A MODEL PROGRAM FOR ENERGY TRANSFER PRICES FOR THE POWER HOLDING COMPANY OF NIGERIA Plc

BY

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PGD/MCS/2003/2004/1122

PGD Computer Science

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BEING

A PROJECT WORK SUBMITTED TO THE DEPARTMENT OF MATHEMATICS / COMPUTER SCIENCE FEDERAL UNIVERSITY OF TECHNOLOGY SCHOOL OF SCIENCE AND SCIENCE EDUCATION MINNA

In Partial Fulfillment of The Award Of Post Graduate Diploma In Computer Science

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CERTIFICATION

This is to certify that this project has been read and approved as meeting the requirements of the Department of Mathematics and Computer Science, Federal University of Technology, Minna.

....

Dr. Y.U. Abubakar **Date**

Project Supervisor

....

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Head of Department

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External Examiner **Date**

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God bless you all.

Under the deformed National Electric Power Authority (NEPA) resources were released to departments / units mostly based on staff strength and maintenance of existing assert and not necessarily the performance of the department or unit. There were no business approaches in the operations of these departments and the sector was virtually providing social services and operating at a huge loss.

With the reform of the power sector, every unit is now funded based on performance. The day to day administration of the various stations is now commercially driven.

There is a market operator who decides what percentage of the revenue goes to each unit as well as penalty for non performance.

The project is therefore an attempt to provide a computer based solution to the critical areas of the funding the business units under the Power Holding Company of Nigeria Plc which would meet the expectations of all stake holders known in the emerging power market as Energy Transfer Pricing.

It is pertinent to note that the experience of author spanning well over a period of twenty years in the power industry has been brought to bear in an effort to provide this solution.

The allocation of fund by a Market Operator to various participants in the power market is known as Energy Transfer Pricing.

1.3 Objective of the Study

The main objective of the study is to design a program that will meet the requirements of the Market Operator who is appointed by PHCN

to allocate fund to each unit or department equitably based on an average daily power generation of **3000MW** and a monthly cash collection of over **N6billion.**

1.4 Significant of the Study

It is envisage that there would be so many participants in the emerging power market that will make the operation of the market very cumbersome without an appropriate computer based program the can effectively allocate fund that would meet the expectations of the market.

The efficiency and effectives of the market operation will solely depend on the computer application.

1.5 Statement of the Problem

The problems associated with revenue allocation in any sector are very controversial issues that can result in total failure of the entire organization to render its statutory services to customers. The utilization of computers for proper resource allocation is therefore inevitable.

1.6 Limit /Scope of the Study

The limit and scope of this project is determined by the income from the sales of electricity for each month and the revenue allocation formula or ratio due to each participating company. The model program is not designed to determine the allocation formula itself but the amount due to each unit. Such decision should be recognized as an executive matter and therefore left for the Market Operator and

Management of PHCN to review and decide from time to time. The ratio chosen by the author is entirely for the purpose of this academic exercise.

1.7 Definitions:

Electric Energy is simply defined as the electric Power (measured in Watts) delivered or consumed over a period. Energy is measured in Joules but larger quantities are in Kilo Watt – Hour (a Thousand Watt- Hour) and Mega-Watt – Hour (ie a million of Watt-hour). The unit of electricity is the Kilo-Watt-Hour (KWh).

The average unit price of electricity in Nigeria is still pegged at the 2003 of figure of N6.50 while the average cost of production is N2.77 *(Source: 2003 NEPA Annual Report).*

Power (P) is the product of electric current (**I**) and voltage (**V**) as well as the phase angle (cos A) between the two ie P = IxV cosA expressed in Watts.

Based Generation is the average power delivered on daily basis excluding technical losses which is about 3000Million Watts

Income is the average monthly cash collections by the eleven Distribution Companies of PHCN (NEPA).

CHAPTER TWO

2.0 REVIEW OF LITERATURE

2.1 Participants in the New Power Market

The restructuring of the power sector has since commenced with the formation of **POWER HOLDING COMPANY OF NIGERIA PLC (PHCN)** in line with the Electric Power Reform Act 2005.

There are now eighteen companies registered under PHCN to carry out the core businesses of the sector. These newly incorporated limited liability companies and a few Independent Power Producers will constitute the initial participants of the power market.

The PHCN companies are:-

a). Six (6) Power Generation companies

b). One (1) Transmission company

c). Eleven (11) Distribution companies based on the formal zonal structure of NEPA

While the Independent Power Producers (IPPs) are:-

1. AES based in Egbin – Lagos
2. Agip based in Okpai in Delta State

2.2 The Role of the Market Operator (MO)

Under the new reform there is a Power market Operator appointed by the management of the PHCN whose functions include but not limited to the following activities:

1. To initiate the Electricity Market in Nigeria
2. To set out and operate the Market Rules for the Transitional Stage for the power market participants
3. **To carry out settlements**
   - **Energy Transfer Prices**
   - Process metering data and calculate settlements
   - Develop and test software
   - Prepare Market payment system
   - Bank accounts and transfer system
   - Security cover
   - Administration of late or non payment
   - Funding and special charges
4. To create awareness amongst participants on the Transitional Stages of the market so as to instill the culture and learning process
5. To start the process of operating the market by improving the transitional stages smoothly and gradually adding new processes and increasing the sophistication/formalities of procedures
6. To review and amend/finalize rules
7. To draft and publish market procedures
8. To supervise compliance of rules and procedures
9. To give performance incentives
10. To organize and maintain data bases

11. To admit and register Participants
12. To publish information and reports
    - MO Website
    - Maximize interactions and sharing information with System Operator
13. To train Participants
14. To prepare commercial Metering System
    - Standard specifications
    - Register metering system in each trading point
    - Centralize readings collection, verify consistency and accuracy, organize for settlement
    - Administering data complaints

2.3 The Role of the System Operator (SO)

In the new Power sector reform there is a System Operator appointed by the management of the PHCN under the Transmission Company whose functions include but not limited to the following activities:

1. To carry out national Load projections
2. To undertake Power System planning and studies, update and complete data bases
3. To establish reliability standards and Ancillary Services by designing realistic transitional plans for improvement in reliability standards
4. Monitoring and enforcing the Policy on operational reserves for both generation and load demand
5. To supervise open access and new connections
6. To establish the System Operator Web site

7. To identify the need, schedule and, when necessary, procure the Ancillary Services required to meet reliability standards
8. To provide operational reserve in transitional Stage for all Power Purchase Agreements (PPA) and contracts obligation
9. To establish Grid Code for all new generation and existing generation if it has technical capability
10. To distribute spinning reserve in thermal units and hydro power plants
11. Provide contingency plans and fast start reserve and assigned to non scheduled generation

2.4 The Six Generation companies

The power generating companies popularly referred to as Gencos and the current capacity of the plants are given in table 1 below.

The main objective of the Gencos is to cost effectively provide reliable and quality electricity for the nation by ensuring optimal availability of their primary energy sources, assert and equipment.

Table 1: New Genco Companies

S/N	GenCo Station	Installed capacity	Current Available capacity	State Located
1	Egbin	1320 MW	1275MW	Lagos
2	Kainji & Jebba	760 MW	480 MW	Niger

		578 MW	540 MW	
3	Shiroro	600 MW	600 MW	Niger
4	Delta	930 MW	480 MW	Delta
5	Afam	987 MW	343 MW	Rivers
6	Sapele	1020 MW	120 MW	Delta
	Total	**6195** MW	**3838** MW	

2.5 **Transmission Company**

The transmission and system operation company popularly called Transysco presently operates a six regional structure namely Bauchi, Benin, Enugu, Kaduna, Lagos and Shiroro with a combined assert base as stipulated under table 2 below.

The main objective is to provide the required capacity of assert, equipment the interconnected system required to meet operational demand for evacuating and dispatching reliable and quality power with minimal technical losses .

Table 2: <u>Transysco Assert</u>

Equipment	**Voltage Level**	**Total Number Installed**
Transformers	330KV	45
	132KV	226
	33KV	34
Circuit Breakers	330KV	217
	132KV	483
	33KV	576

Isolators	330KV 132KV 33KV	783 905 1,159
Reactors	330KV 132KV 33KV	14 1 3
Earth Switch	330KV 132KV 33KV	205 268 270
LINES	330KV 132KV	4,498 Kilometers 5,430 Kilometers
Towers	3330KV 132KV	9,683 17,971

2.6 **The Eleven Distribution companies**

The distribution companies are popularly known as Discos and the objective of this sector is to distribute reliable and quality Electricity required to meet customer demand by ensuring the availability of assert, equipment and network such as those reflected under table 3

Table 3: Disco Assert

Equipment	**Voltage Level**	**Total Number Installed**
Transformers	**33 KV**	**31989**
New Overhead Routes	**33KV** **11Kv**	**841KM** **869Km**

	0.415KV	**1466KM**
New underground cable run	**33KV** **11Kv** **0.415KV**	**10 KM** **64KM** **138KM**

2.7 The Role of the Corporate Head Office

The Power Holding Company of Nigeria PLC (PHCN) and the eighteen (18) other companies were recently incorporated in compliance with the 2005 power reform act which provides for the formation of initial and successor companies and the transfer of assets and liabilities of the NEPA

All the Chief Operating Officers of the 18 companies report directly to the Managing Director and Chief Executive (MD/CE) of PHCN whose oversight functions include but not limited to the following:

- > Monitoring of Key Performance Indicators
- > Government policy implementation
- > Payment of outstanding contracts
- > Settling fuel bills of Thermal and Gas Stations
- > Servicing loans and advances
- > Public Relation
- > Membership of the West African Power Pool (WAPP)
- > Meeting International Obligations
- > Human Resources Management

A provision must therefore be made in the energy transfer pricing for the Head Office to settle all its obligatory commitments.

2.8 The Independent Power Producers

Presently, there two Independent Power Producers (IPPs) in the country these are:-

1. AES based in Egbin – Lagos with 290MW capacity
2. Agip based in Okpai in Delta State with 450MW plants

CHAPTER THREE

3.0 SYSTEM ANALYSIS AND DESIGN

3.1 Review of Existing System

The methods of determining how best to use a computer program along with other resources of the Power Holding Company (NEPA) to perform tasks that meet the objectives of the organization in revenue allocation to the participating companies and the Corporate Head office is the focus of the chapter.

The Power industry is a strategic sector and therefore represents an important infrastructure for the socio-economic development of every country. The present state of the Nigerian economy can be attributed to the neglect of the power sector over the years by successive governments. The following facts obviously underscore this neglect:

- There were no single Power generating stations built between 1990 and 2000 by either government or the private sector
- No major overhaul of the existing plants were carried out under the same period
- Under NEPA, only 19 out of the 79 generating units were in operation by 1999

- Actual output also fell considerably to about 1700Megga Watts in 1999
- No new transmission lines were built since 1987

- Government funding of the sector also decreased.

- The sector was virtually running as a social service without any business approach in its operations

- The NEPA largely depended on overdraft and loans from Banks for most of its operations.

3.2 **Short Comings of the Existing Practice**

Funding of the industry was in the past based on the Federal Government budgetary allocation for capital projects while the income from sales of electricity could not meet staff salaries and other overhead costs and because of wrong allocation of fund even the little resources were not judiciously utilized.

The electricity reform act of 2005 has now repealed the National Electric Power Authority (NEPA) Act of 1973 and provide for the formation of companies to take over the functions, assets, liabilities and staff of the National Electric Power Authority. It also provides for the development of competitive electricity markets; establishment of the Nigerian Electricity Regulatory

Commission that will provide licensing and regulation of generation, transmission, distribution and supply of electricity; enforce such matters as performance standards, consumer rights and obligation as well as the determination of tariffs for matters connected with the power sector.

It was in anticipation of the reform that the Management of NEPA knowing how capital intensive the electricity supply industry and the federal government alone cannot adequately fund the sector and in order to attract private sector participation had since 2003 decided to carry out the unbundling of the industry.

The major steps taken so far in this direction are:

. To institutionalize eighteen (18) Business Units towards commercial orientation

. To improve revenue base and cash collection

. To improve customer service through efficient and timely delivery

, To commence dry-run process of the new electricity market rules.

The focal point of this project is directed at the emerging market rules especially the **Energy Transfer Prices.**

The project is all about developing a model program for an equitable revenue sharing for the participants of the power market under PHCN *(formally NEPA).*

3.3 Input Specifications

Since the commencement of the so called "dry-run" process of the emerging energy market rules in April 2005, it is no longer business as usual at PHCN as the allocation of scarce resources is now purely based on a set of key performance indicators which every participant in the market must meet to remain business.

The following data represent the interim power delivered daily as well as the monthly cash collections by the distribution companies of PHCN which formed the basis for Transfer pricing.

Average Daily Generation: 3000MW

Average Monthly Income: ₦6billion

3.4 Modules and Files Design

MODULE 1: PHCN Energy **Transfer Prices**

This module represents the participating companies of PHCN and the percentage due to each company during the period of the dry-run of

the process of the emerging power market. The funding level is based on minimum operational requirement as well the contribution of each company to the overall service delivery.

S/N	Company	No	Percentage
1	Corporate Headquarter PHCN	1	25%
2	GenCos	6	30%
3	TransysCo	1	25%
4	DisCo	11	20%
	Total %	**19**	**100%**

MODULE 2: GENCO UNITS: N1,800,000,000.00 (30% ALLOCATION)

This module is a second level allocation to the generating companies from a block allocation of the 30% due to all the six companies based on actual capacity and output contributed by each power station.

S/N	GenCo Station	Installed capacity	Available capacity	Amount ₦	Percentage
1	Egbin	1320 MW	1275MW	N450m	25%
2	Kainji & Jebba	760 MW 578 MW	480 MW 540 MW	N630m	35%
3	Shiroro	600 MW	600 MW	N270m	15%
4	Delta	930 MW	480 MW	N180m	10%
5	Afam	987 MW	343 MW	N180m	10%

6	Sapele	1020 MW	120 MW	N90m	5%
	Total	**6195** MW	**3838** MW	**1,800,000,000**	**100%**

MODULE 3:**DISCO UNITS N1,200,000,000 (20%)**

This module is a second level allocation to the eleven distribution companies out of the 20 % due to the sector and it is based on load allocation and cash collection from each zone as follows:

S/N	DisCo NBU	LOAD	Percentage	Amount
1	Eko	300MW	10%	N120,000,000
2	Ikeja West	450MW	15%	N180,000,000
3	Benin	300MW	10%	N120,000,000
4	Port-Harcourt	300MW	10%	N120,000,000
5	Ibadan	300MW	10%	N120,000,000
6	Yola	150MW	5%	N60,000,000
7	Abuja	300MW	10%	N120,000,000
8	Kano	150MW	5%	N60,000,000
9	Kaduna	300MW	10%	N120,000,000
10	Jos	150MW	5%	N60,000,000
11	Enugu	300MW	10%	N120,000,000
	Total	**3,000MW**	**100%**	**₦1,200,000,000**

3. 5 **Output Specifications**

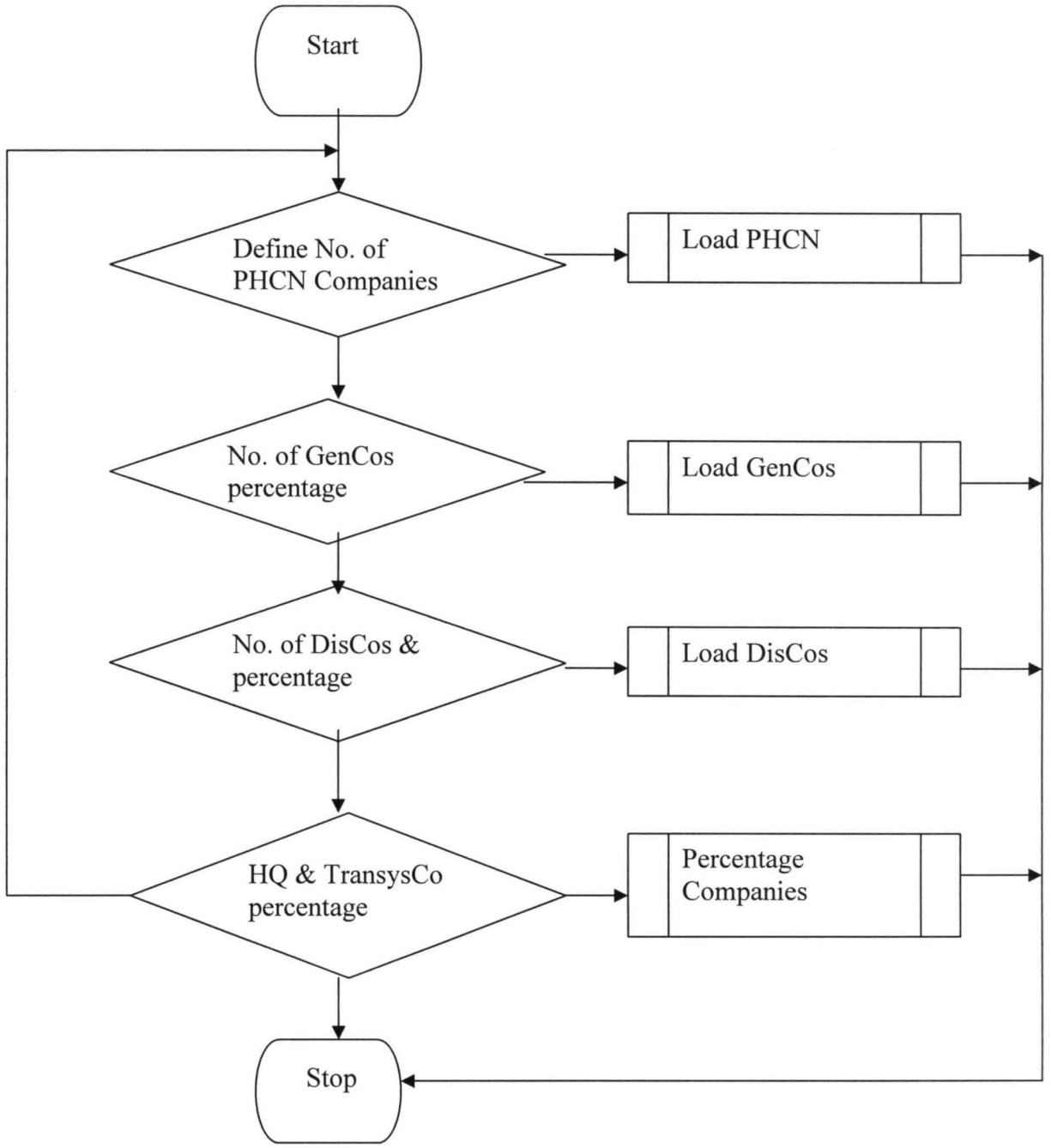
- The output generated is a print out of the report of what is allocated to each of the 19 business units and the Corporate Headquarters. A copy is sent to the General Manager in charge of treasury for transfer of the respective funds to the units. A standard HP laser jet printer is therefore suitable for this purpose. Other hardware requirements include a complete computer system.

CHAPTER FOUR

4.0 SYSTEM IMPLEMENTATION

4.1 Algorithm

The system implementation processes involving the proper coordination of all available resources to ensure that the objective of the program is achieved is the main focus of this chapter.



4.2 Program Listing

The selected program for this project model is the C++ programming language using Microsoft Visual C++ version 6.0. The program listing is as contained in appendix A

4.3 Program Documentation

A simple procedure for the installation of the program is described in this section. The program can easily installed on any computer system with Microsoft Windows 2000 XP or any windows version with a Microsoft visual C++ following the operational steps below:-

> Ensure that the computer system is properly connected to the power supply

> Start up the computer and allow it to run and properly boot

> Select Visual C++ from the packages available and insert the program floppy to load as follows:

Click on the Start button

- Select Microsoft Visual C++ version 6.0
- Select drive A:
- Click compile to load PHCN
- Run the program PHCN
- Check for errors if any
- Compare the results of the report with calculated values

4.4 Data Security

The main server hosting all the applications software for PHCN is highly protected against any unauthorized users. The security of this program is therefore no exception. This in addition to user password provided.

4.5 Dry Run Procedure

During the dry – run or change over period it necessary to ensure the all participants of the power market are properly involved in the over from the old method monthly fund allocation to a new method which purely based on performance. The procedure to adopted should include road shows, training and re-training.

4.6 Interface and Hardware Requirements

Complete computer system with the specification given below is to be procured to serve as a dedicated server for the program:

- Pentium 4 with processor speed of 2GHz
- 40GB Hard Disk and 512MB RAM
- DVD / CD – Multimedia
- Floppy drive
- USB port
- 15" SXGA flat screen Monitor; HP laser jet printer
- Standard Key board and mouse
- Installed with Microsoft Windows and Internet accessible

4.7 Results / Discussion

ENERGY TRANSFER PRICES

S/No:	Company	No of Units	Percentage
1	Corporate Headquarter PHCN	1	25
2	GenCos	6	30
3	TransysCo	1	25
4	DisCo	11	20

DISCO ALLOCATIONS

S/No:	DisCo	Station Load (MW)	Percentage	Amount (Naira)
1	Eko	300	10	120000000.00
2	Ikeja	450	15	180000000.00
3	Benin	300	10	120000000.00
4	Port-Harcourt	300	10	120000000.00
5	Ibadan	300	10	120000000.00
6	Yola	150	5	60000000.00
7	Abuja	300	10	120000000.00
8	Kano	150	5	60000000.00
9	Kaduna	300	10	120000000.00
10	Jos	150	5	60000000.00
11	Enugu	300	10	120000000.00

GENCO ALLOCATIONS

S/No:	GenCo Station	Capacity (MW)	Percentage	Amount (Naira)
1	Egbin	1320	25	450000000.00
2	Kainji	1338	35	630000000.00
3	Shiroro	600	15	270000000.00
4	Delta	930	10	180000000.00
5	Afam	987	10	180000000.00
6	Sapele	1020	5	90000000.00

The result of the program is accurate but would require further development into a graphical user interface. The graphic concept is however beyond the scope of this project.

4.8 Maintenance

The program could be maintenance free but it is necessary that a backup copy be made on a CD and or floppy disk and keep in a different storage area or installed on a remote server that is easily accessible to authorized users.

CHAPTER FIVE

5.0 CONCLUSION

5.1 Projections for the Future

This section of the report provides some future projections to meet the requirements of PHCN, conclusion and recommendations.

It is the views of the writer that the Management of PHCN should consider going into partnership with the Federal University of Technology for the research and development of the appropriate software packages for smooth operation of the new power market.

Close collaboration between PHCN and FUT in the development of the following software should be encouraged.

- **Energy Transfer Prices**
- Process metering data and calculate settlements
- Develop and test software
- Prepare Market payment system
- Bank accounts and transfer system
- Security cover
- Administration of late or non payment
- Funding and special charges
- To organize and maintain data bases
- Register of Participants
- MO Website
- interactions and sharing information with System Operator
- Administering data complaints

5.2 Conclusions

The main focus of this project is to develop one of the several software packages required by the power market operator to function effectively. This effort has been achieved to a larger extend.

5.3 Recommendations

The power sector reforms have no doubt presented challenging opportunities for research and development to both engineers and computer scientists. The sector is witnessing an unprecedented growth that would require a lot of initiative to sustain the industry.

It is hoped that this unique idea would provide a topic for future research work on the development of suitable indigenous software for the power market operations in the following areas:

- Process metering / data
- Administration of late or non payment
- Funding and special charges

It is evident that these three will determine the success of the power market operation.

5.4 References

Y.U. Abubakar (2005) - "System Analysis and Design" Lecture notes unpublished

NEPA Management (2005) – "NEPA Annual Report 2003" published

Jiya Mohammed (2005) – "Database" Lecture notes unpublished

Shehu Musa (2005) – "Computer Programming" Lecture notes unpublished

PHCH Plc (2005) – "Draft Grid Codes" Lecture notes unpublished

Mohamed E. El-Hawary (1995) – "Electrical Power Systems" Published by IEEE Press

Siemens (1994) – "Sinaut Spectrum" Lecture notes published by Siemens - AG

Beatriz Arizu (2005) – "Market Rules and Grid Code Workshop" Lecture notes unpublished

5.5 Appendix A - Program

Program Implementation and Software Design

```
#include <fstream>

#include <iostream>

#include <iomanip>

#include <cstdlib>


#define conpany 5  // number of Company

#define Gencos 6   // number of Power Generation Companies

#define Discos 11   // number of Dictribution Companies


using namespace std;


void error(char* msg1 = " ", char* msg2 = " ");


void main() {

        int d, g;

        char GenCos[Gencos][20]; //names

        char DisCos[Discos][20];


        char companies[][30] = {"Corporate Headquarter PHCN", "GenCos", "TransysCo", "DisCo"};

        int NoCompanies[] = {1, 6, 1, 11};

        int PercCompanies[] = {25, 30, 25, 20};


        int GenCosAval[Gencos] = { 0 };     //Installed Capacity

        int GenCosPercent[Gencos] = { 0 };      // Percentage

        int DisCosLoad[Discos] = { 0 };                     // Load

        int DisCosPercent[Discos] = { 0 };  // Percentage


        float total = 6000000000.0, GencosAmount[Gencos], DiscosAmount[Discos];
```

```
float headqrts = 0, transysCo = 0;

headqrts = transysCo = 25 * total / 10000;


ifstream Discosfile, Gencosfile, DLoadPercfile, GCapPercfile;


Discosfile.open("Discos.txt", ios::in);

if(!Discosfile)

        error("Unable to open file: ", "Discos.txt");


Gencosfile.open("Gencos.txt", ios::in);

if(!Gencosfile)

        error("Unable to open file: ", "Gencos.txt");


DLoadPercfile.open("DiscosLoadPerc.txt", ios::in);

if(!DLoadPercfile)

        error("Unable to open file: ", "DiscosLoadPerc.txt");


GCapPercfile.open("GencosCapPerc.txt", ios::in);

if(!GCapPercfile)

        error("Unable to open file: ", "GencosCapPerc.txt");


d = 0;

while(!Discosfile.eof()) {

        Discosfile >> DisCos[d];

        ++d;

}


d = 0;

while(!DLoadPercfile.eof()) {

        DiscosAmount[d] = 0.0;

        DLoadPercfile >> DisCosLoad[d] >> DisCosPercent[d];
```

```
                DiscosAmount[d] = (DisCosPercent[d] * PercCompanies[3] * total) / (10000);
                ++d;
        g = 0;
        while(!Gencosfile.eof()) {
                Gencosfile >> GenCos[g];
                ++g;
        }

        g = 0;
        while(!GCapPercfile.eof()) {
                GencosAmount[g] = 0.0;
                GCapPercfile >> GenCosAval[g] >> GenCosPercent[g];
                GencosAmount[g] = (GenCosPercent[g] * PercCompanies[1] * total) / (10000);
                ++g;
        }

        ofstream outfile, Genoutfile, Disoutfile;

        outfile.open("reportf.txt", ios::out);
        outfile                                                                                 <<
"================================================================================
=\n";
        outfile << "                                                ENERGY TRANSFER PRICING\n";
        outfile                                                                                 <<
"================================================================================
=\n";
        outfile << "  S/No:       Company            No of Units     Percentage\n";
        outfile                                                                                 <<
"================================================================================
=\n";
```

```
        for(int i = 0; i < 4; ++i) {
                outfile << setw(6) << (i + 1) << setw(31) << companies[i] << setw(8) << NoCompanies[i] <<
setw(17) << PercCompanies[i] ;
                outfile << endl;
        }
        outfile                                                                                    <<
"\n=============================================================================
===\n";

        Genoutfile.open("reportGen.txt", ios::out);
        Genoutfile                                                                                 <<
"=================================================================\n";
        Genoutfile << "                        GENCO ALLOCATIONS                \n";
        Genoutfile                                                                                 <<
"=================================================================\n";
        Genoutfile << "  S/No: GenCo Station  Capacity(MW)  Percentage   Amount(Naira)\n";
        Genoutfile                                                                                 <<
"=================================================================\n";

        for(i = 0; i < 6; ++i) {
                Genoutfile << setw(6) << i+1 << setw(12) << GenCos[i] << setw(13) << GenCosAval[i] <<
setw(12) << GenCosPercent[i];
                Genoutfile.setf(ios::fixed, ios::floatfield);
                Genoutfile.precision(2); Genoutfile << setw(20) << GencosAmount[i];
                Genoutfile << endl;
        }
        Genoutfile                                                                                 <<
"=================================================================\n";

        Disoutfile.open("reportDis.txt", ios::out);
```

```
        Disoutfile                                                                    <<
"================================================================\n";
        Disoutfile << "                    DISCO ALLOCATIONS                    \n";
        Disoutfile                                                                    <<
"================================================================\n";
        Disoutfile << "  S/No: DisCo Station  Load(MW)  Percentage  Amount(Naira)\n";
        Disoutfile                                                                    <<
"================================================================\n";
        for(i = 0; i < 11; ++i) {
                Disoutfile << setw(6) << i+1 << setw(14) << DisCos[i] << setw(9) << DisCosLoad[i] << setw(10)
<< DisCosPercent[i];
                Disoutfile.setf(ios::fixed, ios::floatfield);
                Disoutfile.precision(2); Disoutfile << setw(19) << DiscosAmount[i];
                Disoutfile << endl;
        }
        Disoutfile                                                                    <<
"================================================================\n";


        Discosfile.close();
        Gencosfile.close();
        DLoadPercfile.close();
        GCapPercfile.close();
        outfile.close();
        Genoutfile.close();
        Disoutfile.close();
}


void error(char* m1, char* m2) {
        cerr << "ERROR: " << m1 << m2 << endl;
        exit(1);
}#include <fstream>
```

```
#include <iostream>
#include <iomanip>
#include <cstdlib>

#define conpany 5  // number of Company
#define Gencos 6   // number of Power Generation Companies
#define Discos 11   // number of Dictribution Companies

using namespace std;

void error(char* msg1 = " ", char* msg2 = " ");

void main() {
        int d, g;
        char GenCos[Gencos][20]; //names
        char DisCos[Discos][20];

        char companies[][30] = {"Corporate Headquarter PHCN", "GenCos", "TransysCo", "DisCo"};
        int NoCompanies[] = {1, 6, 1, 11};
        int PercCompanies[] = {25, 30, 25, 20};

        int GenCosAval[Gencos] = { 0 };     //Installed Capacity
        int GenCosPercent[Gencos] = { 0 };      // Percentage
        int DisCosLoad[Discos] = { 0 };                         // Load
        int DisCosPercent[Discos] = { 0 };  // Percentage

        float total = 6000000000.0, GencosAmount[Gencos], DiscosAmount[Discos];
        float headqrts = 0, transysCo = 0;
        headqrts = transysCo = 25 * total / 10000;

        ifstream Discosfile, Gencosfile, DLoadPercfile, GCapPercfile;
```

```
Discosfile.open("Discos.txt", ios::in);
if(!Discosfile)
        error("Unable to open file: ", "Discos.txt");

Gencosfile.open("Gencos.txt", ios::in);
if(!Gencosfile)
        error("Unable to open file: ", "Gencos.txt");

DLoadPercfile.open("DiscosLoadPerc.txt", ios::in);
if(!DLoadPercfile)
        error("Unable to open file: ", "DiscosLoadPerc.txt");

GCapPercfile.open("GencosCapPerc.txt", ios::in);
if(!GCapPercfile)
        error("Unable to open file: ", "GencosCapPerc.txt");

d = 0;
while(!Discosfile.eof()) {
        Discosfile >> DisCos[d];
        ++d;
}

d = 0;
while(!DLoadPercfile.eof()) {
        DiscosAmount[d] = 0.0;
        DLoadPercfile >> DisCosLoad[d] >> DisCosPercent[d];
        DiscosAmount[d] = (DisCosPercent[d] * PercCompanies[3] * total) / (10000);
        ++d;
}
```

```
	g = 0;
	while(!Gencosfile.eof()) {
		Gencosfile >> GenCos[g];
		++g;
	}

	g = 0;
	while(!GCapPercfile.eof()) {
		GencosAmount[g] = 0.0;
		GCapPercfile >> GenCosAval[g] >> GenCosPercent[g];
		GencosAmount[g] = (GenCosPercent[g] * PercCompanies[1] * total) / (10000);
		++g;
	}

	ofstream outfile, Genoutfile, Disoutfile;

	outfile.open("reportf.txt", ios::out);
	outfile                                                                                    <<
"=============================================================================
=\n";
	outfile << "                                                ENERGY TRANSFER PRICING\n";
	outfile                                                                                    <<
"=============================================================================
=\n";
	outfile << "  S/No:       Company            No of Units     Percentage\n";
	outfile                                                                                    <<
"=============================================================================
=\n";

	for(int i = 0; i < 4; ++i) {
```

```
                outfile << setw(6) << (i + 1) << setw(31) << companies[i] << setw(8) << NoCompanies[i] <<
setw(17) << PercCompanies[i] ;
                outfile << endl;
        }
        outfile                                                                                    <<
"\n=============================================================================
===\n";

        Genoutfile.open("reportGen.txt", ios::out);
        Genoutfile                                                                                 <<
"================================================================\n";
        Genoutfile << "                        GENCO ALLOCATIONS                    \n";
        Genoutfile                                                                                 <<
"================================================================\n";
        Genoutfile << "  S/No: GenCo Station  Capacity(MW)  Percentage   Amount(Naira)\n";
        Genoutfile                                                                                 <<
"================================================================\n";

        for(i = 0; i < 6; ++i) {
                Genoutfile << setw(6) << i+1 << setw(12) << GenCos[i] << setw(13) << GenCosAval[i] <<
setw(12) << GenCosPercent[i];
                Genoutfile.setf(ios::fixed, ios::floatfield);
                Genoutfile.precision(2); Genoutfile << setw(20) << GencosAmount[i];
                Genoutfile << endl;
        }
        Genoutfile                                                                                 <<
"================================================================\n";

        Disoutfile.open("reportDis.txt", ios::out);
        Disoutfile                                                                                 <<
"================================================================\n";
```

```
	Disoutfile << "                    DISCO ALLOCATIONS                    \n";
	Disoutfile                                                              <<
"=================================================================\n";
	Disoutfile << "  S/No: DisCo Station  Load(MW)  Percentage  Amount(Naira)\n";
	Disoutfile                                                              <<
"=================================================================\n";
	for(i = 0; i < 11; ++i) {
		Disoutfile << setw(6) << i+1 << setw(14) << DisCos[i] << setw(9) << DisCosLoad[i] << setw(10)
<< DisCosPercent[i];
		Disoutfile.setf(ios::fixed, ios::floatfield);
		Disoutfile.precision(2); Disoutfile << setw(19) << DiscosAmount[i];
		Disoutfile << endl;
	}
	Disoutfile                                                              <<
"=================================================================\n";

	Discosfile.close();
	Gencosfile.close();
	DLoadPercfile.close();
	GCapPercfile.close();
	outfile.close();
	Genoutfile.close();
	Disoutfile.close();
}

void error(char* m1, char* m2) {
	cerr << "ERROR: " << m1 << m2 << endl;
	exit(1);
```

APPNDIX 1: A TYPICAL DAILY OPERATIONAL REPORT

DAY: WEDNESDAY/THURSDAY 21-22/09/2005

1.0 EXUCUTIVE OPERATIONS SUMMARY

DETAILS	**MW**	HRS	DATE
PEAK DEMAND FORECAST	7400	2100	21/09/2005
ACTUAL GENERATION CAPBILITY	3939	2400	-do-
UNITS ON BARS CAPBILITY	3491.6	2400	-do-
PEAK GENERATION	4316.5	1915	-do-
OFF PEAK GENRATION	2708	1100	-do-
3 HOURLY DURATION PEAK	3125.7	00:00-08.00 09:00-16:00 17:00-24:00	21/09/2005 -d0- -d-
PEAK GENERATION UP TO DATE	3774.4	2015	08/08/2005
MAXMIUM INSTALLED AVAILABLE CAPABILITY TO DATE	4563.3	0600	20/09/2005
MAXMIUM ACTUAL GENERATION CAPABILITY	4180	2400	20/09/2005
MAXMIUM ENERGY GENERATED (MWH) TO DATE	76,345.00	0000-2400	20/09/2005

1.2 CRTICAL VOLTAGE

DETAILS	KV	STATION	HRS
HIGHEST VOLTAGE FOR THE DAY	334	Osogbo	1100
LOWEST VOLTAGE FRO THE DAY	275	Kaduna	0500

1.3 FREQUENCY RANGE

DETAILS	HZ	HRS
HIGHEST FREQUENCY	50.61	1100
LOWEST FRQUENCY	49.91	0600

APPENDIX 1B: BREADOWN OF GENERATION NATIONAL PEAK & OFF PEAK PERIODS

STATION	TURBINE TYPE	CAPACITY (MW)	PEAK GEN. MW)	OFF PEAK GEN.(MV)
KANJI	HYDRO	800	410	400
JEBBA	HYDRO	600	516	500
SHIRORO	HYDRO	600	419	---
EGBIN	STEAM	1320	883	785
IJORA	DIESEL;	----	----	----
AJAOKUTA STEEL CO	STEAM	50	48	---
A.E.S	GAS	270	98.5	---
SAPELE	STEAM	250	160	155
OPAI	GAS	300	149	146
AFAM	GAS	400	274	294
DELTA	GAS	500	459	428
CALABAR	DIESEL	----	---	---
TOTAL			**3416.5**	**2708.0**

ENERGY GENERATED

STATION	TURBINE	MWH	MWH/H
KANJI	HYDRO	9818	409.09
JEBBA	HYDRO	11,498.00	479.09
SHIRORO	HYDRO	2424	101.00
EGBIN	STEAM	21,276	886.50
AJAOKUTA	STEAM	----	----
A.E.S	GAS	1740	72.50
SAPELE	STEAM	3736	155.67
OPAI	GAS	3480.2	145.01
AFAM	GAS	6805.1	283.55
DELTA	GAS	459	428
CALABAR	DIESEL	---	---
TOTAL		**71,154.00**	**2964.78**

GENERATION POSITION AT 0600HRS -THURSDAY 22/09/2005

STATION	AVAILABLE UNITS	INSTALLED AVAILABLE CAPABILITY (MW)	ACTUAL GENERATION CAPABILITY (MW)	GENERATION AT 06:00HRS	REMARKS
JAINJI HYDRO	5, 7, 8 & 4	560	450	429	
JEBBA HYDRO	2G1 - 6	578.4	540	522	
SHIRORO HYDRO	411G1 - 4	600	---	---	
EGBIN STEAM	ST1 - 4, 7 & 6	1100	1080	976	
JAOKUTA	ST2	55	46	46	
E.S	202 ,209, 210 & 211	134.1	134.1	134.1	
ORA GAS	GT5	20	15	---	
APELE ST	ST1 & 6	240	165	159	
OPKAI GAS	GT11	150	147	147	
AFAM GAS	GT19 & 20	277	277	296	
DEL;TA GAS	GT3 - 8,15,17,18 & 20	532	470	396	
CALABER DIESEL	---	---	---	---	
TOTAL	42	4237.5	3324	3089	
UNITS ON BAR CAPA.			3140.1		