1. OVERVIEW

1.1 Background of the Feasibility Study

The Federal Democratic Republic of Ethiopia is located in the eastern part of the African continent, commonly referred to as the Horn of Africa. In the past the country was facing Saudi Arabia across the Red Sea, but with the independence of the State of Eritrea, the country became landlocked. The country borders the Republic of Djibouti to the east, the Republic of the Sudan to the west, the Republic of Kenya to the south, the Somali Democratic Republic to the southeast, and Eritrea to the North.

The total area of the country is 1.12 million square kilometers, which is roughly three times of Japan. The total population is 65 million.

About two-third of total area lies on the 1,500-3,000m high African plateau. Therefore, the country has a variety of climates due to altitude and geographical conditions, broadly classified into cold, mild, and hot districts. The capital Addis Ababa is located at 2,400m above sea level with an average yearly temperature of 10-26ºC in the middle of cold and mild district, and has rainy seasons twice a year.

In May 1991, the socialist regime was overthrown and interim government was established. The interim government then enacted a new constitution and held a general election, and then formally transferred its power to the new government in August 1995.

The Ethiopian government has currently established second 5-year national economic development plan (2001-2005) which is under execution.

In the telecommunications field, total number of subscribers is approximately 320 thousand as of the first quarter of 2002. Further, the penetration rate of telephone is 0.5 units per 100 persons, while the rate is much lower in the regional areas, with 0.07 units per 100 persons (as of December 1996). In addition, the country has 160 thousand waiting applicant. Though nationwide telecommunications network has been constructed, most of the telecommunications facilities have been installed 20 or more years ago, and these have passed their expected service life.

The operating organization of telecommunications, namely the Ethiopian Telecommunications Corporation (ETC) had established its seventh 5-year plan, and was expected to increase the telephone penetration rate to 1.28 units per 100 persons by the year 2000, the final year of the plan, with its own funds as well as through financial cooperation provided by various international organizations.

When this study was requested in September of 1999, there were no long-term development plans beyond the seventh 5-year plan described above. It was obviously essential that the telecommunications development plan (a master plan) be established, especially such a plan that

includes expansion of telecommunications networks to the regions where the telephone penetration rate is low.

This is the background that the government of the Federal Democratic Republic of Ethiopia made an official request to the Government of Japan for the establishment of telecommunications networks development plan (master plan) and implementation of feasibility study (F/S) concerning the prioritized projects.

The Government of Ethiopia then established the second 5-year economic development plan (covering years 2001 to 2005), and in conjunction with this plan, ETC established their eighth telecommunications development plan. For this reason, ETC requested for additions and modifications of the plan to the Government of Japan in March of 2001, although this new request was made on unofficial level.

Upon the receipt of the official request, the Government of Japan evaluated the request, conducted discussions, and as a result decided to study for the establishment of the master plan (M/P) with the scope of the entire nation and for a feasibility study concerning the prioritized projects, as requested by the Ethiopian Government.

1.2 Objective of the Feasibility Study

The purpose of this feasibility study (F/S) is to conduct a study for the region (the Bahir Dar region) selected according to the criteria applied in the master plan (M/P), and to conduct technical transfer to the counterpart (CP) through the feasibility study processes.

1.3 Target Area

The Bahir Dar region designated as the project region for the feasibility study (F/S) is one of the most important regions. The region was selected from regions listed in the prioritized projects of ETC, according to the selection criteria stipulated in the M/P in consideration of telephone demand and the present telephone penetration level.

1.4 Study Policy and Schedule

For this feasibility study, the following plans of the Ethiopian government were examined to establish the basic policy for the development of telecommunications networks for the target area of the F/S:

1) Second National Economic Development Plan (2000/1 to 2004/5)
2) Public Sector Investment Plans (2000/1 to 2004/5)
3) Eighth Telecommunications Development Plan of ETC (2000/1 to 2004/5)
4) Telecommunications Development Master Plan (2003/4 to 2020/21)
5) Socio-economic status as well as state of existing telecommunications networks in the target area of F/S.

The basic policy calls for the construction of telecommunications networks that provide both qualitative and quantitative improvements for the project area, along with social and economic revitalization of the selected regions, and to narrow the gap of telecommunications services offered in larger cities and rural areas. These policies are established with consideration for applying them for the future development of telecommunications networks in other regions. The established policies are outlined below:

(1) The Bahir Dar Exchange Areas

Provision of telecommunication services to the areas (such as airport area and new development to the east of Blue Nile River) that are currently not receiving or temporarily receiving telecommunications services or not receiving quality services.

(2) Woreta and Merawi Exchange Areas

New Public Call Offices (PCO) are to be installed in order to decrease the areas without telephone service.

Based on the basic policies described above, the main items proposed by this feasibility study report are as follows:

a) Establishment of telecommunications networks plan for regions subject to the feasibility study

b) Establishment of implementation plans for the above.

c) Estimation of implementation costs and expenses for the above.

d) Evaluation of organization and O/M system based on financial and economic analysis.

Tasks and schedule of this feasibility study are shown in Table 1.1, and tasks and schedule of field survey are shown in Table 1.2 and Table 1.3.

Table 1.1 Tasks and Schedule of This Feasibility Study

Year / Month	2001		2002												2003
	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1
Submission of Report					P/R				IT/R			DF/R		F/R	
Phase															
Work Schedule	(A)	(B)				(C)			(D)	(E)	(F)		(G)		

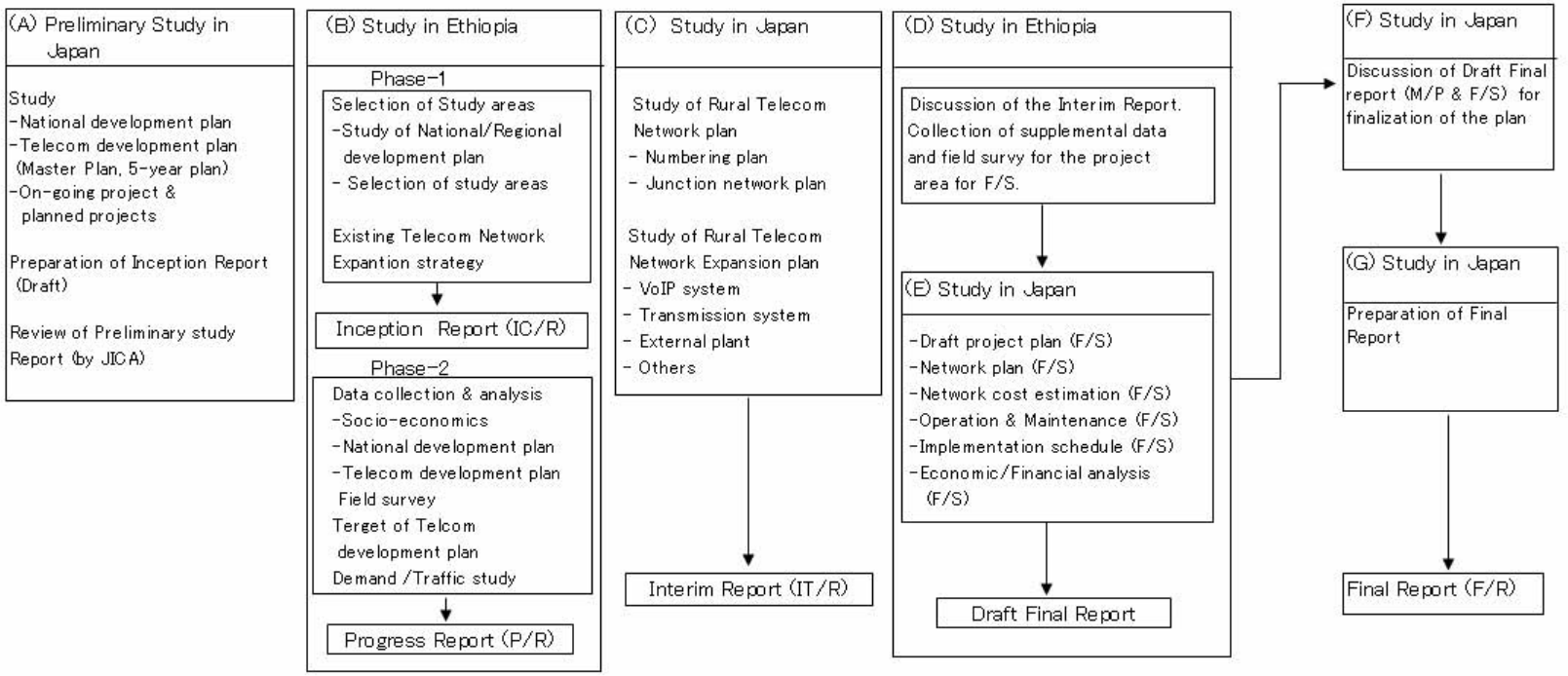

Table 1.2 Schedule of the Field Survey

Schedule for Feasibility Study (OSP Group+VoIP Group) / Bahir Dar

Day	Date	D/week	AM/PM	Description
1	29-Jul.	Mon.		Travel from Addis Ababa to Bahir Dar
2	30-Jul.	Tue.	AM	Meeting in ETC Bahir Dar, Acting Regional Manager - Explanation of Survey Plan, Schedule, Questionnaire survey, etc. and discussion with Counterparts - Survey for existing facilities, transmission system, power plant, building, etc.
			PM	Study Team is divided into two: OSP Group & VoIP Group Map Study for rural area
3	31-Jul.	Wed.	AM/PM	Suvey in **Merawi** city Area: for cable local loop and VoIP system.
4	1-Aug.	Thu.	AM/PM	Survey in **Bahir Dar** city Area: - for applying FTZ and VoIP system
5	2-Aug.	Fri.	AM/PM	Survey in **Bahir Dar** city Area: - for applying FTZ and VoIP system
6	3-Aug.	Sat.	AM/PM	Survey in **Bahir Dar** city Area: - for applying FTZ and VoIP system
7	4-Aug.	Sun.		
8	5-Aug.	Mon.	AM/PM	Survey in **Woreta** city Area: - for applying FTZ and VoIP system
9	6-Aug.	Tue.	AM/PM	Survet in **Bahir Dar** city Area: - for applying FTZ and VoIP system
10	7-Aug.	Wed.	AM/PM	Survey in **Woreta** PCO rural area: - for applying OSP
11	8-Aug.	Thu.	AM/PM	Survey in **Bahir Dar** city Area: - for applying FTZ and VoIP system
12	9-Aug.	Fri.	AM/PM	Data correction and arrangement Travel to Addis Ababa

Table 1.3 Schedule of the Field Survey

Schedule for Feasibility Study (PCO Group) / Bahir Dar

Day	Date	D/week	AM/PM	Description	Remarks
1	29-Jul.	Mon.		Travel from Addis Ababa to Bahir Dar	
2	30-Jul.	Tue.	AM	Meeting in ETC Bahir Dar, Acting Regional Manager - Explanation of Survey Plan, Schedule, Questionnaire survey, etc. and discussion with Counterparts - Survey for existing facilities, transmission system, power plant, building, etc.	
			PM	Map Study for rural area by PCO Group,	
3	31-Jul.	Wed.	AM	Survey in **Woreta area:** - **W. Indris** Rep. for Base St. (1st proposed site) - **Woreta** Exchange for Base St.(2nd proposed site) - Propagation condition for radio link, existing power supply system, transmission system, antenna tower, station building, etc. at Base St. site	
			PM	Survey in **Woreta** area: -Ppropagation condition, power supply availability, etc.	PCO No.1
4	1-Aug.	Thu.	AM	Survey in **Merawi area:** - **Merawi North** Rep. for Base St. (1st proposed site) - **Merawi Exchange** for PCO Base Exchange (2nd proposed site) - Propagation condition, power supply availability, existing power supply system, transmission system, antenna tower, station building, etc.	Base St.
			PM	Survey in M**erawi** area: same as the above	PCO No.1
5	2-Aug.	Fri.	AM	Survey in **Woreta** area: same as the above	PCO No.2,3,4
			PM	Survey in **Woreta** area: same as the above	PCO No.5,6
6	3-Aug.	Sat.	AM	Survey in W**oreta** area: same as the above	PCO No.7,8,9
			PM	Survey in **Woreta** area: same as the above	PCO No.10,11
7	4-Aug.	Sun.			
8	5-Aug.	Mon.	AM	Survey in **Woreta** area: same as the above	PCO No.12,13
			PM	Survey in **Woreta** area: same as the above	PCO No.14
9	6-Aug.	Tue.	AM	Survey in **Merawi** area: same as the above	PCO No.2,3,4
			PM	Survey in **Merawi** area: Same as the above	PCO No.5,6,7
10	7-Aug.	Wed.	AM	Survey in **Merawi** area: same as the above	PCO No.8,9,10
			PM	Survey in **Merawi** area: same as the above	PCO No.11,12

1.5 Organization of the Feasibility Study Team

(1) JICA Feasibility Study Team

1) Feasibility Study Team

Team Leader:	Ryoji Sasaki
Outside Plant and Demand Forecast:	Shinichi Shoji
Switching System and Traffic Forecast:	Takashi Yamamoto
Outside Plant:	Tetsuya Sakamoto
Transmission System:	Hiroshi Fujii
Radio System:	Takashi Matsuoka
Operation and Maintenance:	Kiyofumi Yamamura
Economic, Financial Analysis:	Tomoyuki Kuroda
Organization and Human Resource:	Naoki Hara

2) JICA Advisor Committee

Chairman:	Takashi Miyashita
Member:	Takeshi Hirose

3) JICA Head Office

Task Manager : Miss Miki Inaoka

(2) ETC Staff Members

Names and titles of ETC staff members, who have provided us with valuable opinions and cooperation for the local feasibility study and collection of necessary materials/documents within and outside ETC, throughout the duration of the entire investigative process, are listed below:

1) ETC Headquarters

Mr. Mohammed Yimam

Mr. Mesfin Abraham

Mr. Gizaw Wessene

2) Regional Exchange

Mr. Abebaw Ademe (Acting Regional Manager)

Mr. Tesfaye Tefera (Deputy Regional Manager OSP)

2. SOCIO-ECONOMIC STATUS OF ETHIOPIA

The economy of Ethiopia and per capita income are growing according to the influence of agricultural yield. In the past eight years, however, the gross domestic product (GDP) has been sluggish, with its growth being lower than that of the population. As a principal cause of this phenomenon, the influence of the drought in 1997 can be identified.

2.1 Gross Domestic Product (GDP)

GDP real growth rate has averaged 5.24% during 1993/94 – 1999/2000 according to Ethiopian and IMF data. However, these aggregate figures reflect favourable climate and harvests rather than the discernible, unambiguous impact of policy changes. Table 2.1 indicated that Growth of 10.6% in 1995/96 has been undermined since 1997/98 by drought and war.

Table 2.1 Gross Domestic Product of Ethiopia for Individual Production Sectors

Unit: Birr million

Sector	1993/94	1994/95	1995/96	1996/97	1997/98	1998/99	1999/2000
1. Agriculture, Fishing	6,078.0	6,284.0	7,206.2	7,453.9	6,648.9	6,904.2	7,052.8
2. Industry	1,307.0	1,412.5	1,488.9	1,593.8	1,630.9	1,815.7	1,870.9
3. Distributive Service	1,650.9	1,757.3	1,914.7	2,062.1	2,177.9	2,253.9	2,423.1
4. Other Service	2,963.3	3,190.5	3,377.3	3,603.8	4,084.9	4,487.1	4,955.0
5. GDP	11,999.2	12,644.4	13,987.1	14,713.6	14,542.6	15,460.9	16,301.8
6. Growth Rate	1.70%	5.37%	10.60%	5.19%	-1.16%	6.31%	5.43%

Note: 1980/1981 Factor cost
Source: MoFED (MEDaC)

2.2 Population

According to the Statistical Abstract of Central Statistical Authority of Ethiopia, the overall population of the country in 2001 was approximately 65 million, with the average annual growth rate between 1995 and 2000 being 3.02%.

The average number of people in a household for the year 1994 was 4.8.

Further, 85% of the overall population live in the rural areas, while about half of the remaining 15% live concentrated in Addis Ababa and larger regional cities.

Population distribution obtained as a result of the national census is shown in Table 2.2.

Table 2.2 Population and Land Area of Individual Provinces (investigated in 2001)

Province	Population	Urban Pop.	Rural Pop.	Land Area (Sq.km)
Tigray	3,803,000	638,904	3,164,096	50,078.64
Affar	1,246,000	100,926	1,145,074	n.a.
Amhara	16,773,000	1,727,619	15,045,381	159,173.66
Oromiya	23,058,000	2,720,844	20,337,156	353,006.81
Somali	3,708,000	561,391	3,146,609	n.a.
Benishangul	552,000	48,576	503,424	49,289.46
S.N.N.P.R	12,916,000	994,532	11,921,468	112,343.19
Gambela	217,000	36,890	180,110	25,802.01
Addis Ababa	2,574,000	2,574,000	0	530.14
Dire Dawa	331,000	238,320	92,680	1,213.20
Harar	166,000	100,596	65,404	311.25
Total	65,344,000	9,742,598	55,601,402	1,098,000.00

Source: Central Statistical Authority
Note: All localities with population less than 1,000 persons should be considered as rural.

2.3 Conditions of Project Site

(1) Natural Conditions

1) Climate

The Bahir Dar region subject to this project is located approximately 2,000m above sea level. The climate is mild and the annual precipitation is approximately 1,200mm. The region is comparatively blessed with natural conditions.

2) Topographic Conditions

The area subject to this project is a basin district located near Lake Tana. Though there are some volcanic rocks, the greater part of the area is loamy. Thereby lowland areas are sometimes submerged in heavy rain seasons.

3) Social Conditions

a) Business Area

Low-rise buildings (four or five stories) accommodating government agencies, offices, banks, shops, hotels and so on are constructed along main streets whose roadway and sidewalk, separated by curbstone, are mostly paved. But such buildings are few and more than 95% of buildings are one-story houses. With respect to telecommunications facilities, direct buried cables are led into exchange buildings/cross connection cabinet and connected to distribution points on telephone poles for most of the local cable access network. Dropwires are distributed from the distribution points.

b) Hinterlands

Roads and alleys apart from main roads are unpaved, and areas are composed of offices, shops and dwelling houses.

In many places, direct buried cables of loclal cable are elevated onto telephone poles near road entraces, and then laid as overhead suspension cables.

c) Surrounding Areas

Most roads are unpaved and do not separate roadways and sidewalks each other. No building accommodates offices or shops. Buildings that are not different much from ordinary houses existing together in the same area.

With respect to telecommunications facilities, direct buried cables are led into exchange building/cross connection cabinet and connected to distribution points on telephone poles. Since telephone poles in parallel to electric poles occupy roads and overhead suspension cables are laid over them, enough separation between telephone poles and electric poles is not kept.

d) Residential Areas

Roads are unpaved and do not separate roadways and sidewalks.

With respect to communications facilities, overhead suspension cables are laid between telephone poles. Lead-in poles, walls of buildings and sometimes trees are used to suspend dropwires.

4) Road Traffic Condition

Since greater parts of the regions of this project are residential areas with small volume of car traffic during daytime, there seems no serious difficulty in the construction work. However, it is vital to pay attention to nearby people when carrying materials, equipment, and surplus soil are carried or when parking vehicles.

(2) State of Social Infrastructure

1) Transportation and Traffic

Ethiopian transportation and road traffic infrastructure is quite poor when the land scale of Ethiopia is considered. Even at present, most of the nation's land (agrarian community in particular) is still isolated from traffic and communications networks.

a) Marine Transportation

Ports and harbors that Ethiopia used were Assab Port and Massawa Port in Eritrea and Djibouti Port in the Republic of Djibouti. Assab and Addis Ababa are connected with the

860km paved road. The volume of distribution of goods using Assab Port was accounting for about 80% of the total trade volume of Ethiopia.

However, Ethiopia lost Assab Port and Massawa Port due to the independence of Eritrea. For this reason, trucks via Djibouti Port will transport materials and equipment used in this project.

b) Railroad Transportation

The railroad between Addis Ababa and Djibouti handled 60% of trading goods, but its handling volume is decreasing year by year due to poor maintenance of railroad facilities.

c) Inland Transportation

90% of the domestic transportation volume in Ethiopia relies on roads for both passengers and cargoes. Though poor maintenance and management of loads due to the shortage of fund caused by the civil war temporarily deteriorated road networks, recent financial aids by international organizations and between two countries have considerably developed and improved the major loads.

d) Air Transportation

Because of the underdeveloped domestic land transportation, both international and domestic air transportations are important means of transportation. Of the total passenger mileage, the international transportation accounts for 97%, and the rest is domestic transportation. Regarding cargo mileage, however, the international transportation accounts for 3%, and domesitc transportation accounts for less than 1%. National Ethiopean Airlines is a competitive airline company in Africa and is an important source of acquring foreign money.

2) Situation of Electric Power

In Ethiopia, the national power corporation "Ethiopian Electric Power Corporation" (EEPCO) takes charge of electric power supply. In the Bahir Dar region, power failure rarely occurs except for cases of lightening or accidents. Development plan for major transmission lines is steadily going, and electricity seems to be supplied to all villages and hamlets in the next step.

The standard power voltage of Ethiopia is 220V AC.

3) Water and Gas Supply

In urban areas, 80% of the people including people using wells is receiving safe water. In rural areas, however, only 6% of the people is receiving safe water. Therefore, the rate of people receiving safe water is 17% of the Ethiopian population. Because the Bahir Dar

region has water tanks in its east and west locations and service water supply systems are also provided, the construction work in this region has no water problem. Town gas has not yet spread, so ordinary households use firewood and charcoal for fuel.

(3) Environmental Impacts

1) Protection of Forests

In Ethiopia, environmental degradation due to forest destruction, excessive grazing, and cultivation on sloping ground has become a serious problem. At present, however, the environmental protection research and development program is being promoted with international technical cooperation, focusing on reduction of deforestation and protection of the nature.

To avoid adverse effects on environmental destruction and changes in ecosystem as much as possible, this project decided to use concrete poles or steel poles instead of wooden poles.

2) Construction Materials and Surplus Dug Soil

Since the Bahir Dar project site has already become an urban area, sites to be excavated are roads in principle. Because the construction in this area is small-scale engineering work, the volume of gravel and sand for construction, and surplus dug soil will not much affect environmental contamination and the environment of nearby inhabitants.

3. CURRENT STATUS OF TELECOMMUNICATIONS SERVICES IN THE F/S AREA

The telephone penetration rates per 100 persons (as of year 2000) in the F/S areas are quite low, with 2.74 in the Bahir Dar Area, 0.038 in the Woreta area, and 0.0074 in the Merawi Area. The penetration rates of these areas are lower than those of large cities (6.4%), and urgent implementation of the project is desirable.

While the majority of telecommunications services being offered within the F/S areas are telephone services, a limited non-telephone services such as data communications and Internet services are also being offered in the Bahir Dar Exchange Area.

3.1 Current Status of Telecommunication Networks

3.1.1 Current Status of Switching Facilities

(1) Bahir Dar Exchange

1) Existing Digital Exchange

Switching facilities currently operating contain old and new versions of AXE-10 digital exchanges of Ericsson, manufactured in Sweden. The old version was installed in 1990, and the new version was introduced in 1999 to solve the Y2K problem.

As the result, the old version switching system was integrated into the new exchange and only about 2,000 subscriber lines are being served with the old exchange. The new exchagne can accommodate approximately 8,000 subscriber lines. The total accommodating capacity of both types of exchange is approximately 10,000 subscriber lines.

Local subscribers: 5,801

Pair Gain System: 17 PGS x 11= 187

9 PGS x 4 = 36

The above-mentioned exchanges and the control room are located on the 1F (second floor) of the Bahir Dar Exchange. Three large air conditioners are installed in the exchange room. Considerable floor space is left, which seems to be sufficient for substantial large-scale expansion of equipment.

2) Power Supply Facilities

Both rectifiers and batteries are installed on BF (first floor) of the Exchange building. The following facilities are accommodated in the rectifier room.

Rectifier for new version exchange: -48V x 125AH/Unit x 4

Rectifier for old version exchange: -48V x 100AH/Unit x 3

Since the power room has no extra space, expansion of equipment in this room is almost

impossible.

Not only batteries for exchanges but also those for transmission equipment are installed in the same battery room. If these batteries are relocated, additional batteries can be installed.

As an emergency power supply for commercial power failures, a 125KVA diesel engine generator is installed in another building. The engine of the generator was manufactured in India and the generator unit is of United Kingdom product.

3) ETC's eighth 5-year plan for expansion of communications networks

According to ETC plan, expansion of a digital exchange with a capacity of 6,000 subscriber lines is scheduled. This expansion is expected to eliminate the current waiting applicants.

(2) Merawi

Merawi, a town with a population of 15,000, is located southeast approximately 35km away from Bahir Dar. Only one VHF radio channel is provided for telephone line, which is connected to the Bahir Dar parent Exchange via the Merawi-North repeater station. The telephone line is used for public telephone service with an operator assistance.

The original plan of ETC intended to install a digital exchange with 750 line units.

(3) Woreta

Woreta is located northeast approximately 50km away from Bahir Dar, connected to the Gondar parent Exchange. The existing equipment is NEC's DRMASS which is connected to the parent Exchange via a radio link. The number of channels in use is sixteen (16). Three (3) of the channels are used for subsriber lines including public telephones with operators assistance. The other channels are used for directly connected subscribers. In addition, another 48-channel is being expanded (as of August 1, 2002). Though the number of waiting applicant on the list is 255, considering the city population of 22,986 and the Woreda population (a surrounding area) of approximately 21,000, signicicant potential demand is expected. Even if additional DRMASS units are installed, such great demand cannot be fulfilled.

For this reason, addition of a new digital exchagne with a capacity of 2,000 subscribers is planned in the ETC's eighth 5-year plan.

Table 3.1.1 shows the detailes of automatic exchanges.

Table 3.1.1 Details of Automatic Exchanges

Exchange name	Model	Switching System	Manufacturer	Capacity
Bahir Dar	AXE-10 (1990)	Digital	LM Ericsson	2,000
Bahir Dar	AXE-10 (1999)	Digital	LM Ericsson	8,000

3.1.2 Current Situation of Transmission and Radio facilities

(1) Bahir Dar PC (Primary Center)

Bahir Dar is a local city with 126,000 people. In this city, the Bahir Dar PC (Primary Center) has been established to control the eighth zone (Northwest Region) of ETC telecommunications network, and transmission lines are provided to the capital Addis Ababa and to Gondar, a local city.

A layout plan of Bahir Dar (PC) building is shown in Figure.3.1.2-1 "Bahir Dar Primary Center Building Layout 1F". A layout plan of the equipment in the radio room is shown in Figure 3.1.2-2 "Bahir Dar [PC] Radio/MUX Room Equipment Layout". Details of the site feasibility study results are described in Table 3.1.2-1

(a) Backbone transmission line

The backbone (NEC's analog M/W link constructed in 1977) connecting Addis Ababa and Bahir Dar (Addis Ababa - Debre Markos - Debre Tabor - Washa Indorias - Bahir Dar) has satisfied the demands for communication lines between Addis Ababa and local cities for a long time. However, it is clear that the present analog transmission system and its capacity cannot catch up with the future telecommunications services. To solve the problem of the transmission capacity shortage, ETC is carrying out the system update project (contracted in November 1999) for replacing this route to the R1 route (Addis Ababa - Debre Markos - Gara Beteria - Merawi North - Bahir Dar - Washa Indorias - Gondar Route) according to the eighth telecommunications network extension plan. ETC is further proceeding with the installation of new SDH M/W system facilities at repeater stations.

(Backbone) (Operating/existing)

- NEC analogue M/W radio system: 960 channels (Addis Ababa - Bahir Dar- Gondar)

(Backbone) (Under construction)

- NEC SDH: Digital M/W radio system: STM-1 (3+1) (Addis Ababa - Bahir Dar)
  SDH: Digital M/W radio system: STM-1 (1+1) (Bahir Dar- Gondar)

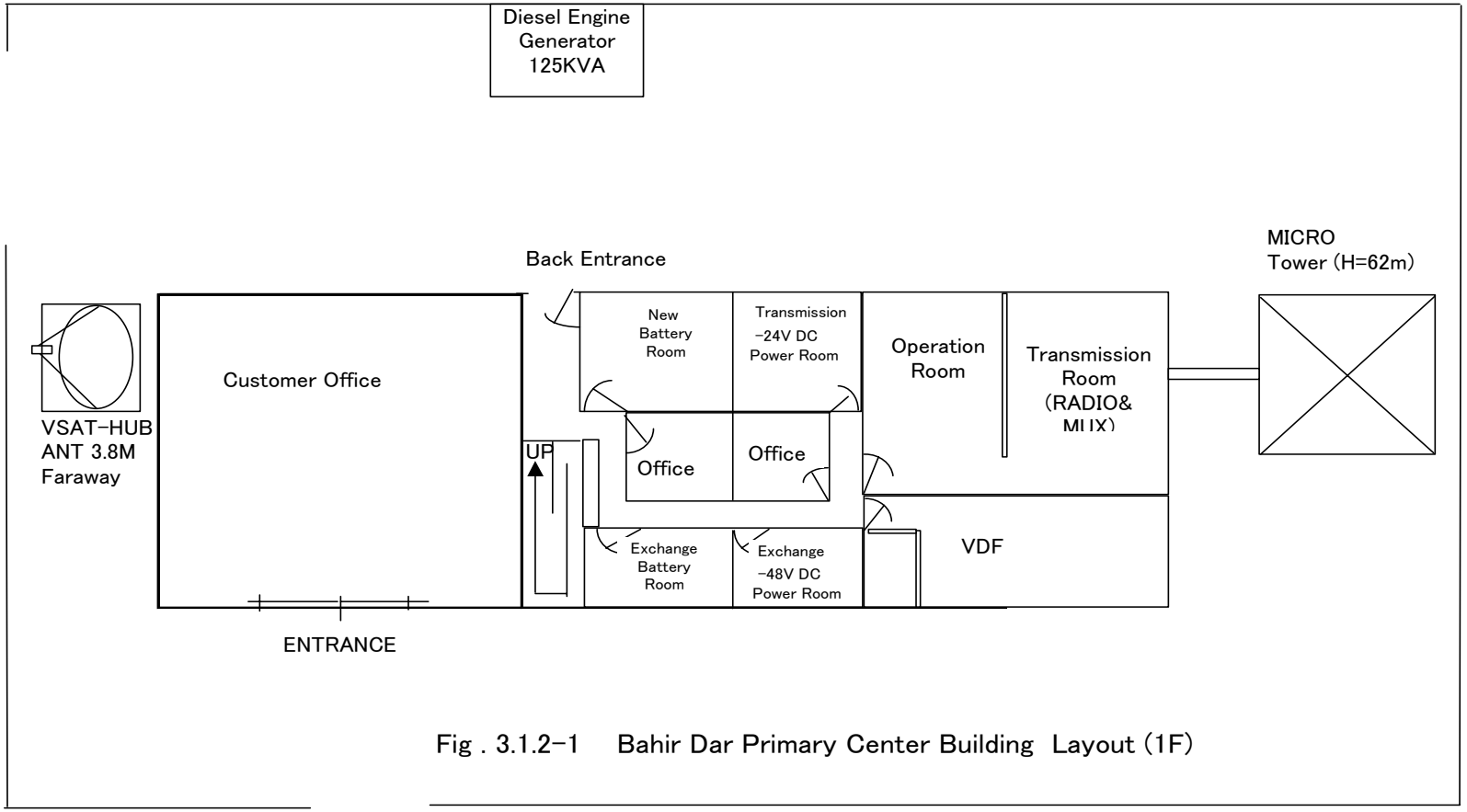

Fig . 3.1.2-1 Bahir Dar Primary Center Building Layout (1F)

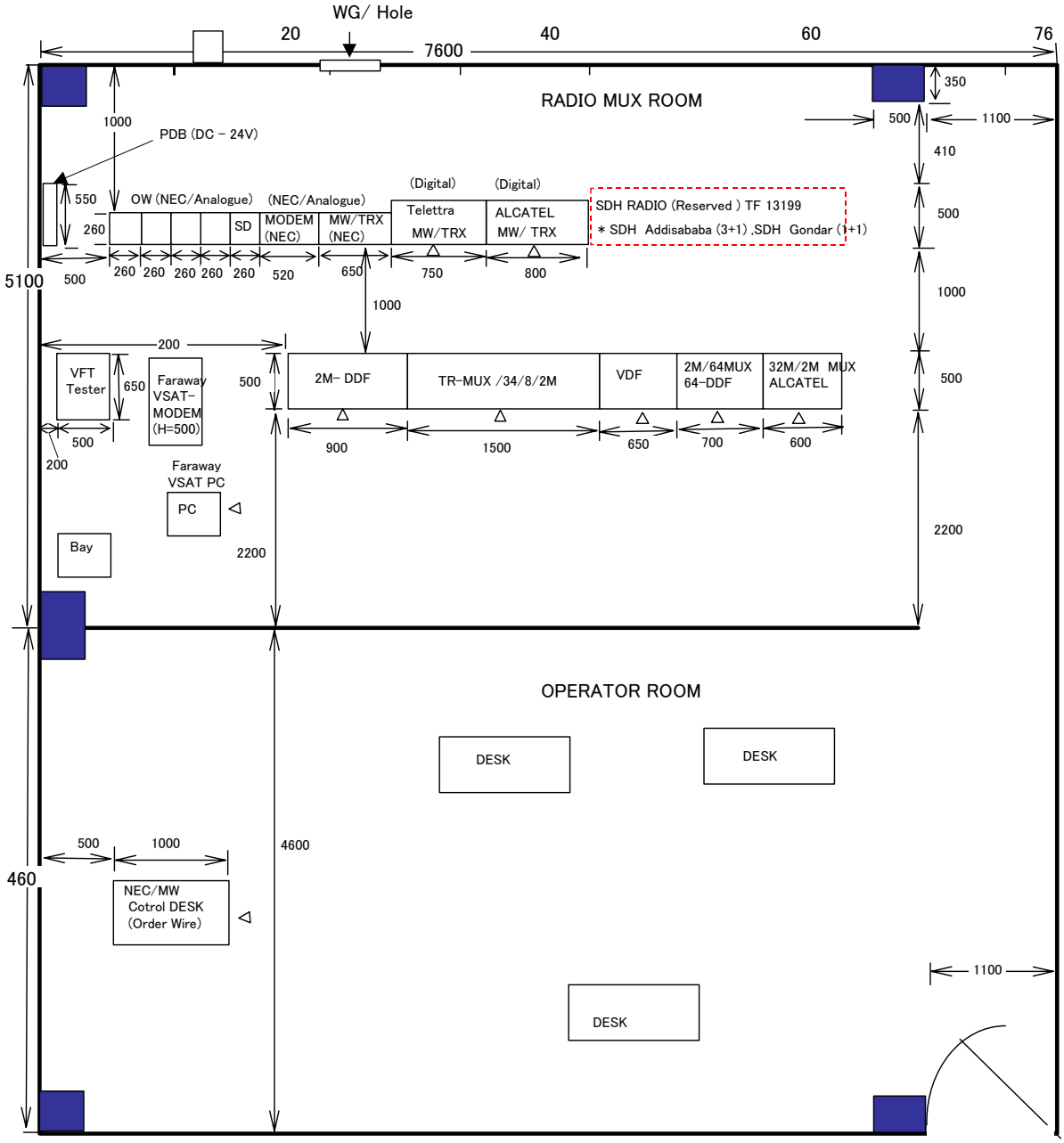

Fig . 3.1.2-2 Bahir Dar RADIO/MUX ROOM Equipment Layout

Ethiopia Rural PCO System F/S Result

Table 3.1. 2-1 Bahir Dar Region Primary Center (PC)

(1) Site Information

Category	*Survey Item*	*Survey Result*	*Remarks*
1. Location	Site Name Latitude Longitude Altitude Site condition	ETC Bahir Dar /Region Primary Center 11° 35′ 50″ N 37° 23′ 11″ E 1,800m See attachment – 1 (photo)	
2. Building	Building Structure Air conditioning Installation place	Existing two-story building Air conditioner is only operating in exchange room, and out of order in Radio/MUX room. M/W antenna tower: Near building M/W facilities : Radio room Transmission Multiplex : MUX room	(See Fig.3.1.2.-1) Air conditioner in exchange room: 19kw + 9kw + 9kw 62m Layout (See Fig.3.1.2-2)
3. Power Facilities	Commercial Power Power for equipment DC power UPS Engine generation	Available (380/220V 3-phase/single-phase 50Hz) Approx. 10m from UPS NFB (200V, 50A) Available (-48V, -24V) None 220V/50Hz 125KVA	Existing NFB: No spare
4. Grounding	Indoor Grounding Outdoor Grounding (Lightning conductor)	Within 20m from earth bar For microwave tower (existing)	
5. Equipment Installation	Vehicle Access Road Material Temporary Storage Vehicle Carrying in/Parking Minimum Entrance space Lifting facilities Special vehicle	OK Approx. 120m^2 (3m×40m) available OK 1.7m(H)/1.0m(W) Provided (Second floor) Crane not required	Exposed to the weather Entrance door (Photo)
6. Others	Population of Site	126,000 (in central area)	

(2) Transmission Facilities

Category	*Survey Item*	*Survey Result*	*Remarks*
1. System Specifications	1) For Woreta PCO Station Adjacent st. : A (existing) Antenna direction M/W transmission system Relay distance	 Repeater station: Washa Indrias Rep. Azimuth: 33.77° SDH M/W system (STM-1/1+1) Approx. 70km (north)	
	2) For Merawi PCO Adjacent st.: B (existing) Antenna direction M/W transmission system Relay distance	Repeater station: Merawi North Rep. Azimuth: 232.9° SDH M/W system (STM-1/3+1) Approx. 30km (south)	
2. Antenna	Location (Bahir Dar) Strength of building Radio path clearance in the direction of rep.	Antenna tower: 62m Unknown (built 25 years ago) Enough	
3. Other Facilities	Space for Equipment	Available	
4. Circuit	Digital Circuit (2xE1) MDF	Provided (currently under expansion) (Section: Bahir – W.Indrias) ETC 8th Telecom Network Expansion Plan (On-Going Project/Route-1) Existing (arranged in expansion project)	
5. Wiring	Outdoor wiring Lead-in opening Indoor wiring IFL cable length (WG) Indoor wiring (vertical) Indoor wiring (horizontal)	Existing piping usable Existing lead-in opening usable Approx. 60m Approx. 80m Existing racks, ducts, holes usable Existing racks usable, with holes on the wall and floor	

Attachment – 1 Bahir Dar Region Primary Center (P.C.)
(Central Building external appearance)

(b) Spur or Rural Transmission lines

Other microwave systems include:

- Telettra digital transmission system: 34Mbps (Bahir Dar- Debre Tabor)

(Line speed)	Debre Tabor	8Mbps
	Hamsuit East	8Mbps
	Addis Zemen	8Mbps

- Alcatel digital transmission line: 34Mbps (Bahir Dar- Debre Markos)

(Line speed)	Debre Markos	8Mbps
	Bure	8Mbps
	Finote Selam	8Mbps
	Kosober	8Mbps

- Alcatel transmission line: 34Mbps (Bahir Dar-M/N- Gara Kar)

(Line speed)	Gara Kar	8Mbps
	Dangla	8Mbps
	Pawe	8Mbps
	Chani	8Mbps

(c) The existing transmission system capacities of the Bahir Dar Exchange (number of relay lines) are as follows:

a) AA - Bahir Dar	192 CH (in terms of telephone lines)
b) Bahir Dar - Debre Markos	70 CH (in terms of telephone lines)
c) Bahir Dar - Gonder	120 CH (in terms of telephone lines)
d) Bahir Dar - Addis Zemen	15 CH (in terms of telephone lines)

(2) Current Status of Washa Indorias Repeater Station

The Washa Indorias repeater station (12° 8’ 50″ north, 37° 43’28″ east), located on the top of a mountain of 2,420 meters above sea level, is equipped with a repeater for analog M/W tradio system between Addis Ababa and Gondar/Bahir Dar (NEC product made in 1977) and a repeater for relaying a line between neighboring Debre Tabor and DRMASS (Gondar -Woreta). The antenna tower is 62m high. As for power supply facilities, both solar power system and diesel-engine generator are installed. In this repeater station, installation work for NEC's SDH Digital M/W equipment is in progress. This replacement work also covers the installation of digital PHD access lines to be connected with Woreta (8Mbps), a neighboring city, Debre Tabor and Addis Zemen. Washa Indoras Rep. was selected as a candidate PCO base station that covers rural areas of Woreta. The distance between Washa Indorias and Woreta is 24.5km.

A layout plan of Washa Indorias repeater station building is shown in Figure.3.1.2-3 “Washa Indorias Rep. station Layout”. A layout plan of equipment in the radio room is shown in Figure

3.1.2-4 "Washa Indorias Radio Room Layout". Details of the site feasibility study are given in Table 3.1.2-2

(i) The capacities of transmission lines newly installed in the Washa Indorias Rep. Station (under construction) are as follows:

a) Washa Indorias - Woreta (PDH 4x 2Mbps)
b) Woreta - Addis Zemen (PDH 4x2 Mbps)
c) Washa Indorias - Debre Tabor (PDH 8x2 Mbps)

(3) Current Status of the Merawi North Repeater Station

The Mearawi North repeater Station (11° 26'57″ north, 37° 11'25″ east), located on the summit of a mountain of 2,146 meters above sea level, is equipped with repeaters for transmission lines to neighboring Dangla and Gara Kar, and for VHF telephones used in neighboring towns. The tower is 40m high. Entire power is supplied by a solar power system. In this repeater Station, installation work for NEC's SDH Digital MW equipment is in progress. Merawi North Rep. was selected as a candidate PCO base station that covers the Merawi rural area, because the station has favorable geographical conditions for radio propagation.

A layout plan of Merawi North Rep. Station building is shown in Figure 3.1.2-5 "Merawi North Rep. Station Layout". A layout plan of equipment in the radio room is shown in Figure 3.1.2-6 "Merawi North Radio Room Layout". Details of the site feasibility study are given in Table 3.1.2-3.

(i) The capacities of transmission lines newly installed in the Merawi North Rep. Station (under construction) are as follows:

a) Merawi North - Merawi (PDH 8x2 Mbps)
b) Merawi North - Dangla (PDH 8x2 Mbps)
c) Merawi North - Debre Mawi/Adet (PDH 8x2 Mbps)

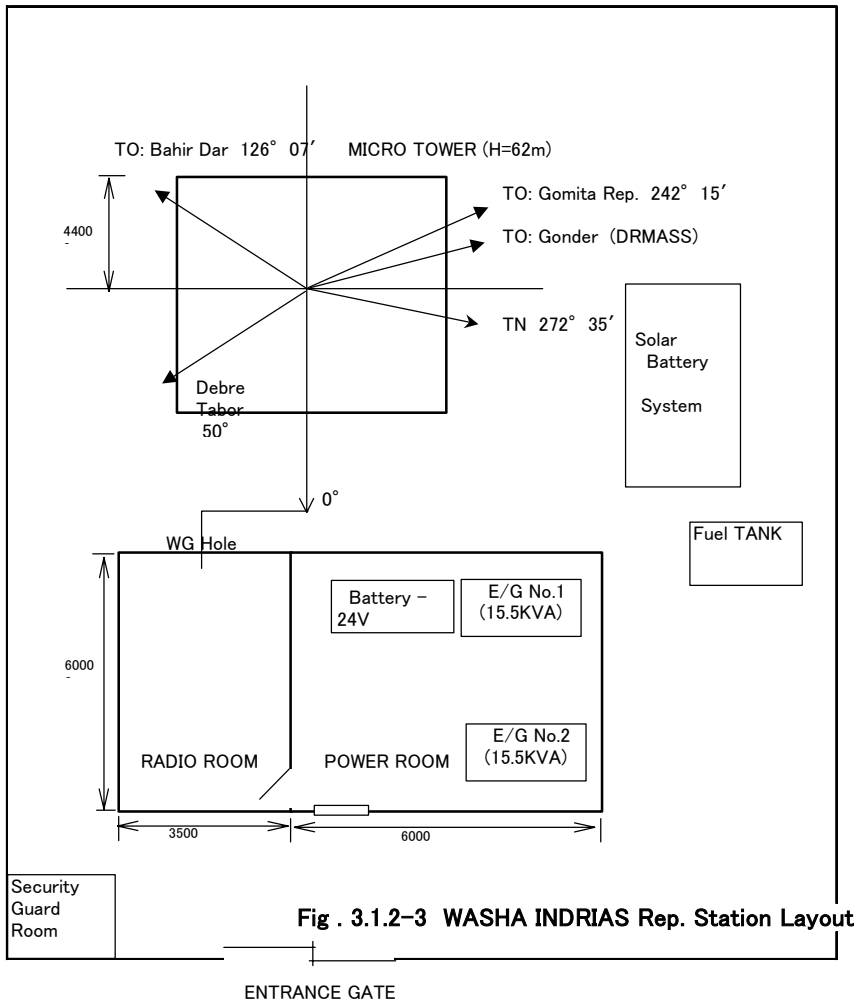

Fig . 3.1.2-3 WASHA INDRIAS Rep. Station Layout

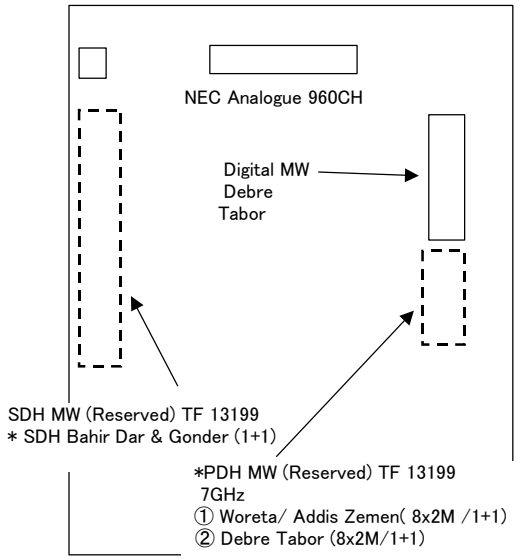

Fig . 3.1.2-4 Washa Indorias Radio room Layout

Ethiopia Rural PCO System F/S Result

Table 3.1.2-2 Washa Indrias Rep. Station

(1) Site Information

Category	*Survey Item*	*Survey Result*	*Remarks*
1. Location	Site Name	Washa Indrias Repeater Station	
	Latitude	12° 8′ 50″ N	
	Longitude	37° 43′ 28″ E	
	Above Sea Level	2,420 m	
	Site condition	See attachment – 2 (Photo)	
2. Building	Building Structure	Existing one-story building	(See Fig.3.1.2-3)
	Air conditioning	None	
	Installation place	Antenna: Existing antenna tower	(Photo) 62m
		Microwave facilities: Equipment room	Layout (See Fig.3.1.2-4)
3.Power Facilities	Commercial Power	None	
	Power supply to indoor equipment	In combination with solar power system and lead battery	
	DC power	DC－24V power supply	
	Engine generation	15.5KVA x 2 sys	
4. Grounding	Outdoor Grounding (Lightning conductor)	For antenna tower (existing)	
5. Equipment Installation	Vehicle Access Road	OK (3km mountain road)	
	Material Temporary Storage	Approx. 100m^2 available	Exposed to the weather
	Vehicle Carrying in/Parking	OK (up to 5 vehicles)	
	Minimum Entrance space	1.7m(H)/1.0m(W)	Entrance door
6. Others	Population of Site	Unknown	

(2) Transmission Facilities

Category	*Survey Item*	*Survey Result*	*Remarks*
1. System	Adjacent stations		
1.1. M/W Station	1) Bahir Dar Station(P.C.)	Analog (2GHz 960 CH)	Being replaced with 5G SDH
	2) Gomita Station	Analog (2GHz 960 CH)	Being replaced with 5G SDH
	3) Debre Tabor Station	Analog (2GHz 960 CH)	Being replaced with 7GHz PDH 8x2Mbps
	4) Gondar Station	DRMASS (Repeater Station)	
	5) Woreta Station (to be constructed)	Digital (7GHz PDH 8x2Mbps)	Under construction (new installation)
	6) Addis Zemen (to be constructed)	Digital (7GHz PDH 8x2Mbps)	Under construction (new installation)
2. Circuit for PCO	Required digital circuit * (2xE1) (*: Subject item for F/S)	Circuit under construction can be used RF Link : W. Indrias - Woreta	Transmission line capacity under construction can be used.

Attachment – 2 Washa Indorias Rep. Station

(Approx. 70km north form Bahir Dar)

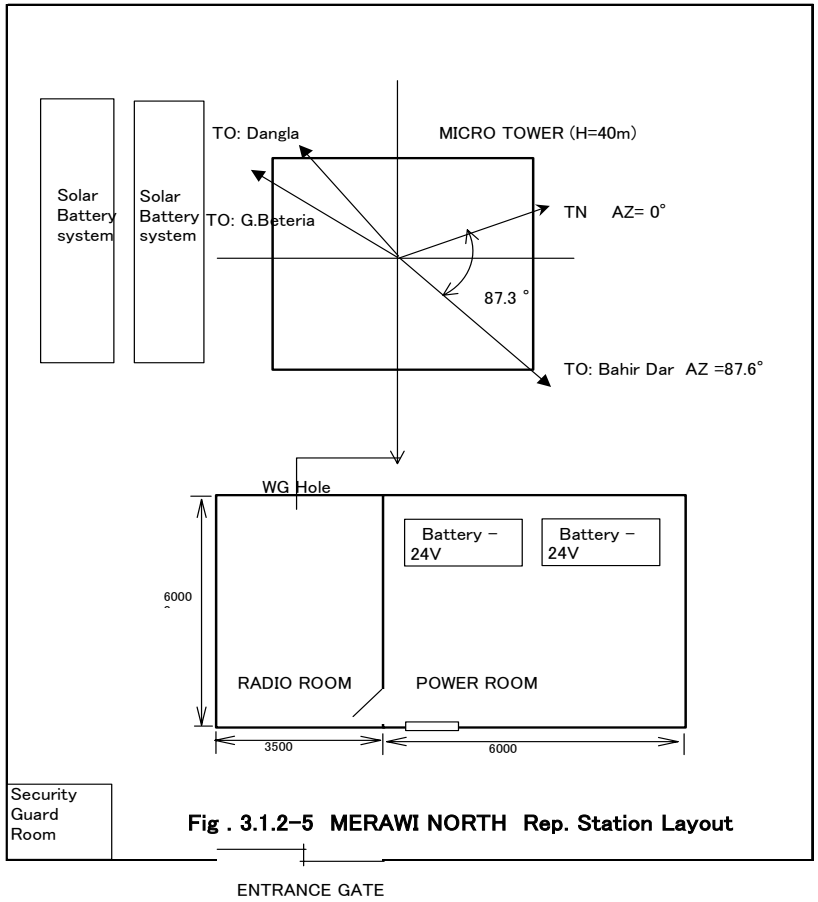

Fig . 3.1.2-5 MERAWI NORTH Rep. Station Layout

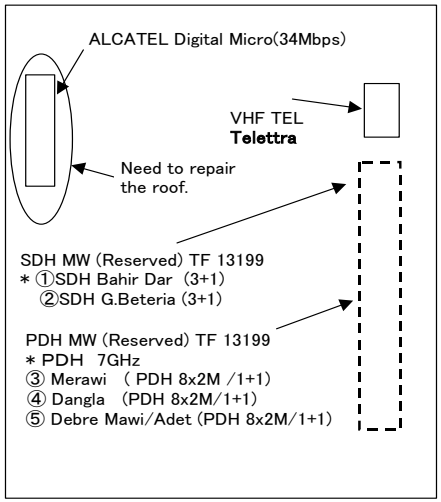

Fig . 3.1.2-6 MERAWI NORTH RADIO ROOM Layo

3.1.3 Current Status of Telecommuniations Services in the PCO Feasibility Study Areas

The PCO network for the rural area communications is one of the key targets of M/P. Woreta (Fogera) Woreda and Merawi Woreda are designated by ETC for PCO application.

(1) Woreta (Fogera) Woreda

Woreta (Fogera) Woreda is a country area centering Woreta, a small city 50km north of Bahir Dar PC (Primary Center), with an area of 1,862.5 km^2 and a population of 220,496. Since Woreta city is far from Bahir Dar, 16 subscribers are temporarily accommodated as the subscribers of northern Gondar exchange by means of DRMASS. In addition, 95 subscribers are accommodated to the manual switch by using DRMASS (3 lines). However, the connection of subscribers by the 3 lines is leading to a deterioration of service quality. Because of this, ETC is implementing a plan to increase number of circuits of the DRMASS system. However, since the telephone tariff rate from Gondar is being applied, subscribers strongly desire to be connected to the immediate Bahir Dar PC.

On the other hand, because no telephone services are provided in rural areas or local villages, communication means of the PCO network is envisaged for this local rural areas. Table 3.1.3-1 provides the details of the site feasibility study results.

(2) Merawi Woreda

Merawi Woreda is a rural area centering Merawi, a small city 50km south of Bahir Dar PC (Primary Center), with an area of 1,602.81 km^2 and a population of 184,642.

In Merawi city, 20 long-distance telephone lines were laid from Bahir Dar in the past, but they were removed because they bacame old and decrepit. Currently public telephone service is being provided by manual switching operation over one VHF telephone line (150MHz). However, one VHF telephone line does not satisfy the demand of people in this area.

On the other hand, because no telephone services are provided in rural areas or local villages, communication means of the PCO network is envisaged for this local rural areas.

Ethiopia Rural PCO System F/S Result

Table 3.1.2-3 Merawi North Rep. Station

(1) Site Information

Category	*Survey Item*	*Survey Result*	*Remarks*
1.Location	Site Name	Merawi North Repeater Station	
	Latitude	11° 26′ 57″ N	
	Longitude	37° 11′ 25″ E	
	Above Sea Level	2,146m	
	Site condition	Attachment – 3 (photo)	
2. Station	Building Structure	Existing one-story building	(See Fig 3.1.2-5)
	Air conditioning	None	
	Installation place	Antenna: Existing antenna tower	(Photo) 40m
		Microwave facilities: Equipment room	(See Fig 3.1.2-6)
3. Power Facilities	Commercial Power	None	
	Power supply to indoor equipment	Solar power	
	DC power	DC－24V power supply	
	Engine generation	None	
4. Grounding	Indoor Equipment Grounding	Within 20m from earth terminal	
	Outdoor Equipment Grounding (Lightning conductor)	For microwave tower (existing)	
5. Equipment Installation	Vehicle Access Road	OK (1km mountain road)	
	Material Temporary Storage	Approx. 100m^2 available	Exposed to the weather
	Vehicle Carrying in/Parking	OK (up to 5 vehicles)	
	Minimum Entrance space	1.7m(H)/1.0m(W)	Entrance door
6. Others	Population of Site	Unknown	

(2) Repeater Station Transmission Equipment

Category	*Survey Item*	*Survey Result*	*Remarks*
1. System 1.1. MW Station	Adjacent stations: 1) Bahir Dar Station (north)	SDH Digital: Under construction	5G SDH (STM1/3+1)
	2) G. Beteria Station (south)	SDH Digital: Under construction	5G SDH (STM1/3+1)
	3) Bahir Dar Station (north)	Digital (2GHz PDH 34Mbps)	
	4) G. Beteria Station (south)	Digital (2GHz PDH 34Mbps) G Beteria (34M)→Gara Kar (34M)	Being replaced with 5G SDH (STM1/1+1)
	5) Dangla Station	Digital (2GHz PDH 8Mbps)	PDH 8x2M Under construction (Being replaced)
	6) Merawi Station (to be constructed)	Existing :VHF (150M 1CH) (Under construction: PDH 8x2M)	PDH 8x2M Under construction (Being newly installed)
2. Circuit for PCO	Required digital circuit* (2xE1) (*: Subject item for F/S)	Circuit under construction can be used RF Link: Bahir Dar-Merawi North	Transmission lines under construction can be used.

Attachment – 3 Merawi North Rep. Station
(Approx. 30km south form Bahir Dar)

Ethiopia Rural PCO System F/S Result

Table 3.2.1 Woreta City Station

(1) Site Information

Category	*Survey Item*	*Survey Result*	*Remarks*
1. Location	Site Name	ETC Woreta City Station	
	Latitude	11° 55′ 30″ N	
	Longitude	37° 41′ 30″ E	
	Above Sea Level	1,820 m	
	Site condition	Attachment -4 (photo)	
2. Building	Building Structure	Existing one-story wooden building (4mx5m)	New station building to be constructed
	Air conditioning	None	
	Installation place		
		DRMASS facilities: Wooden building	(See attachment-5)
		Manual exchange: Wooden building	(See attachment-6)
3. Power	Commercial Power	220V single-phase 50Hz	
	DC power	DC –24 V	
	UPS	None	
4. Grounding	Indoor Grounding	Within 20m from simple earth terminal	
	Outdoor Grounding (Lightning conductor)	Existing pole for MW(DRMASS) H=20m	
5. Equipment Installation	Vehicle Access Road	OK	
	Material Temporary Storage	Approx. 100m^2 available	Exposed to the weather
6. Others	Population of Site	2 24,000 (19,850: Central city)	

(2) Transmission Facilities

Category	*Survey Item*	*Survey Result*	*Remarks*
1. System	Adjacent stations		
1.1. MW Station	1) Washa Indrias Station	DRMASS (16CH for telephones)	Existing lines
	2) Washa Indrias Station	Digital (7GHz PDH 4x2Mbps)	Under construction
	3) Addis Zemen (to be constructed)	Digital (7GHz PDH 4x2Mbps)	Under construction
	4) PCO Base Station (new) (Subject to This F/S)	None	Required
2. Circuit for PCO	Required digital circuit* (2xE1) (*: Subject item for F/S)		Transmission link under construction can partially be used.
	1) Washa Indrias Station	Existing (Section: W. Indrias – Woreta)	
	2) PCO Base Station** (**New installation)	New installation (Link: Woreta city – PCO BASE)	To be newly procured

Attachment – 4 Woreta City Station
(ETC Tele-house in front, DRMASS Antenna in back side)

Attachment – 5 DRMASS facilities in Woreta city Station
(DRMASS subscriber lines (16 CH) from Gondar City)

Attachment – 6 Operator telephone Booth (Manual Switching)
in ETC Woreta Tele-house
(DRMASS subscriber lines for manual switching assigned three lines (3CH)

3.1.4 Outside Plant

1) Conditions of cable network facilities

a) Distribution method

The most common distribution method being used by ETC is the cabinet system, as shown in Figure 3.1.4. In some locations, direct line connections are being implemented, but such direct line connections are employed in the vicinity of exchange office and for stable demand area.

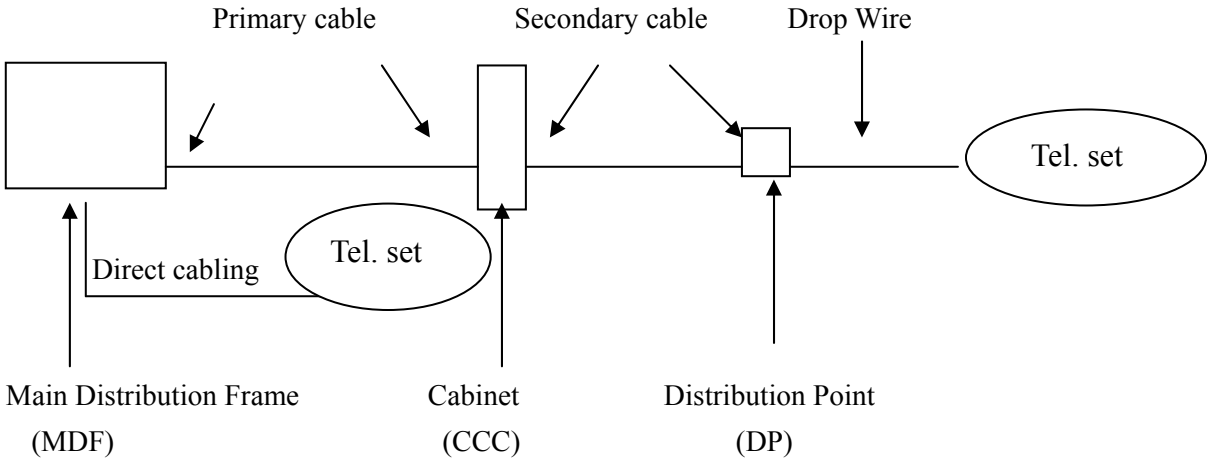

Figure 3.1.4 Distribution Method

b) Subscriber lines are metallic cables, with the primary cables being laid under ground in ducts or direct buried, while the secondary cables are either direct buried or aerial cables. Obsolete paper-insulated lead sheathed cables are still used for underground cables, which is causing faults in rainy seasons. However, PE insulated jerry filled cables are used recently. PE insulated cables are also used as aerial cables.

c) Telephone poles

Wooden poles are being used as telephone poles. Standard height is 8.0m, and standard span is 45m. However, some poles are small at top end and have insufficient strength.

d) Cabinet, distribution point, and subscriber protection unit

- Cabinet cases are made of steel plates and manufactured locally. Inadequate rust proofing of these cases results in deterioration of the lower portions of them. Though the terminals mounted on the board are imported items, these are not filled with moisture proofing additives.

- There are two types of distribution point, one for outdoors and the other for indoors. The outdoor type whose outer case is a locally manufactured plastic uses imported terminals that are not filled with moisture proof compound. Outer case cover of some distribution points are

left off. Spare covers are not prepared.

- The indoor type is a locally manufactured wooden case with an imported terminal board.
- No subscriber protection unit is used, and many telephone units are being connected directly with drop wires. Table 3.1.4 shows conditions of outside plant facilities of Bahir Dar.

Table 3.1.4 Conditions of Outside Plant Facilities of Bahir Dar

Exchange Name	Tel. Region	Fixed Network	Cross Connection Cabinet		
			CCC No.	Primary	Secondary
Bahir Dar	NWR	2,400			
			1	600	700
			2	500	700
			3	600	700
			4	1000	1300
			5	500	700
			6	500	700
			7	500	700
			8	300	600
			9	600	700
			10	500	600
			11	400	700
			12	500	700
			13	600	700
			14	600	700
Sub total		2,400	14	7,700	10,200
Woreta	NWR	600			
Merawi	NWR				
Sub total		600			
Total		3,000	14	7,700	10,200

2) Current Status of Civil Works

Existing manholes have no metal fixtures to support cables and joint closures. While these provide larger space for cabling compared with the number of ducts, these are being used for numerous other purposes, often with the directly buried cables running in the center of the manhole.

Ducts have inner diameter of 100mm, and are made of concrete with multiple holes (2 holes, 4 holes). There are occasions where dirt enters inside the duct through the duct joints, resulting in clogging. Thus such ducts cannot be used even if they are empty. For this reason, only directly buried cables are planned for use in the design stage of the eighth 5-year plan. While it has been mentioned that PVC ducts are now in use, no such ducts existence could be verified during our inspections in the F/S applicable regions.