Optimization Of Time And Water Flow Rate By Opening The Bleed Heating Inlet Valve In The Offline Gas Turbine Rinsing Process

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ABSTRACT

Combined Cycle Power Plant PT. Krakatau Chandra Energy requires good performance to serve its consumers . To get good performance, a water wash is carried out to clean the dirt (Fouling) that sticks to the gas turbine compressor blade so that it is clean again, so that the pressure and temperature of the compressor outlet air (CPD) increases and improves its performance according to design. During the water washing process there are cost inefficiencies . The research objective is to reduce the duration of the gas turbine rinsing water wash by modifying the IBH (inlet bleed heating) drain path. According to its function, it draws compressor output air and directs it to the compressor and increases the temperature of the compressor inlet air by mixing cold ambient air with hot compressor exit air, thereby reducing the density and mass of air to the gas turbine. This process is carried out when the gas turbine stops by making modifications/changes to the gas turbine IBH drain line. The identification results were obtained during the long rinsing water wash process, because the IBH drain was not used in the process. By modifying the gas turbine IBH drain, the duration is expected to be 184.33 minutes. fast. The test is to analyze each decrease in conductivity based on the manual book, namely with Δ result conductivity (water conductivity demin tank - exhaust plenum output water conductivity) at 5 µ s/c m.

Keyword: Gas turbin, IBH (Inlet Bleed Heating), Rinsing, Water wash

1. Introduction

Development technology moment this is not it regardless from need energy especially energy electricity, requires We as user energy for do various method for do efficiency and savings electricity at the company generator electricity various method done with increase efficiency [1]. PT. Krakatau Chandra Energy is company generator electricity have Steam Gas Power Plant consisting of from 2 gas turbine units, 2 HRSG units and 1 turbine unit steam with a total capacity of 120 MW [2]. in the process need reliability and good performance to remain _ Can serve consumers, however good performance is one of them is from gas turbine performance by regularly doing water washing for clean dirt (Fouling) stuck to the blade gas turbine compressor to become clean back, so pressure and temperature The compressor outlet air (CPD) becomes rising and increasing gas turbine performance in accordance with design [3].

So far, the rinsing water wash process carried out at the CCPP Unit of PT. Krakatoa Chandra Energy with average time 184.3 minutes. Duration time it's very long and no efficient Because requires large volumes of water during the Water wash process [4]. A number of method already done For overcome problem inefficiency This including: Manual operation of the detergent solenoid valve by the operator during the washing process due to a problem with the solenoid valve, installation tool measuring For reading demin water for the washing and rinsing process, Installation of a pressure manometer at the inlet of the washing gas turbine.

A number of method the it turns out Not yet capable overcome exists inefficiency especially when rinsing water washing [5][6] . In research This do it effort For modify where is the IBH (Inlet Bleed Heating) drain line in the CCPP unit previously there is an IBH (Inlet Bleed Heating) drain that doesn't Can functioned with exists modifications on the path This expected process efficiency is achieved during rinsing water wash. Therefore, it is necessary to conduct studies/research on how to increase efficiency so that it can provide benefits to the company in general [7].

2. Materials and Methods

Modification testing is carried out using quantitative analysis methods:

2.1. Before making modifications

This research has not yet discussed modifications to the IBH (In Bleed Heating) pathway so that it can be an effort to improve turbine performance so that efficiency can be achieved [8]. Data on decreasing conductivity (bound variable), time duration (free variable) with modification of the inlet bleed heating drain line (free variable) and variations in % opening of the IBH drain valve (free variable) and waste volume from the rinsing process (bound variable).

2.2. Modification testing is carried out using quantitative analysis methods

By varying the IBH drain valve opening (25, 50, 75 and 100%) as one of the independent variables, differences in time, demin water usage and waste volume produced from the GTG washing process can be seen [9]. Data collection here starts from 100% valve opening due to permission from the company which requires time to accelerate and gradually vary the valve opening then wait for the schedule for the washing process.

2.3. Determination Optimal Conditions

Testing This will taken optimum conditions based on Data on decrease in conductivity (dependent variable), time duration (independent variable) with modification of drain inlet bleed heating path (independent variable) and % variation opening of the IBH drain valve (independent variable) as well as the volume of waste from the rinsing process (bound variable).

3. Results and Discussions

3.1. Results before modifications

Based on the results of the research carried out, it can be seen in Table 1 for the GTG 1 Washing Process Before Modification and Table 2 for Testing after modification of the GTG 1 Washing Process and Costs.

For the selection of methods in this research, we refer to several methods to

improve turbine performance, including several research journals such as Fahuda, 2021. An analysis of the effect of water wash on the performance of the gas turbine at PLTG Unit 1 Form PT. PLN electricity generation sector, Tridinanti University Palembang. Setiawan, 2017. An analysis of the effect of compressor washing on compressor efficiency and thermal efficiency of gas turbine block 1.1 PLTG UP MUARA TAWAR, Muhammadiyah University Jakarta. Priyaa, 2013. Real Time Water Wash System of Gas Turbine in Power Plant. Dept of E&I, Bharath University, Chennai-600073, India

Table 1. GTG Washing Process 1 Before Modification

GTG washing process before modification				
No	Inefficiency	parameter	Cost	Total
1	Washing	Detergent	Rp 27,236,342	Rp 27,237,735
2		Electricity	Rp 1,394	
3	Rinsing	Demin	Rp 8,708,333	Rp 11,762,504
4		Electricity	Rp 3,054,171	
5	Demin heater	electric (heater)	Rp 624,400	Rp 624,400
6	Wastewater _	Processing	Rp 34,675,000	Rp 34,675,000
7	GTG production loss ± 35MW		IDR 143,091,666,667	Rp 143,091,666,667

Valve opening	Time	Waste	Washing process	After modification
%	minute	Liter	Cost (Rp)	
0	225	36575.00	Rp 222,741,306	Rp 215,644,626
25	208	33883.33	Rp 208,319,640	Rp 201,222,959
50	200	32616.67	Rp 201,532,973	Rp 194,436,293
75	125	20741.67	Rp 137,907,973	Rp 130,811,293
100	100	16783.3	Rp 116,699,640	Rp 109,602,959

Table 2. Testing after modification on GTG Washing Process and Costs

3.2. Results after Modification

The modifications made in this research were by activating the IBH gas turbine drain and adding a pipe to the sampling pit. In this grouping, the efficient (best) time was obtained at 100 minutes at 100% valve opening with a waste volume produced of 15833.3 liters with a washing process cost calculation of IDR 116,699,640 and washing costs after modification (after deducting investment costs) of IDR 109. 602,959.

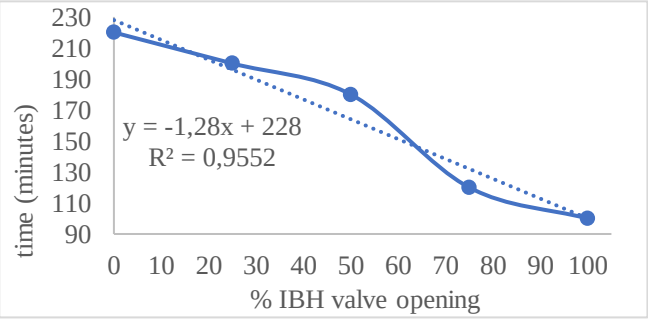

Figure 1. % IBH Valve Opening vs time (minutes)

In the figure 1. % IBH Valve Opening against time (minutes) the mathematical equation is obtained, namely with the value y = -1.332x + 238.2 and the value R^2 = 0.9029. An R^2 value close to 1 indicates that there is a correlation between the two variables, namely % IBH Valve Opening and time (minutes).

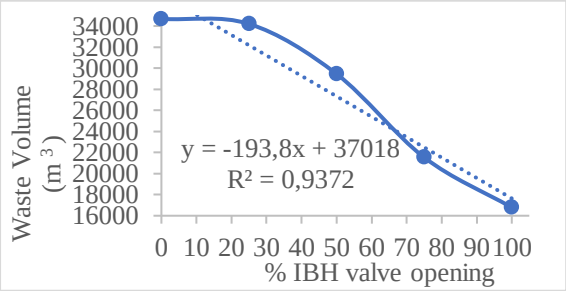

Figure 2. % IBH Valve Opening vs Waste Volume (m^3)

In Figure 2. % IBH Valve Openings to Waste Volume (m^3) the mathematical equation is obtained, namely the value y = -210.9x + 338665 and the value R^2 = 0.9029 . The R^2 value is close to 1, indicating that there is a strong correlation between the independent variable, namely % IBH Valve Openings, and the dependent variable, namely Waste Volume (m^3).

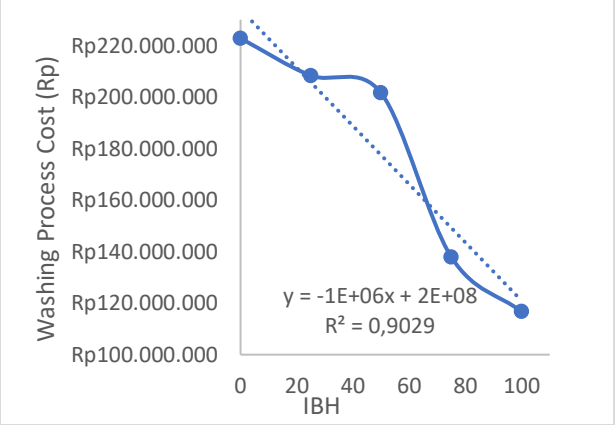

Figure 3 % IBH Valve Opening vs Cost (Rp)

In figure 3. % IBH Valve Openings to Washing Process Costs (Rp), namely only washing process costs (before deducting investment costs). From the picture above, the mathematical equation is obtained with the value y = -1E+06x + 2E+08 and the value R^2 = 0.9029. The R^2 value is close to 1, indicating that there is a strong correlation between the two variables, namely % IBH Valve Opening and Washing Process Cost (Rp).

3.3.Determination Optimum Condition

Based on Testing This obtained optimum conditions based on data on decrease in conductivity (dependent variable), duration of time (independent variable) with modification of drain inlet bleed heating path (independent variable) and % variation opening of the IBH drain valve (independent variable) and the volume of waste from the rinsing process (bound variable) namely under 100% valve opening conditions with a time of 100 minutes . Condition This Can seen in table 2, figure 1, figure 2 and figure 3 .

4. CONCLUSION

The investment cost for modifying the IBH GTG 1 drain line is Rp. 7,096,680.13. The efficiency of the rinsing water wash process is faster than before without modification, amounting to a 44.44% reduction in time (220 minutes to 100 minutes). 45.89% reduction in the volume of waste produced (36575.00 liters to 16783.3 liters) and 52.39 % reduction washing process costs and 50.82% post processing costs investment (Rp. 222,741,306 to IDR 116,699,640). Based on results study This can give profit for company and its reduction waste the resulting liquid from the gas turbine washing process expected Can reduce pollution environment as well as pollution air from follow it burned in room combustion gas turbine [9][10].

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