NO. 1

MINISTRY OF TRANSPORT AND COMMUNICATIONS
THE FEDERAL DEMOCRATIC REPUBLIC OF ETHIOPIA

BASIC DESIGN STUDY REPORT
ON
THE PROJECT
FOR
THE REHABILITATION OF THE TELEPHONE CABLE NETWORK
FOR
ADDIS ABABA
IN
THE FEDERAL DEMOCRATIC REPUBLIC OF ETHIOPIA

MARCH, 1996

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PREFACE

In response to a request from the Government of the Federal Democratic Republic of Ethiopia, the Government of Japan decided to conduct a basic design study on the Project for the Rehabilitation of the Telephone Cable Network for Addis Ababa in the Federal Democratic Republic of Ethiopia and entrusted the study to the Japan International Cooperation Agency (JICA).

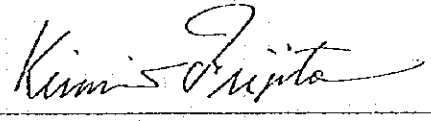
JICA sent to Ethiopia a study team from November 27 to December 26, 1995.

The team held discussions with the officials concerned of the Government of Ethiopia, 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 Ethiopia in order to discuss a draft basic design, and as this result, the present report was finalized.

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 Federal Democratic Republic of Ethiopia for their close cooperation extended to the teams.

March 1996



Kimio Fujita
President
Japan International Cooperation Agency

March 1996

Letter of Transmittal

We are pleased to submit to you the basic design study report on the Project for the Rehabilitation of the Telephone Cable Network for Addis Ababa in the Federal Democratic Republic of Ethiopia.

This study was conducted by Nippon Telecommunications Consulting Co., Ltd., under a contract to JICA, during the period from November 22, 1995 to March 29, 1996. In conducting the study, we have examined the feasibility and rationale of the project with due consideration to the present situation of Ethiopia and formulated the most appropriate basic design for the project under Japan's grant aid scheme.

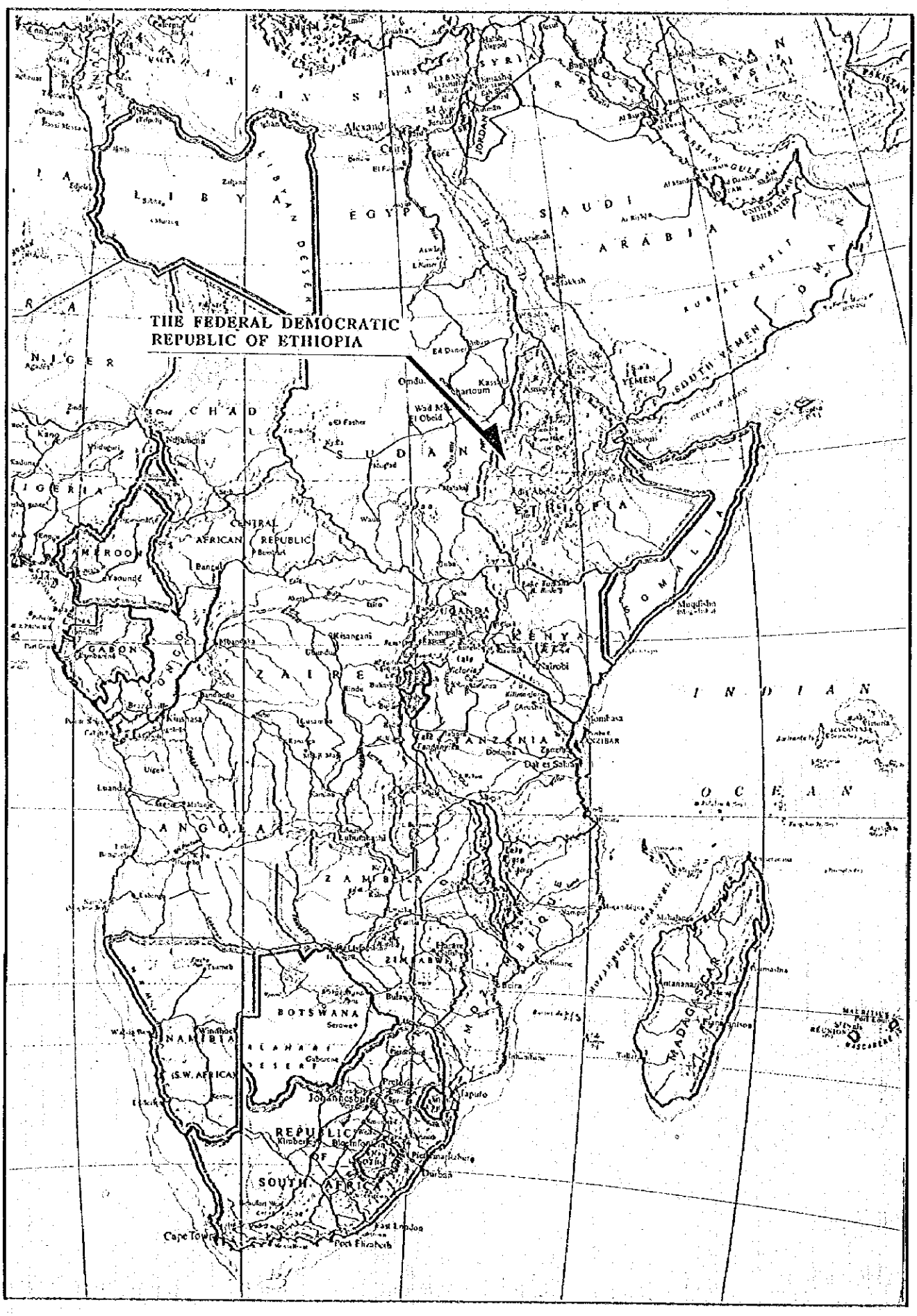
Finally, we hope that this report will contribute to further promotion of the project.

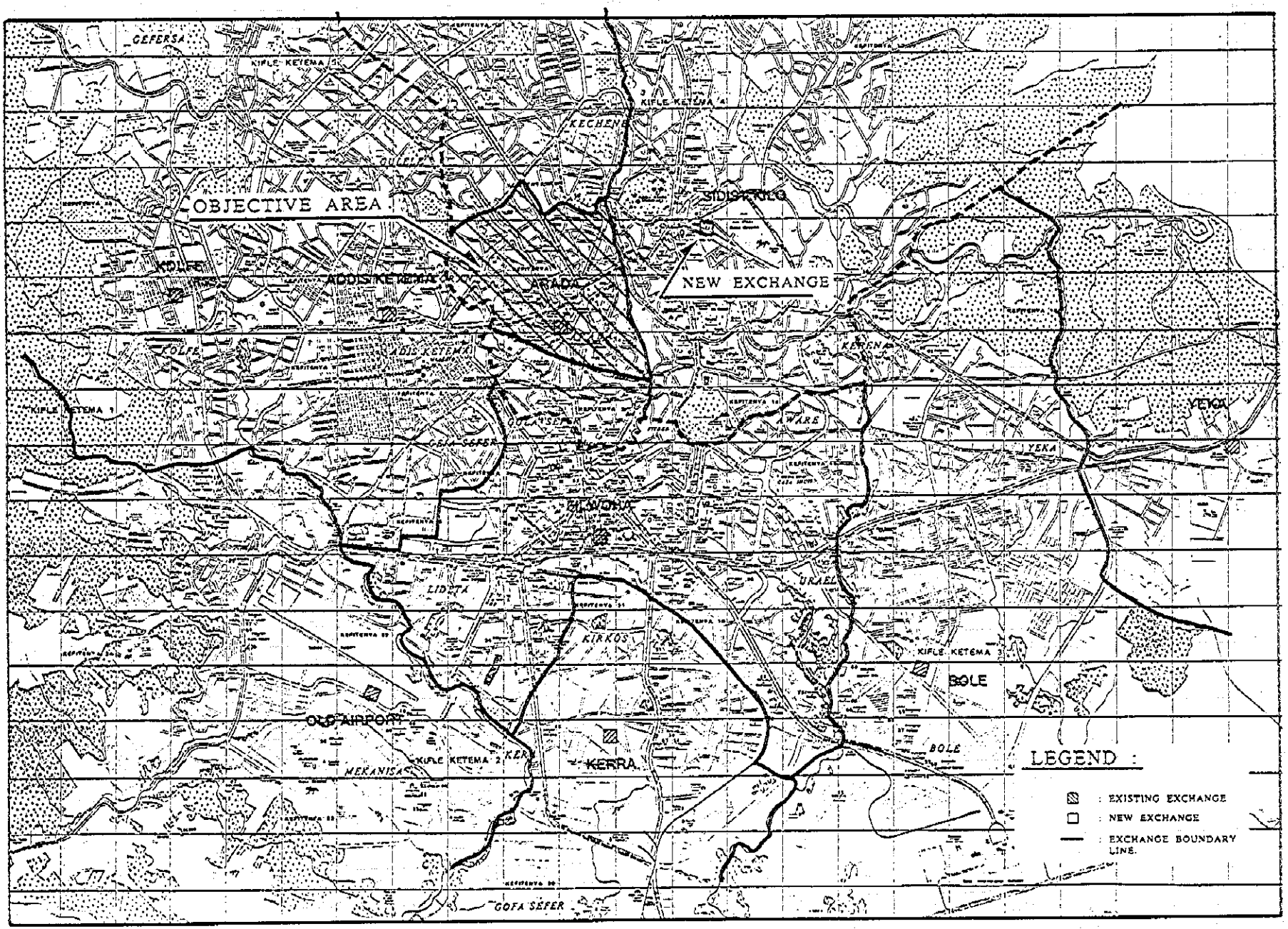
Very truly yours,

Hideo Mitsuhashi
Project Manager,
Basic Design Study Team on the Project
for the Rehabilitation of the Telephone
Cable Network for Addis Ababa of the
Federal Democratic Republic of Ethiopia
Nippon Telecommunications Consulting
Co., Ltd.

LOCATION MAP OF

THE FEDERAL DEMOCRATIC REPUBLIC OF ETHIOPIA





OBJECTIVE AREA IN ADDIS ABABA CITY.

ABBREVIATIONS

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MEDAC	:	Ministry of Economic Development and Cooperation
MTC	:	Ministry of Transport and Communications
ETA	:	Ethiopian Telecommunications Authority
IDA	:	International Development Association
EIB	:	European Development Bank
AfDB	:	African Development Bank
PANAFTEL	:	Pan-African Telecommunication Network
ERRP	:	Emergency Recovery and Reconstruction Project
ISDN	:	Integrated Services Digital Network
SDH	:	Synchronous Digital Hierarchy
PDH	:	Presiochronous Digital Hierarchy
ATM	:	Asynchronous Transfer Mode
MDF	:	Main Distribution Frame
PDF	:	Private Distribution Frame
CCC	:	Cross Connection Cabinet
DP	:	Distribution Point
LU	:	Line Unit

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CHAPTER 1 BACKGROUND OF THE PROJECT

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The Federal Democratic Republic of Ethiopia is located in the "Horn of Africa" in the north-eastern part of Africa. Ethiopia is a landlocked country, having no coast line, as a result of the independence of Eritrea. It neighbours to Saudi Arabia across the Red Sea and assumes an important position geopolitically. It is bordered on the west by Sudan, on the south by Kenya, on the south-east by Somalia, on the east by Djibouti and on the north-east by Eritrea that faces the Red Sea.

It has a total area of approx. 1.12 million sq. km, with the population of approx. 54.49 million. About two-thirds of the country lie at an altitude of 1,500 ~ 3,000 metres above sea level. Climate in the country varies with location and altitude, and broadly the whole country is divided into three districts, i.e., cold district, warm district, and high humidity district. The capital city, Addis Ababa, is situated at an altitude of 2,400 metres above sea level, in an intermediate location between the cold and warm districts. Temperature in Addis Ababa ranges from 10° C and 26° C throughout a year and there are two rainy seasons a year.

In Ethiopia, the then ruling socialist government went out of power in May 1991, and a transitional government was established. The transitional government promulgated a new constitution and conducted general elections. As a result, a new regime was established in August 1995. The Government is now implementing the 5 Year National Development Programme (1995-2000).

In the telecommunications sector, the VIIth Development Programme was formulated in 1989, in line with the former National Development Programme. The Ethiopian Telecommunications Authority (ETA) is an agency responsible for the implementation of this Programme. However, its implementation was delayed as a result of the civil war and started from September 1994. The Government expects that approx. 70% of the necessary funds for the Programme will be covered by the external credits or loans.

At the end of September 1995, the number of existing telephone sets was approx. 180,000, with the telephone density of approx. 0.3 per 100 inhabitants, which is rather low as compared with the average in Africa, i.e., approx. 4.8 per 100 inhabitants. The number of waiting applicants amounts to as much as approx. 180,000, almost equal to the number of the existing subscribers. There is a basic nation-wide

telecommunications network in the country. However, communications services are insufficient quantitatively and qualitatively, with poor facilities consisting of outdated switching equipment (including manual one) and superannuated cable facilities, resulting in a number of faults and troubles.

There are 7 exchanges in a local telephone network in the capital city, Addis Ababa. The Government of Ethiopia intends to expand the switching systems and subscriber lines in Addis Ababa, with the financial assistance from EIB (European Investment Bank), AfDB (African Development Bank), Italy and Sweden. Negotiations for the above are being under way with respective donors.

Telecommunications facilities, particularly most of the cable facilities in Addis Ababa, have been in use for more than 30 years, exceeding their respective life spans, and these poor facilities have resulted in frequent service failures.

The VIIth Telecommunications Development Programme was formulated by the Government to cope with the above situation. Projects for the expansion and rehabilitation of local switching equipment and cable facilities in Addis Ababa and other rural areas have been planned under the Programme. For Addis Ababa, an addition of 97,000 subscriber lines is planned.

Local telephone network facilities can be classified into two categories: external plant and internal plant. External plant facilities extend all over the objective area and are required to cope with various kinds of social and environmental requirements. Hence, rationalised and effective investments in, and operation of, these facilities will be crucial factors in efficient telecommunications business management. On account of the civil war which lasted for a long while, together with some other reasons, no investments have been made for rehabilitation and improvement of outside plant for a long period, as is the case with other African countries.

Under the above situation, the Government of Ethiopia requested Japan's grant aid for the rehabilitation of outside plant and civil facilities in 5 areas in Fillwoha, Arada and Addis Ketema exchange areas, which are the centre of political and economic activities in Addis Ababa. In response to this request, the Japanese Government dispatched a preliminary study team to Ethiopia from August to September 1995 and, based on the results of discussions with the officials concerned of the Ethiopian Government, it has been decided that Japan's grant aid be extended for the rehabilitation of the cable

network in Arada Exchange area, which is the highest priority area among the 3 areas.

JICA dispatched the Basic Design Study Team from November 27 to December 26, 1995, to Ethiopia. The Study Team held discussions with the officials concerned of the Ethiopian Government for confirmation of the contents of the request and examination of the suitability of the project as a grant aid project, covering the scope and size of the project. The Study Team also conducted field surveys in the project area for investigation of the status of telecommunications facilities and services, operation and maintenance management systems, and external assistance for telecommunications development, etc. Based on the field investigation findings and the data obtained, the Study Team prepared, after returning to Japan, a basic design for the required facilities, keeping in mind to make them optimum in content and size, and a final draft study report was drawn up. JICA dispatched the Study Team to Ethiopia again from February 28 to March 10, 1996, for explanation and discussion of the report. Through discussions with the officials concerned of the Ethiopian Government, an agreement was reached with respect to the contents of the report.

CHAPTER 2 CONTENTS OF THE PROJECT

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2.1 Objective of the Project

In Ethiopia, most of telecommunications facilities are those installed in 1960s and deteriorated extremely. The existing cables are outdated paper insulated, lead sheathed cables which have been in use for more than 3o years. Hence, communication failures due to water penetration into cables occur 3 ~ 4 times a month in the rainy seasons (the minor rainy season ranges from February to March, and the main rainy season, from June to September), sometimes resulting in failures of several tens or hundreds of subscriber lines at a time.

Repair and recovery of faulty facilities are undertaken by the maintenance staff ETS. However, due to shortage in foreign exchange, it is difficult to obtain required quantity of maintenance vehicles and spare parts, and prompt recovery of the faulty facilities has been hampered.

The above situation necessitates the rehabilitation and improvement of the whole facilities, and the Government of Ethiopia requested the grant aid of the Government of Japan for the rehabilitation of the outside plant facilities in 5 local areas of 3 telephone exchanges in Addis Ababa, which is the centre of the political and economic activities in Ethiopia.

In response to this request, the Japanese Government sent a preliminary study team to Ethiopia. The study team discussed various matters involved with the persons concerned of the Ethiopian Government, and a conclusion was reached that a part of Arada Exchange area which is given the highest priority be selected as an objective area of the grant aid from the Japanese Government.

The objectives of this project are to rehabilitate and improve the telephone outside plant facilities in the objective district in Arada Exchange area, so as to provide highly reliable telephone services in the district, free from line failures due to rainfall. Telecommunications services thus improved will contribute to enhancement of social and economic activities, and further to successful materialisation of the 5 Year National Development Programme now being promoted by the Ethiopian Government.

2.2 Basic Concept of the Project

This project aims to rehabilitate and improve the existing local telephone network composed of deteriorated and superannuated cables and underground facilities, and to provide high quality telecommunications services, in the objective area located in the central part of the Arada Exchange area, in order to eliminate the main causes of frequent line failures. Major items to be covered by this project are as follows:

(1) Replacement of Existing Cables

The existing underground cables in the objective area are of three types: direct buried cables, conduit cables and aerial cables. Most of these underground cables are paper insulated, lead sheathed cables installed more than 30 years ago, and these overage cables are the main cause of communication failures. These underground cables will be replaced with water-proof, jelly filled, PE insulated and sheathed cables.

In some areas of the objective site are found self-supporting type, PE-insulated and sheathed aerial cables, and improper practice applied on them at the time of cable connection and installation are often the cause of the present cable troubles. These aerial cables, too, will be replaced with new cables, using proper installation practices.

(2) Rehabilitation and Improvement of Underground Civil Facilities

Underground civil facilities consist of manholes and conduits. The existing manholes are not provided with hardware necessary for supporting cables. As a result, direct buried cables are laid in a disorderly manner, passing through the middle of a manhole. In addition, other underground structures (water pipes, power cables, etc.) are also installed in the same manhole, and the inner height of the existing manholes is insufficient to accommodate additional cables, that is, it is difficult to install new cables in the existing manholes under the current conditions.

The existing underground conduits are multi-layers concrete ducts, the insides of which are now filled with earth and sand which has entered through the un-matched joint portion and, therefore, new cable installation in these ducts can hardly be done.

To cope with the above problems, rehabilitation and improvement of the existing manholes and underground civil facilities will be done.

(3) Re-location of Existing Cables and Underground Civil Facilities in Connection with Road Expansion Work

There is a road expansion programme planned by the municipality for the area adjacent to the exchange building premises, which necessitates the re-location of the existing cables and underground civil facilities of ETA. In designing new underground duct routes, due attention should be paid to such re-location work. The difference in ground level between the premises and the public road should also be considered.

2.3 Basic Design

2.3.1 Design Concept

In designing the local cable network for the project, due attention is paid to natural, social and economic conditions in the objective area, since the outside plant facilities are installed covering the whole territory of the objective area. No less attention is paid to demand for communication services, workability and economy of communication facilities so that the network established can be the optimum in ease of operation/maintenance and future expansion, facilitating efficient provision of highly reliable communication services.

Outside plant facilities to be installed by this project are as shown in Figure 2.1 "Configuration of Subscriber Cable System."

The basic design concept of this project is as follows:

(1) Natural Environment

Addis Ababa lies in a tableland at an altitude of 2,400 meters above sea level. Climate there is mild, with temperatures ranging from 8°C to 26°C throughout a year. Being situated near the equator, seasonal climatic changes are moderate, though there are two rainy seasons in a year. According to the meteorological data in 1992, the maximum rainfall in June through September was 400 mm. Some area is subject to flood in a rainy season. Line failures are often caused by water penetration into underground cables due to rainfall, poor insulation of drop wires, etc. There is no fear of cable damages resulting from typhoons, earthquakes, etc.

The objective area is located in a hilly district, and a number of rocks are exposed along the public roads and residential premises. The ground consists of stratum of soft rock and sand. In the main rainy season, there is a fear of landslide on slopes of hills in this district. This should be taken into consideration in selecting the routes of the outside plant facilities.

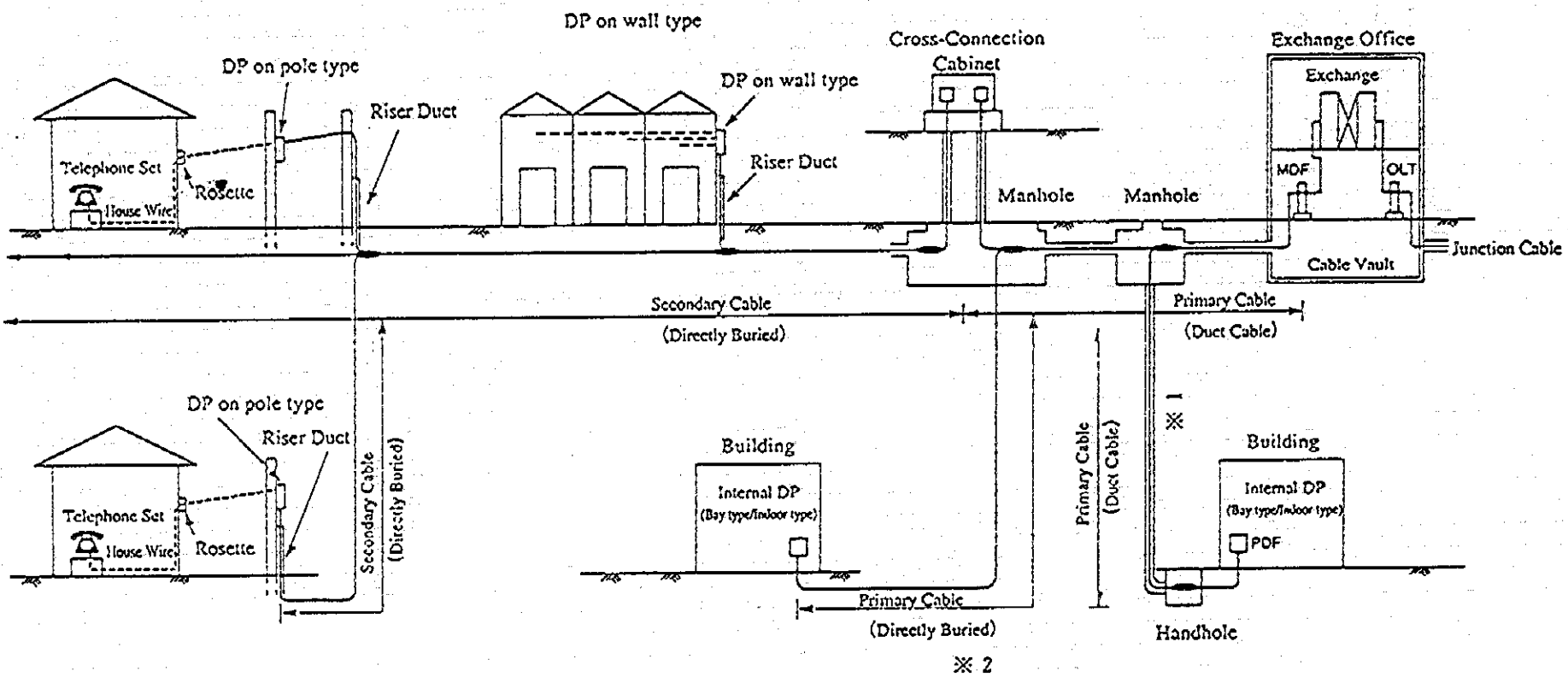


Figure 2.1 Configuration of Subscriber Cable System

※ 1 : Duct system is applied when large scale subscriber lines are 300 lines or more.

※ 2 : Below 300 lines (100 - 200lines), direct buried system is applied.

---- : Works under the Responsibility of Ethiopian Side.

(2) Social Requirements

The objective site embraces a number of important subscribers, such as governmental and public offices, hospitals, clinics, schools, churches, etc., in addition to commercial and business centres which dominate the commercial and economic activities in the nation, such as banks, business offices, stores, hotels, etc. The number of main important subscribers is as listed below.

1)	Governmental and public offices	19
2)	Hospitals and medical offices	4
3)	Police station	1
4)	Schools and churches	6
5)	Banks	2
6)	Hotels	6
7)	Business office and shops	Many
8)	High class apartment houses	Many

Some of main roads are paved and are in good condition and provided with sidewalks. Cable systems along such roads will be so designed that re-excavation of roads for the facility expansion in the future to meet increased telephone demand can be minimised in order not to disturb business and personal activities.

(3) Permission for Road Occupation

All the telecommunications facilities of this project are to be constructed under or on the ground, mostly occupying roads. Hence, permission for road occupation must be obtained from the competent authority responsible for the road management in Addis Ababa. (Formal procedures should be taken by ETA.)

(4) Special Conditions Related to Construction Work

In Ethiopia, there exist no regulations nor license systems to restrict the implementation of construction work.

Due attention, however, should be paid to the following special conditions:

1) Work efficiency in materials transportation and civil work will be low during the daytime because the objective area is a centre of the commercial and business activities and, therefore, vehicle and passenger traffic will be very high during business hours.

2) The ground of the objective site consists of stratums of soft rock and sand. Furthermore, there exist a lot of underground facilities of other authorities, in addition to the existing direct buried cables of ETA. Hence, excavation by machines is difficult and risky in certain places.

3) All through the year, the temperature is moderate, posing no problem with respect to construction work. However, during the rainy seasons (twice a year), they usually have more than 400 mm of rain per month, and work efficiency will have to be lowered considerably.

4) In Ethiopia, outside plant construction work including civil work is undertaken by ETA itself and there is no private telecommunications facilities construction company. Civil work for this project, therefore, will be undertaken by national or private general construction companies under the guidance of the contractor for this project.

5) ETA has approx. 200 technicians specialising in cable work. However, they will be assigned for the commissioning of 3 new exchanges now being constructed with some external financial assistance, and the subscriber line transfer work for this project. Hence no assistance of ETA staff can be expected for the cable and underground facilities construction work for this project. The contractor for this project will have to employ unskilled labourers and have them engage in construction work for this project after conducting suitable training for them.

(5) Use of Local Contractor and Local Products

Use of local general construction companies should be considered positively, and the consultant for this project should provide adequate guidance to them. Utilisation of local products should also be considered positively.

1) There are several cement factories in Ethiopia. The quantity of cement required for this project will be not so large and, therefore, can be procured locally.

2) There are reinforcing iron bars reclamation factories in Ethiopia. However, their products are somewhat inferior in quality as compared to imported ones, and will not be used for this project. Since the quantity of reinforcing iron bars required for the project is not large, imported bars will be purchased locally.

3) For poles, both imported steel poles and home-made wooden poles are in use now. Home-made wooden poles are not satisfactory in quality. However, the quantity of poles necessary for this project is not large and, therefore, it will be practicable to have the contractor manufacture wooden poles for this project domestically in compliance with the specifications under the contract with ETA. This will encourage the domestic production of necessary materials, and support the self-reliance of ETA in operation/maintenance and implementation of new projects for further improvement and expansion of telecommunications facilities in coming years, without depending on the foreign exchange.

4) Materials necessary for civil work, such as gravel, sand, crushed stones, etc. can be obtained locally. There is no problem with regard to quality available.

5) Shuttering material, such as lumber, plywood boards, plate, etc. can be obtained locally, without problem.

(6) Operation/Maintenance Capability of Implementing Agency

The existing operation, maintenance and administration organisation of ETA is well managed. The technical level of ETA staff is quite high, and this is evidenced by the fact that the data on subscribers claims have been compiled statistically. Pre-service training of new recruits and in-service training of staff in various technical fields, particularly on new technologies, are conducted at the Training Institute whenever necessary, contributing to maintaining the high maintenance level.

(7) Construction Work Period

Through the year, the temperature is moderate and poses no problem to construction work. However, more than 400 mm rainfall per month is usual during the rainy season which takes place twice a year, and efficient work performance cannot be expected during the rainy season. This should be taken into account in preparing the implementation time schedule.

(8) Dimensions of Objective Facilities and Service Grade

Dimensions of objective facilities and service grade to be attained by this project are as follows:

1) Distribution System

With a view to ease of operation and maintenance of the installed facilities and efficient cable distribution, CCC (Cross Connection Cabinet) system will be adopted. In this system, the cable from the telephone exchange to CCC, including PDF (Private Distribution Frame), is called the primary cable, while the cable from the cabinet to DP (Distribution Point) is called the secondary cable.

However, for large scale subscribers and buildings accommodating 100 or more pairs, cables will be distributed to PDF of subscribers' premises to facilitate efficient operation and maintenance, without using CCC.

2) Distribution of Primary Cable

In consideration of the security of the facilities, the conduit system will be used for the primary cable systems which have to accommodate a large number of subscribers. This system facilitates easy cable expansion to meet increased demand and easy replacement of faulty cables. This system can also protect cables from damages due to construction work for other underground facilities. Cable connection will be made in manholes. However, the primary cables of 100 to 200 pairs will be installed directly under the ground up to PDF.

3) Distribution of Secondary Cable

For secondary cables, the direct burial cable system in which cables are directly buried under the ground will be used in principle. In case this system is not suitable because soil excavation is difficult topographically or road width is not clear, etc., the aerial cable system will be adopted.

4) Distribution Area

A distribution area is an area used to achieve effective management of outside plant facilities which permits efficient utilisation and proper expansion of facilities and, once established, the area boundary may not be changed easily. The area size will be so designed that approx. 600 subscribers will be accommodated in each area. The area is usually bounded by highways, rivers, railways, etc. The site for CCC should be selected, taking into consideration the city planning, so that there will be no need to change its position in the near future. A site liable to damages due to vehicles, etc. or a site which may obstruct road traffic should be avoided.

5) Types of Underground Cables

For primary and secondary cables to be installed in conduits or buried directly under the ground, jelly-filled, PE insulated and PE sheathed cables will be used, so that cables can be protected from faults due to water penetration. By this method, the cable maintenance level can be raised.

6) Transmission Standards

Transmission standards to be used in local outside plant design are as follows. In addition, cable conductor diameters will be so determined that economic design can be realised.

- Direct loop resistance	:	Maximum 1,500 ohm
- Attenuation (800 Hz)	:	Maximum 7 dB

7) Cable Conductor Diameter

Cables of 0.4 mm conductor diameter will be used for distribution in the local cable network of the objective area which is within 3 km of the exchange. For cables to be used for the re-location of the existing cables due to the road expansion, conductor diameters will be determined, in consideration of the transmission quality of the existing cables.

8) Re-use of Existing Facilities

All the existing primary and secondary cables are old-fashioned paper insulated and lead sheathed cables and, therefore, will not be re-used. However, terminal boxes, poles, drop wires, etc. will be re-used, if utilisable.

(9) Concept of Demand Forecast

This project aims at the rehabilitation and improvement of the outside plant facilities in a part of Arada Exchange area. The microscopic demand forecast will be made for the objective area, based on the field survey findings. The microscopic forecast thus obtained will be adjusted in view of the available macroscopic demand forecast mentioned below, and the project size will be designed based on the results of these studies.

1) Microscopic Demand Forecast

ETA has made the microscopic demand forecast up to 2000 covering the whole Arada Exchange area, for each existing CCC and DP, with the data on the numbers of the existing subscribers and waiting applicants. However, ETA is now planning to divide the Arada Exchange area into two and establish a new exchange, called Sidist Kilo. Hence, prior to the commencement of the field survey, the ETA's microscopic demand forecast was analysed, together with ETA staff, classifying the whole exchange area into three: i.e., the objective area of this project, the other area of Arada Exchange and the area of Sidist Kilo Exchange. Then, for the objective area of this project, the detailed field survey was carried out with ETA staff, and based on the survey results, the ETA's microscopic demand forecast was reviewed and adjusted. The study results are given in Table 2.1.

2) Macroscopic Demand Forecast

The macroscopic demand forecast was made by ETA under the VIIth Development Programme. It is, however, outdated now and not suitable to use for this study. There is another data on macroscopic demand forecast made just recently by JTEC (Japan Telecommunications Engineering and Consulting Service), and this data was referred to in adjusting the demand forecast. The macroscopic demand forecast of the whole nation and the Arada Exchange area are given in Table 2.2

3) Adjustment of Demand Forecast

An analysis and comparative study was made for the adjustment of the demand forecast, based on the numbers of existing subscribers and waiting applicants obtained from ETA, the microscopic demand forecast up to 2000 made by ETA, the macroscopic demand forecast made by JTEC, and the field survey results. The demand in 1995 estimated by JTEC is larger than the visible demand estimated by ETA by 20%, and as for the demand in 2002, the forecast by JTEC is larger than that by ETA by as much as 60%.

In consideration of the purpose of this project being the rehabilitation and improvement of the existing facilities and the average annual increase ratio of visible demand during the past 5 years being approx. 5% according to the ETA data, the size of this project will be designed, based on the ETA's demand forecast and the field survey results. The macroscopic demand forecast, the existing numbers of subscribers and waiting applicants and demand forecast for the whole nation and the Arada Exchange area are given in Table 2.3 through Table 2.6.

Table 2.1 Microscopic Demand Forecast for Objective Area of Arada Exchange

CCC No.	At End of September 1995			Demand Forecast Year	
	No. of Subscribers	No. of Waiters	Expressed Demand	2000	2002
4001	238	188	426	539	594
4002	195	245	440	587	647
4003	219	223	442	576	635
4004	189	146	335	423	466
4005	256	231	487	626	690
4006	315	66	381	421	464
4007	191	292	483	658	725
4008	229	206	435	559	616
4008-1	74	96	170	228	251
4009	210	195	405	522	576
4010	230	172	402	505	557
4011	179	82	261	310	342
4011-1	70	14	84	92	101
4012	224	182	406	515	568
4013	305	242	547	692	763
4014	198	186	384	496	547
4015	160	104	264	326	359
4015-1	70	100	170	230	254
4015-2	50	60	110	146	161
4015-3	70	100	170	230	254
4015-4	100	70	170	212	234
4016	293	137	430	512	564
4017	280	105	385	448	494
4017-1	150	100	250	310	342
4017-2	0	200	200	320	353
4017-3	20	30	50	68	75
4017-4	20	30	50	68	75
4018	266	63	329	367	405
4018-1	50	70	120	162	179
4018-2	50	71	121	164	181
4018-3	20	30	50	68	75
4018-4	59	10	69	75	83
4019	174	117	291	361	398
4020	194	175	369	474	523
4020-1	50	30	80	98	108
4021	322	92	414	469	517
4021-1	65	2	67	68	75
4021-2	30	20	50	62	68
4022	258	85	343	394	434
4022-1	50	10	60	66	73
4023	174	89	263	316	348
4023-1	60	30	90	108	119
4023-2	50	30	80	98	108
合計	6,407	4,726	11,133	13,969	15,401

Table 2.2 Macroscopic Demand Forecast for Whole Nation

Ref. No.	Areas	Year							
		1995	1996	1997	1998	1999	2000	2001	2002
1	Whole Nation	346,000	385,000	428,000	476,000	529,000	588,000	654,000	727,000
2	Central Region	262,640	292,010	324,630	360,970	400,660	446,130	495,920	551,410
3	Addis Ababa City	223,730	248,840	277,060	308,180	343,100	381,580	424,400	472,000
(1)	Addis Ketema	39,150	44,040	49,590	55,780	62,440	69,830	78,500	88,260
(2)	Arada	51,460	56,990	63,170	69,960	77,540	85,850	95,070	104,790
(3)	Fillwoha	38,030	42,050	46,550	51,160	56,610	62,580	68,750	75,520
(4)	Bole	35,130	39,070	43,500	48,380	53,870	59,910	66,210	73,630
(5)	Kera	22,490	25,020	27,850	31,200	34,740	38,630	42,970	48,120
(6)	Nefas Silk	8,830	9,820	10,940	12,250	13,640	15,170	16,870	18,900
(7)	Old Airport	18,120	19,660	21,610	23,420	25,730	28,240	31,410	34,460
(8)	Kolfe	10,520	12,190	13,850	16,030	18,530	21,370	24,620	28,320

Source : Survey Report on National Telecommunications Facilities Expansion Project prepared by JTEC (March 1994)

Table 2.3 Capacity of Switching Systems, Number of Subscribers and Wating Applicants (1993/1994)

Type of Switch	Ref. No.	Exchange Name	Year of 1993/1994 Switch Capacity	Number of Subscribers	Number of Waiters	Usage Ratio (%)
	1	Addis Ababa City				
A	(1)	Addis Ketema I	10,000	9,423		94.23
N	(2)	Arada I	10,000	9,701		97.01
A	(3)	Arada II	10,000	9,564		95.64
L	(4)	Bole I	10,000	9,929		99.29
O	(5)	Filwoha I	4,500	1,907		42.38
G	(6)	Filwoha II	10,000	9,097		90.97
U	(7)	Kirkos I	8,000	7,636		95.45
E	(8)	Old Airport I	5,000	4,831		96.62
		Sub-total	67,500	62,088	0	91.98
S	2	Other Area				
W	(1)	Arba Minch	1,000	510	856	51.00
I	(2)	Awassa	2,000	1,437	2,055	71.85
T	(3)	Dessie	2,000	1,939	2,268	96.95
C	(4)	Dilla	2,000	660	500	33.00
H	(5)	Ghion	800	445	756	55.63
	(6)	Goba	1,000	557	577	55.70
	(7)	Harar	2,600	1,887	1,928	72.58
	(8)	Mekele	3,000	1,918	3,319	63.93
	(9)	Shashemene	2,000	1,375	1,702	68.75
	(10)	Shewa	200	111	50	55.50
	(11)	Welayta	2,000	455	543	22.75
	(12)	Wenji	200	193	191	96.50
		Sub-total	18,800	11,487	14,745	61.10
		Total	86,300	73,575	14,745	85.25
	1	Addis Ababa City				
D	(1)	Addis Ketema II	7,552	5,111	20,040	67.68
I	(2)	Arada III	4,096	3,988	21,533	97.36
G	(3)	Bole II	4,608	4,331	19,668	93.99
I	(4)	Filwoha III	10,112	9,597	12,627	94.91
T	(5)	Kirkos II	5,120	5,015	15,662	97.95
A	(6)	Old Airport	3,072	2,991	9,558	97.36
L	(7)	Kolfe	2,048	2,007	7,523	98.00
		Sub-total	36,608	33,040	106,611	90.25
S	2	Other Area				
W	(1)	Agaro	1,024	903	225	88.18
I	(2)	Akaki	2,048	1,402	2,373	68.46
T	(3)	Assela	1,024	1,019	1,802	99.51
C	(4)	Bahir Dar	2,048	1,583	2,647	77.29
H	(5)	Debre Berhan	2,048	1,616	985	78.91
	(6)	Debre Markos	2,048	1,646	570	80.37
	(7)	Debre Zeit	2,048	1,774	2,581	86.62
	(8)	Debre Dawa	4,096	3,952	4,247	96.48
	(9)	Gondar	2,048	1,422	2,820	69.43
	(10)	Jimma	3,072	2,707	1,711	88.12
	(11)	Nettu	1,024	827	18	80.76
	(12)	Nazreth	4,096	4,070	4,149	99.37
	(13)	Nekemte	1,024	1,002	974	97.85
		Sub-total	27,648	23,923	25,102	86.53
		Total	64,256	56,963	131,713	88.65
T	Total of Addis Ababa City		104,108	95,128	106,611	91.37
O	Total of Other Area		46,448	35,410	39,847	76.24
T	Total of Automatic Switch		150,556	130,538	146,458	86.70
A	Total of Manual Board		28,538	11,913	32,534	41.74
L	Total of Whole Nation		179,094	142,451	178,992	79.54

Source : ETA Data

Table 2.4 Capacity of Switching Systems, Number of Subscribers and Waiting Applicants (As of End of September, 1995)

Type of Switch	Ref. No.	Exchange Name	At of End of September, 1995 Switch Capacity	Number of Subscribers	Number of Waiters	Usage Ratio (%)
ANALOGUE SWITCH	1	Addis Ababa City				
	(1)	Addis Ketema I	10,000	9,420		94.20
	(2)	Arada I	10,000	9,697		96.97
	(3)	Arada II	10,000	9,656		96.56
	(4)	Bole I	10,000	9,888		98.88
	(5)	Filwoha I	4,500	1,900		42.22
	(6)	Filwoha II	10,000	9,199		91.99
	(7)	Kirkos I	8,000	7,710		96.38
	(8)	Old Airport I	5,000	4,855		97.10
		Sub-total	67,500	62,325	0	92.33
	2	Other Area				
	(1)	Arba Minch	1,000	493	879	49.30
	(2)	Awassa	2,000	1,503	2,106	75.15
	(3)	Dessie	2,000	1,972	2,283	98.60
	(4)	Dilla	2,000	689	445	34.45
	(5)	Ghion	800	492	460	61.50
	(6)	Goba	1,000	549	554	54.90
	(7)	Harar	2,600	1,988	1,908	76.46
	(8)	Mekele	5,000	2,285	3,323	45.70
	(9)	Shashemene	2,000	1,393	1,703	69.65
	(10)	Sheva	200	108	50	54.00
	(11)	Welayta	2,000	442	573	22.10
	(12)	Wenji	200	181	209	90.50
		Sub-total	20,800	12,095	14,493	58.15
		Total	88,300	74,420	14,493	84.28
DIGITAL SWITCH	1	Addis Ababa City				
	(1)	Addis Ketema II	7,040	5,254	19,950	74.63
	(2)	Arada III	4,096	3,991	21,734	97.44
	(3)	Bole II	5,120	4,379	20,384	85.53
	(4)	Filwoha III	10,112	9,627	12,824	95.20
	(5)	Kirkos II	5,120	5,022	15,899	98.09
	(6)	Old Airport	3,072	2,993	9,897	97.43
	(7)	Kolfe	2,048	2,007	7,848	98.00
		Sub-total	36,608	33,273	108,536	90.89
	2	Other Area				
	(1)	Agaro	1,024	919	222	89.75
	(2)	Akaki	2,048	1,439	2,970	70.26
	(3)	Assela	1,024	1,017	1,818	99.32
	(4)	Bahir Dar	2,048	1,646	2,194	80.37
	(5)	Debre Berhan	2,048	1,653	662	80.71
	(6)	Debre Markos	2,048	1,641	581	80.13
	(7)	Debre Zeit	2,048	1,828	2,581	89.26
	(8)	Debre Dawa	4,096	3,938	4,334	96.14
	(9)	Gondar	2,048	1,431	2,864	69.87
	(10)	Jimma	3,072	2,736	1,779	89.06
	(11)	Nettu	1,024	852	8	83.20
	(12)	Nazreth	4,096	4,078	4,278	99.56
	(13)	Nekemte	1,024	981	966	95.80
		Sub-total	27,648	24,159	25,257	87.38
		Total	64,256	57,432	133,793	89.38
TOTAL	Total of Addis Ababa City		104,108	95,598	108,536	91.83
	Total of Other Area		48,448	36,254	39,750	74.83
	Total of Automatic Switch		152,556	131,852	148,286	86.43
	Total of Manual Board		28,098	15,517	32,167	55.22
	Total of Whole Nation		180,654	147,369	180,453	81.58

Source : ETA Data

Table 2.5 Capacity of Switching Systems, Number of Subscribers and Wating Applicants and Demand Forecast in Addis Ababa

Ref. No.	Exchange Name	As of End of September 1995				Demand Forecast Year	
		Switching Capacity	Number of Subscribers	Number of Waiters	Expressed Demand	1995	2002
1	Addis Ketema I	10,000	9,420				
	Addis Ketema II	7,040	5,254				
	Sub-total	17,040	14,674	19,950	34,624	39,150	88,260
2	Arada I	10,000	9,697				
	Arada II	10,000	9,656				
	Arada III	4,096	3,991				
	Sub-total	24,096	23,344	21,734	45,078	51,460	104,790
3	Bole I	10,000	9,888				
	Bole II	5,120	4,379				
	Sub-total	15,120	14,267	20,384	34,651	35,130	73,630
4	Filwoha I	4,500	1,900				
	Filwoha II	10,000	9,199				
	Filwoha III	10,112	9,627				
	Sub-total	24,612	20,726	12,824	33,550	38,030	75,520
5	Kirkos I	8,000	7,710				
	Kirkos II	5,120	5,022				
	Sub-total	13,120	12,732	15,899	28,631	22,490	48,120
6	Old Airport I	5,000	4,855				
	Old Airport	3,072	2,993				
	Sub-total	8,072	7,848	9,897	17,745	18,120	34,460
7	Kolfe	2,048	2,007	7,848	9,855	10,520	28,320
8	Nefas Silk					8,830	18,900
	Total	104,108	95,598	108,536	204,134	223,730	472,000

Source 1 : ETA Data
2 : Survey Report on National Telecommunications Facilities Expansion Project prepared by JTEC (March 1994)

Table 2.6 Comparison of JTEC and ETA Data

Data Source	Ref. No.	Exchange Name	Area	As of End of September 1995			Demand Forecast							
				Number of Subscribers	Number of Waiters	Expressed Demand	Year							
							1995	1996	1997	1998	1999	2000	2001	2002
JTEC	1	Arada	Proposed Grant Aid Project Area	6,407	4,726	11,133	12,574	13,926	15,436	17,095	18,947	20,978	23,231	25,606
			Other Area	8,583	6,856	15,439	17,644	19,540	21,658	23,986	26,585	29,434	32,596	35,928
			Sub-total	14,990	11,582	26,572	30,218	33,465	37,094	41,081	45,532	50,412	55,826	61,534
	2	Sidist Kilo	AfDB Project Area	8,354	10,152	18,506	21,242	23,525	26,076	28,879	32,008	35,438	39,244	43,256
	3	Present Arada	Total	23,344	21,734	45,078	51,460	56,990	63,170	69,960	77,540	85,850	95,070	104,790
ETA	1	Arada	Proposed Grant Aid Project Area	6,407	4,726	11,133	11,133					13,969		15,401
			Other Area	8,583	6,856	15,439	15,439					20,111		22,172
			Sub-total	14,990	11,582	26,572	26,572					34,080		37,573
	2	Sidist Kilo	AfDB Project Area	8,354	10,152	18,506	18,506					25,225		27,811
	3	Present Arada	Total	23,344	21,734	45,078	45,078					59,305		65,384

Note 1 : JTEC Data .... Demand in each exchange area was distributed, based on the ratio of visible demand as of the end of September 1995.
Note 2 : ETA Data ..... Demand in 2002 was estimated by applying the annual increase ratio of 5% for year from 1995 to 2000.

2.3.2 Basic Design

Main facilities to be provided by this project consist of underground conduit facilities, cable facilities and associated facilities, as described below:

(1) Outside Plant Facilities

1) Primary Cables

New primary cables will be accommodated in conduits. To protect them from faults due to water penetration, jelly-filled, PE (polyethylene) insulated, LAP (laminated aluminium polyethylene) sheathed cables will be used. However, new primary cables of 100 to 200 lines will be installed directly under the ground up to PDF.

2) Secondary Cables

For secondary cables to be buried directly under the ground, jelly-filled, PE insulated and LAP sheathed cables, armoured with steel tape, will be used. Jelly in cables can protect cables from water penetration, and insulation property can be maintained, while steel armour can keep cables free from damage due to other construction work. For routes where direct buried cable installation is not suitable, self-supporting type, PE insulated and PE sheathed aerial cables will be used.

3) Types of Cables

Cable pair numbers and conductor diameters to be used are listed in Table 2.7.

Table 2.7 Cable Pair Numbers and Conductor Diameters

Kind of Cable	Conductor Diameter	Cable Pairs					
Conduit Cable	0.4 mm	2,400	2,000	1,600	1,200	1,000	800
		600	400	300	200	100	50
		30	20	10			
	0.5 mm	1,600	1,200	1,000	800	600	400
		300	200	100	50	30	20
		10					
	0.6 mm	800	600	400	300	200	100
		50	30	20	10		
Armoured Cable	0.4 mm	200	100	50	30	20	10
	0.5 mm	200	100	50	30	20	10
	0.6 mm	200	100	50	30	20	10
Aerial Cable	0.4 mm		100	50	30	20	10
	0.5 mm		100	50	30	20	10

4) Cable Termination and Connection

Cables to be led into the exchange will be connected with termination cables and terminated at MDF (main distribution frame). The cable joint portion will be filled with compound to make a water-proof dam, so that the cable can be moisture proof.

For cable connection at other locations than the above, the mechanical closure will be employed, to ensure speedy work and uniform work performance.

5) Depth of Direct Buried Cables Under the Ground

A cable will be buried directly in the ground to a depth of 80 cm or greater, measured from the surface of the ground to the top of the cable in case of sidewalk, to protect cables from damages due to construction work for other facilities, etc.

6) Cross Connection Cabinet

Cross connection cabinet (CCC) is a provision to achieve efficient use of cables and will be installed between primary and secondary cables. Cabinets are required to have enough capacity to accommodate required number of primary and secondary cable pairs. Of two types of cabinets, 1,200 or 1,800 pairs in capacity, suitable one for the number of cable pairs to be accommodated will be selected.

7) Distribution Points

Distribution points (DPs) are classified into three types, i.e., the outdoor pole-mounted type, the outdoor wall-mounted type and the indoor wall mounted type.

Pole for DP installation should be so located that drop wires can be easily installed to subscribers' houses, and road traffic will not be obstructed due to their installation. Consideration should also be given so that their location will not need to be changed in the future.

A wall-mounted type DP should be installed on a solid external wall of a building which facilitates easy installation of drop wire to the building and neighbouring houses. The installation position should be so selected that DP will not be required to change its position in the future and not likely to be damaged by a third party.

An indoor wall type DP should be installed at a position which permits easy wiring of cable to a telephone set in a building, facilitates easy access by maintenance personnel and provides good working conditions.

8) Protection of Riser Cable

Riser cables to pole-mounted, wall-mounted and indoor type DPs should be protected by U-shaped guard or steel pipes for the section between 30 cm under the ground and 50 cm under DP, to avoid damages by third parties.

(2) Civil Work

1) Types of Conduits

For underground conduits, PVC (polyvinyl-chloride) pipes will be used in general. Steel pipes will be used for cables installed along a bridge, or for the section liable to damages due to other construction work, or at the crossing of heavy traffic roads, etc., wherever necessary.

2) Types of Manholes

Manholes will be installed at cable connecting or branching points, or any other points necessary for ensuring proper cable installation and maintenance. Sizes of manholes will be determined in view of the following. Standard sizes of manholes are given in Table 2.8.

- Necessary number of conduits
- Required working space
- Existence/non-existence of cable joints
- Size to meet the requirement of radius of curvature

Table 2.8 Manhole Dimensions

Manhole Type	Length (m)	Width (m)	Depth (m)	Number of Ducts
H－1	1.20	0.60	1.10	1 － 4
S－1	1.80	1.00	1.80	4
S－2	2.30	1.30	1.80	8
S－3	3.00	1.40	1.80	16
S－4	3.20	1.40	2.10	24
L－1	1.90	1.00	1.80	4
L－2	2.50	1.30	1.80	8
L－3	3.40	1.40	1.80	16
L－4	3.60	1.40	2.10	24
T－1	2.30	1.10	1.80	4
T－2	2.50	1.30	1.80	8
T－3	3.40	1.40	1.80	16
T－4	3.60	1.40	2.30	24

3) Manhole Spacing

Manhole spacing should be determined in consideration of locations of cable branching and CCC, road configuration, etc. In any case, it should not exceed 200 m in consideration of workability in cable installation.

4) Depth of Underground Conduits

Underground conduits along main roads will be buried to a depth of more than 100 cm, measured from the surface of the ground to the top of the conduit, in order to protect conduits from damages due to construction work for underground structures of other authorities.

5) Protection of Direct Buried Cables

To protect direct buried cables from damages due to construction work for underground structures of other authorities, a warning tape should be buried between the direct buried cables and the ground surface.

(3) Construction of a New Trench

The existing cable vault is located on the slope of a mountain and now approx. 60 cables are laid in it disorderly, with no spare space at the opening (for cable lead-in and -out) and, therefore, it is difficult to install new cables in the vault. Hence a new trench will be constructed under this project.

The number of existing cables in the cable vault and the cable route direction is shown in Table 2.9.

(4) Cable Re-location Work for Road Expansion

The existing cable re-location work to be required for some sections in connection with the road expansion plan will be undertaken by the Japanese side. Removal of the existing cables which have become disused as a result of the above work will be done by ETA. For the transfer of cables from the existing to new ones, the transfer work and tests will be carried out by ETA under the supervision of Japanese engineers for one or two cables, on a sampling basis, and then the transfer of the remaining cables will be done on the responsibility of ETA.

(5) MDF (Main Distribution Frame)

A similar type of MDF frames and terminal blocks to those now being used for the existing digital switching system will be purchased and installed by ETA.

Table 2.9 Existing Cables Accommodated in Cable Vault of Arada Exchange

Ref. No.	Direction of Cable Route	Conduit Cable				Armoured Cable				Remarks
		Conductor Diameter	Cable Pairs	Number of Cable	Total Pairs	Conductor Diameter	Cable Pairs	Number of Cable	Total Pairs	
1	Right Direction	0.4	1,200	2	2,400	0.4	600	3	1,800	Transfer work for road construction is required.
		0.4	600	2	1,200	0.5	600	2	1,200	
		JF 0.5	1,200	3	3,600	0.6	600	6	3,600	
		0.5	1,200	3	3,600	0.6	400	2	800	
		0.5	600	2	1,200	0.9	40	2	80	Junction cable
		0.6	600	1	600	1.3	8	1	8	Junction cable
		Sub-total		13	12,600			16	7,488	
2	Left Direction	0.5	600	1	7,800	0.4	600	2	1,200	
		0.6	600	1	600	0.5	600	7	4,200	
						0.6	600	7	4,200	
						1.3	8	1	8	Junction cable
		Sub-total		2	8,400			17	9,608	
3	Straight Direction					0.4	600	1	600	
						0.6	600	1	600	
		Sub-total						2	1,200	
4	Right Direction (Behind Exchange)	0.4	1,200	1	1,200					
		0.4	600	1	600					
		0.5	600	1	600					
		0.6	600	1	600					
		0.6	400	2	800					
		0.9	22	4	88					Junction cable
		1.3	4	4	16					Junction cable
		Sub-total		14	3,904					
5	Total of Junction Cables			8	104			4	96	
	Total of Local Cables			21	24,800			31	18,200	
	Total of Cables			29	24,904			35	18,296	
	Total of Cables (Conduit + Armoured + Junction)							64	43,200	

(6) Major Facilities

Amounts of major outside plant facilitates to be constructed by this project are given in Table 2.10

Table 2.10 Major Facilities

Facilities		Major Items	Unit	Quantity
Civil Work	1	Manhole	pcs	71
	2	Trench	Km	8.3
Cable Work	3	Primary Cable	Km	16.5
	4	Secondary Cable	Km	68.9
	5	CCC	pcs	23
	6	DP	pcs	1,080
	7	Pole	pcs	925

(7) Vehicle, Spare Parts and Materials for Operation and Maintenance

The following will be supplied as necessary for operation and maintenance of the outside plant facilities installed under this project:

- Vehicle (one truck)
- Cables (primary and secondary cables)
- Cross connection boxes
- Cable splicing materials

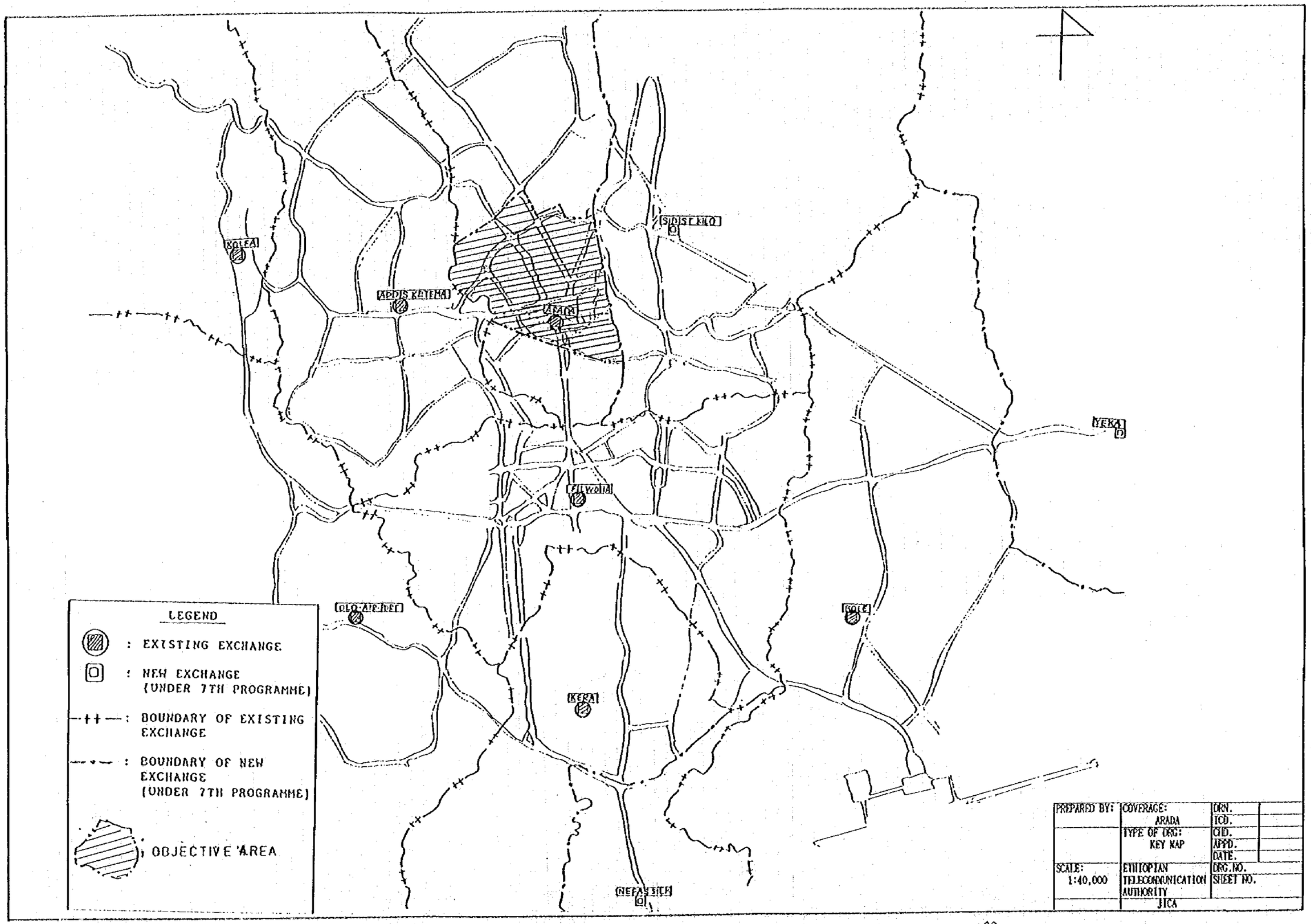
(8) Basic Design Drawings

The undermentioned basic design drawings are attached.

1) Key Map
2) Guide Map of Objective Area
3) Primary Cable Plan
4) Duct Route Plan
5) Secondary Cable Plan (Sample Drawing)

6) Cable Termination Plan

7) Cable Re-location Plan due to Road Expansion Work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AMIN
SIDISTEKLO
YEKA
ELWOIA
OLD AIRPORT
KERA
NEFASSILK
LEGEND
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: NEW EXCHANGE (UNDER 7TH PROGRAMME)
: BOUNDARY OF EXISTING EXCHANGE
: BOUNDARY OF NEW EXCHANGE (UNDER 7TH PROGRAMME)
: OBJECTIVE AREA
PREPARED BY:
COVERAGE: ARADA
TYPE OF DRG: KEY MAP
SCALE: 1:40,000
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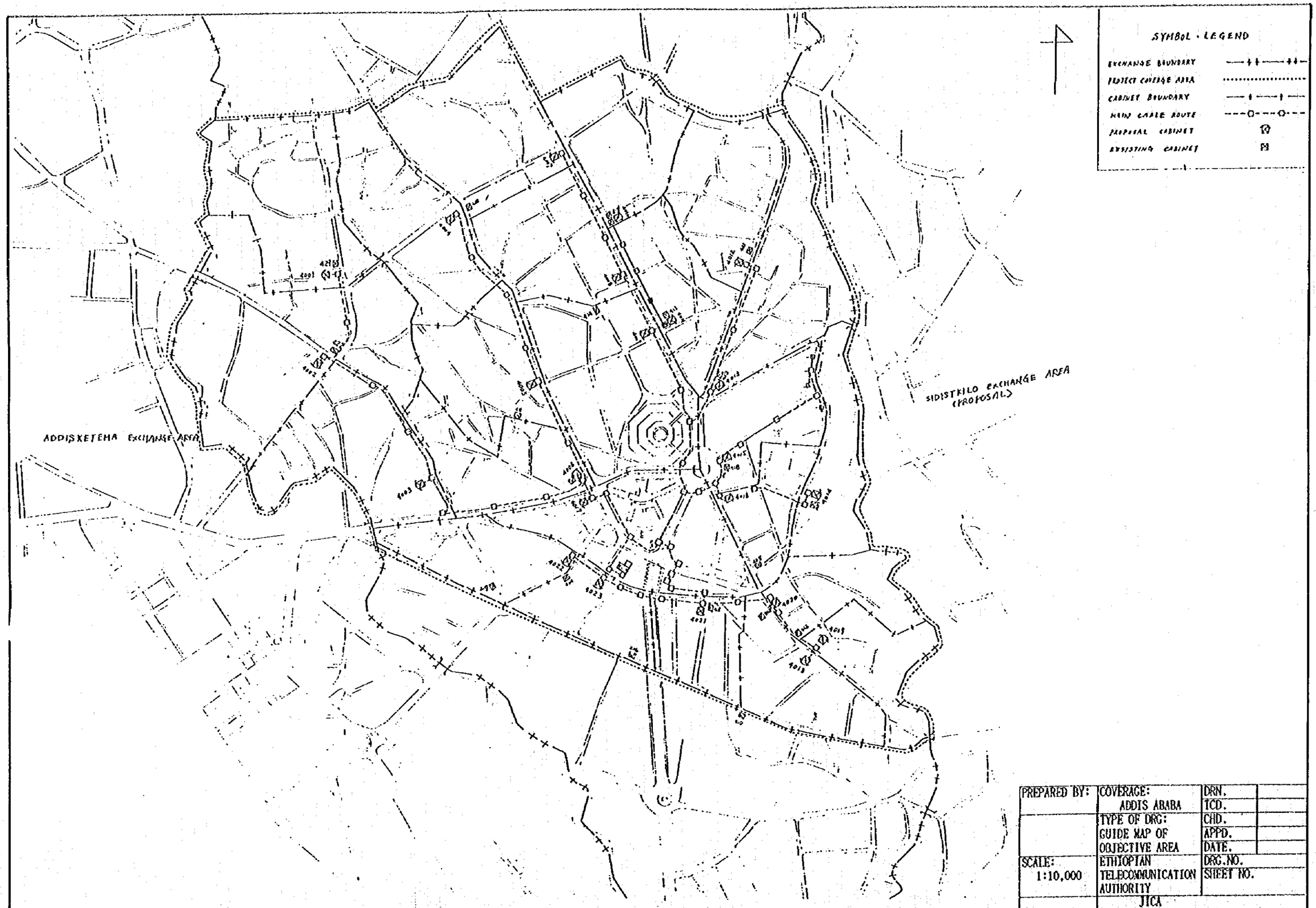
DRN.
TCD.
CHD.
APPD.
DATE.
DRG.NO.
SHEET NO.



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		TCD.	
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		APPD.	
		DATE.	
SCALE: 1:10,000	ETHIOPIAN TELECOMMUNICATION AUTHORITY	DRG.NO.	
		SHEET NO.	
	JICA		

SEE CUT OVER POINT PLAN

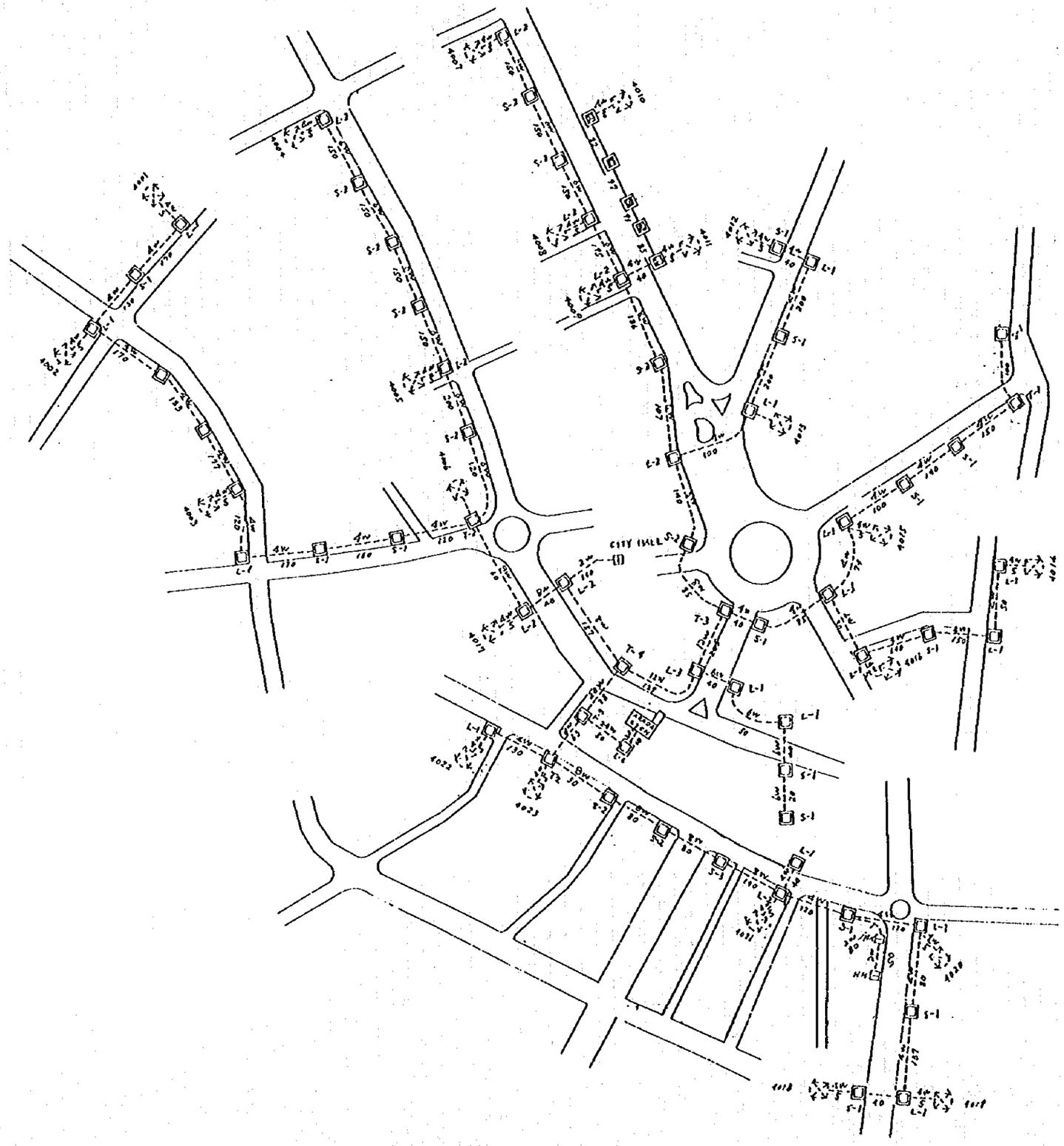
N1 } CUT OVER CABLE
N2 } FOR
N3 } NOUT ARADA AREA
N4 }

S1 } CUT OVER CABLE
S2 } SOUTH ARADA AREA
S3 }
S4 }

SYMBOL - LEGEND

CABINET
CABLE
DUCT CABLE
STUMP CABLE
SPLICING POINT
DISTRIBUTION POINT
Straight Joint
Branch Joint

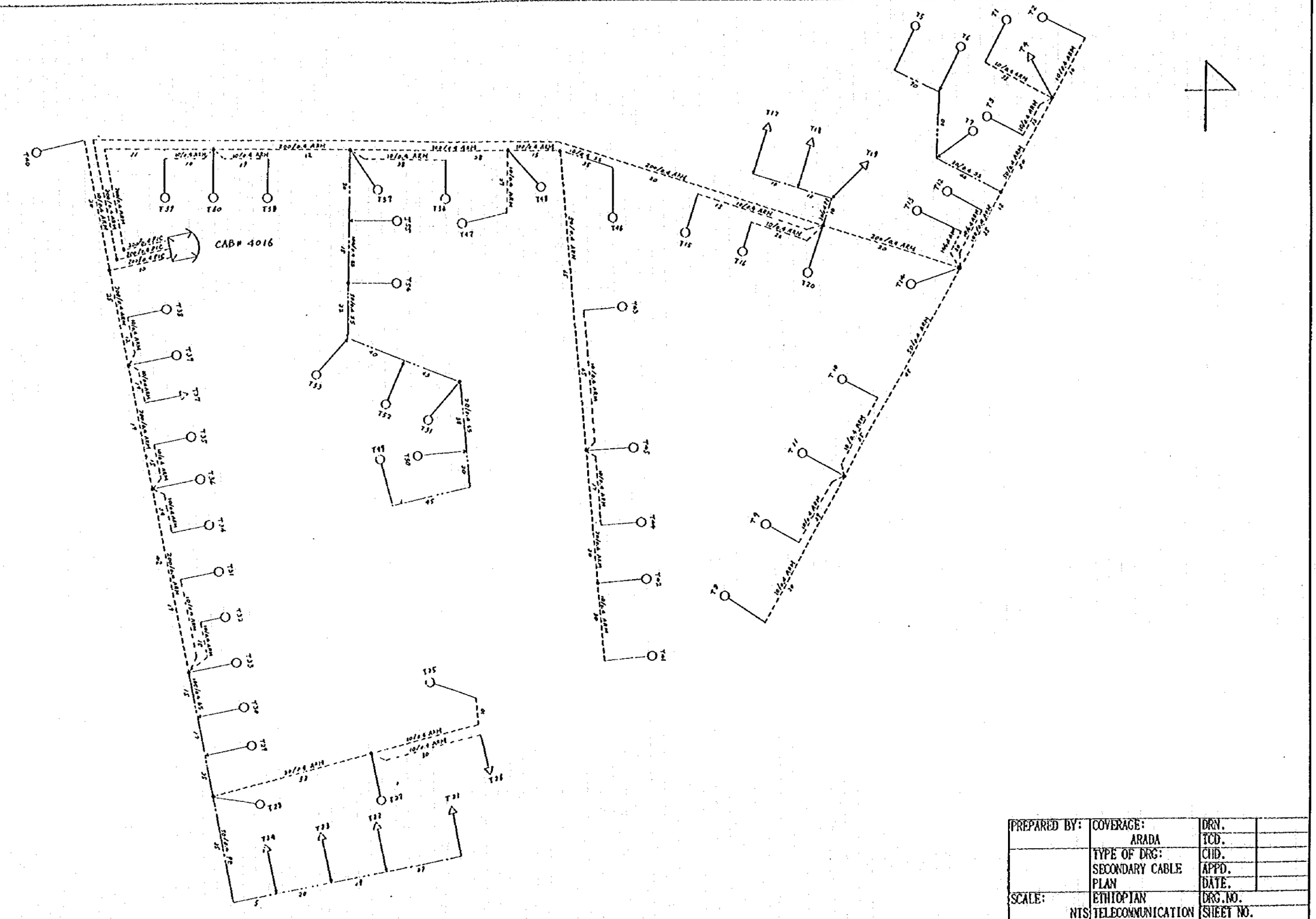
PREPARED BY:	COVERAGE: ARADA	DRN.	
		TCD.	
	TYPE OF DRG: PRIMARY CABLE PLAN	CHD.	
		APPD.	
		DATE.	
SCALE: NIS	ETHIOPIAN TELECOMMUNICATION AUTHORITY JICA	DRG. NO.	
		SHEET NO.	



SYMBOL · LEGEND

PROPOSAL MANHOLE
S TYPE
L TYPE
T TYPE
EXISTING MANHOLE
PROPOSAL HANDHOLE
PROPOSAL DUCT
EXISTING DUCT
PROPOSAL CABINET NUMBER
PROPOSAL CABINET

PREPARED BY:	COVERAGE: ARADA	DRN.	
		TCD.	
	TYPE OF DRG: DUCT ROUTE PLAN	CHD.	
		APPD.	
		DATE.	
SCALE: NTS	ETHIOPIAN TELECOMMUNICATION AUTHORITY	DRG.NO.	
		SHEET NO.	
	JICA		



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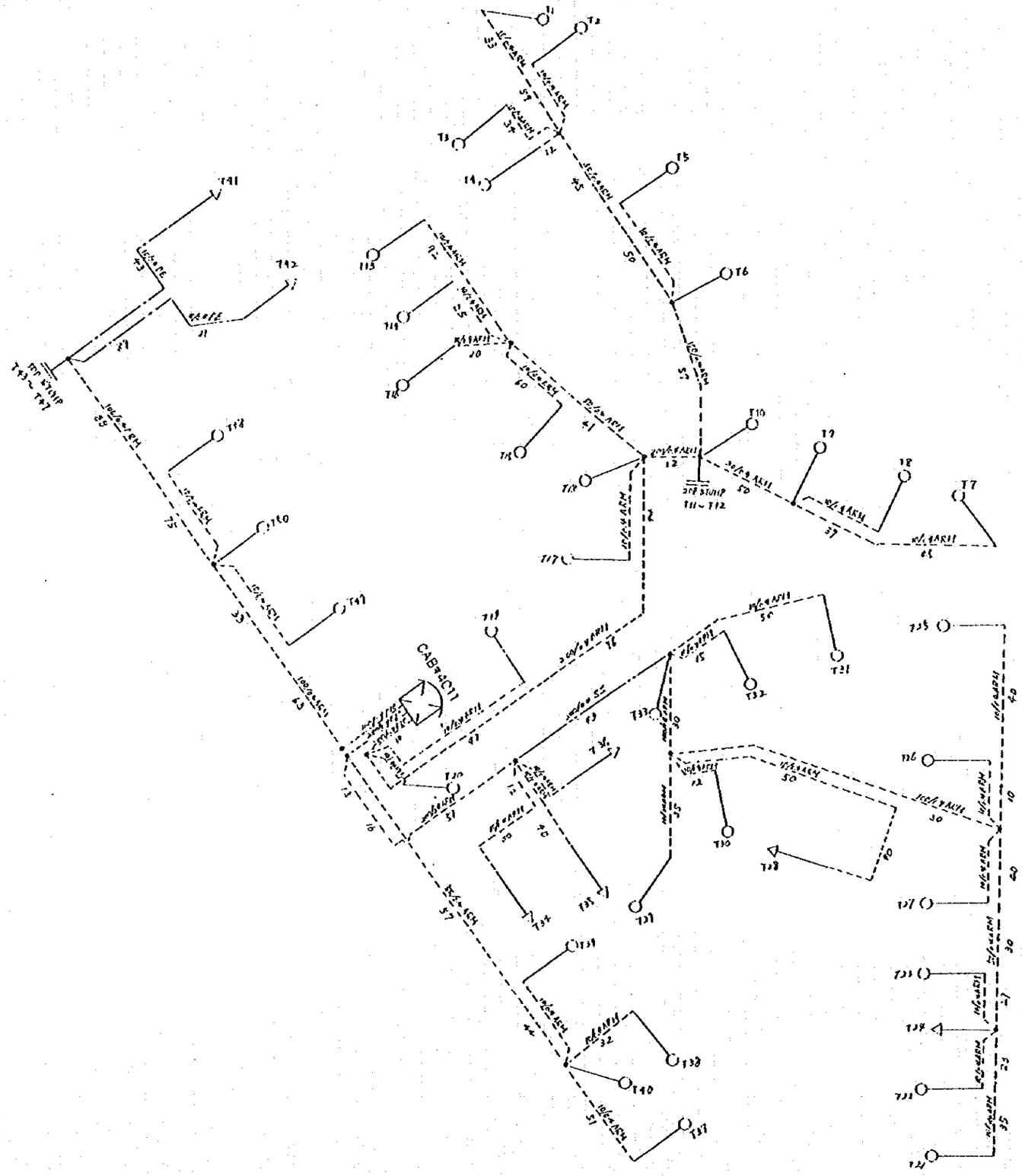
		TCD.	
	TYPE OF DRG: SECONDARY CABLE PLAN	CHD.	
		APPD.	
		DATE.	
SCALE: NTS	ETHIOPIAN TELECOMMUNICATION AUTHORITY	DRG.NO.	
		SHEET NO.	
	JICA		



PREPARED BY:	COVERAGE: ARADA	DRN.	
		TCD.	
	TYPE OF DRG: SECONDARY CABLE PLAN	CHD.	
		APPD.	
		DATE.	
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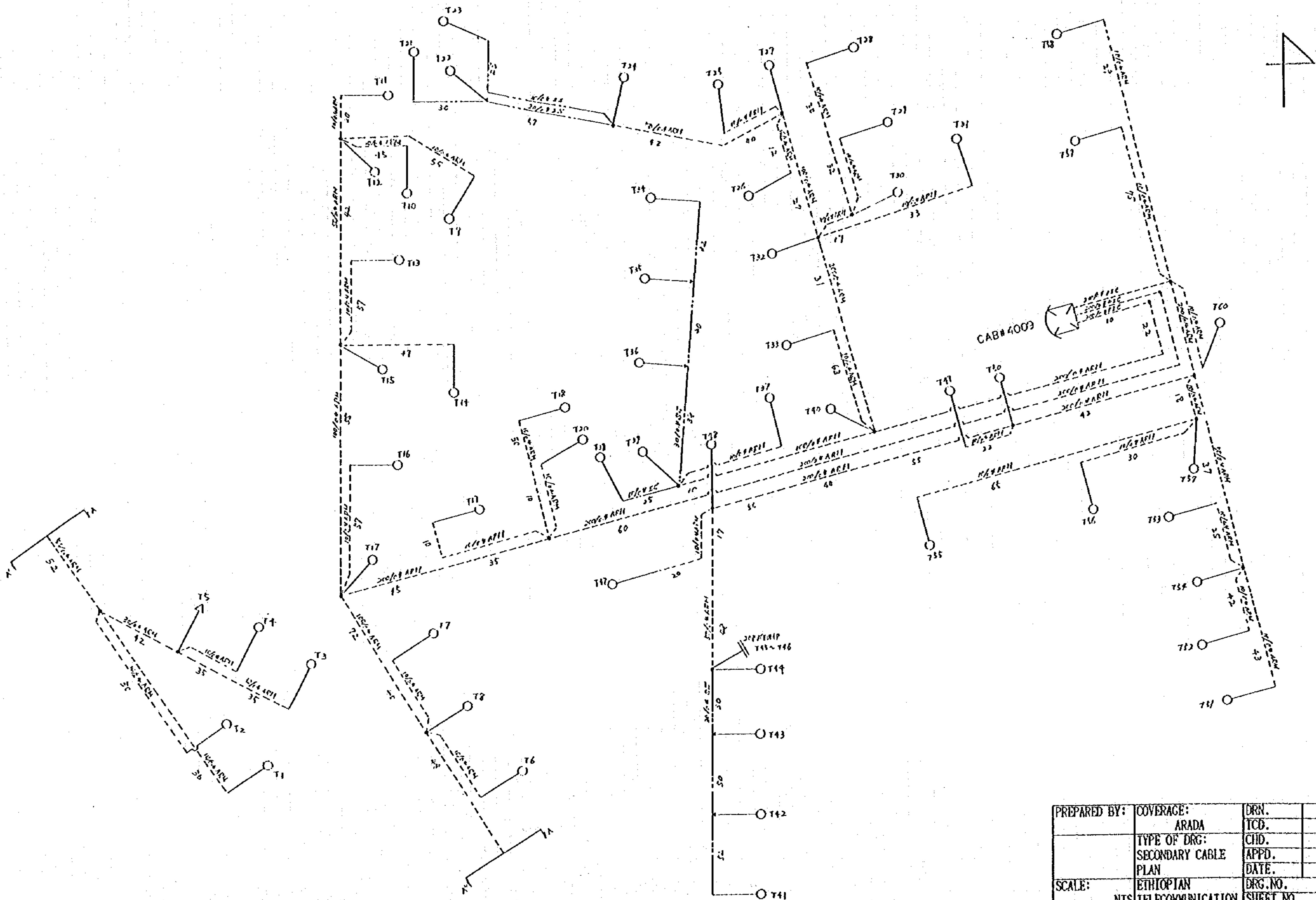

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	TYPE OF DRG:	TCD.	
	SECONDARY CABLE	CHD.	
	PLAN	APPD.	
		DATE.	
SCALE: NTS	ETHIOPIAN TELECOMMUNICATION AUTHORITY	DRG.NO.	
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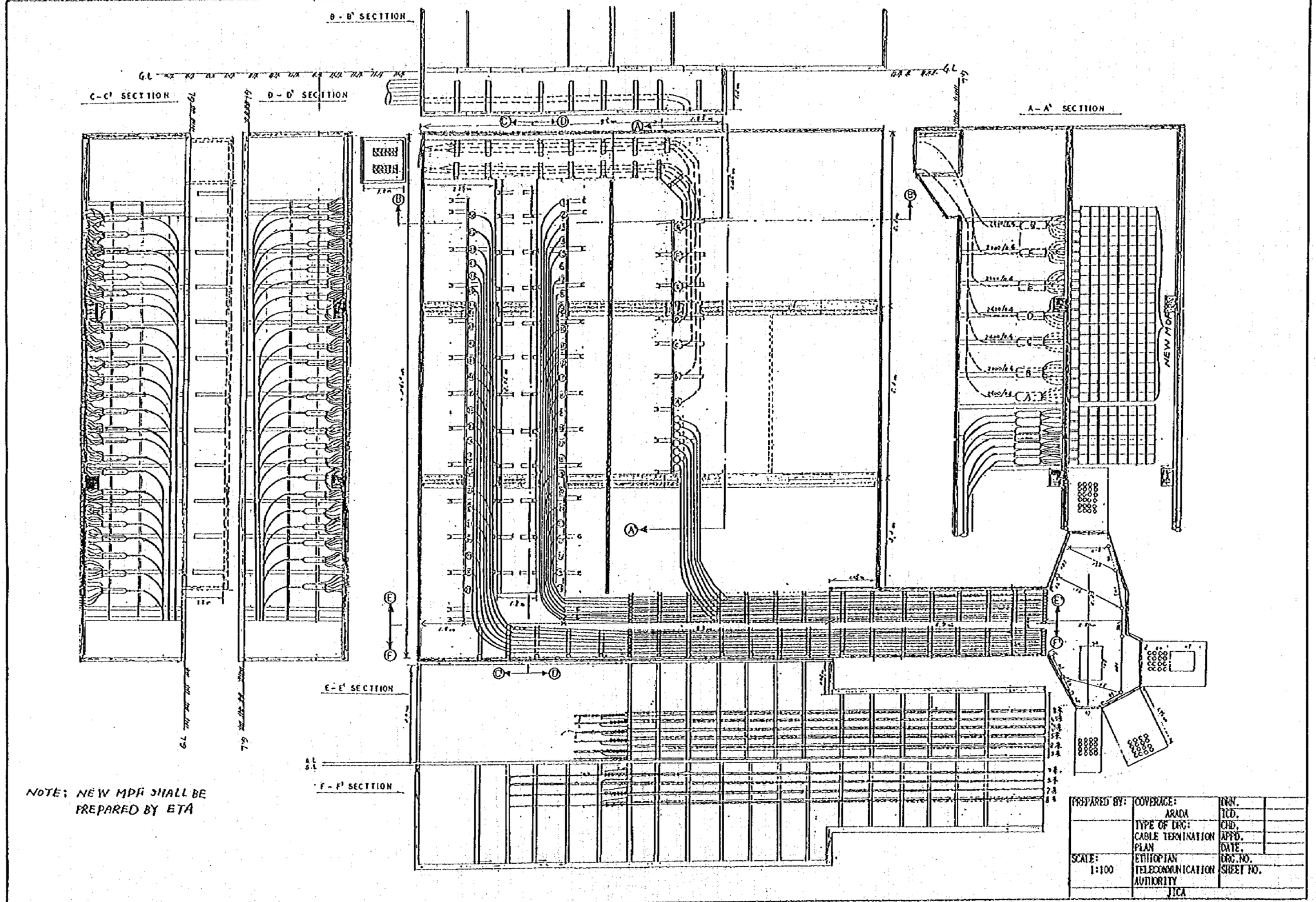
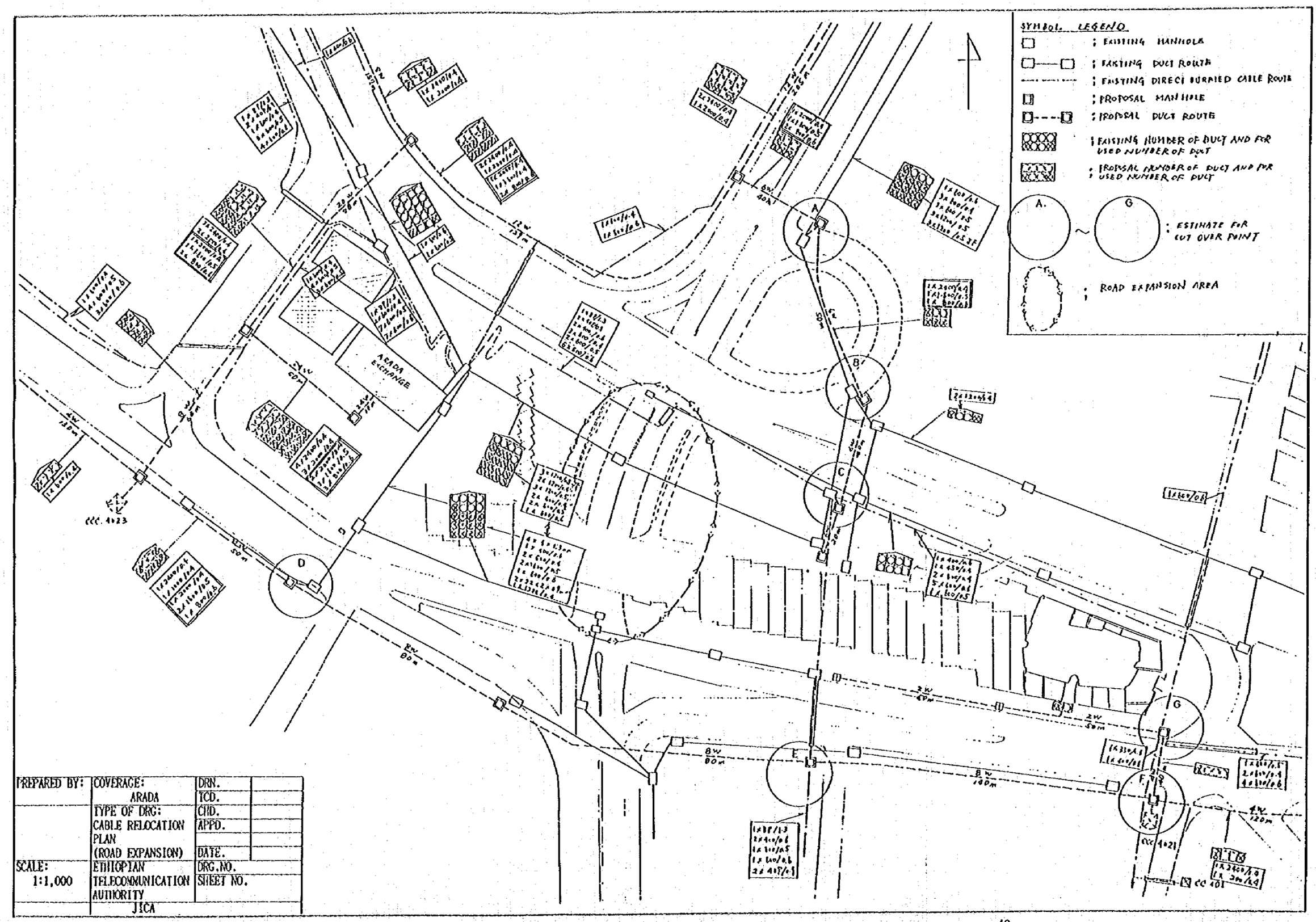


NOTE; NEW MDF SHALL BE PREPARED BY ETA

PREPARED BY:	COVERAGE: ARADA	DRN.	
		TCD.	
	TYPE OF DRG: CABLE TERMINATION PLAN	CHD.	
		APPD.	
		DATE.	
SCALE: 1:100	ETHIOPIAN TELECOMMUNICATION AUTHORITY JICA	DRG.NO.	
		SHEET NO.	


SYMBOL LEGEND
; EXISTING MANHOLE
; EXISTING DUCT ROUTE
; EXISTING DIRECT BURIED CABLE ROUTE
; PROPOSAL MANHOLE
; PROPOSAL DUCT ROUTE
; EXISTING NUMBER OF DUCT AND FOR USED NUMBER OF DUCT
; PROPOSAL NUMBER OF DUCT AND FOR USED NUMBER OF DUCT
A. ~ G. ; ESTIMATE FOR CUT OVER POINT
; ROAD EXPANSION AREA
ARADA EXCHANGE
A
B
C
D
E
F
G
PREPARED BY:
COVERAGE: ARADA
TYPE OF DRG: CABLE RELOCATION PLAN (ROAD EXPANSION)
DRN.
TCD.
CHD.
APPD.
DATE.
SCALE: 1:1,000
ETHIOPIAN TELECOMMUNICATION AUTHORITY
DRG.NO.
SHEET NO.
JICA

CHAPTER 3 IMPLEMENTATION PLAN

CHAPTER 3 IMPLEMENTATION PLAN

3.1 Implementation Plan

3.1.1 Implementation Concept

ETA, an implementing agency of this project, is responsible for coordination and adjustment among all the related departments, divisions and offices, with respect to implementation schedules and work coverage, to ensure smooth implementation of the project in accordance with the planned time schedule. For this purpose, it is recommended to establish an organisation as shown in Figure 3.1.

ETA is required to select, prior to the commencement of the project, from among its employees a project manager and counterpart staff to work with the consultant who will supervise the project implementation. The consultant and the counterpart of ETA will check and review the installation work schedules and technical specifications of individual facilities to be provided by this project. They will also undertake overall progress coordination and adjustment and provide professional advice and guidance to the contractor whenever necessary, while maintaining close contact with the staff concerned of the competent authorities of both countries and reporting the project progress to them. Particularly, speedy actions and careful attention will be required with respect to the legal actions to be taken for the project implementation and the explanation of the work schedules to the inhabitants of the objective area to obtain their understanding, so that the project can be completed without any trouble.

Through the implementation of this project, technology transfer will be made by the consultant and the contractor to ETA staff with respect to the project management and the knowhow on construction, operation and maintenance of the facilities introduced by this project.

(1) Complicated Project Components

ETA is responsible for installation of MDF, subscriber premises, cable transfer in connection with cable re-location for road expansion work, jumper wiring at MDF, removal work, etc.

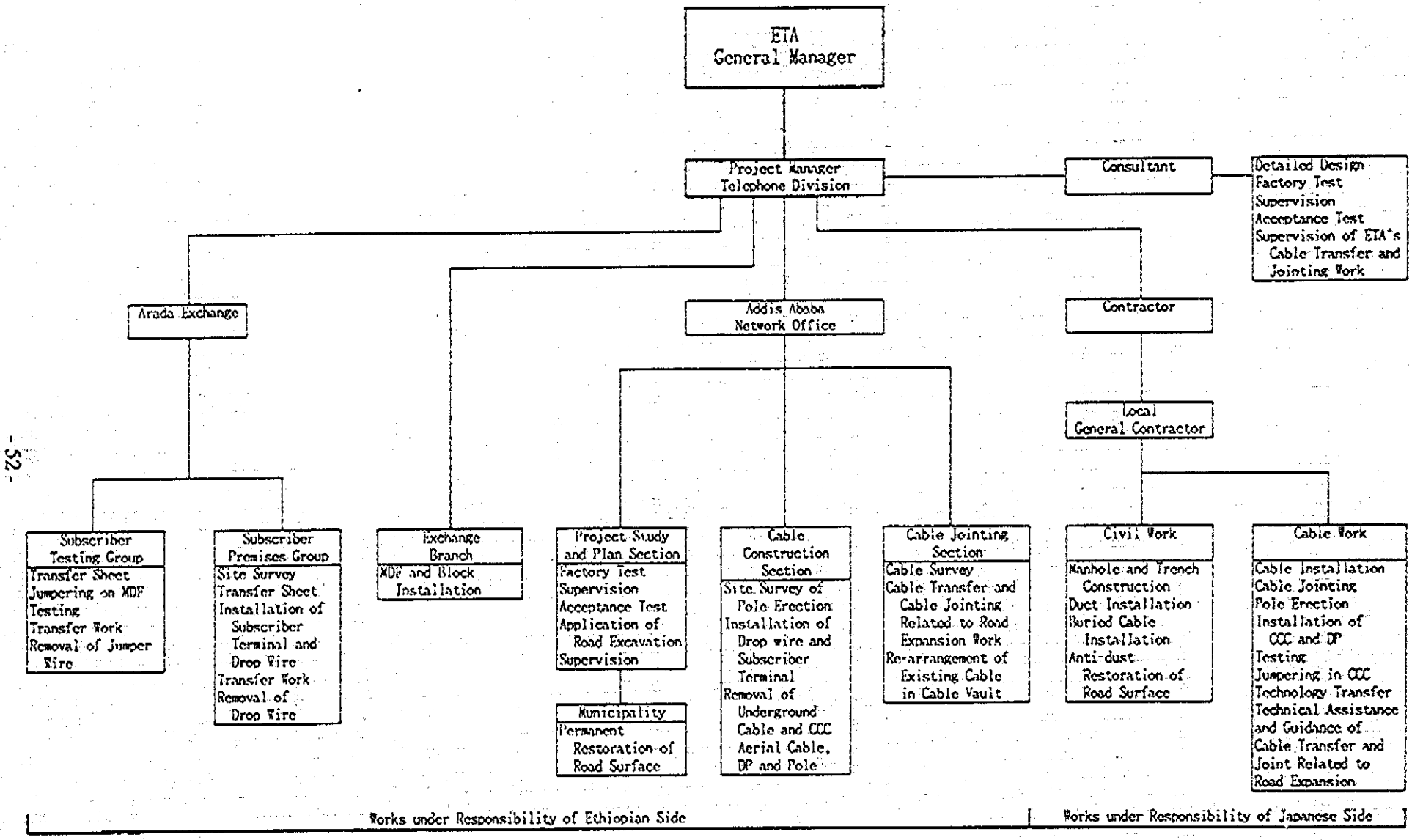


Figure 3.1 Tentative Project Implementation Organization

To ensure satisfactory execution of these works, close coordination and adjustment in work progress must be maintained between the contractor and ETA. For this purpose, the work of either side must be completed in compliance with their respective work schedules. Roads in the objective area are under the control of the relevant municipality authorities, and the contractor will have to obtain the authority's road excavation permission via ETA. Contractor is required to carry out the civil work, based on a carefully thought-out plan so that re-excavation of the same route, suspension of work for a long period, etc. can be avoided, in an effort to minimise the disturbance to the inhabitants to the least.

(2) Utilisation of Local Contractor

No private contractors are available for telecommunications facilities construction in Ethiopia since all the construction work is undertaken by ETA.

The Municipality Authority is in charge of the construction of roads within 20 km from Addis Ababa, and the Road Authority, for other roads. No private road constructing companies exist in Ethiopia. For building construction, there are national and private general contractors. All the national and public buildings and facilities are constructed by the national contractors, and private buildings and facilities are constructed by both national and private contractors. Hence, the Japanese contractor of this project will carry out the necessary civil work utilising these private and national general contractors. For construction of outside plant, also, the Japanese contractor will be required to utilise unskilled labourers of some of these private or national contractors, subject to technical training of them.

(3) Manning Plan

Telecommunication facilities to be constructed by this project consist of outside plant and civil work, but general contractors in Ethiopia have no technical staff specialising in these fields. Hence external experts having sufficient experience will be sent to the objective site in good timing for the project progress.

3.1.2 Implementation Conditions

(1) Road Occupation Permission

All the cable and civil facilities under this project must be constructed after obtaining permission for road occupation from the competent authorities responsible for road management in Addis Ababa. Application for the permission should be submitted by ETA to the authority in advance to the commencement of the relevant work, with good lead time, so that no delay will be caused in the work schedule due to the delay in obtaining the permission.

(2) Rainfall

There are two rainy seasons in a year. The subscriber cable connection work may be delayed due to the rainfall during these seasons. The implementation time schedule should be drawn up deliberately taking into account such probable delay, to ensure the completion of the work within the target period.

(3) Safety Work

In some sections in the objective area, traffic will be heavy day and night. Hence, a careful attention must be paid to the safety work.

(4) Underground Facilities of Other Authorities

There exists a lot of underground facilities of other authorities in the objective area. Therefore, test excavation must be done to check the existence of such facilities prior to determining the location of new manhole installation.

3.1.3 Scope of Works

Works to be done by the Japanese side and the Ethiopian sides for the implementation of this project are as follows:

(1) Works under the Responsibility of the Japanese Side

1) Detail design for construction of outside plant and civil facilities.
2) Provision of major equipment and materials.
3) Procurement of construction work equipment and materials in Ethiopia.
4) Construction of manholes.
5) Construction of a trench in cable vault.
6) Installation of underground conduits.
7) Installation and connection of primary and secondary cables.
8) Installation and connection of new cables for cable re-location due to road expansion work (excluding cable transfer work) by the Municipality.
9) Installation of CCC (Cross Connection Cabinet).
10) Installation of DP (Distribution Point).
11) Dust-prevention treatment pavement after road excavation.
12) As-built drawings of new outside plant and civil facilities.
13) Testing of completed facilities.
14) Preparation of a standard form of subscriber transfer sheet
15) Jumper wiring in CCC for subscriber transfer.
16) Handing-over of maintenance equipment and materials and measuring equipment and tools to ETA.
17) Handing-over of the maintenance vehicle to ETA.
18) Technical assistance and guidance for cable transfer and joint related to the road expansion by the Municipality, and for subscriber transfer works.

(2) Works under the Responsibility of the Ethiopian Side

1) Preparation of warehouses to store equipment and materials imported by the contractor.
2) Obtaining permission from relevant authorities for road occupation and excavation for installation of underground facilities and overhead cables.
3) Payment of costs for complete restoration of paved roads after excavation, to the Municipality Authority.
4) Obtaining agreement of the owner or user on installation of DP and cable and land excavation in their premises or buildings.

5) Removal of equipment, parts and materials stored in the cable vault of Arada Exchange, and cleaning of the cable vault, prior to the commencement of the civil work.
6) Procurement and installation of MDF (Main Distribution Frame)and terminal block.
7) Investigation and design of subscriber's premises for subscriber transfer .
8) Investigation of jumper wire of MDF for subscriber transfer.
9) Entry in the subscriber transfer sheets to prepare for the subscriber transfer work.
10) Installation of subscribers' premises (facilities from new DP up to subscribers, i.e., installation of poles, drop wires, one-pair subscriber terminals, etc.) for subscriber transfer.
11) Jumper wiring at MDF for subscriber transfer.
12) Confirmation test on subscriber transfer after the transfer work.
13) Removal of the existing cables, poles, CCCs, DPs, jumper wires which have become disused after the completion of the subscriber transfer.
14) Subscriber transfer and cable connection for cables re-located in connection with the road expansion work (including works referred to above for the subscriber transfer), under the technical assistance and guidance by the Japanese side.
15) Re-arrangement of the existing cables in the cable vault (where necessary) under the technical assistance and guidance by the Japanese side.
16) Assistance in the local procurement of wooden poles and PVC pipes.

This project aims at the rehabilitation of the local subscriber cable facilities including civil work in the objective area. With a view to efficient and early materialisation, the scope of the work under the responsibility of the Japanese side is to be implemented on a turn key basis.

3.1.4 Consultant Supervision

(1) Services related to Supervisory Work

To supervise the construction work by the contractor, a project implementation organisation consisting of ETA staff and the consultant will be established as shown in Figure 2.1. Supervisory work will cover the progress control, coordination among relevant sectors, authorities, etc., and other necessary items as detailed below.

1) Services Related to Construction Work Contract

Field survey, preparation of detail design, specifications and tender documents, pre-qualification of tenderers, tender announcement, evaluation of tender proposals, assistance in selection of successful contractor, preparation of contract documents, assistance in contract signing, including reporting to ETA.

2) Examination of Documents Submitted from Contractor

Examination and approval of working diagrams, drawings, samples, etc. submitted from the contractor and manufacturers of equipment and materials.

3) Witness to Factory Tests

Witness to factory tests on equipment and materials for the project, prior to their shipping, in order to confirm their compatibility with the contracted specifications. The contractor can ship the equipment and materials after obtaining the consultant's approval.

4) Construction Work Supervision

Examination of the installation practices and work schedule submitted by the contractor, and issue of necessary instructions and comments to the contractor. During the construction work period, supervisory staff will be sent to the work site to confirm the work performance in compliance with specifications and to control the work progress.

5) Cooperation Related to Procedures to be Taken for Payment

Examination of invoices and other documents submitted from the contractor as necessary for payments during and after the construction work, and cooperation in connection with the effectuation of payments.

6) Services Related to Acceptance of Completed Facilities

Witness to the acceptance tests to be made when the construction work by the

contractor has been completed, and examination of the drawings of the completed facilities.

(2) Manning Schedule for Supervisory Work

1) Supervision of Civil Engineering Work

The work site of this project is located in a central part of an urban area where vehicle and passenger traffic is very high. Furthermore, there exists a lot of underground facilities, such as water pipes, power lines, etc., in addition to the existing direct buried telecommunications cables. Hence careful attention must be paid in supervising the civil engineering work so that disturbance to the traffic can be minimised and the underground facilities can be protected from damage due to the work under this project.

2) Overall Control of Work Progress

In supervising the implementation of this project, emphasis is placed on the guidance and instruction to the contractor and assistance and advice to ETA, always bearing in mind the overall work progress, so that the project can be completed as scheduled, meeting the contracted quality requirements for each project component. Particularly, advice to ETA concerning the preparations to be made on the ETA side in connection with its coverage and the adjustment of the work schedule is requisite for satisfactory materialisation of the project.

3) Manning Schedule

To achieve the above, the supervisory staff must be at work site all through the construction work period. Dispatch of a spot supervisor and mobilisation of staff for factory tests should also be taken into consideration to cope with the tight schedule.

3.1.5 Procurement Plan

(1) Main Equipment and Materials

Main equipment and materials, i.e., cables and materials for cable connection, manhole cover, hardware, etc., necessary for implementation of this project will be purchased from Japan and other countries, since they are scarcely manufactured in Ethiopia.

(2) Materials to be Procured in Ethiopia

Of the materials necessary for this project, cement, reinforcing iron bars, sand, gravel, shuttering material, etc. will be procured in Ethiopia as the quality of the obtainable ones are almost equal to those generally accepted.

1) Wooden Poles to be Used

Wooden poles to be used for this project are those guaranteed by ETA with respect to their quality being in compliance with the specifications. In this way EAT is required to support the Contractor in procurement of the wooden poles.

2) PVC Pipes

Locally available PVC pipes will be used, provided that they can meet quality requirements prescribed in the specifications and the manufacturer's production capacity and product testing facilities are judged acceptable. If not, they will be procured from Japan or other countries.

3.1.6 Implementation Schedule

(1) Start of the Project

After the signing of the Exchange of Notes by both the Japanese and Ethiopian Governments, the consulting service contract will be concluded by and between the Ethiopian Government and a Japanese consultant. Then the project will be started.

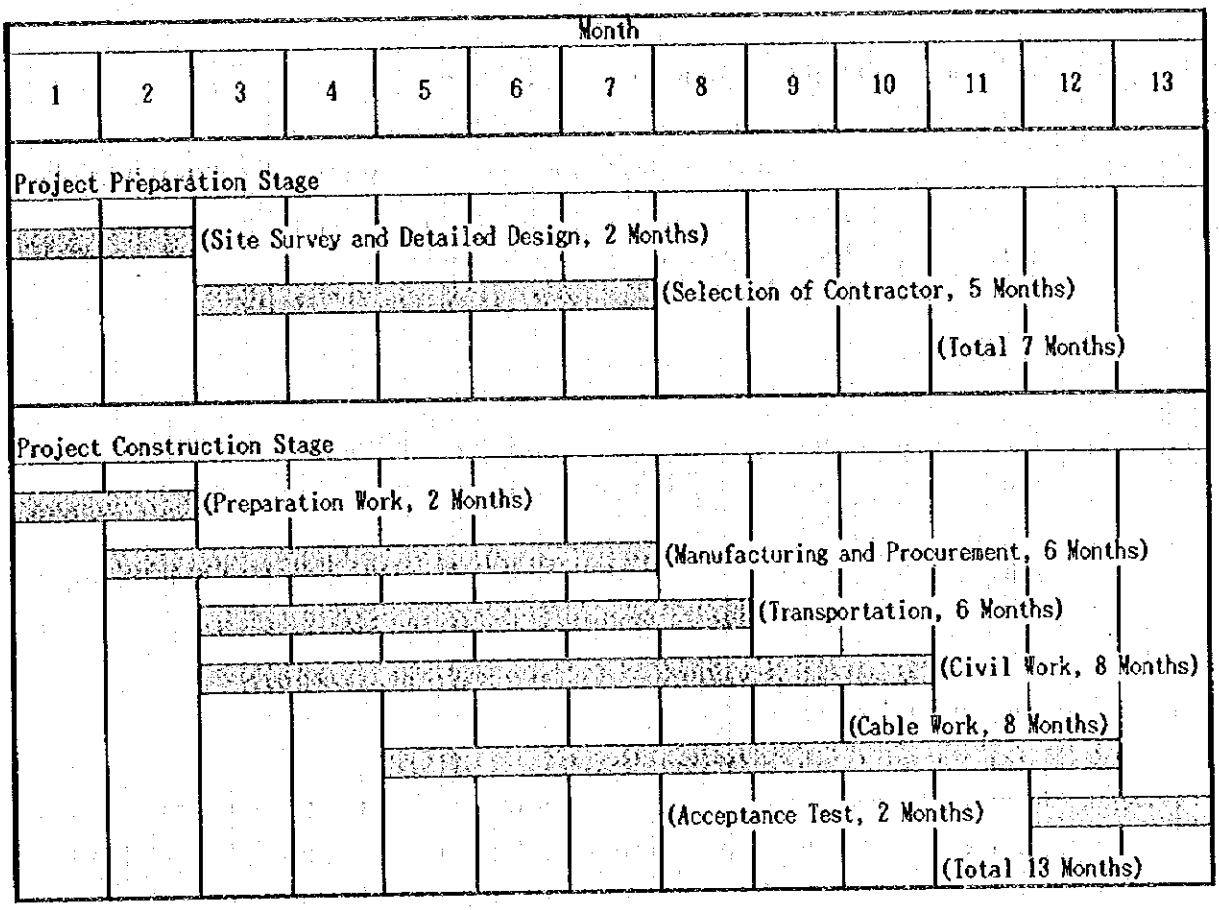
(2) Tendering and Award of Contractor

The consultant will prepare detail design and tender documents for the portion to be as undertaken by the Japanese side, and the tender for that portion will be floated. After evaluation of the proposals submitted, the construction work contract will be concluded with the Ethiopian Government and the successful tenderer will be selected based on the evaluation results. Then the construction work will be started.

(3) Construction Work Time Schedule

The implementation time schedule of this project is shown in Table 3.1. As can be seen from the table, the construction work is scheduled to be completed in 13 months.

Table 3.1 Implementation Time Schedule



3.1.7 Obligations of Recipient Country

In addition to the scope of the works mentioned in Item 3.1.3 above, the following should also be undertaken by the Ethiopian side:

(1) Arrangement for exemption from the following taxes:

- Customs clearance and import taxes on equipment and materials to be imported from foreign countries.
- Taxes on durable consumer goods to be procured locally.

(2) Local Support

- Telecommunications means (toll and local communications).
- Work offices and utilities (fuel and light expenses).

(3) Permits and approvals to be required in connection with the road occupation and excavation.

(4) Issuance of Authorisation to Pay.

Detail designs, tender specifications, equipment and materials procurement, and supervision of construction work for the facilities which fall under the scope of work by the Ethiopian side are to be undertaken by ETA and the Project Implementation Organisation.

3.2 Operation and Maintenance Plan

(1) Improvement of Fault Ratio

Faults due to poor outside plant facilities and subscribers premises account for approx. 80% of the total line faults in the objective area. Restoration of faulty lines sometimes requires more than 1 month in the rainy season. The current fault ratio of ETA is approx. 11 per 100 subscribers per month. With the implementation of this project, the ratio is expected to remarkably improve up to 1 or 2 per 100 subscribers per month.

(2) Area for Operation and Maintenance

ETA now plans to separate eastern half of the existing Arada Exchange area and establish a new exchange, Sidist Kilo, in this area. The objective site of this project is the area around Arada Exchange in the remaining western part.

(3) Division and Transfer of Maintenance Staff

It is proposed that after the inauguration of the new exchange, Sidist Kilo, some of the existing maintenance staff of the Arada Exchange area will be transferred to Sidist Kilo Exchange for the maintenance of the facilities in the new exchange area. Hence, the operation, maintenance and control of the facilities provided by this project will be undertaken by the remaining staff of Arada Exchange. More precisely, one-third of the 130 staff of Arada Exchange, i.e., approx. 40 will be transferred to Sidist Kilo, with 90 to be remained in Arada Exchange. Details are given in Table 3.3.

Table 3.3 Proposed Transfer of Maintenance Staff

Maintenance Staff	Present Arada Exchange (Persons)	Arada Exchange in Future (Persons)	Sidist Kilo Exchange in Future (Persons)
Administration	27	19	8
Outside Plant	65	45	20
Customer Services	33	23	10
Switching Equipment	5	3	2
Total	130	90	40

(4) Surplus Maintenance Staff

With the facilities to be proved by this project, in addition to those newly installed for Sidist Kilo Exchange, the existing demand can be sufficiently satisfied. That is, the work for capacity expansion will not be required for the time being. Moreover, faults due to poor facilities will be substantially decreased, requiring less manpower for repair work. Hence, surplus manpower will be produced, and re-allocation of ETA personnel should be considered.

(5) Revenues

Under this project, the existing outside plant facilities will be rehabilitated, replaced and expanded, to meet the demand for 5 years to come. However, as of the end of September 1995, approx. 97% of the line units of the existing crossbar and digital switching systems in Arada Exchange have already been in use, with only a small number of spare units. That is, the existing switching systems do not have capacity to accommodate new subscribers. Hence additional income from additional subscribers cannot be expected.

1) Revenues from this Project

Income from the new outside plant facilities provided by this project is calculated as follows, disregarding the existing facilities which have already exceeded the service life and have no salvage value.

According to the balance sheet of ETA, the average annual income from a subscriber in 1995 is Birr 1,974. Generally speaking, the average annual income from a subscriber in the metropolitan area is more than 1.5-2.0 times the national average. By applying the lowest value of 1.5 times as no relevant data is available, the average annual income per subscriber of Arada Exchange can be estimated to be Birr 2,961.

Telephone network facilities consist of outside plant, switching, transmission and other associated facilities, and the income from outside plant facilities is usually considered to be 40% of the total income, corresponding to the investment ratio.

Hence the annual average income from the outside plant facilities per subscriber of Arada Exchange is estimated at Birr 1,184.

The number of the existing subscribers in the objective area is approx. 6,400. Therefore, the average annual income from the outside plant facilities in the objective area can be estimated to be Birr 7,577,600.

In 1998, the capacity of the switching system of Arada Exchange will be expanded by 6,000 line units with the assistance from Italy. With this, it will become possible to satisfy the visible demand for 6,000 subscriptions as of 1995 will be satisfied, and the annual income from the facilities provided by this project is estimated to be Birr 14,208,000 in and after that year.

2) Operation and Maintenance Cost of Outside Plant

According to the balance sheet of ETA, the average annual expenditure per subscriber in 1995 is approx. Birr 1,258, covering operation and maintenance costs, financial expenses, corporation tax, and others.

In the metropolitan area, telephone density is high and high efficiency can be achieved in operation and maintenance of facilities. Usually, the number of cables per maintenance personnel is larger than the national average by as much as 30% - 60%. Assuming that the ratio of 30% is applicable for Arada Exchange, the average annual expenditure per subscriber is estimated to be Birr 880, of which 40% (the ratio of the outside plant), i.e., Birr 352, will be the average annual expenditure for the outside plant facilities of Arada Exchange.

In designing the facilities for this project, water-proof treatment and other measures to keep good insulation performance, etc. have been considered for cables, cable joints, CCCs and DPs, to improve cable fault ratio. As a result, the fault ratio is expected to be improved to 1 - 2 from 11 per 100 subscribers per month (less than 20%). Actually this will mean the reduction of the total operation and maintenance costs to approx. 60%. Then the average annual expenditure will be Birr 211.

Although the outside plant facilities provided by this project will have the capacity to accommodate 15,600 subscribers at the maximum, only 6,400

subscribers will be accommodated initially as mentioned above. However, the operation and maintenance of the provided facilities will have to be started with the completion of this project, requiring the operation and maintenance costs amounting to Birr 3,291,600.

3) Depreciation

For the calculation of the depreciation cost, two methods are available: constant value method and constant ratio method. For this project, the constant ratio method will be adopted, assuming that the service life of the outside plant facilities is 20 years. On condition that the portion under the responsibility of the Japanese side (foreign currency portion) is financed by the grant aid from the Japanese Government, and the portion under the responsibility of the ETA (local currency portion) is financed by ETA itself, the annual depreciation cost will be Birr 2,802,000.

4) Revenues and Expenditures

With the start of the operation at the end of fiscal 1997 as scheduled, the following can be expected for fiscal 1998:

	(in Birr)
- Revenues	7,577,600
- Expenditures (operation and maintenance)	3,291,600
- Expenditures (depreciation)	2,802,000

That is, an annual profit in the amount of Birr 1,484,000 can be expected.

After the expansion of the switching facilities which is expected to be done during fiscal 1998, the new outside plant facilities provided by this project can be operated most effectively and the balance will be remarkably improved as follows:

	(in Birr)
- Revenues	14,208,000
- Expenditures (operation and maintenance)	3,291,600
- Expenditures (depreciation)	2,802,000

That is, an annual profit in the amount of Birr 8,114,400 can be expected.

From the above, it can be seen that the maintenance and operation costs can be covered by the operating revenues for the time being, though the personnel expenses will increase year by year.

The current balance sheet of ETA is not bad with small amounts of investments in rehabilitation, improvement and expansion. The balance will be considerably improved with the materialisation of this project. Then the increased profit can be utilised for improvement of local outside plant facilities in other areas of Addis Ababa, as well as rural areas.