Studies in Social Science Research
ISSN 2690-0793 (Print) ISSN 2690-0785 (Online)
Vol. 2, No. 3, 2021
www.scholink.org/ojs/index.php/sssr

Original Paper

Assessment of Equipment Maintenance Practices for Effective Electric Power Distribution in Adamawa State

Dauda Moses[1*], L. C. Ezugu[1], Onwuka Immaculater Akudo[2] & Isaac John Ibanga[1]

[1] Department of Electrical Technology Education, Modibbo Adama University of Technology, Yola Adamawa State, Nigeria

[2] Nigeria Police Academy, Wudil, Kano State, Nigeria

[*] Corresponding E-mail: mulkidon1@gmail.com; htpp://www.mautechyola.edu.ng

Received: June 15, 2021 Accepted: June 25, 2021 Online Published: July 9, 2021

doi:10.22158/sssr.v2n3p12 URL: http://dx.doi.org/10.22158/sssr.v2n3p12

Abstract

The main purpose of this study was to assess equipment maintenance practices for effective electric power distribution in Adamawa State by Yola Electricity Distribution Company. Three research questions and three null hypotheses were formulated to guide the study. The study adopted descriptive survey research design. The population of the study was 69 consisting of 46 technicians and 23 supervisors in Yola Electricity Distribution Company. The whole population was used for the study. The instrument for data collection was a structured questionnaire developed by the researchers titled "Assessment of Equipment Maintenance Practices for Effective Electric Power Distribution Questionnaire (AEMPELPDQ)". The instrument was validated by three experts and a reliability of 0.89 was obtained using Cronbach Alpha reliability method. Mean and standard deviation was used to answer the research questions while t-test was used to test the null hypotheses at 0.05 level of significance. The finding of the study revealed that Yola Electricity Distribution Company adopts monthly routine maintenance on 18 out of the 31 items listed equipment while quarterly routine maintenance is carried out on 11 of the 31 items. Weekly maintenance is adopted for only two (2) of the equipment; Out of the 31 items listed, 22 of the items are semi-annually maintained; while eight (8) of the items are annually maintained and only one (1) of the equipment (distribution board) is weekly maintained. Based on the findings, YEDC should ensure adequate inspection and supervision of equipment to prevent unwarranted breakdown that may affect effective distribution of electrical power; YEDC should ensure at least monthly routine maintenance is carried out on the equipment available to ensure effective usage.

Keywords

Assessment, Equipment, Maintenance, Equipment Maintenance, Maintenance Practices

1. Introduction

Maintenance has been defined in the literature both amply and extensively. It is defined in Endrenyi and Anders (2006) as an activity wherein an un-failed device has, from time to time, its deterioration arrested, reduced or eliminated. The main objective of maintenance is to extend the lifetime of equipment and/or reduce its failure likelihood. Technical requirements and budget constraints are the most influential factors in assigning maintenance activity (Bloom, 2006). Madueme (2002) observed that maintenance of any engineering system consist of performing the following functions: recognition or detection; location or diagnosis; correction, repair or replacement; and verification or checking of emergency failure of components or equipment; setting up and performing scheduled periodic preventive inspections; repair activities in a central facility on failed and replaced items arriving from different operating stations.

According to Abdelmalik (2014), routine maintenance checks to be conducted on a power transformer can be on daily, monthly, half-yearly and annual basis. Routine transformer maintenance testing and checking on daily basis include: maintaining oil filled up to the desired level in Magnetic Oil Gas (MOG) always; replacing the silica gel if its color changes to pink; and sealing any leakage if detected. Transformer maintenance checks on a monthly basis involve checking of oil level in the oil cap so that it doesn't drop below a fixed limit and hence avoid damage due to it; keeping the breathing holes in the silica gel breather clean to ensure proper breathing action at all times and where electrical transformer has oil filling bushing, ensure that the oil is filled up to the correct level.

Preventive maintenance is aimed at thwarting the possible faults that arise from outright negligence of the electric power distribution equipment. Maintenance activities that fall under this category according to Ali, Achinanya, and Nuhu (2004) are usually carried out annually, and include: checking the integrity and condition of ground connections, cable joints and splices, and correcting any issue; inspecting the cleanliness and physical condition of switchgears, transformers, and other above-ground fixtures; conducting contact resistance tests on terminations, insulation resistance tests between ground connections and conductors, to assess damage or wear, among others.

Similarly, Megbowon and Oyebisi (2005) stated that corrective maintenance is conducted in response to underground cable faults (possible damage caused by digging, internal failures such as defective cables, among others) to determine the appropriate remedial action. Corrective maintenance activities carried out on underground cables include checking electric cable routes for possible damage after excavation or road work; insulation resistance testing to detect faults between conductors and ground connections; pinpointing faulty areas using a sheath tester and cable fault locator; and repairing, retesting and re-commissioning faulty electrical cables.

According to Arunagiri and Agarwal (2005), corrective maintenance helps to predict when and what kind of repairs might be needed in the future, or if faulty sections need immediate replacement. The utilization of underground cables for electrical distribution occurs where it is impractical, difficult, or dangerous to use the overhead lines. Underground cables are widely used in densely populated urban areas, in factories, and even to supply power from the overhead pots to the consumer's premises (CIGRE, 2002).

1.1 Statement of the Problem

For an effective distribution of electric power that will meet the demand of the end-users, the equipment and other necessary tools have to be maintained in terms of identified faults on the distribution line, transformers, poles, etc. One of the features of effective distribution of electric power is the rapid response to faults on the distribution line and components. From the researchers' observation, Sangere, Saminaka, Bekaji, Wuro-Jabbe, Yakore and Bajure in Yola, Adamawa State experienced poor rapid response to equipment maintenance from the electricity distribution company. In the above mentioned locations, faults occurred in the transformers and distribution lines which led to electric power outage. This transformers and distribution line faults led to the isolation of the locations for a long time before remedial actions were taken. Also, if there is any report on either a falling or felled poles in Yola, Adamawa state, the time taken for the necessary maintenance to be carried out on the poles or detected distribution line is always unbearable for the consumers. It is against this background that this study sought to assess equipment maintenance practices for effective electric power distribution in Adamawa State by Yola Electricity Distribution Company.

1.2 Purpose of the Study

The main purpose of this study was to assess equipment maintenance practices for effective electric power distribution in Adamawa State by Yola Electricity Distribution Company. Specifically, the study sought to determine:

1. The extent to which Yola Electricity Distribution Company adopts routine maintenance on equipment being utilized for electric power distribution in Adamawa State.
2. The extent to which Yola Electricity Distribution Company adopts preventive maintenance on equipment being utilized for electric power distribution in Adamawa State.
3. The extent to which Yola Electricity Distribution Company adopts corrective maintenance on equipment being utilized for electric power distribution in Adamawa State.

1.3 Research Questions

The following research question guided the study.

1. To what extent does Yola Electricity Distribution Company adopts routine maintenance on equipment being utilized for electric power distribution in Adamawa State?
2. What is the extent to which Yola Electricity Distribution Company adopts preventive maintenance on equipment being utilized for electric power distribution in Adamawa State?
3. To what extent does Yola Electricity Distribution Company adopts corrective maintenance on equipment being utilized for electric power distribution in Adamawa State?

1.4 Hypotheses

H_{O1}: There is no significant difference between the mean responses of technicians and supervisors in Yola Electricity Distribution Company on the extent to which they adopt routine maintenance practices on the equipment being utilized for electric power distribution in Adamawa State.

H_{O2}: There is no significant difference between the mean responses of technicians and supervisors in Yola Electricity Distribution Company on the extent to which they adopt preventive maintenance practices on the equipment being utilized for electric power distribution in Adamawa State.

H_{O3}: There is no significant difference between the mean responses of technicians and supervisors in Yola Electricity Distribution Company on the extent to which they adopt corrective maintenance practices on the equipment being utilized for electric power distribution in Adamawa State.

2. Methodology

The study adopted descriptive survey research design and was conducted in Adamawa State, Nigeria. Adamawa State is located in the North-East of Nigeria within latitude 9^o 15N and 9^o 18N and longitude 12^o 25E and 12^o 30E. It shares boundary with Borno State to the north-east, Gombe and Bauchi States to the north-west, and Taraba State to the south-west. It shares its border with Cameroon Republic. The population of the study was 69 consisting of 46 technicians and 23 supervisors in Yola Electricity Distribution Company. Due to the manageable size of the population, there was no sampling; hence, the whole population was used for the study. The instrument used for data collection was a structured questionnaire developed by the researchers titled: Assessment of Equipment Maintenance Practices for Effective Electric Power Distribution Questionnaire (AEMPELPDQ). The responses on the questionnaire were structured on a 5-point Rating scale of Daily (D)/ Weekly (W) = 5, Weekly (W)/ Monthly (M) = 4, Bi-weekly (BW)/ Quarterly (Q)/ Monthly (M) = 3, Monthly (M)/Semi-Annually (SA)/ Quarterly = 2, Quarterly (Q)/Annually (A)/Semi-Annually (SA) = 1. The questionnaire was validated by three experts, two from the Department of Electrical Technology Education, Modibbo Adama University of Technology Yola, Adamawa State and one from Yola Electricity Distribution Company. A trial test was conducted on 20 technicians and 10 supervisors in Gombe a branch of the Jos Electricity Distribution Company and 0.89 reliability index was obtained for the instrument using Cronbach Alpha reliability method. Data for the study was collected by the researchers with help of two research assistants. Mean statistic was used to answer the three research questions of the study while t-test was used to test the three null hypotheses at 0.05 level of significance.

3. Results

3.1 Research Question One

To what extent does Yola Electricity Distribution Company adopts routine maintenance on equipment being utilized for electric power distribution in Adamawa State?

Table 1. Mean and Standard Deviation of Supervisors and Technicians on the Extent Yola Electricity Distribution Company Adopts Routine Maintenance on Equipment Being Utilized for Electric Power Distribution in Adamawa State

		Respondents						
		Ns = 23		N_T = 46		N_{TT} = 69		
S/NO	ITEMS	$\bar{x}_S$	σ_S	$\bar{x}_T$	σ_T	$\bar{x}_G$	σ_G	RMK
1.	33 KV Line Feeder	4.48	0.51	3.54	0.59	3.86	0.71	Weekly
2.	11 KV Line Feeder	4.48	0.51	4.39	0.49	4.42	0.50	Weekly
3.	Supply Voltage Detector	1.43	0.51	1.54	0.50	1.51	0.50	Monthly
4.	Distribution Transformer	2.52	0.51	1.04	0.21	1.54	0.78	Monthly
5.	Power Transformer (7.5 MVA)	1.70	0.47	1.80	0.40	1.77	0.43	Monthly
6.	Battery Rectifier	1.00	0.00	1.43	0.50	1.29	0.46	Quarterly
7.	Supply Voltage Circuit Breaker	1.00	0.00	1.33	0.47	1.22	0.42	Quarterly
8.	Spring Charger (33KV)	2.43	0.51	1.22	0.42	1.62	0.73	Monthly
9.	Trip Circuit	1.00	0.00	1.59	0.50	1.39	0.49	Quarterly
10.	Low Pressure Gas Indicator	2.04	0.71	1.54	0.72	1.71	0.75	Monthly
11.	Electronic Hooter Alarm	1.26	0.45	1.63	0.49	1.51	0.50	Monthly
12.	Alarm Annunciator	1.13	0.34	1.33	0.56	1.26	0.50	Monthly
13.	System Protector Indicator	1.35	0.49	1.37	0.49	1.36	0.48	Monthly
14.	Transformer Protector (trip)	1.43	0.51	1.52	0.62	1.49	0.58	Quarterly
15.	Voltage Selector	2.48	0.59	1.28	0.46	1.68	0.76	Monthly
16.	A.C mains Fail Indicator	1.70	0.47	1.61	0.49	1.64	0.48	Monthly
17.	Mode Selector	1.00	0.00	1.26	0.44	1.17	0.38	Quarterly
18.	Metering Box	1.00	0.00	1.46	0.50	1.30	0.46	Quarterly
19.	Spring Charger (11KV)	1.61	0.50	1.67	0.47	1.65	0.48	Monthly
20.	High Speed Relay	1.13	0.34	1.39	0.49	1.30	0.46	Quarterly
21.	Gang Isolator	1.30	0.47	1.50	0.51	1.43	0.50	Quarterly
22.	Energy Meter	1.52	0.51	1.70	0.59	1.64	0.57	Monthly
23.	Local remote Switch	2.04	0.71	1.24	0.43	1.51	0.66	Monthly
24.	Transformer Meter	1.48	0.51	1.65	0.48	1.59	0.49	Monthly
25.	Control Unit (CTU)	1.17	0.39	1.39	0.61	1.32	0.56	Quarterly
26.	Busbar	1.09	0.29	1.61	0.49	1.43	0.50	Quarterly
27.	Feeder Pillar Plinth	1.96	0.21	1.50	0.51	1.65	0.48	Monthly
28.	Automatic Circuit Reclosers	1.96	0.64	1.78	0.59	1.84	0.61	Monthly
29.	Voltage Regulators (33KV)	1.74	0.45	1.89	0.67	1.84	0.61	Monthly
30.	Voltage Regulators (11KV)	1.43	0.51	1.76	0.60	1.65	0.59	Monthly

31.	Distribution Board (Automatic)	1.04	0.21	1.28	0.46	1.20	0.41	Quarterly
32.	Distribution Board (manual)	1.74	0.45	1.59	0.50	1.64	0.48	Monthly

$\bar{x}_S$= Mean of Supervisors, $\bar{x}_T$ = Mean of Technicians, σ_S = Standard deviation of Supervisors, σ_T = Standard deviation of Technicians, $\bar{x}_G$= Grand Mean, σ_G = Grand Standard deviation N_S = Number of Supervisors, N_T = Number of Technicians, N_{TT}= Total Number of Respondents, RMK = Remark

From Table 1 above, the respondent indicated with a mean response range of 3.86 and 4.42 and a standard deviation of 0.71 and 0.56 respectively, Yola Electricity Distribution Company adopts weekly routine maintenance on item 1 and 2. The respondents indicated that item 3-5, 8, 10-14, 15, 16, 19, 22-24, 27-30 and 32 with mean responses which ranges between 1.51 and 1.84 and a standard deviation range between 0.43 and 0.78, Yola Electricity Distribution Company adopts monthly routine maintenance on the electric power distribution equipment. The respondents further indicated with mean responses which ranges from 1.26 and 1.46 and standard deviation of 0.48 and 0.73 that in item 6, 7, 9, 14, 17, 18, 20, 21, 25, 26 and 31 are quarterly maintained. The result reveals that Yola Electricity Distribution Company adopts monthly routine maintenance on 18 out of the 31 items listed equipment while quarterly routine maintenance is carried out on only 11 items while weekly maintenance is adopted for only two (2) of the equipment.

3.2 Research Question Two

What is the extent to which Yola Electricity Distribution Company adopts preventive maintenance on equipment being utilized for electric power distribution in Adamawa State?

Table 2. Mean and Standard Deviation of Supervisors and Technicians on the Extent which Yola Electricity Distribution Company Adopts Preventive Maintenance on Equipment Utilized for Electric Power Distribution in Adamawa State

		Respondents						
		Ns = 23		**N_T = 46**		**N_{TT} = 69**		
S/NO	**ITEMS**	$\bar{x}_S$	σ_S	$\bar{x}_T$	σ_T	$\bar{x}_G$	σ_G	**RMK**
1.	33 KV Line Feeder	1.78	0.67	1.74	0.44	1.75	0.53	SA
2.	11 KV Line Feeder	1.78	0.42	1.67	0.47	1.71	0.46	SA
3.	Supply Voltage Detector	1.22	0.42	1.67	0.47	1.71	0.50	SA
4.	Distribution Transformer	1.52	0.51	1.35	0.48	1.52	0.49	SA
5.	Power Transformer (7.5 MVA)	1.74	0.69	1.72	0.54	1.41	0.59	A
6.	Battery Rectifier	1.35	0.49	1.91	0.66	1.72	0.66	SA
7.	Supply Voltage Circuit Breaker	1.39	0.50	1.76	0.43	1.64	0.48	SA
8.	Spring Charger (33KV)	1.30	0.47	1.48	0.51	1.42	0.50	A
9.	Trip Circuit	1.13	0.34	1.37	0.49	1.29	0.46	A

10.	Low Pressure Gas Indicator	1.70	0.47	1.65	0.48	1.67	0.47	SA
11.	Electronic Hooter Alarm	1.35	0.49	2.00	0.60	1.78	0.64	SA
12.	Alarm Annunciator	1.83	0.39	1.93	0.49	1.90	0.46	SA
13.	System Protector Indicator	1.57	0.51	1.41	0.50	1.46	0.50	A
14.	Transformer Protector (trip)	1.57	0.51	1.13	0.34	1.28	0.45	A
15.	Voltage Selector	1.57	0.51	1.89	0.43	1.78	0.48	SA
16.	A.C mains Fail Indicator	1.70	0.70	1.59	0.58	1.71	0.62	SA
17.	Mode Selector	1.96	0.47	1.28	0.50	1.48	0.52	A
18.	Metering Box	1.87	0.76	1.43	0.46	1.48	0.63	A
19.	Spring Charger (11KV)	1.57	0.51	2.02	0.54	1.91	0.53	SA
20.	High Speed Relay	1.70	0.70	1.96	0.77	1.75	0.76	SA
21.	Gang Isolator	1.35	0.49	1.65	0.63	1.57	0.65	SA
22.	Energy Meter	1.39	0.50	1.41	0.48	1.36	0.50	A
23.	Local remote Switch	1.26	0.45	1.37	0.50	1.30	0.48	A
24.	Transformer Meter	1.13	0.34	1.67	0.49	1.29	0.46	A
25.	Control Unit (CTU)	1.74	0.45	1.93	0.47	1.70	0.46	SA
26.	Busbar	1.39	0.50	1.98	0.65	1.75	0.65	SA
27.	Feeder Pillar Plinth	1.83	0.39	1.35	0.45	1.93	0.43	SA
28.	Automatic Circuit Reclosers	1.52	0.51	1.59	0.48	1.41	0.49	A
29.	Voltage Regulators (33KV)	1.04	0.21	1.74	0.50	1.41	0.95	A
30.	Voltage Regulators (11KV)	1.70	0.70	1.67	0.53	1.72	0.59	SA
31.	Distribution Board (Automatic)	1.39	0.50	2.07	1.51	1.84	1.30	SA
32.	Distribution Board (manual)	4.00	0.00	4.72	0.62	4.48	0.61	W

$\bar{x}_S$ = Mean of Supervisors, $\bar{x}_T$ = Mean of Technicians, σ_S = Standard deviation of Supervisors, σ_T = Standard deviation of Technicians, $\bar{x}_G$ = Grand Mean, σ_G = Grand Standard deviation, S-A = Semi Annually, N_S = Number of Supervisors, N_T = Number of Technicians, N_{TT} = Total Number of Respondents, RMK = Remark

From Table 2 above, the respondents shown that Yola Electricity Distribution Company conduct preventive maintenance on item 1-4, 6, 7, 10 - 12, 15, 16, 19 - 21, 25 - 27, 30 and 31 with mean responses which ranges between 1.51 and 1.91 and having a standard deviation which ranges between 0.43 and 0.52 respectively on semi-annual basis. Item 5, 8, 9, 13, 14, 17, 18, 22 - 24, 28 and 29 with mean responses range between 1.28 and 1.41 and standard deviation which ranges between 0.52 and 0.63, the respondents revealed that Yola Electricity Distribution Company adopts preventive maintenance annually on the listed items. The respondents further revealed that item 32 is maintained weekly with a mean response of 4.48 and standard deviation of 0.61. From the results presented, it is revealed that out of the 31 items listed, 22 of the items are semi-annually maintained while eight (8) of the items are annually maintained and only one (1) of the equipment is weekly maintained.

3.3 Research Question Three

To what extent does Yola Electricity Distribution Company adopts corrective maintenance on equipment being utilized for electric power distribution in Adamawa State?

Table 3. Mean and Standard Deviation of Supervisors and Technicians on the Extent which Yola Electricity Distribution Company Adopts Corrective Maintenance on Equipment Being Utilized for Electric Power Distribution in Adamawa State

		Respondents						
		Ns = 23		N_T = 46		N_{TT} = 46		
S/NO	**ITEMS**	$\bar{x}_S$	σ_S	$\bar{x}_T$	σ_T	$\bar{x}_G$	σ_G	**RMK**
1.	33 KV Line Feeder	4.91	0.29	4.11	0.88	4.38	0.82	Weekly
2.	11 KV Line Feeder	4.09	0.79	4.17	0.61	4.14	0.67	Weekly
3.	Supply Voltage Detector	3.78	0.80	4.57	0.50	4.30	0.71	Weekly
4.	Distribution Transformer	3.61	0.84	5.00	0.00	4.54	0.81	Daily
5.	Power Transformer (7.5 MVA)	4.22	0.90	4.57	0.83	4.45	0.87	Weekly
6.	Battery Rectifier	4.30	0.70	3.83	0.74	3.99	0.76	Weekly
7.	Supply Voltage Circuit Breaker	4.35	0.49	3.39	0.49	3.71	0.67	Weekly
8.	Spring Charger (33KV)	4.52	0.59	3.35	0.77	3.74	0.90	Weekly
9.	Trip Circuit	4.17	0.39	4.61	0.65	4.46	0.61	Weekly
10.	Low Pressure Gas Indicator	4.04	0.77	4.43	0.75	4.30	0.77	Weekly
11.	Electronic Hooter Alarm	3.78	0.80	4.46	0.50	4.23	0.69	Weekly
12.	Alarm Annunciator	4.00	0.74	4.59	0.50	4.39	0.65	Weekly
13.	System Protector Indicator	4.48	0.51	4.00	0.00	4.16	0.37	Weekly
14.	Transformer Protector (trip)	4.30	0.47	4.15	0.82	4.20	0.72	Weekly
15.	Voltage Selector	3.83	1.11	3.65	0.87	3.71	0.96	Weekly
16.	A.C mains Fail Indicator	3.70	0.63	4.02	0.80	3.91	0.76	Weekly
17.	Mode Selector	4.65	0.71	4.43	0.69	4.51	0.70	Daily
18.	Metering Box	3.87	0.63	4.20	0.69	4.09	0.68	Weekly
19.	Spring Charger (11KV)	3.65	0.65	4.20	0.91	4.01	0.87	Weekly
20.	High Speed Relay	3.57	0.79	4.41	0.50	4.13	0.73	Weekly
21.	Gang Isolator	4.65	0.65	4.00	0.79	4.22	0.80	Weekly
22.	Energy Meter	4.09	0.90	3.93	0.77	3.99	0.81	Weekly
23.	Local remote Switch	4.17	0.72	4.37	0.64	4.30	0.67	Weekly
24.	Transformer Meter	4.61	0.50	4.22	0.42	4.35	0.48	Weekly
25.	Control Unit (CTU)	4.00	0.00	4.41	0.62	4.28	0.54	Weekly
26.	Busbar	3.96	0.88	3.93	0.90	3.94	0.89	Weekly
27.	Feeder Pillar Plinth	3.74	0.81	3.65	0.60	3.68	0.68	Weekly

28.	Automatic Circuit Re-closers	4.22	0.85	4.54	0.50	4.43	0.65	Weekly
29.	Voltage Regulators (33KV)	4.48	0.51	3.83	0.38	4.04	0.53	Weekly
30.	Voltage Regulators (11KV)	4.13	0.34	4.52	0.72	4.39	0.65	Weekly
31.	Distribution Board (Automatic)	4.35	0.71	4.20	0.69	4.25	0.69	Weekly
32.	Distribution Board (manual)	3.83	0.98	4.70	0.51	4.41	0.81	Weekly

$\bar{x}_S$ = Mean of Supervisors, $\bar{x}_T$ = Mean of Technicians, σ_S = Standard deviation of Supervisors, σ_T = Standard deviation of Technicians, $\bar{x}_G$ = Grand Mean, σ_A = Average Standard deviation, N_S = Number of Supervisors, N_T = Number of Technicians, N_{TT} = Total Number of Respondents, RMK = Remark

From Table 3 above, the result presented revealed that item 1 - 3, 5 - 16 and 18 - 32 with mean responses which ranges between 3.56 and 4.48 and standard deviation which ranges between 0.37 and 0.90, Yola Electricity Distribution Company adopts weekly corrective maintenance. The respondents indicated that Yola Electricity Distribution Company adopts corrective maintenance on item 4 and 17 daily with a mean response of 4.51 and 4.54 and standard deviation 0.70 and 0.81. The result reveals that 29 out of 31 items are maintained weekly while two (2) of the items are maintained daily.

3.4 Hypothesis One

There is no significant difference between the mean responses of technicians and supervisors in Yola Electricity Distribution Company on the extent to which they adopt routine maintenance practices on the equipment being utilized for electric power distribution in Adamawa State.

Table 4. t – test Statistical Analysis of Difference between the Mean Responses of Supervisors and Technicians on the Extent Which Yola Electric Distribution Company Adopt Routine Maintenance Practices on the Equipment being Utilized for Electric Power Distribution in Adamawa State

Respondents	N	Mean	S.D	Df	T	P – value	Remark
Supervisors	23	1.73	0.08				
				67	3.054	0.073	
Technicians	46	1.66	0.10				Not Significant

P >0.05 N= Number of respondents, S.D = Standard Deviation

The result of analysis in Table 4 revealed that there is no significant difference between the mean responses of technicians and supervisors on the extent to which they adopt routine maintenance practices on the equipment being utilized for electric power distribution in Adamawa State. With mean response of 1.73 and standard deviation of 0.08 for supervisors and 1.66 and 0.10 for mean response and standard deviation for technicians at 67 degree of freedom, this implies that Yola Electricity Distribution Company adopts monthly routine maintenance on the equipment used in distribution of electric power in Adamawa State since p<0.05 (t = 3.054, df = 67, p = 0.73).

3.5 Hypothesis Two

There is no significant difference between the mean responses of technicians and supervisors in Yola Electricity Distribution Company on the extent to which they adopt preventive maintenance practices on the equipment being utilized for electric power distribution in Adamawa State.

Table 5. t – test Statistical Analysis of Difference between the Mean Responses of Supervisors and Technicians on the Extent they Adopt Preventive Maintenance Practices on the Equipment being Utilized for Electric Power Distribution in Adamawa State

Respondents	N	Mean	S.D	Df	t	P – value	Remark
Supervisors	23	1.60	0.11				
				67	4.987	0.062	Not Significant
Technicians	46	1.76	0.13				

P >0.05 N= Number of respondents, S.D = Standard Deviation

The result of analysis in Table 5 revealed that there is no significant difference between the mean responses of technicians and supervisors on the extent to which they adopt preventive maintenance practices on the equipment being utilized for electric power distribution in Adamawa State. With mean response of 1.60 and standard deviation of 0.11 for supervisors and 1.76 and 0.13 for mean response and standard deviation for technicians at 67 degree of freedom, this implies that Yola Electricity Distribution Company adopts semi-annually preventive maintenance (59.4%) on the equipment used in distribution of electric power in Adamawa State since p<0.05 (t = -4.987, df = 67, p = 0.062).

3.6 Hypothesis Three

There is no significant difference between the mean responses of technicians and supervisors in Yola Electricity Distribution Company on the extent to which they adopt corrective maintenance practices on the equipment being utilized for electric power distribution in Adamawa State.

Table 6. t – test Statistical Analysis of Difference between the Mean Responses of Supervisors and Technicians on the Extent they Adopt Corrective Maintenance Practices on the Equipment being Utilized for Electric Power Distribution in Adamawa State

Respondents	N	Mean	S.D	Df	t	P – value	Remark
Supervisors	23	4.13	0.10				
				67	2.557	0.083	Not Significant
Technicians	46	4.20	0.12				

P >0.05 N= Number of respondents, S.D = Standard Deviation

The result of analysis in Table 6 revealed that there is no significant difference between the mean responses of technicians and supervisors on the extent to which they adopt corrective maintenance practices on the equipment being utilized for electric power distribution in Adamawa State. With mean response of 4.13 and standard deviation of 0.10 for supervisors and 4.20 and 0.12 for mean response and standard deviation for technicians at 67 degree of freedom, this implies that Yola Electricity Distribution Company adopts weekly corrective maintenance (94%) on the equipment used in distribution of electric power in Adamawa State since $p>0.05$ ($t = 2.557$, $df = 67$, $p = 0.083$).

4. Findings of the Study

Based on the results of the study, the following findings were made:

1. Yola Electricity Distribution Company adopts monthly routine maintenance on 18 out of the 31 items listed equipment which include 11 KV line feeder, power transformer, etc. while quarterly routine maintenance is carried out on 11 of the 31 items. Weekly maintenance is adopted for only two (2) of the equipment.
2. Out of the 31 items listed, 22 of the items are semi-annually maintained which include 33 KV Line Feeder , Supply Voltage Detector , Distribution Transformer; while eight (8) of the items are annually maintained which include automatic circuit reclosers, local remote, switch etc; and only one (1) of the equipment (distribution board) is weekly maintained.
3. 29 out of 31 items are maintained weekly which include distribution board, automatic circuit re-closers, gang isolator, trip circuit and power transformer while two (2) of the items distribution transformer and mode selector are maintained daily.
4. There is no significant difference between the mean responses of technicians and supervisors in Yola Electricity Distribution Company on the extent to which they adopt routine maintenance practices on the equipment being utilized for electric power distribution in Adamawa State
5. There is no significant difference between the mean responses of technicians and supervisors in Yola Electricity Distribution Company on the extent to which they adopt preventive maintenance practices on the equipment being utilized for electric power distribution in Adamawa State
6. There is no significant difference between the mean responses of technicians and supervisors in Yola Electricity Distribution Company on the extent to which they adopt corrective maintenance practices on the equipment being utilized for electric power distribution in Adamawa State.

5. Discussion of Findings

The finding of the study revealed that Yola Electricity Distribution Company adopts monthly routine maintenance on 18 out of the 31 items listed equipment which include 11 KV line feeder, power transformer, etc. while quarterly routine maintenance is carried out on 11 of the 31 items. Weekly maintenance is adopted for only two (2) of the equipment. This finding is in agreement with Madueme (2002) who conducted a study on maintenance culture at Afam Power Station for selected years and the impact of such policies on installed machines and operational efficiency of the station. Madueme reported that the maintenance at Afam power plant is scheduled quarterly due to the equipment involved. This finding is further supported by Sunday and Fagbenle (2011) who asserted that Preventive Maintenance Programme (PMP) implementation on the performance of the Egbin 1320 MW thermal power plant in Nigeria is scheduled routinely and effectiveness of the equipment achieved.

The finding of the study revealed that Out of the 31 items listed, 22 of the items are semi-annually maintained which include 33 KV Line Feeder, Supply Voltage Detector, Distribution Transformer; while eight (8) of the items are annually maintained which include automatic circuit reclosers, local remote, switch etc.; and only one (1) of the equipment (distribution board) is weekly maintained. This finding is in agreement with Dikio, Biobele and Victor (2018) who suggested that the right scheduling and constant interval replacement policy of preventive maintenance is important to increase the electrical infrastructure or equipment availability in the substation. Dikio, Biobele and Victor suggested that that regular schedule inspection, testing, and servicing of equipment should be performed in the UST distribution substation. The finding is further supported by Smith and Hinchcliffe (2004) who suggested that preventive maintenance is created for every item separately according to manufacturers' recommendations or legislation. Preventive maintenance can be carried out on date-based (the date at which the next maintenance will be carried out base on the manufacturer's recommendation) or based on equipment running hours (Time limit at which the equipment is expected to run before carrying out the next maintenance).

The finding of the study revealed that 29 out of 31 items are maintained weekly which include distribution board, automatic circuit re-closers, gang isolator, trip circuit and power transformer while two (2) of the items distribution transformer and mode selector are maintained daily. This finding is in agreement with Santigo (2015) who suggested that time between the origin of the problem and its detection is called the detection time. Santigo further stated that there is a relationship between detection time and total resolution time; the sooner the fault is detected, in general, will have caused less damage and will be easier and cheaper to repair. The finding is further supported by Grasmick et al. (2008), who maintained that corrective maintenance addresses deficiencies that inevitably result from unforeseen events like vandalism, lightning strikes, hail and flooding with exceptions to activities that expand the capacity of equipment or upgrade the equipment to serve needs greater than or different from those originally intended and as such corrective maintenance must be scheduled to reflect the usability of the equipment.

The finding of the study on hypothesis one revealed that there is no significant difference between the mean responses of technicians and supervisors on the extent to which they adopt routine maintenance practices on the equipment being utilized for electric power distribution in Adamawa State. This finding is in agreement with Carter and Carter (2001) who stated that the administrators and engineers at the power station were not different statistically in their opinion on the routine maintenance carried out at the station. The further support of the findings, Omoigui and Komolafe (2000) opined that the frequency of inspection of equipment is determined by the conditions under which it operates and as such the engineers and technicians were not different in their opinion as regard to the routine maintenance on equipment.

The finding of the study on hypothesis two revealed that there is no significant difference between the mean responses of technicians and supervisors on the extent to which they adopt preventive maintenance practices on the equipment being utilized for electric power distribution in Adamawa State. This finding is in agreement with Madueme (2012) who asserted preventive maintenance ensures effective and efficient service of facilities, tools and equipment in workshops as there was no significant difference in the mean response of teachers and workshop attendants on the utilization of power equipment in the workshop. To further buttress the finding, Omoigui and Komolafe (2000) reported that the engineers and technicians were not statistically different in their opinion as regard to the preventive maintenance on equipment

The finding of the study on hypothesis three revealed that there is no significant difference between the mean responses of technicians and supervisors on the extent to which they adopt corrective maintenance practices on the equipment being utilized for electric power distribution in Adamawa State. This finding is in agreement with Carter and Carter (2001) who stated that the opinions of technicians and engineers were unanimous regarding the application of maintenance of electrical gadgets. Furthermore, Zhuang et al. (2015) supported this finding by maintaining that when decisions are always unanimous when the interest is the same as such there was no significant difference in the opinion of engineers and technicians of maintenance of electrical machines in the electric power station.

6. Conclusion

Based on the findings of the study it was concluded that Yola Electricity Distribution Company (YEDC) adopts monthly routine maintenance, semi-annually preventive maintenance and daily/weekly corrective maintenance on electric power distribution equipment in Adamawa State.

7. Recommendation

Based on the findings of this study, the following recommendations are made:

1. YEDC should ensure at least monthly routine maintenance is carried out on the equipment available to ensure effective usage
2. YEDC should ensure adequate inspection and supervision of equipment to prevent unwarranted breakdown that may affect effective distribution of electrical power
3. YEDC should ensure prompt and quick response to faults either on equipment or on power line

References

Abdelmalik, A. A. (2014). Power Transformer Life Management; *relevance to Nigerian power industry*. Department of Physics Ahmadu Bello University Zaria, Nigeria.

Ali, N. A., Achinanya, U. D., & Nuhu, M. S. (2004). Frequency failures of equipment in power system network – the Nigeria experience. *Proc. 8th IEE Int. Conf. Devel. Power Syst. Protect*, *2*(5-8), 603-606.

Arunagiri, T., & Agarwal, O. (2005). *Electricity distribution management system using GIS*. Institute of Remote Sensing, Chennai.

Bloom, N. B. (2006). *Reliability centered maintenance (RCM): Implementation made simple*. McGraw-Hill.

Carter, B. V., & Carter, G. A. (2003). Energy consumption in grain-processing operations in Nigeria: Selected case studies. *Journal of Agriculture Mechanization in Asia, Africa and Latin America*, *13*(2), 30-35.

CIGRE. (2002). *Working Group: Guidelines for Life Management techniques for power Transformers and Life management of transformers*.

Dikio C. I., Biobele, A. W., & Victor, C. I. (2018). Preventive maintenance for substation with aging equipment using Weibull Distribution. *American Journal of Engineering Research (AJER)*, *7*(4), 106-112.

Endrenyi, J. & Anders, G. J. (2006). Aging, maintenance, and reliability approaches to preserving equipment health and extending equipment life. *IEEE Power and Energy Magazine*, 4(3), 59-67. https://doi.org/10.1109/MPAE.2006.1632455

Grasmick, S., Hall, R. E., Collins, A. C., Maloney, T., & Puddester. (2008). *Guidelines for maintenance of public school facilities in Maryland*. Maryland: Interagency Committee on School Construction.

Madueme, T. C. (2002). Maintenance Culture in Electrical Power Industry in Nigeria: Case Study of Afam Power Station. *Nigerian Journal of Technology*, *21*(1), 79-89.

Megbowon, I. O., & Oyebisi T. O. (2005). A reliability assessment of South Western Transmission lines of the Nigerian National Grid. *FUTAJEET*, *4*, 17-22.

Omoigui, B. M. O., & Komolafe, O. A. (2000). *Evaluation of Electricity and Transmission Facilities in Nigeria*. Unpublished seminar paper presented in the Department of Electronic and Electrical Engineering, Obafemi Awolowo University Ile-Ife.

Santigo, S. A. (2015). *Principles and Applications of Geographic Information Systems* (pp. 124-131). Lagos, Panef Press.

Smith, A., & Hinchcliffe, G. (2004). *Reliability centered maintenance: A gateway to world class maintenance*. New York: El-sevier Butterworth-Heinemann.

Sunday, O. O., & Fagbenle, R. O. (2011). A Study of Implementation of Preventive Maintenance Programme in Nigeria Power Industry—Egbin Thermal Power Plant, Case Study. *Energy and Power Engineering*, *3*, 207-220. https://doi.org/10.4236/epe.2011.33027

Zhuang, l. H., Yongjun, Z., Canbing, L., Jing, L., Yijia, C., Diansheng, L., & Huazhen, C. (2015). Utilization efficiency of electrical equipment within life cycle assessment. *Indexes, analysis and a case*, *88*, 885-896. https://doi.org/10.1016/j.energy.2015.07.041