Reliability Optimization analysis and improvement

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Abstract: **Understanding and analyzing the system is a prime concern for its performance improvement and development. If the system is a power plant the emphasis has to be made on the various components of plant and their effects on one another. From the bath tub curve it is a clear indication for the status and settlement of component. As of now so much of work has been done from the various facets of the world. It is also an equal important task to get a complete gist of major functional issues under one roof. This paper is an illustrated and investigated outcome of power plant from the perspective of Reliability optimization.**

IndexTerms - Reliability, Optimization, Bath tub curve.

I. INTRODUCTION

Emphasis is made on the overall components of the power plants. All the components were taken in to consideration and the work breakdown structure has been done. This is a logical diagram and shows the sequential interrelationship between the various components of the plant. The machines were taken as nodes and then the relationship between the machines that is nodes is taken as the activities and that was shown with the arrows. The diagram is a schematic representation of the all machines that were employed in the power plant. Hence the performance that was computed must be accurate and precise. This is however a cumbersome task to consider all the machines in to consideration [1, 2].The reliability of the each component and overall plant is computed using the methodology developed below. The calculation of reliability in the series system and parallel system associated with the star network were experienced. A problem well put is half solved that's the reason all the required data and parameters were considered meticulously.

II. METHODOLOGY

The plant is divided in to five major components they were Coal handling plant, Water handling plant, Air handling plant, Steam and Ash handling plant. Under each head there are again so many number of sub components present in the plant. They were illustrated below.

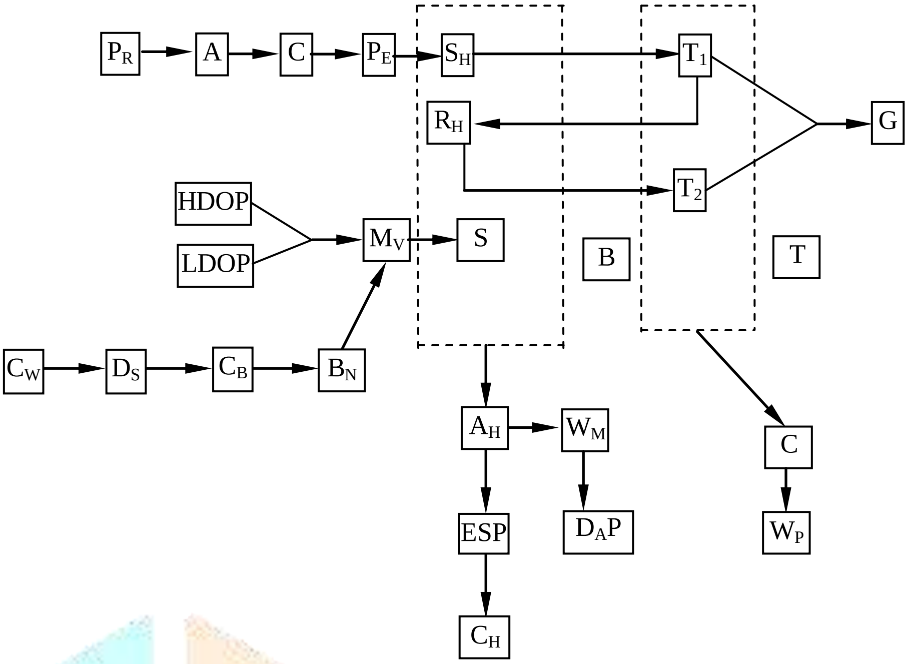
- $Pump_1$ → water filter by aeration → water filter by chlorination → Water softening machine → Pump to economizer → Super heater coils → Turbine → Condenser →
- Coal wagons → Dracula Crain → Dumpers and Dozers → Sedimentation Crain → Shipping to Conveyor Crain → Conveyors → Coal Bunkers → Firing machine.
- Oil tank High dense and Low dense → HDO Pump and LDO pump → Coal and Oil Mixing valve → Spray gun.
- Boiler → Drum→ Turbine
- Boiler → Dry ash unit → Wet ash unit

The above chaaains are the processing lines of the plant. Hence for each component of the plant the availability and reliability have to be calculated and hence the interdependencies of one on another will be found. This does have the parallel and series position in working and based on that the reliability calculations will be done. each machine have to come across the following flow chart and all the data has been processed for the calculation of availability and reliability.

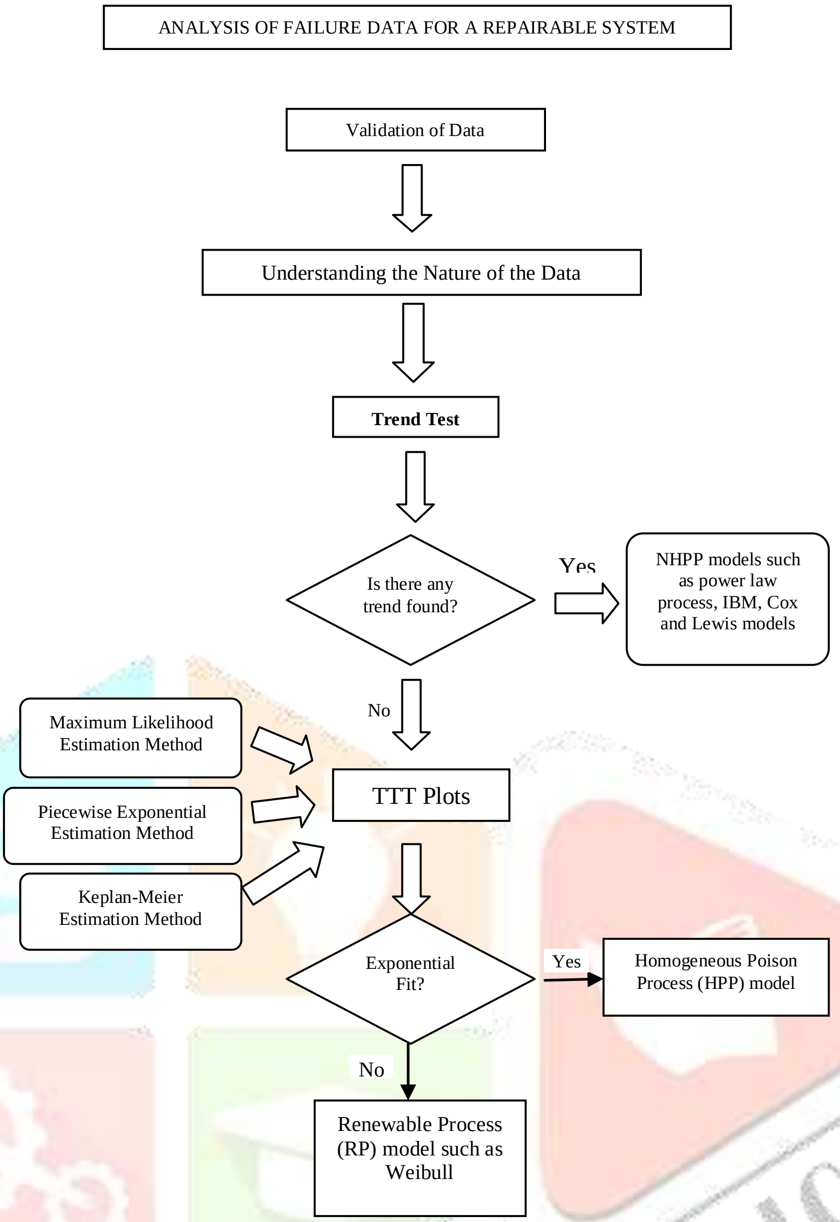
III. ANALYSIS

The data has been processed and their failure times have been recorded. That data is refined and further the trend of the machine failures was calculated. The trend of the failures is calculated by using the following methods Eye ball test, Cumulative plot test, Serial correlation test and Karl Pearson's coefficient of correlation test. These tests have yielded the arena for the calculation of Reliability and Availability. The reliability is thus found by taking the data of Time between Failures and the availability is calculated by the Time to repair data. Both Reliability and Availability were calculated using the Power law process and the results were tabulated. The methodology used for the analysis is shown using the following flow diagram.

The above diagram is a sequential network of operations that were present in the power plant. Here the noteworthy thing is that the components were studied and analysed as parallel or series or star kind of network. This will facilitate the calculations accurate. And the availability and reliability were calculated by the above said network calculations. For each of the individual component the availability and reliability calculations were done as below defined methodology. For the calculation of trend the following tests were used they are Eye ball test, Cumulative plot test, Serial correlation test and Karl Pearson coefficient of correlation tests were used. Among all the majority of the trend is taken as a standard and based on that the reliability and availability were calculated.



P_R= Pump from reservoir,
A= Aeration,
C= Chlorination,
P_E =Pump to Economizer,
S_H = Super heater coils
T_1= Low Pressure Turbine
R_H = Re-heater coils
T_2= High Pressure Turbine
G= Generator,
HDOP =High Dense Oil Pump
LDOP = Low Dense Oil Pump
M_V= Mixing valve
S = Spark igniter
C_W= Coal wagons
D_S = Dracula Separator
C_B= Coal bunkers
B_N = Bunkers
B= Boiler
T= Turbine
A_H= Ash Hopper
C_H = Chimney
W_M = Water Pump for wet ash
ESP = Electro Static Precipitators
D_AP= Dry ash plant
C= Condenser
W_P= Water Pump
PAF=Primary air fan
SAF=Secondary air fan
D= Drum



Method for Reliability Analysis

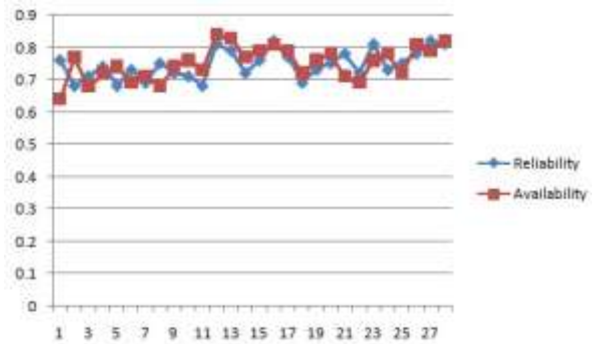
IV. ANALYSIS

Each component reliability and availability was found as follows.

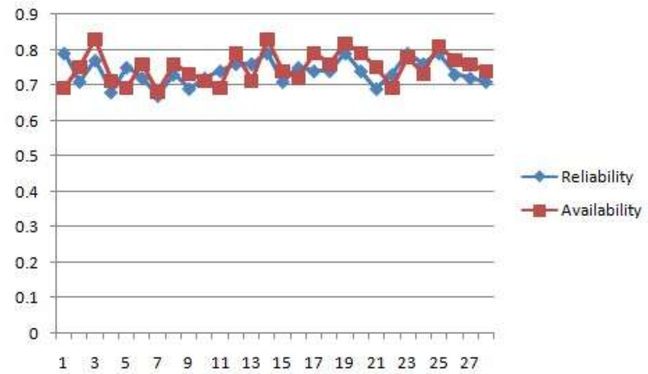
S no	Component	2014		2015		2016		2017	
		Reliability	Availability	Reliability	Availability	Reliability	Availability	Reliability	Availability
1	Pump from reservoir	0.76	0.64	0.79	0.69	0.82	0.95	0.74	0.82
2	Water filter by aeration	0.68	0.77	0.71	0.75	0.68	0.73	0.65	0.72
3	water filter by chlorination	0.71	0.68	0.77	0.83	0.61	0.74	0.69	0.81
4	Water softening machine	0.74	0.72	0.68	0.71	0.82	0.84	0.67	0.73
5	Pump to economizer	0.68	0.74	0.75	0.69	0.81	0.71	0.62	0.75
6	Super heater	0.7	0.69	0.72	0.7	0.83	0.75	0.77	0.82

	coils	3			6				
7	Turbine	0.69	0.71	0.67	0.68	0.74	0.78	0.79	0.74
8	Condenser	0.75	0.68	0.73	0.76	0.79	0.76	0.72	0.78
9	Coal wagons	0.72	0.74	0.69	0.73	0.64	0.66	0.69	0.71
10	Dracula Crain	0.71	0.76	0.72	0.71	0.69	0.72	0.74	0.76
11	Dumpers and Dozers	0.68	0.73	0.74	0.69	0.72	0.76	0.72	0.79
12	Sedimentation Crain	0.81	0.84	0.76	0.79	0.79	0.81	0.78	0.84
13	Shipping to Conveyer Crain	0.79	0.83	0.76	0.71	0.74	0.72	0.73	0.78
14	Conveyors	0.72	0.77	0.79	0.83	0.76	0.79	0.74	0.81
15	Coal Bunkers	0.76	0.79	0.71	0.74	0.69	0.72	0.76	0.74
16	Firing machine	0.82	0.81	0.75	0.72	0.75	0.79	0.74	0.82
17	Oil tank High dense and low dense	0.77	0.79	0.74	0.79	0.81	0.77	0.72	0.74
18	HDO Pump	0.69	0.72	0.74	0.76	0.68	0.71	0.77	0.72
19	LDO Pump	0.73	0.76	0.79	0.82	0.72	0.78	0.69	0.77
20	Coal and Oil Mixing valve	0.75	0.78	0.74	0.79	0.74	0.76	0.71	0.79
21	Spray gun	0.78	0.71	0.69	0.75	0.72	0.73	0.76	0.72
22	Boiler	0.72	0.69	0.73	0.69	0.75	0.79	0.71	0.78
23	Drum	0.81	0.76	0.79	0.78	0.71	0.81	0.74	0.76
24	Dry ash unit	0.73	0.78	0.76	0.73	0.79	0.82	0.78	0.81
25	Wet ash unit	0.75	0.72	0.79	0.81	0.83	0.79	0.76	0.79
26	Electro static precipitator	0.78	0.81	0.73	0.77	0.75	0.78	0.72	0.75
27	Primary air fan	0.82	0.79	0.72	0.76	0.74	0.71	0.75	0.71
28	Secondary air fan	0.81	0.82	0.71	0.74	0.76	0.78	0.73	0.78

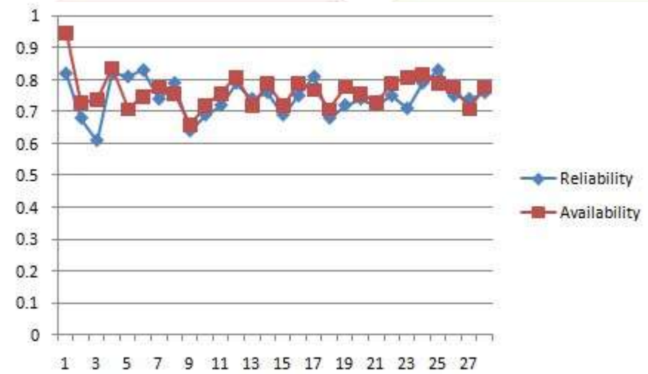
RESULTS AND CONCLUSION



Comparison of reliability and availability for 2014



Comparison of reliability and availability for 215



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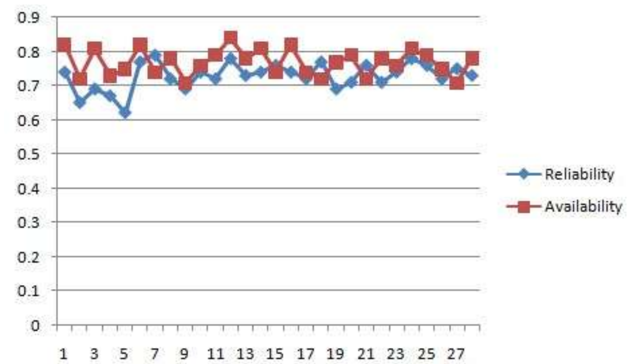

Comparison of reliability and availability for 2017

Out of the 28 machines considered the maximum availability is 0.95 and all the other machines have less availability and the least is 0.61. This has to be improved further more by adopting maintenance policies towards the optimization of the plant performance. It has the further scope to optimize the availability and reliability by developing the optimization function wit h the constraints.

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