NON REVENUE WATER (NRW) SG.LEMBING EXPERIENCED

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A thesis submitted in partial fulfillment of the requirements for the award of the degree of Bachelor of Civil Engineering

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JUNE 2012

ABSTRACT

Water losses are one of the main problems that occur in water distribution network. Malaysia as a developing country is also exceptional to the same problem. Water leakage contributes to the nature sources losses and gives big impact to our country in terms of economic growth. Non Revenue Water (NRW) occurs is due to leakage in main water distribution, error on distribution meter and other losses. According to an investigation done in 2002 by the Malaysia Water Association (MWA), the total amount of losses in NRW due to leakage is approximated between in the range of 16 to 30% from total amount of water production. As matter of fact, a NRW reduction programme should be conducted in order to supply population water demand. To overcome financial losses, an effort of NRW monitoring needs full responsibility and commitment as priority in department of water authorities. In this case study at Sg,Lembing Pahang, NRW is determined based on the differences of volumes between system input volume and billed authorization consumption Besides that, comparison of current leakage percentage in the water system between zones is conducted to analysis factors that influence leakage rate and NRW level. Thus, the results obtained from this study could provide useful information to overcome water leakage problems and design better water distribution system modeling.

ABSTRAK

Kehilangan air merupakan satu daripada masalah utama dalam pembekalan air. Malaysia sebagai sebuah negara membangun tidak terkecuali dalam menghadapi masalah yang sama. Kebocoran air bukan sahaja merugikan sumber semuljadi malah daripada segi ekonomi ia member kesan yang besar kepada negara. Air Tidak Berhasil (NRW) merupakan faktor utama menyumbang kehilangan air. NRW berlaku disebabkan kebocoran pada sistem bekalan air, usia paip, kesilapan pada meter bekalan air dan lain-lain kehilangan. Menurut kepada penyiasatan yang dilakukan oleh pihak Malaysia Water Association (MWA) pada tahun 2002, jumlah kehilangan dalam NRW yang disebabkan oleh kebocoran adalah antara 16 hingga 30% daripada jumlah pengeluaran air. Oleh yang demikian, program pengurangan Air Tidak Berhasil perlu dijalankan demi menampung keperluan peningkatan tarif air. Bagi mengatasai masalah kerugian kewangan pula, usaha pengawalan Air Tidak Berhasil memerlukan tanggungjawab dan komitmen tinggi yang sepatutnya diberi keutamaan oleh pihak berkuasa air. Dalam kajian kes di Sungai Lembing, Pahang, Air Tidak Berhasil ditentukan melalui perbezaan jumlah air antara meter di sistem bekalan dan meter perumahan. Selain itu, perbandingan peratus kebocoran dalam sistem agihan paip antara zon akan dilakukan bagi menganalisis faktor-faktor yang mempengaruhi terhadap kadar kebocoran dan juga terhadap NRW. Justeru itu, hasil yang diperolehi daripada kajian ini dapat memberi maklumat penting dalam mengatasi masalah kebocoran air dan dapat merekabentuk sistem bekalan air yang lebih efektif dan efisien.

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LIST OF SYMBOLS

Q	-	System Input Volume
M	-	Billed Authorization Consumption
N	-	Unbilled Authorization Consumption
1 hr/ m /pressure		One Hour per Meter per Pressure
l/c/d	-	Litres per Service Connection per Day
l/c/d/m pressure	-	Litres per Service Connection per Day per Metre Of Pressure
l/km/d		Litres Per Kilometre of Pipeline per Day
Lm		Mains Length
Nc		Number of Service Connections
Lp		Total Length of Private Pipe Property Boundary to Customer Meter
P		Average Pressure
m^3		Cubic Meter

LIST OF ABBREVIATIONS

WHO	-	World Health Organization
UNICEF		United Nations Children's Fund
IWA	-	International Water Association
AWWA		American Water Works Association
MWA	-	Malaysia Water Association
AWER		Association of Water and Energy Research Malaysia
PAIP		Pengurusan Air Pahang Berhad
UFW		Unaccounted for Water
NRW	-	Non-Revenue Water
ILI	-	Infrastructure Leakage Index
ALI		Apparent Loss Index
CAPL		Current Annual Volume of Physical Losses
MAPL		Minimum Achievable Annual Physical Losses
SCADA		Supervisory Control and Data Acquisition
GIS		Geographical Information System
GPS		Global Positioning System
DMZ		District Metering Zone
PRV		Pressure Reducing Valve
WTP	-	Water Treatment Plant
AC	-	Asbestos Cement
DI	-	Ductile Iron
PVC	-	Polyvinyl Chloride

HDPE	-	High Density Polyethylene
km	-	Kilometer

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CHAPTER 1

INTRODUCTION

1.1 Introduction

Globally, the population growth rates have been highest nowadays. The world's population was estimated approximately 6.6 billion in February 2008. This situation has created a situation of water supply demand are increasing day by day.

According to World Health Organization (WHO)/UNICEF Joint Monitoring Programme (JMP), the latest figures shows that more than 2.6 billion people were living without access to improved sanitation, and nearly 900 million people lacked improved drinking water supplies (WHO/UNICEF, 2010).

Not to be neglected, the developing countries face a huge challenge in order providing an adequate water supply. This phenomenon is also happening in our country

Malaysia. Over the past few centuries, Malaysia does not face scarcity of water supply due to geographical factor, where our country is located in tropical climate and received excessive annual rainfall. However, the abundant of water supplied are decreased due to increasing population and impressive economic growth.

The increasing of population in urban is rapidly and yet expected because of the growing migration from rural areas. Basically, the water demand is always increasing in accordance to the number of consumers and various activities that involves usage of water. Once it is essential to ensure adequate water supplies for those purposes.

In Malaysia, the water distribution system is organized in a network of pipes made of Asbestos Cement (AC), Ductile Iron (DI), Polyvinyl Chloride (PVC), High Density Polyethylene (HDPE) and mild steel. Any disturbance in pipelines will lead to crucial problems that might affect consumers. These pipelines are naturally exposed to natural activities such as raining, hot temperature and windy. After a while, it will deteriorate and damaged because of soil movement, corrosive environments, fluctuation of water pressure, constructing without complying standards and excessive traffic loading. Due to these factors, the pipelines will start to leak, burst and crack.

If there is no prevention on this matter, the situation will contribute to water losses. Water losses can be defined as losing amount of water in water distribution system. The precise term to relate the losses in water distribution system is Non-Revenue Water (NRW). According to The International Water Association (IWA), NRW can defined as the difference between the volume of water put into a water distribution system and the volume that is billed to customers.

1.2 Problem Statement

It is estimated that water utilities in developing countries can lose 40-50% of the water they put into their systems and they are unable to bill their customers for this loss. High levels of NRW are damaging to the financial viability of water utilities, as well as to the quality of water service. Somehow, we cannot completely avoid water losses but we can manage to reduce the amount that might be profitable to other economic activities.

Improvement in a performance of managing water losses can be achieved through replacing aging infrastructure. Therefore, the reduction and control of water losses is vital to minimize NRW levels that threaten the long term sustainability of water resources for future

Pahang is among of the most crucial region in facing NRW problems, recorded level of NRW of 48.3% (MWA, 2004).

1.3 Objectives

The objectives of this study are listed below:

i. Identify the current Non Revenue Water (NRW) and current leakage percentage occurs at Sg.Lembing, Pahang.

ii. Identify the Physical Losses (real losses) components and Commercial Losses (apparent losses) components of current water distribution system at study area; Pahang.

iii. Analyze and classify the existing contributing factor to NRW occurs on water distribution system at study area.

iv. Study and analyse few recommended methods to determine the effectiveness in NRW reduction.

1.4 Scope of Study

The scope of study area is at Sungai Lembing Reservoir and specifically study the Non-Revenue Water (NRW) problem occurs in the water distribution system to Bandar Panching and Bandar Sg. Lembing. Initially, an investigation was done in the study area and both are label as code 1 and code 2. Code 1 represents a data collection from Bandar Panching and code 2 represents Bandar Sg. Panching. Ductile Iron (DI) and Asbestos Cement (AC) are the material used for the pipeline. The data collection obtained will be analyzed based on water balance and terminology. To illustrate NRW in detail, every component in the water balance is described by few methods and shows by calculation. Basically, determination of NRW consists of two part which is current leakage percentage and the performance indicator. The current leakage percentage is analyzed based on the current NRW at study area. This method consists of comparison of current leakage percentage with age, pipe length, number of valves and pressure within the pipe. Meanwhile, performance indicator will be used to evaluate the effectiveness and the Infrastructure Leakage Index (ILI) as performance indicator to identify physical losses.

1.5 Significant of Study

The significant of this study are:

i. To know the level of NRW and identifying the components of the losses.

ii. The current condition of NRW at Sg Lembing can be analyzed and effective precaution steps should be taken to save cost and sources of water.

iii. To study the performance indicator of losses at study area to maximize the best precaution steps.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

Water loss is a major problem occurs at most of developing countries. Water loss can be defined as losing an amount of water supply in water distribution system. According to Association of Water and Energy Research Malaysia (AWER), a modeling study was carried out to determine the financial loss caused by NRW in Malaysia. The modeling took into consideration of total treated water loss, category of users and lowest average tariff of each state (Study on Financial Loss due to NRW, 2010). In addition according to Malaysia Water Industry Guide 2010, average NRW recorded in year 2007 was 37.7% compared to 37.24% in year 2008.

This problem gives so many challenges to a developing countries including Malaysia itself. The obvious outputs we can analyze from this problem is increasing in operational cost, less in water resources and affect the financial viability of water through lost revenues produced from water distribution activities.

2.2 Non-Revenue Water (NRW)

As general, NRW can be classified as the total quantity water that distributed to water distribution system but it is non revenue. In technical term, NRW is the difference between the volume of water put into a water distribution system and the volume that is billed to customers. NRW comprises three components: physical (or real) losses, commercial (or apparent) losses, and unbilled authorized consumption.

i. Physical losses comprise leakage from all parts of the system and overflows at the utility's storage tanks. They are caused by poor operations and maintenance, the lack of active leakage control, and poor quality of underground assets.

ii. Commercial losses are caused by customer meter under registration, data-handling errors, and theft of water in various forms.

iii. Unbilled authorized consumption includes water used by the utility for operational purposes, water used for firefighting, and water provided for free to certain consumer.

$$\text{Non Revenue Water} = \frac{Q - (M+N)}{Q} \times 100\% \tag{2.1}$$

Where; Q = System Input Volume
M = Billed Authorization Consumption
N = Unbilled Authorization Consumption