TECHNICAL LOSSES EVALUATION ON UTP ELECTRICAL NETWORK

NOR ADIBA BINTI ZULKIFLI

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Technical Losses Evaluation on UTP Electrical Network

By

Nor Adiba binti Zulkifli

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Approved by,

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(Puan Khairul Nisak Binti Md Hasan)

FYP Supervisor

Universiti Teknologi PETRONAS

Seri Iskandar

32610 Tronoh

Perak Darul Ridzuan

Malaysia

CERTIFICATION OF ORIGINALITY

This is to certify that I am responsible for the work submitted in this report, that the original work is my own except as specified in the references and acknowledgements, and that the original work contained herein have not been taken or done by unspecified sources or persons.

NOR ADIBA BINTI ZULKIFLI

ABSTRACT

This project represent the electrical losses analysis which conducted in Universiti Teknologi PETRONAS. The project was conducted on the 11 kV distribution system which consist of UTP Old Building and New Academic Complex. As discussed above, the system electrical losses can be divided into two sections which are technical losses and non-technical losses. One of the effects is decreasing economic growth of the country. Technical losses consist of internal losses such as transformer losses, copper losses, line losses and others while non-technical losses or known by external losses occurred due to the accounting mistake, metering and theft. The purpose of this project is to analyze the technical losses that occurred in the UTP network in focusing more on the line losses. This project is conducted to evaluate and analyze the performance of the current electrical network and preparing for future expansion of the network which includes the generation from renewable energy. In addition, the project is conducted to determine whether the current performance of the network is in optimum condition or otherwise. The analysis will be conducted by using Power world as the simulator of the project which using load flow and power flow analysis methods. The line losses mostly cause by resistance and inductance in the cable of the lines. The outcome of this project is the total losses of the whole system of UTP electrical network and also the line losses of the cables between the busses. Lastly, the author discussed about the methods to reduce the losses that occurred in the system. The objectives of the project are achieved.

ACKNOWLEDGEMENTS

Alhamdulillah, praise to the Allah for His Kindness and Merciful for giving the ability to do research and conduct experiments about the project which entitled 'Technical Losses Evaluation on UTP Electrical Network' which is conducted in Universiti Teknologi Petronas (UTP) for two semesters. Even though, I did have a lot of challenges and problems, I still able to complete the research which makes me felt really thankful to Allah for His Bless.

I would also like to express my gratitude to my supervisor Madam Khairul Nisak Bt Md Hassan and my co supervisor of the project Ir Dr Mohd Faris B Abdullah for helping me with the guides and information about the UTP electrical network. Both of them also give a lot of support for the author to complete the project throughout two semesters. I also would like to thank them for giving the opportunity to carry out the project.

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CHAPTER 1: INTRODUCTION

This chapter will briefly introduce the background of the project, objectives, problem statement and also the scope of the project.

1.1 Background of the project

Electrical network divides into three parts which are generation, transmission, and distribution. The electrical losses are classified into two sections which is technical losses and non-technical losses. Non-technical losses or commercial losses classified as the losses occurred due to the electricity theft, non-payment by consumers and human errors such as calculation errors. However, in this project only technical losses will be discussed. Commonly, the technical losses occurred during the transportation of electricity which also related to the equipment used and supply demand. [1] The losses occurred in UTP network are the wasteful energy which caused by internal and external factors. [2] The details of the losses will be discusses in the literature review chapter.

1.2 Problem Statement

This project is carried out mainly to evaluate and analyses the losses that occurred in UTP electrical network since the technical losses could increase the cost of operating electricity throughout UTP. Hence to find the optimum solution to reduce the losses, this project is conducted.

1.3 Objectives

The objectives of the project are listed below:

1. To evaluate and analyses the losses which focus more on the line losses throughout the network for current operation.
2. To propose solution to improve the performance by minimizing line losses.

1.4 Scope of study

UTP electrical network divided into old building and new building. The buildings that included in the old building section are lecture hall 1, lecture hall 2, lecture hall 3, village 1, village 2, block I, J, K, N and others. Meanwhile, the new building consist of Chancellor Hall, Pocket C, pocket D, block 1 – 23, and others.

CHAPTER 2: LITERATURE REVIEW

2.1 Definition of technical losses

Technical losses can be defined as losses occurred during the transmission and distribution of electricity. The major losses are usually observed in primary and secondary distribution which is detected in transmission line, transformer, and distribution line. In addition, there are two kinds of technical losses which are permanent technical losses and non-permanent technical losses.[1]

2.1.1 Permanent losses

The permanent loss is the loss that is not varies with the current. This loss could be from the form of heat or noise as long the transformer is working. The loss example is listed below:

a) Leakage current
b) Dielectric current
c) Open-circuit losses
d) Others

2.1.2 Non-permanent losses

A non-permanent loss is the loss that is varies with the value of electricity. The examples of this loss are impedance loss and the loss occurs during the resistance interaction. For the losses involving resistance it can be lowered by lowering the current, resistance and impedance. It also can be minimize by reducing the voltages.[1]

2.2 Type of losses

Losses that occurred in UTP electrical network can be define in many methods. One of the losses occurred in the resistive materials and magnetized energy in the transformer, motors and the line cables. The losses above can be reduced by decreasing the current, resistance and impedance and also the voltages.[1]

The method used to calculate the electrical power loss is listed below:

a) Transmission losses
b) Differential power loss method
c) Computing line flows and line losses
d) System parameters analysis
e) Load Flow

2.2.1 Transmission losses

Below, the transmission line efficiency calculation formula is stated by the author,

$$\eta = \frac{PR}{PS} = \frac{PR}{PR + PLoss}$$

Where *PR* = power deliver at receiving ends

PLoss = power receiving in the transmission line

PS = power sent from sending ends

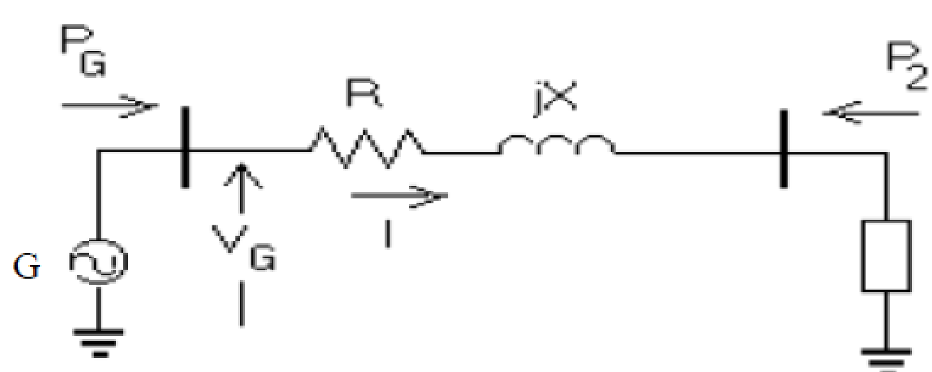


Figure 1: diagram of a generation and a load

The line loss equation is I^2R where I represent current and R represent resistor.

For three-phase equation:

$$PLoss = 3I^2R$$

P_G= Power Generated

V_G= Voltage generated

G=Generator

jX=Reactance

P_2=Power Load

2.2.2 Distribution losses

The core losses can be considering the main power loss in the distribution lines because it affect the system more compare the other loses. The equation of loses will be stated below.[4]

$$P = I^2R$$

P=power

I=current

R=resistance

In addition, the other factor that affect the system is S which is the representative of real and reactive power. The higher the voltage line, the lower the current of the voltage line and vice versa.[4]

$$S = VI$$

Therefore, for a given power level, the higher voltage line will have lower copper losses. The line resistance depends on many factors, such as the length of the line, the effective cross-sectional area, and the resistivity of the metal of which the line is made. The resistance is inversely proportional to the cross-sectional area and directly proportional to both the length and resistivity.[4]

$$R = \rho \frac{L}{A}$$

R= resistance

L=length of line

A= effective cross-sectional area.

ρ= resistivity

Hence, long line will have a higher resistance and larger losses than a short line with the same current flow. Meanwhile, compared to the wider size of a conductor, the smaller conductor causes the higher resistance and bigger losses.[4]

The author have decided to focus on line losses as the technical losses that chosen among of others losses. This is because line losses greatly affect the performance of the electrical system.

2.2.3 Transformer losses

Transformer uses the lagging power factor since it is inductive in nature. However to determine the transformer loss is the load which define the power factor and energy used [4].

Transformer has two main components that drive the losses which are the core and the coils. The core which made by laminated steel is magnetized by magnetic field to produce the energy.[5]

Transformer losses can be categorized as:

i. No load(Wi)
   - Placed at iron/core including the hysteresis losses and eddy current losses in the core.[5][6]

ii. Winding losses/ Load losses

- This losses occur in the winding system. I^2R losses and stray losses are from the function of load current. Eddy current which produced the electromagnetic flux in the winding and core has caused the stray losses to occur.[4][6]

iii. Other losses (W other)

- The other losses that occurs in the transformer such as dielectric losses, oil leakage, joint and cable problem and improper maintenance and connections.[4][6]

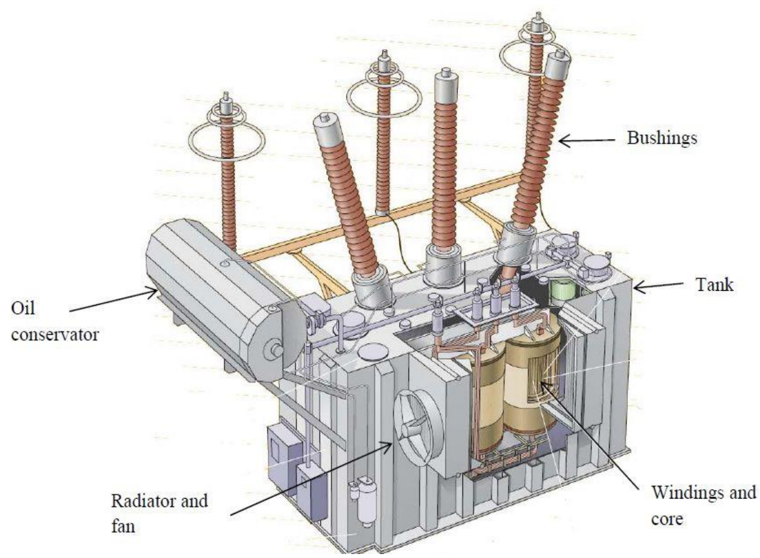


Figure 2: Transformer components

Figure 2 above shows the component of the transformer which are oil conservator, bushings, tank, windings and core, radiator and also fan.

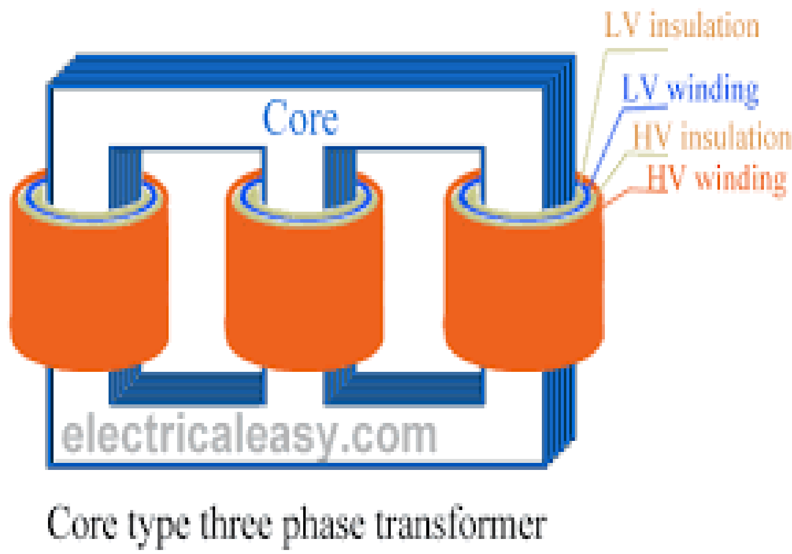


Figure 3: Transformer core

Figure 3 shows the three phase transformer core which divided into two insulations and two winding. For insulation, it consists of LV and HV insulation and also the same for winding.

Table 1: Standard Transformer Loss Table[6]

SI.NO	Transformer Rating KVA	Wi (W)	Wc (W)
1	100	350	2500
2	200	570	3300
3	250	748	3163
4	315	800	4600
5	500	1030	6860
6	1000	1800	11000
7	2000	3000	20000

The equation below is the equation of the winding or copper loss determined from the winding resistance,

$$P = RI^2rms$$

The core loss is a transformer is expressed in terms of hysteresis and eddy currents

$$Pcore \propto f.B^{1.6-2.0}$$

B= flux intensity of the core material

f=frequency

$$E = \oint dWm = \oint H.dB$$

The current induced from magnetism caused the I~R loss, this loss is called eddy current loss.[4]

Meanwhile, harmonics distortion also causes the transformer losses to occur in the electrical network. The increasing harmonic voltage cause losses in the magnetic core while increasing current cause losses to occur in the winding and the structure of transformer. In conclusion, the harmonic losses that occur causes the heat dissipation increased in winding and give impact on the transformer itself as it will reduce the life performance of the transformer.[7]

PT = PNL + PLL

Where,

PT = total loss, watt,

PNL = no load loss, watt,

PLL = load loss, watt

Table 2 below shows the reference that the author refers before starting the project. Basically, the research papers below show different methods based on the authors of the paper preference. Mostly, the authors define that the technical losses occurred due to the line losses and transformer losses.

Table 2: Review of Research Paper

Title/Author	**Abstract/Introduction**	**Methods/Analysis**	**Results/Conclusion**
Title: Minimasation of Distribution Network Real Power Losses Using Smart Grid Active Network Mnagement Sytem Authors: Lynn McDonnald Dr Ivana Kackar Alan Kane Euon Davidson	- Network Losses contribute to carbon emission. -The United Kindom electricity have increased -The smart grid used to provide accurate real time data in power demand.	Method to Reduce Losses : -Network reconfiguration(Optimal the network) -Distribution Generation(Increase and decrease the output) -Transformer Tap levels(increase or decrease transformer position)	This research is being done to create losses minimization algorithm to determine a suitable reconfiguration to be implemented.

Year: 2010 Publisher: IEEE			
Title: The Effect of Technical and Non-Technical losses in Power Outages in Nigeria Authors: Hachimenum N.Amadi, Ephraim N.C. Okafor Year: 2015 Publisher: International Journal of Scientific & Engineering Research	This paper focus on the effects of technical and non-technical losses and more radical measures than current measures that being used to reduce losses. -Nigerian Network is weak and unreliable which have lot of system losses. -It affect negatively to the country.	Technical losses which also called physical losses consist of Transformers, distribution and transmission) Non-Technical losses (theft, error in meter, error in keeping recording)	-Line loss -joint loss -transformer loss -cables loss -high impedance To improve: -Power system network must properly design. -Maintenance and monitor the transmission and distribution lines.

Title: New Method for computation of technical losses in electrical power distribution systems. Author: C.C.B Oliveira N.Kagen A.Meffe S.Jonathan S.Capporoz J.L Cavaretti Year: 2001 Publisher: IET	8 Different segments 1.energy meters 2.Customer connections to network 3.Low voltage network 4.Distribution transformers 5. Medium voltage network. 6.Distribution substations 7.Subtransmission system 8. ETC -Capacitor -voltage regulators -connectors -insulators	Technical losses = supplied energy Non-Technical losses = billed losses This project conducted using PERTEC software.	Energy meter -Iron loss in voltage coils -losses in customer connections -length and electric reistance.
Title: Analysis of technical losses in electrical power system (Nigerian 330KV	-Electric demand increase because of superiority of electric energy and expansion of power generation and transmission is limited due to limited resources. -This paper focus on	Electrical power loss is wasteful energy caused by internal and external factors technology. -resistance, atmospheric conditions, theft, miscalculations System losses increase operating cost of	Minimize total I^2R losses is maintain a balanced set of voltages Mutual coupling cause voltage

network as case study) Author: M.C Anumaka Year: 2012 Publisher:IJ RRAS	math analysis of losses.	electric utilities, hence increase cost of electricity. Losses incurred in resistance materials can be reduced by: -decrease current -decrease resistance and impedance -decrease voltage.	induce cause unbalance phase cause line not share same current. I^2R frequently used to determine power loss B-loss coefficient an Dapezo methguod

CHAPTER 3: METHODOLOGY

3.1 Flow chart of research

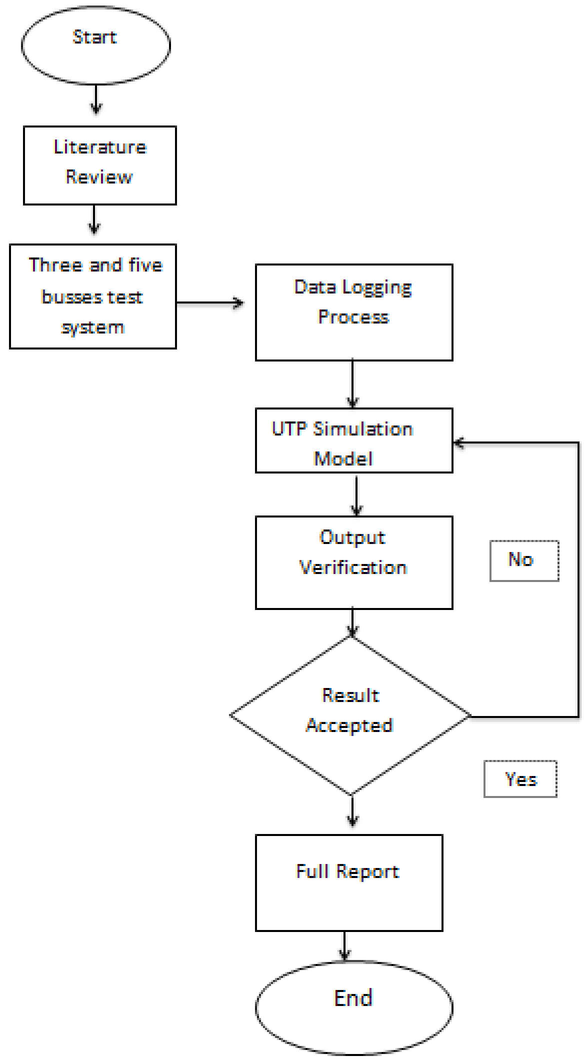


Figure 4: Project Flow Chart

The flow chart above shows the steps for the author to complete the FYP. After the confirmation of the title with supervisor of UTP, the author did a lot of research to understand more about the project and the simulator that suitable to be used in the project. The author then does the simulation example of 3 buses and 5 buses. After the completion of simulation examples, the author starts to gather the data for UTP technical losses and do the simulation to get the output.

3.2 Test System using Power World Simulator

There are several steps taken to design the model. The first step is to select the 'Draw' button and select the component needed which is 'Bus'. Then, filled the information box as shown in the Figure 5 below

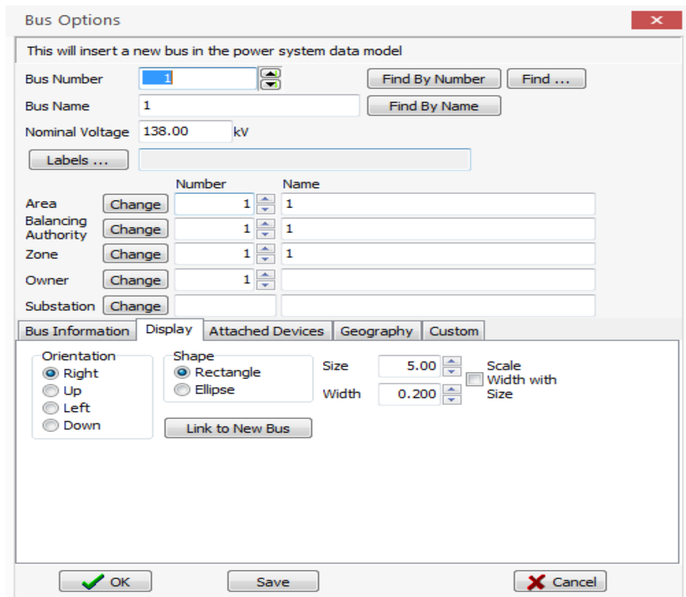


Figure 5: The information box of the Bus

Secondly, the same 'Draw' button is selected and 'Transmission line' is chosen, the drag the mouse to the destination for the transmission line. Next, fill the information box as shown in Figure 6.

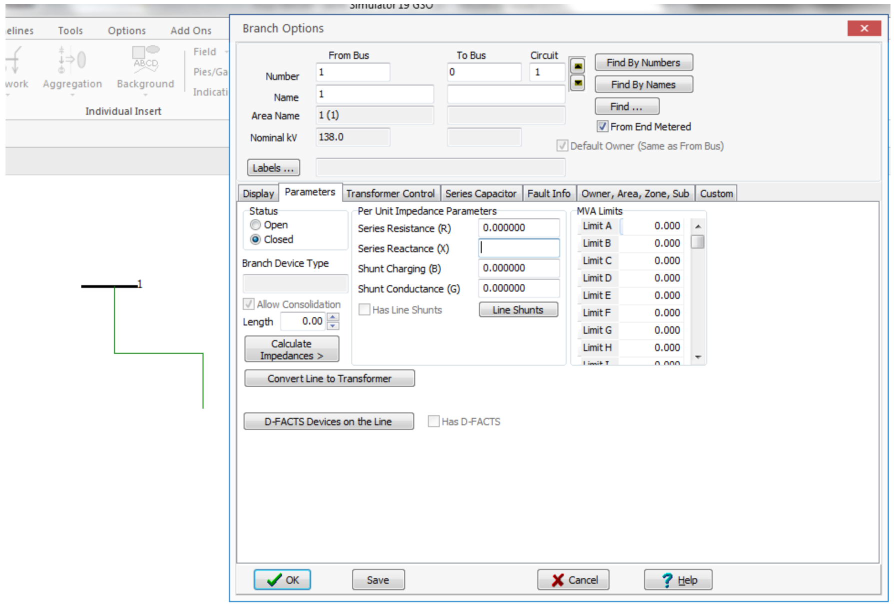
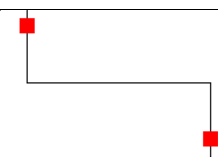
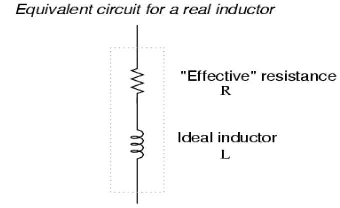
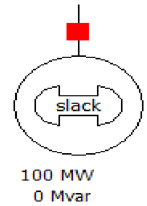
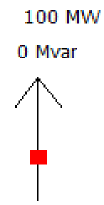
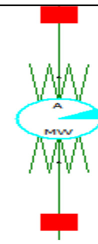


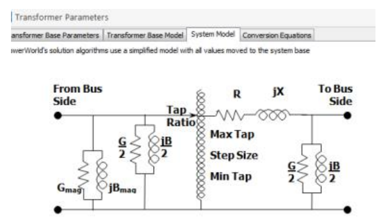
Figure 6: The information box of the Transmission line

The others system and component needed in the simulation are listed below in the Table 3. The same steps above are repeated while choosing the different component.

Table 3: Compilation of system elements and blocks in Power World Simulation

No	System Element	Block Model
1	Bus	
2	Transmission line -consist of inductor, resistor and capacitance. But in the simulation, only inductance and resistance parameter is chosen.	 

<table>
<tr><td>3</td><td>Generator
-supply the power to the lines and load at each busses.</td><td>
</td></tr>
<tr><td>4</td><td>Load
-The load represent the user electricity used per day.</td><td>
</td></tr>
<tr><td>5</td><td>Transformer
-the model used in the system can be observed on the right.
-the transformer use to step down and step up the power.</td><td>


</td></tr>
</table>

In this chapter, the author runs several simulations using Power World simulation to get familiar with the software before using the real data for the UTP network simulation. The simulation consist of three bus and five bus system as the author wants to do simulation with the less busses before modeling for whole UTP network. Figure 4 shows the three bus simulation and figure 5 shows the result based on the running simulation. In Figure 7, the MW losses and MVAR losses can be observe at the right of the bus.

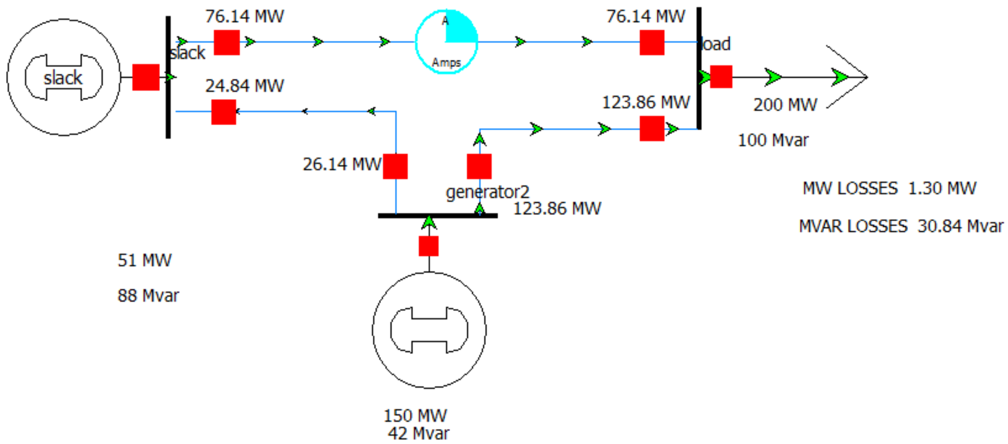


Figure 7: The Three bus simulation

Below shows the figure 8 which represent the 5bus system simulation and result. The line losses can be detect from one point to the another point of line bus which the difference between the power supplied and the power gained.

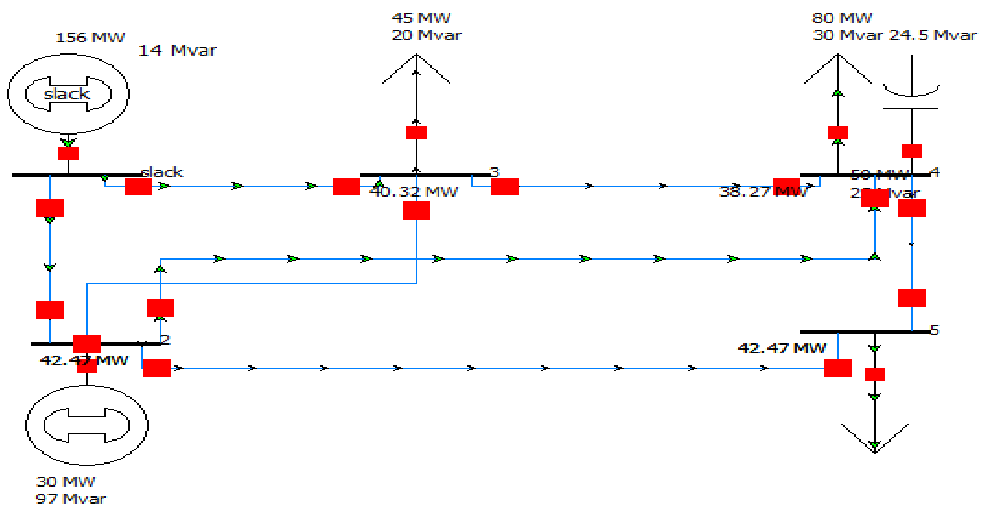


Figure 8: The 5 bus simulation system

3.3 Parameters to modeled UTP simulation

The table 4 below shows the total transformer which is used in UTP electrical network and the rating is included in the simulation in Figure 9 below

Table 4: The details of transformer in UTP

No	Substation	Rated	Tx Brand	Year		Oil liter
1	Compact Substation	750	EWT	1996	2012	4291
2	Mph Substation	1000	EWT	1996	2012	4901
3	Substation 1	1000	EB	1998	2014	7941
4	Substation 5	1000	SGB	2001		6441
5	Substation 5A	1000	SGB	2004		6591
6	Substation 5B	1000	SGB	2004		6591
		1000	SGB	2004		6591
7	Substation ETS	1000	SGB	2005		
8	Substation DS1A	1000	LG	2003		
9	Substation DS1B	1000	LG	2003		
10	Substation DS2	1600	EWT	2000		8291
11	Substation 4	1000	MTM	1994	2014	5281
12	Substation 3	1500	EB	1988	2012	9531
		1500	EB	1988	2012	9531
13	Substation Desajaya	1000	EB	1988	2014	7941
14	3A substation	3000/4200	LG	2002		
		3000/4200	LG	2002		
15	Undercroft	1000/1400	LG	2007		
16	Building 5	2000/2800	LG	2001		

	substation					
		2000/2800	LG	2001		
17	Pocket C substation	1250/1750	LG	2004		
		1250/1750	LG	2004		
18	Pocket D substation	2000/2800	LG	2004		
		2000/2800	LG	2004		
19	MIS 11kV substation	500	EWT	2000		2751
20	Building RND Substation	1500	Scheneider Electric	2013		
		1500	Scheneider Electric	2013		
		1500	Scheneider Electric	2013		
		1500	Scheneider Electric	2013		

Table 4 above shows the total unit of transformer placed in the UTP and its location. The data gained from Mr Tarmizi, the technician in charge for the UTP maintenance. Meanwhile Table 5 indicates the details of the cable that being used in UTP electrical network system. After the author familiar with the simulation tools, the real simulation and data analysis of the UTP network is still in the progression. Power World simulation is used to simulate the power flow and load analysis.

Table 5: XLPE Insulated Power Cable Parameter (Copper Conduction)

Type of Cable	Cable size (mm^2)	Resistance per kilometer (ohm/km)	Inductance per kilometer (mH/km)	Capacitance per kilometer (uF/km)
Three-Core	70	0.32440	0.33740	0.300
	185	0.12800	0.29285	0.430
	240	0.09840	0.28330	0.480
	300	0.07970	0.27375	0.530
Single-Core	400	0.06106	0.38000	0.468

Based on the Table 5 above, the author converted the values of resistance and inductance to the per unit as the simulation required per unit values in the system. The calculated values is represents in the Table 6 below.

Table 6: Converted values of Resistance and Inductance to per unit

Length(km)	Type of core	Cable Size mm2	Resistance(ohm)	Resistance per km	Resistance per km per unit	Inductance (Ohm)	Inductance per km	Inductance per km per unit
1.14	3	300	0.0797	0.090858	0.075089256	0.086	0.09804	0.081024793
1.68	3	240	0.0984	0.165312	0.136621488	0.089	0.14952	0.123570248
0.7	3	300	0.0797	0.05579	0.046107438	0.086	0.0602	0.049752066
0.51	3	70	0.3244	0.165444	0.136730579	0.106	0.05406	0.044677686
0.55	3	300	0.0797	0.043835	0.036227273	0.086	0.0473	0.039090909
0.6	3	300	0.0797	0.04782	0.039520661	0.086	0.0516	0.042644628
1.185	3	300	0.0797	0.0944445	0.078053306	0.086	0.10191	0.08422314
0.453	3	240	0.0984	0.0445752	0.036839008	0.089	0.040317	0.033319835
0.235	3	240	0.0984	0.023124	0.019110744	0.089	0.020915	0.017285124
0.685	3	240	0.0984	0.067404	0.055705785	0.089	0.060965	0.050384298
0.335	3	185	0.128	0.04288	0.035438017	0.092	0.03082	0.025471074
0.772	3	185	0.128	0.098816	0.081666116	0.092	0.071024	0.058697521
1.48	3	240	0.0984	0.145632	0.120357025	0.089	0.13172	0.108859504
0.864	3	240	0.0984	0.0850176	0.070262479	0.089	0.076896	0.063550413
0.55	3	240	0.0984	0.05412	0.044727273	0.089	0.04895	0.040454545
0.546	3	240	0.0984	0.0537264	0.044401983	0.089	0.048594	0.040160331
0.86	3	240	0.0984	0.084624	0.06993719	0.089	0.07654	0.063256198
0.44	3	300	0.0797	0.035068	0.028981818	0.086	0.03784	0.031272727
0.983	3	185	0.128	0.125824	0.103986777	0.092	0.090436	0.074740496
0.688	3	185	0.128	0.088064	0.072780165	0.092	0.063296	0.052310744
0.014	3	185	0.128	0.001792	0.001480992	0.092	0.001288	0.001064463
0.341	3	185	0.128	0.043648	0.036072727	0.092	0.031372	0.025927273
0.339	3	185	0.128	0.043392	0.035861157	0.092	0.031188	0.025775207
0.673	3	185	0.128	0.086144	0.035861157	0.092	0.061916	0.051170248
0.362	3	185	0.128	0.046336	0.038294215	0.092	0.033304	0.027523967
0.012	3	185	0.128	0.001536	0.001269421	0.092	0.001104	0.000912397

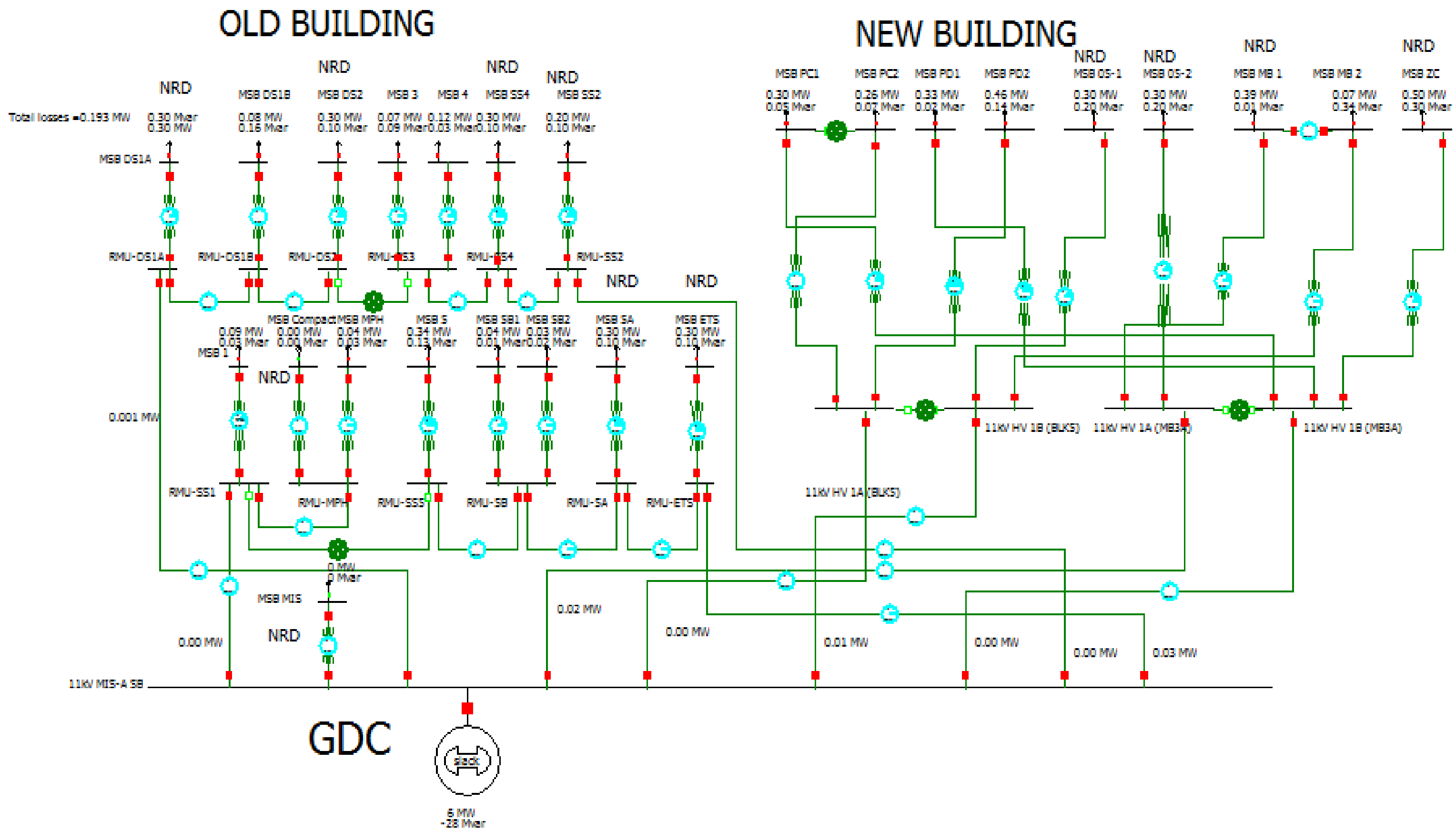


Figure 9: The UTP electrical system simulation

3.4 Data Logging Process

In order to complete the simulation of UTP electrical network using real parameters, data logging process have been conducted based on the schedule on Table 7 below. The process is conducted for one week at certain busses to get the real data of active and reactive power. The equipment used are Fluke 434 1 series, 435 series1 and 2, fluke 1750 and Power Log Classic logger. Figure 10 below shows the connection between the logger to the board of the certain bus at the substation.

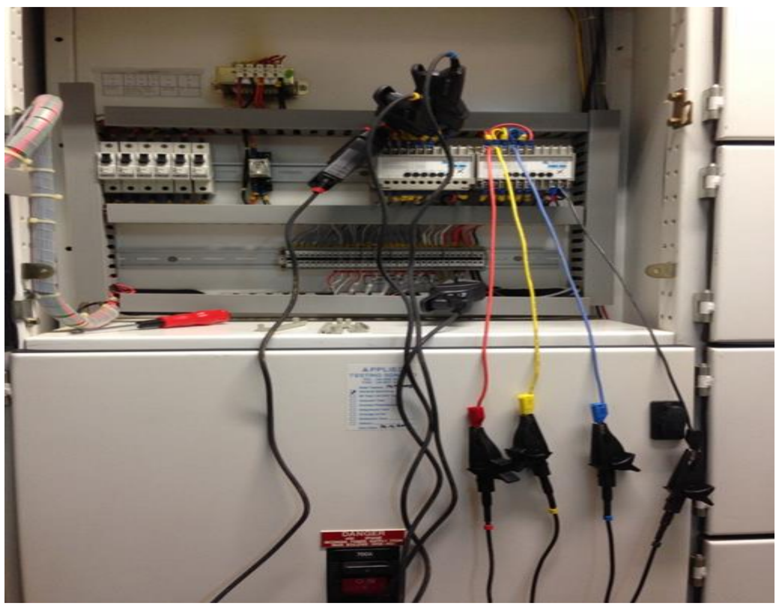


Figure 10: The connection of Logger to the board

Table 7: Data Logging Schedule

Week	Start day	End day	Place	Details	Remark	Time in	Time out	Number of Logger
6	24 Feb (Wed)	2 Mac (Wed)		MSB PC1 MSB PC2 MSB PD1 MSB PD2	435 Series I 1750 Series 434 Series I 435 Series II	10.00 AM 10.00 AM 10.30 AM 10.30 AM	2.30 PM 2.30 PM 2.45 PM 2.45 PM	4
7	9 Mac (Wed)	16 Mac (Wed)		MSB 05-1 MSB 05-2 MSB MB-1 MSB MB-2	435 Series I 1750 Series 434 Series I 435 Series II	3.00 PM 3.00 PM 3.30 PM 3.30 PM	3.00 PM 3.00 PM 3.30 PM 3.30 PM	4
8	2 Mac (Wed)	9 Mac (Wed)		MSB 5 MSB 5A	435 Series I 1750 Series	4.00 PM 4.00 PM	4.00 PM 4.00 PM	2
9	16 Mac (Wed)	23 Mac (Wed)		MSB DS1A MSB DS1B	435 Series I 1750 Series	4.30 PM 4.30 PM	4.30 PM 4.30 PM	2
10	23 Mac (Wed)	30 Mac (Wed)		MSB MPH MSB MIS MSB 5B1 MSB 5B2	435 Series I 1750 Series 434 Series I 435 Series II	4.45 PM 4.45 PM 4.45 PM 4.45 PM	4.45 PM 4.45 PM 4.45 PM 4.45 PM	4
11	30 Mac (Wed)	6 April (Wed)	**Off day**					
12	6 April (Wed)	13 April (Wed)		MSB DS2 MSB SS4 MSB SS2 MSB ETS	435 Series I 1750 Series 434 Series I 435 Series II	10.00 AM 10.00 AM 10.30 AM 10.30 AM	10.00 AM 10.00 AM 10.30 AM 10.30 AM	4
13	14 April (Thu)	21 April (Thu)		MSB 3 MSB 4 MSB 1 MSB Compact	435 Series I 1750 Series 434 Series I 435 Series II	11.30 AM 11.30 AM 11.30 AM 11.30 AM	11.30 AM 11.30 AM 11.30 AM 11.30 AM	2
14	21 April (Thu)	28 April (Thu)	Undercr oft	~~MSB ZC~~ ***Study + Exam Week***	1750 Series	2.00 PM	2.00 PM	1
Total Number of logger								**25**

3.5 Gantt Chart

The table in appendixes section below shows the Gantt chart of the project for the author to complete it within the time frame.

3.6 Key milestone

The table in appendixes section below shows the completion week for the specific task as tabled.

3.7 Tools needed

a) Power World Simulator

Power World simulator is a tool that designed to stimulate and analyses the high voltage power system operation. Hence, the author uses this tool to observe and analyses the UTP electrical network technical losses.

b) Personal computer

The author use this tool to do research and report paper.

c) Google Chrome

The author able to review research papers related to the losses of electricity involving technical and also non-technical losses by using this tool

d) Microsoft Office

The author recorded the data observe from UTP electrical network and research paper using this tools.

e) Power Log Classic

The author use the software to generate the tables of data that being measured at the substations in UTP.

f) Fluke 434 1 series, 435 series1 and 2, fluke 1750

These devices are used in the data logger operation to collect the data from the substation. Figure 11 below shows the equipment used.

Figure 11: Fluke Data Logger.

CHAPTER 4: RESULTS AND DISCUSSION

4.1 Three bus test simulation

This three busses system consists of generator, load, transmission lines and 3 busses. The Losses recorded are 1.30MW for the active power and 30.84Mvar for active power. The Figure 12 below shows the details of losses at each bus.

	From Number	From Name	To Number	To Name	Circuit	Status	Branch Device Type	Xfrmr	MW From	Mvar From	MVA From	Lim MVA	% of MVA Limit (Max)	MW Loss	Mvar Loss
1	1	slack	2	load	1	Closed	Line	NO	76.1	62.2	98.3	400.0	24.6	0.00	9.67
2	1	slack	3	generator2	1	Closed	Line	NO	-24.8	26.1	36.1	0.0	0.0	1.30	1.30
3	3	generator2	2	load	1	Closed	Line	NO	123.9	67.3	141.0	0.0	0.0	0.00	19.87

Figure 12: The result of three bus simulation

4.2 Five bus test simulation

The five busses test system consists of slack bus, generator, load, transmission lines and switched shunt. Figure 13 shows the active and reactive power losses that occurred at each line. At bus 1, the MW loss is 8.64 while the Mvar loss is 17.29.

	From Number	From Name	To Number	To Name	Circuit	Status	Branch Device Type	Xfrmr	MW From	Mvar From	MVA From	Lim MVA	% of MVA Limit (Max)	MW Loss	Mvar Loss
1	1	slack	2	2	1	Closed	Line	NO	63.1	6.0	63.4	0.0	0.0	0.00	12.04
2	1	slack	3	3	1	Closed	Line	NO	92.6	8.0	93.0	0.0	0.0	8.64	17.29
3	3	3	2	2	1	Closed	Line	NO	-1.3	-20.7	20.8	0.0	0.0	0.00	2.09
4	4	4	2	2	1	Closed	Line	NO	-49.3	-24.9	55.2	0.0	0.0	0.00	11.18
5	2	2	5	5	1	Closed	Line	NO	42.5	31.9	53.1	0.0	0.0	0.00	11.29
6	3	3	4	4	1	Closed	Line	NO	40.3	-8.6	41.2	0.0	0.0	2.06	6.17
7	4	4	5	5	1	Closed	Line	NO	7.5	4.7	8.9	0.0	0.0	0.00	0.29

Figure 13: The result of 5 bus system simulation

According to the figure 13, the MW loss occurred at slack bus and also buses 3 while the MVAR loss highest at the slack bus.

4.3 Data Logging Results

The figure 9 shows the connection of UTP electrical network which consist of old building, new academic building and GDC as the generator. The simulation still in progress as the real data still in the analysis stage before can be used in the real simulation.

Figure 14 to figure 35 shows the result of Data logging at UTP substations. The graph shows the power used in each substation according to the time during one week the result being recorded. The highest usage of electricity during the day showed by the peak of the graphs recorded. The peak time is recorded around 11 a.m. to 2 p.m.

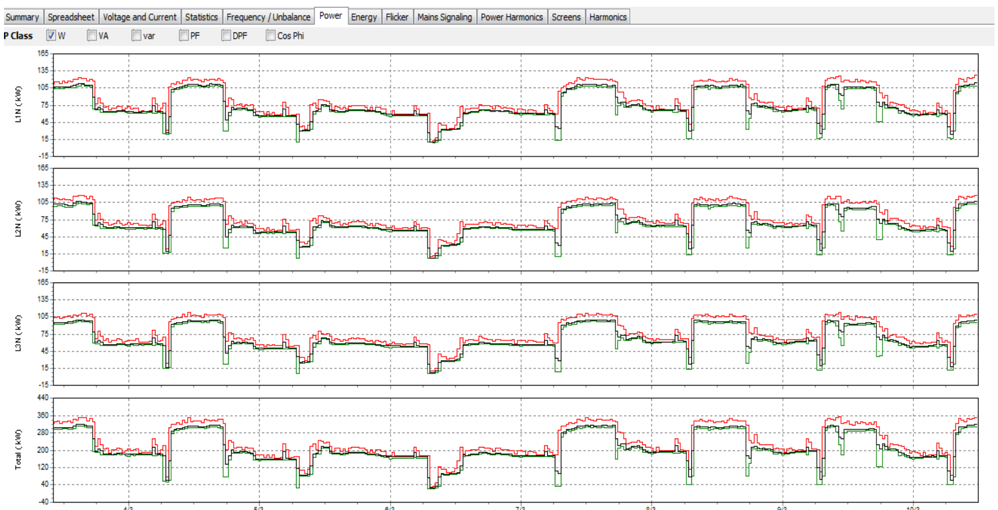


Figure 14: Active Power of MSB 5

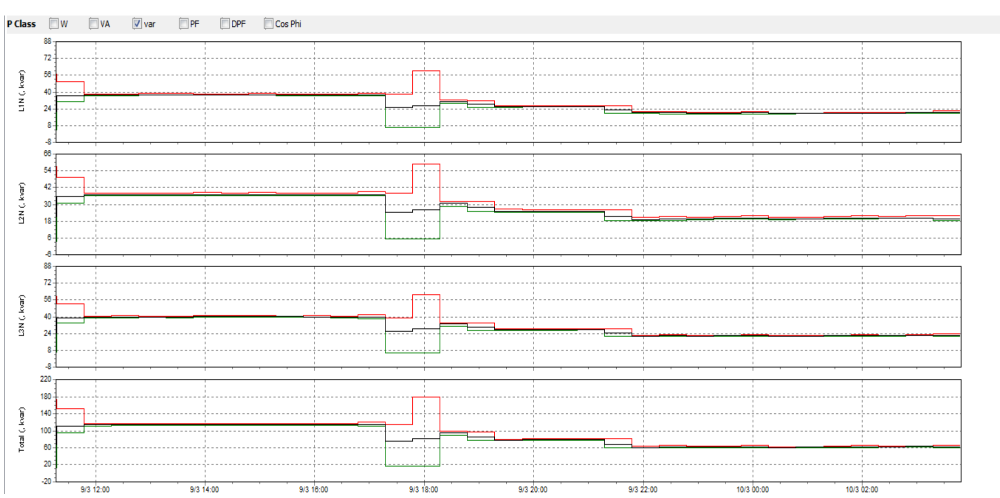


Figure 15: Reactive power of MSB 5

Table 8: The active and reactive power at MSB 5

Day	Active Power (W)	Reactive Power (var)
Monday	25790	14070
Tuesday	33040	26550
Wednesday	20790	11950
Thursday	23260	12690
Friday	31470	16840
Saturday	18010	14710
Sunday	21100	17100

The Table 8 above shows the values of active and reactive power for the whole week at the peak time which is 2 p.m. Moreover, the author decides to choose the peak active and reactive value on Monday to be included in the simulation. The day chosen is fixed for the values of other days also.

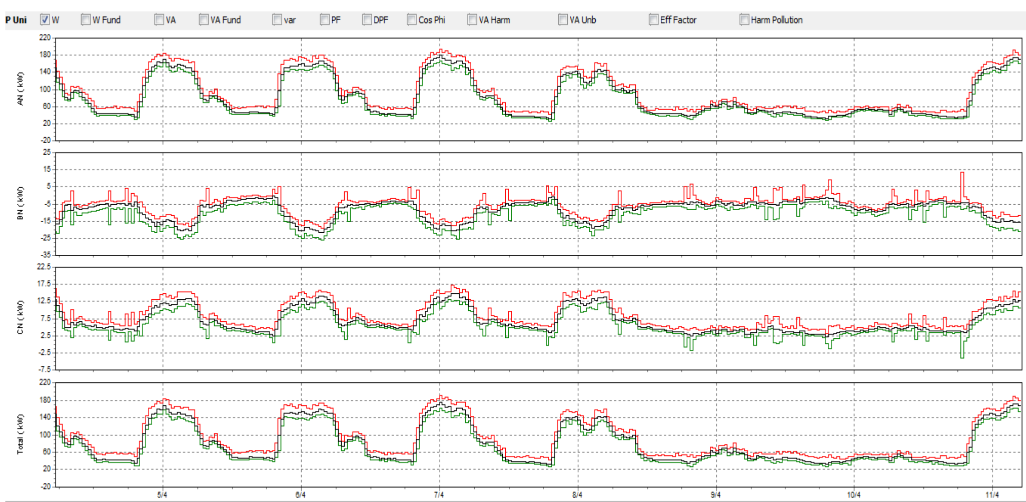


Figure 16: Active power of MSB 3

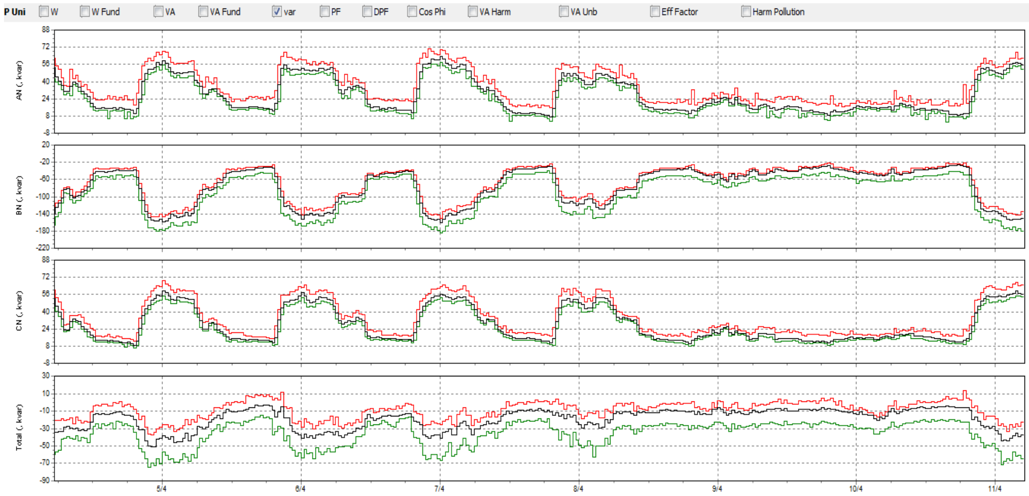


Figure 17: Reactive Power of MSB 3

Figure 16 and Figure 17 shows the recorded graph of active and reactive power at MSB 3 for one week. The real values can be seen at Table 9 below. The peak of the graph shows the highest value of the load being used by the user.

Table 9: The active and reactive power at MSB 3

Day	Active Power (W)	Reactive Power (var)
Monday	70600	94000
Tuesday	67500	92500
Wednesday	66700	93400
Thursday	59900	85100
Friday	65400	91900
Saturday	76000	100300
Sunday	56000	88900

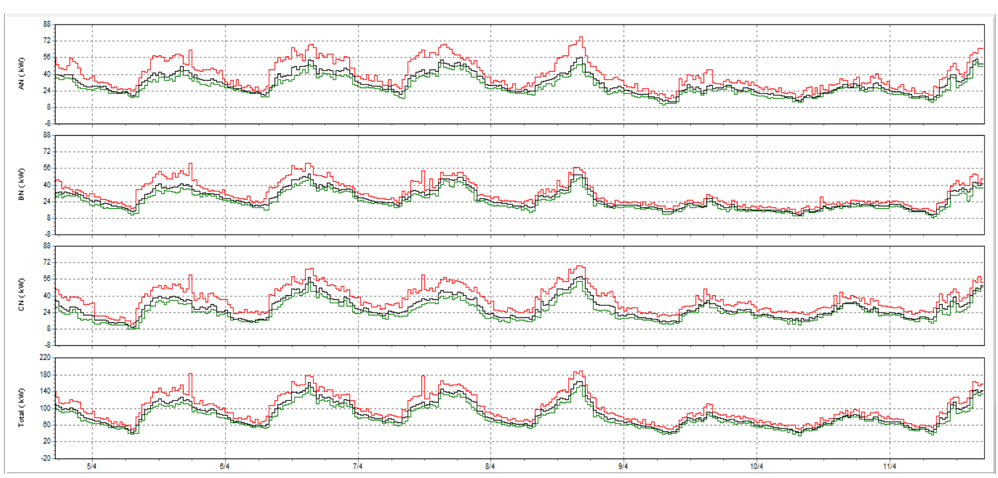


Figure 18: Active Power of MSB 4

Figure 19: Reactive power of MSB 4

Figure 18 and Figure 19 shows the recorded graph of active and reactive power at MSB 4 for one week. The real values can be seen at Table 10 below. The peak of the graph shows the highest value of the load being used by the user. The table below shows the highest active and reactive power recorded at each day which is 2 p.m.

Table 10: The active and reactive power at MSB 4

Day	Active Power (W)	Reactive Power (var)
Monday	124500	33300
Tuesday	139200	46800
Wednesday	154800	45000
Thursday	131700	47400
Friday	170400	57000
Saturday	84000	13200
Sunday	85200	17400

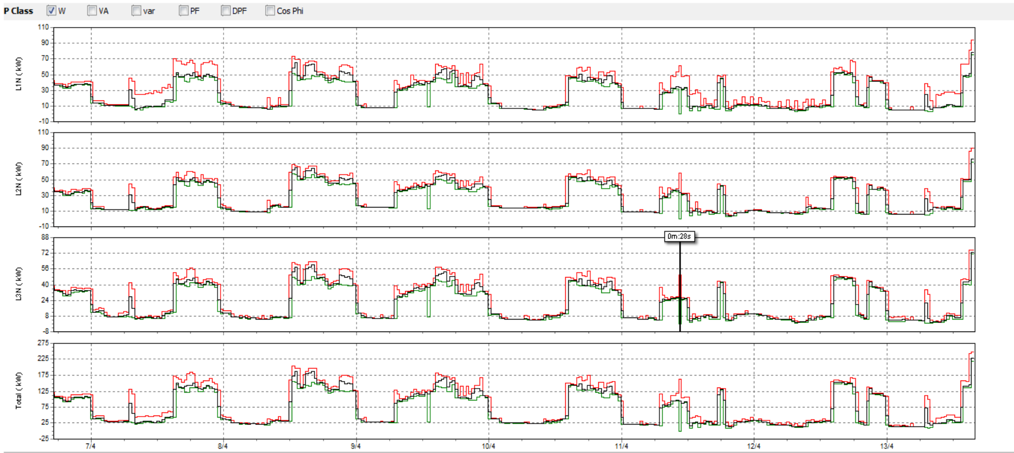


Figure 20: Active power of MPH

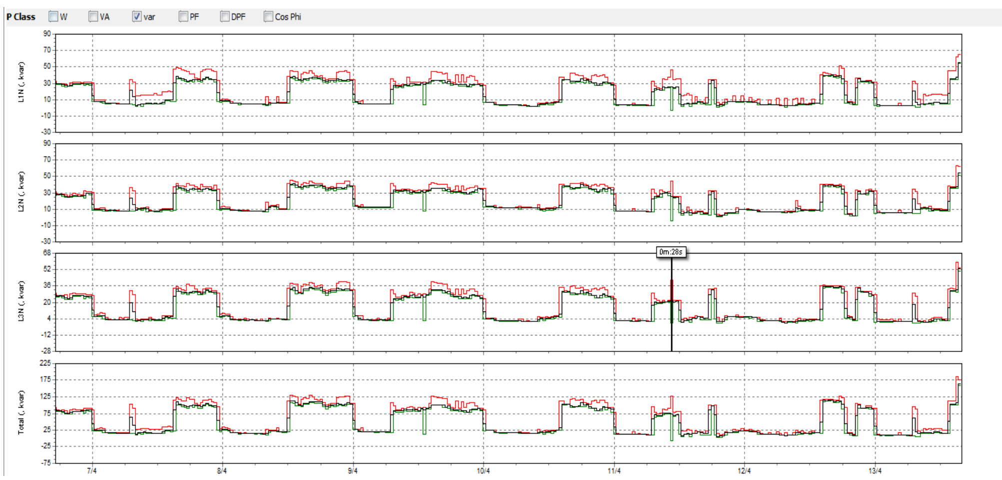


Figure 21: Reactive power of MPH

Figure 20 and Figure 21 shows the recorded graph of active and reactive power at MPH for a week. The peak of the graph shows the highest value of the load being used by the user. Meanwhile, Table 11 shows the recorded power at 2 p.m. of each day.

Table 11: The active and reactive power at MPH

Day	Active Power (W)	Reactive Power (var)
Monday	44960	26133.332
Tuesday	155200	116160
Wednesday	157493.328	112586.664
Thursday	63840	36106.664
Friday	139413.328	102133.328
Saturday	148533.328	105546.664
Sunday	151573.328	112906.664

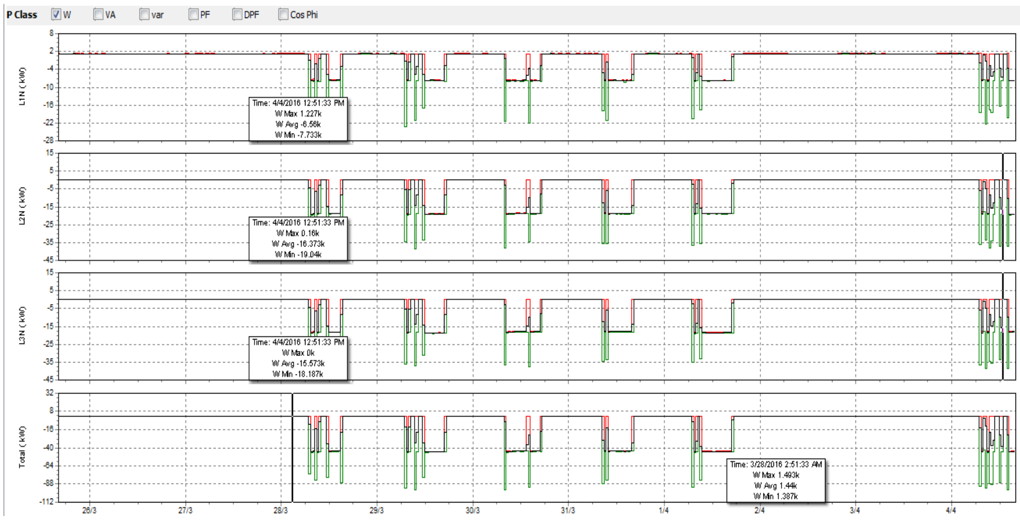


Figure 22: Active power of MSB S5B1

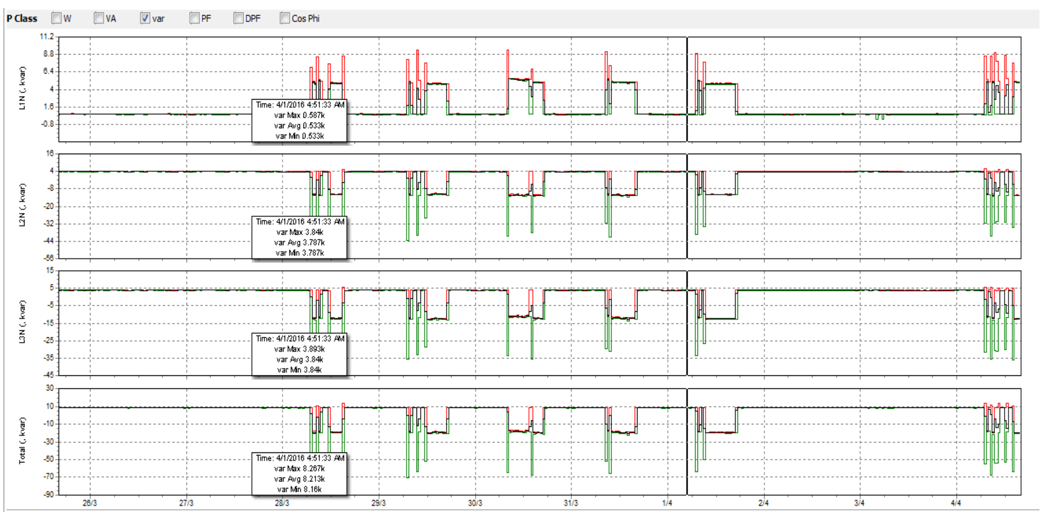


Figure 23: Reactive power of MSB S5B1

Figure 22 and Figure 23 shows the recorded graph of active and reactive power at MSB S5B1 for one week. The real values can be seen at Table 12 below. The peak of the graph shows the highest value of the load being used by the user.

Table 12: The active and reactive power at MSB S5B1

Day	Active Power (W)	Reactive Power (var)
Monday	44693.332	12533.333
Tuesday	45386.664	12480

Wednesday	91626.664	35626.664
Thursday	45546.664	13760
Friday	45173.332	12693.333
Saturday	-1333.333	-3786.667
Sunday	-1440	-3840

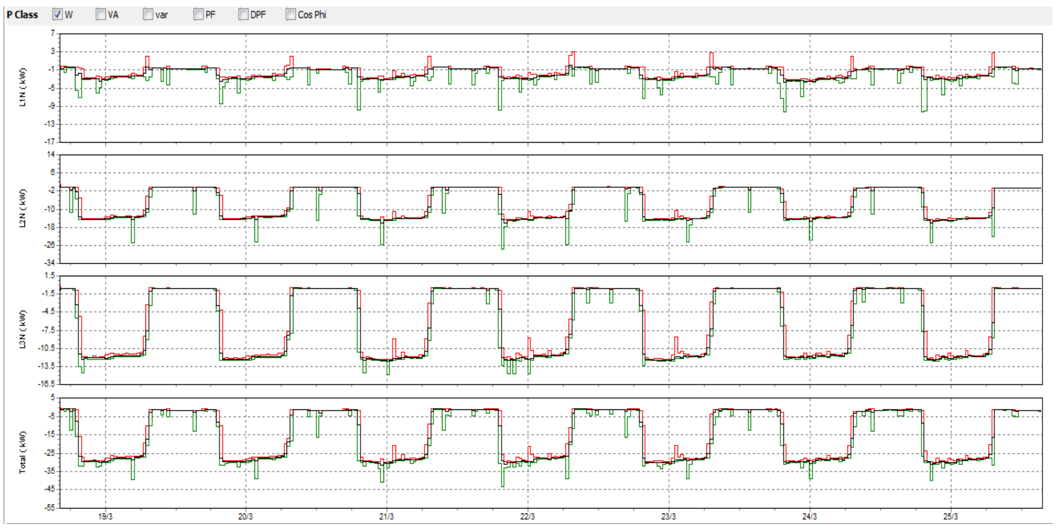


Figure 24: Active power of MSB S5B2

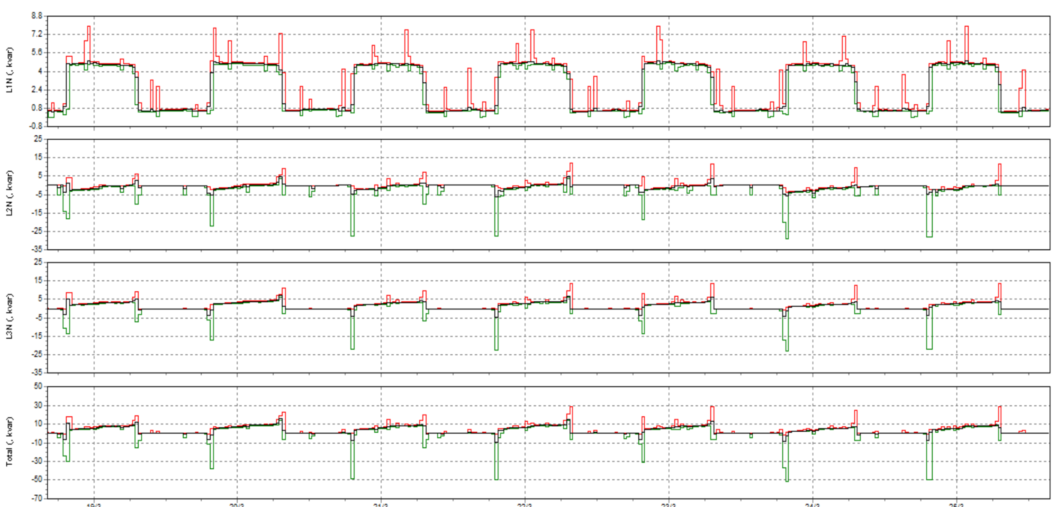


Figure 25: Reactive power of MSB S5B2

Figure 24 and Figure 25 shows the recorded graph of active and reactive power at MSB S5B2 for one week. The real values can be seen at Table 13 below. The peak of the graph shows the highest value of the load being used by the user which at 2 p.m.

Table 13: The active and reactive power at MSB S5B2

Day	Active Power (W)	Reactive Power (var)
Monday	1440	640
Tuesday	3786.667	693.333
Wednesday	1386.667	640
Thursday	1600	533.333
Friday	1866.667	373.333
Saturday	1706.667	533.333
Sunday	1813.333	586.667

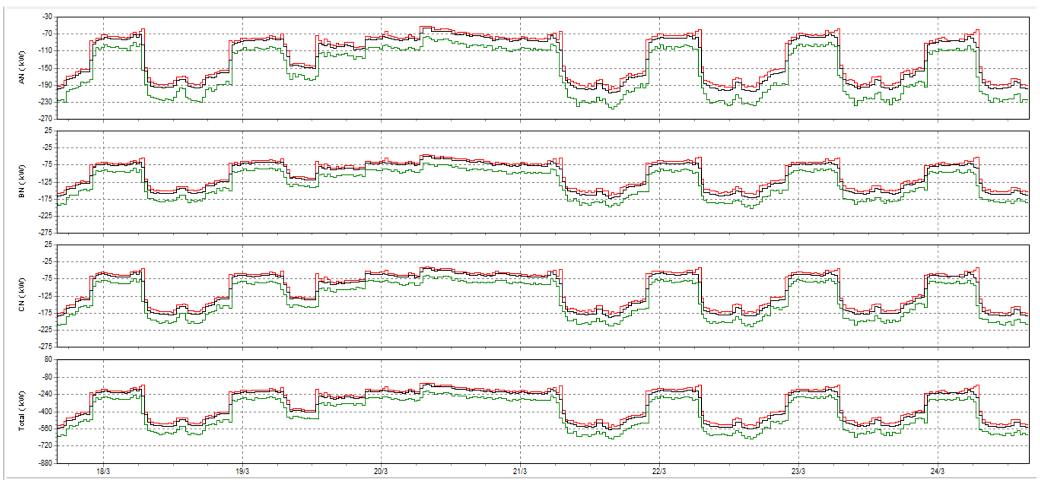


Figure 26: Active power of MSB SB1

Figure 27: Reactive power of MSB SB1

Figure 26 and Figure 27 shows graph of active and reactive power at MSB SB1 for one week Monday to Sunday at 2 p.m. The real values can be seen at Table 14 below. The peak of the graph shows the highest value recorded at each day.

Table 14: The active and reactive power at MSB SB1

Day	Active Power (W)	Reactive Power (var)
Monday	609900	72900
Tuesday	625500	64200
Wednesday	603600	57900
Thursday	613200	68400
Friday	586200	62400
Saturday	337800	71100
Sunday	259200	63300

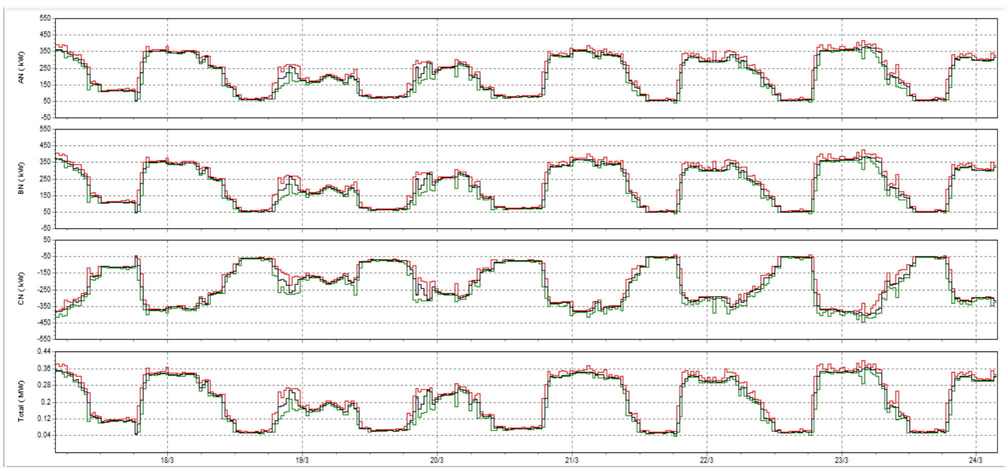


Figure 28: Active power of MSB SB2

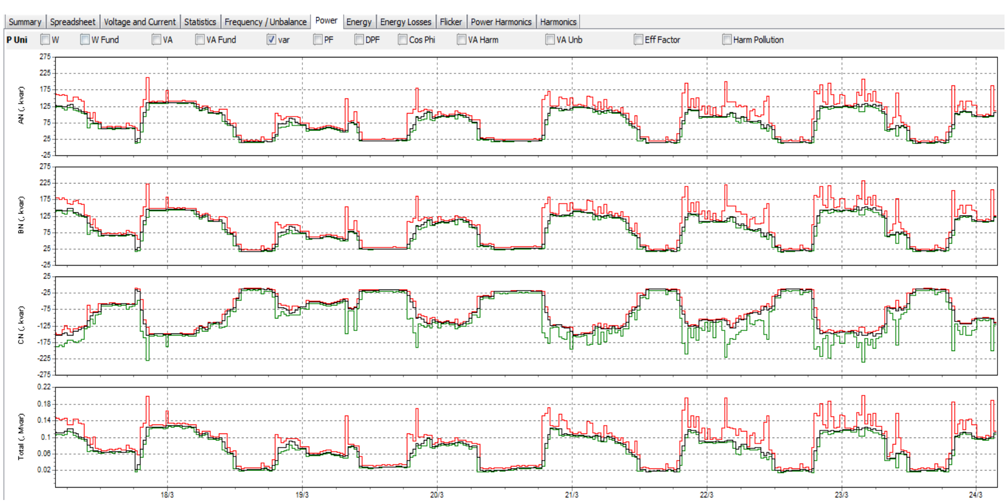


Figure 29: Reactive power of MSB SB2

Figure 28 and Figure 29 shows graph of active and reactive power at MSB SB2 for one week at 2 p.m. The values recorded during data logging can be seen at Table 15 below.

Table 15: The active and reactive power at MSB SB2

Day	Active Power (W)	Reactive Power (var)
Monday	171100	62400
Tuesday	170600	65200
Wednesday	169700	58300
Thursday	352700	201200
Friday	189900	61800
Saturday	221400	73600
Sunday	235300	78400

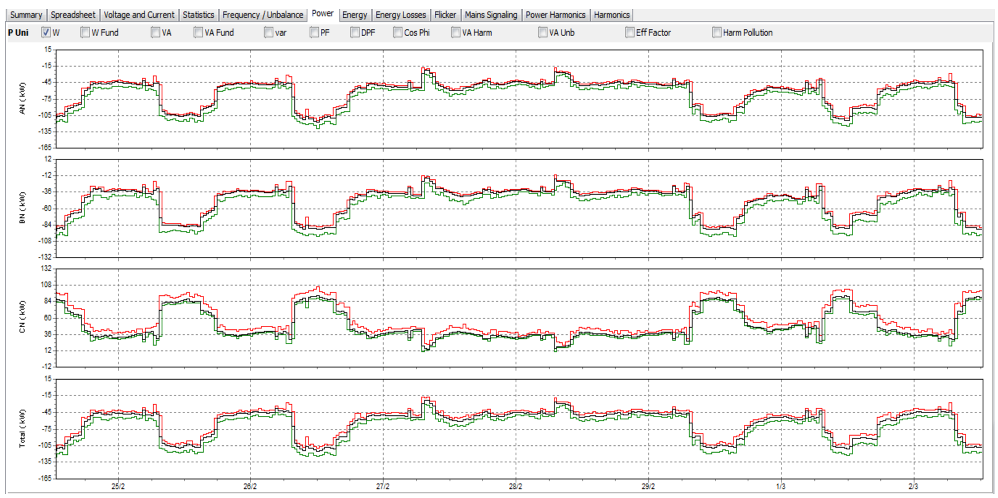


Figure 30: Active power of Pocket C1

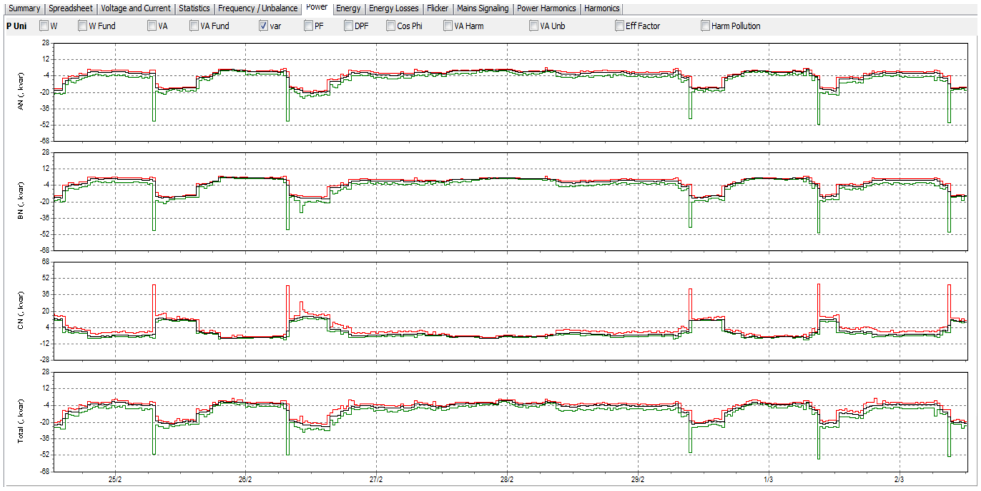


Figure 31: Reactive power of Pocket C1

Figure 30 and Figure 31 shows graph of active and reactive power at Pocket C1 substation for one week at 2 p.m. The data recorded by the data logging equipment can be seen at Table 16 below. The power recorded below is the peak loads at Pocket C1 of every single day.

Table 16: The active and reactive power at Pocket C1

Day	Active Power (W)	Reactive Power (var)
Monday	299300	49100
Tuesday	251500	21900
Wednesday	309700	57700
Thursday	309200	46200
Friday	306900	60200
Saturday	172300	-2000
Sunday	146400	10400

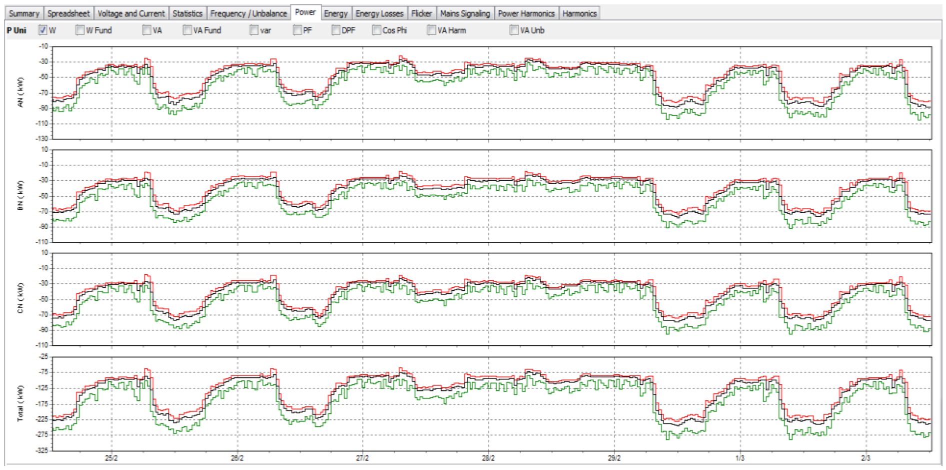


Figure 32: Active power of Pocket C2

Figure 33: Reactive power of Pocket C2

Figure 32 and Figure 33 represent the graph of active and reactive power at Pocket C2 for one week Monday to Sunday at 2 p.m. The real data can be observed at Table 17 below. The peak of the graph shows the highest value recorded at each day

Table 17: The active and reactive power at Pocket C2

Day	Active Power (W)	Reactive Power (var)
Monday	262200	71100
Tuesday	272100	79500
Wednesday	256500	42300
Thursday	247500	63900
Friday	213900	31800
Saturday	149400	17100
Sunday	126300	9000

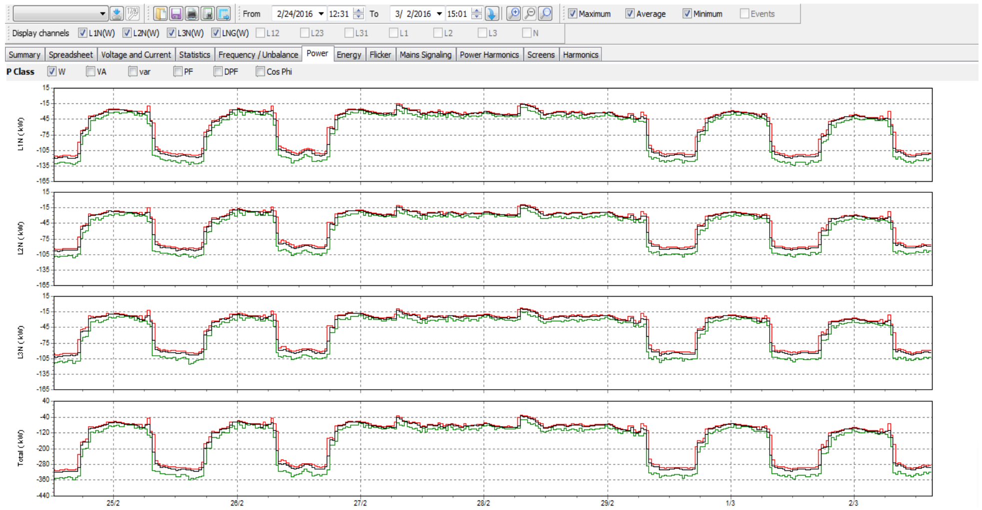


Figure 34: Active power of Pocket D1

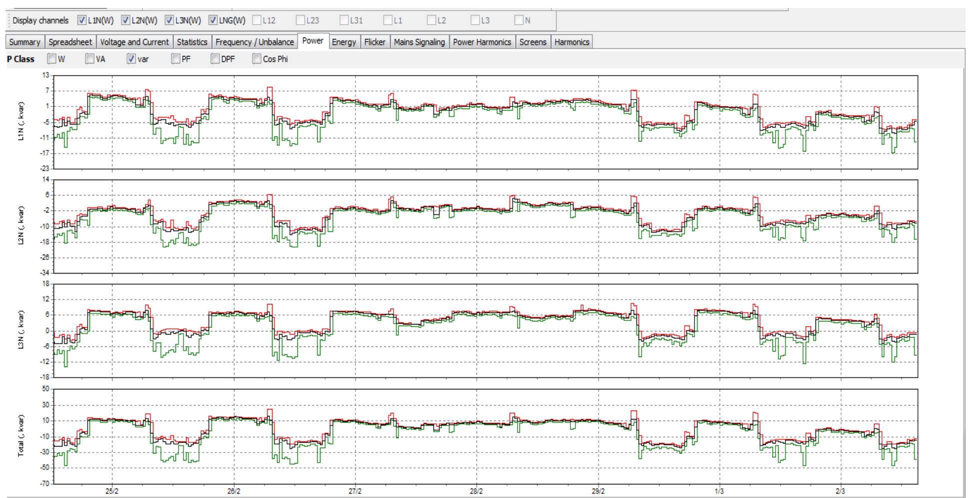


Figure 35: Reactive power of Pocket D1

Figure 34 and Figure 35 shows graph of active and reactive power at Pocket D1 for one week Monday to Sunday at 2 p.m. The data of each day can be seen at Table 18 below which record the highest value.

Table 18: The active and reactive power at Pocket D1

Day	Active Power (W)	Reactive Power (var)
Monday	331200	24666.666
Tuesday	335600	19466.666
Wednesday	345200	34266.664
Thursday	331733.313	21066.666
Friday	313866.656	21333.332
Saturday	102400	-4400
Sunday	102799.992	-8000

4.4 UTP simulation data

4.4.1 Normal Off Point

After several simulations being done, the results are showed in the tables below. There are two results for the simulation which Table 19 shows the result of Losses for every line in the Normal Off point operation. Normal Off Point usually located in midway between substations. Off point in networks allow the continued supply of electric to customer during faults as the feeder is separated into two sections, between two substations. For this operation, the total loss recorded is 0.192 MW.

Table 19: Losses of the Normal Off Point operation

Branch					
From Number	From Name	To Number	To Name	MW Loss	Mvar Loss
7	RMU-5A	8	RMU-ETS	0.077	0.084
6	RMU-5B	7	RMU-5A	0.04	0.043
8	RMU-ETS	1	11kV MIS-A SB	0.028	0.031
1	11kV MIS-A SB	32	11kV HV 1A (MB3A)	0.017	0.015
1	11kV MIS-A SB	31	11kV HV 1B (BLK5)	0.009	0.008
31	11kV HV 1B (BLK5)	41	MSB MB 2	0.008	0.006
6	RMU-5B	13	MSB 5B1	0.005	-10.316
2	MSB MIS	1	11kV MIS-A SB	0.005	-10.02
17	RMU-DS1A	1	11kV MIS-A SB	0.001	0.001
1	11kV MIS-	33	11kV HV 1B	0.001	0.001

	A SB		(MB3A)		
22	RMU-SS2	1	11kV MIS-A SB	0.001	0.001
32	11kV HV 1A (MB3A)	40	MSB MB 1	0	0
1	11kV MIS-A SB	30	11kV HV 1A (BLK5)	0	0
21	RMU-SS4	22	RMU-SS2	0	0
30	11kV HV 1A (BLK5)	37	MSB PD2	0	0
30	11kV HV 1A (BLK5)	35	MSB PC2	0	0
17	RMU-DS1A	18	RMU-DS1B	0	0
32	11kV HV 1A (MB3A)	39	MSB 05-2	0	0
36	MSB PD1	33	11kV HV 1B (MB3A)	0	0
5	RMU-SS5	6	RMU-5B	0	0
33	11kV HV 1B (MB3A)	34	MSB PC1	0	0
20	RMU-SS3	21	RMU-SS4	0	0
18	RMU-DS1B	19	RMU-DS2	0	0
3	RMU-SS1	1	11kV MIS-A SB	0	0
33	11kV HV 1B (MB3A)	42	MSB ZC	0	0
3	RMU-SS1	4	RMU-MPH	0	0
31	11kV HV 1B (BLK5)	38	MSB 05-1	0	0
40	MSB MB 1	41	MSB MB 2	0	-10.054
17	RMU-DS1A	23	MSB DS1A	0	0
5	RMU-SS5	12	MSB 5	0	0
19	RMU-DS2	25	MSB DS2	0	0
21	RMU-SS4	28	MSB SS4	0	0
8	RMU-ETS	16	MSB ETS	0	0
7	RMU-5A	15	MSB 5A	0	0
22	RMU-SS2	29	MSB SS2	0	0
18	RMU-DS1B	24	MSB DS1B	0	0

20	RMU-SS3	27	MSB 4	0	0
20	RMU-SS3	26	MSB 3	0	0
3	RMU-SS1	9	MSB 1	0	0
4	RMU-MPH	11	MSB MPH	0	0
6	RMU-5B	14	MSB 5B2	0	0
19	RMU-DS2	20	RMU-SS3	0	0
4	RMU-MPH	10	MSB Compact	0	0
34	MSB PC1	35	MSB PC2	0	0
3	RMU-SS1	5	RMU-SS5	0	0
32	11kV HV 1A (MB3A)	33	11kV HV 1B (MB3A)	0	0
30	11kV HV 1A (BLK5)	31	11kV HV 1B (BLK5)	0	0

To reduce the loss in the normal off point operation, author suggest to change the point of the normal point from RMU SS5 to the RMU MPH. Table 20 shows the result of the total loss after the normal off point being changed.

Table 20: The total Loss after changing the Normal Off Point.

Branch						
From Number	From Name	To Number	To Name	Circuit	MW Loss	Mvar Loss
7	RMU-5A	8	RMU-ETS	1	0.02	0.02
1	11kV MIS-A SB	32	11kV HV 1A (MB3A)	1	0.02	0.02
3	RMU-SS1	1	11kV MIS-A SB	1	0.02	0.02
6	RMU-5B	7	RMU-5A	1	0.01	0.01
3	RMU-SS1	5	RMU-SS5	1	0.01	0.01
1	11kV MIS-A SB	31	11kV HV 1B (BLK5)	1	0.01	0.01
5	RMU-SS5	6	RMU-5B	1	0.01	0.01
31	11kV HV 1B (BLK5)	41	MSB MB 2	1	0.01	0.01
8	RMU-ETS	1	11kV MIS-A SB	1	0.01	0.01
6	RMU-5B	13	MSB 5B1	1	0.01	-10.17
2	MSB MIS	1	11kV MIS-A SB	1	0.01	-10.02

17	RMU-DS1A	1	11kV MIS-A SB	1	0	0
1	11kV MIS-A SB	33	11kV HV 1B (MB3A)	1	0	0
22	RMU-SS2	1	11kV MIS-A SB	1	0	0
32	11kV HV 1A (MB3A)	40	MSB MB 1	1	0	0
1	11kV MIS-A SB	30	11kV HV 1A (BLK5)	1	0	0
21	RMU-SS4	22	RMU-SS2	1	0	0
30	11kV HV 1A (BLK5)	37	MSB PD2	1	0	0
30	11kV HV 1A (BLK5)	35	MSB PC2	1	0	0
17	RMU-DS1A	18	RMU-DS1B	1	0	0
32	11kV HV 1A (MB3A)	39	MSB 05-2	1	0	0
36	MSB PD1	33	11kV HV 1B (MB3A)	1	0	0
33	11kV HV 1B (MB3A)	34	MSB PC1	1	0	0
20	RMU-SS3	21	RMU-SS4	1	0	0
18	RMU-DS1B	19	RMU-DS2	1	0	0
33	11kV HV 1B (MB3A)	42	MSB ZC	1	0	0
31	11kV HV 1B (BLK5)	38	MSB 05-1	1	0	0
40	MSB MB 1	41	MSB MB 2	1	0	-10.05
17	RMU-DS1A	23	MSB DS1A	1	0	0
5	RMU-SS5	12	MSB 5	1	0	0
19	RMU-DS2	25	MSB DS2	1	0	0
21	RMU-SS4	28	MSB SS4	1	0	0
8	RMU-ETS	16	MSB ETS	1	0	0
7	RMU-5A	15	MSB 5A	1	0	0
22	RMU-SS2	29	MSB SS2	1	0	0
18	RMU-DS1B	24	MSB DS1B	1	0	0
20	RMU-SS3	27	MSB 4	1	0	0
20	RMU-SS3	26	MSB 3	1	0	0
3	RMU-SS1	9	MSB 1	1	0	0
6	RMU-5B	14	MSB 5B2	1	0	0
4	RMU-MPH	11	MSB MPH	1	0	0
19	RMU-DS2	20	RMU-SS3	1	0	0
4	RMU-MPH	10	MSB Compact	1	0	0

34	MSB PC1	35	MSB PC2	1	0	0
32	11kV HV 1A (MB3A)	33	11kV HV 1B (MB3A)	1	0	0
3	RMU-SS1	4	RMU-MPH	1	0	0
30	11kV HV 1A (BLK5)	31	11kV HV 1B (BLK5)	1	0	0

The total loss recorded is 0.14MW compared to the previous result which is 0.192 MW. The loss reduced 0.052MW.

4.4.2 Parallel Operation of UTP Network

The parallel operation, the normal off point in the simulation is closed to indicate that the generators operating in parallel with the utility supply network. Tables 21 showed the losses recorded during parallel operation which concluded that the total loss is 0.35MW.

Table 21: Losses of the Parallel operation of the Network operation

Branch					
From Number	From Name	To Number	To Name	MW Loss	Mvar Loss
1	11kV MIS-A SB	33	11kV HV 1B (MB3A)	0.07	0.06
1	11kV MIS-A SB	32	11kV HV 1A (MB3A)	0.06	0.06
1	11kV MIS-A SB	31	11kV HV 1B (BLK5)	0.05	0.04
1	11kV MIS-A SB	30	11kV HV 1A (BLK5)	0.04	0.04
30	11kV HV 1A (BLK5)	35	MSB PC2	0.03	0.02
7	RMU-5A	8	RMU-ETS	0.02	0.02

3	RMU-SS1	1	11kV MIS-A SB	0.02	0.02
6	RMU-5B	7	RMU-5A	0.01	0.01
3	RMU-SS1	5	RMU-SS5	0.01	0.01
31	11kV HV 1B (BLK5)	41	MSB MB 2	0.01	0.01
33	11kV HV 1B (MB3A)	34	MSB PC1	0.01	0.01
5	RMU-SS5	6	RMU-5B	0.01	0.01
8	RMU-ETS	1	11kV MIS-A SB	0.01	0.01
6	RMU-5B	13	MSB 5B1	0.01	-10.17
2	MSB MIS	1	11kV MIS-A SB	0.01	-10.02
17	RMU-DS1A	1	11kV MIS-A SB	0	0
22	RMU-SS2	1	11kV MIS-A SB	0	0
32	11kV HV 1A (MB3A)	40	MSB MB 1	0	0
21	RMU-SS4	22	RMU-SS2	0	0
30	11kV HV 1A (BLK5)	37	MSB PD2	0	0
40	MSB MB 1	41	MSB MB 2	0	-10.1
17	RMU-DS1A	18	RMU-DS1B	0	0
32	11kV HV 1A (MB3A)	39	MSB 05-2	0	0
36	MSB PD1	33	11kV HV 1B (MB3A)	0	0
32	11kV HV 1A	33	11kV HV 1B	0	-10.11

	(MB3A)		(MB3A)		
34	MSB PC1	35	MSB PC2	0	-10.15
20	RMU-SS3	21	RMU-SS4	0	0
18	RMU-DS1B	19	RMU-DS2	0	0
33	11kV HV 1B (MB3A)	42	MSB ZC	0	0
3	RMU-SS1	4	RMU-MPH	0	0
30	11kV HV 1A (BLK5)	31	11kV HV 1B (BLK5)	0	-10.08
31	11kV HV 1B (BLK5)	38	MSB 05-1	0	0
19	RMU-DS2	20	RMU-SS3	0	0
17	RMU-DS1A	23	MSB DS1A	0	0
5	RMU-SS5	12	MSB 5	0	0
19	RMU-DS2	25	MSB DS2	0	0
21	RMU-SS4	28	MSB SS4	0	0
8	RMU-ETS	16	MSB ETS	0	0
7	RMU-5A	15	MSB 5A	0	0
22	RMU-SS2	29	MSB SS2	0	0
18	RMU-DS1B	24	MSB DS1B	0	0
20	RMU-SS3	27	MSB 4	0	0
20	RMU-SS3	26	MSB 3	0	0
3	RMU-SS1	9	MSB 1	0	0
4	RMU-MPH	11	MSB MPH	0	0
6	RMU-5B	14	MSB 5B2	0	0
4	RMU-MPH	10	MSB Compact	0	0

To reduce the losses that occurred in the parallel operation, author suggests a solution by increasing the size of the cables. Increasing the size of the cables indicates that reducing the values of the inductance and resistance in the cables. The values of inductances and resistances are decreased by 50%. Hence, the results is recorded in the Table 22 below

Table 22: The Loses after the cable size is increased

Branch					
From Number	From Name	To Number	To Name	MW Loss	Mvar Loss
1	11kV MIS-A SB	33	11kV HV 1B (MB3A)	0.03	0.03
1	11kV MIS-A SB	32	11kV HV 1A (MB3A)	0.03	0.03
1	11kV MIS-A SB	31	11kV HV 1B (BLK5)	0.02	0.02
1	11kV MIS-A SB	30	11kV HV 1A (BLK5)	0.02	0.02
30	11kV HV 1A (BLK5)	35	MSB PC2	0.01	0.01
7	RMU-5A	8	RMU-ETS	0.01	0.01
3	RMU-SS1	1	11kV MIS-A SB	0.01	0.01
6	RMU-5B	7	RMU-5A	0.01	0.01
3	RMU-SS1	5	RMU-SS5	0.01	0.01
6	RMU-5B	13	MSB 5B1	0.01	-10.1
2	MSB MIS	1	11kV MIS-A SB	0.01	-10.02
31	11kV HV 1B (BLK5)	41	MSB MB 2	0	0
33	11kV HV 1B (MB3A)	34	MSB PC1	0	0.01
5	RMU-SS5	6	RMU-5B	0	0
8	RMU-ETS	1	11kV MIS-A SB	0	0
17	RMU-	1	11kV	0	0

	DS1A		MIS-A SB		
22	RMU-SS2	1	11kV MIS-A SB	0	0
32	11kV HV 1A (MB3A)	40	MSB MB 1	0	0
21	RMU-SS4	22	RMU-SS2	0	0
30	11kV HV 1A (BLK5)	37	MSB PD2	0	0
40	MSB MB 1	41	MSB MB 2	0	-10.05
17	RMU-DS1A	18	RMU-DS1B	0	0
32	11kV HV 1A (MB3A)	39	MSB 05-2	0	0
36	MSB PD1	33	11kV HV 1B (MB3A)	0	0
32	11kV HV 1A (MB3A)	33	11kV HV 1B (MB3A)	0	-10.05
34	MSB PC1	35	MSB PC2	0	-10.08
20	RMU-SS3	21	RMU-SS4	0	0
18	RMU-DS1B	19	RMU-DS2	0	0
33	11kV HV 1B (MB3A)	42	MSB ZC	0	0
3	RMU-SS1	4	RMU-MPH	0	0
31	11kV HV 1B (BLK5)	38	MSB 05-1	0	0
19	RMU-DS2	20	RMU-SS3	0	0
30	11kV HV 1A (BLK5)	31	11kV HV 1B (BLK5)	0	-10.04
17	RMU-DS1A	23	MSB DS1A	0	0

5	RMU-SS5	12	MSB 5	0	0
19	RMU-DS2	25	MSB DS2	0	0
21	RMU-SS4	28	MSB SS4	0	0
8	RMU-ETS	16	MSB ETS	0	0
7	RMU-5A	15	MSB 5A	0	0
22	RMU-SS2	29	MSB SS2	0	0
18	RMU-DS1B	24	MSB DS1B	0	0
20	RMU-SS3	27	MSB 4	0	0
20	RMU-SS3	26	MSB 3	0	0
3	RMU-SS1	9	MSB 1	0	0
4	RMU-MPH	11	MSB MPH	0	0
6	RMU-5B	14	MSB 5B2	0	0
4	RMU-MPH	10	MSB Compact	0	0

The total losses of the system decreased from 0.35MW to 0.18MW. However, the budget to change the size of the cables is really high and it is not worth by reducing only 0.17MW. Hence the author suggests more reliable way by changing the point of the normal point.

CHAPTER 5: CONCLUSION AND RECOMMENDATION

This chapter will summarize the content of this progress report of the technical losses evaluation on UTP electrical network project paper.

5.1 Conclusion

In a nutshell, the project is a research about the technical losses that occur in UTP electrical network. Since the author focuses more on the line losses, it is affected by the resistance and the inductance in the cables. The lower the resistance and the inductance the lower the losses at the line. The technical losses occurs could increase the operating cost of the electricity and could lead to the economic losses to the Tenaga Nasional Berhad, Malaysia since the losses will not be compensated by the UTP.

5.2 Recommendation

For the author to complete the project, time management is the most important factor. Since the author also involve in other project such as ISDP, there will be a time to focus on one project instead of two to ensure the quality of the project. Hence, the author will give the same focus to the different project without affecting the project results.

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APENDICES

Gantt chart

FYP 1

Table 23: Gantt Chart for FYP 1

	Week	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
No.	Tasks															
1	Literature Review															
2	Familirizing with the simulation tools															
3	Modelling the simulation of UTP netowk															
4	Model various type of losses															
5	Simulation with the experimental data															
6	Verifying the output of the simulation															

FYP 2

Table 23: Gantt Chart for FYP 2

No.	Week / Tasks	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	Data logging activity	■	■	■												
2	Familirizing with the simulation tools				■	■	■	■	■							
3	Completing the construction of UTP network model					■	■	■	■	■	■	■				
4	Preparation for Progress Report						■	■								
5	Simulation with the experimental data						■	■	■	■	■					
6	Analysing data obtained							■	■	■	■	■	■	■		
7	Preparation for pre-sedex									■	■					
8	Preparation for draf final report											■	■	■		
9	Preparation for Final Report and Technical paper													■	■	■
10	Preparation for Viva														■	■
11	Preparation for Final Report (hardbound)														■	■

Key milestone

FYP 1

Table 24: Key Milestone for FYP1

No.	Week / Tasks	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	Literature review completion						■									
2	UTP simulation completed											■				
3	Simulation with filter is carried out												■			
4	Output verification													■		
5	Result achieved														■	
6	Full report completion															■

FYP 2

Table 25: Key Milestone for FYP2

No.	Week / Tasks	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	Progress Report	▨	▨	▨	▨	▨	▨	■									
2	Pre-sedex								▨	▨	■						
3	Draft Final Report											▨	▨	■			
4	Final Report & Technical Paper											▨	▨	▨	■	■	
5	Viva													▨	▨	■	
6	Final Report														▨	▨	■

■ Due date

▨ Process

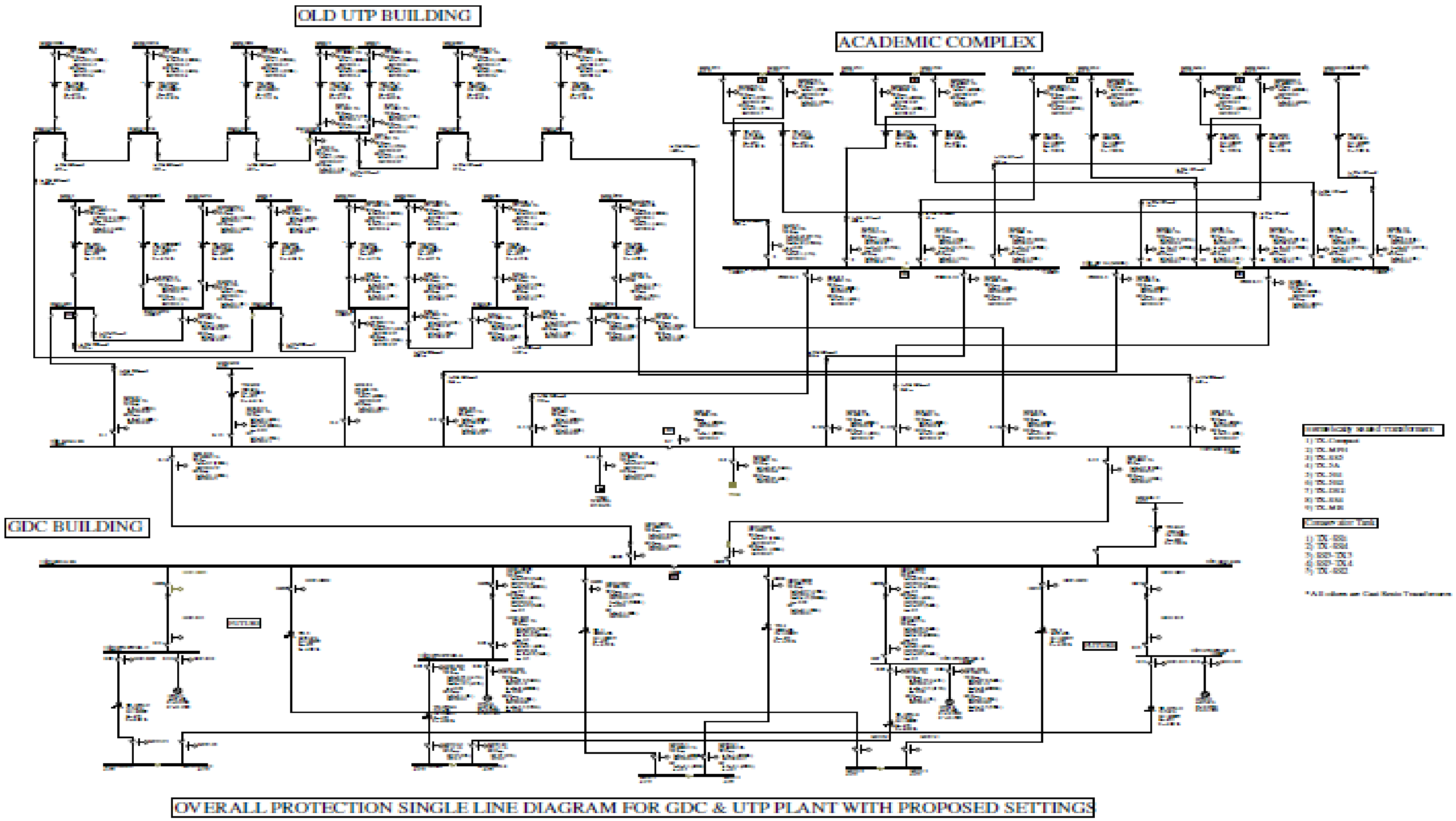

Figure 36: UTP Electrical Drawings