	-	-	38	II	114.71 - 114.87
-	-	-	39	II	115.50 - 115.91
-	-	-	42	II	114.82 - 115.10

Annexure - 2 (1/3)

GRADATION OF TUBES BY ARTIS CARRIED OUT BY M/s TCR

ROW NO.3			ROW NO.4		
Tube No.	**AUS Grade**	**OD Range**	**Tube No.**	**AUS Grade**	**OD Range**
1	II	114.65 – 115.02	1	II	114.91 – 115.20
2	II	114.87 – 115-23	3	II	114.61 – 114.84
3	II	114.74 – 115.12	4	II	114.90 – 115.34
4	II	114.47 – 114.87	5	II	115.57 – 115.70
5	II	114.07 – 114.58	6	II	114.84 – 115.34
6	II	114.70 – 115.03	8	II	115.98 – 116.35
10	II	114.54 – 114.96	9	II	114.84 – 115.08
14	II	115.74 – 116.12	10	II	114.75 – 114.95
15	II	115.40 – 115.85	12	II	114.91 – 115.28
16	II	113.58 – 113.98	14	II	114.94 – 115.25
17	II	114.68 – 115.05	15	II	114.87 – 115.10
18	II	115.60 – 116.02	17	II	114.77 – 115.02
20	II	113.20 – 114.41	18	II	114.81 – 115.12
21	II	113.62 – 114.74	20	II	115.70 – 116.01
22	II	112.94 – 113.97	26	II	115.28 – 115.80
24	II	112.41 – 114.57	28	II	114.60 – 114.91
25	II	114.24 – 114.97	30	II	115.65 – 116.08
27	II	113.04 – 113.87	31	II	114.86 – 115.14
28	II	114.90 – 115.85	32	II	114.57 – 114.97
29	II	114.04 – 114.62	33	II	114.44 – 114.92
30	II	112.70 – 114.77	34	II	114.81 – 115.15
31	II	112.62 – 114.27	35	II	114.80 – 115.05
32	II	113.40 – 114.24	38	II	115.11 – 115.21
33	II	113.34 – 114.24	40	II	114.85 – 115.07
40	II	112.12 – 114.37	41	II	114.68 – 115.38
41	II	112.51 – 114.87	42	II	115.60 – 115.90
42	II	113.74 – 114.85	-	-	-

Annexure - 2 (1/3)

GRADATION OF TUBES BY ARTIS CARRIED OUT BY M/s TCR

ROW NO.5			ROW NO.6		
Tube No.	**AUS Grade**	**OD Range**	**Tube No.**	**AUS Grade**	**OD Range**
3	II	115.18 - 115.47	1	II	114.88 – 115.40
4	II	114.87 – 115.30	5	II	114.70 – 115.22
6	II	114.80 – 115.08	6	II	114.91 – 115.28
8	II	114.90 – 115.00	7	II	115.00 – 115.18
9	II	114.70 – 114.72	8	II	114.84 – 115.15
11	II	115-61 – 115.75	9	II	114.84 – 115.15
12	II	114.88 – 115.00	10	II	115.28 – 115.57
13	II	114.14 – 114.71	14	II	115.71 – 116.07
14	II	113.58 – 114.88	15	II	114.77 – 115.14
15	II	114.02 – 114.68	17	II	114.81 – 115.00
16	II	114.60 – 115.10	18	II	114.80 – 114.97
17	II	115.07 – 115.57	20	II	114.60 – 114.92
20	II	114.62 – 114.88	21	II	112.42 – 113.55
21	II	114.72 – 114.88	22	II	112.86 – 114.34
24	II	114.02 – 114.85	24	II	112.50 – 113.67
25	II	114.34 – 114.89	27	II	114.10 – 115.17
27	II	115.27 – 115.50	28	II	113.94 – 114.84
28	II	114.78 – 114.96	30	II	112.30 – 113.54
29	II	113.94 – 114.71	31	II	113.94 – 114.97
30	II	114.91 – 115.51	32	II	113.10 – 114.22
31	II	113.81 – 114.53	34	II	115.11 – 115.87
33	II	113.05 – 114.14	35	II	113.88 – 115.00
34	II	114.77 – 114.90	36	II	114.42 – 115.02
36	II	113.88 – 114.57	38	II	114.00 – 114.91
37	II	114.54 – 115.51	41	II	114.60 – 116.04
38	II	113.80 – 114.37	-	II	-
39	II	113.22 – 114.14	-	-	-
40	II	114.65 – 115.31	-	-	-
42	II	114.58 – 114.93	-	-	-

Annexure - 2 (1/3)

GRADATION OF TUBES BY ARTIS CARRIED OUT BY M/s TCR

ROW NO.7			ROW NO.8		
Tube No.	**AUS Grade**	**OD Range**	**Tube No.**	**AUS Grade**	**OD Range**
1	II	114.70 – 115.01	2	II	114.51 – 115.87
2	II	114.51 – 114.65	3	II	112.60 – 114.20
4	II	115.17 – 115.24	4	II	111.58 – 114.20
5	II	114.94 – 115.02	7	II	112.68 – 114.38
8	II	114.67 – 115.00	11	II	112.82 – 114.72
11	II	114.67 – 115.01	12	II	111.97 – 113.87
12	II	114.85 – 115.02	13	II	112.27 – 114.76
13	II	114.85 – 115.04	15	II	112.27 – 114.27
14	II	115.62 – 115.71	16	II	113.08 – 114.95
15	II	115.54 – 115.78	18	II	114.14 – 115.32
16	II	114.94 – 115.44	21	II	112.92 – 113.98
17	II	114.84 – 115.04	23	II	114.15 – 114.85
18	II	114.98 – 115.07	24	II	113.70 – 114.46
20	II	114.61 – 114.81	25	II	114.94 – 115.82
21	II	114.85 – 115.40	26	II	113.82 – 115.28
22	II	114.93 – 115.34	27	II	112.14 – 114.41
23	II	114.85 – 115.00	31	II	113.22 – 114.18
24	II	115.55 – 115.80	32	II	112.02 – 113.45
28	II	114.92 – 115.00	34	II	114.42 – 115.67
30	II	115.65 – 116.01	36	II	113.77 – 114.30
31	II	114.91 – 115.12	38	II	112.38 – 114.27
33	II	114.97 – 115.02	40	II	113.64 – 115.42
34	II	114.54 – 114.81	-	II	-
36	II	114.91 – 115.04	-	-	-
37	II	114.81 – 114.94	-	-	-
38	II	115.00 – 115.18	-	-	-
39	II	114.91 – 115.14	-	-	-
40	II	114.81 – 115.07	-	-	-
42	II	115.07 – 115.30	-	-	-

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	00	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	125.64	125.80			X
2	125.41	125.09		X	
3	125.48	125.45		X	
4	125.57	125.48		X	
5	125.76	125.69			X
6	125.57	125.50		X	
7	125.41	125.38		X	
8	125.28	125.31		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	0	-4	-9	-13	-20	-20	-27	-20	-13	-13	-2	-1	-12	-10	-11	-13	-11	-13	-16	-2	0	14
2	-6	0	-7	-10	-13	-14	-20	-20	-13	-9	-2	-26	0	0	-7	5	-14	5	-6	-3	0	0
3	4	0	-7	-14	-15	-14	-19	-16	-12	-3	1	4	6	0	-2	-6	-7	-6	-5	-2	0	2
4	0	0	-2	-8	-10	-11	-10	-8	0	-2	9	0	0	-1	-3	-2	-1	-2	-3	0	6	7
5	-8	3	-3	-4	-6	-9	-10	-7	-7	2	0	0	0	-1	-5	1	0	1	0	5	8	10
6	4	2	0	-5	-8	-10	-8	-6	-8	-12	-4	-17	0	-2	-9	-11	-10	-11	-7	2	0	8
7	4	6	0	-5	-9	-9	-6	-8	-8	-6	-2	-4	-7	-11	-6	-7	-8	-7	-3	0	1	11
8	7	-4	-2	-5	-13	-6	-12	-10	-11	-5	-3	-4	-6	0	-13	-5	-5	-5	-4	-17	7	12

TRANSFER LINE SPRING HANGER LOAD READINGS

ROW	1	2	3	4	5	6	7
READINGS	**-37**	**-28**	**-23**	**-34**	**-40**	**-18**	**-17**

BOTTOM DRAIN READINGS

ROW	1	2	3	4	5	6	7	8
READINGS	**95**	**95**	**100**	**90**	**90**	**97**	**96**	**96**

AUXILIARY BOILER SPRING READINGS

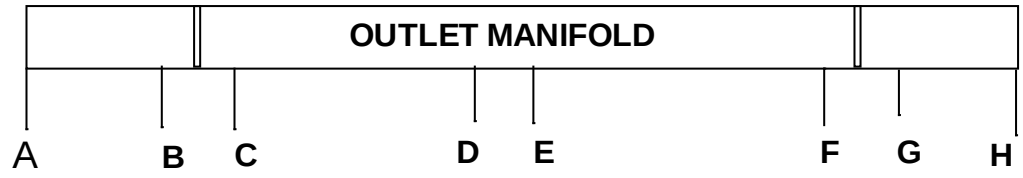
SPRING	S-E	N-E	S-W	N-W
READINGS	**56**	**59**	**58**	**56**

Annexure – 5

CLEARANCE OF OUTLET MANIFOLD FROM GROUND FLOOR IN COLD CONDITION

Header No.	Location of Measurement					
	B	C	D	E	F	G
1			*210	*200		
2			290	280		
3			*180	280		
4			*140	*210		
5			*170	260		
6			*170	*150		
7			*200	*140		
8			270	270		

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-1303-08-14”	14”	120	105-D, SG-33-14	108-D Inlet (Bottom)	12	05	06	No significant defect was observed.
2	SG-1303-09-10”	10”	120	105-D, SG-1303.08-14	108-D Inlet (Bottom)	11	04	-	
3	SG-1303-08-10”	10”	120	SG-1303.08-14” (105-D)	108-D Inlet (Top North)	06	03	-	
4	SG-1303-12-10”	10”	120	SG-1303.08-14” (105-D)	108-D Inlet (Top South)	06	03	-	
5	SG-1303-10-14”	14”	120	108-D	107-C	12	05	-	
6	SG-1303-11-14”	14”	140	107-C	123-C	12	06	-	
7	PG-12A	14”	30	105-CA	PG-26	01	-	-	
8	PG-12B	14”	30	105-CB	PG-26	01	-	-	
9	NG-11-A TO H	6”	120	NG-9	101-B	16	08	-	
10	NG-09-12”	12”	100	101-B	103-D	03	01	-	
11	SG-1303-02-14”	14”	100	121-C	SG-12-14”	16	08	03	
12	SG-1303-03-08”	8”	100	SG-12-14”	137-C	07	02	-	
13	SG-1303-04-8”	8”	100	137-C	SG-51-8”	10	04	-	
14	SG.1303.06-14”	14	100	121-C	124-C	19	07	-	

Annexure – 7

THICKNESS MEASUREMENT SUMMARY OF EQUIPMENT

Sr. No.	Equip. No.	Equipment Description	Shell			Dish End			Channel		
			Nom./ Design	Min. Measured	% Red.	Nom./ Design	Min. Measured	% Red	Nom./ Design	Min. Measured	% Red.
1	104-C	Methanator Feed Heater	17.46	17.2	1.49	19.05	20.9	-			
2	105-CA	CO2 Stripper Gas Exchanger	28.58	28.5	0.28	26.99	32.0	-			
3	105-CB	CO2 Stripper Gas Exchanger	28.58	28.3	0.98	26.99	30.5	-			
4	106-C	Shift Effluent Feed Water Heater	6.35	6.6	-	15.08	15.9	-		19.8	
5	109-CA-1	aMDEA Solution Exchanger	12.70	11.5	9.45	12.70	13.5	-	25.00	24.4	2.40
6	109-CA-2	aMDEA Solution Exchanger	12.70	11.1	12.60	12.70	14.2	-	25.00	24.4	2.40
7	110-CA	CO2 Stripper Condenser	12.70	16.3	-					16.3	
8	110-CB	CO2 Stripper Condenser	12.70	16.3						16.3	
9	114-C	Methanator Effluent	58.00	58.5	-	18.00	17.0	5.56			
10	115-C	Methanator Effluent Cooler	12.50	10.4	16.80	12.50	13.5	-			
11	121-C	NH3 Converter Feed/Converter Effluent Exchanger	-	37.3	-						
12	127-CA	Refrigerant Condenser	18.00	18.0					16.00	14.7	8.13
13	127-CB	Refrigerant Condenser	18.00	17.9	0.56				16.00	14.5	9.38
14	129-JC	Air Compressor Interstage Cooler no.1	12.00	12.6	-	12.00	8.6	28.33			
15	130-JC	Air Compr. Interstage Cooler no.2	NA	12.6	-	NA	8.9	25.83			
16	131-JC	Air Compr. Interstage	15.80	15.0	5.06	NA	9.6				

Sr. No.	Equip. No.	Equipment Description	Shell			Dish End			Channel		
			Nom./ Design	Min. Measured	% Red.	Nom./ Design	Min. Measured	% Red	Nom./ Design	Min. Measured	% Red.
		Cooler no.3									
17	136-C	Synthesis Gas Methanator	15.80	15.8	-	NA	31.0	-			
18	170-CA	Condensate Stripper Feed Bottom Exchanger	9.50	8.9	6.32				14.8		
19	170-CB	Condensate Stripper Feed Bottom Exchanger	9.50	9.3	2.11				12.5		
20	101-EA	New CO2 Absorber	M1,2,3; 33mm thk M4;50thk M5,6; 46 thk	36.1		Top;32 thk Bottom ;46thk.					
21	103-E2LP	L.P. Flash Vessel		14.6							
22	101-F	Stream Drum	106.40	109.14	-	106.40	104.44	1.84			
23	104-F	Synthesis Gas Compressor Suction Drum	24.60		-	23.82	26.2	-			
24	157-F	Process Gas Separator	19.84	23.3		17.46	25.35	-			
25	158-FA	Natural Gas Separator	24.00	22.9	4.58	24.00	23.4	2.50			
26	158-FB	Natural Gas Separator	24.00	22.9	4.58	24.00	22.8	5.0			
27	172-F	Ammonia liquor Tank	12.00	11.4	5.0		12.1				
28	2002-F	Demineralised Water Storage Tank	4.8	4.1	14.58	4.8 (Roof)	4.7				
29	101-JCB	Surface Condenser	NA	12.2	-	NA				11.6	
30	101-JLT	Lube Oil Tank For Air/ Refrigeration Compressor	NA	5.2	-	NA					
31	2012-U	Resin Trap	NA	7.4	-	NA	8.4	-			
32	R-1	Drying Vessel	36.00	35.0	2.78	36.00	35.5	1.39			
33	R-2	Drying Vessel	36.00	35.2	2.22	36.00	35.3	1.94			

NOTE: (1) All readings are in MM

THICKNESS MEASUREMENT SUMMARY OF HT/LT COILS.

SR NO	DESCRIPTION	DESIGN THICKNESS	MEASURED THICKNESS	% REDUCTION
1	HT Convection Zone : HT Steam Super Heater Coil (3rd from bottom)	8.0	7.0	12.5
2	HT Convection Zone : Air-Preheater Coil (2nd from bottom)	6.55	6.3	3.81 -
3	HT Convection Zone : Mixed Feed Coil (Bottom most)	8.0	11.2	-
4	LT Convection Zone : BFW Heater Coil (Bottom most)	5.54	4.2	24.18
5	LT Convection Zone : BFW Heater Coil (2nd from Bottom)	5.54	4.0	27.70
6	LT Convection Zone : BFW Heater Coil (3rd from Bottom)	3.9	3.7	5.12
7	LT Convection Zone : Ammonia BFW Coil (4th from Bottom)	5.54	4.3	22.38
8	LT Convection Zone : LT Steam Super Heater Coil (5th from Bottom)	7.01	5.5	21.54

NOTE: All readings are in MM

ANNEXURE- 8 (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-02	1.5	XXS	10.2	CS	BO-2H	BO-21	8.3	18.63
2	BO-2H	1.5	XXS	10.2	CS	101-F	BO-21-1.5"	10.3	-
3	BO-3H	1	160	6.35	CS	102-C	BO-13-1" (SP-7)	6.2	2.36
4	BO-12H	2	XXS	11.07	CS	AUX.BOILER COIL-C	BLOW DOWN BO-6	8.7	21.40
5	BO-17	1	160	6.35	CS	BO-14-3"	101-CA Header	6.3	0.78
6	BO-20	1	160	6.35	CS	BO-17-1"	BO-20H (101-CB Header)	6.3	0.78
7	MDEA-1212.01	16	XS	12.7	CS	115- JA	101-EA (MDEA-1212-03) USV-933	9.7	23.62
8	MDEA-1212.02	16	XS	12.7	CS	115- JB	101-EA (MDEA-1212-03) USV-935	9.7	23.62
9	PW-17	4	40	6.02	SS304	PW-1-6"	170-C	5.4	10.29
10	PW-19	4	120	11.13	CS	LC-3A	104-E	9.1	18.23
11	PW-31	12	40	10.31	CS	PW-30-14"	104-E	10.4	-
12	SC-07	2.5	80	7.01	CS	SC-42	101-JC	5.0	28.67
13	SC-17	3	80	7.62	CS	156-F	151-C	6.1	19.95
14	SG-13	12	100	21.41	CS	120-C	LETDOWN VALVE (Yellow line)	16.9	21.06

ANNEXURE- 8 (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-20	10	20	6.35	C.S.	101 J	101 B	5.5	13.39
2	A-22*	4	40	6.02	P-11	A 20 SPEC.BRK	SPEC. BRK NG-9	4.12	31.56
3	A-32*	6	40	7.11	CS	101-J LP DISCH.	CV	4.26	40.08
4	BF-2H	6	120	14.27	CS	101-F	101-B	12.8	10.30
5	BF-22	8	100	15.06	CS	HEADER	BF-6	10.5	30.28
6	BO-4H	0.75	160	5.54	CS	BO-2H	BO-12	7.3	-
7	BO-5	1	80	4.56	CS	112-C	BO-16	4.0	11.11
8	BO-5H	1	160	6.35	CS	102-C	BO-15	5.9	7.09
9	BO-8	1	80	4.5	CS	BO-13BH	BO-11	4.4	2.22
10	BO-11	1.5	80	5.1	CS	JCT BO-G7-8-9	BO-14	3.6	29.41
11	BO-12	0.75	160	5.54	CS	BO-4H	SAMPLE COOLER	5.8	-
12	BO-14BH	2	160	8.74	CS	Aux. Boiler	BO-07-1"	10.5	-
13	BO-14	3	40	5.49	CS	HEADER	156-F	5.3	3.46
14	BO-15	1	80	4.56	CS	BO-5H	BO-13	4.4	3.51
15	BO-16	6	40	7.11	CS	BO-5	V-39	6.4	9.99
16	BO-17H	1	160	6.35	CS	BW-21H	BO-17	6.2	2.36
17	BO-25	1	80	4.5	CS	BO-11	BO-13AH	4.5	0
18	BO-26	1	80	4.5	CS	BO-11	BO-14H	4.4	2.22
19	HS-04	12	100	21.41	P-11	HS-3H	HS-7	17.6	17.80
20	aMDEA-8	12	30	8.38	CS	MEA-19 & 18	aMDEA-20	7.8	6.92
21	aMdEA-09B	12	10S	4.57	SS	aMDEA-07	CON.VALVE	4.5	1.53
22	aMDEA-11	14	20	7.92	CS	aMDEA-108 (102-EB)	MEA-12 A& B	7.5	5.30
23	aMDEA-27B	18	20	7.92	CS	102-EB	aMDEA-33B	9.1	-
24	aMDEA-28A	12	20	6.35	CS	aMDEA-33B	105-CA	6.5	-
25	aMDEA-28B	12	20	6.35	CS	aMDEA-33B	105-CB	6.00	5.51
26	aMDEA-33B	16	20	7.92	CS	aMDEA-27B	HEADER	8.9	-
27	MS-03	12	30	8.38	CS	MS-11	MS-2	15.3	-
28	MS-11	16	30	9.53	CS	103-J	MS-3	9.5	0.31

SR. NO.	LINE NO.	N.B. (in.)	SCH.	NOM. THK. (mm)	MAT.	LINE DESCRIPTION		Minimum Thickness Observed (mm)	% RED.
						FROM	TO		
29	MS-30	3	40	5.49	CS	MS-29	A-20	5.4	1.64
30	MS-60	10	30	7.8	CS	MS-2	HEADER	6.0	23.08
31	NG-06A	8	20	8.18	CS	NG-4	150-C	6.0	26.65
32	NG-26	8	40	8.18	CS	NG-23	BURNER	6.9	15.65
		3	40	5.49		NG-23-8"	BURNER	4.5	18.03
33	PG-02	18	100	29.36	P11	102-C	PG-4	-	-
		18	Std	9.53				14.3	-
34	PG-05	14	100	23.8	P11	102-C	PG-4	24.3	-
35	PG-15	14	XS	12.7	CS	102-F	101-E	7.78	38.74
36	PG-16	14	20	7.92	CS	101-E	136-C	6.2	21.72
37	PG-33A	4	40	6.02	SS-304	105-CA	PG-34	5.6	6.98
38	PG-33B	4	40	6.02	SS-304	105-CB	PG-34	6.1	-
39	PW-01	6	80	10.97	CS	102-F	PW-4	10.0	8.84
40	PW-02	2	40S	3.91	SS	SPEC.BRK.	PW-12	3.4	13.04
41	PW-03	2	160	8.74	CS	SPEC.BRK.		6.4	26.77
		2	40S	3.91	SS			3.4	13.04
42	PW-04	2.5	160	9.53	CS	PW-1	106-J	8.0	16.05
		2.5	40S	5.16	SS			4.6	10.85
43	PW-05	2	10S	2.77	CS	106-J	PG-10	2.7	2.53
44	PW-13	6	80	10.97	CS	PW-12	SEWER	4.8	56.24
		4	40	6.02	CS	PW-1	170-C	6.1	-
		4	10S	3.05	SS304			2.5	18.03
45	PW-21	4	120	11.13	CS	170-J	170-C	9.9	11.05
46	PW-21A	4	120	11.13	CS	170-JA	PW-21	10.2	8.36
47	PW-22	4	120	11.13	CS	170-C	173-C	9.2	17.34
48	PW-28	4	120	11.13	CS	PW-27	171-C	9.8	11.95
49	PW-28A	4	120	11.13	CS	PW-27	171-C	10.6	4.76
50	SC-41A	4	40	6.02	CS	112-J	SC-12	6.4	-
51	SC-41B	4	40	6.02	CS	112JA	SC-41A	6.9	-
52	SC-42	4	40	6.02	CS	SC-41A	CV	6.7	-
		6	40	7.11	CS	CV	2005-U	6.3	11.39
53	SG-21	14	120	27.76	CS	121-C	SG-22 & 23	26.6	4.18

SR. NO.	LINE NO.	N.B. (in.)	SCH.	NOM. THK. (mm)	MAT.	LINE DESCRIPTION		Minimum Thickness Observed (mm)	% RED.
						FROM	TO		
54	SG-44	4	40	6.02	CS	SG-11	SG-45	5.7	5.32
55	SG-45	6	40	7.11	CS	SG-44	SG-6	7.0	1.55
56	SG-51	8	100	15.06	CS	SG-1303-04-08" (FICA-15)	SG-35-12"	14.5	3.72
57	SG-52	3	160	11.13	CS	SG-22	EVPT-DISCH	9.2	17.34
58	SG-53	3	160	11.13	CS	SG-22	EVPT-DISCH.	9.1	18.24
59	SG-76A	4	120	11.1	CS	SG-29	102-B	10.6	4.50
60	SG-76B	4	120	11.1	CS	SG-29	102-B	10.2	8.11
61	SG-77	6	40	7.11	CS	C.V. PRC-4	SG-78	6.6	7.17
62	PRC - 1	6	40	7.11	CS	101/102-D INLET	VENT (SP-73)	5.6	21.24
		3	40	5.5				5	9.09
63	PRC-6 D/S (V-27-6")	6	80	10.97	CS	V-27	V-29 (SP-75)	6.1	44.39
64	FICV -14	12	10S	4.57	SS	aMDEA-9B	102-EB	5.1	-
		10	40S	9.27				8.3	10.46

***Note:** Part replacement in following pipe lines were carried out based on the thickness measurement report.

SR. NO.	LINE NO.	N.B. (in.)	SCH.	LINE DESCRIPTION		PART REPLACED
				FROM	TO	
1	A-22	4	40	A 20 SPEC.BRK	SPEC. BRK NG-9	Line Plugged
2	A-32	6	40	101-J LP DISCH.	CV	Pipe pieces replaced

Annexure-9

GAUSS MEASUREMENT & DEMAGNETIZATION REPORT

DESCRIPTION	POSITION	INITIAL (Gauss)	AFTER DEGAUSSING (Gauss)
101-BJT			
Front side Journal Bearing (SILO side)	Top	0.8	
	Bottom	2.1	
Front Journal Shaft (SILO side)		2.0	
Rear side Journal Bearing (CT side)	Top	1.3	
	Bottom	2.0	
Rear Journal Shaft (CT side)		2.9	
101 – JR (High Speed driven Pinion)			
Journal Bearing (CT side)	Top	0.9	
	Bottom	0.8	
Journal Bearing (SILO side)	Top	0.9	
	Bottom	0.5	
Shaft Journal (CT side)	Top	0.3	
	Bottom	0.3	
Shaft Journal (SILO side)	Top	0.8	
	Bottom	1.1	
101 – JR (Low Speed driven Gear)			
Journal Bearing (CT side)	Top	1.6	
	Bottom	1.8	
Journal Bearing (SILO side)	Top	0.8	
	Bottom	1.2	
Shaft Journal (CT side)	Top	0.6	
	Bottom	0.4	
Shaft Journal (SILO side)	Top	1.2	
	Bottom	1.1	
101 – BJ			
Journal Bearing (SILO side)	Top	0.9	
	Bottom	0.6	
Shaft Journal (SILO side)	Top	0.5	
	Bottom	0.5	
101-J (AIR COMPRESSOR)			
101-JT			
Journal Bearing Pad	Thrust End	1.0	
	Non Thrust End	1.8	
Journal Bearing Base ring	Thrust End	0.8	
	Non Thrust End	0.7	
Thrust Bearing Pads	Active	0.6	
	Inactive	0.6	

DESCRIPTION	POSITION	INITIAL (Gauss)	AFTER DEGAUSSING (Gauss)
Thrust Bearing Base ring	Active	0.5	
	Inactive	0.6	
Shaft Journal	Thrust End	2.5	
	Non Thrust End	2.5	
Thrust Collar	Active	1.3	
	Inactive	1.0	
101-JLP			
Journal Bearing Pads	Thrust End	1.2	
	Non Thrust End	0.6	
Journal Bearing Base ring	Thrust End	0.8	
	Non Thrust End	1.6	
Thrust Bearing Pads	Active	1.6	
	Inactive	1.8	
Thrust Bearing Base ring	Active	8.0	1.3
	Inactive	1.3	
Shaft Journal	Thrust End	2.9	
	Non Thrust End	2.4	
Thrust Collar	Active	2.3	
	Inactive	1.6	
101-JR			
Gear Journal Bearing (Low Speed)	North side	T-0.7 B-0.6	
	South Side	T-0.5 B-0.5	
Pinion Journal Bearing (High Speed)	North side	T-0.5 B-0.6	
	South Side	T-0.6 B-0.9	
Thrust Bearing	Active	0.6	
	Inactive	0.5	
Shaft Journal	Thrust End	1.2	
	Non Thrust End	0.6	
101-JHP			
Journal Bearing Pads	Thrust End	0.6	
	Non Thrust End	0.9	
Journal Bearing Base ring	Thrust End	0.8	
	Non Thrust End	0.9	
Thrust Bearing Pads	Active	1.6	
	Inactive	1.2	
Thrust Bearing Base ring	Active	4.8	1.5
	Inactive	4.0	0.8
Shaft Journal	Thrust End	3.6	
	Non Thrust End	3.9	
107-JT (MURRY TURBINE)			
Journal Bearing Governor End	Top Half	0.6	
	Bottom Half	0.8	
	Shaft	1.4	

DESCRIPTION	POSITION	INITIAL (Gauss)	AFTER DEGAUSSING (Gauss)
Journal Bearing Coupling End	Top Half	0.4	
	Bottom Half	0.5	
	Shaft	2.5	
Thrust Bearing Pads	Active	1.4	
	Inactive	0.5	
Thrust Bearing Collar	Active	1.0	
	In Active	1.5	
103-J (SYNTHESYS GAS COMPRESSOR)			
103-JBT			
Journal Bearing Sleeve	Thrust End	0.8	
	Non Thrust End	1.0	
Thrust Bearing Pads	Active	0.9	
	Inactive	1.3	
Thrust Bearing Base ring	Active	0.6	
	Inactive	0.8	
Journal Shaft	Thrust End	1.2	
	Non Thrust End	1.2	
103-JAT			
Journal Bearing Sleeve	Thrust End	1.2	
	Non Thrust End	1.4	
Thrust Bearing Pads	Active	0.5	
	Inactive	0.5	
Thrust Bearing Base ring	Active	1.6	
	Inactive	1.8	
Shaft Journal	Thrust End	0.5	
	Non Thrust End	1.4	
103-JLP			
Journal Bearing Sleeve	Thrust End	-	
	Non Thrust End	0.6	
Shaft Journal	Thrust End	-	
	Non Thrust End	1.7	
103-JHP			
Journal Bearing Sleeve	Non Thrust End	1.0	
Thrust Bearing Pads	Active	1.3	
Thrust Bearing Base ring	Active	1.8	
Thrust Collar		1.5	
Shaft Journal		0.5	
104-JAT (BFW PUMP)			
104 - JAT			
Journal Bearing Pad	North side	0.6	
	South Side	0.9	
Thrust Bearing Pads	Active	0.6	
	Inactive	0.7	

DESCRIPTION	POSITION	INITIAL (Gauss)	AFTER DEGAUSSING (Gauss)
Shaft Journal	NDE	0.8	
	Coupling End	1.6	
104-JA			
Journal Bearing Pad	North side	0.6	
	South Side	0.4	
Thrust Bearing Pads	Active	0.5	
	Inactive	0.5	
Turbine Thrust Collar (North Side)	Active	0.9	
	In Active	0.8	
Shaft Journal	NDE	0.6	
	Coupling End	1.6	
105-J (REF. COMPRESSOR)			
105-JT			
Journal Bearing Pad	Thrust End	0.6	
	Non Thrust End	0.8	
Journal Bearing Base ring	Thrust End	0.8	
	Non Thrust End	0.5	
Thrust Bearing Pads	Active	0.3	
	Inactive	0.6	
Thrust Bearing Base ring	Active	5.0	0.6
	Inactive	0.9	
Shaft Journal	Thrust End	2.1	
	Non Thrust End	1.2	
105-JLP			
Thrust Bearing Pads	Active	0.6	
	Inactive	0.6	
Thrust Bearing Base ring	Active	0.2	
	Inactive	0.4	
Shaft Journal	Thrust End	-	
	Non Thrust End	1.8	
105-JR			
Gear Journal Bearing	North side	0.6	
	South Side	0.6	
Pinion Journal Bearing	North side	0.6	
	South Side	0.5	
Shaft Journal	Thrust End	0.9	
105-JHP			
Thrust Bearing Pads	Thrust End	1.8	
	Non Thrust End	1.0	
Thrust Bearing Base ring	Active	0.6	
	Inactive	0.6	

DESCRIPTION	POSITION	INITIAL (Gauss)	AFTER DEGAUSSING (Gauss)
Shaft Journal	Non Thrust End	1.3	
107-J (MDEA PUMP)			
107-JT			
Journal Bearing Governor End	Top Half	0.9	
	Bottom Half	1.3	
	Shaft	1.6	
Journal Bearing Coupling End	Top Half	0.6	
	Bottom Half	0.6	
	Shaft	0.8	
Thrust Bearing	Collar	Active-1.3 Inactive- 1.4	
	Pad	0.3	
115-J (SEMI LEAN PUMP)			
115-JAT			
Journal Bearing Liner	Thrust End	1.8	
	Non Thrust End	1.7	
Thrust Bearing Pads	Active	1.7	
	Inactive	1.5	
Thrust Bearing Base ring	Active	0.6	
	Inactive	1.2	
Shaft Journal	Thrust End	2.4	
	Non Thrust End	1.8	
115-JA			
Journal Bearing Liner	Thrust End	0.9	
	Non Thrust End	0.6	
Thrust Bearing Pads	Active	1.5	
	Inactive	1.8	
Thrust Bearing Base ring	Active	1.8	
	Inactive	1.5	
Shaft Journal	Thrust End	1.0	
	Non Thrust End	1.0	
115-JR			
Gear Journal Bearing	DE (North side)	1.2	
	NDE (South Side)	1.6	
Shaft Journal	DE (North side)	2.8	
	NDE (South Side)	1.8	
Pinion Journal Bearing	DE (North side)	1.3	
	NDE (South Side)	0.6	
Shaft Journal	DE (North side)	0.6	
	NDE (South Side)	1.1	
115-HT			
Journal Bearing Liner	Thrust End	0.4	
	Non Thrust End	1.3	

DESCRIPTION	POSITION	INITIAL (Gauss)	AFTER DEGAUSSING (Gauss)
Thrust Bearing Pads	Thrust End	1.0	
	Non Thrust End	0.9	
Thrust Bearing Base ring	Active	0.9	
	Inactive	1.4	
Shaft Journal	Thrust End	0.8	
	Non Thrust End	1.4	
115-JBT			
Journal Bearing Liner	Thrust End	0.8	
	Non Thrust End	1.6	
Thrust Bearing Pads	Active	1.0	
	Inactive	0.8	
Thrust Bearing Base ring	Active	1.5	
	Inactive	1.3	
115-JB			
Journal Bearing Liner	Thrust End	0.4	
	Non Thrust End	0.6	
Thrust Bearing Pads	Active	1.8	
	Inactive	1.4	
115-JB			
Gear Journal Bearing	DE (North side)	1.7	
	NDE (South Side)	0.6	
Shaft Journal	DE (North side)	1.0	
	NDE (South Side)	0.6	
Pinion Journal Bearing	DE (North side)	0.9	
	NDE (South Side)	0.9	
Shaft Journal	DE (North side)	0.5	
	NDE (South Side)	2.4	

ANNEXURE-10

DETAILS OF INSITU-METALLOGRAPHIC INSPECTION

SR. NO.	LOCATION	MOC	MICROSTRUCTURE OBSERVATION	REMARK
1	Location: 1 (Weld/HAZ) Riser No.-1, 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 precipitation is observed along the grain boundaries. Presence of inter-granular cracks observed at HAZ region.	Inter-granular cracks are observed at HAZ region. **Needs attention.**
2	Location: 2 (Weld/HAZ) Riser No.-2, 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 precipitation is observed along the grain boundaries. Presence of inter-granular crack filled with oxide scale is observed at HAZ region.	Inter-granular cracks are observed at HAZ region. **Needs attention.**
3	Location: 3 (Weld/HAZ) Row No.-3, Tube NO.40, Tube to Weldolet Weld Joint	Tube-G-4852MWeldolet800HT	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 precipitation is observed along the grain boundaries. Presence of inter-granular cracks observed at HAZ region.	Inter-granular cracks are observed at HAZ region. **Needs attention.**
4	Location: 4 (Weld/HAZ) Riser No.-4, Riser to Weldolet Weld Joint	Tube-G-4852MWeldolet800HT	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 precipitation is observed along 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
5	Location: 5 (Weld/HAZ) Riser No.-5, Riser to Weldolet Weld Joint	Tube-G-4852MWeldolet800HT	Microstructure at weld shows dendritic structure of ferrite pools in austenite matrix with carbides, whereas HAZ microstructure shows coarse-grained austenitic grains. Microstructure at parent metal shows fine & coarse austenitic grain with twins. Second phase carbide precipitation is observed along the grain boundaries. Presence of inter-granular cracks observed at HAZ region.	Inter-granular cracks are observed at HAZ region. **Needs attention.**
6	Location: 6 (Weld/HAZ) Riser No.-6, Riser to Weldolet Weld Joint	Tube-G-4852MWeldolet800HT	Microstructure at weld shows dendritic structure of ferrite pools in austenite matrix with carbides, whereas HAZ microstructure shows coarse-grained austenitic grains. Microstructure at parent metal shows coarse austenitic grain with twins. Second phase carbide precipitation is observed along the grain boundaries. Presence of inter-granular cracks observed at HAZ region.	Inter-granular cracks are observed at HAZ region. **Needs attention.**
7	Location: 7 (Weld/HAZ) Riser No.-7, Riser to Weldolet Weld Joint	Tube-G-4852M	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 precipitation is observed along the grain boundaries. Presence of inter-granular cracks observed at HAZ region.	Inter-granular cracks are observed at HAZ region. **Needs attention.**
8	Location: 8 (Weld/HAZ) Riser No.-8, Riser to Weldolet Weld Joint	Tube-G-4852MWeldolet800HT	Microstructure at weld shows dendritic structure of ferrite pools in austenite matrix with carbides, whereas HAZ microstructure shows coarse- grained austenitic grains. Microstructure at parent metal shows coarse austenitic grain with twins. Second phase carbide precipitation is observed along 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
9	Location: 9 (Weld/HAZ) Row No.-1, Tube NO.35, Tube to Weldolet Weld Joint	Tube-G-4852MWeldolet800HT	Microstructure at weld shows dendritic structure of ferrite pools in austenite matrix with carbides, whereas HAZ microstructure shows coarse-grained austenitic grains. Microstructure at parent metal shows fine & coarse austenitic grain with twins. Second phase carbide precipitation is observed along the grain boundaries. Presence of inter-granular cracks observed at HAZ region.	Inter-granular cracks are observed at HAZ region. **Needs attention.**
10	Location: 10 (Weld/HAZ) Row No.-3, Tube NO.40, Tube to Weldolet Weld Joint	Tube-G-4852M Weldolet 800HT	Microstructure at weld shows ferrite pools in austenite matrix with carbides, whereas HAZ microstructure shows coarse-grained austenitic grains. Microstructure at parent metal shows fine & coarse- grained austenitic grain with twins. Presence of inter-granular cracks observed at HAZ region.	Inter-granular cracks are observed at HAZ region. **Needs attention.**
11	Location: 11 (Weld/HAZ) Row No.-6, Tube No.18 Tube to Weldolet Weld Joint	Tube-G-4852MWeldolet800HT	Microstructure at weld shows ferrite pools in austenite matrix with carbides, whereas HAZ microstructure shows coarse-grained austenitic grains. Microstructure at parent metal shows fine & coarse- grained austenitic grain with twins. Presence of inter-granular cracks observed at HAZ region.	Inter-granular cracks are observed at HAZ region. **Needs attention.**
12	Location: 12 (Weld/HAZ) Row No.-7, Tube NO.37, Tube to Weldolet Weld Joint	Tube-G-4852MWeldolet800HT	Microstructure at weld shows dendritic structure of ferrite pools in austenite matrix with carbides, whereas HAZ microstructure shows coarse-grained austenitic grains. Microstructure at parent metal shows coarse austenitic grain with twins. Second phase carbide precipitation is observed along the grain boundaries.	Microstructure is free from any micro cracks. Monitor after 1 year of service.
13	Location: 13 (Parent Metal) Riser Tube No.-7	Tube-G-4852M	Microstructure shows dendrite structure of primary carbides along with secondary precipitation including carbides in the austenite matrix. The primary and secondary fine precipitate seems to have coarsened within the matrix.	Microstructure is free from any micro cracks. Monitor after 1 year of service.

SR. NO.	LOCATION	MOC	MICROSTRUCTURE OBSERVATION	REMARK
14	Location: 14 (Weld/HAZ) 102B SG-62B-4” line	P5	Weld microstructure shows dendritic structure of tempered bainite/martensite structure, Whereas at HAZ shows fine-grained ferrite and bainite structure. Parent metal microstructure shows fine-grained ferrite & bainite structure. In-situ spherodization of bainite is observed.	IInd stage of creep degradations. Monitor after 1 year of service.
15	Location: 15 (Weld/HAZ) 102B SG-62A-4” line	P5	Weld microstructure shows dendritic structure of tempered bainite/martensite structure, Whereas at HAZ shows fine-grained ferrite and bainite structure. Parent metal microstructure shows fine-grained ferrite & bainite structure. In-situ spherodization of bainite is observed.	IInd stage of creep degradations. Monitor after 1 year of service.
16	Location: 16 (Weld/HAZ/PM) SG-1303, 10- 14 (H-36) On 108D converter Outlet nozzle, HAZ of nozzle	P-22	Weld microstructure shows ferrite and carbides in dendrite form, Whereas at HAZ microstructure shows tempered bainite & ferrite structure. Parent metal microstructure shows fine- grained ferrite and bainite structure. In-situ spheroidization of bainite is observed.	IInd stage of creep degradations. Monitor after 1 year of service.
17	Location: 17 (Weld/HAZ/PM) SG-1303, 10- 14 (H-36) On 108D converter Outlet nozzle of bend at top	P-22	Weld microstructure shows ferrite and carbides in dendrite form, Whereas at HAZ microstructure shows tempered bainite & ferrite structure. Parent metal microstructure shows fine tempered bainite structure. In-situ spheroidization of bainite is observed.	IInd stage of creep degradations. Monitor after 1 year of service.
18	Location: 18 (Parent Metal) SG-1303 11-14 (H-34) On 107C Gas inlet PM of bend	P-11	Microstructure shows coarse-grained non-uniformly distributed ferrite and pearlite structure.	No significant degradation observed. Monitor after 2 years of service.
19	Location: 19 (Weld/HAZ/PM) SG-1303 11-14 (H-34) On Gas outlet nozzle & HAZ of nozzle	P-11	Weld microstructure shows ferrite and carbides in dendrite form. Microstructure at HAZ shows fine-grained bainite and ferrite structure. Parent metal microstructure shows fine-grained ferrite and pearlite structure.	IInd stage of creep degradations. Monitor after 1 year of service.

SR. NO.	LOCATION	MOC	MICROSTRUCTURE OBSERVATION	REMARK
20	Location: 20 (Weld/HAZ/PM) SG-1303 11-14 (H-34) On 107C Gas outlet nozzle & HAZ of bend	P-11	Microstructure at weld shows dendritic structure ferrite and carbides and bainite structure. Microstructure at HAZ shows fine & coarse-grained pearlite/bainite and ferrite structure. Parent metal microstructure shows fine-grained ferrite and pearlite structure. In-situ spherodization of pearlite is observed.	Initial stage of degradation is observed. Monitor after 2 years of service.
21	Location: 21 (Weld/HAZ/PM) SG-26-6" MICA-16 Upstream Flange weld	CS	Microstructure at weld metal shows ferrite and carbides in dendritic form. Whereas at HAZ microstructure shows fine-grained ferrite and pearlite structure. Parent metal microstructure shows fine- grained non-uniformly distributed ferrite and pearlite structure. Presence of few widmanstatten ferrite is observed.	No significant degradation observed. Monitor after 2 years of service.
22	Location: 22 (Weld/HAZ/PM) SG-27-6" MICA-14 Upstream Flange weld	CS	Microstructure at weld metal shows ferrite and carbides in dendritic form. Whereas at HAZ microstructure shows fine-grained ferrite and pearlite structure. Parent metal microstructure shows fine- grained non-uniformly distributed ferrite and pearlite structure. Presence of few widmanstatten ferrite is observed.	No significant degradation observed. Monitor after 2 years of service.
23	Location: 23 (Weld/HAZ/PM) SG-28-6" MICA 13 Upstream Flange weld	CS	Microstructure at weld metal shows ferrite and carbides in dendritic form. Whereas at HAZ microstructure shows fine-grained ferrite and pearlite structure. Parent metal microstructure shows fine- grained non-uniformly distributed ferrite and pearlite structure. Presence of few widmanstatten ferrite is observed.	No significant degradation observed. Monitor after 2 years of service.
24	Location: 24 (Weld/HAZ/PM) SG-32-6" MICA-15 Upstream weld	CS	Microstructure at weld metal shows ferrite and carbides in dendritic form. Whereas at HAZ microstructure shows fine-grained ferrite and pearlite structure. Parent metal microstructure shows fine- grained non-uniformly distributed ferrite and pearlite structure.	No significant degradation observed. Monitor after 2 years of service.

SR. NO.	LOCATION	MOC	MICROSTRUCTURE OBSERVATION	REMARK
25	Location: 25 (Parent Metal) On face of 1st Bend of NG-9-12" (101B-mixed feed coil outlet to NG-11)	P 11	Microstructure shows fine-grained ferrite and pearlite structure. Degradation of pearlite observed in terms of spherodization. Possibilities of isolated creep cavities are observed.	SEM interpretation is mentioned at 25.1.
25.1			Microstructure shows alloy carbides with isolated creep cavities at the grain boundaries	Creep cavities are present. IInd stage of creep. Monitor after 1 year of service.
26.	Location: 26 (Weld/HAZ) On weld betn. Pipe & Elbow (elbow side) of NG-9-12" (101B-mixed feed coil outlet to NG-11)	P 11	Microstructure at weld shows ferrite and bainite in dendritic form Whereas at HAZ shows fine-grained bainite and ferrite structure. Microstructure at parent metal shows fine- grained ferrite and pearlite structure. Degradation of pearlite observed in terms of spherodization. Possibilities of isolated creep cavities are observed.	SEM interpretation is mentioned at 26.1.
26.1			Microstructure shows alloy carbides with isolated creep cavities at the grain boundaries.	Creep cavities are present. IInd stage of creep. Monitor after 1 year of service.
27	Location: 27 (Parent Metal) , NG-9-12" (101B-mixed feed coil outlet to NG-11)	P 11	Microstructure shows fine-grained ferrite and pearlite structure. In-situ spherodization of pearlite is observed.	IInd stage of creep degradations. Monitor after 1 year of service.
28	Location: 28 (Weld/PM) On dissimilar Weld Between pipe piece & Nozzle of Header towards HAZ of SS304, NG-9-12" (101B- mixed feed coil outlet to NG-11)	P 11 to SS 304	Microstructure at weld shows dendritic structure of ferrite pools in austenite matrix, Microstructure at parent metal shows fine- grained ferrite and pearlite structure. In-situ spherodization of pearlite is observed.	IInd stage of creep degradations. Monitor after 1 year of service.

SR. NO.	LOCATION	MOC	MICROSTRUCTURE OBSERVATION	REMARK
29	Location: 29 (Weld/HAZ) On Weld Between BFW outlet Nozzle (East) of 103C to elbow weld+HAZ towards elbow (BW-11H-8)	CS	Microstructure at weld metal shows ferrite and carbides in dendritic form. Whereas at HAZ microstructure shows fine-grained ferrite and pearlite structure. Parent metal shows fine-grained ferrite and pearlite structure. Initial stage of in-situ spheroidization of pearlite is observed at grain boundaries.	IInd stage of creep degradations. Monitor after 1 year of service.
30	Location: 30 (Weld/HAZ) On weld bet^{n}. flange & Bend of gas inlet nozzle. PG-6 –18 towards east side of 103-C	P 11	Microstructure at weld metal shows ferrite and carbides in dendritic form. Coarsening of ferrite is observed in the weld region, Whereas at HAZ microstructure shows essentially fine & coarse grained ferrite with few pearlite structure. Parent metal shows essentially fine-grained ferrite with few pearlite structure. Pearlite is observed at the grain boundaries. Possibilities of isolated creep cavities are observed.	SEM interpretation is mentioned at 30.1.
30.1.			Microstructure shows alloy carbides with isolated creep cavities at the grain boundaries.	Creep cavities are present. IInd stage of creep. Monitor after 1 year of service.
31	Location: 31 (Weld/PM) On dissimilar weld between 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. Microstructure shows fine-grained ferrite and pearlite structure.	No significant degradation observed. Monitor after 2 years of service.
32	Location: 32 (Weld/PM) On dissimilar weld between 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. Parent metal microstructure shows fine-grained ferrite and pearlite structure.	No significant degradation observed. Monitor after 2 years of service.
33	Location: 33 (Parent Metal) PIC-13B Drain on Weldolet	CS	Microstructure shows coarse-grained widmanstatten ferrite and pearlite structure.	No significant degradation observed. Monitor after 2 years of service.

SR. NO.	LOCATION	MOC	MICROSTRUCTURE OBSERVATION	REMARK
34	Location: 34 (Parent Metal) PIC-13B Drain On Elbow	CS	Microstructure shows coarse-grained widmanstatten ferrite and pearlite structure.	No significant degradation observed. Monitor after 2 years of service.
35	Location: 35 (Parent Metal) PIC-13B Drain On Tee	CS	Microstructure shows coarse-grained widmanstatten ferrite and pearlite structure.	No significant degradation observed. Monitor after 2 years of service.
36	Location: 36 (Parent Metal) PIC-13A Drain On Weldolet	CS	Microstructure shows fine-grained ferrite and pearlite structure. In-situ spherodization of pearlite is observed.	IInd stage of creep degradations. Monitor after 1 year of service.
37	Location: 37 (Parent Metal) PIC-13A Drain On Elbow	CS	Microstructure shows coarse-grained widmanstatten ferrite and pearlite structure.	No significant degradation observed. Monitor after 2 years of service.
38	Location: 38 (Parent Metal) PIC-13A Drain On Tee	CS	Microstructure shows coarse-grained widmanstatten ferrite and pearlite structure. Ferrite is observed at prior austenite grain boundaries.	No significant degradation observed. Monitor after 2 years of service.
39	Location: 39 (Parent Metal) MIC-22 Drain On Weldolet	CS	Microstructure shows coarse-grained widmanstatten ferrite and pearlite structure.	No significant degradation observed. Monitor after 2 years of service.
40	Location: 40 (Parent Metal) MIC-22 Drain PI On Elbow	CS	Microstructure shows coarse-grained widmanstatten ferrite and pearlite structure.	No significant degradation observed. Monitor after 2 years of service.
41	Location: 41 (Parent Metal) MIC-22 Drain On Tee	CS	Microstructure shows coarse-grained widmanstatten ferrite and pearlite structure.	No significant degradation observed. Monitor after 2 years of service.

Note: Location no. 1, 2, 3, 4, 5, 6, 7, 8, 10, 11, 12, 13, 14, 15, 16, 17, 19, 25, 26, 27, 28, 29, 30 and 36 shall be monitored during next turnaround in detail as recommended by M/S TCR

Annexure - 11

UFD & RT STATUS OF CONVERTER LOOP

JOINT NO.	2012		2013		2014		2015	
	UFD	RT	UFD	RT	UFD	RT	UFD	RT
FROM 108D TO 107C, LINE NO: SG-1303-10-14", SCH-120 (27.79MM NOM THICK.)								
Elbows 1 to 5	NSD	--	NSD	--	NSD	--	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	New Joint NSD, After SR	NSD	--	NSD	--	NSD	--
J-12	NSD	New Joint NSD, After SR	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	--	E-2 & E-5 Rest of All NSD	--	NSD	--	NSD	--
J-1	NSD	--	NSD	--	NSD	--	NSD	--
J-2	NSD	--	NSD	--	NSD	--	NSD	--
J-3	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	--	NSD	--
J-9	NSD	NSD	--	NSD	NSD	--	NSD	--
J-9A	NSD	NSD	--	NSD	NSD	--	NSD	--
J-9B	NSD	--	--	NSD	NSD	--	NSD	--
J-10	NSD	NSD	--	--	NSD	--	NSD	--
J-11	NSD	NSD	NSD	--	NSD	--	NSD	--
J-12	NSD	NSD	NSD	--	NSD	--	NSD	--
J-13	NSD	NSD	NSD	--	NSD	--	NSD	--
J-14	NSD	NSD	NSD	--	NSD	--	NSD	--

JOINT NO.	2012		2013		2014		2015	
	UFD	RT	UFD	RT	UFD	RT	UFD	RT
J-15	NSD	NSD	NSD	--	NSD	--	NSD	--
J-16	NSD	NSD	NSD	--	NSD	--	NSD	--
J-17	NSD	NSD	NSD	--	NSD	--	NSD	--
J-18	NSD	NSD	NSD	--	NSD	--	NSD	NSD
J-19	NSD	NSD	NSD	--	NSD	--	NSD	--
J-20	NSD	NSD	NSD	--	NSD	--	NSD	--
J-21	NSD	NSD	NSD	--	NSD	--	NSD	--
J-22	NSD	NSD	NSD	--	NSD	--	NSD	--
J-23	NSD	NSD	NSD	--	NSD	--	NSD	--
J-24	NSD	NSD	NSD	--	NSD	--	NSD	--
J-25	NSD	NSD	NSD	--	NSD	--	NSD	--
J-26	NSD	NSD	NSD	--	NSD	--	NSD	--
J-27	NSD	NSD	NSD	--	NSD	--	NSD	--
J-28	NSD	NSD	NSD	--	NSD	--	NSD	--
J-29	NSD	NSD	NSD	--	NSD	--	NSD	--
J-30	NSD	NSD	NSD	--	NSD	--	NSD	--
J-T1	NSD	--	NSD	NSD	NSD	--	NSD	--
J-T2	NSD	--	NSD	NSD	NSD	--	NSD	--
J-T3	NSD	--	NSD	NSD	NSD	--	NSD	--
J-T4	NSD	--	NSD	NSD	NSD	--	NSD	--
J-T5	NSD	--	NSD	NSD	NSD	--	NSD	--
J-T6	NSD	--	NSD	NSD	NSD	--	NSD	--
FROM 107D TO 123C, LINE NO: SG-1303-11-14", SCH-140 (31.75MM NOM THICK.)								
Elbows 1 to 6	NSD	--	E-2 & E-3 Rest of All NSD	--	NSD	--	NSD	--
J-1	NSD	--	NSD	--	NSD	--	NSD	--
J-2	NSD	--	NSD	--	NSD	--	NSD	--
J-3	NSD	--	--	--	NSD	--	NSD	--
J-4	NSD	--	--	--	NSD	--	NSD	--
J-5	NSD	--	--	--	NSD	--	NSD	--
J-6	NSD	--	--	--	NSD	--	NSD	--
J-7	NSD	--	NSD	--	NSD	--	NSD	--
J-8	NSD	--	NSD	--	NSD	--	NSD	--
J-9	NSD	--	NSD	NSD	NSD	--	NSD	--
J-10	NSD	--	NSD	NSD	NSD	--	NSD	--
J-11	NSD	--	NSD	NSD	NSD	--	NSD	--
J-12	NSD	--	NSD	NSD	NSD	--	NSD	--

NSD: No Significant Defect

UREA PLANT
(INSPECTION)

During Annual Shutdown 2015, 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.P. Scrubber Top (H-1203).
- Helium Leak Detection in Autoclave (V-1201).
- Eddy Current Testing of H.P. Stripper (H-1201) tubes 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) & Visual Inspection of its tube bundle in Pulled-out condition.
- 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**.
- Insitu-Metallography was carried out at selected location on equipment. Summary of observations and microstructure analysis is given at **Annexure-5**.
- Radiographic Examination of HP Line Fittings. List is attached at **Annexure-6.**
- The detailed observations and recommendations for corrective actions required on individual equipment are given below. All the observations were recorded during inspection and were handed over to concerned maintenance and operation group for necessary corrective action.

HIGH PRESSURE VESSELS

Following High-pressure equipments were inspected. The observations are listed below:

AUTOCLAVE (V-1201)

VISUAL INSPECTION

Thorough visual inspection of the liner, its welds, trays and internals were carried out. Observations made on each compartment are mentioned below.

Compartment No.1 (Top Compartment)

- Roughening /corrosion of dome liners observed and grayish oxide layer observed on dome / man way surface.
- 1-1.5'' wide area just above man way liner's top circumferential seam observed to have high corrosion attack in entire circumference. This was observed during previous inspection also.
- Liner plate segment just below dome liner was found silver bright in colour throughout the circumference.
- Overall Tray corrosion is high in all four segments.
- 1 no. of "J" bolt found missing just near down comer funnel at north side.
- Overall under Tray corrosion is high in first compartment.
- Total 03 no's of defects observed, marked as D1, D2 and D3.
- D1-In Shell liner South-West side, besides ''L'' Seam Pits/Localized corrosion of 1 to 1 .5 mm depth, 10-12 mm in diameter observed, marked for necessary action.
- D2 –Localized pit besides D1, marked for necessary action.
- D3 – In East direction near liquid box localized pit 1 to 1.5 mm in depth & 5 to 6.0 mm in diameter, marked for necessary action.

Compartment No.2

- Roughening of tray holding clits and grayish brown oxide layer was observed on bottom side of trays same was observed during previous inspection.
- Few nos. of tray holding 'J' bolts, tray segment fasteners were found loose.
- Weld joints condition found satisfactory.
- 01 no. of tray holding clit was found blackish in coloration and having severe corrosion attack including its welds, same observed in previous inspection.
- Due to corrosion / erosion of trays, gap increased between tray and shell liner plate.
- Down comer found dark brown in colour and rough in surface.
- Total 02 no's of defects observed, marked as D1 and D2.
- D1 – Localized pit/ erosion of 2'' length and 1.0-1.5 mm depth observed in N – W side just above "C" Seam near clit welding, marked for necessary action.
- D2 – In Other side of same clit localized pitting / erosion of 2'' long and 1.0-1.5 mm in depth observed, marked for necessary action.

Compartment No.3

- Bulging of approx. 8mm depth and 2.5" width was observed behind tray skirt in SW to South direction, same was observed during previous inspection.
- 04 nos. of tray holding clits were found to be blackish in coloration and having severe corrosion attack including its welding, same observed in previous inspection.

- Due to corrosion / erosion of trays, gap increased between tray and shell liner plate.
- Overall condition of circumferential and long seam welding found satisfactory.
- High corrosion observed at bottom portion of trays.
- Total 03 no's of defects observed, marked as D1, D2 and D3.
- D1 - Localized pit/ erosion of 2'' long and 1.0-1.5 mm in depth observed at north side just above "C" seam near clit welding, marked for necessary action.
- D2 – Besides D1 defect in west direction near clit welding localized pit/ erosion of 1.5'' long and 1.0-1.5 mm in depth observed, marked for necessary action.
- D3 – In N–W direction one no old clit is not properly removed and its welding has developed crevices with shell liner which is required to be ground / re welded, marked for necessary action.

Compartment No.4

- Approx. 30 mm below circumferential weld, depression of approx. 100 mm dia. and 3 mm depth was observed at West side of the liner. Same was observed during previous inspection.
- Convex bulging of liner plate approx. 4.0 mm height observed just above circumferential weld 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.
- Grayish and brownish oxide layer was observed on the bottom side of trays, prominent on west side.
- 03 nos. of tray holding clits were found black and having severe corrosion attack including its welding, same was observed during previous inspection.
- Due to corrosion / erosion of trays, gap increased between tray and shell liner plate.
- Total 04 no's of defects observed, marked as D1, D2, D3 and D4.
- D1 – N-W side just above "C" Seam near clit welding crevices developed along the clit length, marked for necessary action.
- D2 – In East direction besides clit welding localized pit/ erosion of 1.5'' long and 1.0-1.5 mm in depth observed, marked for necessary action
- D3 – In S –W direction near "C" Seam in welding cavity / porosity observed, marked for necessary action.
- D4 – In South direction just above "C" Seam near clit welding localized Pits / Erosion observed along the clit length, marked for necessary action.

Compartment No.5

- Convex bulging of approx. 3 to 9 mm observed just above the C-Weld seam in almost entire periphery. The same was observed during previous inspection.
- Concave depression of approx 2-6 mm was observed at approx. 500 mm below the C-weld seam in entire periphery. The same was observed during previous inspection.

- Grayish and brownish oxide layer was observed on the bottom portion of tray segments.
- Overall C- Weld seam and previously repaired locations found satisfactory.
- Total 03 no's of defects observed, marked as D1, D2, and D3.
- D1 – In North side just above "C" Seam near clit welding pits & weld cavity , marked for necessary action
- D2 – In East direction besides clit welding a weld cavity and under cuts / crevices at bottom side of C-Weld seam observed with liner approx 1.5'' length, marked for necessary action.
- D3 – In N–W direction near "C" Seam in Clit welding localized Pits / erosion observed, marked for necessary action.

Compartment No.6

- Approx. 3 to 10 mm Convex bulging of liner plate was observed just above the C- Weld seam, starting from N-W to S-E direction, approx. 4500 mm in length. Same was observed during last inspection also.
- Concave depression of approx. 5 mm depth was observed at approx. One meter below C-weld seam from East to West side L-seam through North side of the shell. Same was observed during previous inspection.
- New welding was done on C-Weld seam and L-Weld seam by M/s. Dowel Erectors in 2012, found satisfactory.
- High corrosion observed in the bottom portion of tray segments in N-W corner.
- Overall C-Weld seam, L-Weld seam and previously repaired locations found satisfactory.
- Total 02 no's of defects observed, marked as D1 and D2.
- D1 – In North side just above C- Weld seam, welding of one no. clit found heavily eroded marked for necessary action.
- D2 – In West direction L- Weld seam porosity / pinhole, marked for necessary action.

Compartment No.7

- Approx. 2 to 6 mm Convex bulging of liner plate was observed above the C-Weld Seam at few locations. The same was observed during previous inspection.
- Approx 5 mm concave bulging below approx 1200mm of C-Weld seam observed in 60% periphery, prominent near liquid box.
- 04 nos. of tray holding clits were found to be blackish in coloration and having severe corrosion attack including its welding. Same was observed during previous inspection.
- Erosion observed in the bottom portion of tray segments.
- New welding was done on C-Weld seam and L-Weld seam by M/s. Shree Ganesh Engg. in 2014, found satisfactory.
- 01 no of defect was observed, marked as D1.
- D1 – In S–W direction approx 1'' below C- Weld seam localized pitting / erosion of 1'' in length and 1 to 1.5 mm depth observed, marked for necessary action.

Compartment No.8

- Concave bulging at the elevation of approx. 300 mm above tray and 3 to 6 mm. depth was observed in entire circumference. Same was observed during previous inspection.
- 05 nos. of tray holding clits were found blackish in colour and having corrosion attack including its welding. Same was observed during previous inspection.
- Previously repaired defects on liner found satisfactory.
- Insert liner found silver shiny in color. Its weld condition found satisfactory.
- New welding was done on both L-Weld seams by M/s. Shree Ganesh Engg. in 2014, found satisfactory.

Compartment No.9

- 02 Nos. of tray holding clits found blackish in color and having severe corrosion attack near liquid box including its welding. Same was observed during previous inspection.
- Insert liner found silver shiny in color.
- New welding was done on C-Weld seams of insert liner and both L-Weld seams by M/s. Shree Ganesh Engg. in 2015.

Compartment No.10

- Concave depression of approx. 7mm depth and 100 mm diameter at approx 70mm below the C-Weld seam in South side of shell observed. Same was observed during previous inspection.
- Approx. 9 mm Concave depression just above the C-weld seam towards the South side of man way and adjacent to L-Weld seam in approx. 100 mm dia. was observed. Same was observed during previous inspection.
- Vertical bulging of approx. 2-3 mm height and 25mm width observed from the C-Weld seam to the bottom of the compartment in north side of the shell. Same was observed during previous inspection.
- Concave depression of approx 5mm depth at 70mm below C-Weld seam in West side just adjacent to L-Weld seam observed in 100 mm area. Same was observed during previous inspection.
- 02 nos. of tray holding clits near liquid box found blackish in color and having severe corrosion attack including its welding, same was observed during previous inspection.
- 01 no. Pinhole detected in Helium leak test in C-Weld towards S-E direction which was repaired by welding after grinding. Detailed procedure of Helium Leak test is mentioned separately in this report.
- New welding was done on C-Weld seams of insert liner and both L-Weld seams by M/s. Shree Ganesh Engg. in 2015.

Compartment No.11

- Just below C-Weld seam concave depression of approx. 5 to 6 mm depth and 100mm dia. observed in N-W direction. Same was observed during previous inspection.

- Concave depressions of approx. 5mm and 9mm depth & approx. 100mm dia. observed just above the C-weld seam in North and West side of the shell respectively. Same was observed during previous inspection.
- In insert liner convex bulging of max. 3 mm height and 10 mm width observed just above circumferential stitch welds (approx. 125 mm long). Same was observed during previous inspection.
- Concave depression of approx 5 to 6 mm was observed just above and below of C-Weld seam in old and new liner. Same was observed during previous inspection.
- Both L-Weld seams welding roughening found.

Compartment No.12 (Bottom Compartment.)

- South side tray skirt is touching the shell liner may cause rubbing with liner. Same was observed during previous inspection.
- Down comer nozzle with dish end liner weld joint edges were observed exposed. Same was observed during previous inspection.
- Dark brown coloration observed on dish end.
- Concave depression of approx. 2-3 mm depth and approx. 5mm depth were observed at approx. 200mm above the C-Weld seam in 4"dia in East and West direction of the shell respectively. Same was observed during previous inspection.
- Roughening / corrosion/ erosion observed at bottom portion of the tray segments.
- All tray holding clits were found blackish in color and having corrosion attack including its welding.
- D.P test of all nozzles welding with liner carried out and found satisfactory.
- The entire dish end petal's welding, C- Weld seam found satisfactory.

NOTE

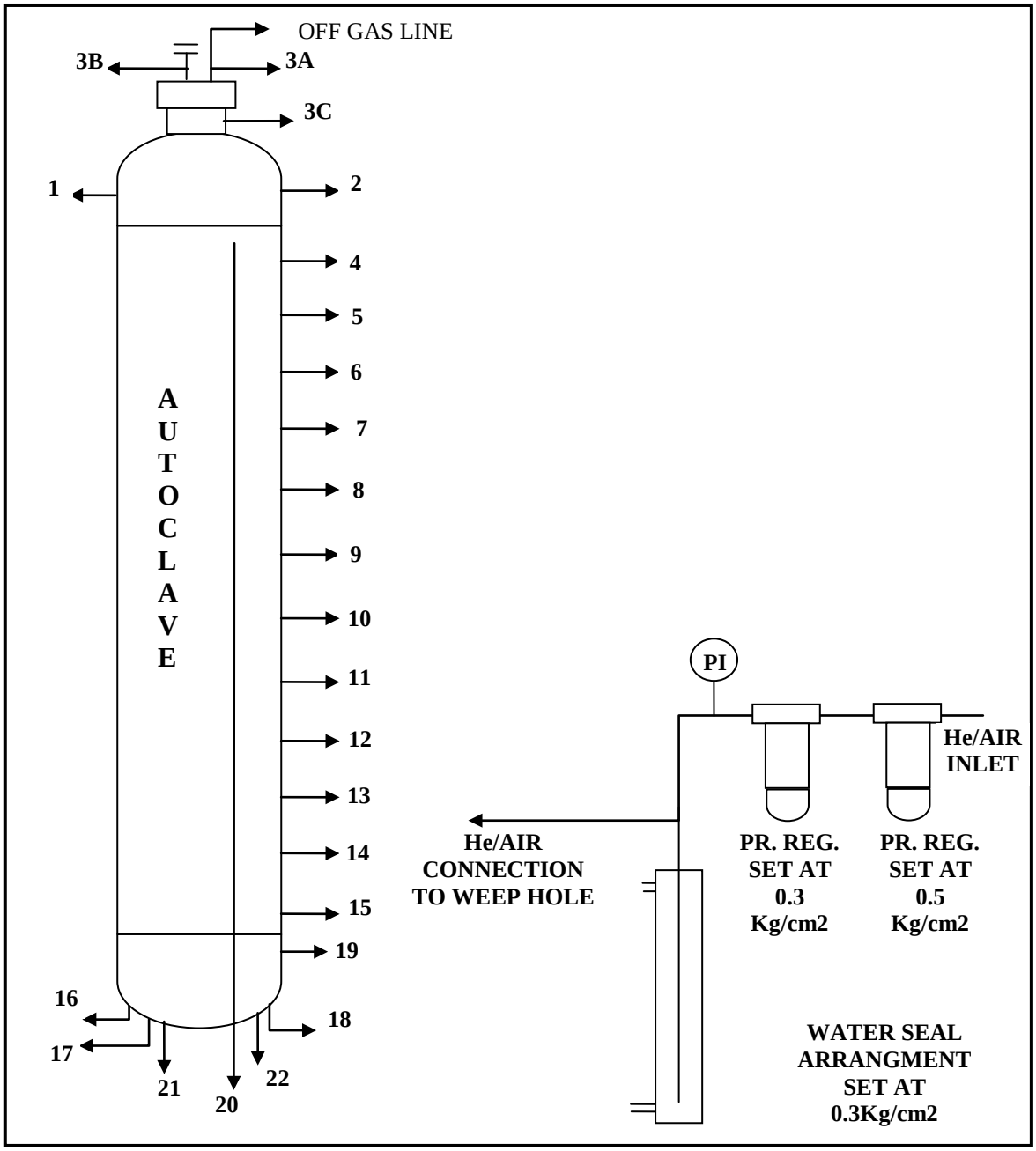
- Total 18 No's of defects marked for necessary repair. All marked defects were repaired by welding and found satisfactory in D.P. test.
- Severe etching observed on Downcomer in almost all the compartment.
- NE-North East, SW-South West, NW-North West, SE- South East L-Long seam, C-Circumferential seam.
- In general, few tray holding "J" bolts and tray segment fasteners were found loose / missing.

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

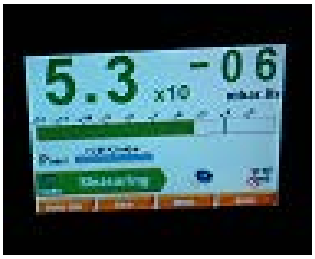
After De-pressurization of the H.P. System and Steam purging of Autoclave following activities were performed:

- 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 Air/Helium fed (Weep Hole No 15), at 3rd floor.
  - Pressure Indicator attached (Weep hole No 4), near the G-M tube.

- Pressurized the Annular space with air up to 0.28 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.
- All the shell TI tapping plugged after removing the TI element.
- Visually checked the Liner welds from inside the Autoclave for any leakage.
- The weld joints of the shell liner from Inside masked by Polyethene with the help of Aluminum Tape/White Masking Tape including clit welds. Welds behind the tray portion couldn't be masked due to space limitation.

- When all the weep holes found clear, connection of the Helium cylinder made with the weep hole no. 15 thru which air was fed.
- Soaking time of 3 hrs. was given in order to accumulate the helium gas in the annular space to a concentration & permeate thru the leak. Annular space pressure maintained at 0.28 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 1.3 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.

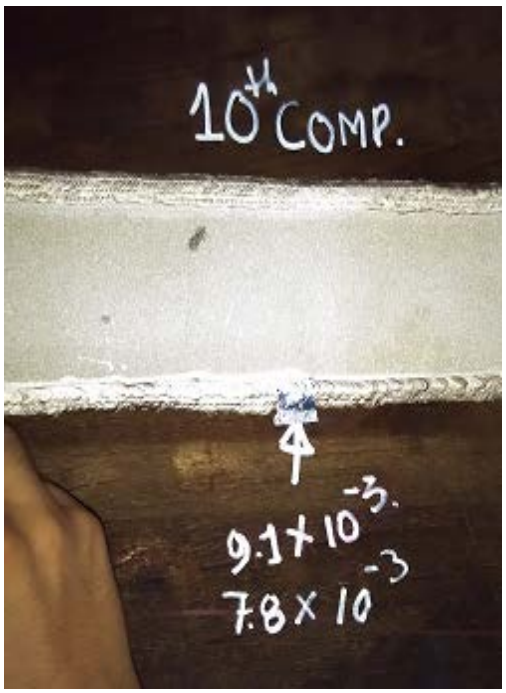


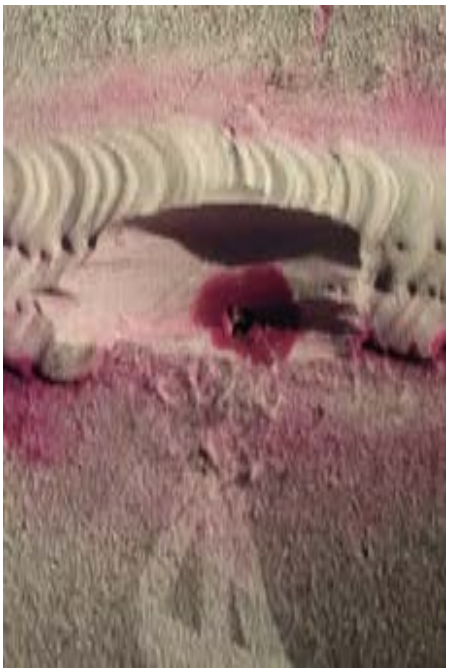
- Punctured the polythene sheets and inserted probe inside the envelop for detection of helium gas presence. In case of an indication of increased helium concentration above normal background reading, removed polythene envelope from identified portion and performed scanning to locate the leak.

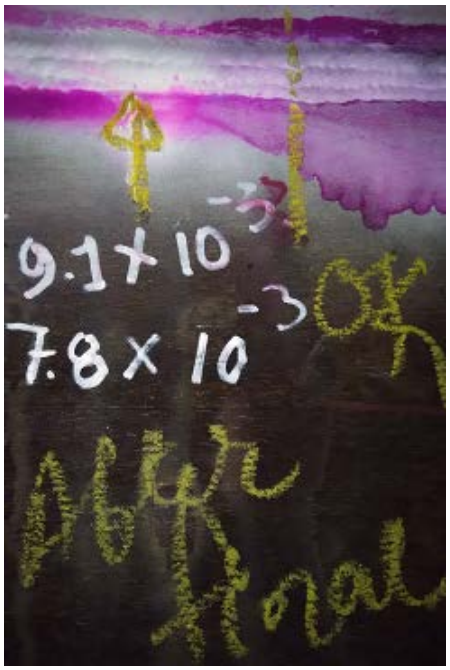
- Scanning was started from bottom most shell compartment no. 11.Scanning of all the C-Weld seams & L-Weld seams of Compartment no 11th to 2nd was carried out including Clit weld joints with the liner. Leak observed while scanning the bottom C-Weld seam of 10th compartment Insert liner and concentration of Helium increased to 7.8 x 10^{-3} std.cc/sec. Again background was checked and found as 5.0 x 10^{-6} std. cc/sec.

  Scanning for pin pointing the leak from C-Weld seam of 10th compartment carried out.

  Leak Observed with the maximum rate of 9.1 x 10^{-3} std.cc/s. Marked for necessary repair.







The Leak testing procedure submitted by M/s Gulachi Engineers, Ghaziabad is attached at **Annexure-7.**

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)	6.50	6.59	6.69	6.89	6.59	750mm Section Replaced in Yr. 2002 by BC-05.
	Shell Liner Old (Top)	5.00	4.10	4.42	4.29	3.83	
	Shell Liner (Middle)	5.00	4.16	4.59	4.51	4.24	
	Shell Liner (Bottom)	5.00	4.13	4.56	4.70	4.11	
	Top-Dome	6.50	6.59	4.84	6.49	6.52	Replaced in Yr. 2002 by BC-05.
	Tray Segment -1	8.00	3.24	3.26	3.44	3.29	
	Tray Segment -2	8.00	3.39	3.69	3.42	3.29	
	Tray Segment -3	8.00	3.29	**2.99**	3.14	2.99	Overall Min. tray thickness
	Tray Segment -4	4.42	4.21	3.40	3.30	3.60	
	Manway Liner	6.88	7.01	6.86	6.92	6.81	Replaced in Yr. 2002 by BC-05.
02	Shell Liner (Top)	5.00	3.90	4.32	4.42	**3.49**	Overall Min. liner thick.
	Shell Liner (Middle)	5.00	4.01	4.29	4.39	4.11	
	Shell Liner (Bottom)	5.00	4.06	4.44	4.59	4.05	
	Tray Segment-1	8.00	3.29	4.06	3.25	5.39	

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	8.00	3.62	3.65	3.61	3.25	
	Tray Segment-3	8.00	3.41	3.61	3.52	3.24	
	Tray Segment-4	8.00	3.30	3.66	3.45	3.52	
	Down-Comer	10.00	5.62	5.79	5.94	5.72	
03	Shell Liner (Top)	5.00	3.99	4.21	4.12	4.30	
	Shell Liner (Middle)	5.00	4.27	4.35	4.10	4.07	
	Shell Liner (Bottom)	5.00	4.40	4.19	4.22	4.21	
	Tray Segment-1	8.00	3.39	3.80	3.96	3.65	
	Tray Segment-2	8.00	3.70	3.81	4.14	3.26	
	Tray Segment-3	8.00	3.65	3.82	3.69	3.29	
	Tray Segment-4	8.00	3.65	3.78	3.97	3.99	
	Insert Liner	6.50	6.82	6.71	6.84	6.58	Replaced in Yr. 1997
	Down-Comer (Shiny)	10.00	9.11	8.82	8.92	9.02	
	Down-Comer	10.00	**5.10**	5.14	5.59	5.69	Overall Minimum Down- Comer thickness
04	Shell Liner (Top)	5.00	4.12	3.90	3.86	4.21	
	Shell Liner (Middle)	5.00	4.23	4.21	4.03	4.30	
	Shell Liner (Bottom)	5.00	4.48	4.29	4.21	4.36	
	Tray Segment-1	8.00	3.78	3.99	3.85	3.52	
	Tray Segment-2	8.00	3.86	4.01	4.17	3.62	
	Tray Segment-3	8.00	3.92	4.11	4.21	3.96	
	Tray Segment-4	8.00	3.98	3.80	3.94	3.69	
	Insert Liner	6.50	6.18	6.31	6.29	6.28	Replaced in Yr.1999
	Down-Comer	10.00	5.90	5.98	5.96	5.96	
05	Shell Liner (Top)	5.00	4.31	4.62	4.36	4.62	
	Shell Liner (Middle)	5.00	4.91	4.76	4.52	4.79	
	Shell Liner (Bottom)	5.00	4.69	4.82	4.69	4.90	
	Tray Segment-1	8.00	3.57	4.24	4.33	4.36	
	Tray Segment-2	8.00	4.21	4.01	3.88	3.95	
	Tray Segment-3	8.00	4.09	3.80	3.99	4.14	
	Tray Segment-4	8.00	3.76	4.06	4.36	3.88	
	Down-Comer	10.00	6.11	6.18	6.29	6.09	
	Down-Comer (Shiny)	10.00	8.98	9.11	8.72	9.21	

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)	
06	Shell Liner (Top)	5.00	4.31	4.52	4.40	4.45	
	Shell Liner (Middle)	5.00	4.26	4.79	4.49	4.59	
	Shell Liner (Bottom)	5.00	4.52	4.53	4.36	4.90	
	Tray Segment-1	8.00	4.48	4.60	4.36	4.49	
	Tray Segment-2	8.00	4.92	4.69	4.99	5.01	
	Tray Segment-3	8.00	4.72	4.19	4.62	5.22	
	Tray Segment-4	8.00	4.98	5.09	5.11	4.36	
	Down-Comer	10.00	6.42	6.31	6.12	6.30	
07	Shell Liner (Top)	5.00	4.36	4.57	4.51	4.62	
	Shell Liner (Middle)	5.00	4.49	4.81	4.60	4.59	
	Shell Liner (Bottom)	5.00	4.36	4.69	4.51	4.71	
	Tray Segment-1	8.00	5.01	5.09	5.15	4.99	
	Tray Segment-2	8.00	4.94	4.79	5.19	5.11	
	Tray Segment-3	8.00	4.90	4.92	4.92	4.76	
	Tray Segment-4	8.00	4.96	4.60	5.11	5.16	
	Down-Comer	10.00	6.39	6.31	6.45	6.39	
08	Shell Liner (Top)	5.00	4.59	4.40	4.65	4.60	
	Shell Liner (Middle)	5.00	4.60	4.68	4.60	4.56	
	Shell Liner (Bottom)	5.00	4.65	4.50	4.72	4.63	
	Tray Segment-1	8.00	5.01	4.82	4.92	4.78	
	Tray Segment-2	8.00	5.42	5.32	5.66	5.30	
	Tray Segment-3	8.00	5.64	5.39	5.62	5.75	
	Tray Segment-4	8.00	5.92	5.89	5.99	5.89	
	Insert Liner	6.50	6.43	6.89	6.52	6.56	Replaced in Yr. 2000
	Down-Comer	10.00	6.69	6.69	6.65	6.67	
09	Shell Liner (Top)	5.00	4.56	4.60	4.65	4.53	
	Shell Liner (Middle)	5.00	4.62	4.59	4.60	4.52	
	Shell Liner (Bottom)	5.00	4.86	4.55	4.59	4.69	
	Tray Segment-1	8.00	6.62	6.52	6.72	6.62	
	Tray Segment-2	8.00	5.42	6.40	6.48	6.43	
	Tray Segment-3	8.00	5.89	6.02	6.05	6.02	
	Tray Segment-4	8.00	6.21	5.96	6.29	6.44	
	Insert Liner	6.50	6.25	6.59	6.67	6.69	Replaced in Yr. 2001
	Down-Comer	10.00	6.82	6.99	6.96	7.01	

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)**	
10	Shell Liner (Top)	5.00	4.79	5.18	5.21	4.92	
	Shell Liner (Middle)	5.00	4.99	5.36	5.15	5.13	
	Shell Liner (Bottom)	5.00	5.02	5.61	5.25	5.02	
	Tray Segment-1	8.00	6.45	6.35	6.25	6.35	
	Tray Segment-2	8.00	6.83	7.01	7.02	6.31	
	Tray Segment-3	8.00	6.89	6.90	6.82	6.89	
	Tray Segment-4	8.00	6.65	6.80	7.30	6.56	
	Insert Liner	6.50	6.61	6.72	6.52	6.63	Replaced in Yr. 2002
	Down-Comer	10.00	7.16	7.29	7.21	7.88	
11	Shell Liner (Top)	5.00	4.59	4.72	4.58	4.69	
	Shell Liner (Middle)	5.00	4.66	4.67	4.71	7.76	
	Shell Liner (Bottom)	5.00	4.65	4.62	4.52	4.65	
	Tray Segment-1	8.00	6.90	7.01	7.29	7.05	
	Tray Segment-2	8.00	7.01	7.45	6.82	7.01	
	Tray Segment-3	8.00	7.69	7.55	7.29	7.32	
	Tray Segment-4	8.00	7.49	7.52	7.22	7.59	
	INSERT LINER	6.50	6.51	6.68	6.60	6.71	Replaced in Yr. 2002
	DOWN-COMER	10.00	7.74	7.82	7.72	7.67	
12 BOTTOM COMPARTMENT	SHELL LINER	5.00	4.68	4.64	4.63	4.81	
	PETAL PLATE	7.00	6.33	6.10	6.69	6.30	
	BOTTOM DOME	7.00	6.40	6.33	6.51	6.42	Replaced in Yr. 1993
	REDUCER- 10" X 8"	10.00	9.67	9.86	9.78	9.65	Replaced in Yr. 1997
	10" - PIPE	10.00	8.01	8.03	8.11	8.14	
	8" - PIPE (DISTANCE PIECE)	6.00	4.75	5.80	4.72	4.95	Replaced in Yr. 2000
	NOZZLE-8"	6.00	4.30	3.98	4.35	4.78	

Note :-

- Tray segment No. 01 from East side and Measurement point no. 1 from North side.
- The Complete down-comer was replaced in 1997.
- All the Trays were replaced in 1997 by H.E. Trays supplied by Scholler & Blackmenn, Austria.

HP STRIPPER (H-1201)

VISUAL INSPECTION

TOP CHANNEL

- The condition of sealing face was satisfactory.
- Overlay welding and liner in the gas phase (man way, dome and part of cylinder) was covered by thin grayish oxide layer, 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 was observed, more prominent in East - West direction between the tubes on tube sheet area, Suggested for cleaning.
- The tubes were found smooth from inside.

BOTTOM CHANNEL

- The condition of sealing face was found satisfactory.
- The overlay welds in the man way were 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 found more etched than the surrounding areas.
- 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.
- The tubes from inside were smooth.
- The liquid outlet pipe and the gas inlet pipe were bright, shiny and having no noticeable defect. Their nozzles and welds were in satisfactory condition.
- 01 no. Impingement plate washer of CO2 Inlet line turned black and 01 no. was found missing. This was marked for repair / replacement.

BOTTOM COVER

- The overlay welding was very 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.

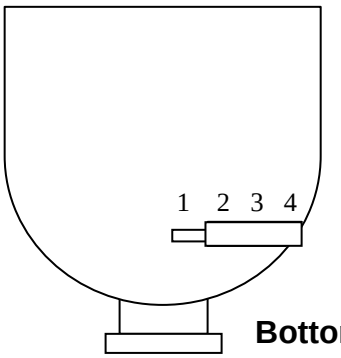
BOTTOM DOME

	Minimum Thickness (mm)	Maximum Thickness (mm)	Design Thickness, mm (Minimum)
Man way (Overlay)	19.35	21.85	8.0
Dome area (Overlay)	12.25	13.58	8.0
Cylindrical area (Liner)	8.12	8.52	8.0
Tube sheet-Overlay weld	13.15 (Machined)	15.85 (Machined)	8.0
Bottom Cover (Overlay)	17.15	18.12	8.0

TOP DOME

	Minimum Thickness (mm)	Maximum Thickness (mm)	Design Thickness, mm (Minimum)
Man way (Overlay)	19.38	23.63	8.00
Dome area (Overlay)	11.43	13.58	8.00
Cylindrical area (Liner)-Gas phase	8.26	8.71	8.00
Cylindrical area (Liner)-Liquid phase	7.79	7.99	8.00
Tube sheet-Overlay weld	13.57 (Machined)	13.99 (Machined)	8.00

RADIOACTIVE SOURCE WELL



Bottom Dish End

POINT NO.	DESIGN THK.	MEASURED THICKNESS (Minimum)
1	7.5	8.54
2	19.0	18.62
3	19.0	18.73
4	19.0	18.58

All measurements are in mm.

FERRITE MEASUREMENT

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

EDDY CURRENT TESTING OF TUBES

Eddy current inspection of tubes was carried out by M/s TesTex NDT India Pvt. Ltd. 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 : 0.51 to 0.60 mm observed in 01 tube
- Wall loss : 0.65 to 0.69 mm observed in 02 tubes
- Wall loss : 0.70 to 0.75 mm observed in 72 tubes
- Wall loss : 0.76 to 0.80 mm observed in 324 tubes
- Wall loss : 0.81 to 0.85 mm observed in 746 tubes
- Wall loss : 0.86 to 0.90 mm observed in 994 tubes
- Wall loss : 0.91 to 0.95 mm observed in 460 tubes

Result and Conclusion: Majority of the wall thinning was observed between 2nd to 5th baffle from top tube-sheet. (Tube sheet layout attached at **Annexure-8**).

H.P. CONDENSER (H-1202)

VISUAL INSPECTION

TOP CHANNEL HEAD

- The gasket sealing face was found satisfactory.
- The liner and welds in the channel were shiny and slightly rough.
- Circumferential Weld seam, patch plate in South direction and long seam welding of shell liner found rough.
- 06 nos. crevice cavities were observed and marked & numbered with yellow chalk.
- The liners above to the gas inlet have scattered bluish grey oxide scale.
- Minor roughening was observed on the tube sheet overlay near tube sheet to channel circumferential weld joint in complete periphery. It was observed more predominant in West & South direction.
- The tray support clips were shiny and slightly etched.
- The tube-to-tube sheet welds were found satisfactory.
- Few tube ends were found slightly damaged.
- Many tube showed burn-through at ID of tube, these were also observed in earlier inspections.

BOTTOM CHANNEL HEAD

- The sealing face was found satisfactory.
- Man-way, Shell and dish end liner was silvery, shiny in color.
- Approx 1.5mm deep dent was observed on shell liner just above the dome to shell liner weld joint in North-West direction, marked with Yellow chalk.
- Please refer attached Photograph.

- All liner welds and repairs were bright and smooth.
- The tube to tube sheet welds were bright shiny and smooth.
- Many tubes showed burn-through defects, these were also observed in earlier inspections.
- Roughening of Gas outlet nozzle long seam welding observed.

- **02 no's of Crevice/Cavity observed in the I.D. of Gas Outlet Nozzle to elbow weld. Need to be built-up by welding. Marked with the Yellow chalk.**

BOTTOM COVER

- The sealing face was found satisfactory.
- The liner was shiny and slightly etched.

THICKNESS MEASUREMENT

Weld Overlay and Liner thickness measurement:

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

BOTTOM DOME

	Minimum Thickness (mm)	Maximum Thickness (mm)	Design Thickness (mm)
Man way (Liner)	**4.52***	**6.47**	**6.0**
Dome area (Liner)	**6.71**	**6.88**	**6.0**
Cylindrical area (Liner)	**6.51**	**7.74**	**6.0**
Tube sheet-Overlay weld	**9.40**	**10.7**	**8.0 (Min)**
Bottom Cover (Liner)	**19.83**	**20.06**	**18.0**

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

TOP DOME

	Minimum Thickness mm	Maximum Thickness mm	Design Thickness mm (Minimum)
Man way (Liner)	5.48	6.92	6.0
Dome area (Liner)	6.51	6.64	6.0
Cylindrical area (Liner)	6.28	6.42	6.0
Tube sheet-Overlay weld	7.82	8.88	8.0 (min)

FERRITE MEASUREMENT

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

EDDY CURRENT TESTING OF TUBES

- Eddy current inspection was carried out by M/s TesTex NDT India Pvt. Ltd. Total tubes in H.P. condenser are 1970 out of which 218 tubes were tested for 12000mm tube length and 1725 tubes tested for 4000mm length. 10 tubes could not be tested due to tray support pads obstructing the probe. 15 tubes were plugged before inspection. The observations are as under:
- One tube, Row no 35 x Tube no 31 having I.D. pits, resulting wall loss in the range of 31-40 %. This tube was plugged as a precautionary measure.

AIR-BUBBLE TEST FOR LEAK DETECTION

- Air Bubble test was carried out to detect any leakage from the Tube or Tube to Tube-sheet weld joints. Following two tubes observed having leakage at 2.8 Kg/cm^2

	Row No.	Tube no.
1.	25	27
2.	31	23

Both tubes were plugged.

- No leakage was observed from tube to tube-sheet welds.

HYDRO TEST FOR LEAK DETECTION

- The shell side of H.P. Condenser was pressurized at 11.0 Kg/cm2. One tube, Row No. 23 & Tube no 23 observed having leakage, the same tube was plugged. Equipment found satisfactory in re-hydro test.

04 Nos. tubes were plugged in this turnaround. Total 19 tubes are plugged till date. The tube sheet layout is attached at **Annexure-9.**

FERRITE MEASUREMENT

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

H.P.SCRUBBER (H-1203)

TOP SHELL

- Shell internal surface was found brownish black in coloration.
- CO_2 inlet nozzle flange (3/4”NB) located at west side found corroded.
- Condition of liquid inlet and gas outlet pipe found satisfactory.
- CO_2 Inlet line in south side was found intact.
- Shell liner weld joint below the diaphram plate found satisfactory.
- Condition of liquid inlet and gas outlet pipe found satisfactory.
- Tube bundle is not removed.

INSPECTION OF OTHER VESSELS / EQUIPMENT

H-1104 (C02 SPRAY COOLER)

- Demister pad condition was found satisfactory.
- Risers holding clamps with Liquid distributor tray were found satisfactory.
- Weld joint condition was found satisfactory.
- Some foreign particles were found lying inside.

H-1131-A (LO COOLER OF P-1102-A)

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

H-1131-B (LO COOLER OF P-1102-B)

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

H-1131-C (LO COOLER OF P-1102-C)

- Thin creamy scales were observed inside few the tubes.
- Tube sheet condition was found satisfactory.

H-1204 (RECIRCULATION HEATER):

- Hard blackish scaling prominent at bottom side observed inside the tubes.
- Brownish scaling was observed on both top and bottom tube sheet.
- Foreign particles, Glass wool wastage found lying on top tube sheet,suggested to clean before box up.

H-1205 LP CARBAMATE CONDENSER

IRIS INSPECTION OF TUBE BUNDLE

The tubes were inspected first time after new exchanger was put in service during April-2014 by M/s TesTex NDT India Pvt. Ltd, Mumbai by Internal Rotating Inspection System (IRIS). 02 No. of tube holes were plugged earlier due to leakage. Total 1160 tubes were inspected. (Total No. of U-tubes are 581 Nos. or 1162 tube holes)

Result and Conclusion:

% Wall Loss	No. of Tubes (Total 1160)
0-10	1104
11-20	46
21-30	07
31-40	01
41-55	Nil
>56	02

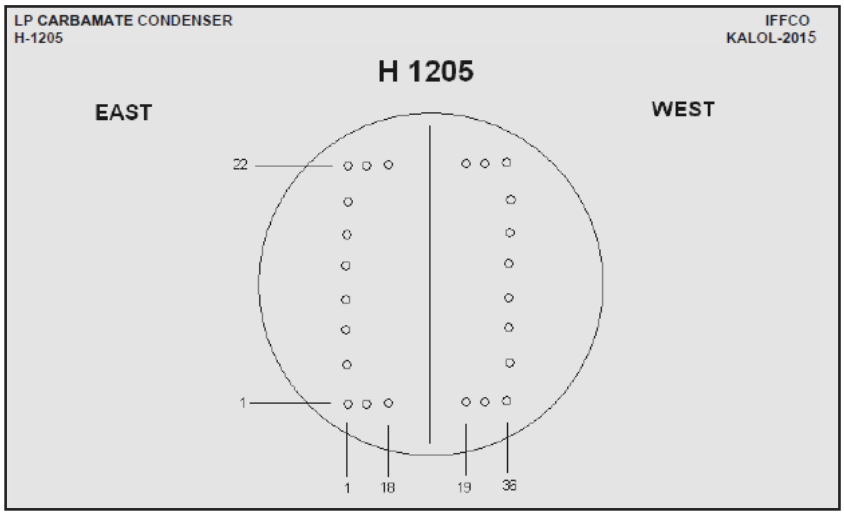
VISUAL INSPECTION OF TUBE BUNDLE

L.P. Carbamate Condenser was removed from its shell. Visual Inspection of the same was carried out. The observations made are as under:

Sr. No	Row No.	Tube No.	Visual Observations	Remarks
1	**1**	**14**	Dent/Rub of approx 0.8mm depth was observed.	Plugged (33%Wall loss in IRIS)
2	**1**	**15**	Dent/Rub of approx 0.4mm depth was observed.	---
3	**2**	**1**	Severe Rubbing	Plugged (Min. reading in IRIS 0.89mm)
4	**2**	**25**	Rub Observed	Already Plugged Tube.
5	**5**	**1**	Minor rub observed.	---
6	**6**	**1**	Minor rub observed.	---
7	**11**	**1**	Severe Rubbing of approx 1.0mm depth	Plugged
8	**32**	**1**	Minor rub observed.	---
9	**32**	**30**	Dent/Rub of approx 0.3mm depth was observed.	Tube is touching the baffle ring.
10	**35**	**1**	Severe Rubbing	Plugged (Min. reading in IRIS 0.89mm)
11	**35**	**25**	Approx. 15mm hole observed in tube	Already Plugged Tube.

Note:

- Row No. East to West
- Tube No. North to South



03 Nos. U-tubes plugged in this turn-around. Total plugged U-tubes till date are FOUR. The tube sheet layout is attached at **Annexure-10.**

Hole in Tube No. : 25 of Row No. : 35

Rubbing mark in Tube No. : 01 of Row No. : 02

H-1207 (CIRCULATION SYSTEM -II COOLER)

- Pitting 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 all tubes.
- Epoxy primer may be applied inside channel cover.

H-1352 (REFLUX CONDENSER)

TOP TUBE SHEET

- Tube to tube sheet welding was found satisfactory.
- Scaling was observed on the inside surface of all the tubes and also on tube-sheet area.

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.
- Tubercules formations observed inside the outlet side channel.
- Epoxy primer paint inside the channel area may be applied
- Thermowells were found intact in position, however CW outlet side thermowell was found covered with thick scaling .

H-1421, FLASH TANK CONDENSER

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

H-1422 (FIRST STAGE EVAPORATOR):

- The shell and Dish ends have grayish black in coloration.
- Colour of tube sheet was blackish.
- Tubes to tube sheet weld joints were found satisfactory, however minor bending of outer periphery was observed.
- Condition of impingement cone was found satisfactory.
- Impingement cone to support bolts were bent but tack welded and found satisfactory.
- Top distributor outlet vanes found clear and intact.
- Condensate flushing spargers (08 nos.) were found in satisfactory condition, but minor urea solution was observed inside it.
- At bottom dish end water and urea lumps were observed.

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.
- Thick brownish scales were observed on the tube sheet.
- Minor scales were observed inside few tubes.
- Tubes were found filled with water.

H-1815 (SURFACE CONDENSER)

SOUTH SIDE HALF (EAST SIDE CHANNEL)

TOP HALF

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

- Thermowell was found intact.
- Minor scaling was observed at ID of few tubes.

BOTTOM HALF

- Tube sheet was found in satisfactory condition.
- Minor scaling was observed at ID of few tubes.

SOUTH SIDE HALF (WEST SIDE CHANNEL)

TOP HALF

- Tube sheet was found in satisfactory condition.
- Minor scaling was observed inside the tubes.
- Debris was found collected above partition plate.
- Wire piece found lying inside the tube.

BOTTOM HALF

- Tube sheet was found in satisfactory condition.
- Thermo well was found intact.
- Minor damage of epoxy coating was observed

NORTH SIDE HALF (EAST SIDE CHANNEL)

TOP HALF

- Tube sheet was found in satisfactory condition.
- Epoxy coating was found intact.
- Thermo well was found intact.
- Minor scaling was observed at ID of few tubes.

BOTTOM HALF

- Tube sheet was found in satisfactory condition.
- Epoxy coating was found peeled off at few locations and corrosion started.
- Minor scaling was observed at ID of few tubes.

NORTH SIDE HALF (WEST SIDE CHANNEL)

TOP HALF

- Tube sheet was found in satisfactory condition.
- Minor scaling was observed inside the tubes.
- Epoxy coating was found intact.

BOTTOM HALF

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

V-1101 (CO2 KNOCK OUT DRUM)

- Epoxy paint was found peeled off from few locations in bottom dish end and shell

- Three segments of Demister pads were found shifted upwards from its position.

V-1202 (RECTIFYING COLUMN)

FROM TOP MANHOLE

- Grey hard scales were observed on entire shell portion.
- Cleats for holding the trays have fastener holes, these holes were observed elongated downwards.
- Tray support / Mesh Grid support strips found satisfactory and they were covered with grayish hard scales.

FROM BOTTOM MANHOLE

- Coloration of top cone was brownish with white solution like layer on it observed.
- Condition of the nozzles found satisfactory

V-1206 (ATMOSPHERIC VENT SCRUBBER):

- Demister pads were found intact and satisfactory in position.
- Shell observed brownish red in colour from inside.
- All bolts of liquid inlet flange found satisfactory.
- Hard scaling were observed at scattered locations.
- Overall condition was found satisfactory.

V-1301 (SECOND DESORBER)

BOTTOM COMPARTMENT

- Shell observed brownish in colour from inside.
- One clamp of the tray was found tied with the adjacent one with wire.
- Nozzle condition was found satisfactory.
- Thermo well was found intact.
- Overall condition was found satisfactory.

TOP COMPARTMENT:

- Shell Internal surface found rusty / brownish in colour.
- Fasteners and its clamp of the tray observed in good condition.
- 4" nozzle found satisfactory.

V-1351 (HYDROLYSER)

TOP COMPARTMENT

- Brownish black coloration was observed on Top dish end and shell
- Trays also observed brownish black in color.
- Fasteners of top sieve tray were found intact in position.
- Nozzles and top sieve tray holes found clogged with thick layer of sludge.

BOTTOM COMPARTMENT

- Grayish black coloration was observed from inside.
- Condition of the perforated trays found satisfactory.
- Tray clamps & steam inlet pipe found satisfactory.
- Flange and clamp fasteners of Steam inlet pipe were found loose.

V-1352 (FIRST DESORBER)

FROM BOTTOM MANHOLE

- Brownish coloration was observed inside the vessel.
- Thin scaling was observed on the shell surface.
- Condition of the perforated trays found satisfactory.
- Weld joint condition was found satisfactory.

FROM TOP MANHOLE

- Brownish coloration was observed inside the vessel.
- All fasteners were found intact
- Weld joint condition was found satisfactory.

V-1418 (PRE EVAPORATOR SEPARATOR):

- Top half observed silver and bottom half observed brownish in colour.
- Condition of the cone and weld joints was found satisfactory.
- Entire surface of the tube sheet was covered with grayish scales/rust.
- Tube to tube sheet weld appeared to be in satisfactory condition.
- Tubes found satisfactory.
- Impingement cone was found in intact condition.
- Little water was found accumulated on the bottom of the dish end.

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.
- Solidified urea solution particles were found adhered on demister pads at few locations.
- Support channels and outer ring of demister pads were found lifted in East direction, tied by metallic wires which were broken.

V-1502 (23 ATA STEAM DRUM)

- Brownish black coloration was observed inside the vessel.
- Scaling was observed at both dished ends.
- Condition of distributor pipe, all welds, all nozzles and thermo-well found satisfactory.

V-1811 (1ST STAGE SEPARATOR)

- Demister pads were found intact in position.
- Vortex breaker was found intact in position.
- Condition of the weld joints was found satisfactory.
- Demister drain pipe bottom tack weld found broken, need to be tack welded.
- All Nozzles found clear from inside.
- 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.
- Demister drain pipe was found intact in position.
- All 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) seems to be detached from its weld joint and lying freely inside the vessel (in vertical condition).This was observed during previous inspections also.
- Vessel from inside was found grayish in colour.

T-1301 (AMMONIA WATER TANK)

- Bottom plate and bottom half of shell observed brownish in colour
- Silver bright colour observed on top half of shell.
- Bottom plate was found bulged upwards at various locations.
- Weld joints and nozzle condition was found satisfactory.
- Thermowell condition was found satisfactory.
- Internal surface of the shell was found oily.
- Condition of the roof was found satisfactory.

T-1301-A, NEW AMMONIA WATER TANK

- Bottom plate and bottom half of shell observed brownish in colour.\
- Top dome observed silver shiny in colour.
- All the weld joints and nozzle condition was found satisfactory.
- Thermo-well found intact.
- Overall condition was satisfactory.

T-1401, UREA SOLUTION TANK

- Brownish coloration observed inside of the shell.
- Thermo-well condition found satisfactory.
- Nozzles and weld joints condition found satisfactory.
- Bottom plate having upward bulging at centre and downward at entire
- Circumference as observed in the past also.
- Stiffener provided on top roof plate was found intact in position.

T-1401-A , NEW UREA SOLUTION TANK

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

T-1501 (CONDENSATE TANK).

- Condition of weld joints was found satisfactory.
- Reddish brown coloration was observed inside the tank.
- Supports of 6” condensate inlet were found intact.
- Loose welding rod pieces and metallic debris were found lying inside the tank, need to be cleaned.
- Overall condition of the tank was found satisfactory.

MISCELLANEOUS JOBS

D.P. TEST

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

D.P. test of all the coupling bolts of Hitachi compressor train carried out and found satisfactory.

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.

VARIOUS MODIFICATION / REPLACEMENT JOBS

- During this shutdown, various modifications/replacement carried out by Technical Group. Inspection activities viz. DP Test, Radiography review and repairs etc. were carried out on the weld joints as per the fabrication procedure
- Performance qualification test of 06 Nos. welders offered by M/s Shree Ganesh Engineering was carried out. 06 nos. of welders were qualified during the test. These welders were allowed to perform welding in V-1201 Liner Weld joint repair, Steam Condensate Line Job, Ammonia line Valve replacement, H-1205 Elbow replacement and Steam Tracing line in Urea plant And Silo Dust plate jobs, CCS-1 Pipeline Job in B&MH Plant.

ANNEXURE-1

PIPELINE THICKNESS MEASUREMENT SUMMARY OF HP 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	23.01	K-1801,III	H-1813	22.00	4.38
1A	CO-F10-2119-PP25	1.5	160	7.14	K-1801,III	H-1813	7.03	1.44
1B	CO-F10-2119-PP25	0.75	160	5.54	K-1801,III	H-1813	5.20	6.13
2	CO-F10-2124	8	160	23.01	K-1801,DIS.	GA-1112	22.20	3.52
2A	CO-F10-2124	0.75	160	5.54	K-1801,DIS.	GA-1112	5.03	9.20
3	CO-E10-2139-PP25	4	80	8.56	CO-F10-2140-4” (TV-1808)	CO-E10-2122-6”	6.96	18.69
4	CO-F10-2140	4	160	13.49	K-1801,III	V-1813	12.14	10.00
4A	CO-F10-2140	0.75	160	5.54	CO-F10-2140-PP25	DRAIN	5.29	4.51
5	CO-E10-2122	6	80	10.97	H-1813	V-1813	9.73	11.30
6	GA-1112	6	F2	14.27	K-1101-2	GA-1201	11.28	20.95
6A	GA-1112	1.5	X1	5.08	FROM GA-1112	TO BYPASS	3.81	25.00
6B	GA-1112	1	F2	6.35			6.43	-----
7	GA-1201	6	X4	13.33	GA-1112	H-1201	14.34	-----
7A	GA-1201 TI-1207	1.5	X4	5.08	GA-1112	H-1201	4.89	3.74
8	GA-1202	1	F2	6.35	GA-1112-6"	Control-Valve (GA-1203)	4.14	38.80
9	GA-1203	1	X1	4.55	GA-1202	H-1203	3.75	17.58
9A	GA-1203 DRAIN	0.5	X1	3.73	GA-1202	H-1203	3.57	4.28
10	GA-1204	1	X1	4.55	H-1203	PR-1231	3.92	13.84
10A	GA-1204 DRAIN	0.5	X1	3.73	H-1203	PR-1231	2.95	20.91
11	GA-1602	8	F2	22.83	K-1801	GA-1112	21.34	6.52
11A	GA-1602	4	160	13.49	K-1801	GA-1112	12.08	10.45
11B	GA-1602	0.75	160	5.54	K-1801	GA-1112	5.41	-----
11C	GA-1602	0.5	80	3.73	K-1801	GA-1112	3.61	3.21
12	GA-1603	4	F2	11.13	GA-1602	GA-1604	10.03	9.88
13	GA-1606	1	B3	3.38	GA-1607-0.75”	GA-1350-1”	3.01	10.94
14	GA-1607	0.75	X3	2.87	K-1801	GA-1606-1”	2.06	28.22
15	MA-1106-B	4	E2	8.56	MA-1605-6"	MA-1203-4"	6.62	26.66
15A	MA-1106-B	1	E2	4.55	MA-1605-6"	MA-1203-4"	5.57	-----

SR. NO.	LINE NO.	NB (inch)	SCH.	NOM. THK. (MM)	LINE DESCRIPTION FROM	TO	MIN. THK. OBSERVED	%AGE RED.
15B	MA-1106-B	0.75	E2	3.91	MA-1605-6"	MA-1203-4"	4.17	-----
15C	MA-1106-B	1.5	E2	3.68	MA-1605-6"	MA-1203-4"	3.81	-----
16	MA-1106-A	4	E2	8.56	P-1102-A	MA-1605-6”	7.32	14.48
16A	MA-1106-A	0.5	E2	3.73	P-1102-A	MA-1605-6”	4.03	-----
17	MA-1123	4	E2	8.56	P-1102/B	MA-1605	7.10	17.05
17A	MA-1123	0.75	E2	3.91	P-1102/B	MA-1605	3.78	3.06
18	MA-1201	3	E2	7.62	MA-1605-6"	MA-1202-3"	6.83	10.36
18A	MA-1201	1.5	E2	5.08	MA-1605-6"	MA-1202-3"	3.36	33.85
19	MA-1202	3	X4	7.62	MA-1201	V-1201	6.37	16.40
19A	MA-1202	2	X4	5.54	MA-1201	V-1201	5.41	2.34
20	MA-1203	4	X4	9.14	MA-1106-6"	PR-1230	9.09	0.54
21	MA-1603	6	C2	7.11	MA-1122-6"	P-1102 /C	6.01	15.47
21A	MA-1603	1	C2	4.55	MA-1122-6"	P-1102 /C	4.09	10.10
21B	MA-1603	0.75	C2	3.91	MA-1122-6"	P-1102 /C	3.00	23.27
22	MA-1603	4	C2	6.02	MA-1122-6"	P-1102 /C	5.33	11.46
23	MA-1604***	3	E2	7.62	P-1102 /C Discharge	MA-1604-4"	5.49	27.95
23A	MA-1604	1	E2	4.55	P-1102 /C Discharge	RV	4.35	4.39
24	MA-1604	4	E2	8.56	MA-1604-3"	MA-1605-6"	7.02	17.99
24A	MA-1604	2	E2	5.54	MA-1604-3"	MA-1605-6"	5.12	7.58
24B	MA-1604	0.75	E2	3.91	MA-1604-3"	MA-1605-6"	3.13	19.94
25	MA-1605	6	E2	14.27	MA-1106	MA-1203	12.80	10.30
25A	MA-1605	0.75	E2	3.91	MA-1106	MA-1203	3.24	17.13
26	MA-1605	4	E2	8.56	MA-1106	MA-1203	8.10	5.37
27	MA-1607	4	C2	6.02	MA-1605	MA-1116	5.41	10.13
27A	MA-1607 DRAIN	0.75	C2	3.91	MA-1605	MA-1116	3.10	20.71
28	MA-1609	4	C2	6.02	MA-1603-6”	MA-1604-3”	4.83	19.76
29	PR-1201	8	X1	19.58	V-1201	H-1201	15.25	22.11
30	PR-1202	10	X1	24.33	H-1201	H-1202	20.01	17.75
31	PR-1203	8	X1	19.58	H-1202	V-1201 (Vapour Line)	17.02	13.07
32	PR-1204	8	X1	19.58	H-1202	V-1201 (Liquid Line)	17.08	12.76
32A	PR-1204 (TR-1202)	1.5	X1	5.08	H-1202	V-1201 (Liquid line)	4.04	20.47

SR. NO.	LINE NO.	NB (inch)	SCH.	NOM. THK. (MM)	LINE DESCRIPTION FROM	TO	MIN. THK. OBSERVED	%AGE RED.
33	PR-1205	6	X1	15.24	PR-1205-8"	V-1202	10.59	30.51
33A	PR-1205	1.5	X1	5.08	PR-1205-8"	V-1202	4.32	14.96
33B	PR-1205	0.75	X1	3.91	PR-1205-8"	V-1202	3.47	11.25
34	PR-1205	8	X1	19.58	H-1201 Bottom	V-1202	16.53	15.57
34A	PR-1205	6	X1	15.24	H-1201 Bottom	V-1202	11.49	24.60
34B	PR-1205 (TR-1210)	1.5	X1	5.08	H-1201 Bottom	V-1202	4.83	4.92
35	PR-1206	4	X1	10.40	PR-1210-10”	H-1203	12.27	-----
36	PR-1208	4	X1	10.40	V-1201 Top	PR-1206-4"	11.13	-----
36A	PR-1208 (TR-1206)	1.5	X1	5.08	V-1201 Top	PR-1206-4"	6.48	-----
37	PR-1211	1.5	X1	5.08	PR-1208-4”	PR-1212-4"	4.18	17.71
38	PR-1212	4	X1	10.40	H-1203	V-1201Bottom	9.00	13.46
39	PR-1213	2	X4	5.54	PR-1201	PR-1205-6"	4.09	26.17
40	PR-1224	3	X4	7.62	P-1201B	PR-1638-4"	6.31	17.19
41	PR-1225	3	X4	7.62	P-1201A/B, PR1638-4"	H-1203	6.72	11.81
42	PR-1226	2	X4	5.54	PR-1224	H-1205	4.28	22.74
43	PR-1230	6	X1	15.24	MA-1203-4"	H-1202	13.00	14.69
43A	PR-1230 (TR-1205)	1.5	X1	5.08	MA-1203-4"	H-1203	4.28	15.74
44	PR-1231	3	X1	7.62	H-1203	PRCV-1201	6.90	9.44
45	PR-1232 (JACKET)	6	-	-	PRCV-1201 (RV-1209)	ATMOS	3.10	-----
46	PR-1234	4	X4	10.41	PRC-1201 (H-1203)	V-1203	10.38	0.28
47	PR-1234	3	X4	7.62	P-1201A	PR-1638-4"	6.00	21.25
48	PR-1637	3	X4	7.62	P-1201C	PR-1638-4"	6.82	10.49
49	PR-1638	4	X4A	9.14	P-1201A/B/C	PR-1230-6"	12.08	-----
49A	PR-1638	1.5	X4A	5.08	P-1201A/B/C	PR-1230-6"	5.76	-----
50	PR-1666	2	X4A	5.54	PR-1637	PR-1226	4.18	24.54

***Segment of MA 1604 3” E2 was replaced with 4” E2.

ANNEXURE-2

PIPELINE THICKNESS MEASUREMENT SUMMARY

(SC, ST LINES)

Sr. No	LINE NO.	NB (inch)	SCH	NOM. THK. (MM)	LINE DESCRIPTION		Min. Thk. Observed	%Agered.
					FROM	TO		
SC-LINES								
1	CW-1118 / SC-1101	14	B1	9.525	H-1102	H-1206	8.3	12.86
2	SC-1102 (CW-1119-6")	6	B1	7.11	SC-1228	SC-1101	6.3	11.39
3	SC-1102 (CW-1119-12")	12	B1	9.525	SC-1228	SC-1101	9.1	4.46
4	SC-1102 (CW-1119-14")	14	B1	9.525	SC-1228	SC-1101	5.8	39.11
6	SC-1209	10	B4	9.27	H-1207	H-1203	8	13.70
7	SC-1211	10	B4	9.27	H-1203	P-1204	6.6	28.80
8	SC-1212**	10	B4	9.27	SC-1210	SC-1209	6.1	34.20
	SC-1212	4	B4	6.02	SC-1210	SC-1209	8.06	
9	SC-1213	6	B4	7.11	H-1201	V-1502	5.7	19.83
11	SC-1228	10	B4	9.27	P-1202	H-1102	8.5	8.31
12	SC-1407	3	B4	5.49	H-1422	T-1501	4.63	15.66
13	SC-1407	8	B4	8.18	H-1422	T-1501	6.28	23.23
14	SC-1409	4	B4	6.02	H-1424	T-1501	4.1	31.89
15	SC-1502	3	B4	5.45	P-1501/6	V-1501	4.60	15.60
16	SC-1502	2	B4	3.91	P-1501/6	V-1501	4.4	
17	SC-1504	6	B4	7.11	V-1503	V-1501	7.71	
17	SC-1504	4	B4	6.02	V-1503	V-1501	5.09	15.45
18	SC-1506	4	B4	6.02	T-1501	P-1505	4.44	26.25
19	SC-1507	3	B4	5.49	P-1505-A/B RETURN LINE	T-1501	4.78	12.93
20	SC-1510	2	XS	5.54	P-1502	PCV-1501	4.16	24.91

Sr. No	LINE NO.	NB (inch)	SCH	NOM. THK. (MM)	LINE DESCRIPTION		Min. Thk. Observed	%Aged.
					FROM	TO		
21	SC-1512	4	B4	6.02	SC-1213	LCV-1501	5.9	1.99
22	SC-1513	4	B4	6.02	LCV-1501	V-1503	4.66	22.59
23	SC-1514	4	B4	6.02	T-1501	SEAL POT	4.10	31.89
24	SC-1523	3	B4	5.49	HEADER	SC-1409	5.0	9.11
25	SC-1525	2	B4	3.91	SC-1536/7/8	SC-1522	4	
26	SC-1525	3	B4	5.49	SC-1536/7/8	SC-1522	4.9	10.75
29	SC-1601	10	C2	9.27	SC-1211	H-1418	7.64	17.58
30	SC-1607	1	B4	4.55	SC-1226	PR-1636	3.72	18.24
ST-LINES								
31	ST-1302	6	B4	7.11	ST-1504	V-1301	5.9	17.02
32	ST-1409	6	B4	6.02	ST-1504	H-1424	4	33.55
33	ST-1412	6	B4	7.11	ST-1415	P-1424	5.9	17.02
34	ST-1502	8	B4	8.18	ST-1116	V-1503	7.3	10.76
35	ST-1502	2	B4	3.91	PICV-1502	V-1503	4.6	
36	ST-1502	3	B4	5.49	ST-1502	V-1503	5.1	7.10
37	ST-1502	4	B4	6.02	ST-1502	V-1503	4.5	25.25
38	ST-1507	6	B4	7.11	ST-1506	ST-1302	5.9	17.02
39	ST-1614	4		6.02	ST-1409	H-1424	5	16.94

Note(**):

- SC-1212-10''-B4 (Sr.No-8) one 10''NB Tee,10''x4'' Reducer,4''straight pipe piece,4'' NB 01 no elbow replaced (Till TRCV-1201) due to heavy external corrosion and thickness reduction.
- ST-1502-6''-4'' (Sr.No-04) having thickness reduction in 6''x4'' Reducer so patch provided.

ANNEXURE-3

UREA PLANT VESSEL THICKNESS MEASUREMENT SUMMARY

Sl. 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-1102	L.P. Ammonia Preheter	8.0	10.1	---	10.0/ 8.0	10.1	----	17.0	15.0	11.76
2	H-1202	HP Condenser	20.26 / 14.35	20.26 / 14.35	---	---	---	---	---	---	---
3	H-1204	Recirculation Heater	11.0	10.7	3.00	9.0/7.0	9.56	---			
4	H-1209	LP Absorber Circulation Cooler	10	9.9	1.00	11.5	10.5	8.7	7.5	7.9	6.7
5	H-1303	Effluent Cooler	10.0	9.8	2.00	12.0/ 10.0	10.6	---	12.0/ 10.0	10.3	14.2
6	H-1419	Pre-Evaporator Condenser	9.5	9.7	---	12.7	11.3	11.2	12.7	12.2	4.0
7	H-1423	1st Stage Evaporator Condenser	10.0(T) /7(B)	11.3 /7.9	---	10.0/ 7.0	11	---	15.0/ 12.0	12.4	17.3
8	H-1425	2nd Stage Evaporator I Condenser	14.0	14.2	---	10(T) / 7.0(B)	18.1/18.0	---			
9	H-1426	2nd Stage Evaporator Ii Condenser	10.0(T) / 7.0 (B)	10.86/ 7.7	---	13.0/10.0(T) 9.0/7.0 (B)	12.72 (T) 8.96 (B)	---	10.0	9.0	10.40
10	H-1502	Vent Condenser	10.0	10.1	---	13.0/ 10.0	9.7	---	---	---	---
11	H-1811	1st Stage Gas Cooler of K-1801	12.0	12.8	---	12.0	11.96	0.33	---	---	---
12	H-1812	2nd Stage Gas Cooler of K-1801	10.0	10.5	---	10.0	11.7	---	21.0	22.22	---
13	H-1813	3rd Stage Gas Cooler of K-1801	10.0	10.1	---	10.00	9.34	6.60	30.0	32.08	---
14	H-1814 A	Main Lub Oil Cooler For K-1801	12	11.26	6.17	---	---	---	30.0	30.97	---
15	H-1814 B	Main Lub Oil Cooler For K-1801	12	11.4	5.00	---	---	---	30.0	31.95	---
16	H-1815	Surface Condenser	15(T) 12(B)	15.4 12.0	---	---	---	---	---	---	---
17	V-1101	CO_2 Knockout Drum	12.0/ 15.0	12.0/ 15.38	---	---	---	---	---	---	---
18	V-1202	Rectifying Column	9.0	10.3	---	11.0	11.9	---	---	---	---
19	V-1301	Second Desorber	6.0	5.8	3.33	6.0	8.8	---	---	---	---
20	V-1352	First Desorber	8.0	8.3	---	10.0	9.3	7.0	---	---	---
21	V-1353	Level Tank For Reflux Condenser	6.0	5.9	1.67	6.0/4.5	5.3	11.67	---	---	---

Sl. No	Equip. No.	Equip. Description	Shell			Dish End			Channel		
			Nom / Desig.	Min. / Meas	% Red.	Nom. / Desig.	Min. Meas.	% Red	Nom. / Desig.	Min./ Meas	% Red
23	V-1406	Flash Tank Separator	8.0	8.7	---	10.0	9.0	10.0	---	---	---
24	V-1409 A	Urea Solution Filter	6.0	6.7	---	6.0	5.7	5.0	---	---	---
25	V-1409 B	Urea Solution Filter	6.0	6.6	---	6.0	6.6	---	---	---	---
26	V-1418	Pre-Evaporator	12.0	12.2	---	10.0	10.5	---	---	---	---
27	V-1811	1st Stage Separator	5.0	5.8	---	6.0	5.66	5.6	---	---	---
28	V-1501	4 ATA Steam Saturator	15.0	15.22	---	15.0	15.62	---	---	---	---
29	V-1812	2nd Stage Separator	10.0	10.3	---	10.0	11.64	---	---	---	---
30	V-1813	3rd Stage Separator	30.0	30.2	---	30.0	28.5	5.0	---	---	---
31	V-1201	Autoclave	103.0	102.3	---						

ANNEXURE-4

GAUSS MEASUREMENT & DEMAGNETIZATION REPORT

K-1801 (HITACHI COMPRESSOR)

DESCRIPTION	POSITION	BEFORE (Gauss-max.)	AFTER (Gauss max.)
TURBINE (FREE ENDSIDE)			
Journal Bearing Pads	Governor side	0.7	Within limits
Journal Bearing Base Ring	Governor side	Top–0.5 Bottom–0.8	"
Shaft Journal	Governor side	1.0	"
Thrust Collar	Governor side	1.5	"
Thrust Bearing	Governor side	0.8	"
Thrust Base Ring	Governor side	0.9	"
Thrust Bearing Pads	Governor side	0.6	"
TURBINE (NORTH END)			
Journal Bearing Pads	Top Half	1.2	"
	Bottom half	1.8	"
Shaft Journal		0.9	"
Journal Bearing Base Ring	Top Half	0.8	"
	Bottom half	1.2	"
Collar	Active	0.9	"
	Inactive	0.6	"
L.P. CASE (TURBINE END)			
Shaft Journal		1.8	"
Journal Bearing Pads		Top– 0.4 Bottom–0.3	"
Journal Bearing Base Ring	Top	0.8	"
	Bottom	1.3	
Thrust Bearing pads		1.2	
L.P. CASE (G.B. END)			
Shaft Journal		1.8	"
Journal Bearing Pads		1.0 Max	"
Thrust Bearing Pads	Active	0.9	"
	Non active	0.8	
Thrust Collar		1.2	"
GEAR BOX			
L.S. Shaft Journal Bearing L.P. Side	Top half	1.0	"
	Bottom half	1.3	
L.S. Shaft Journal Bearing H.P. Side	Top half	0.8	"
	Bottom half	1.2	

DESCRIPTION	POSITION	BEFORE (Gauss-max.)	AFTER (Gauss max.)
H.S. Shaft Journal Bearing L.P. Side	Top half	1.0	"
	Bottom half	1.1	
H.S. Shaft Journal Bearing H.P. Side	Top half	0.4	"
	Bottom half	1.4	
Journal Bearing Pads		Top–0.6 Bottom–0.8	"
Thrust Base Ring	Inboard side	Top–1.2 Bottom–1.0	"
	Outboard side	Top– 1.4 Bottom–1.6	
Thrust Pads	Inboard side	0.4	"
	Outboard side	0.3	
Thrust Collar		1.0	"
Thrust Collar Journal		0.9	"
H.P. CASE (FREE END SIDE)			
Shaft Journal		0.8	"
Journal Bearing Pads		Top– 0.5 Bottom–0.6	
Journal Bearing Base Ring	Top	0.6	"
	Bottom	0.7	"
	Bottom	0.6	
Thrust Base Ring	Inboard side	Top-1.2 Bottom-1.7	
	Outboard side	Top-1.2 Bottom-1.8	
Thrust Pads	Inboard	0.8	
	Outboard	0.9	
Thrust Collar		1.1	"
H.P. CASE (G.B.SIDE)			
Shaft Journal		1.1	"
Journal Bearing Pads		Top– 1.1 Bottom–1.3	
Journal Bearing Base Ring	Top	0.6	"
	Bottom	0.8	"
Thrust Pads	Inboard	0.7	
	Outboard	0.6	
Thrust Collar		1.6	"
Thrust Collar Journal		0.9	"

ANNEXURE-5

METALLOGRAPHIC EXAMINATION LIST UREA PLANT-S/D-2015

SR. NO.	LOCATION	MOC	MICROSTRUCTURE OBSERVATION	REMARK
1	H1202, H.P.Condenser Stub end Gas outlet bottom side	SS	Presence of weld spot is observed at PM region. Weld metal microstructure shows dendritic structure of ferrite pools in austenite matrix. Microstructure at parent metal shows coarse-grained worked austenitic structure with twins	Presence of weld spot is observed at PM region. Microstructure is free from any micro cracks. Monitor after 2 years of service.

ANNEXURE- 6

RADIOGRAPHIC EXAMINATION OF HP LINE FITTINGS

Sr No.	Fitting Description	Location	Size (OD)	Nom. Thick. (mm)	RT Result
P-1102-A					
1	Drain of both recycle I/V-D/S	Ground Floor	½'' Sch.80	3.73	Satisfactory
2	Drain of discharge line U/S of strainer	Ground Floor	½'' Sch.80	3.73	Satisfactory
3	Pressure Transmitter tapping from strainer top,U/S of 1st Dis.Valve	Ground Floor	½'' Sch.80	3.73	Satisfactory
4	Vent and Drain between both Discharge I/V	Ground Floor	1" Sch. 80	4.55	Satisfactory
P-1102-B					
1	Drain of suction strainer	Ground Floor	1" Sch. 80	4.55	Satisfactory
2	One welded point in discharge line D/S of Dampener	Ground Floor	1" Sch. 80	4.55	Satisfactory **(Replaced in S/D 2014)**
3	Pressure Transmitter tapping point	Ground Floor	½'' Sch.80	3.73	Satisfactory
4	Recycle line drain	Ground Floor	½'' Sch.80	3.73	Satisfactory
5	Drain between both discharge I/V	Ground Floor	¾'' Sch.80	3.91	Satisfactory **(Replaced in S/D 2014)**
P-1102-C					
1	Drain between both suction I/V	Ground Floor	1" Sch. 80	4.55	Satisfactory
2	Vent D/S of both suction I/V	Ground Floor	1" Sch. 80	4.55	Satisfactory
3	Pressure Transmitter tapping 03 Nos	Ground Floor	¾'' Sch.80	3.91	Satisfactory
4	Vent between both recycle I/V	Ground Floor	1" Sch.80	4.55	Satisfactory

- Radiography carried out on total 6 no's randomly selected Weld joints of P-1102 A/B/C (HP Ammonia Pump) discharge line to assess the condition.
- No significant defects observed.

ANNEXURE- 7

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 0.28 bar to avoid any deformation in liner.

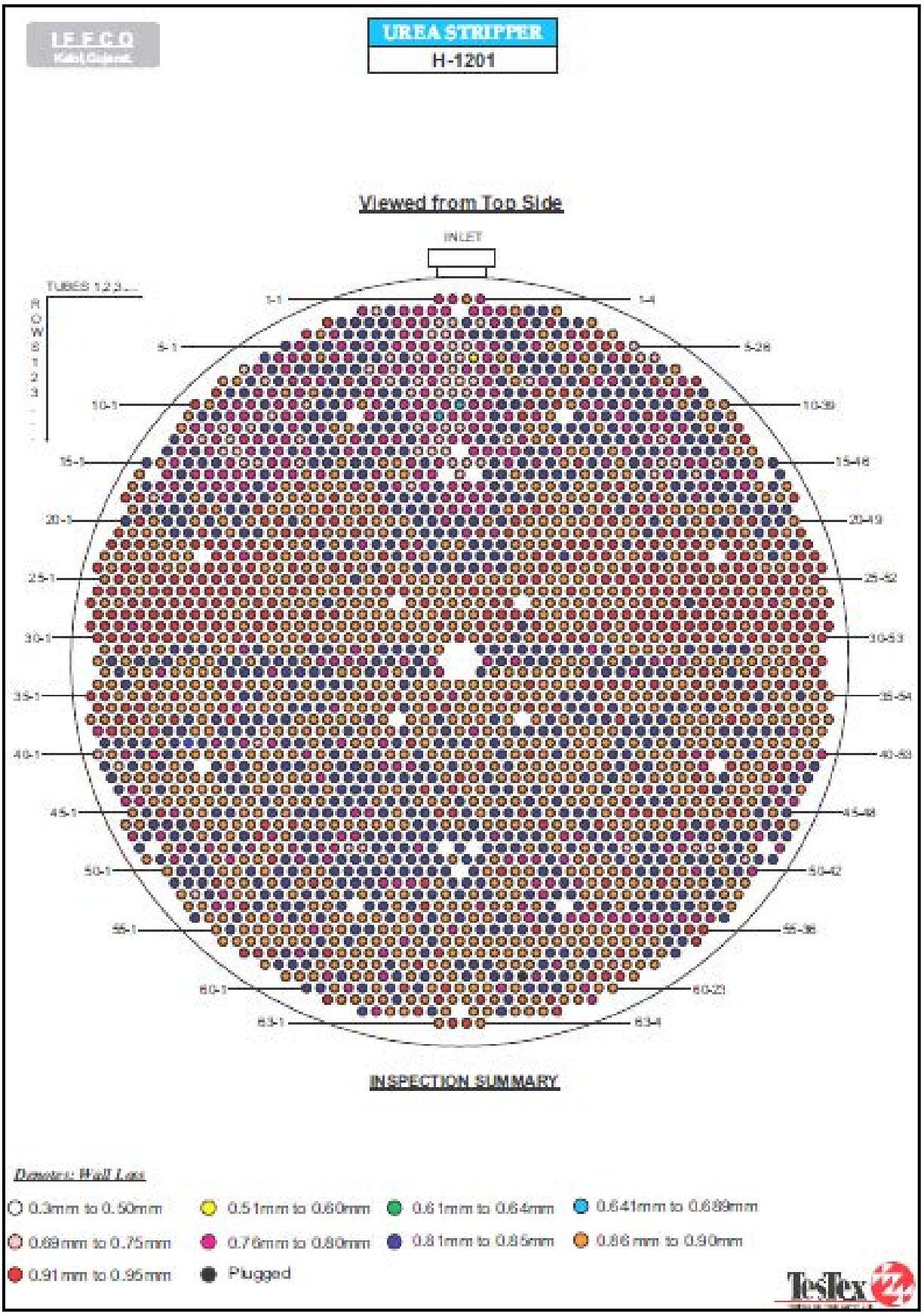
- **CALIBRATION**
  - HLD Calibration: Permeation type standard leak of the order 1.3×10^{-7} std.cc/sec fitted internally with Helium Detector shall be used to calibrate the instrument before testing and after testing and at intervals of not more than 4 hours during test
  - System Calibration: Scanning 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.

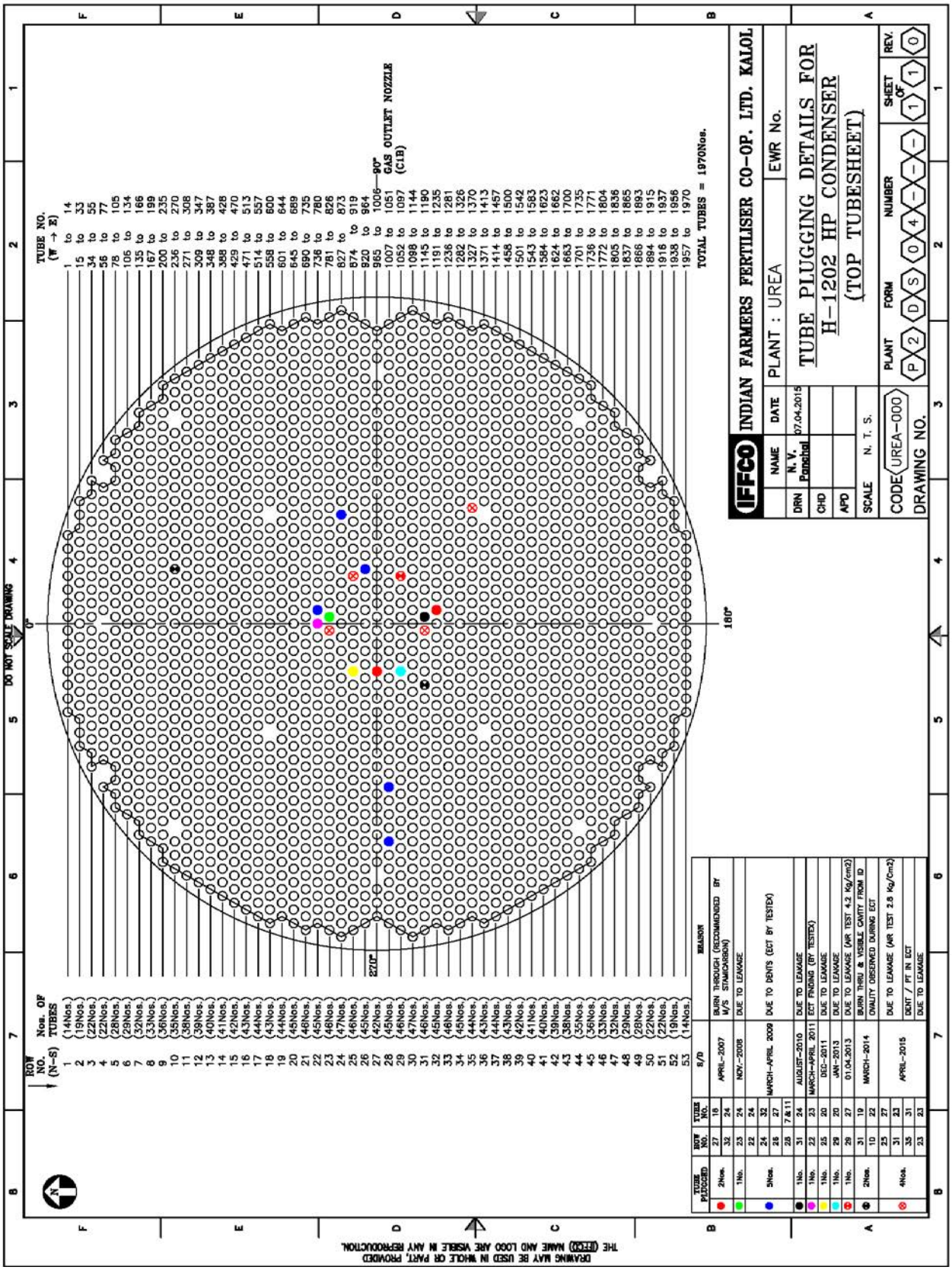
ANNEXURE- 8

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



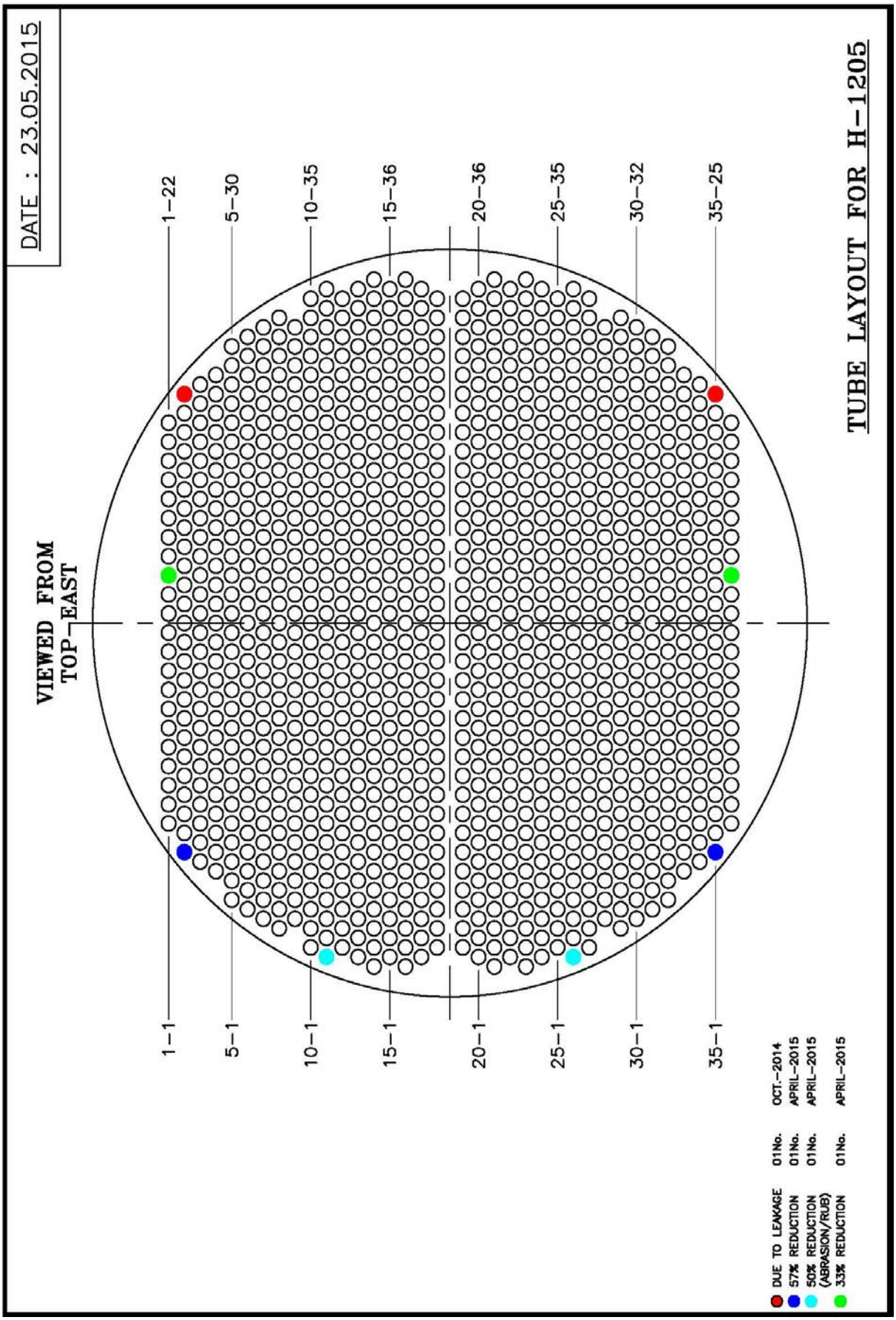
ANNEXURE- 9

TUBE SHEET LAY OUT OF H-1202 (VIEWED FROM TOP)



ANNEXURE- 10

TUBE SHEET LAY OUT OF H-1205 (VIEWED FROM TOP)



UTILITY PLANT
(INSPECTION)

The following inspection activities were performed in Utility Plant during Annual Shut-down 2015.

- Inspection of Deaerator.
- Inspection of boiler drums.
- Inspection of 52” NB CW Inter connection line of P-4405 and P-4401 C/D sump.

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

BHEL BOILER (GT-2068)

Visual inspection and ultrasonic thickness measurement of Steam Drum and Mud Drum was carried out.

STEAM DRUM

- The internal surface of the drum observed brownish black in colour.
- All the weld joints found satisfactory.
- Feed water inlet header 4’’NB one No’s ‘’ U’’ Clamp found broken from thread, it may be replaced. (4th Clamp from west side.)
- Overall condition of the steam drum found satisfactory.
- Minimum thickness of 100.45 mm and 79.13 mm was observed on shell and dished end respectively against the nominal thickness of 97.0 mm and 72.00 mm.

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.
- Overall condition of the mud drum found satisfactory.
- Minimum thickness of 81.52 mm and 55.74 mm was observed on shell and dished end respectively against the nominal thickness of 78.0 mm and 54.00 mm.

DEAERATOR

Inspection of the Deaerator Head and the Storage Shell carried out and observations are as under

Deaerator Head

- Bottom two tray segments were found displaced from its position. However few tray tack weld found cracked.
- Brownish coloration was observed inside the shell and dish end.

Deaerator Storage Shell

- Brownish coloration was observed inside the shell and dish end.
- Condition of the weld joint was found satisfactory.
- Minor rusting observed at both dish ends.

52"NB COOLING WATER INTER CONNECTION LINE OF P-4405 TO P4401C/D

- Epoxy paint was found peeled off at many locations however primer was found intact.
- Blisters of Epoxy paint also observed at many locations.
- All circumferential and long seam welds found satisfactory.

MISCELLANEOUS JOBS

D.P. TEST

Dye penetrant examination of weld joints of all the pipelines fabricated by contractors/departmentally, new pipeline fabrication / modifications job done by technical and maintenance groups etc. was carried out after root run welding and after final welding, as per requirement.

RADIOGRAPHIC EXAMINATION

Radiographic examination of weld joints of all the pipelines fabricated by contractors/departmentally, new pipeline fabrication / modifications job done by technical and maintenance groups etc. was carried out after root run / final welding, as per requirement.

Defects observed during the test were rectified & rechecked again for acceptance.

WELDER QUALIFICATION TESTS

- Performance qualification test of 22 Nos. welders offered by M/s General Engineering, Bharuch (W.O.No- 201004151497) was carried out. 12 nos. of welders were qualified during the test. These welders were allowed to perform various miscellaneous non-critical & Technical Departments' welding jobs.
- Performance qualification test of 04 Nos. welders offered by M/s Shiv Engineering was carried out. 04 nos. of welders were qualified during the test. These welders were allowed to perform Vibrating Screen Jobs, Misc CS/SS Jobs, and valve replacement Jobs & Technical Departments' welding jobs.

GAUSS MEASUREMENT

Measurement of residual magnetism (Gauss) on rotary and stationary parts of BFW pump (P-5111) 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.

GAUSS MEASUREMENT OF EQUIPMENT

BFW Pump Drive turbine (Q-5111)		
Journal Bearing Coupling Side	Top	0.4
	Bottom	0.7
Journal Bearing Governor Side	Top	0.6
	Bottom	0.7
Shaft Journal	Thrust End	1.5
	Non Thrust End	1.3
BFW Pump (P-5111)		
Journal Bearing Free End	Top	0.9
	Bottom	1.0
Journal Bearing Coupling side	Top	1.2
	Bottom	0.9
Thrust Bearing Pads	Active	0.7
	Inactive	0.4
	Inactive	0.6
Thrust Collar		0.9
Shaft Journal	Thrust End	1.2
	Non Thrust End	0.9

INSTRUMENTATION

AMMONIA PLANT
(INSTRUMENTATION)

Control valve Maintenance jobs

FRCV- 1 : Actuator diaphragm was checked, found ok. General cleaning of air filter regulator was carried out. Gland packings were replaced. Finally control valve stroke was checked & found ok.

FRCV-2 : Control valve was removed from bonnet for complete overhauling. Actuator diaphragm was checked, found ok. Plug & seat inspection was carried out & found plug was in damaged condition so it was replaced with spare one also air regulator was replaced with new one. General cleaning of positioner, air filter regulator was carried out. Gland packings were replaced. Related tubing had been replaced with new one. Finally control valve was re-assembled; stroke was checked & found ok.

FRCV-3 : Control valve was removed from bonnet and trim parts were checked. All parts were cleaned and overhauled. Actuator diaphragm was opened and checked & found ok. General cleaning of valve positioner was carried out. Gland packings were replaced. Finally the stroke was checked & found ok.

FICV-470 : Control valve was opened from bonnet for complete overhauling. After inspection it was found that actuator stem was completely damaged. New actuator stem of SS410 material was prepared in mechanical workshop & same got hard chrome plated outside. Air regulator was replaced with new one. Old pneumatic tubing was also replaced with new one. After complete overhauling control valve boxed-up, control valve operation was checked & found satisfactory.

FICV-485 : Control valve was removed from bonnet for complete overhauling. Plug, seat & cage were found in damaged condition so it was replaced with spare one. Lapping work was also carried out. Air regulator & air tubing was replaced with new one. Finally control valve was re-assembled & stroke checked, found ok.

LCV-490 : Control valve was opened from bonnet for inspection. Cleaning of trim parts was carried out. Control valve was checked for tight shutoff. Actuator diaphragm was inspected & found ok. Complete Overhauling was carried out & also provided new gland packings & bottom gasket. Finally Stroke was checked & found ok.

FRCV-5 : Control valve general maintenance was done. Gland packing was replaced with new one. Cleaning of all parts of control valve was done. Finally stroke was checked & found ok.

LCV-19 : Old control valve was replaced with new control valve. Related signal cable & air supply tubing work was carried out. Finally control valve stroke was checked and found ok.

FICV-14 : Control valve was opened from line for complete overhauling. Plug & seat was inspected & found ok. General cleaning was done. New gland packings were provided. Finally control valve stroke was checked & found ok.

LCV-502 & PICV-16 : Control Valves were dismantled from line for passing problem. Diaphragms inspected & found in damaged condition, replaced with new ones. Lapping work was carried out to achieve tight shut-off. Hydro-test was performed at 5kg/cm2 & found satisfactory. Air tubing was replaced with new one. Finally control valves were taken in line, stroke checked & found ok.

TRCV-142A : Control valve was replaced with new one. Related cabling & tubing jobs carried out. Control valve operation logic developed in DCS. Stroke checked, found ok.

PICV-11A : Control valve was opened from bonnet for complete overhauling. Plug & seat were inspected & found ok. General cleaning had been done. New gland packings were provided. Finally control valve stroke had been checked & found ok.

PICV-44 : Actuator diaphragm was checked & found damaged condition so it was replaced with new one. General cleaning of air filter regulator was carried out. Gland packings were replaced. Finally control valve stroke was checked & found ok.

PICV-13A : Actuator diaphragm was checked, found ok. Air filter regulator was replaced with new one. Gland packings were replaced. Finally control valve stroke was checked & found ok.

LCV-16 & LCV-18 : Old control valves were replaced with new control valves. Related signal cable & air supply tubing work carried out. Finally control valve stroke was checked and found ok.

FICV-15 : Volume booster had leakage problem, so booster was replaced with new one. General cleaning of all parts of control valve was done. New gland packings were also provided. Finally stroke was checked & found ok.

MICV-10 : Old control valve was replaced with new higher capacity control valve. Related signal cable & air supply tubing work was carried out. Finally control valve stroke was checked and found ok.

FICV-20 : New control valve was installed in line. Stroke checked, found ok.

HICV-435A : New control valve was installed in line. Stroke checked, found ok.

General Maintenance & stroke checking of control valves :

Following important control valves general cleaning/ greasing were carried out. Provided new gland packings wherever required. Also valve positioner was cleaned and air header & regulators also flushed & stroke checking was carried out:

1.	V-4	9.	PICV-002
2.	PRCV-1	10.	MICV 1A to 9A
3.	MICV 1 to 9		
4.	LICV-27		
5.	FICV-100B		
6.	MICV-17		
7.	MICV-16		
8.	LCV-15		

COMPRESSOR HOUSE JOBS

Air Compressor (101J)

Removed all Radial, Axial and key-phasor probes along with relevant junction Boxes, speed pick-ups, bearing pad temp T/C & RTD, pressure gauges and local THI to facilitate M/M jobs. All proximitor JBs were cleaned. After completion of M/M jobs the instruments and probes/pick-ups were fixed back after cleaning/functional checking. Gap voltage adjustments for radial and axial probes were carried out.

HIC-101J : General cleaning and overhauling of governor positioner was carried out. New lip seal of piston/Cylinder was provided. Calibration of I/P Converter was carried out. New pressure gauge was provided for I/P converter, air supply Regulator. Finally governor actuator was fixed and stroke checking was performed.

TRIP-101J : Mechanical trip feedback Limit switch was overhauled and checked its operation.

VS-101J : The Trip Solenoid valve was overhauled. Coil of trip solenoid valve was replaced with new one. Finally its operation was checked & found ok.

101J / 105J MOP : Electronic governor actuator output signal cable & two nos. of MPUs were removed to facilitate mech. maintenance Jobs and also speed probe location modified as required by M/M. After completion of jobs the same were fixed back.

101J (Trip logic) : Checked the setting for alarm and trip logic.

ZSH-18 : Control valve OPEN/CLOSE Feedback Limit switch was overhauled and checked its operation.

Ammonia Refrigeration Compressor (105J):-

Removed all Radial, Axial and key phasor probes along with relevant junction boxes, speed pick-ups, T/C, pressure gauges and THIs to facilitate mechanical jobs. All Proximitor JBs were cleaned. After completion of Mech. jobs the instruments and probes/pick-ups were fixed back after cleaning/functional checking. Gap voltage adjustments for radial and axial probes were carried out.

PRC-9 : General cleaning and overhauling of governor positioner carried out. 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 fixed and stroke checking was performed.

TRIP-105J : Mechanical trip feedback Limit switch was overhauled and its operation was checked.

VS-105J : The Trip Solenoid valve was overhauled. Coil of trip solenoid valve was replaced with new one. Finally its operation was checked & found ok.

105J (Trip logic) : Checked the setting for alarm and trip logic.

Synthesis Gas Compressor (103J)

Removed all Radial, Axial and key-phasor probes along with relevant junction boxes, speed pick-ups, T/C, pressure gauges and THIs to facilitate mechanical jobs. All Proximitor JBs were cleaned. After completion of Mech. jobs the instruments and probes/pick-ups were fixed back after cleaning/functional checking. All the Temp points were sealed. Gap voltage adjustments for radial and axial probes were carried out.

PRCV-12 (103JAT) & MIC-23 (103JBT) : General cleaning and overhauling of governor positioner 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 fixed and stroke checking was performed.

VS-103J & VS-103 : The Trip Solenoid valves were overhauled. Coils of trip solenoid valves were replaced with new one. Finally its operation were checked & found ok.

103J (Trip logic) : Checked the setting for alarm and trip logic.

Field Instrument jobs

115-JAT & 115-JB : Removed & reinstalled different instruments (RTD, MPU, SV etc.) at 115-JAT to facilitate Mechanical Maintenance jobs. Checked both MPUs of Electronic Governor for 115-JAT. One RTD of 115-JA was replaced with new one as old one found damage.

101-BJT (ID Fan Turbine) : Removed & reinstalled different instruments (RTD, MPU, SV etc.) at 101-BJT to facilitate Mechanical Maintenance jobs. Checked both MPUs of Electronic Governor for 101-BJT. New tapping was provided for 2oo3 logic in lube oil header.

MCC-5 Replacement job : 2 numbers of Junction Boxes were installed inside new MCC-5 room. 2 numbers of Multi-pair Signal Cables & 2 numbers of Multi-Pair Power cables were laid from those Junction boxes to DCS Marshalling cabinet/Contactor box. Cable tray laying job carried out. Cables terminated at both ends. Loops were checked. Finally checking with operation of Motors was done from Control Room. Found ok.

JBT-31 Replacement job : 4 numbers of new Junction Boxes were installed near Primary Reformer. 2 numbers of Multi-pair cables were shifted from old junction box to new junction boxes. 4 numbers of Multi-pair K-type thermocouple cables were laid from new junction boxes to DCS Marshalling cabinet. 1-pair branch cables were laid from thermocouple element head to junction boxes. Cable tray laying job carried out. Cable glanding & termination jobs carried out. Damaged thermowells were replaced with ones prepared in Mech. W/S. Old thermocouple elements were replaced with new ones. Loops were checked.

104-J : Removed & reinstalled different instruments (RTD, MPU, SV etc.) at 101-BJT to facilitate Mechanical Maintenance jobs. Checked both MPUs of Electronic Governor for 104-J.

AR-7 : New fitting was provided for Dearator Ph meter AR-7 as found leakage from old one.

PI-18, PI-82 & LI-101F : Steam drum critical transmitters were cleaned & zero was checked through Hand Held Communicator & found satisfactory.

PT-14 : Transmitter was relocated. Related tubing & signal cable laying, termination work was done.

JBT-115JA & JBT-115JB : Damaged 12 triad cables for Bearing temperature RTD were replaced with new ones. Related cable lugging, ferruling & termination work was carried out in field junction box end & DCS marshalling cabinet end. Also those tags were shifted to new locations in DCS.

Provided low range Pressure Gauges at different locations in plant as per requirement of production dept. for purging & maintenance purpose.

Following PDR'S Impulse line was removed as per requirement of M/M, Provided new impulse line. Root valves were replaced by M/M:l

1.	PDR-26	2.	PDR-27
3.	PDR-34	4.	PDR-35
5.	PDR-36	6.	PDR-37

Level-State (101-F) : All Electrodes were cleaned by flushing the chamber & connections had been tightened.

New air header was provided for the following critical control valves/equipments:

1.	FRC-1	2.	FRC-2
3.	FRC-3	4.	PRC-5
5.	117-J		

Boiler Inspection (101F, 112C & 107C) : Provided standard 10" dial size Pressure gauges on steam drum, 112C and 107C. 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-471 : New RADAR Level transmitter was installed in CO2 Absorber, related fabrication work was done, cable laying, dressing & termination work was also done in field side & marshalling cabinet end. New tag was defined in DCS. Loop checked, found ok.

All Metal temperature thermocouples (MTI-105, MTI-106, MTI-107 & MTI-108) were removed & re-fixed to facilitate mechanical maintenance.

Draft point Manometer tubing had been removed & re-fixed to facilitate Mech. Maintenance jobs.

LIC-12 : Level troll was calibrated & cleaned properly, found ok.

TI-0127 & TI-0128 : 109-C inlet & outlet thermocouples were removed to facilitate M/M & same were re-fixed back.

PT-675 & 676 : Transmitter impulse tubes were hanging, so new supports were provided for the impulse tubes.

PT-79B/C : Two new transmitters were installed with new impulse line tapping to provide 2oo3 Low surface condenser vacuum turbine trip logic for 101-J/103-J/105-J. Related cable laying, dressing & termination work was done in field side. Trip amplifiers were installed in related marshalling cabinet side & wiring connection was done. Trip amplifiers were set as per trip setting value. Trip logic was modified as per requirement.

S-50 : 108-D converter four thermo-wells gland packing were provided.

PRC-23 : Cylinder & damper mechanism were over-hauled. Damper Positioner was checked & found ok.

VS-203A : A new On-Off control valve was installed in line. A new Solenoid valve was also installed for its operation. Related cabling & tubing jobs carried out. Logic was prepared for it's operation. Same was checked & found ok.

PAL-99 : Pressure switch cable was identified from field end to marshalling cabinet end by checking its continuity. It was terminated in DCS digital marshalling cabinet C-112.

Following critical Solenoid valves were replaced with new one:

1.	VS-19	**7.**	LIC-134	**13.**	VS-104-JAT
2.	V-15	**8.**	PIC-137	**14.**	TTV-115JB
3	V-16	**9**	HV-141	**15.**	TTV-116JAT
4.	VS-10	**10.**	PIC-139	**16.**	FRC-100 A
5.	VS-3	**11.**	TTV-115JA	**17.**	FRC-100 B
6.	V-4	**12.**	VS-161		

Steam Drum (101F) : Following instruments of steam drum were checked :

1. Level monitoring system- Level State.
2. Level transmitters.
3. Pressure Transmitters.
4. Level switches.

General cleaning & Calibration were carried out for ISO & CDM related instruments.

Following ISO related Quality/Safety affecting instruments were calibrated:

1	PT-7	**7**	TRC-12	**13**	PT-1027	**19**	PT-36	**25**	PT-80
2	PT-150	**8**	PT-501	**14**	TI -0117	**20**	FT-100	**26**	FT-1
3	PT-62	**9**	PT-8	**15**	TI-0039	**21**	FT-1006	**27**	TI-104E

4	FT-2	**10**	PT-5	**16**	PT-503	**22**	TRC-10	**28**	FT-1005
5	AR-1	**11**	PT-9	**17**	PT-10	**23**	TI-0036	**29**	TI-0011
6	PIC-1A	**12**	FT-3	**18**	PT-4	**24**	PT-28	**30**	TIC-1025

Following CDM related instruments were calibrated:

1.	PI-82	**4.**	FQI-181	**7.**	TI-0043
2.	FR-6	**5.**	PI-676	**8.**	TI-0023
3	FI-65	**6**	AR-5	**9.**	TI-0065

Annual Maintenance Jobs for DCS/ESD, UPSS & Gas Analyzers

YIL DCS

DCS shutdown maintenance activities were carried out as per AMC procedure. The following activities were carried out in Ammonia plant :

- 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 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.
- In FCS0101 Input tags were shifted from cards at slot-5 & slot-6 of node-3 to cards at slot-1 & slot-2 of node-1.
- Graphic modification work was carried out for graphic number GR0089, GR0092 & GR0098.
- Manual Reset Block was provided for operation of VS-3, VS-10, LY-134 & LY-134B.

- A new logic was defined for operation of TY-142A, now if TRC-142 MV> 25% then TY-142A MV=100.
- Data was collected for all HIS & FCS in Project backup for reference.
- All Operator stations & engineering station Anti-virus software was updated.
- Control room dust level & temperature was observed & found within limit.
- Cooling fan for HIS 0157 was replaced with new one.

PROSAFE-RS ESDS

- For Prosafe-RS ESD following shutdown/ preventive maintenance activities were carried out as per the AMC procedure :
- Cleaning of filters, fans, cabinets etc. was carried out for all the three SCS.
- Redundancy of all the CPU, PS, V net / IP Bus and IO cards was checked and found ok.
- Latest Back up was taken on DVD media.
- New DI Card SDV141 was defined in SCS0107 at node-2 slot-3 & slot-4.
- New tags PSH73B & PSH79C were defined in SCS0107, also new 2oo3 logic was made for low vacuum trip of 101-J/103-J/105-J in SCS0107 & SCS0108.
- In SCS0107 PH Value of ANLG_S block for tag LI472-A, B & C was changed from 90 to 100.
- Fuse TB of ESD Marshalling cabinet C-273, C-274 & C-275 was replaced with new one.

FUJI UPSS

Servicing of UPSS was carried out. Air filters of all the cabinets were cleaned and the exhaust/cooling fans were checked. Voltage on all the test points were measured. Both UPSS Power supply was switched off & total load was taken on battery bank for one & half hours. Before load transfer voltage was 229 V at 52 A & after load transfer, voltage was 209 V at 52 A. Also load was transferred on AVR & change-over was found ok. After one hour power for both UPSS were switched on & found ok. Battery cleaning, cell voltage measurement & electrolyte level checking were done.

Electrolyte level top-up was done for battery cells wherever required. Alarm & trip setting for UPSS were checked & found ok. Software data were checked by UPS Loader & the same was found ok. Tightening of all control cables & sockets were done.

ON LINE GAS ANALYZER

- Preventive maintenance of CH_4 analyzer AR-2 and Hydrogen analyzer ARC-3 was carried out. Cleaned sample path by flushing it with air jet. Cleaned sample conditioning system.
- Manual Calibration of both the analyzers were performed & found ok.

CAPITAL JOBS CARRIED OUT IN ANNUAL TURNAROUND

FICV-20 : New control valve was installed in line. Stroke checked, found ok.

TRCV-142A : Control valve was replaced with new one. Related cabling & tubing jobs were carried out. Control valve operation logic was developed in DCS. Stroke was checked, found ok.

LCV-16, LCV-18 & LCV-19 : Old control valves were replaced with new control valves. Related signal cable & air supply tubing work was carried out. Finally control valve stroke was checked and found ok.

EWR / SUGGESTION SCHEME / RECOMMENDATION COMMITTEE AND TECHNICAL DEPT. RELATED JOBS:

MIC-10 : Old control valve was replaced with new control valve. Related signal cable & air supply tubing work was carried out. Finally control valve stroke was checked and found ok.

HIC-435A : A new control valve was installed in parallel with HICV-435 for operation flexibility.

VS-203A : A new On-Off control valve was installed in line. A new Solenoid valve was also installed for its operation. Related cabling & tubing jobs were carried out. Logic was prepared for it's operation. Checked & found ok.

CONTINUAL IMPROVEMENT

LT-471 : New RADAR Level transmitter was installed in CO2 Absorber, related fabrication work was done, cable laying, dressing & termination work was also done in field side & marshalling cabinet end.

LCV-16 : Old control valve was replaced with new control valve. Related signal cable & air supply tubing work was carried out. Finally control valve stroke was checked and found ok.

LCV-18 : Old control valve was replaced with new control valve. Related signal cable & air supply tubing work was carried out. Finally control valve stroke was checked and found ok.

LCV-19 : Old control valve was replaced with new control valve. Related signal cable & air supply tubing work was carried out. Finally control valve stroke was checked and found ok.

UREA PLANT
(INSTRUMENTATION)

CONTROL VALVES MAINTENANCE JOBS

HICV-1421 : Valve was dropped from the line and was replaced by spare overhauled valve. Valve was boxed up with new teflon seat and checked for operation. Also replaced its SOV, HCO-1423 with a new one. After mounting the proximity switches for ON and OFF positon sensing, checked valve operation.

HICV-1201 : Valve was opened from the bonnet and overhauled the trim parts. All other parts were cleaned & overhauled. Replaced the pneumatic positioner and position transmitter with new one. Provided new gland packing and seal rings.The valve was installed back in the line then carried out control valve stroke checking and calibration of positon transmitter.

LRCV-1201 : Valve was dropped from the line. Replaced its damaged plug and seat of MOC: Safurex with that of MOC: HVD1. Provided new gland packing set and sealing rings for seat and bonnet. All parts were cleaned & overhauled. The valve was installed back in the line then carried out control valve stroke checking and calibration of positon transmitter.

FRCV-1201 : The control valve was opened from the bonnet. Valve was found stuck up due to metal chips trapped in between plug and seat, and due to which plug and seat got damaged. Replaced the damaged plug and seat with spare one. Also replaced seat and bonnet gaskets. The valve was boxed up with new gland packing set and then control valve operation and stroke checking were carried out.

PICV-1128 : The control valve was opend from the bonnet. To solve passing problem machining was done over its trim parts after which lapping and blue test of seating area was performed. Boxed up the valve with new seat and bonnet gaskets and provided new gland packings set. Also repalced air pressure regulator of valve positioner and overhauled valve positioner. Finally the valve was assembled and operation and stroke checking were carried out.

FICV-1303 : Valve was opened from bonnet. Machining was done over its trim parts. All parts were cleaned & overhauled and provided new gland packing. Finally the valve was assembled and operation and stroke checking were carried out.

PICV-1202 : Valve was dropped from the line. Lapping was done on plug and seat. Provided new flange gasket & gland packing. All parts were cleaned & overhauled. Finally control valve was box up and checked valve operation and valve stroke.

FICV-1281 : Valve was dropped from the line. Overhauled the trim parts, provided new gland packing and flange gaskets. Box up the, control valve mounted it in line and checked control valve operation and valve stroke.

HICV-1206 : Valve was opened from bonnet. All parts of valve were cleaned and overhauled. Boxed up the valve with new gland packing set. Finally control valve operation and valve stroke were checked.

HICV-1207 : Valve was dropped from the line. Replaced the plug and seat with new one. Also replaced its actuator diaphragm. Provided new flange gaskets and gland

packing. All parts were cleaned & overhauled. Hydro test was carried out and valve was installed back in the line. Finally control valve operation and valve stroke were checked.

LICV-1351 & LICV-1352 : Valves were dropped from the line. The plug stems found broken. Replaced plug, seat and guide bush with new one. General cleaning & overhauling of its internals was done. Valves were box up with new gland packing set and operation and stroke were checked.

LICV-1502A : Valve was opened from the bonnet. All parts were checked, cleaned and overhauled. Replaced its gland packings. Valve was assembled and its operation and stroke were checked.

PICV-1130 & PICV-1181 : General checking of control valves, actuators and valve positoners were carried out. Valve stems were taken down for tight shut-off. Then control valve operation and stroke checking were carried out for both control valves.

PRCV-1201 & HICV-1202 : General checking of control valves, actuators and valve positoners was carried out. Valve positioner was overhauled and stroke checking was done.

CICV-1422 : Control valve was removed from line and checked operation of inside ball during ON /OFF conditon. Boxed up valve with new flange gaskets.

PRCV-1481 : Overhauled the valve positioner and its pneumatic relay was replaced with new one. Also provided new air pressure regulator and booster relay. The current to pneumatic(I to P) converter was calibrated and then valve operation and stroke checking were carried out.

LICV-1807 : Control valve was removed from line for clearance to Mech. maint section. Same was fixed back in line after overhaluing. General operation and stroke checking were carried out.

Replaced the gland packings for the following control valves :

FICV-1351, TRCV-1422, FRCV-1421, HICV-1211, , LICV-1203 , PICV-1979A & PICV-1979B

General cleaning & stroke checking of following control valves was carried out.

PICV-1129, FICV-1102, PRCV-1202 , FICV-1204, PICV- 1502A/B, LICV1502A/B, TRCV-1202, HICV-1221A/B, TRCV-1102, HICV-1222A/B

COMPRESSOR HOUSE JOBS

- All the temp. and pressure gauges were removed to facilitate mechanical jobs. Same were checked and fixed back after completion of jobs. Faulty temp. and pressure gauges were repalced with new one.
- All bearing RTDs in turbine, HP case, LP case & Gear Box were removed to facilitate mechanical jobs. Same were checked and re-fixed after the completion of jobs. One simplex RTD for TI-1829 and one duplex RTDs for TI-1827 and TI-1828 were replaced with new one.
- All vibration probe for Radial, Axial and key-phasor points in turbine, HP case, LP case and Gear Box were removed to facilitate mechanical jobs. After completion of jobs, the same were re-fixed. Gap voltage adjustments for radial, axial and

keypahsor probes were carried out. Replaced the axial vibration probe XE-1808A and its housing/head type junction box by new one. Extension cables were replaced for vibration probes XE-1804A and XE-1804B.

- The faulty DPM on local control panel for TI-1803(2^{nd} stage suction temperature) was repalced with new OMRON make DPM and its configuration was done.

- Following pressure switches for two out three trip logic function for CO2 compressor trip logic I-1800 were replaced with Pressure transmitters thereby providing live readings and switching actions through DCS to improve realiability of trip logic.

  PSLL-1801A, PSLL-1818A, PSLL-1838A, PSHH-1839A, PSHH-1843A
  PSLL-1801B, PSLL-1818B, PSLL-1838B, PSHH-1839B, PSHH-1843B

- Following pressure switches for Alarm and Trip functions were cleaned, checked and their settings were checked.

  PSLL-1801C, PSLL-1818C, PSLL-1838C, PSHH-1839C, PSHH-1843, PSL-1816, PSL-1812, PSL-1813, PSLL-1844

- Following low level and high level switches of separators & surface condenser were 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 & LICT-1821

- Following old trip Solenoid valve were repalaced with new ASCO make solenoid valves for relaibility improvement.

  HV-1801, HV-1803 and PV-1810 respectively for HICV-1801, HICV-1803 and PICV-1810.

- All the field Junction Boxes, Local Control Panel and turbine local control boxes were cleaned and all wiring connections were tightened.

- Mock up test was carried out for Woodward governor for CO2 Compressor for HP and LP Valves stroke checking. Also checked the stroking for admission steam valve . Calibration of all three I to H converter (HP valve, LP valve and admission steam valve) was also checked.

- General cleaning & stroke checking of following control valves was carried out.

  HICV-1801, HICV-1802, HICV-1803, PICV-1810, LICV-1803, LICV-1805, LICV-1807, LICV-1821A/B, PICV-1979A/B

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 was removed from its mounting at Autoclave to facilitate mechanical maintenance jobs. This decayed radioactive source of Autoclave was shifted and stored in underground pit made for the purpose. After

completion of mechanical maintenance jobs installed new radioactive source of Co60 with activity of 1400mCi.

- Empty count reading with new radioactive source 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 HP Stripper (LRC-1201) were removed and installed back to facilitate 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 same and updated its configuration.

- For Helium leakage test at Autoclave V-1201, blocked all TI point tapping and Weep holes tapping on cylinderic portion of Autoclave vessel. Three series regulator setup with seal pot of 3 meter height was connected at bottom most weep hole for supply of air or helium gas. Also provided a pressure gauge with vent isolation valve arrrangement at top most weep hole of Autoclave vessel to monitor venting of pressure.

- General inspection and checking was carried out for N/C ratio meter mono block valve and pressure reducing capilliary. NC Ratiometer relief valve was checked and replaced with spare one to attend the passing problem. N/C Ratiometer local panel and JB cables and wiring were also checked and tightened all terminals.

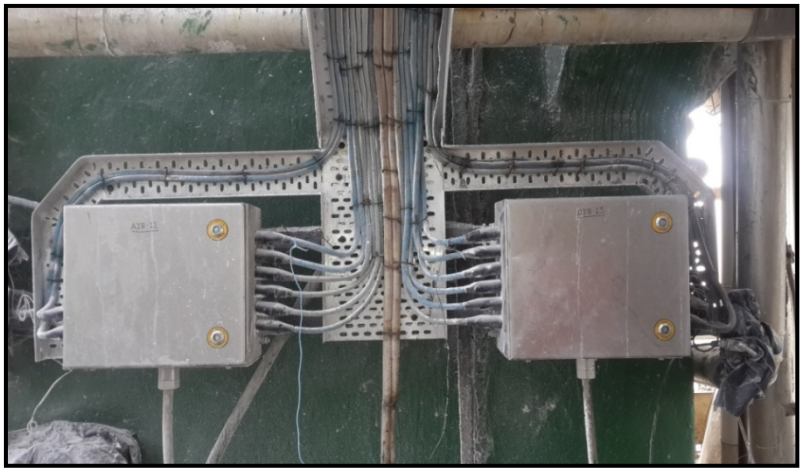
- Following HP Thermowells were removed, hydro tested & checked by Inspection Section for thickness.

  TR-1205, TR-1207. TR-1209, TR-1210

- Mass Flowmeter FS-1101 was removed from line and sent to EQDC for Calibration. After receiving duly calibrated meter same was mounted back in modified line. New mass Flowmeter FS-1101A was removed from mounting for line modification as per EWR-U268 to reduce pressure drop in Ammonia supply system.

- Replaced following old corroded Field Junction box with new SS juction box. All wiring terminals were lugged and connected with new ferrules.

  AJB-12, AJB-13 & JBS-3



New SS Junction Box AJB-12 and AJB-13 at Prill Tower Top

- Inspection of following magnetic flow meters was done:

  FICT-1435, FICT-1352 & FICT-1353

- Following extended pad type transmitters were checkled and calibrated:

  LICT-1421, LT-1481, LICT-1201, LICT-1202 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

- Following leveltrolls were calibrated:

  LICT-1235, LICT-1501 & LICT-1203

- Manometer set up with pressure gauge and rotameter was provided for differential pressure measurement of HP stripper ferrules.

- All the field instruments and control valves were removed for CCS-1 and CCS-II line replacement job. At CCS-I, provided new mounting stands for I to P convertors and air pressure regulators. All the instruments and control valves were connected back with new air supply and signal tubing after installation of valves in new line.

- Cleaned the I/P panel at prill bucket room and general checking of the I/P converters/associated tubing for leakage etc was carried out.

- Painting and earthing on all Prill Tower top control valves were done.

- The instrument air headers were flushed for any foreign particles accumulation.

- Thermowell TR-1210 and TI-1422 were removed and fixed back for vessel draining..

DCS RELATED CONTROL/ MARSHALLING ROOM JOBS

- DCS System & Panel earth resistance were checked, found within limits.

- Vibration monitoring system cabinet was cleaned, checked and tightened all wiring terminals.

- In the DCS System, complete system was “powered down” and dismantled. All the hardware of FCS0201, FCS0501 and HIS0260 to HIS0263 and Engineering station were cleaned and installed back. All the System, marshalling and vibration cabinets were cleaned. The system was “powered on” and put in service. After power ON, system functioning was found ok.

- HIS0260 was reported having frequent hanging problem. Hence, its PC was repaced with new PC. In the DELL make new PC operating system software Window7, DCS software CentumVP, anti virus software McAfee and printer drivers were installed and configured it as HIS0260. Connected the the PC to the network and downloaded project from Engineering Station EWS(HIS0264) and equalised the same.

- Measured control room temperature and dust level, both were found within limits.
- AC/ DC Power Supplies and battery voltages were measured, wherever applicable, for all the stations and found within limits.
- Checked overall system healthiness. Checked CPU, PSU and communication cards and bus redundancy and found working fine. Checked overall system functionality and found working normal.
- All operator stations and Engg. Stations were up graded with anti-virus McAfee AV updates.
- Application Project backup was taken for DCS in DVDs (two set). One Set of the backup retained with us and one set of the backup is kept by M/S YIL for their future reference.
- Following field switches were replaced by transmitters. Soft DIs were generated and same were used in place of direct DI from Pressure switches in compressor trip logic I-1800.

  PSLL-1801A by PI-1801A and PSLL-1801B by PI-1801B

  PSLL-1818A by PI-1818A and PSLL-1818B byPI-1818B

  PSLL-1838A by PI-1838A and PSLL-1838B by PI-1838B

  PSHH-1839A by PI-1839A and PSLL-1839B by PI-1839B

  PSHH-1843A by PI-1843A and PSLL-1843B by PI-1843B
- For Boiler Steam vent valve logic, one physical DO was generated from CO2 compressor trip logic I-1800, for compressor common trip signal, with Tag COMMON-TRIP-BLR. A single pair cable was laid for connecting same DO from cabinet C201 to C114 were it was connected with multipair cable available for boiler DCS connectivity.
- P-1102A, P-1102B and P-1102C LO pressure low Trip with LO pressures Indication.

  Generated soft /internal DI tag for low LO pressure trip signal PLCO-1102A from PI-1135, PLCO-1102B from PI-1136 and PALL-1195 from PI-1136 with tunning parameter LL. These signals were already linked in existing trip logic I-3A, I-3B and I-3C for pump P-1102A, P-1102B and P-1102C respectively. Also updated all related DCS graphics for same logic.
- P-1201A and P-1201B LO pressure low Trip with LO pressure Indication.

  Generated soft /internal DI tag for low LO pressure trip signal PLCO-1201A from PI-1235, and PLCO-1201B from PI-1236 with tunning parameter LL. Both signals were already linked in existing trip logic I-4A, and I-4B for pump P-1201A and P-1201B respectively. Also updated all related DCS graphics for same logic.

CAPITAL JOBS CARRIED OUT IN ANNUAL TURNAROUND

Following existing control valves were replaced with the new valves.

FICV-1202, FICV-1435 and PICV-1502B

New C/V FICV-1202

New C/V PICV-1502B

Following existing magnetic flowmeters were replaced with the new magnetic flowmeter with HART protocol.

FI-1204, FIC-1203

New Magnetic Flowmeter FI-1204

New Magnetic Flowmeter FIC-1203

EWR JOBS

Motor Current/Ampere Indication for Scrapper motor M-1402-1 and M-1402-2 and Conveyer motor M-1403-1 (EWR U-257)

To convert high current signal of 0-1 amp given by electrical section through CT to Std instrument signal of 4 to 20mA, necessory current to current convertors were installed in a JB in MCC-6 and same were connected in DCS marshalling cabinet with multipair signal cable. Current / Ampere indications for Scrapper motor M-1402-1 and M-1402-2 and also for conveyor motor M-1403-1 were configured in DCS.

CONTINUAL IMPROVEMENT

- Old & obsolete Control valve FICV-1202, FICV-1435 and PICV-1502B were replaced with new control valve manufactured and supplied by M/s MASCOT Valve Pvt. Ltd.
- Old and obsolete Flowmeter FIC-1203 and FI-1204 were replaced with new Magnetic Flowmeter with HART protocol manufactured and supplied by M/s KROHNE MARSHALL Pvt. Ltd. and M/s Yokogawa India Ltd. respectively.
- Old trip Solenod valve of HV-1801, HV-1803 and PV-1810 were repalced with ASCO make new Solenoid valve.
- Two pressure switches of 2 out 3 Trip logic I-1800 for CO2 Compressor were repalced with Yokogawa make pressure transmitters as mentioned below. Pressure switch tags were generated as Soft/Internal DI tags from pressure indication tags of related pressure transmitter.

  PI-1801A for PSLL-1801A and PI-1801B for PSLL-1801B
  PI-1818A for PSLL-1818A and PI-1818B for PSLL-1818B
  PI-1838A for PSLL-1838A and PI-1838B for PSLL-1838B
  PI-1839A for PSHH-1839A and PI-1839B for PSHH-1839B
  PI-1843A for PSHH-1843A and PI-1843B for PSHH-1843B

New Pressure Transmitter PI-1843A for PSHH-1843A, PI-1843B for PSHH-1843B and existing Pressure switch for PSHH-1843C

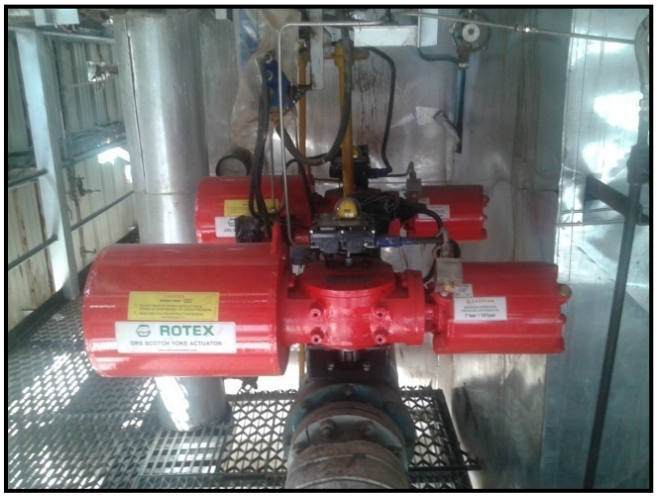
OFFSITES & UTILITY PLANT

(INSTRUMENTATION)

CONTROL VALVES

LCV-01 & LCV-02 : Cooling Tower (surface condenser level control) old control valve was replaced with new Control valve. Related signal cable & air supply tubing work was carried out. Finally control valve stroke was checked and found ok.

BTV-1-4A & BTV-1-4B : Boiler plant burner-1, burner trip valve's scotch type actuator was replaced with new one. Related tubing & cable connection work was carried out. Finally action was checked from control room. Found ok.



PICV-5305 : IG Plant (HP air pressure control) control valve was removed from line for complete overhauling. Actuator diaphragm was checked, found ok. Plug & seat were inspected & found plug damage, so it was replaced with repaired one. Lapping work was done for plug & seat. General cleaning of positioner was carried out and replaced air filter regulator with new one. Finally control valve was re-assembled, checked valve stroke and carried out pressure test for passing/leakage in close condition. Found o.k.

FICV-3101: Liquid Ammonia flow to Rail Gantry line new control valve was installed in ammonia storage area. Related signal cable & air supply tubing work was carried out. Finally control valve stroke was checked and found ok.

pHICV-4401 & pHICV-4402 : Cooling tower Ammonia & Urea side NaOH dosing pH control valves were placed with new one. Related signal cable & air supply tubing work was carried out. Finally control valve stroke was checked and found ok.

FCV-1 : Cooling tower (40 ata steam to Q-4412 turbine) control valve was removed from line. Trim parts were checked & machining work done for plug & seat. All parts were cleaned and overhauled. Actuator diaphragm was opened for inspection & found ok. General cleaning of valve positioner was carried out. Gland packings were replaced. Finally the stroke was checked & found ok.

PICV-5401 : IG Plant **:** Old IG Ammonia Vaporizer pressure control valve was replaced with new one. Related signal cable & air supply tubing work was carried out. Finally control valve stroke was checked and found ok.

FCV- 2 : Boiler plant **:** (30% BFW flow) control valve was removed from bonnet and trim parts were checked. Plug & seat lapping work was done. All parts were cleaned and overhauled. Actuator diaphragm was checked & found ok. General cleaning of valve positioner was carried out. Gland packings were replaced. Finally the stroke was checked & found ok.

MICV-5501 & MICV-5502 : IG Plant : Combustion chamber inert gas vent & inert gas outlet to compressor ON-OFF valves were replaced with new one. Related signal cable & air supply tubing work was carried out. Finally control valve operation was checked and found ok.

HICV-5151 : Boiler plant : (60 to 40 ata steam letdown) control valve removed from bonnet and trim parts were checked. All parts were cleaned and overhauled. Actuator diaphragm was checked & found ok. General cleaning of valve positioner was carried out. Gland packings were replaced. Finally the stroke was checked & found ok.

Following control valve's preventive maintenance was carried out. (General cleaning and control valve stroke checking)

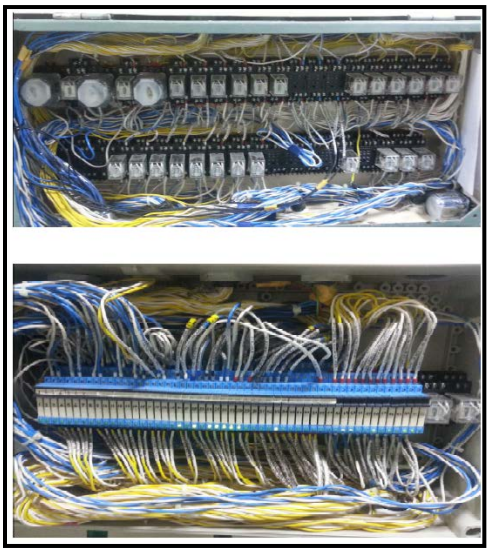
Sr. No.	Tag	Description	Area
1.	FRC-22	Main Gas Flow control	Boiler
2.	PICV-25	RLNG Pressure control	Boiler
3.	TCV-1	De-super heater Temperature control	Boiler
4.	LCV-3	CBD Tank Level control	Boiler
5.	PCV-42	Syn. Gas Pressure control	Boiler
6.	FCV-42	Syn. Gas Flow control	Boiler
7.	PIC-3	4 ata Steam vent	Boiler
8.	PIC-50	Dearator Pressure control	Boiler
9.	LCV-4	Dearator Level control	Boiler
10.	HICV-5153	40 ata Steam to Ammonia plant	Cooling Tower
11.	HICV-5154	4 ata steam Inlet	Cooling Tower
12.	HICV-4401B	Steam to Q-4402 Turbine	Cooling Tower
13.	FICV-4502	Combine Effluent Flow control	ETP
14.	pHICV-4502	Combine Effluent pH control	ETP
15.	FCV-2201	Anion 1 outlet flow control	DM
16.	FCV-2202	Anion 2 outlet flow control	DM
17.	FCV-2203	Anion 3 outlet flow control	DM
18.	FCV-2204	Anion 4 outlet flow control	DM
19.	FCV-2205	Anion 5 outlet flow control	DM
20.	LCV-2905	DM Water Buffer tank Level control	DM
21.	PCV-3008	T-3301 Tank Pressure Control	Ammonia Storage
22.	PCV-3009	NH_3 Vapor to Stack Pressure control	Ammonia Storage
23.	PCV-3055A/B	Receiver Pressure control	Ammonia Storage
24.	PCV-3064A/B	Condenser Pressure control	Ammonia Storage
25.	LCV-3051A/B	Saturator Inlet Level control	Ammonia Storage
26.	LCV-3055A/B	Receiver Level control	Ammonia Storage
27.	LCV-3058A/B	Inter stage cooler Level control	Ammonia Storage
28.	LCV-3065A/B	Gas Separator Level control	Ammonia Storage

FIELD JOBS - BOILER

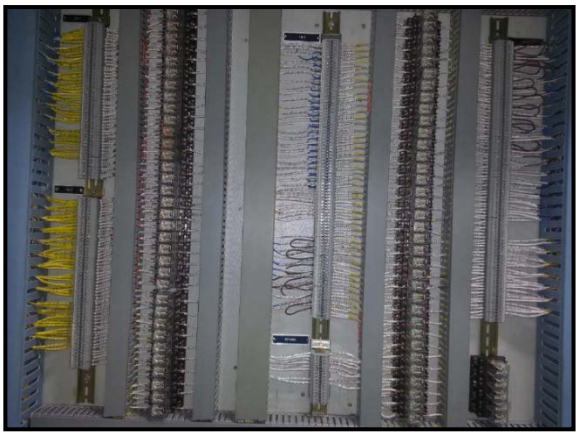
MCC interface Relay Box replacement job

Following are the details of work carried out for Relay box replacement job:

- Existing old relay box was removed from its location. Cables were removed from old relay box & interfacing JB inside MCC-15.
- New relay box was installed in place of old one. Fabrication work was carried out for new mounting frame for relay box.
- Cable glanding, wiring, ferruling & termination work was done.
- New ferruling, lugging & termination work was carried out in MCC-15 interfacing junction box as well as Marshalling cabinet end.
- Finally all tags (MOV, Selector Switches) operation was checked from control room & found ok.



MCC INTERFACE BOX - OLD



MCC INTERFACE RELAY BOX - NEW

Q-5113 & P-5111 : F.D. Fan turbine side & BFW pump related field instruments (Switches, speed probe, temperature & pressure gauges) were removed in order to facilitate mechanical maintenance job and re-fixed back.

Damper : FD fan outlet damper PC-2 SOV & coil was replaced with new one. APH By-pass line damper air tubing was replaced. Complete overhauling of Air Pre-Heater inlet damper was carried out.

TR-13 & TR-13-A : Furnace Temperature thermocouples were replaced with new one.

O_2 Analyzer : Flue Gas O2 analyzer sensor was removed from location for complete overhauling. Sensor was checked & cleaned properly. All parts were inspected & found in healthy condition. Finally sensor was re-fixed back in its location.

Igniter : Burner 1 & 2 Igniter gun was taken out for inspection. New cable was provided between current transformer to gun. General cleaning & overhauling was done. Spark was checked & found satisfactory. Finally igniter was re-fixed back in its location & found ok.

Flame Scanner : All four flame scanner's general cleaning & checking was done. Flame scanner of burner 2 was replaced with spare one as it was not giving response.

Furnace draft points were checked & cleaned properly.

Steam drum level indicator electrodes were checked, cleaned and tightened all terminals.

All pressure gauges (PI-2, PI-3, PI-4 and PI-5) were calibrated as required for boiler inspection.

Burner 2 BTV actuator was replaced with repaired one as old one was not working properly.

BFW & FD Fan trip SOV power cable was replaced with new one.

All Syn. Gas related BTV operation was checked & found ok.

Old obsolete pneumatic controller PIC-3 was removed from field.

Following Critical field switches set values were checked & found ok:

1.	PSH-11	2.	PSH-12	3.	PSL-24
4.	PSL-25	5.	PSN-26	6.	PSH-26
7.	PSL-27	8.	PSL-8	9.	PSL-30
10.	LSLL-1	11.	PAL-Q-5112	12.	PLCI-Q-5112
13.	PLCO-Q-5111	14.	PLCI-P-5113	15.	PLCO-P-5112
16.	PAL-M-5113	17.	PLCO-P-5113	18.	LLCO-5111
19.	LLCI-5111	20.	LAHH-5111	21.	DPAH-5111
22.	PSL-42	23.	PSH-42		

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 -1	8.	PSH-11	9.	PSH-12
10.	LSLL-1	11.	LT-1	12.	LT-4

Following BTV Limit Switches operation was 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

FIELD JOBS - COOLING TOWER

Q-4411 : Elliott Turbine all radial vibration probes, Trip SOV, speed pick-up probes, local temperature & pressure gauges were removed & reinstalled in order to facilitate mechanical maintenance jobs.

Q-4402 & Q-4403 : Turbine side speed pick-up probes, local temperature & pressure gauges were removed & reinstalled in order to facilitate mechanical maintenance jobs. Old obsolete tachometer was removed & fixed blind plate in place of it.

FI-4410 : Transmitter main isolation valve was replaced with new one. Calibration of transmitter was done with Hand Held Communicator & found ok.

Following Level switches of H-4411(surface condenser) were cleaned and set:

1.	LSHH-1	2.	LSAH-2
3.	LSAL-3		

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

Cleaning of control panel & tightening of all terminals inside panel was carried out.

Old air header from control room was removed.

FIELD JOBS - I.G. PLANT

Hydrogen Analyzer : AMC work was carried out for ABB Make Hydrogen Analyzer. Checked analyzer by passing span gas of 5% H_2 which showed satisfactory result. Analog output connected & checked with DCS & found ok. Display unit & control unit were checked & cleaned properly.

Following ISO related Quality/Safety affecting instruments were checked:

1.	PI - 5301	2.	PI - 5302
3.	PI - 5401		

FIELD JOBS - DM PLANT

FT-4210 : (De-Cation water flow for Cation regeneration) transmitter old tubing was replaced with new one.

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 : (Ammonia Analyzer) Cleaning of sampling system and calibration of Ammonia analyzer were carried out.

pHI-4502 : Combined effluent pH meter was cleaned & calibrated.

pHIC-4502 : Signal multiplier was provided in DCS Marshalling cabinet & related wiring work was done.

FIELD JOBS - AMMONIA STORAGE AREA:

LI-3001: T-3001 Tank servo level indicator LI-3001 analog output wiring connection was connected with marshalling cabinet of DCS. Now level indication is available on DCS.

Following Critical field switches settings were checked & 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		

B & MH. PLANT
(INSTRUMENTATION)

ASHBEE MAKE WEIGH BRIDGE:

Ashbee make Weigh bridge maintenance was carried out by service engineer from M/S Ashbee Systems. Calibration of Weigh Bridge was carried out with standard weights. Stamping of the weigh bridge was done. Painting of platform and weighbridge pit was also carried out.

POWER BUILD MAKE AUTOMATIC BAGGING MACHINES:

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 required.
- New Power ON-OFF switch were provided for weighing scales.
- Provided isolation switches for both Hopper's level switch for packer scale 9 A/B & 10 A/B & checked it's function. Found ok.
- Diverter 1 & 2: Cleaned solenoid, relay & limit switch and checked its function. Box of SOV was replaced with new one.
- 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 of new reclaim machine belt-weighing system was done.
- Cleaned the Dust Extraction plant panel.
- Cleaned all field instruments (Control valve, Transmitter) related to DES
- 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, Narmada, IG/CT & Storage area:
- 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 Power Supply 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 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.
- Data was collected for all HIS & FCS in Project backup for reference.
- All Operator stations & Engineering station Anti-virus software were updated.
- Control room dust level & temperature were observed & found within limit.
- Marshalling Cabinet fans were replaced with new one (5 numbers in Boiler, 3 numbers in DM & 5 numbers in Narmada plant).
- Boiler Plant HIS0362 CPU was replaced with new one.
- New Logic was prepared for PICV-6 (60 ata steam vent when Urea Hitachi compressor trips) in Boiler plant DCS.

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 EMERSON NETWORK POWER and M/s Syntech Power System respectively were carried out.
- Replaced the Mimic display of both the UPSS as old one was not working properly.
- Performance of UPS was checked with draining of battery for about 45 Minutes.
- Redundancy Functions of UPS checked. Load taken on AVR for 15 minutes.
- Bypassed one AMCO battery cell as it was found unhealthy.
- Checked the Battery voltage/performance during charging & discharging. Found ok.

DB Power make 2 X 5 KVA UPSS - JASPUR

- AMC Jobs for 2 X 5 KVA DB Power make UPS were carried out.
- Redundancy/functionality tests were carried out & found ok.
- Checked tightness of all power cables, control cables, PCB mounting & found ok.
- Cleaning of both the UPSS was done one by one with blower.

DB Power make 2 X 10 KVA UPSS - NARMADA

- AMC Jobs for 2 X 10 KVA DB Power make UPSS were carried out.
- Redundancy/functionality tests were carried out & found ok.
- Checked tightness of all power cables, control cables, PCB mounting & found ok.
- Cleaning of both UPSS was done one by one with blower.

EMERSON make 2 X 10 KVA UPSS - AMMONIA STORAGE

- AMC jobs for 'EMERSON' make 2 x 10 KVA UPSS and AMCO battery bank was carried out.
- Redundancy/functionality tests were carried out & found ok.
- Checked tightness of all power cables, control cables, PCB mounting & found ok.
- Cleaning of both UPSS was done one by one with blower.

CAPITAL JOBS CARRIED OUT IN ANNUAL TURNAROUND

BTV-1-4A & BTV-1-4B : Boiler plant burner-1 burner trip valve scotch type actuator was replaced with new one. Related tubing & cable connection work was carried out. Finally operation was checked from control room and found ok.

FICV-3101 : Liquid Ammonia flow to Rail Gantry line new control valve was installed in Ammonia storage area. Related signal cable & air supply tubing work was carried out. Finally control valve stroke was checked and found ok.

pHICV-4401 & pHICV-4402 : Cooling tower Ammonia & Urea side NaOH dosing pH control valves were replaced with new ones. Related signal cable & air supply tubing work was carried out. Finally control valve stroke was checked and found ok.

MICV-5501 & MICV-5502 : IG Plant : Combustion Chamber inert gas vent & inert gas outlet to compressor ON-OFF valves were replaced with new ones. Related signal cable & air supply tubing work was carried out. Finally control valve stroke was checked and found ok.

EWR/SUGGESTION SCHEME / RECOMMENDATION COMMITTEE JOBS

FICV-3101 : Liquid Ammonia flow to Rail Gantry line new control valve was installed in Ammonia storage area. Related signal cable & air supply tubing work was carried out. Finally control valve stroke was checked and found ok.

pHICV-4401 & pHICV-4402 : Cooling tower Ammonia & Urea side NaOH dosing pH control valves were replaced with new one. Related signal cable & air supply tubing work was carried out. Finally control valve stroke was checked and found ok.

CONTINUAL IMPROVEMENT

MCC interface Relay Box Replacement Job

Following are the details of jobs carried out for Relay box replacement :

- Existing old relay box was removed from its location. Cables were removed from old relay box & interfacing JB inside MCC-15.
- New relay box was installed in place of old one. Fabrication work was carried out for new mounting frame for relay box.
- Cable glanding, wiring, ferruling & termination work was done.
- New ferruling, lugging & termination work was carried out in MCC-15 interfacing junction box as well as Marshalling cabinet end.
- Finally all tags (MOV, Selector Switches) operation were checked from control room & found ok.

ELECTRICAL

AMMONIA PLANT

(ELECTRICAL)

Modification and New Installations

- **PGR Heater replacement**: Process gas was leaking out from the flange and punctured heater element coil. Defective heater assembly replaced with new.

- **Replacement of carbon earthing brush of compressor:** Old shaft grounding carbon brush was damaged. Induced voltage was frequently observed. During shutdown old carbon brush has been replaced with new.

New installation

Revamping of MCC-5, with new L&T panel

New RCC trench for MCC installation with base frame at new location was done.

New cable trench was prepared for laying of cables to connect MCC loads from old locations to the new locations.

Necessary cable trays were installed for laying of cables for new locations.

New MCC -5 is installed at new location with interconnection of bus bars & sections.

All the loads from MCC-5 old are shifted to MCC-5 new. Necessary cable laying & jointing was done for shifting of motors/loads to new locations.

Necessary cables are laid for incomers & emergency power and the MCC was charged by taking that power in line. The changeover scheme was also tested for both normal two incomer auto changeover and emergency power changeover during power failure.

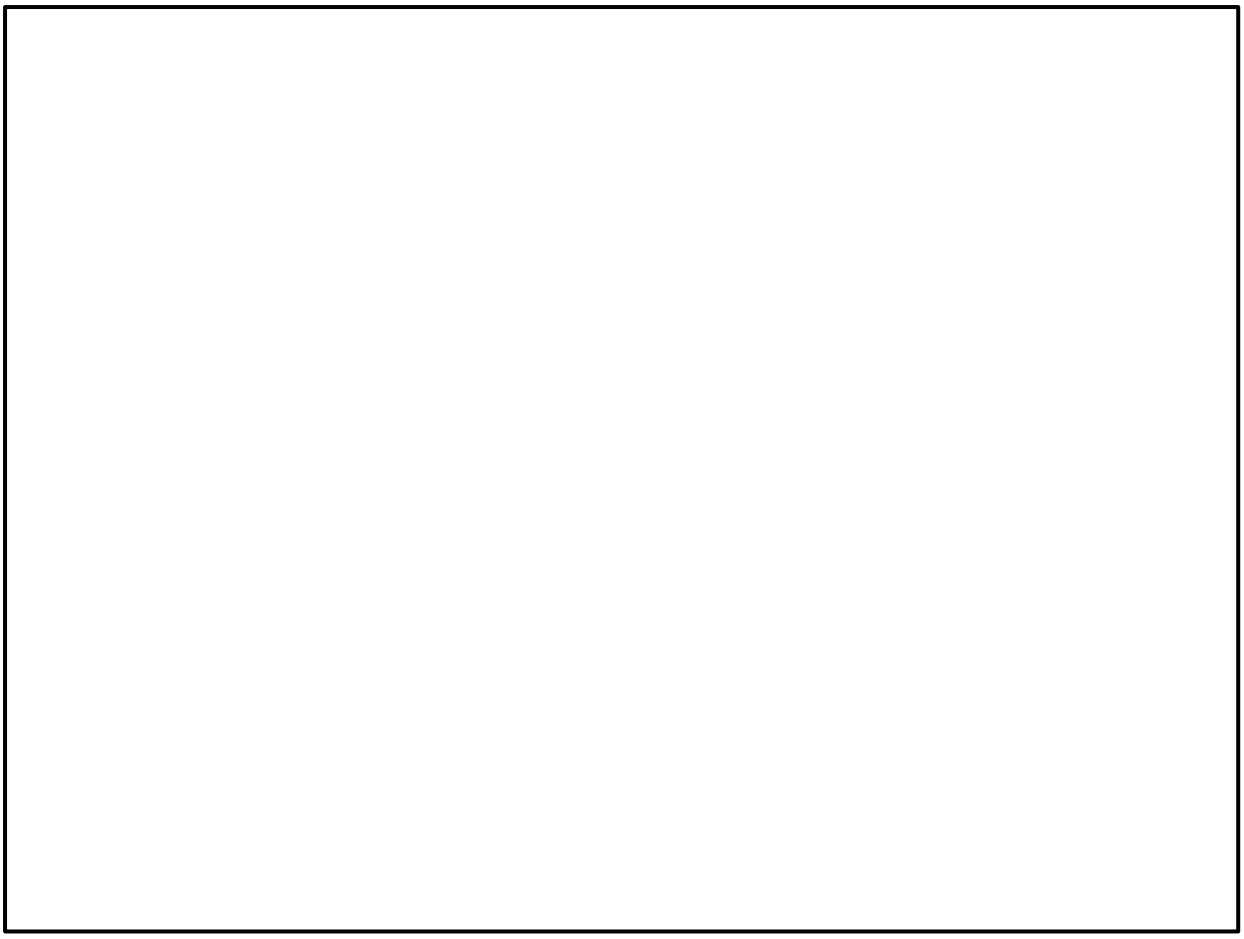
All the numerical relays for incomers & motors are tested & calibrated for its successful operation.

Every motor loads are tested for their DOR & operation from DCS as well as LCS.

All other loads are tested for their functionality and lighting circuits are also tested.

Desired loads are also interfaced with instrument JB for indication, operation & interlocks in DCS for smooth functioning.

The picture of the new installed MCC-5 is as follows-



Scheduled Preventive Maintenance

Preventive maintenance of transformer:

Most of the equipment of ammonia plant is getting electric power from MCC-5, 5A, 5B and 16. TR-6 and TR-21 & 22 feeding power to these MCC.

Start up heater is also part of ammonia plant and same is getting power from TR- start up.

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.

Preventive maintenance of MCC

Preventive maintenance carried out on all the feeder compartments in MCC-5, MCC-5A, MCC-5B & MCC-16 and the job details are as under.

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.

117JM AOP	AOP for 117JM
104JA	AOP for 104J
104J	AOP for 104J
104JT	AOP for 104J
104JTA	AOP for 104J
101BJT	AOP for 101BJ
101BJ	AOP for 101BJ

Preventive maintenance of actuators carried out for the following MOVs and tested with their interlocks:

SP1, SP3, SP4, SP5, SP70, SP151, SP152, SP 154, SP 156 and SP 158 & SP 159.

Testing & calibration of power analyzer installed in MCC-16 for 117 J compressors has been carried out.

UREA PLANT
(ELECTRICAL)

Scheduled Preventive Maintenance

Preventive maintenance of transformer:

Most of the equipment of urea plant is getting electric power from MCC-6, 14, & 15. TR-7A, 7B, 17, 18 & 20 feeding power to theses MCC.

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 6, MCC 14, and 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.

M-1403/1	3 part conveyor
M-1403/3	3 part conveyor
M-1402/2	Scrapper motor
M-1401/B	Prill bucket
M-1403/1	3 part conveyor
P-1815/B	Condensate pump
M-1401/A	Vibro pillar
P-1817	LOP hitachi
M-1419	Link Conveyor
M-1421	Cool urea Conveyor
P-1408	Melt pump
K-1401/1	PT fan
K-1401/2	PT fan
K-1401/4	PT fan
P-1501	BFW pump motor
P-1815/A	Condensate pump
M-1402/1	Scrapper Motor

Preventive maintenance of actuator of following MOV's was carried out:

MOV 1101, 1102, 1201, 1202, 1203, 1501 & 1801

Testing and Servicing of TMG Air Circuit breakers were carried out in MCC-6.

OFFSITES & UTILITY PLANT

(INSTRUMENTATION)

Preventive maintenance of transformer

Preventive maintenance of transformer TR-2A, 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 2B & 2E, 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

P-4412	LOP of Q-4401 A
P-4405	LOP of Q-4401 B
P-4403	LOP of Q-4403
P-5119	Ammonia Dosing Pump
P-5111A	A O P FOR PUMP P-5111
P-5112 A	AOP for PUMP 5112
P-5112 B	AOP for Motor 5112
P-5117	Hydrayzne dosing pump

P-5118 A	Phosphate dosing pump
P-5118 B	Phosphate dosing pump
P-5111 B	A O P FOR PUMP Q -5111
P-5120	condensate Pump
P-5113	AOP of E-5113
P-4411 A	Condensate pump C.T area
P-4405/A	Cooling water pump motor

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

Offsite Plant

New installation

Replacement of DG set battery bank

Removed and shifted all power cables disconnected from old Battery set.

Testing, installation and commissioning of new battery set was done.

Re-termination of all power cables was carried out .

Scheduled Preventive Maintenance

Preventive maintenance of transformer

Preventive maintenance of transformers Tr-1A, 1B, 15, 4A and TR-4B 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-DG set, MCC-3, MCC-10& 10A and MCC-Jaspur 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 maintenanceof 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 JYOTI 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.
- RE 300-relays are replaced in defective feeders.
- 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.

Panel No	BKR NO
17	TR-8 (P-4402)
7	TR-14(P-4401/C)
10	TR-23 (P-4404)
11	TR-11 (P-5112)
20	TR-12 (P-4401/D)
3	TR-18
2	TR-21
22	Tie-1
19	TR-20
66KV	52-C
66KV	52P
66KV	52K (630A)
66KV	52N
21	TR-16

Panel No	BKR NO
12	52U
5	52S
14	52T
23	Capacitor-3
1	Capacitor-4
8	TR-19 (Spare)
9	Tie-2
66KV	Township
66KV	52_R
66KV	52-Q
66KV	52-H
18	TR-22
MCC-13	P-4404

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

Specific activity carried out during maintenance:

- Two clamps of "B" Phase Tie isolator found corroded. Opened the clamps and cleaned & fitted the clamps with new nut bolts.

- All phase connection of Chhatral side GEB PT to isolator (89.4) found corroded. All Connections (lug) opened and cleaning done. After cleaning reconnection of isolators to PT done.

- Main isolator of chhatral line was not closing properly.Alignment done ofthe isolator done and operation tested & found OK.

- CT Contact of 52 B breaker found corroded.Open the contacts from terminal and cleaned. After cleaning reconnect the same.

Special activity carried out during total power shutdown during ATA-15 on 06/04/2015

- 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.

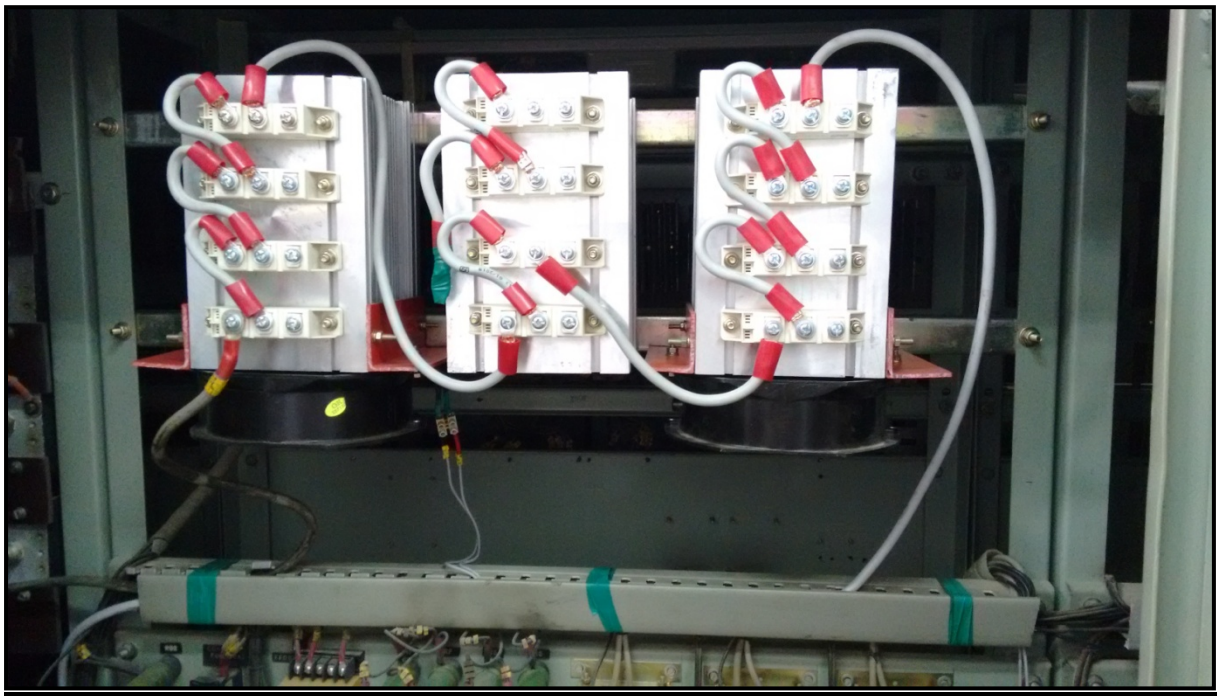
- Checking & maintenance of bus bars in 11KV MPSS & all MCCs incomers & bus couplers by load sharing & load management.

Servicing of Chhabi make Battery charger in 11 KV MPSS

We have installed lead acid battery in place of Ni-Cd in last shutdown. 245 V is required for charging the new battery bank with exiting charger. As recommended by OEM for the above we have installed Voltage dropping device (VDD) diodes 20 Nos.(Total 24 nos.) including routine servicing of battery charger

Now Charging Voltage is 245 V and load voltage is 210 V**.**

Cleaning and servicing of DG set battery charger was carried out.Stand by float battery charger not working checked and rectified loose connection on HVPF Socket and SCR socket. Trial taken found ok.



Picture of dropper diodes installed in battery charger during ATA-15

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.

Testing of protective relays in plant & township

Following list of protective relays are tested for its functionality & operation.

Panel No.	Type of relay	Relay Sr. No.	Description
1A/Siemens	7SJ6001	BF0703046288	SPARE FOR CAPACITOR BANK
8/Siemens	7SJ6001	BF9912045145	MCC-3 INCOMER-A
7/Siemens	7SJ6001	BF9907056148	MCC-7 INCOMER-A
8/Siemens	CAA11	,130031420005010	MCC-3 INCOMER-A
8/Siemens	VAJH13	,130006009946014	MCC-3 INCOMER-A
7/Siemens	VAJH13	,99350663004	MCC-7 INCOMER-A
7/Siemens	CAA11	,130021420005016	MCC-7 INCOMER-A
3FB	CDG-34	,97028879010	FIRE MCC Replaced

Panel No.	Type of relay	Relay Sr. No.	Description
6FA	CDG-34	,97028879009	SPARE
4FC	VAJH-13	,97020034003	FIRE MCC
3FC	CDG-34	,97028879011	MP-1102A
4FC	VAX-31	,97020265010	FIRE MCC
4FC	VAJH-13	,97020032006	MP-1102A
4FC	VAX-31	,97020265013	MP-1102A
5FC	VAJH13	,97020032005	SPARE
5FC	VAX-31	,97020265003	SPARE
5FC	VAJH13	,97020034005	MP-1201A
5FC	VAX-31	,97020265004	MP-1201A
6FB	CDG-34	,97028881002	MP-1201A
6FC	CDG-31	,140213330424003	INCOMER-1
7FB	VTT-11	,97020522005	INCOMER-1
7FB	VAGM-22	,97020185009	INCOMER-1
7FB	VAGM-22	,97020186001	INCOMER-1
7FC	VAX-31	,97020265020	INCOMER-1
7FC	VAJH-23	,97020265003	INCOMER-1
7FC	CAG-14	,97028934002	INCOMER-1
7FC	CDG-11	,140213340424004	INCOMER-1
8FA	CDG-31	,140213350424001	B/C-1
8FB	SKE-11	,97020478002	B/C-1
8FC	VAX-31	,97020269001	B/C-1
8FC	VAJH-23	,97020064005	B/C-1
9FB	VTT-11	,97020555001	B/C-1
9FB	VAG-21	,97102522001	B/C-1
9FB	VAGM-22	,97020186002	B/C-1
9FC	VTT-11	,97020523001	B/C-1
9FC	VAG-21	,97102522006	B/C-1
9FC	VAGM-22	,97020186004	B/C-1
10FB	VAGM-22	,97020185009	INCOMER-2
10FB	VAGM-22	,97020186005	INCOMER-2
10FC	VAX-31	,97020269005	INCOMER-2
10FC	VAGM-23	,97031346006	INCOMER-2
10FC	CAG-14	,97028934001	INCOMER-2
10FC	CDG-11	,140213340424005	INCOMER-2
11FA	CDG-34	,97028879005	MP-1102B
11FB	CDG-34	,97028880005	MP-1201B
11FC	CDG-31	,140213330424005	INCOMER-2
12FC	VAJH13	,97020032002	MP-1102B
12FC	VAX-31	,970220265019	MP-1102B
12FC	VAJH13	,97020032001	MP-1201B
12FC	VAX-31	,97020265014	MP-1201B
13FB	VAJH13	,97020032003	SPARE
13FB	VAJH13	,97026032007	SPARE
13FB	VAX-31	,97020265018	SPARE
14FC	VAJH13	,97200034004	MCC-4A

Panel No.	Type of relay	Relay Sr. No.	Description
14FC	VAJH13	,97020034002	MCC-11
14FC	VAX-31	,97020265011	MCC-4A
14FC	VAX-31	,97020265007	MCC-11
15FB	CDG-34	,97028879014	MCC-4A
15FC	CDG-34	,97028879001	MCC-11
20FA	CDG-31	,140213340424002	B/C-2
20FB	SKE-11	,97020478001	B/C-2
20FC	VAX-31	,97020279003	B/C-2
20FC	VAJH-12	,97031346004	B/C-2
21FB	VTT-11	,97020555002	B/C-2
21FB	VAG-21	,97012522011	B/C-2
21FB	VAGM-22	,97020185011	B/C-2
22FB	VTT-11	,97020554001	INCOMER-3
22FB	VAGM-22	,97020185006	INCOMER-3
22FB	VAGM-22	,97020185008	INCOMER-3
22FC	VAX-31	,97020265005	INCOMER-3
22FC	VAJH-23	,97020064001	INCOMER-3
22FC	CAG-14	,97028932001	INCOMER-3
22FC	CDG-11	,140213340424003	INCOMER-3
22FC	CDG-31	,140213330424004	INCOMER-3
23FC	VAJH-13	,97020036002	MP-1102C
23FC	VAX-31	,97020265016	MP-1102C
23FC	VAJH-13	,97020032008	MP-1201C
23FC	VAX-31	,97020265001	MP-1201C
24FA	CDG-34	,97028879003	SPARE
24FB	CDG-34	,97028879017	MP-1102C
24FC	CDG-34	,97028879008	MP-1201C
25FC	VAJH13	,97020032012	SPARE
25FC	VAJH-13	,97020033001	SPARE
25FC	VAX-31	,97020265012	SPARE
25FC	VAJH-13	,97020032011	SPARE
25FC	VAX-31	,97020265015	SPARE
26FC	VAJH-13	,97020032010	MCC-14
26FC	VAX-31	,97020265002	MCC-14
26FC	VAJH-13	,97020032013	PMCC-E
26FC	VAX-31	,97020269006	PMCC-E
27FB	CDG-34	,97028879006	MCC-14
27FC	CDG-34	,97028879002	PMCC-E
1FC	VTT-11	,97020522004	I/C-NORMAL
1FC	VAJH-23	,97020064002	I/C-NORMAL
1FC	VAX-31		I/C-NORMAL
1FC	VAGM-22	,97020185004	I/C-NORMAL
1FC	VAGM-22	,97020185012	I/C-NORMAL
1FC	CDG-34	,97028880003	I/C-NORMAL
2FA	VTT-11	,97020522007	I/C-DG
2FA	VTT-11	,97020522008	I/C-DG

Panel No.	Type of relay	Relay Sr. No.	Description
2FA	VTT-11	,97020522001	I/C-DG
2FC	VAX-31	,97065340025	I/C-DG
2FC	VAJH-23	,97020064004	I/C-DG
2FC	VAGM-22	,97020185010	I/C-DG
2FC	VAGM-22	,97020185007	I/C-DG
2FC	CDG-34	,97028879009	I/C-DG (Faulty)
8F	7SJ6001	BF0710107583	B/C (Defective)
8F	VAGM-22	,131368450810002	BUS-B
8F	VAJH-13	,139364850811001	B/C
8F	VAGM-22	,131368430810003	BUS-B
8F	VAGM-22	,131342810805002	BUS-A
8F	VAGM-22	,1313428108050000	BUS-A
9F	CAG-14	,131364890809001	I/C-2
9F	7SJ6001	,BF0710107579	I/C-2
9F	VAJH-13	,131359970810003	I/C-2
9F	VAA-11	,131427630821001	I/C-2
9F	VAA-11	,131018720642003	I/C-2
9F	VAA-13	,1313648808111001	I/C-2
7F1	CAG-14	,130878310603001	I/C-1
7F1	7SJ6001	,BF0702107410	I/C-1
7F1	VAJH-13	,131103500713006	I/C-2
7F1	VAA-13	,131137320713001	I/C-2
7F1	VAA-11	M199619	I/C-2
7F1	VAA-11	N198615	I/C-2
7F1	VTT-11	,131113650708006	I/C-2
1F1	7SJ6001	BF0702107411	DG I/C
1F1	VAA-11	M198628	DG I/C
1F1	VAA-11	M198633	DG I/C
1F1	VAJH-13	,131103560713001	DG I/C
1R1	VTT-11	,131228490727001	DG I/C
6FA	VAGM-22	,97020186003	I/C-1
6FA	VAGM-22	,97020182004	I/C-1
6FA	CDG-11	,140213340424002	I/C-1
6FA	CAG-14	,97028933001	I/C-1
6FA	VTT-11	,970205021002	I/C-1
6FA	VAX-31	,97020265006	I/C-1
6FA	VAJH-23	,97020065002	I/C-1
6FA	CDG-31	,140213330424002	I/C-1
6FA	CDG-31	,140213330424002	I/C-1
6FA	CDG-31	,140213330424002	I/C-1
2/Siemens	7SJ6001	BF9912045141	TR-2B
2/Siemens	CAA-11	,130031420005008	TR-2B
2/Siemens	VAJH-23	,130006009946018	TR-2B
10/SIEMENS	7SJ6001	BF9912045151	TR-6
10/SIEMENS	CAA-11	,130031420005007	TR-6
10/SIEMENS	VAJH-23	,130006009946005	TR-6

Panel No.	Type of relay	Relay Sr. No.	Description
11/Jyoti	MOTPRO	,96124763006	TR-11 (P-5112)
11/Jyoti	CDAG-51 R	,96123370003	TR-11 (P-5112)
11/Jyoti	CDAG-51 E/F	,96123370003	TR-11 (P-5112)
11/Jyoti	CDAG-51 B	,96123370003	TR-11 (P-5112)
11/Jyoti	VAX-31	,96124194012	TR-11 (P-5112)
2/JYOTI	VAJH-13	,96123872009	TR-21
2/JYOTI	VAX-31	,95052563004	TR-21
2/JYOTI	CDAG-51 R	,96123370002	TR-21
2/JYOTI	CDAG-51 E/F	,96123370002	TR-21
2/JYOTI	CDAG-51 B	,96123370002	TR-21
10/JYOTI	VAX-31	,96124194018	TR-23
10/JYOTI	CDAG-51 R	,961233700013	TR-23
10/JYOTI	CDAG-51 E/F	,961233700013	TR-23
10/JYOTI	CDAG-51 B	,961233700013	TR-23
10/JYOTI	VAJH-13	,96124194018	TR-23
14/JYOTI	VAJH-13	,95090795001	I/C (52-T)
14/JYOTI	VAX-31	,96078169006	I/C (52-T)
14/JYOTI	VAX-31	,96078169006	I/C (52-T)
14/JYOTI	VAJH13	,95090795001	I/C (52-T)
14/JYOTI	VAGM-22	,96016894001	I/C (52-T)
14/JYOTI	VAGM-22	,96054953001	I/C (52-T)
14/JYOTI	CDG-31 R	,96123545004	I/C (52-T)
14/JYOTI	CDG-31 E/F	,96123545004	I/C (52-T)
14/JYOTI	CDG-31 B	,96123545004	I/C (52-T)
28/SIEMENS	CAA-12	M168277	SPARE
28/SIEMENS	VAJH-13	,131093730702011	SPARE
28/SIEMENS	7SJ6001	BF0702103390	SPARE
5/SIEMENS	7SJ6001	BF9907056149	TR-2A
5/SIEMENS	CAA-11	,13003142005009	TR-2A
5/SIEMENS	VAJH-13	,130006009946006	TR-2A
22/JYOTI	CDAG-51 R	,96123370005	TIE-1
22/JYOTI	CDAG-51 E/F	,96123370005	TIE-1
22/JYOTI	CDAG-51 B	,96123370005	TIE-1
22/JYOTI	VAJH-13	,96123872015	TIE-1
22/JYOTI	VAX-31	,96124194013	TIE-1
1/JYOTI	VAJH-13	,96078016016	CAPACITOR BANK-4
1/JYOTI	VAX-31	,96124194005	CAPACITOR BANK-4
1/JYOTI	VDG-14	,95102509126	CAPACITOR BANK-4
1/JYOTI	VDG-13	,96031966003	CAPACITOR BANK-4
1/JYOTI	VDG-11	,96077894001	CAPACITOR BANK-4
1/JYOTI	CDG-31 R	,96123545001	CAPACITOR BANK-4
1/JYOTI	CDG-31 E/F	,96123545001	CAPACITOR BANK-4
1/JYOTI	CDG-31 B	,96123545001	CAPACITOR BANK-4
20/SIEMENS	7SJ6001	BF9912045142	STARTUP HEATER
23/JYOTI	VAJH-13	,96028356010	CAPACITOR BANK-3
23/JYOTI	VAX-31	,96128356006	CAPACITOR BANK-3

Panel No.	Type of relay	Relay Sr. No.	Description
23/JYOTI	VDG-14	,95102509121	CAPACITOR BANK-3
23/JYOTI	VDG-11	,96066679001	CAPACITOR BANK-3
23/JYOTI	VDG-13	,96031964002	CAPACITOR BANK-3
17/JYOTI	VAX-31	,96124194017	P-4402
17/JYOTI	VAJH-13	,96028356008	P-4402
20/JYOTI	VAJH-13	,130006009946008	TR-12
20/JYOTI	CAA-11	,130031420005006	TR-12
20/JYOTI	VAX-31	,96124194003	TR-12
20/JYOTI	VAJH-13	,96123872012	TR-12
9/JYOTI	VAX-31	,96124194007	TIE-2
9/JYOTI	VAJH-13	,96123872022	TIE-2
27/SIEMENS	VAJH-13	,13006009946003	TIE-2
3/SIEMENS	VAJH-13	,130003879944002	I/C-1
18/SIEMENS	VDG-14	,98505237001	CAP. BANK-2
18/SIEMENS	VDG-13	,96077913001	CAP. BANK-2
18/SIEMENS	VDG-11	,130015169949001	CAP. BANK-2
18/SIEMENS	VAJH-13	,130018579950001	CAP. BANK-2
25/SIEMENS	CAA-11	,130031420005004	TR-17
2F1	MOTPRO	,97020647002	K-1702
2F2	MOTPRO	,96124763007	K-1701
1	CAG-14	M107072	I/C-1
2F1	VDG-13	,88050104002	K-1702
1	CDG-11	M186082	I/C-1
2F2	VDG-13	,88050104001	K-1701
2F2	VAJH-13		K-1701
2F1	VAJH-13		K-1702
1	VAJH-13		I/C-1
1	CDG-31 R		I/C-1
1	CDG-31 E/F		I/C-1
1	CDG-31 B		I/C-1
2/JYOTI	VAJH-13	,88050175037	TR-1A
2/JYOTI	VAJH-13	,93026304025	TR-1A
3/JYOTI	CDAG-51 R	M847945	B/C-1
3/JYOTI	CDAG-51 E/F	M847945	B/C-1
3/JYOTI	CDAG-51 B	M847945	B/C-1
3/JYOTI	VAJH-13	,130089660035001	B/C-1
CRP	CDG-61	M168268	TR-1A 66 KV SIDE
CRP	CDG-31	M168274	TR-1A 11 KV SIDE
CRP	CDD-21 A	M168269	TR-1A
CRP	CDD-21 B	M168270	TR-1A
CRP	CDD-21 C	M168271	TR-1A
CRP	CDD-21 N	M168272	TR-1A
CRP	DTH-31	M452553	TR-1A
CRP	VAJH-13	M168276	TR-1A
CRP	CAA-12	M344461	TR-1A
CRP	CDG-11	M168275	TR-1A

Panel No.	Type of relay	Relay Sr. No.	Description
CRP	CDG-31	M205169	TR-1A
CRP	VAA-93	M167065	TR-1A
CRP	CDG-61	M343797	TR-1B
CRP	CDG-31	M343799	TR-1B
CRP	CDD-21 A	M343003	TR-1B
CRP	CDD-21 B	M343804	TR-1B
CRP	CDD-21 C	M343805	TR-1B
CRP	CDD-21 N	M343806	TR-1B
CRP	DTH-31	M452552	TR-1B
CRP	VAJH-13	M-343807	TR-1B
CRP	CAA-12	M205180	TR-1B
CRP	CDG-11	M343801	TR-1B
CRP	CDG-31	M343798	TR-1B
CRP	SKE-11	M793625	TR-1B
CRP	CDG-61 R	,97028743003	TR-1C 66 KV SIDE
CRP	CDG-61 E/F	,97028743003	TR-1C 66 KV SIDE
CRP	CDG-61 B	,97028743003	TR-1C 66 KV SIDE
CRP	CDG-11 R	,97042053001	TR-1C 11 KV SIDE
CRP	CDG-11 E/F	,97042053001	TR-1C 11 KV SIDE
CRP	CDG-11 B	,97042053001	TR-1C 11 KV SIDE
CRP	DTH-31	M452554	TR-1C
CRP	VAJH-13	,97042062001	TR-1C
CRP	VAA-11	,97042118001	TR-1C
CRP	CDG-11	,96091818001	TR-1C
CRP	SPEM2Z	,97092100001	TR-1C
CRP	SPEM2Z	,9702100001	TR-1B
CRP	SPEM2Z	,9702100003	TR-1A
1FC	VTT-11	,97020522011	I/C-1 (NORMAL)
1FC	VAJH-23	,97031346001	I/C-1 (NORMAL)
1FC	VAX-31	,97020270066	I/C-1 (NORMAL)
1FC	VAGM-22	,97020182003	I/C-1 (NORMAL)
1FC	VAGM-22	,97020182008	I/C-1 (NORMAL)
1FC	CDG-33	,140213360424001	I/C-1 (NORMAL)
2FA	VTT-11	,97020521003	I/C (DG)
2FA	VTT-11	,97020522003	I/C (DG)
2FA	VTT-11	,97020522010	I/C (DG)
2FA	VAX-31	,97020265009	I/C (DG)
2FA	VAJH-23	,97031346005	I/C (DG)
2FA	VAG-21	,97102522009	I/C (DG)
2FA	VAGM-22	,97020182007	I/C (DG)
2FA	VAGM-22	,97020182006	I/C (DG)
2FA	CDG-33	,140213360424002	I/C (DG)
3FC	MPTPRO	,96124763002	CRACKER
3FC	VAJH-13	,97020032014	CRACKER
3FC	VAJH-13	,97020032015	CRACKER
3FC	VAX-31	,97020270005	CRACKER

Panel No.	Type of relay	Relay Sr. No.	Description
4FC	CDG-34	,9702881007	TO FIRE MCC
4FC	VAJH-13	,97020033004	TO FIRE MCC
4FC	VAJH-13	,97020032009	TO FIRE MCC
4FC	VAX-31	,97020270002	TO FIRE MCC
4FB	CDG-34	,97028880002	SPARE
5FB	P-220	,36110202/04/12	K-5306
5FB	VAJH-13	,9702003304	K-5306
5FB	VAX-31	,970202650000	K-5306
7FA	CDG-31	,140213350424003	B/C
7FB	SKE-11		B/C
7FC	VAX-31	,97020265017	B/C
7FC	VAJH-23	,97020064003	B/C
8FB	VTT-11	,97020522012	B/C
8FB	VAG-21	,97102522007	B/C
8FB	VAG-21	,97012522005	B/C
8FB	VAGM-22	,97020182007	B/C
8FC	VAG-21	,97102522003	B/C
8FC	VAGM-22	,97020182002	B/C
9FB	VTT-11	,97020523002	I/C-2
9FB	VAGM-22	,97020182010	I/C-2
9FB	VAGM-22	,97020182005	I/C-2
9FC	VAX-31	,97020270003	I/C-2
9FC	VAJH-23	,97031346003	I/C-2
9FC	CDG-11	,142013340424001	I/C-2
9FC	CAG-14	,97028933002	I/C-2
9FC	CDG-31	,140213330424001	I/C-2
10FC	VAJH-13	,97020032016	SPARE
10FC	VAX-31	,9602413010	SPARE
10FC	VAJH-13	,97020033003	SPARE
10FC	VAX-31	,96124193002	SPARE
11FA	CDG-34	,97028881006	SPARE
11FB	CDG-31	,97028881009	SPARE
11FC	CDG-34	,142013360424003	TO PMCC-E
12FC	VAJH-13	,97020033005	117JM
12FC	VAJH-13	,97020033002	PMCC-E
12FC	VAX-31	,970020270004	PMCC-E
12FC	MPTPRO	,3037770030200	117JM
12FC	VAJH-13	,97020034001	117JM
12FC	VAX-31	,96124195008	117JM
13FB	P-220	,36110203/04/12	P-4405
13FB	VAJH-13	,97020032004	P-4405
13FB	VAX-31	,97020270001	P-4405
1FC	VTT-11	,97020522009	I/C-1
1FC	VAJH-23	,97525038001	I/C-1
1FC	VAX-31	,97525128001	I/C-1
1FC	VAGM-22	,97046423001	I/C-1

Panel No.	Type of relay	Relay Sr. No.	Description
1FC	VAGM-22	,97046424002	I/C-1
1FC	CDG-34	,97028881005	I/C-1 E/F was faulty
2FA	VTT-11	,97000520002	I/C-2
2FA	VTT-11	,97020521004	I/C-2
2FA	VTT-11	,9700521001	I/C-2
2FC	VTT-11	,97046451001	I/C-2
2FC	VAJH-23	,97031346002	I/C-2
2FC	VAX-31	,97112003002	I/C-2
2FC	VAGM-22	,97020185002	I/C-2
2FC	VAGM-22	,97020185003	I/C-2
2FC	CDG-34	,97028881004	I/C-2
3FC	MOTPRO	,96102704001	M-3701
3FC	VAJH-13	,97066330001	M-3701
3FC	VAJH-13	,97066330002	M-3701
3FC	VAX-31	,97020269004	M-3701
20/JYOTI	MOTPRO	,97020647003	P-4401D
21/JYOTI	CDAG-51 R	,96123370001	TR-16
21/JYOTI	CDAG-51 E/F	,96123370006	TR-16
21/JYOTI	CDAG-51 B	,96123370006	TR-16
21/JYOTI	VAX-31	,96124104002	TR-16
21/JYOTI	VAJH-13	,95090795011	TR-16
12/JYOTI	CDG--31 R	,97123545006	B/C
12/JYOTI	CDG--31 E/F	,97123545006	B/C
12/JYOTI	CDG--31 B	,97123545006	B/C
12/JYOTI	VAX-31	,95052563002	B/C
12/JYOTI	VAJH-13	,96123872004	B/C
12/JYOTI	SKD-11	,97102469002	B/C
8/JYOTI	CDAG-51 R	,96123370006	TR-19 SPARE
8/JYOTI	CDAG-51 E/F	,96123370001	TR-19 SPARE
8/JYOTI	CDAG-51 B	,96123370001	TR-19 SPARE
8/JYOTI	VAX-31	,97124194014	TR-19 SPARE
8/JYOTI	VAJH-13	,96123872014	TR-19 SPARE
6/JYOTI	VAGM-22	,9712419404	BUS-A PT
6/JYOTI	VAGM-22	,96124063006	BUS-A PT
6/JYOTI	VAG-21	,89093187002	BUS-A PT
7/JYOTI	CDAG-51 R	,96123370007	P-4401 C
7/JYOTI	CDAG-51 E/F	,96123370007	P-4401 C
7/JYOTI	CDAG-51 B	,96123370007	P-4401 C
7/JYOTI	VAX-31	,96124194011	P-4401 C
7/JYOTI	VAJH-13	96078020001	P-4401 C
7/JYOTI	P-220	,36110201/04/12	P-4401 C
3/JYOTI		,96123370012	TR-18 MCC-15
18/JYOTI	CDAG-51 R	,96123370015	TR-22 MCC-16
18/JYOTI	CDAG-51 E/F	,96123370015	TR-22 MCC-16
18/JYOTI	CDAG-51 B	,96123370015	TR-22 MCC-16
18/JYOTI	VAX-31	,96124194009	TR-22 MCC-16

Panel No.	Type of relay	Relay Sr. No.	Description
18/JYOTI	VAJH-13	,95090797035	TR-22 MCC-16
0/JYOTI	CDAG-51 R		TO 52-D
0/JYOTI	CDAG-61 E/F		TO 52-D
0/JYOTI	CDAG-51 B		TO 52-D
0/JYOTI	VAX-31		TO 52-D
0/JYOTI	VAJH-13		TO 52-D
5/JYOTI	CDG-31 R	,96123545002	I/C-52-S
5/JYOTI	CDG-31 E/F	,96123545002	I/C-52-S
5/JYOTI	CDG-31 B	,96123545002	I/C-52-S
5/JYOTI	VAGM-22	,96124089004	I/C-52-S
5/JYOTI	VAGM-22	,96124063008	I/C-52-S
5/JYOTI	VAX-31	,96078960009	I/C-52-S
5/JYOTI	VAJH-13	,95090795008	I/C-52-S
4/JYOTI	CDAG-51 R	,M358730	SPARE MOTOR FDR
4/JYOTI	CDAG-51 E/F	M358729	SPARE MOTOR FDR
4/JYOTI	CDAG-51 B	M358730	SPARE MOTOR FDR
4/JYOTI	VAX-31	,96124194019	SPARE MOTOR FDR
4/JYOTI	VAJH-13	,	SPARE MOTOR FDR
4/JYOTI	MOTPRO	,96124763010	SPARE MOTOR FDR
15/JYOTI	CDAG-51 A	M205181	SPARE MOTOR FDR
15/JYOTI	CDAG-51 E/F	M205181	SPARE MOTOR FDR
15/JYOTI	CDAG-51 B	M205181	SPARE MOTOR FDR
15/JYOTI	VAX-31	,95091113005	SPARE MOTOR FDR
15/JYOTI	VAJH-13	,95090795007	SPARE MOTOR FDR
15/JYOTI	MOTPRO	,96124763008	SPARE MOTOR FDR
16/JYOTI	CDAG-51 A	M358729	SPARE MOTOR FDR
16/JYOTI	CDAG-51 E/F	,96123370011	SPARE MOTOR FDR
16/JYOTI	CDAG-51 B	M358729	SPARE MOTOR FDR
16/JYOTI	VAX-31	,96016997009	SPARE MOTOR FDR
16/JYOTI	VAJH-13	,95064050008	SPARE MOTOR FDR
16/JYOTI	MOTPRO	,97020647001	SPARE MOTOR FDR
1A/SIEMENS	VAJH-13	,131093730702040	SPARE
1A/SIEMENS	VDG-11	,13112054070808010	SPARE
1A/SIEMENS	VDG-14	,131095930702017	SPARE
1A/SIEMENS	VDG-14	,131028630642002	SPARE
2F1	7SJ6001	BF1207085771	B/C
5F1	7SJ6001	BF1301503394	DG I/C
2F1	SKE-11	,32146309	B/C
8F1	7SJ6001	BF1012050021	B/C
FDR-20	CAG-14	M189421	I/C-2
FDR-20	VAJH-13	M186094	I/C-2
FDR-20	CDG-11	M186083	I/C-2
FDR-20	VAA-11	M198644	I/C-2
FDR-20	VAA-13	M186109	I/C-2
FDR-20	VAA-11	M198644	I/C-2
FDR-20	CDG-31 R	M186068	I/C-2

Panel No.	Type of relay	Relay Sr. No.	Description
FDR-20	CDG-31 E/F	M186068	I/C-2
FDR-20	CDG-31 B	M186068	I/C-2
FDR-19	VAJH-13	M196097	B/C
FDR-19	CDG-31 R	M186068	B/C
FDR-19	CDG-31 E/F	M186068	B/C
FDR-19	CDG-31 B	M186068	B/C
FDR-18	CAG-14	M198420	I/C-1
FDR-18	VAJH-13	M186088	I/C-1
FDR-18	CDG-11	M186084	I/C-1
FDR-18	VAA-11	M198634	I/C-1
FDR-18	VAA-13	M186108	I/C-1
FDR-18	VAA-11	M198646	I/C-1
FDR-18	CDG-31 R	M186067	I/C-1
FDR-18	CDG-31 E/F	M186067	I/C-1
FDR-18	CDG-31 B	M186067	I/C-1
6F1	7SJ6001	BF0704061638	D/G-I/C
6F1	VAJH-13	,131255490736004	D/G-I/C
6F1	VTT-11	,131203990726002	D/G-I/C
8F1	7SJ6001	BF0708061686	B/C
8F1	VAJH-13	,131255490736001	B/C
8F1	VTT-11	,131264090739005	B/C
8F1	VTT-11	,131204080726001	B/C
10F1	7SJ6001	BF0706042533	SPARE
10F1	VAJH-13	,131204180730004	SPARE
5F1	7SJ6001	BF0708061687	SPARE
5F1	VAJH-13	,13116846718002	SPARE
7F3	CDG-61 R	,97028743007	TO MCC-16
7F3	CDG-61 B	,97028743007	TO MCC-16
6F2	CDG-61 R	,97028743008	
6F2	CDG-61 B	,97028743008	
16F1	CAG-14	M189425	
16F1	VAGM-22	,97020212009	
16F1	VAGM-22	,97020212013	
17F1	CDG-21	,97042867002	I/C-2
17F1	CDG-21	,97042867003	I/C-2
17F1	CDG-11	M205175	I/C-2
Relay PNL	CDG-61	,97028743003	
Relay PNL	CAG-34	,97017188002	
Relay PNL	SKE-11	,97017629002	
22/SIEMENS	7SJ6001	BF9912045147	TR-5B
22/SIEMENS	CAA-11	,130031420005002	TR-5B
23/SIEMENS	7SJ6001	BF9912045139	TR-7B
23/SIEMENS	VAJH-13	,991108/40004	TR-7B
23/SIEMENS	CAA-11	,130031420005011	TR-7B
06/SIEMENS	VAJH-13	,130006009946010	TR-3A
06/SIEMENS	CAA-11	,130031420005003	TR-3A

Panel No.	Type of relay	Relay Sr. No.	Description
06/SIEMENS	VAHJ-13	,99350663003	TR-3A
06/SIEMENS	7SJ6001	BF0007052115	TR-3A
26/SIEMENS	VAJH-13	,130006009946009	TR-3B
26/SIEMENS	CAA-11	,130031420005018	TR-3B
26/SIEMENS	7SJ6001	BF9912045138	TR-3B
11/SIEMENS	CAA-11	,130031420005015	TR-7A
11/SIEMENS	7SJ6001	BF9912045150	TR-7A
22/SIEMENS	VAJH-13	,13000387994400	TR-5B
10F	7SJ6001	BF1108170788	I/C-2
	7SJ6001	BF1301523942	
7	CTMM 506	DF20489079525001	180J
3.3 KV PNL	MOTPRO	,96081041012	P-4404
7F2	CDG-61	,97028745006	2.2 MW DG
Relay PNL	CCUM-21	,9707959300	2.2 MW DG
Relay PNL	VAJHM-33	,97017286002	2.2 MW DG
Relay PNL	VTUM-21	,97032291002	2.2 MW DG
Relay PNL	VAA-51	,97017521001	2.2 MW DG
Relay PNL	CVD-62 R	,97017144001	2.2 MW DG
Relay PNL	CVD-62 E/F	,97017144001	2.2 MW DG
Relay PNL	CVD-62 B	,97017144001	2.2 MW DG
5F	7SJ6001	BF0708061685	TO NARMADA I/C
9F	7SJ6001	BF0706100236	I/C-B
	CDG-31	M567068	I/C FROM 2F
18	CDG-11	M186084	I/C-A
18	CDG-31 R	M186067	I/C-A
18	CDG-31 E/F	M186067	I/C-A
18	CDG-31 B	M186067	I/C-A
18	CDG-31	M186065 R,E/F,B	I/C-B
18	CDG-11	M186083	I/C-B
7F1	CAG-14	,31618160	I/C-1
7F1	7SJ6001	BF1012050022	I/C-1
1F1	7SJ6001	BF14011900815	TO MCC-11
1F1	VAJH-13	,32776351/12/13	TO MCC-11
6F1	VAJH-13	,32776350/12/13	K-5305
2F1	VTT-11	,31631025	B/C
9/SIEMENS	7SJ6001	,BF9912045140	TR-5A
9/SIEMENS	CAA-11	,13003142000500	TR-5A
9/SIEMENS	VAJH-13	,130006009946002	TR-5A
4/SIEMENS	VDG-14	,99203261001	CAP.BANK-1
4/SIEMENS	VDG-11	,99090045001	CAP.BANK-1
4/SIEMENS	VDG-13	,97028897001	CAP.BANK-1
4/SIEMENS	7SJ6001	BF9907056143	CAP.BANK-1
4/SIEMENS	VAJH-13	,130018579950006	CAP.BANK-1
15/SIEMENS	7SJ6001	BF9907056144	B/C-52 E
15/SIEMENS	VAJH-13	,130006004946001	B/C-52 E
21/SIEMENS	7SJ6001	BF9912045146	TR-4B

Panel No.	Type of relay	Relay Sr. No.	Description
21/SIEMENS	CAA-11	,130031420005014	TR-4B
21/SIEMENS	VAJH-13	,130006009946016	TR-4B
24/SIEMENS	7SJ6001	BF9912045148	TR-10 B
24/SIEMENS	CAA-11	,130031420005001	TR-10 B
24/SIEMENS	VAJH-13	,130018579950005	TR-10 B
13/SIEMENS	CAA-11	,13003142000512	SPARE
13/SIEMENS	VAJH-13	,99350663002	SPARE
6F	VTT-11	,131203990726002	I/C-DG
6F	VAJH-13	,131255490736004	I/C-DG
7F	VTT-11	,131203990726001	I/C-A
7F	VAA-13	,131264050742002	I/C-A
7F	7SJ6001	BF070806616684	I/C-A
8F1	VAJH-13	,131255490736001	B/C
8F1	VTT-11	,131264090739005	B/C
8F1	VTT-11	,131204080726001	B/C
10F	VAJH-13	,131204180730004	SPARE
11F	VAJH-13	,131168460718002	SPARE
7R	VAGM-22	,131261540738003	I/C-1`
7R	VAGM-22	,131261550738001	I/C-1`
7R		,131255490736002	I/C-1`
8R	VAGM-22	,131265260739001	BUS-A PT
8R	VAGM-22	,131265290739004	BUS-A PT

Total more than 530 different types of relays are tested and defective relays are also replaced with the spares. Some relays are also calibrated for proper operation.

Minor defects are also rectified in relays during testing in plant as well as township HT/LT panels.

In some motors MICOM P-220 relay was also retrofitted in place of conventional Motrpro relay & tested with all setting for no-load to full load operation of the motors in MCC-16 & MPSS.

B & MH PLANT
(ELECTRICAL)

Preventive maintenance of Transformer

Preventive maintenance of transformer Tr-5A & 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:

P-2704/A	Dust solution pump
P-2704/B	Dust solution pump
K-2161	Dust blower B&MH
K-2704/3	Dust blower B&MH
M-2122	Conveyor
M-2122 A1	Conveyor
M-2122 A2	Conveyor
M-2112	Conveyor

M-2121(New)	Conveyor
M-2110	Conveyor
M-2117	Conveyor
M-2137	Conveyor
Link Conveyor	Reclaimer link conveyor
Slewing	Reclaimer slewing
Luffing	Reclaimer Luffing

Non plant

Preventive maintenance of transformer: Preventive maintenance of TR-10A, 10B, T/S-1 and T/S-2 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 fire MCC 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.

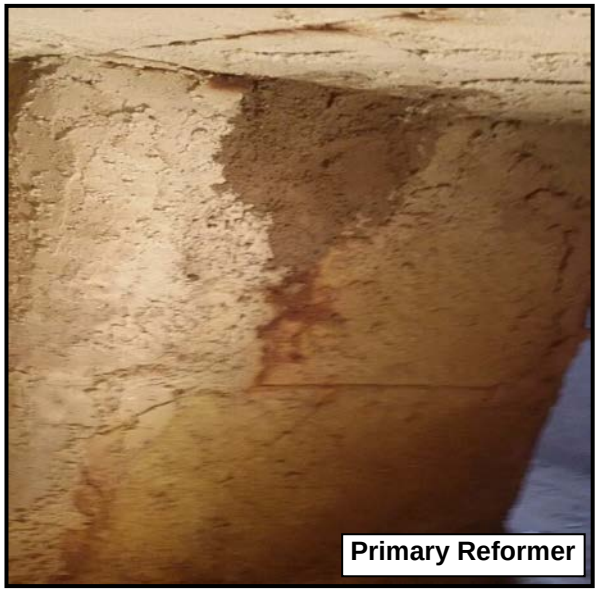
CIVIL

AMMONIA PLANT

(CIVIL)

Refractory repairing jobs in primary reformer (HT & LT zone), Auxillary boiler

The refractory repairing in primary reformer & auxillary boiler were carried out. The 10 no. of hollow blocks in primary reformer were replaced. The casting of auxiliary boiler side panels was carried out by civil section using the refractory material ''Insulyte-11''.



Primary Reformer

Side Panel of Auxillary Boiler

UREA PLANT

(CIVIL)

Rehabilitation of Lift room (outside) & stair case at prill tower top by providing elastomeric lining.

The lift room & stair case at the prill tower top was badly damaged. The plaster was broken & urea was penetrated in the wall. It was required to rehabilitate the bucket room. The procedure provided by M/S Greensboro polychem Pvt. Ltd for B&MH plant structure in packer scale was repeated for lift room & stair case. The procedure involves removal of existing plaster, cleaning of the surface, application of Polydee-RC (Rust convertor), application of bond coat, providing polymer modified mortar (PMM), proper curing of the PMM & application of 1 mm thick elastomeric layer.

Cleaning of the Surface

Lift Room of PTT

Application of PMM

Application of elastomeric coating

Lift room walls, Beams & columns at prill tower top before & after the treatment

To create space for crane movement for replacement of LPCC

To replace LPCC in urea plant, it was required to demolish flooring behind urea plant for crane approach. Accordingly, flooring of one meter height and 50 m^2 area was

demolished. After completion of job same has to be constructed with RCC wall and floor.

Retrofitting of the existing foundations and construction of the additional supports on Ammonia pump line in urea plant

There was the problem of the vibrations in the ammonia pump line in urea plant. To arrest the vibrations additional supports were provided in the urea plant. Total 10 no. of additional supports were constructed during the annual turnaround.

Newly constructed foundations in urea plant

OFFSITE & UTILITY PLANT

(CIVIL)

Replacement of marine plywood sheet in cooling tower deck

Damaged plywood sheets of the cooling tower deck were replaced with new marine plywood sheets. Approximately 150 m2 of the marine plywood sheets were replaced during the shutdown. The marine plywood is cut in the size of 4'X4' & pieces are to be fixed at the cooling tower deck.

Rehabilitation job of the cooling tower basin

The cooling tower basin outside walls are badly damage and prone to seepage. The outside brickwork & plaster was carried out during the shutdown.

Excavation of cooling tower header for wrapping & coating of the pipe lines & backfilling including PCC of the header

The surrounding area of cooling water return headers was excavated for the preventive maintenance including wrapping & coating of the headers. Excavation of the header for the depth of 1.5 meters was carried out. Same were back filled after completion of mechanical maintenance job. The top PCC layer was provided around the headers to restrict the ingress of water & to reduce the possibility of corrosion of MS header.

Application of the epoxy monolithic plaster beneath the clarriflocculator rail

The circumferential rail of clarriflocculator was replaced during the annual turnaround 2014. The civil jobs involves the leveling of surface, fixing of ''Hilti'' make anchor fasteners of diameter 16 mm with chemical & grouting of the plate over the circumferential wall. The remaining space beneath the rail was filled with the epoxy monolithic plaster during the annual turnaround 2015.

B & MH PLANT

(CIVIL)

Providing IP Net coating in Silo, conveyor gallery & transfer tower

IP Net coating was provided as a rehabilitation measures in Silo, transfer tower & reclaim conveyor gallery (M-2117). The process included the cleaning of the surface & application of putty on the eroded surface to make the surface uniform & application of three coat system of I P Net. The scaffolding arrangement for conveyor belt M-2117 was crucial as the height of the conveyor belt was approximately 8 meter & length of belt is approximately 217 Meters. The job was executed successfully and within specified time by M/s Krishna Conchem Pvt Ltd.

The gallery & transfer tower before and after application of IP Net.

Rehabilitation of wagon floor (beams, columns & soffit) & dust dissolving tank area of B & MH plant by providing elastomeric lining

The condition of the concrete structure in wagon floor & dust dissolving area is in very damaged condition. To rehabilitate the concrete condition, It was decided to provide the chemical treatment offered by M/S Greensboro polychem Pvt. Ltd. Accordingly the job was carried out which included removal of existing plaster, cleaning of the surface, application of Polydee-RC (Rust convertor), application of bond coat, providing polymer modified mortar (PMM), proper curing of the PMM & application of 1 mm thick elastomeric layer. The supply of material and job execution was carried out by m/s Greensboro Polychem Pvt Ltd..

Dust dissolving tank area & wagon floor before & after application PMM & elastomeric coating

TECHNICAL

AMMONIA PLANT

(TECHNICAL)

Installation of bypass control valve (HCV-435A) with by Pass line (Ref. : EWR No. A-299 Dated 28/05/2014)

EWR No. A299 was raised to provide the smaller size control valve in parallel to HCV-435 which is installed on bypass line of 115-HT on MDEA-1202.05-18''.

New control valve HCV-435A of 6 inch size has been provided as a bypass of HCV-435 (By pass line of hydraulic pump 115-HT) .The details of New HCV-435A are as under :-

1	TAG No.	**HICV-435A**	24	FLUID STATE	**Liquid & vapor**
2	SERVICE	Rich aMDEA Solution	25	FLOW : MIN / NOR / MAX	110 /132 /170.5 T /HR
3	LINE SIZE / MATERIAL	6" / SS 304	26	UPSTREAM TEMP. NORMAL /MAX	80 ° C
4	MODEL NO	38-41612 AS/EPP/HW	27	DESIGN PRESSURE	30.6 Kg/cm2
4	AREA CLASSIFICATION	HAZRDOUS ,ZONE-2 Gr.IIC	28	UPSTREAM PRESSURE :MIN /NOR /MAX	25 / 27.1 /28.1 KG/CM^2 G
5	TYPE OF BODY	Heavy Duty Globe	29	AIR FAIL POSITION	CLOSE
6	BODY SIZE	6"	30	HAND WHEEL/ LOCATION	YES / SIDE
7	GUIDING	Cage	31	MAKE & MODEL No	MIL 8013
8	END CONNECTION & RATING	FLANGED, 6" 300# RF	32	TYPE	ELECTRO-PNEUMATIC (NON-SMART)
9	FLOW DIRECTION	Flow to Close	33	AREA CERTIFICATION	HAZRDOUS, ZONE-2 Gr.IIC AS PER IEC
10	BODY MATERIAL	ASTM A 351 Gr. CF8	34	WEATHER PROOF TO	IP-65
11	PACKING MATERIAL	PTFE	35	ACTION	DIRECT
12	% OPENING MIN / NOR/MAX	41.29 / 47.9 / 60.66	**36**	POWER SUPPLY	18- 24 VDC
13	BONNET TYPE	STANDARD (With Mod. Finned Extn.)	37	GAUGES/BYPASS	YES, 3 Nos
14	TRIM TYPE	ANTI CAVITATION TYPE	38	INPUT	4-20 mA DC
15	FLOW CHARACTERISTICS	LINEAR	39	AIR SETS	YES WITH O/P GAUGE
16	Cv REQUIRED / SELECTED	70	40	DOWNSTREAM PRESS.	6.5 / 7.3 /7.5 KG/CM^2 G
17	SEAT MATERIAL	SS 316 + Stellite No. 6	41	DIFF. PRESSURE Nor/Max.	18.5 / 19.8/ 20.6 KG/CM^2
18	CAGE/ PLUG/STEM MATERIAL	SS 316 + Stellite No. 6	42	MAX. SHUT-OFF DP	30.6 KG/CM^2 G
19	SEAT LEACAGE CLASS	CALSS IV	43	SP. GRAVITY	1.074
20	ALLOWABLE SOUND LEVEL	< 85 dBA	44	OPTG VISCO / DENSITY	0.35 Cp
21	MODEL No. & SIZE	MIL/38/15 In	45	CAVITATION INDEX	0.7
22	TYPE	SPRING DIAPHRAGM	46	Cv MIN/NOR /MAX	28.906 / 33.53 / 42.46
23	dP FOR SIZING	30.6 Kg/cm2	47	DOWNSTREAM PRESS.	6.5 / 7.3 /7.5 KG/CM^2 G

Advantage : The benefits obtained from the implementation are operation flexibility and reduce CO2 flow fluctuation.

Replacement of MICV-10 (Ref. EWR No. A-282Dated 20/05/2013) :

In existing system 'Tunnel burners' are provided to burn fuel gas (NG) for raising the flue gas temperature at convection section inlet when more heat is required in the convection section coils. Fuel gas (NG) is supplied to these burners through FG- 6 line (3"), Fl-64 indicates the fuel flow to tunnel burners. Control valve MICV-10 is provided to controls the fuel flow to these burners and have bypass provision.

As per above EWR MICV-10 with increase CV has been installed to achieve sufficient flow of fuel in tunnel burner.The details of new MIC-10 are as under :

1	TAG No.	**MICV-10**	26	FLUID STATE	**NATURAL GAS**
2	SERVICE	Natural gas	27	FLOW : MIN / NOR / MAX	- / 2600 /3700 Nm^3 /HR
3	LINE SIZE / MATERIAL	3" / CARBON STEEL (WCB)	28	UPSTREAM TEMP. NORMAL /MAX	110 / - º C
4	MODEL NO	VENDOR TO SPECIFY	29	DESIGN PRESSURE	4 kg/CM2 g
4	AREA CLASSIFICATION	HAZRDOUS ,ZONE-2 Gr.IIC	30	UPSTREAM PRESSURE : MIN /NOR /MAX	--- / 3.2 / -- KG/CM^2 G
5	TYPE OF BODY	GLOBE RECIPROCATING	31	DOWNSTREAM PRESS.	--- / 1.7 / -- KG/CM^2 G
6	BODY SIZE	3" / FULL PORT	32	DIFF. PRESSURE Nor/Max.	1.5 KG/CM^2
7	GUIDING	SINGLE	33	MAX. SHUT-OFF DP	4.0 KG/CM^2 G
8	END CONNECTION & RATING	FLANGED, 3" 300# RF	34	MOL .WT	16.34
9	FLOW DIRECTION	FLOW TO OPEN	35	DESIGN PRESSURE	4 kg/CM2 g
10	BODY MATERIAL	**ASTM A 216 WCC**	36	UPSTREAM PRESSURE :MIN /NOR /MAX	--- / 3.2 / -- KG/CM^2 G
11	MODEL No. & SIZE	Linear Contoured	37	DOWNSTREAM PRESS.	--- / 1.7 / -- KG/CM^2 G

12	TYPE	SPRING DIAPHRAGM	**38**	DIFF. PRESSURE Nor/Max.	1.5 KG/CM^2
13	dP FOR SIZING	4KG/CM2	39	MAX. SHUT-OFF DP	4.0 KG/CM^2 G
14	AIR FAIL POSITION	CLOSE	40	MOL .WT	16.34
15	HAND WHEEL/ LOCATION	YES / SIDE	41	SEAT LEACAGE CLASS	CALSS IV
16	MAKE & MODEL No	88-21114	42	ALLOWABLE SOUND LEVEL	< 85 dBA
19	TYPE	ELECTRO-PNEUMATIC (NON-SMART)	43	Cv MIN/NOR /MAX	48.13/ 68.55
20	AREA CERTIFICATION	HAZRDOUS ,ZONE-2 Gr.IIC AS PER IEC	44	% OPENING MIN / NOR/MAX	60-70% OR 48.13 to 68.55
21	WEATHER PROOF TO	IP-65 OR HIGHER	45	AIR SUPPLY PRESSURE	4.5 KG/CM^2 (Max)
22	ACTION	DIRECT	46	POWER SUPPLY	18- 24 VDC
23	POWER SUPPLY	18- 24 VDC	47	GAUGES/BYPASS	YES, 3 Nos
24	GAUGES/BYPASS	YES, 3 Nos	48	**INPUT**	**4-20 mA DC**
25	**INPUT**	**4-20 mA DC**	49	AIR SUPPLY PRESSURE	4.5 KG/CM^2 (Max)

Advantage : Sufficient fuel gas flow achieved without increasing PRC-2 by throttling individual fuel headers to attain mixed feed coil temperature and steam superheat coil temperature around 450^{0}C

Installation of solenoid operated valve for isolating purge gas from PIC-7, PIC-8 and PIC-13 on actuation of I-47/I-14 (Ref. : EWR A-296 dated 03/03/2014)

In existing system, purge gas from PIC-7, PIC-8 and PIC-13 is used as fuel in Primary Reformer. On actuation of I-47/ I-14, Purge gas shall be cut-off to primary reformer for safety of furnace. One plug valve is provided for manually isolation of purge gas.

Solenoid valve (V-203A) has been provided which was available with Instrument department in 151-C inlet line no. SG-39-4'' upstream of block valve.

Advantage : This solenoid valve will provide additional safety of furnace on actuation of I-47/ I-14

Installation of Check Valve at Lean MDEA Pumps (107-J/JA) common discharge line to Absorber (101-EA) (EWR A-320 dated 06/04/2015)

In existing conditions there was no check valve at lean MDEA Pumps (107-J/JA) common discharge line to Absorber (101-EA)

In the above EWR it was requested for provision of Check valve at lean MDEA Pump (107-J/JA) common discharge line to Absorber (101EA) to avoid reversal flow of Gas from Absorber to lean MDEA Pump.

Therefore 10'' SS Check Valve installed which was procured from M/s ZED Valves during shutdown . The job was completed by M/s Shiv Engg. who was engaged for fabrication work during shutdown.

Provision of U/S isolation valve of 141-C RV (PSV-2201), {Ref. : EWR A-308 Dated 10-November-2014}

Presently, there is no isolation valve at upstream line of 141-C RV (PSV-2201) . 141-C is operated at 2.0 Kg/cm2g pressure.

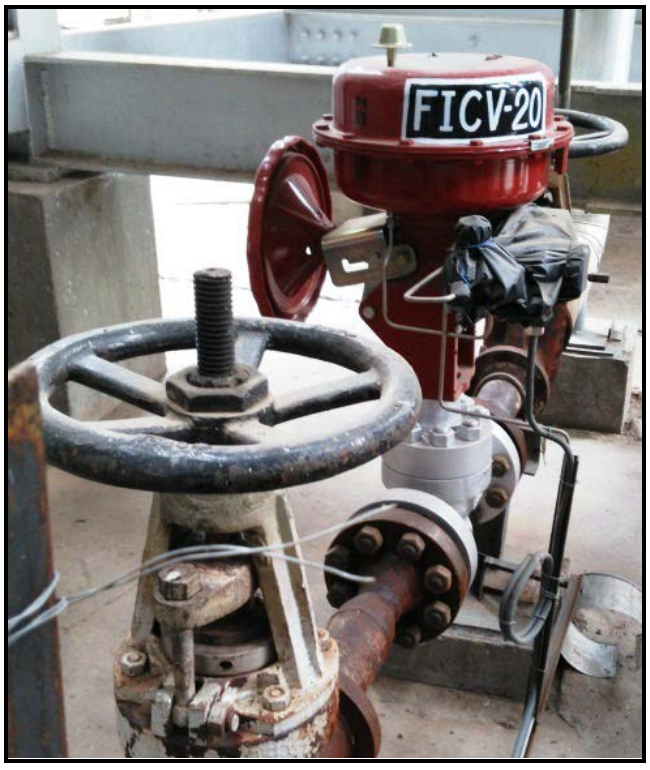
4 inch isolation valve of LTCS material has been installed at upstream of RV.

However, RV outlet line has not been connected to vent header as per request of production department.

Installation of FICV-20 (EWR: A-274 dated 15-01-2013)

New control valve has been installed on 3" line from 123-C shell side outlet 6" line to offsite BFW coil outlet 6" line.

With this control valve, more flow through 123-C can be achieved from 123-C outlet line to Utility BFW coil outlet line.



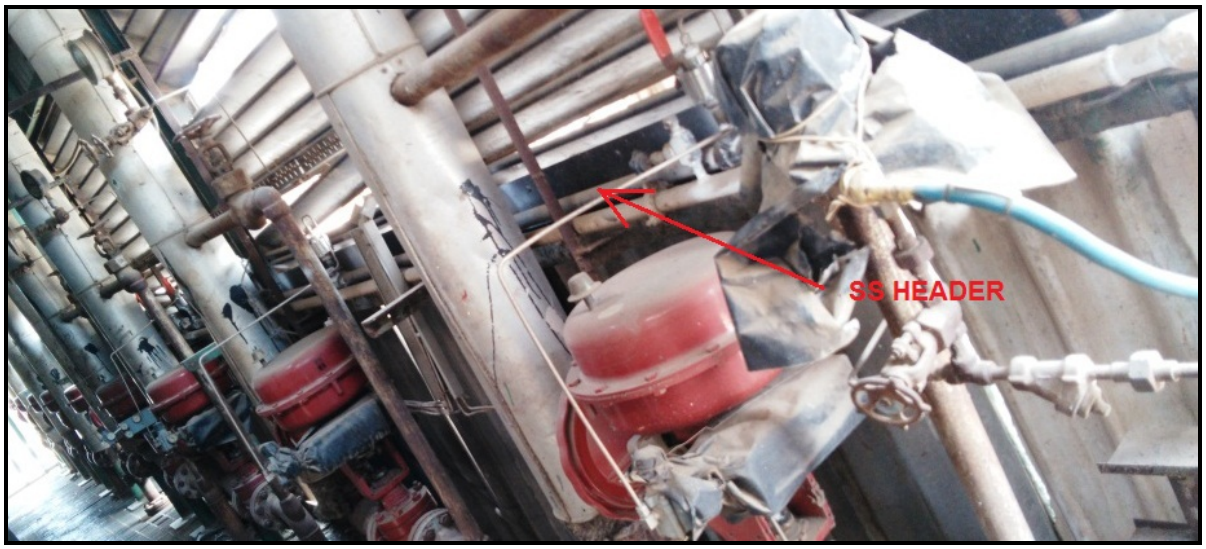
The details of new FICV-20 are as under :-

	PO No. 201004140936		
1.1	Tag No.		**FICV- 20**
1.2	Service		BFW from 123-C to Utility Boiler
1.3	Line size & Material		2” (50 NB) / Carbon Steel
2	**SERVICE CONDITIONS**		
2.1	Fluid / Fluid state		Boiler feed water
2.2	Flow	Min/Nor/Max	/ /30 m^3 /hr
2.3	Upstream pressure	Min/Nor/Max	110 / / 115 Kg/cm^2 g
2.4	Downstream pressure	Min/Nor/Max	80 / -- / 80 Kg/ cm^2 g
2.5	Diff. Pressure	Min/Nor/Max	30 / / 35 Kg/ cm^2 g
2.6	Operating temperature	Min/Nor/Max	200 / / 220 deg.C
2.7	Operating density / viscosity		----
2.8	Calculated Cv Min/Nor/Max		5.947/--/5.429
2.9	Selected Cv		15
2.10	% opening at max flow		63.92 – 65.99 %
3	**VALVE BODY & TRIM DETAILS**		
3.1	Type		Globe, Reciprocating, Model: 88-21124.
3.2	Body size / Port size		2”.
3.3	End Connection & Rating		Flanged, ANSI B 16.5 RTJ,1500#
3.4	Body material		Carbon steel A216 Gr WCC
3.5	Seat material		316 St St Hard Faced
3.6	Plug & other wetted parts material		316 St St Hard Faced
3.7	Stem material		630 (H1075) St St
3.8	Bonnet type		Standard.
3.9	Gland packing		Graphite.
3.10	Flow action		Flow to Open.
3.11	Flow characteristics		Equal %
3.12	Leakage class		Class IV.
3.13	Allowable sound level		< 70 db a,

Replacement of CS instrument header with SS material

Balance CS instrument header of Primary Reformer area, BFW pump area has been replaced with SS instrument headers.

Approximately 200 Mtr CS header of sizes 1”/ ¾”/ ½” NB has been changed to SS material and approx. 50 Nos. SS ball have been provided.



Proper steam Jacketing on NG feed and fuel Lines (EWR No. A287, Dt.02/08/2013)

½'' size Combined vent header for steam jacket jump over lines has been provided and vent valves have been provided at suitable height for removing of inert to make steam jacketing more effective.

UREA PLANT
(TECHNICAL)

Provision of condensate heating system (Sparger) in condensate tank T-1501. (Ref. EWR No. U-245 Dt. 27/11/2012)

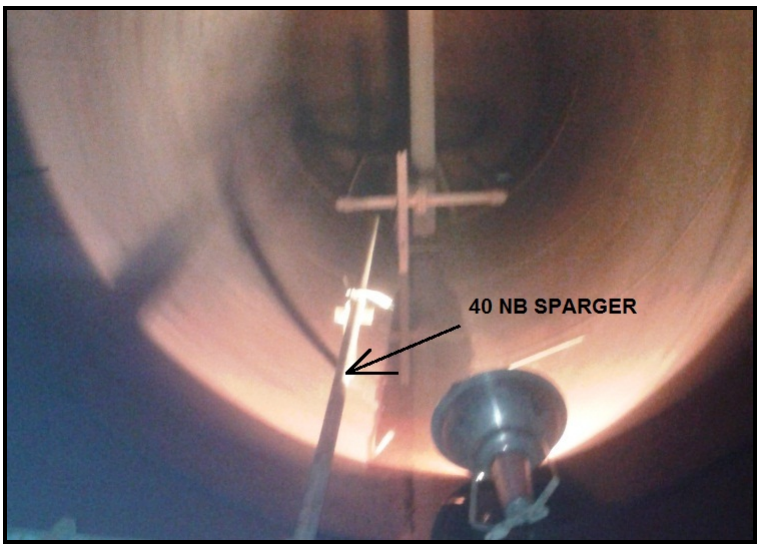
Atmospheric condensate tank (T-1501) is provided for collection and distribution of the steam condensate from various heaters, jackets, tracing lines etc. in urea plant. There is

no provision for heating of DM water in steam condensate tank. Flushing and filling of system with DM water / Condensate during plant shutdown/ start-up is not effective.

In the above EWR, It was requested to provide steam sparger in Steam Condensate Tank (T-1501) to increase the temperature of DM water during shutdown or start-up of plant. Accordingly sparger having following details have been provided in condensate tank

Details of steam sparger inside steam condensate tank (T-1501)

- 40 mm NB Sparger provided in the steam condensate tank,
- LP steam supplied from the 4 ata steam header .
- LP steam consumption is around 4500 kg/h.
- Approximate length of sparger = 5.0 m
- No. of holes on the sparger = 70
- Size of holes = 5 mm



Increase of Nozzle size of Urea Solution Tanks (EWR No. U-266 Dated 22/11/2014)

According to EWR, the urea solution tanks getting pressurized during the plant start-up when LP system is upset and seal provided on T-1401A breaks and discharge ammonia to atmosphere, create unsafe working environment.

To avoid the problem of pressurization of T-1401A and water seal break during the plant start-up when LP system is upset, the Nozzle size of Urea solution tank (T-1401) increased from 6 inch to 10 inch and in Additional Urea solution tank (T-1401A) from 4 inch to 8 inch.

Benefits

- Tank over pressurization problem for urea solution tanks resolved with increase the nozzle sizes of urea solution tanks.
- This avoid water seal failure of T-1401 and in turn stop ammonia vapour release from urea solution tank to environment during plant upset conditions.

UTILITY PLANT
(TECHNICAL)

Installation of Silencer in 60 ATA steam header in BHEL Boiler

Advantage :

Provision of additional steam venting from 60 ata steam header in BHEL boiler during urea plant start-up and shutdown (EWR no: SG-63)

It is requested in EWR, to provide additional venting of about 40 t/h by providing control valve to adjust with steam drawl style of urea plant during plant start up and shutdown.

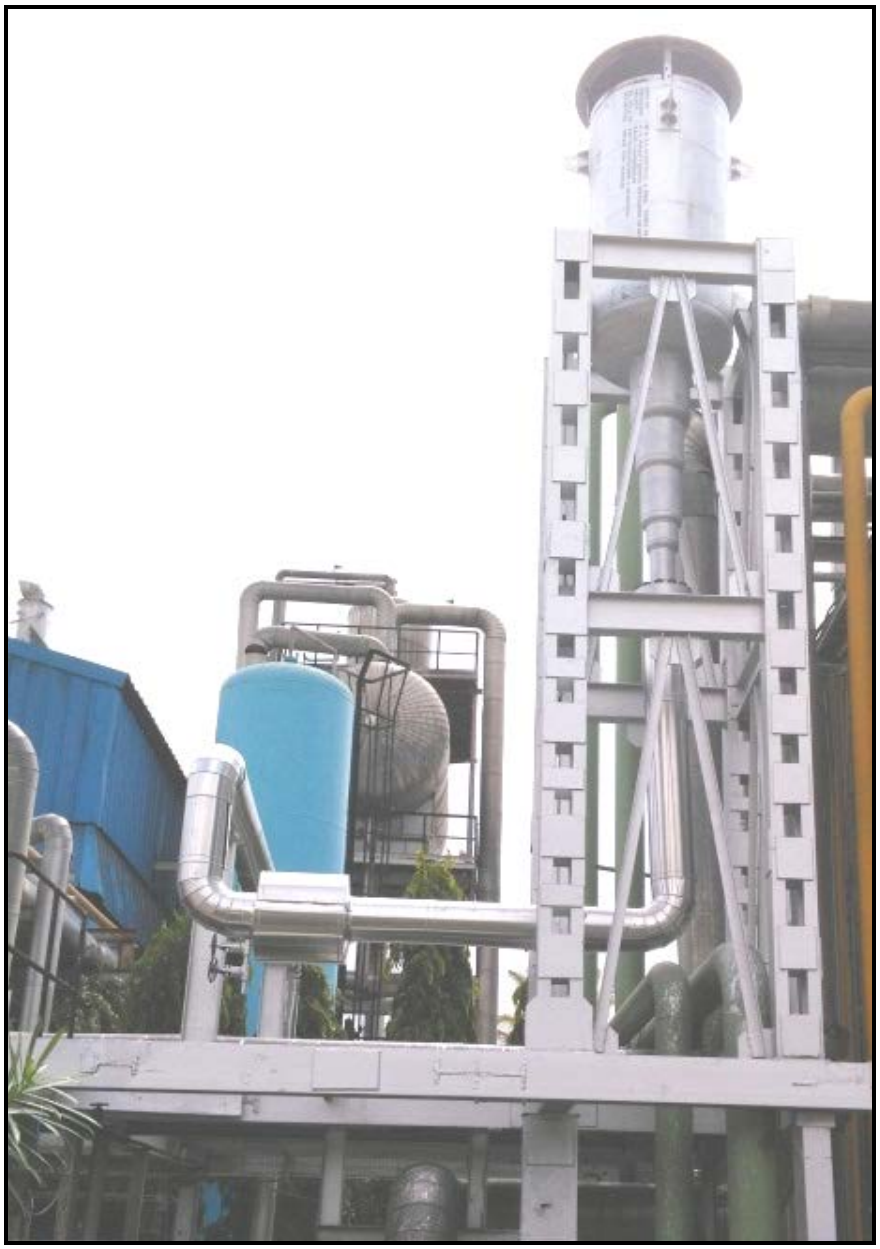
Accordingly to have independent system for steam venting in BHEL boiler, 150mm tapping with isolation valve taken on 60 ata steam header to Urea plant in boiler battery limit to install following facilities :-

- Control valve of about 40 t/h.
- New silencer for venting 60 ata steam to atmosphere.
- Logic : The valve will work as PICV to control preset header pressure of 60 ata steam to Urea palnt

Details of vent silencer are as under :-

Sl No.	Description	Steam vent silencer
01	Flow medium	Steam
02	Type	Vertical
03	Set Pressure Kg/Cm^{2}g	58.0
04	Temperature (^{0}C)	415
05	Flow to be handled (Kg/hr)	40000
06	Noise level to be maintained dB(A)	85dB(A)@1 M Distance
07	End Connections	Flanged
12	Inlet size	6''NB,1500#, **WNRTJ**
13	Quantity	01
14	Corrosion allowance on CS parts only	3.0mm
15	Inlet noise level (dBA)	150
16	Casing/ Outer shell	SA516Gr.70
17	Dished End	SA516Gr.70
18	Support bracket, lifting lugs	IS2062Gr.B
19	Diffuser pipe	Rolled out of dia 16'' SA 516 Gr.70
20	Rain Hood/ Weather cowl	IS 10779Gr.0
21	Drain Pipe	¾'', Sch80, SA 106Gr.B
22	Bird screen	G.I.
23	Wire mesh	G.I.
24	Perforated sheet	SS 304

25	Acoustics materials	Mineral wool (100Kg/m^3), IS8183
26	Inlet pipes	SA106Gr.B
27	Inlet Flange	SA105, 6'',Sch80, A105, ASME B 16.5, WNRTJ
28	Bolts	SA193Gr.B7
29	Nuts	SA194Gr.2H
30	Name Plate	SS



Benefit : For better control of 60 Ata export header pressure and on CO_2 compressor trip, Boiler tripping shall be avoided.

Tapping for installation of control valve was taken during shutdown and job was continued after shutdown . Also, Control valve could not be installed due to its rejection.

B & MH. PLANT
(TECHNICAL)

Installation of Vibrating screens and Urea Feeding System in Silo

02 Nos. of vibrating screens having 125ton/Hr capacity each have been supplied by M/s McNally Sayaji. The same have been installed on new civil foundations in Silo.

The feeding mechanism for Urea feeding into the above vibrating screens have been installed which consists of following equipments :

1) Pneumatic Plough Diverter
2) Two way chute with flap gate
3) Vibrating Feeders-2Nos.
4) Connecting chute between vibrating feeder and vibrating screens
5) Screened product conveyor
6) Fines conveyor

Installation of Diverter on Reclaim conveyor (M-2117) and installation of hood on Main conveyor (M-2121) has been carried out during shutdown. However, all other jobs continued after shutdown.

Following parties are involved for the completion of job :

- M/s McNally Sayaji : Supplied the vibrating screens
- M/s Shiv Engg. : Erected vibrating screens and structure for Urea Feeding mechanism.
- M/s Thermal Alliance : Erection and supply of Urea Feeding system
- Civil foundation by M/s Pavan super structure Pvt. Ltd.
- Miscellaneous platform and structure work by M/s Gen Engg. works

Details of New vibrating screens are as under :-

Feed capacity of each screen	125 ton/ Hr.
Type	Rectangular, Inclined, single deck with bottom plate , Circular motion type
Angle of repose	27^0 to 28^0
Required Output size analysis	-4 to +1 mm : 98 to 100% -1mm : 0 to 2 %
Screen Angle	15^0
Efficiency of the screen	85-90 %
Mesh Size	1.2mm Sq. opening (Under trial)
Over all size	Approx. 7x3.3x3 Mtr.
Screen mesh, Body, Frame	SS304
Dust Cover	SS304
Base Frame	MS Powder coated

Technical data of Diverter

Sr. No.	ITEM	DESCRIPTION
1	Type of Diverter	Pneumatic Diagonal Plough Type
2	Application	Diversion of urea prills from reclaim belt conveyor M- 2117 to distribution chute
3	Capacity	300 TPH (Design) 250 TPH (Normal)
4	Quantity	01 Nos.
5	Type of actuator	Pneumatic linear type
6	Limit Switch	Considered
7	Diverter pad type	Natural Rubber Blade with SS:304 Supporting plate. The frame made of IS:2062 With Epoxy painting
8	Material to be handled	Neam oil coated Urea Prills Size: (-)1 to (+)4mm dia.

Technical data for Vibrating Feeder

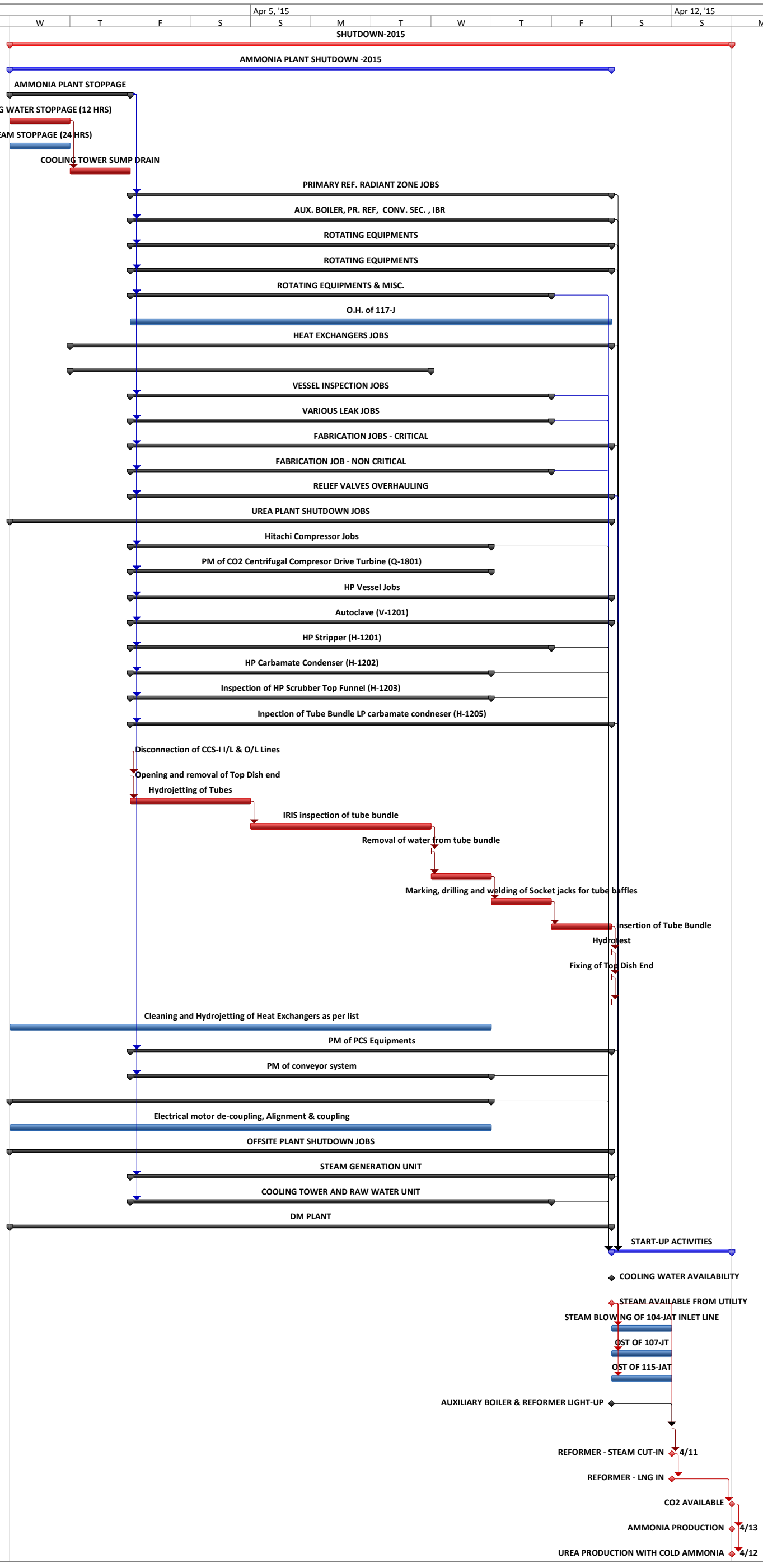
Sr. No.	ITEM	DESCRIPTION
1	Type of Vibrating feeder	Spring mounted suspended type with unbalanced mass motor
2	Application	Uniform feeding of urea along the full width of vibrating machines.
3	Capacity	150 TPH (Design) 125 TPH (Normal)
4	Pan size (mm)	Aprox 1800 x 2200
5	Frequency of Vibration (Vibration/ Min.)	50Hz, 3000 Vibration per minute
6	Amplitude of vibration (mm)	Aprox 3mm
9	Angle of inclination	8 to 12 Deg.
10	Motor Power	2x 3.7 KW
11	Feeder pan body	Base plate of SS304 with Min. 6.0 mm thk
12	Drive	Unbalanced Twins Motor
13	Quantity	02 Nos.
14	Material to be handled	Urea Prills Size: (-)1 to (+)4mm dia.

BAR CHART

MASTER BAR CHART (PLANNED) - PLANT TURNAROUND MARCH - APRIL - 2015

PLANNING SECTION
REV.:0

ID	Task Mode	Task Name	Duration
1		SHUTDOWN-2015	280 hrs
2		AMMONIA PLANT SHUTDOWN -2015	232 hrs
3		AMMONIA PLANT STOPPAGE	36 hrs
4		COOLING WATER STOPPAGE (12 HRS)	12 hrs
5		STEAM STOPPAGE (24 HRS)	24 hrs
6		COOLING TOWER SUMP DRAIN	24 hrs
7		PRIMARY REF. RADIANT ZONE JOBS	192 hrs
25		AUX. BOILER, PR. REF, CONV. SEC. , IBR	186 hrs
51		ROTATING EQUIPMENTS	188 hrs
226		ROTATING EQUIPMENTS	192 hrs
263		ROTATING EQUIPMENTS & MISC.	164 hrs
269		O.H. of 117-J	184 hrs
270		HEAT EXCHANGERS JOBS	206 hrs
333		Replacement of 101-CA tube Bundle	138 hrs
367		VESSEL INSPECTION JOBS	180 hrs
371		VARIOUS LEAK JOBS	168 hrs
374		FABRICATION JOBS - CRITICAL	192 hrs
390		FABRICATION JOB - NON CRITICAL	180 hrs
399		RELIEF VALVES OVERHAULING	192 hrs
412		UREA PLANT SHUTDOWN JOBS	238 hrs
413		Hitachi Compressor Jobs	144 hrs
414		PM of CO2 Centrifugal Compresor Drive Turbine (Q-1801)	144 hrs
431		HP Vessel Jobs	192 hrs
432		Autoclave (V-1201)	192 hrs
438		HP Stripper (H-1201)	168 hrs
442		HP Carbamate Condenser (H-1202)	144 hrs
448		Inspection of HP Scrubber Top Funnel (H-1203)	144 hrs
452		Inpection of Tube Bundle LP carbamate condneser (H-1205)	202 hrs
453		Disconnection of CCS-I I/L & O/L Lines	6 hrs
454		Opening and removal of Top Dish end	6 hrs
455		Hydrojetting of Tubes	36 hrs
456		IRIS inspection of tube bundle	72 hrs
457		Removal of water from tube bundle	12 hrs
458		Lifting of Tube Bundle assembly	8 hrs
459		Marking, drilling and welding of Socket jacks for tube baffles	36 hrs
460		Insertion of Tube Bundle	10 hrs
461		Hydrotest	6 hrs
462		Fixing of Top Dish End	4 hrs
463		Fixing of Connected lines	6 hrs
464		Cleaning and Hydrojetting of Heat Exchangers as per list	192 hrs
465		PM of PCS Equipments	192 hrs
491		PM of conveyor system	144 hrs
496		Fabrication jobs	192 hrs
504		Electrical motor de-coupling, Alignment & coupling	8 days
505		OFFSITE PLANT SHUTDOWN JOBS	228 hrs
506		STEAM GENERATION UNIT	188 hrs
532		COOLING TOWER AND RAW WATER UNIT	180 hrs
548		DM PLANT	228 hrs
559		START-UP ACTIVITIES	42 hrs
560		COOLING WATER AVAILABILITY	0 hrs
561		STEAM AVAILABLE FROM UTILITY	0 hrs
562		STEAM BLOWING OF 104-JAT INLET LINE	12 hrs
563		OST OF 107-JT	18 hrs
564		OST OF 115-JAT	18 hrs
565		AUXILIARY BOILER & REFORMER LIGHT-UP	0 hrs
566		FLOATING OF RVs	4 hrs
567		REFORMER - STEAM CUT-IN	0 hrs
568		REFORMER - LNG IN	0 hrs
569		CO2 AVAILABLE	0 hrs
570		AMMONIA PRODUCTION	0 hrs
571		UREA PRODUCTION WITH COLD AMMONIA	0 hrs



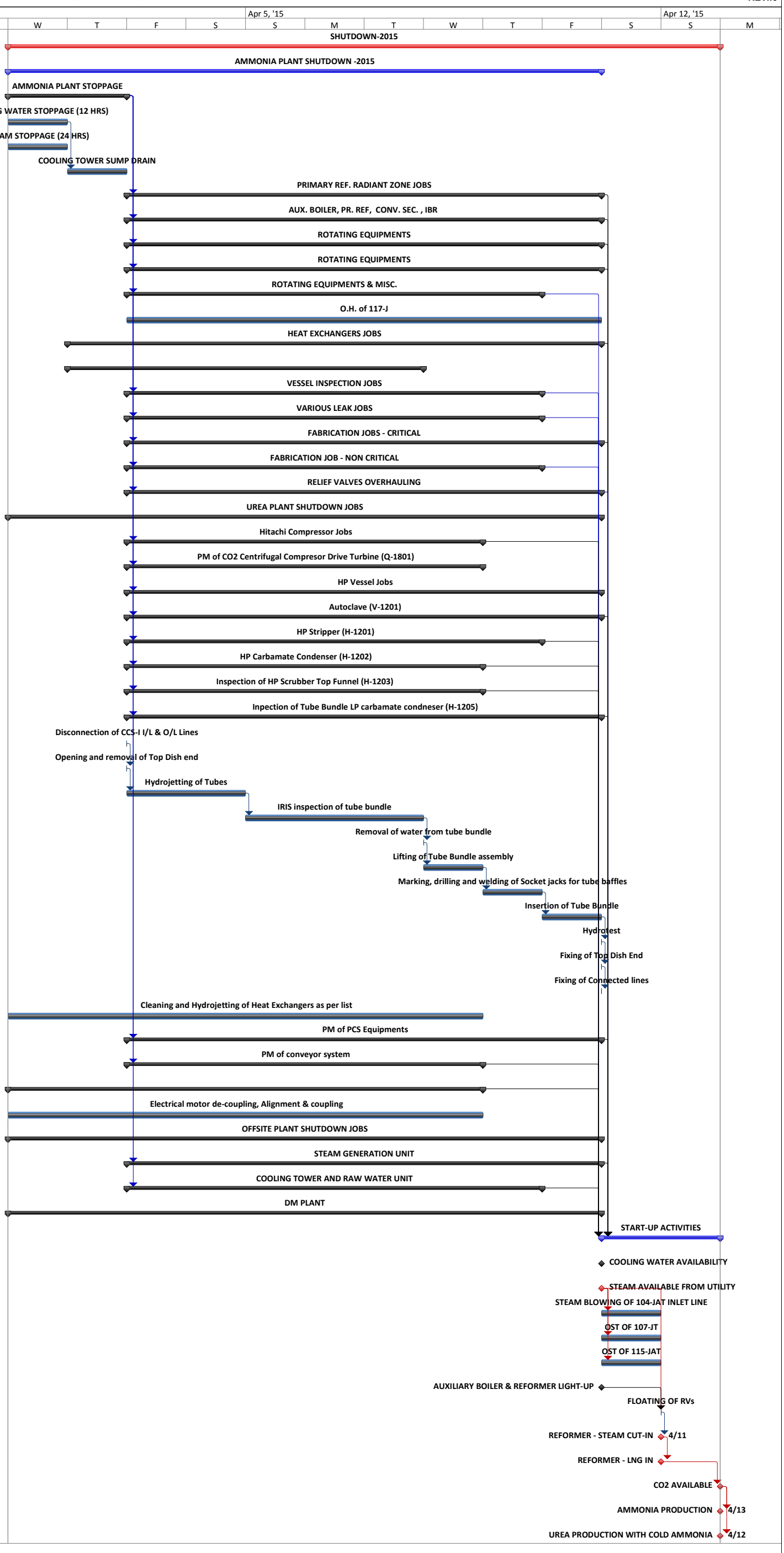
Project: msproj11
Date: Fri 11/6/15

Task	Project Summary	Inactive Milestone	Manual Summary Rollup	Deadline
Split	External Tasks	Inactive Summary	Manual Summary	Critical
Milestone	External Milestone	Manual Task	Start-only	Critical Split
Summary	Inactive Task	Duration-only	Finish-only	Progress

MASTER BAR CHART (ACTUAL) - PLANT TURNAROUND MARCH - APRIL - 2015

PLANNING SECTION
REV.:0

ID	Task Mode	Task Name	Duration
1		SHUTDOWN-2015	280 hrs
2		AMMONIA PLANT SHUTDOWN -2015	232 hrs
3		AMMONIA PLANT STOPPAGE	36 hrs
4		COOLING WATER STOPPAGE (12 HRS)	12 hrs
5		STEAM STOPPAGE (24 HRS)	24 hrs
6		COOLING TOWER SUMP DRAIN	24 hrs
7		PRIMARY REF. RADIANT ZONE JOBS	192 hrs
25		AUX. BOILER, PR. REF, CONV. SEC. , IBR	186 hrs
51		ROTATING EQUIPMENTS	188 hrs
226		ROTATING EQUIPMENTS	192 hrs
263		ROTATING EQUIPMENTS & MISC.	164 hrs
269		O.H. of 117-J	184 hrs
270		HEAT EXCHANGERS JOBS	206 hrs
333		Replacement of 101-CA tube Bundle	138 hrs
367		VESSEL INSPECTION JOBS	180 hrs
371		VARIOUS LEAK JOBS	168 hrs
374		FABRICATION JOBS - CRITICAL	192 hrs
390		FABRICATION JOB - NON CRITICAL	180 hrs
399		RELIEF VALVES OVERHAULING	192 hrs
412		UREA PLANT SHUTDOWN JOBS	238 hrs
413		Hitachi Compressor Jobs	144 hrs
414		PM of CO2 Centrifugal Compresor Drive Turbine (Q-1801)	144 hrs
431		HP Vessel Jobs	192 hrs
432		Autoclave (V-1201)	192 hrs
438		HP Stripper (H-1201)	168 hrs
442		HP Carbamate Condenser (H-1202)	144 hrs
448		Inspection of HP Scrubber Top Funnel (H-1203)	144 hrs
452		Inpection of Tube Bundle LP carbamate condneser (H-1205)	202 hrs
453		Disconnection of CCS-I I/L & O/L Lines	6 hrs
454		Opening and removal of Top Dish end	6 hrs
455		Hydrojetting of Tubes	36 hrs
456		IRIS inspection of tube bundle	72 hrs
457		Removal of water from tube bundle	12 hrs
458		Lifting of Tube Bundle assembly	8 hrs
459		Marking, drilling and welding of Socket jacks for tube baffles	36 hrs
460		Insertion of Tube Bundle	10 hrs
461		Hydrotest	6 hrs
462		Fixing of Top Dish End	4 hrs
463		Fixing of Connected lines	6 hrs
464		Cleaning and Hydrojetting of Heat Exchangers as per list	192 hrs
465		PM of PCS Equipments	192 hrs
491		PM of conveyor system	144 hrs
496		Fabrication jobs	192 hrs
504		Electrical motor de-coupling, Alignment & coupling	8 days
505		OFFSITE PLANT SHUTDOWN JOBS	228 hrs
506		STEAM GENERATION UNIT	188 hrs
532		COOLING TOWER AND RAW WATER UNIT	180 hrs
548		DM PLANT	228 hrs
559		START-UP ACTIVITIES	42 hrs
560		COOLING WATER AVAILABILITY	0 hrs
561		STEAM AVAILABLE FROM UTILITY	0 hrs
562		STEAM BLOWING OF 104-JAT INLET LINE	12 hrs
563		OST OF 107-JT	18 hrs
564		OST OF 115-JAT	18 hrs
565		AUXILIARY BOILER & REFORMER LIGHT-UP	0 hrs
566		FLOATING OF RVs	4 hrs
567		REFORMER - STEAM CUT-IN	0 hrs
568		REFORMER - LNG IN	0 hrs
569		CO2 AVAILABLE	0 hrs
570		AMMONIA PRODUCTION	0 hrs
571		UREA PRODUCTION WITH COLD AMMONIA	0 hrs



Project: msproj11
Date: Fri 11/6/15

Task	Project Summary	Inactive Milestone	Manual Summary Rollup	Deadline
Split	External Tasks	Inactive Summary	Manual Summary	Critical
Milestone	External Milestone	Manual Task	Start-only	Critical Split
Summary	Inactive Task	Duration-only	Finish-only	Progress