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STAFF APPRAISAL REPORT

FEDERAL REPUBLIC OF NIGERIA

POWER SYSTEM MAINTENANCE AND REHABILITATION PROJECT

JULY 28, 1989

Industry and Energy Operations Division
Western Africa Department

CURRENCY EQUIVALENTS

Currency Unit = Naira (₦)

On September 26, 1986, Nigeria adopted a flexible exchange rate policy and introduced a Second-tier Foreign Exchange Market (SFEM) comprising an auction and an interbank market. On July 2, 1987, SFEM and the official (e.g., first-tier) rates were merged. On January 9, 1989, Nigeria moved from the fortnightly auction system to direct daily sales of official sources of foreign exchange to the banks, and the exchange rate is now established in the interbank market. The exchange rate on January 9, 1989 was US$1 = ₦6.87. A rate of US$1 = ₦6.9 has been used for project analysis.

US$1.00 = ₦6.90
₦1.00 = US$0.14
₦1.00 = Kobo 100

MEASURES AND EQUIVALENTS

1 kilometer (km)	=	0.621 miles
1 ton (t)	=	1,000 kilograms (kg) = 2,200 pounds (lbs)
1 ton of oil equivalent (toe)	=	10.2 million kilocalories, 40.5 million BTU or 7.33 barrels of oil
1 cubic feet (cft)	=	0.0283 cubic meters (m^3)
1 MCF	=	1,000 standard cubic feet
1 kilowatt (kW)	=	1,000 watts
1 megawatt (MW)	=	1,000 kW
1 kilowatt hour (kWh)	=	1,000 watt-hours (Wh)
1 gigawatt hour (GWh)	=	1 million kWh
1 kilovolt (kV)	=	1,000 volts (V)
1 megavolt ampere (MVA)	=	1,000 kilovolt ampere (kVA) = 1,000 volt ampere (VA)

GLOSSARY OF ABBREVIATIONS

AGM(s)	-	Assistant General Manager(s)
CBN	-	Central Bank of Nigeria
FGN	-	Federal Government of Nigeria
FMFED	-	Federal Ministry of Finance and Economic Development
FMMPS	-	Federal Ministry of Mines, Power and Steel
FMPR	-	Federal Ministry of Petroleum Resources
KfW	-	Kreditanstalt für Wiederaufbau
MIS	-	Management Information System
NCC	-	Nigerian Coal Corporation
NEPA	-	National Electric Power Authority
NNPC	-	Nigeria National Petroleum Corporation
ODA	-	Overseas Development Administration (UK)
PPF	-	Project Preparation Facility
SOE	-	Statement of Expenditure
TSCF	-	trillion standard cubic feet

FISCAL YEAR

January 1 to December 31

FEDERAL REPUBLIC OF NIGERIA

POWER SYSTEM MAINTENANCE AND REHABILITATION PROJECT

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ANNEXES

MAP

FEDERAL REPUBLIC OF NIGERIA

POWER SYSTEM MAINTENANCE AND REHABILITATION PROJECT

Loan and Project Summary

Borrower: National Electric Power Authority (NEPA)

Guarantor: Federal Republic of Nigeria

Amount: US$70 million equivalent

Terms: Twenty years, including a five-year grace period, at the Bank's standard variable interest rate.

Project Description: The major objectives of the Project are to: (a) assist NEPA in carrying out much-delayed maintenance and rehabilitation of selected generation, transmission and distribution facilities, so as to improve the supply of power in the near term; and (b) help establish institutional strengthening of NEPA and provide the basis for a commercially viable entity, capable of delivering a reliable and economic supply of electricity to its customers. The Project includes four components: (i) maintenance and rehabilitation component covering improvements in selected generation, transmission and distribution facilities, metering equipment, vehicles and assistance in the conversion of the Egbin plant to gas; (ii) institutional strengthening of NEPA; (iii) project management assistance; and (iv) studies and future project preparation assistance.

Project Benefits and Risks: The Project will help (a) improve the efficiency, availability and reliability of power supply in the country; and (b) relieve power shortages and reduce the high cost of private autogeneration. The Project will also contribute substantially towards institution building to improve the efficiency and management of NEPA, and help establish it as a commercially viable utility.

The main risks of the Project are related to possible delays in project implementation, cost overruns, and the achievement/sustainability of institutional improvements. The establishment of a Project Implementation Coordination Team in NEPA, and specialist assistance in project management should minimize the risk of a delay in implementation. The project design is such that should project costs exceed the estimates, the scope of the work may be decreased to accommodate the funds available with little detrimental effect upon the completed portion. The Government is fully committed to the strengthening of the power sector, and

recent changes in the attitude towards the importance of management of NEPA and parastatals in general should ensure political support for institutional improvements. The prospects of new actions to improve the performance of NEPA are, therefore, now brighter than before. The presence of strong technical assistance through the utility assistance program should also minimize this risk. Annual reviews of NEPA's achievements would provide a framework to ensure satisfactory implementation of the institutional aspects of the proposed Project.

Estimated Cost:

	Local a/	Foreign	Total
	US$ million equivalent		
Maintenance and Rehabilitation			
Generation improvements	16.9	49.4	66.3
Transmission improvements	5.3	13.2	18.5
Distribution improvements	5.5	11.4	16.9
Metering equipment	1.7	3.5	5.2
Vehicles	9.4	8.0	17.4
Conversion of the Egbin Plant to gas	0.1	0.3	0.4
Subtotal	38.9	85.8	124.7
Institutional Strengthening	2.6	8.0	10.6
Project Management	0.3	1.0	1.3
Studies & Future Project Preparation	0.3	1.3	1.6
Base Cost	42.1	96.1	138.2
Physical Contingencies	1.4	3.5	4.9
Price Contingencies	3.0	7.0	10.0
Total Project cost	46.5	106.6	153.1
Refinancing of PPF Advance	-	1.5	1.5
Total Financing Required	46.5	108.1	154.6

a/ Including US$28 million equivalent in duties and taxes.

Financing Plan:	Local	Foreign	Total
	US$ million equivalent		
IBRD	-	70.0	70.0
Federal Republic of Germany			
Commodity Aid	-	15.4	15.4
KfW Loan	-	9.1	9.1
UK - ODA Grant	-	5.0	5.0
Suppliers' Credit	-	8.6	8.6
NEPA (Internal Funds)	20.5	-	20.5
Government Loan	26.0	-	26.0
Total	46.5	108.1	154.6

Estimated Disbursements:

Bank FY	90	91	92	93	94
	US$ million equivalent				
Annual	19.0	35.0	10.0	5.0	1.0
Cumulative	19.0	54.0	64.0	69.0	70.0

Economic Rate of Return: 18.4%

FEDERAL REPUBLIC OF NIGERIA

POWER SYSTEM MAINTENANCE AND REHABILITATION PROJECT

I. THE ENERGY AND POWER SECTORS

A. Energy Resources and Consumption

1.01 Nigeria has substantial and diversified energy resources, especially oil, natural gas, hydro potential, coal and fuelwood. Since the first commercial discovery of oil in 1956, Nigeria has become a leading oil-exporting country. Its proven reserves of oil, on-shore and off-shore in the Niger River Delta, are currently estimated at around 2.2 billion tons, in addition to gas reserves of about 85 trillion standard cubic feet (TSCF) - equivalent to about 2.1 billion tons of oil. About half of its gas reserves are in the form of associated gas. It is estimated that another 1.1 billion tons of recoverable oil reserves and 65 TSCF of gas reserves exist, and are so far undiscovered. Proven indicated and inferred reserves of coal and lignite are estimated at between 270 and 980 million tons located in the south-east of the country. Output of coal declined sharply, however, from its late-1950s peak of 900,000 tons, and has not recovered since, and amounted to only 117,000 tons in 1987.

1.02 Nigeria's hydro-electric potential, based upon the Niger river system, is significant. It has been estimated at over 11,000 MW, of which some 1,300 MW have already been harnessed, and another 600 MW will be harnessed in the near future upon completion of the Shiroro project. Potential future projects identified by NEPA include Zungeru (950 MW), Mambilla (2,600 MW) and Katsina-Ala (260 MW), together with several mini-hydro projects.

1.03 The principal source of energy for the rural population is woodfuel, which is, however, in relatively short supply. Total annual consumption has been conservatively estimated at 15 million cubic meters (cu.m.), against an estimated incremental annual supply from all sources (forest reserves and farm lands) of only about 10 million cu.m. The growing imbalance between demand and supply, in keeping with population growth, indicates an increasing trend of deforestation. It is estimated that, excluding forest reserves, the standing volume of tree stocks represents less than 10 years' supply at the current level of consumption.

1.04 After the oil crisis in 1973-74, the increase in Nigeria's national income was accompanied by a marked increase in commercial usage of energy. During 1974-81, commercial energy consumption increased from 3 million tons of oil equivalent (toe) to 11.2 million toe, a growth rate of 20.7% per annum (p.a.). This increase marked a fundamental structural transformation of a predominantly agrarian society using traditional fuels into an urban-based one using large quantities of commercial fuels for its activities. The level of consumption of commercial energy has been positively correlated with the level of economic growth. Whereas energy consumption increased rapidly when the economy was in an upswing, the

increase could not be sustained in the wake of falling oil prices and general economic recession.

1.05 Total annual energy consumption in Nigeria is estimated at about 20 million toe. Commercial energy accounts for about 60% of the total. Petroleum products make up about 70% of commercial energy consumption, the balance being distributed between gas (20%), and hydro and coal (10%). Consumption of petroleum products increased at a rate of 15% p.a., from 3.9 million tons in 1976 to over 9.2 million tons in 1982, declining somewhat thereafter between 1983 and 1987, to around 8.5 million tons.

B. Institutions

1.06 The energy sector in Nigeria is dominated by State-owned enterprises. This is particularly true in electricity and coal, where the Federal Government of Nigeria (FGN) has a virtual monopoly through the National Electric Power Authority (NEPA) and the Nigerian Coal Corporation (NCC), and to a lesser degree in petroleum marketing, where all three existing refineries (and a fourth under construction) are owned and operated by the Nigeria National Petroleum Corporation (NNPC). Three of the eight petroleum marketing companies (African Petroleum, National and Unipetrol) are also controlled by NNPC, which together hold a 34% market share for gasoline, kerosene and gasoil, and nearly 50% for other products, such as fuel oil, base oils and asphalt. Nigerian nationals have a 60% majority ownership in the remaining five companies, which are subsidiaries of international oil companies (Agip, Mobil, Texaco, Total and Elf). About 75% of the small liquefied petroleum gas (LPG) market is served by eleven major Nigerian distribution companies.

1.07 During its early years, NNPC mainly oversaw state participation in the oil companies. However, in recent years, it has taken a more active role in exploration, refining and marketing. NNPC has recently been decentralized and "commercialized." As a consequence, individual units have been given more autonomy, and the organization as a whole will no longer be dependent upon FGN for capital funding. NNPC is now expected to raise loans on its own from commercial banks and other financial institutions within and outside Nigeria to finance its investment program. It is now also free to set prices for its products on the basis of commercial considerations.

1.08 In the power sector, NEPA generates and distributes most of the public supply of electricity. NEPA was created in 1972 through the merger of the Electricity Corporation of Nigeria and the Niger Dams Authority, under the National Electric Power Decree, giving it the monopoly to generate, transmit and distribute electricity throughout the country. NEPA operates under the general oversight of the Federal Ministry of Mines, Power and Steel (FMMPS). In recent years, the quality of NEPA's service to its customers has been poor. As a result, a large autogeneration capacity by consumers, unable to obtain adequate and reliable supply of power, has been built up in the country.

1.09 Following on the heels of NNPC's commercialization, and the Government's decision to privatize and commercialize some 135 parastatals, the Government has decided to effect a partial commercialization of NEPA as

well. A Sub-Committee of the Technical Committee for Commercialization and Privatization has currently examined the various options available, and its recommendations are now being considered by the Government. However, it is anticipated that although NEPA, as a public utility, would not receive the same freedom of operation as NNPC, it would nevertheless receive some degree of autonomy in several critical areas, notably in compensation policy, tariff setting, and in determining its capital expenditure program. The Government intends to also restructure NEPA's management, and a new organization chart has already been approved (Chapter II).

1.10 The administration of forest lands is a state responsibility. The FGN's Department of Forestry plays largely an advisory, investment-financing and coordinating role. The divergence of interests between the states and the various federal organizations has made it very difficult to evolve a coordinated energy strategy based on rational economic criteria. The office of the Special Advisor to the President on Petroleum and Energy, which used to perform some coordinating functions, was abolished in 1984, and so far it has not been replaced by any alternative body. FGN has recently set up a National Energy Commission under the Ministry of Science and Technology in an attempt to fill this gap.

C. Energy Policy and Pricing

1.11 In the absence of a specific energy ministry at the federal level, a clear-cut energy policy is difficult to find. In general, however, the Government's energy sector priorities are increasingly concerned with (a) the preservation of oil reserves for export; (b) the channelling of energy sector investments into foreign exchange-earning hydrocarbon projects and least-cost power sector programs; and (c) ensuring that energy prices gradually evolve to approach their economic opportunity costs.

1.12 FGN has played a major role in the determination of the country's energy prices. Until recently, there has been a tendency to set energy prices at levels well below their economic opportunity costs which has created distortions in resource allocation. Low domestic petroleum prices meant an implicit subsidy to consumers, which in 1981 amounted to around 60% of the average export price, and in 1987 - despite price increases earlier in 1986 - to about 72%. A pricing policy for natural gas based upon the economic costs of supply is now being developed. For many years, customers were served by NNPC-Shell under price agreements signed 15-20 years ago. New customers - Delta Steel, and NEPA's Sapele and Afam plants - were being served without formal sales agreements, and prices between them and NNPC were under dispute. Subsequently, prices were being administered by an inter-agency committee of NNPC and major gas consumers, established under the Federal Ministry of Petroleum. With the recent commercialization of NNPC, this position will soon change. NNPC has already raised prices for petroleum products, in effect from April 1, 1988, by 6% for gasoline, 124% for kerosene, 375% for aviation fuel, 18% for diesel oil, 21% for engine oil, 58% for fuel oil, and 160% for base oil used in the manufacture of lubricants. The price of gasoline was increased further in January 1989, by another 43% for private cars. NNPC has negotiated a new price for gas with NEPA for its Egbin power plant, at about ₦5.24 per thousand standard cubic feet with an escalation of 8% p.a.

1.13 Electricity tariffs had remained unchanged since 1979, when they were raised to about 7 kobos/kWh. At that level, they represented only about one-sixth of the long-run marginal cost of supply, and were totally inadequate to cover even cash operating costs of generating, transmitting and distributing power. Following extensive discussions on the proposed project and in accordance with the Government's decision to partially commercialize NEPA, electricity tariffs have been raised as of June 1989 to an average of about 27.5 kobos/kWh. Under the proposed project, actions would continue to be taken to raise tariffs to appropriate levels (paras 2.38 and 2.39).

D. Existing Electricity Supply Facilities and Performance

1.14 Nigeria's installed generating capacity is substantial, and, on the face of it, more than adequate to meet its current peak load. Yet, the country has faced constant problems of supply for more than a decade due to considerable inoperable capacity and a low level of system reliability. Current installed generating capacity is about 4,700 MW, consisting of the Kainji and Jebba hydro plants (1,300 MW or 28% of the total), the Sapele and Egbin (steam) thermal plants (2,040 MW or 43%), and the Delta, Sapele and Afam (gas) thermal plants (1,274 MW or 27%), and the Ijora oil-based thermal plant (60 MW or 2%). Although the current peak load is about 2,000 MW, there have been constant supply shortfalls. The principal reason for this has been the non-availability of a significant portion of the capacity for one reason or another, coupled with bottlenecks in the transmission and distribution systems. In addition to capacity that has become inoperable, even plants in good working order have not been fully available all of the time. For example, the relatively new Egbin plant has been running at well below its rated capacity due to until recently a delay in commissioning the gas pipeline from Escravos to Lagos, and the fact that NEPA because of its low tariffs could not afford the cost of the alternative fuel oil. Similarly, hydro generation until recently was affected by the relatively poor rainfall.

1.15 An additional 600 MW of capacity is expected from the Shiroro hydro project nearing completion, and another 600 MW by the Delta IV gas fired station. If these are commissioned on schedule, NEPA's installed capacity should rise to over 5,800 MW by the end of 1992.

1.16 As a consequence of the unreliable electricity supply, substantial captive generating capacity has been established in the country. While no precise estimates are available, data on licenses issued for new autogeneration capacity, plus renewals of existing licenses, for the past three years alone, all of which cover only a portion of the total captive sets available in the economy, indicated the presence of a minimum of 500 MW of captive generating sets with commercial and more affluent households. Actual autogeneration availability, as estimated in the Bank's Energy Assessment for Nigeria (1983), may well be as high as 1,500 MW.

1.17 NEPA's transmission system consists of about 4,500 km of 330 kV lines, twenty two 330 kV/132 kV step-down sub-stations, about 4,500 km of 132 kV lines with 80 sub-stations feeding the main distribution networks at 33 kV and 11 kV. Overall, the transmission system is characterized by a

relatively small number of long transmission lines connecting generating stations which, with the exception of the Egbin plant in Lagos, are remote from load centers. The reliability of the system has so far been poor with frequent cascading transmission outages and even total system collapses having taken place in the past. NEPA is planning to construct about 870 km of 330 kV lines, covering Benin-Onitsha, Alaoji-Enugu, Enugu-Makurdi, and Gombe-Maiduguri, which will strengthen and extend the reach of the transmission network.

1.18 The distribution system consists of nearly 60,000 km of overhead and underground lines, more than 13,000 sub-stations and some 2 million service connections. It is composed of: (a) 9,500 km of 33 kV lines, with 330--33/11 kV sub-stations, and 3,400 MVA 33/11 transformer capacity; (b) 15,750 km of 11 kV lines, with 12,800--11/0.415 kV sub-stations, and 3,700 MVA transformer capacity; and (c) 34,000 km of 415V LT lines. The system has been constrained from expanding by shortages of materials, vehicles and foreign exchange. The shortage of vehicles, in particular, is so severe that only about 400 - 500 of NEPA's original fleet of 3,000 is estimated to be in good working order. This has seriously impeded NEPA's ability to attend to faults and to maintain its system adequately.

1.19 As of September 1988, 26 out of NEPA's 65 generating units - covering 1,860 MW of capacity (40% of the total) - were non-operational. A number of units have remained out of operation for periods ranging between 1 to 4 years. Moreover, most of the operating units at the Sapele steam station, and at the gas fired stations at Afam, Sapele, and Delta were found to be overdue for maintenance. The current status of NEPA's generating capacity is summarized in Annex 3-1.

1.20 Inability to maintain and repair equipment has contributed, to a significant extent, to NEPA's failure to deliver a reliable supply of electricity. This has been true of transmission and distribution as much as of generation. In transmission, on account of financial constraints, NEPA has faced difficulties in recent years in obtaining critical spare parts and manpower services necessary for maintaining circuit breakers and other equipment, with the result that many of its transmission facilities have become run-down and, in some cases inoperable.

1.21 In distribution, similarly, NEPA has been experiencing problems with its transformers, a large number of which have been getting overloaded. A system emergency reinforcement committee in NEPA in 1987 estimated that 11 transmission sub-stations and 66 distribution injection sub-stations were loaded to above 85% of their ratings and were in need of immediate reinforcement. Overloading of transformers is currently resulting in a monthly loss in energy consumption of about 5.2 GWh, especially in Lagos North, Enugu and Kaduna. An estimated 350 MW of load is also currently being suppressed on this account.

1.22 The unreliability of electricity supplies has partly been because NEPA's National System Control Center is still not fully operational and lacks the monitoring facilities needed to enable its load dispatchers to analyze and respond quickly to system disturbances. As a result, it has been difficult to maintain unified grid operations and to prevent system collapses. There were about 22 total system collapses and

11 partial system faults in 1987. Of these, 17 faults originated from the transmission system. Similarly, during the first 6 months of 1988, six out of 9 major system disturbances were due to problems in the transmission system, and the remaining 3 faults were due to problems in the generation system.

1.23 System disturbances of such an order have had a devastating impact upon the stability and durability of the generation equipment, especially for vulnerable components such as gas turbine blades. Moreover, the thermal stations have invariably had to take 3 to 4 hours to resume operations, and on average, about 2 GWh of generation is estimated to have been lost on each such occasion, in addition to increased fuel consumption for start-up purposes.

E. Electricity Consumption

1.24 Electricity consumption in Nigeria has increased rapidly over the past decade. Trends in system peak demand, system demand for energy generated (consumption), and energy sales during the past decade are summarized in Annex 1-1. The system peak load has risen steadily from 800 MW in 1977 to 1,855 MW in 1987, at an average annual growth rate of about 8.7%. It increased to 1,905 MW in March 1988, and to 1,995 MW in January 1989. The consumption of electric energy increased at a rate of 9.3% p.a.; in terms of energy sales the rate of growth has, however, been slightly slower - 6.8% p.a. This reflects NEPA's relatively poor performance in metering and billing (para. 2.19). Between 1977 and 1987, the number of consumers increased from about 700,000 to more than 2 million, 40% of whom are in the Lagos area.

1.25 The distribution of electricity consumption in Nigeria has moved increasingly in favor of the residential sector, as shown below.

Share of Electricity Consumption
(% of total energy sales in GWh)

	1977	1987
Residential	43.4	56.6
Commercial	18.7	10.1
Industrial	37.9	33.3
	100.0	100.0

1.26 To some extent, the declining share of commercial and industrial consumers in total electricity sales reflects the somewhat lesser dependence of these groups upon the relatively unreliable supply of electricity from the grid, and the correspondingly greater usage of captive generation sets. The balance between the demand from this group and the residential consumer group is likely to change once grid supply becomes more reliable. At the same time, given the still very low level of electricity consumption in the country - only about 16% of the population is estimated to have access to electricity - the potential for an increase in residential consumption remains high. Many smaller urban centers in the

country are not yet electrified, and the schedule of suppressed load shows waiting lists of up to 2 years in many of the up-country districts.

1.27 As a consequence of this distribution of consumption, the shape of the load curve is weighted towards an evening-time (lighting) peak. To the extent that future growth in consumption is relatively more influenced by industrial and commercial load, this shape would become flatter, so that increases in energy consumption could be met with less-than-proportionate increases in generating capacity.

1.28 On account of the distortion in electricity prices in Nigeria, and in the absence of adequate data on elasticity of demand for electricity, it is difficult to project load growth over the medium-to-long-term with a high degree of confidence. A load forecast made by Tractbel Engineering International (Brussels), Consulting Engineers, as part of their "25-Year NEPA power System Development Study" (June, 1988), projected demand for electric energy, as well as for peak output, to increase at a rate of 8.3% p.a. up to 1992, at 7.9% between 1993 to 1996, and at 6.7% between 1997 and 2002. The forecasting model used GDP growth (projected at 3% p.a., after averaging out projections for individual sectors) as the principal independent variable, and made allowances for the effects of suppressed loads.

1.29 Taking into account the projected recovery of the Nigerian economy (an average annual growth rate of 5% in GDP in medium term), and an anticipated change in the load curve on account of the relatively more rapid increase in (grid) consumption by the industrial and commercial sectors, the electricity consumption and the system peak demand are assumed to increase at annual rates of 7% and 5% respectively over the forthcoming decade. These growth rates are lower than those observed during the past decade, mainly to adjust for the likely effect of upward revision in electricity tariffs in the future. On the other hand, industry and part of the commercial sector are in any case incurring substantially higher costs of supply than is reflected in NEPA's tariffs, through their use of autogeneration, and, therefore, the demand projections to some extent may prove to be on the low side.

F. Power System Development Program (1989-93)

1.30 NEPA's Fifth National Development Plan (1988-92) had as its objective the provision of "a reliable and efficient system of electricity supply to meet the increasing demand of consumers in all parts of the country." Towards this end, NEPA's facilities would need to be adequately maintained and optimally utilized, and new facilities created where necessary to meet future demand. The objectives of NEPA's plan remain relevant, and constitute the basis of its medium-term development program.

1.31 The priorities of NEPA's development program have not changed substantially from the time of the previous Bank mission in May 1987 to appraise a power system improvement project (Power VII), which did not proceed because of the lack of action on tariffs and the commercialization of NEPA. In generation, the immediate priority is to increase available capacity as quickly as possible through rehabilitation of existing, but currently inoperable capacity, maintenance of the operating units, and

investment in projects with a high sunk-cost element. The proposed project focusses on the rehabilitation and maintenance of selected generation facilities. The 600 MW Shiroro hydro plant financed by the Government is very close to completion. NEPA contracted for the 600 MW Delta IV gas turbine plant as far back as 1982. Financing for the foreign exchange cost of this plant has since been arranged with the US EXIM Bank and Japan; the plant could begin to augment system capacity as early as 1990. Since the recently completed Egbin plant will be running to full capacity by then, and Shiroro should commence operations by that time also, it would probably not matter if the construction of Delta IV were to be postponed by a few years, say until 1992. In any event, the increase in generation capacity resulting from these investments should be sufficient to meet the projected increase in demand for electricity until 1997.

1.32 Regarding transmission and distribution, the immediate priorities are to remove bottlenecks, which are currently constraining the efficient supply of electricity generated, followed by a rapid expansion of the transmission and distribution system, so as to cater to the increased generation capacity that the above investments would be creating. The proposed project includes priority maintenance and rehabilitation improvements of the transmission and distribution systems. The expansion of the transmission and distribution systems would be addressed by a program of investments covering the various items which had been determined to be of high priority during the Power VII appraisal. These include the construction of: (a) four single circuit 330 kV transmission lines together with related switching facilities, step-down stations and a 132 kV double circuit line connecting Makurdi substation to the existing Yandev substation; (b) nineteen 132/33 kV substations, together with extension of 11 existing substations and expansion of existing substation capacity by some 2,300 MVA; and (c) addition of some 400 MVA of 11/0.4 kV distribution capacity on distribution systems outside Lagos. These investments are expected to be financed by the African Development Bank (AfDB) and suppliers' credits.

1.33 On this basis, NEPA's minimum needs capital expenditure program has been drawn up for the period covering 1989-1993 (Annex 1-2), amounting to US$1.2 billion as follows:

	(in US$ million)
The Project	155
Shiroro Completion	122
Delta IV	172
Transmission Extensions	285
Transmission Improvements	200
Distribution Improvements	133
Other (vehicles, metering, NSCC, etc.)	139
Total	1,206

1.34 The proposed Project is a part of this investment program, to be implemented during 1989-1992. An agreement has been obtained from NEPA that it will prepare and furnish to the Bank by October 31 of each year,

from 1989 to 1993, for exchange of views with the Bank, its investment program and financing plan for the next five years. Such an exchange of views on a rol'ing five year investment program would help determine the nature and composition of capital expenditures planned, taking into account the prevailing economic environment, the extent of realized load growth, and the availability of financing.

1.35 The above investment program would be adequate to meet the growth in demand until about 1997. The projected energy balance under the investment program for the 1988-1998 period is shown in Annex 1-3. Beginning 1997, demand begins to exceed supply, indicating that further investments in generating capacity would become necessary fairly soon after the completion of the currently-envisaged investment program. In projecting the energy balance, it has been assumed that technical losses will decline from their current level of 15% to 10% by 1993. This process should be assisted by the proposed project through strengthening of the transmission and distribution system, and through provision of appropriate technical assistance and manpower training. Available capacity, electricity balance and fuel cost for the period 1988-1993 are shown in Annex 1-4.

G. Bank Group Assistance

1. Past Bank Involvement

1.36 The Bank has been involved with the power sector in Nigeria since 1963. Six loans totalling about US$400 million have been made for projects covering the Kainji hydro-electric scheme, transmission and distribution facilities throughout the country, technical assistance and training. While the Bank's involvement in the sector has been generally successful in terms of the physical development of the power system, it has been less than satisfactory in the context of institutional development.

1.37 One of the Bank's principal contributions during the first four loans (1964-72) has been in the consolidation of sector planning, development and operations. The Bank was instrumental in the creation of NEPA, through the integration of the separate Electricity Corporation of Nigeria and the Niger Dams Authority. As a consequence of the Bank's assistance during these years, the first systematically-integrated master plan for power development in Nigeria was drawn up, and a planning function (a high level Planning Committee) instituted within NEPA.

1.38 The two most recent projects - Power V and VI (Loans 1766 and 2085-UNI), intended to provide transmission and distribution facilities in Lagos and other major cities, experienced implementation delays and cost overruns. The Power V project, approved in November 1979, has experienced major implementation delays caused mainly by late Government approvals of contract awards; the Power VI project (approved in January 1982) had to be redesigned in 1984, as a consequence of the change in the economic environment, and expansion of the distribution system in cities outside of Lagos was dropped, and part of the loan reallocated to provide emergency spare parts for generation and transmission. The Power VI project advanced more rapidly than Power V because of the use of turnkey contracts and the absence of major delays in contract awards. It was completed with its

modified scope almost on schedule during 1987. The Power V project is now expected to be completed in 1990.

1.39 The Bank's first loan to NEPA in 1972 (the fourth in the sector, Loan No. 847-UNI) contained components aimed at helping the new utility establish sufficient management, operational, financial and training capabilities for it to operate successfully and meet rapidly increasing demand and to support the utility's planning for further development. The Project Performance Audit Report (Sec M85-1300) of December 10, 1985, on this project identified NEPA's lack of commitment to training, in particular, as posing a risk to the sustainability of the entity's development. Both Power V and Power VI Projects included substantial training/technical assistance components aimed at helping NEPA to achieve these goals. Despite the substantial technical assistauce and training provided by various donors and equipment suppliers, NEPA has made little progress as an institution, and in some respects is weaker than when it was first set up. Part of the difficulty has been due to the application of civil service scales for salaries of NEPA's staff (which are too low to attract scarce, qualified manpower from the labor market, and which limit staff commitment), the lack of autonomy and accountability because of Government interference in day-to-day operations of NEPA, and a very weak financial position because of low tariffs which remained unchanged since 1979. The seventh power project (Power System Improvement Projec' Power VII), which was appraised in May 1987, did not proceed due to the lack of action on electricity tariffs and the commercialization of NEPA. During this period, due to its continued inability to pay bills, NEPA has been unable to obtain critical spare parts and services required for even routine plant maintenance, seriously exacerbating the supply difficulties. This has led to reformulate the Bank's assistance under the proposed project focussing on urgent rehabilitation and maintenance, and on institutional strengthening of NEPA. The Government has now recognized the need to provide more autonomy to NEPA, adjust tariffs to improve its financial health and hold it responsible for its performance through partial commercialization. NEPA's management has also recognized the need to commit itself to the development of its human resources. As a result, the prospects for success are now much brighter than before.

2. Bank Role in the Power Sector

1.40 The Nigerian economy has deteriorated sharply in recent years, and this has contributed to the collapse of the power sector as well. The provision of adequate and satisfactory power supply is essential to the recovery of the Nigerian economy and, in particular, the industrial sector. The Bank's long-term strategy is to: (a) assist the Government in defining a clear power sector strategy and in the effective implementation of the necessary reforms, including commercialization of NEPA; (b) assist NEPA in developing and financing support programs to improve its operational efficiency; (c) help rationalize investment priorities; and (d) participate in the financing of NEPA's investment program and help secure cofinancing. However, the development and implementation of such a strategy would undoubtedly take a long time.

1.41 A targeted Bank intervention is necessary at this time to (a) help NEPA in its efforts to restore normal power supply in the country, and

meet the needs of its consumers and thereby make the requisite contribution to the nation's economic recovery; and (b) assist in the longer-term process of rationalizing the sector and improving its efficiency. The proposed project is an attempt to address the sector's most immediate and urgent problems. It would provide assistance to NEPA to enable it to carry out critical and much-delayed maintenance and rehabilitation of its selected facilities, thus preventing deterioration in the power supply. In addition, it would help strengthen NEPA and provide the basis for a commercially viable entity. The project would provide technical assistance through a twinning arrangement over the medium-term with a mature operating utility to assist NEPA in the initial implementation of the programs for commercialization, and in all areas of its operations including upgrading of the billing and collection system, reduction in system losses, and improving the operational efficiency in general (paras 2.23-2.25). Once NEPA is on the way to recovery and to a much improved service to its customers, it would be possible to implement a comprehensive program to support NEPA's long-term investment program and recovery efforts.

II. NEPA - THE IMPLEMENTING AGENCY

A. Organization and Management

2.01 The structure and role of NEPA are governed by the National Electric Power Decree of 1972 which provides for a nine-member Board responsible for policy formulation and supervision of NEPA's management. At present, the Board consists of eight members (including the Managing Director, who until recently held the title of General Manager) with expertise ranging from engineering to commercial. Only one member, the Director General of the Federal Ministry of Mines, Power and Steel (FMMPS) represents the Government. In theory, NEPA should operate with a substantial measure of autonomy but, in practice, government actions have reduced substantially NEPA's managerial freedom. FGN controls tariff fixing, investment expenditures, borrowing, contract awards, pay and employment policies and senior staff appointments.

2.02 NEPA's present organization structure (excluding the recent restructuring of the top management) is set out in Annex 2-1. Responsibility for day-to-day operations lies with the Managing Director assisted by seven Assistant General Managers (AGMs) in charge of engineering, generation, transmission, distribution, commercial/corporate planning, finance, and administration. Corporate functions, together with the construction and operation of the generation and transmission (above 33 kV) systems are concentrated at NEPA's headquarters in Lagos. Distribution and commercial activities are decentralized. Eleven regional distribution directorates handle the planning, design and construction of 33 kV lines. Within the regional directorates, 24 district offices, each with its own manager and complement of engineers, commercial staff and accountants are responsible for distribution systems below 33 kV and for metering, billing and other customer related activities. Following the Government's recent decision to partially commercialize NEPA, NEPA has begun to make some key changes in its organization and management.

2.03 Prompted by the need to strengthen its metering, billing and collection functions and improve its relationship with customers, NEPA has recently reorganized the commercial/corporate planning and distribution departments at the district level. The post of district manager has been eliminated, and replaced by two positions for district managers: one responsible for commercial and the other for distribution activities. Both managers report directly to their respective regional directors. The district distribution manager is exclusively concerned with the technical operation including connections and disconnections. The district commercial manager is responsible for meter reading, billing and collection. In addition, the Government has appointed two Deputy Managing Directors responsible for generation/transmission and distribution/sales under the Managing Director. This is a welcome step since under the existing organization structure, the Managing Director's span of control, extending from the Secretary's Department to Audit, Legal, Public Relations and the seven AGMs, is too wide to be effective. The proposed organization structure, which has already been approved by FGN, is also given in Annex 2-1.

2.04 NEPA's public image has deteriorated rapidly in recent years due to poor quality and unreliability of service. There were 22 total system blackouts and at least 11 partial system collapses in 1987. Average consumer outages are in the range of some 500 to 600 hours per year--over 100 times the level of a typical rural system in developed countries. These operational problems, the most apparent to consumers, are the result of poor management, the lack of staff motivation and insufficient foreign exchange for spare parts, vehicles and repairs. Other serious contributory factors have been inadequate preventive maintenance programs, cumbersome and slow contract approval within FGN, lack of proper training, poor maintenance supervision, and even suspected sabotage. Belatedly, NEPA's management has recognized the seriousness of the situation, especially the financial crisis, and has begun to tackle some of the major problems. One unhealthy development has been FGN becoming increasingly involved with NEPA's day-to-day operations in response to the poor power supply situation.

B. Staffing and Personnel Management

2.05 NEPA's operations have long been affected by poor management and poor utilization of its human resources. With about 32,900 employees serving some 2.03 million customers, NEPA has an employee/customer ratio of 1:62 which represents a low level of efficiency. While this ratio reflects an improvement over previous years, it excludes the use of contractors, and does not reflect an additional 6,500 authorized, but unfilled positions which would lower the ratio to 1:51. Despite the excessive number of employees, NEPA has never been able to achieve an appropriate skills mix within the work force. While senior staff positions (managers, supervisors, engineers, and technicians) make up 16% of the work force, they account for 30% of total vacancies, and a majority of these are in the critical engineer/technician categories. In contrast, large surpluses exist at the lowest grades where approximately 28,000 unskilled and semi-skilled workers are concentrated.

2.06 NEPA's ability to recruit qualified senior and junior staff continues to be constrained by the civil service salary structure which imposes wage rates as low as a third of those in the private sector for comparable positions. Staffing problems are further compounded by weak supervision and the imposition of civil service personnel policies which make it extremely difficult to transfer, promote, and/or discipline employees. In many cases, employees also lack the necessary skills and knowledge required for their jobs. In addition, even when they have the requisite skills, and are motivated and properly supervised, they frequently lack the basic essentials (e.g., tools, equipment, fuel, supplies, etc.) to perform their jobs satisfactorily. The combination of all these factors had a damaging effect on NEPA's operational efficiency.

2.07 As part of an overall strategy to improve operational efficiency, NEPA needs to streamline its work force. This will require large reductions of lower level semi and unskilled personnel and, at the same time, recruitment of appropriate numbers of skilled senior managerial, supervisory and technical staff. In July 1988, the General Manager issued orders to stop all further recruitment of staff except in special positions with his approval. While this is a desirable first step, NEPA needs to identify all redundant positions at various levels and systematically slim down its staff according to a firm plan of action. NEPA recently established a committee to review the staffing situation in the area of electricity distribution (which accounts for about 70% of the total staff), and to develop a rationalization program. An agreement has been obtained from NEPA that it will complete by June 30, 1990, with assistance from the utility partner (paras 2.23 - 2.25), an overall manpower development study including an assessment of required positions at various levels, the resultant redundancies and a plan of action to rationalize the staff to required strength; NEPA will review the findings with the Bank and implement them in a phased manner by December 31, 1991. In addition, productivity and manpower cost control targets will need to be established throughout the organization. During this time, efforts must also be made to improve personnel management policies, manpower planning, employee incentives (including salaries, benefits, and bonuses), work force supervision, and employee discipline. A major objective in this area should be to achieve autonomy from the civil service remuneration system to permit the establishment of competitive salaries and benefits within NEPA. At the same time, improvements in the workplace environment (e.g., tools, equipment, supplies and materials) will have to be made to permit employees to use their skills productively.

C. Training

2.08 Since its inception in 1972, NEPA has had problems with regard to the capability and efficiency of its workforce. These problems are primarily the result of difficulties in recruiting qualified workers from the labor market, and in upgrading the job qualifications of its existing employees. To compensate for these workforce deficiencies, NEPA has always maintained a Training Department both to prepare new employees for their job assignments, and to upgrade existing workers so that they can become more productive. The Training Department operates three training centers at Ijora, Afam, and Kainji (two other centers at Kaduna and Jos are not yet operational) under the supervision of a Director of Training who reports

directly to the AGM Administration. The training centers provide training and job skills upgrading to mid-level technical and supervisory staff, crafts and trades level employees and lower level non-technical employees (e.g., secretarial and clerical). Training for non-technical staff (e.g., accounting, administrative and commercial operations) is usually conducted by external training institutions and paid for through the Training Department budget.

2.09 The strengthening of NEPA's training operations has been the objective of several previous Bank and bilaterally financed projects during the past decade. Despite extensive investments in training facilities, training program development, and technical assistance to train both employees and NEPA trainers, the benefits of training have been difficult to measure in terms of increased worker efficiency and productivity (which are frequently affected by non-training factors, e.g., low operating budgets, poor supervision, lack of motivation, lack of tools and equipment etc.). During recent years, however, the Training Department has shown improvement in managing training activities under the supervision of a professionally committed Director of Training. It has played an active role in implementing NEPA's manpower development strategy despite problems of inadequate budgets, inadequate facilities, and shortages of instructional staff (presently being alleviated through greater participation of line staff as short term instructors for specific courses).

2.10 In order to further strengthen the operations of the Training Department, and taking into account the experience of training investments made under previous projects, the proposed Project will support improvements in training facilities to permit greater emphasis on practical/skills-oriented training activities (para 3.05). In addition, the Project would provide technical assistance from original equipment suppliers for improving the operational and maintenance practices of generation facilities (para 3.04).

D. Management Information Systems

2.11 NEPA suffers from poor internal communications and the lack of timely information critical to effective management. Poor accounting and financial reporting systems preclude performance setting and cost control monitoring. Lack of management information systems, particularly at the corporate level, results in confusion, uninformed decision making, increased costs, loss of control, no confidence in the reliability of information, and a slow, reactive style of management. By any measure, NEPA's operating environment is complex. Yet, most of the generally accepted information systems in a typical power utility are either non-existent in NEPA, or where provided, unreliable. Major automated systems that are lacking include payroll, general accounting, materials management, budget management, fleet management, personnel data, accounts payable, property plant and equipment.

2.12 It is clear that the existing systems must be computerized as soon as possible, utilizing wherever possible, proven software packages. However, it is essential that appropriate policies, practices and business procedures be developed in each functional area before a computerized

management information systems can be prepared in detail and implemented. The utility partner under the project (paras 2.23 - 2.25) will assist NEPA in developing (a) appropriate policies, practices and business procedures including those for improved consumer billing, collection procedures and accounting; (b) a comprehensive data processing plan; and (c) requirements for personal computers and software, to be followed by an implementation plan. The Project would provide assistance for improving data processing (para 3.05). An understanding has been reached with NEPA that prior to procuring personal computers and software, it will develop an action program and requirements for improved billing and collection procedures and accounting, the overall management information systems, and a data processing plan, with assistance from the utility partner.

E. Accounting, Audit and Insurance

2.13 Accounting. NEPA maintains its books in accordance with internationally accepted accounting practices. Accounts are kept on an historical cost basis but foreign debt and transactions are revalued annually at prevailing year-end exchange rates. Any exchange gains/losses are treated in accordance with accepted international standards. Much of the accounting is decentralized to the directorates which report monthly figures to the headquarters for consolidation. NEPA prepares quarterly financial and management statements and annual operating and capital budgets. As a result of inadequately trained staff, a defective communication system, inadequate equipment, an ineffective budgetary control system, and improper accounting procedures, NEPA's accounting and reporting system is weak and its books do not provide a completely reliable or accurate picture of the authority's financial position. The acquisition of personal computers and application software as well as the necessary technical assistance from the utility partner will assist NEPA in addressing accounting and budgeting shortcomings.

2.14 Audit. NEPA had agreed under Loan Nos. 1766 and 2085-UNI to have its accounts and financial statements audited by acceptable, independent auditors and to submit them to the Bank within six months of the end of each fiscal year. NEPA has not been able to meet the six-month deadline primarily because of the weakness in its Accounting Department described above. However, following recent efforts, audit reports through 1987, together with the long-form reports, have now been received. The reports highlight NEPA's inability to reconcile inventory levels, accounts receivable, the provision for bad debts and the imprest account balances. As a result of a special dispensation granted by the Central Bank of Nigeria (CBN), all foreign loans outstanding as of September 26, 1986 were translated at concessionary rates ruling on that date, e.g. ₦1.6 = US$1.0. The application of this rate created an exchange gain of about ₦1,450 million in 1987, which was credited to an exchange equalization reserve account. However, about ₦955 million thereof relating to construction work-in-process was not credited back to the projects. Under the proposed Project, the requirement to submit future audited accounts within six months of the year-end would be repeated. However, it will not be possible for NEPA to meet this target for the 1988 accounts, and, therefore, a phased approach for achieving a more timely preparation of the audited accounts will be adopted. The following agreements have been obtained from NEPA that it will furnish to the Bank: (a) its audited accounts and the

long-form report for 1988 by December 31, 1989, on the basis of historical costs together with a separate Memorandum for Financial Planning on the basis of revalued assets; (b) its audited accounts and the long-form report for 1989 by June 30, 1990, on the basis of revalued assets using an engineering valuation methodology; and (c) its audited accounts and the long-form report for each year thereafter within six months of the close of the fiscal year. Agreements have also been obtained that (i) the audited accounts will be prepared at least every five years on the basis of revalued assets using an engineering valuation methodology; and (ii) for other years, NEPA will also prepare a separate Memorandum for Financial Planning on the basis of revalued assets using a methodology satisfactory to the Bank. NEPA's accounts will be audited by independent auditors acceptable to the Bank in accordance with appropriate accounting principles consistently applied.

2.15 Insurance. NEPA maintains an extensive range of cover against most utility risks. However, insured amounts have not been increased to properly reflect replacement costs, and are now inadequate, particularly in the light of the recent devaluations. A major significant omission is the coverage for engineering risks, particularly boiler explosion, and for fidelity risks. There is general fire insurance but not for fire caused by short circuits. Furthermore, NEPA does not always ensure that liability risks on plants under construction continue to be covered even after the contractor's responsibility has expired. NEPA recently undertook a review of its insurance practices to ensure the adequacy of insurance arrangements but decided not to complete it until realistic values of its assets are determined. An understanding has been reached with NEPA that it will (a) complete a review of its insurance practices by March 31, 1990, taking into account the realistic values of its assets; (b) determine, in consultation with the Bank, the range of insurance cover it proposes to have against various utility risks; and (c) implement the findings soon thereafter.

F. Past Financial Performance and Present Position

2.16 Salient features highlighting NEPA's historical operating results and present position are summarized in the table on the following page, and are shown in detail in Annex 2-8.

Summary of NEPA's Selected Operating Results
(in Naira million unless otherwise noted)

	Actual					Est.
	1983	1984	1985	1986	1987	1988
Electricity Sales (GWh)	6,106	5,487	6,152	7,380	7,476	7,804
Average Tariff (Kobos/kWh)	7.0	7.4	7.2	7.0	7.1	7.1
Total Revenues	432	413	461	529	544	570
Operating Expenses a/	370	364	410	545	651	1,203 c/
Operating Income	62	48	51	(15)	(107)	(634) c/
Net Income (after interest)	52	(25)	(118)	(247)	(529)	(792)
Operating Ratio (%)	85.6	88.3	88.9	102.9	119.7	211.2
Average Net Fixed Assets in Operation (ANFA) b/	1,557	1,639	1,785	1,915	2,000	7,719
Rate of Return on ANFA (%)	4.0	2.9	2.9	(0.8)	(5.4)	(8.2)
Debt Service Coverage Ratio	2.8	1.9	1.2	0.5	(0.0)	(0.3)
Annual Contribution to Construction (%)	30.5	24.7	22.5	31.8	(5.0)	(95.6)
Current Ratio	1.6	1.4	1.3	1.1	0.8	0.5
Debt/Equity Ratio	76:24	79:21	83:19	103:(-3)	88:14 d/	28:62 e/
Receivables (months)	11.4	14.3	15.5	13.5	16.7	15.4

a/ Including depreciation on historically valued assets except in 1988.
b/ Revalued in 1972 when NEPA was established, and subsequent additions are at original cost; for 1988, assets were revalued by Bank staff.
c/ Depreciation calculated on the basis of revalued assets.
d/ Improvement due to the concessionary exchange rate N1.6 = US$1.0 allowed by CBN for servicing of external debt outstanding in September 1986.
e/ Improvement due to a revaluation of assets. It does not reflect conversion of short-term debt due to FGN into a long-term debt; after this conversion, the debt/equity ratio will be 32:68.

2.17 NEPA's financial performance has deteriorated seriously in recent years. Inadequate tariffs (which had remained unchanged since 1979 until the recent increase in June 1989), and limited sales due to the economic downturn and poor asset maintenance have limited NEPA's revenues. Poor billing and collection practices have deprived NEPA of its revenues and have added to its liquidity problems. NEPA's operating income has been negative since 1986, and it has not been able to meet debt service from internally generated funds since 1984. As a result, NEPA was forced to severely cut back on almost all plant and equipment maintenance work, leading to the current state of widespread equipment failure and system breakdowns. Had NEPA carried out its normal maintenance during the past four years, its financial performance could have significantly improved.

2.18 Under Loan Nos. 1776 and 2085-UNI, it was agreed that NEPA will earn a minimum 8% return on revalued net fixed assets in service. Return on assets, however, is presently not a meaningful performance indicator as the assets have not been revalued to accurately reflect their increasing replacement costs. However, even with significantly undervalued assets, NEPA has generated low returns, which fell from 4% in 1983 to 2.9% in both 1984 and 1985, and have been negative since then. In 1988, NEPA's operating expenses including depreciation on the basis of revalued assets are estimated to be about 110% more than its revenues, and its cash flow before depreciation is estimated to be a negative N127 million. As a result, NEPA now has to rely on FGN to meet even its cash operating expenses. NEPA has rundown its cash balances and is in arrears in payments to its creditors. Consequently, many suppliers now only deal with NEPA on a pre-paid cash basis. NEPA's capitalization as of December 31, 1987 is summarized in the table on the following page.

Summary of NEPA's Capitalization as of December 31, 1987 a/

	Naira Million	US$ Million Equivalent	% of Total
Assets			
Net Fixed Assets in Operation	2,018	336	27
Work in Progress	4,158	693	57
Other Assets	17	3	0
Current Assets	1,189	198	16
Total Assets	7,379	1,230	100
Equity and Liabilities			
Equity	764 b/	127	10
Long-term Debt	4,526 c/	755	62
Current Liabilities	1,843 d/	307	25
Consumer Contributions	246	41	3
Total Equity and Liabilities	7,379	1,230	100

a/ Figures may not add because of rounding.
b/ Includes N258 million in paid up capital, N(946) million in retained earnings (negative), and N1,454 million in exchange equalization reserve from the concessionary exchange rate allowed by CBN for servicing of external debt outstanding as of September 1986.
c/ Includes N2,530 million due to FGN and N1,998 million in external debt.
d/ Includes N692 million due to FGN and N349 million due to contractors.

2.19 By the end of 1987, NEPA was facing severe liquidity and solvency problems, and had to rely on FGN for servicing of its external debt and on non-payment of debt service to FGN on naira debt. It had a negative working capital of N654 million in 1987 (a current ratio of only 0.6), and significant debt service arrears. The following four major factors have contributed to NEPA's weak operating results:

(a) NEPA's tariffs have remained unchanged since 1979, while its operating expenses have increased. For example, fuel costs increased from N31 million in 1985 to N160 million in 1987 and to an estimated N225 million in 1988, and the cost of spares increased significantly in naira terms in recent years due to the devaluation of the naira.

(b) NEPA's accounts receivable are very high--N737 million equivalent to 16.7 months of sales at the end of 1987, against an achievable norm of three months of billings. Of these, N229 million or 31% of the total are due from the Government and its agencies; a Government Committee is at present looking into the whole matter of cross-debts among all parastatals and the Government and its agencies. A major cause of NEPA's financial difficulties is the poor state of its billing procedures and collection of revenues. Some 6% of billings are written off annually as bad debts, a level that is more than six times higher than in a properly run utility. The remaining 94% of billings are expected to be ultimately collected, but over a long period of time. Meanwhile, the delinquent customers do not pay any delayed payment charge for late payments, and are thereby encouraged to regard the unpaid amounts as an easy source of credit.

(c) NEPA's system losses are very high--close to 35%. Technical losses are estimated at about 15% of the electricity generated

due to an inefficient and poorly maintained transmission and distribution system. Non-technical losses account for the remaining 20% and are due to poorly maintained meters, theft through direct connections to the lines, underbillings through collusion between relatively underpaid meter readers and customers, and in some districts, a cumbersome and slow billing process.

(d) As a result of a severe liquidity problem, NEPA has been unable to obtain spare parts for carrying out even routine maintenance, and the condition of its plants has deteriorated badly, leading to frequent system failures. It has limited NEPA's capacity to meet the electricity demand and increase its revenues.

G. Commercialization of NEPA

2.20 The organization and management of NEPA have been extensively studied in recent years principally by consultants. While many opportunities for reforms were identified, no action was taken to implement them and FGN has continued to maintain a close oversight of NEPA's operations. In 1987, NEPA, in response to a Government request, submitted its proposals for commercialization. In July 1988, FGN announced its decision to commercialize NEPA as part of its broad reforms of the public enterprise sector involving privatization and commercialization of some 135 parastatals. The recommendations of a panel, established by FMMPS in September 1988 to advise on the implementation of the commercialization measures, were submitted to the Government in November 1988. In addition, a Sub-Committee of the Technical Committee for Privatization and Commercialization has examined NEPA's situation in more detail, and submitted its findings and detailed proposals to the Government in March 1989. The Government is currently reviewing these proposals and a decision on the detailed scope of commercialization is expected soon.

2.21 The Government has clearly recognized the need for NEPA to become a financially sound utility, and improve the efficiency of its services to customers. The proposed Project will provide support for the Government's efforts to achieve commercialization of NEPA. The commercialization of NEPA will require giving it autonomy (e.g., in personnel policies, salaries, procurement, and management of its financial affairs, etc.), and making it accountable for its performance in return for greater autonomy. As a revenue earning entity, NEPA should be financially viable. The commercialization of NEPA is a prerequisite to a restructuring of the power sector in order to make it responsive to market forces, improve the environment in which NEPA functions, and increase incentives to enhanced utility efficiency, which is critical for a sustained recovery of Nigeria's economy. The Government's operational and financial objectives for NEPA could be incorporated in a formal performance contract between the Government and NEPA against which NEPA's achievements could be assessed. Key performance objectives and targets for inclusion in such a contract, which have been presented to FGN and NEPA in October 1988 by the Bank, are given in Annex 2-2, and cover staffing levels and productivity, generation plant availability, system performance, system losses, revenue collections, financial performance, accounting and management information systems. Details of a financial recovery program to be pursued under the Project are discussed in paras 2.28 to 2.44.

2.22 An understanding has been reached with FGN and NEPA on the main elements of the commercialization of NEPA to ensure that NEPA will become self-reliant, have more autonomy and be accountable for its performance. The following agreements have been obtained: (a) NEPA will furnish to the Bank the detailed proposals for its commercialization as soon as available; (b) NEPA will discuss with the Bank the proposed performance contract to be entered into between FGN and NEPA, and implement the commercialization plan and the performance contract in a satisfactory manner; and (c) the Government and NEPA will exchange views annually with the Bank on NEPA's progress in meeting targets under the performance contract. In view of the urgency to enhance the commercial orientation of NEPA's operations and improve NEPA's financial health, the Government plans to implement quickly the commercialization proposals as soon as they have been approved.

2.23 Utility Assistance Program. The realization of the institutional strengthening of NEPA would require new ideas, outside know-how, and, therefore, large technical and managerial inputs. NEPA would benefit from an association over the medium-term with a mature power utility, who would provide technical services for the overall strengthening of NEPA, assist it in the implementation of the commercialization program, and provide a range of technical and training support services. Partnership or twinning arrangements with a mature utility in place of ad hoc technical assistance provided under previous Bank and other donor financed projects will offer many benefits to NEPA including operating experience, integration of technical assistance with training, flexibility to alter the work program over time, and the possibility of long-term cooperation. Yet, the success of such technical assistance will depend on NEPA's commitment and willingness during project implementation to have strong counterpart staff to absorb the know-how and learn from the experience of the utility partner.

2.24 As discussed earlier, NEPA requires specialist assistance in many areas:

- Generation maintenance and rehabilitation programs and plant failure analysis
- Implementation of a coordinated system protection plan
- System control, load dispatching functions and analysis of system faults
- Transmission maintenance and rehabilitation
- Distribution operations
- Maintenance management systems
- Implementation of effective systems for procurement, purchasing and inventory management
- Implementation of programs for effective meter reading, billing and collection systems
- Development of a system loss reduction program
- Implementation of sound financial systems and effective financial management
- Development of an effective management information system and data processing plan
- Internal audit

- Development of a manpower plan including staff numbers and levels, reward systems and training needs
- Implementation of the commercialization of NEPA's operations in general
- Implementation of a pilot district program for efficiency improvements
- System planning, design and standards

2.25 The objective of technical assistance will be to help NEPA ensure a continuous reliable supply of electricity at minimum cost without having to rely on expatriate personnel in the long-run to the extent possible. Essentially, the emphasis would be on team work and joint participation by the staff of both utilities. The utility partner will fill key positions where special skills are needed or where staff members of NEPA are on training. The technical assistance would include short-term assignments to address particular and specific needs, as well as long-term technical assistance, and is estimated at about 40 man-years for the next 3 1/2 years ending 1992. The detailed work program between NEPA and the utility partner will be agreed on an annual basis to maintain flexibility in assistance to meet NEPA's needs and capabilities as they evolve. An outline of arrangements for technical assistance under the utility partnership program is given in Annex 2-3. Agreements have been obtained from NEPA that it will (a) employ a mature utility as its utility partner for technical assistance over the medium-term in various areas of NEPA's operations covering technical, financial, managerial and administrative matters, according to terms of reference satisfactory to the Bank; the employment of the utility partner is a condition of loan effectiveness; and (b) develop by June 30, 1990, with assistance from the utility partner, a comprehensive maintenance strategy and plans for the power system, and implement it thereafter taking into account the Bank's comments.

2.26 Pilot District Program for Efficiency Improvements. Due to the size and complexity of NEPA's operations and based on past experience, it is considered desirable to implement efforts to increase workforce productivity and efficiency of NEPA's operations, including implementation of improved billing and collection systems, first in selected districts. In the past, NEPA has had a satisfactory experience from the establishment of a "model district" in Lagos (Island District) between 1975 and 1979 with assistance from Ontario Hydro, and financed by Canada. This model district was set up to provide an example for other districts on ways to improve both technical and commercial operations. During the four-year period of its operation, the model district showed a marked improvement in system operations and maintenance, commercial operations, and overall efficiency. With the departure of technical assistance and Canadian financial support in 1979, the model district regressed as NEPA management gradually lost interest in the concept, operating budgets were reduced, tools and equipment deteriorated or were lost, and staff morale declined.

2.27 The Project would provide assistance to NEPA in reestablishing, with assistance from the utility partner, a pilot district program for efficiency improvements in selected districts on the basis of geographic and technical considerations. Its objectives are to develop, based upon experience in selected districts, an operational model that can be standardized for use throughout NEPA. An outline of the operational objectives is given in Annex 2-4.

H. Financial Recovery Program

1. Improvements in Billing, Collection and System Losses

2.28 Billing and Collection. NEPA has already initiated a program to improve its revenue collection with the recent reorganization of its commercial functions at the district level (para. 2.03), the introduction of a pilot program for the collection of bills (bonuses for better performance), and an improved coordination with the Data Processing personnel to ensure that bills are accurately recorded, and promptly delivered. The following agreements have been obtained: (a) from NEPA that it will make adequate arrangements to ensure that as from July 1, 1989, electricity bills are paid by all customers including those from the Government and all Government agencies within 60 days after billing; (b) from the Government that it will take appropriate measures to ensure the prompt payment of its own and all its agencies' electricity bills within sixty days from the billing date beginning July 1, 1989; and (c) from NEPA that it will (i) develop by December 31, 1989 an action program to improve revenue collection, including improvements in the functions of the Commercial Department, a strict policy for disconnections and reconnections of delinquent customers, the requirement for security deposits from them and stiff penalties for late payments, development of a management information system for NEPA's commercial activities, and improvements in the computerized system with adequate checks to enhance the quality of bills; (ii) reduce the average age of accounts receivable to 8 months' sales by December 31, 1989, 4 months' sales by December 31, 1990, and 3 months' sales by December 31, 1991, and maintain it thereafter at this level; (iii) write off by December 31, 1989, its bad debt as of December 31, 1988, which is deemed uncollectible, and install improved bill collection procedures to reduce its provision for doubtful debts from the current level of 6% to 4% in 1990, 3% in 1991, 2% in 1992 and 1% in 1993.

2.29 System Losses. An agreement has been obtained that NEPA will (a) develop by December 31, 1989 an action program to improve metering and billing systems and to strengthen the transmission and distribution systems; and (b) after taking into account the views of the Bank, implement it thereafter so that overall system losses are reduced progressively to 20% by 1993 as given in para 2.30 below.

2.30 Annual targets for improvements in billing and collection, and system losses are summarized in the table below:

Year	Maximum Technical & Non-technical Loss Level - %	Accounts Receivable in terms of Months' Sales
1988	35	15
1989	31	8
1990	27	4
1991	24	3
1992	22	3
1993	20	3

2. Revaluation of Fixed Assets

2.31 At the time of the merger of the ECN and the NDA in 1972, their fixed assets were revalued by professional independent valuers and transferred to NEPA. Since April 1, 1972, all fixed asset additions have been included in NEPA's accounts at historic cost. In 1981, during preparation of the Power VI project, NEPA agreed to develop indices to provide an acceptable method of revaluing its fixed assets by December 31, 1982. However, this was not done because NEPA remained unconvinced of the effectiveness of any of the proposed revaluation methods, citing the lack of agreement and acceptance of such procedures among professional accountants. Following the recent major devaluations of the naira, the need for NEPA to revalue its fixed assets has become altogether more critical. Based on macroeconomic indices, the cost of NEPA's net fixed assets at current prices in 1988 would be about ₦13.4 billion compared with about ₦2 billion without the revaluation (Annex 2-5). Consequently, tariffs based on historic depreciation and rate of return are totally inadequate. NEPA's management has recognized the need, under the changed circumstances, to revalue its fixed assets, and has already made arrangements for the employment of consultants for the revaluation of assets. Agreements have been obtained from NEPA that it will (a) complete by December 31, 1989, the revaluation of its assets, in accordance with procedures satisfactory to the Bank; and (b) continue to revalue its assets thereafter as follows: (i) at least every five years on the basis of a methodology using engineering valuation satisfactory to the Bank; and (ii) for other years on the basis of an agreed methodology so as to reflect their current replacement value. Draft terms of reference for the revaluation of fixed assets are given in Annex 2-6.

3. Capital Restructuring

2.32 As noted in paras 2.16 to 2.19, NEPA's capital structure is very weak. In 1986, NEPA's debt/equity ratio was 103/(-3). The capitalization of NEPA has been under review for some time in light of the continued depreciation of the naira and its adverse impact on its debt service obligations. NEPA was recently granted a special dispensation by CBN to allow it to service all foreign loans outstanding in September 1986, at a concessionary exchange rate of ₦1.6 = US$1.0 prevailing on September 26, 1986. As a result, NEPA's debt/equity ratio improved significantly from a negative net worth in 1986 to 86/14 in 1987. The proposed revaluation of its assets in 1988 will help recapitalize NEPA further, and its debt/equity ratio is expected to improve to a favorable 28/62. However, because of only a gradual improvement projected in its operating income in 1989 and 1990, NEPA will have difficulty in servicing its debt and financing its investment program for a few years without some debt relief. NEPA owed to FGN some ₦4,131 million including ₦3,045 million in long-term naira debt of various maturities, and an estimated ₦1,086 million in current liabilities. An agreement has been obtained from the Government that as a condition of loan effectiveness, it will convert into equity and/or long-term loans all of its naira loans (including short-term loans) owed by NEPA and outstanding as of December 31, 1988. This will not involve any new financial outlay from the Government. The financial projections for NEPA (paras 2.43 and 2.44), however, conservatively assume only a rescheduling into a long-term loan with a maturity of 15 years, including a three-year grace period.

2.33 An agreement has also been obtained from the Government that it will make long-term loans in 1989 (estimated at ₦1,294 million) and in 1990 (estimated at ₦347 million) to NEPA to help meet all NEPA's debt service obligations for 1989 and to finance a part of its investment program for 1989 and 1990. Beyond 1990, NEPA's financial position is expected to improve materially, and there should not be a need for any additional Government financing.

4. Investment Program and Financing Plan (1989-93)

2.34 During the period 1989-93, NEPA's construction and rehabilitation program based upon the minimum needs investment program (paras 1.30 - 1.33), is estimated to require about ₦10,447 million. Of this, about ₦1,257 million or 12% of the total is for the proposed project. The sources of financing for NEPA's investment program covering the period 1989-93 are summarized in the table below, and details are given in the funds flow statements in Annex 2-8.

NEPA's Financing Requirements and Sources (1989-93)

	Naira Million	% of Total
Requirements		
Capital Expenditure		
The Project	1,257	12
Other Investments	9,190	88
Total Requirements	10,447	100
Sources		
Internal Cash Generation	13,972	134
Less: Increase in Working Capital a/	2,830	(27)
Debt Service	(8,788)	(84)
Contribution to Investment	2,354	23
Borrowings		
Government Loans	1,641	16
Foreign Loans	6,412	61
Total Borrowings	8,053	77
Other (Grants)	40	0
Total Sources	10,447	100

a/ Includes an increase in cash of ₦179 million to restore NEPA's liquidity to satisfactory levels.

2.35 Of the total requirements of ₦10,447 million, about ₦2,354 million or 23% of the total on average would be financed by NEPA from internal cash sources after allowing for an increase in working capital and debt service. The balance of ₦8,093 million would be financed from

borrowings except for a grant (about ₦40 million) which is expected to be made available by ODA for the utility assistance program. Foreign loans amounting to ₦6,412 million equivalent, including disbursements under the Project, would finance about 61% of the total requirements. FGN would finance about 16% of the total in long term loans to NEPA in 1989 and 1990 (₦1,641 million).

5. Financial Objectives and Electricity Tariffs

2.36 As noted earlier, electricity tariffs have remained unchanged over a decade at about 7 kobos/kWh, and as a result NEPA's financial situation has been very weak. It has led to inadequate maintenance, difficulties in supplying reliable power and a heavy burden on the Government's budget. As an important step towards NEPA's commercialization (e.g., to arrest the further de-capitalization of NEPA, improve its capital base, promote economic efficiency, minimize further drain on the budget, and to set NEPA on the path towards financial health), the Government has increased electricity tariffs as of June 1989 by almost 300% to an average of 27.5 kobos/kWh. This should enable NEPA to begin to cover from revenues all operating costs including depreciation on the basis of revalued assets. Yet, the analysis shows that tariffs would need to be raised further to about 53 kobos/kWh to make NEPA financially independent and earn a rate of return of 8% on its revalued assets. Since after the recent sharp increase in tariffs in June 1989, it will be politically and socially difficult to raise tariffs further in one-step to the required levels, it is proposed that NEPA moves towards financial self-sufficiency in stages.

2.37 The minimum financial objectives for NEPA under a phased approach would include the following:

(a) to meet from revenues in 1990, all operating expenses, service its debt from internal funds and generate internally adequate funds to finance at least 30% of the annual investment program, and continue to achieve this objective in each year thereafter;

(b) to earn annual rates of return on revalued net fixed assets of not less than 6% in 1991, 7% in 1992, and 8% in 1993 and thereafter;

(c) maintain beginning in 1991, a debt service coverage ratio of at least 1.5, and not incur any debt unless a reasonable forecast shows that the debt service coverage ratio in all succeeding years will be at least 1.5; and

(d) maintain a maximum debt/equity ratio of 40:60.

2.38 To achieve the above objectives, electricity tariffs will need to be increased in stages and in a timely manner. Based on financial projections described in para 2.43 below, average tariffs would need to increase from the present 27.5 kobos/kWh (since June 1989) to 37 kobos/kWh in 1990, 43 kobos/kWh in 1991, 48 kobos/kWh in 1992 and 53 kobos/kWh in 1993.

2.39 An agreement has been obtained from the Government and NEPA that they will take by January 31, 1990, all measures, including increases in tariffs, so as to enable NEPA to finance in 1990 from internal funds at least 30% of its annual investment program. For this purpose, an understanding has also been reached with NEPA that it will prepare and furnish to the Bank by October 31, 1989, for an exchange of views with the Bank its financial plans for 1990 in the form of projected income statement, balance sheet, funds flow statement, and working capital statement (para 2.44).

2.40 Agreements have also been obtained on the principles for annual increases in tariffs for the period 1991-93: FGN and NEPA to take all measures, including adjustments in tariffs, which will enable NEPA to (a) earn an annual return of not less than 6% in 1991, 7% in 1992 and 8% in 1993 and thereafter, of the average net value of its fixed assets in operation, revalued in accordance with sound and consistently maintained methods of valuation satisfactory to the Bank; and (b) continue to generate internally adequate funds in each year beginning in 1991 and thereafter to finance at least 30% of its annual investment program.

2.41 The above tariff increases are based on an average price of ₦5.24/MCF for gas as of May 1989, with an annual escalation of 8% thereafter. If NEPA's fuel costs were to change due either to changes in fuel prices or changes in the pattern of generation, the financial position of NEPA could change significantly. In order that such fuel cost increases do not impact adversely on NEPA's financial position, an agreement has been obtained that NEPA will incorporate beginning January 1, 1990 a fuel adjustment clause in its tariff structure, which will provide for an adjustment of electricity rates commensurate with changes in its fuel costs.

2.42 Agreements have also been obtained from NEPA that it will: (a) maintain in each year beginning in 1991, a debt service coverage ratio of at least 1.5, and will not incur any debt in any fiscal year unless a reasonable forecast shows that the debt service coverage ratio in 1991 and in all succeeding years will be at least 1.5; and (b) not incur any debt, if after incurring such debt the ratio of debt to equity shall be greater than 40 to 60.

6. Future Finances

2.43 Key assumptions used in the financial analysis of NEPA are given in Annex 2-7. The projected financial statements (income statements, balance sheets, funds flow statements and working capital statements) for the period up to 1993 are given in Annex 2-8. A summary of forecast operating results for the period 1989-93 is given on the following page.

NEPA - Forecast Operating Results
(in Naira million, unless otherwise stated)

	1989	1990	1991	1992	1993
Electricity Sales (GWh)	8,761	9,803	10,723	11,723	12,722
Average Tariff (kobos/kWh)	19.0 a/	37.1	43.2	48.3	52.6
Total Revenues	1,679	3,653	4,681	5,687	6,719
Operating Expenses b/	1,966	2,616	3,066	3,537	3,990
Operating Income	(287)	1,037	1,615	2,150	2,729
Operating Ratio (%)	117.1	71.6	65.5	62.2	59.4
Return on Currently Valued Net Fixed Assets in Operation (%)	(1.7)	5	6	7	8
Debt Service Coverage Ratio	0.5	1.6	1.8	1.7	1.6
Internal Contribution to Annual Investment (%)	(97.9)	30.0	41.6	32.5	35.9
Current Ratio	1.21	1.26	1.07	1.11	1.72
Debt/Equity Ratio	32:68	32:68	32:68	32:68	29:71
Receivable (months)	8	4	3	3	3
System Losses (%)	31	27	24	22	20
Provision for Bad Debt (%)	5	4	3	2	1

a/ Weighted average: 7.1 kobos/kWh for January-May 1989 and 27.5 kobos/kWh for June-December 1989.
b/ Depreciation on the basis of revalued assets.

2.44 With the appropriate actions mentioned earlier, e.g., improvements in system losses and in billing and collection, capital restructuring, revaluation of assets, and electricity tariffs, the financial situation of NEPA is expected to improve significantly in a steady manner. Operating income is expected to increase gradually from a near break-even position in 1989 to ₦2.7 billion in 1993, and the operating ratio is expected to decline from 117% in 1989 to 59% in 1993. The debt service coverage ratio is expected to improve from 0.5 in 1989 to 1.6 in 1990, 1.8 in 1991, 1.7 in 1992 and 1.6 in 1993. NEPA is expected to generate internal funds adequate to finance at least 30% of its annual investment program beginning 1990 compared with a negative contribution to investment in 1989, which is the first year of the transition period. The liquidity position of NEPA is expected to become comfortable with an increasing current ratio from 1.2 in 1989 to 1.7 in 1993. The debt to equity ratio also remains satisfactory throughout the forecast period. An agreement has been obtained from NEPA that it will prepare and furnish to the Bank by October 31 of each year, starting in 1989 and up to 1993, for exchange of views with the Bank, its financial plans in the form of projected financial statements, for the next five years, and take appropriate measures in a timely manner to maintain financial viability.

III. THE PROJECT

A. Rationale for Bank Involvement

3.01 The provision of adequate and satisfactory power supply is essential to the recovery of the Nigerian economy and, in particular, the industrial sector. The Bank's long-term strategy is to assist the Government in defining a clear power sector strategy and in effectively implementating the necessary reforms including commercialization of NEPA, improving operational efficiency and rationalizing investment priorities,

the financing of NEPA's investment program, and securing cofinancing. However, a targeted Bank intervention is necessary at this time to (a) enable NEPA to meet the needs of its consumers and make the requisite contribution to the nation's recovery through reliable power supply; and (b) assist in the longer term process of rationalizing the power sector, and improving its efficiency.

B. Project Objectives

3.02 The Project would (a) assist NEPA in carrying out much-delayed maintenance and rehabilitation of selected generation, transmission and distribution facilities, so as to improve the supply of power in the near term; and (b) help establish institutional strengthening of NEPA and provide the basis for a commercially viable entity, capable of delivering a reliable and economic supply of electricity to its customers.

C. Project Description

3.03 The Project includes four components: (a) maintenance and rehabilitation component covering improvements in generation, transmission and distribution, metering equipment, vehicles and assistance in the conversion of the Egbin plant to gas; (b) institutional strengthening of NEPA; (c) project management assistance; and (d) studies and future project preparation assistance. A detailed project description is given in Annex 3-1, and the main elements are described below.

1. Maintenance and Rehabilitation Component

3.04 The maintenance and rehabilitation component includes five subcomponents as discussed below:

(i) The generation improvements subcomponent would include (a) the rehabilitation of seven units currently inoperable at the Sapele, Afam IV, and Delta power plants (606 MW), and capital maintenance (major overhauls) in a phased manner of ten units (850 MW) which are operating but are overdue or will soon become overdue for major overhauls at Sapele and Afam IV; (b) the supply of running spares, repair of blades, and the supply of consumables for two years for the above 16 units at Sapele and Afam; and (c) technical services for operations, maintenance and training from manufacturers of the above units to help ensure safe and reliable operations of the units--72 man-months for Sapele steam boilers, 72 man-months for Sapele steam turbogenerators, and 48 man-months each for the Sapele and Afam gas stations. This subcomponent includes engineering services for inspections, where needed, to define the precise scope of work prior to the rehabilitation and overhauls of the units.

(ii) The transmission improvements subcomponent would help diminish system faults and interruptions through rehabilitation and maintenance of the transmission system. It would cover the following critical areas: (a) parts and services for the overhaul of major 330/132 kV substations; (b) replacement of 37 old airblast circuit breakers, fault throwers in eight critical locations, and 10-132 kV circuit breakers in critical locations by SF-6 breakers; (c) spare parts for the power line carrier party line and telex communication system; (d) radio equipment for improving communications between major substations and service centers; and (e)

technical services for completion of selected 132 kV transmission lines and associated substations in Lagos.

(iii) The distribution improvements subcomponent would strengthen the distribution system in selected priority areas to overcome present weaknesses and to maintain existing distribution facilities, and add about 370 MVA of distribution system capacity through the provision of (a) power transformers (28--33/11 kV with a total capacity of 170 MVA), (b) distribution transformers (140--33/0.415 kV with a total capacity of 50 MVA, and 400--11/0.415 kV with a total capacity of 150 MVA); (c) 33 kV and 11 kV switchgears; (d) high tension and low tension cables and joining accessories; (e) overhead line materials; (f) protection, communication and capital equipment components; (g) Raychem cable joining kits; and (h) rechargeable lamps and district communication equipment.

(iv) The metering equipment subcomponent would include the supply of about 20,600 consumer meters for services to new customers.

(v) The vehicles subcomponent would supply about 320 standard and special urgently needed vehicles together with spare parts for generation (38 vehicles), transmission (52), distribution (227) and training (3).

(vi) The conversion of the Egbin plant to gas subcomponent provides engineering services for the supervision and monitoring of the conversion of the plant to gas.

2. Institutional Strengthening of NEPA Component

3.05 The institutional strengthening of NEPA includes the following subcomponents:

(i) Utility Assistance Program: NEPA requires new ideas, outside know-how, and, therefore, large technical and managerial inputs. The project would support an "utility assistance program" for NEPA with a well-known international utility company within a medium-term framework to provide technical assistance (about 500 man-months) in various areas of NEPA's operations (technical, engineering, financial, managerial and administrative matters).

(ii) Data Processing: The project would provide personal computers and software to improve consumer billing, materials management, general accounting applications and MIS at the Headquarters, plants and distribution centers.

(iii) Training: The operational capabilities of the Training Department will be improved through support for (a) the relocation of the overcrowded Ijora Training Center to another newly constructed building of simple design in the Lagos area; (b) renovations and additions to the Kainji and Afam Training Centers; (c) training equipment for the three Training Centers; and (d) the acquisition of three buses for trainee transport and auxiliary services (included under the vehicles subcomponent).

3. Project Management Assistance Component

3.06 This component would provide engineering services (about 60 man-months) for project implementation and management (project implementation planning, scheduling, procurement assistance including preparation of bidding documents and bid evaluation, supervision of maintenance and rehabilitation work, cost control and other matters). Draft terms of reference for the project management assistance are given in Annex 3-2.

4. Studies and Future Project Preparation Component

3.07 This component will provide consultancy services (about 100 man-months) for studies to prepare a least-cost priority investment program taking into account recent developments, and the preparation of feasibility and other studies necessary for developing future investment projects for external financing.

D. Project Implementation

1. Project Status and Management

3.08 Project Status. In May 1987, the Bank had approved an advance of US$1.5 million under the Project Preparation Facility (PPF) to finance consultancy services for preparation of the Power VII project, and to provide interim technical support to NEPA to improve electricity service. NEPA has used this advance to finance consultants for trouble shooting assignments and to prepare action programs for improvements in the generation, transmission and distribution facilities so as to improve electricity services. As the current project now replaces the Power VII project, the validity of the PPF advance was extended by twelve months in order to assist in the preparation of the current project. Discussions with the original equipment suppliers are now at an advanced stage for maintenance and rehabilitation of the generation facilities. NEPA invited proposals for project management assistance in April 1989, and the selected engineering firm is expected to start services in about September 1989. Substantial progress has been made towards the selection of the utility partner. As mentioned earlier, the panel set up by FMMPS to develop an action plan for commercialization of NEPA submitted its report in November 1988 for review by the Government. A Sub-Committee under the Technical Committee for Privatization and Commercialization has examined NEPA, and submitted to the Government its recommendations for commercialization of NEPA in March 1989. The Government is currently reviewing the commercialization proposals.

3.09 Project Management. While each AGM will be responsible for the component in his division, NEPA has established a Project Implementation Coordination Team, under the direct supervision of the Managing Director, with adequate authority to ensure effective planning, coordination and monitoring of implementation of the overall project. The team is headed by a full-time Director of Special Duties and comprise one other Director (Generation Rehabilitation), five Chief Engineers and the Manager of Finance. It will continuously review progress including procurement and take timely action to remove any constraints affecting project implementation.

3.10 In view of the rehabilitation nature and complexity of the project involving several components, NEPA needs to employ experienced engineering consultants to assist it in project management--one expert on a full-time basis with specialized backing from the home office of the selected engineering firm. The selected engineering consultants are expected to start project management assistance in about September 1989.

3.11 Implementation Schedule. The maintenance and rehabilitation component is expected to be completed by August 1992, and the utility assistance program will be implemented over a period of about 45 months (October 1989-June 1993). The overall project is expected to be completed by June 30, 1993. The project implementation schedule is given in Annex 3-3. The project schedule, which is different from the standard profile of power projects, is achievable considering the maintenance and rehabilitation nature of the project involving no major civil works and erection compared with a greenfield power project.

2. Monitoring and Reporting Requirements

3.12 The proposed project would require careful coordination within NEPA and frequent Bank supervision. The Directors of relevant departments within NEPA will be responsible for physical works, e.g., improvements in generation, transmission, and distribution systems. Monitoring of institutional performance and the utility assistance program would involve the Managing Director and relevant corporate directors. Overall coordination and report preparation would be carried out by the Head of the Project Implementation Coordination Team. An agreement has been obtained that the Project Implementation Coordination Team will prepare quarterly progress reports, covering the work of consultants, physical progress, project cost, disbursements and administrative aspects of the Project as well as institutional performance, and submit them to NEPA's Board, FMMPS, the Bank and other financing agencies.

3.13 Agreements have been obtained that project accounts, the special account, and the statements of expenditure (SOEs) would be audited annually by independent auditors satisfactory to the Bank according to acceptable auditing standards. SOEs will be reviewed by the Bank on a regular basis. In addition to the quarterly progress reports, agreements have been obtained that NEPA will submit to the Bank and the cofinanciers: (a) copies of all consultants' reports and studies financed under the proposed project; and (b) a Project Completion Report within six months of project completion.

E. Environmental Aspects

3.14 The Project involves only maintenance and rehabilitation work, and will not, therefore, affect the environment adversely.

F. Project Capital Cost

3.15 The total project cost is estimated at US$154.6 million equivalent including US$108.1 million equivalent or 70% of the total in foreign exchange. The capital cost estimates are detailed in Annex 3-4 and summarized in the table on the following page.

Summary of Capital Cost Estimate a/

	Naira million			US$ million			% of Total
	Local	Foreign	Total	Local	Foreign	Total	
Maintenance and Rehabilitation Component							
Generation Improvements	116.6	340.8	457.4	16.9	49.4	66.3	42.9
Transmission Improvements	38.5	91.1	127.6	5.3	13.2	18.5	11.9
Distribution Improvements	38.0	78.7	116.7	5.5	11.4	16.9	10.9
Metering Equipment	11.7	24.2	35.9	1.7	3.5	5.2	3.3
Vehicles	64.9	55.2	120.1	9.4	8.0	17.4	11.3
Conversion of Egbin to Gas	0.7	2.0	2.7	0.1	0.3	0.4	0.3
Base Cost Estimate	268.4	592.0	860.4	38.9	85.8	124.7	80.6
Physical Contingency b/	9.7	24.2	33.9	1.4	3.5	4.9	3.2
Price Contingency c/	73.4	162.7	236.1	2.9	6.4	9.3	6.0
Subtotal	351.5	778.9	1,130.4	43.2	95.7	138.9	89.8
Institutional Strengthening Component							
Utility Assistance Program	11.0	41.4	52.4	1.6	6.0	7.6	4.9
Data Processing	3.5	6.9	10.4	0.5	1.0	1.5	1.0
Training	3.5	6.9	10.4	0.5	1.0	1.5	1.0
Subtotal	18.0	55.2	73.2	2.6	8.0	10.6	6.9
Price Contingency c/	4.8	14.6	19.4	0.1	0.6	0.7	0.5
Subtotal	22.8	69.8	92.6	2.7	8.6	11.3	7.4
Project Management d/	2.7	7.9	10.6	0.3	1.0	1.3	0.8
Studies & Future Project Preparation d/	2.6	10.6	13.2	0.3	1.3	1.6	1.0
Refinancing of PPF Advance	-	10.4	10.4	-	1.5	1.5	1.0
Total Project Cost	379.6 e/	877.6	1,257.2	46.5	108.1	154.6	100.0

a/ Base cost and physical contingencies (in January 1989 prices) have been calculated using an exchange rate of N8.9 = US$1.00.
b/ 5% of base cost estimate excluding: (i) a total of US$11.4 million for running spares and consumables, and for consultancy services for operations, maintenance and training under the generation improvements subcomponent; and (ii) a total of US$17.4 million for vehicles.
c/ Total price contingency (as % of base cost estimate and physical contingency) is estimated at about 7.2% when costs are expressed in US dollar and about 26.4% when costs are expressed in naira.
d/ Includes contingencies.
e/ Includes about N230 million in duties and taxes.

3.16 The base cost estimates are in January 1989 prices, and are based on (a) the estimates of NEPA following information submitted by manufacturers; and (b) the Bank's own cost information obtained from potential suppliers. Physical contingencies for the maintenance and rehabilitation component are calculated at 5% of the base cost estimate; no physical contingencies are included for (i) running spares and consumables, and for consultancy services for operations, maintenance and training under the generation improvements subcomponent, and (ii) vehicles. For base cost and physical contingencies, the exchange rate of ₦6.9 = US$1 has been used. For the calculation of price contingencies, it is assumed that exchange rate adjustments will, on average, be made to maintain "purchasing power parity." On this basis, price escalation for both foreign and local costs (a) when expressed in US dollars, is based on expected international annual inflation rates (trade weighted for Nigeria) of 7.7% in 1989, -1.2% in 1990, 1.4% in 1991, 1.7% in 1992 and 3.3% in 1993; (b) when expressed in naira, is based on domestic inflation of 15% in 1989, and 10% p.a. in 1990-1993.

3.17 The maintenance and rehabilitation component accounts for about 90% of the total project cost, and the institutional strengthening, project management, and studies and future project preparation components account for the remaining 10%. The cost estimates include about 1,550 man-months of services for maintenance and rehabilitation improvements, operational assistance, project management, institutional strengthening and studies and future project preparation.

G. Financing Plan

3.18 The proposed Bank loan of US$70 million equivalent would meet about 64.8% of the total foreign exchange and 55.3% of the total financing (net of taxes) required. The proposed financing arrangements are summarized in the table below.

Financing Plan
(in US$ million equivalent)

	Local	Foreign	Total	% of Total
IBRD	-	70.0	70.0	45.3
Federal Republic of Germany				
Commodity Aid	-	15.4	15.4	10.0
KfW Loan	-	9.1	9.1	5.9
UK - ODA Grant	-	5.0	5.0	3.2
Suppliers' Credit	-	8.6	8.6	5.6
NEPA (Internal Funds)	20.5	-	20.5	13.2
Government Loan	26.0	-	26.0	16.8
Total	46.5 a/	108.1	154.6	100.0

a/ Of this US$28 million is for duties and taxes.

3.19 The proposed Bank loan will be made to NEPA at the Bank's standard variable interest rate for 20 years including 5 years of grace with a commitment charge of 0.75%. NEPA will bear the foreign exchange risk. There will be a Guarantee Agreement between the Bank and the Federal Government of Nigeria.

3.20 About US$38.1 million equivalent of cofinancing is required to cover the remaining foreign exchange cost for the project. The Federal Republic of Germany has offered US$15.4 million equivalent in Commodity Aid repayable over 40 years, including 10 years grace, at 3% interest to finance goods for the maintenance and rehabilitation of the generation and transmission facilities, and US$9.1 million equivalent in KfW loan repayable over 10 years, including a grace period of about 18 months, at 8.08% interest and a commitment fee of 0.375% to finance maintenance and rehabilitation of boilers at the Sapele power station. The Overseas Development Administration (ODA), UK, is favorably considering to provide about US$5 million equivalent in a grant for financing of the utility assistance program. The foreign exchange cost of vehicles (US$8.6 million equivalent) is assumed to be financed through suppliers' credit. NEPA will finance US$20.5 million equivalent in local costs from internally generated funds. The remaining amount of US$26.0 million equivalent to cover local cost expenditures in 1989 and 1990 would be financed by the Government on loan terms to NEPA (long-term debt with a maturity of 15 years, including 3 years of grace and at market interest rates). A condition of loan effectiveness will be the effectiveness of cofinancing from the Federal Republic of Germany (Commodity Aid and the KfW loan) and the ODA grant for the utility assistance program, which are critical to the implementation of the project and its success.

H. Procurement

3.21 The procurement arrangements are summarized in the table below.

	Procurement				
	ICB	International Shopping	Direct Contracting	Other a/ b/	Total
	(in US$ million equivalent)				
Equipment, Material & Spares					
- Generation improvements	-	-	34.9 (15.7)	13.3	48.2 (15.7)
- Transmission improvements	6.5 (6.5)	-	3.7 (3.0)	4.4	14.6 (9.5)
- Distribution improvements	12.9 (12.9)	-	-	6.2	19.1 (12.9)
- Metering equipment	3.9 (3.9)	-	-	1.9	5.8 (3.9)
- Vehicles	-	-	8.6	10.1	18.7
- Data processing	0.8 (0.8)	0.3 (0.3)	-	0.5	1.6 (1.1)
Training equipment	0.9 (0.9)	0.2 (0.2)	-	0.5	1.6 (1.1)
Engineering and Consultancy Services					
- Generation improvements	-	-	-	21.0 (11.8)	21.0 (11.8)
- Transmission improvements	-	-	-	6.2 (4.7)	6.2 (4.7)
- Conversion of Egbin plant to gas	-	-	-	0.4 (0.3)	0.4 (0.3)
- Project management	-	-	-	1.3 (1.0)	1.3 (1.0)
- Operations, maintenance and training (generation)	-	-	-	4.9 (3.8)	4.9 (3.8)
- Utility assistance program	-	-	-	8.1 (1.4)	8.1 (1.4)
- Studies and future project preparation	-	-	-	1.6 (1.3)	1.6 (1.3)
Refinancing of PPF Advance	-	-	-	1.5 (1.5)	1.5 (1.5)
Total	25.0 (25.0)	0.5 (0.5)	47.2 (18.7)	81.9 (25.8)	154.6 (70.0)

a/ Consultancy services will be procured using Bank procedures.
b/ Includes duties and taxes (US$28.0 million equivalent) and other local costs.

Note: Figures in parentheses are items financed by Bank loan.

3.22 Equipment and material, financed by the Bank, will be procured in accordance with Bank procurement guidelines through international competitive bidding (ICB) except in cases where international shopping and direct contracting are more appropriate. Orders for small items under contracts with an estimated value of up to US$100,000 each for data processing and training may be procured through international shopping with price quotations from at least three qualified and eligible suppliers up to an aggregate amount of US$0.5 million equivalent. Direct contracting will be used for spare parts and components (up to an aggregate amount of US$15.7 million equivalent) for the rehabilitation and overhaul of gas turbines, steam turbines and boilers with the original equipment suppliers to ensure that the supplier is responsible for guaranteeing the performance of the plant after rehabilitation. The training of local personnel is also best achieved by having this responsibility assigned to the original equipment suppliers. In addition, proprietary spare parts for improvements of the transmission system may be procured through direct contracting up to an aggregate amount of US$3 million equivalent. Packages over US$100,000 each will be subject to prior Bank review, and packages below US$100,000 each will be subject to ex-post reviews by the Bank. Consultants for engineering services, and technical assistance financed by the Bank will be contracted in accordance with Bank guidelines for use of consultants. For the rehabilitation and maintenance of the generation facilities, NEPA plans to use the services of the original suppliers of equipment and technology to ensure proper performance after rehabilitation and sustaining performance guarantees. NEPA's approach is considered appropriate. All contracts for services will be subject to the Bank's approval prior to signature. To proceed with the necessary preparation work and to avoid delays in project execution, the Bank loan will retroactively finance up to US$7 million of eligible expenditures after October 1, 1988, for generation improvements, engineering supervision services for conversion of the Egbin power plant to gas, and project management assistance. To expedite procurement, an understanding has been obtained that NEPA will use standard bidding documents for procurement under the Bank loan.

I. Allocation and Disbursement of Bank Loan

3.23 The proposed allocation of the Bank loan is summarized in the table on the following page.

Bank Loan Allocation
(in US$ million equivalent)

1.	Equipment, Materials and Spares		
(a)	Generation improvements	14.0)	100% of foreign
(b)	Transmission improvements	7.5)	expenditures
(c)	Distribution improvements	11.5)	
(d)	Metering	3.9)	
(e)	Data processing	1.0)	
(f)	Training	1.0)	
2.	Engineering and Consultancy Services		
(a)	Generation improvements	10.8)	100% of foreign
(b)	Transmission improvements	4.0)	expenditures
(c)	Assistance for conversion of the Egbin plant to gas	0.3))	
(d)	Project management	1.0)	
(e)	Operations, maintenance and training (generation)	3.8))	
(f)	Utility assistance program	1.4)	
(g)	Studies and future project preparation	) 1.3)	
3.	Refunding of PPF Advance	1.5	
4.	Unallocated	7.0	
		70.0	

3.24 The Bank loan will cover 100% of foreign expenditures for directly imported goods, and engineering and consultancy services. The PPF advance of US$1.5 million will be refinanced under the proposed loan. To facilitate disbursements, a special account will be established in US dollars in a bank acceptable to the Bank with an authorized allocation of US$5 million, equivalent to an average disbursement for about four months. Disbursements will be against full documentation except for contracts valued less than US$100,000 equivalent each, which would be against statements of expenditure. Documents in support of statements of expenditures will be retained by NEPA and made available to the Bank for review during supervision missions. An estimated disbursement schedule for the Project, along with disbursement profile of power projects completed in the Region, is given in Annex 3-5. The expected disbursement of the proposed Bank loan is faster than the standard profile since the Project consists of maintenance and rehabilitation, involving essentially a large number of activities of short duration, and given that NEPA will be assisted by consultants in implementing the Project, the proposed disbursement schedule is realistic. The loan closing date will be December 31, 1993.

IV. PROJECT JUSTIFICATION, BENEFITS AND RISKS

4.01 Justification. The Project is part of NEPA's medium-term system development program for the power sector, and accounts for about one-eighth of the total investment cost. The program as a whole is intended to correct the long-standing imbalance between demand and supply for electricity in the country, through investments in generation, transmission and distribution, aimed at improving the utilization of existing assets through maintenance and rehabilitation, and expanding the system capability. The proposed Project will help improve the utilization of existing assets by bringing into operation some of NEPA's currently inoperable plant and equipment, and by strengthening the transmission and distribution system on a selective basis. A portion of NEPA's large capacity, created at considerable cost, is at the moment unutilized and in a state of disrepair. In addition, there are many units which are operating but are overdue or will soon become overdue for major overhauls. As a result, NEPA is unable to fully cope with the load on its system. By rehabilitating existing generating capacity together with critical improvements in transmission and distribution facilities, a marked improvement in NEPA's ability to deliver power could be brought about at a relatively modest cost. If the overhaul and repair of many units is delayed much further, eventual costs of rehabilitation will become significantly higher than at present, and power shortages will increase, thereby limiting economic recovery.

4.02 By bringing on stream, and within a relatively short time, additional generating capacity at a fraction of the investment cost of new equipment 1/, the Project constitutes the first step of the least-cost solution to meeting the anticipated increase in demand for electricity in Nigeria over the next decade. Strengthening of the transmission and distribution systems, and improved maintenance practices under the Project will also help reduce forced outage rates. The Project will restore 606 MW of currently inoperable capacity, and overhaul 850 MW of currently operational capacity which is overdue or will soon be overdue for capital maintenance. This increase should provide NEPA with a "breathing space" in which to undertake planned maintenance of other plant and equipment, and to reorganize the power system so as to improve its stability and reliability.

4.03 The institutional strengthening component of the Project, though small in terms of costs, will help improve NEPA's operational efficiency over the medium-term, and assist in the transformation of NEPA into a commercially viable entity. The proposed utility assistance program will provide NEPA with valuable technical assistance on an on-going basis, in all areas of operations. The provision of data processing equipment would help improve NEPA's billing and materials management capability.

4.04 The total capital expenditure program (1989-93), as set out in Annex 1-2, is similar in content to the program for 1988-92, envisaged at

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1/ The cost of rehabilitating/overhauling generating units at Sapele and Afam under the project is about US$40/kW, as against the estimated US$530/kW for constructing the Egbin plant.

the time of the previous appraisal mission for the Power System Improvement Project (Power VII), which did not materialize (para 1.39); it includes appropriate adjustments for changes in timing and project composition. The program will augment NEPA's generation capacity sufficiently to meet the anticipated load growth up to 1997, with appropriate increase in transmission and distribution capacity. Apart from the project itself, the program is justified for the following reasons:

(a) The Shiroro hydro project largely represents a sunk investment. Completion of the plant will add some 2,000 GWh of average year output to system availability, and displace more costly thermal output.

(b) The 330 kV transmission extensions are justified for system security reasons.

(c) Investments for improving generation and transmission equipment, and for system control are required to improve the quality of NEPA's service. The expected growth in system load makes this an even greater priority.

(d) Investments in data processing equipment, metering and vehicles are necessary to maintain the normal working efficiency of the system and of NEPA's commercial operations. Some investments in these components are included in the project itself; the balance would be undertaken over the duration of the program.

(e) Investments in the 132 kV transmission and distribution components are necessary to reduce the possibility of overloading existing distribution stations, especially in light of the anticipated increase in load over the forseeable future.

4.05 Economic Costs and Benefits. Details of the economic analysis, including a summary of system economic costs and benefits, are given in Annex 4. As mentioned above, the Project is part of the least-cost development program for the power sector in Nigeria (paras 1.30 - 1.35). The economic rate of return of the project is accordingly estimated from the incremental costs and benefits of the program. The increments are a function of the scenario that would prevail if no rehabilitation, improvement or development of NEPA's power system were to take place, e.g., the "future without program". Such a scenario would assume that the only increase in generation would be on account of the conversion of the Egbin thermal plant to gas, which would enable it to utilize all of its six units. The completion of Shiroro, the rehabilitation of the Sapele and Afam IV units, and the construction of the Delta IV plant (along with investments in complementary transmission and distribution facilities to handle the increase in generation) would not--under this scenario--take place. Incremental costs, therefore, represent the difference in total system costs, including capital expenditures, operations and maintenance costs, and fuel, in the "with" and "without" program scenarios. Incremental benefits, similarly, represent the difference between the value

of total served demand for power between the two cases and also take into account the reduction in system technical losses.

4.06 Power system investment costs are valued at January 1989 price levels, and exclude all local taxes and duties. A standard conversion factor of 0.84 is used to adjust the local cost component. An exchange rate of US$1 = ₦6.9 has been used. Incremental operating and maintenance costs are estimated at 2.5% of cumulative investment costs each year. Incremental fuel costs/savings are estimated on the basis of the projected energy balance "with" and "without" program. Incremental benefits are derived from the increase in served demand that would result from implementation of the program.

4.07 Despite the recent increase in tariffs (para 2.36), the existing level of tariffs is still out of line with the resource costs of supplying electricity. Therefore, the increase in served demand is valued on the basis of the minimum tariffs envisaged to ensure the fulfillment of NEPA's financial objectives agreed during negotiations (para 2.38). Under this scenario, nominal tariffs would rise from 27.5 kobos/kWh at present (effective June 1989) to 53 kobos/kWh by 1993. After adjustments for converting nominal tariffs in constant January 1989 prices, they have been used in the economic analysis as a minimum estimate of the electricity's benefit to the consumer. On this basis, the economic rate of return for the development program (1989-93) is estimated at 18.4%, which exceeds the opportunity cost of capital (about 12%), indicating that the proposed investments are justified economically. This estimate is conservative, as it assumes that in the absence of the development program, there would be no deterioration in NEPA's ability to supply power. This is an optimistic assumption, since in the absence of an increase in available generating capacity, and given the anticipated increase in load, NEPA would in fact find it increasingly difficult to shut down units for planned maintenance, with a resultant increase in risk of unplanned shutdowns and system failures. In that event, the economic benefits of the development program would be correspondingly larger, and economic returns higher.

4.08 Electricity tariffs used in the economic analysis do not reflect the considerable consumer surplus that prevails in the power sector in Nigeria. It is likely that the consumer surplus is substantial on the basis of observed reactions to power shortages and outages. As detailed in Annex 4, a large diesel autogeneration capacity has been established in the country because of the poor electricity supply. The cost of electricity from autogeneration is estimated to range between 51 kobos/kWh and ₦1.01/kWh for various configurations of the diesel autogenerators. Therefore, a large number of industrial and commercial users as well as more affluent households should be willing to pay considerably more than NEPA's tariffs. Tariff levels in Nigeria's neighboring countries are even higher. Using 40 kobos/kWh (US¢5.8 kWh) and 50 kobos/kWh (US¢7.2/kWh) to capture part of the consumer surplus in a sensitivity analysis, gives economic rates of return of 22% and 28%, respectively, which demonstrate that the proposed new investments are clearly justified economically.

4.09 Risks. There are no unusual risks associated with the proposed project. The risk of possible delays in project implementation has been minimized through the establishment of a Project Implementation

Coordination Team in NEPA, and the provision of specialists to assist in project management. In view of the rehabilitation nature of the project, there is the possibility that project costs may exceed the estimates. However, the project design is such that should this occur, the scope of the work may be decreased to accommodate the funds available with little detrimental effect upon the completed portion. As for the risk related to the achievement/sustainability of institutional improvements, FGN is fully committed to strengthening the power sector, and recent changes in the attitude towards the importance of reliable and efficient power supply and management of NEPA and parastatals in general should ensure political support for the process. The prospects of new actions to improve the performance of NEPA are, therefore, now brighter than before. The presence of strong technical assistance through the utility assistance program should also minimize this risk. Finally, annual reviews by FGN and the Bank of NEPA's achievements would provide a framework to ensure satisfactory implementation of the institutional aspects of the proposed project.

V. AGREEMENTS AND UNDERSTANDINGS REACHED AND RECOMMENDATIONS

5.01 During negotiations, agreements have been obtained on the following:

(a) reviews every year on NEPA's rolling investment program for the next five years (para 1.34);

(b) preparation by June 30, 1990, of (i) a manpower development study and implementation of findings in a phased manner by December 31, 1991 (para 2.07); and (ii) a comprehensive maintenance strategy and plans for the power system, and implementation thereafter (para 2.25);

(c) arrangements for audit of financial accounts (para 2.14), reporting and auditing of project accounts, special account and statements of expenditure (paras 3.12 and 3.13), and procurement and disbursement (paras 3.22 and 3.24);

(d) NEPA's commercialization plan including a performance contract, and annual reviews of performance (para 2.22);

(e) NEPA to make adequate arrangements to ensure that as of July 1, 1989, electricity bills are paid by all customers including those from the Government and all Government agencies within 60 days after billing; and the Government to take appropriate measures for payments of electricity bills by its agencies within sixty days from the billing date beginning in July 1, 1989 (para 2.28);

(f) improvements in revenue collection and accounts receivable, and writing off of bad debt deemed uncollectible (para 2.28); and reduction of system losses (para 2.29);

(g) revaluation of 1988 assets by December 31, 1989, and annual revaluation thereafter (para 2.31);

(h) FGN to provide to NEPA necessary funds in a timely manner in long-term naira debt in 1989 to help meet NEPA's debt service obligations and finance a part of NEPA's investment program, and in 1990 to finance NEPA's investment program (para 2.33);

(i) FGN and NEPA to take by January 31, 1990 all measures including increases in tariffs so as to enable NEPA to finance in 1990 from internal funds at least 30% of its annual investment program (para 2.39);

(j) NEPA (i) to earn at least 6%, 7%, and 8% rates of return on revalued net fixed assets in 1991, 1992 and 1993, respectively; (ii) to continue to generate internally adequate funds each year beginning in 1991 to finance at least 30% of its annual investment program (para 2.40); (iii) NEPA to incorporate a fuel adjustment clause in its tariff structure beginning January 1, 1990 (para 2.41); (iv) to maintain in each year beginning in 1991, a debt service coverage ratio of at least 1.5, and not to incur any debt unless the projected debt service coverage ratio is at least 1.5; and (v) not to incur any debt if its debt/equity ratio will be greater than 40:60 (para 2.42); and

(k) NEPA to prepare and review with the Bank every year its financial plans in the form of projected financial statements for the next five years, and to take timely measures to maintain financial viability (para 2.44).

5.02 Conditions of <u>loan effectiveness are</u>:

(a) employment of a utility partner for technical assistance to NEPA in various areas of its operations according to terms of reference satisfactory to the Bank (para 2.25);

(b) conversion by FGN into equity and/or in long-term loans all of its naira loans (including short-term loans) owed by NEPA to FGN as of December 31, 1988 (para 2.32); and

(c) effectiveness of cofinancing from the Federal Republic of Germany (commodity aid and the KfW loan), and the ODA grant from the U.K. for the utility assistance program (para 3.20).

5.03 During negotiations, <u>understandings</u> have been reached with (a) FGN and NEPA on the main elements of the commercialization of NEPA to ensure that NEPA will become self-reliant, have more autonomy and be accountable for its performance (para 2.22); (b) NEPA that prior to purchasing personal computers and software, it will develop an action program and requirements for improved billing and collection procedures and accounting, the overall management information system and a data processing

plan (para 2.12); (c) NEPA on a review of its insurance practices by March 31, 1990 and the implementation of findings soon thereafter (para 2.15); (d) NEPA to prepare and furnish to the Bank by October 31, 1989, for an exchange of views with the Bank, its financial plans for 1990 in the form of projected income statement, balance sheet, funds flow statement and working capital statement (para 2.39); and (e) NEPA to use standard bidding documents for procurement under the Bank loan (para 3.22).

5.04 On the basis of the above agreements reached, the Project is suitable for a Bank loan of US$70 million equivalent to the National Electric Power Authority (NEPA) with a guarantee of the Federal Republic of Nigeria at the Bank's standard variable interest rate for twenty years, including a five-year grace period and a commitment fee of 0.75%.

AF4IE
July 1989

NIGERIA - POWER SYSTEM MAINTENANCE AND REHABILITATION PROJECT

Installed Capacity, Generation, Sales, Staff and Consumer Data (1977-1987)

	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
Installed Generation Capacity (MW)	1,071	1,645	1,978	2,171	2,483	2,772	2,857	3,178	3,651	4,318	4,852
System Maximum Demand (MW)	794	989	1,193	1,185	1,326	1,451	1,438	1,536	1,712	1,811	1,955
Energy Generated (GWh)	4,611	5,219	6,523	5,303	7,822	8,566	8,718	9,038	10,338	10,627	11,220
Energy Sales (GWh)											
- Residential	1,645	2,100	1,844	2,130	2,724	3,018	3,136	2,861	3,186	4,175	4,233
- Commercial	708	752	677	774	753	603	742	715	750	742	751
- Industrial	1,439	1,306	1,404	1,749	2,150	2,295	2,228	1,911	2,216	2,463	2,492
Total Sales	3,792	4,158	3,925	4,653	5,627	5,916	6,106	5,487	6,152	7,380	7,476
Number of Consumers ('000)	708	829	984	1,071	1,221	1,380	1,537	1,674	1,841	1,970	2,026
Number of Staff	15,454	16,370	18,172	19,473	19,836	22,465	27,470	28,027	31,049	32,474	32,912
Percentage Staff Increase (%)	18.0	5.9	11.0	7.2	1.9	13.3	22.3	2.0	10.8	4.6	1.3
No. of Consumers per Employee	45.8	50.6	53.0	55.0	61.6	61.4	56.0	59.7	59.3	60.7	61.6
No. of Employees:											
- per GWh Sales	4.1	3.9	4.6	4.2	3.5	3.8	4.5	5.1	5.1	4.4	4.5
- per MW Installed Capacity	14.4	10.0	9.2	9.0	8.0	8.1	9.6	8.8	8.5	7.5	7.1

Source: NEPA

AF4IE
November 1988

NIGERIA - POWER SYSTEM MAINTENANCE AND REHABILITATION PROJECT

Summary of Capital Expenditure Program (1989-1993) a/
(in current US$ million)

	1989			1990			1991			1992			1993			Total Program		
	Local	Foreign	Total	Local	Foreign	Total	Local	Foreign	Total	Local	Foreign	Total	Local	Foreign	Total	Local	Foreign	Total
1. The Project	3	22	25	23	49	72	16	29	45	4	8	11	1	1	2	47	108	155
2. Other Investments																		
330 kV Transmission Extension				6	17	23	18	47	65	16	44	60	5	13	18	45	121	166
132 kV Transmission Extension				5	11	16	15	31	46	14	31	45	4	7	11	39	80	119
Distribution Improvements				3	5	8	13	20	33	23	35	58	13	20	33	53	80	133
Vehicles							7	20	27	6	18	24	3	8	11	15	46	61
Data Processing							1	5	7	1	4	5	0	1	2	3	10	13
Metering				1	3	4	4	10	14	5	13	18				9	26	35
Consultancy Services	2	2	4	2	2	4	2	2	4							5	6	11
National Control Center				3	9	12										3	9	12
Training							2	1	3	2	1	2	1	0	1	5	2	7
Completion of Shiroro b/	8	20	28	14	30	44	11	30	41	4	5	9				37	85	122
Transmission Improvements	—	—	—	—	—	—	10	30	40	20	60	80	20	60	80	50	150	200
Subtotal	13	44	57	58	126	182	98	226	324	95	218	312	46	111	157	310	724	1,034
Delta IV c/	24	40	64	15	30	45	13	25	38	10	15	25	—	—	—	62	110	172
Total	37	84	121	72	156	227	111	251	362	105	233	337	46	111	157	372 d/	834	1,206

a/ Figures may not add because of rounding.
b/ About 80% of the project has already been completed.
c/ 600 MW Gas Turbine Power Station. The output of this plant is, however, not expected to be needed to meet demand until about 1995.
d/ Of this, about US$138 million is for duties and taxes.

AF4IE
January 1989

NIGERIA - POWER SYSTEM MAINTENANCE AND REHABILITATION PROJECT

Electricity Demand and Supply Under the Capital Expenditure Program (1988-1998)

(in GWh)

	Estimate	Projected								
	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
Energy Available to Send Out:											
(a) Hydro:											
Kainji	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000
Jebba	1,650	1,650	1,650	1,650	1,650	1,650	1,650	1,650	1,650	1,650	1,650
Shiroro			1,000	1,300	2,000	2,000	2,000	2,000	2,000	2,000	2,000
Subtotal Hydro	3,650	3,650	4,650	4,950	5,650	5,650	5,650	5,650	5,650	5,650	5,650
(b) Thermal (Gas & Steam):											
Egbin (ST)	2,643	4,820	5,800	5,800	5,800	5,800	5,800	5,800	5,800	5,800	5,800
Sapele (ST)	1,639	1,980	2,630	2,630	2,630	2,630	2,630	2,630	2,630	2,630	2,630
Sapele (GT)	1,013	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000
Afam (GT)	2,310	2,310	2,310	2,310	2,310	2,310	2,310	2,310	2,310	2,310	2,310
Delta 1,2,& 3 (GT)	1,000	700	700	700	700	700	700	700	700	700	700
Delta IV (GT)			350	1,050	1,750	2,600	2,600	2,600	2,600	2,600	2,600
Ijora	250	50	50	50	0	0	0	0	0	0	0
Subtotal Thermal	8,855	10,860	12,840	13,540	14,190	15,040	15,040	15,040	15,040	15,040	15,040
Total Energy Available to Send Out	12,505	14,510	17,490	18,490	19,840	20,690	20,690	20,690	20,690	20,690	20,690
System Demand for Generated Energy	12,005	12,696	13,429	14,206	15,029	15,903	17,016	18,207	19,482	20,844	22,304
Ratio of Demand to Available Energy	0.96	0.88	0.77	0.77	0.76	0.77	0.82	0.88	0.94	1.01	1.08
Technical Losses (%) a/	15.0	14.0	13.0	12.0	11.0	10.0	10.0	10.0	10.0	10.0	10.0
Energy Served	10,205	10,919	11,683	12,501	13,376	14,312	15,314	16,386	17,533	18,621	18,621

a/ Technical Losses to be reduced in a phased manner by one percentage point each year for the period beginning 1989 through 1993.

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NIGERIA - POWER SYSTEM MAINTENANCE AND REHABILITATION PROJECT

Available Capacity, Electricity Balance and Fuel Cost (1988-1993)

A. Power Market and Available Capacity

Power Market		Actual 1987	Estimate 1988	Forecast 1989	1990	1991	1992	1993
Electricity Consumed (GWh)		9,537	10,205	10,919	11,683	12,501	13,376	14,312
Consumption Growth Rate (%)			7	7	7	7	7	7
Estimated Technical Losses (%)		15	15	14	13	12	11	10
Net Generation--Sytem Demand (GWh)		11,220	12,005	12,698	13,429	14,208	15,029	15,903
Non-Technical Losses (%)		18	20	17	14	12	11	10
Total System Losses (%)		33	35	31	27	24	22	20
Electricity Billed (GWh)		7,476	7,804	8,761	9,803	10,798	11,723	12,722
Peak Demand (MW)		1,855	1,950	2,048	2,150	2,257	2,370	2,489
Available Capacity (MW)								
	Installed Capacity							
Hydro - Kainji	760		500	500	500	500	500	500
- Jebba	540		450	450	450	450	450	450
- Shiroro	600		-	-	300	600	600	600
Subtotal (Hydro)			950	950	1,250	1,550	1,550	1,550
Oil Gas Turbine (G.T.)								
- Ijora	60		60	60	60	60	0	0
Gas G.T. - Delta	312		140	160	160	180	180	180
- Sapele	280		210	210	210	210	210	210
- Afam	682		452	452	522	522	522	522
- Delta IV	600		-	-	200	400	600	600
Subtotal (G.T.)			802	822	1,092	1,312	1,512	1,512
Gas Steam - Sapele	720		360	600	600	600	600	600
- Egbin	1,320	(Gas available end-1988)	-	1,100	1,100	1,100	1,100	1,100
Subtotal (Steam)			360	1,700	1,700	1,700	1,700	1,700
Oil Steam - Egbin	1,320 MW (in 1987 & 1988)		440	-	-	-	-	-
Subtotal (Thermal)			1,662	2,582	2,862	3,072	3,212	3,212
Total Capacity			2,612	3,532	4,102	4,622	4,762	4,762
Ratio of Capacity to Peak Demand			1.34	1.73	1.91	2.05	2.01	1.91

B. Available Energy and Energy Output

	Estimate 1988	Forecast 1989	1990	1991	1992	1993
Available Energy (GWh)a/						
Hydro - Kainji	2,000	2,000	2,000	2,000	2,000	2,000
- Jebba	1,650	1,650	1,650	1,650	1,650	1,650
- Shiroro	-	-	1,000	1,300	2,000	2,000
Subtotal (Hydro)	3,650	3,650	4,650	4,950	5,650	5,650
Oil G.T. - Ijora	250	50	50	50	-	-
Gas G.T. - Delta 1,2,3	1,000	700	700	700	700	700
- Sapele	1,013	1,000	1,000	1,000	1,000	1,000
- Afam	2,310	2,310	2,310	2,310	2,310	2,310
- Delta IV	-	-	350	1,050	1,750	2,600
Gas Steam - Sapele	1,639	1,980	2,630	2,630	2,630	2,630
- Egbin	-	4,820	5,800	5,800	5,800	5,800
Oil Steam - Egbin	2,643	-	-	-	-	-
Subtotal (Thermal)	8,855	10,860	12,840	13,540	14,190	15,040
Total Available Energy	12,505	14,510	17,490	18,490	19,840	20,690
Energy Demand	12,505	12,696	13,429	14,206	15,029	15,903
Energy Reserve	500	1,814	4,061	4,284	4,811	4,787
Ratio of Supply to Demand	1.04	1.14	1.30	1.30	1.32	1.30
Output (GWh)						
Hydro - Kainji	1,853	2,000	2,000	2,000	2,000	2,000
- Jebba	1,650	1,650	1,650	1,650	1,650	1,650
- Shiroro	-	-	800	1,100	2,000	2,000
Subtotal (Hydro)	3,503	3,650	4,450	4,750	5,650	5,650
Oil G.T. - Ijora	250	-	-	-	-	-
Gas G.T. - Delta 1,2,3	1,000	55	55	55	55	55
- Sapele	1,013	900	900	700	600	750
- Afam	2,310	1,491	824	701	524	648
- Delta IV	-	-	300	1,000	1,100	1,600
Gas Steam - Sapele	1,639	1,800	1,900	2,000	2,000	2,000
- Egbin	950	4,800	5,000	5,000	5,100	5,200
Oil Steam - Egbin	1,340	-	-	-	-	-
Subtotal (Thermal)	8,502	9,046	8,979	9,456	9,379	10,253
Allocated Supply to meet Demand for Generated Energy	12,005	12,696	13,429	14,206	15,029	15,903

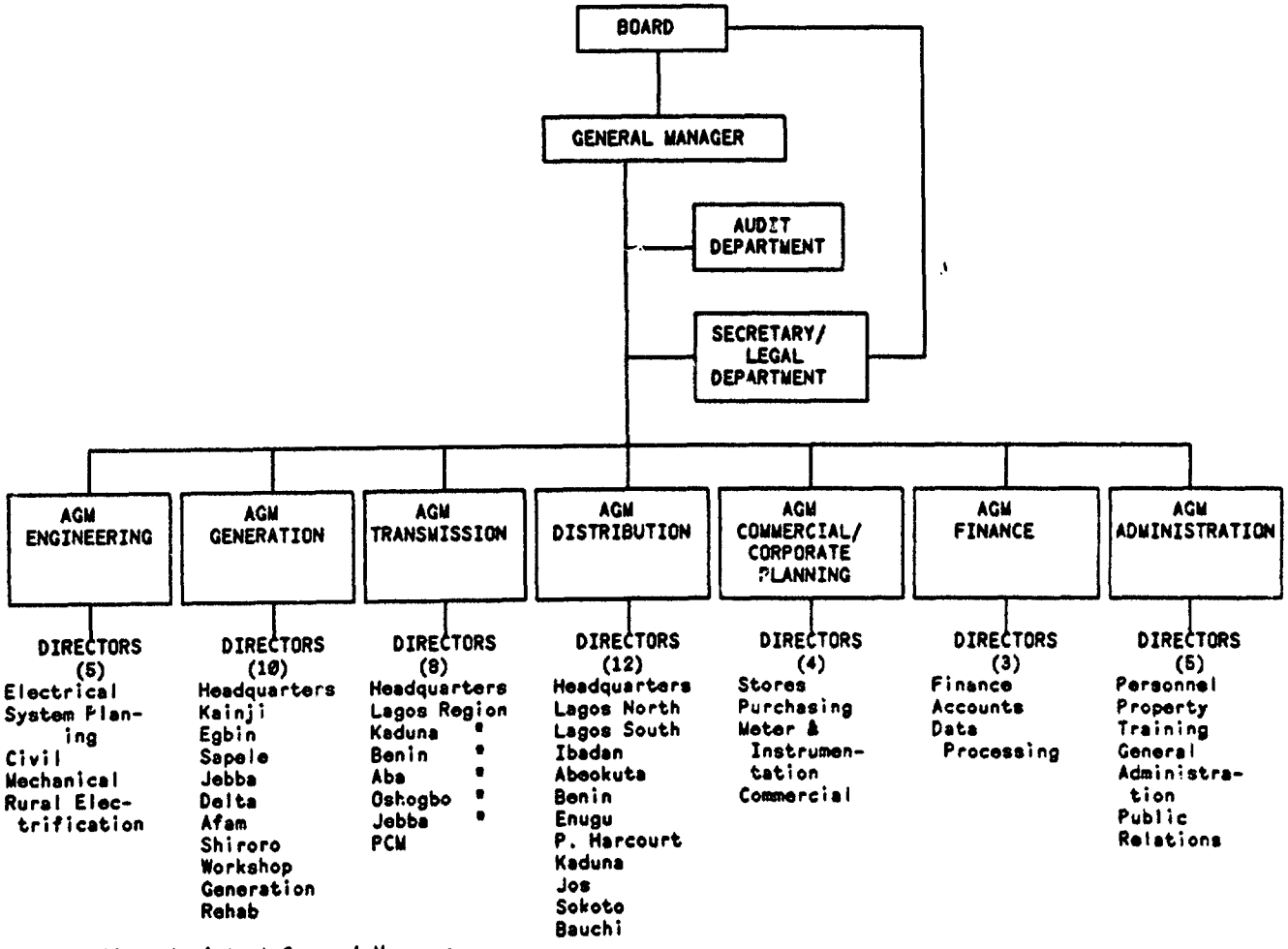
C. Fuel Costs

Total Gas Volume (billion cubic feet)	111	109	115	113	124
Gas Price (N/MMBTU)	5.24	5.66	6.11	6.60	7.13
Total Fuel Costs (Naira million)	584 b/	616	700	747	887
Total Thermal Generation (GWh)	9,046	8,979	9,456	9,379	10,253
Average Fuel Cost (kobos/kWh)	6.46	6.86	7.40	7.97	8.65

a/ Capacity factors assumed are: Kainji (45%), Jebba (44%), Shiroro (46%), Ijara (50% in 1988, 10% to 1991 and 0% thereafter), Delta, Sapele, Afam and Egbin (50%).
b/ Assuming that the new gas price of N5.24/MMBTU applies for the whole year.

NIGERIA - POWER SYSTEM MAINTENANCE AND REHABILITATION PROJECT

Present Organization Chart of NEPA



Notes: AGM = Assistant General Manager

Source: NEPA, September 1988

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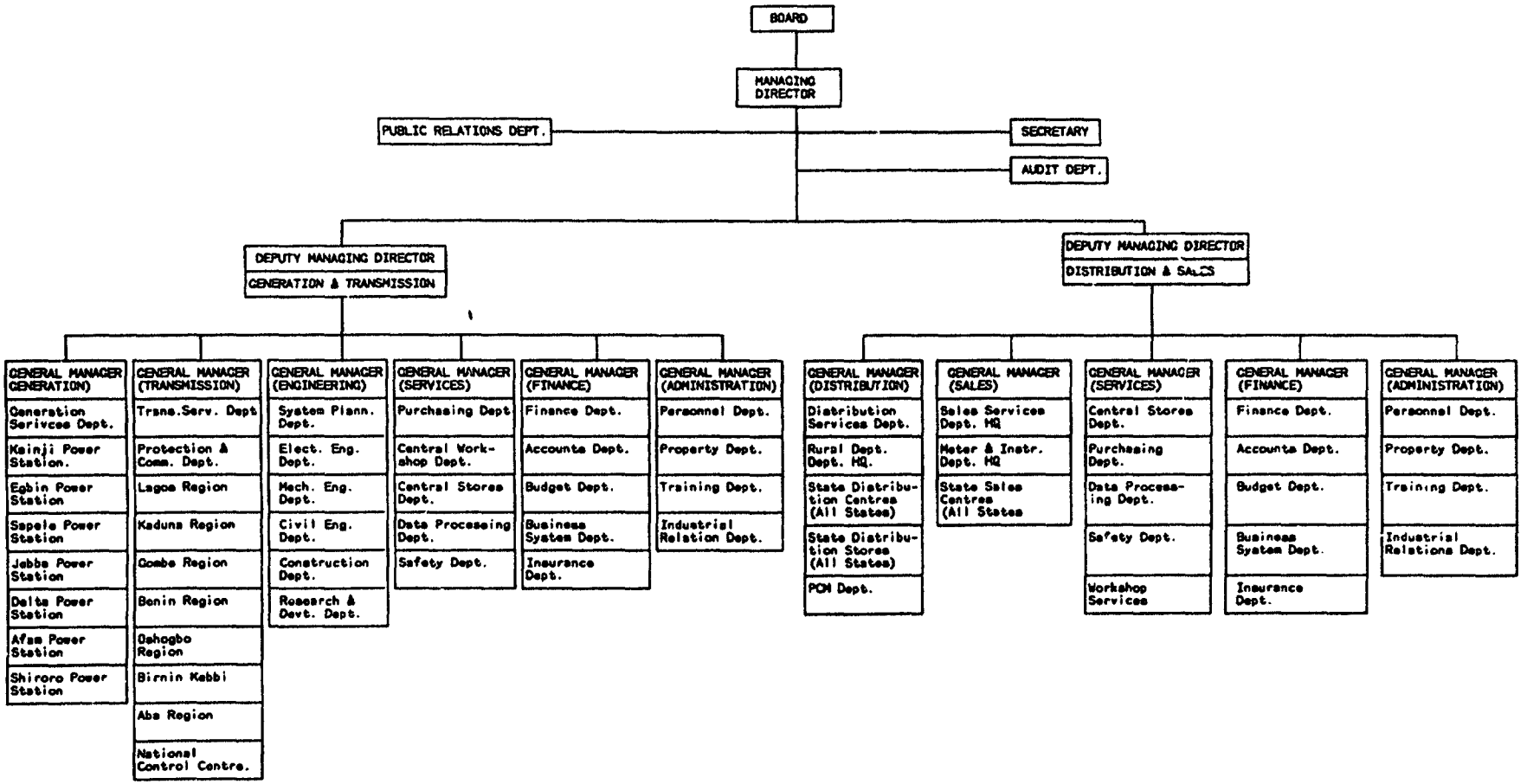
NIGERIA - POWER SYSTEM MAINTENANCE AND REHABILITATION PROJECT

Proposed Organization Chart of NEPA



Notes: 1. Managing Director's office to include Corporate Planning Unit.
2. Area offices for Transmission Division in the following locations: Enugu, Kainji, Abuja, Ikeja West, Akangba, and Onitsha.

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NIGERIA - POWER SYSTEM MAINTENANCE AND REHABILITATION PROJECT

Commercialization of NEPA

1. The future relationship between the Government and NEPA should be based on the following: (a) establishing clear and attainable objectives compatible with commercial operations; (b) providing NEPA's management greater autonomy over its operations and the selection of managers capable of operating independently; (c) establishing clear rules and procedures for government involvement in decision making; and (d) holding the management accountable by negotiating targets, monitoring and evaluating results and rewarding them and their staff on the basis of performance.

2. The above new relationship between the Government and NEPA could best be achieved through a "performance contract," under which the Government would set up medium-term objectives for NEPA, pledge to meet its financial and other obligations in a timely manner and extend greater autonomy in exchange for NEPA's commitment to achieve agreed performance in the efficiency and reliability of its power services and in the maintenance of its assets. The first performance contract need not be a perfect one. The performance contract could be reviewed annually and modified as necessary based on experience.

3. The Government should agree to the following:

(a) Provide support for NEPA's efforts to make its organization more responsive to power sector needs in fulfillment of its assigned role under the National Power Authority Act of 1972 "to develop and maintain an efficient, coordinated and economical system of electricity supply ...".

(b) Make NEPA's management accountable to its Board and not to the Federal Ministry of Mines, Power and Steel (FMMPS). Therefore, it would be self-defeating for the Chairman of NEPA's Board to be from within either the Government or NEPA itself. The members of the Board should be individuals and representatives of commercial and consumer groups who are properly qualified with extensive and proven management capabilities and understandings of the power sector, and who offer a diversity of skills, independent view-points and experiences. They should be compensated well and take the job seriously. The Managing Director of NEPA should be an ex-officio member of the Board. The Government should decentralize power to the Board of Directors as a way to depoliticize decisions and take NEPA's interests into account.

(c) Assure that the management team of NEPA is competent, business-minded, and action-oriented with utmost regard to efficiency in

operational/financial matters. The Managing Director should be appointed by the Board in consultation with and approval of the Government. The Managing Director should be left free to appoint his top management team.

(d) Give the Board the primary responsibility for providing strategic guidance to the management and monitoring performance within the overall framework of long-term objectives of the Government for the power sector. The Board's functions would include decision-making on the medium and long-term borrowing over and above stated amounts, short-term borrowings in excess of normal requirements, major capital expenditures exceeding predefined limits, new or revised compensation programs, salary increases and bonuses for the Managing Director and top executives. It would review and approve strategic plans, annual budgets and audited financial statements, and discuss regular and special reports. It would review management's effectiveness in running the day-to-day business, but abstain from intervention in day-to-day operations. The Board should be responsible to the Government, which would restrict its role to the setting of long-term objectives for NEPA, including key monitorable performance indicators, against which the performance of the organization and its Board would be judged. If this performance is unsatisfactory, the Government could replace the Board in part or in its entirety.

(e) Delegate authority to NEPA to determine all contract awards for capital goods, spares and maintenance up to a predetermined limit. NEPA's management should be able to award contracts with Board approval up to this limit which should be about ₦100 million per contract. Within this limit, the NEPA management should be able to award contracts (without the Board approval) up to ₦50 million. These limits should be revised regularly to keep pace with inflation. For very large contracts outside these limits, processing within the Government of NEPA contract award approvals should be streamlined to minimize project delays.

(f) Delink NEPA's salary structure from that of the civil service, as in the case of NNPC. The salary structure should be competitive and flexible to attract and retain qualified and highly competent personnel.

(g) Agree on financial objectives for the sector.

(h) Provide NEPA in a timely manner with the capital required for commercially unattractive projects the Government wishes NEPA to construct (e.g., rural electrification).

(i) Convert into equity and/or long-term loans all naira loans of NEPA owed to the Government to help restructure NEPA's capital

(this would require no new cash outlay by the Government). In addition, the Government will need to provide in 1989 and 1990 financial assistance to NEPA in long-term debt to enable NEPA to service its debt and cover cash shortfalls to finance the investment program.

(j) Arrange as soon as possible for a settlement by Government departments and parastatals of their past due electricity bills with NEPA; and also of arrears of NEPA to other parastatals (e.g., NNPC). Institute a mechanism to ensure that the Government departments and parastatals will pay their electricity bills to NEPA within 60 days.

(k) Allow NEPA to effect regular tariff increases as necessary to achieve its financial objectives. These increases would be in addition to the recent increase, effective June 1989 in average tariffs to about ₦27.5 kobos/kWh. Allow NEPA to incorporate a fuel-adjustment clause in tariffs so as to neutralize the impact of unforeseen increases in fuel costs to NEPA, either because of an increase in fuel prices or changes in the mix of generation, without the need to obtain specific Government approval for this purpose.

4. To summarize, the Government's role should be limited to setting basic objectives for NEPA (to develop and maintain an efficient, coordinated and economical system to supply electricty on a commercial basis); approving Board members, and the Board's selection of the Managing Director; reviewing and evaluating performance of the Board in meeting the above objectives; reviewing financing decisions that affect public funds (for example, requests for Government equity, debt with Government guarantee, etc.); reviewing tariff levels proposed by NEPA according to agreed principles; and long-range planning and coordination across sectors. The performance evaluation should focus only on a comparision of efficiency and profitability achievements with targets. Reliable and timely flow of appropriate standardized information is critical to good performance evaluation.

5. <u>NEPA should agree to the following</u>:

(a) Develop and implement improved personnel management policies and a staffing plan aimed at streamlining the work force to match job requirements with appropriate skills and eliminate overstaffing.

(b) Promote operational efficiency, increase productivity from 62 consumers per employee in 1987 to realistic levels (say 80-85 consumers per employee by 1990).

(c) Establish an end-of-year staff performance award system for the achievement of preset productivity improvement targets.

(d) Increase monthly system generation availability through improved maintenance (annual expenditures of about 2% of assets) and operational practices to about 60% for end-1989, 70% for end-1990 and 75% for end-1991.

(e) Take steps to improve metering, billing and collection systems so that the system losses are reduced in a phased manner from the present 35% to 20% by 1993.

(f) Reduce the average age of accounts receivable to 8 months' sales by end-1989, 4 months' sales by end-1990, and 3 months' sales by end-1991, and maintain it thereafter at the same level.

(g) Standardize a regular meter reading and billing system for all customers by June 1990, possibly by contracting out these functions to the private sector.

(h) Write off by December 31, 1989 its bad debt which is deemed uncollectible, and install improved bill collection procedures so as to reduce its provision for doubtful debts from 6% to 4% in 1990, 3% in 1991, 2% in 1992 and to 1% in 1993.

(i) Develop plans by December 31, 1989 for improved management information, budgeting and financial reporting systems and take steps for their implementation.

(j) Develop plans by June 30, 1990 for an improved manpower development program, and take steps to implement the findings in a phased manner by December 31, 1991.

(k) Establish by March 31, 1990 a "pilot district program" in three districts to increase productivity and efficiency of NEPA's operations. Experience gained will help in the extension of the improved system on a nation-wide basis.

(l) Have its accounts audited by qualified and independent auditors in a timely manner within six months of the close of the fiscal year. However, the 1988 accounts should be audited by December 31, 1989.

(m) Improve its tariff levels and operations to (i) generate in 1990 and in each year thereafter, adequate internal funds to finance at least 30% of the annual capital expenditures, and (ii) earn a rate of return on net fixed assets on the basis of revalued assets of not less than 6% in 1991, 7% in 1992 and 8% in 1993 and thereafter.

Utility Assistance Program

6. The realization of the institutional strengthening of NEPA would require new ideas, outside know-how and, therefore, very large technical

and managerial inputs. In this respect, an "utility assistance program" with a well known international utility within the medium-term framework covering various aspects of NEPA's operations is critical. To avoid the pitfalls of past experience, NEPA would need to make plans for effective utilization of the outside expertise so that knowledge and skills could be internalized. This would require strong counterpart teams, with a positive attitude and motivation, working hand in hand with the experts.

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June 1989

NIGERIA - POWER SYSTEM MAINTENANCE AND REHABILITATION PROJECT

An Outline of Technical Assistance Under the Utility Assistance Program

A. Objectives

1. The main objectives of the technical assistance to be provided by the utility partner are: (a) engineering, technical, accounting and managerial expertise on all aspects of electric utility operations to assist NEPA towards achieving its objective of ensuring a continuous reliable supply of electricity at minimum cost; and (b) on-the-job and formal training assistance both at the NEPA's plant and abroad to ensure that NEPA achieves about 70% self-reliance within three years. Since the experience of past technical assistance provided to NEPA has been far from satisfactory, it is essential for the success of technical assistance under the utility partnership that the underlying spirit of the relationship between the utility partner and NEPA is to cooperate and collaborate their resources to effect the transfer of know-how from the utility partner to NEPA.

B. Scope of Work

2. NEPA requires specialist assistance in many areas including the following:

(a) Generation maintenance and rehabilitation programs and plant failure analysis

(b) Implementation of a coordinated system protection plan

(c) System control, load dispatching functions and analysis of system faults

(d) Transmission maintenance and rehabilitation

(e) Distribution operations

(f) Maintenance management systems

(g) Implementation of effective system for procurement, purchasing and inventory management

(h) Implementation of programs for effective meter reading, billing and collection systems

(i) Development of a system loss reduction program

(j) Implementation of sound financial system and effective financial management

(k) Development of an effective management information system and data processing plan

(l) Internal audit

(m) Development of a manpower plan including staff members and levels, reward systems and training needs

(n) Implementation of the commercialization of NEPA's operations

(o) Implementation of a pilot district program for efficiency improvements

(p) System planning, design and standards

3. Emphasis in technical assistance will be on team work and joint participation by the staff of both utilities. The utility partner will fill key positions where special skills are needed, or where staff members of NEPA are on training. The technical assistance would include short-term assignments to address particular and specific needs, as well as long-term technical assistance.

4. The detailed work program between NEPA and the utility partner will be agreed on an annual basis to maintain flexibility in assistance to meet NEPA's needs and capabilities as they evolve. While NEPA intends to seek assistance from the utility partner in all above areas, emphasis on assistance during the first year would be to make accelerated progress in areas listed in items (f) through (o).

C. Organization of Work

5. The utility partner will appoint a very senior member of its organization to act as the director of the partnership (twinning) relationship. The authority of this director must be such that he is able to ensure that the full expertise of the utility partner is available to the project team and that suitably skilled and experienced staff are provided both for specific short-term assignments and long-term resident experts in NEPA. He should be able to also devote a substantial proportion of his time to the twinning relationship. He will be responsible for reviewing progress and developing any changes required in the overall technical assistance program.

6. The utility partner will provide a Senior Resident Consultant to act as Team Leader who will assist and advise the Managing Director of NEPA in the implementation of technical assistance activities.

7. The services will be provided in two phases: (a) a diagnostic phase first, and (b) an implementation second phase. In the first phase, the utility partner (senior representatives of the utility) will prepare a study jointly with senior NEPA management team and staff that identifies the critical/priority areas on which significant and rapid changes can be made to quickly improve the continuity of electricity supply in Nigeria,

and the efficiency of NEPA's overall operations (e.g., financial and managerial), and help to ensure that these improvements are maintained in the longer term. In addition to the diagnostic studies, five specific studies will also be undertaken in the following areas: (a) relay coordination; (b) system control facilities particularly the National Control Center at Oshogbo; (c) rehabilitation needs for the Kainji hydro-electric power station; (d) a detailed assessment of manpower and training needs; and (e) the metering, billing and collection facilities and procedures. The utility partner will then prepare a comprehensive program to recommend immediate as well as longer term corrective actions to develop effective organization structures, and staffing systems and procedures appropriate to each major priority area. For each main corrective action recommended, the study will give estimates of foreign and local manpower requirements in numbers and specialties, estimates of required manufacturers' services, terms of reference for any recommended further studies (by other consultants if necessary), foreign and local cost-estimates, implementation schedules and results to be achieved. Work to be done locally, by both long-term resident experts and short-term staff, and at the utility partner's home office will be specified. Finally, an overall implementation plan will be prepared based on the relative priorities of the individual actions so that the combined resources of the utility partner/NEPA can be used to implement corrections in the most cost-effective manner. It is anticipated that the diagnostic phase will allocate only about one-third of the total available resources. The Steering Committee (para 9) will allocate the balance of resources during implementation of the second phase.

8. The first phase is expected to be performed over a period of about three months. Phase II is expected to take up to three years depending on the action plans for each priority area. The utility partner will begin with the help of NEPA staff, the implementation of actions, studies and training programs as specified by NEPA. For each of these activities, specific individuals from the staff of NEPA and the utility partner will be designated. The services will be primarily provided by personnel of the utility partner.

9. A Steering Committee will be established to monitor the technical assistance services. The Committee would (a) advise NEPA's management on the course of action to be taken on the basis of the diagnostic phase; (b) review periodically the progress of the contract between NEPA and the utility partner; and (c) identify difficulties and decide on "what should be done and by whom" to remedy/eliminate these possible difficulties. The members of the Committee should include (i) NEPA's senior management team; (ii) the Senior Resident consultant of the utility partner; (iii) the director of the utility partner; and (iv) a representative of ODA.

10. As for the training of the senior management personnel in the home office of the utility partner, it is often difficult for NEPA to release its senior management personnel for training, but it is equally necessary for them to participate in a senior management development program. To meet this need, the utility partner will appoint members of its own management staff of the appropriate seniority and expertise to work

alongside NEPA's managers and assume responsibility for their work, to enable them to be released for the necessary period of senior management training. The managers seconded from the utility partner would also identify areas of weakness and areas of potential improvement, and establish a program of suggestions for improvement in management practice. NEPA's manager under training would thus return to his post with a broader experience, but also with clearly stated objectives as to how he should put his recently acquired knowledge of management principles into practice. The utility partner's manager would remain for a time working along with NEPA's manager, assisting him in executing the program.

AF4IE
June 1989

NIGERIA - POWER SYSTEM MAINTENANCE AND REHABILITATION PROJECT

Operational Objectives of the Pilot District Program for Efficiency Improvements

The utility partner will assist NEPA in the implementation of a pilot district program in three selected districts. The operational objectives of the program are summarized below:

(a) Productivity and Cost Control Targets. All transmission, distribution, and commercial operations will be reviewed to determine existing productivity and cost control levels (e.g., employee/customer ratios, size of payroll, system losses both technical and non-technical, system outages, equipment downtime, system maintenance requirements, illegal connections, etc.). A program will be established to raise these levels to an acceptable standard and the achievement of these targets will be the measure of success for each model district.

(b) Improving Operational Procedures. Operating procedures will be reviewed in all work units to determine constraints to productivity and efficiency (e.g., overlapping responsibilities, lines of communication and authority, inventory control, procurement, work order processing, emergency operations, meter reading, billing and collection procedures, accountability, etc.). A revised district procedures manual will be developed and used on a pilot basis over a two year period; NEPA will make final modifications to be used in all NEPA districts.

(c) Improving Personnel Management. Personnel management procedures and practices will be reviewed to determine constraints to effective use of the workforce (e.g., matching employee qualifications with job assignments, personnel record keeping, recruitment and promotion practices, corroborating attendance and payroll, processing of disciplinary actions, etc.). A personnel management program will be established to address the deficiencies found in the review and targets will be set to achieve specific objectives (e.g., computerization of personnel files, testing and evaluation of employees' job skills, stricter adherence to work rules and regulations, updating of all job descriptions, etc.).

(d) Streamlining the Workforce. Following the productivity and personnel management reviews, a manpower audit will be conducted to determine the most efficient staffing levels in each work unit within the district. The audit will focus on numbers of staff required to carry out each unit function, abilities of employees to perform according to their job descriptions, key vacancies that need to be filled, and employees that should be transferred or made redundant. A workforce improvement program will be implemented over a two year period to achieve staffing level targets established from the results of the manpower audit.

(e) Improving the Workplace Environment. A survey of all work locations (e.g., commercial offices, administrative offices, substations, workshops, and field locations) will be conducted to determine constraints on efficiency and productivity in the workplace. The survey will focus upon conditions such as lack of tools, materials, and equipment to carry out assignments, cleanliness and orderliness of work areas, presence of persons not employed by NEPA, work area security, means of transport and communication, diversion of materials and supplies to non NEPA activities, and lack of consumable supplies. A workplace improvement program will be implemented over a two year period to resolve the constraints noted in the survey. Results will be measured against targets established to meet program objectives.

(f) Improving Workforce Supervision and Discipline. A review of workforce supervision and discipline will be conducted at the district level to determine their effects upon work outputs (e.g., response to instructions, delegation of authority, delegation of tasks, management of objectives, attendance, disregard for work and safety regulations, and disciplinary actions). A series of training workshops will be implemented to present the findings of the review and to instruct managers and supervisors in improved supervisory techniques. Targets will be established to achieve supervisory improvements over a two year period (e.g., individual manager and supervisor work plans, reduced absenteeism, improved work unit safety records, reduced number of disciplinary actions, etc.).

(g) Job Skills Upgrading. Following the manpower audit, a training needs analysis will be conducted within the district to determine the training requirements of employees at all levels of operation (this will not include employees being transferred or made redundant). On-the-job training programs will be established for each employee as necessary to upgrade job skills according to his/her job description. These will be supplemented with specialized courses run by NEPA's Training Department and other external Nigerian training institutions. The objective of this activity is to have all district personnel (from the highest down to the semi-skilled grade levels) certified as competent in their existing job positions at the end of the program period.

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January 1989

NIGERIA-POWER SECTOR MAINTENANCE AND REHABILITATION PROJECT

Revaluation of Fixed Assets

(in millions of Nairas)

Year	Local Inflatio a/ (%)	International Inflation b/ (%)	% Annual Change in US$ Rate of the Naira	% Annual Change in MUV Expressed in Naira c/	Annual Composite Factor d/ (%)	Cumulative Composite Factor (%)
1973	46.8	14.6	0.0	14.6	25.9	25.9
1974	45.0	19.8	9.4	10.4	22.5	48.4
1975	19.2	13.9	(1.7)	15.6	17.0	65.4
1976	14.7	(1.6)	(0.7)	(0.9)	4.5	69.9
1977	8.8	9.3	(3.2)	12.5	11.2	81.1
1978	17.7	14.9	0.6	13.4	14.9	96.0
1979	15.0	12.4	15.5	(3.1)	3.2	99.2
1980	9.9	9.2	2.6	6.6	7.8	107.0
1981	18.4	0.5	(11.0)	11.5	13.9	120.9
1982	9.9	(1.4)	(8.8)	7.4	8.3	129.2
1983	23.2	(2.6)	(6.9)	4.3	10.9	140.1
1984	39.6	(1.7)	(5.3)	3.6	16.2	156.3
1985	5.5	1.1	(14.4)	15.5	12.0	168.4
1986	5.4	18.3	(33.0)	51.3	35.3	203.6
1987	10.0	10.6	(66.7)	77.3	53.7	257.3
1988	25.0	8.2	(20.0)	28.2	27.1	284.4
1989	15.6	7.7	(32.0)	39.7	31.1	315.5
1990	10.0	(1.2)	(10.3)	9.1	9.4	324.9
1991	10.0	1.4	(8.2)	9.6	9.7	334.6
1992	10.0	1.7	(7.1)	8.8	9.2	343.9
1993	10.0	3.3	(5.8)	9.1	9.4	353.3

Revalued Fixed Assets			1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
Gross Fixed Assets	GFA	GFA(1+RF)+AA	460	569	688	749	858	1,172	1,314	1,892	2,671	3,066	3,492	4,319	5,037	7,044	10,964	17,949
Cumulative Depreciation	CD	CD(1+RF)+AD	132	179	225	250	297	344	383	445	614	741	906	1,151	1,365	1,984	3,264	4,527
Net Fixed Assets	NFA	GFA-CD	328	390	463	499	561	829	931	1,447	2,057	2,324	2,586	3,167	3,652	5,060	7,800	13,422
Work in Progress	CWIP	CWIP(1+RF)+AA	18	38	86	171	312	475	752	600	911	1,363	1,994	2,533	3,251	4,759	7,688	3,868
CWIP Increment	CWIPI	CWIPRF		9	15	8	35	71	24	47	127	113	218	410	391	1,678	4,129	1,031
GFA Increment	GFAIRF	GFAIRF		128	117	34	96	175	42	147	371	254	382	699	606	2,484	5,890	4,861
CD Increment	CDIRF	CDIRF		40	38	11	33	51	12	35	85	62	99	186	167	699	1,760	1,226
Revaluation Factor (%)	RF	Input		22.5	17.0	4.5	11.2	14.9	3.2	7.8	13.9	8.3	10.9	16.2	12.0	35.3	53.7	27.1
Exchange Rate $/N at Year-End	ER	Input		1.6228	1.5957	1.5853	1.5352	1.5444	1.7841	1.8300	1.6290	1.4850	1.3820	1.3090	1.1200	0.7500	0.2500	0.2000
Asset Additions	AA	Input		5	23	30	25	186	104	476	516	173	91	261	199	231	136	4016
Annual Depreciation	AD	Input		17	16	15	19	2	20	33	107	76	84	96	95	111	112	566
CWIP Additions	CWIPA	Input		16	41	82	121	117	262	-211	228	376	482	216	414	361	371	102

Note: AEFA Assets revalued officially done in 1972.

a/ Nigerian GDP Deflator (IFS 1986 Yearbook) & Guidelines on Inflation, Exchange Rates (AF4CO).
b/ Unit Value of Manufactured Exports (trade weighted for Nigeria)(AF4CO).
c/ Foreign Cost Inflation converted at ruling year-end exchange rates.
d/ Weighted annual revaluation factor based on 65% weight for foreign cost of the plant and 35% weight for local cost of the plant.

AF4IE/MGM
30-Jan-89

ANNEX 2-5

Attachment 1

NIGERIA-POWER SYSTEM MAINTENANCE AND REHABILITATION PROJECT

Projected Asset Revaluation

(in millions of Naira)

Work-in-Progress:	1988	1989	1990	1991	1992	1993
Opening Balance	7,722	3,808	1,923	1,190	1,151	1,088
Plus:-						
Additions During Year	102	883	1,796	3,095	3,116	1,557
Foreign Exchange Losses Capitalized	0	32	71	165	222	165
Less:-						
Transfers	4,016	2,800	2,600	3,300	3,400	2,373
Year-End Balance	3,808	1,923	1,190	1,151	1,088	436
Fixed Asset Schedule:						
Opening Balance	10,964	17,949	26,323	31,400	37,758	44,650
Revaluation Rate	27.1%	31.1%	9.4%	9.7%	9.2%	9.4%
Revalued Balance	13,933	23,523	28,800	34,458	41,250	48,845
Addition to Revaluation Reserve	2,969	5,574	2,477	3,058	3,492	4,195
Additions During Year	4,016	2,800	2,600	3,300	3,400	2,373
Balance at Year-End	17,949	26,323	31,400	37,758	44,650	51,218
Depreciation Schedule:						
Opening Balance	3,164	4,527	6,707	8,349	10,372	12,773
Revaluation Adjustment	857	1,406	631	813	959	1,200
Depreciation Rate	3.5%	3.5%	3.5%	3.5%	3.5%	3.5%
Depreciation During Year	506	775	1,010	1,210	1,442	1,678
Closing Balance	4,527	6,707	8,349	10,372	12,773	15,651
Revaluation Surplus Schedule:						
Beg. Bal. Revaluation Res.	5,765	11,463	15,631	17,477	19,722	22,255
Additions	2,112	4,168	1,846	2,245	2,533	2,995
W.I.P. Rev. Adjustment	3,566					
End Balance	11,463	15,631	17,477	19,722	22,255	25,250

AF4IE/MDM
02-Feb-89
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ANNEX 2-6

NIGERIA - POWER SYSTEM MAINTENANCE AND REHABILITATION PROJECT

Draft Terms of Reference for the Revaluation of Fixed Assets

1. The National Electric Power Authority (NEPA) intends to have a consultant(s) determine the value of its fixed assets as of December 31, 1988. The consultants would also devise a method for the future regular recording of pertinent asset data, develop an appropriate methodology and procedures for the annual updating of the valuation, and train NEPA staff in the use of the method and procedures.

2. The consultant(s) shall limit their engineering valuation to generating plant and other facilities representing about 75% of the total net value of NEPA's fixed assets.

3. The consultant(s) shall prepare an inventory of fixed assets, noting for each item: (a) its description, specifying the number of units and for each unit technical characteristics, if necessary using separate lines for the different units of identical items; and (b) its condition (in service, usable after repair, unusable, obsolete, etc.).

4. For each item, the consultant shall estimate:

   (a) its age;

   (b) its remaining economic life (the expected service life of each asset should be prepared on the basis of "best estimates");

   (c) its depreciated replacement value as of December 31, 1988;

   (d) its annual depreciation rate in percentage terms (100/(a+b)); and

   (e) its cumulative depreciation (a*c*d).

5. The remaining technical and service life of the fixed assets representing about 25% of the total asset value shall be prepared by comparison with the other 75% after taking due consideration of their function and the place where they are employed.

6. NEPA staff shall be included in the consultants' team for training, and will subsequently inventory and make the precise valuation of the said 25% under the supervision of consultants.

7. The consultants shall state how fixed assets should be revalued from one year to the next, pending a future engineering valuation, utilizing appropriate cost indices (for example, a construction or building cost index for part of the value of assets pertaining to civil engineering works, a foreign capital equipment cost index for the part of the value accounted by imported goods, and a domestic inflation index for other local costs).

AF4IE
January 1989

NIGERIA - POWER SYSTEM MAINTENANCE AND REHABILITATION PROJECT

Assumptions for Financial Analysis

A. Price Levels and Revenues

1. Prices. The following inflation and exchange rates have been assumed:

Year	International Inflation a/ (%)	Domestic Inflation (%)	Average Exchange Rates b/ (US$/₦)	(₦/US$)
1989	7.7	15	0.136	7.37
1990	-1.2	10	0.122	8.20
1991	1.4	10	0.122	8.90
1992	1.7	10	0.104	9.62
1993	3.3	10	0.098	10.25

a/ Unit value index for manufactured exports (trade weighted for Nigeria).
b/ Exchange rate of ₦6.9 = US$1 is assumed in January 1989.

2. Sales and revenue. Electricity sales (in GWh) and revenues are based on NEPA's audited operating results for 1987, and its estimated 1988 data. The estimated data for 1988 reflect a 35% level for system losses. Electricity consumption is assumed to increase by 7% p.a.

3. System losses (technical and non-technical) are assumed to decrease from 35% in 1988 to 20% in 1993, through improved metering and billing system and the improvement and strengthening of the transmission and distribution system: 4 percentage points each year in 1989 and 1990, 3 percentage points in 1991, and 2 percentage points each year in 1992 and 1993.

4. Average electricity tariffs are assumed to be as follows: 19 kobos/kWh in 1989 (weighted average of 7.1 kobos/kWh for January-May 1989 and 27.5 kobos/kWh for June-December 1989), 37.1 kobos/kWh in 1990, 43.2 kobos/kWh in 1991, 48.3 kobos/kWh in 1992 and 52.6 kobos/kWh in 1993. These tariffs levels were arrived at based on financial objectives given in para 2.37 in Chapter II.

5. Other revenues are estimated to increase at the same rate as GWh sales.

B. Operating Costs

6. Fuel expenses are based on the fuel consumption data prepared by NEPA, and appropriate adjustments for expected generation and sales conditions. The fuel cost estimate for 1988 is based on NEPA's budget estimates. A gas price of ₦5.24/MCF is assumed as of May 1989, with an increase of 8% p.a. in the future (as proposed by NNPC). The first increase is assumed to take affect in January 1990. Any increase in fuel cost in subsequent years due to price changes and/or a change in the hydro/thermal supply mix is assumed to be recovered through the proposed fuel adjustment clause in the tariff schedule.

7. Generation - other expenses are based on NEPA's 1988 budget estimates. Since the maintenance of generation facilities has been grossly inadequate in the past, a 50% increase in real terms in 1989, and a further 20% increase in real terms each year for 1990-1992 was assumed. In 1993, expenses are assumed to increase by the domestic inflation.

8. Transmission and distribution expenses are based on NEPA's 1988 budget estimates, and are assumed to increase in real terms as follows: 50% in 1989, and 20% each in 1990, 1991 and 1992. In 1993, they are assumed to increase by the domestic inflation.

9. The cost of consumer services is forecast to increase by 8% in nominal terms on the basis of data provided by NEPA.

10. Provisions for bad debt assume that a more efficient revenue collection program would be in place. The level of bad debts is forecast to fall progressively by one percentage point annually from the present 6% to 5% in 1989, 4% in 1990, 3% in 1991, 2% in 1992 and 1% thereafter.

11. Depreciation is calculated on a straight-line basis at an average rate of 3.5% on average gross fixed assets in service as revalued at the end of each year. The investment component of the Project is considered to extend the useful life of the underlying assets, and therefore these investments are depreciated at the same average rate as noted above.

C. Other Income Statement Items

12. Exchange Losses Pre-SFEM exchange rates are applied on all outstanding foreign debt on September 26, 1986. For all new loans, exchange rates given in para 1 above are applied. Exchange losses on construction loans each year are capitalized. Exchange losses on all other loans are charged to the revenue account in the period in which they occur.

13. Interest expense on all existing foreign loans is calculated on the basis of the data on loan amounts, repayment terms and interest rates, as provided by NEPA. Interest on restructured debt and on new naira debt from FGN is calculated at a rate of 14% p.a.; a 15 year maturity is assumed including 3 years of grace. A schedule of loan amounts, repayment terms, and interest rates for loans during the forecast period is given in para 22 below.

Interest expenses on loans relating to operations are charged to the revenue account.

D. Balance Sheet Items

14. Gross fixed assets in service and accumulated depreciation have been revalued each year. Assets were revalued from the 1972 cost level using a weighted revaluation index (Annex 2-3) based on domestic inflation (35% weight) and a Unit Value Index for Manufactured Exports (trade weighted for Nigeria), adjusted for the exchange rates in para 1 (65% weight).

15. Inventories have been estimated as a percentage of revalued gross fixed assets (GFA) in service as follows: 2% each in 1989, 1990 and 1991, 2.4% in 1992 and 3.5% in 1993.

16. Accounts receivable. Improvements in NEPA's billing and collection are assumed to reduce the accounts receivable from 15.4 months' revenues in 1988 to 8 months in 1989, 4 months in 1990, and 3 months thereafter. A vigorous program to achieve these targets is assumed to be in place.

17. Other current assets represent mostly salary advances to staff. They have been estimated at ₦108 million per year based on NEPA's figures.

18. Equity (paid-in capital) represents the FGN's interest in the Authority on the vesting date (April 1, 1972), computed in accordance with the provisions of the 1972 Decree.

19. Long term debt. External debt outstanding on September 26, 1986 is expressed in naira terms using a concessionary exchange rate of ₦1.6 = US$1 as allowed by the Central Bank of Nigeria. The terms and conditions of outstanding debt were modelled to determine the amortization for the remaining life of the debt. The new external debt after September 1986 was converted into nairas using prevailing and forecast exchange rates. The rescheduled naira debt owed to FGN is assumed to have a maturity of 15 years, including three years of grace.

20. Current maturities on long term debt reflect the portion of long-term debt due in the next 12 months.

21. Other current liabilities are based on the following: (a) accounts payable at the end of each fiscal year are assumed to decrease progressively from 10 months' cash operating expenses in 1989 to 6, 5, 4, and 2 months in 1990, 1991, 1992 and 1993, respectively; and (b) accrued interest is assumed to represent 3 months' annual interest expense.

E. Funds Flow Items

22. Total borrowing envisaged is assumed to be as follows:

Source	Currency	Equivalent Loan Amount (US$ Million)	Interest (%)	Term (years)	First Year of Principal Repayment (Estimated)
Proposed Project:					
- IBRD	US$	70.0	7.65	20	1994
- Commodity Aid from the Federal Republic of Germany	DM	15.4	3.00	40	1999
- KfW	DM	9.1	8.08	10	1991
- Suppliers' Credit	Pound Sterling	8.6	8.08	10	1991
Investment Outside the Project:					
- AfDB (132 kV) (transmission & distribution)	US$	156	8.00	20	1995
- US EX-IM Bank (Delta IV)	US$	110	8.75	20	1995
- SACE (Italy) (330kV lines)	Lira	121	6.00	8	1993
- Suppliers' Credit (unidentified)	US$	259	10.00	7	1993
- FGN a/	US$	227	14.00	15	1994
Total		976			

a/ FGN is expected to provide an estimated ₦1,294 million (US$182 million equivalent) in 1989 and ₦347 million (US$42 million) in 1990 in long-term debt necessary to cover NEPA's operational cash shortfalls.

23. The unidentified amount of US$259 million in foreign exchange requirements is not considered serious, given that (a) it occurs in later years, and (b) FGN has been able to mobilize in the past reasonable financing in bilateral aid and/or suppliers' credits for the power sector.

F. Debt Service

24. Foreign currency loans outstanding in September 1986 have been converted into naira using a concessionary rate of ₦1.6 = US$1, allowed by the Central Bank of Nigeria for servicing of these loans. New foreign currency loans have been converted into naira using the prevailing and projected exchange rates given in para 1 above. Foreign currency obligations in other currencies have been converted into US$ using the exchange rates prevailing at the end of 1988; this relationship between the US dollar and other foreign currencies is assumed to continue during the forecast period.

25. Customer contribution and security deposits totalling ₦613 million are assumed for the 1989-93 period. These reflect (a) consumer contributions for non-economic extensions and/or cost of extensions beyond the normal free portion permitted in tariffs; and (b) deposits under a new security deposit policy requiring new customers to post deposits of ₦150 for residential connections and ₦1,000 for industrial groups.

AF4IE
June 1989

NIGERIA-POWER SYS

Income Statements

(in millions of Nairas)

	Actual				Estimate		Projected					Total
	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1989-93
Sales Increase (%)	3.2	(10.1)	12.1	20.0	1.3	4.4	12.3	11.9	10.1	8.6	8.5	
Energy Sales (GWh)	6,106	5,487	6,152	7,380	7,476	7,804	8,761	9,803	10,796	11,723	12,722	
Average Price (kobos/KWh)	7.0	7.4	7.2	7.0	7.1	7.1	19.0	37.1	43.2	48.3	52.6	
REVENUES:												
Energy Revenue	428	406	446	518	530	553	1,661	3,632	4,659	5,662	6,692	22,306
Other Revenue	4	7	15	11	14	16	18	21	23	25	27	114
TOTAL REVENUES	432	413	461	529	544	570	1,679	3,653	4,681	5,687	6,719	22,419
OPERATING EXPENSES:												
Fuel	34	34	31	85	160	225	410	616	700	747	887	3,360
Purchased Power	1	2	2	2	4	6	0	0	0	0	0	0
Generation-Other	19	19	20	20	30	54	93	123	162	214	235	827
Transmission	13	14	15	18	19	26	45	62	81	108	118	414
Distribution	70	65	70	75	84	91	157	217	286	378	416	1,454
Consumer Services	19	20	22	25	26	40	43	46	49	55	60	253
Bad Debts Provision	26	24	27	31	32	33	83	145	140	113	67	548
Administration & General	100	89	121	169	167	206	361	397	437	481	529	2,204
Amortization of Development Costs	3	0	8	9	17	16	0	0	0	0	0	0
Depreciation	84	98	95	111	112	506	775	1,010	1,210	1,442	1,678	6,115
TOTAL EXPENSES	370	364	410	545	651	1,203	1,966	2,616	3,066	3,537	3,990	15,175
Operating Income	62	48	51	(15)	(107)	(634)	(287)	1,037	1,615	2,150	2,729	7,244
Foreign Exchange Gain/(Loss)	15	(8)	(59)	(47)	(16)	0	(20)	(52)	(155)	(295)	(312)	(834)
Interest on Deposits	10	7	1	5	4	0	0	0	0	0	0	0
Net Income Before Interest	87	47	(7)	(57)	(119)	(634)	(307)	984	1,460	1,855	2,417	6,410
Less:Interest	35	72	111	190	410	158	752	963	1,075	1,280	1,410	5,479
NET INCOME	52	(25)	(118)	(247)	(529)	(792)	(1,058)	21	385	575	1,007	931
Rate Base (average) a/	1,557	1,639	1,785	1,915	2,000	7,719	16,519	21,334	25,219	29,631	33,722	25,285
Rate of Return on Rate Base	4.0%	2.9%	2.9%	-0.8%	-5.4%	-8.2%	-1.7%	5%	6%	7%	8%	5.0%
Operating Ratio (%)	85.6	88.3	88.9	102.9	119.7	211.2	117.1	71.6	65.5	62.2	59.4	75.2

a/ Assets revalued from 1988.

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18-Jun-89
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NIGERIA-POWER SYSTEM MAINTENANCE AND REHABILITATION PROJECT

Balance Sheets

(in millions of Nairas)

	Actual						Estimate		Projected				
	1982	1983	1984	1985	1986	1987	1988	1988R a/	1989	1990	1991	1992	1993
Fixed Assets													
Plant in Service	1,998	2,089	2,350	2,549	2,780	2,924	17,949	17,949	26,323	31,400	37,758	44,650	51,218
Less: Depreciation	445	529	626	702	796	908	4,527	4,527	6,707	8,349	10,372	12,773	15,651
Net Fixed Assets	1,554	1,561	1,724	1,846	1,984	2,016	13,422	13,422	19,616	23,052	27,386	31,877	35,567
Work in Progress	1,046	1,540	1,750	2,164	3,928	4,156	3,808	3,808	1,923	1,190	1,151	1,088	438
Investments	2	1	1	1	1	1	1	1	1	1	1	1	1
TOTAL FIXED ASSETS	2,602	3,102	3,475	4,012	5,913	6,173	17,232	17,232	21,540	24,243	28,538	32,966	36,006
Other Assets													
Deferred debits	71	6	(31)	7	20	16	0	0	0	0	0	0	0
Current Assets													
Cash	450	130	70	74	133	119	119	119	119	119	194	204	299
Inventories	141	188	263	239	341	334	359	359	526	628	755	1,027	1,793
Receivables	359	405	485	577	584	737	712	712	1,125	1,218	1,170	1,422	1,680
Other Current Assets	0	0	0	0	0	0	108	108	108	108	108	108	108
TOTAL CURRENT ASSETS	949	723	818	890	1,058	1,189	1,299	1,299	1,879	2,073	2,227	2,761	3,879
TOTAL ASSETS	3,622	3,831	4,262	4,909	6,991	7,379	18,531	18,531	23,420	26,317	30,766	35,727	39,886
Equity:													
Paid in Capital	256	256	256	256	256	256	256	256	256	256	256	256	256
Retained Earnings	461	527	503	446	(418)	(946)	(1,737)	(1,737)	(2,795)	(2,774)	(2,389)	(1,813)	(806)
Revaluation Reserve b/	0	0	0	0	0	0	11,463	11,463	15,631	17,472	19,722	22,255	25,250
Exchange Equalization Reserve c/	0	0	0	0	0	1,454	1,454	1,454	1,454	1,454	1,454	1,454	1,454
Other	0	0	0	0	0	0	0	0	4	15	28	40	40
TOTAL EQUITY	717	783	759	702	(162)	764	11,436	11,436	14,550	16,428	19,071	22,192	26,194
Long Term Debt:													
Government	2,303	2,303	2,444	2,539	2,577	2,530	3,045	4,132	5,426	5,773	5,610	5,025	4,640
State Government Loans							8	8	8	8	8	8	8
Foreign	166	230	400	872	3,390	1,996	1,347	1,347	1,521	2,039	3,708	5,442	6,141
Total	2,469	2,533	2,844	3,411	5,968	4,526	4,401	5,488	6,956	7,820	9,127	10,475	10,790
Current Liabilities:													
Payables	353	435	573	680	910	1,518	2,074	987	993	803	773	698	385
Loan Interest	0	0	0	0	0	0	0	0	188	241	269	320	352
Current Maturities of LT Debt-Foreign	17	7	9	15	56	325	324	324	328	504	520	884	671
Current Maturities of LT Debt-FGN	0	0	0	0	0	0	0	0	0	0	363	385	385
Consumer Deposits	0	0	0	0	0	0	0	0	50	100	152	204	258
TOTAL CURRENT LIABILITIES	369	442	582	695	967	1,843	2,398	1,311	1,559	1,648	2,076	2,492	2,252
Consumer Contributions	67	73	77	100	218	246	296	296	356	421	492	569	651
TOTAL EQUITY & LIABILITIES	3,622	3,831	4,262	4,909	6,991	7,379	18,531	18,531	23,420	26,317	30,766	35,727	39,886
LT DEBT/(LT DEBT + EQUITY) (%)	77.5	76.4	78.9	82.9	102.8	85.6	27.8	32.4	32.3	32.2	32.4	32.1	29.2
CURRENT RATIO	2.6	1.6	1.4	1.3	1.1	0.6	0.5	1.0	1.21	1.26	1.07	1.11	1.72
RECEIVABLES (MONTHS)	10.1	11.4	14.3	15.5	13.5	16.7	15.4	15.4	8.0	4.0	3.0	3.0	3.0

a/ Restructured 1988 Acounts to reflect the conversion of current maturities due to FGN of N1,086 million as well as the rescheduling of all debt (including the restructured debt) totalling N4,131 million over 15 years at 14% interest.
b/ Assets revalued from 1988.
c/ Reflecting the exchange gain resulting from the application of pre-SFEM concessionary exchange rates on all foreign loans outstanding at September 26, 1986.

AF4IE/MDM
18-Jun-89
12:13:05

NIGERIA-POWER SYSTEM MAINTENANCE AND REHABILITATION PROJECT

Funds Flow Statements

(in millions of Nairas)

	Actual					Estimate	Projected				Total
	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1989-93
INTERNAL SOURCES OF FUNDS												
Operating Income	62	49	51	(15)	(107)	(634)	(287)	1,037	1,615	2,150	2,729	7,244
Depreciation	84	98	95	111	112	506	775	1,010	1,210	1,442	1,678	6,115
Consumer contributions	6	4	24	118	27	50	60	65	71	77	82	355
Other sources a/	10	12	1	(42)	(8)	16	50	50	51	53	54	258
Prior Year Adjustment	13	1	42	39	(1)	0	0	0	0	0	0	
TOTAL INTERNAL FUNDS	175	162	212	211	22	(62)	598	2,162	2,948	3,722	4,543	13,972
OPERATIONAL REQUIREMENTS												
Change in Working Capital	11	17	(48)	(122)	(462)	(447)	386	331	82	547	1,304	2,650
Interest Charged to Operations	35	72	111	190	410	158	752	963	1,075	1,280	1,410	5,479
Debt Repayment (Amortization)-Foreign	17	7	9	15	56	325	324	328	504	520	884	2,561
Debt Repayment (Amortization)-FGN	0	0	0	0	0	0	0	0	0	363	385	748
Other Payments	(66)	(37)	47	13	0	0	0	0	0	0	0	0
TOTAL OPERATIONAL REQUIREMENTS	(3)	59	119	96	4	36	1,462	1,623	1,660	2,710	3,983	11,438
CONTRIBUTION TO INVESTMENT	178	103	93	115	19	(98)	(865)	539	1,288	1,012	559	2,534
CAPITAL INVESTMENT												
The Project	0	0	0	0	0	0	203	576	365	97	16	1,257
Other Investments	584	419	414	361	371	102	680	1,220	2,730	3,019	1,541	9,190
TOTAL CAPITAL INVESTMENT	584	419	414	361	371	102	883	1,796	3,095	3,116	1,557	10,447
BALANCE TO BE FINANCED	406	316	321	247	353	200	1,748	1,257	1,807	2,104	998	7,913
FINANCED BY:												
Government Debt	12	141	110	79	220	200	1,294	347	0	0	0	1,641
Foreign Debt	74	115	215	226	116	0	450	898	1,869	2,102	1,093	6,412
Other	0	0	0	0	0	0	4	12	13	12	0	40
TOTAL CAPITAL SOURCES	86	256	325	305	336	200	1,748	1,257	1,882	2,114	1,093	8,093
CASH INCREASE/(DECREASE)	(320)	(60)	4	59	(14)	0	0	0	74	10	95	
CASH AT BEGINNING OF YEAR	450	130	70	74	133	119	119	119	120	194	204	
CASH AT YEAR END	130	70	74	133	119	119	119	119	194	204	299	
ANNUAL DEBT SERVICE COVERAGE	2.8	1.9	1.2	0.5	0.0	(0.3)	0.5	1.6	1.8	1.7	1.6	
ANNUAL CONTRIBUTION:												
To Construction (%)	30.5	24.7	22.5	31.8	5.0	(95.6)	(97.9)	30.0	41.6	32.5	35.9	

a/ Includes Consumer Deposits beginning 1989.

Note: NEPA's practice is to capitalize foreign exchange losses arising from the revaluation of construction loans and include them in the construction work-in-Progress. The foreign exchange losses applicable for the period under review and for the projected period are as set out below:

	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	Total 1989-93
Foreign Debt Exchange Loss Provision	0	50	201	1,651	0	0	32	71	165	222	165	656
Foreign Exchange Loss Capitalised	0	50	201	1,651	0	0	32	71	165	222	165	656

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NIGERIA-POWER SYSTEM MAINTENANCE AND REHABILITATION PROJECT

Working Capital Statements

(in millions of Nairas)

	Actual					Estimate		Projected				
	1983	1984	1985	1986	1987	1988	1988R a/	1989	1990	1991	1992	1993
RECEIVABLES												
Energy Revenue	405	485	567	584	737	692	692	1,113	1,211	1,165	1,416	1,673
Other Revenue	0	0	0	0	0	21	21	12	7	6	6	7
TOTAL RECEIVABLES	405	485	567	584	737	712	712	1,125	1,218	1,170	1,422	1,680
INVENTORIES												
Gross Plant	188	263	239	341	334	359	359	526	628	755	1,027	1,793
TOTAL INVENTORIES	188	263	239	341	334	359	359	526	628	755	1,027	1,793
OTHER CURRENT ASSETS	0	0	0	0	0	108	108	108	108	108	108	108
TOTAL CURRENT ASSETS (Excluding Cash)	593	748	806	925	1,070	1,179	1,179	1,760	1,954	2,034	2,557	3,580
CURRENT LIABILITIES												
Accrued Interest								188	241	269	320	352
Accounts Payable	435	573	680	910	1,518	2,074	987	993	803	773	698	385
TOTAL CURRENT LIABILITIES b/	435	573	680	910	1,518	2,074	987	1,181	1,044	1,042	1,018	738
WORKING CAPITAL (Excluding Cash)	158	175	126	14	(448)	(894)	192	579	910	992	1,538	2,843
INCREASE/(DECREASE in WORKING CAPITAL	158	17	(48)	(122)	(462)	(447)	0	386	331	82	547	1,304

a/ Restrucutured 1988 accounts to reflect the conversion of current maturities due to FGN of N1,086 million to Long-Term Debt.
b/ Total excludes cash shortfall and current maturities, consumer deposits (see balance sheet)

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NIGERIA - POWER SYSTEM MAINTENANCE AND REHABILITATION PROJECT

Electricity Supply Facilities and Detailed Project Scope

A. Generation Maintenance and Rehabilitation

1. Background. The unavailability of foreign exchange in the 1982-84 period meant that NEPA had to forego any significant preventive maintenance measures and regular overhaul programs. Generating units gradually failed; in 1983 only 1,100-1,200 MW of the capacity was available and load had to be interrupted accordingly, resulting in a major expansion of autoproducer capacity. The reallocation of US$44.4 million (of this, US$22 million was for generation maintenance) from Loan 2085-UNI in late 1984 permitted a substantial increase in capacity, relieving load shedding due to capacity restraints. By late 1986, the capacity situation had improved considerably through generation rehabilitation and addition of new capacity (Egbin and Jebba). NEPA now has about 4,700 MW of installed capacity. However, due to serious financial constraints, NEPA has been unable to obtain critical spare parts and carry out normal maintenance and rehabilitation work for the units, and the overall actual plant availability is very low; delays in the completion of the Escravos-Lagos gas pipeline until recently (completed only in late 1988) and the high cost of oil to operate the Egbin plant also contributed to the non-availability of the Egbin plant. The average plant availability in 1986 was about 2,650 MW, deteriorating further to 2,330 MW in 1987 and to 2,005 MW in the first half of 1988, to meet a peak load of about 1,900 MW in early 1988 (a reserve margin of only 6%). As a consequence, load shedding became frequent and widespread.

2. The status of the generation system (September 1988) is shown in Attachment 1. In September 1988, out of a total 65 generating units, only 39 units (2,800 MW) were available. Many of the units have remained out of operation ranging from 1 to 4 years. Much work remains to be done to complete the rehabilitation of some units and to undertake overhauls that are long overdue. Besides rehabilitation, normal maintenance work on generating plants usually requires an annual expenditure of about 2% of the original investment. On this basis, NEPA needs to spend about US$50 million on average for annual maintenance of the operating capacity. This would involve major overhauls of hydro units every 5 years, steam units every 4 years, and gas turbine inspections and overhauls of varying intensity at 8,000, 16,000, 24,000 and 32,000 hours of operation. At NEPA, there is a serious backlog of rehabilitation and overhaul maintenance work. The US$22 million provided for generation maintenance under Loan 2085-UNI has only acted as a stop gap measure. A generation maintenance consultant for the preparation mission for the Power VII project in November 1986 estimated the cost of generation improvements at about US$180 million.

3. While the changeover of the Egbin plant to gas has provided some stability (base load operation) in the power supply, there is still an urgent need for rehabilitation and maintenance through proper overhaul of selected and economically sized plants so as to improve and maintain a reliable power supply. NEPA in the past has required a large amount of excess generating capacity because of frequent breakdowns arising from inadequate maintenance and planning and lack of resources. A significant change in this situation cannot be expected in the short term. In addition, the full output from the Egbin plant will depend on the sustained availability of gas in adequate quantity and proper plant operations and maintenance. Therefore, an adequate margin in generation capacity is necessary to meet the expected load growth and to ensure a reliable power supply.

4. In its system operation, NEPA has been facing major disturbances, some of which were attributable to sudden tripouts of the larger thermal units at Sapele and Afam. Due to the poor plant condition, the daily availability of these large units has also been unpredictable, severely affecting NEPA's daily system availability. A better availability of the large units through a proper rehabilitation and maintenance program is expected to give some stability to the NEPA system. In view of these considerations in conjunction with serious resource constraints, NEPA has decided to rehabilitate six large units currently out of operation at Sapele and Afam IV, and undertake in a phased manner overhauls of the ten large operating units (which are overdue for such maintenance) at Sapele and Afam IV; this approach is satisfactory. The scope of the generation maintenance and rehabilitation subcomponent included in the project is given below.

5. Scope of the Generation Maintenance and Rehabilitation Work. In total, 7 units (total 606 MW) at the Sapele, Afam IV, and Delta plants, currently inoperable will be rehabilitated, and 10 units (total 850 MW), which are operating but are overdue or will soon become overdue for major overhauls at Sapele and Afam IV, will be overhauled.

(a) Rehabilitation and Overhauls

(i) Completion of the ongoing rehabilitation and overhaul work for ST1 (120 MW) and GT2 (70 MW) at Sapele as follows:

ST1 Boiler: supply of chemicals and chemical cleaning, supply of necessary instrumentation and electrical equipment spare parts, replacement of cannibalized relays, technical services for recommissioning of the boiler.

ST1 Turbogenerator: Supply of necessary spare parts for instrumentation and control equipment, and technical services for hot recommissioning of the unit.

GT2: Supply of instrumentation spare parts and technical services for hot commissioning of the unit.

(ii) Complete rehabilitation and overhaul of the inoperable units ST2 and ST5 at Sapele (120 MW each), GT 17 and GT18 at Afam IV (70 MW each), and GT2 at Delta (36 MW) as follows:

ST2: Pre-rehabilitation inspections to assess the condition of the boiler, turbogenerator; spares including pneumatic and electrical spares, and consumables for the boiler, technical services for boiler overhaul; reblading of the damaged 7th and 8th row blades of the LP rotor and the diaphragms (stator blades), mechanical, pneumatic and electrical control and other spares, consumables, and technical services for the rehabilitation and overhaul of the turbogenerator.

ST5: Pre-rehabilitation inspection of the turbogenerator (inspection of the boiler already done); spares and consumables, technical services for overhaul of the boiler; LP blades for 7th and 8th rows, spares and consumables, and technical services for the overhaul of the turbogenerator.

GT17 and GT18: Pre-rehabilitation inspections; replacement of the damaged hot gas path turbine inner casing; refurbishing of the turbine blades (repairs and rechromising), spares and consumables, and technical services for major overhauls.

GT2 at Delta: Technical services for rehabilitation of the unit utilizing spare parts at site, purchased earlier for GT2 and GT1.

(iii) Overhauls in a phased manner of the economically sized and operating 10 units which are already overdue or will soon become overdue for capital maintenance: ST3, ST4 and ST6 at Sapele (120 MW each), GT1, GT3 and GT4 at Sapele (70 MW each), and GT13, GT14, GT15 and GT16 at Afam IV (70 MW each). The overhaul of each unit will include technical services for pre-overhaul inspections (including boilers in the case of Sapele steam units), supply of spare parts and consumables for overhaul, and technical services for the overhaul and recommissioning; in the case of gas turbine units, testing and repairs will include the combustion chamber, inner casing, and repairs and rechromising of turbine blades.

(b) Spare Parts. Supply of running spares, repairs of and spare blades, and consumables for two years for the above 16 units at Sapele and Afam IV.

(c) Technical Services for Operations, Maintenance and Training

The project provides for expert services for two years (total 240 man-months) from manufacturers of the above units for supervision of plant operations and maintenance, and training of the NEPA technical staff to help ensure the safe and reliable operations and maintenance of the units.

Sapele Steam Boilers (72 man-months)

1 commissioning/operations expert (24 man-months)
1 mechanical maintenance expert (24 man-months)
1 chemical expert (6 man-months) followed by an instrumentation expert 18 man-months)

Sapele Steam Turbogenerators (72 man-months)

1 commissioning/operations expert
1 mechanical maintenance expert
1 electrical works expert
(The expert on the electrical side will also assist in the electrical side for the Sapele gas and Afam gas plants)

Sapele and Afam Gas Stations (96 man-months or 48 man-months each)

For each station, 2 experts for 2 years:
1 commissioning/operations expert
1 mechanical maintenance expert

B. Transmission Maintenance and Improvements

6. Background. NEPA's transmission system consists of about 4,500 circuit km of 330 kV lines, twenty two 330 kV/132 kV main stepdown substations, about 4,500 circuit km of 132 kV lines with 80 substations feeding the subtransmission and primary distribution networks at 33 kV and 11 kV. The system is characterized by a relatively small number of long transmission lines connecting generating stations which, with the exception of the Egbin plant in Lagos, are remote from load centers. The reliability of the transmission system has been poor.

7. NEPA is planning to construct about 870 km of single circuit 330 kV transmission lines--Benin-Onitsha (137 km), Alaoji-Enugu and Enugu to Makurdi (423 km) and Gombe-Maiduguri (310 km), together with switching facilities at existing stations and new 330/132 kV stepdown stations at Makurdi and Maiduguri. These lines will strengthen ties with the southeast load area, provide second circuit for evacuating output from the Afam plant, and improve the supply situation.

8. The NEPA transmission system has an adequate 330/132 kV stepdown transformer capacity of about 5,000 MVA. However, the combined 132/33 kV and 132/11 kV (a small portion of the total) stepdown capacity is only

about 3,400 MVA and is inadequate. Since most stations are designed with 2 transformers to allow service to be maintained if a transformer fails, the 132/33 kV capacity should be at least about 4,000 MVA if fully loaded or about 5,000 MVA if allowance is made for low power factor, future load growth and load diversity. The inadequate 132/33 kV transformer capacity on the NEPA system is causing load suppression due to overloading on specific stations. NEPA is planning to construct about 19-132/33 kV substations and extend 11 existing substations, together with connecting 132 kV lines, to increase electricity supply from the existing transmission networks by adding about 2,300 MVA of 132/33 kV substation capacity.

9. Substantial progress was achieved in rehabilitating the transmission system under Loan 2085-UNI (about US$12 million for spare parts, replacement of SF6 breakers, and manufacturers' services to correct the most serious deficiencies). Since then, due to the serious financial constraint, NEPA has not been able to obtain the needed spare parts and manpower services for maintaining the circuit breakers and other equipment, and virtually no routine maintenance has been carried out. As a result, the transmission facilities of NEPA are in a poor condition. There is, therefore, a need for considerable support in improving NEPA's transmission facilities and providing transformers, reactors (necessary for controlling the voltage levels), circuit breakers and fault throwing switches (which guide the line repair crews in locating the faults). There is also a need to strengthen and make fully operational the National System Control Center.

10. NEPA's system has been experiencing major system collapses. In 1987, there were about 22 system collapses (blackouts) and 11 partial system faults, of which 17 faults originated from the transmission system. During the first half of 1988, six out a total of 9 major system disturbances were due to problems in the transmission system; the remaining three faults were due to problems in the generation system. The recent experience of the power system performance is summarized below.

	Major System Disturbances			Partial System Disturbances			
Year	Total No.	Due to Transmission Faults	Due to Generation Faults	Total No.	Due to Transmis-sion Faults	Due to Generation Faults	Total Grid Collapses Resulting in Total Loss of Supply
1984	95	78	17	47	40	7	32
1985	48	35	13	32	22	18	13
1986	13	7	6	8	2	6	6
1987	22	17	5	11	10	1	22
1988	9	6	3	1	1	-	8

During such system disturbances, it invariably took a long time, about half an hour for partial system recovery to about 3 to 4 hours for complete station recovery. Such disturbances have a devastating effect on the stability of machines at thermal stations. Sapele steam power station often lost supply of demineralized water, and bringing back the units required about 4 hours for effecting complete system recovery. During such system disturbances, an estimated 2 GWh of generation out of a total average daily generation of about 32 GWh were lost on each occasion (or

some 6.25% of the total). It also led to increased fuel consumption for start-up purposes. Estimates of lost generation due to system disturbances are given below.

	Loss of Electricity Output due to System Disturbances (GWh)
1985	160
1986	42
1987	66
1988	20

11. The post fault analysis by NEPA confirms that the protective schemes are not able to cope adequately for clearing the faults, and result in minor system faults developing into major system faults. Such frequent sudden system collapses have a large adverse effect on the stability of the machines particularly at the thermal and gas fired stations. The gas turbine blades and other components are prone to sustain damage due to sudden thermal shocks on account of full load tripouts. The poor reliability of the system also had an adverse effect on the overall image of NEPA.

12. A number of power transformers in the system (about 21 transformers with a total of 720 MVA capacity) are getting overloaded in the range of 90% to 135% for a period of about 4 hours each day. As a result, some of the area control centers have to resort to shedding loads to avoid overloading of transformers for a period of 1 to 3 hours, which results in an estimated daily loss in electricity consumption of about 1 GWh (or 3%). A number of 132/33 kV injection transformers (about 20 with a total of 275 MVA capacity) are loaded up to 85%, and are, therefore, due for reinforcement. Due to load shedding for this reason, an estimated 0.5 GWh of electricity consumption is being lost daily. This has also restricted connections for additional service.

13. Scope of Transmission Improvements. The project would provide equipment, spares and services for improvements of the transmission system in the following critical areas:

(a) Spare parts and services for the overhaul of major 330/132 kV substations.

(b) Replacement of 37 old air blast circuit breakers (installed some 20 years ago and now obsolete) by SF-6 breakers.

(c) Replacement of fault throwers in eight critical locations by SF-6 circuit breakers.

(d) Replacement of 10-132 kV circuit breakers by SF-6 breakers in critical locations.

(e) Spare parts for the power line carrier party line and telex communication system.

(f) Radio equipment for imp oving communication between major substations and service centers.

(g) Technical services for completion of selected 132 kV transmission lines and associated substations in Lagos, which are an important part of NEPA's Lagos Distribution System Expansion Scheme.

C. Distribution Improvements

14. Background. NEPA's distribution system consists of the following: (a) 33 kV distribution system (about 9,500 km of 33 kV lines, 330--33/11 kV substations, and 3,400 MVA 33/11 kV transformer capacity); (b) 11 kV distribution network (about 15,750 km of 11 kV lines, 12,800--11/0.415 kV substations, and 3,700 MVA 11/0.415 kV transformer capacity); (c) 415V LT lines; and (d) about 2.026 million service connections (September 1988). In recent years, the shortage of distribution materials and vehicles has constrained expansion of the distribution system and new service connections.

15. Although the total substation capacities appear adequate, there are area overloads due to load imbalances. This has led to load shedding at several locations and restriction on new service connections; the average monthly loss in electricity sales is estimated at 5.2 GWh. An estimated 350 MW load is also presently suppressed. A System Emergency Reinforcement Committee in NEPA in 1987 identified eleven transmission substations and 66 distribution injection substations with overloading of the transformers, and hence requiring reinforcements. There is also some work still needed to complete the distribution facilities in the Lagos area.

16. Scope of Distribution Improvements. The proposed project aims at strengthening the distribution system in selected priority areas to overcome the present weaknesses and for assuring maintenance of existing distribution facilities. It will add about 370 MVA of distribution substation capacity as well as help expand and strengthen distribution lines. The detailed scope is given in Attachment 2 and summarized below.

(a) Power transformers (28--33/11 kV with a total capacity of 170 MVA).

(b) Distribution transformers (140--33/0.415 kV with a total capacity of 50 MVA, and 400--11/0.415 kV with a total capacity of 150 MVA).

(c) 33 kV and 11 kV switchgears.

(d) High tension and low tension cables and joining accessories.

(e) Overload line materials.

(f) Protection, communication and control equipment components.

(g) Raychem cable joining kits.

(h) Rechargeable lamps and district communication equipment.

D. Metering Improvements

17. The project includes the supply of about 20,600 consumer meters for services to new customers as follows:

- maximum demand meters	600
- polyphase meters	20,000
- associated current transformers	2,000

E. Vehicles

18. Background. The existing NEPA vehicle fleet (about 3,000) is almost worn out, and the day-to-day operations of the entity are severely constrained by vehicle shortages. NEPA's policy is to change cars and vans every four years, and trucks every six years. However, the age of the present fleet is in the 5-10 year range as no new purchases have been made since 1983. Many vehicles are immobilized due to spare parts shortages and/or lack of funds for repairs. Overall, only some 10-20% of the fleet is operational. It is estimated that about 1,600 standard vehicles are required as replacements. In addition, NEPA utilizes special vehicles, including cranes, bulldozers, and pole trailers, etc. It is estimated that NEPA requires about 140 special vehicles as replacements.

19. Scope. The project includes the supply of about 320 standard and special replacement vehicles together with spare parts for generation, transmission, distribution and training, as follows:

	Distribution	Transmission	Generation	Training	Total
	Number of vehicles				
Vans	29	7	8	-	44
Station wagons	29	7	8	-	44
Pickups	121	7	8	-	136
4-wheel drives	24	19	-	-	43
5-ton lorries	12	6	7	-	25
10-ton cranes	12	6	7	-	25
32-seater buses	-	-	-	3	3
Total	227	52	38	3	320

F. Conversion of the Egbin Plant to Gas

20. The project includes engineering services for supervision and monitoring of the conversion of the Egbin plant from oil to gas. The changeover to gas was completed in April 1989.

G. Utility Assistance Program

21. The project would finance a "utility assistance program" for NEPA with a well-known international utility company within the medium-term framework (until about mid-1993) to provide technical assistance (about 500 man- months) covering various aspects of NEPA's operations (technical, engineering, financial, managerial and administration).

H. Data Processing

22. The project will provide personal computers and proven software to improve consumer billing, materials management, general accounting applications, and MIS at the headquarters, plants and distribution centers. The detailed scope will be prepared with the assistance of the utility partner during the second half of 1989.

I. Training

23. The project will assist NEPA's Training Department in improving operational capabilities at the three training centers through support for (a) the relocation of the overcrowded Ijora Training Center to another newly-constructed building of a simple design in the Lagos area; (b) renovations and additions to the Kainji and Afam Training Centers; (c) training equipment for the three Training Centers; and (d) the procurement of buses for trainee transport and auxiliary services (included under the vehicles component). The utility partner under the Utility Assistance Program will provide technical assistance as needed for specialized course development and implementation. The estimated base costs are summarized below.

	Local	Foreign	Total
	(in US$ million)		
Construction/renovation of training centers	0.4	-	0.4
Training equipment	0.1	1.0	1.1
Total base cost	0.5	1.0	1.5

J. Project Management

24. The project includes engineering services (about 60 man-months) for project implementation and management (project implementation planning,

scheduling, procurement assistance including preparation of bidding documents and bid evaluation, supervision of maintenance and rehabilitation work, cost control and other matters in project implementation.

K. Studies and Future Project Preparation

25. The project includes consultancy services (about 100 man-months) for updating of available studies to prepare a least cost priority investment program taking into account recent developments, preparation of feasibility studies and other studies necessary for developing the future investment projects for external financing.

AF4IE
June 1989

ANNEX 3-1
Attachment 1

NIGERIA - POWER SYSTEM MAINTENANCE AND REHABILITATION PROJECT

Status of Generation Capacity, September 1989

Plant/Unit		Year	Installed Capacity (MW)	Available Capacity (MW)	Unavailable Capacity (MW)	Remarks
Kainji Hydro						
	G5	1978	120	120		
	G6	1978	120	120		
	G7	1968	80	80		
	G8	1968	80		80	Damage to generator winding
	G9	1969	80	80		
	G10	1969	80		80	Damage to generator winding
	G11	1976	100		100	Damage to transformer
	G12	1976	100	100		
Subtotal			760	500	260	
Jebba Hydro						
	G-1	1983	90	90		
	G-2	1984	90		90	Damage to damper winding (excitation problem)
	G-3	1984	90	90		
	G-4	1984	90	90		
	G-5	1984	90	90		
	G-6		90	90		
Subtotal			540	450	90	
Total Hydro			1,300	950	350	
Egbin (Steam)						
	ST1	1986	220			All units available as capacity but the high cost of oil has limited operations. Units are being changed to gas firing (to be completed by March 1989).
	ST2	1985	220			
	ST3	1985	220			
	ST4	1986	220			
	ST5	1987	220			
	ST6	1987	220			
Subtotal			1,320	660	660	
Sapele (Steam)						
	ST1	1978	120		120	Under rehabilitation.
	ST2	1979	120		120	Out due to damaged turbine blades.
	ST3	1979	120	120		Overhaul overdue.
	ST4	1979	120	120		Overhaul overdue.
	ST5	1980	120		120	Damage to unit transformer, and breaker requires overhaul and rehabilitation
	ST6	1980	120	120		Overhaul overdue.
Subtotal			720	360	360	
Total Thermal Steam			2,040	1,020	1,020	
Sapele (Gas)						
	GT1	1981	70	70		Overdue for overhaul.
	GT2	1981	70		70	Under rehabilitation.
	GT3	1981	70	70		Overdue for overhaul.
	GT4	1981	70	70		Overdue for overhaul.
Subtotal			280	210	70	
Afam (Gas)						
	GT1	1963	12	7		
	GT2	1963	12		8	Scraped
	GT3	1965	17	15		
	GT4	1965	17		15	Damaged turbine inner casing.
	GT5	1976	24	20		
	GT6	1976	24	20		
	GT7	1976	24	20		
	GT8	1976	24		20	Turbine blade failure.
	GT9	1979	27		25	Overhaul overdue.
	GT10	1978	27	25		
	GT11	1978	27	25		
	GT12	1978	27	25		
	GT13	1982	70	70		Overdue for overhaul.
	GT14	1982	70	70		Overdue for overhaul.
	GT15	1982	70	70		Overdue for overhaul.
	GT16	1982	70	70		Overdue for overhaul.
	GT17	1982	70		70	Starting equipment problem.
	GT18	1982	70		70	Damaged turbine inner casing.
Subtotal			682	437	268	
Delta (Gas)						
	GT1	1966	36		36	Rehabilitation needed.
	GT2	1936	36		36	Rehabilitation needed.
	GT3	1975	20	20		Overdue for overhaul.
	GT4	1975	20		20	Reduction gear fault.
	GT5	1975	20		20	Vibration problem.
	GT6	1975	20	20		Overhaul overdue.
	GT7	1975	20		20	Damaged reduction gear problem.
	GT8	1975	20	20		Overdue for overhaul.
	GT9	1978	20	20		Overdue for overhaul.
	GT10	1978	20	20		Overdue for overhaul.
	GT11	1978	20		20	Damage to generator breaker.
	GT12	1978	20	20		Overdue for overhaul.
	GT13	1978	20	20		Overdue for overhaul.
	GT14	1978	20		20	Generator winding fault.
Subtotal			312	140	172	
Ijora (Gas)						
	GT4		20		20	Under maintenance
	GT5		20	20		
	GT6		20		20	Under maintenance.
Subtotal			60	20	40	
Total Thermal Gas			1,334	807	490	
Total			4,674	2,777	1,860	

NIGERIA - POWER SYSTEM MAINTENANCE AND REHABILITATION PROJECT

Distribution Improvements--Project Scope

1. Power transformers 33/11 kV - 28 Nos., total capacity of 170 MVA

2. Distribution transformers 33/0.415 kV - 140 Nos., total capacity of 50 MVA
   Distribution transformers 11/0.415 kV - 400 Nos., total capacity of 150 MVA

3. 33 kV and 11 kV switchgear and control panels
   33 kV transformer control panels - 40 Nos.
   Spare parts for 33 kV circuit breakers like turbulator components, vents, fixed and moving contact assemblies, closing and tripping cost, motor changing spring, etc.

Incomer 11 kV circuit breakers	-	22 Nos.
Bus section 11 kV CCT	-	10 Nos.
Feeder 11 kV CCT	-	45 Nos.
Spare 11 kV VTS	-	10 Nos.
Other spares of 11 kV breakers, and fuses	-	6,500 Nos.
Silica gel	-	50 drums

4. High tension and low tension cables and accessories

33 kV cable 3 x 240 sq. mm.	-	12 km
33 kV cable 1 x 300 sq. mm.	-	4 km
11 kV cable XLPE 35 sq. mm.	-	18 km
11 kV cable 3 x 70 sq. mm.	-	4 km
11 kV cable 1 x 300 sq. mm.	-	12 km
Cable sockets of various sizes	-	2,300 Nos.

   Tapes, fluxite, ferrules, electroclean, fuses, G-38 compound, etc.

5. Overhead Line Materials

Line taps for various sizes of conductors	-	13,000 Nos.
Bimetal connectors in various sizes	-	2,250 Nos.
'D' fuses - 11 kV	-	600 Nos.
'D' iron complete	-	10,000 Nos.
Snail clamps	-	2,000 Nos.
Adopter socket	-	22,500 Nos.
Stay wires	-	15 km
11 kV pin insulators	-	15,000 Nos.
33 kV pin insulators	-	15,000 Nos.
Stay insulators	-	4,000 Nos.
Tie straps - 33 kV	-	5,000 Nos.
11 kV	-	5,000 Nos.
Stay rods	-	4,000 Nos.
Adoptor sockets sets	-	15,000 Nos.
Fused isolator 11 kV	-	50 Nos.
Line isolators 11 kV	-	50 Nos.

Bare copper conductor - 70 sq. mm.	-	100 km
Strain insulators - 11 kV	-	10,000 Nos.
Shackle insulators	-	25,000 Nos.
11-kV spindle and pin insulators	-	15,000 Nos.
33-kV 'D' fuses	-	100 Nos.
33-kV fuse isolator rocking	-	100 Nos.
33-kV line isolator	-	100 Nos.
11-kV and 33 kV 'D' fuse elements for 11 kV	-	10,500 Nos.
33 kV	-	4,500 Nos.
Earth rods	-	10,000 Nos.
Lightning arrestors 33 kV	-	500 Nos.
11 kV	-	750 Nos.
33-kV spindles	-	15,000 Nos.
6. Protection, Communication and Metering Equipment		
33 kV VT's (voltage transformers?)	-	8 Nos.
33 kV CTs	-	8 Nos.
Spare relays - O/C and E/F	-	20 Nos.
Flag relays	-	20 Nos.
Trip relays	-	20 Nos.
Differential relays	-	20 Nos.
SBEF relays	-	20 Nos.
Alarm system relays	-	4 Nos.
Machining CTs	-	30 Nos.
Tripping units - 110V D.C., 75 AH	-	40 Nos.
30V D.C.	-	5 Nos.
Multi amp. relay test kits & other test instruments	-	11 Nos.
Oil filtering machines	-	10 Nos.
7. Raychem Materials--		
Raychem cable jointing kits for various sizes of cables:		
95 sq. mm.	-	60 Nos.
185 sq. mm.	-	185 Nos.
90 sq. mm. HT	-	50 Nos.
185 sq. mm.	-	250 Nos.
95 sq. mm.	-	50 Nos.
185 sq. mm. right angle	-	60 Nos.
300 sq. mm.	-	30 Nos.
and other jointing accessories		
8. District Communication Equipment		
VHF consolate base radios, including antennas and other accessories	-	50 Nos.
VHF mobile radio sets and installation accessories	-	30 Nos.
RHF walkie-talkie type sets	-	65 Nos.
Emergency rechargeable lamps	-	50 Nos.

NIGERIA-POWER SYSTEM MAINTENANCE AND REHABILITATION PROJECT

Project Management Services for the Project Implementation Coordination Team in NEPA

Draft Terms of Reference

1. The National Electric Power Authority (NEPA) is undertaking a power sector maintenance and rehabilitation project and has applied for a loan from the World Bank for financing of the project. The main objectives of the project are to: (a) carry out much-delayed maintenance and rehabilitation of selected generation, transmission and distribution facilities, so as to improve the supply of power; and (b) promote institutional strengthening of NEPA and help initiate a rational medium-term recovery program.

Project Management and Status

2. While each Assistant General Manager (AGM) will be responsible for the component in his division, a Project Implementation Coordination Team, under the direct supervision of the General Manager, will have adequate authority to ensure effective planning, coordination and monitoring of implementation of the overall project. The team would be headed by a senior manager and comprise senior representatives of each division. The rehabilitation and overhauls of the facilities will be planned and carried out in a manner so as to minimize interruptions to the power supply.

3. NEPA wishes to strengthen its Project Implementation Coordination Team with an experienced technical expert from an international consulting firm specializing in engineering to assist it in project management -- one expert on a full-time basis in Nigeria with specialized backing from the home office of the selected engineering firm.

4. The rehabilitation and overhauls of the 17 generation units will be carried out by the original equipment suppliers (Deutsche Bobcock for the boilers at Sapele, ASEA Brown Boveri for the turbogenerators and gas turbines at Sapele, gas turbines at Afam IV and at Delta). They will be responsible for carrying out inspections where needed of the units to be rehabilitated/overhauled, the supply of spares and components, installation, testing and commissioning.

Scope of Services Required

5. The scope of services required shall include, but not be limited to, the following:

(a) Develop and implement systems and procedures for planning and scheduling for implementation of the rehabilitation and maintenance components for the generation, transmission and distribution systems at each project implementation stage

(inspections, procurement, shipping, erection, testing and commissioning);

(b) keep under review and control project costs and monitor progress of expenditures;

(c) coordinate organization of pre-rehabilitation and maintenance work, including inspections;

(d) optimize project implementation arrangements to minimize unit shut-downs, interruptions to power supply, etc.;

(e) coordinate work of individual supplier's personnel with a view to minimizing cost of services;

(f) review contractors' periodic progress reports;

(g) train NEPA staff in project cost control, planning and monitoring of the rehabilitation work;

(h) assist in the review of the inspection reports of the generation units and the resulting scope of work prior to rehabilitation/overhauls;

(i) assist NEPA in the preparation of bidding documents and bid evaluation (for transmission, distribution, metering, vehicles, training equipment, and personal computers), negotiations of the contracts (for all rehabilitation and maintenance work including the generation facilities), and contractual arrangements with contractors including testing and commissioning and performance guarantees. The consultants will assist NEPA in the preparation of technical specifications as necessary;

(j) provide information on the international market for equipment, goods and materials related to the project;

(k) assist in ensuring strict observance of contractual agreements and all appropriate guarantees form contractors;

(l) provide assistance in international procurement of equipment under the project; and

(m) assist in the monitoring of international shipping arrangements, and their timing vis-a-vis overall implementation schedule to minimize costs.

Data, Local Services and Facilities to be Provided by NEPA

6. Data. NEPA is to provide the consultants with all available information that may be reasonably required for carrying out the assignment.

7. Facilities and Supporting Staff for the Consultants. NEPA is to provide the following staff and facilities to help the consultants in performing the services in Nigeria:

(a) counterparts to work with the consultants;

(b) suitable furnished office accommodation, including utilities, telephone and office equipment and supplies;

(c) suitable housing;

(d) adequate administration and clerical personnel;

(e) cost of transportation and transportation facilities within Nigeria.

Schedule of Implementation and Reports

8. The overall project is expected to take about 36 months to implement. As for the generation subcomponent, rehabilitation of the six units currently inoperable at Sapele and Afam IV will be carried out in a phased manner over a period of about 15 months. Overhauls of the ten generation units, which are running, will be done in a phased manner over a period of about 24 months. The rehabilitation and maintenance of the transmission and distribution systems is expected to be implemented over a period of 18 months.

9. The consultant will prepare periodic reports on the project status and progress.

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ANNEX 8-8

NIGERIA - POWER SYSTEM MAINTENANCE AND REHABILITATION PROJECT

Project Implementation Schedule

Sub-Project	Implementation Stage	1989				1990				1991				1992				1993	
		1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2
Rehabilitation/overhauls of seven units presently out at Sapele, Afam and Delta: ST1, ST2, ST5, GT2 at Sapele, GT17 and GT18 at Afam, and GT2 at Delta	Contract prep. & award - Boilers a/ - Turbogenerators and gas turbines b/ Inspection/rehabilitation/overhauls																		
Overhauls of ten units presently operating at Sapele and Afam: 1. ST3, ST4 and ST6 at Sapele 2. Gas Turbines--GT1, GT3 and GT4 at Sapele 3. Gas Turbines--GT13, GT14, GT15 and GT16 at Afam	Inspection & overhauls - Boilers - Turbogenerators Inspections & overhauls Inspections & overhauls																		
Technical services for operations, maintenance and training for generation	Boilers at Sapele Turbogenerators at Sapele Gas turbines at Sapele Gas turbines at Afam																		
Transmission improvements	Procurement Equipment/material manufacturing & shipping Installation																		
Distribution improvements	Procurement Equipment/material manufacturing & shipping Installation																		
Metering equipment	Procurement Meter manufacturing & shipping Installation																		
Vehicles	Procurement Vehicle manufacturing and shipping																		
Egbin gas conversion																			
Institutional strengthening	Utility assistance Data processing - Commputer & software ordering - System installation Training																		

a/ This contract will also cover inspection and overhauls of boilers for ST3, ST4 and ST6 at Sapele, and technical services for operations and maintenance and training.

b/ This contract will also cover inspection and overhauls of turbogenerators for ST3, ST4 and ST6 at Sapele, gas turbines for GT1, GT3 and GT4 at Sapele, and GT13, GT14, GT15 and GT16 at Afam, and technical services for operations and maintenance and training.

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NIGERIA - POWER SYSTEM MAINTENANCE AND REHABILITATION PROJECT

Capital Cost Estimates by Project Components

A. Generation Maintenance and Rehabilitation
(in US$ million)

	Sapele Steam						Sapele Gas			Afam IV Gas c/			Total		
	Boilers			Turbogenerators											
	Local	Foreign	Total	Local	Foreign	Total	Local	Foreign	Total	Local	Foreign	Total	Local	Foreign	Total
Rehabilitation and Overhauls															
Equipment, Material & Spares	1.11	6.16	7.27	1.71	9.50	11.21	0.38	2.09	2.47	1.83	7.87	9.70	4.53	25.12	29.65
Engineering Services	0.66	3.93	4.59	0.91	5.48	6.39	0.34	2.03	2.37	0.52	3.14	3.66	2.43	14.58	17.01
Running Spares, Consumables, Repairs of and Spare Blades	0.16	0.86	1.02	0.16	0.86	1.02	0.31	1.72	2.03	0.48	2.68	3.16	1.11	6.12	7.23
Consultancy Services for Operations, Maintenance and Training	0.18	1.08	1.26	0.18	1.08	1.26	0.12	0.72	0.84	0.12	0.72	0.84	0.60	3.60	4.20
Taxes and Duties	1.94	-	1.94	2.80	-	2.80	1.07	-	1.07	2.44	-	2.44	8.25	-	8.25
Base Cost Estimate (BCE, in January 1989 prices)	4.05	12.03	16.08	5.76	16.92	22.68	2.22	6.56	8.78	4.89	13.91	18.80	16.92	49.42	66.34
Contingencies:															
Physical a/	0.19	0.60	0.69	0.27	0.75	1.02	0.09	0.21	0.30	0.21	0.53	0.74	0.76	1.99	2.75
Price b/	0.30	0.90	1.20	0.48	1.27	1.70	0.17	0.49	0.66	0.37	1.04	1.41	1.27	3.70	4.97
Total Cost	4.54	13.43	17.97	6.46	18.94	25.40	2.48	7.26	9.74	5.47	15.48	20.95	18.95	55.11	74.06

a/ 5% of base cost estimate excluding: (i) running spares and consumables; and (ii) consultancy services for operations, maintenance and training.

b/ Price escalation for both foreign and local costs (expressed in US dollars) is based on expected trade weighted international annual inflation rate of 7.7% in 1989, -1.2% in 1990, 1.42% in 1991, 1.7% in 1992, and 3.3% in 1993, assuming that exchange rate will, on average, adjust to maintain purchasing power parity during the project implementation period.

c/ Includes about US$250,000 in foreign exchange for technical services for rehabilitation of the GT2 unit at Delta.

NIGERIA - POWER SYSTEM MAINTENANCE AND REHABILITATION PROJECT

Capital Cost Estimates by Project Components
(in US$ million)

Project Item	Equipment, Material & Spares	Engineering/ Consultancy Services	Taxes & Duties	Base Cost Estimate	Contingencies Physical	Contingencies Price	Total
B. Transmission Improvements							
Local cost	1.63	0.95	2.74	5.32	0.22	0.33	5.87
Foreign cost	9.07	4.11	-	18.18	0.73	1.00	14.91
Total	10.70	5.06	2.74	18.50	0.95	1.33	20.78
C. Distribution Improvements							
Local cost	2.06	-	3.43	5.49	0.27	0.41	6.17
Foreign cost	11.42	-	-	11.42	0.57	0.87	12.86
Total	13.48	-	3.43	16.91	0.84	1.28	19.03
D. Metering Equipment							
Local cost	0.63	-	1.05	1.68	0.08	0.13	1.89
Foreign cost	3.50	-	-	3.50	0.18	0.26	3.94
Total	4.13	-	1.05	5.18	0.26	0.39	5.83
E. Vehicles							
Local cost	1.44	-	8.00	9.44	-	0.68	10.12
Foreign cost	8.00	-	-	8.00	-	0.57	8.57
Total	9.44	-	8.00	17.44	-	1.25	18.69
F. Conversion of Egbin Plant to Gas							
Local cost	-	0.07	0.03	0.10	-	-	0.10
Foreign cost	-	0.30	-	0.30	-	-	0.30
Total	-	0.37	0.03	0.40	-	-	0.40

NIGERIA - POWER SYSTEM MAINTENANCE AND REHABILITATION PROJECT

Capital Cost Estimates by Project Components
(in US$ million)

	Project Item	Equipment, Material & Spares	Engineering/ Consultancy Services	Taxes & Duties	Base Cost Estimate	Contingencies Physical	Contingencies Price	Total
G.	**Utility Partnership Program**							
	Local cost	-	1.0	0.6	1.6	-	0.11	1.71
	Foreign cost	-	6.0	-	6.0	-	0.43	6.43
	Total	-	7.0	0.6	7.6	-	0.54	8.14
H.	**Data Processing**							
	Local cost	0.2	-	0.3	0.5	-	0.04	0.54
	Foreign cost	1.0	-	-	1.0	-	0.07	1.07
	Total	1.2	-	0.3	1.5	-	0.11	1.61
I.	**Training**							
	Local cost	0.3	-	0.2	0.5	-	0.04	0.54
	Foreign cost	1.0	-	-	1.0	-	0.07	1.07
	Total	1.3	-	0.2	1.5	-	0.11	1.61
J.	**Project Management**							
	Local cost	-	0.2	0.1	0.3	-	0.02	0.32
	Foreign cost	-	0.9	-	0.9	-	0.06	0.96
	Total	-	1.1	0.1	1.2	-	0.08	1.28
K.	**Studies & Future Project Preparation**							
	Local cost	-	0.2	0.1	0.3	-	0.02	0.32
	Foreign cost	-	1.2	-	1.2	-	0.10	1.30
	Total	-	1.4	0.1	1.5	-	0.12	1.62

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January 1989

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ANNEX 3-5

NIGERIA - POWER SYSTEM MAINTENANCE AND REHABILITATION PROJECT

Estimated Disbursement Schedule for Bank Loan

IBRD Fiscal Year	Africa Region-wide Disbursement Profile for Power Projects (Cumulative % Disbursement) a/	Estimated Disbursement Schedule		
		Cumulative % Disbursement	Disbursement during Semester	Cumulative Disbursement
			--- (in US$ million) ---	
FY90 - 12/31/89	2	7	5.0 b/	5.0
06/30/90	7	27	14.0	19.0
FY91 - 12/31/90	15	56	20.0	39.0
06/30/91	26	77	15.0	54.0
FY92 - 12/31/91	37	86	6.0	60.0
06/30/92	48	91	4.0	64.0
FY93 - 12/31/92	57	96	3.0	67.0
06/30/93	67	99	2.0	69.0
FY94 - 12/31/93	74	100	1.0	70.0
06/30/94	82			
FY95 - 12/31/94	90			
06/30/95	95			
FY96 - 12/31/95	98			
06/30/96	100			

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a/ Based on 38 power projects in the Africa Region financed by IBRD and IDA during 1978-1987.

b/ Includes repayment of PPF advance.

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NIGERIA - POWER SYSTEM MAINTENANCE AND REHABILITATION PROJECT

Economic Analysis

A. Key Assumptions

1. Capital Costs. The capital expenditures of NEPA's development program (1989-93) are given in Annex 1-2. The economic costs were arrived at by subtracting duties and taxes, and by converting the capital expenditures in January 1989 prices, using inflation factors given in para 1 of Annex 2-7. A standard conversion factor of 0.84 was used to convert local costs into economic costs.

2. Operations and Maintenance (O&M) Costs. Incremental annual operating and maintenance costs have been estimated at 2.5% of cumulative capital costs under the development program.

3. Fuel Costs/Savings. The economic cost of gas has been estimated at US$1/MCF. To arrive at incremental fuel costs/savings, fuel costs with and without the development program were estimated as shown below:

Annual Fuel Costs
(in US$ million)

	1989	1990	1991	1992	1993	1994	1995	1996	1997-2003
With Development Program	111	109	115	113	124	139	154	171	189
Without Development Program	115	126	139	139	139	139	139	139	139
Incremental Fuel Costs	-	-	-	-	-	0	15	32	50
Incremental Fuel Savings	4	17	24	26	15	-	-	-	-

4. Incremental Energy Served. As a result of the development program, technical losses are assumed to decrease by 1% per year during the 1989-93 period, i.e., from 15% in 1988 to 10% in 1993. The estimates of the incremental served demand under the development program are shown below.

Annual Served Demand (GWh)

	1989	1990	1991	1992	1993	1994	1995	1996	1997-2003
With Development Program	10,919	11,683	12,501	13,376	14,312	15,314	16,386	17,533	18,621
Without Development Program	10,919	11,683	12,501	11,956	11,956	11,956	11,956	11,956	11,956
Incremental Served Demand with the Development Program	0	0	0	1,420	2,356	3,358	4,430	5,577	6,665

5. Economic Value of Incremental Energy Served. The incremental served demand is valued, most conservatively, at tariffs which will be charged by NEPA to achieve its financial objectives. As discussed in para 2.38 in Chapter II, NEPA's tariffs in nominal terms would have to rise to 48.3 kobos/kWh in 1992, and 52.6 kobos/kWh in 1993 to achieve a return of 8% on revalued net fixed assets by 1993. These tariffs in January 1989 prices, are estimated at 34.5 kobos/kWh in 1992 and 1993. Therefore, incremental energy served is valued at a tariff of US¢5/kWh in January 1989 prices (using an exchange rate of US$1=₦6.9).

B. Results of Economic Analysis

6. Economic Rate of Return. The incremental cost and benefit streams for economic rate of return calculations are shown in the table below.

	Costs			Benefits		
	Investment Expenditure	O&M Costs	Fuel Costs	Fuel Savings	Value of Incremental Energy Served	Net Benefits a/
	(in US$ million)					
1989	96	2	-	4	-	(94)
1990	168	7	-	17	-	(158)
1991	263	13	-	24	-	(252)
1992	239	19	-	26	71	(161)
1993	107	22	-	15	118	4
1994	-	22	-	-	168	146
1995	-	22	15	-	222	185
1996	-	22	32	-	279	225
1997-2003 (same every year)	-	22	50	-	333	261

a/ Figures may not add because of rounding.

7. The economic rate of return for the development program is calculated at 18.4%.

C. Sensitivity Analysis Based on Consumers' Willingness to Pay

8. NEPA's tariffs had remained unchanged since 1979 at about 7 kobos/kWh and were so low in relation to the resource cost of supplying power that they provided no indication of the real economic value. Despite the recent increase in June 1989 to about 27.5 kobos/kWh, tariffs are still low. To arrive at an economic price for electricity, one approach available is to estimate the consumers' willingness to pay, which, however, can only be done imperfectly, on account of data constraints.

9. At current tariffs, there is a considerable suppressed load for power from the system, as evidenced from the long lists of consumers awaiting connection from NEPA. It is also known that a large autogeneration capacity exists in the country. No reliable data on this are, however, available. The World Bank's Energy Assessment Report (1983), estimated the autogeneration capacity in the country at that time at about 1,200-1,500 MW. Data on licenses issued for new autogeneration capacity, plus renewals of licenses for the past three years alone, all of which cover only a portion of the total capacity available, corroborates the presence of at least 500 MW of captive generating sets with industrial and commercial establishments, and more affluent households.

10. Costs of generation from captive sources are high in Nigeria, despite the relatively low domestic prices of diesel fuel, as shown in the table below for various generator sizes.

Costs of Electricity from Privately Installed Generators in Nigeria

Technical Parameters					
Generator Size (kVA)	10.5	21.0	32.0	52.0	75.0
Typical Power Factor	0.8	0.8	0.8	0.8	0.8
Max.Power Output (kW)	8.4	16.8	25.6	41.6	60
Fuel Consumed	Diesel	Diesel	Diesel	Diesel	Diesel
Annual Usage (Hours)	3,000	3,000	3,000	3,000	3,000
Av. Capacity Factor	0.75	0.75	0.75	0.75	0.75
Annual Load Factor	0.25	0.25	0.25	0.25	0.25
Av.Energy Produced (MWh)	19	38	58	94	135
Operating Life (Hrs)	10,000	10,000	10,000	12,000	12,000
Working Life (Yrs)	5	5	5	7	7
Specific Fuel Consumption (liters/kWh)	0.45	0.45	0.45	0.4	0.4
Financial Costs					
Capital Cost (₦)	65,400	91,200	108,000	189,000	255,600
Capital Annuity Factor @ 12%	0.248	0.248	0.248	0.196	0.196
Annual Capital Cost (₦)	16,199	22,589	26,750	36,976	50,006
Fixed O&M Cost/Year	654	912	1,080	1,890	2,556
Fuel Cost(kobos/litre)	30	30	30	30	30
Variable O&M Cost (kobos/kWh)	2	2	2	2	2
Average Variable Cost (kobos/kWh)	15.5	15.5	15.4	14	14
Annual Variable Cost (₦)	2,945	5,890	8,990	13,160	18,900
Total Annual Cost (₦)	19,144	28,479	35,740	50,136	68,906
Average Cost (₦/kWh)	1.01	0.75	0.62	0.53	0.51

11. The above table presents cost data for a range of sizes of diesel generating sets. Costs are estimated on the assumption that consumers' total power requirements are met from this source, so as to maximize economies of scale. Estimates, therefore, represent the lowest

average costs of power from autogeneration. Capital costs are based on actual retail price quotations in Nigeria, and include duties and taxes. The same is true of fuel costs. Capital annuity factors are based on estimated working lives of equipment, on the assumption that adequate maintenance is carried out.

12. The analysis shows that costs of generation of electricity from private sources vary between 51 kobos/kWh (for large and medium sized diesel generators used by industrial and large commercial units) and ₦1.01/kWh (for small commercial units and households). Operating costs of small generating sets are about double those of the large sets, and all costs are significantly higher than prevailing electricity tariffs despite the increase in June 1989. If private generators are used only on a partial basis, purely as stand-by, their costs of operation would undoubtedly be still higher. The above estimates may in fact be relatively conservative even under the assumption of extensive usage. In actual practice, industrial/commercial users really depending upon this source of generation on a full-time basis would need the security of an additional stand-by generator. They would, therefore, have to incur the additional capital expense necessary for an additional stand-by generator.

13. Although data on elasticity of demand for electricity is not available at the present time, the average willingness to pay for all classes of consumers is clearly higher than the level of the current electricity tariff. Not only the industrial, commercial and high-income household consumers are actually incurring significantly higher costs of electricity supply through the necessity of installing expensive stand-by generating capacity, even for low-income household consumers, who are not connected to the grid and who cannot afford to install private generating sets, actual costs of lighting through use of kerosene lamps are considerably higher than reflected by the current tariff rate. The estimated cost of using kerosene lamps is currently about 18.4 kobos/kWh equivalent, or nearly three times the prevailing tariff level of about 7 kobos/kWh for households with monthly electricity consumption below 100 kWh.

Estimated Cost of Lighting in Nigeria Using Kerosene Lamps

1.	Cost of kerosene fuel	20 kobos/litre
2.	Equivalent kWh per litre of kerosene	3.4 kWh/litre
3.	Ratio of conversion efficiencies of kerosene and electrical appliances	0.4
4.	Equivalent cost of utilizable energy from kerosene = (1÷2)÷3	14.7 kobos/kWh
5.	Capital cost of kerosene lamp	₦10
6.	Capital annuity factor at 12% and 3-yr life	0.372
7.	Equivalent capital cost over 100 kWh/year/lamp (5*6)	3.72 kobos/kWh
8.	Total cost of using kerosene for lighting equivalent (4+7)	18.42 kobos/kWh

14. In the absence of accurate information on consumer characteristics, an accurate estimate of an average "willingness to pay" is

difficult to calculate. Financial analysis indicates that an average tariff level of about 34.5 kobos/kWh in January 1989 prices will be needed to enable NEPA to cover its costs and meet its proposed financial objectives 1/. Yet, actual costs of electricity supply from standby generating capacity being incurred by a substantial portion of electricity consumers range between 51 to 101 kobos/kWh (or even higher if usage is intermittent, or back-up capacity has to be provided), which is up to three times the proposed new tariff. Even after the tariff revision, it is likely that a consumer surplus would continue to exist, the magnitude of which is difficult to estimate without additional supporting data. It is, however, not unreasonable to assume that average consumer "willingness to pay" is high enough to be able to sustain a level of tariffs comparable to those in some of Nigeria's neighboring countries. For example, tariffs in Cote d'Ivoire, Togo and Benin are currently about 57 CFA/kWh, equivalent to US¢18 or ₦1.24/kWh. In Senegal, medium and low voltage tariffs are currently 61 and 70 CFA/kWh, respectively (or US¢20 and 23/kWh, respectively - equivalent to ₦1.38 and 1.59/kWh). Consumers in neighboring countries are, therefore, actually paying between ₦1.2/kWh and ₦1.6/kWh. Against this background, it is conservatively expected that consumers' willingness to pay in Nigeria should be at least 40 to 50 kobos/kWh (or US¢5.8 to 7.2/kWh).

15. While the economic rate of return, on the basis of an economic price set at projected tariff levels, e.g., 34.5 kobos/kWh (US¢5/kWh), is calculated at 18.4%, the sensitivity analysis using conservative estimates of consumers' willingness to pay as a proxy for the economic value of electricity indicates that the economic rate of return will increase to 22% with consumers' willingness to pay of 40 kobos/kWh (US¢5.8/kWh), and to 28% with consumers' willingness to pay of 50 kobos/kWh (US¢7.2/kWh).

1/ As outlined in para 2.38, tariff policy for NEPA based upon the financial projections detailed in Annex 2-6 would necessitate average tariffs being raised to 48.3 kobos/kWh by 1992, and 52.6 kobos/kWh by 1993, at which point NEPA would be earning a rate of return of 8% on revalued net fixed assets. Given the inflation rates assumed in Annex 2-2, this works out to about 34.5 kobos/kWh in 1992 and 1993 (in January 1989 prices).

ANNEX 5

NIGERIA - POWER SYSTEM MAINTENANCE AND REHABILITATION PROJECT

SELECTED DOCUMENTS AND DATA AVAILABLE IN THE PROJECT FILE

A. Technical Report prepared by P. Khirwadkar (consultant), October 1988.

B. Reports prepared by NEPA, "NEPA Crash Program," June and September 1988.

C. 25-Year NEPA Power System Development Study prepared by Tractebel Engineering International and Oladipo Ilumoka and Associates (Consultants), June 1988.

D. Power System Improvement Project (Power VII), Draft Yellow Cover Staff Appraisal Report, October 16, 1987.

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December 1988

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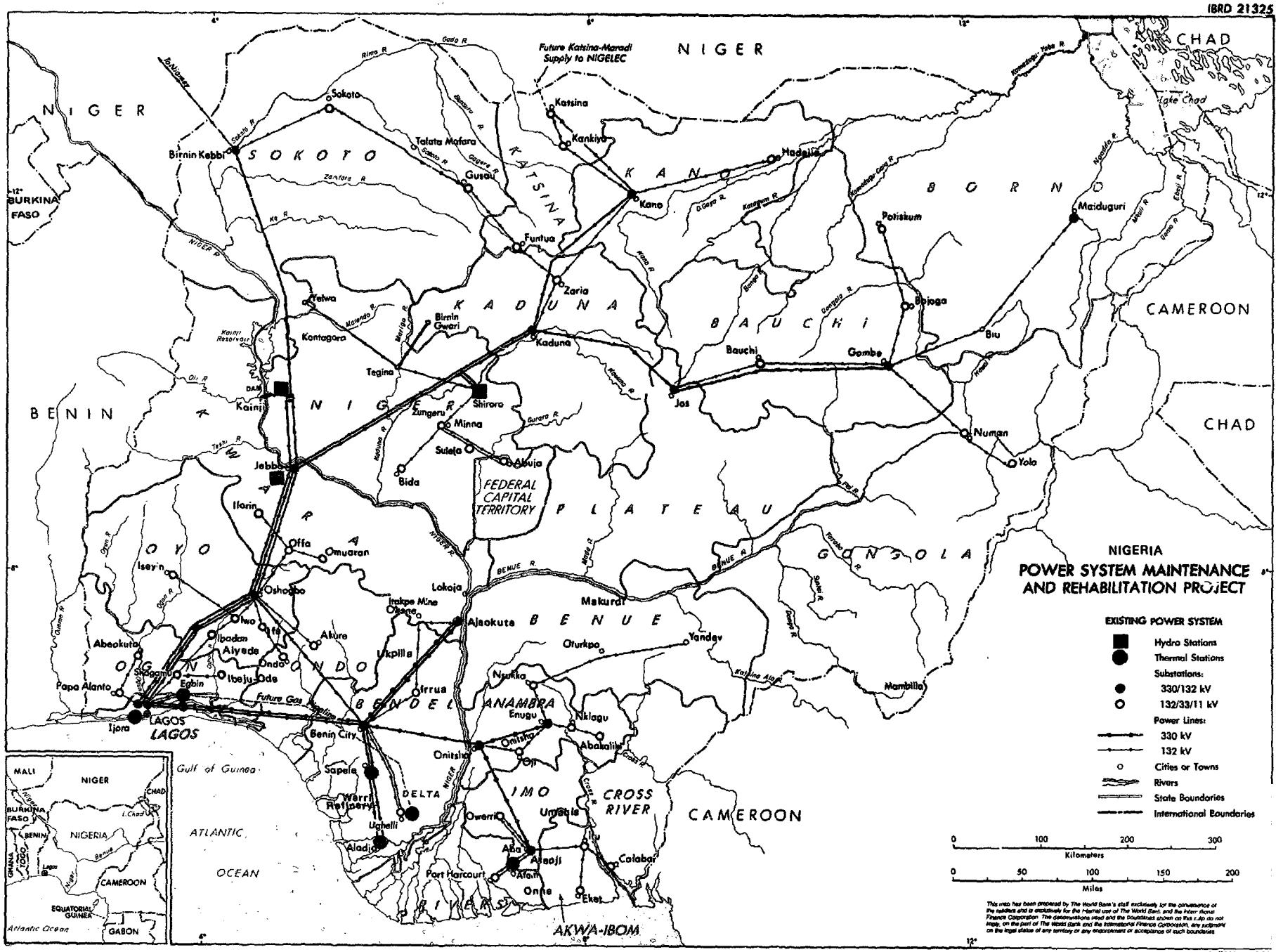

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