

**DEVELOPMENT OF ASSET DAMAGE REPORT WITH APPLIED
GIS FOR THE METROPOLITAN ELECTRICITY AUTHORITY**

KANISTHA YOOUYUEN

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Thematic Paper
entitled
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.....
Miss Kanistha Yooyuen
Candidate

.....
Assoc. Prof. Panya Kaimuk, M.D.
Major advisor

.....
Asst. Prof. Bovornlak Oonkhanond,
Ph.D.(Chemical Engineering)
Co-advisor

.....
Prof. Banchong Mahaisavariya,
M.D., Dip Thai Board of Orthopedics
Dean
Faculty of Graduate Studies
Mahidol University

.....
Asst. Prof. Rawin Raviwongse, Ph.D.
Program Director
Master of Science Program in
Technology of Information System
Management
Faculty of Engineering
Mahidol University

Thematic Paper
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was submitted to the Faculty of Graduate Studies, Mahidol University
for the degree of Master of Science
(Technology of Information System Management)
on
December 27, 2010

.....
Miss Kanistha Yooyuen
Candidate

.....
Lect. Somnida Bhatranand,
Ph.D.
Chair

.....
Assoc. Prof. Panya Kaimuk, M.D.
Member

.....
Lect. Worasit Choochaiwattana,
Ph.D.
Member

.....
Asst. Prof. Bovornlak Oonkhanond,
Ph.D. (Chemical Engineering)
Member

.....
Prof. Banchong Mahaisavariya,
M.D., Dip Thai Board of Orthopedics
Dean
Faculty of Graduate Studies
Mahidol University

.....
Asst. Prof. Rawin Raviwongse, Ph.D.
Dean
Faculty of Engineering
Mahidol University

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Kanistha Yooyuen

DEVELOPMENT OF ASSET DAMAGE REPORT WITH APPLIED GIS FOR THE METROPOLITAN ELECTRICITY AUTHORITY

KANISTHA YOOYUEN 5036686 EGTI/M

M.Sc. (TECHONOLOGY OF INFORMATION SYSTEM MANAGEMENT)

THEMATIC PAPER ADVISORY COMMITTEE: PANYA KAIMUK, M.D., BOVORNLAK OONKHANOND, Ph.D. (CHEMICAL ENGINEERING).

ABSTRACT

The aim of this study was to develop an asset damage report with applied GIS for the Metropolitan Electricity Authority which will replace the former asset report via E-mail and Fax. This study was intended to develop a system to support an Internet Web Application to allow the user to pinpoint the damage location on a map and thoroughly understand the scope of service, as well as issue the monthly damage report, district damage report, error report and map including business details for making the repair.

The system was designed as a Web Application to link data from Oracle 10g through the program ArcGIS 9.3 for map data and using Microsoft Visual Studio 2008(c#) as the tool to develop the system interface.

The study showed that the asset damage report web application enables the user to locate and define a problem immediately where internet connection is available, resulting in the reduction of operational time and the minimization of documentation. This has eliminated various errors and increased the work efficiency, such as increasing the accuracy of the map for the officers so they can manage and handle the problem without any delay. Moreover, this system also allows the officers to report the problem to the MEA immediately when they find the problem, without having to write up reports.

KEY WORDS: GIS/DAMAGE REPORT/METROPOLITAN ELECTRICTY
AUTHORITY

68 pages

การประยุกต์ใช้ระบบสารสนเทศภูมิศาสตร์ (GIS) เพื่อพัฒนาระบบแจ้งทรัพย์สินเสียหาย ของ
พนักงานการไฟฟ้านครหลวง

DEVELOPMENT OF ASSET DAMAGE REPORT WITH APPLIED GIS FOR THE
METROPOLITAN ELECTRICITY AUTHORITY

กนิษฐา อยู่ยี่น 5036686 EGTI/M

วท.ม.(เทคโนโลยีการจัดการระบบสารสนเทศ)

คณะกรรมการที่ปรึกษาสารนิพนธ์ : ปัญญา ไข่มุก, M.D., บวรลักษณ์ อุนคานนท์, Ph.D.
(CHEMICAL ENGINEERING)

บทคัดย่อ

การศึกษาการประยุกต์ใช้ระบบสารสนเทศภูมิศาสตร์(GIS) เพื่อพัฒนาระบบแจ้ง
ทรัพย์สินเสียหาย ของพนักงานการไฟฟ้านครหลวงในครั้งนี้เป็นการเสนอแนวคิดและศึกษาการนำ
ระบบสารสนเทศภูมิศาสตร์ มาประยุกต์ใช้ในการแจ้งทรัพย์สินเสียหาย จากเดิมเป็นการแจ้งผ่านทาง
E-mail, Fax โดยเป้าหมายหลักของการศึกษาในครั้งนี้คือ พัฒนาระบบให้รองรับการทำงานผ่าน
Internet ผู้ใช้สามารถระบุตำแหน่งความเสียหายลงบนแผนที่ โดยระบบเขตการบริการได้อย่าง
อัตโนมัติ พร้อมทั้งออกรายงานความเสียหายประจำเดือน, รายงานความเสียหายประจำเขต, รายงาน
ความผิดพลาด และแผนที่พร้อมรายละเอียดเพื่อประกอบการดำเนินการแก้ไข

ในการพัฒนาระบบผู้ศึกษาได้พัฒนาระบบให้อยู่ในรูปแบบของเว็บแอปพลิเคชัน ซึ่งม
ีการเชื่อมโยงข้อมูล Oracle 10g โดยใช้โปรแกรม ArcGIS 9.3 ในการให้บริการข้อมูลแผนที่ และใช้
Microsoft visual studio 2008(c#) เป็นชุดเครื่องมือในการพัฒนาเว็บอินเตอร์เฟสของระบบ

การศึกษาแสดงให้เห็นว่าการพัฒนาระบบแจ้งทรัพย์สินเสียหายให้อยู่ในรูปแบบของ
เว็บแอปพลิเคชันทำให้ผู้ใช้สามารถค้นหาตำแหน่งและแจ้งปัญหาที่พบได้ทันทีที่เชื่อมต่อ
อินเทอร์เน็ตผลที่ได้คือช่วยลดเวลาในการดำเนินงาน ลดการใช้เอกสาร กำจัดข้อผิดพลาดต่างๆที่
เกิดขึ้น และเพิ่มประสิทธิภาพในการทำงาน เช่น เพิ่มความถูกต้องของแผนที่เพื่อให้พนักงาน
สามารถจัดการกับปัญหาต่างๆได้อย่างรวดเร็ว นอกจากนี้ระบบยังช่วยให้พนักงานสามารถรายงาน
ปัญหาที่พบไปยังการไฟฟ้านครหลวงได้ทันทีโดยไม่ต้องเขียนรายงาน

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CHAPTER I

INTRODUCTION

1.1 Problems Significance and Background

To date, information technology has been extensively used due to technological advancement with software production for further results compilation. Information technology has become more essential for people in education, business operation, communication, services and industry. Furthermore, Information Technology contributed to both government and private agencies operation which enabled them to perform effectively, provide better services, and well respond to the need of the people that led to effective service and country development based on the report of the National Science and Technology Development Agency [1]. Modern technology is being applied with spatial data as being seen in GIS which overlay data or information in the same area for analysis to find appropriate use of each resource with definite site. Identifying problems for further analysis made data improvement easier and faster (Her Royal Highness Princess Maha Chakri Sirindhorn [2]).

The Metropolitan Electricity Authority is the leading power generation in organization in South East Asia that had been expanding its business to other related areas with social and environmental responsibilities. Its mission is to effectively operate and managed electrical business and gain customers' satisfaction through excellent service based on good management and trustworthy image that focused on employee's value and continued developing, including social and environment responsibilities.

In 1994, the Metropolitan Electricity Authority has continued updating GIS which made the land base, distribution and communication available within the area of Bangkok Metropolitan Administration, Nonthaburi and Samutprakarn, estimated 3,200 square kilometers and divided into 18 districts. Such system can be applied extensively with the operation of the Metropolitan Electricity Authority such

as planning and designing electricity generation, quick and convenient services, including registered electrical use, electrical repairing and providing administrative data. GIS of the Metropolitan Electricity Authority which has fine resolution of 1:1000 scale including constantly updated basic consumers' data such as address, roads, soi and all constructed buildings, enable us to analyze expanded rate well.

Electricity generation, essential for people, is comprised of the asset of Metropolitan Electricity Authority that required regular maintenance to continue servicing.

Testing and receiving asset damage report of the Metropolitan electricity Authority staff is important process to build organization culture. By being the owner of well operated company, the Metropolitan Electricity Authority had required the staffs higher than C9 level to report 4 asset damages annually through E-mail with full details of the damage and the site so all 18 service districts can access the area and report each repair status. Problems occurred when the staffs in some service area made incorrect report which delayed the repair or unable to find the site of damage asset from unclear report.

The application of GIS in the report of asset damage can reduce such problem because it can clearly identify damage site in the service area for the district office to accurately repair the damage and display repair status. Therefore, the focus is on developing asset damage reporting system to replace the current E-mail report and display GIS application feasibility in reporting asset damage by the Metropolitan Electricity Authority Staffs so the work can be done conveniently and effectively.

1.2 Research Objectives

The operational procedures for developing asset damage

1.2.1 To present and study GIS so the system can be used for reporting asset damage through the former E-mail system, using Internet Network.

1.2.2 To identify damage location of asset on the map with fine details as much as 1:1000 based on the set standard.

1.2.3 To correctly identify responsible asset area of the Electricity Authority.

1.2.4 To aid the electrician in using map for travelling to repair the damage.

1.2.5 To assist the staff higher than C9 level in reporting asset damages through Internet Network.

1.3 Research Scope

1.3.1 To study and design asset damage reporting system through former E-mail system, using internet network

1.3.2 To develop asset damage reporting system with the application of GIS

1.3.3 To develop asset damage system that able to identify responsible area and build traveling map correctly.

1.3.4 To study asset damage system sample report of the Metropolitan Electricity Authority staffs

1.4 Expected Benefits

1.4.1 Being the guideline to apply GIS in reporting asset damage of the Metropolitan Electricity Authority Staff

1.4.2 Being able to identify asset damage site on the map with standard resolution and scale.

1.4.3 Being able to identify service district and damage site accurately.

1.4.4 Being able to construct traveling map correctly.

1.4.5 Being able to assist staff higher than C9 level to make correct report.

CHAPTER II

RELEVANT LITERATURES AND RESEARCHES REVIEW

2.1 GIS Definition

Tanakorn [3] defined GIS as the developed tools or methods for more effective data collection, including actual results display through Geo reference or Coordinate System, aiming to use for different purposes. Data referenced under the same coordinate would display as the annotation or figures linking with each other systematically.

Sura[4] defined GIS as the process for using Hardware, Software, Geographic Data and Personnel Design to build effective data storage, modify, calculate and analyze data so it can display geographical reference. It is also referred to computer capacity in storing and using data to explain conditions on earth based on geographical features as the link between data.

Her Royal Highness Princess Maha Chakri Sirindhorn [2] had defined GIS as the application of information or various data on the same area to overlay and analysis for appropriate resource planning and showing definite coordinate. Then, problem solving can be decided and solved quicker and easier.

Niwat [5] defined GIS as one of the IT groups quite different from other IT groups. Significant component which indicated the difference is data associated with location on earth or Spatial Data. Therefore, IT would link to knowledge development in numerous disciplines related to spatial data.

Pipop [6] defined GIS as graphic software to store map data or data image such as Satellite Images, Arial photographs. Such software could store map data or area photograph as specific program of each layer or overlays or coverage. Then, these data are being used for compiling results to find spatial data.

Suree [7] defined GIS as geographical information system with computerized system for inputting, storing, preparing, transforming, modifying, managing, and analyzing data including the display of required spatial data. Therefore,

GIS is the essential technology for managing and administering natural resources and environment effectively.

Aronoff [8] defined GIS as the system operated through computer to increase efficiency in managing spatial data in the following 4 aspects 1) input 2) storing priority and usage 3) transformation and data analysis based on the set objectives and 4) designed outcome from analysis for further decision-making.

TYDAC Technology Inc. [9] defined Geographic Information Systems (GIS) as follows “Geographic Information System are software packages which can be use to create and analyze spatial information. With such systems, maps, air photos and diagrams describing natural and man-made features can be translated into an electronic code which can be recalled, modified and analyzed.”

The Metropolitan Electricity Authority [10] defined GIS as geological information management with computerized application to display information as figures and alphabets. Most applications involved different geological information displayed as figures and alphabets. GIS is able to input, record, analyze, design and display both outcomes better than Information System. Besides, GIS also supports executives’ decision in solving problems and managing data.

2.2 GIS Component

The Institute for the Promotion of Teaching Science and Technology [11] identified 5 significant elements of GIS as Data/Information, Hardware, Software, Procedure and User/People

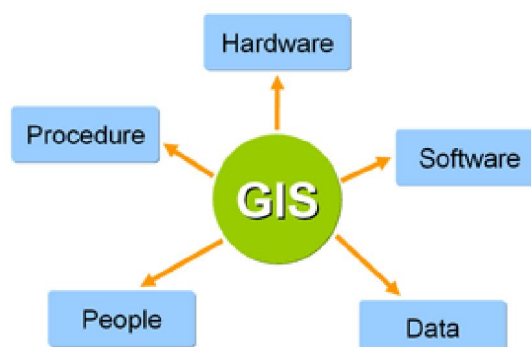


Figure 2.1 GIS Component

2.2.1 Data/Information

GIS input should be specific Theme, updated data that is accurate and reliable and able to give appropriate answers.

There are 2 types of GIS, Spatial Data and non-Spatial Data or Attribute Data

Spatial Data indicated Geo-Reference Data of Graphic Feature in Vector Data and Raster Data

Vector Data is comprised of the following 3 features:

- Point such as location for villages, schools or temples
- Line such as roads and rivers
- Polygon such as surface water

Raster Data is small Grid Cell or Pixel in equal size, joining each other to display Geographic coordinate. The size of data resolution depended on the number of row and column. Examples for storing with Grid Cell such as statelier figures, Digital Elevation Model: (DEM).

2.2.2 Hardware

Total hardware is consisted of computerized input equipment such as Digitizer, Scanner, Global Positioning System (GPS), data reading, maintaining and displaying equipments such as Printer Plotter. Each equipment functions differently.

2.2.3 Software

Software is defined as the managing and commanding program for hardware to perform or recall data in the database. Generally, GIS program is consisted of unit for inputting and managing data, including data analysis, transformation, display and User Interface.

2.2.4 Procedure

In the GIS, data accuracy is matter the most because incorrect analysis and wrong decision could cause errors, leading to the loss in labor, effort and investment until becoming big waste. In order to build good database, operational procedures must be clearly defined for efficiency. Database should be designed to share in various activities.

2.2.5 Staffs

Staffs are comprised of system analyst and user with expertise in GIS and already received training. Generally, system users would choose own hardware and software to serve their own needs and respond to agency's demand. As for users, they are planner or Decision-maker who applied data to solve problems.

2.3 GIS Usefulness

2.3.1 It is able to mix various data and form various model (graphic, alphabets, numbers and figures) from different sites. Furthermore, the rate for map structure had link with maps and mix data from Remote Sensing.

2.3.2 It is possible to share acquired information between related units.

2.3.3 Data compilation and analysis could be effectively done such linking social and economic with Spatial Overlay.

2.3.4 Model must be constructed, tested and compared alternatives before actual application.

2.3.5 Data should be frequently updated to keep up with the world events.

2.3.6 It is able to manage large database.

2.4 Metropolitan Electricity Authority GIS

2.4.1 The Metropolitan Electricity Authority GIS/AM/FM

The Metropolitan Electricity Authority had applied GIS in its operation starting from 1989-1990 and joined with the following 4 agencies to prepare Bangkok Land Information System (BLIS) at Chulalongkorn University (Metropolitan Electricity Authority, 2004).

1. The Bangkok Metropolitan Administration
2. The Metropolitan Waterworks Authority
3. TOT Public Company Limited
4. Land Department

BLIS is the prototype for constructing GIS and its use with the assistance of foreign experts. This project aims to develop information system for Bangkok Land Department to use with related utility agencies. The utility network is overlapped to consider construction model and coordinate work with other agencies to repair utilities without conflicts. This should aid executive's decision making, planning policies and agencies' operation in Bangkok or other agencies, including State Enterprises to operate efficiently by aiming at 2 goals:

1. To prepare BASE MAP with the rate 1:1000 on the target area estimated 25 square kilometers (Klongtoey at present), expect to complete in 1989 by using map section for issuing land deed , including Ariel pictures from the Land Department.
2. Testing Land Information in certain area, estimated 3 kilometers with program development, proper computer as well as preparing for relevant data and developing personnel.

However, the project was neglected, partly because many agencies had not prepared themselves or some had no needed to invest in this area due to high investment cost. However, the operation assessment at the Metropolitan Electricity Authority indicated extensive demand until it was unable to update map data to keep up with increasing demand.

Therefore, the Metropolitan Electricity Authority had decided to invest in map making for internal administration and servicing the general public in the year 1996 by hiring ESRI to collect data for database and develop applied program based on Ariel pictures with scale 1:1000 and acquired data on the electricity distribution from the field survey. This included data from documents prepared by agencies under the Metropolitan Electricity Authority. The Metropolitan Electricity Authority had prepared GIS/AM/FM at the Electricity Distribution Map Information Unit, Map and Distribution Equipment Division by dividing the operation into 5 phases as follows (Table 1 and Figure 1).

Table 2.1: GIS/AM/FM Operational Time Period and Budget

GIS/AM/FM Project	Budget Year	Operational Area (Square Kilometer)	Investment Capital (Million Baht)
Phase 1(Wat Laeb and Klong Toey Districts) from August 2 nd 2537 to January 24 th 2539 (total 1 year 6 months)	1997-1999	39.91	173.83
Phase 2(Rat Burana District, Samsaen District, Thonburi District)) from March 18 2539 to March 18, 2542 (total 3 years).	1999-2002	500.91	326.78
Phase 3 (Yanawa District, Bangkapi District, Bangkaen District, Bangkuntien District, Minburi District) from 14 February 2000 to 14 February 2003 (total 3 years 9 months).	1997-2000	1,228.39	649.0
Phase 4 (Nonthaburi District, Samutprakarn District) from June 1,2001 to November 23,2002 (total 1 year 6 months)	2001-2002	566	167.86
Phase 5 (Bangplee Yai District and Bang Yai District) from September 30, 2002 to September 30, 2004 (total 2 years)	2545-2547	1,025	188.50
Total		3,191.60	1,505.97

2.4.2 The Metropolitan Electricity Authority GIS functions

The Metropolitan Electricity Authority GIS/AM/FM is divided into 2 parts as follows:

1) AM Application (Automated Mapping Application) is the program designed for modifying and displaying the map such as Power Tools. There are 7 types of constructed map:

- Base Map
- Meter Map
- Overhead Line Map

- Underground cable Map
- Duct Route Map
- Public Light Map
- Feeder Map)

Besides, it is the program for updated data on the base map and electrical system when changes occurred in the services. This program is currently in use with the electrical system, map, work distribution and meter service.

2) FM Application (Facilities Management Application) is consisted the following 4 applied programs:

2.1 JP/DE (Job Planning/ Design Environment) is the applied program for electricity distribution/ materials acquisition and estimated cost.

2.2 TOR (Trouble Calls/ Outage /Reliability) is the program designed to receive power outage and find initial cause with system Reliability Analysis

2.3 IMS Locator tool (Internet Map Server Locator) is used for locating site for users and initial checking data on electrical posts and lines as well as printing map to accompany users' petition for electricity.

2.4 The Distop (Distribution Operations) is the program to analyze electricity distribution system.

2.5 GIS/AM/FM objectives of the Metropolitan Electricity Authority

The Metropolitan Electricity Authority has applied GIS in the making of map database and electricity distribution for accurate and accurate application of map and information in efficient planning, designing and maintaining electricity distribution.

2.6 The Metropolitan Electricity Authority GIS Basic Components

The Metropolitan Electricity Authority GIS is consisted of 5 major components as follows: Hardware, Software, Data, Process and People ware.

2.6.1. Hardware

Hardware is the main computer component, including other peripheral related to the computer such as case, monitor, keyboard and mouse. Personal computer is mainly consisted of the Case to compile results acquired from other equipments. The internal components are main circuit, transformer, CPU, Hard disk, memory displayed and sound card.

The Monitor shows statement as the Disk drive to read and write data on the diskette. The keyboard would input information into the computer. Mouse is being used for commanding and choosing items appeared on the monitor. As for the Speaker, it is to display outcome in the form of sound. The widely used computer among medium and large organization are the following hardware:

2.6.1.1 Computerize Server is the main tool for system compilation. It is considered as the heart of present computerized system because it has been used as the center to distribute Data or Application to Client. A computer used as the Server must have extremely capacity with speed in compilation and enough support for future system expansion.

2.6.1.2 Client same as Server is being used for results compilation from user's computer. It is the main tool to link user's work with stored data in the Server. A computer used for this purpose only required moderate capacity, not as high as the Server, but enough to support the work of each user. To date, widely selected computers are mostly employed UNIX, NT systems or Windows.

2.6.1.3 Peripheral in general computerized system, besides having the computer as the brain to think and compile results, it came equip with additional equipment or other peripheral to make it much more complete. For example, the application of Digitizer helped to input map data provided that the Hard disk drive must be available to store those data. Meanwhile, the computer may reveal outcomes in various forms after results compilation. With laser's printer, outcomes would be print out or using Plotter to print map. The peripheral is maily extended from each computer in the system.

2.6.1.4 GIS Local Area Network of the Metropolitan Electricity Authority is the system designed for the organization operation which required more than 1 person to operate. Meanwhile, this type of computer required

more than single computer connected together in the same system. Such connection depended on the Network equipment and technology already attached to each computer. Then, the signal would be connected for sending and receiving data or transmitted to other connected computers. In the case where the computers are closely located, the system designer usually set up Local Area Network (LAN). For further distance, Wide Area Network (WAN), a much more complex and costly system must be set up. The benefit from setting up the network is to share resources, whether being the peripheral or result compilation unit for convenient and effective system.

2.6.2 Software

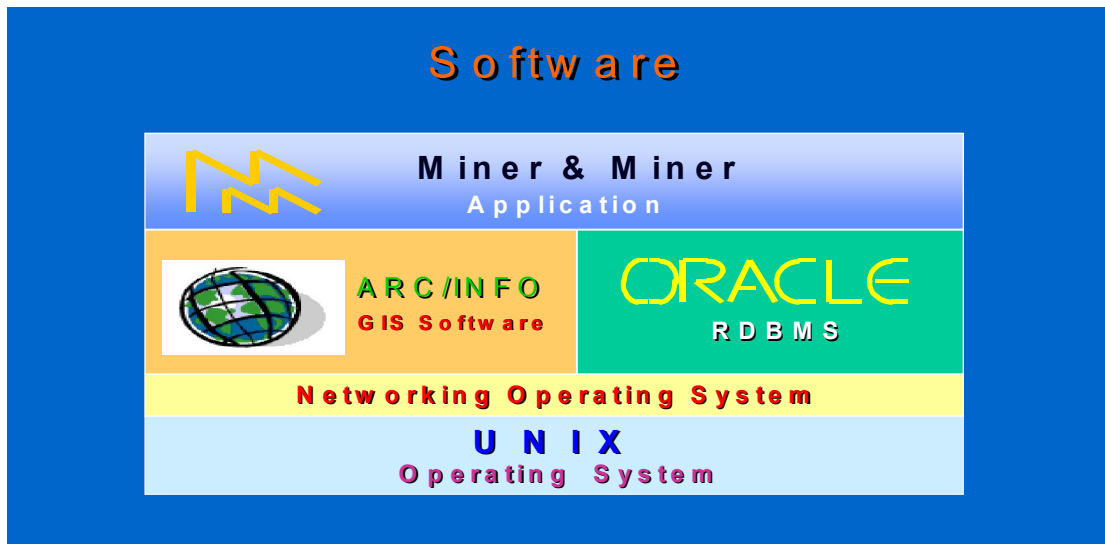
Software is the program or controlling command for the computer to function properly. Hardware which came from the factory is unable to perform instantly without software or command. It requires man-made language or Programming Language with Programmer to write various design software. The following software is available for use.

2.6.2.1 Operation System Software is specific computerized section to communicate between the machine and user through direct command or applied program. Available GIS are as follows:

- Solaris by Sun Micro System Co., Ltd. applied UNIX to control Server and Network.

- Windows by Microsoft Co., Ltd for PC. -Network Operating System is the operation system to control the communication Network.

2.6.2.2 GIS Software is the main software specifically designed for GIS application, having the tool to manage, store, analyze and display geographical outcomes that enabled the users to operate those basic tools for GIS improvement with full capacity. GIS software wears the trade name of Arc/Info and PC Arc View as illustrated in Figure 2.



Authority, 2004

Figure 2.2: Applied Program Source: The Metropolitan Electricity Authority

2.6.2.3 Application Software is applied GIS to allow users conveniently access GIS faster through the system hardware GUI (Graphic User Interface). This system would allow the user to give select the menu on the monitor and command with the Keyboard and Mouse. Benefits from using applied program are its ability to gather numerous demands from the computers through GUI application without the user's knowledge of command in each computer. The user is only required to understand the operation procedures and know correct button to press, including feeding proper data through the Keyboard and Mouse.

2.6.2.4 Relational Database Management Software is the software for managing GIS database so GIS/AM/FM could manage database better. Software used had the Oracle trademark.

2.6.3 Data

Data is considered important part of GIS. Normally, graphic data of GIS would be stored with reference in UTM rate which divided into Layer, depending on data type or characteristic. Its usage must be clearly defined whether for results display or analysis accordingly such as layer of road linear, layer of water source, layer of underground wireless pipe. Each layer may consist of Point, Arc, Polygon and Annotation based on the use. For example, road edge data would include linear data

with street name on the map. Meanwhile, the layer data of distribution system also linear would be electrical circuit. Point data would be location of the switch, transform and annotation indicated size of electrical line, size and number of transformer and electrical switch. Graphic data which are being stored at the Metropolitan Electricity Authority consisted of the following 2 groups.

2.6.3.1 Land base is the basic data for reference, distribution since the following distribution system depended on the database map as reference.

- Road edge indicated the line on the road in the Metropolitan Electricity Authority electricity distribution district. This graphic data is consisted of linear data and annotation which were stored in LB_ROADEDGE.

- Building revealed the building line in the electricity distribution district of the Metropolitan Electricity Authorization. This graphic data is consisted of linear data and annotation which were stored in LB_BUILDING.

- Landmark and Land edge display location of line and other important location, including the fence edge and other non-road division lines, outside the electrical distribution area of the Metropolitan Electricity Authority. This graphic data is consisted of linear data and annotation which were stored in LB_LANDMARK.

- Hydrology indicated location of the edge of water resources in the Metropolitan Electricity Authority district which consisted of linear data and annotation which were stored in LB_HYDROLOGY.

- Road Centerline indicated location of line in the middle of the road in the Metropolitan Electricity Authority district which consisted of linear data and annotation which were stored in LB_CENTERLINE

- MEA District indicated electrical distribution area of the Metropolitan Electricity Authority as graphic data consisted of closed information and annotation to show the road edge which is kept in LB_DISTRICT.

- MEA Meter Zone indicated location of meter zone in each distribution district of the Metropolitan Electricity Authority district which consisted of closed information and annotation which were stored in LB_ZONE.

2.6.3.2 Distribution Map is distribution data of the Metropolitan Electricity Authority consisted of the following data layers:

- Distribution Circuit shows the electrical edge and location of equipment in the electricity distribution area.
- Duct shows the edge of underground tubes and ponds in the Metropolitan Electricity Authority.
- Meter shows the location for reading electrical current in the distribution district of the Metropolitan Electricity Authority.

Graphic which is stored by GIS software and Attribute data has made graphic data more complete. GIS used huge software or Oracle to collect those data.

2.6.4. Process

Even though the system is comprised of 4 elements as mentioned, it cannot function smoothly without operational manual. Generally, GIS involved the following steps:

2.6.4.1 Project Management Plan

GIS project required the field expert to set up the system due to its complex nature in storing and managing database. The administrator must set up both short-term and long-term plans to prepare for future expansion. When the project started to operate, he must control and manage the project to accomplish in time. Furthermore, the administrative plan should cover the project inspection and results evaluation periodically.

2.6.4.2 Training Procedure

Because GIS is computerized system, highly evolved during short period of time, whether being GIS software, GIS application in field data collection, and database management. The training was arranged so all concerned parties would be able to keep up with changing technology which is crucial part of the project.

2.6.4.3 Update procedure is to keep up with the changes and preserve valuable information. Without constant update, the system which has been function promptly when it was installed would fail. Therefore, data improvement plan must be invented and preceded as soon as the system is ready for operation. Most plans required daily operation, including speedy improvement to match the work routine turnaround.

2.6.4.4 System procedure is the plan to upgrade Hardware and Software so the system can keep up with technological progress in computer which continues to happen rapidly. Therefore, the support plan must be set up and revised periodically for system improvement.

2.6.4.5 Backup and Recovery Procedure

Even though the computer had installed the protection system, but the damage may result from fire, burger or carelessness of concerned parties. Unexpected damages may happen and eventually loss of irreplaceable data. Prevention can be done in various ways, for example, back up data on the magnetic tape and store in the secure place so all data can be retrieved incase unexpected happened .

2.6.4.6 People ware is the most significant part in developing GIS. All concerned staffs must understand the purposes and operational steps thoroughly. Staffs are classified in the following levels:

- Project Manager is a person closely monitored the project progress, especially the beginning of the project. The project manager must ensure the project feasibility. He is the one set up and controlled the available resource for efficient use. Furthermore, he must have wide vision and keep up with ever changing technology.

- System Analyst is an employee who coordinated works between users or Software, organization manager and programmer to intend to study former system and design new system, including operational assessment. Therefore, most analysts must have more knowledge Programmer.

- System Engineer is a person, who had designed, maintained and looked after Hardware so the computer can function properly. He must know about the Hardware structure, its main functions and be able to design hardware. This person must graduate with Bachelor Degree or higher in Electronic major, Computer Engineering.

- Administrator is the computerized system operator which divided into the following groups.

Computer Center Administrator is a staff assigned for computer operation only. This person is responsible for setting up policies and planning administrative assignments to accomplish the organization goals. In the Computer

Center, a person may be assigned to work as an executive in certain division such as system analysis and design, database administration, information technology and operation.

1) Database Administrator: DBA is the staff who responsible for setting up policies and planning administration, managing and maintaining the database, including the selection of Hardware and Software to manage the organization database. Most of them completed Master Degree in Information Technology, Faculty of Computer.

2) Operator is a group of personnel responsible for daily operation or mission related to computer such as controlling machine opening and closing, monitoring the operation, preparing data for input, making operational schedule. Majorities work in the computerized center or large information unit.

3) End-users are staffs computer users to serve their objectives or perform daily task. Staffs in this group responsible for learning or training on how to use software for work such as accounting officer ,

Then, within a GIS project, there are many parties involved which must interact with each other to ensure the system success with maximum efficiency.

2.7 Relevant Researches

Narong [12] studied map modification process for GIS by the Metropolitan Electricity Authority at Rat Burana District. Research findings indicated that GPS and Digitizer for survey by the Metropolitan Electricity Authority were quite effective and easy to use. Moreover, the data copy machine to be stored in database of the Metropolitan Electricity Authority so data could be applied repeatedly as well as keeping data updated and accurate. The reason for upgrading the map of Metropolitan Electricity Authority is to develop work-efficient personnel and modern instruments.

Surachai [13] applied GIS in the system to guide location of building or facilities at King Mongkut's University of Technology Thonburi for professors, students and visitors who wanted to contact University departments. The database would specify location of departments, classroom buildings, and parking located within the University area. Furthermore, GIS helps to solve problem in insufficient

parking spaces. This system was developed and presented descriptive data and map in 7 levels as follows (1) location of the University (2) buildings (3) each building level (4) roads (5) Controlled exit and entrance (6) parking and (7) other important places.

Conclusions were made from the operation that those accessed the system are able to learn information on each building or location directly from KMUTT/MAP. Information appeared on the desired location with explanation. Besides, results can be printed on the printer. However, input must be entered constantly on the program to update information when location had been changed.

CHAPTER III

OPERATIONAL METHODOLOGY AND TOOL

The operational procedures for developing asset damage report by the Metropolitan Electricity Authority staffs with applied GIS were divided into 5 steps as follows:

- 3.1 Data collection and study
- 3.2 System analysis and design
- 3.3 System building and development
- 3.4 System function testing and improvement
- 3.5 Documents preparation for operation

3.1 Studying and Collecting Data

The study of applied GIS data to develop system for reporting asset damage of the Metropolitan Electricity Authority staffs conducted the study in the following areas:

3.1.1 Studying Earlier Educational System (through E-mail)

Earlier asset damaging report system was under the study since the existing system required the staffs to report to the Analysis and Examination District Office, mainly through E-mail with detail damages and draft map to display location for such equipment. Then, the Analysis and Examination District Office would list asset separately to identify service area and report back for further report. Therefore, the study of earlier system allowed us to learn its operational steps and system flaws so the data can be used with applied GIS for further improvement in reporting asset damage.

3.1.2 Studying New System (Reporting Damage)

During the study of applied GIS in reporting asset damage, the informant could access the system through Internet to report equipment damages in details and display site. This way he can learn the repair procedures, new system component, including advantages of applied GIS in reporting asset damage that may be used for solving earlier system.

3.1.3 Studying System Development Tool

Tool for developing system

Map Data			
List	Data	Type	Details
Land base			
1.	Road edge	Arc	Identify location of road edge in the distribution area
2.	Building	Arc	Identify location of building in the distribution area
3.	Landmark and Land edge	Arc	Identify location of landmark and land edge, non-road
4.	Hydrology	Arc	Identify location of hydrological sites
5.	MEA District	Polygon	Identify location of MEA District in the distribution area
6.	MEA Meter Zone	Polygon	Identify location of MES Meter Zone in each distribution area
Distribution Map			
7.	Electricity Post	Point	Electricity Post Location

Table 3.1 Tool for developing system

Software

- Operating System (OS) uses Windows 2003 Server R2
- Oracle 10g
- ArcGIS Server 9.3 is the Program used in data map management
- ArcGIS Desktop 9.3 is the Program used in map design management
- Microsoft Visual Studio 2008 is the tool set for developing interface web of Asset Damage Reporting

Hardware

- CPU Quad-Core Intel Xeon X5355 2.66 GHz
- RAM 4 GB ECC
- HDD 160 GB SATA II

3.2 System Analysis and Design

During the analysis and design, process was being separated into 4 parts as follows:

-Part 1: Staffs higher than C9 level was asked to report asset damages in full details including identify damaging site.

-Part 2: District staffs reviewed damaging asset status and request repairing asset damages in own area.

-Part 3: District staffs changed repair status such as, requesting modification, during editing, and successfully modified.

-Part 4: District staffs prepared the map to display asset damage location, including detail explanations of damaging property

-Part 5: District office for Analysis and Examination issued all monthly report in each service area and number of repairs by each staff higher than C 9 level.

System operation is divided into 3 major parts as follows:

3.2.1 Operational Results Displayed

Staffs higher than C level can report asset damages, using GIS through WEB Interface with the repair status.

3.2.2 Storing Data

Data on damaging area had been stored in the database to identify damaging site with service area and responsible person to reduce errors in reporting service area of Analysis and Examination District Office and Examination and Distribution Maintenance Unit

3.2.3 Issuing Report

Summarized monthly service reports were issued, including monthly repair report in each service area and number of individual report by staffs higher than C9 level and traveling map for the district staffs.

3.3 System Building and Development

Steps for developing system are as follows:

3.3.1 The application of data from the database of the Metropolitan Electricity Authority using Oracle 10g.

3.3.2 The monitor must be designed to input and display data by maintaining similar model in reporting data such as giving detail explanation of asset damages. Data in full details derived from the need to store data by Metropolitan Electricity Authority staffs.

3.3.3 System development for web Application to facilitate GIS usage and display through ArcGIS Server 9.3 was done as the management program so the end-user could report the damage site as well as reporting the service area to accurately verify such location.

3.3.4 Monthly repair reports of each area were summarized which also indicated numbers of repair by each individual staff higher than C9 level

3.4 System Operation Efficiency Analysis and Test Run

3.4.1 Prepare technical audit to test the effectiveness of operational system if it could be applied in all aspects, including data collection and displayed to ensure system operation.

3.4.2 Verify accuracy for further improvement.

3.4.3 Compare the acquired system with the set objectives to see if the system can actually solve the problem. Besides, the study should be done on existing limitation to derive at guideline for further improvement.

3.4.4 Analysis the operation efficiency of former system and the use of property damage report through GIS, applying the Measures of Central Tendency as an analysis formula to find Arithmetic or Mean. Then, total data outcomes were divided with total numbers of data to construct the following formula:

$$\bar{x} = \frac{\sum x}{N}$$

Given \bar{x} = Mathematic/ Mean
 $\sum x$ = Total Outcomes
 N = Total Data

3.5 Documents for Operation

Written documents for system operation were prepared by Analysis and Examination District Office and all service areas which indicated operational steps and procedures, including the responsibilities of end-users in each unit.

CHAPTER IV

OPERATIONAL RESULT

This operation intended for developing the monitor and asset damage report through GIS by the Metropolitan Electricity Authority staffs as the Web Application to support working through Internet. Operational results are stated in the following details:

- 4.1 System analysis and design
- 4.2 Developing asset damage reporting
- 4.3 System Operation Efficiency Analysis and Test Run

4.1 System analysis and design

4.1.1 Old Process

Findings from the former asset damage report through E-mail are being summarized as follows (Figure 4.1):

- Staffs higher than C9 level informed the damage in full details with equipment code and hand draw map.
- The district office analysis staffs identified the damage area and responsible district from the map before sending information to the service staffs in such area. Informed data from each unit were collected and updated to display reporting numbers on the organization Intranet.
- Check the report to see if the damage happened in the district staffs' responsibility.
- Report to the District Analysis Office immediately if the damage happened outside the responsible area so the District Analysis Office could locate responsible party.
- Responsible district must send a full detail report with more explanation to clarify the matter and inform the technician as well.

- The technician would search for location in actual map through GIS of electrical repair department before printing a map in full details such as the damage location, equipment number, and overall damage details to be sent further to the site staffs for repairing.
- Sites staffs then opened work order and repaired the identified damage on the map. Sites staffs closed the work and reported repair details to the district staffs.
- The district staffs informed the District Analysis Office on the performance progress.
- The District Analysis Office gathered data from all districts on the monthly basis to analyze the damage before presenting to the upper management.
- The District Analysis staffs informed the stakeholders after the operation had been completed.

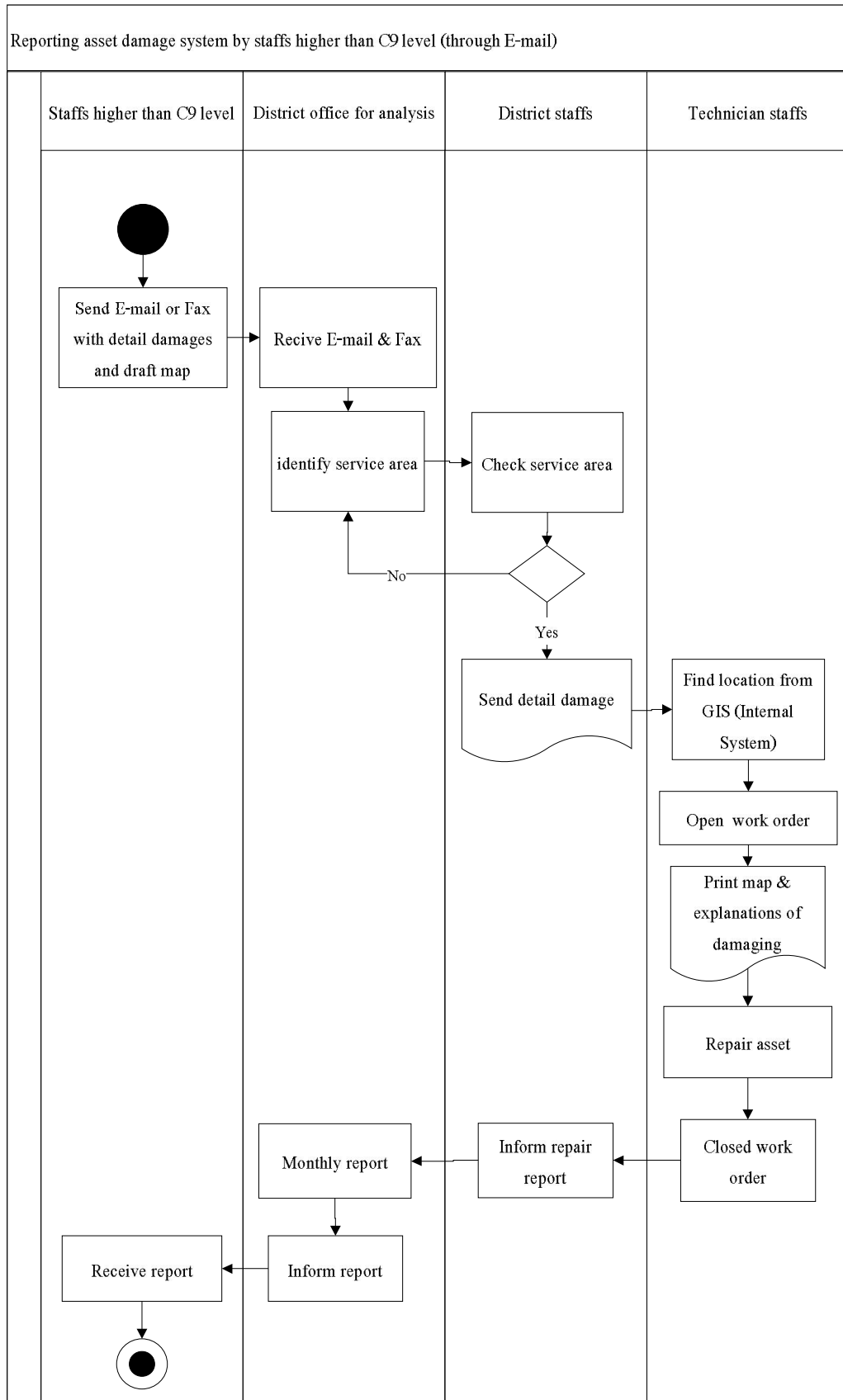


Figure 4.1 Old Processes

4.1.2 New Process

Data collected for developing the system revealed the steps which involved with the asset damage reporting system as Data Flow Diagram as follows (Figure 4.2):

- Staffs higher than C9 reported the damage through Internet by Login on Interface, including the damage site so the system could display responsible party for such area automatically.
- The district analysis and examination staff examined the damage report and immediate report to each unit. The District staff also examined damages on the new report together with updated the operation status soon after receiving the report.
- The district staff ordered map to be printed with full details for the repair such as the damage site, equipment type, and damage details to be sent further to the site staff for repairing.
- The site staff opened the work order for repairing soon after receiving the map. After repairing, he would close the work to report the detail of repairing to the district staff.
- When the district staff received the report, he would update status of the operation.
- The district analysis and examination staff analyzed the damage occurred each month in each district. Also, the district staff and informant could view the status of damage asset as soon as the district staff updated the status.

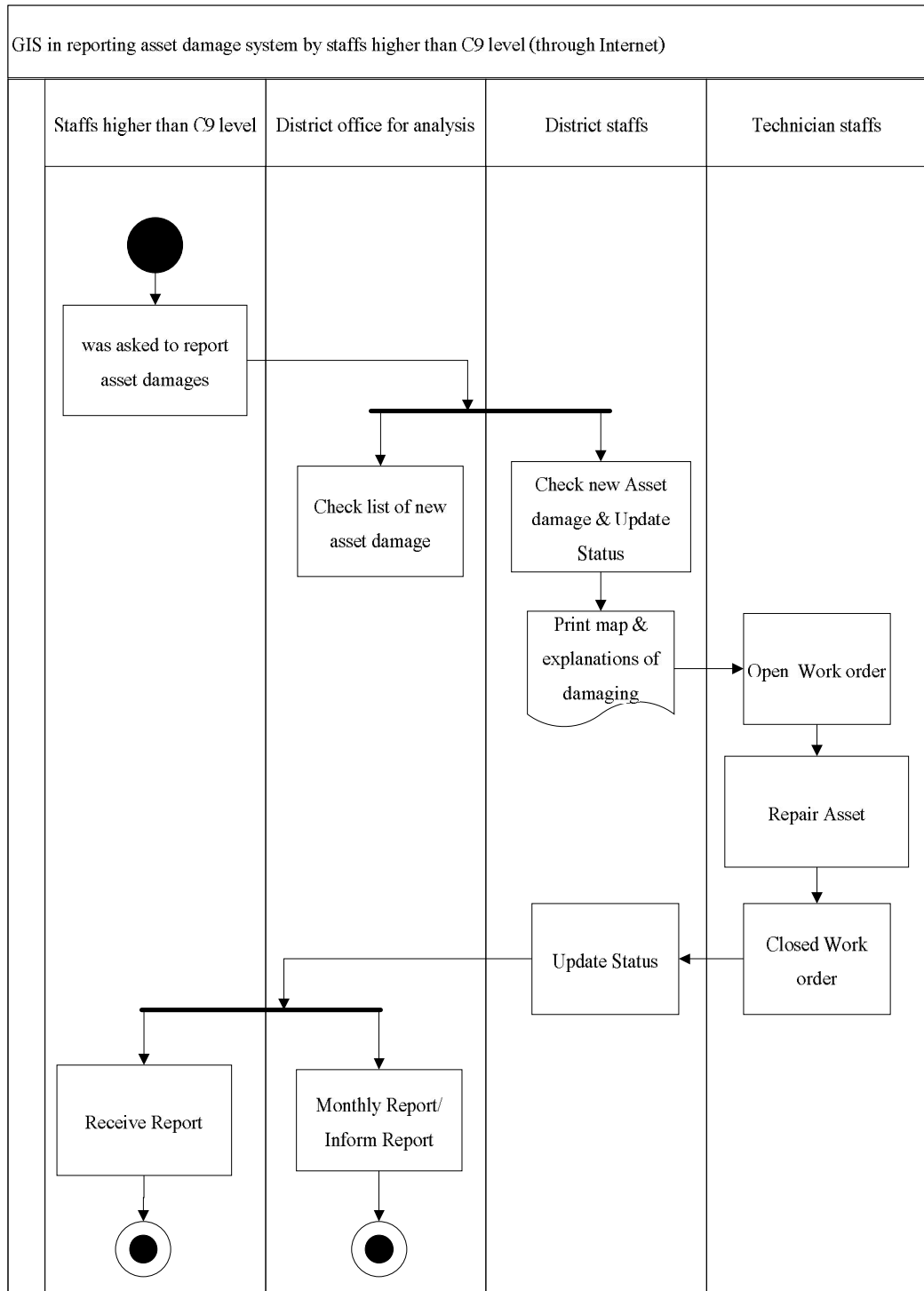


Figure 4.2 New Processes

4.1.3 Database Design

Entity Relationship diagram (Figure 4.3)

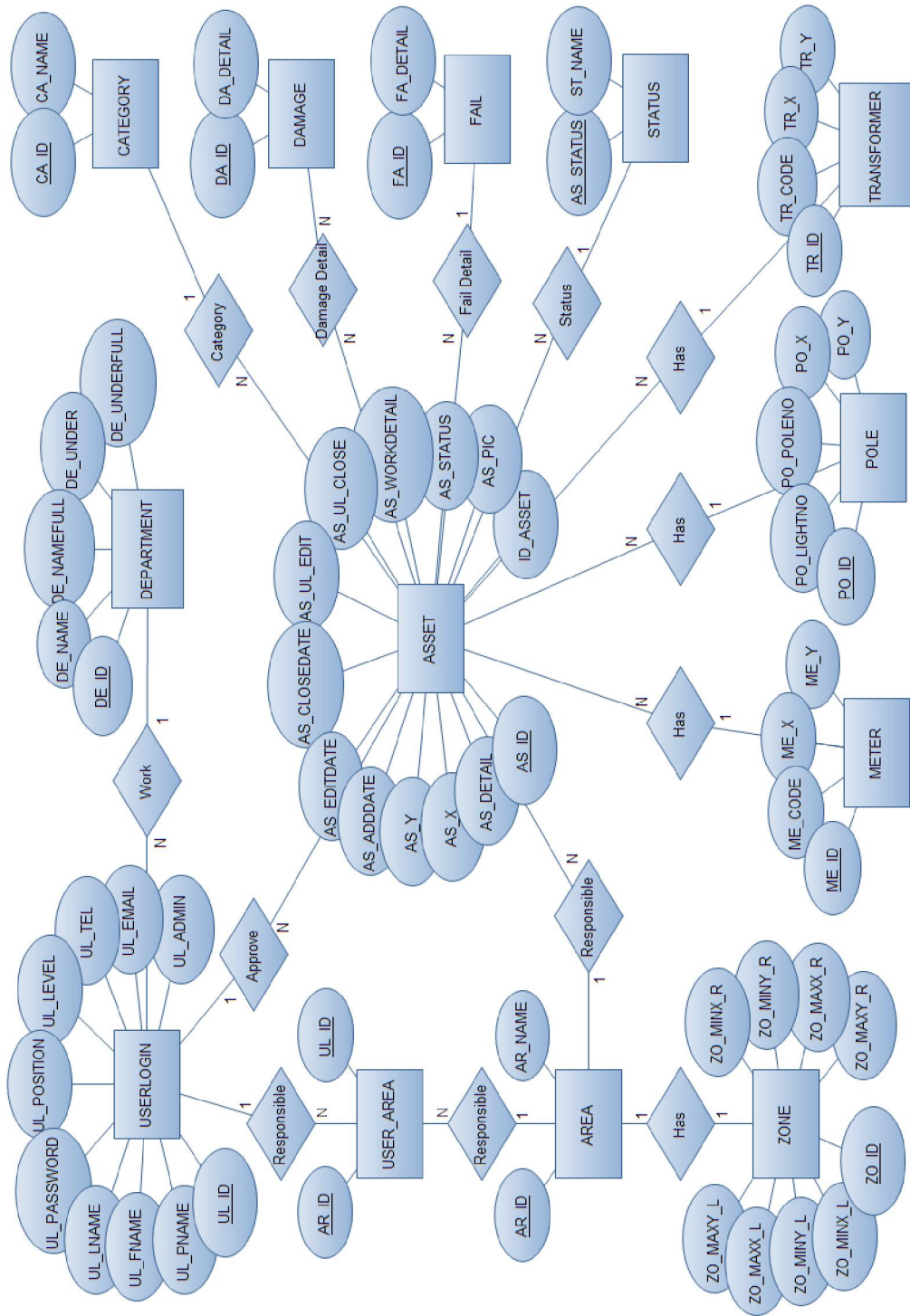


Figure 4.3 Entity Relationship diagram of asset damage report

Based on the Entity Relationship Diagram, data relations are summarized as follows:

- DEPARTMENT is used for storing each unit data such as short and full name and ตำบล. It allows many staffs in each unit.
- USERLOGIN is used for storing data of each employee such as employee code, Password, first name – surname, title, C level, work unit, access allowed. This function only allows one employee per work unit.
- USER-AREA is used for storing data when 1 employee servicing more than 1 district.
- AREA is used for storing all 18 district names.
- ZONE is used for storing each service area which involved 1 coordinate per 1 service area.
- 4.1.2.6 METER is for storing meter data such as numbers and coordinate of meter which allowed 1 meter to report many damages.
- POLE is used for storing pole data such as numbers of public pole and lamp and pole coordinate which allowed one pole to report many damages.
- TRANSFORMER is used for storing transformer data such as numbers and coordinate of transformers which allowed one transformer to report many damages.
- STATUS is for storing updated status.
- FAIL is for storing details in error when the function FAILS.
- DAMAGE is for storing damage data of each equipment type to specify details of each type of equipment that may cause numerous damages.
- CATEGORY is used for storing electrical gadgets such as meter, pole, transformer which only limited to one category.
- ASSET is used for storing separate damage data on equipment such as equipment type, damage type, details, equipment responsible zone, equipment coordinate, damage informant, repair status and updated person status.

4.2 Developing asset damage reporting

To develop the asset damage reporting, the monitor was separated into each section based on the position of users such as staffs higher than C9 level, district

staffs, District Analysis and Examination. The menus for reporting damaged asset are designed to cover the following areas:

- Identified Damage Asset Site

It is for searching the intended equipment for reporting damages with the numbers of equipment, meter, public pole and lamp, and transformer. All users can access this menu

- Damage Asset Report

This menu is for reporting the damage on all equipments. When the damage is located, it can be reported by choosing location and adding the damage details. All users can access this menu.

- Damage Report History

This menu is for displaying the damage report history from each staff based on User Login to count the number of reports and check the status on self-report asset damage. All users can access this menu.

- Status Improvement

This menu is used to Update Status soon after receiving the damage report by allowing the user to search for own responsible zone. Only the district staff and the district analysis and examination staffs can access this menu.

- Designing Map Printing

This is the menu for printing map after updating status to send further to the site staff for repairing. Only, the district staff and the district analysis and examination staff are allowed to access this function.

- Recall Menu

This is the menu for viewing the report, issuing the report on asset and equipment damages soon after being informed by the staff. It is also issued the report on errors detected during the operation such as examining the site but unable to locate the asset or no damages on the examined equipment. All users can access this menu.

- Map Layer

This menu display is designed to work on the floor map, such as pinning position indicated damage See all maps of the scope. All users can access this menu.

- Equipment Menu

It is the menu to apply all equipments related to the map such as adjusting overall viewpoint, map expansion, map reduction, map adjustment, recalling previous page, and recalling next page.

- Exit Menu

It is being used for leaving the system when the user finished his task.

System is consisted of the following (Figure 4.4):

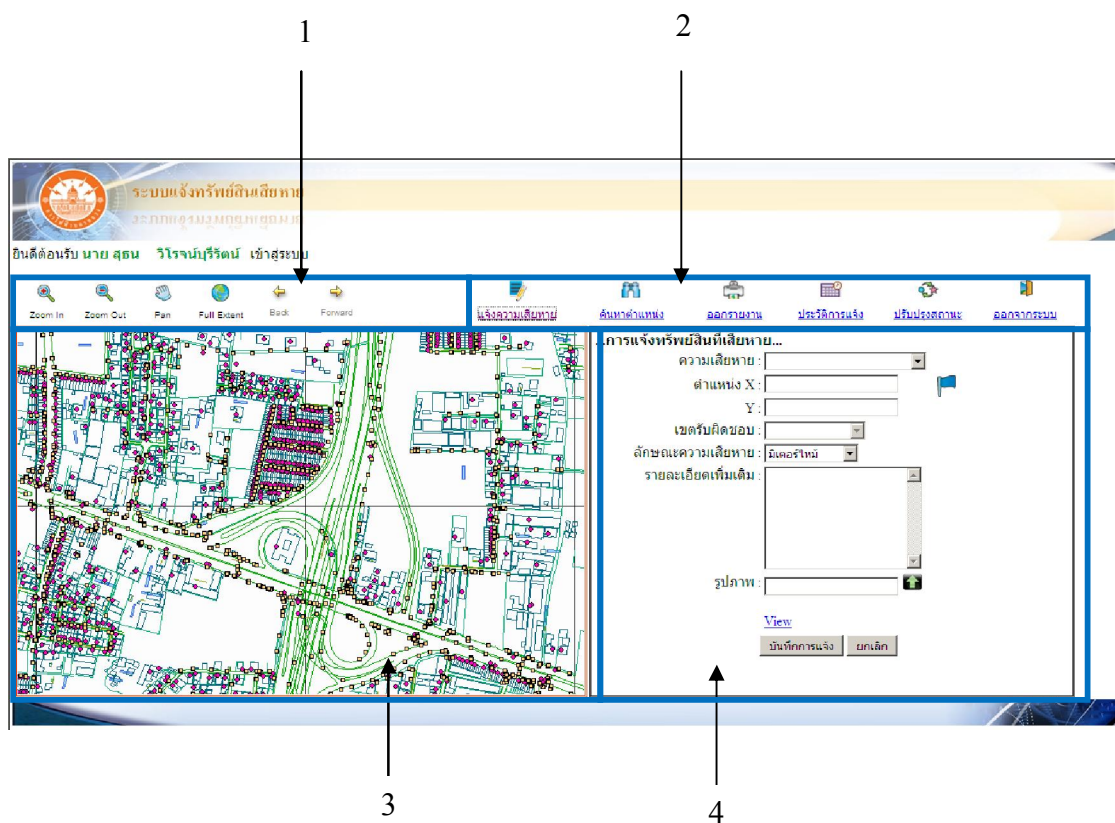


Figure 4.4 Displayed Monitor for Asset Damage Reporting

- **No. 1:** Show map’s functions such as Zoom in map, Zoom out map, Pan Location, Full Extent map, back to pervious map, go to forward map

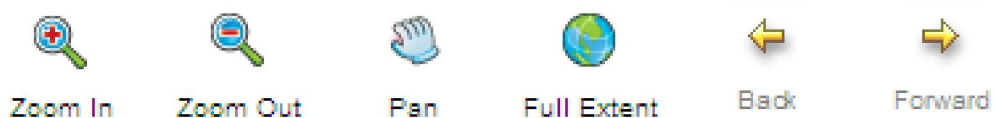


Figure 4.5 Show map’s functions

- **No. 2:** Operate menu such as damage reporting, site searching, printing report, reporting history, modified status, exit the system



Figure 4.6 Show Operate menus

- **No. 3:** Display map showing details based on the users' preference

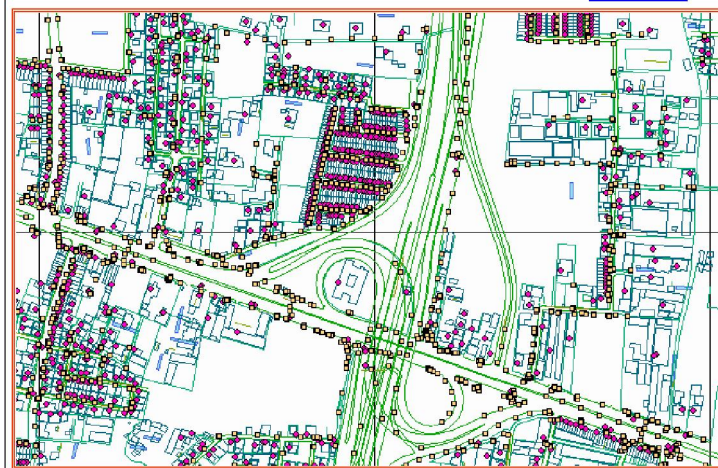


Figure 4.7 Display map

- **No. 4:** Operation details in each step based on the users' preference

...การแจ้งทรัพย์สินที่เสียหาย...

ความเสียหาย :

ตำแหน่ง X :

Y :

เขตรับผิดชอบ :

ลักษณะความเสียหาย :

รายละเอียดเพิ่มเติม :

รูปภาพ :

[View](#)

Figure 4.8 Display Operation details

4.2.1 Entering Code

Displayed monitor for receiving name and password of users as being shown in Figure 4.9.

The users were comprised of staffs higher than C9 level, district staffs, District Analysis and Examination Staff.

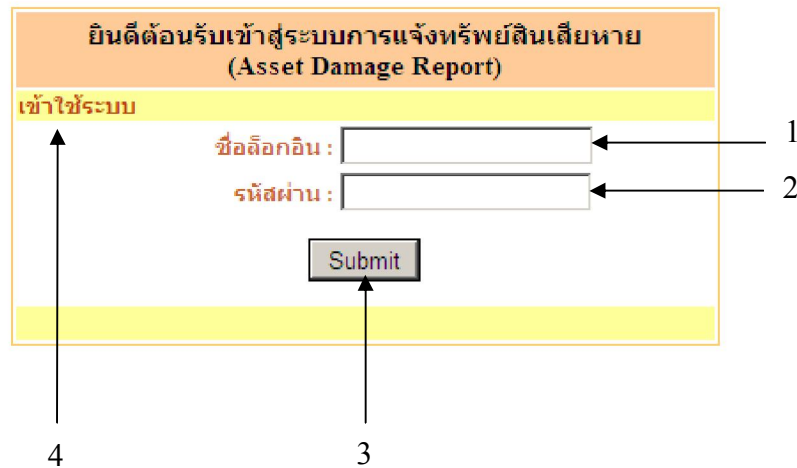


Figure 4.9 Displayed Monitor for Coding

Number	Explanation
1	Text boxes for username.
2	Text boxes for password.
3	Status descriptions to access the system.
4	Submit to sign in

4.2.2 Displayed Monitor for Asset Damage Site

The displayed monitor for asset damage site used damage asset number such as meter number, pole and transformer numbers to identify location on GIS with identify damage site, type of damage asset, nature of damage, additional details, upload equipment, including responsibility on damage equipment as being shown in figure 4.10.

System user located the asset damage site through the equipment number to check whether the identified site on the map agreed with the report. On the search table, the user could recall the report site by entering equipment number; the system would then zoom to the damage location. Likewise, reporting damage would allow the

user to access the damage reporting screen. In case the damage equipment number was not known, the user could use the number of equipment nearby to search for the damage area.

The users were comprised of staffs higher than C9 level, district staffs, District Analysis and Examination Staff.

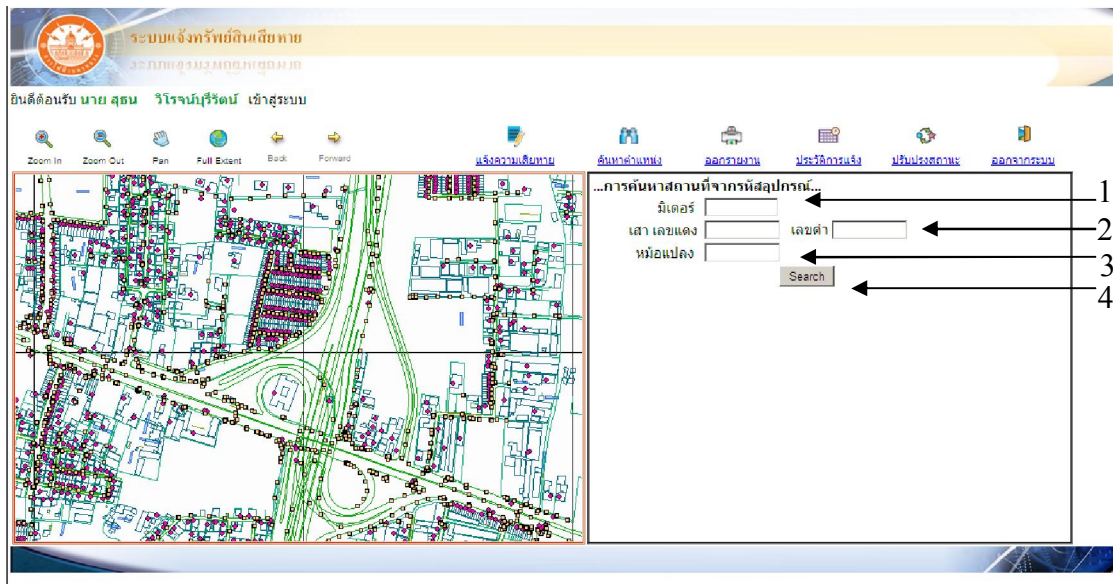


Figure 4.10 Monitor for Reporting Asset Damage

Number	Explanation
1	Text boxes for the meter number.
2	Text boxes for the pole number.
3	Text boxes for the transformer number.
4	Search button.
5	Table showing details of search

4.2.3 Reporting Asset Damage Monitor

This screen was used for reporting the damage asset by identifying the damage site, asset type, nature of damage and additional details, including upload equipment pictures and the display of responsible area as being shown in figure 4.11.

In this section, the user would list damage details reported by 2 cases. Firstly by searching equipment number, the system would display equipment type including the coordinate and responsible area automatically. This was the case when

the system stored the damages by history based on the reported equipment code. Secondly by the user self-report through site searching on the map. The user must choose the damage type that identified the coordinate for the system to show responsible area automatically.

Next, the damage type was chosen and additional report was filed in details. In the damage case, the user could upload a picture and record the damage report to complete the process.

The users were comprised of staffs higher than C9 level, district staffs, District Analysis and Examination Staff.

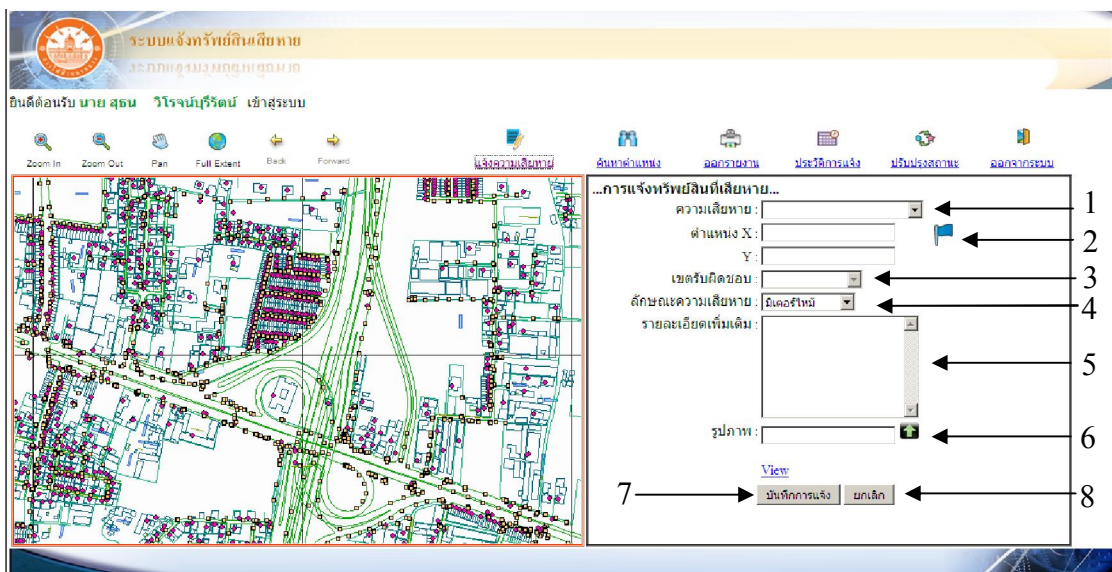


Figure 4.11 Reporting Asset Damage Monitor

Number	Explanation
1	Select the asset type.
2	Identifying the damage site.
3	Automatic display responsible area.
4	Select nature of damage
5	Additional details.
6	Upload picture.
7	Save Report Damage.
8	Cancel this transaction.

4.2.4 Displayed Monitor for Damage History

Having displayed monitor for reporting damage history in details such as reporting order, damage equipment, damage details, reporting date including status of equipment repair and damage location on GIS as being shown on Figure 4.12.

When the user record the damage, self-report history would be displayed automatically on the screen or choosing reporting history button on the menu. The user could updated report details by choosing new status report to enter updated screen as being seen on figure 4.13.

The users were comprised of staffs higher than C9 level, district staffs, District Analysis and Examination Staff.

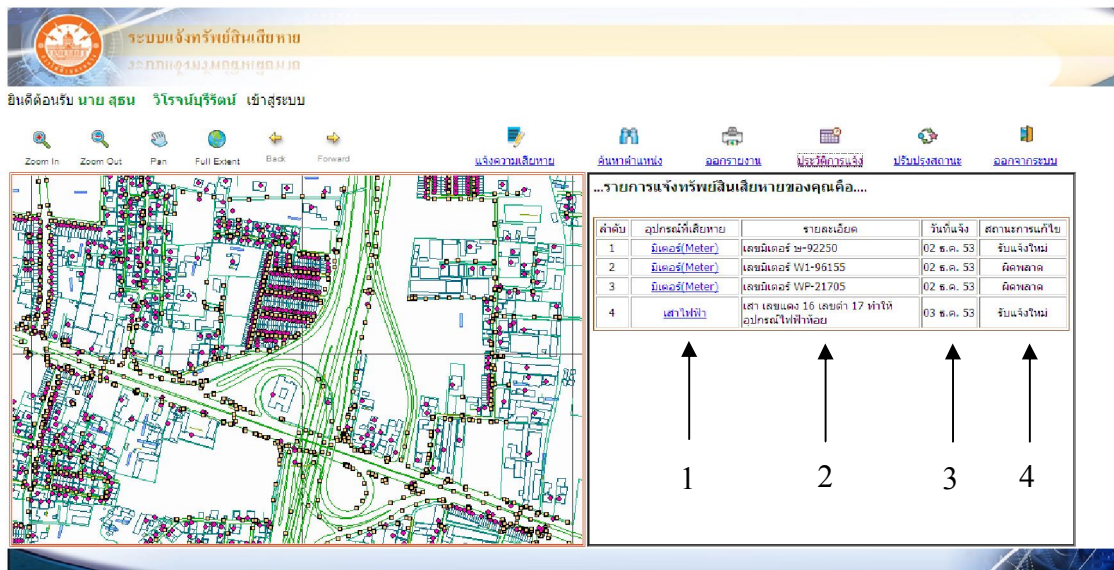


Figure 4.12 Displayed Monitor for Damage History

Number	Explanation
1	User records the damage.
2	Detail damage.
3	Reporting date.
4	Status of equipment repair.

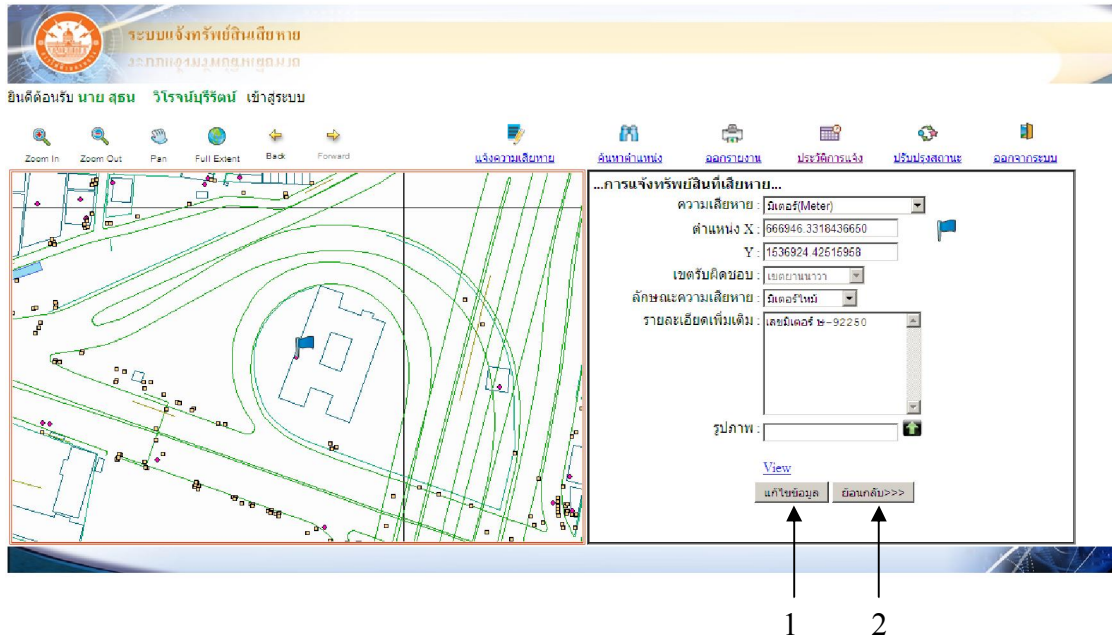


Figure 4.13 Displayed Monitor for Edit Damage History

Number	Explanation
1	Save your changes.
2	Back to Forward.

4.2.5 Displayed Monitor for Improvement

Displayed Monitor for improving the operation such as newly inform, during modification, successfully modifies and error. Furthermore, it also revealed damage details of the equipment on names, type of damage, detail damage, date report, date received report, completed work, additional explanation and location of damage equipment on GIS as being shown on Figure 4.14.

Next, the user used this section to update operation status by searching for responsible area. The system would display the details of equipment damages in each district. Then, the user selected equipment needed improvement to access the screen that displayed full details report. The status was updated to under operation, completely done or detecting error. In case of error, users could explain the error on full details. Furthermore, the system automatically record with date of status change and staff's code of user who upgraded the status.

The user could print the repair map together with the operation report for the site staffs by selecting the printing map button as being shown in figure 4.15, pressing the asset button to view the upload picture or replay button to return to previous page for searching table.

The users were comprised of district staffs, District Analysis and Examination Staff.

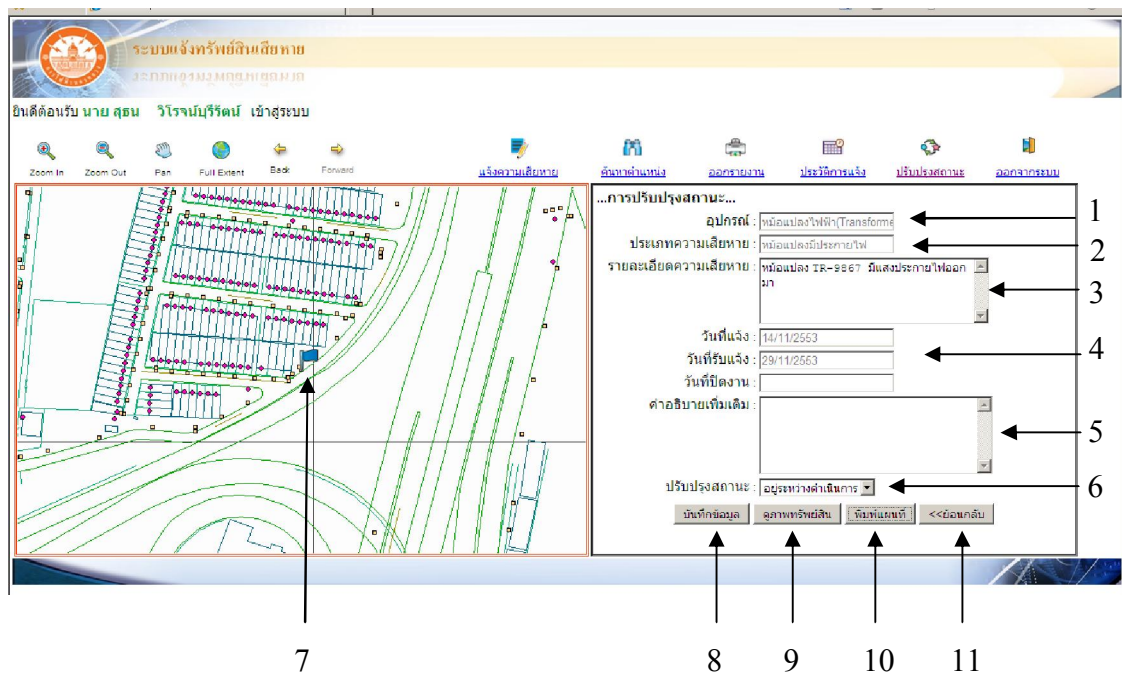


Figure 4.14 Displayed Monitor for Improvement

Number	Explanation
1	Show the asset type.
2	Show type of damage.
3	Show detail.
4	Show date change for each status.
5	Add detail of repairing.
6	Change status.
7	Automatic display responsible area.
8	Save record.
9	View image.
10	Print map.
11	Back to Forward.

4.2.6 Displayed Monitor for Printing Map

Displayed Monitor for Printing Map to aid traveling. The monitor and locating damage equipment with the following detail, name of informant, type of damage asset, date reporting, date receiving report, damage detail, additional explanation and location of damage equipment on GIS.

The users were comprised of district staffs, District Analysis and Examination Staff.

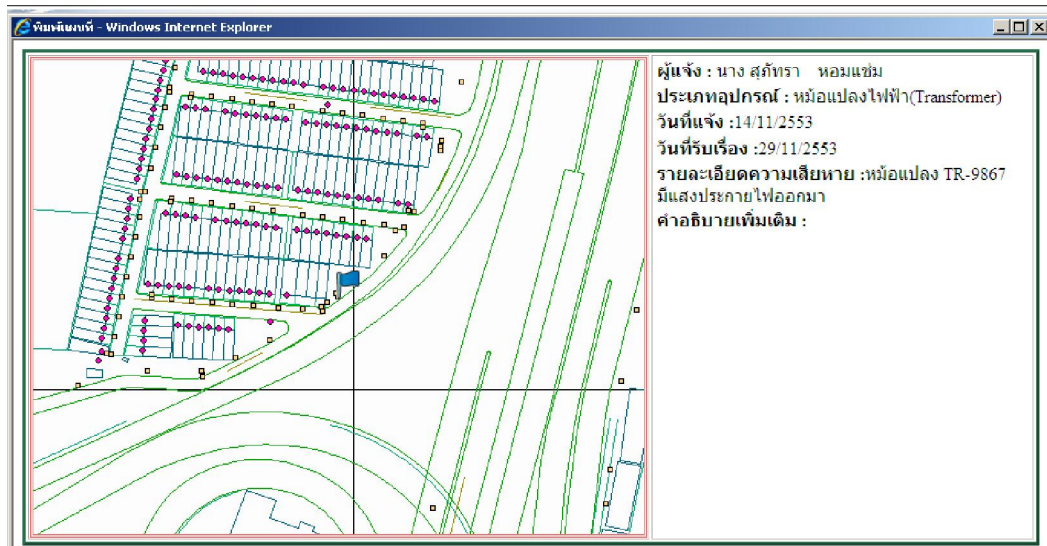


Figure 4.15 Displayed Monitor for Printing Map

4.2.7 Displayed Monitor for Reporting

Displayed monitor for issuing the following reports 1) asset damage report 2) equipment damage report 3) error during modification report

The users were comprised of district staffs, District Analysis and Examination Staff.

4.2.7.1 Reporting Damage Asset

Users can issue this report by choose department to report. Then press the button to print a report shown in figure 4.16.

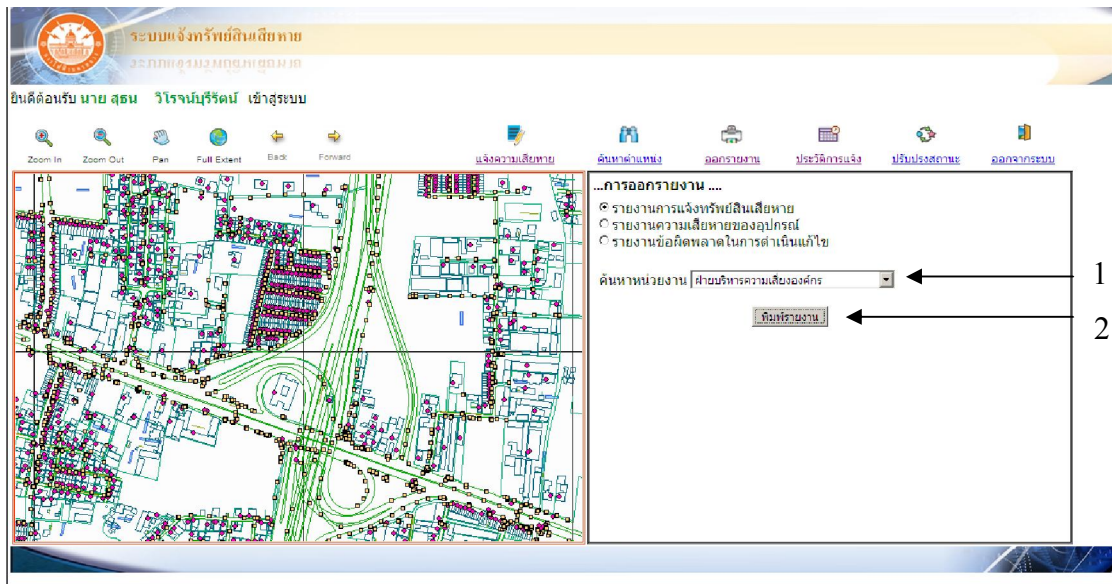


Figure 4.16 Displayed Monitor for Reporting Asset Damage

Number	Explanation
1	Choose department to report.
2	Print report.

Results were displayed with details of the informant based on the following categories: Name and surname, site, numbers of earlier and current reports, report intention, remaining damages as being illustrated in figure 4.17

รายงานการแจ้งทรัพย์สินเสียหาย - Windows Internet Explorer

เรียน หัวหน้าหน่วยงาน

สวัสดี. ขอแจ้งผลการดำเนินการตัวชี้วัด KPI ตามวัฒนธรรมด้านที่ 4 เป็นเจ้าขององค์กรเน้นเหนียว แสดงความเป็นเจ้าขององค์กร ประจำปี 2553 โดยมีรายงานการดูแลทรัพย์สินของ กฟน. ซึ่งการดำเนินการของหน่วยงานของท่านปรากฏดังนี้

ลำดับ	ชื่อ-นามสกุล	ตำแหน่ง	จำนวนรับแจ้ง	เป้าหมาย	คงเหลือ
1	นางวราวัลย์ สายะศิลป์	นักบริหาร 11 ผู้อำนวยการฝ่าย	2	4	2
2	นายบัณฑิต ตะวันวง	นักบริหาร 10 ผู้อำนวยการกอง	0	4	4
3	นางเสาวคนธ์ วีระขจร	นักบริหาร 10 ผู้อำนวยการกอง	2	4	2
4	นางสาธิตา บุญยการ	นักบริหาร 9 ผู้ช่วยผู้อำนวยการกอง	2	4	2

หากยอดคงเหลือมีค่า(-) แสดงว่าแจ้งเกินเป้าหมาย(4 ครั้ง)
 สำนักงานวิเคราะห์และตรวจสอบส่วนเขต

ข้อมูลได้รับแจ้งถึงวันที่ 2/12/2553

Figure 4.17 Displayed Monitor for Monthly Reporting Asset Damage

4.2.7.2 Report Equipment Damage

Users can issue this report by choose area and selecting the month and year to report. Then press the button to print a report shown in figure 4.18.

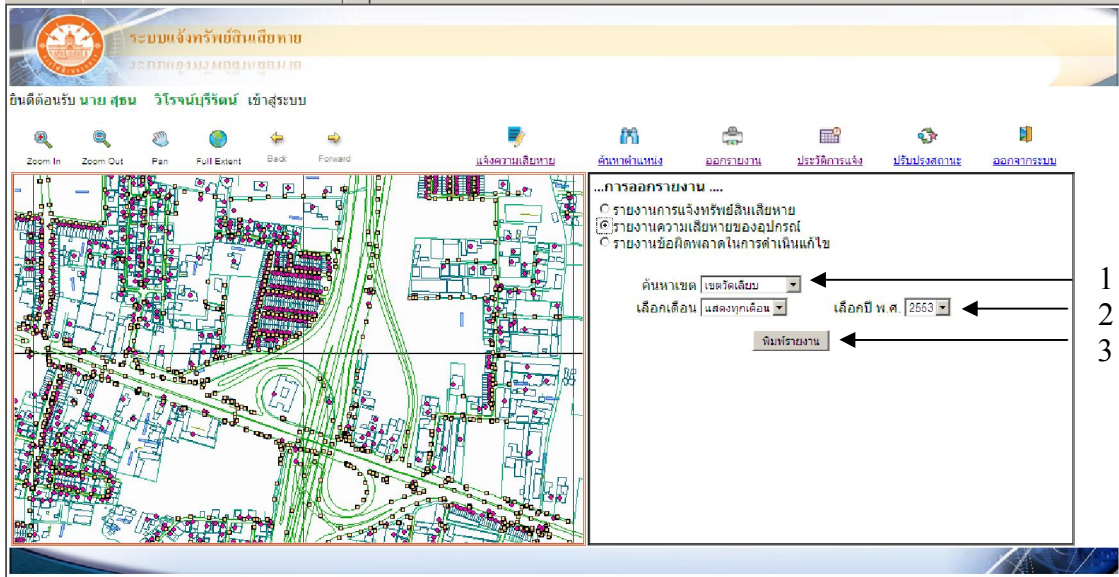


Figure 4.18 Displayed Monitor for Reporting Asset Damage

Number	Explanation
1	Choose area to report.
2	Choose month and year to report.
3	Print report.

Report Equipment Damage in details from each district as being shown in figure 4.19 the counts by type of equipment damage.

ลำดับ	อุปกรณ์ที่เสียหาย	จำนวน									
1	หม้อแปลงไฟฟ้า(Transformer)	1									
<table border="1"> <thead> <tr> <th>ลำดับ</th> <th>รหัสอุปกรณ์</th> <th>รายละเอียด</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>TR-9867</td> <td>หม้อแปลง TR-9867 มีแสงประกายไฟออกมา</td> </tr> </tbody> </table>			ลำดับ	รหัสอุปกรณ์	รายละเอียด	1	TR-9867	หม้อแปลง TR-9867 มีแสงประกายไฟออกมา			
ลำดับ	รหัสอุปกรณ์	รายละเอียด									
1	TR-9867	หม้อแปลง TR-9867 มีแสงประกายไฟออกมา									
2	เสาไฟฟ้า	1									
<table border="1"> <thead> <tr> <th>ลำดับ</th> <th>รหัสอุปกรณ์</th> <th>รายละเอียด</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>13 - 12</td> <td>เสา เลขแดง 12 เลขดำ 13 ล้มเสียหาย</td> </tr> </tbody> </table>			ลำดับ	รหัสอุปกรณ์	รายละเอียด	1	13 - 12	เสา เลขแดง 12 เลขดำ 13 ล้มเสียหาย			
ลำดับ	รหัสอุปกรณ์	รายละเอียด									
1	13 - 12	เสา เลขแดง 12 เลขดำ 13 ล้มเสียหาย									
3	มิเตอร์(Meter)	2									
<table border="1"> <thead> <tr> <th>ลำดับ</th> <th>รหัสอุปกรณ์</th> <th>รายละเอียด</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>W1-96155</td> <td>เลขมิเตอร์ W1-96155</td> </tr> <tr> <td>2</td> <td>WP-21705</td> <td>เลขมิเตอร์ WP-21705</td> </tr> </tbody> </table>			ลำดับ	รหัสอุปกรณ์	รายละเอียด	1	W1-96155	เลขมิเตอร์ W1-96155	2	WP-21705	เลขมิเตอร์ WP-21705
ลำดับ	รหัสอุปกรณ์	รายละเอียด									
1	W1-96155	เลขมิเตอร์ W1-96155									
2	WP-21705	เลขมิเตอร์ WP-21705									

Figure 4.19 Displayed Reports for Reporting Asset Damage

4.2.7.3 Reporting Error during Modification

Users can issue this report by selecting the month and year to report. Then press the button to print a report shown in figure 4.20.

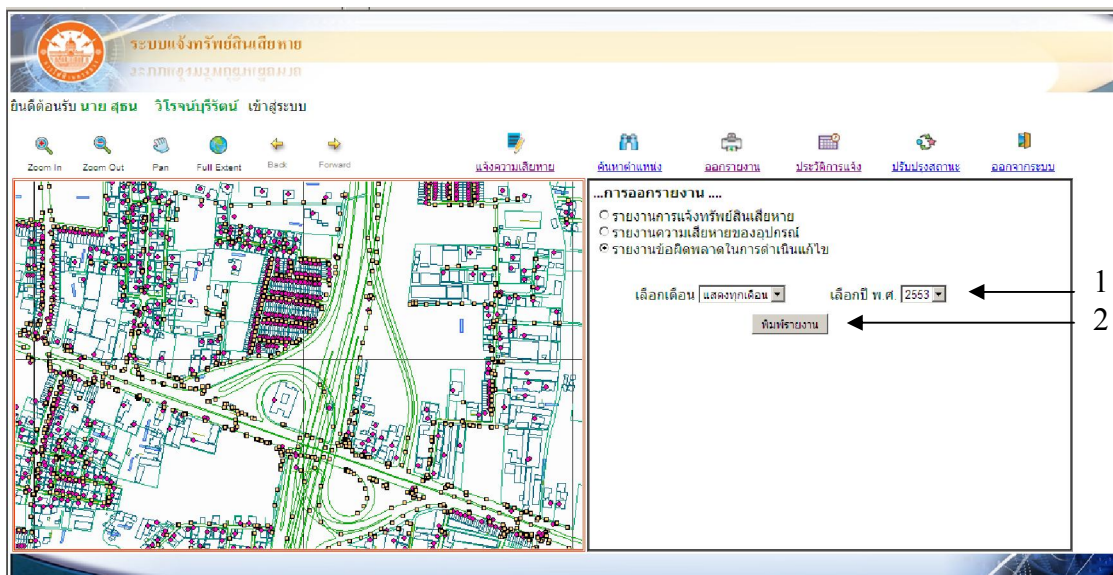


Figure 4.20 Displayed Monitor for Reporting Error during Modification

Number	Explanation
1	Choose month and year to report.
2	Print report.

Reporting error during modification each month as a result from damage on non- asset of Metropolitan Electricity Authority, no damage found after checking, unable to relocate the report asset as being shown in figure 4.21. The counts by type of reporting error.

ลำดับ	ประเภทความผิดพลาด	เขตรับผิดชอบ	จำนวน
1	ทรัพย์สินที่แจ้งไม่พบ	เขตวัดเสียบ	1
2	ความเสียหายที่แจ้งไม่ใช้ทรัพย์สินของ กฟน.	เขตวัดเสียบ	1

Figure 4.21 Displayed Reports for Reporting Error during Modification

4.3 System Operation Efficiency Analysis and Test Run

System Operation Efficiency Analysis was done to compare the former operating system with the current one, using Random sampling to select 500 samples from the list of those reporting asset damage during 2008. Findings indicated that it took C9 and above C9 staffs total mean 2.25 days before they could inform the Analysis and Examination District Office to identify responsible scope and assigned the responsibility to each district staff as being shown in table 4.1 in fine details.

Year 2008	Mean
January	3.5
February	1
March	0.6
April	1.7
May	2.88
June	2.24
July	3.08
August	2.85
September	1.15
October	1.89
November	1.62
December	3.78
Total Mean	2.25

Table 4.1 Each Report Mean classified by Month

The asset damage report automatically revealed the scope of services which could reduce operational steps of the Analysis and Examination District Office since the system improvement had been done to support the work on Internet so the District staff might examine the damage asset immediately after receiving the report.

The system test run was done as Technical audit to ensure the system efficiency in all process by the examiner who collected and interpreted the data and made sure the system application was accurate.

CHAPTER V

CONCLUSIONS AND RECOMMENDATIONS

The development of asset damage report by the Metropolitan Electricity Authority staffs was planned for staffs above C 9 level to engage GIS in reporting asset damage, replacing E-mail with reporting through Internet and Intranet instead. This allowed the staffs to locate the damage site and identify responsible area on the map correctly with the ratio of 1:1000 in high resolution which increased the standard accuracy so the electrician could follow the map to get to the asset damage site to make the repair quicker and more effective.

The operational procedures for developing asset damage report by the Metropolitan Electricity Authority staffs with applied GIS started from studying and gathering data, analyzing and designing the system, constructing developing the system as well as analyzing system efficiency and test run, preparing work documents. Findings from this development can be concluded in the following problems, obstacles and recommendations.

5.1 Results Conclusion

The operational procedures for developing asset damage report by the Metropolitan Electricity Authority staffs with applied GIS was done to apply the existing resources with the staffs' performance for the maximum benefit.

The system analysis and design divided into 3 parts as follows: reporting asset damage, identifying responsible area automatically, improving situation, printing map showing the asset damage site, issuing the reports in asset damage, equipment damage and error in the operation. All of these were developed as Web Application linking with the database Oracle 10g and displayed as GIS which set the data sample by the Metropolitan Electricity Authority, having the standard ratio 1:1000 with high resolution, and constructed with ArcGIS Server 9.3 to service on the map through Web Application.

The monitor was designed to compliment with GIS of other divisions in the Metropolitan Electricity Authority to facilitate their learning and feeding the asset damage data. The system would immediately show the responsible area as soon as the data recorded in the database with accuracy which should minimize the procedures to identify responsibility of the District Analysis and Examination Office.

Findings from the efficiency analysis and random sampling from 500 asset damage items in 2008 reports indicated the mean of identifying damage area in each assignment equaled to 2.25 days which had been reported immediately as soon as the damage was recorded.

The map was constructed for site staffs to facilitate the field work and issue the asset damage site report on the map including details on the damage. Moreover, the asset damage report can be issued individually based on the responsible division and the equipment damage report issued by district, including the report of errors during the repair which should make data more reliable and could lead to more results analysis in other related divisions. The limitations of reporting on the performance of the property 4 pieces per person per year.

This program was developed to support the work of staffs higher than C9 level, district staffs, District Analysis and Examination Staff with different data access levels.

5.2 Problems and Obstacles

Problems and obstacles occurred during the system development.

5.2.1 This system development was done only on the map of the Metropolitan Electricity Authority only since the data was confidential and treated as the Metropolitan Electricity Authority asset which forbidden to publish without authorization.

5.2.2 The ArcGIS Server 9.3 and Oracle 10g required the use computer with high capacity to develop this system.

5.2.3 Data on assets of the Metropolitan Electricity Authority is enormous in term of million with staffs above C9 level over 500. Therefore, the system must be carefully tested for its effectiveness before the actual application.

5.3 Recommendation for Further Researches

The operational procedures for developing asset damage report by the Metropolitan Electricity Authority staffs with applied GIS is done as the pilot study that can be developed further.

5.3.1 Improving the report channel such as reporting through mobile phone that displayed the coordinate.

5.3.2 Applying data with relevant analysis such as the procurement or administer data warehouse of the Metropolitan Electricity Authority.

5.3.3 Privacy Information such as reporting of assets damage has been developed should consider privacy of informant that information released may affect the reliability of individual.

5.3.4 Definition of number of assets damage notification each year are subject to change, so it should have data analysis used to determine the amount of notice in assets damage each year for convenience.

5.3.5 Nature of the damage due to the nature of the damage has a lot of type. Therefore, officer should can increase or decrease appearance of damage for ready to consistent with the operation.

5.3.6 Protection duplicate of data should be notification if assets of damage reporting in several times for filter and reduce duplication of data.

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APPENDICES

APPENDIX A

OPERATION MANUAL

Asset Damage Reporting Manual Applied GIS by the Metropolitan Electricity Authority staffs is the crucial process of the organization to reinforce organizational culture and bondage. The system access is divided into 3 major levels: First level assigned to staffs higher than C9 for reporting the asset damage, reviewing the results and checking self-report. Second level assigned to the district staffs to check and improve operation staffs so they could be informed and printed details for further operation. Third level access assigned to District Analysis and Examination Staffs to issue the report based on unit, damage repair report and error report.

System test run using staffs' coding sample to access system as follows:

Staffs Access Level: Above C 9

- Username: 1252904 Password: 1252904

Staffs Access Level: District Staffs

- Username:871819 Password: 871819

Staffs Access Level: District Analysis and Examination Staffs

- Username: 1569321 Password: 1569321

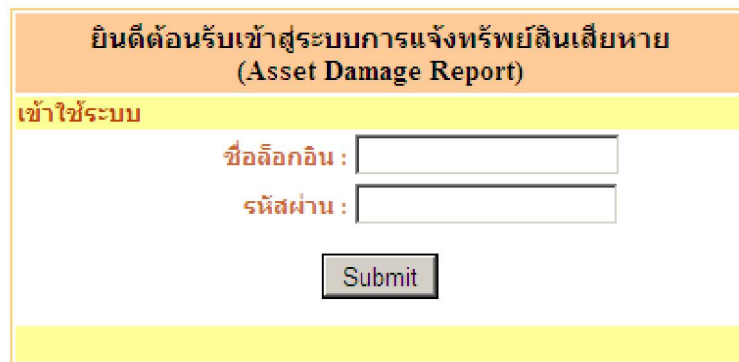
Asset damage report through the following steps:

1. Entering the System

Typed <http://localhost/asset/LogIn.aspx> on the screen to access the system, followed by entering Username, and Password as shown on figure 6. Then, press



to enter the system.



ยินดีต้อนรับเข้าสู่ระบบการแจ้งทรัพย์สินเสียหาย
(Asset Damage Report)

เข้าใช้ระบบ

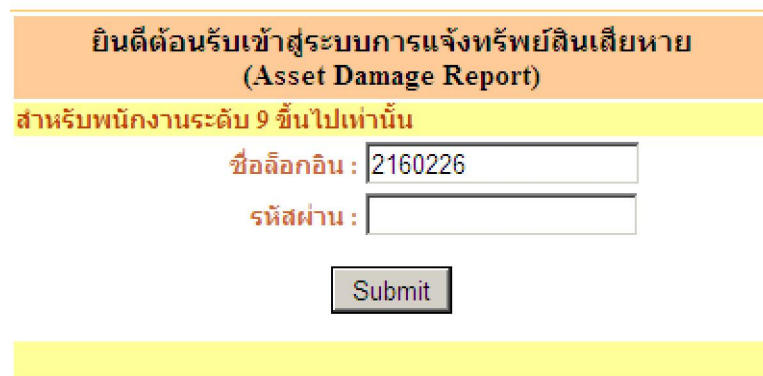
ชื่อล็อกอิน :

รหัสผ่าน :

Submit

Figure 6 Entering the System

The system would deny any staffs user under C9 level by flashing the statement.



ยินดีต้อนรับเข้าสู่ระบบการแจ้งทรัพย์สินเสียหาย
(Asset Damage Report)

สำหรับพนักงานระดับ 9 ขึ้นไปเท่านั้น

ชื่อล็อกอิน :

รหัสผ่าน :

Submit

Figure 7 Entering the System (staffs user under C9 level)

2. Reporting Asset Damage

Reporting can be done for 2 cases, unknown asset damage code and knowing damage code with the following details:

2.1 Unknown asset damage code

Select Report Damage button to start working as being displayed on the screen:

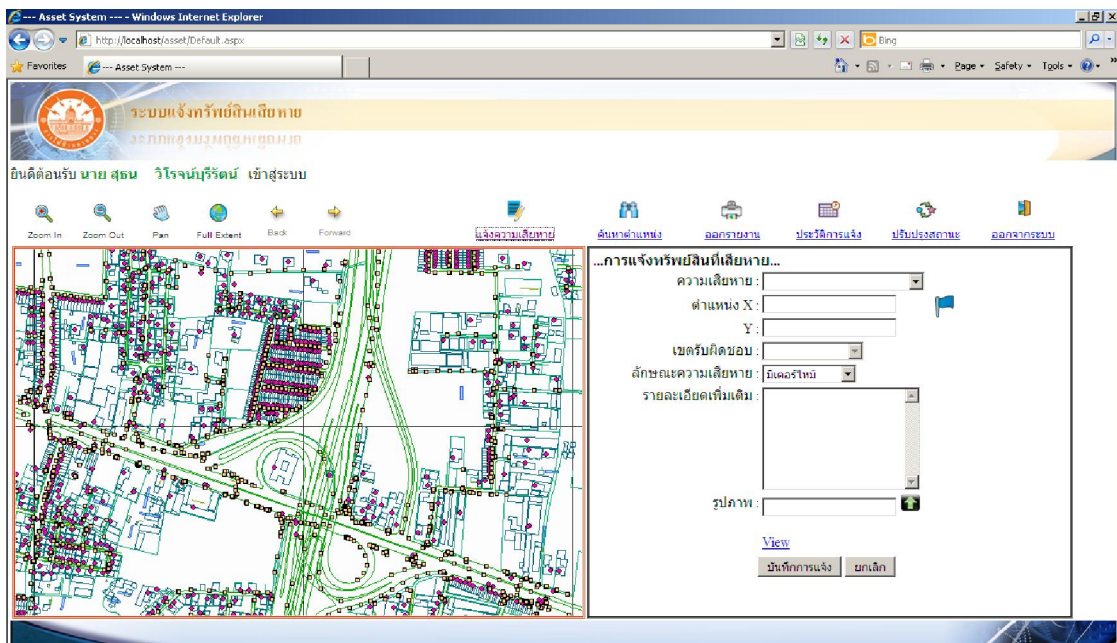



Figure 8 display Reporting Asset Damage

2.1.1 Use gadget on the map to search for damage asset

2.1.2 Select  and choose location on the map to show coordinate automatically for all responsible district based on the chosen site as being shown on the figure.

2.1.3 Add more detail damages as follows:

- Type of the damage equipment
- Select the damage nature
- Clarify the nature of addition damage
- Upload the damage picture

2.1.4 Select the recording button to display the report as being shown on the figure 9.

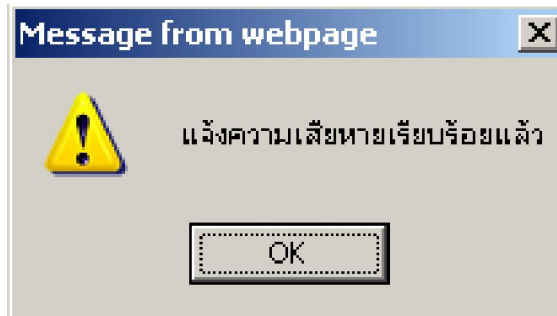


Figure 9 complete the Reporting Asset Damage

2.2 Knowing the Asset Damage Code

To operate the screen, select the search button as being shown on the monitor

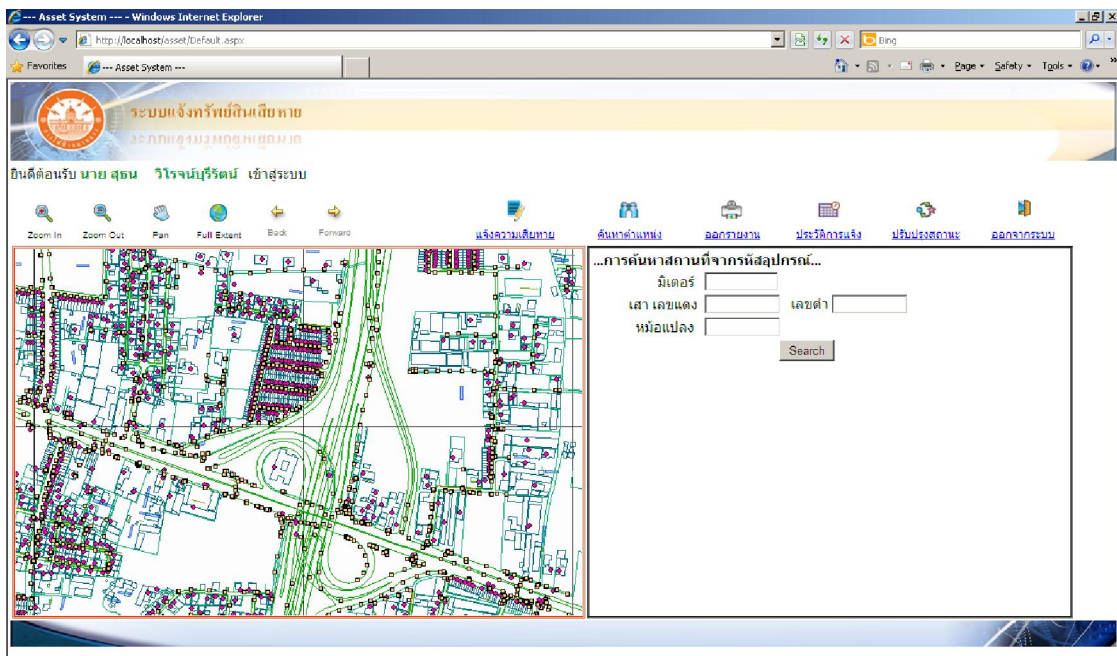


Figure 10 monitor for Asset Damage Code

2.2.1 Enter known equipment number, followed by pressing the search button to display detail as shown in the figure 11.

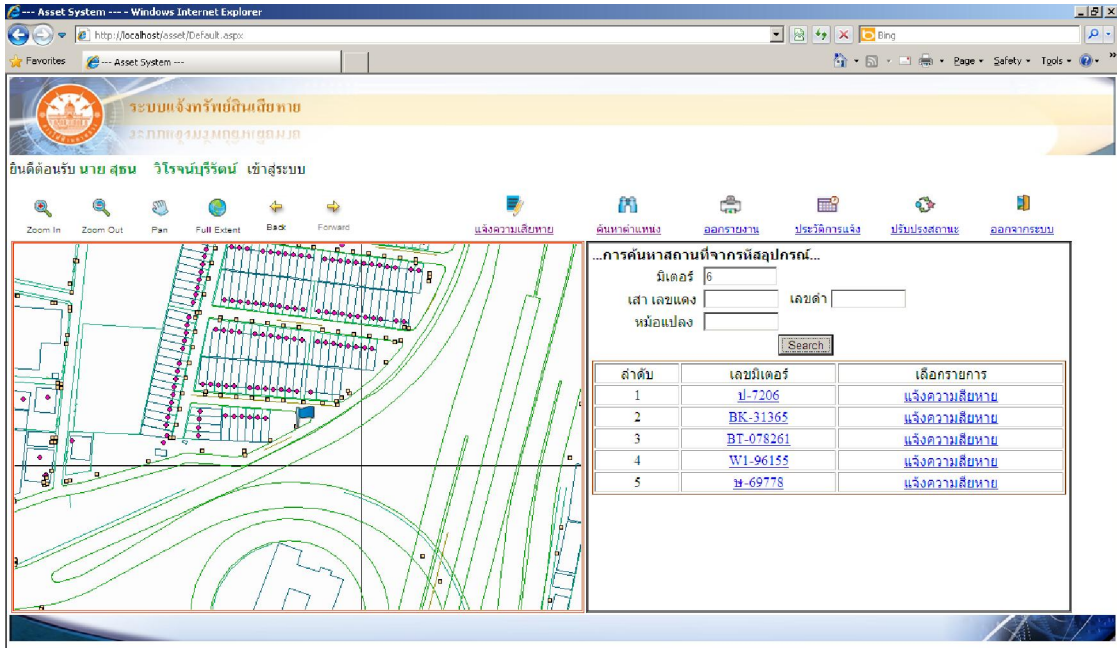


Figure 11 monitor for Asset Damage Code

2.2.2 Select equipment code for Zoom picture to reveal equipment site or select Reporting damage to display equipment damage in that code on the screen as being shown on the figure 12.

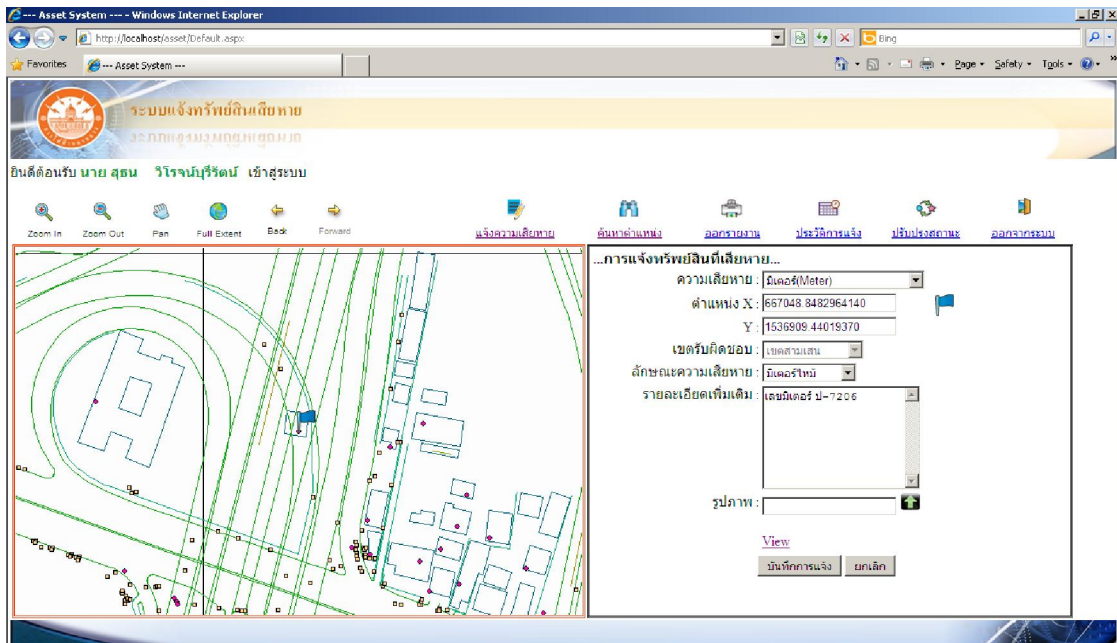


Figure 12 monitor for Select equipment code

2.2.3 The system displays type of equipment, site coordinate X, Y and responsible areas automatically. User could choose damage nature, addition explanation on damages, and Upload damage pictures.

2.2.4 Select Recording Report button for reporting damage as appeared on the figure 13.

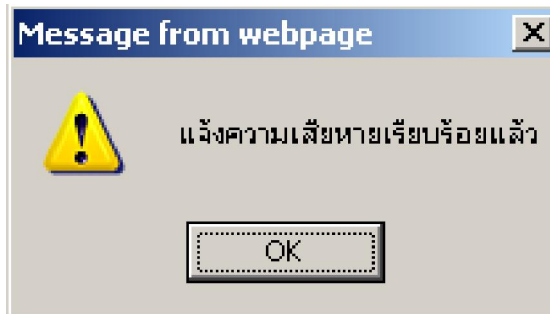


Figure 13 complete the Reporting Asset Damage

3. Reporting History

When the damage is recorded, the system would show the user’s history in full details, step by step such as type of reporting equipment, damage details, report date and repair status as being shown in the figure 14.

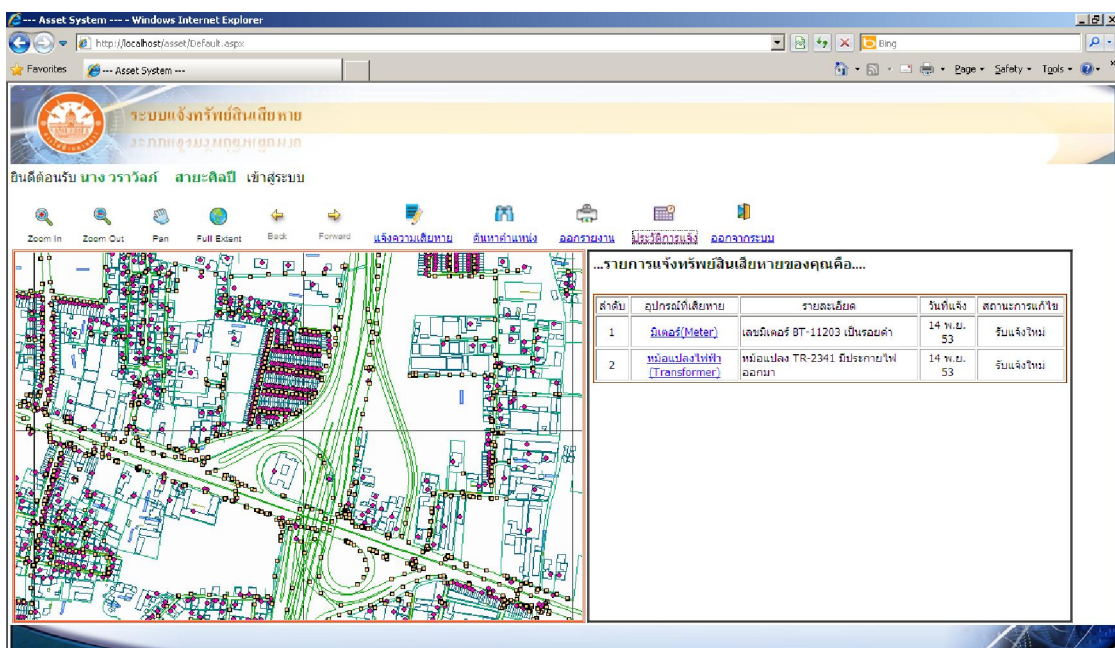


Figure 14 Display Reporting histories

4. Modifying Data

The correction after reporting can be done by choosing Reporting History button, followed by choosing modified equipment as being shown on the screen. For changing details, select Data Correction, then, the system would inform the user of the correction.

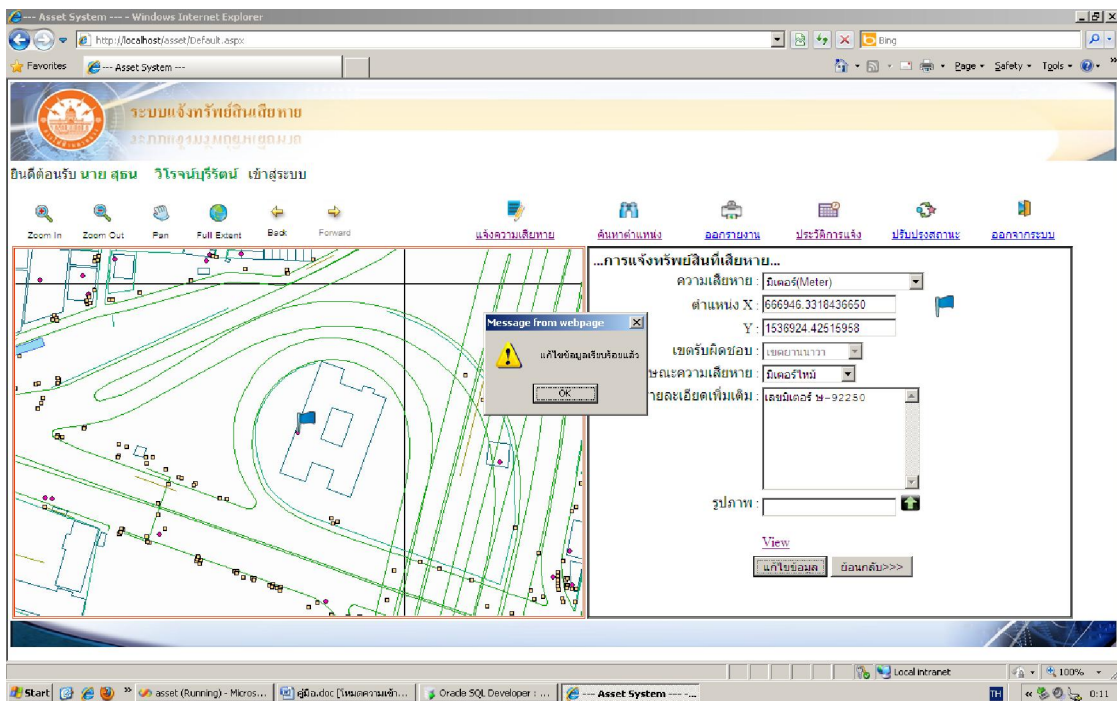


Figure 15 Display Modifying Data

5. Improving Status

It is the section to identify staffs' access for the district staffs, District Analysis and Examination Staffs only through the following procedures:

5.1 Select Improve Status button

5.2 Select district under the user's responsibility, followed by pressing Search button to display equipment type, damage equipment details, report date, operation status as being shown in the figure 16.

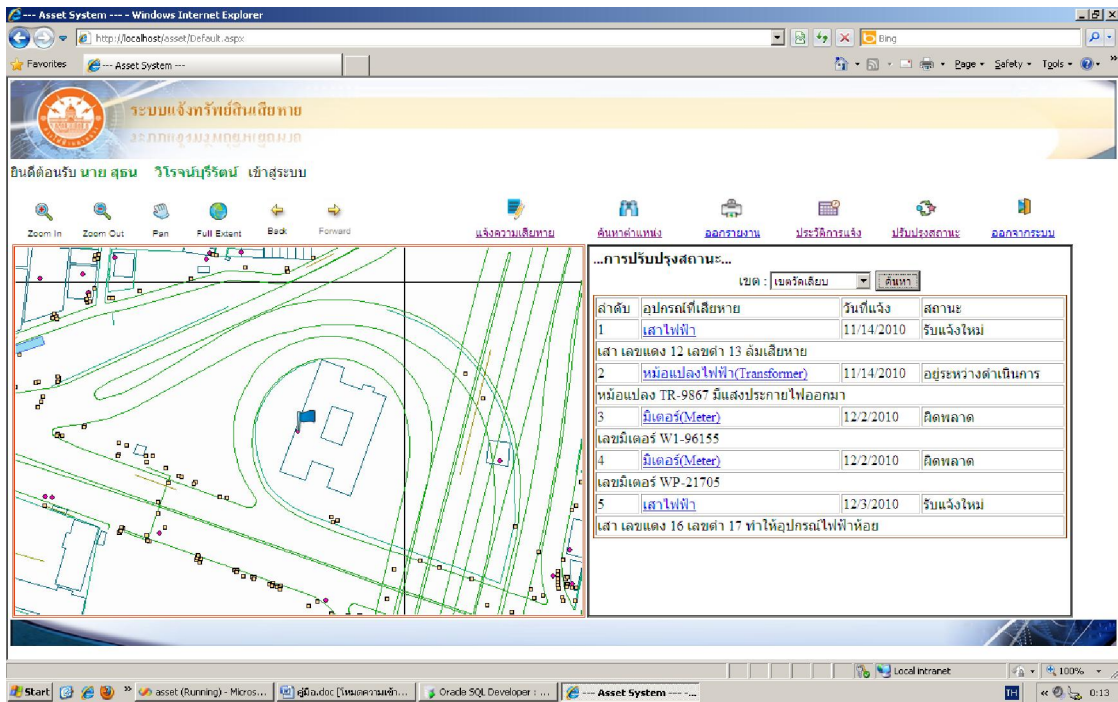


Figure 16 Display Improving Status

5.3 Select equipment that required modification from the modification as appeared on the screen in details as being report through the figure 17.

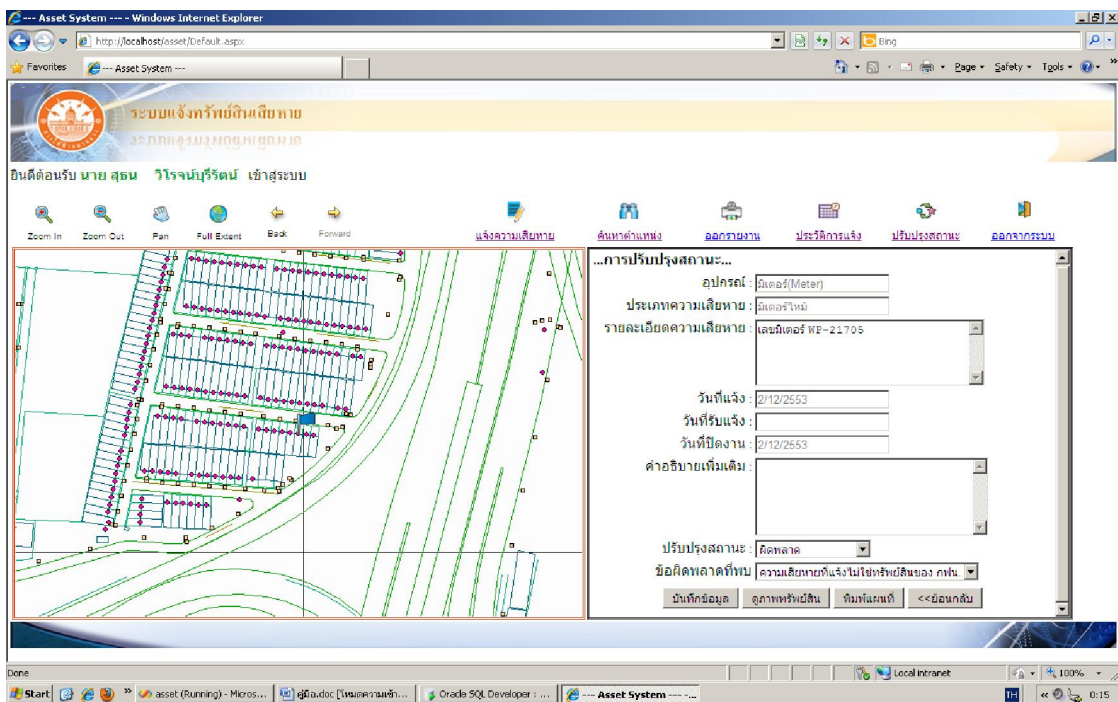


Figure 17 Display Improving Status

5.4 Modify operation as follows:

-New reporting status from the moment receiving updated damage report.

- Between operation status refers to steps for receiving damage nature and inform site staffs to work on the damage.

- Modified status is when the district staffs had been informed by site staffs about work completion.

- Error status is when the district staffs or site staffs found errors after checking the damage site. Error can be chosen with explanation from options provided.

5.5 Select Record Data to record modification status

5.6 Select Print Map to print map for staffs traveling for repair in the following details: informant name, damage equipment type, report date, received date, damage details, additional explanation and damage site on GIS.

5.7 Select Return button to revise equipment status

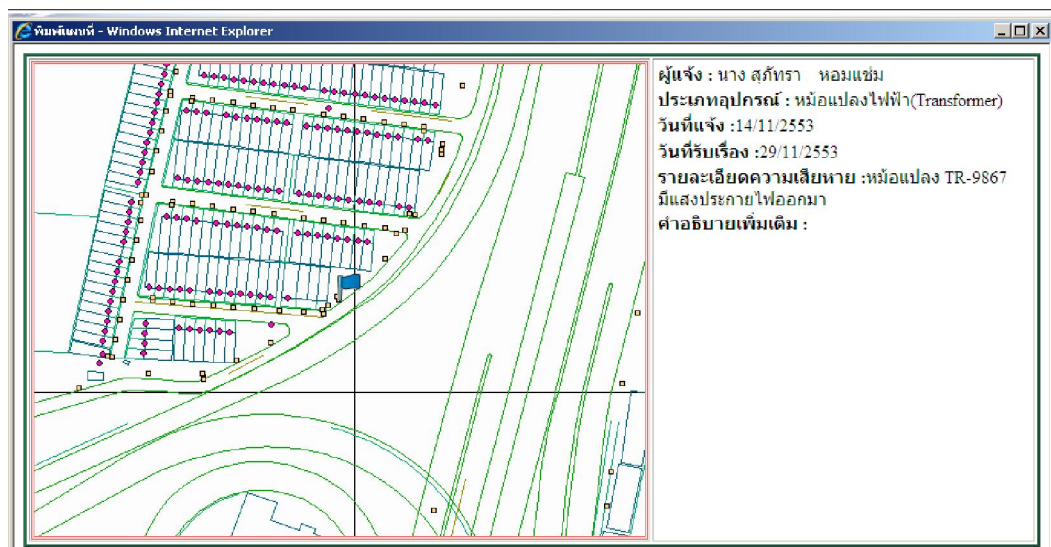


Figure 18 Display Print Map

6. Reporting

Reporting is designed in 3 ways as follows: Asset damage, Equipment damage, Modified errors.

6.1 Report Asset Damage

User searches for desired unit from the monitor to print the report as being seen in the figure 19-20.

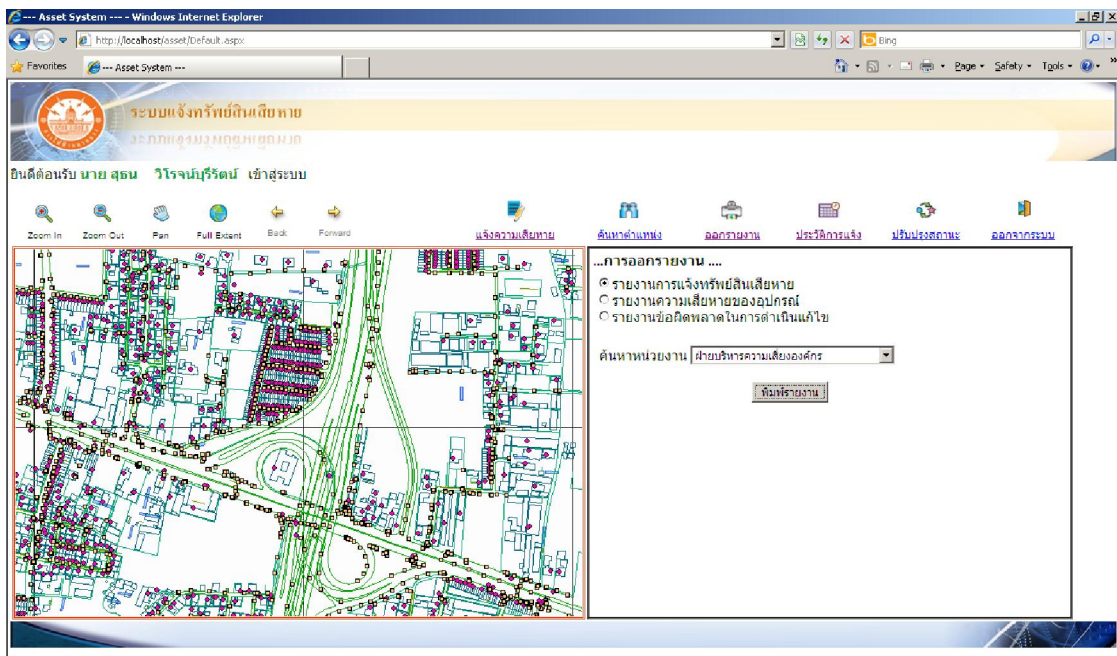


Figure 19 Display Report Asset Damage

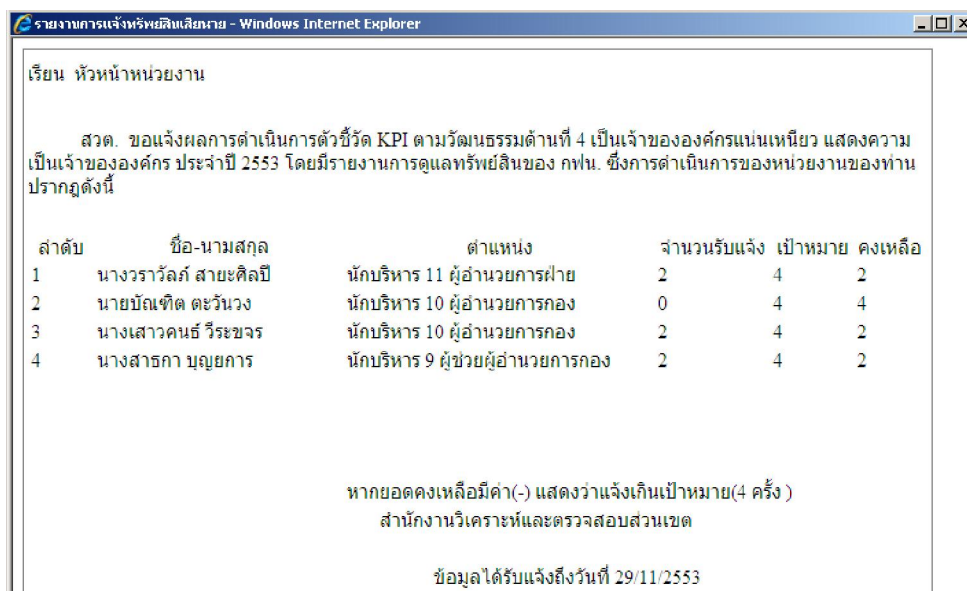


Figure 20 Display Report Asset Damage

6.2 Report Equipment Damage

User selects equipment damages in details in each district which would display in monthly report, followed by pressing printing report for the damage as being seen in the figure 21-22.

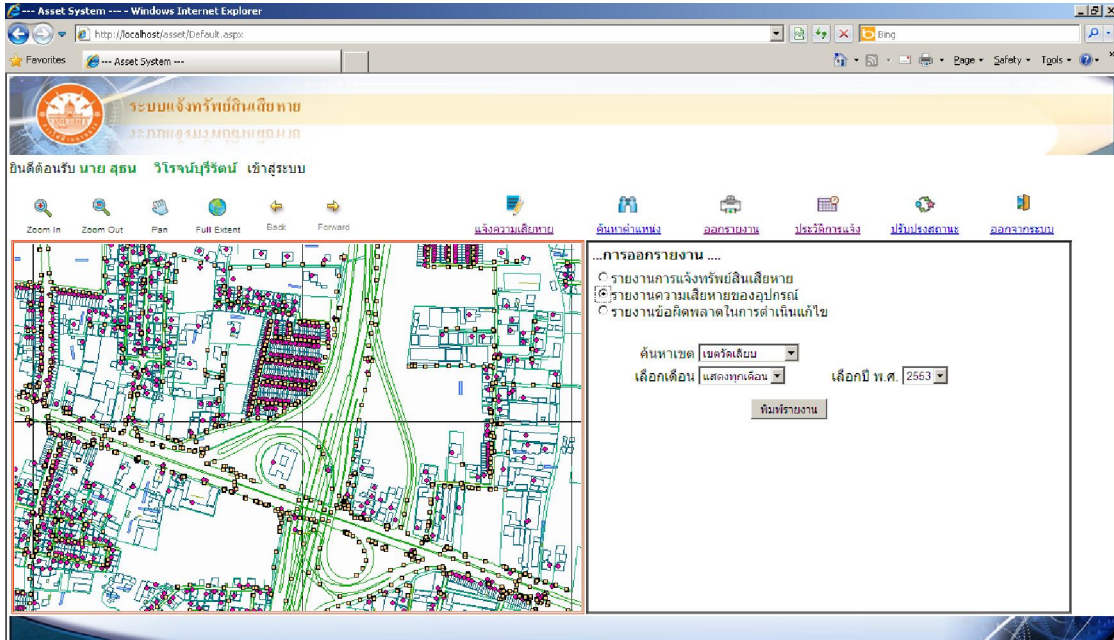


Figure 21 Display Report Equipment Damage

รายงานสรุปความเสียหายของอุปกรณ์ประจำปี 2010
เขตวัดเตี้ย

ลำดับ	อุปกรณ์ที่เสียหาย	จำนวน									
1	หม้อแปลงไฟฟ้า(Transformer)	1									
	<table border="1"> <thead> <tr> <th>ลำดับ</th> <th>รหัสอุปกรณ์</th> <th>รายละเอียด</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>TR-9867</td> <td>หม้อแปลง TR-9867 มีแสงประกายไฟออกมา</td> </tr> </tbody> </table>	ลำดับ	รหัสอุปกรณ์	รายละเอียด	1	TR-9867	หม้อแปลง TR-9867 มีแสงประกายไฟออกมา				
ลำดับ	รหัสอุปกรณ์	รายละเอียด									
1	TR-9867	หม้อแปลง TR-9867 มีแสงประกายไฟออกมา									
2	เสาไฟฟ้า	1									
	<table border="1"> <thead> <tr> <th>ลำดับ</th> <th>รหัสอุปกรณ์</th> <th>รายละเอียด</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>13 - 12</td> <td>เสา เลขแดง 12 เลขดำ 13 ล้มเสียหาย</td> </tr> </tbody> </table>	ลำดับ	รหัสอุปกรณ์	รายละเอียด	1	13 - 12	เสา เลขแดง 12 เลขดำ 13 ล้มเสียหาย				
ลำดับ	รหัสอุปกรณ์	รายละเอียด									
1	13 - 12	เสา เลขแดง 12 เลขดำ 13 ล้มเสียหาย									
3	มิเตอร์(Meter)	2									
	<table border="1"> <thead> <tr> <th>ลำดับ</th> <th>รหัสอุปกรณ์</th> <th>รายละเอียด</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>W1-96155</td> <td>เลขมิเตอร์ W1-96155</td> </tr> <tr> <td>2</td> <td>WP-21705</td> <td>เลขมิเตอร์ WP-21705</td> </tr> </tbody> </table>	ลำดับ	รหัสอุปกรณ์	รายละเอียด	1	W1-96155	เลขมิเตอร์ W1-96155	2	WP-21705	เลขมิเตอร์ WP-21705	
ลำดับ	รหัสอุปกรณ์	รายละเอียด									
1	W1-96155	เลขมิเตอร์ W1-96155									
2	WP-21705	เลขมิเตอร์ WP-21705									

Figure 22 Display Report Equipment Damage

6.3 Report Error in Modification

User selects warning on the screen, followed by printing report. Then, report would show on the screen. By pressing detail button, each district details and error would be displayed as being shown in the figure 23-24.

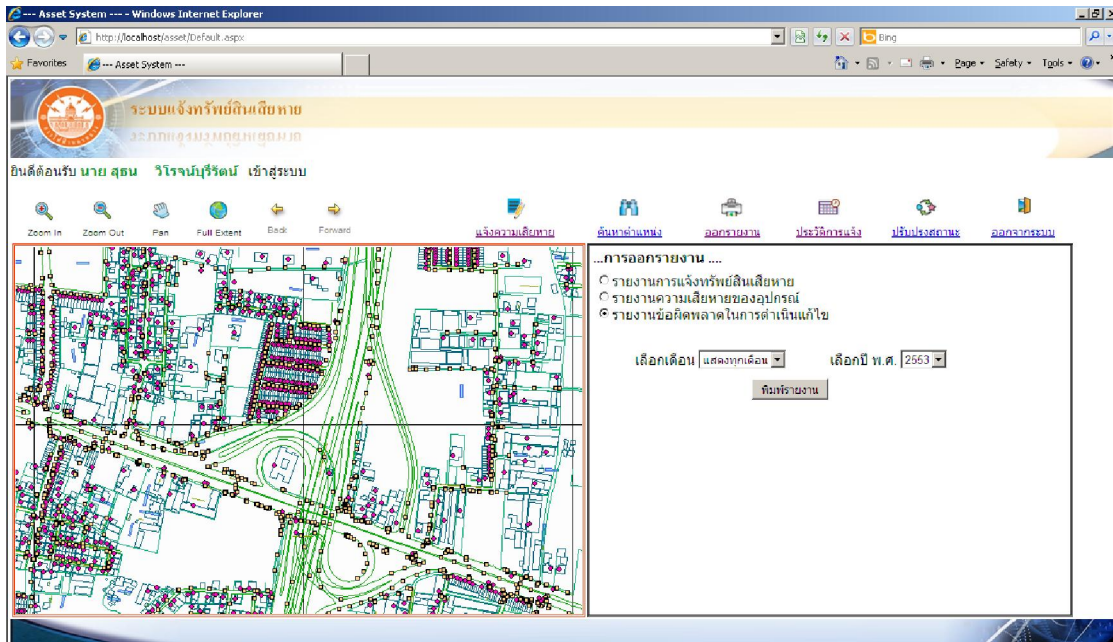


Figure 23 Display Report Error in Modification

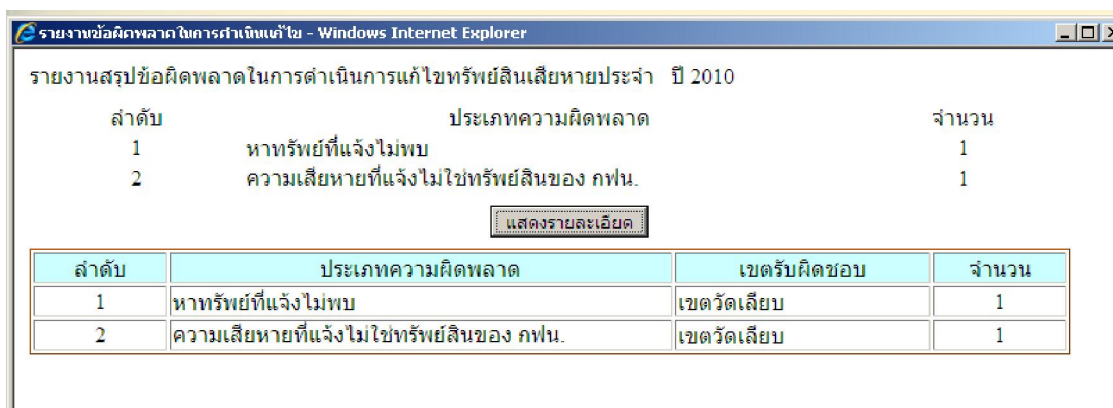


Figure 24 Display Report Errors in Modification

APPENDIX B

DATA DICTIONARY

Table 1 Data Dictionary of AREA

Field Name	Data Type	Length	Key	Reference Table
AR_ID	NUMBER		PK	ASSET
AR_NAME	VARCHAR2	50		

Table 2 Data Dictionary of ASSET

Field Name	Data Type	Length	Key	Reference Table
AS_ID	NUMBER		PK	
AS_X	FLOAT			
AS_Y	FLOAT			
AR_ID	NUMBER		FK	AREA
CA_ID	NUMBER		FK	CATEGORY
AS_DETAIL	VARCHAR2	500		
UL_ID	NUMBER		FK	USERLOGIN
AS_STATUS	VARCHAR2	20	FK	STATUS
AS_ADDDATE	DATE			
AS_EDITDATE	DATE			
AS_CLOSEDATE	DATE			
AS_UL_EDIT	VARCHAR2	20		
AS_UL_CLOSE	VARCHAR2	20		
AS_WORKDETAIL	VARCHAR2	500		
DA_ID	NUMBER		FK	DAMAGE
FA_ID	NUMBER		FK	FAIL
ID_ASSET	NUMBER			
AS_PIC	VARCHAR2	50		

Table 3 Data Dictionary of CATEGORY

Field Name	Data Type	Length	Key	Reference Table
CA_ID	NUMBER		PK	ASSET
CA_NAME	VARCHAR2	50		

Table 4 Data Dictionary of DAMAGE

Field Name	Data Type	Length	Key	Reference Table
DA_ID	NUMBER		PK/FK	
CA_ID	NUMBER		FK	
DA_DETAIL	VARCHAR2	100		

Table 5 Data Dictionary of DEPARTMENT

Field Name	Data Type	Length	Key	Reference Table
DE_ID	NUMBER		PK	USERLOGIN
DE_NAME	VARCHAR2	10		
DE_NAMEFULL	VARCHAR2	70		
DE_UNDER	VARCHAR2	10		
DE_UNDERFULL	VARCHAR2	70		

Table 6 Data Dictionary of FAIL

Field Name	Data Type	Length	Key	Reference Table
FA_ID	NUMBER		PK	ASSET
FA_DETAIL	VARCHAR2	200		

Table 7 Data Dictionary of METER

Field Name	Data Type	Length	Key	Reference Table
ME_ID	NUMBER		PK	
ME_X	FLOAT			
ME_Y	FLOAT			
ME_CODE	VARCHAR2	30		

Table 8 Data Dictionary of POLE

Field Name	Data Type	Length	Key	Reference Table
PO_ID	NUMBER		PK	
PO_X	FLOAT			
PO_Y	FLOAT			
PO_LIGHTNO	VARCHAR2	10		
PO_POLENO	VARCHAR2	10		

Table 9 Data Dictionary of STATUS

Field Name	Data Type	Length	Key	Reference Table
AS_STATUS	NVARCHAR2	20	PK	ASSET
ST_NAME	VARCHAR2	20		

Table 10 Data Dictionary of TRANSFORMER

Field Name	Data Type	Length	Key	Reference Table
TR_ID	NUMBER		PK	
TR_X	FLOAT			
TR_Y	FLOAT			
TR_CODE	VARCHAR2	30		

Table 11 Data Dictionary of USER_AREA

Field Name	Data Type	Length	Key	Reference Table
UL_ID	NUMBER		PK	
AR_ID	NUMBER		PK	AREA

Table 12 Data Dictionary of USERLOGIN

Field Name	Data Type	Length	Key	Reference Table
UL_ID	NUMBER		PK	ASSET
UL_PASSWORD	VARCHAR2	20		
UL_PNAME	VARCHAR2	20		
UL_FNAME	VARCHAR2	50		
UL_LNAME	VARCHAR2	50		
UL_LEVEL	NUMBER			
DE_ID	NUMBER		FK	DEPARTMENT
UL_ADMIN	VARCHAR2	1		
UL_TEL	VARCHAR2	20		
UL_EMAIL	VARCHAR2	50		
UL_POSITION	VARCHAR2	100		

Table 13 Data Dictionary of ZONE

Field Name	Data Type	Length	Key	Reference Table
ZO_ID	NUMBER		PK	
AR_ID	NUMBER		FK	AREA
ZO_MINX_L	FLOAT			
ZO_MINY_L	FLOAT			
ZO_MAXX_L	FLOAT			
ZO_MAXY_L	FLOAT			
ZO_MINX_R	FLOAT			
ZO_MINY_R	FLOAT			
ZO_MAXX_R	FLOAT			
ZO_MAXY_R	FLOAT			

BIOGRAPHY

NAME	Miss Kanistha Yooyuen
DATE OF BIRTH	4 March 1985
PLACE OF BIRTH	Pathumthani
INSTITUTIONS ATTENDED	University of the Thai Chamber of Commerce 2003-2007 Bachelor of Science (Computer Science) Mahidol University 2007-2010 Master of Science (Technology of Information System Management)
HOME ADDRESS	41/7 M.8, 345 Road, Bangkuwat, Muang, Pathumthani, Thailand Tel.086-077-4771 E-mail: kanistha.y@gmail.com