SGA
COMPRESSED AIR OPTIMISATION

- *Project:* *Optimisation of compressed air consumption*
- *Baseline:* *No of Compressor running for station load of 850MW is 9.*
- *Target:* *Reduction to running of 7 compressors for the same load condition*

Resources - Team Members

Name	Role	Dept/Function
Bimalendu Mohapatra	**Facilitator**	**Tech Cell (SEL)**
Sreeram Pavan Nemani	**Leader**	**Tech Cell (SEL)**
Arnab Srimani	**Member**	**Maintenance (Steag)**
Akshat Paliwal	**Member**	**Maintenance (Steag)**

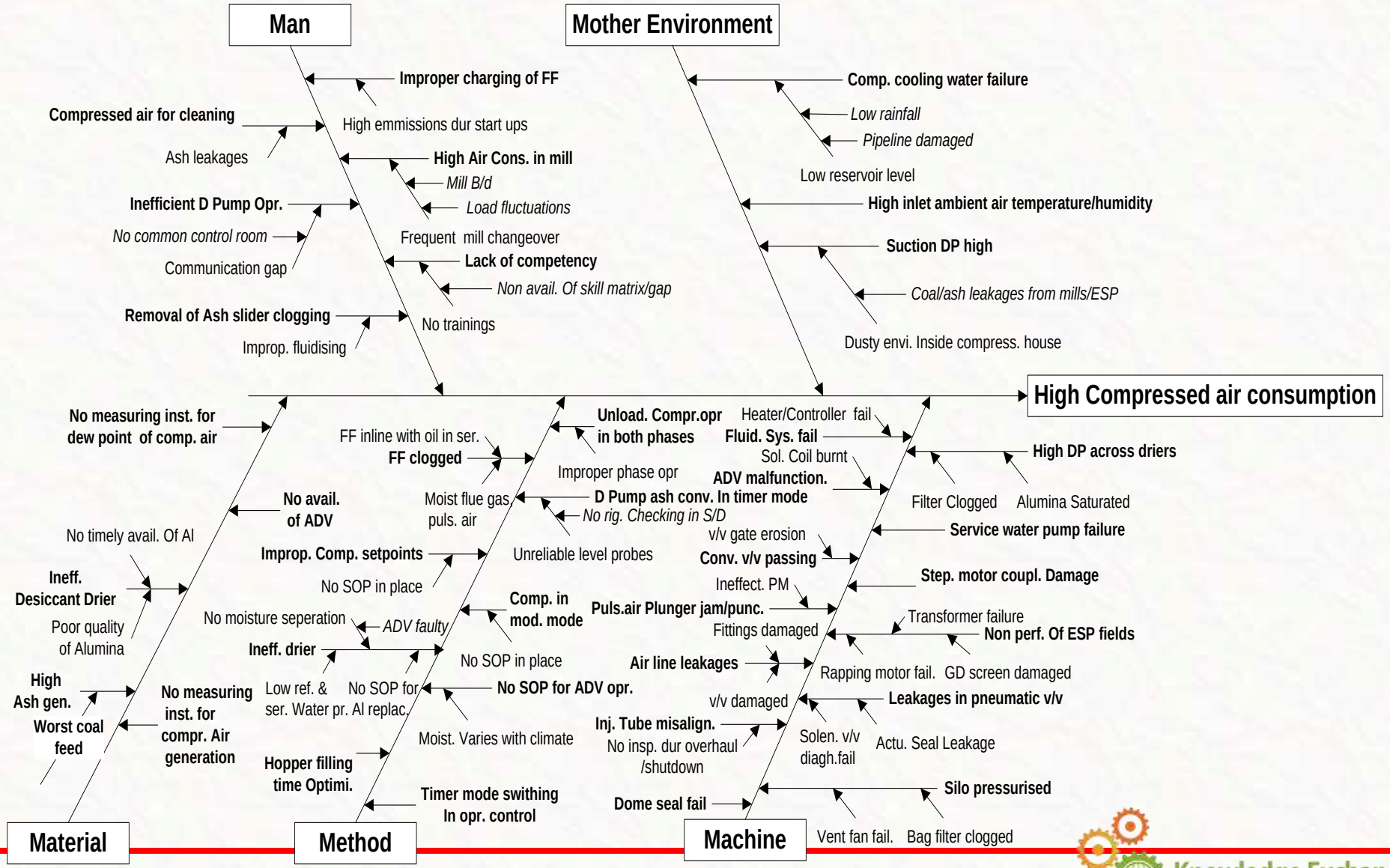
PROBLEM SELECTION

➢ Brain storming session was conducted to identify issues of high priority, wherein **"Reduction in compressed Air Consumption"** project was selected based on project rating

S.No	Issues	Y1 IMPACT ON ORGANISATION (TANGIBLE/ INTANGIBLE)) (RATING: 1, 3, 9)	Y2 (Efforts level. If High - rating 1, if medium - 3, if low - 9)	Y3 Alignment to Direct Customer (If High - rating 9, if medium - 3, if low - 1)	PROJECT-RATING SCORE (Y1*Y2*Y3)
1	Raw Water Consumption is High	5	6	4	120
2	**Compressed Air Consumption is High**	**9**	**3**	**9**	**243**
3	Belt Utilisation is low	6	5	6	210
4	HRH Steam Temperature of U3 is low	7	6	4	168
5	Mill Utilisation is low	6	6	4	22

CAUSE & EFFECT DIAGRAM

Aluminium & Power, Jharsuguda



Knowledge Exchange Platform
Transmitting Knowledge through Best Practices

C&E PRIOTRIZATION

S.No	Cause	Y	S.No	Cause	Y
1	Ash Leakages	6	12	No measuring inst. For dew point	4
2	High emission during start up.	3	13	Poor quality of Alumina	4
3	Mill Breakdown	3	14	No availability of ADV	3
4	Load fluctuations	3	15	FF inline with oil in service	4
5	No common control room	4	16	Moisture in flue gas, pulsing air	6
6	Non avail of skill matrix	3	17	No SOP in place for Comp. set point	4
7	Improper fluidising	4	18	ADV faulty	4
8	Pipeline Damages	5	19	Low refrigerant & Seal water press. Of Drier	3
9	Low rainfall	2	20	Hopper Fill time optimisation	7
10	High inlet air ambient air temp.	4	21	Moist. Variation with climate	5
11	Coal/ash leakages from Mills/ESP	6	22	Unreliable level probes	4

C&E PRIOTRIZATION

S.No	Cause	Y	S.No	Cause	Y
23	Improper phase operation	7	35	Service water pump failure.	4
24	Heater or controller failure	3	36	Stepping motor coupling failure	2
25	ADV solenoid coil burnt	3	37	ESP field transformer failure/availability	3
26	Valve gate erosion	4	38	ESP field rapping motor failure/availability	7
27	Ineffective PM	3	39	ESP field GD screen failure	4
28	Pneumatic fitting damaged.	6	40	Solenoid valve diaphragm failure.	4
29	Pneumatic v/v damaged.	3	41	Actuator seal leakage.	4
30	No inspection of FF injection tubes.	2	42	Vent fan failure	3
31	Dome seal failure.	3	43	Silo bag filter clogged.	4
32	Drier filter clogged.	4	44	Worst coal feed	8
33	Alumina saturated.	4	45	Service water pump failure.	4
34	High DP of FF	7	46	Unloaded Compressors	7

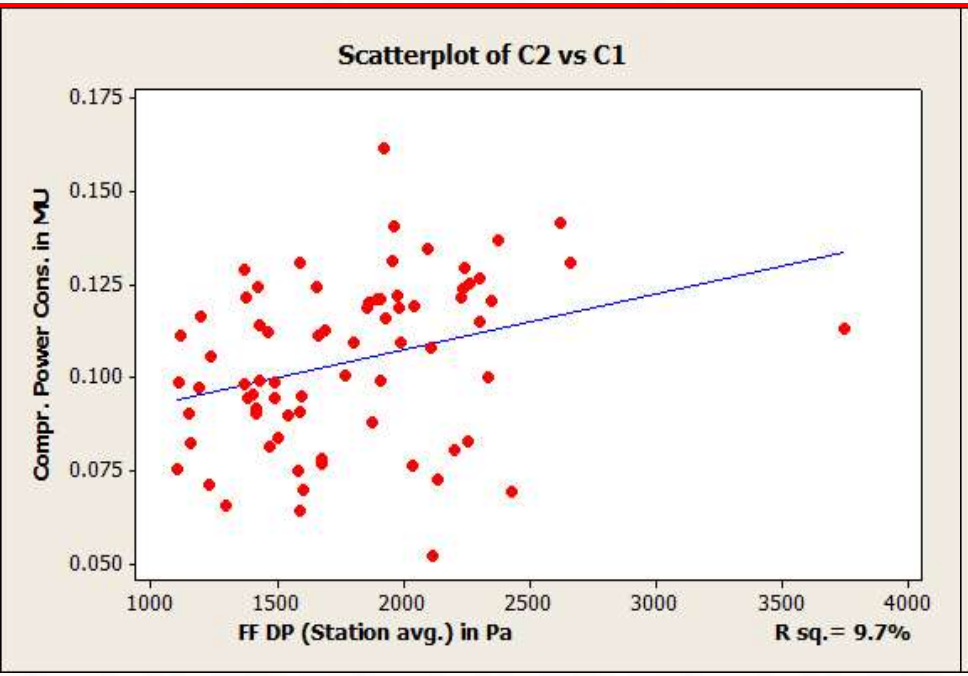
HIGH IMPACT ROOT CAUSES

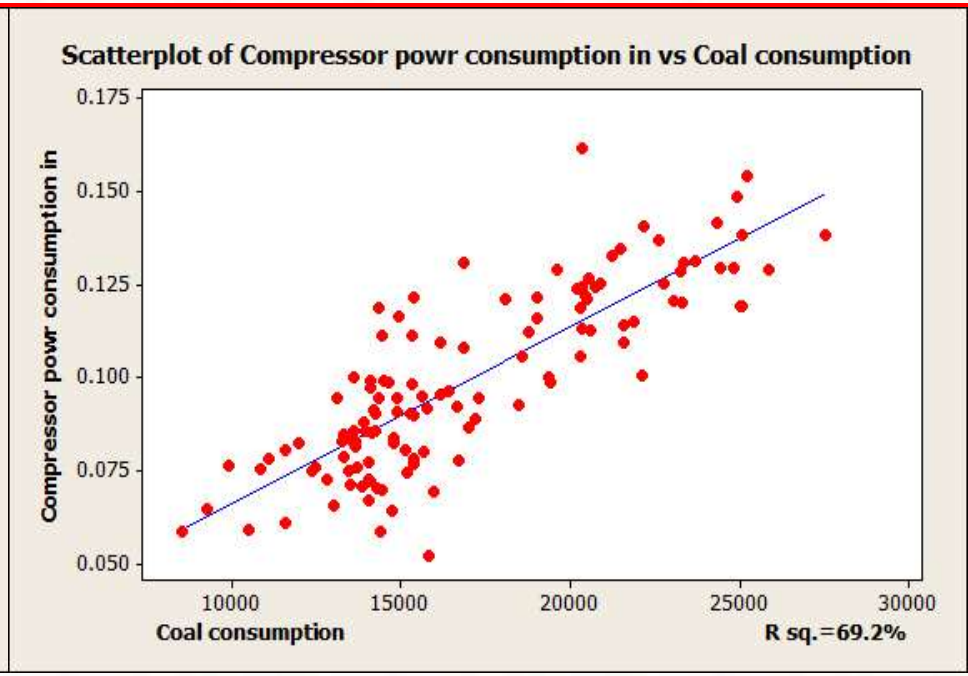
Root cause	DEFINITION
Leakages	Some of the compressed air is being wasted on account of leakages from the fittings, gaskets, punctured or damaged pipelines etc.
High DP of FF	If the differential pressure across the fabric filter is more than 1200 Pa, the pulsing frequency increases and pulsing continues till the DP falls down to 1200 Pa.
ESP Field Availability	If the fields of the electrostatic precipitators are running at lowered efficiency / unavailable, the consumption of air will increase due to high pulsing frequency in FF.
Unloaded Compressors	Unloaded operation refers to the state of compressors where in the compressors are electrically live and rotating but generating pressure required for circulation of coolant only. It does not generate pressure required for actual process operation.
Coal flow	Coal Flow measured in tonnes per hour has a direct impact on air consumption. Higher the coal flow, more is the ash generated and more is the air consumed for conveying of the ash, thereby requiring more compressors to run.
Dew Point	Atmospheric Dew Point of service air between -4°C to -10°C. ADP for instrument air between -20°C to -40°C
Probe mode Operation	In order to improve the material loading of the evacuation system, probe mode operation to be done.

IMMEDIATE ACTIONABLES

S.No	Cause	Action Proposed	Responsibility	Target date	Status
1	More no. of unloaded compressors	Interconnection of instrument air header of Ph#1 & Ph#2	Sreeram	15-1-14	Completed
2	Low material loading factor of ash evacuation system	Operation shifted from timer mode to probe mode.	Arnab	20-2-14	Completed
3	Frequent Leakages in ash conveying system.	Forming Special task force for arresting air leakages and v/v passing in AHP.	S.Sahoo	10-1-14	Completed
4	Sealing of compressor house	Seal compressor house. To ensure proper ventilation, install industrial exhaust fan	Akshad	15-1-14	Completed

GRAPHICAL ANALYSIS





Hypothetical Statement-There is a relation between FF DP & Compressor Pow. Cons..

Result-The Plot shows no significant relation between FF DP & Compressor Pow. Cons.

Hypothetical Statement- There is a relation between Coal cons.& Compressor Pow. Cons..

Result- The Plot shows a significant relation between between Coal cons.& Compressor Pow. Cons.

IDEAS/CREATIVE SOLUTIONS

S No	Idea	Area of Work
1	Dew point of service air to be maintained < 15 degree Celsius.	Driers and auto drain valve.
2	System air Leak test will be carried out in Ph-1 & Ph-2.	Conveying system
3	Air Leakage from instruments are to be identified and arrested. Monthly audits of instruments to be carried out .	Entire plant
4	Removal of one filter (inlet/outlet) from dryer and differential Pressure to be monitored across the dryer. If DP is reduced & performance is not affected, air filters to be removed from other dryers also.	Compressor house
5	Isolating supply of service air to Boiler & TG area.	BTG
6	Compressor operator to coordinate with AHP control room.	AHP
7	Installation of dew point monitors for online monitoring of compressed air dew point	Compressor house
8	Installation of high dust seperation system	Compressor house

IDEAS/CREATIVE SOLUTIONS

S No	Idea	Area of Work
9	Feasibility study to be done for taking 2 no. Receivers before the drier.	Compressor house
10	System air Leak test will be carried out in Ph-1 & Ph-2.	Compressor house
11	Feasibility study to be done for modifying Suction line for compressors from inside the chamber to outside.	Compressor house
12	Online Free Air Delivery meter to be procured.	Compressor house
13	Installing isolation v/v in AHP headers (wherever required) for online arresting of air leakages.	Conveying system
14	Feasibility checking to be done for bypassing dryer for service air.	Compressor house
15	Optimizing loading and unloading pressure set points for all compressors.	operation
16	Replacement of normal bends with cast basalt/ceramic lined bends.	Conveying system
17	Auto drain valves to be installed in Receiver tanks.	Compressor house
18	Proper sealing of compressor house and installation of exhaust fan.	Compressor house

LIST OF SELECTED SOLUTIONS

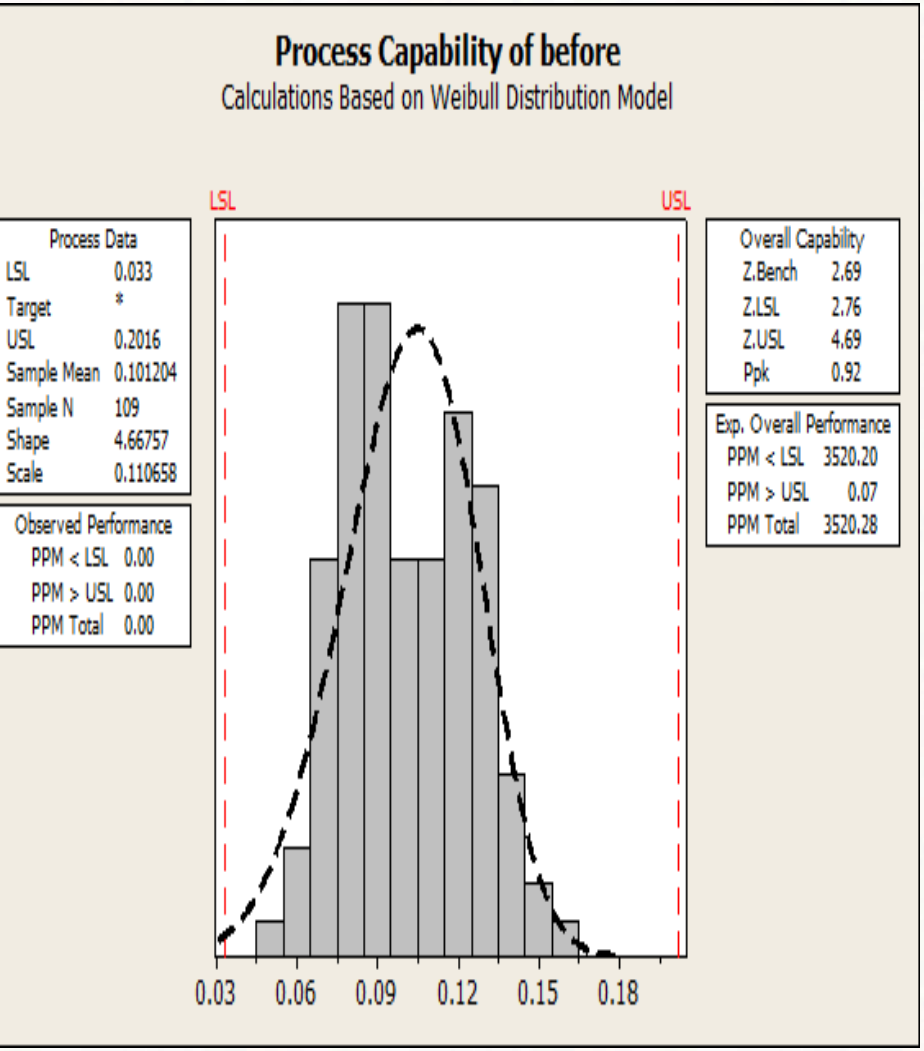
SL	SOLUTIONS
1	Header Drain valve size increased from 0.5" to 1"
2	Auto drain valves to be installed in Receiver tanks.
3	Installation of dew point monitors for online monitoring of compressed air dew point
4	Installation of high dust separation system.
5	Installation of isolation valve in purging header
6	Optimizing loading and unloading pressure set points for all compressors.

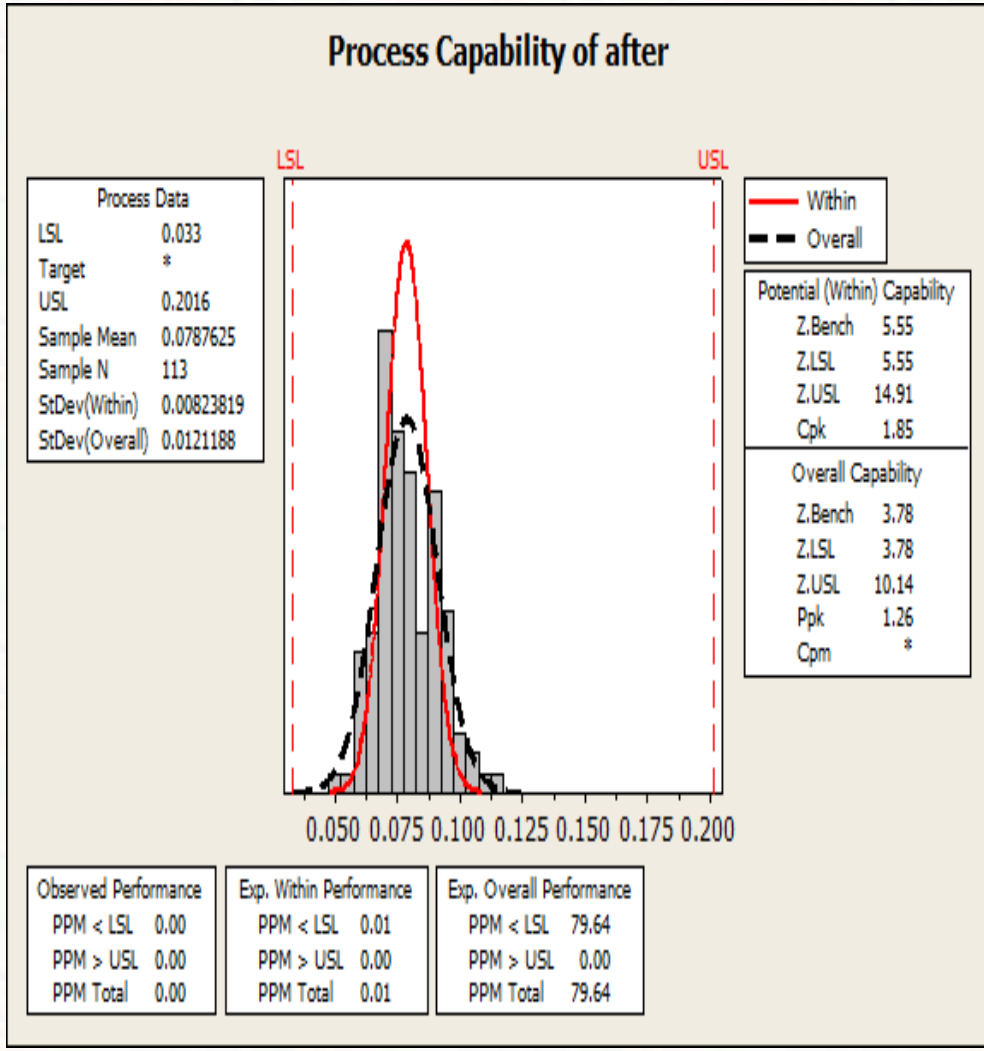
TRIAL IMPLEMENTATION PLAN

SGANAME: Reduction in compressed Air Consumption	DEPARTMENT: Ash Handling Plant/BOP/C&I

SL	Solution	Control Action Number	Improvement Action	Responsible Individual/ Solution Owner	Issues/Barriers	Risk Mitigation	Target/ Actual Complete Date	Current Status/ Comments
1	Installation of high dust seperation system in compressor number 7 of phase 1	1	Compressor inlet vacuum will improve and better capacity utilization will take place	Akshat	Modification required in compressor package		15th feb'14	Completed
2	Installation of auto drain valves	2	Improve dew point of air and less carryover of moisture to fabric filter	Sameer	High lead time of the drain valves	Other fittings required for installation to be made ready beforehand	25th dec'13	Completed
3	Installation of the online dew point meter	3	Continuous monitoring of the air dew point	Sameer	Unit shutdown required	...	10th jan'14	Completed
4	Header Drain valve size increased from 0.5" to 1"	4	Proper draining of moisture from headers, evaporators and moisture separators	Deepak Parasar	Unit shutdown required	All erection to be completed beforehand. Only single welding joint to be left for opportunity work	20th dec'13	Completed
5	Installation of isolation valve in purging header	5	Monitoring the cooling effect at different flow setting and Setting flow accordingly	Sameer	No Barriers	...	13th Jan'14	Completed
6	Optimization of loading and unloading set point of compressors	6	To minimise the unloading hours of the compressors	Sreeram	No Barriers		15th Nov'13	Completed

IMPROVED PROCESS CAPABILITY





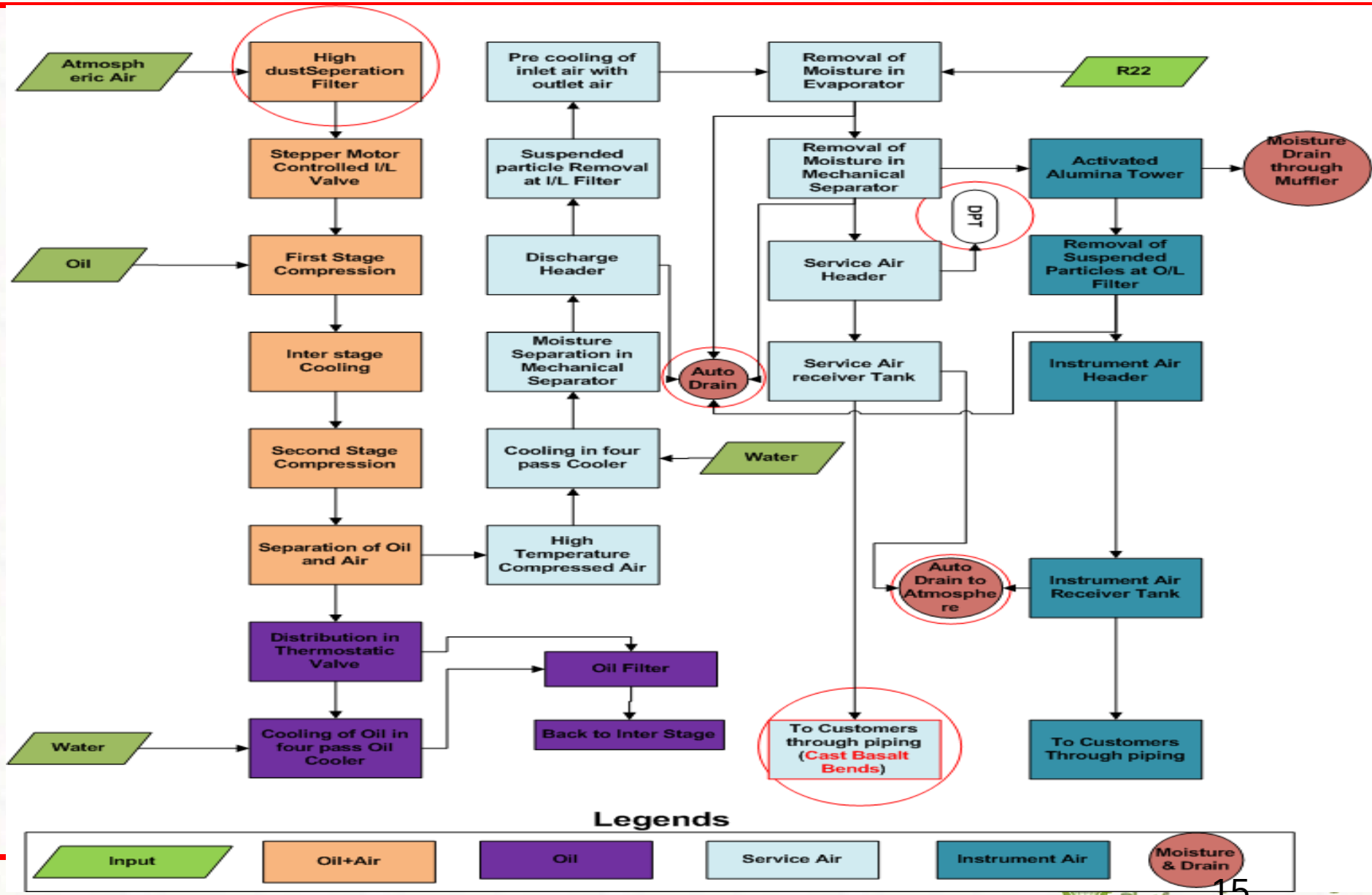
Sigma level 4.19

Sigma level 5.28

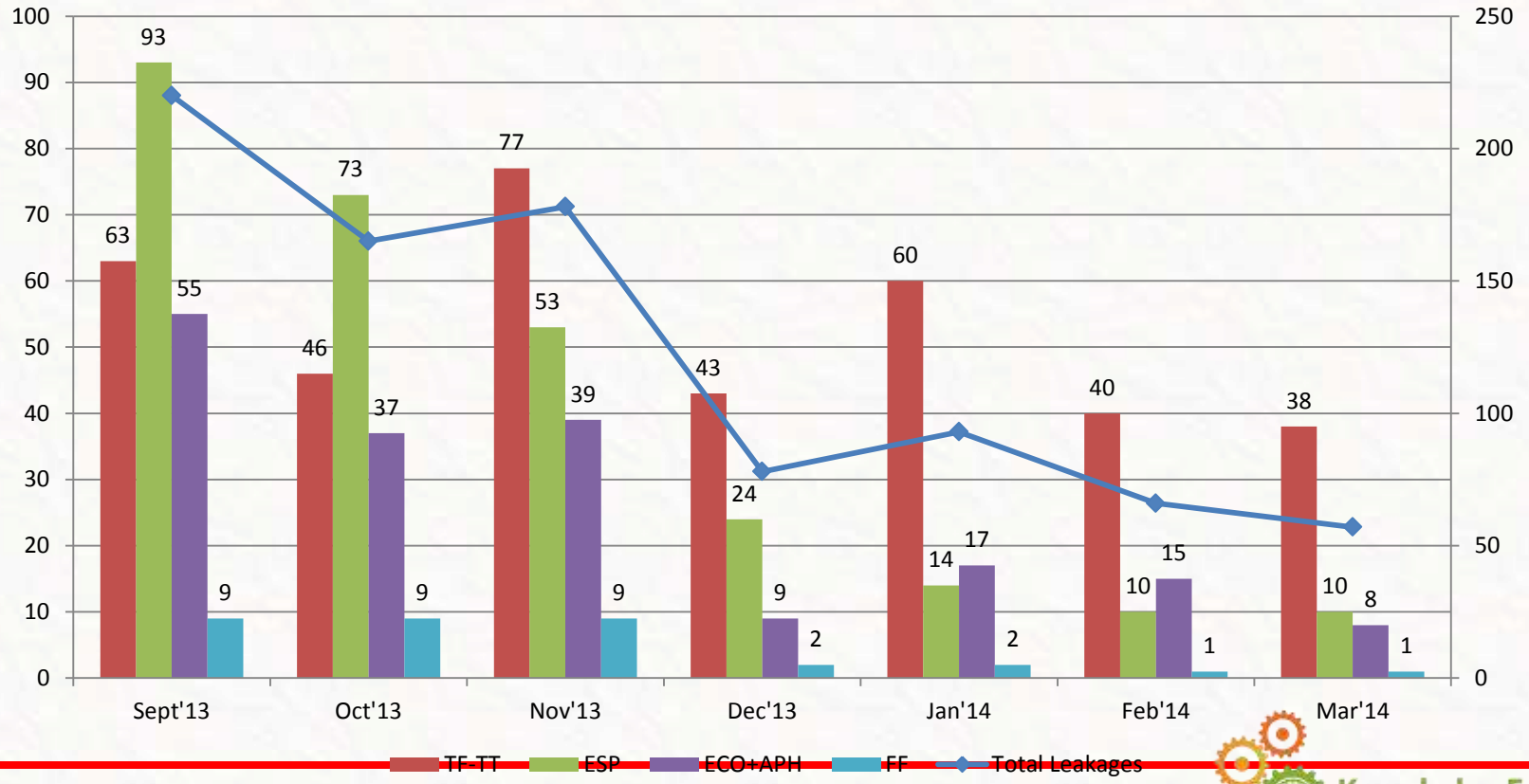
CONTROL PLAN

Process Step	parameter	Process	Input Output	Specification (LSL,USL, Target)	MSA	Current Control Method	Sample size	Sample Frequency	Reaction Plan
Suction of Atmospheric air through filter			√	USL: 3 Microns	NA	Inlet Filter	Continuous	Continuous	Inlet Vacuum < 0.05 Kg/cm^2
Compression of air & oil		√		LSL: 4 Kg USL: 8 Kg	Cal. Sheet Attached	Pressure Tx.	Continuous	Continuous	Safety v/v pop up.
Cooling of air & oil.		√		LSL: 85 Degrees C ; USL 109 Degrees C	NA	RTD	Continuous	Continuous	tripping on 110 degrees C
Drying of compressed air	Dew Point	√		LSL: 4 Degrees C & USL: 10 degrees C	Calib. Sheet attached.	Dew Pont Meter	Continuous	Continuous	If the dew point increases beyond 10 degrees C, The auto drain valves are checked.
Storage & distribution of compressed air	Pressure		√	LSL: 4.5 Bar, USL: 5.5 Bar	Calib. Sheet attached	Auto set points, pressure transmitter.	Continuous	Continuous	Unloaded compress. Take load when the press. Decreases and vice versa.

REVISED PROCESS MAP



LINE LEAKAGE VALIDATION



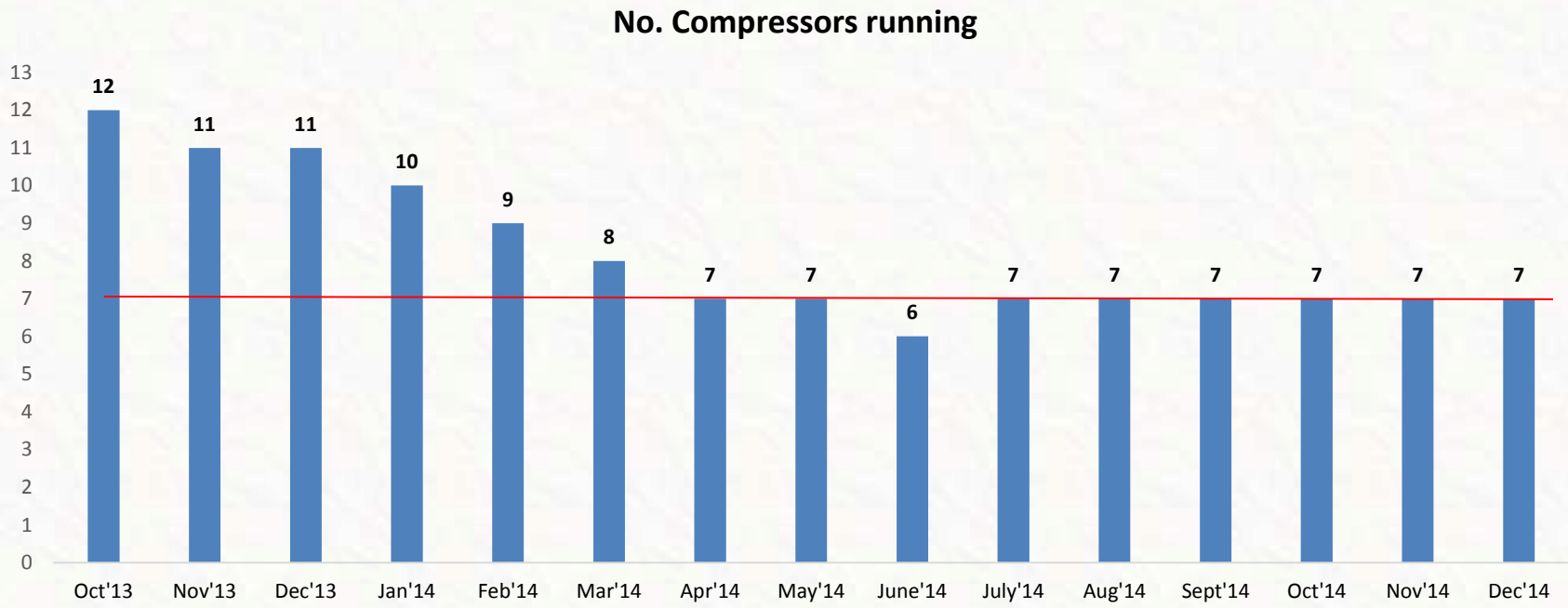
FMEA VALIDATION

FAILURE MODE EFFECT ANALYSIS FOR HIGH COMPRESSED AIR CONSUMPTION & HIGH POWER CONSUMPTION

Process	Process Requirment	Potential Failure Mode	Potential Failure Effects	SEV	Potential Causes	OCC	Current Controls	DET	RPN	Actions Recommended	Resp.	Target Date	Status	SEV	OCC	DET	RPN
		In what ways does the Equipment/Process go wrong?	What is the impact on the Key Output Variables?	How Severe is the effect?	What causes the Key Input to go wrong?	How often does cause or FM occur?	What are the existing controls and procedures (inspection and test) that prevent either the cause or the Failure Mode? **Should include an SOP number.**	How well can you detect cause or FM?	Risk Priority Number	What are the actions for reducing the occurrance of the Cause, or improving detection? **Should have actions only on high RPN's or easy fixes.**	Whose Responsible for the recommended action?	2/8/2013					
COMPRESSED AIR SYSTEM	Compressor	Chocking/Partial blockage	Reduced flow, High heat generation, More power consumption	7	Dusty Atmosphere	9	Inlet vaccuum shall be <0.1kg/cm²	1	63	Cleaning/Replacement of the filters	arnav	1/8/2013	C	7	4	1	28
										Installation of high dust seperation filters	deepak	17-5-2013					
										Sealing the compressor room so as to prevent dust & ash ingress	rajesh	17-5-2013					
				7	high moisture % in air	4		2	56	Cleaning/Repalcement	sreeram	1/8/2013	C	7	2	2	28
		damage/puncture	entry of dust,moisture and high operating temperatures	7	Continuous operation with higher differential pressure	6	Filter cleaning every PM or as required	1	42	Cleaning of filters as soon as DP>0.1kg/cm² OR every PM	arnav	1/8/2013	C	7	4	1	28
				7	Untimely replacement of filters	7	change of filter (<4000 hrs)	1	49	Replacement of filter if DP do not decrease even after cleaning	deepak	1/8/2013	C	7	4	1	28
				7	Poor quality of filters	4	OEM reccommended filters	1	28	Procurement of filters from OEM	Sameer	1/8/2013	C	7	3	1	21
			screw element damage	10	ingress of foreign material	1	change of filter (<4000 hrs)	8	80	Cleaning/Repalcement	sreeram		C	10	1	6	60
			Increased coolant contamination	10		4		3	120	Cleaning & replacement	arnav	1/11/2013	C	10	2	3	60

FMEA Compressors

SUSTENANCE


No. Compressors running
13
12
11
10
9
8
7
6
5
4
3
2
1
0
12
11
11
10
9
8
7
7
6
7
7
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7
7
Oct'13
Nov'13
Dec'13
Jan'14
Feb'14
Mar'14
Apr'14
May'14
June'14
July'14
Aug'14
Sept'14
Oct'14
Nov'14
Dec'14

ACTUAL BENEFIT CALCULATION

No. of Compressors Running for average load of 850MW (before improvement)	No. of Compressors Running for average load of 850MW (After improvement)
9	7

Particular	UOM	Quantity
Power consumption / Compressor	KW	350
Annual Saving of Power	MU	6.14
Annual Saving	Crores Rs.	1.22

THANK YOU