Chapter I Introduction

I.1 Background

The needs of the fuel energy in this world is increasing everytime.According to the projection of International Energy Agency – IEA, until 2030 the demands of fuel energy is increasing 45% or the average point is increasing to 1.6% each year. The distribution of using the fuel energy in the world is 500 x 10^{15} BTU/year.

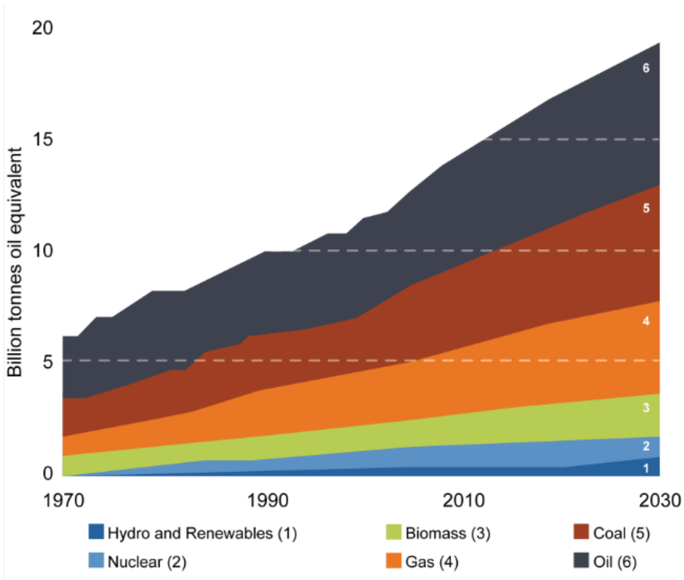

Figure I.1 Future Energy Needs
Source: International Energy Agency Outlook

After the Oil, the world energy is distributed by coal, gasoline, biomass, nuclear, hydro and renewables energy. The role of the renewable energy in electrical industry is increasing. Projected starting in 2010, the role of the renewable energy in electrical industry occupying the second position after the coal and hydro. On the other side the rising of the fossil fuel using is the trigger of the climate changes. That is why IEA recommends to using clean and efficient energy to reduce carbon emissions.

The sources of renewable energy are solar energy, wind energy, water pump energy, geothermal energy, and biomass energy.

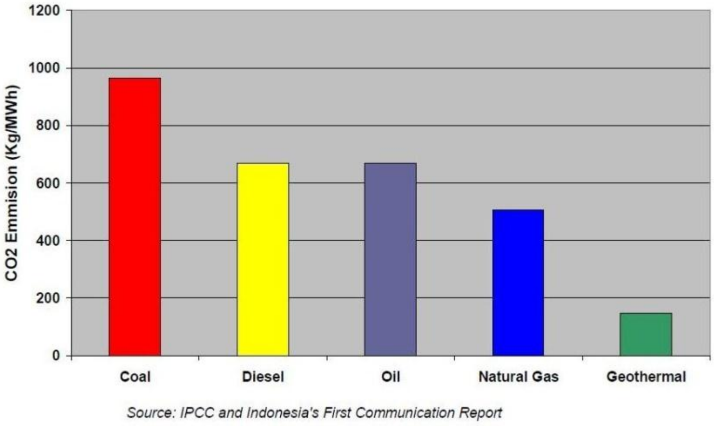

Figure I.2 The Content of Emission

Source: IPCC and Indonesia's First Communication Report 2009

Geothermal energy is an energy that is extracted from the heat that kept inside the Earth. It is from the techtonical activities in the earth since the planet was made. The heat is also from the sun heat that is absorbed by the earth surface.

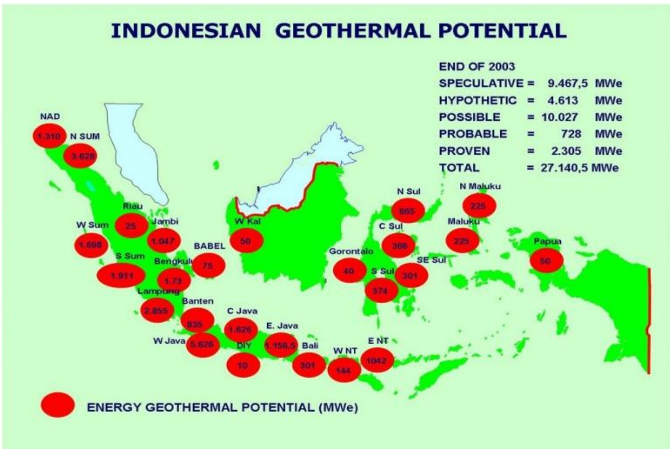

Figure I.3 Distribution of Potential Geothermal Indonesia
Source: Ministry of ESDM

About 10 Gigawatt of geothermal electrical plant have been installed around the world in 2007, and distributing about 0.3% of the total of electrical energy in the world. The geothermal energy is friendly to nature because the geothermal fluid, which is the heat energy changed into electrical energy, and the resiuade of the fluid will be returned to reservoir through injection well.

Indonesia has 40% or 27.140 MW geothermal potential in the world. That is why geothermal energy is the best source of energy that is need to be invented in Indonesia. From the total of the potention, only 4.2% that is already used as the electrical energy.

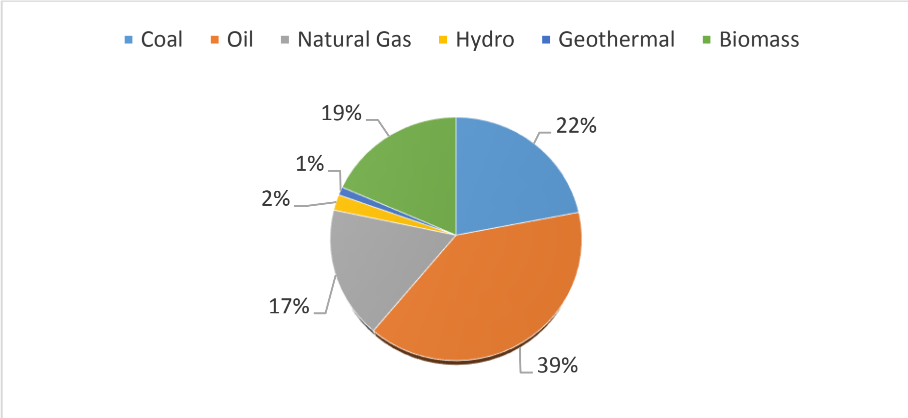

Figure I.4 Indonesian Electictry Production Type by Source
Source: Handbook of Energy & Economic Statistic Indonesia 2012

Pertamina Geothermal Energy (PGE), is a company of PT Pertamina (Persero), standing since 2006 and has already given an instruction from the government to develop 15 Geothermal Companys in Indonesia. The new era of geothermal energy is started by the opening of Geothermal Kamojang field in 29th January 1983. PLTP Kamojang unit 4 is one of the plant owned by PGE, the location of it is 41 kms south east of Bandung, where in Kecamatan Ibun, Kabupaten Bandung, West Java. PGE PLTP Kamojang Unit 4 has 1 PLTP unit installed with capacity 60 MW.

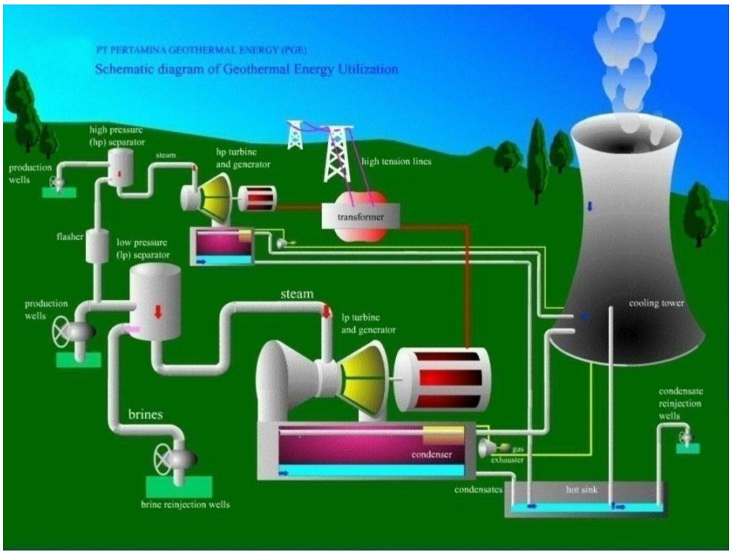

Figure I.5 The Flow of the Production Process
Source: Pertamina Geothermal Energy 2013

In figure I.5 can be seen the flow of electrical production process in PGE KMJ 4. Production began when the steam inside the earth running through the pipes in every wells, then head scrubber for separate the steam with other materials such as other gas or material which is brought along the steam from the earth that can make a corrosive. While the solid and liquid fluid will be injected back to the earth. After that, the steam will flow to the steam turbine to convert the heat of the steam into mechanical energy then distribute it to the plant to change it into the electrical energy. The steam pressure entering the steam tribune is 1.02 Mpa with temperature 181°C. Next the fluid from the steam tribune will be supplied to the condencer to be converted from the steam into water. And others than the water steam will go to the gas removal system to eliminate it. The water from the condencer will be injected to the earth and the others will be pumped using the hotwell pump to the cooling tower to be cooled. Then the water will flow back again to the condencer which is used to change the steam from the steam turbine into water. This production is working 24 hours every day.

A plant using continuously for 24 hours a day and 7 days a week, it must be in a good condition to produce the electric. This thing is based from the Key Priority Index (KPI) from PGE KMJ 4 as the minimum standard of electric production. So, the maintenance division and production division must have a standard operational procedure according to the company's KPI. One of the maintenance division strategys is classifying the critical equipments so it will get a special treatment. The critical equipment has a big role in the production in power plant, so it will need a special treatment and the right way, so the critical equipments can work properly.

Table I.1 MPI PGE Area Kamojang PLTP Unit 4

Rank	Equipment	Score MPI	Critical Index
242	Main Oil Tank	245,2987	3
243	LRVP	265,4376	
244	Cooling Tower	396,0519	

245	Hot Well Pump	514,0873	2
247	Condenser	665,2175	1
249	Steam Turbine	689,5133	

From all of the mean equipments on table above, the company have already classified the mean equipments according to the critical index. The company has the Maintenance Priority Index (MPI), by classifying the critical level into 5 parts. Which are Ring 1, 2, 3, 4, and 5. The Parameters that build the MPI are safety, maintenance cost, environment, the failure effect, ramp rate influence and the recovery time.

With this thing, the research will focus on the 3 critical equipments and the supporting equipments. These equipments will be classified in sub system according to the System Breakdown Structure in figure I.6.

That is why it needs an effective and efficient maintenance activities according to the failure charactertistic in every 3 sub system components by using Reliability Centered Maintenance method. To make the managing of the management assets easier is by using the software reliasoft RCM++.

In deciding the optimal machine maintenance policy, considering the reliability by using the RCM method supported by counting the needs of spare parts. Counting the spare parts is to know how many repairable spare parts and non-repairable spare parts to support the maintenance activities. To decide the right needed spare parts is by using Poisson Distribute as the accurate fortelling technique (Fukuda, 2008). Poisson distribute is same with the purpose of the research, which is deciding the total of the needed repairable and non-repairable spare parts.

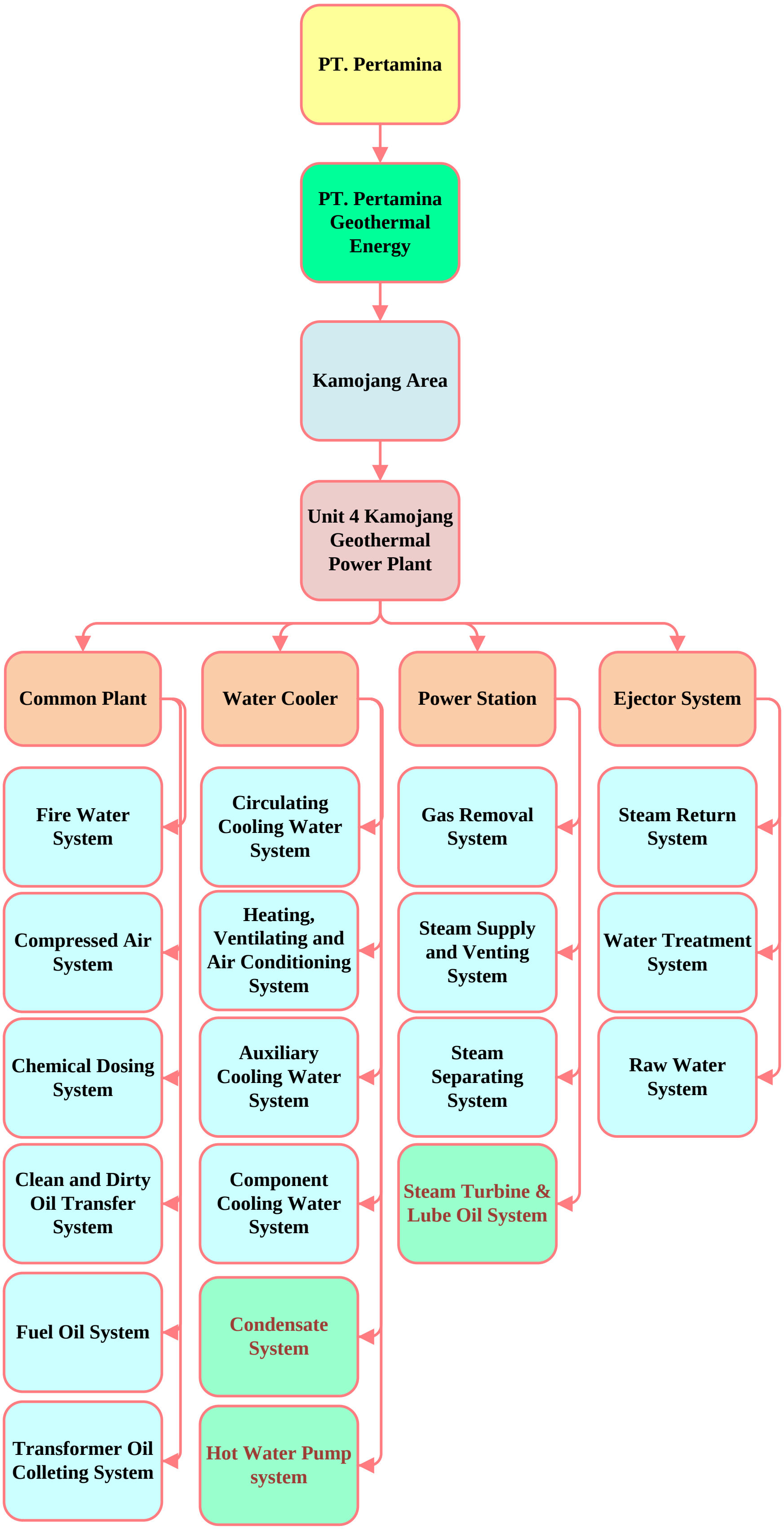

Figure I.6 System Breakdown Structure

I.2 Problem Formulation

The problem formulation in the final project research is :

1. How the equipment hierarchy in the PGE KMJ critical sub system by using the System Breakdown Structure (SBS)?
2. How the critical components in the PGE KMJ 4 critical sub system by using matrix risk?
3. How the optimal maintenance policy in PGE KMJ 4 critical sub system by using Reliability Cenetred Maintenance (RCM)?
4. How the maintenance policy using Reliasoft RCM++ in PGE KMJ 4 critical sub system?
5. How to deicide the optimal total of the spare parts from PGE KMJ 4 critical sub system based on the Reliability Centered Maintenance (RCM)?

I.3 Research Objective

Based on the problem formulations above, so it can be decided the purpose of the research, as follows :

1. Building a hierarchy of sub critical systems equipment the PGE KMJ 4 by using the System Breakdown Structure.
2. Determine the critical part of the PGE KMJ 4 critical sub system equipment by using risk matrix.
3. Make the optimal maintenance policy in PGE KMJ 4 critical sub system by using Reliability Centered Maintenance method.
4. Make the maintenance policy by using Reliasoft RCM++ in PGE KMJ 4 critical sub equipment.
5. Specifies the number of the component spare parts of PGE KMJ 4 critical sub system based on the output of Reliability Centered Maintenance (RCM).

I.4 Problem Boundaries

The problem limitations of this research are :

1. The technical aspect in maintenance activities such as repairing the components, attaching it, or reconstruct the machine, these all do not include in the discussion.

2. The research conducted only in the critical components from PGE KMJ 4 critical sub system.
3. The period of used data is from 2009 until 2013.
4. The data were not obtained using assumptions.

I.5 Research Advantage

The advantage of the research in this final project are :

1. Pertamina Geothermal Energy Kamojang area of policy evaluation can determine the treatment that was applied to the company.
2. Pertamina Geothermal Energy Kamojang area can determine optimal interval of PGE KMJ 4 critical sub system components maintenance based on the academic calculation by considering the factors of failure, reliability, and the maintenance cost.
3. Pertamina Geothermal Energy Kamojang area may know the optimal total number of the spare parts for the PGE KMJ 4 critical sub system components based on the academic calculation.
4. Pertamina Geothermal Energy Kamojang area can documented the management assets by using the Reliasoft RCM++.
5. Pertamina Geothermal Energy Kamojang area can determine the comparison cost ratio between existing maintenance policy and proposed maintenanance policy.

I.6 Writing Systematic

The research is described into these writing systematic :

Chapter I Introduction

In this chapter is containing about the explanation of the research background, the problem formulation, the purpose of the research, the research limitations, the results of the research, and the writing systematic.

Chapter II **Theoritical Basis**

In this chapter is containing about the relevant literate with the researched problem. The things that become the base of the research are maintenance management, Reliability Centered Maintenance, Rick Matrix, Reliability and Availability.

Chapter III **Research Methodology**

In this chapter is explaining detailed steps of the research, such as the step of making the problem formulation, improving the conceptual model and solving problem systematic.

Chapter IV **Data Collective and Data Processing**

In this chapter is containing of the processing data whether it is quantity or quality from the data obtained from the interview or historical, such as existing machine maintenance activities data and operating and maintenance cost data. Next is the making of the equipment hierarchy, deciding the critical equipment by using the risk matrix, processing RCM, the failure items data processing, maintenance interval time, cost control, and the optimal total of spare parts.

Chapter V **Analysis**

In this chapter is analyzing the results of the data processing from the previous chapter.

Chapter VI **Conclusion and Suggestion**

In this chapter is containing the conclusion and the suggestion of the research for the next research.