No. 1

JAPAN INTERNATIONAL COOPERATION AGENCY

(THE REPUBLIC OF ZAMBIA)
(MINISTRY OF COMMUNICATIONS AND TRANSPORT)

BASIC DESIGN STUDY REPORT
ON
THE REHABILITATION OF TELEPHONE CABLE NETWORK
IN
LUSAKA CITY
IN
THE REPUBLIC OF ZAMBIA

SEPTEMBER 1992

NIPPON TELECOMMUNICATIONS CONSULTING CO., LTD.

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PREFACE

In response to a request of the Government of the Republic of Zambia, the Government of Japan decided to conduct a basic design study on the Rehabilitation of Telephone Cable Network in Lusaka City and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent to Zambia a study team headed by Mr. Takao Yamazaki, Telecommunications Development Specialist, JICA and constituted by members of Nippon Telecommunications Consulting Co., Ltd. from March 29 to April 26, 1992.

The team exchanged views with the officials concerned of the Government of Zambia, and conducted a field study at the study area. After the team returned to Japan, further studies were made. Then, a mission was sent to Zambia in order to discuss a draft report and the present report has been prepared.

I hope that this report will contribute to the promotion of the project and to the enhancement of friendly relations between our two countries.

I wish to express my sincere appreciation to the officials concerned of the Government of the Republic of Zambia for their close cooperation extended to the team.

September 1992

Kensuke Yanagiya

Kensuke Yanagiya
President
Japan International Cooperation Agency

September 1992

Mr. Kensuke Yanagiya
President
Japan International Cooperation Agency
Tokyo, Japan

Letter of Transmittal

We are pleased to submit to you the basic design study report on the Rehabilitation of Telephone Cable Network in Lusaka City in the Republic of Zambia.

This study has been made by Nippon Telecommunications Consulting Co., Ltd., based on a contract with JICA, from March 25 to September 30, 1992. Throughout the study, we have taken into full consideration of the present situation in the Republic of Zambia, and have planned the most appropriate project in the scheme of Japan's grant aid.

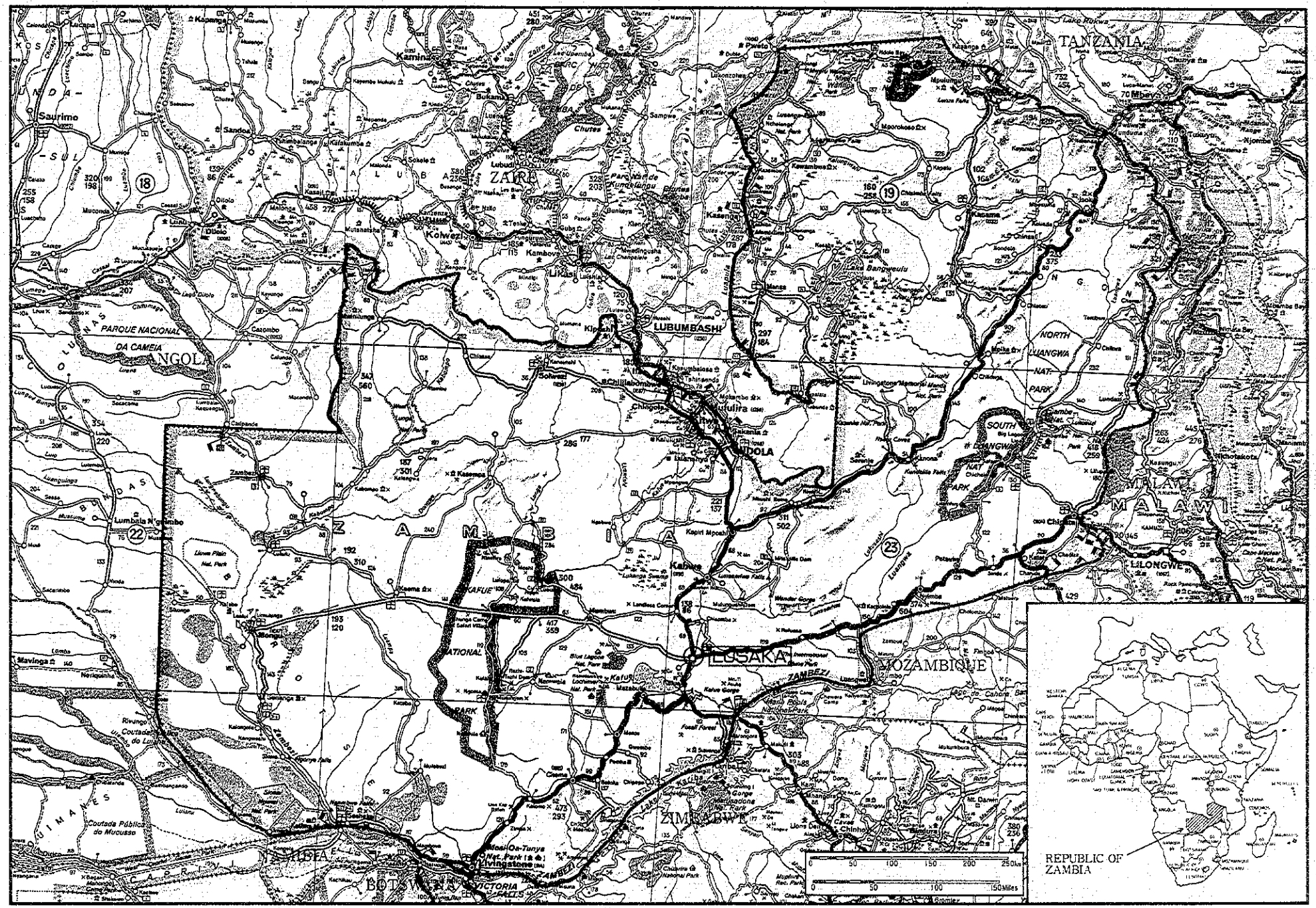
We wish to take this opportunity to express our sincere gratitude to the officials concerned of JICA, the Ministry of Foreign Affairs, Posts and Telecommunications and Embassy of the Republic of Zambia. We also wish to express our deep gratitude to the officials concerned of Posts and Telecommunications Corporation Limited, JICA Office, Embassy of Japan for their close cooperation and assistance during our study.

At last, we hope that this report will be effectively used for the promotion of the project.

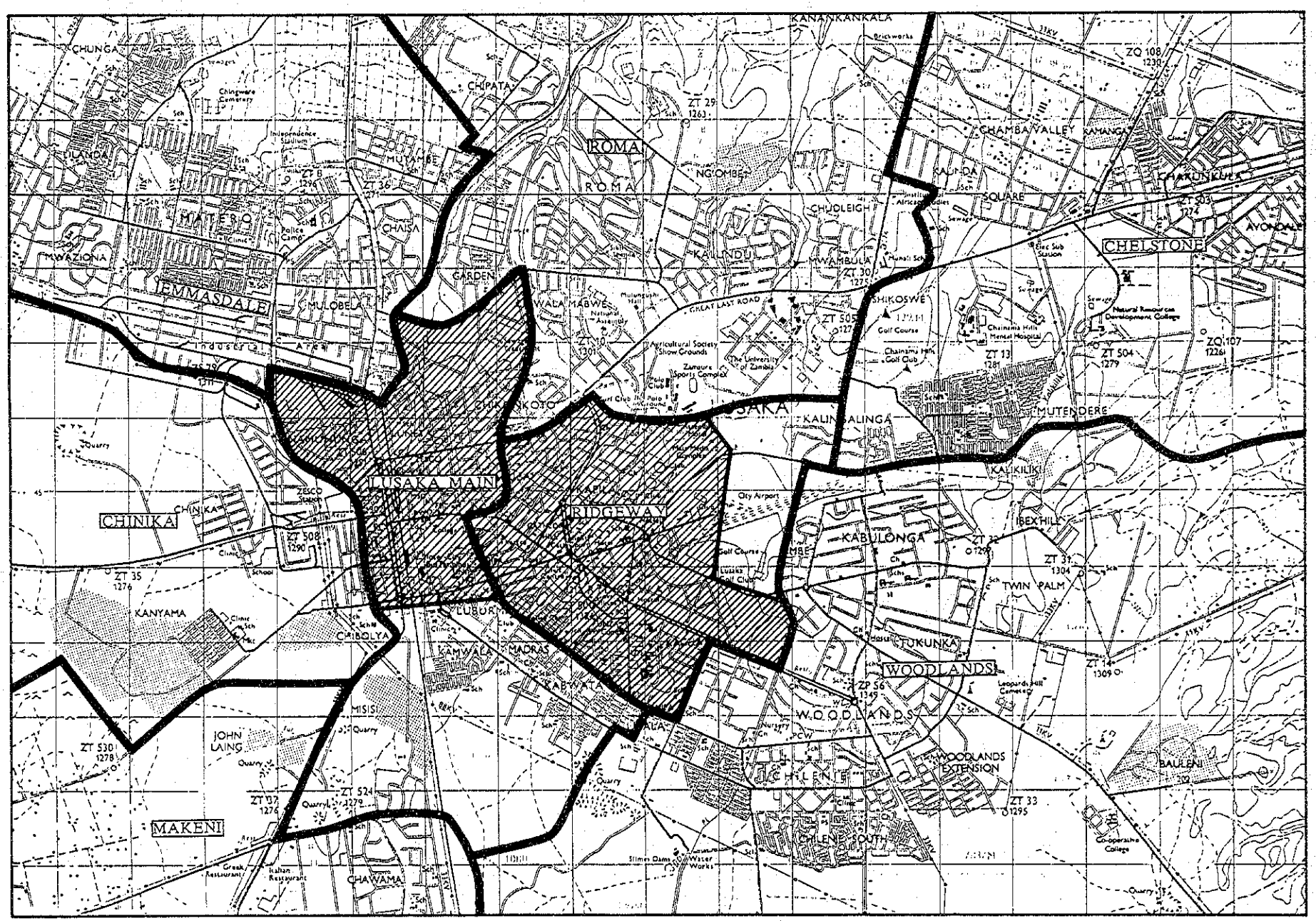
Very truly yours,

Project Manager, Sumio Shimizu
Basic Design Study Team on the Rehabilitation
of Telephone Cable Network in Lusaka City
Nippon Telecommunications Consulting Co., Ltd.

REPUBLIC OF ZAMBIA



OBJECT AREA FOR REHABILITATION OF TELEPHONE CABLE NETWORK IN LUSAKA CITY



SUMMARY

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The Republic of Zambia is now implementing the Fourth National Development Plan, aiming at the reconstruction of her national economy, which depends largely upon minerals, particularly copper. The Development Plan aims to develop industries in diversified sectors and to remote the regional economic activities as well, intending to thereby revitalize the national economy which is stagnant at present. Emphasis is placed on the rehabilitation of infrastructures.

To support the promotion of the National Development Plan, the Posts and Telecommunications Corporation Ltd. (PTC) has been exerting great efforts for the improvement of telecommunications mainly through the rehabilitation of inter-regional communication facilities and the renewal of switching systems. Due to shortage of funds, however, the telephone cable network in Lusaka City has been left unimproved.

In consequence, the external plants in Lusaka remain superannuated and communication failures are repeated frequently, resulting in serious troubles in commercial, social and private activities. Shortage of telephone cables has also constrained the effective and efficient use of the digital exchanges recently installed by other projects.

To improve the above situation, the PTC has formulated a plan, as one of the most urgent projects, to rehabilitate the facilities in Lusaka Main Exchange and Ridgeway Exchange areas, which are most important areas in Lusaka City from the social, economic and political standpoint. For realization of this plan, the Government of Zambia requested the Japanese Government's grant aid.

In response to this request, the Japanese Government decided to carry out the basic design study for this plan, and the Japan International Cooperation Agency dispatched the Basic Design Study Team to Zambia from March 29 to April 26, 1992, for the field survey.

The survey team investigated the contents of the project and the background factors, in addition to the status quo of telecommunications and related matters. The team exchanged views with the persons

concerned of the Government of Zambia through repeated discussions, and surveyed the project sites and the condition of the existing telecommunications facilities, including their availability.

After returning to Japan, the team analyzed and studied the data obtained through the field survey, and drafted the Basic Design Study Report comprising the basic design and the implementation plan. Then the team visited Zambia again from July 19 to July 31, 1992, to discuss and explain the Report to the persons concerned of the Government of Zambia.

An outline of the Project formulated through the above study is given below.

(1) Scale of Rehabilitation of Telephone Network

This Project aims at (1) the rehabilitation of the subscriber cable networks in Lusaka Main Exchange and Ridgeway Exchange areas in Lusaka City, (2) the replacement of the switching equipment in Ridgeway Exchange, and (3) the rehabilitation of junction cables between Lusaka Main Exchange and Ridgeway Exchange, including associated works, so as to establish stable telephone networks in the object areas.

For the subscriber cable network, the existing unreliable paper insulated cables are to be replaced with jelly filled polyethylene insulated cables which are highly reliable and easy to maintain. By this arrangement, main causes of the current communication troubles, i.e., breaking of cable conductors, line failures due to penetration of water into cables, etc., can be eliminated.

For switching equipment, the existing crossbar switch (analogue type) of which spare parts are difficult to obtain will be replaced with a digital switch which is capable of digital exchange. The same type of digital switches have already been introduced in other 6 exchanges in Lusaka. In conjunction with this digitalization, the existing analogue type junction lines connected to Lusaka Main Exchange will also be digitalized.

(2) Main facilities covered by this Project are as follows:

a) Subscriber Cable Facilities and Associated Civil Facilities

Main Facilities	Object Area	
	Ridgeway	Lusaka Main
Entrance Cable (pairs)	6,800	13,200
Primary Cable (Km)	9.5	15.4
Secondary Cable (Km)	33.8	64.6
Conduits (Km)	9.4	11.1

b) Switching Equipment, Junction Equipment and Associated Power Supply Equipment

Main Facilities	Object Area	
	Lusaka Main	Ridgeway
Digital Switch	-	5,000 L.U.
Junction Equipment (Cable PCM)	1 set	1 set
Junction Cable	-	2.6 Km
Power Supply	-	1 set

Among the above, the digital switch, junction equipment and cables and power supply for Ridgeway Exchange are those requested by the PTC additionally at the time of the discussion with the PTC for confirmation of the contents of the original request.

Reasons for the additional request are:

1) The original request was submitted in 1988. Since then, the telephone facilities in Lusaka City has underwent deterioration considerably and presently a number of line failures and other troubles take place so frequently.

2) The Ridgeway Exchange area is characterized by the concentration of a number of important subscribers, such as government offices, foreign embassies, etc.

3) For other 6 exchanges in Lusaka City, digital switches have already been introduced.

4) The benefits and effects of this Project will be enhanced if the obsolete switch in Ridgeway Exchange is replaced with an advanced one in conjunction with the cable network improvement in its exchange area.

The Japanese Government examined the additional request and decided to include it in the scope of this Project.

(3) The estimated amount of funds to be provided by the Government of the Republic of Zambia for this project is 41.2 million yen (40.4 million Kwacha). The said fund is to be appropriated from the PTC's own budget.

The time frame for the project is estimated to be a total of 29 months after the signing of the Exchange of Notes by both governments, consisting of 5 months for preparation of detailed design and bidding procedures, and 24 months for construction.

Upon completion of this Project, the stable telephone service will be provided, with no disconnection due to faults and no line failure resulting from water penetration. The communication service thus improved will facilitate speedy transmission of information which, in turn, will surely support realization of efficient administrative services, revitalization of economic activities, and enhancement of social welfare and other benefits.

The Government of Zambia is now implementing the Fourth National Development Plan, together with the Public Investment Programme recently revised. The rehabilitation of telecommunications service will greatly contribute to the efficient advancement of these Plan and Programme, and the Japanese cooperation in the form of grant aid for realization of the above will be very significant.

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CHAPTER 1 INTRODUCTION

CHAPTER 1 INTRODUCTION

Telecommunications operations in the Republic of Zambia are conducted by the Posts and Telecommunications Corporation Limited (PTC) under the Ministry of Communications and Transport. The PTC is also in charge of the postal services in Zambia.

The PTC has formulated a Ten-Year Development Plan for Telecommunications which includes infrastructure rehabilitation under the Fourth National Development Plan. In accordance with this Ten-Year Development Plan, telecommunications rehabilitation and improvement are now being implemented with the assistance from international financial institutions, such as World Bank, African Development Bank, etc. and donor countries such as France, Belgium, Norway, Denmark, Canada, Japan.

The telephone service in the capital city, Lusaka, is extremely poor, particularly during the rainy season, owing to the overage cable network. Obsolete and faulty cable conductors are increasing and, as a result, available capacity of the subscriber cable lines is decreasing, preventing the efficient utilization of the digital switches supplied from France and Japan, with the assistance from ADB and the French Government. In addition, the subscriber cable network rehabilitation plans which the PTC was to fund from its own budget have scarcely been implemented due to the lack of funds resulting from the national economic crisis persisting since 1980 and the shortage of foreign currency in Zambia.

To improve the above situation, the Government of Zambia requested the Government of Japan to implement the rehabilitation of telephone cable networks in Lusaka City in the form of grant aid.

In response to this request, the Government of Japan decided to carry out a basic design study for this Project, and the Japan International Cooperation Agency (JICA) sent a basic design study team headed by Mr. Takao Yamazaki, Telecommunications Development Specialist, JICA, to Zambia, from March 29 to April 26, 1992.

In order to study the appropriateness of the Project as a subject of grant aid and to review contents and scale of the Project, the study team surveyed the status quo of the existing telecommunications facilities including their availability, operation and maintenance conditions, training plans, as well as the status of infrastructures. Several Discussions were held with the officials of the Government of Zambia and the PTC personnel. The minutes of discussions were agreed upon and signed by both parties.

After returning to Japan, the study team further studied and analyzed the survey results and confirmed the appropriateness of the Project for grant aid. Then the team drew up the basic design, the implementation plan, and the operation and maintenance plan for the Project, including the project evaluation.

The team headed Mr. Takao Yamazaki of JICA visited Zambia again from July 19 to July 31, 1992, to explain the draft report to the Zambian officials and to discuss its contents.

This report covers the results of the basic design study executed as described above. The member list of the survey team, survey schedule, minutes of discussions, etc. are given in Annexes.

CHAPTER 2 BACKGROUND OF THE PROJECT

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2-1 Background of the Project

The Republic of Zambia is a landlocked country and, therefore, main transportation means are the roadway, railway and airway. A crucial problem for the country is an access to ports/harbours for the facilities of export and import of commodities. The main route is the Tanzania-Zambia Railways to Dar es Salaam in Tanzania. Recently the road transport to Durban in South Africa via Zimbabwe and Botswana is increasingly being used as it offers better safety and security of export and import.

The ministry of Communications and Transport is responsible for policy formulation in respect of national posts and telecommunications services. The PTC is an executing agency of such policies and its long-term plans.

That is, the PTC is in charge of the public telecommunication and postal services in Zambia, under the Ministry of Communications and Transport. The PTC was established as a statutory body by the Posts and Telecommunications Act, 1975, and in April 1988, it was incorporated as a limited liability company by the Posts and Telecommunications Act, 1987. It is a wholly government owned corporation under the Zambia Industrial and Mining Corporation Limited (ZIMCO).

The ZIMCO is a wholly government-owned company established for the development of industries and mining. Currently, the ZIMCO controls almost all the government business and enterprises.

The chairman of the Board of Directors of the PTC is an executive of the ZIMCO. The ZIMCO offers guidelines on the PTC's budgets and investment plans management in conformity with its policy formulated by the Ministry of Communications and Transport.

The status quo of the local telephone facilities in Zambia is described in the following:

Table-1 Summary of Local Telephone Facilities in Zambia

(As of September, 1991)

Item	Lusaka	Rural Areas	Total
Number of Telephone Exchanges	8	86	94
Digital Exchanges	6	11	17
Analogue Exchanges	3	69	72
Manual Exchanges	0	5	5
Switching Capacities (L.U.)	47,000	67,474	114,474
Digital Switches	19,000	26,000	45,000
Analogue Switches	28,000	41,324	69,324
Manual Switches	0	150	150
Telephone Subscribers	20,980	46,605	67,585
Waiting Subscribers	10,877	39,535	50,412
Telephone Density (%)	2.13	0.68	0.86
Population	982,000	6,836,000	7,818,000

As can be seen from the above Table-1, the telephone density in Zambia is as low as 0.86 per 100 population. It should be noted that the telephone density is much lower as compared to the world average of 14.5. It is also known from the table that the available existing switching capacities in Zambia are not fully utilized. The table shows that the number of telephone subscribers is much lower than the capacity of the switching equipment. For examples while the utilization ratio of switching equipment in the rural areas is 69.1%, that in Lusaka City is as low as 44.6%, and in the object area is the lowest at 39.1%.

Four types of switching equipment are in operation now: manual, crossbar, analogue ESS and digital ESS. Most of the switching equipment in operation are the crossbar and the analogue ESS, and most of them were installed in 1970 through 1980. The oldest crossbar switching equipment is found in Ridgeway Exchange in Lusaka City, which was committed in 1967.

The PTC has been implementing the rehabilitation of inter-regional communication systems, in addition to replacement of switching systems,

with the funding from the international financial institutions and donor countries. All in all, the available fund is limited and therefor the rehabilitation of the external network is yet to be implemented. That is, the overage cable networks in operation are still left superannuated. As a result, faulty cables are increasing in number, leading to decrease in available capacity of conductors and utilization ratio of switching equipment, making it difficult to accommodate new subscribers.

The quality of telephone service can be evaluated in terms of the number of fault reports from subscribers and the time required for their clear as shown below. The data are those on external plant and the survey period is the six months from April to September 1991.

- Number of telephone exchanges subjected to faults report	:	38
- Number of working lines in the above exchanges	:	42,776
- Number of fault reports received during the survey period	:	15,422
- Number of faults which occurred before, and were cleared during, the survey period	:	3,327
- Total number of faults	:	18,749
- Number of faults cleared during the survey period	:	8,317
- Number of faults not cleared during the survey period	:	10,432

According to the above data, the number of faults per 100 subscribers during the six months is 36.1, and the number of faults to be cleared is 43.8. Faults clear rate during the six months is as low as 44.3%. Since the faults in switching equipment account for only a small percent of the entire faults, it can be said that the delay in clearing faults in external plants is the main cause of telephone service deterioration.

Under the above situation, it is very difficult to maintain satisfactory telecommunication services in the country. Now the delay in improvement and rehabilitation of telecommunication facilities constitutes a major obstacle to the social and economic development of the nation. Particularly the telephone service in the capital city, Lusaka, is far behind the national level, though it is a center of the political and economic activities of the nation. Hence, the rehabilitation of the local telephone network in Lusaka City is a pressing need.

Urgent problems to be solved by the PTC are:

- Rehabilitation, operation and maintenance of overage cable networks and renovation of superannuated switching equipment of which spare parts are difficult to obtain.
- Relief of long waiting applicants.

2-2 Outline of Correlated Development Plans

Under the Fourth National Development Plan, the PTC has drawn up the Ten Year Development Plan for Telecommunications (1992-2002), the Capital Budget Plan 1991/1992 and the Investment Plan 1991/1992 - 1993/1994. In accordance with these plans, the PTC is endeavoring for rehabilitation and development of telecommunication networks. The overall Plan aims to accomplish the following:

1) Replacement and installation of local exchange equipment to such an extent that the total capacity at the end of the Plan period will be 253,346 line units.
2) Rehabilitation of the external plant (local cable network) for 130,472 subscriber connections.
3) Improving and upgrading the trunk network, both the transit exchanges and transmission links.
4) Improving and extending the telex network, by replacing the Lusaka telex exchange with a new one.
5) Improving and extending the international and inter-territorial network, through the expansion of the

international telephone switching center, digitalization of Satellite Earth Station Mwembeshi II and replacement of Mwembeshi I.

6) Provision of the mobile radio telephone service and radio monitoring facilities.
7) Extension of telecommunications services to all rural areas through multiaccess radio telephone systems.
8) Establishing a packet switching network for data communication.
9) Enhancement of the maintenance and support system.

On October 31, 1991, general and presidential elections were held and a new government has been established. The above mentioned Fourth National Development Plan is being reviewed by the new government and new public investment plan is being formulated.

2-3 Outline of the Request

(1) Background of the Request

The PTC has been vigorously pushing forward the rehabilitation of telecommunications in Zambia by implementing such projects as nationwide terrestrial microwave network improvement, satellite earth station expansion, switching equipment digitalization, etc. with the financial and technical assistance from the World Bank, African Development Bank, and donor countries. Efforts, however, have so far been concentrated on the terrestrial links and switching equipment, leaving out the local cable networks in Lusaka City due to shortage of funds. As a consequence, the external plant consisting of old cable network installed over 20 years ago has deteriorated considerably. This has resulted in telecommunications services failures, increase in the number of faulty cables, and the resulting shortage of available cable pairs. At present new connections can hardly be provided, posing serious problems in business and social activities.

To solve the above problem, the Government of Zambia requested the grant aid of the Japanese Government for rehabilitation of the telephone cable network in Lusaka Main Exchange and Ridgeway Exchange Areas. Of 8 exchange areas in Lusaka City, these two are most important in terms of social, economic and political activities of the nation.

(2) Outline of the Request

Originally, the request was to cover only the rehabilitation of subscriber cable networks in part of Lusaka and Ridgeway Exchange areas.

However, when the Study Team visited Zambia for confirmation and review of the request, the Zambian side presented the additional request for renovation of switching equipment in Ridgeway Exchange for the following reasons:

1) The original request was submitted in 1988. Thereafter the telephone facilities in Lusaka City have deteriorated as evidenced by frequent faults and outage.

2) A number of governmental offices and agencies, foreign embassies and other important subscribers are concentrated in the Ridgeway Exchange area.

3) Of 9 exchanges in Lusaka, 6 exchanges have already been digitalized. The crossbar switching equipment in Ridgeway Exchange has been in services for 26 years, and it is oldest crossbar exchange in Zambia. It has outlived its economic life.

4) Replacement of the switching equipment in Ridgeway Exchange in conjunction with the rehabilitation of the cable network in the Ridgeway exchange area will enhance effects and benefits of this Project.

The Government of Japan studied this additional request and approved of the including of the additional request in the study items of the Basic Design Study, on the basis of the following conditions:

- Priority in implementation be given to rehabilitation of external plant.
- The purpose and scale of the request be examined by the Study Team to evaluate its appropriateness as a subject of grant aid, together with the cost estimation, after the Study Team has returned to Japan.

The main scope of work in the minutes of discussions signed between the Study Team and the Zambian side are outlined below in order of priority.

1) Rehabilitation of Subscriber Cable Network

		Lusaka Main	Ridgeway	Total
Primary Cables	(pair-Km)	20,000	15,000	35,000
Secondary Cables	(pair-Km)	5,500	8,200	13,700
Conduits	(pipe-Km)	55	55	110

Though some arithmetical errors were found in the request, the study results have proved that the above are necessary for this Project.

2) Procurement of maintenance equipment, tools and materials necessary for the subscriber cable networks (closures, terminal boxes, drop wires, etc.).

3) Replacement of switching equipment (5,000 L.U.) of Ridgeway Exchange and rehabilitation of junction facilities between Lusaka Main and Ridgeway Exchanges.

2-4 Overview of the Project Area

(1) Characteristics of Object Areas

In the following are summarized the characteristics and general conditions of the object areas. Figure-1 presents the map of the object areas.

1) Lusaka Main Exchange

In the western part of this exchange area exist the business quarters of Lusaka City and the center of social and economic activities of the nation. Banks and offices of important companies are concentrated in this quarter. Main trunk roads and railways start from here and extend nationwide. In the center are located governmental offices and agencies and other public utilities, while in the southern part exist shopping centers. In the north-western part extends a light industrial belt, and in the north-eastern part, high class residential areas, both being the high telephone demand areas.

2) Ridgeway Exchange

The Ridgeway Exchange area is the center of political activities. Governmental offices including Statistic Bureau, foreign embassies, the Lusaka Municipality Government Office, and other important subscribers occupy almost all the area. In the north-western and south-eastern areas extend high class residential areas.

(2) Overview of Telecommunications Facilities in Object Areas

The telephone service quality in terms of fault reports from subscribers is as follows. The number of faults reported during six months from April to September 1991 was 4,765 and the number of faults not cleared until April was 225, totaling 4,990. The fault occurrence rate in the object areas is 6.8 per 100 subscribers per month (national average: 6.0 per 100 subscribers per month) and the number of faults cleared is 1,922, with the fault clear rate of 38.5% which is lower than the national average, 44.3%.

1) Cable Network

Almost all the existing subscriber cables in the object areas of this Project are lead sheathed paper insulated cables installed over 20 years ago and have deteriorated considerably, resulting in problems stated in items a) and b) below. Plastic cables now used for a part of the primary cables do not serve for service quality improvement at all as they are employed just for emergency repair of faulty sections.

a) The time required for clearing faults is prolonged due to shortage of repair equipment, tools and materials. In some cases, fault clearing is impracticable.

b) The existing cables are obsolete. Moreover, due to repeated repairs on the same sections, sheath and conductor splicing portions have been deteriorated extremely. In consequence, most of the cables become faulty during the rain season, owing to water penetration into cables and resultant inferior insulation.

2) Civil Works

A tunnel to lead cables into Lusaka Main Exchange is available for this Project. However, an entrance to the tunnel has fully been occupied, with no vacant conduits. Therefore, a new entrance will have to be provided. In addition, the trench in Ridgeway Exchange is inadequate in capacity. Since switching equipment replacement is to be carried out under this Project, the location of a new entrance and the cable termination method on MDF should be decided in view of the new switching equipment installation position.

Overage concrete pipes are found in the existing underground facilities. Some of them are broken and not usable. Also, manhole covers made of concrete are not suitable.

3) Subscriber Premises

Drop wires for wiring from terminal boxes to subscribers' residences are superannuated and easy to cause troubles, some being too close to power lines, etc. Station protectors to protect subscribers and premises are not installed at all.

4) Switching Equipment

6 of 9 exchanges in Lusaka City are of digital switching equipment. Of remaining 3 exchanges, Ridgeway Exchange is equipped with the overage crossbar switching equipment of which spare parts can no longer be obtained from manufacturers. Thus, each equipment failure leads to decrease in switching capacity.

Status quo of switching equipment in Lusaka City is presented in Table-2.

Table-2 Switching Equipment in Lusaka City

(as September 1991)

Exchanges	Make	Type of Switches	Line Units	Working Lines	Waiting	Remarks
Lusaka Main	NEAX 61	Digital ESS	10,000	6,309	3,882	
	NX-1E	Analogue ESS	15,000	3,000		
Ridgeway	ARF	Analogue X-bar	5,000	2,408	1,192	To be replaced
Chelston	NX-1E	Analogue ESS	3,000	1,232	1,935	
Roma	NEAX 61	Digital ESS	2,500	1,980	588	
Emmasdale	NEAX 61	Digital ESS	4,000	1,258	1,789	
Chinika	NEAX 61	Digital ESS	1,500	715	132	
Makeni	NEAX 61	Digital ESS	1,000	435	83	
Woodlands	E10B	Digital ESS	5,000	3,643	2,389	

Note: The number of working lines of Lusaka Main includes those for 600 subscribers in Ridgeway Exchange area.

5) Transmission Facilities

Almost all the junction lines in Lusaka City are of cable PCM system. However, the junction line between Lusaka Main and Ridgeway Exchanges, i.e., the major two exchanges in Lusaka, is of a voice channel employing outdated metallic cable and a number of lines are unavailable due to faulty conductor, as is the case with the subscriber cables mentioned above. In addition, many circuits provide poor service due to deteriorated cable parameters.

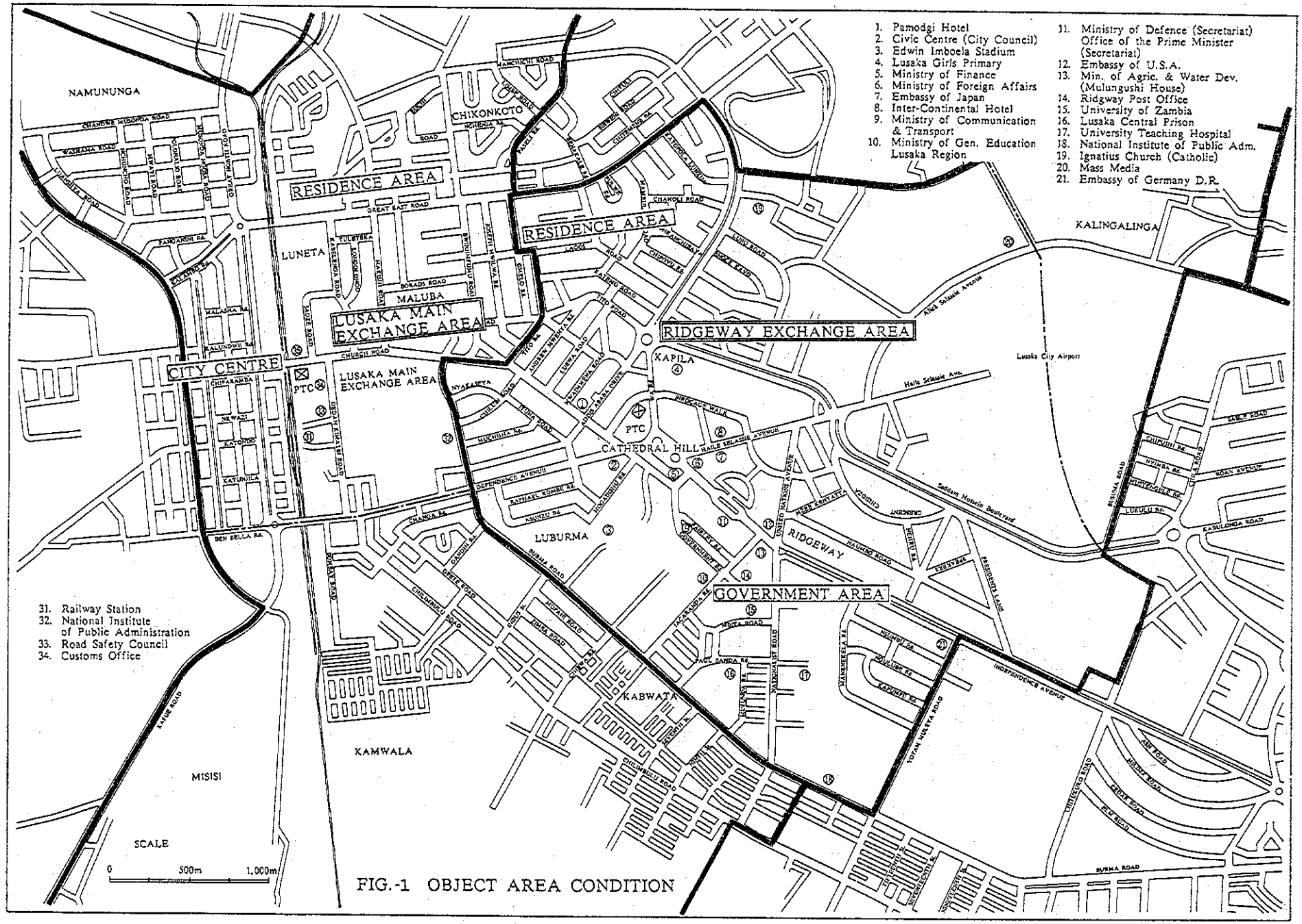

FIG.-1 OBJECT AREA CONDITION

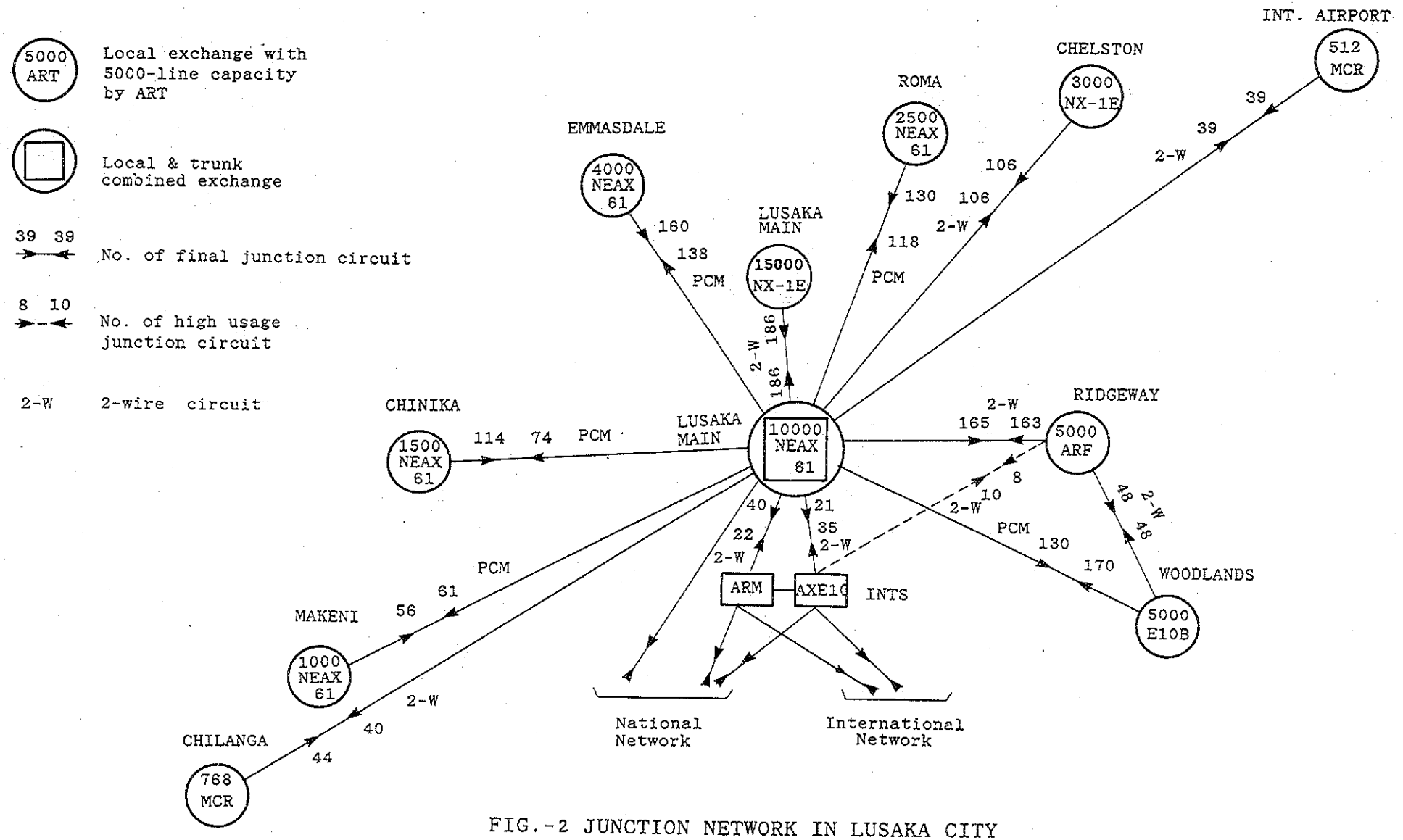

FIG.-2 JUNCTION NETWORK IN LUSAKA CITY

CHAPTER 3 SCOPE OF THE PROJECT

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3-1 Objectives

The purpose of this Project is to rehabilitate the subscriber cable networks in Lusaka Main and Ridgeway Exchange areas in Lusaka City, which are the most important areas for the social, economic and political activities of the nation, and to replace the existing switching equipment in Ridgeway Exchange. The Project aims at not only the improvement of telecommunications services in the object areas, but also the advancement of the Fourth National Development Plan, the revitalization of social and economic activities, and the upgrading of the people's living standard.

3-2 Study and Examination of the Request

3-2-1 Necessity and Justification of the Project

The Government of the Republic of Zambia has formulated the Fourth National Development Plan aiming at the reconstruction of its national economy through revitalization of economic activities and correction of increasing imbalance in wealth between the rich and the poor, putting emphasis on rehabilitation of infrastructures.

The PTC is accordingly, making efforts for telecommunications facilities rehabilitation and expansion, as part of infrastructure rehabilitation, in accordance with its Ten Year Telecommunications Development Plan and the Budget and Investment Plans.

The implementation of this Project which aims to rehabilitate the subscriber cable networks in Lusaka Main and Ridgeway Exchange areas in Lusaka City, replace the switching equipment in Ridgeway Exchange and rehabilitate the junction lines connecting Lusaka Main and Ridgeway Exchanges will be very significant as viewed from the advancement of the National Development Plan and also in terms of public interests since object areas are characterized with the concentration of politically and economically important institutions.

With the implementation of this Project, the telephone service in Lusaka City can be improved remarkably. In particular, faults in external plant networks (from MDF to terminal boxes) will be almost removed, and those on the switching side will also be eliminated with the renewal of the switching equipment in Ridgeway Exchange. In addition, rehabilitation of the junction lines will serve for improvement of the international and toll communication services, as well.

Such a distinct improvement will no doubt greatly contribute to revitalization of social and economic activities in Zambia and underline the necessity of this Project. The development of the telecommunications sector will upgrade the living standard of the people and also support the balancing of social and economic development in the country. Hence urgent implementation is desirable.

Japan regards the Republic of Zambia as one of the most important countries in the world since Zambia takes a leading position internationally among Southern African countries and, in addition, a friendly relationship has been established between Japan and Zambia through the economic cooperation particularly in import of copper.

The ODA from Japan for the Republic of Zambia started with the loan in fiscal 1972, which was followed by the project and commodity loans up to fiscal 1983. However, no yen credit has been extended since fiscal 1984, except those for the re-scheduled projects due to the delay in repayment of the loans by the Government of Zambia. Since then, the Japanese assistance has been made in the form of grant aid, initially for the agricultural sector and then mainly for the fundamentals such as water supply and education. Recently, grant aids have been extended to basic infrastructures, also. Table-3 presents the record of Japan's ODA towards the Republic of Zambia.

Table-3 Japan's ODA towards the Republic of Zambia

(unit: million Yen)

Fiscal Year	Financial Cooperation Loan	Financial Cooperation Grant	Equipment Supply	Technical Cooperation
1972	9,240	-		
1977	6,670	-		
1978	5,000	-		
1980	5,450	550		
1981	-	2,187		
1982	7,049	2,273		
1983	8,920	3,381	(Aggregate	(Aggregate
1984	-	3,338	up to 1985)	up to 1985)
1985	1,863	3,677	(769)	(4,456)
1986	5,357	3,968	153	1,213
1987	-	6,197	322	1,443
1988	-	3,325	131	1,490
1989	-	7,438	343	2,143
1990	-	5,476	485	2,364
Total	49,550	41,810	2,203	13,111

(Source: "Japan's ODA 1991" by Economic Cooperation Bureau, Ministry of Foreign Affairs, Japan)

3-2-2 Similar Projects and Other Foreign Assistance

(1) On-Going Projects

A switching equipment rehabilitation project is now under way for the following exchanges, with the financial assistance from the African Development Bank. All the works are scheduled to be completed by the end of 1992. Total amount of assistance from the Bank is US$45,000,000 for the foreign currency portion and US$19,000,000 for the local currency portion, which covers a part of the undermentioned works.

Exchange	Local Switch	Local/Toll Switch
Lusaka Main	10,000 L.U.	7,000 L.U.
Emmasdale	4,000	
Roma	2,500	
Chinika	1,500	
Makeni	1,000	
Mongu	1,000	
Monsa	1,000	
Solwezi	1,000	
Kitwe Main	8,000	4,000
Itimpi	500	
Chambeshi	500	
Kalulushi	3,000	
Chillilabombwe	2,000	

(2) Projects Under Planning

Main telecommunications network rehabilitation and expansion projects now being planned by the PTC are as follows. As for the financial resources for them, bilateral loan, soft loan and non-governmental loans are expected.

a) Rehabilitation of telephone switching system

- Replacement of switching equipment

  78 exchanges, 124,100 L.U.

  Project cost

  Foreign currency: US$44,670,000

  Local currency : US$19,330,000

  Total : US$64,000,000

- Upgrading of E10B Digital ESS

  3 local switches, 40,000 L.U.

  Project cost

  Foreign currency: US$6,500,000

  Local currency : US$3,800,000

  Total : US$13,000,000

- Upgrading of NEAX-61 Digital ESS

  26,000 L.U.

Project cost

Foreign currency: US$6,500,000

Local currency : US$2,700,000

Total : US$9,200,000

- Upgrading of International Telephone Switching Center (ITSC)

2,000 L.U.

Project cost

Foreign currency: US$4,000,000

Local currency : US$1,600,000

Total : US$5,600,000

b) Replacement of Telex Switching Equipment

3,000 L.U.

Project cost

Foreign currency: US$2,500,000

Local currency : US$1,000,000

Total : US$3,500,000

c) Rehabilitation of Subscriber Cable Network

130,500 lines

Project cost

Foreign currency: US$20,000,000

Local currency : US$84,400,000

Total : US$104,400,000

d) Rehabilitation of Radio Links

- Microwave links

Project cost

Foreign currency: US$42,000,000

Local currency : US$22,000,000

Total : US$64,000,000

- Spur links

Project cost

Foreign currency: US$5,600,000

Local currency : US$2,600,000

Total : US$8,200,000

e) Multi-access Radio Telephone Systems

60 systems with 4,000 subscribers

Project cost

Foreign currency: US$30,000,000
Local currency : US$17,000,000
Total : US$47,000,000

f) Radio Monitoring Station

Project cost

Foreign currency: US$3,100,000
Local currency : US$2,040,000
Total : US$5,140,000

g) Mobile Radio Telephone System

Project cost

Foreign currency: US$8,000,000
Local currency : US$4,000,000
Total : US$12,000,000

h) Satellite Communication

Project cost

Foreign currency: US$12,300,000
Local currency : US$4,200,000
Total : US$16,500,000

i) Packet Switching

Project cost

Foreign currency: US$1,500,000
Local currency : US$ 700,000
Total : US$2,200,000

j) Subscribers' Apparatus

- Private Automatic Branch Exchanges (PABXs)

250 PABXs

Project cost

Foreign currency: US$5,000,000
Local currency : US$2,500,000
Total : US$7,500,000

- Telephone Instruments

160,000 telephone sets & 400 coin boxes

Project cost

Foreign currency: US$5,000,000
Local currency : US$2,500,000
Total : US$7,500,000

- Teleprinters

2,000 sets

Project cost

Foreign currency: US$4,000,000

Local currency : US$2,000,000

Total : US$6,000,000

- Facsimile Machines

1,000 sets

Project cost

Foreign currency: US$1,000,000

Local currency : US$ 500,000

Total : US$1,500,000

k) Renovation and New Installation of Main Frame Computer

Project cost

Foreign currency: US$1,200,000

Local currency : US$ 500,000

Total : US$1,700,000

l) Logistics

- Vehicles for Maintenance : 900

Project cost

Foreign currency: US$9,000,000

Local currency : US$4,500,000

Total : US$13,500,000

- Computer for Maintenance

Project cost

Foreign currency: US$ 500,000

Local currency : US$ 250,000

Total : US$ 750,000

3-2-3 Component of Project

This project covers the rehabilitation of subscriber and junction cable network and replacement of switching equipment. These three aspects compose a local telecommunication network and, therefore, their systematic integration is a key to efficient and effective establishment of the network.

3-2-4 Scope of the Requested Facilities

(1) Rehabilitation of subscriber cable networks in part of Lusaka Main and Ridgeway Exchange areas

The requested project scope is to rehabilitate the external facilities in the object areas, consisting of cables, cross connection cabinets, terminal boxes, poles and other ancillary facilities, and the underground facilities consisting of conduit pipes to accommodate cables for protection, manholes and other ancillary facilities.

In addition to being superannuated, the existing external plants are not maintained properly due to shortage of spare parts, and a lot of defective facilities are left unrepaired.

In view of the above, this Project will employ jelly filled polyethylene sheathed, polyethylene insulated cables which are easy in maintenance and high in reliability. A suitable joint system will be adopted. For subscriber cable networks, the cross connection cabinet system will be employed, since it is flexible and easy in maintenance.

For accommodation and protection of primary cables between a telephone exchange and a cross connection cabinet, a conduit system will be employed and pipes and manholes will be installed anew. For the section between a cross connection cabinet and a terminal box, a direct buried cable system will be adopted.

(2) Replacement of Switching Equipment in Ridgeway Exchange and Rehabilitation of Junction Lines between Lusaka Main and Ridgeway Exchanges and Associated Works

The requested scope is to replace the existing ARF crossbar switching equipment in Ridgeway Exchange (analogue type with 5,000 line units) with the digital ESS capable of digital switching, the similar to those installed in Lusaka City. In conjunction with this digitalization, the existing analogue circuit junction lines connected to Lusaka Main Exchange will also be digitalized through installation of cable PCM system.

The existing crossbar switching equipment was manufactured in 1966. It has a lot of moving parts and is now entirely obsolete, with frequent malfunctions. Since spare parts for repair can no longer be obtained from its manufacturer, the actual switching capacity of this equipment is decreasing day by day. The number of faults in the NEAX-61 digital ESS in Lusaka Main Exchange is only 2.06 per 100 subscribers, while that in the crossbar equipment in Ridgeway Exchange amounts to 6.48, three times the former.

3-2-5 Basic Policy in Implementing the Project

The benefits and feasibility, as well as the capability of the implementing agency, of this project have been confirmed through the studies mentioned above. The study result has also proved that the effect of this Project meets the purpose of the Japan's grant aid. Therefore, this Project is judged suitable for a Japan's grant aid.

An outline of, and the basic design for, the Project are described in the following, assuming that the Project will be implemented by the Japan's grant aid.

3-3 Project Description

The object areas and facilities are outlined in the previous chapter.

3-3-1 Executing Agency and Operational Structure

The executing agency for this Project on the side of the Republic of Zambia is the Posts and Telecommunications Corporation Limited (PTC). With respect to telecommunications policy, the PTC is placed under the Ministry of Communications and Transport, and with respect to its budgets, under the Zambia Industrial and Mining Corporation Limited (ZIMCO), a state-owned holding company.

Figure-3 presents the organization of the PTC, Figure-4, the organization of Telecommunication Division, and Figure-5, the organization of Telecommunications Operation & Maintenance Division.

The PTC operates the following services and businesses:

Telecommunications Division

- National/International Telephone Service
- National/International Telex Service
- National/International Telegraph Service
- National/International Programme Transmissions
- Radio Frequency Allocation and Management

Postal Division

- Mail Service
- Post Bus Service
- Remittance Service
- Stamp Issues and Philately

As of March 31, 1991, the PTC employs a total of 6,447 persons comprising 3,706 for Telecommunications Division, 1,980 for Postal Division, and 761 for Corporate Division.

Efficient assignment of operation and maintenance personnel will be achieved by the implementation of this Project under which measuring equipment, tools, parts and materials for faults detection and repair are to be supplied, facilitating prompt and reliable trouble shooting and prevention of troubles from occurring.

Planning and Development Department of Telecommunications Division comprises individual technical services. On the other hand, Operation and Maintenance Department consists of 2 regions to cover the maintenance of northern and southern regions. Each region has both individual technical groups which are controlled by an area manager.

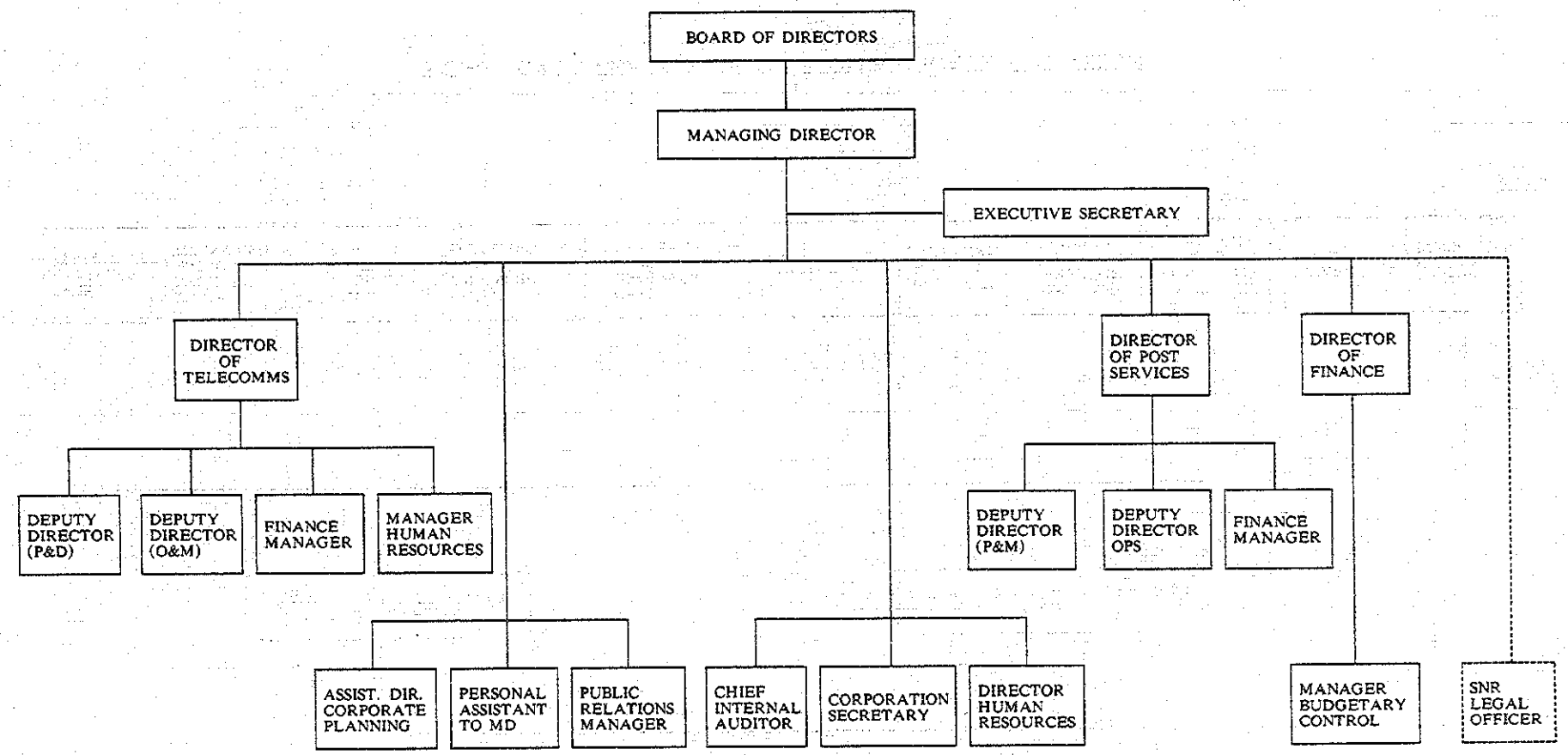

FIG.-3 ORGANIZATION OF PTC

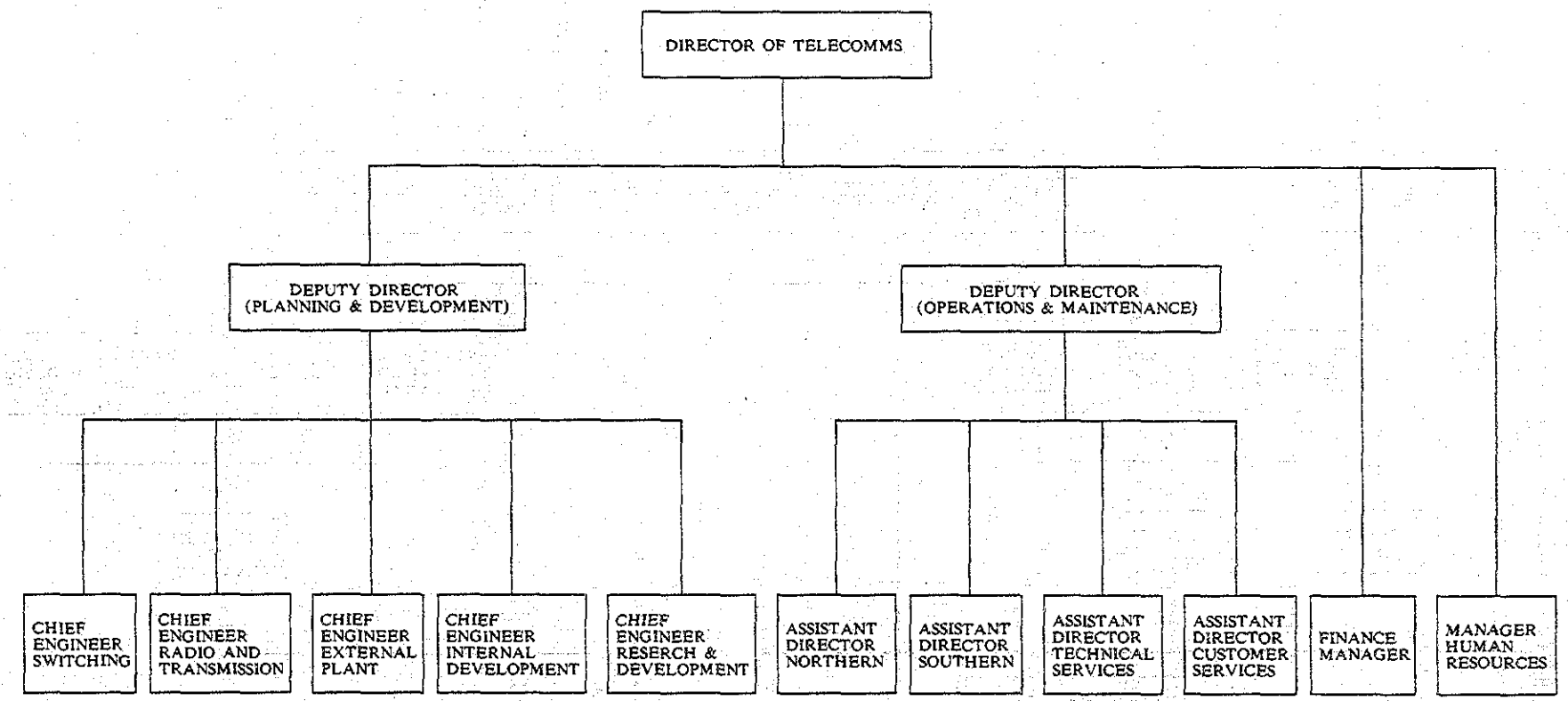

FIG.-4 ORGANIZATION OF TELECOMMUNICATIONS DIVISION

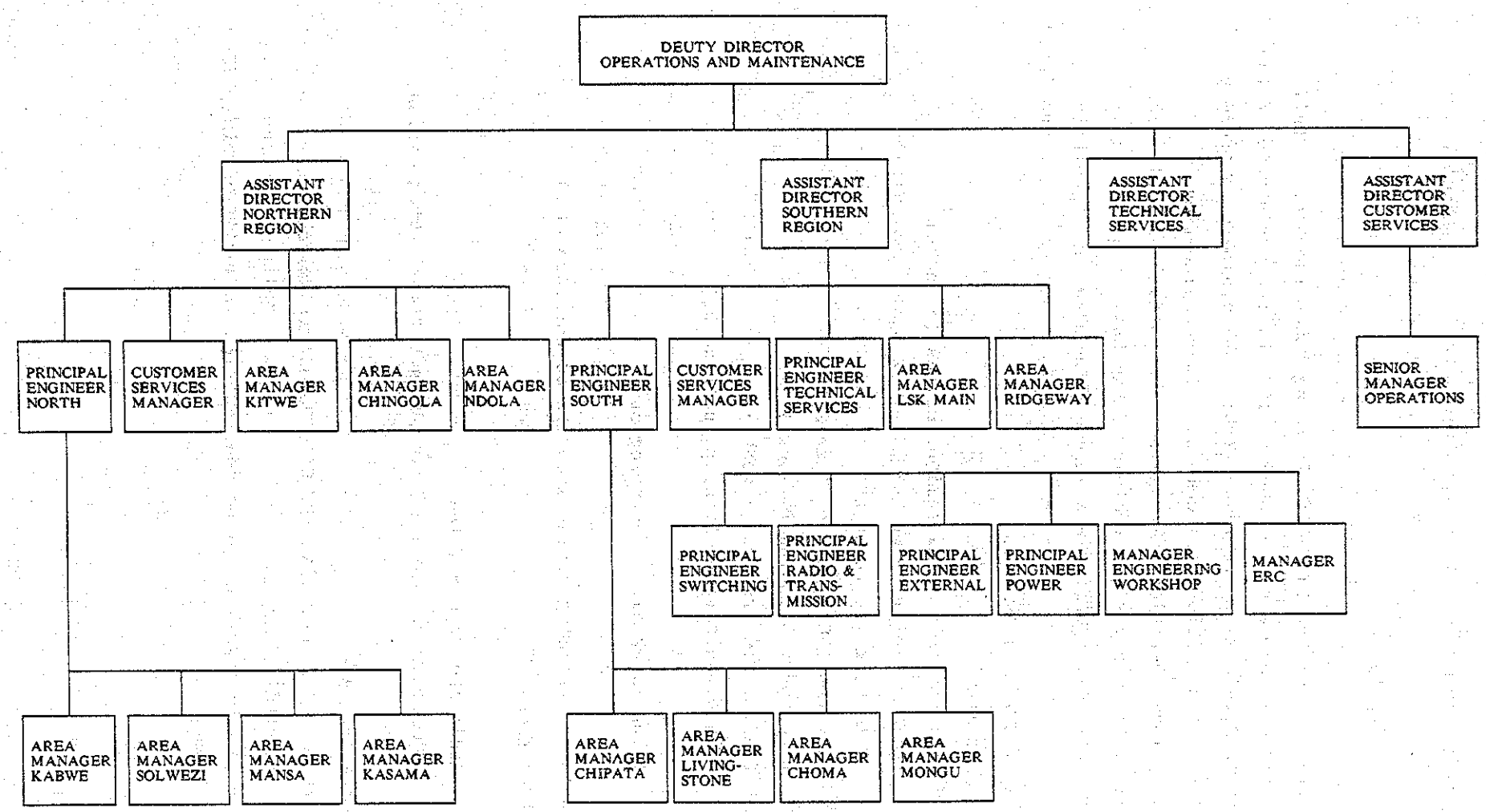

FIG.-5 ORGANIZATION OF OPERATIONS & MAINTENANCE DIV. OF TELECOMMS

3-3-2 Training Plan

(1) Training System

The training of the PTC staff is being conducted at the Staff Training College in Ndola established in 1972 by the assistance of the United Nations Development Programme (ITU). The training is broadly classified into four fields: telecommunications engineering, telecommunications operations, management and postal services. The engineering training comprises two parts: the basic training and specialized training. Curriculums at the Center are outlined below.

a) Basic Training Modules

- Introduction to Telecommunications (5 weeks)
- DC Electricity (5 weeks)
- AC Electricity (6 weeks)
- Electronic Components (4 weeks)
- Electronic Circuits (9 weeks)
- Digital Electronics (6 weeks)
- Telecommunications Principles (6 weeks)

b) Training in Specific Technologies

One-year training course is prepared for each of the following:

- Radio and Transmission
  Frequency division multiplex, satellite communication, etc.
- Switching
  Teleprinter, NEAX-61, E10B, crossbar switch, etc.
- External Plant
  Cable jointing, plant construction, trouble shooting, etc.
- Power

c) Telecommunications Operations Training Programme

- Telegraph Operation
- Telephone Operation
- Telephone Sales & Account, etc.

d) Management Training Programme

e) Postal Training Programme

The number of courses run in 1991 is given below together with the total number of trainees and training weeks:

	Number of Courses Run	Total Number of Trainees	Total Number of Training Weeks
- Telecommunications Engineering Course			
Radio & Transmission	18	145	123
Switching	10	59	84
External Plant	35	306	116
Power	1	6	6
- Telecommunications Operations Course	16	127	142
- Store Keepers Course	1	6	8
Total	81	649	479

(2) Training under individual Projects

The training of the PTC staff is conducted also under individual projects by respective contractors concerned in respective fields, either during, or after completion of, the projects in Zambia and the contractors' countries and/or other related countries.

Under this Project, a large quantity of jelly filled cables and a number of manholes and conduits will be installed. To ensure satisfactory operation of the system consisting of such facilities, maintenance personnel will be trained in construction, operation and maintenance of these facilities, in the form of class-room and on-the-job training. For the digital switching equipment and the junction facilities of cable PCM, re-training of maintenance personnel will be made in the form of class-room and on-the-job training in Zambia.

3-3-3 Equipment and Materials to be Supplied under this Project

After studying the contents of the request as described in Section 3-2 above, the scope of this rehabilitation project has been determined as follows:

(1) Scope of the Project

a) Rehabilitation of Subscriber Cable Networks in the following exchange areas

- Lusaka Main Exchange
  Subscriber cable networks in Lusaka Main Exchange area except those in Kabwata, Kamwala and Misisi districts in the southern part.

- Ridgeway Exchange
  Subscriber cable networks in Ridgeway Exchange area except those in Kalingalinga district in the eastern part.

b) Replacement of Switching Equipment in Ridgeway Exchange and Rehabilitation of Junction Facilities between Lusaka Main Exchange and Ridgeway Exchange, including Associated Power Supply System

The dimensions of the Project have been determined as described below, on the basis of the study results. Telephone demands in the object exchange areas and those in cross connection cabinet areas in respective exchange areas estimated by the Basic Design Study are shown in Table-4 and Table-5, respectively. For primary cable, capacities to cover the demands for 5 year period is adopted.

Table-4 Telephone Demand Forecast for Object Exchange Areas

{ ( ): Exist. Subs. + Waiting Subs }

Demand Forecast	Lusaka Main Ex. Area		Ridgeway Ex. Area	
Existing (1990.9)		(12,912)		(3,475)
Existing (1991.9)	9,309	(15,801)	2,408	(3,600)
1st year later	16,391		3,861	
2nd year later	17,005		4,122	
3rd year later	17,643		4,410	
4th year later	18,307		4,719	
5th year later	19,039		4,907	

Table-5 Telephone Demand Forecast for Cross Connection Cabinet Areas

Lusaka Main Exchange

New No.	Exist No.	S-in	5 Y	15 Y	New No.	Exist No.	S-in	5 Y	15 Y
201	E0	169	206	309	101	E06	296	360	540
102	E06	290	353	530	103	CB22	196	240	360
105	CB22	194	235	353	104	CB23	251	305	458
106	CB10	220	252	378	107	CB10	193	250	375
108	CB29	132	161	242	202	E05	130	161	242
203	E05	130	150	225	204	E05	119	150	225
301	E03	610	747	1121	302	E03	610	750	1125
305	E03	610	750	1125	306	E03	633	750	1125
303	E04	580	700	1050	307	E04	580	700	1050
308	E04	586	724	1086	304	CB11	400	487	731
401	E01	230	280	420	402	E01	230	280	420
404	E01	230	280	420	405	E01	223	271	407
403	E02	300	370	555	406	E02	317	381	572
407	CB3	459	552	828	408	CB3	447	550	825
409	CB16	631	768	1152		Total	9996	12163	18245

Ridgeway Exchange

New No.	Exist No.	S-in	5 Y	15 Y	New No.	Exist No.	S-in	5 Y	15 Y
302	CB1	190	224	336	303	CB1	200	250	375
301	CB2	239	291	437	304	CB3	127	155	233
206	CB4	115	150	225	207	CB4	142	163	245
404	CB6	235	250	375	405	CB6	229	215	323
105	CB17	353	429	644	104	CB19	213	259	389
102	CB20	122	148	222	103	CB21	156	190	285
101	E0	158	190	285	201	E0	155	190	285
202	E0	155	190	285	203	E0	155	190	285
204	E0	155	190	285	205	E0	155	190	285
401	E0	155	190	285	402	E0	155	190	285
403	E0	122	177	266		Total	3656	4521	6781

(2) Components of Targeted Facilities

Figure-6 presents the configuration of the targeted subscriber cable facilities.

a) Subscriber Cable Facilities and Associated Underground Facilities

The targeted subscriber cable facilities of this Project are demarcated to be from the main distribution frame in each object exchange to the terminal boxes of subscribers of the exchange area concerned.

- External Facilities: Termination to MDF, Primary Cables, Secondary Cables, Terminal Boxes.
- Underground Facilities: Pipes and Manholes

Main facilities are:

		Lusaka Main Ex.	Ridgeway
- Entrance Cables	(pairs)	13,200	6,800
- Primary Cables	(Km)	15.4	9.5
- Secondary Cables	(Km)	64.6	33.8
- Conduits	(Km)	11.1	9.4

b) Switching Equipment, Junction Facilities and Associated Power Facilities

The targeted switching equipment, junction facilities and power facilities of this Project are the switching equipment of Ridgeway Exchange, the transmission equipment in Ridgeway and Lusaka Main Exchanges, the junction facilities between Ridgeway and Lusaka Main Exchanges, and the power facilities in Ridgeway Exchange.

- Switching Equipment: Digital Switching Equipment