WHOLE ENERGY BALANCE FOR 1KW STEAM POWER PLANT

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SESI PENGAJIAN: 2009/2010

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We certify that the project entitled Whole Energy Balance for 1kW Steam Power Plant is written by Mohd Azri bin Aris . We have examined the final copy of this project and in our opinion; it is fully adequate in terms of scope and quality for the award of the degree of Bachelor of Engineering. We herewith recommend that it be accepted in partial fulfilment of the requirements for the degree of Bachelor of Mechanical Engineering.

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WHOLE ENERGY BALANCE FOR 1KW STEAM POWER PLANT

MOHD AZRI BIN ARIS

Thesis submitted in fulfilment of the requirements
for the award of the degree of
Bachelor of Mechanical Engineering

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NOVEMBER 2009

SUPERVISOR'S DECLARATION

I hereby declare that I have checked this project and in my opinion, this project is adequate in terms of scope and quality for the award of the degree of Bachelor of Mechanical Engineering.

Signature
Name of Supervisor: MR. MOHD YUSOF BIN TAIB
Position: LECTURER
Date: November 2009

STUDENT'S DECLARATION

I hereby declare that the work in this project is my own except for quotations and summaries which have been duly acknowledged. The project has not been accepted for any degree and is not concurrently submitted for award of other degree.

Signature
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LIST OF ABBREVIATIONS

E	Energy
KE	Kinetic Energy
U	Internal Energy
ACC	Accumulation
PROD	Production

LIST OF NOMENCLATURE

Q	Energy
m	Mass flow rate
j	Joule
kg	Kilogram
^0C	Degree celcius
K	Kelvin
L	Litre
s	Second
p	Pressure
w	Work
q	Heat
h	Enthalpy
η	Efficiency
ρ	Density
$\emptyset$	Relative humidity
ω	Specific humidity
N	Revolution per minute
T	Temperature
C_p	Specific heat capacity
υ	Specific density
ε	effectiveness

CHAPTER 1

INTRODUCTION

1.1 PROJECT BACKGROUND

Electricity is an important need to human live nowadays. It is a form of energy that easy to produce, to use, to transport and to control. To produce electricity, a terminal or power plant need to build. There are many type of power plant such as thermal, hydraulic, gas turbine and nuclear power plant. Steam power plant is among of the commonly used terminal to produce electricity and it is becoming increasingly used as electrical or energy generators for mass electrical production for industry around the world. For this particular purpose power plant have been and are being used for case study to improve and maximize the produced energy of electricity.

Reciprocating steam engines have been used for mechanical power sources since the 18th Century, with notable improvements being made by James Watt. As generator sizes increased, eventually turbines took over due to higher efficiency and lower cost of construction. By the 1920s any central station larger than a few thousand kilowatts would use a turbine or prime mover. The theory and design of power plant have advanced significantly during the past 89 years. Today's power plants are very easy to be operated and to be analyzing in term of energy study because of the size and technologically control. The power plant unit used for this project is Cussons P7690/SP Steam Power Plant. It is designed as a comprehensive self-contained unit with all relevant items of equipment factory mounted on a common steel bedplate.

1.2 PROBLEM STATEMENT

In case of energy study, steam power plant is the best unit to be used as an experiment apparatus. Practically subject to be determine are principle plant component efficiencies, energy balance for cooling tower, analysis on losses and boiler efficiency to find optimum cooling water flow rate, and whole energy balance for 1 kW steam power plant. Energy balance is practically be analyzed and calculated from the power plant to know how efficient the unit working to convert steam into electric energy and to determine the uses of the energy supplied. Many parameters need to be consider to get the best result of energy balance. Faculty of Mechanical Engineering has a 1 kW steam power plant. An intensive study on the steam power plant is needed especially to analyze energy balance on the system. Besides that, it is very useful and important for mechanical engineering student to analyze and adapt the basic concept of first and second law of thermodynamics on the actual practice.

1.3 PROJECT OBJECTIVE

The objective of this project is to study detail and analyze the whole energy balance of the 1 kW steam power plant and to determine the plant efficiency and losses.

1.4 PROJECT SCOPES

In order to perform an experiment for analyzing the whole energy balance for the 1kW steam power plant, a detail theoritical background studies about steam power plant is do. The thoeritical aspect that being study are Rankine cycle, how steam power plant works and energy balance principle. It is very important to know what process are involved during one complete Rankine Cycle and basic working principle of every component that involve in steam power plant such as pump, boiler, turbine and condenser. Detail studies and method on how to analyze every parameter involved in each component of the plant is being study using ‘manual operating book’ and ‘theoritical background of steam power plant’. The first law of thermodynamics is the best example equation for energy balance and a detail study about this terms is study to perform the analysis and for the calculation of energy that involved in each component

of the plant. Experiment is carry out to archive the objective of the thesis using Cussions P7790/SP Steam Power Plant. Data is collect and a calculation is make to get a result of whole energy balance of the plant.

1.5 PROCESS FLOW CHART

The Figure shows the separation of information or processes in a step-by-step flow and easy to understand diagrams showing how steps in a process fit together. This makes useful tools for communicating how processes work and for clarity due to time limitation how a particular job is done in Final Year Project 1. The detail of the project gantt chart can be refer in Figure 1.1.

ABSTRACT

This thesis is deals with whole energy balance for 1kW steam power plant. The steam power plant that been used for this thesis is Cussons P7690/SP. The objective of this thesis is to study detail and analyze the whole energy balance of the steam power plant, the efficiencies, and losses. The thesis describes the procedure of three sets of experiment to achieve the objective. Those three sets of experiments are energy balance of a plant as a whole analysis, determination of principal plant component efficiencies, and energy balance for cooling tower analysis. Detail study of each plant component had been done before those experiments run. Those study such as forms of energy, function of main component in steam power plant, energy balance, component efficiencies and psychrometry theory. Parameters involved in experiment was then be analyzed to be use for each sets of experiments. These parameters as guide for the thesis will be done according to the objective and time planning. Calculation and analysis had been done after all parameters needed for the thesis has been observed. The obtained results indicated that the energy generated by the plant and energy produced from the plant are balanced. Also, the efficiency value of main plant component such as boiler, superheater, and condenser are obtained. From the calculated result, state that energies in cooling tower of this plant are not balanced. By the end of the thesis, the successful of the project had been stated and some of recommendations had been given for future research and development.

ABSTRAK

Tesis ini membentangkan tentang keseimbangan secara keseluruhan tenaga untuk sebuah penjana kuasa wap 1kW. Model penjana kuasa yang digunakan untuk menjalankan eksperimen sepanjang thesis ini ialah Cussons P7690/SP. Objektif tesis ini ialah untuk mengkaji secara mendalam dan menganalisis keseluruhan tenaga, peratusan kecekapan, dan juga nilai kehilangan tenaga pada penjana kuasa tersebut. Tesis ini menerangkan prosedur-prosedur penting untuk menjalankan tiga set eksperimen untuk mencapai objektif yang telah dinyatakan. Tiga set eksperimen tersebut ialah keseimbangan tenaga penjana kuasa secara keseluruhan, penentuan peratusan kecekapan komponen utama penjana kuasa, dan keseimbangan tenaga pada menara pendingin. Kajian secara mendalam pada komponen-komponen utama telah dilakukan sebelum kesemua set eksperimen dijalankan. Antara kajian yang telah dijalankan ialah penghasilan kuasa, fungsi setiap komponen utama panjana kuasa, keseimbangan tenaga, kecekapan komponen dan juga teori psychrometry. Parameter yang terlibat telah dianalsis untuk digunakan pada setiap set eksperimen. Parameter tersebut dijadikan sebagai panduan untuk melengkapkan thesis merujuk kepada objektif dan tetapan masa yang telah dirancang. Pengiraan dan analisis dilakukan selepas semua parameter yang diperlukan diperolehi. Melalui keputusan yang diperolehi, tenaga yang diwujudkan dan dihasilkan oleh penjana kuasa adalah dalam keadaan seimbang. Selain itu, nilai kecekapan komponen utama seperti dandang, pemanas, dan alat kondensi juga diperolehi. Daripada keputusan pengiraan, dapat dinyatakan bahawa tenaga-tenaga di menara pendingin berada dalam keadaan tidak seimbang. Di akhir tesis ini, kejayaan projek ini dinyatakan dan beberapa cadangan telah diberikan untuk kajian masa akan datang.

a. Improvise the connection of the fuel, steam, and water line.

b. Improvise the maintenance of the main component of the plant

5. A detail study of losses should be done and analyze to get a specific value and place of losses

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APPENDIX A1

Gantt Chart for PSM1

TASK	W 1	W 2	W 3	W 4	W 5	W 6	W 7	W 8	W 9	W 10	W 11	W 12	W 13	W 14