CABLE INFORMATION SYSTEM (CAIS) FOR SICMENS LIMITED

by

Ms. Suwanna Arounchaiyapong

A Final Report of the Three - Credit Course
CS 6998 System Development Project

Submitted in Partial Fulfillment
of the Requirements for the Degree of
Master of Science
in Computer Information Systems
Assumption University

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Project Title	Cable Information System (CAIS) for Sicmens Limited
Name	Ms. Suwanna Arounchaiyapong
Project Advisor	Assoc.Prof.Dr. Suphamit Chittayasothorn
Academic Year	November 2000

The Graduate School of Assumption University has approved this final report of the three-credit course, CS 6998 System Development Project, submitted in partial fulfillment of the requirements for the degree of Master of Science in Computer Information Systems.

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ABSTRACT

This System Development Project was developed to improve the existing system for the Cabel Informaiton System (CAIS), currently it is being done manually which often causes problems and errors associated with manual operations. It covers the analysis, design, testing and implementation of the computerized system of Sicmens Ltd.

The scope of this project covers the telecommunication department and the activities of this section. The proposed system will operate a variety of cable information in an integrated and timely manner. It will create better operation and provide more accurate.

ACKNOWLEDGEMENTS

The writer wishes to express her sincere thanks to her advisor, Assoc.Prof.Dr. Suphamit Chittayasothorn for his valued advice and assistance throughout the project preparation and also the staff of Sicmens Ltd. for all the valuable information of the Cable Information System (CAIS).

She would also like to thank all the project committee members of Graduate School of Computer Information Systems at Assumption University for providing an opportunity to pursue this project, and all the lecturers of MS(CIS) program who have imparted their knowledge and made her fulfill this project.

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I. INTRODUCTION

1.1 Background of the Project

Sicmens is a multinational corporation with branches and subsidiaries in over 170 different countries. In Thailand it had a presence since the beginning of the century. Originally supplying telephones, telegraph and electric motors, Sicmens is now a major implementor in the field of power generation and distribution.

The Transportation Systems Group is constructing the first mass transit railway system to be built in Bangkok. When completed, the Bangkok Transport System (BTS) railway, will consist of 23 stations, with two additional trackside locations reserved for future stations. A Depot will be built with maintenance and stabling facilities, and an Administration building, located adjacent to the Depot, will house the railway operations control center and main telecommunications facilities.

The trains will be controlled by a fully automatic signaling systems. Comprehensive SCADA, Automatic Fare Collection and Telecommunications system will be installed at every station, and linked to central control systems located in the Administration building via a fiber optic network. The Telecommunications system includes Fibre Optic Transmission, Telephone, Radio, Closed Circuit Television, Public Address and Time Distribution (Master Clock) systems.

In a Modern railway, all of these systems are fully computerized and the main part consists of rack of equipment linked by many kilometers of fibre optic and copper cables. In order to keep track of all these cables, it was necessary to design a cable management system database. Known as the "Telecommunications Cable Information

System or Cable information System," the design of this cable management system has been chosen as the object of this project.

1.2 Objectives of the Project

The objectives of the project are as follows:

(1) To determine the information requirements through interviews with the Design, installation and Commissioning Engineer concerned, and to investigate hard data

(2) To design a Computer-based information of Cable Information System

(3) To improve the capacity in keeping records of Cable and enable it to retrieve corresponding requirements

(4) To control quantities of cable in stock

(5) To estimate quantities of cable and spare parts in Maintenance phase to be more effective and efficient

(6) To save time in searching for Cable Information

(7) Provide queries and reports as Site Management requests for supportive installation and Commissioning Phase

1.3 Scope of the Project

The project covers all Cable Information System of Telecommunication department in the skytrain project, which includes the following activities:

(1) Investigate and list all information by using single line diagram form design engineer, civil engineer and all other relevant engineer

(2) Using computerized system in data storage, checking, updating, summarizing and reporting the details of the cable from each system

1.4 Deliverables

For the Cable Information System (CAIS) project of Sicmens, we begin to study the existing system from the beginning of January 2000 and we plan to deliver the proposed system to the user at the end of June 2000 (as Gantt Chart presents in Figure 1.1).

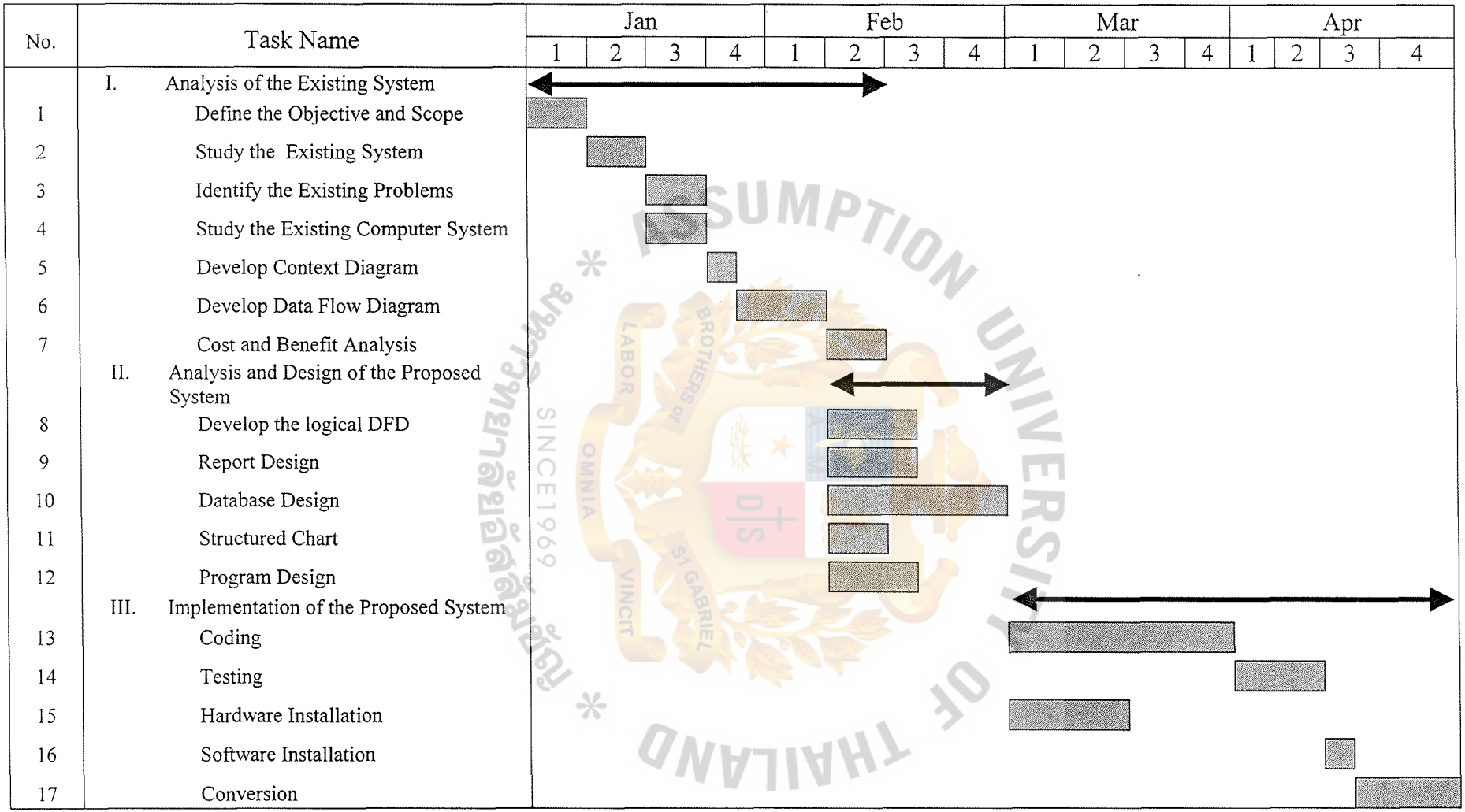

Figure 1.1. Project Plan of Cable Information System.

II. THE EXISTING SYSTEM

2.1 Background of the Organization

Sicmens is a multinational corporation with branches and subsidiaries in over 170 different countries. In Thailand it had a presence since the beginning of the century. Originally supplying telephones, telegraph and electric motors, Sicmens is now a major implementor in the field of power generation and distribution. Sicmens has also played a major part in expanding and modernizing the country's communications infrastructure.

Currently about 1,500 people are employed by Sicmens Ltd., Thailand. There are four other joint venture companies which Sicmens participates in Thailand. The company is mainly engaged in manufacturing, sales, marketing, service and maintenance and for the entire range of its own Sicmens products and systems.

The Transportation Systems Group is constructing the first mass transit railway system to be built in Bangkok. When completed, the Bangkok Transport System (BTS) railway will consist of 23 stations, with two additional trackside locations reserved for future stations. A Depot will provide maintenance and stabling facilities, and an Administration building, located adjacent to the Depot which will house the railway operations control center and main telecommunications facilities.

The railway is laid out as two distinct lines - the Sukhumvit (SKIT) Line and the Silom (SLM) Line, with an interchange at the central station. All the stations are constructed to the same basic design, with the elevated stations linked by a dual-track-railway running on an overhead viaduct.

The trains will comprise three car sets, with a driving cab at each end controlled by a fully automatic signaling system. Comprehensive SCADA, Automatic Fare Collection and Telecommunications system will be installed at every station, and linked to central control systems located in the Administration building via a fibre optic network. The Telecommunications system includes Fibre Optic Transmission, Telephone, Radio, Closed Circuit Television, Public Address and Time Distribution (Master Clock) systems.

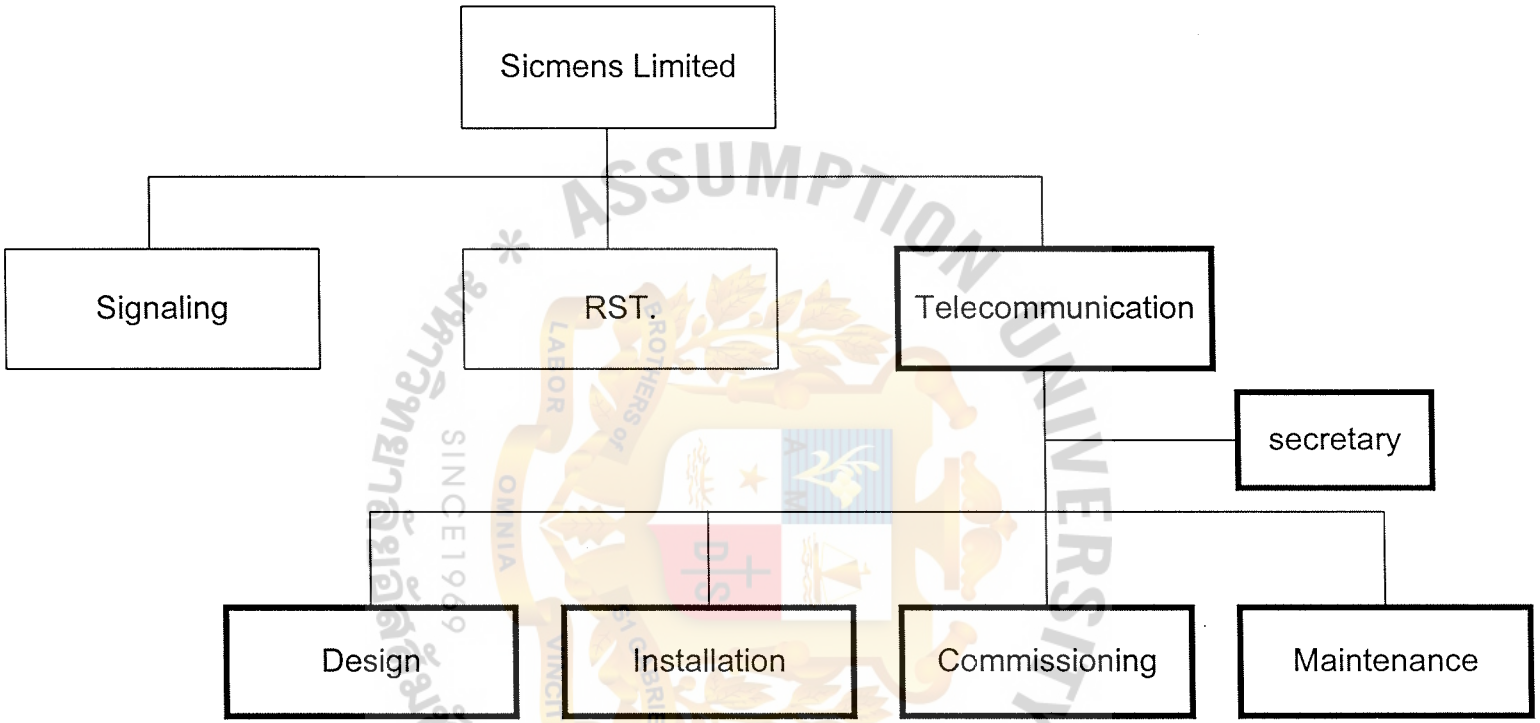

Figure 2.1. Organization Chart of Telecommunication Department.

2.2 Existing Business Function

(1) Plan Diagram

(2) Design Single Line Diagram

(3) Set Cable ID

(4) Set the installation point

(5) List information

(6) Maintain the overall system

(7) Print various report

2.3 Overview of the Current System

About the current system, we use it in manual operation. For example: use microsoft excel to keep data and print the Cable Information Listing (as shown in Appendix B).

The processes of work are shown as follows:

(1) Verify the diagram

(2) Register new cable

(3) Update Cable Information

(4) General Cable Report

Output of the Existing System

(1) Cable Information Report

(2) Cable Type Information Report

(3) Cable Length Calculation Report

(4) Station Information Listing

2.4 Current Problems

Current problems in the existing system can be identified as follows:

(1) Using for small LAN in each station

(2) System failure

(3) Inaccurate and out of date information about cable availability and quantity on hand

(4) Long searching time for updating or retrieving the written records in the system

(5) No standard format of record keeping

(6) Excessive hard-copies being kept

(7) Inconsistent database and difficulties in analysing information

(8) No information-based center

(9) Ineffectiveness and deficiency in the system

(10) Delay and poor security control system

III. THE PROPOSED SYSTEM

3.1 User Requirements

The objective of the new system requirements is to assemble an overall picture of input, operations and resources required by the system to meet the present and future needs of the organization.

After analyzing the existing system procedures, new system requirements can be mainly stated for a sharable computerized database. The user expected that with such database the system will provide them faster information retrieval and they can get better information and decision making. The new system requirements can be clarified as follows:

(1) To reduce time and difficulties in searching for the required information

(2) To reduce error and redundant database

(3) To reduce paper waste

(4) To be familiarized with the system and be easy to use

(5) To prepare various reports

(6) To provide up-to-date and accurate information

(7) To provide ease of maintenance

(8) To operate Menu-Driven procedure

(9) To protect data by using security and operation control

(10) To increase productivity

3.2 System Design

The current problems, existing procedure and user requirements are used as a basis for designing a new system. The computerized information system is proposed to the solution of the current problems. Details of new system are represented as follows:

(1) Entity Relationship Diagram -ER (Appendix A)

(2) Context and Data Flow Diagram of the Existing System (Appendix B)

(3) Context and Data Flow Diagram of the Proposed System (Appendix C)

(4) Module Specification (Appendix D)

(5) Structure Chart (Appendix E)

(6) Data Dictionary (Appendix F)

(7) Screen Design (Appendix G)

(8) Output Report (Appendix H)

Overview of the Proposed System

There are 4 processes in the new proposed system as follows:

Process 1.0: Verify Diagram

(1) To verify diagram which design by the engineer

Process 2.0: Update Cable Information

(1) View data

(2) Add data

(3) Edit data

(4) Delete data

(5) Update data

Process 3.0: Maintain Location Information

(1) Retrieve data

(a) Room Information

(b) Level Information

(c) Equipment Information

(2) Verify data

(3) Update information

Process 4.0: Prepare Various Report

(1) Retrieve User Requirement

(2) Print Report

(a) Cable Information Report

(b) Location Information Report

Proposed Screen Layout

The proposed screen layouts of the Cable Information System (CAIS) are represented in Appendix G.

Proposed Output Report

The proposed output reports are shown in Appendix H, as detailed below:

(1) Update Cable Information

(2) Adding new cable information

(3) Delete cable information

(4) Cable Information Master Report

(5) Location Information Report

(6) Location Level Information Report

(7) Location Room Information Report

(8) Equipment Information Report

(9) Cable Type Information Report

(10) Cable Length Calculation Report

(11) Summary for Cable Length

(12) Sample cable ID report

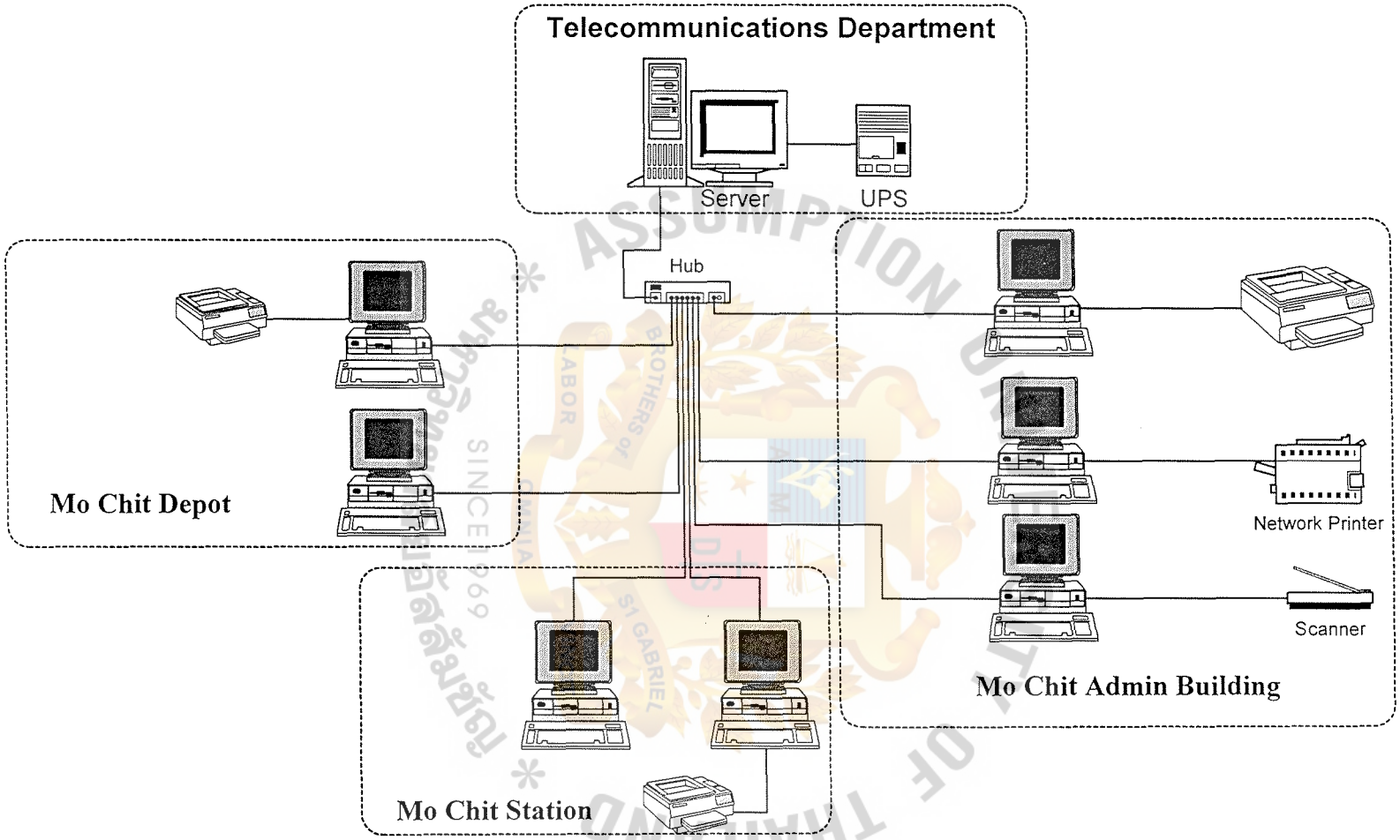

Figure 2.2. Computer Hardware Configuration of Telecommunication Department.

3.3 Hardware and Software Specification

We can use a lot of software, which can transform a normal based PC Server, Application Server and Database Server. The software is designed to integrated with Microsoft Windows NT Server, and is also pack together with Microsoft Back Office suite.

We plan to use the Microsoft Back Office suite as the major software for our proposed system. Therefore, the server must have the hardware specification, which can run both Microsoft Windows NT and the other software in the suite include the application software. The hardware and software specification for the proposed system is shown in the Tables 3.1 and 3.2 respectively.

Table 3.1. The Hardware Specification for the Server.

Hardware	Specification
Server	AlphaServer DS 10
CPU	Alpha 6/466, or higher
Memory	256 Mbs or higher
Hard Disk	10 Gbs or higher
Monitor	15" Color SVGA Display
Network	Lan Card 3 com [100 Mbits/sec]

Table 3.1. The Hardware Specification for the Server (Continued).

Hardware	Specification
Printer	TEKTRONIX PHASER 750 (Color Laser Network Printer)
HUB	3 Com 24 port
UPS	APC Smart UPS SU700/NET

Table 3.2. The Software Specification for the Server.

Software	Specification
Operating System	Windows NT Server vrsion 4.0 (Thai Edition)
DBMS	Microsoft SQL Server 7.0 (Thai Edition) – 25 clients
Network	Protocol TCP/IP, NETBEUI

In the proposed system, the client machine will have capacity only high enough to run Microsoft office professional 2000 and the application program. Therefore, in general standard, it should have hardware specification high enough to run Microsoft windows 95 and Microsoft Office 97 or higher. The hardware and software specifications for each client machine are shown in the Tables 3.3 and 3.4 respectively.

Table 3.3. The Hardware Specification for Each Client Machine.

Hardware	Specification
Client	AMD DURON 600
CPU	PC Pentium 600 MHz Up
Memory	64 Mbs or higher
Hard Disk	20 Gbs or higher
Monitor	17" SOCOS
Network	Lan Card 3 com [10 Mbits/sec]
Printer	HP Laserjet 2100 M
Scanner	Minolta QSM SC-200
Others	AC97 Sound, Speaker 120 Watts, 250 watts ATX tower

Table 3.4. The Software Specification for Each Client Machine.

Software	Specification
Operating System	Microsoft Windows 2000
DBMS	Microsoft Data Access 2.0 Up
Browser	Internet Explorer 5.0
Software Package	Office Professional 2000 – 20 licenses Visio Technic 2000 – 5 licenses
Application Program	Cable Information System (CAIS)

3.4 Security and Controls

Recognition of the necessity for security is a natural outgrowth of the belief that information is a key organizational resource. It is useful to think of the security of systems, data and information or an imaging continuum from totally secure and totally open.

(1) Physical Security: Securing the computer facility, its equipment and software through physical means.

(a) Discretionary Security Protection system/ Discretionary Access Control

(b) Human sign – in / out system

(c) Backup data frequently

(2) Logical Security: Refers to logical controls within software itself.

(a) System Security: User should enter the login name and correct password before using the system and key "logout" after exiting the program.

(b) Application Security: it can be used for protection data from unauthorized or non-privileged users.

(3) Backup and Recovery process

3.5 Cost / Benefit Analysis

(1) Costs of Existing System

Table 3.5. Cost Analysis for Existing System, Baht.

Cost Items		Years				
		1	2	3	4	5
Fixed Cost						
Hardware Cost:						
Acer Pentium 133	30 units@ 25,000	750,000.00	750,000.00	750,000.00	750,000.00	750,000.00
printer	10 units@ 22,000	220,000.00	220,000.00	220,000.00	220,000.00	220,000.00
Total Hardware Cost		970,000.00	970,000.00	970,000.00	970,000.00	970,000.00
Maintenance Cost:						
Maintenance Cost		-	-	-	55,000.00	38,000.00
Total Maintenance Cost		-	-	-	55,000.00	38,000.00
Software Cost:						
Microsoft Office - 10 Licenses		130,000.00	130,000.00	130,000.00	130,000.00	130,000.00
Total Software Cost		130,000.00	130,000.00	130,000.00	130,000.00	130,000.00
Implementing Cost:						
User Training		30,000.00	-	-	-	-
Setup Cost		35,000.00	-	-	-	-
Total Implemention Cost		65,000.00	-	-	-	-
Office Equipment Cost:						
Calculator	15 units@ 1,250	18,750.00	-	-	-	-
Total Office Equipment Cost		18,750.00	-	-	-	-
Total Fixed Cost		1,183,750.00	1,100,000.00	1,100,000.00	1,155,000.00	1,138,000.00
Operating Cost						
Peopleware Cost:						
Staff	50 persons@10,000	500,000.00	550,000.00	605,000.00	665,500.00	732,050.00
Supervisor	5 persons@18,000	90,000.00	99,000.00	108,900.00	119,790.00	131,769.00
(increase 10 % per year)						
Total Monthly Salary Cost		590,000.00	649,000.00	713,900.00	785,290.00	863,819.00
Total Annual Salary Cost		7,080,000.00	7,788,000.00	8,566,800.00	9,423,480.00	10,365,828.00
Office Supplies & Miscellaneous Cost:						
Paper	18,500 per month	222,000.00	233,100.00	244,755.00	256,992.75	269,842.39
Stationary	6,500 per month	78,000.00	81,900.00	85,995.00	90,294.75	94,809.49
Utility	5,000 per month	60,000.00	63,000.00	66,150.00	69,457.50	72,930.38
Miscellaneous	8,000 per month	96,000.00	100,800.00	105,840.00	111,132.00	116,688.60
(increase 5 % per year)						
Annual Office Supplies & Miscellaneous Cost		456,000.00	478,800.00	502,740.00	527,877.00	554,270.85
Total Operating Cost		7,536,000.00	8,266,800.00	9,069,540.00	9,951,357.00	10,920,098.85
Total Computerized System Cost		8,719,750.00	9,366,800.00	10,169,540.00	11,106,357.00	12,058,098.85

The Formula of Annual Cost of the Existing System:

$$\text{Annual Cost} = \frac{\text{Investment Cost + Implement Cost}}{\text{Estimated System life in year}} + \text{Annual Operating Cost}$$

Estimated system life in 5 years

$$\text{Annual Cost} = \frac{8{,}719{,}750 + 65{,}000}{5} + 7{,}536{,}000 = 9{,}292{,}950 \text{ Baht}$$

Table 3.6. Five Years Accumulated Existing System Cost, Baht.

Year	Total Computerized Cost	Accumulated Cost
1	8,719,750.00	8,719,750.00
2	9,366,800.00	18,086,550.00
3	10,169,540.00	28,256,090.00
4	11,106,357.00	39,362,447.00
5	12,058,098.85	51,420,545.85
Total	51,420,545.85	-

(2) Proposed System Cost Analysis

Table 3.7. Proposed System Cost Analysis, Baht.

Cost Items	Years				
	1	2	3	4	5
Fixed Cost					
Hardware Cost:					
Alpha Server DS10	305,000.00	305,000.00	305,000.00	305,000.00	305,000.00
AMD DURON 600 30 units@ 32,900	987,000.00	987,000.00	987,000.00	987,000.00	987,000.00
HP Printer 10 units@ 34,040	340,400.00	340,400.00	340,400.00	340,400.00	340,400.00
Network Printer 5 units@ 140,200	701,000.00	701,000.00	701,000.00	701,000.00	701,000.00
Network Card 31 units@ 2,550	79,050.00	79,050.00	79,050.00	79,050.00	79,050.00
Scanner	15,400.00	15,400.00	15,400.00	15,400.00	15,400.00
HUB 2 units@ 24,950	49,900.00	49,900.00	49,900.00	49,900.00	49,900.00
Cable and Interfaces	35,000.00	35,000.00	35,000.00	35,000.00	35,000.00
UPS	15,500.00	15,500.00	15,500.00	15,500.00	15,500.00
Backup Tape	36,000.00	36,000.00	36,000.00	36,000.00	36,000.00
Total Hardware Cost	2,564,250.00	2,564,250.00	2,564,250.00	2,564,250.00	2,564,250.00
Maintenance Cost:					
Maintenance Cost	-	-	-	22,000.00	20,000.00
Total Maintenance Cost	-	-	-	22,000.00	20,000.00
Software Cost:					
Microsoft Office Pro 2000 - 20 Licenses	354,400.00	354,400.00	354,400.00	354,400.00	354,400.00
Microsoft SQL V 7.0 - 25 Client	350,000.00	350,000.00	350,000.00	350,000.00	350,000.00
Visio Technic 2000 - 5 Licenses	55,000.00	55,000.00	55,000.00	55,000.00	55,000.00
Application	200,000.00	200,000.00	200,000.00	200,000.00	200,000.00
Total Software Cost	959,400.00	959,400.00	959,400.00	959,400.00	959,400.00
Implementing Cost:					
User Training	580,000.00	-	-	-	-
Setup Cost	650,000.00	-	-	-	-
Total Implemention Cost	1,230,000.00	-	-	-	-
Office Equipment Cost:					
Calculator 15 units@ 1,250	18,750.00	-	-	-	-
Total Office Equipment Cost	18,750.00	-	-	-	-
Total Fixed Cost	4,772,400.00	3,523,650.00	3,523,650.00	3,545,650.00	3,543,650.00
Operating Cost					
Peopleware Cost:					
Staff 35 persons@10,000	350,000.00	385,000.00	423,500.00	465,850.00	512,435.00
Supervisor 3 persons@18,000	54,000.00	59,400.00	65,340.00	71,874.00	79,061.40
(increase 10 % per year)					
Total Monthly Salary Cost	404,000.00	444,400.00	488,840.00	537,724.00	591,496.40
Total Annual Salary Cost	4,848,000.00	5,332,800.00	5,866,080.00	6,452,688.00	7,097,956.80
Office Supplies & Miscellaneous Cost:					
Paper 10,500 per month	126,000.00	132,300.00	138,915.00	145,860.75	153,153.79
Stationary 3,500 per month	42,000.00	44,100.00	46,305.00	48,620.25	51,051.26
Utility 5,000 per month	60,000.00	63,000.00	66,150.00	69,457.50	72,930.38
Miscellaneous 10,000 per month	120,000.00	126,000.00	132,300.00	138,915.00	145,860.75
(increase 5 % per year)					
Annual Office Supplies & Miscellaneous Cost	348,000.00	365,400.00	383,670.00	402,853.50	422,996.18
Total Operating Cost	5,196,000.00	5,698,200.00	6,249,750.00	6,855,541.50	7,520,952.98
Total Computerized System Cost	9,968,400.00	9,221,850.00	9,773,400.00	10,401,191.50	11,064,602.98

Annual Cost of the Proposed System:

The Formula of Annual Cost of the Proposed System:

$$\text{Annual Cost} = \frac{\text{Investment Cost + Implement Cost}}{\text{Estimated System life in year}} + \text{Annual Operating Cost}$$

Estimated system life in 5 years

$$\text{Annual Cost} = \frac{9{,}968{,}400 + 1{,}230{,}000}{5} + 5{,}196{,}000 = 7{,}435{,}680 \text{ Baht}$$

Table 3.8. Five Years Accumulated Proposed System Cost, Baht.

Year	Total Computerized Cost	Accumulated Cost
1	9,968,400.00	9,968,400.00
2	9,221,850.00	19,190,250.00
3	9,773,400.00	28,963,650.00
4	10,401,191.50	39,364,841.50
5	11,064,602.98	50,429,444.48
Total	50,429,444.48	-

(3) The Comparison of the System Costs between Proposed System and Existing System

Table 3.9. The Comparison of the System Costs, Baht.

Year	Accumulated Existing Cost	Accumulated Proposed Cost
1	8,719,750.00	9,968,400.00
2	18,086,550.00	19,190,250.00
3	28,256,090.00	28,963,650.00
4	39,362,447.00	39,364,841.50
5	51,420,545.85	50,429,444.48

Payback Period

The Payback period is defined as the number of years required to accumulate earnings sufficient to cover its cost using for the proposed system which covers the following:

$$P = \frac{I}{(1-T)R}$$

P = Payback Period

I = Investment

R = Average annual return on investment

T = Corporate tax rate in percentage (30%)

Find Average annual return on investment = total saving - Annual Operating Cost

Total saving: reduce 50 staffs to 35 staffs = 1,800,000 baht

calculate from: salary/mth. 10,000 baht (average)

for 15 staffs = 10,000 x 15 = 150,000 baht

salary/yr. = 150,000 x 12 = 1,800,000 baht

Annual Operating Cost 5,196,000 baht

R = 5,196,000 – 1,800,000 = 3,396,000 baht

$$\text{Payback Period} = \frac{9{,}968{,}400}{(1\text{-}0.30)3{,}396{,}000} = 4.19 \text{ yrs.}$$

The payback period (after taxes) for the proposed system is 4.19 years.

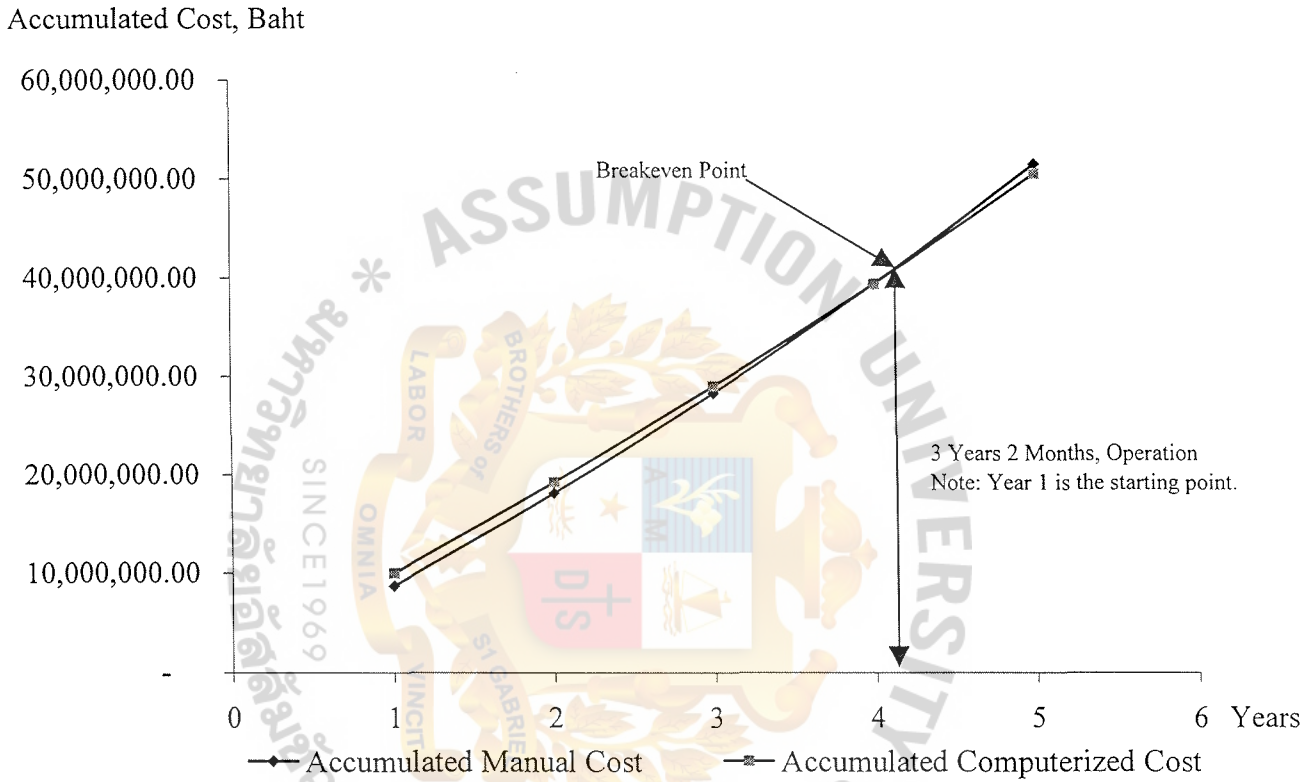

Figure 3.1. Cost Comparison between Manual and Proposed System.

Benefit Expected

The benefits from the proposed system will be as follows:

(1) Provide up to date database access ability

(2) Enhanced accuracy & reliability

(3) Reduced Risk

(4) Easy to control Centralized Database

(5) Easy to maintain

(6) Security Control

(7) Productivity benefits

(8) Enhanced accuracy & reliability

(9) Improved the quality, efficiency and effectiveness of Tasks

(10) Reduced paper work

(11) Operation and Personnel savings

(12) Reduced Time Consumption

(13) Management improvement

(14) Provision of better planning information

(15) Better control and decision making

(16) Reduced Risk

IV. PROJECT IMPLEMENTATION

4.1 Implementation

Project Implementation is the process of assuring that the information system is operational and involving well-trained users in its operation. It consists of 3 parts which are as follows:

(1) Training and system maintenance

(2) Conversion

(3) Post-Implementation Review

Training:

A well-designed training program can help overcome staff anxiety and potential resistance to change and make the difference between a successful and unsuccessful system implementation.

Most user training deals with the operation of the system itself. Training in data coding emphasizes the methods to be followed in capturing data from transactions or preparing data needed for decision support activities.

The manual system is the one of the way for supporting the user in training. It is divided into 2 section. The manual system is for the system administrators and the user manual is for the user.

System Maintenance

The technical staff will need to be devoted to maintenance activities once several systems are in operation. In addition to providing quick-response maintenance, system designer must develop emergency back up procedures to be followed any time

operational systems are down for any reason.These backup procedures should be given great care and staff must be well trained in their use also.

Conversion

The data kept in the existing system in the format of Microsoft Excel file, database file or manual books needed to be converted to Microsoft access by importing function or data input. The process also requires the investigation of correctness of the imported data, editing and completing the missing data.

Post-implementation Review

The reviews includes how well the proposed system is designed and implemented. It also determines whether the system is meeting expectations and where improvements are needed.

4.2 Testing

Testing is essential for quality assurance. It is the process of executing a program with the explicit intention of finding errors, that is making the program fail. It is done to turn up any existing problems and interfaces before the system is actually used. The most common way of testing is the top down approach. It will be tested from general level to more specific levels in order to ensure that the program runs in an expected manner and also meets users' requirements.

V. CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

The Cable Information System for the Bangkok Transport system (BTS) railway is a computerized system developed to replace the existing non-system. The proposed system facilitates and eases the complexities of Cable Information process. Using computer as interactive tools, the staff can share the same data information with those who are in different locations in the real time. It is an integrated system that accomplish the information requirements which reduces reproducing work and load burden of manual activities. The menu screen interface allows the users to enter, update or print report easily. So, the user can access the required information and get reports to support their decision-making in the mean time.

The system is simple for the user's operation, application implementation and is easy for maintenance. It also reduces redundancy and workload of operation process.

The cost analysis show that the cost of computerized system is a bit higher, it will be break-even in the near future due to requirement for hiring more staff if using the existing system. The shorter the payback period, the less the exposure will be also.

For security controls, we plan to control by Physical Security and Logical Security. Discretionary Security Protection System is the one of the Physical Securities and Password Protection is one of the Logical Securities also.

In summary, the implementation of the developed system reveals that the aimed objectives are achieved. The proposed computer-based system supports not only the operational functions but the management function also. Thus, it enhances the firm's efficiency and productiveness that increases the potential to compete with competitors.

Table 5.1 shows time performance on each process of the proposed system compared with the existing system. It shows that each process of the proposed system performs less time than each process of the existing system, which has to operate many work steps in the existing system. So, it can be concluded that the proposed system is more efficient and effective than the existing system.

Table 5.1. The Degree of Achievement of the Proposed System.

Process	Existing System	Proposed System
Application Process	2 hrs.	30 mins.
Inquiry Process	30 mins.	10 mins.
Modification Process	30 mins.	12 mins.
Printing Process	10 mins.	8 mins.
Total	3 hrs. 10 mins.	1 hr.

Application Process from proposed system reduced work steps in manual system and when the system keep the records which generate number of document from solution. Inquiry Process from proposed system reduced time of inquiry process because the proposed system use relation database. Modification Process, in this process it easy for modification information because every record have a number. Printing Process it easy from generate output because the proposed system have a menu reports for selection.

5.2 Recommendations

Cable Information System (CAIS) is prepared to use for Telecommunication Department only. In the near future, we plan to use this CAIS system in relation to all others systems. And we plan to record the maintenance of the various cables in the system including date/ time and results. There are the cable price, usage time and dealer information which will occur in the cable Information System also.

The implementation of the project development is the conversion of the design to an operating system which requires careful planning and control. Training is another important factor to be concerned with because this will help our staff understand the proposed system better and know how to use it and learn how it can provide benefits to them. If the staff know how the proposed system can help them in working more smoothly and more efficiently, they will be eager to learn and apply the new modern technology in their daily working life.

In addition, the software development needs revision on the modification to meet users requirement. In the near future, the cable information system will be applied to the related system. Every operation function will be processed by the computerized system. Computer security will be well-designed in order to protect it from unauthorized persons and keep internal database confidential. And we plan to use the intranet technology to support it. Disk capacity will be expanded to support a large database in the future. For maintaining data, the user can backup the data in ranging time and recovery the data if database error occurs.

APPENDIX A

ENTITY RELATIONSHIP (ER)

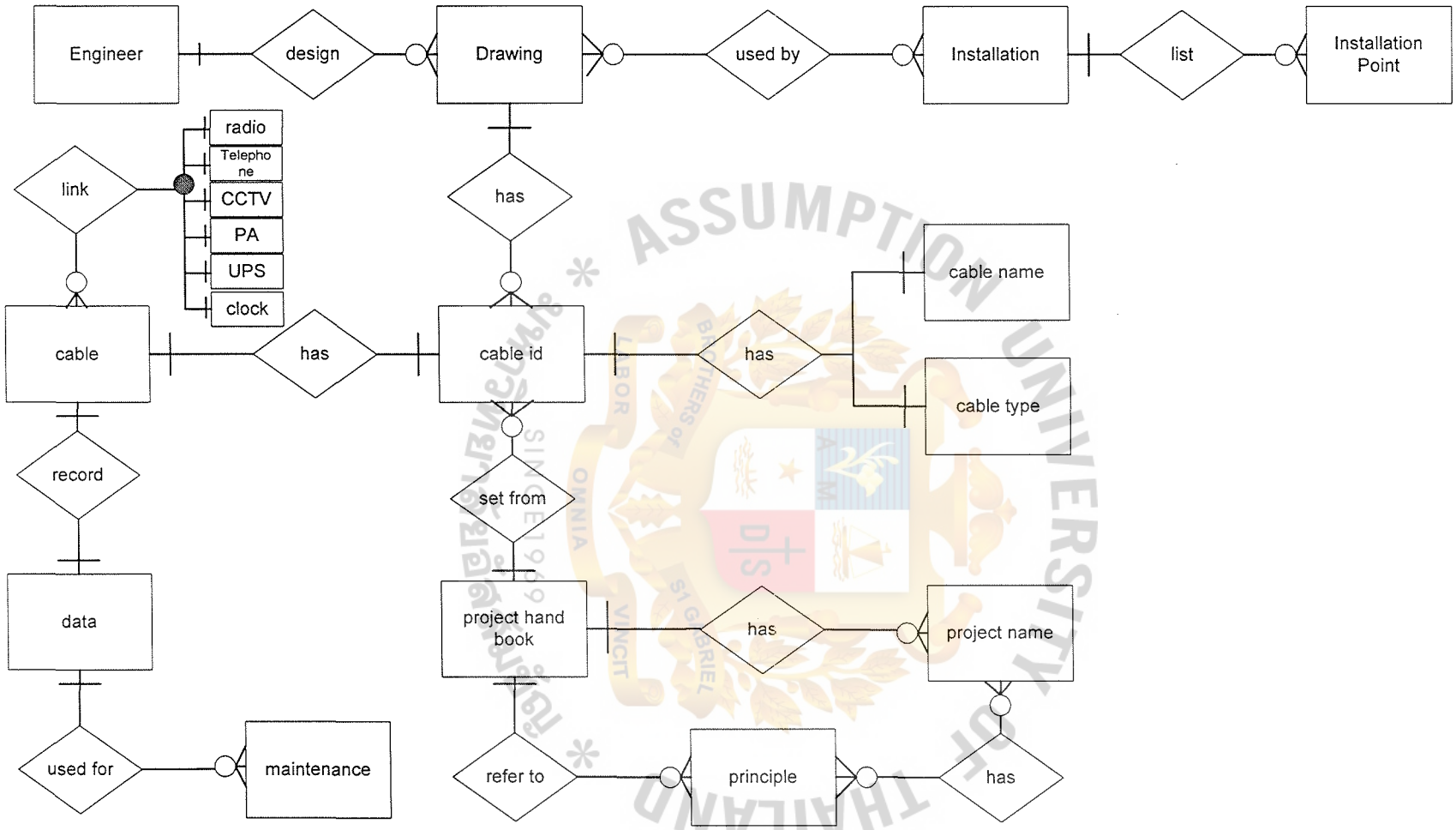

Figure A.1. Entity Relationship Diagram of Cable Information System.

APPENDIX B

CONTEXT AND DATA FLOW DIAGRAM OF THE EXISTING SYSTEM

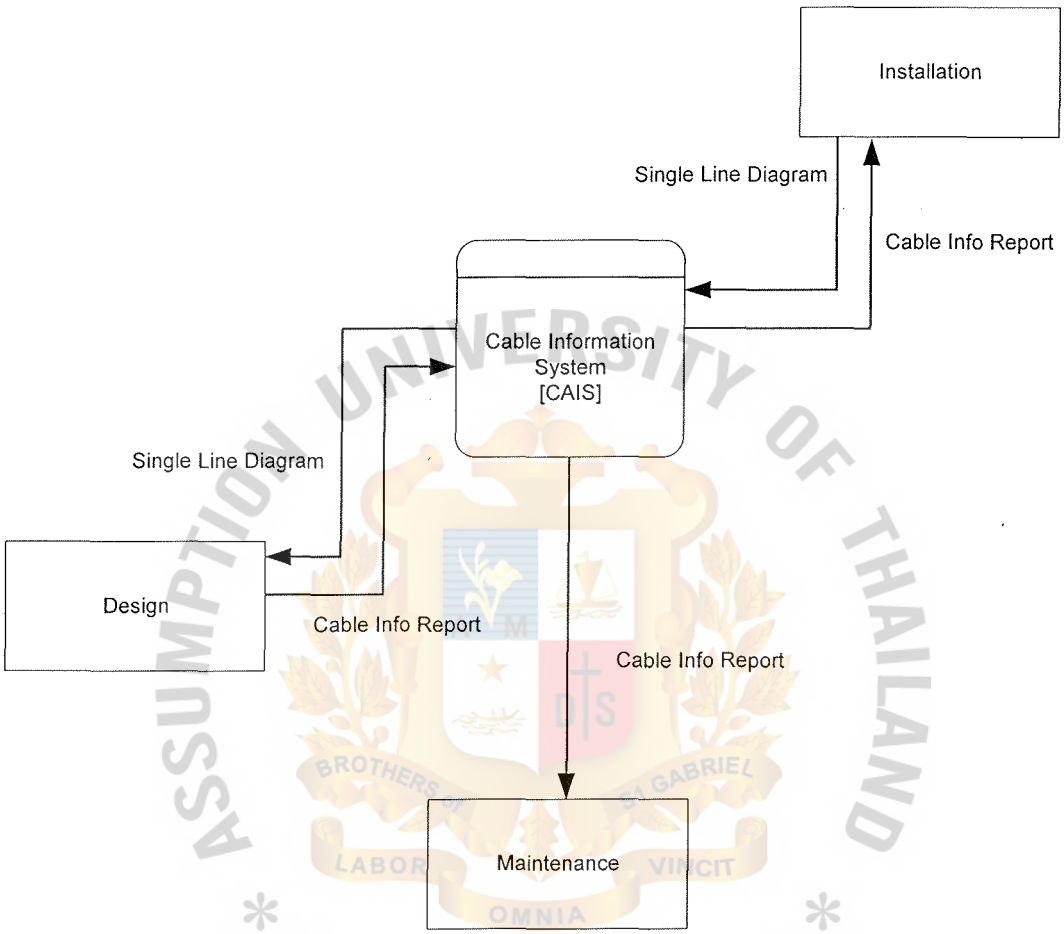

Figure B.1. Context Diagram of the Existing System.

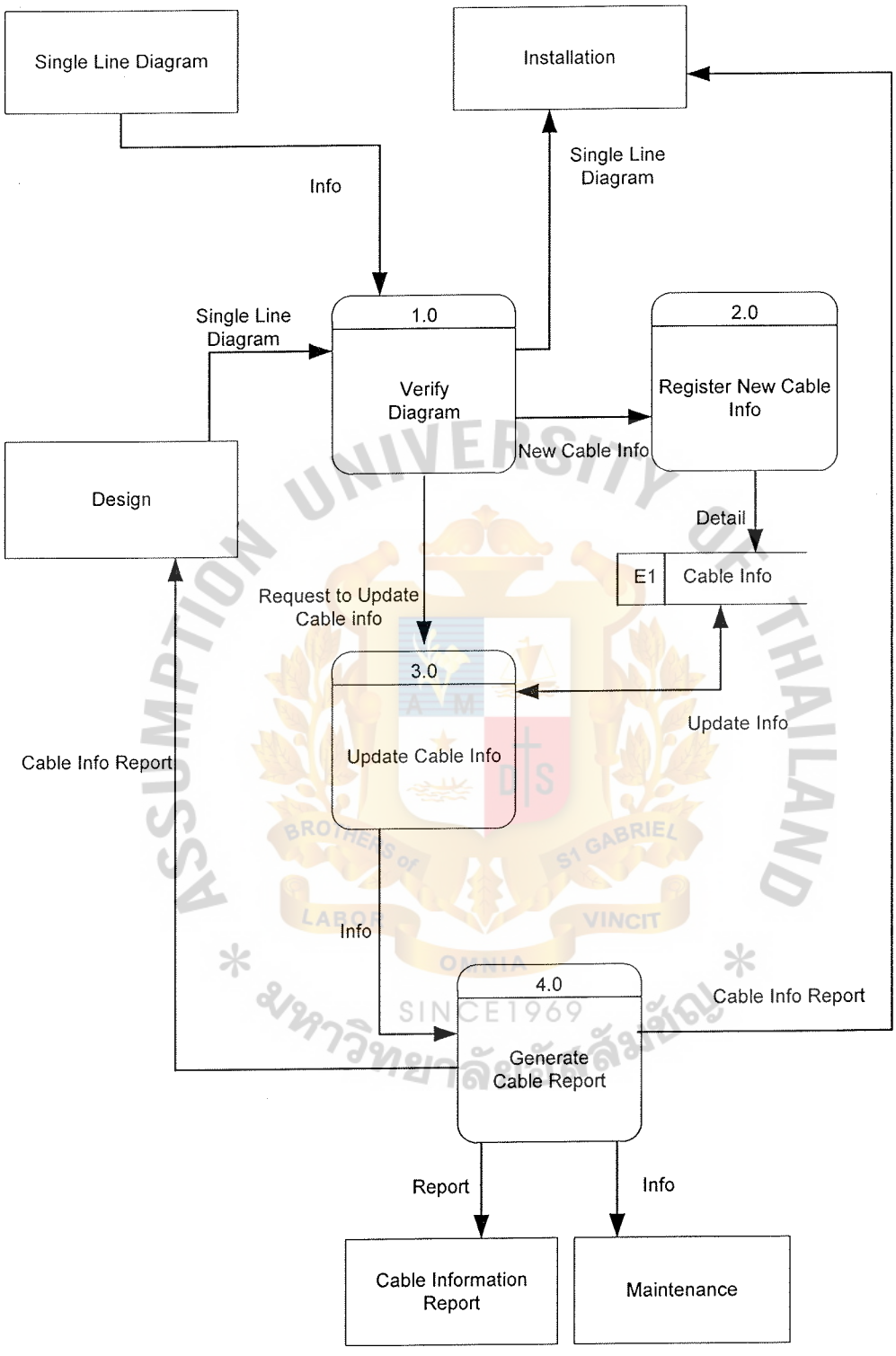

Figure B.2. DFD Level 0 of the Existing System.

APPENDIX C

CONTEXT AND DATA FLOW DIAGRAM OF THE PROPOSED SYSTEM

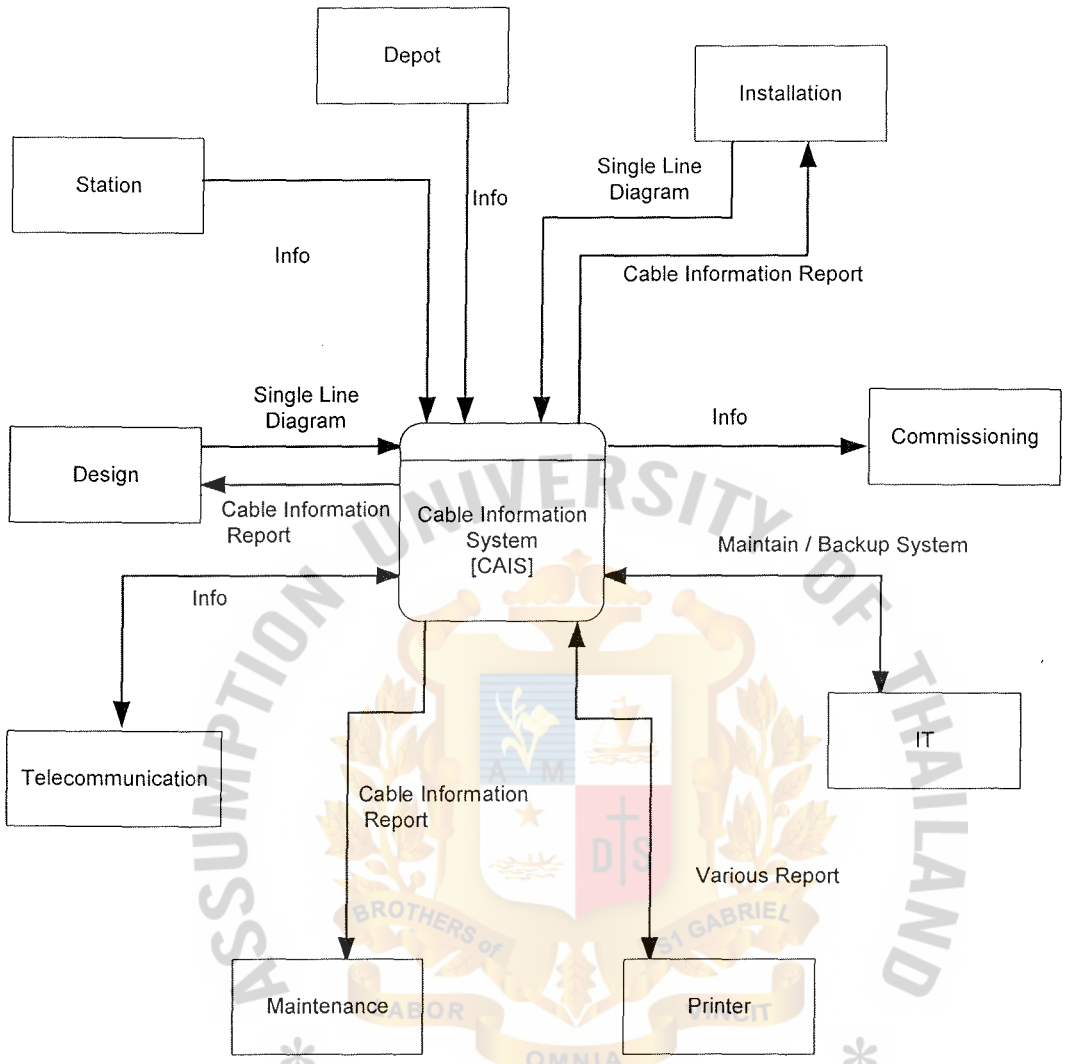

Figure C.1. Context Diagram of the Proposed System.

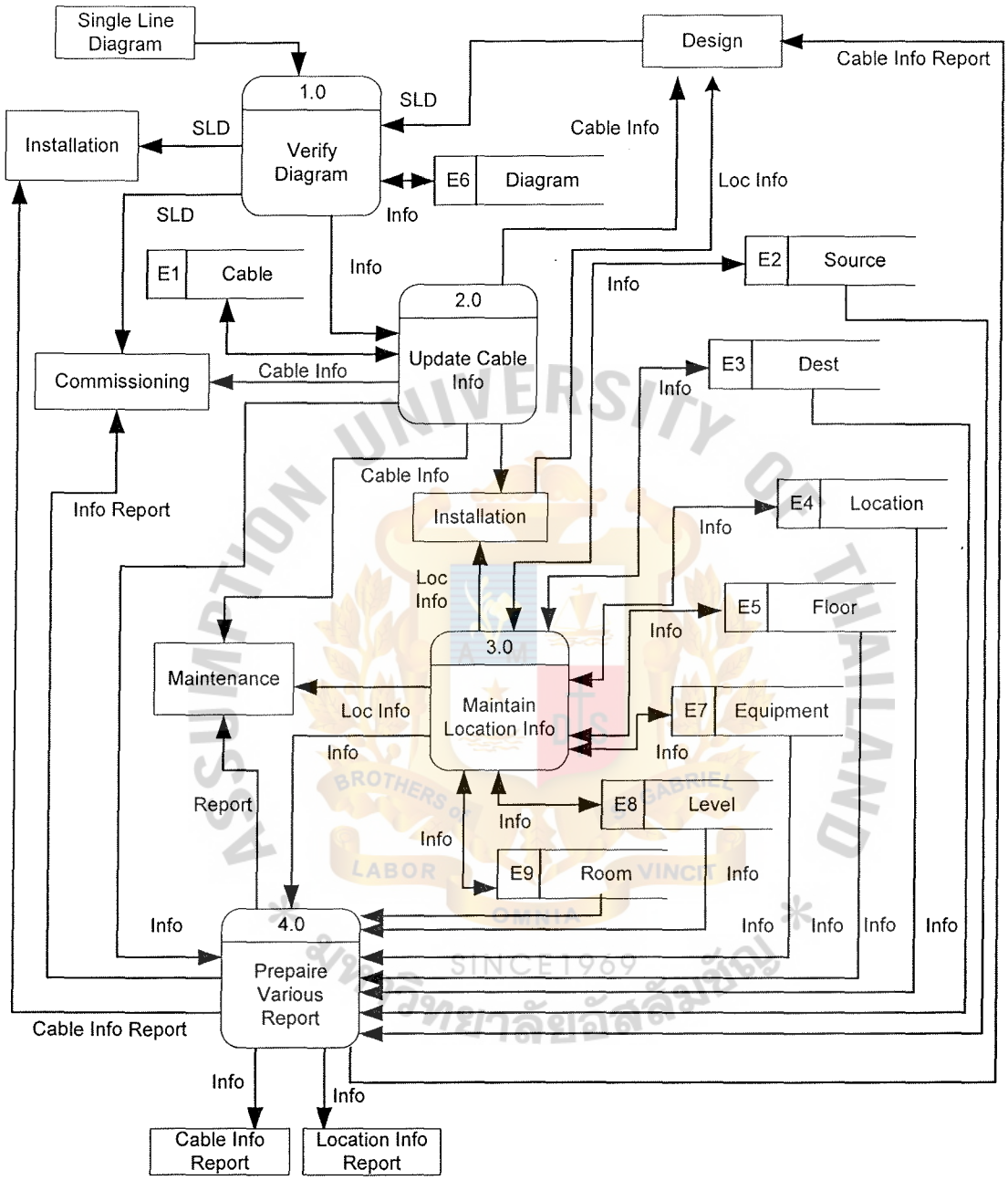

Figure C.2. DFD Level 0 of the Proposed System.

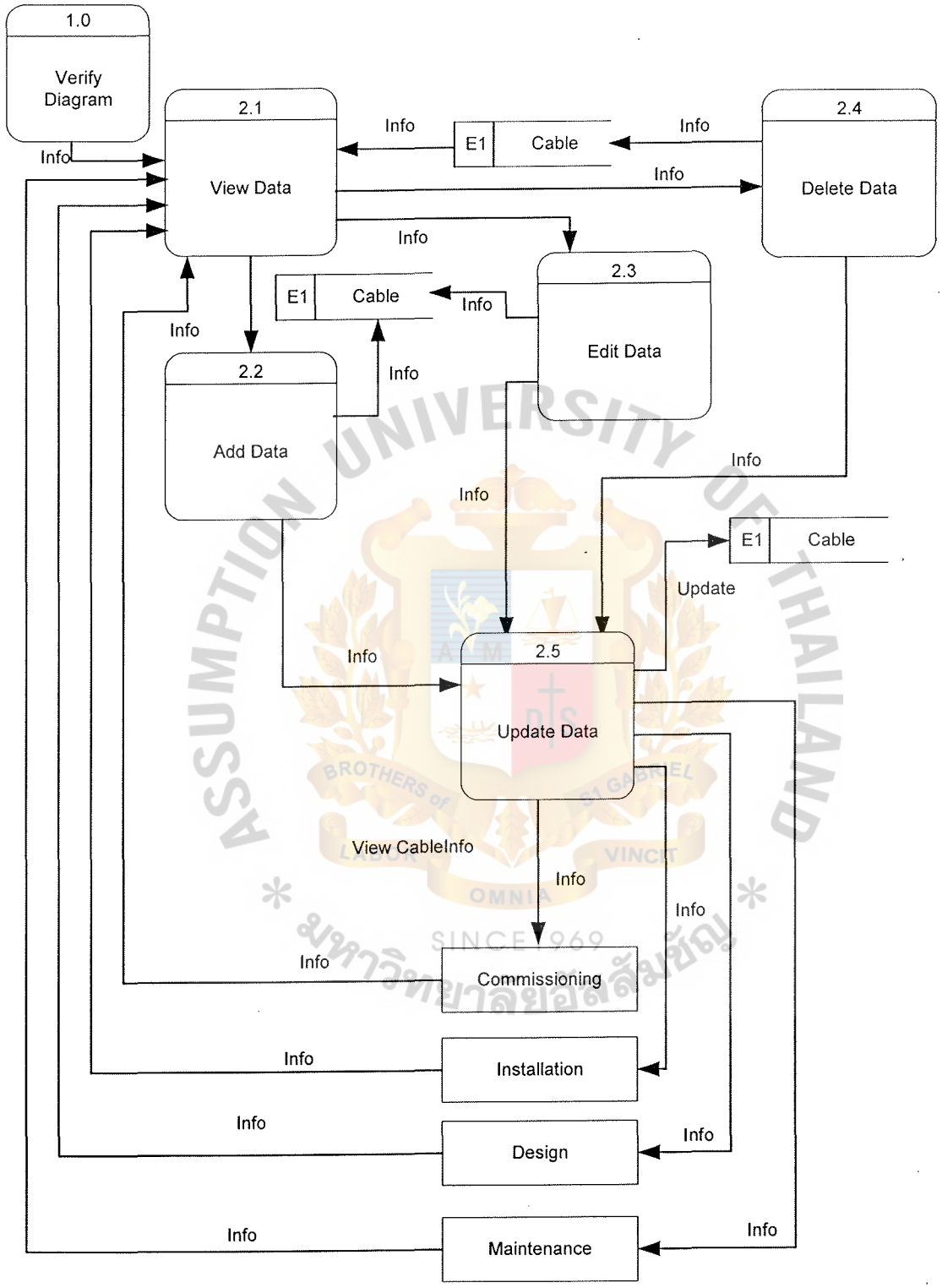

Figure C.3. DFD Level 1 of Process 2.0 Update Information of the Proposed System.

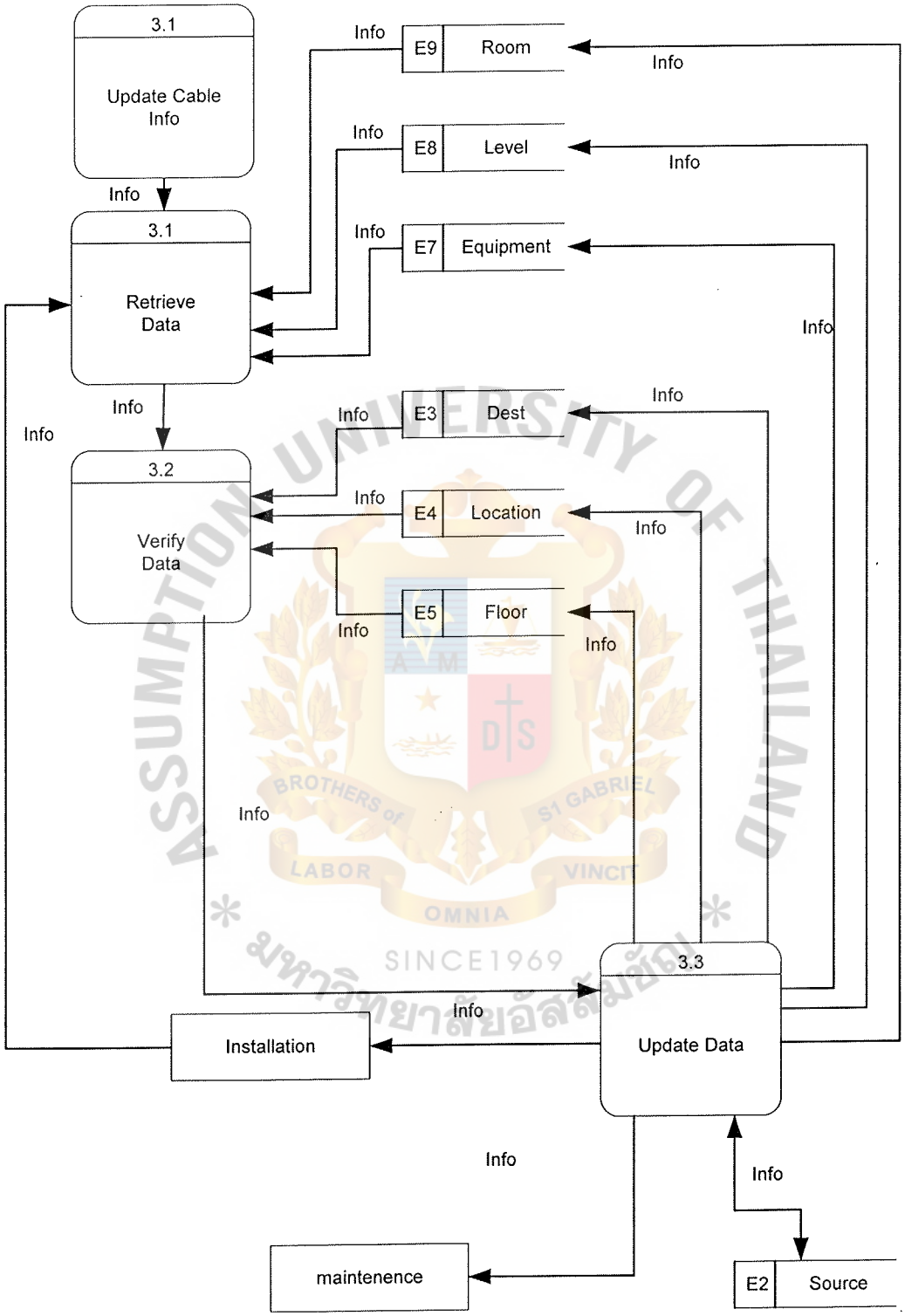

Figure C.4. DFD Level 1 of Process 3.0 Maintain Location of the Proposed System.

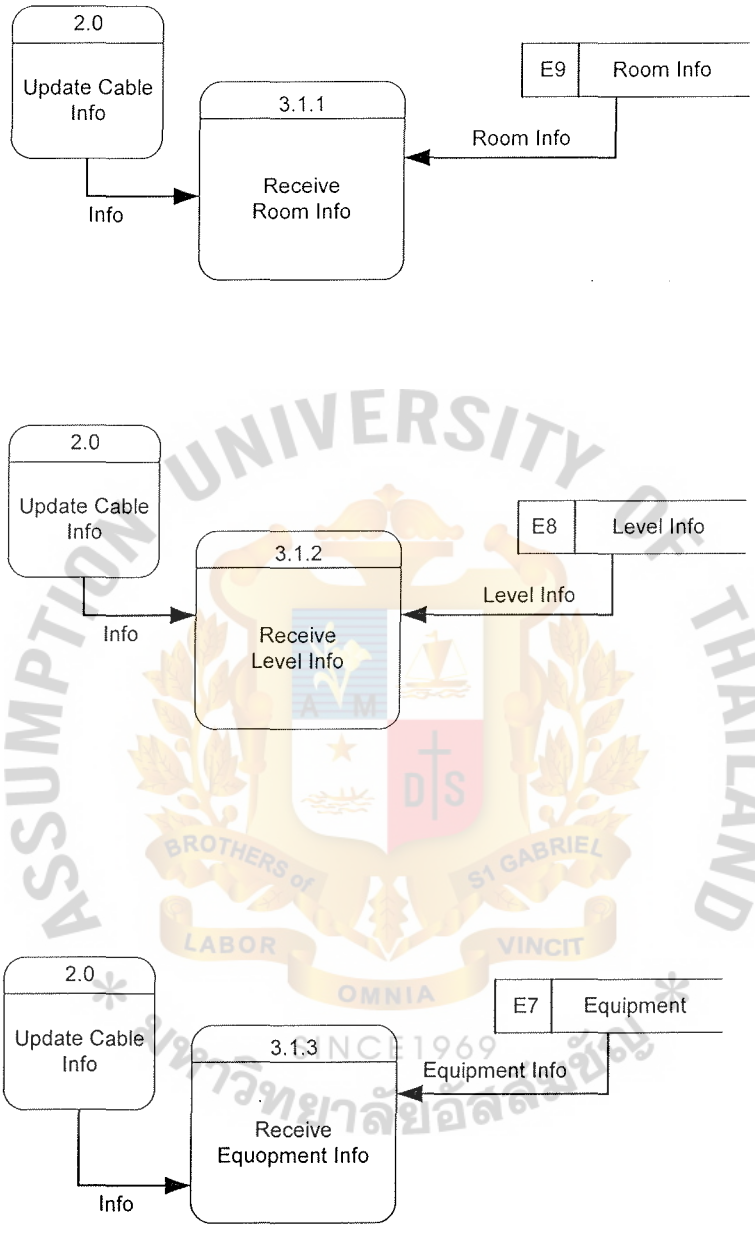

Figure C.5. DFD Level 2 of Process 3.1Retrieve Data of the Proposed System.

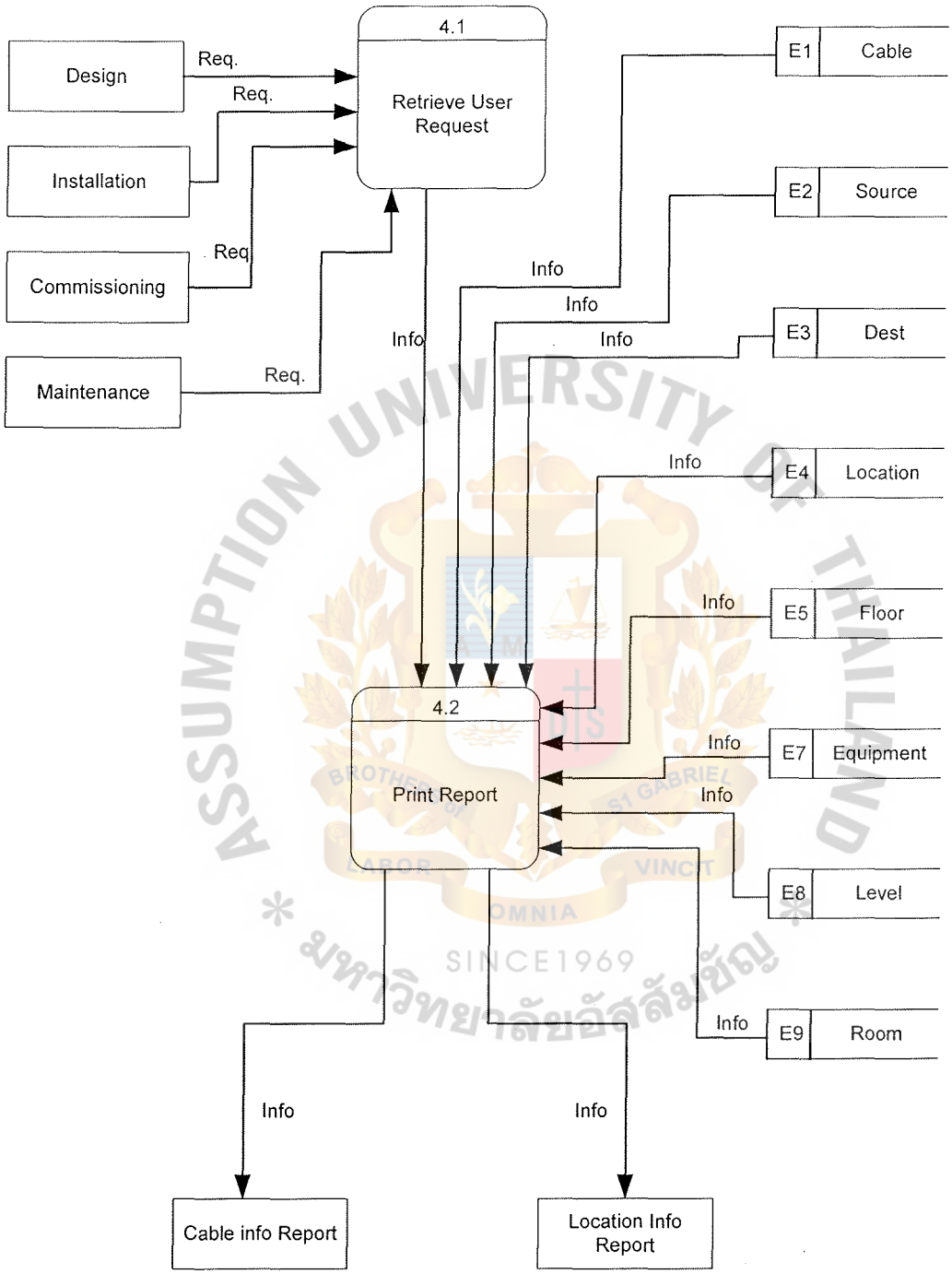

Figure C.6. DFD Level 1 of Process 4.0 Prepare Various Report of the Proposed System.

APPENDIX D

MODULE SPECIFICATION

Module : Update Cable Information

Purpose : To update cable information

Uses : Cable information

Return : Cable data

Begin

Clear cable data

Call get detail

Call write new record

Repeat

Until there are no more cable record

End

Module : Verify diagram

Purpose : To give the diagram into diagram computerized form

Uses : Diagram form

Diagram information

Return : Diagram id

Begin

Clear diagram data

Call project name

Check diagram id

If record is found

Display diagram data

Else

Create new diagram id

End if

End

Module	:	Prepare Various Report
Purpose	:	To prepare the request report
Uses	:	Cable information
		Request report
Return	:	Cable information report

Functional details

1. Receive cable information
2. Check cable detail
3. Prepare cable information
4. Print report

Module : Maintain location information

Purpose : To maintain location information

Uses : Location information

Location id

Return : Location record

Functional details

1. Retrieve location information
2. Verify location detail
3. Update location record

Module : Retrieve Data

Purpose : To retrieve data information

Uses : Data information

Return : Data

Functional details

1. Receive data information
2. Check data detail
3. Prepare data information
4. Keep record

APPENDIX E

STRUCTURE CHART

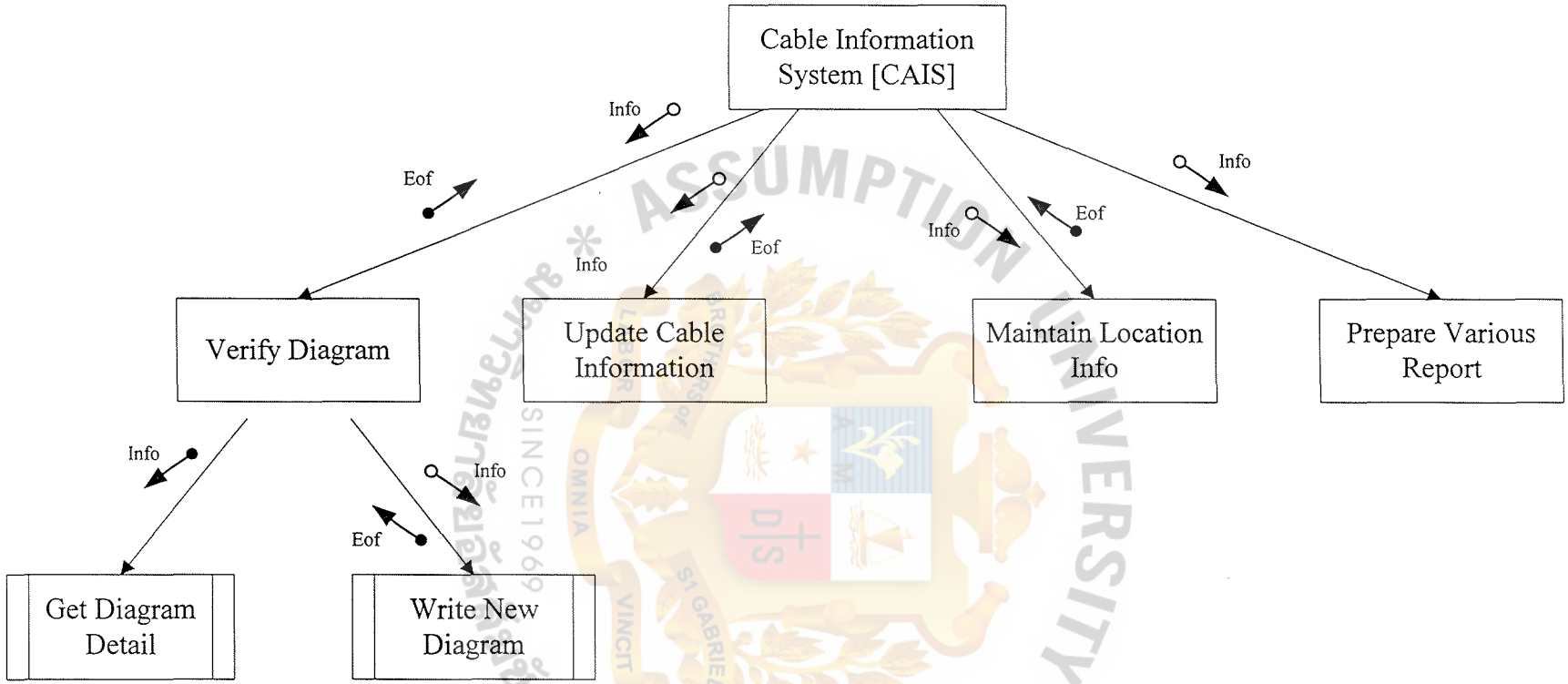

Figure E.1. Structure Chart of Cable Information System.

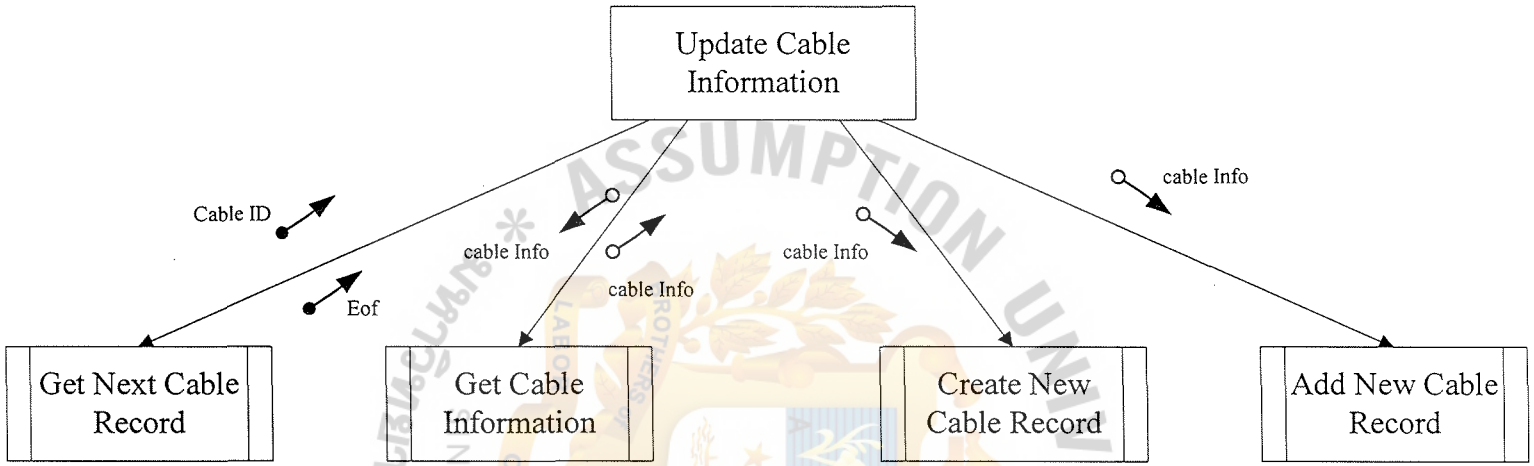

Figure E.2. Structure Chart of process 2 update cable information.

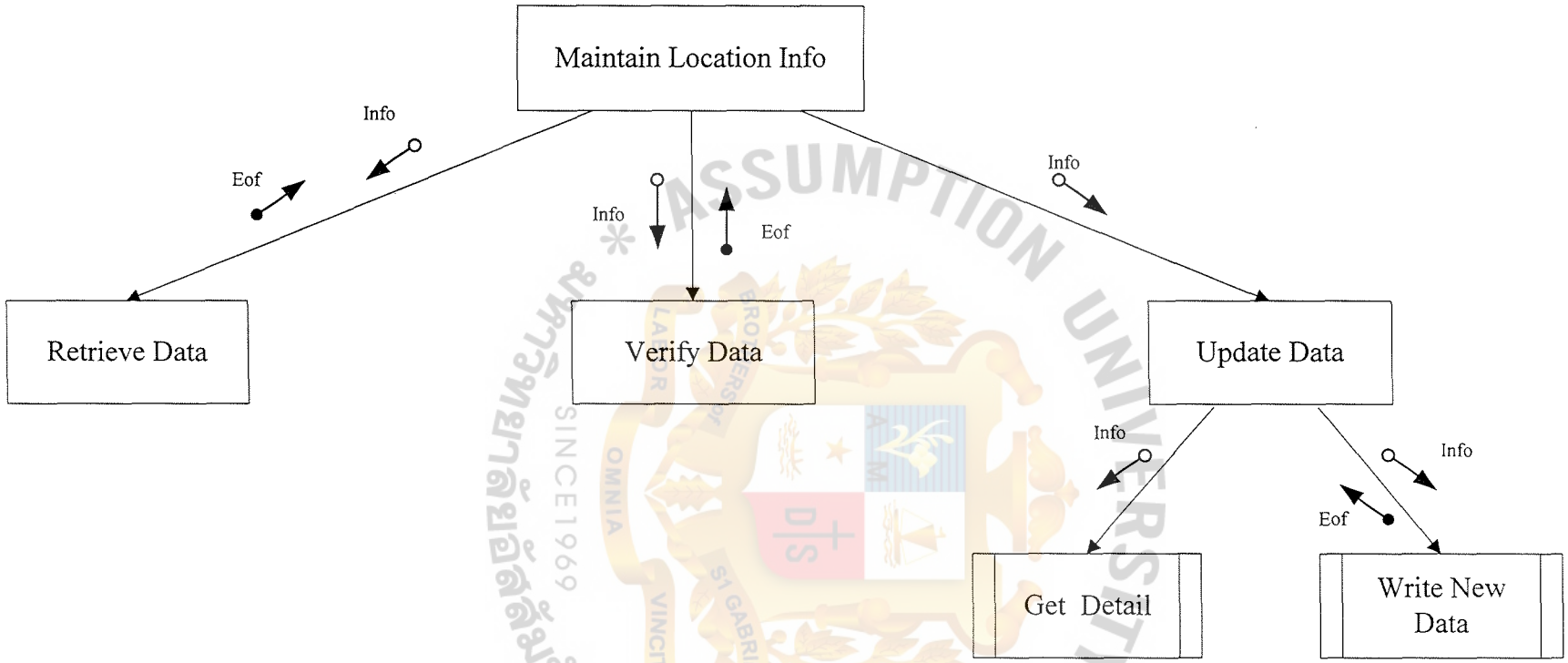

Figure E.3. Structure Chart of process 3 maintain location information.

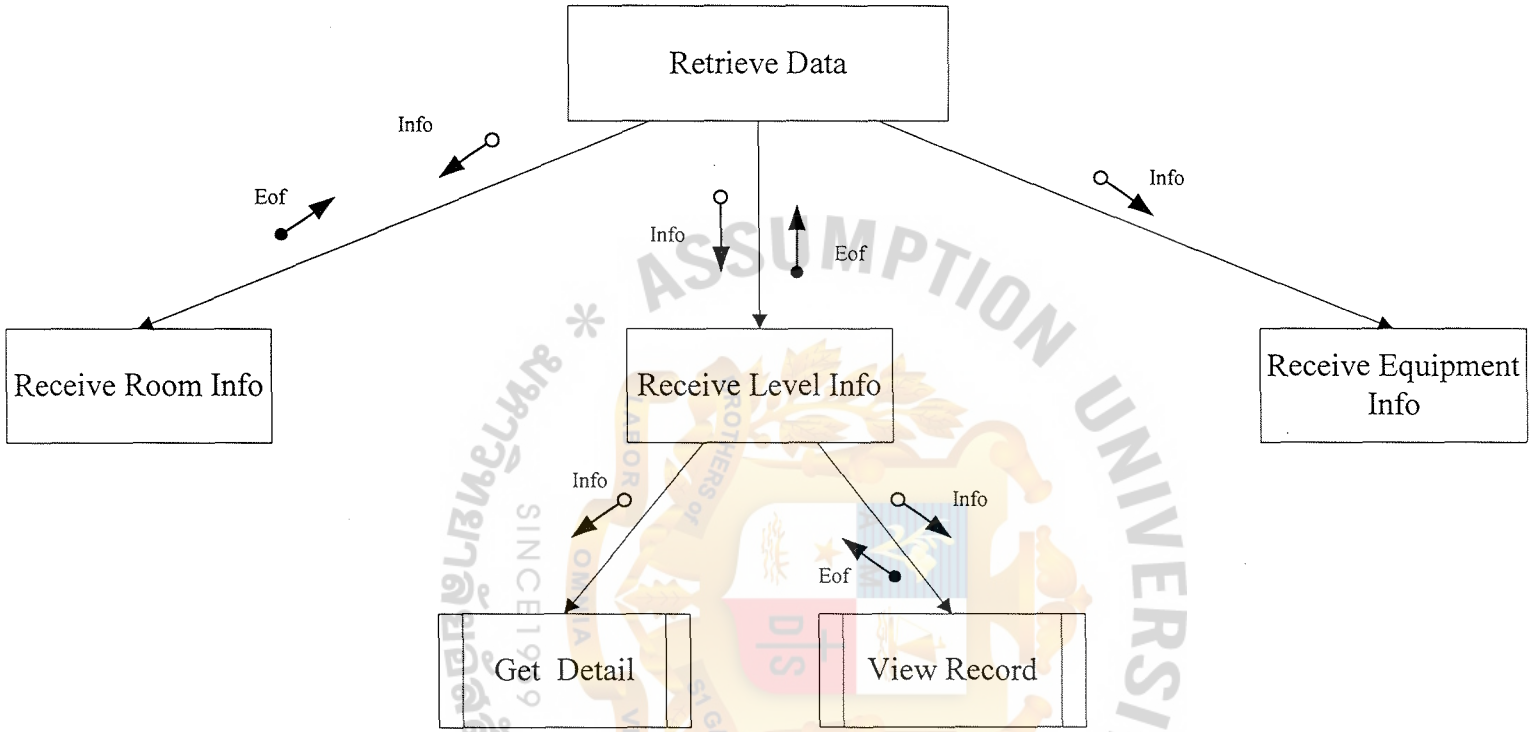

Figure E.4. Structure Chart of process 3.1 retrieve data.

APPENDIX F

DATA DICTIONARY

Table F.1. Cable Information.

Field Name	Description	Type	Width/format	Index
id	cable code	text	14	N
type	cable type	text	18	N
length	cable length	number	integer	N
signal	signal	text	13	N

Table F.2. Source Information.

Field Name	Description	Type	Width/format	Index
s_id	source id	text	16	Y
s_name	source name -eqip	text	20	N
s_floor	floor of equip	text	10	N
s_loc	equip location	text	30	N

Table F.3. Destination Information.

Field Name	Description	Type	Width/format	Index
d_id	destination id	text	16	Y
s_name	destination name	text	20	N
s_floor	floor of equip	text	10	N
s_loc	destination location	text	30	N

Table F.4. Location Information.

Field Name	Description	Type	Width/format	Index
l_id	record no. - key field	number	long integer	Y
l_name	name	text	30	N

Table F.5. Floor Information.

Field Name	Description	Type	Width/format	Index
F_id	record no. - key field	number	long integer	Y
F_name	name	text	50	N
F_desc	description	text	250	N
F_abrev	shorter name	text	10	N

Table F.6. Diagram.

Field Name	Description	Type	Width/format	Index
Di_id	id	text	10	Y
Di_prono	project id	text	12	N
Di_prona	name	text	100	N
Di_start	date start	date	8	N
Di_end	date end	date	8	N

Table F.7. Eqipment Information.

Field Name	Description	Type	Width/format	Index
eq_id	id	number	long integer	Y
eq_name	equipment id	text	20	N
eq_desc	description	text	250	N

Table F.8. Level Information.

Field Name	Description	Type	Width/format	Index
le_id	id	number	long integer	N
le_name	level name	text	15	N
le_note	detail	text	250	N

Table F.9. Room Information.

Field Name	Description	Type	Width/format	Index
R_id	room no - key field	number	long integer	Y
R_name	room name	text	25	N
R_loc	location	text	30	N
R_floor	floor	text	10	N
R_desc	description	text	250	N

APPENDIX G

SCREEN DESIGN

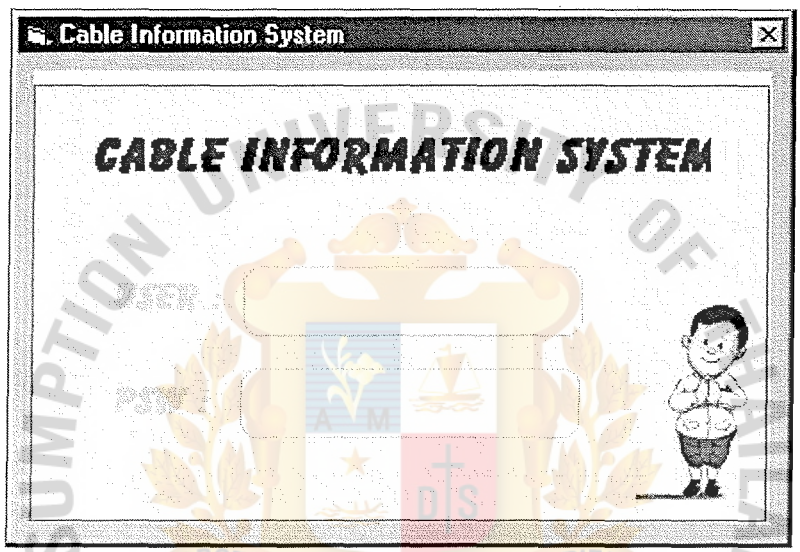

Figure G.1. Cable Information System Log On Screen.

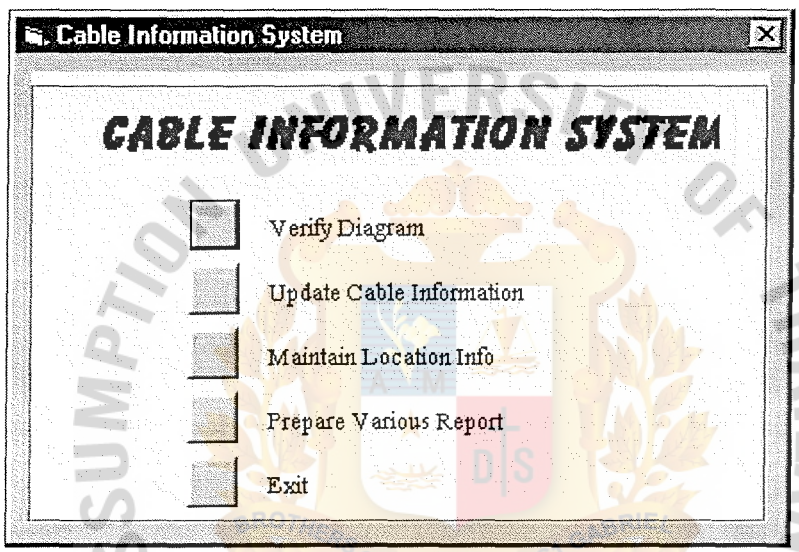

Figure G.2. Cable Information System Menu.

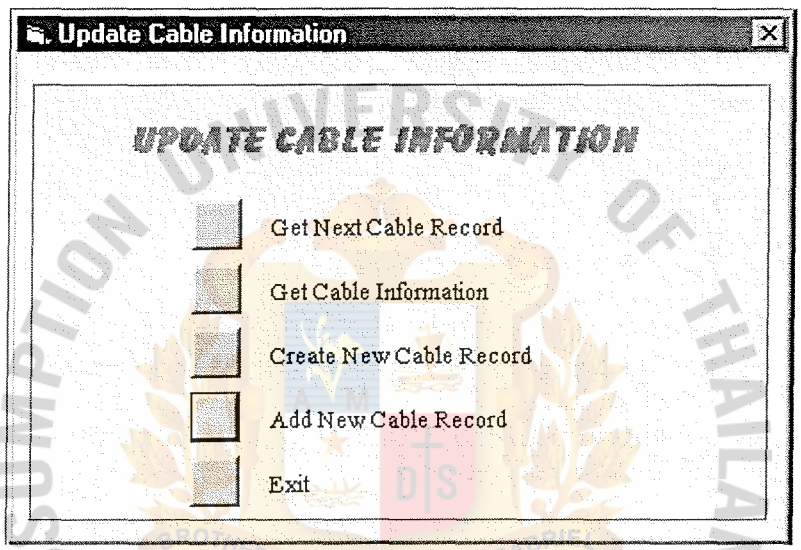

Figure G.3. Update Cable Information Menu.

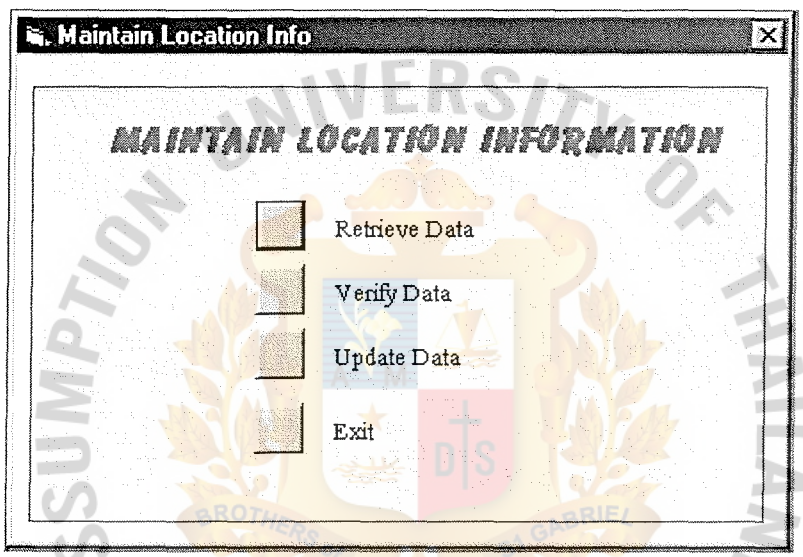

Figure G.4. Maintain Location Info Menu.

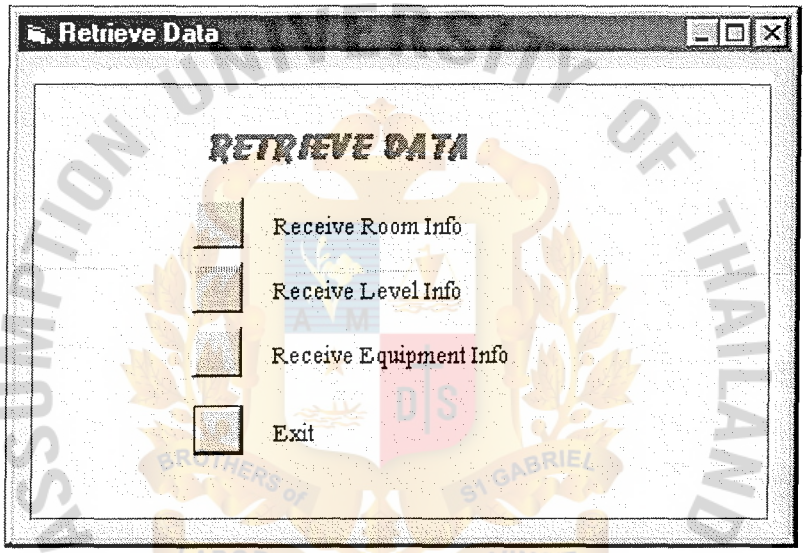

Figure G.5. Retrieve Data Menu.

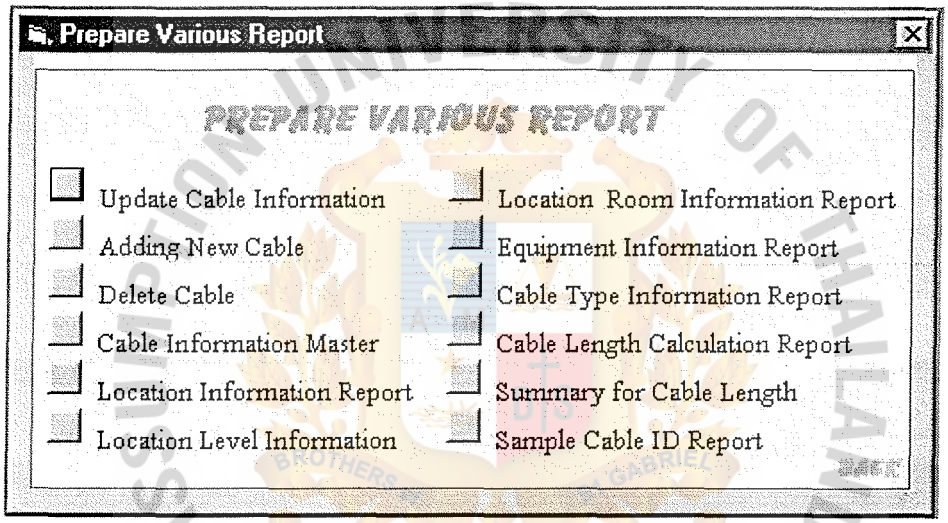

Figure G.6. Prepare Various Report Menu.

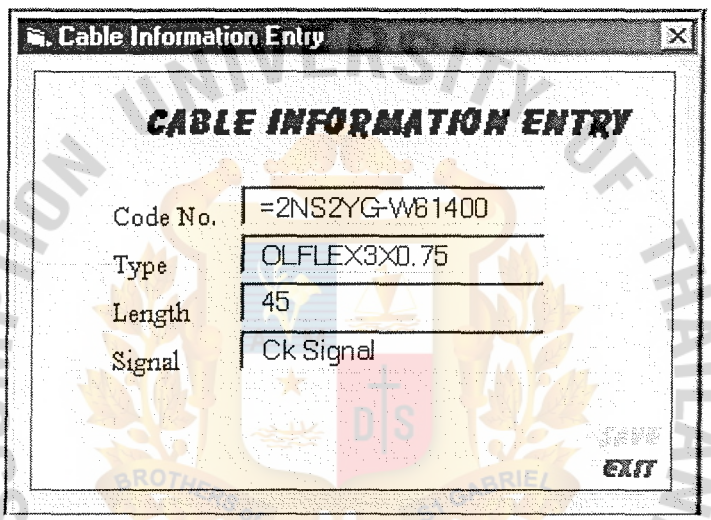

Figure G.7. Cable Information Entry Menu.

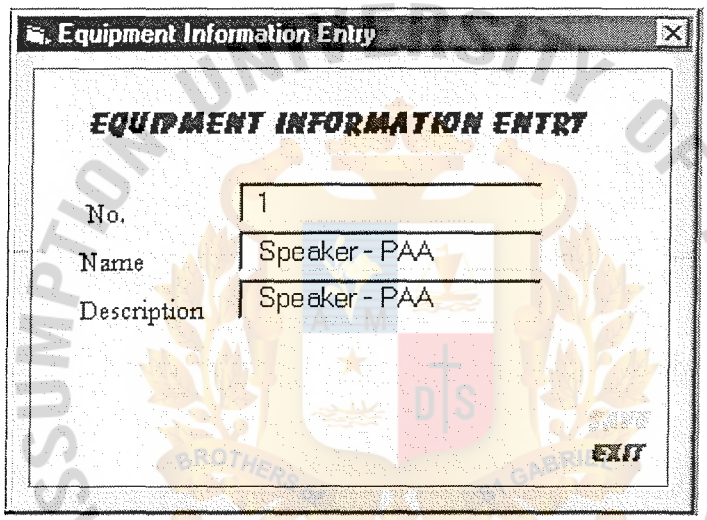

Figure G.8. Equipment Information Menu.

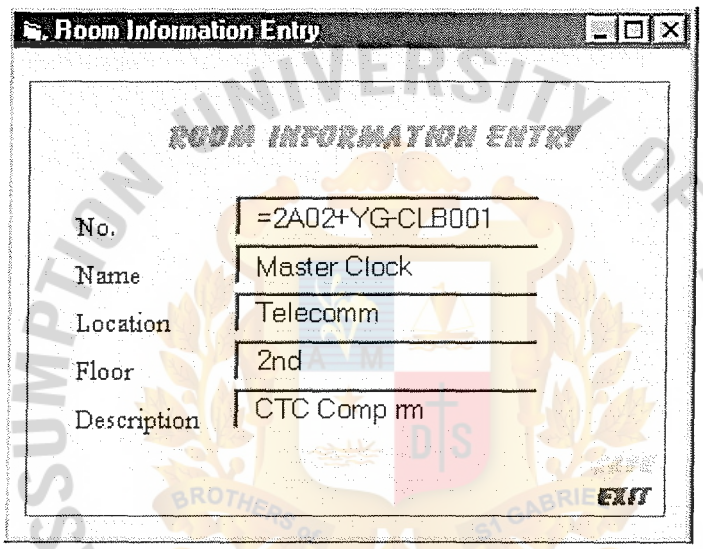

Figure G.9. Room Information Entry Menu.

RPT 001

Cable List for Clock System at Station N2

Source Loc.	Source Lev.	Room No.	Source Equip.	Source ID.	Cabe Type	Cable ID.	Signal	Dest Loc.	Dest. Lev.	Room No.	Dest Equip.	Dest ID.	Route		Length
													from	to	
Stn. N2	Conc	Stn crtl rm - 2-02	CLI	=2NS2+YG-CLI001	OLFLEX3XO.75	=2NS2YG-W61400	CK Signal	Stn. N2	Conc	Public Area	CLE	=2NS2+YG-CLE002			45
Stn. N2	Conc	Pub. Area - 3-01	CLE	=2NS2+YG-CLE002	OLFLEX3XO.75	=2NS2YG-W61400	CK Signal	Stn. N2	Conc	First Aid Rm.	CLD	=2NS2+YG-CLD003			25
Stn. N2	Conc	First ad. Rm. - 2-07	CLD	=2NS2+YG-CLD003	OLFLEX3XO.75	=2NS2YG-W61400	CK Signal	Stn. N2	Conc	Police Room 2-06	CLD	=2NS2+YG-CLE004			20
Stn. N2	Conc	Ticket Off	CLI	=2NS2+YG-CLI004	OLFLEX3XO.75	=2NS2YG-W61400	CK Signal	Stn. N2	Conc	Pub. Area - 3-01	CLE	=2NS2+YG-CLD006			15
Stn. N2	PI	Platform	CLF	=2NS2+YG-CLF005	OLFLEX3XO.75	=2NS2YG-W61403	CK Signal	Stn. N2	PI	Platform	CLF	=2NS2+YG-CLF012			
Stn. N2	PI	Platform	CLF	=2NS2+YG-CLF006	OLFLEX3XO.75	=2NS2YG-W61403	CK Signal	Stn. N2	PI	Platform	CLF	=2NS2+YG-CLF010			
Stn. N2	PI	Platform	CLF	=2NS2+YG-CLF007	OLFLEX3XO.75	=2NS2YG-W61403	CK Signal	Stn. N2	PI	Platform	CLF	=2NS2+YG-CLE009			

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Figure H.1. Cable List for Clock System at Station N2.

RPT 002

Cable List for P.A System at Station N3

Source Loc.	Source Lev.	Room No.	Source Equip.	Source ID.	Cabe Type	Cable ID.	Signal	Dest Loc.	Dest. Lev.	Room No.	Dest Equip.	Dest ID.	Route		Length
													from	to	
Stn. N3	PI 1	Tel. Rm. 2-12	Speaker - PAA	=2NT3+YF-PAA 1-01	(N) HXH E30 3x1.5 RE	=2NT3YF-W51400	Voice Signal	Stn. N3	PI 1		Speaker - PAA	=2NT3+YF-PAA 1-03			
Stn. N4	PI 1		Speaker - PAA	=2NT3+YF-PAA 1-03	(N) HXH E30 3x1.5 RE	=2NT3YF-W51400	Voice Signal	Stn. N3	PI 1		Speaker - PAA	=2NT3+YF-PAA 1-05			
Stn. N5	PI 1		Speaker - PAA	=2NT3+YF-PAA 1-05	(N) HXH E30 3x1.5 RE	=2NT3YF-W51400	Voice Signal	Stn. N3	PI 1		Speaker - PAA	=2NT3+YF-PAA 1-07			
Stn. N6	PI 1		Speaker - PAA	=2NT3+YF-PAA 1-07	(N) HXH E30 3x1.5 RE	=2NT3YF-W51400	Voice Signal	Stn. N3	PI 1		Speaker - PAA	=2NT3+YF-PAA 1-09			
Stn. N7	PI 1		Speaker - PAA	=2NT3+YF-PAA 1-09	(N) HXH E30 3x1.5 RE	=2NT3YF-W51400	Voice Signal	Stn. N3	PI 1		Speaker - PAA	=2NT3+YF-PAA 1-11			
Stn. N8	PI 1		Speaker - PAA	=2NT3+YF-PAA 1-11	(N) HXH E30 3x1.5 RE	=2NT3YF-W51400	Voice Signal	Stn. N3	PI 1		Speaker - PAA	=2NT3+YF-PAA 1-13			
Stn. N9	PI 1		Speaker - PAA	=2NT3+YF-PAA 1-13	(N) HXH E30 3x1.5 RE	=2NT3YF-W51400	Voice Signal	Stn. N3	PI 1		Speaker - PAA	=2NT3+YF-PAA 1-15			

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Figure H.2. Cable List for P.A System at Station N3.

RPT 003

Cable List for DEPOT

Source ID.	Source Name	Source Floor	Source Loc.	Cable ID.	Cabe Type	Length	Dest Id.	Dest Name	Dest Floor	Dest Location
=2DGO+YC-LDF 001	LDF	Gd	Telecomm Room	=2D00YC-W61600	J-H(st)H 2x2x0.8 mm	0	=2DGO+YC-TLC 1- TLC01	SCADA	Gd	Workshop Area
=2DGO+YC-LDF 001	LDF	Gd	Telecomm Room	=2D00YC-W61601	J-H(st)H 2x2x0.8 mm	0	=2DGO+YC-TLC 1- TLC01	SCADA	Gd	Workshop Area
=2DGO+YC-LDF 001	LDF	Gd	Telecomm Room	=2D00YC-W61602	J-H(st)H 2x2x0.8 mm	0	=2DGO+YC-TLC 1- TLC01	SCADA	Gd	Workshop Area
=2DGO+YC-LDF 001	LDF	Gd	Telecomm Room	=2D00YC-W61603	J-H(st)H 2x2x0.8 mm	0	=2DGO+YC-TLC 1- TLC01	SCADA	Gd	Workshop Area
=2DGO+YC-LDF 001	LDF	Gd	Telecomm Room	=2D00YC-W61604	J-H(st)H 2x2x0.8 mm	0	=2DGO+YC-TLC 1- TLC01	SCADA	Gd	Workshop Area
=2DGO+YC-LDF 001	LDF	Gd	Telecomm Room	=2D00YC-W61605	J-H(st)H 2x2x0.8 mm	0	=2DGO+YC-TLC 1- TLC01	SCADA	Gd	Workshop Area
=2DGO+YC-LDF 001	LDF	Gd	Telecomm Room	=2D00YC-W61606	J-H(st)H 2x2x0.8 mm	0	=2DGO+YC-TLC 1- TLC01	SCADA	Gd	Workshop Area

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Figure H.3. Cable List for DEPOT.

RPT 004

Cable List for [Type J-H(st)h 4x2x0.5 mm2]

Source ID.	Source Name	Source Floor	Source Loc.	Cable ID.	Cabe Type	Length	Dest Id.	Dest Name	Dest Floor	Dest Location
=2A02+YG-CLB 001	Master Clock	2nd	Telecomm Room	=2A02YG-W61406	J-H(st)H 4x2x0.5 mm2	60		SCADA	Gd	SCADA Comp rm
=2A02+YG-CLB 001	Master Clock	2nd	Telecomm Room	=2A02YG-W61407	J-H(st)H 4x2x0.5 mm2	50		SCADA	Gd	Tel rm
=2A02+YG-CLB 001	Master Clock	2nd	Telecomm Room	=2A02YG-W61408	J-H(st)H 4x2x0.5 mm2	13	=2A02+YC-TLI 001	PABX	2nd	Tel rm
=2A02+YG-CLB 001	Master Clock	2nd	Telecomm Room	=2A02YG-W61409	J-H(st)H 4x2x0.5 mm2	15	=2A02+YC-TLI 001	OTN Silom Line	2nd	Tel rm
=2A02+YG-CLB 001	Master Clock	2nd	Telecomm Room	=2A02YG-W61410	J-H(st)H 4x2x0.5 mm2	16	=2A02+YC-TLI 001	Radio	2nd	Tel rm
=2A02+YG-CLB 001	Master Clock	2nd	Telecomm Room	=2A02YG-W61411	J-H(st)H 4x2x0.5 mm2	17	=2A02+YC-TLI 001	AFC	2nd	AFC Comp rm
=2A02+YG-CLB 001	Master Clock	2nd	Telecomm Room	=2A02YG-W61412	J-H(st)H 4x2x0.5 mm2	17	=2A02+YC-TLI 001	SCADA	2nd	
						188				

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Figure H.4. Cable List for Type J-H (st)h 4x2x0.5 mm2.

Cable List for Radio at Admin.

Source ID.	Source Name	Source Floor	Source Loc.	Cable ID.	Cabe Type	Length	Dest Id.	Dest Name	Dest Floor	Dest Location
=2A02+YD-RCS 001	Radio Switch	2nd	Telecomm Room	=2A02YD-W61400	J-H(st)H 16x2x0.8 mm2	7	=2A02+YC-TLI 001	OTN Node 30-7	2nd	Telecomm. Room
=2A02+YD-RCS 001	Radio Switch	2nd	Telecomm Room	=2A02YD-W61401	J-H(st)H 16x2x0.8 mm2	7	=2A02+YC-TLI 001	OTN Node 31-6	2nd	Telecomm. Room
=2A02+YD-RCS 001	Radio Switch	2nd	Telecomm Room	=2A02YD-W61402	J-H(st)H 16x2x0.8 mm2	7	=2A02+YC-TLI 001	OTN Node 31-7	2nd	Telecomm. Room
=2A02+YD-RCS 001	Radio Switch	2nd	Telecomm Room	=2A02YD-W61403	J-H(st)H 16x2x0.8 mm2	7	=2A02+YC-TLI 002	OTN Node 31-8	2nd	Telecomm. Room
=2A02+YD-RCS 001	Radio Switch	2nd	Telecomm Room	=2A02YD-W61404	J-H(st)H 16x2x0.8 mm2	7	=2A02+YC-TLI 002	OTN Node 32-7	2nd	Telecomm. Room
=2A02+YD-RCS 001	Radio Switch	2nd	Telecomm Room	=2A02YD-W61405	J-H(st)H 16x2x0.8 mm2	7	=2A02+YC-TLI 002	OTN Node 32-8	2nd	Telecomm. Room
=2A02+YD-RCS 001	Radio Switch	2nd	Telecomm Room	=2A02YD-W61406	J-H(st)H 16x2x0.8 mm2	7	=2A02+YC-TLI 002	OTN Node 02-6	2nd	Telecomm. Room
						49				

For Construction Only

Data Date : 10.06.2000

Print Date : 11.06.2000

Figure H.5. Cable List for Radio at Admin.

RPT 006

Equipment Information Report

Type	ID.
Signal	W6
PA Speaker	W5
Power	W2

For Construction Only

Data Date : 10.06.2000

Print Date : 11.06.2000

Figure H.6. Equipment Information Report.

RPT 007

Cable Length for Admin. BLDG

Cable Type	Total (m)
Cable 8x2x0.6	80
Cable 8x2x0.8	30
Coaxial Cable	2826
HX SL HX CHX 3x0.75	3189
J-H(st)H 16x2x0.8 mm	2156
TTY	526

Figure H.7. Cabel Length for Admin. BLDG.

RPT 008

Location Room Information

Floor	Location
2nd	AFC Comp rm
2nd	SCADA Comp Room
2nd	Telecomm Room
Gd	CTC Comp rm
Gd	Telecomm Room
Gd	UPS Battery Room

Figure H.8. Location Room Information Report.

RPT 009

Cable Type Information Report

Cable ID.	Cabe Type	Signal
=2NS2YG-W61400	OLFLEX3XO.75	CK Signal
=2NT3YF-W51400	(N) HXH E30 3x1.5 RE	Voice Signal
=2D00YC-W61600	J-H(st)H 2x2x0.8 mm	CK Signal
=2D00YC-W61601	J-H(st)H 2x2x0.8 mm	
=2A02YG-W61409	J-H(st)H 4x2x0.5 mm2	
=2A02YD-W61405	J-H(st)H 16x2x0.8 mm2	

Figure H.9. Cable Type Information Report.

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