" I hereby declare that I have read through this report entitle *"Study Of The Impact Routine Adjustment And Static Factor For Commercial Buildings"* and found that it has comply the partial fulfillment for awarding the degree of Bachelor of Electrical Engineering (Industrial Power)

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Date :…….

STUDY OF THE IMPACT ROUTINE ADJUSTMENT AND STATIC FACTOR FOR COMMERCIAL BUILDINGS

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A thesis submitted in fulfillment of the requiremens for the degree of Bachelor of Electrical Engineering (Industrial Power)

Faculty of Electrical Engineering
UNIVERSITI TEKNIKAL MALAYSIA MELAKA

2016

I declare that this report entitle *"Study Of The Impact Routine Adjustment And Static Factor For Commercial Buildings"* is the result of my own research except as cited in the references. The report has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

Signature :……..

Name : MOHD REDZWAN BIN MAHAT

Date :……

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ABSTRACT

This final year project report 2 will illustrate the impact of routine adjustment for energy avoided in commercial buildings by using Option C of International Performance Measurement and Verification Protocol (IPMVP) that is whole facility measurement. This method is implemented in order to verify the accurate energy saving declaration whether for commercial and industrial buildings respectively. In this project, the Faculty of Manufacturing buildings in Universiti Teknikal Malaysia Melaka (UTeM) has been identified to execute the buildings auditing process and recommendation of energy conservation measures analysis concurrently. There are a few constraints has been notified during Measurement and Verification planning while the real auditing process will be conducted after verifying the initial of routine adjustment correlation. All routine data has been collected and their impact to the result of the energy avoided based on standard errors and confidently level has been presented accordingly. It is hope that the proposed method will be implemented by the entire Energy Manager in order to determine the real percentage of energy avoided for the future sustainable energy management reports.

ABSTRAK

Laporan akhir projek tahun 2 ini menggambarkan kesan pelarasan rutin untuk mengurangkan pengguanan tenaga dalam bangunan komersial dengan menggunakan pilihan C dari Prestasi Pengukuran Antarabangsa dan Protokol Pengesahan (IPMVP) iaitu ukuran kemudahan keseluruhan. Kaedah ini dilaksanakan bagi mengesahkan pengisytiharan penjimatan tenaga yang tepat sama ada untuk bangunan komersial dan industri. Dalam projek ini, bangunan fakulti pembuatan di Universiti Teknikal Malaysia Melaka (UTeM) telah dikenal pasti untuk melaksanakan proses pengauditan bangunan dan cadangan tenaga analisis langkah-langkah pemuliharaan serentak. Terdapat beberapa kekangan telah dimaklumkan semasa pengukuran dan pengesahan merancang manakala proses pengauditan sebenar akan dijalankan selepas mengesahkan korelasi awal pelarasan rutin. Semua data rutin telah dikumpulkan dan kesannya terhadap hasil penguranagn tenaga yang dapat dielakkan adalah berdasarkan kesilapan standard dan tahap keyakinan telah dibentangkan dengan sewajarnya. Adalah diharapkan kaedah yang dicadangkan ini akan dilaksanakan oleh seluruh pengurus tenaga untuk menentukan peratusan sebenar tenaga dielakkan untuk laporan pengurusan tenaga lestari masa depan.

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Chapter 1

INTRODUCTION

1.1 MOTIVATION

Based on Suruhanjaya Tenaga (ST) final electricity consumption for commercial buildings in Malaysia has been increased 14% from year 2010 to 2013 [1]. This statistic has showed that people still less aware toward sustainable energy management in their daily life routine. Energy Conservation is the most common issue and everyday people try to invent new technology that can save energy and increase their efficiency. Currently, people still not alert about the efficiency of the appliance and they just bought it because they are cheap.

On 29th July 2009, Malaysia's Prime Minister YAB Dato' Sri Mohd Najib Tun Abdul Razak has launched The National Green Technology Policy [2]. Energy, environment, economy and social was the four pillars in The National Green Policy [3] . The purpose of this policy is to search for the independence energy and promote the efficient of energy simultaneously. In order to implement this green policy projects and activities that related with the four pillars, there are a few goals that have been set in Malaysia Plan. The 10th Malaysia Plan in 2011 for short term goal has stated that there are four of the most significant and the main improvement toward the National Green Technology Policy that is energy sector, buildings sector, water and waste sector and transportation sector [4]. In energy sector there are two parts which are energy supply sector and energy utilization sector. The energy utilization sector is the application of Green Technology by the industrial and commercial buildings while the energy supply sector is the management aspect including co-generation.. For the mid-term goal of this policy has been stated in the 11th Malaysia Plan in 2015 that is Green Technology become the preferred choice in selecting a products or services [5]. Besides that, it also spread the increased of Green

Technology products production and enhancement application of Green Technology in economy sector.

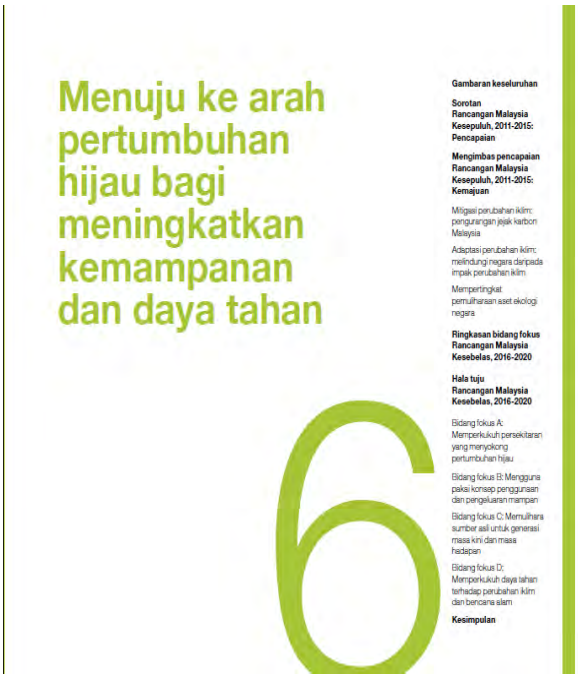

Figure 1.1: 11th Malaysia Plan (Chapter 6)

One of the government initiatives for the commercial and industrial energy management system is the introduction of Energy Performance Contract (EPC) and the concept of Energy Service Companies (ESCO). ESCO also is companies that provide service such as manpower, energy audit system and retrofit project and energy project management. In Malaysia, design, build and fund project of energy saving, energy avoidance cost and operation and maintenance cost reduction for owner facility are being develop by ESCO [6]. Other than that, ESCO

provided the guarantee the amount of energy avoidance at some defined pricing level to the owner of the facility. However, the equipment that is capable of operating at a stated level of efficiency may be a simple guarantee to the owner. Thus, the performance of any equipment or system that being installed is under responsibility of the ESCO.

MAESCO
(Pertubuhan Syarikat Syarikat Perkhidmatan Tenaga Malaysia)
Malaysia Association of Energy Service Companies

(Pertubuhan Syarikat-Syarikat Perkhidmatan Tenaga Malaysia)
Malaysia Association of Energy Service Companies

Figure 1.2: Example of Energy Service Companies

In order to implement the energy avoidance in every buildings, ESCO will provide a contract for the facility owner that is known as Energy Performance Contract (EPC) and contract between these two parties are made. The implementation of energy conservation measurement will be done based on EPC. EPC is an innovative financing technique that repay the cost of installing in Energy Conservation Measure (ECM) by the cost saving from the avoidance of energy consumption [7]. Due to these reasons and motivation; the measurement and verification process has been introduced in order to verify the accuracy of the saving based on the EPC that has been signed between owner of the buildings and ESCO. In Malaysia, it is still less knowledge regarding to this issue and not many auditors could respond for the measurement and verification process. Thus, the next sub-topic will explain in details the problem that has been faced by the country in order to implement the EPC and the concept of ESCO accordingly.

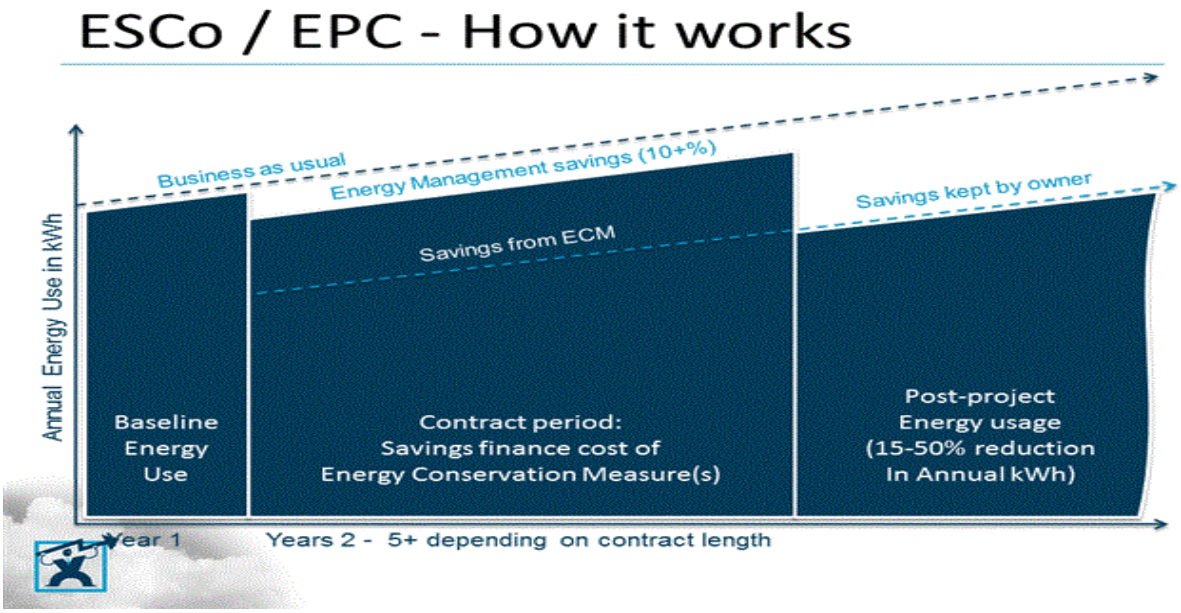

Figure 1.3: Energy Performance Contract (EPC) concept

1.2 PROBLEM STATEMENT

Generally, ESCO will provide EPC to owner facility in order to conduct energy saving project and this contract are made between these two parties. In fact, ESCO will promise a guarantee to the owner the amount of energy avoidance at some defined pricing level but at the end of the contract, the energy saving that being achieved is less than promises or not sustain. Other than that, ESCO also request to the owner to renegotiate the contract to extend the length of time needed to achieve the saving. Delayed to resolve technical problems and bad project management are the factor that make ESCO may needed more time to complete the project. Furthermore, building owner did not have independent verifier to verify the M&V plan that being execute by ESCO. ESCO did not follow the international guideline, International Performance and Verification Protocol (IPMVP) such as the M&V plan that being perform is

not clearly state in which option IPMVP and method to be used to determine the energy saving. In spite of that, weak in M&V plan may result low level of confident level of the saving reporting the end of the project. In order to resolve this problem, a few objectives have been stated to execute this Final Year Project. These three objectives have been presented in next sub-topic accordingly.

1.3 OBJECTIVE

The objectives of this project are to;

a) Model the best regression method for Correlation Identifying

b) To analyze the impact of independent variables by using Self-Organizing Map (SOM) toward energy saving.

c) Quantify energy avoided based on IPMVP for commercial building

1.4 SCOPE

This project involve whole facility that relate to energy use in the Faculty of Manufacturing, UTeM .The Option C in M&V planning has been identified to be implemented for this study. There are three major aspects have been considered to be audited which are; cooling system, room data and lighting system respectively. Other than that, the Cooling Degree Day (CDD) and number of working day have been considered as independence variables in the M&V planning process. All CDD and number of working days data have been collected monthly for one year that is from August 2014 until July 2015 while the base line for this study will be started from June 2013- July 2014. Static factor such as change in building size, design and operation of installed equipment will be taken as the factors that contribute to the results of the energy saving.

Chapter 2

LITERATURE REVIEW

2.1 Introduction

Nowadays, the population growth in Malaysia has been increased every year and statistic showed that there are 30.4 million people in 2014 [8]. This will affect the energy utilization in Malaysia that will increase the generation of the energy supply. Statistic from Suruhanjaya Tenaga also shows that people are still in less awareness toward energy management in their daily life. From this statistic, the government should take an action to create more awareness program for the Malaysian' in order to achieve the National Green Technology Policy. Due to rapid development in Malaysia, there are many buildings, industrial factory and residential has been constructed. In spite of that, the hypothesis for this situation is the more buildings, factory and etc. being constructed; the number of energy supply will be increased. Therefore, to identify the reduction of the energy consumption and energy wasted, M&V plan and audit are the solutions to find real energy saving potential in commercial buildings. In this chapter, the basic theory of the study and previous work done will be discussed accordingly.

2.2 Related Theory

2.2.1 Concept of Energy

A property of matter that can be converted into work, heat or radiation is known as energy. There are various type of energy present in this world that is kinetic energy for motion, thermal energy for high temperature, chemical energy for molecules that can react and produce heat, electrical energy for voltage and current and many more [9]. Different type of energy are

expressed in different units. Other than that, energy cannot be created or being destroyed but it can be converted from one form to another form that known as energy conversion such as radiation to electrical energy in solar [10]. In fact, energy conversion is important for energy utilization by the society for agriculture, industrial and residential usage. It show that energy is important in daily of society in order to undergo all their routine activities as usual.

Type of energy	Physical manifestation	Example
Kinetic	Motion	
Gravitational	Height above some reference level	
Elastic	Stretch or compression	
Chemical	Molecules that can react and give off heat	
Nuclear	Nuclei that can react and give off heat	
Thermal	High temperature	
Electrical	Voltage and current	
Radiant	Light and other electromagnetic waves	

Figure 2.1 : list of energy

Besides that, generation of energy also is important to keep constantly producing the energy for the demand supply. Currently, there are alternative way to generate energy from the natural source such as sunlight, wind, geothermal, biomass and etc. [11]. This natural source are known as renewable energy and example of renewable energy is wind energy from wind turbine, biomass from waste material, solar energy from sun radiation, hydro resources from water reservoirs and streams and many more.

Figure 2.2 : example of renewable energy

2.2.2 Electrical Energy

Electrical energy is the most important energy sources and has contributed much in producing heating, lighting, refrigerating, communication and many more. It can be a 'crisis' in the mind of society if it's unavailable for a few minute cause it can affect some of routine activity in their life. It is so easily can be transmitted from one place to another and also can be converted into other form of energy [12]. Positive and negative are the two type of electrical charge, as example to complete a simple circuit using battery and a bulb, in order to light up the bulb, the positive charge must be connected to the negative charge. If not connected the bulb will not be light up. There are a few variable and units that present in electricity such as electric current (A), Voltage (V), Power (P) and Charge (C) [13].