CHAPTER I

INTRODUCTION

1.1. Background

Development of renewable technology machinery in wind turbine energy nowadays is increasing and it will encourage all industrial enterprises in order to adopt the renewable technology to produce an optimize quality product regardless of the investment cost. The development in wind turbine energy technology is not limited to the significant increase in the size of modern units, but also includes the high reliability and availability of the current machines (Abderrazzaq & Hahn, 2006). The fundamental operating feature of the power system is that the electrical energy production and consumption are simultaneous. Therefore, the reliability requirement within the electricity industry is very high (Kumar et al., 2007). If wind turbine which refers to distributed energy resource are not managed effectively, it will increase investment cost and sharply increase system operation cost that affect the absorption of distributed energy resource itself by the system in return (Xia & Liu, 2016).

Maintenance can be defined as all activities necessary to restore equipment or in this case, is machinery and also to keep in a state which it can perform its designated function (D. Jonge, 2017). The maintenance of power system equipment and especially the maintenance of generating units are implicitly related to power system reliability and have a tremendous bearing on the operation of the power system (Kumar et al., 2007). Therefore, it is necessary to assess the plant availability by analysing the actual fault and maintenance records even there are some restriction in deveoping this strategies which can be attributed to the variation in location, resources and other factors that are claimed to be the sole province of the end user of the product (Abderrazzaq & Hahn, 2006). Unfortunately, only few researchers have discussed the performance and reliability of existing wind turbines. Whereas the majority of works in this field were either very general or just focused on the reliability of a specific part of wind turbine (Abderrazzaq & Hahn, 2006). Another rarely studied issue is the long-term impact of distribution network on the turbine performance and productivity. In contrast, most

of the researches are now oriented towards the impact of wind turbines on the networks, and not the opposite (Boulaxis et al., 2001). In general for complex systems, e.g., electric systems, maintenance does not necessarily mean replacing the whole system. It often includes the repair or replacement of a part of the system (Perez-canto & Rubio-romero, 2013).

Therefore, the main objectives of the current study are to investigate the real condition to analyze the maintenance issued in Hybrid Power Plant (PLTH Bayu Baru). As a renewable energy resource power plant, Hybrid Power Plant is one of alternative solution which can replace the conventional generator which needs oil and gas emission. Hybrid Power Plant use wind power and solar power to generate the power plant. Hybrid Power Plant has less cost compared to the Fossil Power Plant (PLN) because it doesn't require oil to provide the energy for electricity and it is long term exploitation electricity energy because it needs wind power and solar power. The first maintenance issued in Hybrid Power Plant Bayu Baru according to the field observation is the lack of labor in maintenance of wind turbine system. The current condition of maintenance on wind turbine unit 1 KW only has 9 technician to conduct the maintenance of wind turbine 1 kw. Based on the recommendation from the technician, PLTH Bayu Baru requires to optimize the performance of maintenance wind turbine by analyze the number of labor. Therefore, the analysis of labor requirement in PLTH Bayu Baru will include in objectives to the current study.

The second issued that arised in PLTH Bayu Baru maintenance process of wind turbine 1 kw is the duration to complete the maintenance process of wind turbine 1 kw. Therefore, the current study will elaborated the maintenance strategies with the project management strategies in order to find the optimum solution to solve the issued which arised in maintenance process of wind turbine 1 kw in PLTH Bayu Baru. Project management has special qualities, which the management of working time is limited by a predetermined schedule (Hartawan, et al., 1995). This study has focused in the maintenance wind turbine unit 1 KW because the machinery has the most unit that are 21 units which placed in the west group. In other to respond the phenomenon above, this study aimed to give an idea of maintenance project scheduling of maintenance wind turbine unit 1 KW in PLTH Bayu Baru. Project scheduling is a form of project planning that is created with the aim that the project is completed on time. Critical Path Method and Project Evaluation Review Technic (PERT) are two of several methods used to make project scheduling. To achieve the satisfying result, it requires several information data of each maintenance activity duration from the start to

finish. After information already gathered, it needs to find the pattern of each activity in the maintenance network. By using Project Evaluation Review Technic *(* PERT) method of maintenance wind turbine 1 KW, the next step will be able to calculate the data that already been collected from the technician and give the further result for PLTH Bayu Baru.

According to Azaron (2006), PERT breaks down the project into events and activities, and lays down their proper sequence, relationships, and duration in the form of a network. Jiang (2010) said that, the length (duration) of the critical path is the duration of the project, and any delay occurring along it delays the whole project. While Critical path method (CPM) is a step-by-step project management technique for process planning that defines critical and non-critical tasks with the goal of preventing time-frame problems and process bottlenecks. The critical path method is ideally suited to projects consisting of numerous activities that interact in a complex manner (Trietsch, 2005). CPM analysis tools allow a user to select a logical end point for a project and quickly identify its longest series of dependent activities (its longest path). These tools can display the critical path (and near critical path activities if desired) as a cascading waterfall that flows from the project's start (or current status date) to the selected logical end point (Bongsang, 2007). In order to finish the project as fast as possible, it is important to decide which activity should be done first or which activity that can be done in the same time as the other activity to create time efficiency by analyzing the Critical Path on the maintenance network of the wind turbine 1 KW.

Since PLTH Bayu Baru is managed by the government (DPUP and ESDM Province of D.I.Y), the third problem regarding this issues are the cost of maintenance. The operational costs of PLTH are carried by the government which makes the imposition of financing dependent on the Budget Revenue and Regional Expenditure (APBD). The total cost of the project can be calculated by analyzing each of activity inside the process of maintenance process that has already conducted by PLTH Bayu Baru. By gathering all the information of the activity cost, the resource allocation analysis will be conducted in order to carry this issue of maintenance process cost on wind turbine 1 KW. By analyzing the resource allocation, it is expected to optimize the cost of maintenance process from the calculation of the labor cost. This study is expected to provide benefits for PLTH Bayu Baru and also for the researcher/other parties with an interest in this issue in order to be more concern about the renewable technology considering this technology are very useful for the future.

1.2 Problem Formulation

This study intended to become guidance for PLTH Bayu Baru in term of network analysis and resource allocation the maintenance process of wind turbine 1 KW system. Related to the purpose, main research question addressed in this review are:

1. How to determine the optimum number of labor for maintenance process of wind turbine 1 KW system in Hybrid Energy Power Plant?
2. What is the optimum duration for maintenance process duration of maintenance process of wind turbine 1 KW system in Hybrid Energy Power Plant?
3. What is the total cost in maintenance process for wind turbine 1 KW system in Hybrid Energy Power Plant?

1.3 Research Objectives

Based on problem formulation above, this research is created to fulfill several objectives as mentioned below:

1. To determine the optimum number of labor for maintenance process of wind turbine 1 KW system at Hybrid Energy Power Plant.
2. To optimize the duration of maintenance process for wind turbine 1 KW system at Hybrid Energy Power Plant.
3. To analyze the total cost in maintenance project for wind turbine 1 KW system at Hybrid Energy Power Plant.

1.4 Research Limitation

Problem limitation is a limitation of problems to make a border in the research in order to keep the research inside the scope. Base on the background there are several scopes to make the research focus, the scope as follows:

1. The research will be limited on labor, time, and cost analysis of maintenance process for wind turbine 1 KW system at Hybrid Energy Power Plant**.**

2. The research only focuses on horizontal wind turbine type 1 KW of West group as commercial wind energy generator.

3. The research has conducted at Hybrid Energy Power Plant**,** New Coast Pandansimo, District of Bantul, Daerah Istimewa Yogyakarta.
4. Information data of time and cost of maintenance process based on interviewing the field coordinator and several technicians at PLTH Bayu Baru.

1.5 Research Benefit

It is expected that by conducting this research, some benefits can be earned:

a. To complete the project on maintenance schedule by uses of time efficient and avoid time wasting in each activity of the project.
b. To avoid expenditures that are not necessary during execution in maintenance process of wind turbine 1 KW system at PLTH Bayu Baru
c. To know which activities that need to sort out into timetable schedule.
d. Research question can be used for better future research.

1.1 Systematical of Thesis Writing

Furthermore, this thesis writing will be continued as follows:

CHAPTER I INTRODUCTION

This chapter are consists of a background of research, problem formulation, the scope of research, research objective, the benefit of research, and systematical of thesis writing.

CHAPTER II LITERATURE REVIEW

This chapter will elaborate about the inductive and deductive study. Inductive study is primarily important to determine the literature study of the previous research. The deductive study is needed to be elaborated to provide basic supporting theories to develop the benchmarking assessment.

CHAPTER III RESEARCH METHODOLOGY

This chapter will describe the methodology which is applied in the study. It consists of several parts: the arrangement of research position, conceptual model and model development as an improvement.

CHAPTER IV DATA COLLECTING AND PROCESSING

This chapter will present the elaboration of whole aspect assessment using the data that has been collected based on the research. The result of assessment would be developed a model and simulated by using Microsoft Project.

CHAPTER V DISCUSSION

Chapter five is going to discuss the results of data processing and the analysis. The discussion will be presented the result of assessment based on historical data of maintenance and operation process. It will also discuss the simulation result that has been generated.

CHAPTER VI CONCLUSION AND DISCUSSION

The final section will describe the overall conclusions from the results of the study and the suggestion for the future research.

REFERENCES

APPENDIX