COMPUTERIZATION OF OPERATIONS AND MAINTENANCE OF ELECTRICAL EQUIPMENT IN NEPA NETWORK. A CASE STUDY OF SHIRORO POWER STATION.

BY

PATRICK OKON OSUTUK
(PGD/MCS/015/93)

MARCH, 1998

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A PROJECT SUBMITTED TO THE DEPARTMENT OF MATHEMATICS AND COMPUTER SCIENCE IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE AWARD OF POST GRADUATE DIPLOMA IN COMPUTER SCIENCE OF THE FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA.

MARCH, 1998.

CERTIFICATION

This project title "Computerization of operations and maintenance of Electrical Equipment in NEPA Network, A case study of Shiroro power station by PATRICK OKON OSUTUK meets the regulation governing the award of postgraduate Diploma in Computer Science by the Federal University of Technology, Minna and is approved for its contribution for computer application in other fields of study.

_____ DATE: _____

DR K. R. ADEBOYE

PROJECT SUPERVISOR

_____ DATE: _____

DR. K. R. ADEBOYE

HEAD OF DEPARTMENT

_____ DATE: _____

EXTERNAL EXAMINER

DEDICATION

I dedicate this project to my first child AKANIMO PATRICK OSUTUK whose birth brought additional joy to my family during the project work.

ABSTRACT

The growth of Electricity consumption means an increased number of equipments making up a complex Electrical Network which has to be run economically and safely.

This project therefore present an analysis and use of Telecontrol Technique and the implementation of modern data processing system to provide real time monitoring and control of Electrical equipments used for power generation, Transmission and Distribution section of NEPA.

ACKNOWLEDGEMENT

I am thankful to the ALMIGHTY CREATOR GOD for making this project work possible for me to complete.

I am grateful to DR. K. R. ADEBOYE, Head of Mathematics and Computer Science Department for his advice and supervision of this project.

My sincere thanks equally goes to the course co-ordinator PRINCE R. BADMOS and other members of the department for their support.

Also this research paper bears eloquent testimony to the support which I have received not only to produce a work of this nature but also to earn a COMPUTER SCIENCE EDUCATION IN TODAY'S WORLD.

My appreciation must extend to my beautiful wife, MARGARET J. OSUTUK and others too numerous to mention, their support which cannot be expressed in words.

The effort of Mallam B. M. Abdullahi and Mr. R. A. Udoudo both of NEPA-Shiroro deserve special mention here, I am sincerely indebted for their assistance.

My gratitude equally goes to Mallam Nma Mohammed and Yusuf Musa for their special assistance during typing of this project.

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CHAPTER ONE

1.0 INTRODUCTION

1.1 OVERVIEW OF NEPA ACTIVITIES

The history of power generation in Nigeria can be divided into 2 ERAS:

These Eras can be termed;

i) The first Generation Era (ECN Days 1950 - 1972).

ii) The second Generation Era which is NEPA ERA JANUARY 6TH, 1973 to date (this represents the fusion of ECN with Niger Dams Authority to form NEPA).

a. THE FIRST GENERATION - ECN ERA (1950 - 1973)

Electricity development in Nigeria started with the installation of a small generator to serve the colonial masters in 1898 in the city of Lagos.

Various generating sets were later installed in different towns as the imperial rule spread across the country. This plants were maintained by the Public works Department (PWD). The Native Authorities (NA) took care of the running of these plants.

However in 1950, the then colonial Government integrated all these isolated power stations previously under the electricity undertaking section of the PWD under a new statutory body called Electricity Corporation of Nigeria.

Government Ordinance No. 15 of 1950 therefore created "ECN". ECN was then charged with generations, transmission, distribution and sale of electricity in Nigeria.

b . **SECOND GENERATION (JANUARY 6TH, 1973) NEPA ERA**

The second generation was born with the fusion of the ECN with the Niger Dams Authority in September 1973. Niger Dams Authority was established by an act of parliament in 1962 for the construction and maintenance of dams on River Niger, generating electricity by means of water power (Hydro), improving navigation on the Niger and the development of fisheries and irrigation on River Niger. The Kainji dam was built between 1964 and 1968.

The second generation therefore gave birth to NEPA when the Federal Military Government of January 6th 1973 merged the Niger Dam Authority (NDA) with ECN. The decree No. 24 of 29th June, 1972 merged the two bodies.

The merger did not become effective until 6th January, 1973 when the studies by Shawmont of Canada (consultant) was implemented.

The NEPA, like the ECN was charged with the responsibility of developing and maintaining an efficient power generation transmission and distribution for all part of the Federation.

b. NEPA POWER STATIONS

National Electric Power Authority (NEPA) has 2 main sources of power generations:

i) Hydro Generation - Shiroro, Kainji and Jebba.

ii) Thermal Generation - Egbin, Sapele, Ughehi (Delta) Afam, isolated Power stations and Ijora making a total of 10 power station.

Presently, the 10 power stations supply the Nation's demand and have total generating capacity of 6000MW made up as follows.

S/N	Power Station	Installed Capacity MW	No. of Units	Mode of operation
1.	Afam Station Power station	700.9	18	Gas
2.	Delta Thermal Power Station Ugheli	812	20	Gas
3.	Egbin Thermal Power Station	1320	6	Steam
4.	Ijora Power Station Lagos.	66.7	3	Gass
5.	Sapele Thermal Power station Ogorode.	1020	10	Steam(6Unit) Gas(4Unit)
6.	Jebba Hydro-Electric Power Station.	540	6	Water
7.	Kainji Hydro-Electric Power Station	760	8	Water
8.	Shiroro Hydro-Electric Power Station	600	4	Water
9.	Oji River Power Station.	30	4	Coal
10	Isolated Power Station.	10.33	2	Fuel(Diesel)
	Total	5900.6	79 Units	

However, NEPA has not been able to adequately meet the nation's expectation of uninterrupted and stable power supply because of:

i) Non-availability of spinning reserves.

ii) Inadequate gas supply to thermal stations.

iii) Erratic rainfall, drought, etc that affect water supply to the lakes for the Hydro electric dams.

iv) Problems of spare parts.

v) Inadequate man-power for operation and maintenance of plant.

vii) Vandalization of NEPA transmission lines and facilities.

d. **GENERATION OF POWER**

Hydro Generation as Case Study

A Hydro Power station converts the potential or inherent energy stored in water under pressure into Electrical energy.

Component of Hydrogeneration:

a) Reservoir or lake

b) Dam

c) Power intake

d) The Penstocks

e) Trash Racks

f) Spill way

g) Power house

h) Draft tube

i) Tailrace Reservoir

l) Dam instrumentation

e) **HYDRAULIC/HYDRO POWER GENERATION**

Hydraulic turbines utilize water falling from a height on the turbine blade (Wheels) to generate power.

The power generated from the falling water is derived from the equation below:

$$Pt = \frac{HQe_t}{8.82} \quad \text{Horse Power}$$

Where P_t = turbine power output

H = Hydraulic tread (in feet)

Q = rate of flow of water (Cum.ft/Sec)

e_t = turbine efficiency.

To obtain the power output from a Hydroelectric plant we have to convert the turbine output in Horse power to the generator output (Pg)

$$Pg = \frac{HQe_te_g}{8.82} \times 0.746 \text{ Kw}$$

Where Pg = Generator output

e_g = Generator efficiency

The manufacturers of generators and the turbines will usually give the range of values for both the turbine and generator efficiencies.

However, both et and eg vary from 0.90 tot 0.98 for large power stations.

The generation of Power from water involves 4 main stages of power conversion.

i) Mechanical energy

ii) Potential energy

iii) Kinetic energy

iv) Electrical energy.

The water that is stored in the lake has a latent energy. When the power intake gates are opened, the latent potential energy is converted to Kinetic energy as the water moves through the penstock through a height to a scroll case where it turns the water wheels.

The Kinetic energy caused the rotation of the wheels on which the turbine shaft is attached.

The turbine shaft now rotating in turn, turns also the generator shaft which is coupled to the turbine shaft. The rotor of the generator is firmly connected to the generator shaft and this is inturn also turns in the magnetic field of the rotor. The induced electromotive force thus produced in the stator is passed through the solid bus bar and then tapped for further transformation.

1.2 THE OBJECTIVE OF THE PROJECT

The objective is to introduce a new method of computer based and telecontrol technique into NEPA Grid Network to achieve a centrally controlled body to obtain information in real time, about Electricity Network as follows:

i) To gather information about the status of switch gears such as transformers, transformers taps, circuit breakers and isolators switches.

ii) The (alarm) condition of Equipment and loading of Electrical Network.

iii) To make it easy for the transfer of information to the central control center and display it for the system operator

for further action.

iv) To provide a means whereby information received from the Remote stations by the master station is presented visually on the computer monitor and mimic board.

v) To also provide a Printout of eventful activities thereby producing hard copy of the grid performance.

1.3 METHODOLOGY

TELECONTROL INTERFACE (TC1)

(TRANSDUCER AND MIMIC BOX)

The telecontrol interface handles the traffic to the remote stations and operates either as a stand alone system or optionally in conjuction with an identical second one in a redundant mode.

The standard traffic modes available are:

- Point to point traffic.
- Multiple point to point traffic.
- Polling traffic.

They are implemented on the basis of the SINAUT 8-FW message structure. The telecontrol interface has an actual message image (replica) of all the connected RTV (Remote Terminals Unit) and performs preprocessing via data.

Information messages are compared old against new ones. Only changes in the information are sent to the computer as spontaneous messages.

Analogue are subject to threshold check. Only those analogues which exceed or fall below a specific threshold are sent to the computer as spontaneous messages. Furthermore a check is made to

establish whether the expected analogue are transmitted from the RTV to the control center within a stipulated cycle.

Metered value messages are transmitted as spontaneous message after receipt of the special command (end of metering period) the telecontrol interface transmits the corresponding meter advance data to the computer.

An RTU's or a particular RTU can be interrogated (Scanned) by the on-line work station, commands from the computer are converted in the telecontrol interface to the SINAUNT 8-FW message structure and transmitted as spontaneous message to the particular RTU in line with the telecontrol interface message structure. It allows output of process data to mimic diagram, alarm signed annunciators and instrument panels independent of the computer.

The SINAUT 8-FW system uses the (operating system MS.200, which is widely used for workstation and personal computer. It is easy to use and highly transparent on computer level. The software system for the SINAUT 8-FW control center system is characterized by its great flexibility.

1.4 PROCESS INTERFACE

The data acquisition is performed by the RTUs at site and data are transmitted via a communication network to the telecontrol interface.

The data received from RTUs are transferred from TCI (Telecontrol Interface) to the on-line work station. The on-line work station cyclically interrogate the TCI. When changes occurred, telegrams are then transmitted to the on-line

workstation. If no changes have taken place, the TCI answers with a message nothing new to report.

Commands and setpoint telegrams are sent to the TCI when initiated by the operator.

The following message types are used between TCI and on-line workstation.

- Interrogate and confirm.
- Alarms and indication.
- Analogue.
- Counter value.
- Commands.
- Set points.
- Substation interrogation.
- Start of metering period.

DIAGRAM OF SYSTEM CONFIGURATION

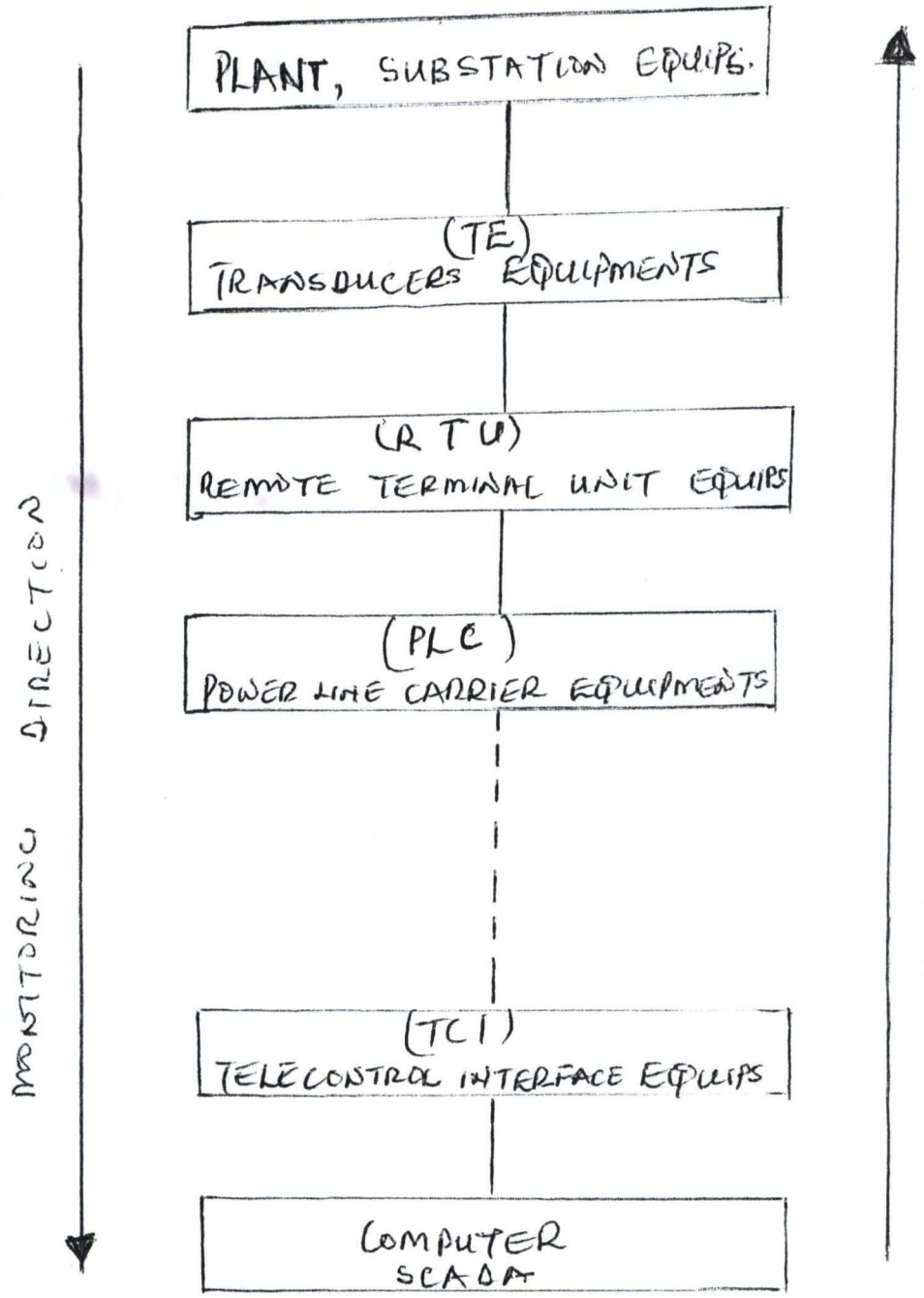


FIG 1.0 TELECONTROL TECHNIQUE CONFIGURATION (NEPA NETWORK)

MODE OF DATA COLLECTION

Process variable are:

i) Indications

ii) Alarms.

iii) Measured values - current, voltage, power

iv) Metered values energy (MWH).

v) Transformer taps indication

vi) Derived indications.

vii) Derived measured value.

viii) Derived metered value.

The various states of the process variable are represented by different colours in the display. All types of variables are displayed in violet until they have been recorded or calculated.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 ANALYSIS OF THE OLD SYSTEM

In the old system there was no effective facilities for processing data, so the National control center at Osogbo continue to depend on the alertness of area control staff for monitoring the grid network.

The commissioned eleven remote stations of the BBC DASA type scheme were not utilizable by NCC - National control center for gird control, due to excessive metering errors and generally unreliable teleindication. Crucial minute by minute decisions on active and reactive power dispatch continued to be dependent on laborious 2-3 hourly collection of data from outstations by telephoning.

These decisions hence continued to be frequently behind time and inaccurate for purposes of frequency and voltage control.

The PAX facilities at Remote stations were not fully commissioned and have become unreliable while PAX links with substations have deteriorated. These problems have worsened communications to these stations considerably, in some stations only PLC links existed. Where there are no reliable communications there can be no efficient system operations.

The status of switch gears like, isolator, circuit breakers, transformer, transformer tap were centrally controlled and monitor by the use of indicatioins and alarms on the control room instrument panel and sometime on routine inspections hourly.

BASIC LAYOUT OF THE NEW SYSTEM

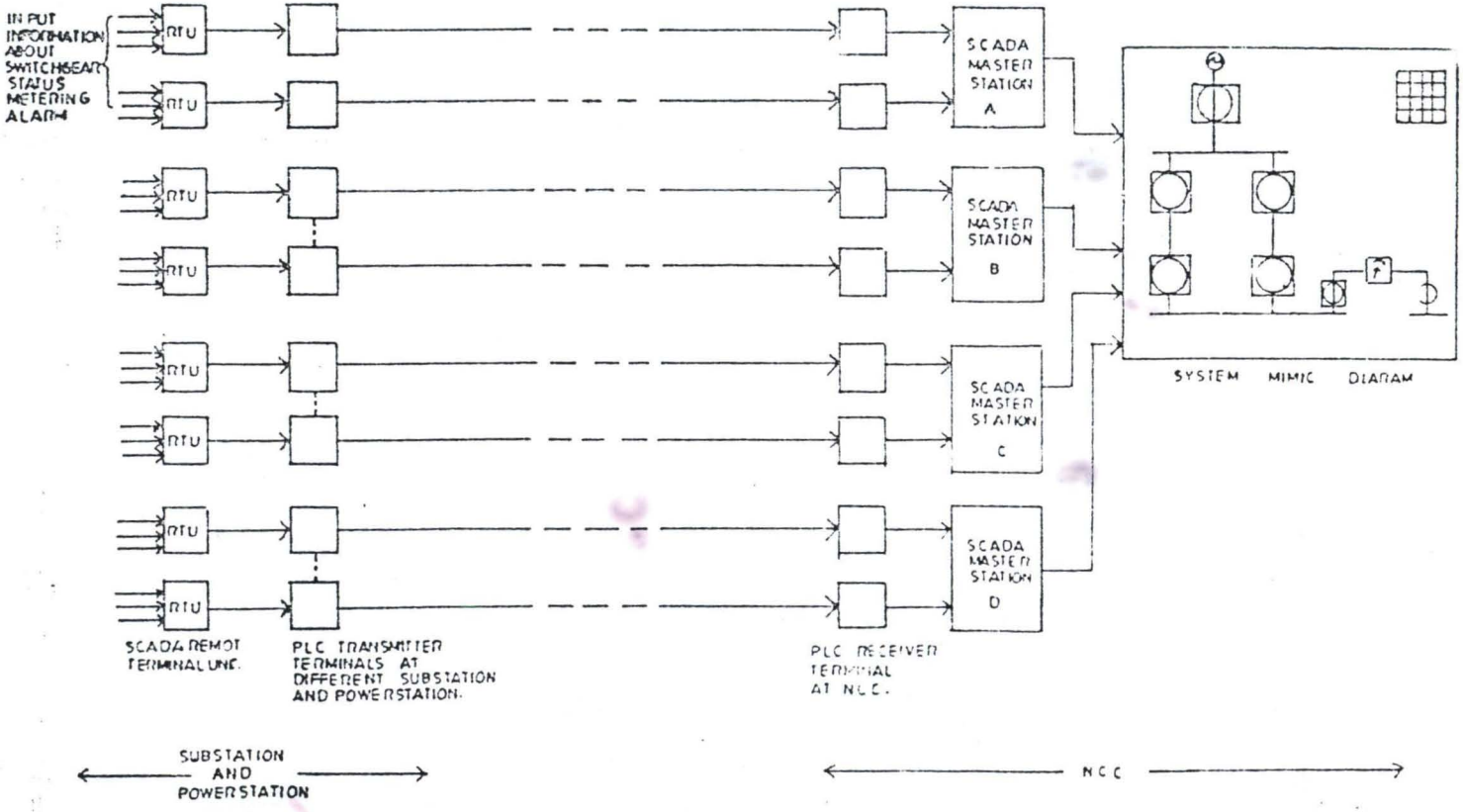


FIG. 2.0

Relaying of messages about the status of equipments in the grid Network were effected by telex machine installed at the various remote station.

2.2 THE NEW SYSTEM WITH COMPUTER APPLICATIONS

This is a computer based system which is equipped as follow:

1. SINAUT-8-FWA of Shiroro substation is the master station (MS).
2. With four SINAUT PC-32 computer work stations and the mimic board at the Shiroro ACC (Area Control Center).
3. SINAUT-8-FFW64 RTU serves as the remote station.

The five remote stations are equipped with SINAUT-8FW 64 RTU (Single or cascaded) to monitor the status of:

i) Circuit breakers (ON/OFF).

ii) Isolator switches (ON/OFF).

iii) Transformer and Transformer tap positions.

iv) Station alarms (group alarms).

While the measured values of:

v) Busbar voltage (KV)

vi) Mains/system frequency Hz.

vii) Transformer loading (Active and reactive)

viii) Feeder flow (active and reactive).

2.2.2 COMPONENT OF THE NEW SYSTEM

a) COMPUTER HARDWARE

The computer - workstation has a 32-bit personal computer (PC) that is equipped with:

- CPU 80386.

- Co-processor 80387.
- 4Mbyte standard RAM.
- 70Mbyte Hard Disk.
- 3 1/2 1.44 Mbyte Floppy Disk Drive.
- QWERTY Key board.
- Mouse.
- 60 Mbyte Magnetic tape streamer and
- A semi-graphic VDU (also called monitor).
- A high - quality printer.

Out of the four computer - workstations, two are capable of communicating directly with the process; one as the ON-LINE workstation and the other in STAND-BY mode.

Generally, at an instance, there is an ON-LINE workstation and the other in STAND-BY mode.

Generally, at an instance, there is an ON-LINE workstation which serves the other three DIALOG WORKSTATION.

NOTE:

When the computer is operating ON-LINE, all activities in he system network can be viewed as it happens ,and all on-line function can be accessed with the correct passwords. This display will show the present state of circuit-breaker, isolator, meterings and alarms.

b) **THE SCREEN LAYOUT**

The first three lines of the screen of the VDU operating on-line are reserved for the operator's dialog lines.

1st Line - LHS - output of messages relating to device faults.

- RHS - current data and time.

2nd line - Dialogue input and notes.

3rd line Display of current number of unacknowledged alarms.

c) **OVERVIEW AND DISPLAYS**

The summary of all information available on this computer managed network are displayed on some pages and are called overviews.

There are one hundred and fifty (150) display pages which can be displayed on the VDU using function keys or the mouse.

d) **DISPLAY SELECTION VIA FUNCTION KEY**

Input: (display number)

The information on the display number is displayed on the screen.

e) DISPLAY SELECTION WITH MOUSE

The mouse cursor should be placed at any of the digits in the brown color soft key for the display.

Press: - LHS mouse button.

f) **NEPA OVERVIEW 1**

This contains a summary of all relevant display numbers for station diagrams, alarms and other useful summary. This NEPA overview I can be selected via the function key F2 after imputing page 150 or by clicking the RHS mouse key.

g) **ACC SHIRORO OVERVIEW**

This display shows a concentrated single line diagram of all stations under Shiroro ACC supervision - see fig. 3

h) **ALARM OVERVIEW - (AOV)**

This overview contains the state of alarms in the substations.

This can be displayed:

Input: [station number]

Press: F1

Four colored symbols will be displayed and their explanation is as follows.

	IND MEAS	ITT
IND-	Indication symbol is -	Brown if at least one indication is enter manually.
		- Red if at least one indication .
		- Violet if not all indications are recorded

If a station is blocked, the name is shown in red while if the station is disturbed or not yet recorded, it will show in violet.

MEAS-Measured value

Brown if at least

- Blue if one measured values measuring range is violated.
- Red if at least one measured value's lower/upper limit is violated .
- Violet if not all measured values are recorded.

TT - Transformer Tap

- Red if at least one transformer tap is disturbed
- Violet if not all transformer taps are recorded.

If a station is blocked, the name is shown in red while if the station is disturbed or not yet recorded, it will show in violet.

OVERVIEW TECHNOLOGICAL STATION - (OTS)

This is possible to block a whole station or some switch gears in the station, this overview shows whether the station or groups of variables are blocked.

Input: (number of technological station)

Press: Shift + F1.

Groups of variables are:

- Indication.
- Measured value.
- Commands.
- Transformer taps.

Blocked stations are displayed in REDCOLOUR, Blocked variable groups are marked in Brown color.

j) **EVENT LOGG-[ELI]**

The event log contains all events which occur in the computer based system. It shows ;the list of activities, the date and time of occurrence.

Press F6. An added prefix show he event types as defined;

ALR - Alarm message

ERR - Error

IND - Indication display

SSP - Output or setpoint value

STA - Station locked release printout.

STS - System status indications.

TXT - House keeping message display.

Events occurrences are marked as `appearing' and where it returns to the normal state as `disappearing'.

SUBST-V - (Substitute Value) variable update

RELAESE: - Variable released.

LIM-APP: - LIMIT violation appearing

LIM -Dis - Limit violation

AL -APP - Range violation appearing.

LIM-SET - Limit set.

BLOCKED - Variable on station blocked

APPEAR - Appearing event types

DISAPP - Disappearing of even types

OUTPUT - Output of command/set point/general/request.

k) **ALARMS DISPLAY - (ALI)**

Alarms are displayed when this list is selected.

Input: [Priority Number (1.....7)]

Press F10

or

Position mouse cursor on ALI and click LIH button.

The alarms are categorized according to urgency and are given different priority level 1.... 7.

On the ON-LINE computer, the number of unacknowledged alarms are displayed red or white. This number flashes until the latest unacknowledged alarm has been given at least once on the monitor (screen).

These alarms can be acknowledged in three ways:

1. Acknowledge single alarms by positioning mouse cursor at the blinking event identification of the alarm and press left mouse button.
2. Acknowledge displayed alarms of the same priority by ;positioning mouse cursor at alarm color character in line 3 and press left mouse button.
3. Acknowledge all displayed alarms by positioning mouse cursor at the `A' in line 3 and press left mouse button.

Single alarms can be deleted by entering `L' or `C' position mouse cursor at event identifier of the alarm and press left mouse button.

iii) **SINGLE LINE DIAGRAMS**

The detailed single line diagram of Shiroro Network as stored on separate display pages of the on-line computer are shown on the screen or monitor.

SHIRORO SUBSTATION DISPLAY 330KV

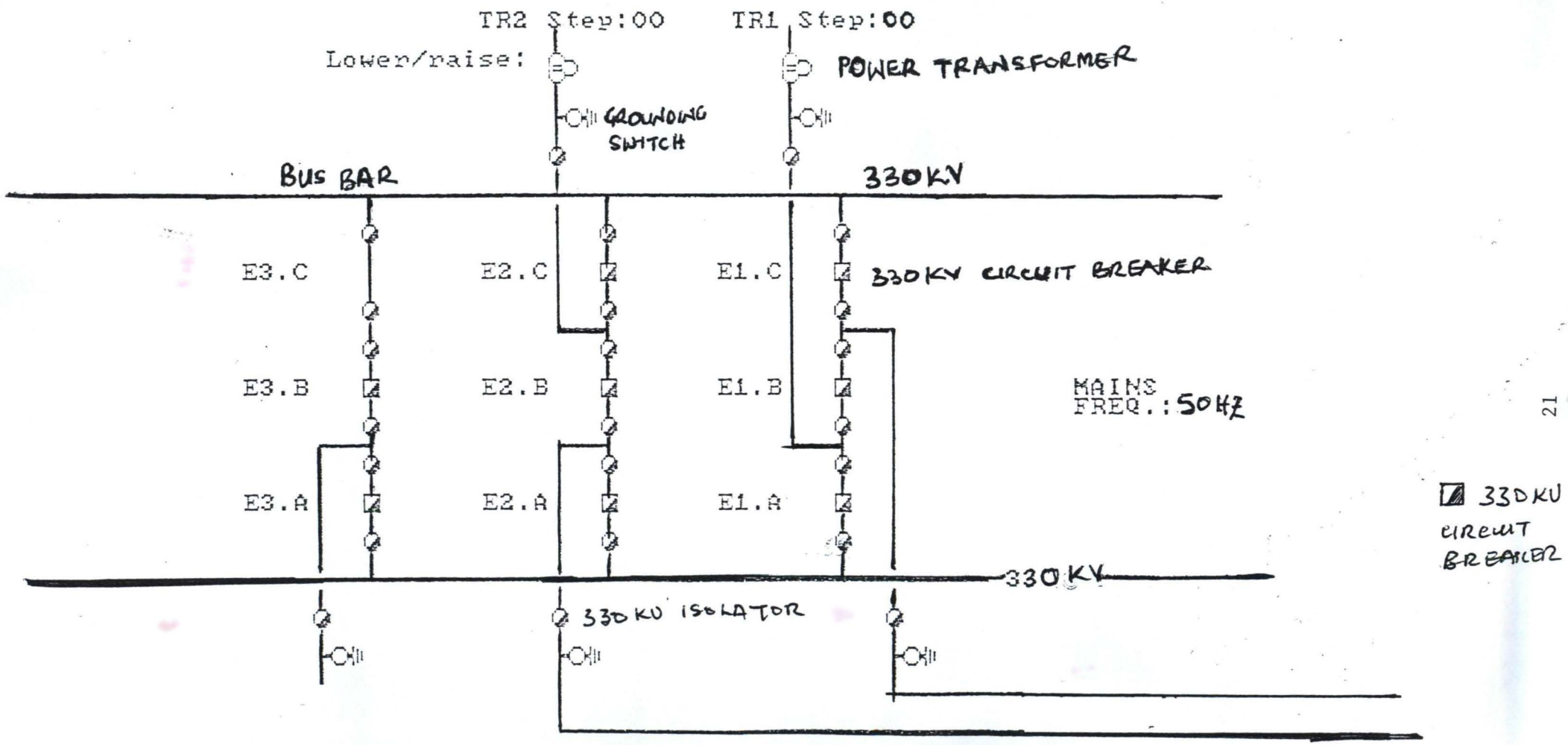


FIG 3.0

The diagrams show the measured values (meter readings) of the bus-bar, feeder flow, transformer tap position.
any switch gear that is OPENED OR CLOSED will also be displayed accordingly. See fig. 3,0 below

m) **COMPUTER SOFTWARE**

The computer operates with MS-DOS on operating system. The application software available in this computer are:

- Basic SCADA.
- Off line data amendment.
- Long term data storage (data archieve) and
- Trend display.

In addition the system can accommodate the preparation of charts, graphs and the distribution and transmission of data to other woorkstation in the Network system.

DIALOG FUNCTIONS 1		REMARK
Function	Input	KEY
Alarm Overview	[Station number]]	F1
Function Overview	-	F2
Diagram selection	Diagaram number	F2
Display Event log	[Day Mth Yr[Hour[MIN]]]	
Print Record	Record Number	F7
Acknowledge Display	-	F8
Alarm - Single Acknowledge	-	F10
Alarm - Group Acknowledge	-	Alt+F10
Clear Screen	-	Ctrl+F10
Output general-check	-	AAlt+F2
Output general-check	Station Number	Alt+F3
Re-programming	-	Ctrl+F9
T-Station Overview	-	Shft+F1
Paging	-	Pg Up/Dn
Abort dialog	-	End.

DIALOGU FUNCTIONS 2			REMARK
Function	INPUT	MOUSE	KEY
Command Output "ON"	-	Command	F3
Command output "OFF"	-	Command	F4
Setpoint Output	Setpoint value	Setpoint	F5
Send Command or setpoint	-	-	Alt+F1
Dissplay Limits	-	Met.value	Alt+F4
Change Limit	-	Met.value	Alt+F5
Manually enter variables	[Replacement]	Variable	Ctrl+F1
Enable variable	-	Variable	Ctrl+F2
Block Station	Station Number	-	Ctrl+F3
Enable Station	Station Number	-	Ctrl+F4
Block Command	-	Command	Ctrl+F5
Enable Command	-	Command	Ctrl+F6
Block T.Station	T.Station Number	-	Ctrl+F7
Enable T. Station	T.Station Number	-	Ctrl+F8

2.3 IMPROVEMENT IN THE SYSTEM

(i) By this system/structure, it is possible to monitor system (the Grid network) and equipments regularly and prevent any loss or muddling up of data.

(ii) Operations and maintenance of the system equipment are safely handled overviewed and displayed.

(iii) Changes in the program modules area easier to accomplish.

(iv) There is provision also for system security in the form of password.

(v) Coordination and effective handling of critical situations is easy.

(vi) All data relating to the network being gathered at one point can be quickly analyzed to make amendment to the operation of the network. This mean the quality of electricity supply will be improved thereby enhancing the revenue income of the Authority (NEPA).

CHAPTER THREE

3.0 SYSTEM ANALYSIS AND DESIGN

3.1 NEPA GRID NETWORK

A Grid Network or on an integrated system as it is called is a system in which all sources of electricity (i.e) all the generating stations and all the load centers or injection points are physically interconnected in such a way that power can flow from any source to any load. (See figs. 4, 5, and 6 below)

The system as of today has eight (8) major generating stations. These stations are connected together abd to the load centers by transmission lines. The load centers as for now are Lagos (Akangba and Ikaja West). Benin, Oshogbo, Aiyede, Onitsha, Aba, Kaduna, Kano, Gombe, Abuja. Lagos load centers consumes the the highest of about 46& of the National Supply. The supply is step down from the transmission voltages and in each the load centers, to the distribution voltages level (33KV and 11 KV). Our system is yet to grow when compared with those in advance countries.

ADVANTAGES AND DISADVANTAGES OF GRID SYSTEM

ADVANTAGES:

1. It provides maximum security for each of the loads fed from the pool, by providing an automatic alternative feed to the load.
2. It permits maximum flexibility and economy in scheduling of resources to meet the load.
3. It allows significant savings to be made by interchanging energy between systems where there is appreciable difference in cost of generation.
4. It enables heavily loaded centers to be effectively catered for, from variously located genration stations.
5. It makes it easy for the maintenance of any generating equipment to be carried out with minimum effect to the load.

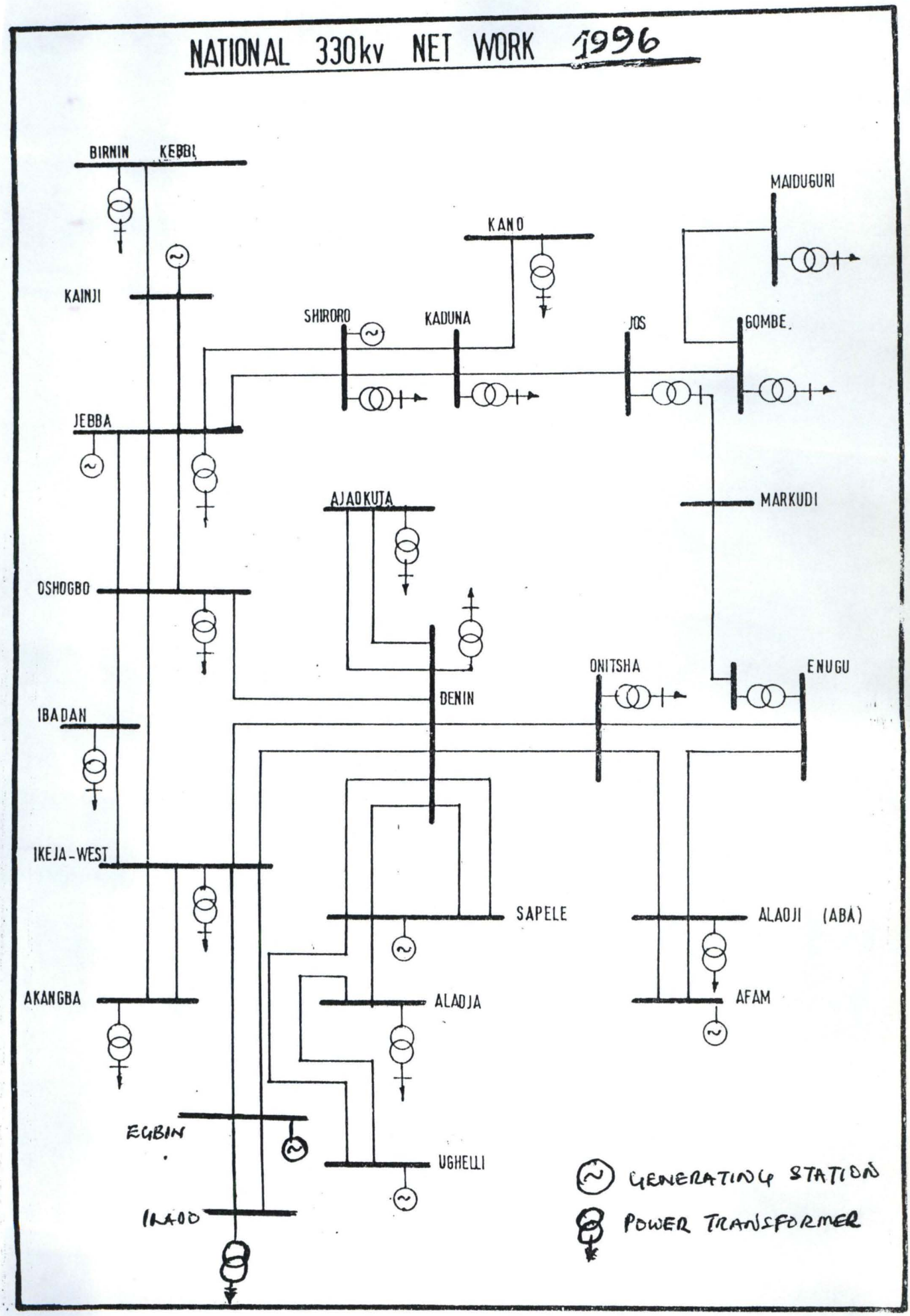

NATIONAL 330kv NET WORK 1996
BIRNIN KEBBI
KAINJI
KANO
MAIDUGURI
SHIRORO
KADUNA
JOS
GOMBE
JEBBA
AJAOKUTA
MARKUDI
OSHOGBO
ONITSHA
ENUGU
BENIN
IBADAN
IKEJA-WEST
SAPELE
ALAOJI (ABA)
AKANGBA
ALADJA
AFAM
EGBIN
UGHELLI
IKOD
GENERATING STATION
POWER TRANSFORMER

FIG 4.0

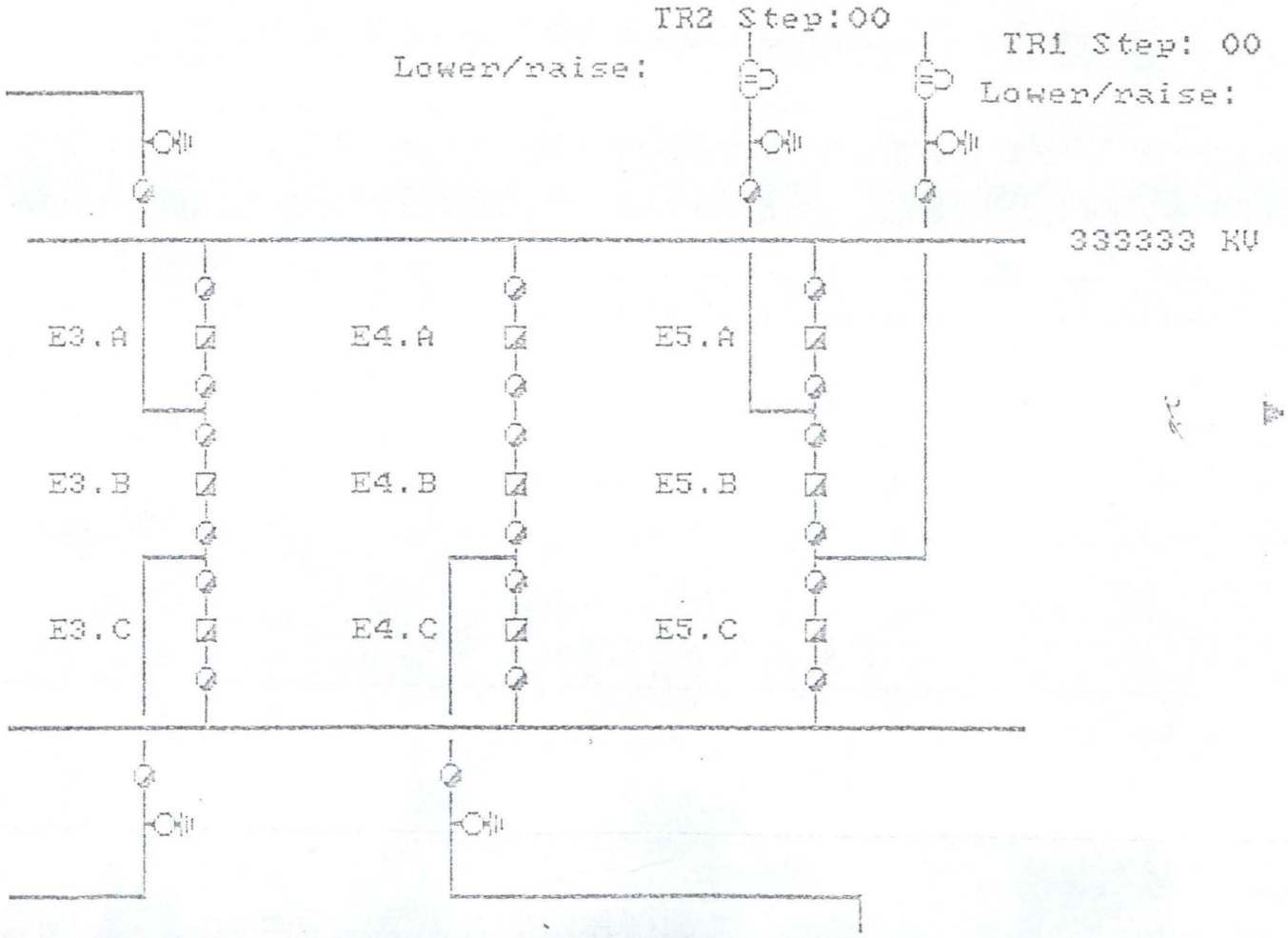
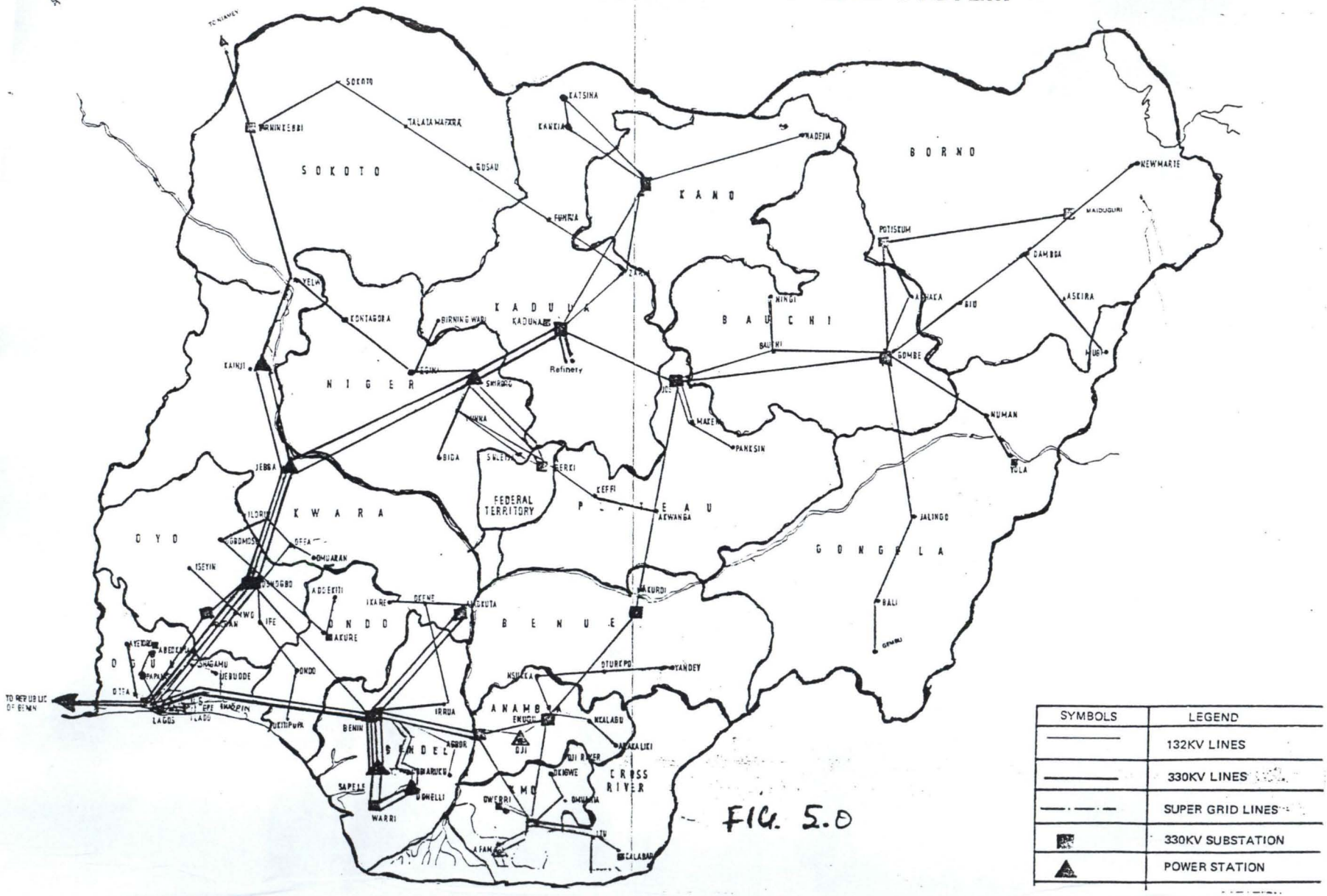

TR2 Step:00
Lower/raise:
TR1 Step: 00
Lower/raise:
333333 KV
E3.A
E4.A
E5.A
E3.B
E4.B
E5.B
E3.C
E4.C
E5.C

FIG. 6

MAP OF NIGERIA SHOWING NEPA GRID SYSTEM



SYMBOLS	LEGEND
	132KV LINES
	330KV LINES
	SUPER GRID LINES
	330KV SUBSTATION
	POWER STATION

FIG. 5.0

DISADVANTAGES

1. The main disadvantage is that it is costly to build as there are many duplications of equipment.
2. Where the Grid has a weak link, it could cause instability of troubles on the weak link of the interconnected groups will be seen on the other part of the system.
3. Where the level of Technology is low the needed sophisticated computerization may suffer maintenance and replacement problems.
4. Without precise control of generation and frequency undesirable tie-line flow will result.

CONSTRAINTS

This is divided into 3 aspects:

i) System control constraints.

ii) Generation constraints.

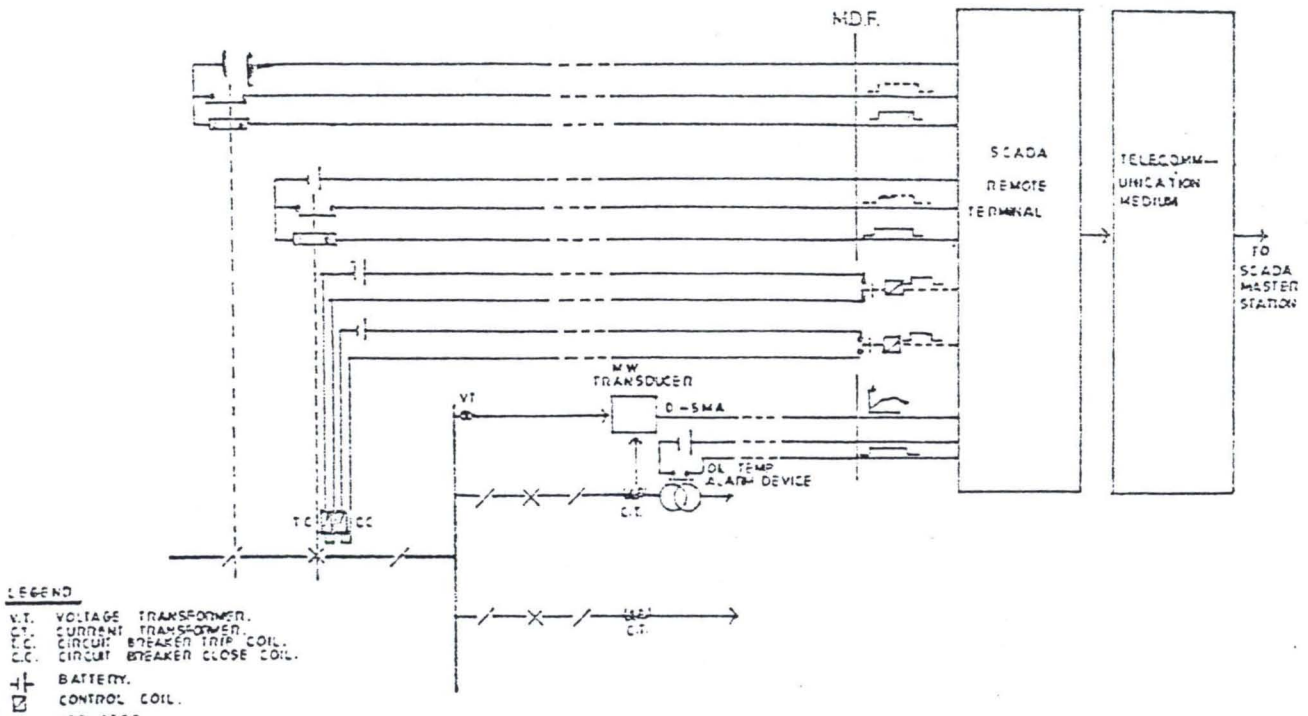
iii) Transmission constraints.

3.1.0 DEFINITION OF SCADA

It simply means supervisory control and Data Acquisition. It is a computer based system. As the name suggests a SCADA equipment is used for supervision and control of a process/processes and also for systematic gathering of important data of the process/processes.

In modern terms, SCADA is applied to a NEPA Electricity Network in order to achieve a central supervision and well - co-ordinated control of the sub-system in different geographical locations while collecting data from all sub-system to central

INPUT INFORMATION DERIVATION METHOD AT SUBSTATION



LEGEND

V.T. VOLTAGE TRANSFORMER.
C.T. CURRENT TRANSFORMER.
T.C. CIRCUIT BREAKER TRIP COIL.
C.C. CIRCUIT BREAKER CLOSE COIL.

BATTERY.
CONTROL COIL.
ISOLATOR.
CIRCUIT BREAKER.
POWER TRANSFORMER
NORMALLY OPEN SW. GR. AUXILIARY SWITCH.
NORMALLY CLOSED SW. GR. AUXILIARY SWITCH.

FIG. 6.0

point at the same time.

3.1.1 OPERATION OF SCADA SYSTEM

The application of SCADA equipment to the management of electricity network requires a central point (control center) for displaying all information gathered from the network. Usually, the system is made up of a master station (MS), located in control center which supervises a number of remote stations) in which the remote terminal unit (RTU) are installed.

The remote terminal unit (RTU) is interfaced with the switchgears, alarms and the metering circuits of the substation to create a replica, after electronic processing.

The replica is transferred through the PLC (Power line carrier) communication channel to the master station (MS) which recreates the replica on a mimic board/computer workstation in the control center.

Conversely a command is initiated from the mimic/computer workstation through the master station (MS) to the remote terminal unit (RTU) to control a particular process in the substation.

(See diagram attached above fig. 6).

INTRODUCTION TO THE SINAUT-8-FW TELECONTROL SYSTEM

The trade name of the SCADA equipment manufactured by SIEMENS(AG) is the SINAUT-8-FW Telecontrol system.

The SINAUT-8-FW Telecontrol is a family of SCADA equipment that can be configured to solve the requirement of any electricity grid. It is a computer managed system.

In NEPA, the Shiroro computer based system is equipped as follows:

1. SINAUT-8-FW at Shiroro substation is the master station ((MS).
2. With four(4) Sinaaut PC - 32 computer workstation and the and mimic board at the Shiroro ACC.
3. SINAUT-8-FW 64 RTU serves as the remote station.

3.3.0 POWER SUPPLY SYSTEM TO THE WORK STATION

A special power supply arrangement for the workstation is needed because of the sensitivity of the computer system and also to ensure continuous operation of the workstation in event of power failure.

This special arrangement employed the un-interruptible power system (UPS) -= siemens type B4105 - to supply the workstation with un-interruptible and secure power.

3.4 FUNCTION OF CONTROL OPERATOR IN NEPA SYSTEM

The Shiroro ACC consists of four computer workstations and a mimic board.

The responsibilities of a control operator is to relate to the work substation under Shiroro ACC control through computer workstations and the mimic board and to derive maximum benefit from the data archive.

The major functions to be performed by the control operator in order to manage the telecontrol (computer based) system effectively are mentioned in this chapter:

3.4.0 START - UP

Any of the four computers in the ACC can be started in two ways either, by:

COLD BOOT: **i.e through the main switch of the CPU (the system unit) or**

WARM BOOT: **(i.e) by pressing CTRL+ALT+DEL keys simultaneously.**

NB.* THE WARM BOOT SHOULD BE USED ALL THE TIME.

3.5.0 SYSTEM CONFIGURATION UNDER NORMAL AND ABNORMAL SITUATION

3.5.1 SYSTEM CONFIGURATION UNDER NORMAL CONDITION

The system configuration is the mode of operation designated to each computer. The usual system configuration is as listed:

- One ON-LINE COMPUTER.
- One STANDBY COMPUTER, which is the 1st Dialog computer.
- 2nd Dialog computer and
- 3rd Dialog computer.

3.5.2 STARTING ON-LINE COMPUTER

The procedure for configuring the computer network is as follow:

* Warm-boot the first computer, CTRL+ALT+DEL to start as the ON-LINE COMPUTER.
* As the system starts up this request shall be "START AS DIALOG COMPUTER (Y/N)?. This statement is referred to as the `SYSTEM START REQUEST'

  To START-THE COMPUTERS ON-LINE press Y.RETURN, otherwise. N.RETURN will start the computer as DIALOG COMPUTER.

3.5.3 STARTING STAND-BY COMPUTER

** After starting the ON-LINE computer; warm-boot the remaining computer one after the other. The next computer will be started as Dialog No. 1 then a request to START AS STANDBY COMPUTER (Y/N)? appears.

Pressing Y. RETURN will configure the computer as STAND-BY COMPUTER.

If the computer starts successfully as STAND-BY COMPUTER a letter `S' is displayed on the first line right-hand corner of the screen.

3.5.4 STARTING DIALOG COMPUTER

** The other computer will be started as described above as

Dialog Computer No. 2 and

Dialog Computer No 3 respectively.

3.5.5 SYSTEM CONFIGURATION IN ABNORMAL SITUATION

- In case of a power failure the. ON-LINE computer automatically resumes its selected configuration after a restart.
- In case the ON-LINE computer breaks-down, the STANDBY-computer will take the functions of ON-LINE COMPUTER.
- The computer can be deliberately stopped (aborted) with.

  `+ Shift + F10 keys for ON-LINE computer and

  + Shift + F10 keys for Dialog computer.
- If the ONLINE COMPUTER is aborted, this system request will appear

  RECONFIGURE COMPUTER (Y/N)?

Pressing Y. RETURN will delete the current ON-LINE configuration and the SYSTEM START Request will appear otherwise N, RETURN input will retain the current configuration.

- If the dialog computer is aborted the configuration has to be reselected when the system is started.

NOTE

Ensure that each computer is configured properly otherwise abort it and re-configure.

a. **START - UP INSTRUCTIONS**

The control operator is to ensure a proper system start by `WARM-BOOTING' each computer and configuring them as ON-LINE, STAND-BY (1st Dialog), 2nd Dialog and 3rd Dialog computers respectively.

- **If there is a power failure or other system maloperation, the computer may have to be re-configured. These computers can be deliberately stopped, i.e. aborted, if necessary.**
- **If the ON-LINE computer is successfully started the Logos of NEPA will appear and a request to press function key F2 or LHS mouse key to continue.**

The STAND-BY COMPUTER, which has a letter `S' displayed on the first line, right hand corner of the screen, monitors the ON-LINE computer fails the STAND-BY COMPUTER restarts automatically as ON-LINE computer when booted.

When the Dialog computers is successfully started, the dialog main menu will appear. Also the `Screen-save' facility will be activated and this ensures the computer monitor to be switched off if no key is pressed within 5 minutes period. The screen can be

switched on again by pressing any key.

b. DIALOG MAIN MENU

The dialog main menu is a list of instructions on how to operate and activate some functions in the commuter by pressing the corresponding function keys.

After activating a function, pressing key END returns you to the main menu.

c) PASSWORDS

Passwords are secret codes used to protect functions avaialable in the main menu or on-line functions. With the correct passwords the relevant functions would be activated.

All functions on the ON-LINE DIALOG computers are proected by password. If a protected function key is type the PASSWORD..... request is displayed, and the computer accepts the input of the password. The operator can have access to a series of specified functions by pressing Shift+F7 to LOG ON.

The LOG ON STATE can be reactivated by pressing Shift+F9 to LOG OFF.

NB.

- An automatic LOG OFF is selected during system start.
- If a function under another password level is selected, the message ACCESS DENIED will appear meaning that function is not protected with the current password.

d) REAL-TIME OPERATION OF DIALOG COMPUTER

Inputing F1 on the Dialog computer allows the real-time operation of the system to be monitored.

This state can be reactivated by pressing Shift + F10.

CHAPTER FOUR

4.0 PROGRAMMING CONCERT

4.1 CHOICE OF PROGRAMMING LANGUAGE

The realization of the importance of data has meant there is a need for proper management and efficient organization of the data. It is also important that data are not locked away so that they can easily be accessible to the user through the software used. The programming language used is dbase III plus).

4.2 DEFINITION OF DATABASE MANAGEMENT SYSTEM AND OBJECTIVE

i) A Database management system (DBMS) is a software that constructs, expands and maintains the data contained in the database. It also provides the interface between the user and the data in such a way that it enables the user to record organize, select, summarize, extract, report on, and otherwise manage data contained in a database.

ii) DBMS programs keep information in files, and within each file is a collection of related information. The data in a file are organized into rows and columns with each row making up a record. A column of data is known as a field and the column heading is a field name. The content of a field determines the field type.

The usual field types are numerics, character, memo, date etc.

iii) OBJECTIVE OF DBMS

The overall objective in the development of database technology has been to treat data as an organizational resource and as an integrated whole. Database systems allow the data to be protected and organized separately ;from other resources (e.g. hardware, software and program).

Specifically the objective of database management system are as follows:

i) Data redundancy is reduced or eliminated.

ii) Data integration is achieved.

iii))Data independence can be achieved.

iv) Data are centrally controlled.

vi) Data integrity can be maintained.

Throughout this project work, the programming language used is DBase III Plus.

iv REASON FOR THIS APPROACH

a) DBase III plus offers a programming language that enables one to construct his own database applications. A large number of ;built in functions are provided, including mathematical functions, string manipulation functions. The programming language includes commands to perform conditional branching, looping, calculations, sort records, format input screens, output reports, and so on.

b) Files are organized in the form of a table made up of rows of records.

c) A screen design facility is provided for us to design our input and output screens and to perform error checking and editing on input. DBase II PLUS also provides a local area network operating mode, permitting multiple users to access the same data base on a local area network system.

d) We can use DBase III plus in a very simple manner, using a menu facility called the assistant. We can also use DBase commands (called dot command).

4.3 DESIGNS FEATURES AND PROGRAM SUITE

Investigation and inspection conducted indicated that there is a need for coded form of Electrical power generation equipment in the system Network taking into consideration the maintenance procedure and necessary data for translating the field work to report generation.

Based on the above, the Electrical Equipment coding system is designed. The field types usually defined to be characters, where letters and numbers are combined to give a code. The first field of four digits represent the technological station and department where the equipment is situated or installed. The fifth is a slash and the next is the parameter of the equipment, followed by a slash and month/year for the last four digits. Example is shown below:

SPPS/SGRBAY/1290

SHPS = Shiroro Power Station - Technological station

SGR = Switchgear (circuit breakers, isolator, Transformers tap etc.

BAY = GRID LINE IDENTIFICATION

12 = Month of December.

1990 = Year 1990.

4.4 DATA PREPARATION AND ENTRY

The system is divided into;

a) Recording and reporting of operations and maintenance of selected Electrical equipments where the equipment parameters are entered into other system to generate the final report.

b) Deletion of unwanted records.

c) Retrieve (Edit of data inputs).

d) Viewing of records entered.

e) Processing and reports.

NOTE:

i) The data collection is shown through the ON-LINE computer in the form of indications on the system network stationed at the master station (MS). This is shown on the visual display unit (monitor).

ii) For remote terminal unit, checks and inspections are carried out on hourly basis by distance operators. Their observations are relayed to the master stations for necessary action.

iii) Data entry through keyboards are displayed directly under the data entered for further scrutiny.

However the field record should reflect the following in the station log book:

1) Station name

2) Station code

3) Number of technological stations

4) Hourly readings of system currents, voltage and power.

5) Hourly reading of reactive power M_{VAR} .

6) Status of circuit breaker ON/OFF position.

7) Status of isolator switch ON/OFF position.

8) Operating oil pressure for circuit breaker-bar.

9) Operating SF_6 pressure for circuit breaker-bar

10) Transformer winding temperature in degree-^{o}C

11) Ambient temperature-^{o}C

iv) DATA ENTRY

1) Data entry is accepted through key board/VDU.

2) Error reports are displayed on the terminal of VDU if VDU is used.

3) Modules within the data entry are;

a) Input electrical equipment maintenance management system-EEMMS .

b) Maintenance schedule and check list.

c) Man-power,tools,man-power requirements.

4) Edit all the inputs .

5) Update and validate database files.

6) Sort and write EEMMS activities.

v) ACCESS TO INFORMATION

Input entries are entered through status report of indications and alarms from both master station (MS) and remote terminal units (RTU).

The system is divided into 5 main separate modules:

a) The Entry of:

i) ELECTRICAL EQUIPMENT MAINTENANCE MANAGEMENT SYSTEM EEMMS

ii) MAINTENANCE SCHEDULE AND CHECKLIST.

iii) MANPOWER, TOOLS AND SPARE PART REQUIREMENT

b) Deletion of unwanted record(s).

c) Retrieval and Editing of record(s).

e) Report and forms.

The use of computer system is considered.

vi) PROGRAM STRUCTURE

The input modules are made up of separate submodules of DBase III PLUS

PROGRAMS

a. Data entry for: ELECTRICAL EQUIPMENT MAINTENANCE MANAGEMENT SYSTEM (EEMMS) FOR CIRCUIT BREAKER, ISOLATOR SWITCHES, TRANSFORMER AND TAP POSITION AND ALARMS.

b. Data entry for: MAINTENANCE SCHEDULE AND CHECKLISTS.

C. Data entry for: MANPOWER, TOOLS AND SPARE PART REQUIREMENT.

EQUIPMENT SECURITY

The operation and maintenance of Electrical Equipment maintenance management system are carried out by qualified technical personal on issuance of permits from the control room (central control body) to avoid accidents.

i) Access to the system is through identification by password which gives a pass into the system's main program.

ii) Authorization for use of files is required.

vii) PROGRAM CALLS

a) To produce any report or do any processing of update or creation of files, the function name is called (ie) (a) to append the data base files; call (ie) DO ADD. PRG.

THEN THE SYSTEM COMES WITH;

PLEASE ENTER PASSWORD.

And when the password is correct, the system will display;

PRESS ANY KEY FOR DATA ENTRY

And when the entry session ends, we press ENTER twice to leave the session.

b) To Edit the database files,

DO EDIT, PRG.

The system come up with

PLEASE ENTER PASSWORD.

If the password is correct, then the system will display:

PRESS ANY KEY TO BEGIN EDITING.

Any when the editing session ends, we press ENTER twice to leave the session.

viii) GUIDE TO MODIFICATION

The programs are written with comments for easy reference of the program for modification.

a) THE APPEND OR ADDITION OF DATA TO EXISTING.dbf.

If redundancy is found in the data entry then the first five field entries should be made all the samples. If they are from the same equipment and same technological station, the same numerical.

Comment and changes are included in appropriate areas.

b) REPORT LAYOUT

Modification of names and layout of the entire report may be designed to reflect the environment of the report. This can be made by changing the.

@.....SAY and @.....GET

New layout of reports can be made by redefining new files for each report, but this affects the restructuring of the program(s).

4.5 SECURITY AND INTEGRITY OF THE SYSTEM

The security and integrity of the system is designed to take ample account of the following:

i) Data preparation.

ii) Data Handling.

ii) Storage and manipulation.

iv) Programming standards.

4.6 TYPES OF DATA VALIDATION BUILT INTO THE SYSTEM

Before any of the numeric fields are written, they are validated, and if that field is not numeric, the data are rejected.

This only guards against alphabetic being written in place of numeric fields.

The following checks are built into many parts of the program.

i) Format check that data items are presented in the appropriate character set.

ii) Check-code verification for EEMMS analysis.

iii) Range (or limit) check that the value of an items is within an expected range. Any data failing any of these checks is reported and ignored.

Incorrect data and their associated reports are returned to the human system for investigation and correction.

4.7 ACCESS AND SECURITY

Access to the system is restricted by password to restrict initial and subsequent access for unauthorized changes to information on secret files or viewing records inside these files.

NOTE

Passwords should be changed periodically, depending upon the security classification of the information to which they afford access.

FUTURE ENHANCEMENT

a) SYSTEM DEVELOPMENT

For comprehensive and quick Electrical Equipment Maintenance Management System - EEMMS system, equipment like CIRCUIT BREAKERS, ISOLATORS, TRANSFORMERS, TAP POSITION, INDICATION AND ALARMS can be developed into a major area on their own, and for the benefit of this project, attention should be focussed on types. operations and maintenance.

On maintenance technique: the recognized strategies should include:

i) PREDICTIVE MAINTENANCE

Here, physical inspections are conducted and with the data collected, estimation techniques is used to analyze the data collected to ensure maintenance of failing parts.

ii) ROUTINE/PLANNED MAINTENANCE

Here strategy is based on either data supplied by the manufacturer as to the equipment capability after a certain number of switching operation or drawn up chart based on experience of operation of similar equipment.

iii) BREAKDOWN MAINTENANCE

This is partial or catastrophic use of data supplied by the maintenance Engineer and also due to failure to ensure compliance with the drawn up maintenance chart.

This is a costly method.

These strategies techniques when developed will enhance are more accurate and up to date of information on the particular switchgear concerned. It will also facilitate the building up of

a comprehensive data bank for quickest response of system changes and improve the overall system security and reliability.

5.3 SYSTEM RECOMMENDATION

i) For effective and efficient handling of Electrical operations and maintenance of equipment for record keeping and retrieval, a computerized information management system is proposed for each arm of Technical section of NEPA.

This application will require a greater degree of system investigation, subject to system studies and also the purchase of a computer system.

ii) A lot of personnel has to be trained on the use of computer and more computer operating environment must be created.

CONCLUSION

The system security and reliability will continue to depend on:

i) Application of good and modern maintenance culture.

ii) Availability of qualify operational and maintenance personnels.

iii) Provision of modern communication system.

iv) Availability of spare part for immediate replacement.

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APPENDIX

LIST OF ERRORS AND OTHER MESSAGES

LIST OF ERROR AND OTHER MESSAGE

A ERROR MESSAGES

ERROR MESSAGE	MEANING
1. A memo field cannot be selected.	You attempted to select or enter memo field in the Assistant when it was not appropriate.
2. Beginning of file encountered.	You positioned the record printer before the first record in the file.
3. Database is not indexed.	You attempted to execute a FIND, SEEK, or update command on a database file without an open index file.
4. Data type mismatch.	You attempted an operation with conflicting data types. Some of the conditions that cause this error message to occur are summarized below under headings:

EXPRESSION, REPLACE, SEEK, AND SORT.

5. Command not recognized — The command you entered while in HELP does not exist You attempted

6. CONTINUE without locate — You attempted to execute a FIND, SEEK, or update command on a database file without an open index file.

7. Database is not indexed — You attempted to execute a FINE, SEEK or update command on a database file without an open index file.

a. EXPRESSION: You attempted to compose an expression of data items that are not of the data type.

b. SORT: You attempted to SORT on a logical menu filed.

c. REPLACE: You tried to REPLACE a filed with an expression of a different data type.

d. SEEK You used the seek command with an expression that evaluate as the same data type as the active index key.

Dbase file cannot be opened. You attempted to USE a database file containing a memo field.

8. Dbase file cannot be opened: You attempted to USE a database file containing a memo field when DBASE III PLUS cannot find. dbase file containing the memo field text.

9. SKIP You skipped past the last record in the database file.

EQUIPMENT IN THE SYSTEM NETWORK

SIZE: 110 CHARACTERS

FIELD DESCRIPTION	TYPE	SIZE	DEC
SF6 CIRCUIT BREAKER	CHARACTER	30	
ISOLATOR	CHARACTER	8	
TRANSFORMER TAP	CHARACTER	14	
NO. OF TECHNOLOGICAL STATION	CHARACTER	20	
EQUIPMENT CODE	CHARACTER	10	
EQUIPMENT COST	NUMERIC	10	
DATE	DATE	8	
COMMENT	MEMO	10	

ELECTRICAL MAINTENANCE CHECKLIST

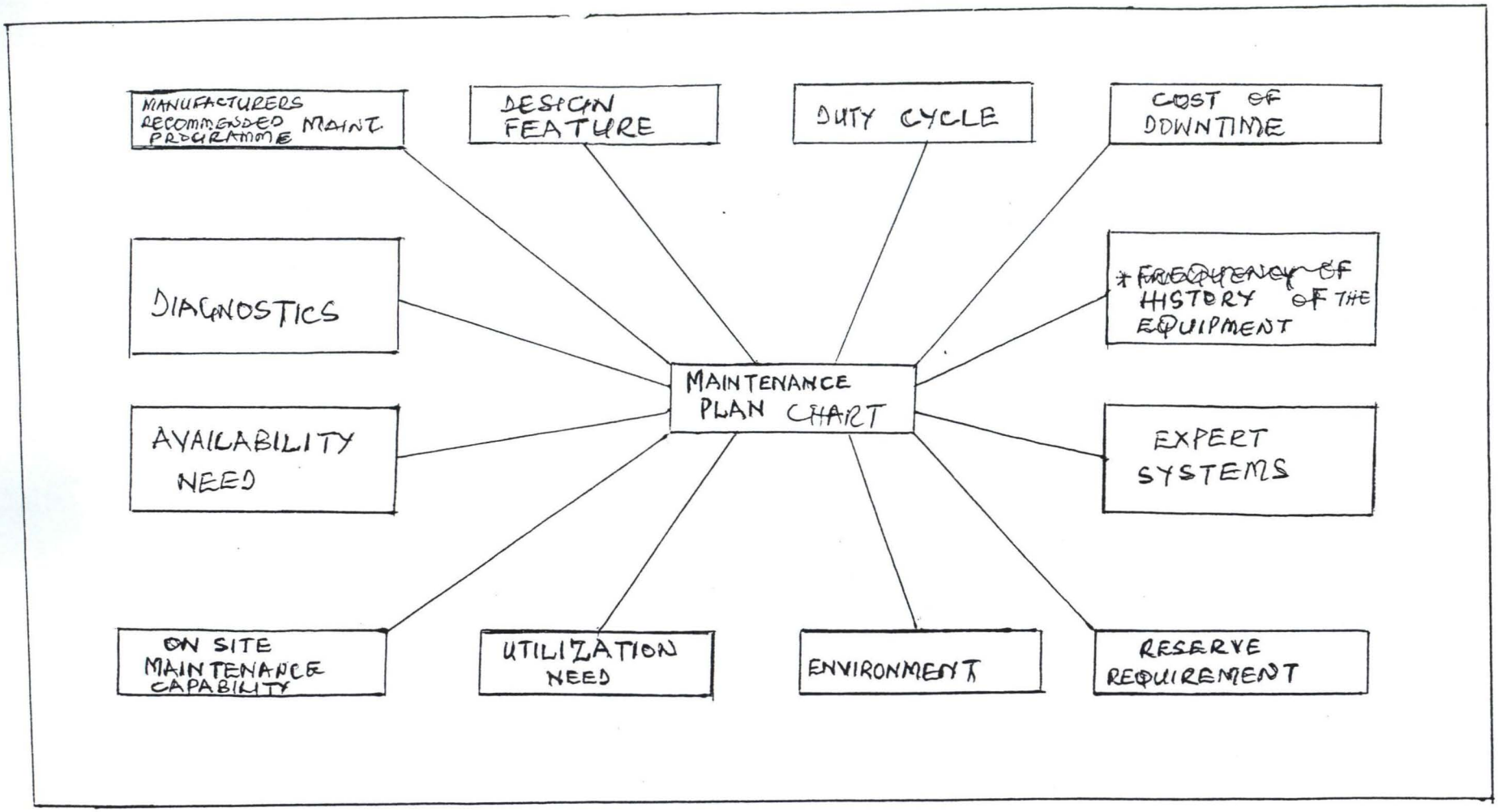
SIZE: 196

FIELD DESCRIPTION	TYPE	SIZE	DEC
Check: CIRCUIT BREAKER;			
OIL PRESSURE	CHARACTER	10	
GAS PRESSURE	CHARACTER	10	
CRACKS AND DIRTS	CHARACTER	12	
AUXILIARY CONTACT	CHARACTER	20	
SPACE HEATER	CHARACTER	10	
MOVING PARTS	CHARACTER	10	
CHARGING SPRING	CHARACTER	12	
MECHANISM BOX	CHARACTER	15	
INSULATION RESISTANCE	CHARACTER	20	
FIXED CONTACT	CHARACTER	10	
OIL AND GAS LEVEL	CHARACTER	10	
DOOR, HINGS AND GASKET	CHARACTER	15	
BREAKER CODE	CHARACTER	12	
BREAKER COST	NUMERIC	12	
DATE	DATE	8	
COMMENT	MEMO	10	

ELECTRICAL TOOLS AND SPARE PARTS

SIZE: 274

FIELD DESCRIPTION	TYPE	SIZE	DEC
MULTI-METER	CHARACTER	15	
ALLEN-KEY	CHARACTER	12	
PLIERS	CHARACTER	6	
SCREW DRIVERS	CHARACTER	20	
SPANNERS-ASSORTED	CHARACTER	20	
HAMMER-METAL	CHARACTER	16	
MALLET	CHARACTER	10	
HAND SAW	CHARACTER	10	
OIL TESTER	CHARACTER	10	
GAS LEAKAGE DETECTOR	CHARACTER	25	
INSULATION RESISTANCE TESTER	CHARACTER	25	
GASKET	CHARACTER	8	
110/240V RELAY	CHARACTER	18	
O/L SEAL	CHARACTER	10	
FILLED GAS CYLINDER	CHARACTER	15	
DRUM OF OIL	CHARACTER	14	
110V MOTOR DC	CHARACTER	12	
CONTACTOR	DATE	8	
DATE	MEMO	10	
COMMENT			



KEY FACTORS AFFECTING ELECTRICAL EQUIPMENT MAINTENANCE MANAGEMENT SYSTEM

FIG. 7.0

MAINTENANCE SCHEDULE (ELECTRICAL)

The maintenance group's duty is to maintain the Electrical equipments in the system Network in order to improve or enhance availaibity of the equipment.

Information gained from manufacturers guidelines, plant history (ie) failure trends and maintenance carried out, equipment status, is used to establish a customized maintenance schedule.

Electrical maintenance activities are carried out in two stages:

a) PLANNING (done in the office)

This involves complete analysis of the work content, allocations of resources (manpower and money), spare parts availability, tools, safety appliance and time.

b) EXECUTION (done in the field)

This involves the physical job aspect, controlling, co-ordinating while ensuring that the safety procedures are observed,

Typical examples of work procedure sheet and maintenance report sheet are shown below:

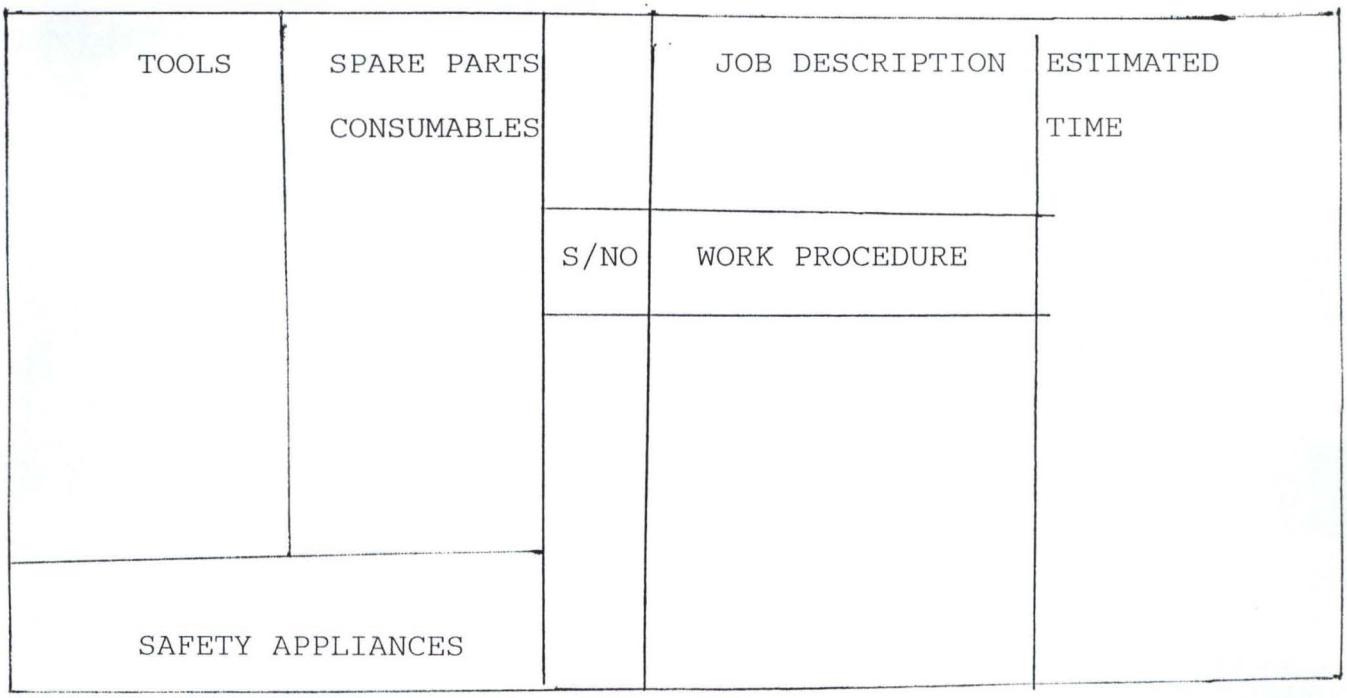


Fig. 8.0

MAINTENANCE REPORT

UNIT..... EQUIPMENT.....DEFECT CARD NO.....

DEFECT REPORT..... DATE.....

OBSERVATION.....

JOB DONE.....

MAN POWER	DURA-TION	COST	MATE-RIAL USED	COST	TOTAL COST	REMARK

Fig. 9.0

GROUP A

1No. Senior Manager (Electrical)

2No. Deputy Manager (Electrical)

2No. Officer I (ELECTRICAL)

3No. Artisans (ELECT)

1No. Cleaners.

GROUP B

1No. MANAGER (ELECT)

1No. ASST. MANAGER (ELECT)

2No. OFFICER 1 (ELECT)

3No. OFFICER III (ELECT)

1No. ARTISAN (ELECT)

2No. CLEANER

GROUP C

1No. DEPUTY MNAGER (ELECT)

2No. ASST. MANAGER (ELECT)

3No. OFFICER I (ELECT)

4No. OFFICER III (ELECT)

1No. ARTISAN (ELECT)

1No. CLEANER.

GROUP D

1No. SENIOR MANAGER.

1No. ASST. MANAGER.

3No. OFFICER I

2No. OFFICER II

2No. CLEANERS

With reference to Table A-D, Manpower requirement for Group A-D are listed above. Group D is the standby team to take care of the functional units.

The size of each group is according to the job demand and such that overcrowding can be avoided, and adequate control exercised.

N/B

Responsibility on the group leader increases with increase in the number of the maintenance crew.

OVERHAULING SCHEDULE

In planning overhauling schedule, the maintenance sections should not be overloaded (ie) a team should be left to take care of the running system Typical examples of overhauling schedule for Shiroro (Hydro Power Station) are discussed below:

For complete overhauling of the station (Hydro) some of the procedures that could be adopted are as follows:

1. Determination of the work content.
2. Determination of the time required.
3. Manpower demand and cost .....NX
4. Organization of tools e.g. special tools etc.
5. Spares Organization .....NY
6. Miscellaneous expenditure for staff entertainment transportation etc.....NZ

Total demand = N(X + Y + Z)

Plus 20% consolidation = 1.2 (X + Y + Z)

Therefore: Total ;amount to be budgeted

= N1.2(X + Y + Z)

GLOSSARY OF TECHNICAL TERMS IN ELECTRICITY INDUSTRY USED IN THE PROJECT

1. TURBINE

   A rotating machine for transforming, the energy of steam, gas or falling water into mechanical energy.

2. PENSTOCK

   A closed conduit for supply water under pressure to turbine. Large penstocks are usually made of curved steel plates, rivetted or welded together sometime embedded in concrete.

3. DRAFTTUBE

   An outlet of water from the turbine to the tailrace.

4. TAIL-RACE

   A channel conducting water away from a turbine or hydraulic power plant.

5. SPILLWAY

   A safety valve by which excess water is discharged without damaging the dam.

6. GENERATOR

   A machine for transforming mechanical energy into electric energy.

7. TRANSFORMER

   An electrical device for changing the magnitude of alternating-current voltage.

8. STEP-UP

   An increase in voltage as through a step-up transformer.

9. STEP-DOWN

A reduction in voltage through a step down-down transformer.

10. SWITCH YARD

The point at which electricity is fed into the distribution network, and it has safety devices to protect the transformers and generating equipment.

11. TRANSMISSION LINE

The conductors and their supporting structures, used to convey electric energy from a generating station to a distant point.

12. WATT

The basic unit of electric power, expressing the rate at which electric energy is being expended.

13. MEGAWATT

It is a system of units for measuring power.

1 Megawatts (MW) = 1,000KW or 1,000,000 watts

1 Horse power (HP) = 746 watts.

14. LOAD

The power requirement (usually measured in Kilowatts) of a system or the average rate of energy consumption during a designated period of time.

15. CIRCUIT BREAKER

Is an electrical device designed to break a load under normal or abnormal condition.

16. ISOLATOR

A no-load switch designed to operate after the opening of the circuit breaker.

17. SWITCH GEARS

Equipment employed in power system to insulate, discharge, make or insulate the electrical circuit for smooth breakers, isolator Earthing switches, Lighting arresters etc.

18. MAINTENANCE

In a simplified form, is service plus repairs replacement of an equipment for greater reliability and efficiency.

19. SERVICE

This is in conjunction with replacement turns out to be overhauling.

WELCOME TO THE ELECRICAL EQUIPMENT MAINTENANCE MANAGEMENT SYSTEM-EEMMS THE SYSTEM IS DESIGNED TO KEEP EEMMS ACTIVITIES IN THE SYSTEM NETWORK. BELOW ARE LISTED THE MENU SELECTION AND DESCRIPTION.

Designed by: Pat. O. Osutuk

.....Press any key too continue.....

```
----------------------------------------------------------------

          P L E A S E     E N T E R     P A S S W O R D

----------------------------------------------------------------
```

```
            MENU OF EEMMS

      *     *     *     *     *     *     *......*(1)

   **1   ADD RECORD

   **2   DELETE RECORD PROGRAM

   **3   EDIT/RETRIEVE RECORD PROGRAM

   **4   VIEW RECORDS PROGRAM

   **5   GENERATE REPORT PROGRAM

   **6   EXIT MAIN MENU
```

ENTER YOUR CHOICE = 0

```
          MENU FOR  NEW RECORDD ENTRY

     *    *    *    *    *    *    *    *..........*


**1. EEMMS

**2  MAINTENANCE SCHEDULE AND CHECKLIST

**3  MANPOWER, TOOLS AND SPARE PART REQUIREMENT

**4  RETURN TO MAIN MENU
```

:ENTER YOUR CHOICE:0

```
                MENU FOR DELETE RECORD

*     *     *     *     *     *     *...........*

**1    EEMMS

**2   MAINTENANCE SCHEDULE AND CHECKLIST

**3   MANPOWER, TOOL AND SPARE PART REQD.

**4   RETURN TO MAIN MENU
```

:ENTER YOUR CHOICE = 0

```
        MENU FOR EDITING RECORD

*     *     *     *     *     *     *.......    *

**1   EEMMS

**2   MAINTENANCE SCHEDULE AND CHECKLIST

**3   MANPOWER, TOOLS  AND SPAREPART REQD

**4   RETURN TO MAIN MENU
```

ENTER YOUR CHOICE: 0

MENU FOR VIEWING RECORDS

* * * * * * *.....*

**1 EEMMS

**2 MAINTENANCE SCHEDULE AND CHECKLIST

**3 MANPOWER, TOOLS AND SPARE PART REQDD.

**4 RETURN TO MAIN MENU

ENTER YOUR CHOICE: (1 - 4) = 0

MENU FOR REPORT GENERATION

* * * * * * *.....*

**1 EEMMS

**2 MAINTENANCE SCHEDULE AND CHECKLIST

**3 MANPOWER TOOLS AND SPARE PART REQD

**4 RETURN TO MAIN MENU

ENTER YOUR CHOICE:0

```
*MAIN.PRG FOR ELECTRICAL EQUIPMENT MAINTENANCNE MANAGEMENT SYSTEM
                          MAIN MENU
@ 22,24  TO 24, 56 DOUB
@ 5,  5, SAY "MENU OF ELECTRICAL EQUIPMENT MAINTENANCE MANAGEMENT
SYSTEM
@ 6, 5, SAY **************************************"
@ 10, 5, SAY "** 1. ADD RECORD PROGRAM"
@ 12, 5, SAY"** 2. DELETE RECORD PROGRAM"
@ 14, 5, SAY"** 3. EDIT/RETRIEVE RECORD PROGRAM"
@ 16, 5, SAY"** 4. VIEW RECORD(S) PROGRAM"
@ 18, 5, SAY"** 5. GENERATE REPORT PROGRAM
@ 20, 5 SAY"** 6, EXIT MAIN MENU"
@ 2, 2, TO 21, 56 DOUB
CHOICE = 0
@ 23, 25 SAY "ENTER YOUR CHOICE : "GET CHOICE PICT "9" RANGE 1,6
READ
     DO CASE
          CASE CHOICE = 1
          DO ADD PROGRAM
          CASE CHOICE =  2
          DO DELETE PRG.
          CASE CHOICE = 3
          DO EDIT PRG.
          CASE CHOICE = 4
          DO VIEW PRG.
          CASE CHOICE = 5
```

```
        DO REPORT. PRG
        CASE CHOICE = 6
        CLEAR
        EXIT
OTHERWISE
        CLEAR
        @ 20, 0 SAY "*** ENTER NUMBER 1 TO 5    ***"
        @ 22, 0 SAY" YOU ENTER" + STR (CHOICE, 2)
END CASE
END DO
SET TALK OF
SET SCOREBOARD OFF
SET STATUS OFF
RETURN.
```

```
******ADD.PRG for adding records to the EEMMS system
CLEA ALL
SET TALK OFF
SET SCOREBOARD OFF
***** PASSWORD FOR ACCESS TO ADD RECORDS TO FILES PASSWORD =O
SET COLO TO W/B, N/N
STORE SPACE (4) TO PATUK
DO WHILE .T.
      @ 10, 10 SAY""
      @ 12, 10 SAY "PLEASE ENTER PASSWORD FOR  RECORD ENTRY"
      SET CONSO  OFF
      @ 12, 52 GET PATUK
      READ
      SET CONSO ON
      IF UPPER (PATUK) = "REEN"
            EXIT
      ELSE
            CLEA COLO TO W/RB+
            @ 10, 5 SAY "WRONG PASSWORD,  TRY AGAIN"
            @ 11, 0
            WAIT
            PASSWORD = PASSWORD + 1
            IF PASSWORD = 3
                  CLEA
                  SET COLO TO RG+
                  @12, 5 SAY "ACCESS IMPOSSIBLE, LEAVE THE SYSTEM"
                  ?
                  WAIT
                  RETURN
            ELSE
                  CLEA
                  LOOP
            END IF
      END IF
            ENDO
            G = O
            DO WHILE G < = 400
            G = G + 1
            ENDDO
            CLEA
            SET COLO TO W/RG+
            @ 12, 13 CLEA TO 15, 10
            @ 13, 23 SAY "YOU HAVE ENTERED CORRECT PASSWORD"
            SET COLO TO
            K = O
            ENDDO
            SET COLO TO W/B+
            CLEA
            BEGIN = RECOUNT ( )
```

```
        ADDREC = .t.
        CHOICE = O
        LET COLO TO W+/G*, BG*/GR+, B
        DO WHILE ADDREC.
        @5,10 SAY "MENU FOR NEW RECORDS ENTRY"
        @6,10 SAY "**************************"
        @10,5 SAY "** 1 ELECTRICAL EQUIPMENT IN  SYSTEM
        NETWORK"
        *@12,5 SAY "** 2 MAINTENANCE SCHEDULE AND CHECKLIST"
@14, 5 SAY "**.3 TOOLS,MATERIAL SPARE,MANPOWER  REQUIREMENT
@16,5 SAY **4 RETURN TO MAIN MENU
CHOICE = O
@3, 3, TO 18, 45 DOUB
@20, 9 TO 22, 29, DOUB
@21, 9 SAY "ENTER YOUR CHOICE' GET CHOICE PICT "9" RANGE 1,4
READ
CLEAR
@11,0
IF CHOICE > 0 .AND. CHOICE < = 3
WAIT "PRESS ANY KEY TO BEGIN ENTERING NEW RECORDS"
ENDIF
DO CASE
        CASE CHOICE = 1
        CLEAR
        USE EEMMS DATA
        APPEND BLACK
        SET FORMAT TO EEMMS DATA . FMT
        READ
        CLOSE FORMAT
        @22,0 SAY "*** RECORD ENTERED **"
        @24, O SAY "ENTER ANOTHER RECORD?(Y/N): "  GET ADDRES
        READ
        CLEA
                LOOP
                        ELSE
        WAIT "PRESS ANY KEY TO EXIT ELECTRICAL EQUIPMENT ENTRY
        PROGRAM
        EXIT
ENDIF
CASE CHOICE = 2
CLEAR
USE MAINTENANCE SCHEDULE AND CHECKLIST. FORMAT.
READ
CLOSE FORMAT
@22, O SAY "*** RECORDED ***"
@24, O SAY "ENTER ANOTHER RECORD? 9Y/N)"GET ADDREC
READ
CLEAR
        LOOP
```

```
                ELSE
        WAIT "PRESS ANY KEY TO EXIT MAINT.SCHE: AND CHECKLIIST ENTRY
        PROGRAM
        EXIT
        ENDIF
        CASE CHOICE = 3
        CLEAR
        USE TOOLS AND SPARE MANPOWER REQUIREMENT
        APPEND BLANK
        SET FORMAT TO T AND MSR
        READ
        CLOSE FORMAT
        @22,0 SAY "*** RECORD ENTERED ***"
        @24, O SAY "ENTER ANOTHER RECORD? (Y/N) " GET ADDREC
        READ
        CLEAR
              LOOP
        WAIT "PRESS ANY KEY TO EXIT T & MSR ENTRY PROGRAM
        EXIT
ENDIF
CASE CHOICE = 4
        CLEAR
        EXIT
OTHERWISE
        CLEAR
        @20, O SAY "YOU ENTERED" + STR (CHOICE, 2) + "CHOICE"
        @22, O SAY "** ENTER NUMBER 1 TO 4 ****"
        @23, O
        WAIT
        CLEAR
        ENDCASE
ENDDO
CLEAR
@11, O SAY "YOU HAVE ADDED" + LTRIM (STR (RECCOUNT C) - BEGIN, 10)) +;
RECORDS
WAIT
SET TALK OFF
SET SCORE BOARD OFF
RETURN
```

```
***** DELETE. PRG FOR DELETING RECORDS IN  EEMMS SYSTEM
      CLEAR ALL
      SET TALK OF
      SET SCOREBOARD OFF
      SET COLO TO R/W
      PASSWORD = O
      SET COLO TO  W/B, N/N
      STORE SPACE (5) TO  PATUK
      DO WHILE .T.
      @20, 10 SAY ""
      @12, 10 SAY "PLEASE ENTER PASSWORD FOR RECORD DELETION:"
            SET CONSO OFF
            @12, 55 GET PATUK
            READ
            SET CONSO ON
            IF UPPER (PATUK) = "RECDE"
                  EXIT
            ELSE
            CLEA
            SET COLO TO W/BG+
            @10, 5 SAY "WRONG PASSWORD, TRY AGAIN"
            @11, 0
            WAIT
            PASSWORD = PASSWORD + 1
            IF PASSWORD = 3
                  CLEA
                  SET COLO TO  RG+
                  @12, 5 SAY "ACCESS IMPOSSIBLE, LEAVE THE SYSTEM"
                  ?
                  WAIT
                  RETURN
            ELSE
                  CLEA
                        LOOP
                  ENDIF
            ENDIF
      ENDDO
      G = O
      DO WHILE G < = 400
       G = G+1
      ENDDO
      CLEAR
      SET COLO TO W/RG+
      @12, 13 CLEA TO 15, 60
      @13, 23 SAY "YOU HAVE ENTERED CORRECT PASSWORD"
      SET COLO  TO W/B+
      G = O
      DO WHILE P < 400
      P = P + 1
```

```
ENDDO
CLEAR
*COLO TO  W/B+
EDDITING = RECNO ( )
EDITREC = .T.
CHOICE = 0
ADDEL = .T.
SET COLO TO W+/G+, BG+/GR+, B
DO WHILE EDITREC
      @3,5 SAY "ELECTRICAL EQUIPMENT MAINT MGT. SYSTEM"
      @4,5 SAY "**********************************
      @6,10 Sy "MENU FOR DELETING RECORDS"
      @7,10 SAY "**********************"
      @10,5 SAY "**1. DELETE ELECTRICAL EQUIPMENT IN THE
                        SYSTEM NETWOKR RECORD ENTRY
      @12,5 SAY "**2. MAINTENANCE SCHEDULE AND CHECKLIST
RECORD ENTRY
      @14,5 SAY"**3. TOOL, MATERIAL SPARE MANPOWER REQD
RECORD ENTRY
      @16,5 SAY "**4. RETURN TO MAIN MENU"
      @1, 3 TO 18, 53 DOUB
      @20, 8 TO 22,32 DOUB
      @21,10 SAY "ENTER YOUR CHOICE" GET CHOICE PICT "A" RANGE
1,4
      READ
      CLEAR
      @11,0
      IF CHOICE > 0 .AND. CHOICE < = 3
      WAIT "PRESS ANY KEY TO BEGIN DELETION"
      ENDIF
            DO CASE
      CASE CHOICE = 1
      USE EEMMS.DAT
      CLEAR
      GO TOP
      @5,20 SAY "READY TO RETRIEVE A RECORD"
      KEY = SPACE (20)
MDATE = CTOD ("--/--/--")
@10, 10 SAY "ENTER EQUIPMENT "CODE GET KEY PICT '@!"
@12, 10 SAY "ENTER YEAR OF INSTALLATION" GET
                  INSTALATION PICT "@"!
@14,10 SAY "ENTER MAINTENANCE PROCEDURE" GET MAINTENANCE
PROCEDURE PICT @!"
@16, 10 SAY "ENTER MANPOWER, TOOL AND SPARES PART" ET
MANPOWER TOOL AND SPARE  PICT "@!"
@18,10 SAY "ENTER ESTIMATED TIME"  GET ESTIMATED TIME PICT "@!"
READ
IF KEY = SPACE (20) EQUIPMENT CODE = 40.AND.
YEAR OF INSTALLATION = 35 .AND. MAINT. PROCEDURE
```

```
        = 30 AND MANPOWER TOOLS AND SPARE = 45 AND
        ESTIMATED TIME = 25 .AND. MDATE = CTOD ("--/--/--")
        EXIT
        @2,5
OTHERWISE
        CLEAR
        @20,0 SAY "YOU ENTERED" + STR (CHOICE,) + "CHOICE"
        @22, 0 SAY "*** ENTER NUMBER FROM 1 TO 4 ***"
        @23,0
        WAIT
        CLEAR
        ENDCASE
ENDDO
CLEAR
@11, 0 SAY "YOU DELETED" + LTRIM (STR(RECOUNT()-
              EDITING, 10 10)) + "RECORDS"
        WAIT
        SET TALK OFF
        SET SCOREBOARD OFF
        RETURN
```

```
***** EDIT.PRG for editing records in EEMMS system
      CLEAR ALL
      SET TALK OFF
      SET SCOREBOARD OFF
      SET COLO TO W/RGG+
      PASSWORD = 0
      SET COLO TO W/B, N/N
      STORE SPACE (7) TO PATUK
            DO WHILE .T.
            @10, 10 SAY ""
            @12, 10 SAY "PLEASE ENTER PASSWORD FOR RECORD EDITING"
            SET CONSO
            @12, 52 GET PATUK
            SET CONSO ON
            IF UPPER (PATUK) = "RECED"
                  EXIT
            ELSE
                  CLEAR
            SET COLO TO W/BG+
            @10, 5 SAY "WRONG PASSWORD, TRY AGAIN"
            @11, 0
            WAIT
            PASSWORD = PASSWORD + 1
            IF PASSWORD = 3
            CLEAR
            SET COLO TO RG+
            @12, 5 SAY "ACCESS IMPOSSIBLE, LEAVE THE SYSTEM
            ?
            WAIT
            RETURN
            ELSE
                  CLEAR
                  LOOP
      ENDIF
      ENDIF
ENDDO
G = 0
DO WHILE G < = 00                                    86
G = G+1
ENDDO
CLEAR
SET COLO  TO W/RG+
@12, 13 CLEAR TO 15, 60
@13, 23 SAY "YOU HAVE ENTERED CORRECT PASSWORD"
SET COLO TO W/B+
K = 0
DO WHILE P < = 400
P = P + 1
ENDDO
```

```
SET COLO TO W+/g+, Bg+/gr+,b
CLEAR
SET COLO TO W/B+
EDITING = RECNO ()
EDITREC = .T.
CHOICE = 0
      DO WHILE EDITREC
      @3,5 SAY "ELECTRICAL EQUIP MAINT MGT. SYSTEM
      @4,5 SAY "**********************************"
      @6,10 SAY "MENU FOR EDITING RECORDS "
      @7,10 SAY "*******************************"
@10, 5 SAY "**1. EDIT ELECTRICAL EQUIPMENT IN THE SYSTEM NETWORK
                RECORD ENTRY"
@12, 5 SAY ""**2. EDIT MAINTENANCE SCHEDULE AND CHECKLIST RECORD
                ENTRY"
@14,5 SAY "**3. TOOLS, MATERIAL SPARE, MAN POWER REQD RECORD ENTRY
      @16, 5 SAY "**4 RETURN TO MAIN MENU
      @1,3 TO 18,51 DOUB
      @21, 10 SAY  ENTER YOUR CHOICE, CHOICE PICT "9"
                   RANGE 1,4
      @20, 8 TO 22, 32 DOUB
      READ
      CLEAR
      @11,0
      IF CHOICE < 0.AND CHOICE < = 3
      WAIT "PRESS ANY KEY TO BEGIN  EDITING
      ENDIF
            DO CASE
      USE EEMMS DATA
      CLEAR
      @5, 20 SAY GO TOP   READY TO RETRIEVE A RECORD"
      KEY = SPACE(20)
      MDATE = CTOD ("--/--/--/")
      EDITING = RECORD NO ()
      @10, 10 SAY "ENTER EQUIPMENT NAME AND YEAR OF INSTALLATION"
      GET KEY  PICT" "@!"
      @12, 10 SAY "ENTER MAINT. PROCEDURE GET MAINT PROCEDURE
PICT""@!"
@14, 10 SAY "ENTER MANPOWER, TOOLS", SPARE PART"     MANPOWER,
TOOLS, SPARE PICT" `@!"
SET FORMAT TO EEMMS DATA
READ
CLOSE FORMAT
CLEAR
@10, 10 SAY "DO YOU WANT TO DELETE THE  RECORD? (Y/N)" GET ADDEL IF
ADDEL = "Y"
DELETE
CLOSE FORMAT
ELSE
```

```
CLEAR
EXIT
ENDIF
@24,O SAY "DO YOU WANT TO STILL REMOVE TTHIS RECORD COMPLETELY?;
        (YN)" GET ADDEL
IF ADDEL = "Y"
        PACK
ELSE
        RECALL
ENDIF
        CLEAR
ELSE
CONTINUE
        CLEAR
        @10,10 SAY "** RECORD NOT FOUND **"
        @1, 0
WAIT
ENDIF
@22,0 SAY "DELETE ANOTHER RECORD? (Y/N)" GET EDITREC
        CLEAR
CASE CHOICE = 4
        CLEAR
        EXIT
```

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```
*** VIEW.PROG For viewing only, no modification possible
CLEAR ALL
SET TALK OFF
SET SCORE BOARD OFF
CHOICE = 0
*SET COLO TO B/B
SET COLO TO W/RB+
DO WHILE .T.
@5,10 SAY "MENU FOR VIEWING RECORDS"
@6,10 SAY "**************************
@10,5 SAY "**1 VIEW ELECTRICAL EQUIPMENT IN THE SYSTEM NETWORK"
@12,5 SAY "**2 VIEW MAINTENANCE SCHEDULE AND CHECKLIST"
@14,5 SAY "**3 VIEW MANPOWER, TOOLS AND SPARE PART"
@16,5 SAY "**4 RETURN TO MAIN MENU"
@3,3 TO 18, 57 DOUB
@22, 20 SAY"ENTER YOUR CHOICE (1-4)" GET CHOICE PICT "9" RANGE 1,4
@21,  3 TO 23, 57 DOUB
READ
CLEAR
@11,0
IF CHOICE > 0 .AND. CHOICE < = O
      WAIT "PRESS ANY KEY TO BEGIN VIEWING"
ENDIF
      DO CASE
            CASE CHOICE = 1
                  CLEAR
                  USE EQUIPMENT NAME
DISPLAY ALL EQUIPMENT CODE, LOCATION .AND. NOS OF TECHNOLOGICAL
                        STATION;
WAIT
CASE CHOICE = 2
      CLEAR
      USE MAINTENANCE SCHEDULE AND CHECKLIST
      DISPLAY ALL DAILY, WEEKLY AND MONTHLY SCHEDULE FOR CIRCUIT
BREAKER, ISOLATOR TRANSFORMER TAP. DATE, LOCATION.
      WAIT
      CASE CHOICE=3
      CLEAR
      USE MANPOWER, TOOLS, SPARE PART.
            REQUIREMENT.
      DISPLAY ALL AVAILABLE MANPOWER, TOOLS, SPARE PART.
      WAIT.
      CASE CHOICE = 4
      CLEAR
      EXIT
OTHERWISE
      CLEAR
      @22,0 SAY "YOU ENTERED "+ STR (CHOICE, 2) + "CHOICE"
      @22, O SAY *** ENTER NUMBER FROM 1 TO 4 ***"
```

```
        @23,0
        WAIT
        CLEAR
ENDDO
SET TALK ON
SET SCOREBOARD ON
RETURN
```

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```
**** REPORT. PRG for making reports on the  ELECTRICAL EQUIP MAINT. MGT.
SYSTEM
CLEAR ALL
SET TALK OFF
SET SCOREBOARD OFF
SET COLO TO W/RG+
PASSWORD = O
SET COLO TO W/B, N/N
STORE SPACE (6) TO  PATUK
DO WHILE .T.
        @10, 10 SAY""
        12,     10 SAY "PLEASE ENTER PASSWORD FOR REPORT GENERATION"
        SET CONSO  OFF

        @12, 55 GET PATUK
        READ
        SET CONSO ON
        IF UPPER (PATUK)= "REPGEN"
                EXOT
        ELSE
        CLEAR
        SET COLO TO W/BGG+
        @10, 5 SAY "WRONG PASSWORD, TRY AGAIN"
        @11,0
        WAIT
        PASSWORD=PASSWORD + 1
        IF PASSWORD = 3
        CLEAR
        SET COLO TO RG+
        @12,5 SAY " ACCESS DENIED, LEAVE THE SYSTEM
        ?
        WAIT
                RETURN
        ELSE
                CLEAR
                LOOP
        ENDIF
        ENDIF
ENDDO
G = O
DO WHILE G< = 400
G = G+1
ENDDO
CLEAR
SET COLO TO W/RG+
@12, 13 CLEAR TO 15,60
@13,23 SAY "YOU HAVE ENTERED CORRECT PASSWORD"
SET COLO TO W/B+
```

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```
P = O
DO WHILE P < = 400
P = P + 1
ENDDO
CLEAR
SET COLO TO W/B+
CHOICE = 4
REPOREC = .T.
SET COLO TO W+/G+,BGG+/GR+,B
DO WHILE REPOREC
@5 10 SAY "MENU FOR REPORT GENERATION"
ACCEPT "SHALL O SEND THIS REPORT TO PRINTER? (Y/N)" TO YN
IF UPPER 9YN) = "Y"
SET PRINTER ON
END DO
SET TALK ON
SET PRINT OFF
CLOSE DATA BASE
CLEAR
RETURN
CASE CHOICE = 4
CLEAR
EXIT
ENDDO
SET TALK ON
SET SCORE BOARD ON
CLOSE DATA BASES
ENDIF (IF PRINTER WAS SELECTED)
RETURN.
```