OPTIMAL UTILIZATION OF GENERATORS IN FUT MINNA

A PROJECT PRESENTED

TO THE DEPARTMENT OF ELECTRICAL/ COMPUTER

ENGINEERING

BY

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In partial fulfilment for the award of Bachelor's Degree in

Electrical,computer Engineering.

OCTOBER 2003

Certification

We certify that this project is done by Bohari M Hassia in partial fulfillment of the requirement for the award of Bachelor of Engineering (B .ENG) degree in electical/ computer department.

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ENGR M. N. NWOHU

Project supervisor

17/10/03

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Date

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ENGR M.N NWOHU

Head of Department

17/10/03

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Date

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External examiner

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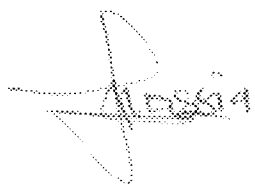
Date

Dedication

I dedicate this project to Allah , who by His grace this project work is carried out successfully , and also to my mother Fassouma Mahamman who has taken the burden of supporting me throughout my career.



Ackownledgment

Praise be to Almighty Allah , the Omnipotent Who gives health, protection and guidance in all my work.

My sincere appreciation goes to my project supervisor ENGR NWOHU M N for his assistance ,guidance and encouragements.

My thanks goes to ENGR Oyedetun from the works department for his contribution towards the success of this project.

My profund gratitude goes to my parents ,grand parents, relatives especially Mme Laouali Aicha Mahaman and Abdoulaye Bohari who assisted me financially and morally towards the sucessfull achievement of my academic programme.

My special thanks go to my friends and collcagues here in F U T .

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Abstract

This project highlights the analysis of the running cost of standby generators against the outage duration of power by NEPA and the total cost (running cost plus maintenance cost)against NEPA bill.

In order to realize this task , some datas were collected from the works department of Federal University of Technology Minna with which comparison was made to ascertain the reliability and economic use of standby generators in the university.

With these datas some tables and some graphs were drawn to indicate the relationship existing between the cost of running the standby generator and power outage by NEPA.

My cases of study are the 365 KVA generator installed on June 1991 and is located at the back of female hostel and the 500 KVA generator installed on October 2000 which is located by the male hostel .When the 365 KVA generator is fully loaded it consumes 60litres of fuel per hour while the 500 KVA generator consumes 75 litres of fuel per hour when it is fully loaded.

CHAPTER ONE

1.0 INTRODUCTION

In a country like Nigeria, with a population of about hundred (100) millions, their power utility, National Electric Power Authority (NEPA) could not provide enough electricity for everybody because of the large population. This, of course has led to considering the alternative power source by some electricity consumers in this country. Further more the incessant power failure in this country, Nigeria and this effects on consumers appliances and electrical equipments have led to the proliferation of the use of stand-by generator in many residential houses and industrial outfits.

In order to meet the power demand of consumers, as the effects of under voltage and over voltage are becoming more pronounced on their electrical fittings and appliances, stand-by generators should be installed.

In this project we are going to study how best generators installed in F.U.T Minna can be used.

1.1 AIMS AND OBJECTIVE.

Sometimes generators are not used in the way they should have been used. The aims and objectives of this project are:

- To improve lighting performances to the consumers.
- To improve service reliability.
- To evaluate the running cost and maintenance expenditure of stand-by generators.
- To evaluate the equipment cost.
- To assess the economic use of stand-by generators.

CHAPTER TWO

2.0 LITERATURE REVIEW

In 1831, the English physicist Michael Faraday invented a device for converting mechanical energy to electrical energy. His machine, a special kind of d c generator was the forerunner of all modern generators. This kind of generator sometimes called a Faraday disc is now called a homopolar generator because the conductors always move across the magnetic field in the same direction.

Just one year after Faraday's invention, the French inventor Hippolyte Pixii built an a c generator, one of the first of its kind. During the 1870's numerous inventors besides Gramme made further improvement in the electric generator.

The mechanical energy needed to drive a generator is obtain from the prime mover, such as a water turbine, a stream turbine, an internal combustion engine or a gas turbine.

Different kind of generators.

i. Elementary kinds of generators.

This machine has a many turn coil rotating in a magnetic field. Connections made to the moving coil by fastening their ends to two slips rings which are usually made of carbon, that slide on the slip rings.

ii Rotating-field a.c generator.

To generate a voltage induction there should be a relative motion between the conductors and the magnetic field. There are two kinds of rotating field

a c generator, namely, the non salient-pole generator and the salient pole generator. Each kind has two major parts called a stator and a rotor. The staor or stationary part carries the a.c conductors while the rotor or rotating part carries the magnetic field winding. For both the salient-pole and the non salient-pole, there is a fundamental relationship between the frequency f the alternating current, the number of magnetic poles and the speed of the rotor.

This relationship is $f = (N/60)(P/2) = NP/120$

Where f is the frequency in Hertz (cycle per second), N is the speed of the rotor in revolution per minute (rpm), P is the number of poles.

iii. Direct current generators (d.c).

An elementary d c generator consists of stationary magnetic poles, a rotating coil, a commutator and brushes. Each coil end is connected to a segment of a commutator, which is like a slip ring cut in half, with each half section insulated from the other.

In all practical d c generators, the stator and the rotor are separated only by a small air gap.

D c generators are usually classified according to the way in which their fields are excited. D c generators may be divided into two: a separately excited generator and self excited generators.

Separated-excited generators are those where whose field magnets are energised from an independent external source of d c current.

Self-excited generators are those whose field magnets are energised by the current reproduced by the generator themselves.

iv. Homopolar generator.

The homopolar generator is the only machine that directly produces d c, all the other kinds of d c generator generate a c in their armature windings and then convert a c to d c by means of commutator.

v. Magneto hydrodynamic generator.

Basically consist of high-speed jet of electrically conductive (ionised) gas electrodes and field coils that produce a magnetic field.

vi. High frequency a c generator.

Frequencies higher than the typical 60-Hertz power supply frequency are especially useful when a minimum size or weight of the electrical equipment is important.

A c generator now produces almost all electricity. These machines, which are also called alternators or synchronous generators, are the main generators in nearly all steam-electric and hydroelectric power plants. The transformer makes it easy to increase alternating voltage for economical transmission and then decrease it for distributing and use.

2.1 Various faults of a generator.

More frequently, generator develops faults as a result of failure to observe maintenance schedule and poor sensing and operation under conditions for which they are not designed or intended.

Faults on this electrical machine may be classified into mechanical and electrical. Mechanical faults include bat-bitt lines melted out of slip bearing; cases, balls or rollers in antifriction bearings, broken rotor (armature) shafts, commutator and slip ring worn in grooves and ridges, loosened pole-pieces or stator cares in the yoke, broken or displaced wire binding on rotor (armature) loosened rotor (armature) cares etc.

Electrical faults include an insulation breakdown to the frame, broken conductors in a winding inter-turn, short circuit, poor contacts and failing soldered (brozed) and welded joints, reduced insulation resistance due to ageing, deterioration or moisture pick-up, etc.

Visual inspection can only reveal external defects, internal defects (such as short turn in the stator winding) insulation breakdown to the frame, shorted commutator bus and poor soldered joints in the winding while some other electrical faults can be identified only by appropriate measurements and tests.

2.2 Faults, locating them and effecting repairs

FAULTS	REPAIRS
Engine oil too viscous	Replace engine oil with correct grade.
Restricted flow in the oil cooler passage or leakages.	Remove and clean. Rectify leakages.
No fuel or fuel is partially supply.	Pump, check filters clean and fill with clean fuel.
Electrical fault.	Charge weak batteries rectify starter motor and switches, poor or broken connections. Rectify charging system, which has fault.
Sticking valve or broken spring or exhaust system chocked.	Rectify causes of sticking; replace broken spring and clean exhaust system.
Faulty turbo charger.	Remove and over-haul.
Complete loose of compression.	Remove engine for complete major over-haul.
Fan failure and fan blades assembly faults. water pump faults.	Replace broken or worn fan belt and adjust correctly. Replace faulty water pump.
Checked coding system or excessive leakage.	Rectify restrictions to air flow or remove radiator and clean the inside, rectify leakages.

CHAPTER THREE

3.0 CASE STUDY.

3.11 365 KVA generator

The 365 KVA generator is installed in FUT Minna on June 1991,it cost ₦ 900,000.00.This generator is located at the back of female hostel(block N and O).The power obtained from the generator is conveyed through overhead lines that feed the following sections:

Section1: generator room

Section 2: audio visual block, water pump unit, student affairs, library, Dean`s block office, laboratories, block D, maths Department

Section 3 clinic, staff quarters female hostels

Section 4: senate building, computer center.

When the generator is fully loaded, it can produce up to 400 A, which is 75% of its capacity of production. Its consumption rate of fuel (diesel) is about 60 litres per hour and one litre of diesel costs ₦30. 00. Since the generator consumed per hour is 60 x 30 = ₦1,800. 00. It uses 75 litres o engine oil (type SAE 40 RUBIAH) at ₦ 200 per litre.

3.1.2 Maintenance work on 365 KVA generating set.

There is various maintenance works carried out at some intervals of time on the generator. The first service carried out after 30 hours of constant operation. The second service was carried out after 100 hours of operation. The third service was carried out after 200 hours of operation. In June 1991, maintenance and repair had to be done on the alternator.

In 1995, the works department part carried out the maintenance on partaking improvement part (PIP) that is, checking if all the equipment are working. Subsequently the battery of the generator was replaced as it is being done every two years, (1993, 1995, 11997, 1999, 2001).

In 1999, some maintenance and repairs where done on the turbo charger, the radiator, the rings and the cost for the repair was N800, 000. 00.

It was observed that there was noticeable drop in voltage, which consequently led to the maintenance of the generator and repair of the module sensor, the stop valve and replacement of the potentiometer. The cost of the maintenance was about ₦ 350,000.00. Furthermore, general routine maintenance was carried out by the works department, which included the checking of the battery acid, water in the radiator and engine oil level.

3.2.1 500 KVA installed generator

The 500 generator is installed in FUT Minna on October 2000, it costs ₦13,547520 .This generator is located by the male hostel(block P and Q).the power obtained from the regenerator is conveyed through overhead lines that feed the following sections:

Section 1: generator room

Section 2: boys hostel (block P and Q), agric farm, work department

Section 3: cafeteria, eng. Offices, school agric offices, school of science education, environment complex

Section 4: eng.complex and laboratories, lecture theatre, new classroom block, school of science offices, staff school and new lecture theatre. When the generator is fully loaded,

it produces 600A (75% of its capacity of production) and the consumption rate of fuel (diesel) is about 75 litres per hour.

Since the generator consumed per hour is 75x30 = ₦2, 250.00. It uses 80 litres of engine oil (type SAE 40 RUBIAH) at N200.00 per litre.

3.2.2 Maintenance works on 500 KVA generating set.

There is few maintenance works carried out at some intervals of time on the generator. The first service was carried out after 100 hours of operation. The second service was carried out after 200 hours of operation. The third service was carried out after 400 hours of operation.

In 2001, the 800A changeover switch developed some problem, was repaired. Furthermore, general routine maintenance was carried out by the works department, which included the checking of the battery acid, water in the radiator and engine oil level.

3.2.3 Tables on the operation of 365 KVA and 500 KVA generators in year 2002

Operation on 365 KVA generator

January 2002

Date	Outage duration (Hour)	Quantity of fuel replaced (litres)	Fuel consumed (Litres)	Running cost (Rc) at ₦30/L	Maintenance Cost (Mc) (₦)	Total cost Tc=Rc+Mc (₦)	NEPA (bill) Cost (₦)	Difference
6-01-02	3.5		200	6,000.00				
10-01-02	0.5	240	15.02	450.6				
11-01-02	0.5		15.02	450.6				
14-01-02	2.41		72.39	2171.7				
18-01-02	4		120.15	3604.5				
19-01-02	0.58		17.42	522.6				
21-01-02	3.66	440	284.53	8575.9				
24-01-02	2		155.47	4664.1				
25-01-02	2	300	266.67	8000.1				
29-01-02	0.25		33.33	999.9				
				35,400.00	74,000.00	109,400.00	36,925.40	72,474.6

Operation on 365 KVA generator

February 2002

Date	Outage of fuel replaced (litres)	Quantity of fuel replaced (litres)	Fuel consumed (litres)	Running cost (Rc) (₦)	Maintenance cost (Mc) (₦)	Total cost (Mc) (₦)	NEPA bill cost (₦)	Difference
1-02-02	3.33		303.30	9099				
4-02-02	0.66	480	60.11	1803.3				
7-02-02	0.01		0.92	27.6				
8-02-02	0.66		60.11	1803.3				
9-02-02	0.61		55.56	1666.8				
14-02-02	4.5		98.18	2945.4				
25-02-02	0.66	240	14.4	432		317,777.4		
				17,777.4	300,000.00		14,649	303,128.4

OPERATION ON 365 KVA Generator

March 2002

Date	Outage duration (hrs)	Quantity of fuel replaced (litres)	Fuel consumed (litres)	Running cost(Re) at ₦30/litre	Maintenance Cost(Mc) ₦	Total cost Tc=Re+Mc ₦	NEPA (BILL) ₦	Difference
8-03-02	0.8		18.45	553.5				
9-03-02	0.68		14.84	445.2				
11-03-02	2.16		47.13	1413.9				
12-03-02	1.33		29.02	870.9				
13-03-02	0.01		0.21	6.6				
14-03-02	0.86		18.76	562.8				
15-03-02	1.78	280	36.24	1086.72				
18-03-02	4.3		89.05	2671.5				
19-03-02	0.05		1.04	31.2				
20-03-02	0.66		13.67	410.1				
22-03-02	6.83	400	154.60	4638				
24-03-02	0.53		12	360				
26-03-02	1.56		35.30	1059				
27-03-02	0.86		19.47	584.1				
28-03-02	0.86		19.47	584.1				
				19,477.8		24,577.8	67,145.93	42,568.13

OPERATION ON 365 KVA GENERATOR

April 2002

Date	Outage Duration (Hours)	Quantity of fuel replaced (litres)	Fuel consumed (litres)	Running cost (Rc) at ₦30/litre	Maintenance cost (Mc) (₦)	Total cost Tc=Rc+Mc (₦)	NEPA bill cost (₦)	Difference
2-04-02	0.95		22.64	679.2				
5-04-02	2		45.27	1358.1				
7-04-02	0.58		13.13	393.9				
9-04-02	2		45.27	679.2				
10-04-02	1.5		33.95	1018.5				
11-04-02	4	220	220	6,600				
12-04-02		600						
13-04-02	6.25		600	18,000				
16-04-02	5.28	90	59.26	1,777.8				
17-04-02	e.66		7.40	222				
18-04-02	1.33		14.92	447.6				
20-04-02	0.75		8.42	256.6				
21-04-02	0.70	90	90	2,700				
22-04-02	0.95	50	17.59	527.7				
23-04-02	1.75		32.41	972.3				
26-04-02	0.58	240	15.23	456.9				
29-04-02	0.33		8.66	259.8				
30-04-02	3.66		96.11	2,883.3				
				39,907.8		39,907.8	71,024.10	31,116.3

OPERATION ON 365 KVA GENERATOR

May 2002

Date	Outage duration (hours)	Quantity of fuel replaced(L)	Fuel consumed (litres)	Running cost (Rc) at ₦30/L	Maintenance cost (Mc) ₦	Total cost Tc=Rc+Mc	NEPA bill cost ₦	Difference
1-05-02	0.33	240	47.71	1431.3				
2-05-02	1.33		192.29	5766.87				
3-05-02	6.83	240	121.42	3642.6				
4-05-02	0.75		13.34	400.2				
6-05-02	0.43		7.64	229.2				
7-05-02	4.08		72.53	2175.9				
8-05-02	0.08		1.42	42.6				
9-05-02	1.33		23.64	709.2				
13-05-02	2.66	120	66.22	1986.6				
15-05-02	2.16		53.78	1613.4				
17-05-02	4.50	1160	1011.63	3048.9				
18-05-02	0.66		148.37	4451.1				
19-05-02	0.33	100	6.27	188.1				
20-05-02	1.33		25.28	758.4				
21-05-02	0.60		11.42	342.66				
23-05-02	3		57.03	1710.9				
24-05-02	0.5	120	12.68	380.4				
28-05-02	0.66		16.76	502.8				
31-05-02	0.41		10.40	312		56,995.2	152,126.63	95,131.43
				56,995.2				

OPERATION ON 365 KVA GENERATOR

June 2002

Date	Outage duration (hours)	Quantity of fuel replaced (litres)	Fuel consumed (litre)	Running cost (Rc) at ₦30/litre	Maintenance cost (Mc) ₦	Total cost Tc=Mc+Rc ₦	NEPA bill cost ₦	Difference
1-06-02	1.58		40.08	1202.4				
2-06-02	1.58		40.08	1202.4				
3-06-02	2.58	320	61.12	1833.6				
4-06-02	1.33		31.50	945				
7-06-02	2.11		49.98	1499.4				
8-06-02	1		23.68	710.4				
18-06-02	3.08		72.96	2188.8				
19-06-02	0.08		1.89	56.7				
20-06-02	0.33		7.81	234.3				
21-06-02	3		71.06	2131.8				
23-06-02	1	220	38.66	1159.8				
26-06-02	1.33		51.42	1542.60				
28-06-02	0.95		36.73	1101.9				
29-06-02	1.75		67.67	2030.1				
30-06-02	0.66		25.52	765.6				
				18,604.8	69,000.00	87,120.25	67,484.25	20,484.55

OPERATION ON 365 KVA GENERATOR

July 2002

Date	Outage duration (hours)	Quantity of fuel replaced (litres)	Fuel consumed (litre)	Running cost (Rc) at ₦30/litre	Maintenance cost (Mc) N	Total cost Tc=Mc+Rc ₦	NEPA bill cost ₦	Difference
1-07-02		100						
2-07-02	2.5		15.98	479.4				
3-07-02	1.75		11.19	335.7				
4-07-02	0.33		2.12	63.6				
7-07-02	0.66		4.22	126.6				
8-07-02	2.58		14.39	431.7				
9-07-02	2.25	400	400	12,000.00				
11-07-02		240						
13-07-02	0.25		7.08	212.4				
14-07-02	3.25		91.87	2756.1				
15-07-02	0.33		9.33	279.9				
17-07-02	1.43		40.42	1212.6				
18-07-02	0.41		11.59	347.7				
20-07-02	0.66		18.65	559.5				
21-07-02	2.16		61.06	1831.8				
24-07-02	1.5	240	72	2160				
25-07-02	3.5		168	5040				
26-07-02		240						
30-07-02	2.75		90.78	2723.4				
				32,123.4		32,123.4	45,852.98	13,729.58

OPERATION ON 365 KVA GENERATOR

August 2002

Date	Outage duration (hours)	Quantity of fuel replaced (litres)	Fuel consumed (litre)	Running cost (Rc) at ₦30/litre	Maintenance cost (Mc) ₦	Total cost Tc=Mc+Rc ₦	NEPA bill cost ₦	Difference
				1515.3				
1-08-02	1.53		50.51	405.9				
3-08-02	0.41		13.53	2586.1				
4-08-02	2.58	150	85.17	4500				
6-08-02	3.38	110	150	332.7				
8-08-02	0.83		11.09	300.9				
9-08-02	0.75		10.03	164.4				
10-08-02	0.41		5.48	1066.5				
12-08-02	2.66		35.55	1435.5				
13-08-02	3.58	200	47.85	4814.1				
14-08-02	5.4		160.47	1114.5				
15-08-02	1.25		37.15	71.4				
18-08-02	0.08	155	2.38	4650				
20-08-02	0.25	90	155	641.1				
28-08-02	4.83		21.37	464.4				
29-08-02	3.5		15.48	309.6				
30-08-02	2.83		10.32	43.8				
31-08-02	0.33		1.46					
				24,385.2				
27,385.05						24,385.2	51,770.25	

OPERATION ON 365 KVA GENERATOR

September 2002

Date	Outage duration (hours)	Quantity of fuel replaced (litres)	Fuel consumed (litres)	Running cost (Rc) at ₦30/litre	Maintenance cost (Mc) ₦	Total cost Tc=Mc+Rc ₦	NEPA bill ₦	Difference
1-09-02	4.33		19.16	574.8				
2-09-02	2.75		12.17	365.1				
3-09-02	1.41		6.24	187.2				
4-09-02	0.86		3.80	114				
5-09-02	1.75	240	78.95	2367				
9-09-02	0.41		18.49	554.7				
10-09-02	0.50		22.56	676.8				
14-09-02	2.33	240	96.91	2907.3				
15-09-02	2.58		107.32	3219.6				
16-09-02	0.86		35.77	1073.1				
17-09-02	0.63	240	43.7	1311				
19-09-02	2.83		196.3	5889				
20-09-02	1.50	220	56.22	1686.8				
21-09-02	1		37.48	1124.4				
22-09-02	0.21		7.87	236.1				
23-09-02	3.16		108.43	3252.9				
25-09-02	5.66	240	115.12	3453.6				
27-09-02	0.91		18.51	555.3				
29-09-02	0.91		18.51	555.3				
30-09-02	2.08		42.30	1269				
				35,274.3		35,274.3	89,075.30	53,801

OPERATION ON 365 KVA GENERATOR

OCTBER 2002

Date	Outage duration (hours)	Quantity of fuel replaced (litre)	Fuel consumed (litre)	Running cost (Rc) at ₦ 30/litre	Maintenance cost (Mc) ₦	Total cost Tc=Rc+Mc ₦	NEPA bill cost ₦	Difference
3-10-02	1.6		23.59	707.7				
4-10-02	1.08		21.97	659.1				
5-10-02	0.5	250	27.84	835.2				
8-10-02	0.66		36.75	1102.5				
9-10-02	3.33		185.41	5562.3				
10-10-02	0.28	140	5.28	158.4				
11-10-02	2.06		37.74	1132.2				
13-10-02	1.9		35.86	1075.8				
14-10-02	0.41		7.73	231.9				
15-10-02	2.75		51.89	1556.7				
16-10-02	3.33	240	121.64	3649.2				
18-10-02	1.5		54.80	1644				
19-10-02	0.75		27.40	822				
20-10-02	0.50		18.26	547.8				
21-10-02	0.33		12.08	361.8				
30-10-02	0.16		5.84	175.2				
31-10-02	5.25	240	240	7200				
				27,466.8		27,466.8	129,895.50	102,428.7

OPERATION ON 365 KVA GENERATOR NOVEMBER 2002

Date	Outage duration (hours)	Quantity of fuel replaced (litre)	Fuel consumed (litre)	Running cost (Rc) at ₦ 30/litre	Maintenance cost (Mc) ₦	Total cost Tc=Rc+Mc ₦	NEPA bill cost ₦	Difference
1-11-02	0.3	240	38.07	1142.1				
4-11-02	1.75		201.93	6057.9				
6-11-02		240						
8-11-02	2		39.47	1184.1				
10-11-02	0.5		9.87	296.1				
11-11-02	1.25		24.67	740.1				
12-11-02	2.33		45.99	1379.7				
13-11-02	2.75	240	55.84	1675.2				
15-11-02	2.66		54.00	1620				
16-11-02	1.5		30.46	913.8				
17-11-02	3.41		69.24	2077.2				
18-11-02	1.50		30.46	913.8				
19-11-02	4.50	480	312.59	9377.7				
23-11-02	0.66		45.85	1375.5				
24-11-02	0.25		17.36	520.8				
25-11-02	1.50		104.20	3126				
26-11-02	2.66	240	240	7200				
27-11-02	4.78	240	182.67	5480.1				
29-11-02	1.5		57.33	1719.9				
				50,400.00		50,400.00	130,203.20	88,803.2

OPERATION ON 365 KVA GENERATOR DECEMBER 2002

Date	Outage duration (hours)	Quantity of fuel replaced (litre)	Fuel consumed (litre)	Running cost (Rc) at ₦30/litre	Maintenance cost (Mc) ₦	Total cost Tc=Mc+Rc ₦	NEPA bill cost ₦	Difference
2-12-02	1.25	2000	2000	60,000				
4-12-02	0.66	240	48.44	1153.2				
9-12-02	2.16		158.53	4755.9				
10-12-02	0.25		18.35	550.5				
11-12-02	0.20		14.68	440.4				
14-12-02	1.25	240	62.24	1867.2				
16-12-02	3.16		157.34	4720.2				
27-12-02	0.41		20.42	612.6				
				74,400.00	69,000.00	143,400.00	127,642.20	15,757.8

365 KVA GENERATOR

Months	Outage duration (hours)	Fuel consumed (litre)	Running cost (Rc) at ₦30/litre	Maintenance cost (Mc) ₦	Total cost Tc=Mc+Rc ₦	NEPA bill cost ₦	Difference
January	19.4	1180	35,400	74,000.00	109,400.00	36,925.4	72,474.6
February	10.43	592.58	17,777.4	30,000.00	317,777.4	14,649.00	303,128.8
March	23.21	649.26	19,477.8	_	24,577.8	67,145.93	42,568.13
April	33.27	1330.26	39,907.8	_	39,907.8	71,024.10	31,116.3
May	34.72	1899.84	56,995.2	_	56,995.2	152,126.63	95,131.43
June	22.36	620.16	18,604.8	69,000.00	87,604.8	67,120.25	20,484.55
July	26.31	1070.78	32,123.4	_	32,123.4	45,852.98	13,729.58
August	34.09	812.84	24,385.2	_	24,385.2	51,770.25	27,385.05
September	31.13	1175.81	35,274.3	_	35,274.3	89,075.30	53,801.00
October	25.97	917.96	27,466.8	_	27,466.8	129,895.50	102,428.7
November	35.83	1680	50,400.00	_	50,400.00	139,203.20	88,803.2
December	9.34	2480	74,400.00	69,000.00	143,400.00	127,642.20	15,757.8

OPERATION ON 500 KVA GENERATOR JANUARY 2002

Date	Outage duration (hours)	Quantity of fuel replaced (litre)	Fuel consumed (litre)	Running cost (Rc)at ₦30/litre	Maintenance cost (Mc) ₦	Total cost Tc=Mc+Rc ₦	NEPA bill cost ₦	Difference ₦
11-01-02	0.58	600	56.86	1705.8				
14-01-02	2.21		216.67	6500.1				
18-01-02	1.83		179.41	5382.3				
19-01-02	0.5		49.02	1470.6				
20-01-02	1		98.04	29451.2				
21-01-02	0.25	660	38.82	1164.6				
22-01-02	2		310.39	9317.7				
24-01-02	2		310.59	9317.7				
25-01-02	2	660	46.21	1386.3				
29-01-02	0.41		9.47	284.1				
				59,270.4	14,000.00	33,270.4	299,900.16	226,629.76

OPERATION ON 500 KVA GENERATOR FEBRUARY 2002

Date	Outage duration (hours)	Quantity of fuel replaced (litre)	Fuel consumed (litre)	Running cost (Re)at N30/litre	Maintenance cost (Mc) ₦	Total cost Tc=Mc+Rc ₦	NEPA bill cost ₦	Difference ₦
1-02-02	4		92.44	2773.2				
4-02-02	0.5		11.58	347.4				
5-02-02	3.66		84.58	2537.4				
7-02-02	0.13		3.00	90				
8-02-02	1.33		30.73	921.9				
12-02-02	2.25		52	1560				
14-02-02	0.5	480	14.44	433.2				
25-02-02	0.33		9.53	285.9				
				8949.00	60,000.00	66,249.00	607,498.50	538,529.5

OPERATION ON 500 KVA GENERATOR MARCH 2002

Date	Outage duration (hours)	Quantity of fuel replaced (litre)	Fuel consumed (litre)	Running cost (Rc) at ₦30/litre	Maintenance cost (Mc) ₦	Total cost Tc=Mc+Rc ₦	NEPA bill cost ₦	Difference ₦
8-03-02	1.66		47.94	1438.2				
9-03-02	0.5		14.44	433.2				
11-03-02	1.16		33.51	1005.3				
12-03-02	1.58		445.63	1368.9				
13-03-02	0.25		7.22	216.6				
14-03-02	0.83		23.97	719.1				
15-03-02	1.50		43.32	1299.6				
18-03-02	3.83	600	542	1626				
20-03-02	0.41		58	1740				
22-03-02	6.83	900	260.13	1803.9				
24-03-02	0.38		14.47	434.1				
26-03-02	1.83		60.70	2091				
27-03-02	0.83		31.61	948.3				
28-03-02	0.25		9.52	285.6				
				20,110.2		20,110.2	57,456.53	37,346.33

OPERATION ON 500 KVA GENERATOR APRIL 2002

Date	Outage duration (hours)	Quantity of fuel replaced (litre)	Fuel consumed (litre)	Running cost (Rc) at N30/litre	Maintenance cost (Mc) ₦	Total cost Tc=Mc+Rc ₦	NEPA bill cost ₦	Difference ₦
2-04-02	2.68		102.07	3062.1				
3-04-02	0.58		22.09	662.27				
9-04-02	2		76.17	2285.1				
11-04-02	5		190.43	5712.9				
12-04-02	9		114.26	3427.8				
13-04-02	0.25		9.55	286.5				
14-04-02	0.33	600	20.67	620.1				
16-04-02	6.03		377.66	11,329.8				
17-04-02	0.66		41.33	1239.9				
18-04-02	1.33		83.29	2498.7				
20-04-02	1.23		77.05	2311.5				
21-04-02	0.21	600	71.78	2153.4				
22-04-02	0.83		279.80	8394				
23-04-02	0.33		111.23	3336.9				
28-04-02	0.08		26.96	808.8				
29-04-02	0.33		111.23	3336.9				
30-04-02	3.75	600	282.30	8469				
				59,906.1		59,906.1	71,024.10	11,118.00

OPERATION ON 500 KVA GENERATOR MAY 2002

Date	Outage duration (hours)	Quantity of fuel replaced (litre)	Fuel consumed (litre)	Running cost (Rc)at N30/litre	Maintenance cost (Mc) ₦	Total cost Tc=Mc+Rc ₦	NEPA bill cost ₦	Difference ₦
1-05-02	0.66		49.68	1490.4				
2-05-02	0.28		21.07	632.4				
3-05-02	1.34		100.87	3026.1				
6-05-2	0.6		45.17	1355.1				
7-05-02	3	600	198.67	5960.1				
8-05-02	0.3		19.86	595.8				
9-05-02	1.03		68.23	2046.9				
13-05-02	2.33		154.30	4629				
15-05-02	2.40		158.94	4768.2				
16-05-02	1.58	880	880	26,400				
17-05-02	5.75	600	460.62	13,818.6				
18-05-02	0.41		32.84	985.2				
20-05-02	1.33		106.54	1015.2				
21-05-02	1.40	300	57.40	17,200				
22-05-02	0.35		13.43	402.9				
23-05-02	3.08		125.40	3762				
25-05-02	1.25		50.89	1526.7				
26-05-02	0.33		13.43	402.9				
27-05-02	1.41		57.42	1722.6				
28-05-02	1.16		47.23	1416.9				
31-05-02	0.7		28.50	855				
				77,898.00		77,898.00	152,126.63	74,228.63

OPERATION ON 500 KVA GENERATOR JUNE 2002

Date	Outage duration (hours)	Quantity of fuel replaced (litre)	Fuel consumed (litre)	Running cost (Rc) at ₦30/litre	Maintenance cost (Mc) ₦	Total cost Tc=Mc+Rc ₦	NEPA bill cost ₦	Difference ₦
1-06-02	0.66	120	39.8	1194				
2-06-02	1.33		80.2	2406				
3-06-02	2	240	85.26	2557.8				
4-06-02	1.63		69.48	2084.4				
7-06-02	2		85.26	2557.8				
8-06-02	0.5	120	103.45	3103.5				
11-06-02	0.08		16.55	496.5				
20-06-02	1.25	220	220	6600				
21-06-02	0.16	60	5.52	165.6				
23-06-02	1.58		54.48	1634.4				
25-06-02		400						
26-06-02	1.33		160.24	4806.72				
28-06-02	0.75		90.36	2710.8				
29-06-02	0.91		109.63	3288.9				
30-06-02	0.33		39.76	1192.8				
				34,800.00		34,800.00	408,330.30	373,530.3

OPERATION ON 500 KVA GENERATOR JULY 2002

Date	Outage duration (hours)	Quantity of fuel replaced (litre)	Fuel consumed (litre)	Running cost (Rc)at ₦30/litre	Maintenance cost (Mc) ₦	Total cost Tc=Mc+Rc ₦	NEPA bill cost ₦	Difference ₦
1-07-02		100						
2-07-02	1		30.86	925.8				
3-07-02	1.41		43.32	1299.6				
4-07-02	0.33		10.18	305.4				
7-07-02	0.5		15.44	463.2				
8-07-02	0.91	400	23.53	705.9				
9-07-02	1.5		38.78	1163.4				
13-07-02	0.75		19.39	581.7				
14-07-02	2.5		64.64	1939.2				
17-07-02	1.08		27.92	837.6				
18-07-02	0.41		10.60	318				
20-07-02	0.41		10.60	318				
21-07-02	2.66		68.78	2063.4				
24-07-02	1.41		36.48	1094.4				
25-07-02	3.84		99.28	2978.4				
26-07-02	0.25	400						
29-07-02	2.55		4.86	145.8				
30-07-02			49.63	1488.9				
				16,634.7	74,000.00	90,634.7	433,725.60	3433,090.9

OPERATION ON 500 KVA GENERATOR AUGUST 2002

Date	Outage duration (hours)	Quantity of fuel replaced (litre)	Fuel consumed (litre)	Running cost (Rc)at ₦30/litre	Maintenance cost (Mc) ₦	Total cost Tc=Mc+Rc ₦	NEPA bill cost ₦	Difference ₦
1-08-02	1.55		30.17	905.1				
3-08-02	0.15		2.94	88.2				
4-08-02	2.41		46.90	140.7				
6-08-02	2		38.95	1168.65				
8-08-02	0.33		6.42	192.6				
9-08-02	0.83		16.15	484.5				
10-08-02	3.86		75.13	2253.9				
12-0802	2.07		40.29	1208.7				
13-0802	4.55		88.56	2662.8				
14-08-02	4.6	440	319.24	9577.2				
15-08-02	1.25		86.76	2602.8				
18-08-02	0.33		22.90	687				
19-08-02	0.16		11.10	333				
20-08-02		300						
25-08-02	1.3		18.65	559.5				
28-08-02	0.66		9.47	284.1				
29-08-02	4.33		62.12	1863.6				
30-08-02	0.08		1.47	44.1				
31-08-02	0.18		2.58	77.4				
				26,400.15		26,400.15	208,273.80	181,873.65

OPERATION ON 500 KVA GENERATOR SEPTEMBER 2002

Date	Outage duration (hours)	Quantity of fuel replaced (litre)	Fuel consumed (litre)	Running cost (Rc) at ₦30/litre	Maintenance cost (Mc) ₦	Total cost Tc=Rc+Mc ₦	NEPA bill ₦	Difference ₦
1-09-02	4.08		58.53	1755.9				
2-09-02	2.75		39.45	1183.5				
3-09-02	1.33		19.08	572.4				
4-09-2	0.83		11.90	357				
5-09-02	0.5		4.30	125				
7-09-02	0.33		4.73	141.9				
10-09-02	0.33		4.73	141.9				
14-09-02	2		28.69	860.7				
15-09-02	2.41		34.57	1037.1				
16-09-02	3.75	150	118.42	3552.6				
17-09-02	1		31.58	947.4				
19-09-02	3.83	300	139.44	4183.2				
21-09-02	0.91		33.14	994.2				
22-09-02	0.5		18.20	548				
23-09-02	3		109.22	3276.6				
25-09-02	4.43	180	150	4500				
26-09-02		600						
27-09-02	0.83		136.06	4081.8				
29-09-02	1		163.94	4918.8				
30-09-02	1.83		300	9.000				
				38,095.60		38,095.60	185,275.50	147,179.9

OPERATION ON 500 KVA GENERATOR OCTOBER 2002

Date	Outage duration (hours)	Quantity of fuel replaced (litre)	Fuel consumed (litre)	Running cost (Rc) at N30/litre	Maintenance cost (Mc) ₦	Total cost Tc=Rc+Mc ₦	NEPA bill ₦	Difference ₦
3-10-2	1	480	32.78	983.4				
4-10-02	1.25		40.98	1229.4				
8-10-02	0.36		11.08	354				
9-10-02	4.41		144.59	4337.7				
11-10-02	2.41		79.03	2370.9				
13-10-02	1.88		61.64	1849.2				
14-10-02	0.5		16.39	491.7				
15-10-02	2.83		92.79	2783.7				
16-10-02	3.83	240	105.57	3167.1				
18-10-02	1.41		44.70	1341				
19-10-02	1.75		55.48	1664.4				
20-10-02	0.41		13.02	390.6				
21-10-02	0.25		7.92	237.6				
22-10-02	0.06		1.90	57				
29-10-02	0.16		5.07	152.1				
30-10-02	0.2		6.34	190.2				
31-10-02	5.30	240	58.37	1751.1				
				23,351.1		23,351.1	27,191.22	3840.12

OPERATION ON 500 KVA GENERATOR NOVEMBER 2002

Date	Outage duration (hours)	Quantity of fuel replaced (litre)	Fuel consumed (litre)	Running cost (Rc) at N30/litre	Maintenance cost (Mc) ₦	Total cost Tc=Rc+Mc ₦	NEPA bill ₦	Difference ₦
4-11-02	1.5		16.52	495.6				
8-11-02	2.08		22.91	687.3				
10-11-02	1.25		13.77	413.1				
11-11-02	1.33		14.65	439.5				
12-11-02	2		22.05	661.5				
13-11-02	1.33		14.65	439.5				
15-11-02	2.5		27.53	825.9				
16-11-02	1.5		16.52	495.6				
18-11-02	3		33.04	991.2				
19-11-02	1	480	59.11	1773.3				
20-11-02	0.08		4.73	141.9				
23-11-02	0.5		29.65	889.5				
24-11-02	0.21		12.48	374.4				
25-11-02	1.5		88.67	2660.1				
26-11-02	2.5		147.78	4433.4				
27-11-02	0.75		44.53	1335.9				
29-11-02	1.58		93.50	2805				
				19,848.9		19,848.9	32,763.57	12,914.67

OPERATION ON 500 KVA GENERATOR DECEMBER 2002

Date	Outage duration (hours)	Quantity of fuel replaced (litre)	Fuel consumed (litre)	Running cost (Rc) at N30/litre	Maintenance cost (Mc) ₦	Total cost Tc=Rc+Mc ₦	NEPA bill ₦	Difference ₦
2-12-02	0.75	4,000.00	94.83	2844.9				
9-12-02	2.16		273.10	8193				
10-12-02	0.25		31.61	948.3				
11-12-02	0.08		10.11	303.33				
14-12-02	1.31		165.63	4950				
16-12-02	2.75		347.70	10,431				
27-12-02	0.33		41.72	1251.6				
				28,922.13	24,000.00	52,922.13	25,979.31	26,942.52

500 KVA GENERATOR

Months	Outage duration (hours)	Fuel consumed (litre)	Running cost (R) ₦	Maintenance cost (Mc) ₦	Total cost Tc=Mc+Rc ₦	NEPA bill ₦	Difference
January	12.78	1975.68	59,270.4	14.000	73,240.4	299,900.16	226,629.76
February	12.7	298.3	8949	60.000	68.949	607,478.50	538,529.5
March	21.84	670.34	20,110.2	_	20,110.2	57,456.53	37,346.33
April	28.62	1996.87	59,906.1	_	59,906.1	71,024.10	11,118
May	30.67	2596.6	77,898	_	77,898	152,126.63	74,228.63
June	13.51	1160	34,800	_	34,800	408,330.30	373,530.3
July	21.51	554.49	16,634.7	74.000	90,634.77	433,725.60	343,090.9
August	35.17	880	26,400.15	_	26.400.15	208,273.80	181,873.65
September	35.64	1269.85	38,095.60	_	38,095.60	185,275.50	147,275.5
October	28.01	778.37	23,351.1	_	23,351.1	27,191.22	3840.12
November	24.51	661.63	19,848.9	_	19,848.9	32,763.57	12,914.67
December	7.63	964.07	28,922.13	24.000	52,922.13	25,979.31	26,942.82

3.3.1 Analysis of 500 KVA generator with respect to the graphs.

Generally the total cost appears to be negligible compared to the NEPA bill, this is because the transformer in the substation is under loaded (fig.1). From the fig.2, we can observe that the running costit is not proportional to the outage duration this is because of the variation on the load at different periods. From the fig. 3, on January, February, July and December, the total cost is high compared to the other months due to some c maintenance work and repair done on the generator. But in May the total cost is high because of the running of the generator das a result of long duration of outages.

Fig. 1: Total cost against NEPA bill

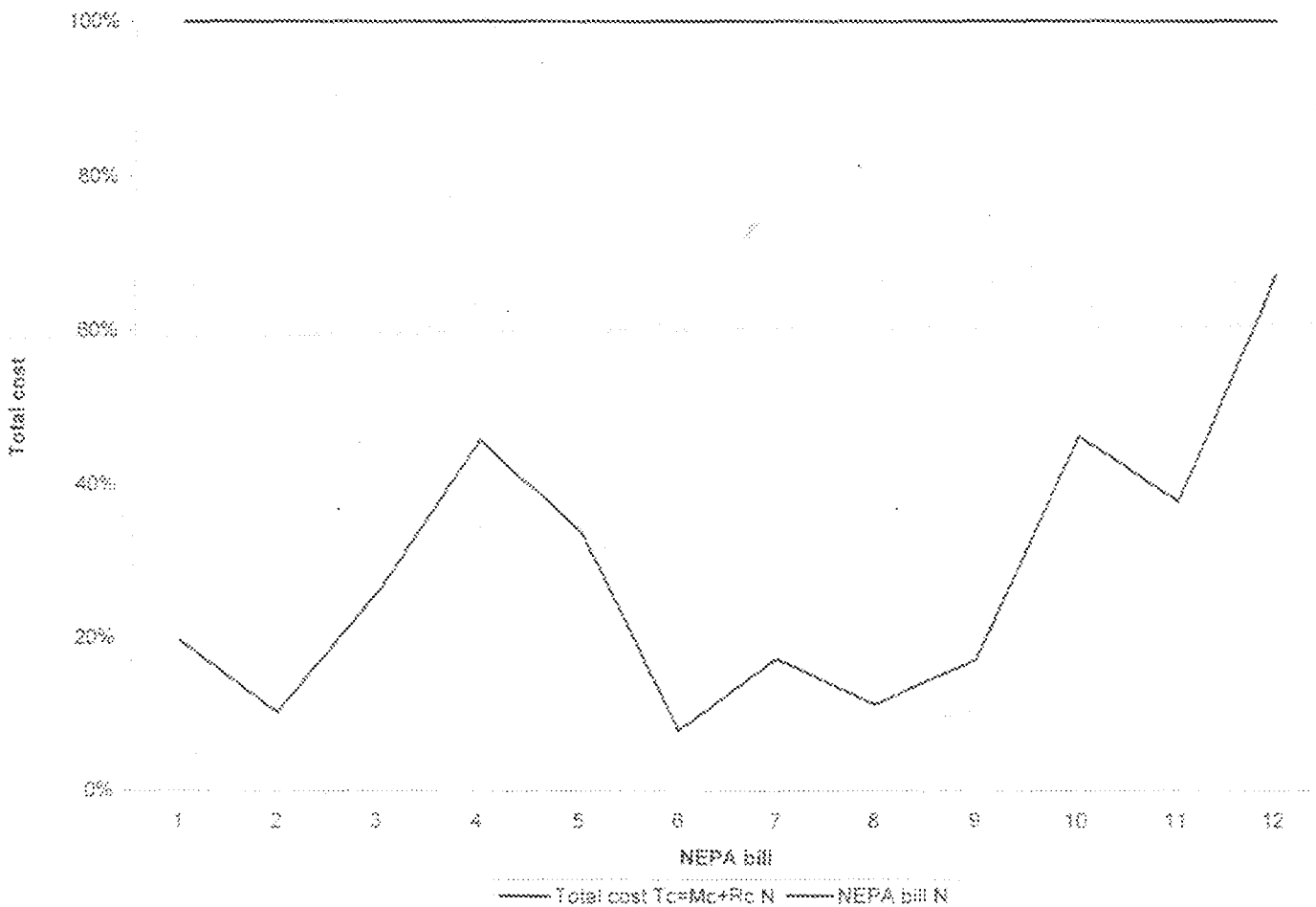


Fig 2 Runing cost against outage duration

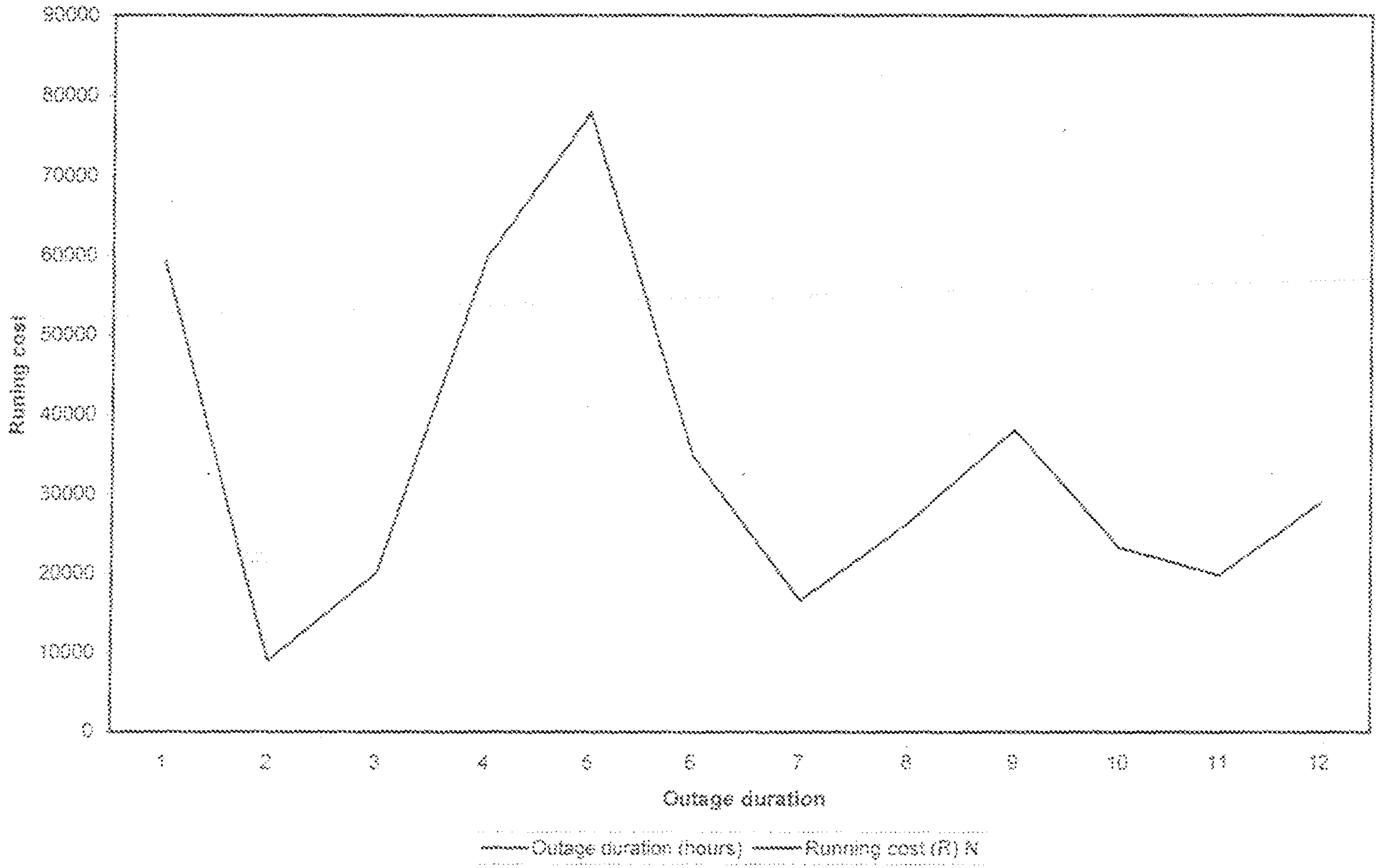
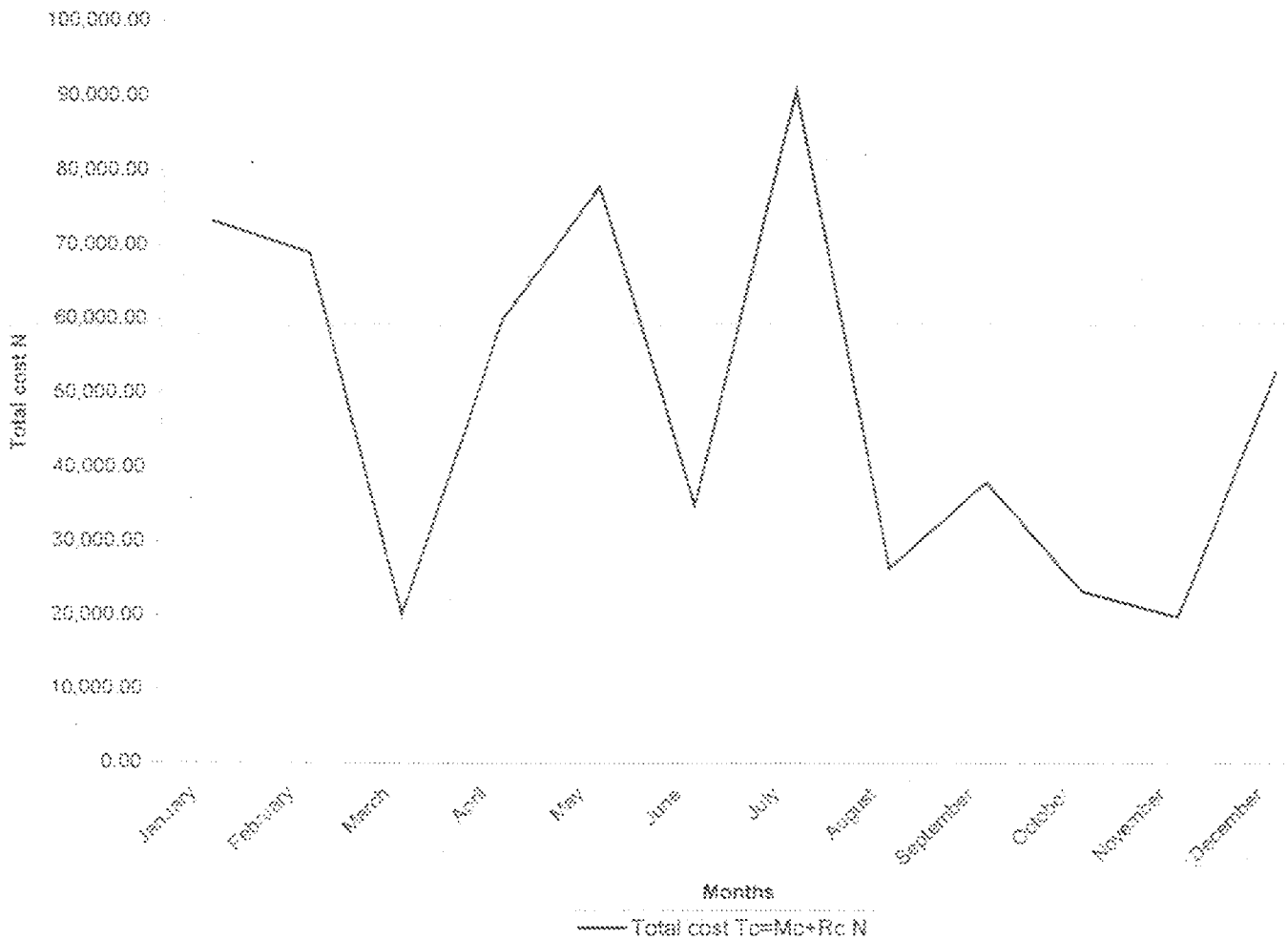


Fig. 3: Total cost against Months



3.3.2 Analysis of 365 KVA generator with respect to the graphs

When the total cost is high, the NEPA bill is low and vice versa (fig.1). From fig.2 we can see that the running cost depend on the outage duration but in some cases the running cost does not depend on the outage duration but on the quantity of the load due to much consumption of electricity by students on campus.

Also, from fig.3 on January, February, June, and December we can observe that the total cost is high compared to the other months. This increase of the total cost is due to the maintenance work done on the generator.

Fig.1: Total cost against NEPA bill

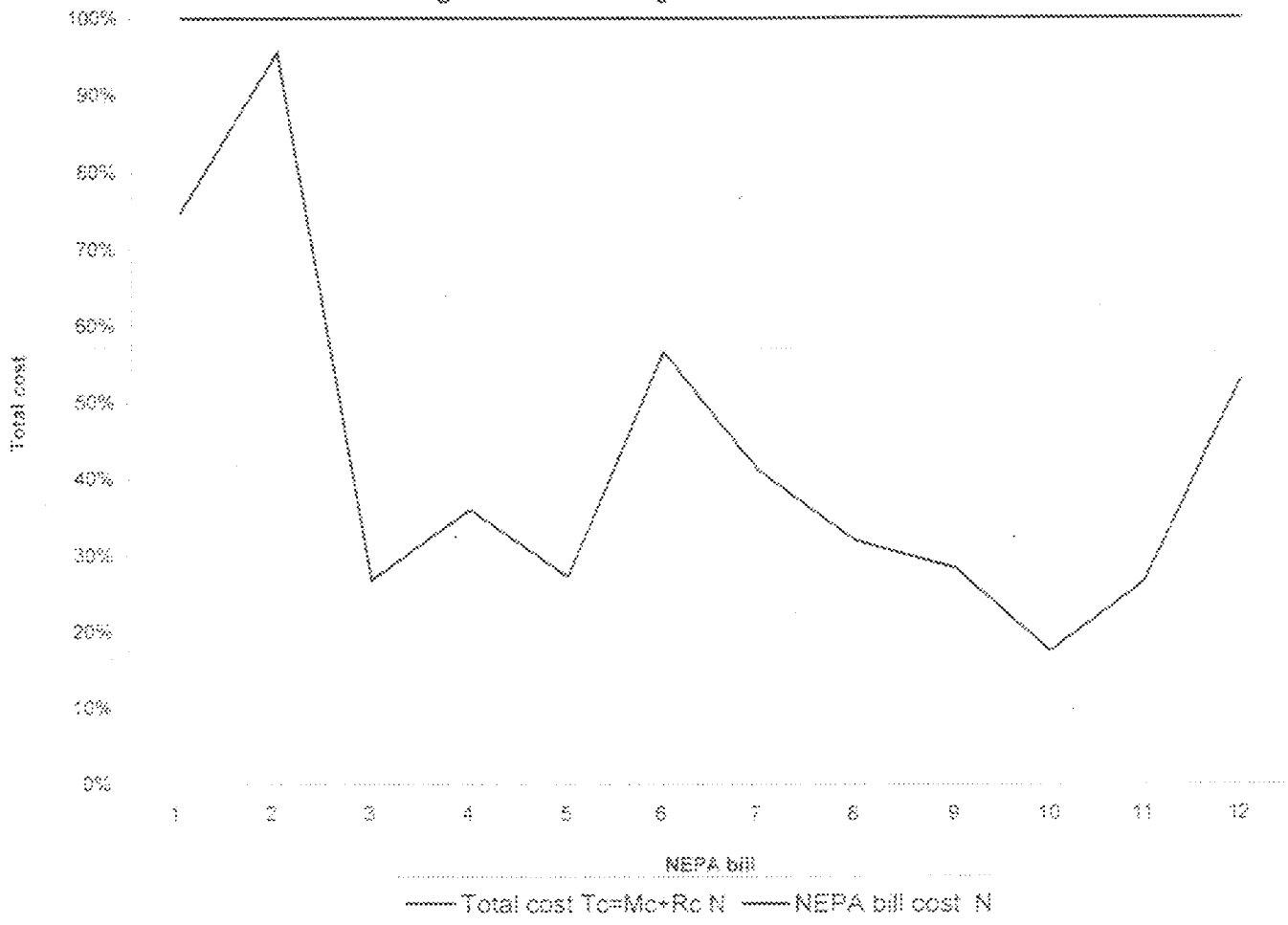


Fig.2: Running cost against Outage duration

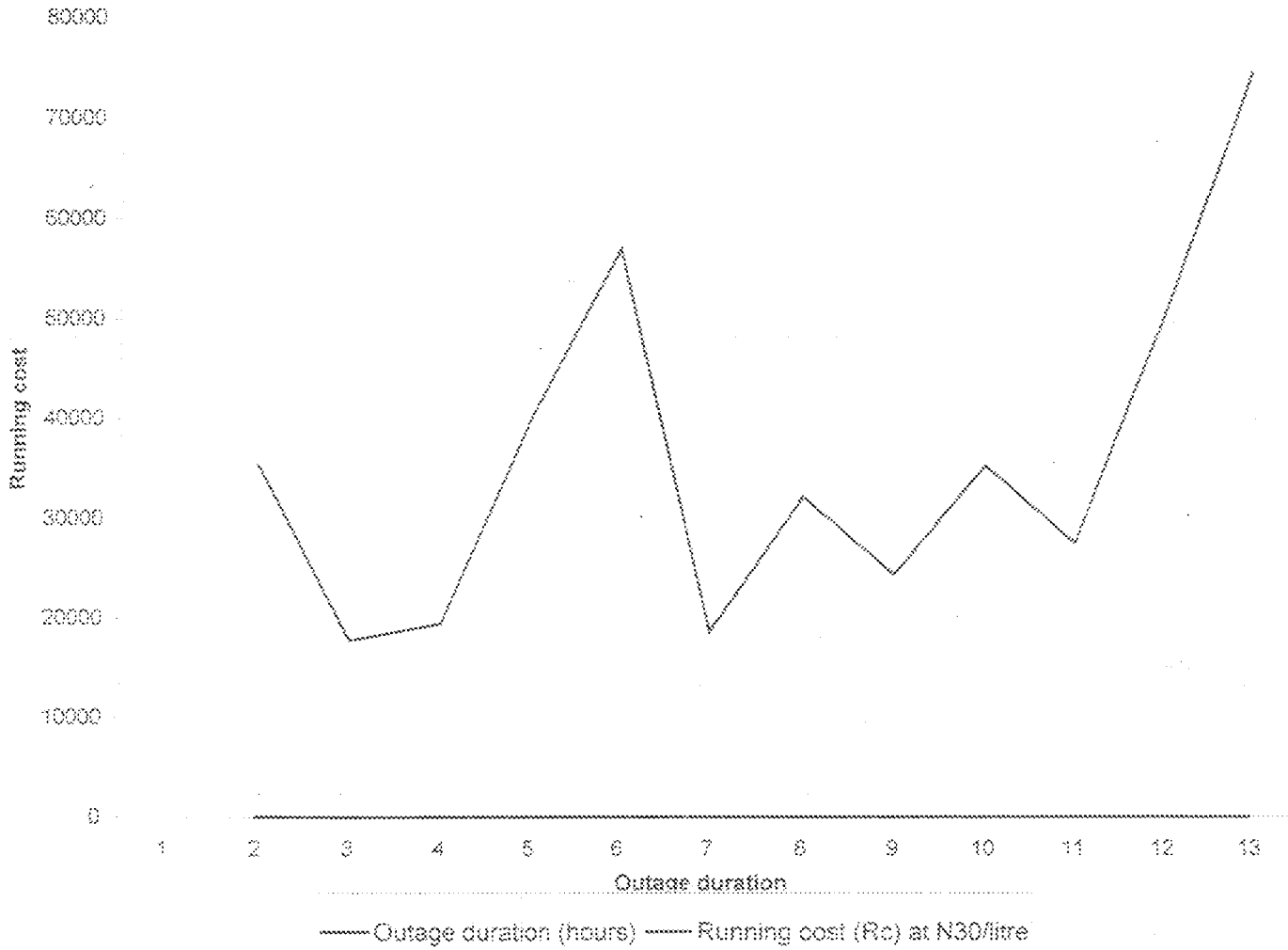
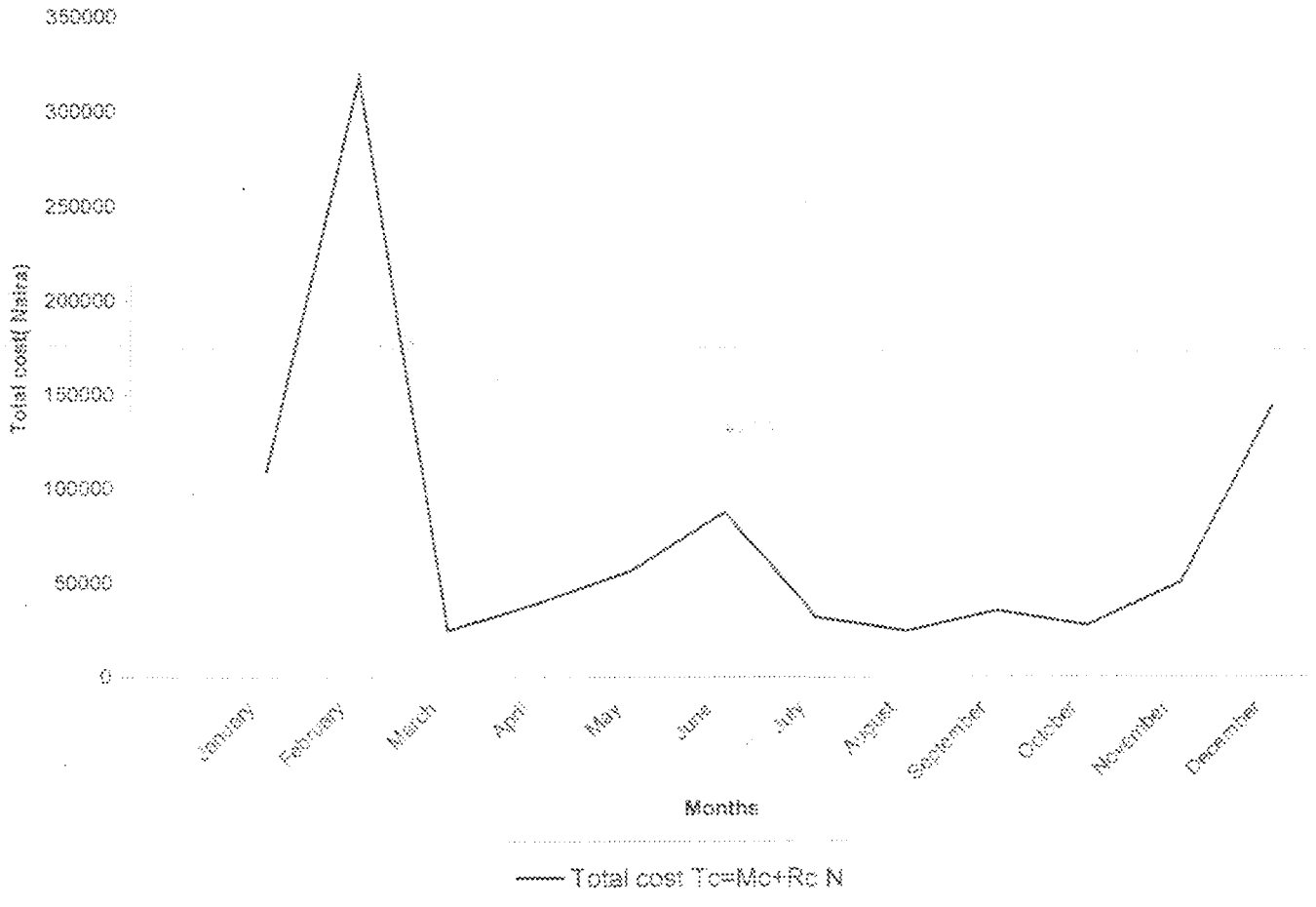


Fig. 3: Total cost against Months



CHAPTER 4

4.1 CONCLUSION

From the analysis of the case, we can say that the use of generators is good for every body (staff and students) because our comfort is not distorted at the interruption of electric power supply by NEPA.

Another thing is that the electricity generated from the generators is reliable. While the electricity provided from NEPA is not reliable.

However, the use of these generators by the university is not economical because of much expenses incurred by the university in buying fuel for the running of the generators and the maintenance and the repairs of the generators.

4.2 RECOMMANDATION

The electric utilities are expected to provide constant supply of electricity to their customers at a reasonable rate by making economical use of available system and apparatus. Experience indicates that the most distribution system service interruptions are as a result of adverse effects from natural elements such as lightning, wind, animals, etc and overloading the system (illegal connections).

To achieve the aim of satisfying the public demand for electricity, the NEPA must increase the reliability of the electricity. However, increased reliability can only be obtained by increasing the cost of the services provided.

The factor required to assess this balance is to solve the problem of maintenance such as unavailability of spare parts, inadequate release of funds and bureaucracy. The success of any power distribution system depends on the alertness of the men working around the equipment.

The generators also have to be maintained two or three times in a year. This will make the generator to have a good reliability. As a student the recommendation I can give to the University Authority is to allow the generators to be used beyond the designated for their operation especially in the night.

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