- Digitalization of telephone networks is a trend in world telecommunications systems, and the introduction of digital exchanges will contribute to functional improvements and economical operations of the networks in the future.

- The Government of Burma has already installed digital exchanges for practical exercises in the training center to meet the needs of the times, and is now developing the necessary personnel to cope with future digitalization of telephone service networks.

3.3.3 Service Area and Equipment Capacity

Service Area : within a 15 km
In a conventional design of a telephone service network, the line distance between the exchange office and the most remote subscriber is limited to about 15 km. So, if the telephone service area were to be set over an entire township, a conventional system design would be unable to cover subscribers living on the remote outskirts of the township because the township usually expands more than 15-20 km from the central town. That is why introduction of special systems such as RCS and MAS (see Note) are necessary. In the Project, however, each service area need not cover the entire township since most existing subscribers and subscriber applicants presently known live within 15 km radius from each exchange office.
Therefore, we conclude that the service areas for each township under the Project will be limited to within a 15 km radius from exchange offices and can be covered with ordinary system designs.

Equipment Capacity : 3 years from the commencement of service.
Regarding the equipment to be introduced, all equipment and facilities will be so designed that the equipment to be installed in the initial stage does not cause an overinvestment and has sufficient capacity to meet future increases in demand for telephone service without causing a "standstill" (equipment capacity full state).

In other words, the equipment will be designed to have sufficient capacity to cover the potential increase in demand for at least 3 years from the commencement of service in consideration of the duration during which installation of additional equipment and facilities would be practically difficult.

(Note) RCS: Remote Control System
MAS: Multiple Access System

3.3.4 Required Facilities

Basic facilities for the project will consist of various equipment and materials. The scope of work to be implemented by the Japanese side and to be undertaken by the Burmese side is as follows.

- Exchange facilities

Japanese side	Exchange equipment and manual boards
Burmese side	Sites, foundation beds for container type exchange equipment, and buildings

- Outside plant

Japanese side	Cables, poles, stays, cabinets, terminal boxes, drop wires protectors, and so forth.
Burmese side	Blocks for stays, foundation beds, and the concrete, gravel, sand, and so forth necessary for installation work

- Toll transmission facilities

Japanese side	Tie cables, toll cables, UHF radio equipment, antennas, VDF, and carrier terminal equipment for UHF systems
Burmese side	Carrier terminal equipment for microwave systems

- Power equipment

Japanese side	Power transformers for high-tension power reception, AVR and engine generators for emergency use, day tanks, underground fuel tanks, rectifiers, batteries, power distribution boards, and so forth
Burmese side	Lead-in work for commercial power, foundation beds for container type power equipment and installation work for underground fuel tank

- Premises equipment

Burmese side	Telephone sets

3.4 Outline of The Project

3.4.1 Implementation Organization and Operational System

The Ministry of Transport and Communications is in control of telecommunications in Burma and the Posts and Telecommunications Corporation (PTC) carries out the business operations.

PTC is to carry out the Project under the guidance of the Ministry of Transport and Communications. To achieve smooth implementation of the Project, PTC will appoint a project manager. He will handle all business concerning the promotion of the Project such as planning, managing of technical matters, control of installation work, and so forth.

3.4.2 Telephone Demand, Telephone Traffic, and Number of Circuits

(1) Telephone demand

The estimated demand for telephone subscription in each district covered by the Project was calculated by the following equation which is usually used for demand forecasts considering the number of households, the rate of increase in population, and the propagation ratio of telephones in the local exchange area of each selected township according to the results of the examination of the contents of the request.

$$Dt = Nt \times Pt$$

Where, Dt: Number of telephones in demand after t years

$$Nt = No \times (1 + C)^{t}$$

Where, Nt: Number of households after t years
No: Initial number of households (in 1986)
C: Constant of increase in households

The rate of increase of households in the local exchange area of each township is necessary for the calculation, but no data was available. So, the average (1.99%) of annual population increase in Burma in recent years was applied here because of its similarity to the rate of growth in the number of households.

$$Pt = Po \times (1 + G)^{t}$$

Where, Pt: Telephone propagation ratio to the number of social units after t years
Po: Initial propagation ratio
G: Constant (0.075) of increase of telephone propagation ratio

The national average annual increase in the propagation ratio of telephones (7.5%) was applied as the increment of propagation ratio of telephones. Where the propagation ratio of telephones is relatively low, its increase is closely related to the increase in equipment investment, and it coincides with the average growth rate (7.5%) of GDP in the telecommunications field in Burma.

Table 3.5 and Table 3.6 list the values related to the demand forecasts for the eight selected townships and the estimated demand for telephone subscriptions in the same townships respectively.

Table 3.5 Estimated Value Concerned with Demand Forecasts for Eight Target Townships

Township	Population in Each Local Exchange Area	Number of houses in Each Local Exchange Area	Population Growth Rate (%)	Telephone Demand
Myaungmya	75,367	15,741	1.99	565
Minbu	36,180	6,392	1.99	414
Thayetmo	54,995	9,963	1.99	299
Yenangyaung	75,320	14,158	1.99	582
Tharrawaddy	51,013	10,717	1.99	190
Maubin	40,194	7,959	1.99	233
Thaton	63,319	12,528	1.99	533
Myede	40,650	8,001	1.99	395

Table 3.6 Forecast of Telephone Demand in Eight Target Townships

Township	Value of Telephone Demands													
	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	.....	2000	.....	2010
Myaungmya	565	595	625	655	695	735	775	825	875	925	.....	1,325	.....	2,915
Minbu	414	418	428	438	448	458	468	478	498	508	.....	618	.....	1,028
Thayetmyo	299	310	310	320	330	340	350	360	370	390	.....	480	.....	860
Yenangyaung	582	590	600	610	630	640	660	670	690	710	.....	850	.....	1,410
Tharrawaddy	190	203	203	213	233	243	253	273	283	303	.....	423	.....	893
Maubin	233	248	268	288	308	328	358	378	408	448	.....	668	.....	1,568
Thaton	533	548	558	568	588	598	618	638	658	678	.....	838	.....	1,468
Myede	395	400	410	420	430	440	450	460	480	490	.....	590	.....	1,000

(2) Telephone traffic and number of circuits

Traffic forecasts show the traffic volume to be transmitted among 37 townships and calculates the necessary number of circuits to conduct the traffic. The 37 townships included the 8 townships of the Project and 24 townships whose exchanges were already automated (Rangoon has a total of ten automatic exchange offices including one under construction, but they are counted as one township) and 5 other townships (Myanaung, Mergui, Tavoy, Swebo and Haka) for which automization is scheduled under another program.

Figure 3.6 shows the network configuration covering these 37 townships.

The traffic was calculated by the following equation world-wide used for such matters:

According to the results of study into the contents of the request, we decided to forecast the traffic and calculate the number of circuits for the year 1993 when service to every exchange office is supposed to be inaugurated.

The traffic forecasting procedure is as follows:

- The Total Number of Originating Calls and The Growth Rate of Traffic -

(i) The total number of originating calls

This is the actually surveyed originating calling rate multiplied by the number of subscribers in the basic year.

(ii) The total number of originating calls in 1993

This is estimated by the following formula from the number of calls in 1986.

$$Di\ (t) = Di\ (1986) \times \left(\frac{Si\ (t)}{Si\ (1986)} \right)^{0.7}$$

Where, Di: the total number of originating calls in exchange i (in the year t)

Di (1986): the total number of originating calls in exchange i (in 1986)

Si (t): the number of subscriber lines in exchange i (in the year t)

Si (1986): the number of subscriber lines in exchange i (in 1986)

(iii) The growth rate of traffic caused by the policy for promotion of STD

This is estimated at the time of improvement of the service system as follows.

Delay service	Manual nondelay service	1.45
Manual nondelay	Subscriber trunk dialing service	1.40
Delay service	Subscriber trunk dialing service	2.03

- Interexchange Traffic Matrix

(i) Estimation method

Traffic matrix of the interexchange traffic Tij in the basic fiscal year between the outgoing (i) and incoming (j) exchanges is obtained using a Gravity Model.

$$Tij = \frac{Cij\ Di \cdot Dj}{\sum_{j=1}^{n} Cij \cdot Dj}, \qquad Cij = \frac{1}{(dij)^{\alpha}}$$

where, Di.Dj: Total outgoing traffic from exchange i or j.

dij: Distance between exchange i and exchange j

α : Coefficients

(ii) Growth rate of traffic

1) The total amount of originating traffic

$$yi\ (t_0 \longrightarrow t_1) = Dt\ (t_1)/Di\ (t_0)$$

where yi: growth rate of originating traffic in exchange i

t_0: basic year

t_1: year to be estimated

Ti: the total amount of originating traffic in exchange i

2) Interexchange traffic

$$yij = \sqrt{yi \cdot yj}$$

where, yij: growth rate of traffic between exchange i and exchange j.

(iii) Traffic in the year to be estimated

$$Tij(t) = Tij(t_0) \cdot yij\ (t_0 \longrightarrow t_1)$$

where, $Tij\ (t_1)$: interexchange traffic between exchange i and exchange j in the year to be estimated.

$Tij\ (t_0)$: interexchange traffic between exchange i and exchange j in the basic year

(iv) Estimation of traffic concerning newly established exchange offices

The traffic between new local exchange offices that did not exist in the initial stage is to be estimated with the gravity model by proportioning the estimated number of subscribers for the new exchange offices to that of subscribers accommodated in the old exchange offices which formerly covered the areas according to the similarities observed between the two offices and by using the Cij concerning the old office.

The traffic to be interchanged at the end of 1993 for the eight exchange offices (towships) covered by the Project is estimated as shown in Figure 3.7.

Figure 3.8 shows the numbers of toll transit circuits calculated from the nondelay full availability trunk-group loads table (Table 3.7.), which is applied for calculating interexchange traffic and the usual number of circuits.

Appendix XI and XII shows the result of the traffic Matrix among the 37 townships and the calculated number of toll circuits.

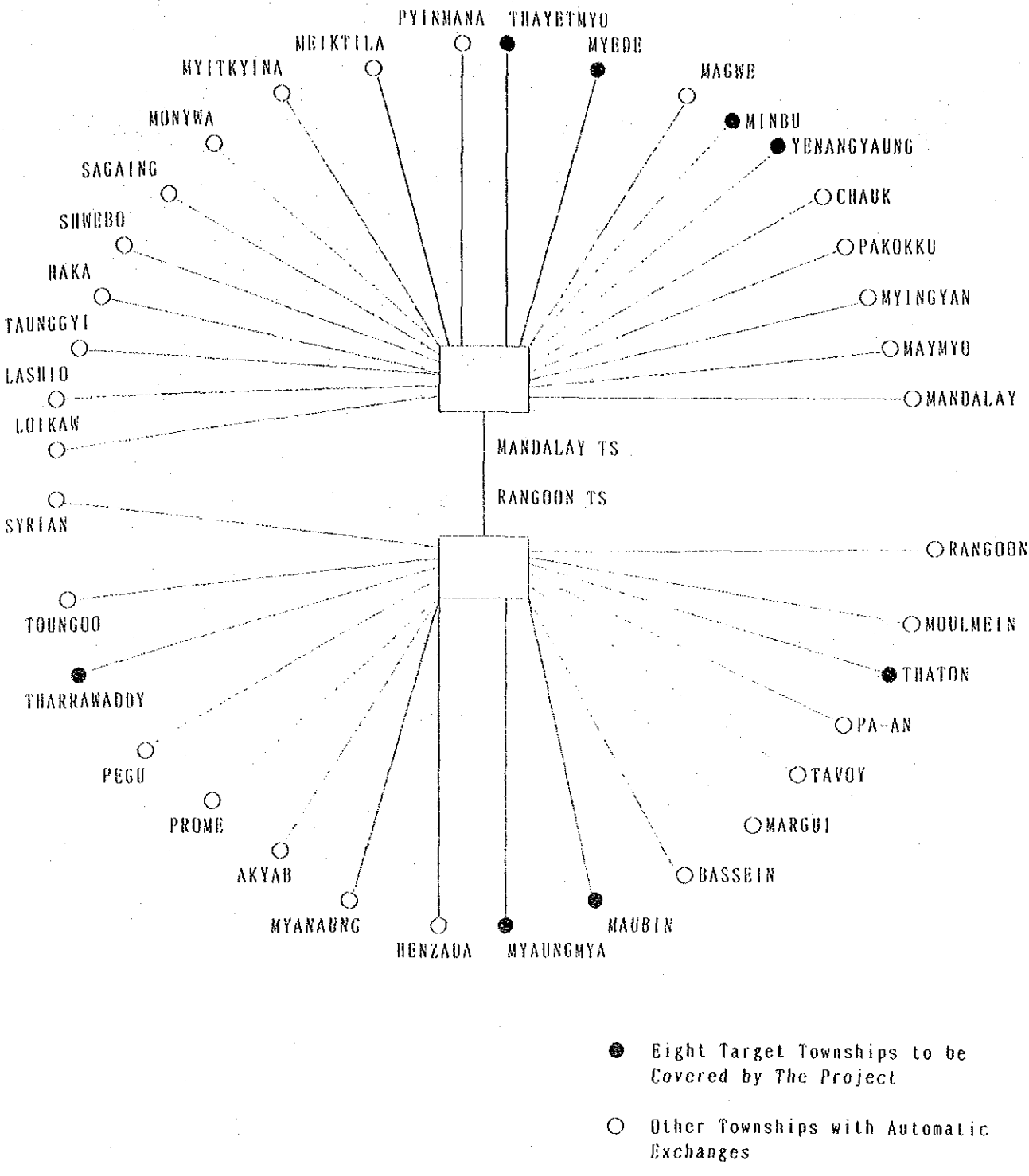
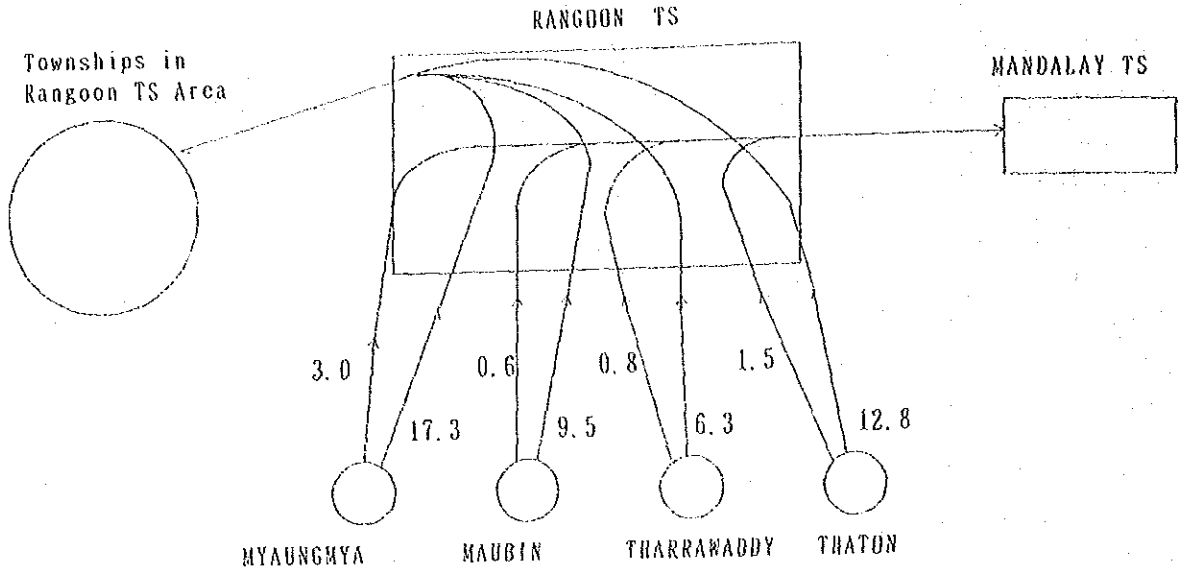
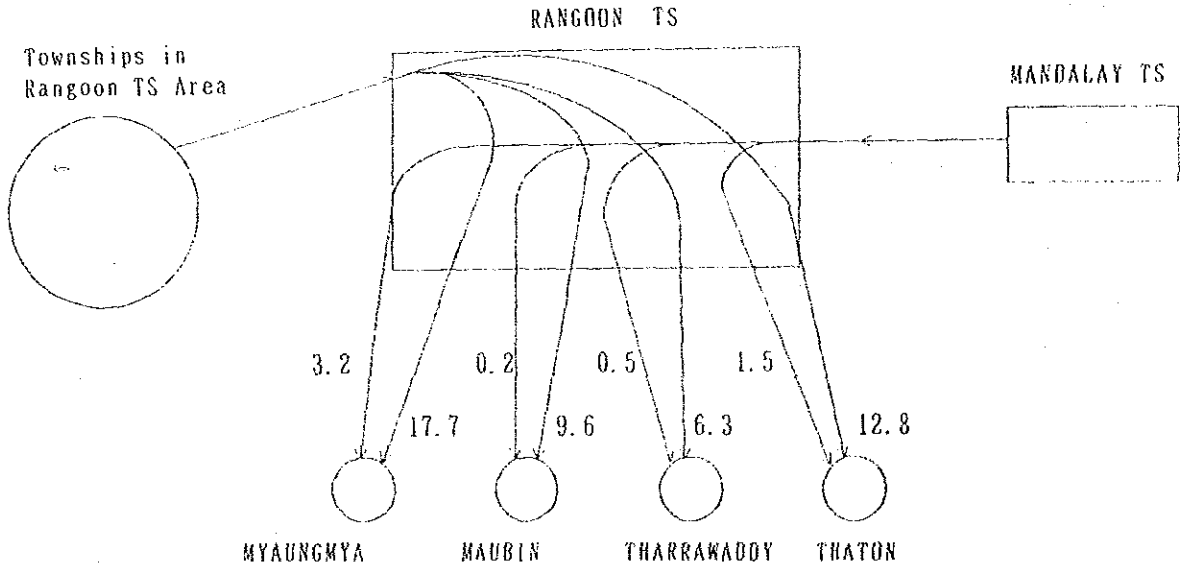


Fig. 3.6 Network Configuration (at year end of 1993)

(Originating call)



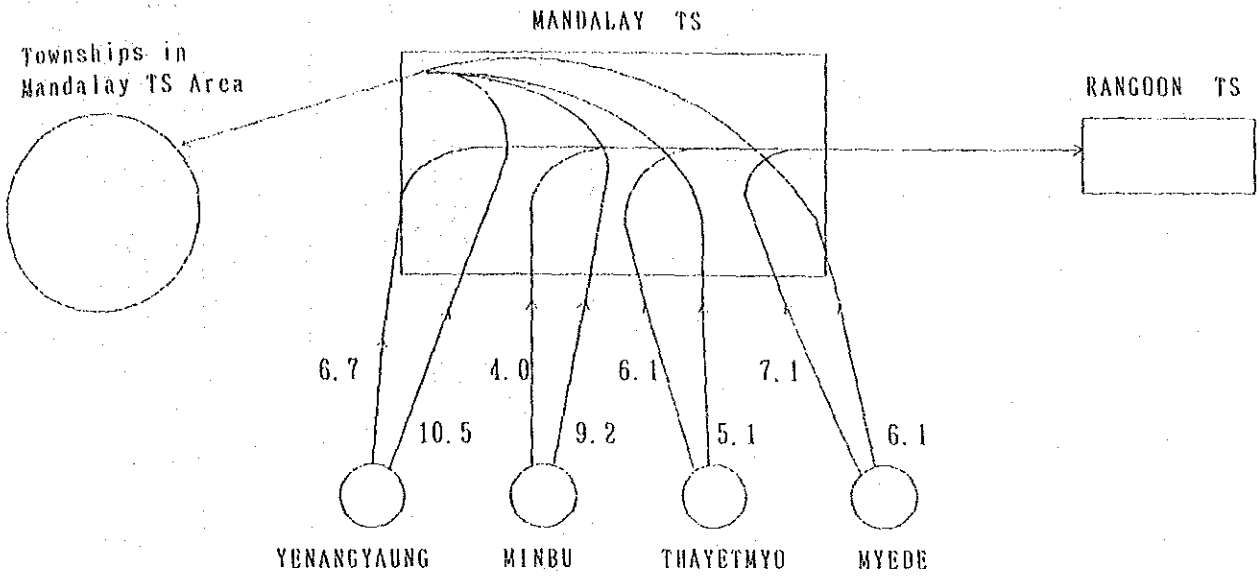
(Terminating call)



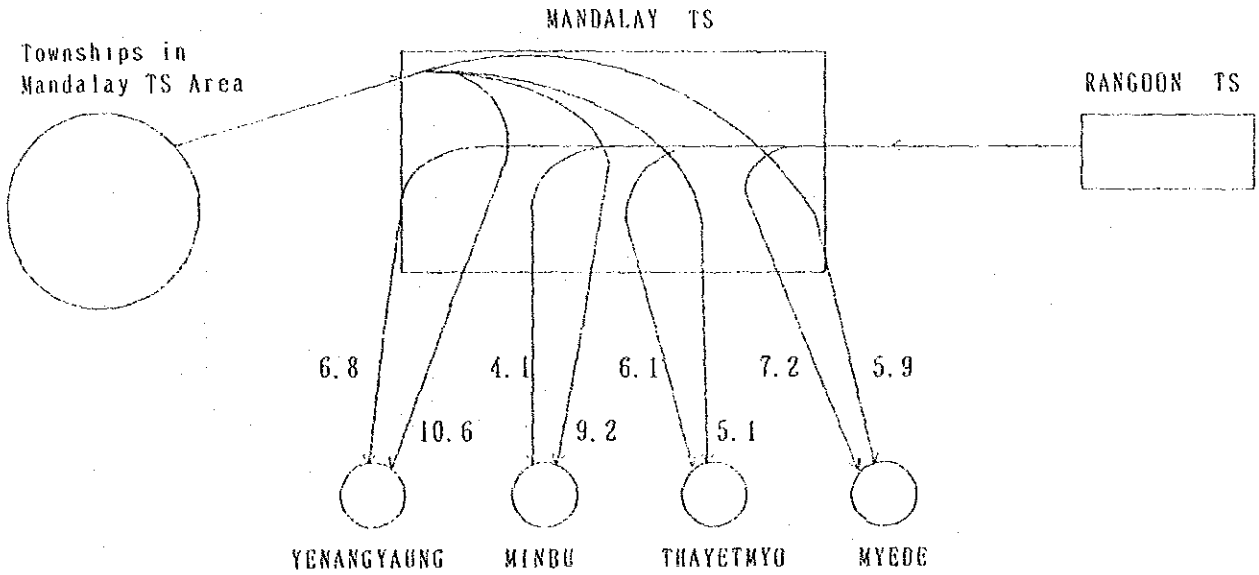
(Unit ; Balang)

Fig. 3.7 (1/2) Traffic Estimation (at year end of 1993)
(concerning 4 townships in the Rangoon TS Area)

(Originating call)



(Terminating call)



(Unit ; Ealang)

Fig. 3.7 (2/2) Traffic Estimation (at year end of 1993)
(concerning 4 townships in the Mandalay TS Area)

Table 3.7 Nondelay Full Availability Trunk-Group Loads Table

(Probability of loss : 0.01)

Number of Circuits	Traffic	Number of Circuits	Traffic
1	0.01erlang	46	34.32erlang
2	0.15	47	35.21
3	0.46	48	36.11
4	0.87	49	37.00
5	1.36	50	37.90
6	1.91	51	38.80
7	2.50	52	39.70
8	3.13	53	40.60
9	3.78	54	41.50
10	4.46	55	42.41
11	5.16	56	43.31
12	5.88	57	44.22
13	6.61	58	45.13
14	7.35	59	46.04
15	8.11	60	46.95
16	8.88	61	47.86
17	9.65	62	48.77
18	10.44	63	49.69
19	11.23	64	50.60
20	12.03	65	51.52
21	12.84	66	52.44
22	13.65	67	53.35
23	14.47	68	54.27
24	15.30	69	55.19
25	16.12	70	56.11
26	16.96	71	57.03
27	17.80	72	57.96
28	18.64	73	58.88
29	19.49	74	59.80
30	20.34	75	60.73
31	21.19	76	61.65
32	22.05	77	62.58
33	22.91	78	63.51
34	23.77	79	64.43
35	24.64	80	65.36
36	25.51	81	66.29
37	26.38	82	67.22
38	27.25	83	68.15
39	28.13	84	69.08
40	29.01	85	70.02
41	29.89	86	70.95
42	30.77	87	71.88
43	31.66	88	72.82
44	32.54	89	73.75
45	33.43	90	74.68

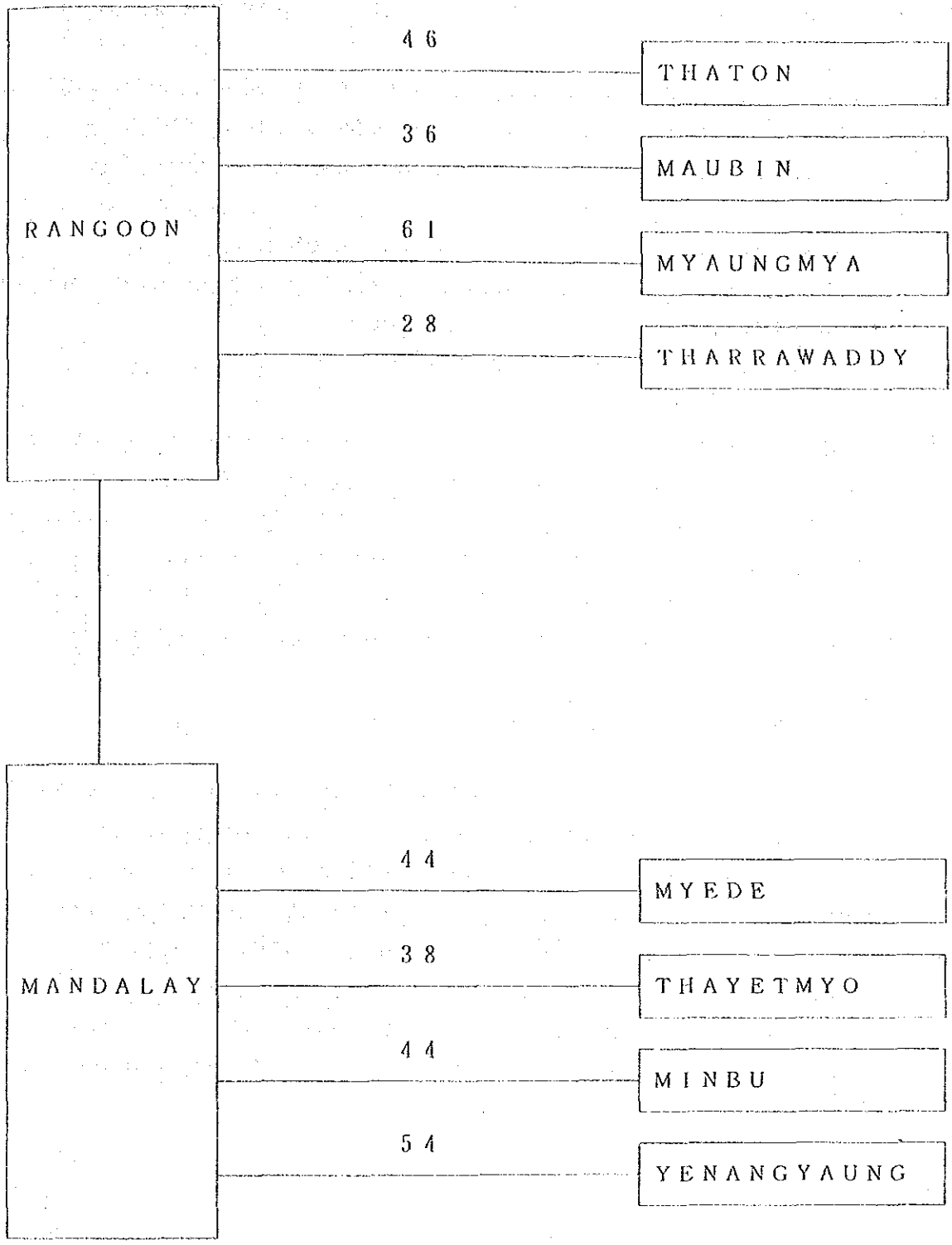


Fig. 3.8 Number of Toll Circuits for Eight Townships

3.4.3 Positions and Circumstances of Project Sites

The eight townships to be covered by the Project belong to the following provincial administrative divisions. Their geographical positions in Burma are shown in Figure 3.9.

IRRAWADDY DIVISION	Myaungmya, Maubin
MAGWE DIVISION	Minbu, Thayetmyo, Myede, Yenangyaung
PEGU DIVISION	Tharrawaddy
MON STATE	Thaton

The respective town maps of the above eight townships are shown in Appendix IX. As stated later, container type digital exchanges are scheduled to be introduced for the development of telephone networks in the eight townships, and the study team closely examined the installation sites. The sites of the new exchange offices and their circumstances are as follows:

- Myaungmya

  The present manual exchange is housed in the same office building as the microwave station. The present site, almost fully occupied by the business office, the antenna tower and quarters, has no space for the new exchange office. Therefore, the new exchange office will be constructed about 500 m east of the present office building. The new site faces the main street of the town, and a power cable runs near the site. It is a good site for the new exchange office.

- Minbu

  The present manual exchange is at the same site as the UHF station. The site is too small to install a new exchange. Therefore, the new exchange office will be constructed about 700 m northwest of the present office building. The new site is adjacent to the Township People's Council office and closer to the town center than the present office. This is a good site for the new exchange office.

- Thayetmyo

The present manual exchange is about 500 m southeast of the UHF station. The site is too small for installation of a new exchange. Therefore, the new exchange office will be constructed at the site of the UHF station. This UHF station site is large enough and the conditions of the location are excellent. There is no problem with this site.

- Yenangyaung

The present manual exchange is located about 2 km west of the microwave station. The site is large enough. This site is in the center of the town, and the new exchange office will be constructed in an open area of the site.

- Tharrawaddy

The present manual exchange is about 200 m north of the microwave station. The site is too small for installation of a new exchange. Therefore, the new exchange office will be constructed at the microwave station site in an open area adjacent to it. Since the microwave station site is not large enough to offer sufficient space for the new exchange office, the construction site must be expanded to the neighboring open area. This open area lies in front of the Township People's Council office and the conditions of the location are excellent.

- Maubin

The present manual exchange is accommodated on the same site as the UHF station. The site, almost fully occupied by the office, the antenna tower and the quarters, has no space for the new exchange office. Therefore, the new exchange office will be constructed about 500 m southwest of the present exchange office. The new site is adjacent to the Township People's Council office near the market area, and the conditions of the location are excellent.

- Thaton

  The present manual exchange is about 3.5 km southwest of the microwave station. The site is too small for installation of a new exchange. Therefore, the new exchange office will be constructed about 500 m southeast of the present exchange office. The new site is in a large estate owned by the PTC. The post office and the telegraph office are also in that estate. The conditions of the location are excellent because the site is close to the town center and a power cable runs near the site.

- Myede

  The present manual exchange is about 1.2 km northwest of the microwave station. The site is rather narrow and lies on low land along the Irrawaddy River. Therefore, the new exchange office will be constructed, about 400 m east of the present exchange office. The new site is a large estate owned by the PTC and lies on high land about 600 m from the Irrawaddy River. It is close to the town center and the conditions of the location are excellent.

(See in Appendix IX for the relative locations of the present manual exchange office, the new exchange office, the microwave station, and the UHF station in each town.)

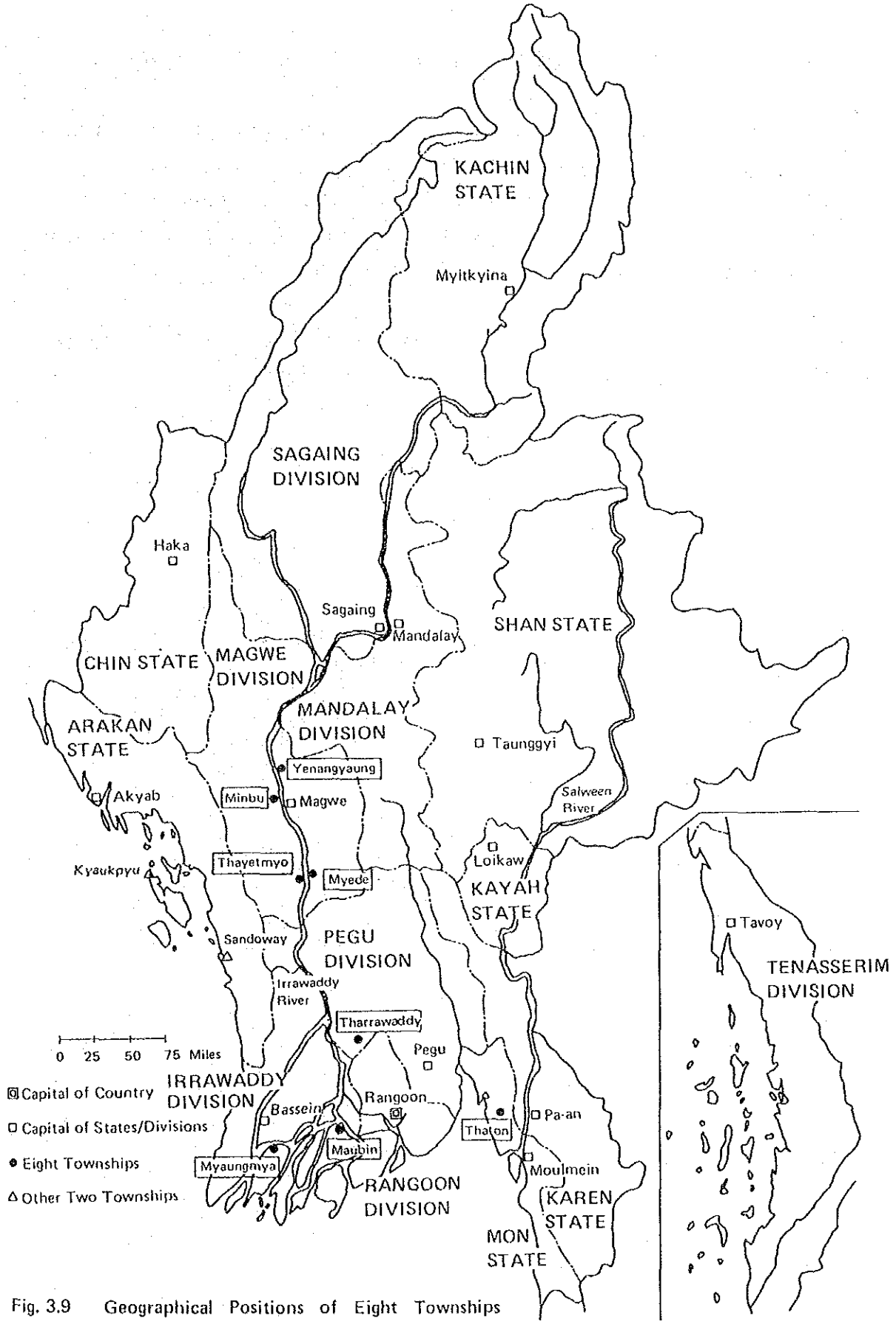


Fig. 3.9 Geographical Positions of Eight Townships to be Covered by The Project

3.4.4 Outline of Equipment, Facilities, and Materials

In the Project, exchange facilities, power equipment, outside plant, and toll transmission facilities will be newly introduced for the development of telephone networks in the selected eight townships. Table 3.8 outlines the equipment, facilities, materials, and so forth necessary for the Project.

Table 3.9 lists the necessary equipment, materials, and so forth to be supplied by Burma for the Project.

Table 3. 8 Outline of The Project —The Project for Telephone Network Development in Eight Townships in The Socialist Republic of The Union of Burma

Item / Township	Basic Data					Basic Design													
	Population in Local Exchange Area (Unit:1000)	Data on Existing Telephone Service			Situation of Commercial Power Supply	Exchange and Power Facilities				Outside Plant						Toll Transmission Facilities			
		Exchange System	Number of Subscribers	Number of Applicants		Type of Exchange	No. of subscriber terminals accommodated by exchange	Power Equipment	Manual Board (set)	Underground Cable (Km)	Aerial Cable (Km)	Underwater Cable (Km)	Pole	Vehicle for Construction Work	Training Material	UHF Radio Equipment	Carrier Terminal Equipment	Tie or Toll Cable	Power Equipment
① Myaungmya	75.4	Manual Common-battery Exchange	290	275	24 hour Service	One container type digital automatic exchange	900	One Container Type Power Equipment	1	2.9 (*)	23.3	0.4	583	(1)	(1)			Toll Cable (0.5 Km)	AVR, Battery, and Control Board
② Minbu	36.2	Manual Magneto Exchange	76	338	24 hour Service	One container type digital automatic exchange	500	One Container Type Power Equipment	1	15.5 (*)	25.6	0	640	(1)	(1)	1 SYS	44 CH (Opposite Magwe)	Toll Cable (0.7 Km)	
③ Thayetmyo	55.0	Manual Magneto Exchange	69	230	24 hour Service	One container type digital automatic exchange	400	One Container Type Power Equipment	1	1.2	18.4	0	460	(1)	(1)	1 SYS	38 CH (Opposite Myede)	Tie Cable 30 m	
④ Yenangyaung	75.3	Manual Magneto Exchange	102	480	24 hour Service	One container type digital automatic exchange	700	One Container Type Power Equipment	1	6.9 (*)	17.0	0	427	(1)	(1)			Toll Cable (2.0 Km)	
⑤ Tharrawaddy	51.0	Manual Magneto Exchange	87	103	24 hour Service	One container type digital automatic exchange	300	One Container Type Power Equipment	1	4.4	27.6	0	700	(1)	(1)			Tie Cable 40 m	
⑥ Maubin	40.2	Manual Magneto Exchange	165	68	24 hour Service	One container type digital automatic exchange	400	One Container Type Power Equipment	1	3.6 (*)	25.3	0.6	640	(1)	(1)			Toll Cable (0.5 Km)	
⑦ Thaton	63.3	Manual Magneto Exchange	115	418	24 hour Service	One container type digital automatic exchange	700	One Container Type Power Equipment	1	1.7	26.1 (*)	0	550	(1)	(1)			Toll Cable (4.0 Km)	AVR, and Control Board
⑧ Myede	40.7	Manual Magneto Exchange	75	320	24 hour Service	One container type digital automatic exchange	500	One Container Type Power Equipment	1	4.0 (*)	15.5	0	390	(1)	(1)			Toll Cable (0.8 Km)	AVR, and Control Board
Total							4,400			40.2	178.8	1.0	4,390	1	1				
Remarks	Surveyed at the end of 1986		Surveyed in February and March, 1987.		Commercial power supply in all the Townships is often disturbed by voltage drops and power failures.	Digital Switching Unit, LAMA Unit, MDF, Control Board, and so forth		Emergency Engine Generator, Transformer, AVR, Rectifier, Battery, Power Distribution Board, and so forth.		(*) Including Toll Cables				Centralized Supply	Centralized Supply	Digital 60 CH	Digital	Toll cables to be specified again.	
(Note) The circled Nos. ①–⑧ denote the order of priority.																			

(Note) The exchange facilities, power equipment, outside plant and transmission facilities listed above include necessary equipment, facilities, materials for installation and maintenance, spare parts, and so forth.

Table 3.9 List of Equipment, Facilities, Materials, and so forth to be supplied by Burma

Township	Exchange Office Site	Commercial Power Lead-in	Foundation Bed Placing	Construction of Manual Board Office Building	Materials for Outside Plant Work	Procurement of Telephone Sets	Carrier Terminal Equipment for Microwave Link
Myaungmya	Acquisition of New Site	High-tension Power Lead-in to Exchange Office	Bed for Container×2 and Bed for Transformer ×1	Concrete Office Building×1	Blocks for Stays, Cabinet Beds, Concrete, Sand, Gravel, and so forth.	622 sets	61 circuits
Ninbu	Acquisition of New Site	High-tension Power Lead-in to Exchange Office	Bed for Container×2 and Bed for Transformer ×1	Concrete Office Building×1	Blocks for Stays, Cabinet Beds, Concrete, Sand, Gravel, and so forth.	456 sets	—
(Nagwe)	—	—	—	—	—	—	44 circuits
Thayetmyo	at UHF Station Site	High-tension Power Lead-in to Exchange Office	Bed for Container×2 and Bed for Transformer ×1	Concrete Office Building×1	Blocks for Stays, Cabinet Beds, Concrete, Sand, Gravel, and so forth.	329 sets	—
(Kyedo)	—	—	—	—	—	—	38 circuits
Yenangyaung	Present Manual Exchange Office Site	High-tension Power Lead-in to Exchange Office	Bed for Container×2 and Bed for Transformer ×1	Concrete Office Building×1	Blocks for Stays, Cabinet Beds, Concrete, Sand, Gravel, and so forth.	641 sets	54 circuits
Tharrawaddy	Acquisition of New Site Adjacent to Microwave	High-tension Power Lead-in to Exchange Office	Bed for Container×2 and Bed for Transformer ×1	Concrete Office Building×1	Blocks for Stays, Cabinet Beds, Concrete, Sand, Gravel, and so forth.	209 sets	28 circuits
Naubin	Acquisition of New Site Adjacent to Microwave	High-tension Power Lead-in to Exchange Office	Bed for Container×2 and Bed for Transformer ×1	Concrete Office Building×1	Blocks for Stays, Cabinet Beds, Concrete, Sand, Gravel, and so forth.	257 sets	36 circuits
Thaton	In the Estate Owned by PTC	High-tension Power Lead-in to Exchange Office	Bed for Container×2 and Bed for Transformer ×1	Concrete Office Building×1	Blocks for Stays, Cabinet Beds, Concrete, Sand, Gravel, and so forth.	587 sets	46 circuits
Kyedo	In the Estate Owned by PTC	High-tension Power Lead-in to Exchange Office and Low-tension Power Lead-in to Microwave Station	Bed for Container×2 and Bed for Transformer ×1	Concrete Office Building×1	Blocks for Stays, Cabinet Beds, Concrete, Sand, Gravel, and so forth.	435 sets	44 circuits
Total			Bed for Container×16 and Bed for Transformer ×8	Concrete Office Building×8		3536sets	351 circuits

(Note 1) The number of telephone sets to be procured for each exchange office is calculated as (the number of subscribers + the number of waiting subscriber applicants) × 1.1

(Note 2) Additional installation of carrier terminal equipment for microwave links is planned in another project for the new development of an entire microwave network.

3.4.5 Management and Personnel Plan

The digital exchanges and manual boards to be introduced through the Project are supposed to be operated and maintained on a 24-hour basis. The number of personnel required in each office is estimated as follows.

Digital exchange	Communications engineer	1
	Junior engineer	1
	Technicians (including a technician for power supply)	2 or 3
Operators		3 or 4
Lines	Junior engineer	1
	Technicians	4 or 5
	Total	12-15

Since the scale of the transmission facilities to be introduced is relatively small, the existing maintenance system will adequately cover necessities.

3.5 Technical Cooperation

Upon execution of the Project, engineers must be trained in the new techniques and in the management of efficient and precise construction work. The Government of Burma is hoping Japan to provide the following training on a government to government basis:

Burmese engineers to be trained in Japan

Exchange engineer	1 person, 3 months
Outside plant engineer	1 person, 3 months
Transmission engineer	1 person, 3 months

With the implementation of this technical cooperation as planned, equipment and material to be provided this time will be used more effectively.

CHAPTER 4 BASIC DESIGN

CHAPTER 4 BASIC DESIGN

4.1 Design Policy

The planning and design policies for each type of facility involved in the Project are as follows.

In addition, the total length of time required for the planning of these various facilities, (the total number of extra years for equipment volume as predicted at the time service is initiated) has been set at three years.

- From the standpoint of efficient equipment investment, objectives are to safeguard against excessive equipment investment which leads to a situation where there is idle equipment and to avoid the necessity for repetitive, short-term construction projects.

- With an increase in demand, after coming to a "standstill", a minimum of one year will be required for equipment planning activities and budget measures to be carried out by the administrative organization. In addition, after obtaining a budget, a minimum of two years will be required for the procurement of necessary materials and for the completion of construction work. Therefore, a minimum of three years will be required after coming to a "standstill" and until the next new installations are completed.

- Measures must be taken to prevent the occurance of delayed applicants due to a lack of facilities during the period between the "standstill" and the completion of new facilities. Delayed applicants refer to subscriber applicants who cannot be accommodated due to a shortage of equipment.

- Concerning the total length of time required for planning, the average in Japan is between three and ten years and the average in foreign countries is between three and fifteen years, with the majority of other comparable projects taking from three to five years. However, in view of the slow growth in demand for telephone service in Burma, it is predicted that three years will be sufficient.

4.1.1 Exchange Facilities

(1) Concerning the automatic exchanges in the Project, based on the results of a comparison between digital and analog types as shown in Table 4.1-1 and the results of the requirement studies given in item 3.3, it has been decided that digital exchanges are to be used.

(2) As for the type of exchange facilities in the Project, based on the demand estimates and the results of a comparison made between container and intra-office installed types as shown in Table 4.1-2, it has been decided to use container type exchange facilities.

(3) As for the number of subscriber terminals to be used, considering the period of time between "standstill" and installation of new facilities designing will be based on a 3-year period after the beginning of service. Exchanges will be installed in minimum units of 100 terminals to allow for expansion by package. The capacity of a common control unit for an exchange will be matched to the minimum capacity of the container type.

(4) Manual boards having an interface compatible with the digital exchanges and with the following functions must be installed together with automatic exchanges in the eight townships.

- Reception and connection of toll calls on a delay basis to the destination exchange office lacking toll circuits

- Directory assistance services

- Manual toll call connection services (similar to the dial 100 service in Japan) for charge checking and semi-automatic connections

Table 4.1-1 Comparison between Digital and Analogue Type Exchanges

Particulars	Digital Exchange	Analogue Exchange
Installation Space	(1/3 Space of That Required by Analogue Type) ○	(Limited Possibilities for Reduction in Size) △
Facility Economy	(Mass Production) ○	(By Special Order) △
Message Quality	(No Inclusion of Noise) ○	(Inclusion of Noise) △
Rate of Difficulty in Production	(Standard Specifications) ○	(By Special Order) △
World-wide Trends	(Leading Facility Now in Use) ○	(Limited to Partial Extention Use) △
Economy of Future Network	(No Need for A-D Conversion) ○	(A-D Conversion Required) △
Formation of Integrated Service Network	(Ease in Formation of Non-Telephone Type Service) ○	(Difficulty in Formation of Non-Telephone Type Service
Study Results	◎	△

Table 4.1-2 Comparison between Container Type and Exchange Office Installed Type Exchange

Particulars	Container Type	Exchange Office Installed Type
Need for Exchange Office Building	(No Needed for Exchange Office Building) ○	(Exchange Office Building Necessary) △
Site Area Required	(Small) ○	(Large) △
Construction Considerations	(Only Needed for Installation of Container) ○	(Needed For Basic Foundation Work in Machine Room etc.) △
Reduction in Length of Time Required for Installation Work	(Good) ○	(Limited) △
Air Conditioning Capacity	(Small) ○	(Large) △
Overall Economy Factors	(Low Installation and Office Costs) ○	(Relatively High Costs Due to Need for Exchange Office Buildings) △
Inland Transport in Burma	(Relatively Difficult due to Large Size of Equipment) △	(With possibility of assembly, Transport is made easier) ○
Study Results	○	△

4.1.2 Power Equipment

(1) The power failure rates in each of the eight townships designated for the Project are as shown in Table 4.1-3. Considering that the frequency of power failures in all of the eight townships is extremely high and the long lasting, emergency engine generators will be installed in every exchange office concerned. Furthermore, considering engine reliability and maintenance factors, those emergency generators will be equipped in dual system and day tanks, and underground fuel tanks will be installed.

(2) Compensation ranges of voltage fluctuation of the power supply facilities are as shown in the following table.

Compensation Range of Power Equipment

Power Equipment	Voltage Fluctuation Compensation Range
Rectifier	207 - 252 V
AVR	170 - 230 V
Engine generator	less than 170 V

NOTE:This table shows an example of the input voltage in single phase.

Because the records (Appendix X) from the eight target townships indicate that the voltage fluctuations exceeded the rectifier input capacity, an AVR must be installed in every exchange office. In the event the voltage drops to 170V or less, the power source must be switched over to the emergency engine generator of Item (1).

(3) According to the commercial power voltage fluctuation records, deterioration in voltage occurs most often between 6:00 pm and 10:00 pm, when general household usage is at its peak. This indicates that the power company lacks transformation capacities under the low-tension power supply.

Since the power consumption of the exchange facilities in the Project is around 50 kW, which is considerable, high voltage power reception will be employed similar to that of other automatic exchange offices in Burma to avoid adversely affecting general consumers and to prevent large scale voltage drops. It is general practice for the power receiving side to arrange for a transformer from high-tension to low-tension, and since the matter is closely related to the technical specification of telephone office facilities, the transformer is to be supplied from Japan.

(4) Since every exchange office is to be equipped with emergency engine generators, the batteries should have a minimum capacity of two hours.

(5) The power equipment for the Project will be of the container type, similar to the exchange facilities, for economy and reduction of installation time. However, power transformer and underground fuel tank will be installed outdoor for functional reason.

Table 4.1-3 Occurrence of Power Failures in the Eight Target Townships

Township	Frequency of Power Failures	Length of Power Failures
Myaungmya	3 ~ 21 Times/Week	2 ~ 4 Hours each time
Minbu	3 ~ 7 Times/Week	1 ~ 3 Hours each time
Thayetmyo	2 ~ 7 Times/Week	1 ~ 3 Hours each time
Yenangyaung	2 ~ 7 Times/Week	1 ~ 3 Hours each time
Tharrawaddy	3 ~ 14 Times/Week	2 ~ 4 Hours each time
Naubin	2 ~ 7 Times/Week	2 ~ 6 Hours each time
Thaton	2 ~ 7 Times/Week	2 ~ 3 Hours each time
Myede	3 ~ 21 Times/Week	1 ~ 4 Hours each time

4.1.3 Outside Plant

(1) Outside plant designing in the Project will be based on a 3-year period after the beginning of telephone service according to the design policy.

(2) The handling of existing outside plant will be as follows.

(a) Cable Lines

- In view of the lack of capacity of existing cables in addition to their being of a small number of pairs (40 pairs or less) and obsolescent, it will be necessary to add new cables for the Project. As for overhead cables, according to PTC policy, only one cable line can be hooked up to telephone poles. Consequently, new cables will cover existing subscribers, applicant subscribers on waiting list and prospective future demand, and existing cables will be removed. Existing underground cables will be abandoned as they are because of obsolescence after ten years or more from the time of installation.

- Regarding the removed cables, PTC shall decide on the future use of cables judged reusable. As there is no PTC standard for determining the usability of old cables, those falling under the following categories will be abandoned, according to Japanese standards:

  * Those cables installed more than six years ago and which are now obsolete

  * Cable pairs 10% or more broken, or having deteriorated insulation

  * Those cables falling short of 50 m per piece

(b) Open Wires

- Open wire is being abandoned in Japan and in projects under Japanese economic cooperation because of the matters of demand and troubles caused. Under the Project, open wires for subscriber's lines will be removed and discarded.

(c) Telephone Poles

- The majority of existing telephone poles are made of wood with spliced type steel pipe poles accounting for 10-20% of the total. As they were not constructed under technical standards for materials and design, many of them are decayed, corroded or broken. Furthermore, as existing outside plants consist of open wire and rubber insulated wire, they cannot guarantee a mechanical strength (200 kg or more) compatible with the cable lines to be used in the Project. As a result, when setting up new cables, it will be necessary to remove existing telephone poles.

- As there are no PTC standards for the handling of removed telephone poles, those poles which have been standing for over six years, corroded or bent or broken, will be abandoned according to Japanese standards.

- Even those poles determined as reusable cannot guarantee sufficient mechanical strength to handle cables and they pose safety problems. Therefore, those poles will be used for drop wire to subscribers.

(3) Judging from the socio-economic activities and population growth in the townships involved, it is thought that there is little likelihood of a sudden surge in demand or a major error in demand estimates. Therefore, no spare cable units will be supplied.

In consideration of distribution losses for cable units, direct wiring methods and cabinet wiring methods, the methods most often world-wide used in telecommunications projects will be used in the Project.

(4) The following tables show the results of comparisons made between various wiring types. Comparisons were made on the basis of such factors as construction costs, term of construction, safety factors involved in construction and maintenance work, the reliability of facilities against mechanical trouble, fire and natural disasters, the capacity to adjust to changes in demand and the saving of manpower and economical maintenance.

Comparison between Underground Lines and Overhead Lines

Conditions		Underground lines		Overhead Lines	Comments
		Conduit Method	Direct Burying Method		
Construction Costs	Primary cable	△	◎	○	Applicable to toll cables as well
	Secondary cable	△	○	◎	
Terms of construction work		△	◎	○	
Construction and maintenance work safety		◎	◎	△	
Reliability of facilities		◎	○	△	In relation to trouble and fire
Ability to adjust to changes in demand		○	△	◎	
Manpower saving and economical maintenance		○	◎	○	

NOTE: ◎, ○ and △ symbols represent order of priority with ◎ symbol indicating the highest level and △ symbol indicating the lowest level.

The applicable standards for wiring style, as determined after studying the comparison results and PTC's policy are shown below.

Applicable Standards for Underground Lines and Overhead Lines

Conditions	Underground Lines		Overhead Lines	Comments
	Conduit Method	Direct Burying Method		
Cable pairs of 200 or less	3	2	1	Usually corresponds to secondary cable pairs number
Sum total of cable pairs is 201 or more and 300 or less	2	1	3	Corresponds to primary and secondary cable pairs number
Sum total of cable pairs is 301 or more	1	2	3	Usually corresponds to primary cable pairs number
Number of lines for overhead cables is more than two	2	1	3	
Toll cables	3	1	2	

NOTE: The number 1, 2 and 3 show the order of priority.

(5) The cables to be used in the Project are as described below.

- Overhead cables: Although it is possible to use both round and self-supporting type (SS type) CCP cables, in consideration of construction costs and workability, SS type, CCP cables will be used.

  NOTE: CCP Cable: Color Coded Polyethylene Cable

- Underground Cables: For prevention of flooding of the cables and manpower saving in maintenance work, JF (Jelly-Filled) cables will be used. They are most widely used in telecommunications projects in the developing countries.

- Underwater Cables: For the same reasons given above, underwater cables will be of the JF type.

(6) In the calculation of materials, it is necessary to allow for at least two meters of extra cable length per cable for extra joining lengths and slack.

(7) Steel pipe poles will be used as a result of comprehensive studies on material costs, durability, ease of construction work, safety, possibilities of procurement in Burma and ease of shipping.

Telephone Pole Type Comparison

Particulars	Type of Telephone Pole		
	Concrete	Steel Pipe	Wood
Material costs (length : 8 m, design weight : 200 kg)	◎	○	○
Durability (in years)	◎	◎	△
Ease of construction and work safety	△	◎	◎
Possibilities of procurement in Burma	×	×	×
Ease of shipping (from Japan to Burma)	△	○	○
Use priority in Burma	3	1	2

NOTE 1: Symbols ◎, ○, △ and × indicate the order of priority.

NOTE 2: Although steel pipes and wooden poles are produced domestically in Burma, there are problems of safety due to the lack of mechanical strength. Anti-corrosion treatment is incomplete, resulting in poor durability, therefore, it is impossible to procure domestically the type of high performance poles required for the Project.
In addition, steel pipe poles were used in the previous economic grant aid projects in Burma.
For the above reasons, domestically produced poles were not used in IDA and other projects either.

4.1.4 Toll Transmission Facilities

(1) The most economical method, which also meets technical conditions, will be used for toll transmission facilities, that link exchange offices and microwave stations.

Conditions	Facilities to be Used
When an exchange office and a microwave station are located on the same site (when cable length is 300 m or less)	Tie cable (see NOTE 1) (SWVP tie or PCM cables)
When an exchange office and a microwave station are located on different sites (when cable length is 300 m or more and 4 km or less)	Toll cables (see NOTE 2) (JF or CCP cables)
When an exchange office and a microwave station are located on different sites (when cable length is 4 km or more)	UHF radio system (see NOTE 3)

NOTE 1: A tie cable is designed for the connection of equipment located in the same site. Although it is cheap, costing roughly one-third the price of toll cables, it is structurally weak and is standardly used only for connecting equipment located in the same site using a cable length of less than 300 m.

NOTE 2: A toll cable is designed for connecting equipment located on different sites and it is structurally strong.
However, price increases with distance, and it is cheaper to use UHF radio systems for distances greater than 4 km.

NOTE 3: UHF radio systems are designed for connecting equipment located on different sites. Price is fixed and does not increase with distance.
The system is cheaper to use for a distance greater than 4 km.

(2) When toll cables are used for toll transmission equipment, direct burying methods will be used according to the design policy for outside plant except for in a mountainous area where direct burying is not applicable.

(3) Of the existing tie cables and toll cables, those installed more than six years ago and having more than 10% breakage and/or deterioration of core wire insulation will be removed.

(4) The two connecting sections designated for UHF radio system in the Project are the Thayetmyo-Myede section for the Thayetmyo exchange office and the Minbu-Magwe section for the Minbu exchange office. Both of those segments are already equipped with 24-channel analog UHF radio systems. However, because of a lack of capacity, the following three countermeasure proposals were considered.

Proposal A Installing, simultaneously, 24-channel analog UHF radio systems

Proposal B Replacing the existing systems with 60-channel analog UHF radio systems

Proposal C Replacing the existing systems with 60-channel digital UHF radio systems

As shown in Table 4.1-4(comparison of proposals), Proposal C is most suited to the needs of the Project, hence the existing systems in those two sections will be replaced with digital UHF radio systems accordingly. The existing systems to be removed will be used elsewhere.

(5) Regarding VDF (Voice Distribution Frame) of the UHF station and microwave station, all of them will be put to use as they have extra terminal boards space.

(6) As a rule, all existing power supply facilties of the UHF station and microwave station will be used. However, new AVR or new storage batteries will be provided in case of beginning to receive commercial power and replacing obsolescent or short capacity equipment.

(7) All designs for UHF radio systems to be used in the Project will be drawn up in accordance with CCIR recommendations and other pertinent international standards.

Table 4.1-4 Comparison of Different UHF Radio Systems

Particulars	Proposal A Combination to 24 channel Analogue Sustem	Proposal B Replacement to 60 channel Analogue System	Proposal C Replacement to 60 channel Digital System
Use of Existing Station Building and Steel Towers	(Possible) ○	(Possible) ○	(Possible) ○
Use of Existing Power Equipment	(Needed for Addition to UHF Station) △	(Possible) ○	(Possible) ○
Intra-office Structure of Radio Station	(Complicated) △	(Simple) ○	(Simple) ○
Compatibility with Exchange Facilities	(Needed for A-D Conversion) △	(Needed for A-D Conversion) △	(Possible Direct Digital Connection) ○
Difficulty of Production	(By Special Order) △	(By Special Order) △	(Standard Specification) ○
Economy	(Expensive Analogue Terminal Equipment) △	(Expensive Analogue Terminal Equipment) △	(Inexpensive Digital Terminal Equipment) ○
Study Results	△	△	◎

4.2 Study of Design Conditions

4.2.1 Network Configuration

The future plan for the telephone network configuration in Burma has been conceptualized with a four level switching hierarchy as shown in Figure 4.2-1. However, due to the lack of the necessary conditions, the construction of such a network cannot be met under the present situation. Therefore, as shown in Figure 4.2-2, a two level switching hierarchy with trunk circuits being set up between each local exchange and the toll exchange in Rangoon or Mandalay will be constructed under the Project.

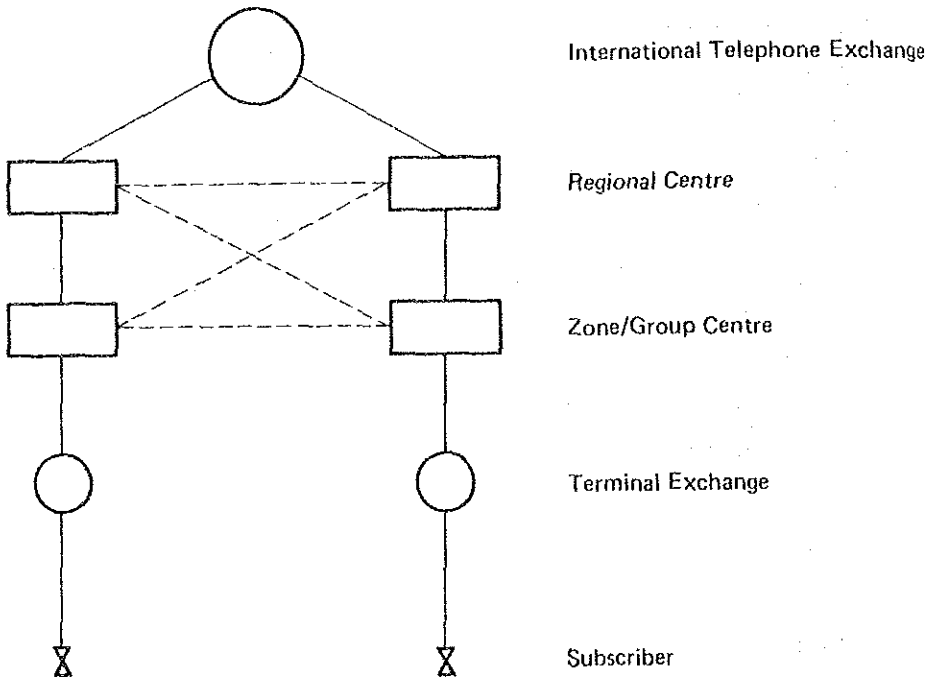


Fig. 4.2-1 Future Plan for Telephone Network Configuration in Burma

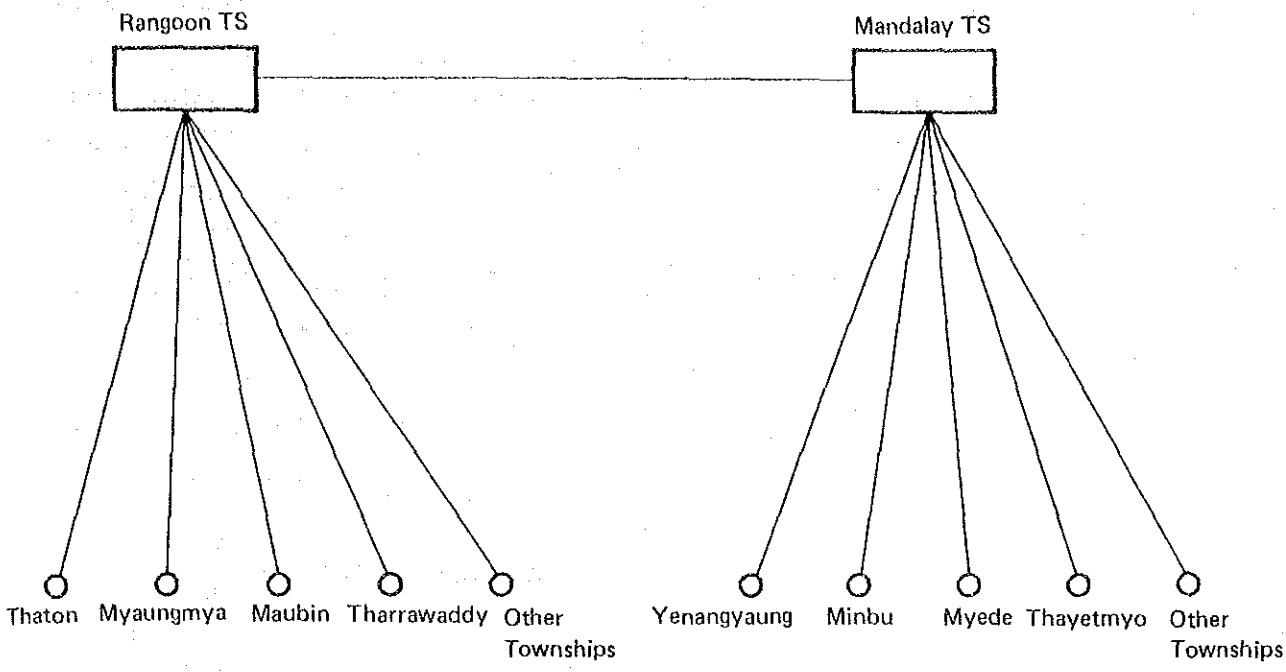


Fig. 4.2-2 Telephone Network Configuration for The Project

4.2.2 Traffic Engineering Standards

The probability of switching loss applied to the Project are the following values which are generally used as standards:

- Intra-office calls	0.002
- Local calls	0.003
- Toll calls	0.01

Figure 4.2-3 shows the distribution of switching loss of the anticipated four level switching hierarchy in the future.

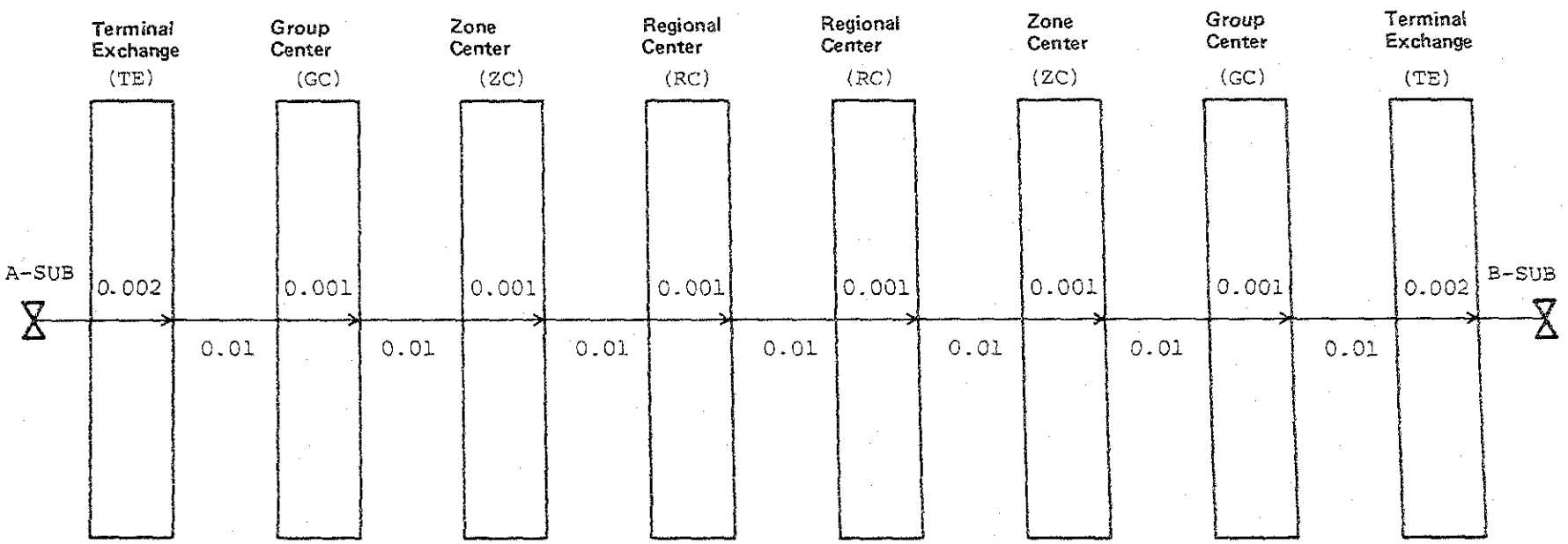


Fig. 4.2-3 Distribution of Switching Loss Probability

4.2.3 Transmission Engineering Standards

The transmission engineering standards to be applied to the project are the following values which are generally used as standard.

(1) The reference equivalent (RE) shall be used for evaluation of the transmission performance.

(2) The objective value of subscriber-to-subscriber transmission loss aims at 32.6 dB and less.

Its loss assignment shall be as follows.

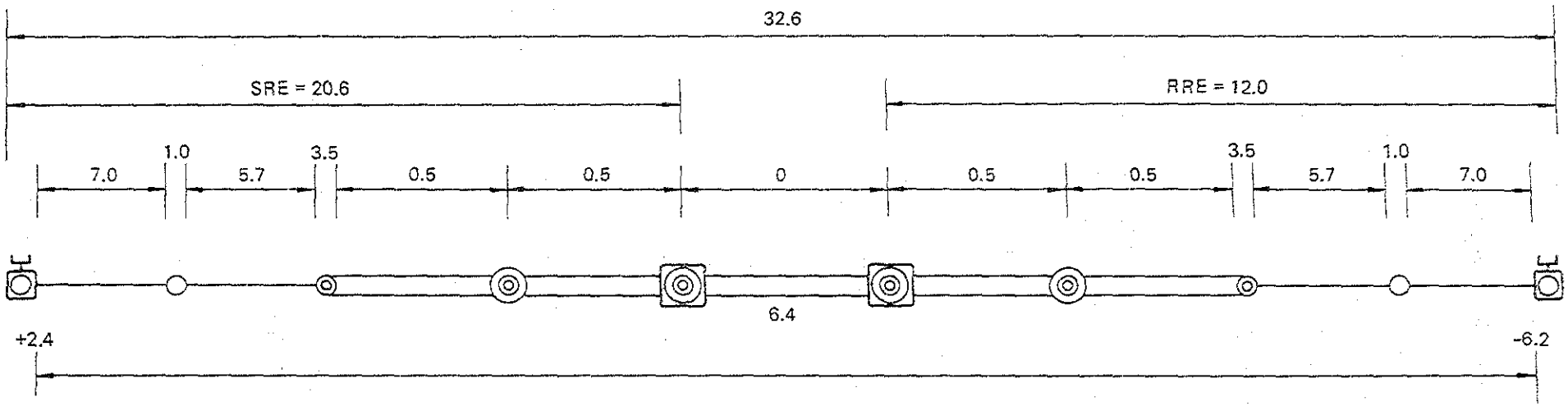
- Transmission loss between toll exchanges shall be 0 dB.
- Loss at 2W/4W conversion points (Hybrid loss) shall be 3.5 dB.
- Transmission loss in subscriber's line shall be 7.0 dB.

Transmission loss assignment plans for applying these standards are shown in Figure 4.2-4.

(3) Transmission performance of telephones to be introduced shall be as follows.

SRE: +2.4 dB
RRE: -6.2 dB

(4) Transmission performance of international calls shall be based on CCITT recommendation.



LEGEND

- Regional Centre
- Zone Centre
- Group Centre
- Terminal Exchange
- Telephone Set

* All figures are shown in dB.

Fig.4.2-4 Transmission Loss Distribution

4.2.4 Signaling Plan

The inter-office signaling is as follows.

(1) The inter-office signaling between existing inter-urban crossbar exchanges is based on the MFC-R2 signaling system recommended by CCITT. Provided that the offering signal is added.

(2) The interoffice signaling between digital exchange and the crossbar exchange is based on the MFC-R2 signaling system as well.

(3) The RD signaling system is applied between the manual exchange and automatic exchange. Also, operator trunk dialing is used by the subscriber dialing system.

(4) The MF signaling system is used between crossbar exchange and manual boards of the same exchange.

(5) The signaling between digital exchanges in Rangoon is based on the No. 7 common channel signaling system recommended by CCITT.

4.2.5 Charging Plan

(1) Local Calls

(i) Automatic exchange

Local calls are charged per call without time limits. A LAMA system is used in digital exchanges.

(ii) Manual exchange

Local calls are not charged on a message rate system, but charged on a flat rate per year system.

(2) Toll Calls

(i) Subscriber trunk dialing calls

The charge is based on the system which counts rates by distance and time. The subscriber trunk dialing call is charged for the initial three minutes and for each additional one minute. A centralized automatic message accounting system utilizing toll exchanges of regional centers is used.

(ii) Operator Calls

Operator calls have the same charging system as the above (i). The charge is recorded on a call ticket.

(3) International Calls

A detailed billing system is to be introduced. The subscriber trunk dialing calls and the operator calls are charged for the first three minutes and each additional one minute.

4.2.6 Numbering Plan

(1) National Numbering Plan

(i) "0" is used for trunk prefix (Open numbering system).

(ii) Every area code is unique irrespective of originating offices (Universal numbering system).

(iii) Closed numbering system is employed within the same local exchange area.

(iv) The composition of a number for toll calls is as follows.

(Trunk prefix) + (Area code) +
(Local exchange code) + (Subscriber number)

A national number consists of six or seven digits except for the trunk prefix "0".

(v) Each digit of the national number is represented by codes A, B, C, D, E, F, G.

(vi) "0" cannot be used for A code, which has not used a digit "9".

(vii) The first digit of the directory numbers do not use the digits "0" and "1".

Table 4.2-1 shows examples of the national numbering plan.

(2) Area Code Allocation

The current area code allocation in Burma is as follows:

- Rangoon toll exchange area

Rangoon area	01 code
Moulmein area	03 code
Bassein area	04 code
Prome area	05 code

- Mandalay toll exchange area

Mandalay area	02 code
Magwe area	06 code
Myitkyina area	07 code
Taunggyi area	08 code

Figure 4.2-5 shows the area code allocation.

(3) Numbering Plan for 8 Townships

The assignment plan of A, B, C, D codes for the 8 townships involved in the Project is as follows:

Myaungmya	4544-4553
Minbu	6262-6263
Thayetmyo	5377-5378
Yenangyaung	6320-6329
Tharrawaddy	5520-5529
Maubin	4520-4529
Thaton	3420-3429
Myede	5370-5374

(4) Special Service Number

(i) Subscriber's Special Service Number

As shown in Table 4.2-2, subscriber's special service numbers are composed of the digits represented by 1XY.

(ii) Operator's Special Number

This number is to be used for operators and maintenance purposes. Operator's special number is as shown in Table 4.2-2. Dialing is as follows:

(Toll number) + (Operator's special number)

(5) International Numbering Plan

Internatinal call numbers are composed as follows:

(International call prefix) + (Country code)
+ (National significant number)

The number "00" is used for the international prefix.

Table 4.2-1 National Numbering Plan

Area Code	Local Exchange Code	Subscriber Number	Applied Areas
A □	B C □□	D E F □□□	Rangoon (1) Mandalay (2) only
A □	B C □□	D E F G □□□□	Used in future
A B □□	C D □□	E F G □□□	All area except Rangoon and Mandalay

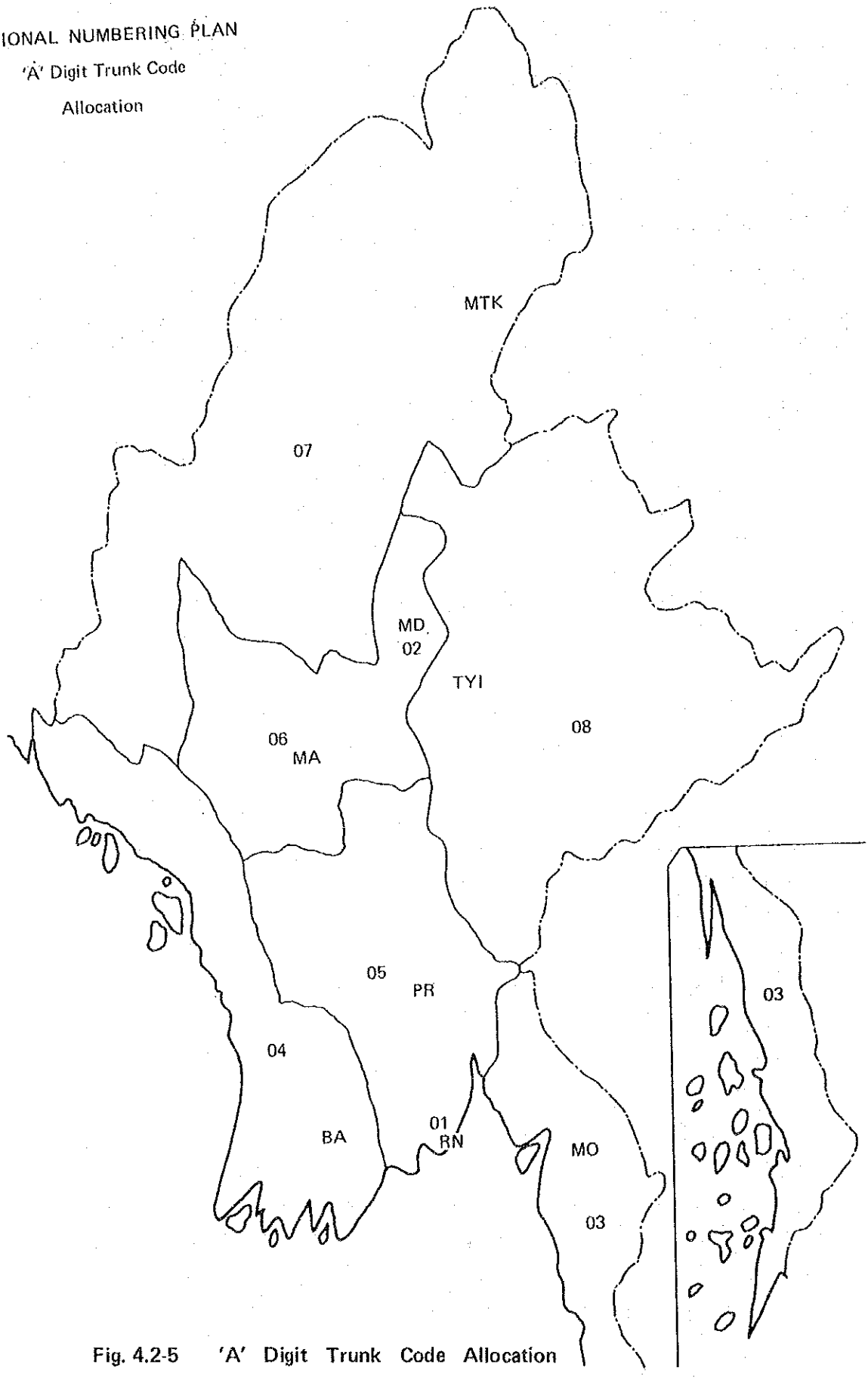


Fig. 4.2-5 'A' Digit Trunk Code Allocation

Table 4.2-2 Special Service Number Plan

1XY	Special Services	Charged	Uncharged
1 0 0	Local Information(Enquiry)		○
1 0 1	Trunk Booking		○
1 0 2	Complaints		○
1 0 3	Long Distance Information		○
1 0 4	Telegram Service	○	
1 1 2	Access to Line Test Desk for Lineman		○
1 2 1	Operator Access Code (for Operator Only)		○
1 3 0	International Information (Enquiry)		○
1 3 1	International Booking		○
1 3 5	International Price Required Call	○	
1 5 0	Time Announcement	○	
1 7 1	Automatic Subscriber Line Test		○
1 7 2	Operational Test		○
1 7 3	Operational Loss & Noise Test		○
1 7 7	Price Required Call (Trunk)	○	
1 7 8	Simulation of A-subscriber hang up first		○
1 7 9	Simulation of B-subscriber hang up first		○
1 9 1	Fire		○
1 9 2	Police		○
1 9 3	Ambulance		○

4.3 Basic Plan

According to the aforementioned design policies, container type digital exchanges will be installed in the eight selected townships. Basic plans for each type of equipment are as follows:

4.3.1 Exchange Facilities

(i) Capacity of Exchanges to be Newly Installed

Total capacity of exchanges to be newly installed in the Project is calculated on the basis of the estimated demand result for each of the eight townships. Details are as shown in the table below.

Township	Number of Terminals Planned by The Project	(Reference : Number of Terminals Requested)
Myaungmya	900 terminals	(900 terminals)
Minbu	500 terminals	(500 terminals)
Thayetmyo	400 terminals	(500 terminals)
Yenangyaung	700 terminals	(600 terminals)
Tharrawaddy	300 terminals	(500 terminals)
Maubin	400 terminals	(700 terminals)
Thaton	700 terminals	(700 terminals)
Myede	500 terminals	(600 terminals)
Total	4,400 terminals	(5,000 terminals)

(ii) Digital Exchange

Each exchange office will be equipped with one container type digital exchange. Furthermore, each container will accommodate the main components essential to the exchanges, including digital switching equipment, charge information recording equipment (LAMA), main distribution frames (MDF), control boards, and rectifiers, storage batteries, power distribution board and so forth.

Also, air conditioners appropriate to the capacity of exchanes will be installed.

- Digital Exchange Equipment:

  Subscriber's packages corresponding with the number of terminals planned will be accommodated.

- Charge Information Recording Equipment (LAMA):

  One set of LAMA equipment complete with charge information recording functions will be necessary.

(iii) Manual Board

One set of manual board with interface compatible with digital exchange will be installed in each exchange office for the purpose of toll calls connection, toll calls reservation and directory assistance services. As operators will be needed for each manual board, the board will be installed inside the exchange office building.

A small capacity air conditioner will be installed in the room where the manual board is located.

The basic designs of the exchanges for the eight townships are as shown in Table 4.3-1. Site plans of new exchange offices are as shown in Figure D1.1-D1.8.

Table 4.3－1 Result of Basic Design for Exchange Facilities

Exchange Office	Number of Subscriber Terminals	Exchange Containers (Set)	Digital Switching Equipment (Set)	MDF	Control Board (Set)	LAMA Equipment (Set)	Air Conditioner for Exchange Container (Set)	Manual Board (Set)	Air Conditioner for Manual Board (Set)
Myaungmya	900	1	1	1	1	1	1	1	1
Minbu	500	1	1	1	1	1	1	1	1
Thayetmyo	400	1	1	1	1	1	1	1	1
Yenangyaung	700	1	1	1	1	1	1	1	1
Tharrawaddy	300	1	1	1	1	1	1	1	1
Maubin	400	1	1	1	1	1	1	1	1
Thaton	700	1	1	1	1	1	1	1	1
Myede	500	1	1	1	1	1	1	1	1

4.3.2 Power Equipment (For Exchanges)

(i) Power Source Containers

One container will be provided for each exchange office. The container will be equipped with emergency engine generators, automatic voltage regulator (AVR), AC distribution board, day tank and other necessary equipment.

A breakdown of the equipment to be included in this container is as follows.

- Emergency Engine Generators

Since the power consumption of exchange facilities to be used in the Project is approximately 50 kW or less, a dual type emergency engine generator of 60 kVA or less shall be set up in each exchange office.

A day tank with a capacity of 200 liters shall be installed for the emergency engine generator in consideration of its use at night when no technician is in attendance.

An underground fuel tank with a capacity of 2,000 liters shall be installed. The capacity will be sufficient to cover the fuel consumption, with a monthly supply of fuel, in view of the power failure situation in the eight townships.

Day Tank:	Capacity of 200 liters (Enough fuel for running an engine continuously for twelve hours; to be accommodated in the container)

Underground Fuel Tank: Capacity of 2,000 liters (Enough fuel for running an engine for 5 days in succession; to be buried outside the container)

- Automatic Voltage Regulator (AVR)

One AVR of 60 KVA or less shall be installed in each exchange office.

- Control Boards

One control board shall be installed in each exchange office for automatic switchover from commercial power sources to the emergency engine generator.

- AC Power Distribution Board

AC power distribution board shall be installed in a power source container.

(ii) Power Transformer for High Tension Power

A power transformer of 60 KVA or less shall be installed in each exchange office for carrying out AC 3 phase, 11 kV/400 V or 6.6 kV/400 V conversion. Power transformers will be installed outdoors.

(iii) Power Equipment to be Installed in the Container for the Exchange

Power equipment to be installed in the container for the exchange is as follows:

- Rectifiers

Rectifiers with a capacity of 48 V 200 A or less shall be installed in every exchange office.

- Storage Batteries

  Storage batteries with a capacity of 1,000 AH or less shall be installed in each exchange office.

- AC and DC Power Distribution Boards

  AC and DC power distribution boards shall be installed in the exchange container.

The basic designs for power equipment in the eight townships are as shown in Table 4.3-2.

The site layout plan for the new exchange offices are as shown in Figure D1.1-D1.8.

Table 4.3-2 Result of Basic Design for Power Equipment (for exchange facilities)

Exchange Office	Power Container (set)	Emergency Engine Generator (set)	Power Transformer (set)	A V R (set)	Control Board (set)	Rectifier (set)	Storage Batteries (set)	Power Distribution Board (set)
Myaungmya	1	2 (less than 60KVA)	1 (11KV/400V less than 60KVA)	1 (less than 60KVA)	1	1 (less than 48V 200A)	1 (less than 1000 AH)	AC: 2 DC: 1
Minbu	1	2 (less than 60KVA)	1 (11KV/400V less than 60KVA)	1 (less than 60KVA)	1	1 (less than 48V 200A)	1 (less than 1000 AH)	AC: 2 DC: 1
Thayetmyo	1	2 (less than 60KVA)	1 (6.6KV/400V less than 60KVA)	1 (less than 60KVA)	1	1 (less than 48V 200A)	1 (less than 1000 AH)	AC: 2 DC: 1
Yenangyaung	1	2 (less than 60KVA)	1 (11KV/400V less than 60KVA)	1 (less than 60KVA)	1	1 (less than 48V 200A)	1 (less than 1000 AH)	AC: 2 DC: 1
Tharrawaddy	1	2 (less than 60KVA)	1 (11KV/400V less than 60KVA)	1 (less than 60KVA)	1	1 (less than 48V 200A)	1 (less than 1000 AH)	AC: 2 DC: 1
Maubin	1	2 (less than 60KVA)	1 (11KV/400V less than 60KVA)	1 (less than 60KVA)	1	1 (less than 48V 200A)	1 (less than 1000 AH)	AC: 2 DC: 1
Thaton	1	2 (less than 60KVA)	1 (11KV/400V less than 60KVA)	1 (less than 60KVA)	1	1 (less than 48V 200A)	1 (less than 1000 AH)	AC: 2 DC: 1
Myede	1	2 (less than 60KVA)	1 (6.6KV/400V less than 60KVA)	1 (less than 60KVA)	1	1 (less than 48V 200A)	1 (less than 1000 AH)	AC: 2 DC: 1

4.3.3 Outside Plant

The basic designs for the outside plant of the selected eight townships are as shown in Table 4.3-3.

Local cable route maps in each township are as shown in Figure D2.1-D2.8.

Table 4.3-3 Result of Basic Design for Outside Plant

Item / Township	Classification of Outside Plant and the Quantity								
	Local Cables (Unit : Km)			Toll Cables (Unit : Km)		Cross Connection Cabinet (unit:piece)	Distribution Point Boxes (unit:piece)	Telephone Poles (unit: per pole)	Drop Wires (unit: per line)
	Underground Cables	Aerial Cables	Underwater Cables	Underground Cables	Aerial Cables				
Myaungmya	2.4	23.3	0.4	0.5	0	4	82	583	565
Minbu	14.8	25.6	0	0.7	0	4	87	640	414
Thayetmyo	1.2	18.4	0	0	0	2	67	460	299
Yenangyaung	4.9	17.0	0	2.0	0	3	84	427	582
Tharrawaddy	4.4	27.6	0	0	0	2	68	700	190
Maubin	3.1	25.3	0.6	0.5	0	2	48	640	233
Thaton	1.7	22.1	0	0	4.0	4	96	550	533
Myede	3.2	15.5	0	0.8	0	2	95	390	395
Total	35.7	174.8	1.0	4.5	4.0	23	627	4390	3211

(Notes) The amount of drop wires is the sum of existing subscribers and applicants on the waiting list.

The above Table includes toll cables used in toll transmission facilities.

4.3.4 Toll Transmission Facilities

The results of basic designs for toll transmission facilities for the eight selected townships drawn according to the design policies are as follows:

(i) Myaungmya

- Toll cables shall be directly buried over a distance of 500 meters connecting the new exchange office and microwave station.

- Because the AVR in Myaungmya's microwave station was made in 1965 and is now obsolete, with insufficient capacity of 3 kVA, those facilities shall be replaced with new AVR (capacity 7.5 kVA). Furthermore, the capacity of 100 AH of the existing storage batteries may cause a serious shortage in the future. New batteries with a capacity of 240 AH shall replace the existing batteries, guaranteeing a minimum capacity.

- Currently, switchover from commercial power sources to an emergency engine generator at Myaungmya's microwave station is being carried out manually. However, considering the frequency of power failures, the size of fluctuations in voltage, and the increase of traffic expected from the Project, a control board shall be installed for automatic exchange to keep power failures and voltage fluctuations at a minumum.

(ii) Minbu

- 700 meters of toll cable will be directly buried between the new exchange office and the UHF station.

- There are 44 circuits between Minbu and Magwe. Since the capacity of the existing 24-channel analog radio system is insufficient for the interval traffic between the Minbu UHF station and the Magwe microwave station, a 60-channel digital system shall replace the old system. Furthermore, digital carrier terminal equipment shall be set up at the Minbu UHF station and the Magwe microwave radio station.

- There is a need to replace the Minbu UHF station's antenna with an 800 MHz band grid antenna for use with the 60-channel digital radio system. In addition, 30 meters of feeder cable must be provided.

- There is a need to replace the Magwe microwave station's antenna with an 800 MHz band grid antenna for use with the 60-channel digital radio system. In addition, 50 meters of feeder cable must be provided.

(iii) Thayetmyo

- 30 meters of overhead tie cable will be installed between the new exchange office and UHF station.

- There are 38 circuits between Thayetmyo and Myede. Since the capacity of the existing 24-channel analog radio system is insufficient for the interval traffic between the Thayetmyo UHF station and the Myede microwave station, a 60-channel digital system shall replace the old system. Furthermore, digital carrier terminal equipment shall be set up at the Thayetmyo UHF station and the Myede microwave station.

- There is a need to replace the Thayetmyo UHF station's antenna with an 800 MHz band grid antenna for use with the 60-channel digital radio system. In addition, 30 meters of feeder cable must be provided.

- There is a need to replace the Myede microwave station's antenna with an 800 MHz band grid antenna for use with the 60-channel digital radio system. In addition, 50 meters of feeder cable must be provided.

(iv) Yenangyaung

- 2 kilometers of directly buried toll cable shall be installed between th new exchange office and the microwave station.

(v) Tharrawaddy

- 40 meters of overhead tie cable shall be installed between the new exchange office and the microwave station.

(vi) Maubin

- 500 meters of directly buried toll cable shall be installed between the new exchange office and the microwave station.

(vii) Thaton

- Since the area between the new exchange office and the microwave station is mountainous, connection shall be made with 4 kilometers of overhead toll cables.

- The AVR at the Thaton microwave station was installed in 1965 and is now obsolete. In addition, it has a small capacity of 3 kVA. A new AVR (capacity 7.5 kVA) shall replace the old unit.

- Currently, switching from commercial power sources to an emergency engine generator at the Thaton microwave station is being carried out manually. However, considering the frequency of power failures, the size of fluctuations in voltage, and the expected increase of traffic due to the Project, an automatic control board shall be installed to keep power failures and voltage fluctuations at a minimum.

(viii) Myede

- 800 meters of directly buried toll cables shall be installed between the new exchange office and the microwave station.

- As described in the section on Thayetmyo, there is a need for the installation of a 60-channel digital radio system and digital carrier terminal equipment at the Myede microwave station.

- Currently, the microwave station is not receiving commercial power, but due to the ease of lead-in commercial power, it has been decided that the station shall begin receiving low voltage power from commercial sources. For this, the station shall be equipped with an AVR (capacity 7.5 kVA). An automatic control board shall be installed to help minimize power failures and voltage fluctuations, taking into consideration the expected increase in traffic from the Project. This board will handle the automatic switchover from commercial power sources to the emergency engine generator when trouble occurs.

The basic design for the toll transmission facilities for the eight selected townships is as shown in Table 4.3-4.

The basic design drawings are as shown in Figure D3.1-D3.17.

Table 4.3 -4 Result of Basic Design for Toll Transmission Facilities

Station	UHF Radio Equipment	Carrier Terminal Equipment	Antenna	Feeder Cables	Tie Cables	Toll Cables (Note)	AVR	Storage Batteries	Control Board
Myaungmya						500m	7.5KVA × 1	120AH ×2	1
Minbu	Digital 60cH 1SYS	Digital 44cH	Grid Antenna 1	30m		700m			
Magwe	Digital 60cH 1SYS	Digital 44cH	Grid Antenna 1	50m					
Thayetmyo	Digital 60cH 1SYS	Digital 38cH	Grid Antenna 1	30m	30m				
(Myede)	Digital 60cH 1SYS	Digital 38cH	Grid Antenna 1	50m					
Yenangyaung						2Km			
Tharrawaddy					40m				
Maubin						500m			
Thaton						4Km	7.5KVA × 1		1
Myede						800m	7.5KVA × 1		1

(Note) Toll cables are added up in the outside plant facilities (cf. Table 4.3-3).

4.3.5 Equipment and Materials for Construction and Maintenance

(1) Exchange, Power and Transmission Facilities

For construction and maintenance work of the exchange, power and transmission facilities to be newly introduced under the Project, measuring instruments and tools for the exchange and power facilities of the eight exchange offices and the transmission facilities of the four stations will be provided.

Furthermore, in consideration of the scale of facilities, exchange and power equipment will be provided at each office and the transmission equipment will be centrally provided.
Table 4.3-5 show the equipment required.

(2) Outside Plant

To maintain high safety standards and to guarantee the most efficient progress in construction work for the outside plant of the eight townships of the Project, special vehicles designed for telecommunications construction will be needed. These vehicles will be used in the construction of telephone poles, digging of underground cable routes, construction work in high places, and the stringing and laying of cables.

Most of the existing tools and measuring instruments for outside plant work used by the Posts and Telecommunications Corporation are for open wires, and they are not applicable for the present work. Therefore, for efficient execution of the main construction work for the eight townships, maintenance of construction quality and maintenance work, tools will be needed, and for engineering tests and the maintenance of equipment, measuring instruments are needed.

Furthermore, because a different engineering method, which has never been used in Burma before, is applied to the construction of outside plant under the Project, a training course must be held to educate workers in construction methods and the correct use of tools and measuring instruments before actual construction work begins. Therefore, materials for the training course must be obtained.

The materials and equipment for the construction and maintenance of outside plant and for the workers' training course are listed in Table 4.3-6.

The special vehicles for telecommunications construction work and measuring instruments will be maintained centrally and will be sent to individual townships when needed. Other tools will be furnished to each township.

Table 4.3-5
Construction and Maintenance Materials for Exchange, Power and Transmission Facilities

Digital Exchange and Power Equipment (for 8 Exchange Offices)			
Materials		Quantity	Remarks
Measuring Equipment	Oscilloscopes	8 unit	For waveform measurement, including accessories
	Digital Multimeter	8 unit	For digital display, including accessories
	Universal Counters	8 unit	For pulse cycle measurement, including accessories
	Circuit Testers	8 unit	For voltage and current measurement, including accessories
	Level Meter	8 unit	For noise measurement, including accessories
	Photocorders	8 unit	For voltage fluctuation measurement, including accessories
	Attenuators	8 unit	For special circuit testing, including accessories
	Automatic Test Call Generators	2 unit	For automatic test call generation, including accessories
Construction Tools	Construction Tools	8 set	Soldering irons, cable cutters, buzzers, wrapping tools, wrenches etc.
	Maintenance Tools	8 set	Package extraction tools, hand lamps, extension packages, nippers, drivers etc
Transmission Facilities (UHF Digital Radio Equipment, PCM Terminal Equipment) (for 4 Stations)			
Materials		Quantity	Remarks
Measuring Equipment	Power Meters	1 unit	For transmission output measurement, including accessories
	Frequency Counters	1 unit	For frequency measurement, including accessories
	Voltmeters	1 unit	For IF output level measurement, including accessories
	Standard Signal Generators	1 unit	For AGC special measurement, including accessories
	Testers	1 unit	For power supply voltage measurement, including accessories
	Bit Error Meters	1 unit	For error measurement, including accessories
	PCM Multitesters	1 unit	For voice frequency measurement, including accessories
Construction Tools	Construction Tools	1 set	Soldering irons, wrapping tools, U links, cable cutters, wrenches, etc
	Maintenance Tools	1 set	Panel extraction tools, torque wrenches nippers, extension cords, screwdrivers, etc

Table 4.3-6 (1/2) Machines and Materials
for Construction and Maintenance
-Outside Plant-

	Machines and Materials	Quantity	Comments
Specially Designed Vehicles for Construction Work	Shovel Cars	1	. For digging underground cable routes. . (1 vehicles/work site) x (1 work site) . Spare parts for maintenance.
	Crane and Auger Trucks	2	. For use in erection of poles, taking out poles, loading and unloading heavy materials, and carrying a few poles. . (1 vehicle/work site) x (2 work sites) . Pole extracting machine, auger for rock quality foundation, hand drills, supports for carrying poles, tools used to keep poles from sliding during transport, accessories and spare parts for maintenance.
	Bucket Trucks	2	. For use in safe and efficient work at heights less than ten meters off the ground. . (1 vehicle/work site) x (2 work sites) . Spare parts for maintenance.
	Trucks with Cranes	2.	. For carrying poles, cables and other long or heavy materials. . For laying cables by winch. . (1 vehicle/work site) x (2 work sites) . Shift drive winches, pole carrying supports, tools used to keep poles from sliding during transport, accessories and spare parts for maintenance.
	W-Cab Trucks	2	. For the transport of small materials, tools, measuring devices, and workers. . (1 vehicle/work site) x (2 work sites) . Spare parts for maintenance.
Measuring Instruments	Insulation Resistance Meters	8	. For the measurement of cable line insulation resistance at the time of construction or maintenance operation. . (1/ offices) x (8 offices)
	Underground Metal Scanners	2	. Used for Checking underground buried metals. . (1 scanner/work site) x (2 work sites)
	Wheatstone Bridge Testers	2	. For the detection of cable damage. . (1/4 offices) x (8 offices)
	Cable Characteristic Testers	1	. For evaluation in regarding to quality of cable line or investigation the reason of damage by measuring characteristic in line transmission and varios noise. . For the detection of damage points in cable and points of cutting off frequency. . (1/8 offices) x (8 offices)

Table 4.3-6 (2/2) Machines and Materials for Construction and Maintenance

-Outside Plant-

	Machines and Materials	Quantity	Comments
Tools for Construction Work	Common Basic Tools		. Portable generator (8), underwater pumps (8), adjustable ladders (8), tolls for taking off old telephone pole (2)
	Cable Laying Tools		. Cable cutters (8), cable benders (2), line pullers (4), level Jacks (4), aerial man basket (8), tranceivers (10), pulley (8), cable rollers (200)
	Cables Connection Tools		. Cable connection tool kits (5) SS cable cutting tools (6), Receiver for line testing (16), checking tools of cable line (4), boards for pole top work (6), tents (6), covers with a roof (4)
	Safety Work		. Helmets (100), safety belts for kits poletop work (70), electricity detector (8), checker for electricity detector (1), safety corns (8), safety fences (4), shurts for working (100), trousers for working (100), safety shoes (100)
	Tools for Internal Work		. Tools for internal work (6), foot steps (6)
Materials for Training	Telephone Poles	10	10 poles/training session
	Under ground Cables	50m	50 m/training session
	Overhead Cables	200m	200 m/training session
	Steel Standed Wires for Stays	12 lines	12 stays/training session
	Connection Materials	enough for 20 sites	20 cable connection points /training session
	Distribution Points	20	20 distribution points/training session
	Drop Wires	200m	10 drop wires/training session 20 m of drop wire/line
	Textbooks for Training	100	Textbooks for training of construction method 400 pages/book

(Note) Number of parenthesis shows quantity.

4.3.6 Spare Parts

(1) Exchange, Power and Transmission Facilities

Those intra-office facility units which, when out of order, can be repaired through the replacement of parts, will be repaired on site. However, repairs which require more extensive work will be done by the equipment manufacturers. The repair process takes a minimum of two months and involves shipping time to the Japanese manufacturer, repair work in Japan and sending the repaired units back to Burma.

In order to guarantee normal operation of the exchange, power and transmission facilities during the two-month period, it will be necessary to provide spare parts for the said equipment. One set of spare packages for every four exchange facilities and one set of spare panels for every four transmission facilities must be supplied to a central maintenance point.

In addition, as initial troubles take place during the first year after the completion of construction, one year's worth of spare parts for subscriber circuit packages, electronic circuit parts for repairs and other consumable materials must be supplied to each exchange office.

(2) Outside Plant

Since Burma imports almost all materials for the construction and maintenance of outside plant, it is impossible to promptly cope with a situation in the case of moving, fire, natural disaster etc. Meanwhile, deterioration of the reliability of facilities and temporary shutting down of telephone services due to a lack of materials or use of non-standard methods and improper materials must be avoided.

Therefore, it is necessary to provide a sufficient supply of spare parts for maintenance.

One year's supply of maintenance materials for the eight townhips was calculated on the basis of predictable maintenance work as shown in Table 4.3-7 because actual statistics were not available.
Spare parts for the maintenance of outside plant based on Table 4.3-7 are as shown in Table 4.3-8. Such materials shall be centrally provided in Rangoon.

Table 4.3-7 Predicted Outside Plant Repair Work

Repair Work	Causes	Main Processes	Frequency of Occurrence
Trouble Transference Work	Widening of roads	10 Telephone poles, 5 stays, 500m of overhead cables (13 sections, 2 junctions), 6 Connection points, 4 distribution terminal boxes, 15 drop wires	0.5 instances /office.year
Overhead Cable Replacement Work	Fire damage to cables caused in the dry season	100m of overhead cables (2 sections between telephone poles), 3 connection points 1 distribution terminal box, 5 drop wires	1 instance /office.year
Underground Buried and Overhead Cable Replacement Work	Damage caused to cables by moisture during the rainy season	· 150m of underground buried cables, 2 connection points · 150m of overhead cables, 2 connection points, 2 telephone poles	0.5 instances /office.year
Drop Wire Replacement Work	General troubles	1 Drop wire	10 instances /office.year

Table 4.3-8 Spare Parts for Outside Plant

Materials			Quantity	Comments
Spare Materials For Maintenance	Telephone poles (steel poles)		48	
	Cables	Underground Cables 0.5-200 JF Cable	200 m	
		Underground Cables 0.6-100 JF Cable	150 m	
		Underground Cables 0.9-150 JF Cable	250 m	
		Underground Cables Total	600 m	
		Overhead Cables 0.5-10 CCP Cable	700 m	
		Overhead Cables 0.5-30 CCP Cable	800 m	
		Overhead Cables 0.5-50 CCP Cable	300 m	
		Overhead Cables 0.5-100CCP Cable	300 m	
		Overhead Cables 0.6-10 CCP Cable	300 m	
		Overhead Cables 0.6-30 CCP Cable	200 m	
		Overhead Cables 0.9-10 CCP Cable	300 m	
		Overhead Cables 0.9-30 CCP Cable	500 m	
		Overhead Cables Total	3,400 m	
	Materials for Stays		20 lines	Steel stranded wires, wire grip, stay rods, etc.
	Connection Materials	Materials for Underground Buried Cable Connections	8 points	Connectors, splicing closers, jellies, etc.
		Materials for Overhead Cable Connections	56 points	Connectors, splicing closers, etc.
	Distribution Boxes		24	10 pairs only
	Drop Wires		18.0 km	(100m/line) × (180 lines)

4.4 Construction Work Plan

4.4.1 Construction Circumstances and Construction Work Policies

The purpose of the Project is to develop telephone networks for eight townships in Burma. PTC will manage and implement the Project for the construction work.
The construction work must be carried out directly by PTC under the guidance and supervision of Japanese engineers.

It would be desirable for the construction work to be divided into three phases, in consideration of the one-year budget policy applied to grant aid from Japan.

4.4.2 Construction Classification

The classifications defining the scope of responsibilities to be taken by Japan in relation to the grant aid and necessary measures to be taken by the Burmese government are given below.

(1) The Scope of Japanese Responsibility under Grant Aid

- Supply of materials and equipment

- Supervision of construction work and dispatching of engineers.

- Consultation concerning detailed designs, tendering and supervision of construction work.

(2) The Scope of Burmese Responsibility and Necessary Measures

- Supply of commercial power to the Project sites

- Tax exemption for the materials and equipment brought into Burma for use in the Project, necessary measures for customs clearance and prompt unloading

- Entry visa and stay permit for all Japanese nationals staying in Burma for the Project

- Efficient and effective maintenance and operation of all facilities provided under the grant aid

- The payment of all expenses other than those to be borne by the grant aid necessary for the transportation as well as the installation of the equipment

- Construction of buildings and foundations necessary for the Project

- Arrangement of the storage place for outside plant materials, equipment, etc. and transportation of them to the Project sites.

- Extention of microwave toll circuits.

- Procurement of telephone sets required for the Project

4.4.3 Construction Management Plan

The Project, upon completion of the basic design study, will be submitted for a cabinet decision on the grant aid related to the Project. After the signing of Exchange of Notes between the Government of Japan and the Government of Burma, the Burma Posts and Telecommunications Corporation and a Japanese consultant will conclude a consulting agreement under which detailed design and construction management will begin.

(1) Detailed design

On the basis of the data determined under the present basic design study, the consultant carries out detailed design with the Burmese Authorities to decide on general conditions, special conditions and technical detailed specifications necessary for the implementation of the construction work. The consultant, depending on the result of the detailed design, prepares documents needed for tendering.

(2) Construction management

(a) Tender to select contractor

The consultant carries out the invitations for tender, acceptance and evaluation of tender documents and assists Burmese Authorities and the Japanese contractor in concluding the agreement.

(b) Examination of approval drawings

The consultant, on behalf of Burma and for an early Project completion, examines the production drawings of materials and equipment submitted by contractors.

(c) Acceptance inspection at supplier's factory

Prior to the shipment of materials and/or equipment by the supplier, the consultant verifies through inspection at the supplier's factory that such materials and/or equipment conform to the terms and conditions of purchase agreements.

(d) Construction supervision

According to the terms of agreement concluded between the Burmese authorities and the consultant, the latter sends to the Project sites engineers as required to supervise construction work.

(e) Witness to Acceptance tests

Upon completion of the construction, the consultant and PTC shall be present at the acceptance tests to make a final verification of facilities introduced under the Project.

4.4.4 Plan for Procurement of Materials and Equipment

The materials and equipment to be supplied under the Project include exchange facilities, power equipment, outside plant, toll transmission facilities and the related accessories and spare parts for construction and maintenance purposes. All of these equipment and materials will be procured within Japan and shipped to Burma.

4.5 Implementation Schedule

Owing to the characteristics of the Project and the restrictions on the fiscal year on grant aid from Japan, the Project shall be divided into the following three phases:

Phase I : Execution of construction of exchange, power and toll transmission facilities for the first four townships.

Phase II : Execution of construction of outside plant for the first four townships, and execution of exchange, power and toll transmission facilities for the remaining four townships.

Phase III: Execution of construction of outside plant for the remaining four townships.

4.6 Maintenance Management Costs

After the introduction of equipment under the Project, each exchange office will require 9 to 11 maintenance personnel and 3 to 4 operators.

A sum of 527,000 Kyats (11,900 thousand yen) will be needed annually for maintenance management costs for the Project's facilities. The breakdown of the said cost are as follows:

Salaries	281,000 Kyats
Repairs	78,000 Kyats
Vehicles	
Maintenance	9,000 Kyats
Fuel etc.	159,000 Kyats
Total	527,000 Kyats

4.7 Project Cost

The Project cost to be borne by Burma is estimated at approximately 5.05 million Kyats.

(equivalent to 114 million yen)

Breakdown is as follows:

(a) Construction costs of exchange and power facilities	1.67 million Kyats
(b) Construction costs of outside plant	2.97 million Kyats
(c) Construction costs of toll transmission facilities	0.41 million Kyats
Total	5.05 million Kyats

CHAPTER 5 PROJECT EVALUATION

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When the Project is completed, the accommodation capacity for subscribers in the eight selected townships will become four times as many as at present, enabling each township to solve the problem of applicants waiting for subscription. It is expected that the number of subscribers of those townships will increase within a very short time to approximately three times the number of present subscribers. Furthermore, the improvement of telephone service from the present delay service to automatic non-delay service will render telephone calls much easier and the traffic is estimated to reach double the present figure. Traffic as a whole is thus expected to rise to approximately six times that at present. Implementation of telephone network development on a nationwide scale in the eight selected townships where needs are the greatest will bring to the nation the following benefits.

(1) Improved efficiency of economic activities in provincial societies

At present, telecommunications facilities in regional areas are coming to a standstill and the functions of provincial towns are not fully exercised due to unreliability of information and its delay. Through a drastic improvement of telephone networks for the eight townships under the Project, information transmission among the government offices and the private sector will sharply increase, and the actuation of highly efficient economic activities in the provincial societies can be expected.

(2) Improvement of social welfare service

In the event of storms, floods, fires and other disasters or emergencies, emergency messages could hardly reach the central or regional control organizations promptly.

With the introduction of telecommunications facilities that guarantee high reliability and good quality, telephone services will become available around the clock, thereby improving social welfare services for the inhabitants in provincial areas.

(3) More efficient transportation system

Smoother transmission of information through the improvement of the telecommunications network under the Project will bring forth higher efficiency to the transportation system for the nationwide distribution of provincial products and the supply of vital materials to the provinces. The improved telecommunications service is expected to cover the shortcomings in the transportation systems.

(4) Increase of telephone demand

The eight selected townships of the Project are individually the centers of growing provincial areas and each township has a considerable number of applicant subscribers on waiting lists. With the ease of telephone calls brought forth by the improvement of the telecommunications networks, further increase in the demand for telephone subscription is expected. As the conveniences of telephone service become known among the people, communication between the subscribers in the target areas and others in the central and regional cities is expected to drastically increase, contributing to an increased business income for PTC.

(5) Improvement of telephone charge collection ratio

Because of frequent failures of telephone service in the provincial areas, the collection ratio of telephone charges remains at a low percentage.

However, with the implementation of the Project, the subscriber information in the target areas such as name, telephone number, and telephone charges become readily available. This, with the increase of calls to important areas by customers, will lead to an increase of the collection ratio from those subscribers in the target areas by establishing an adequate charge collecting system.

(6) Improvement of technical level

Telecommunications equipment to be introduced under the Project will be that which is suitable to the townships' conditions and will bring to Burma the latest technology, which will be transferred to Burma's engineers and technicians through their participation in the construction, operation, and maintenance of the facilities. Training of many engineers and technicians will make the future configuration of the telecommunications network much easier, eventually contributing to the improvement of the national engineering level.

(7) Improved maintenance of equipment

Because of the extreme shortage of vehicles, tools, measuring instruments and materials, and maintenance parts for telecommunications facilities in provincial areas at present, it is quite difficult to take prompt action in the event of troubles. However, materials and equipment introduced under the Project will enable each offices to take immediate measures against various troubles in the target provincial area, and an effective maintenance/operation system is expected to be established.

As described thus far, the Project will help realize a higher level of efficiency for economic activities in the provincial societies of Burma. In this regard, the facilities introduced are expected to be utilized to the fullest extent of their performance. Furthermore, PTC will reap the benefits of the increase in demand, upgrading of techniques, and improved maintenance of facilities. And most of all, the implementation of the Project will benefit the entire country of Burma.

CHAPTER 6 CONCLUSION AND RECOMMENDATIONS

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Telecommunications services in the provincial areas of Burma remain insufficient. In the eight selected townships of the Project, telecommunications facilities have already reached an impasse. Many applicant subscribers are waiting, and the townships are in no position to deal with increased demand for telephone services in the future.

When the Project is implemented, the telecommunications services in the eight townships will be drastically improved, solving the above-mentioned problems and enabling smooth local and toll calls with automatic dialing connections. Service quality will be greatly enhanced and the subscribers will benefit from high quality, high reliability telecommunications services. This, in turn, is expected to cause a still larger increase in demand for telephone services.

Accordingly, it can be concluded that the Project will contribute, to a great extent, to the vitalization of socioeconomic activities through high efficiency telecommunications in the provincial areas of Burma, eventually achieving the correction of regional disparity through the development of the provincial economy as strongly desired by the Government of Burma. In addition, the telecommunications facilities to be introduced are what Burma needs the most at present, and taking into consideration the fact that the grant aid from Japan to Burma in the past was most effectively used, it is expected that the facilities of the Project would be again effectively used and become one of the strongest aspects of the infrastructure of the country.

As mentioned above, in consideration of all the elements, the grant aid from Japan for the implementation of the Project will be most significant.

The following self-help efforts on the part of Burma are indispensable for the successful completion of the Project.

(1) Construction to be executed by Burma

Construction work to be executed by Burma for the Project such as the acquisition of land, leveling of ground, lead-in of commercial power supply, and the construction of foundations for containers and buildings for manual boards has a great influence on the schedule of the Project. In this connection, it is most desirable that the Government of Burma should take prompt measures on the budget and execution plans, and so forth, so that the construction work will be promptly completed according to the set construction schedule.

(2) Establishments of organizations for execution and management of the Project

PTC is to carry out the execution and management of the Project. As such, PTC will be required to choose responsible persons for the Project, personnel in charge of each department and office, engineers for management and operation of the Project and so forth.

(3) Personnel Plan

For the maintenance and operation of the equipment and facilities to be introduced under the Project, each telephone office will require a team of 12-15 personnel. It is desirable that the Government of Burma will systematically train these engineers for securing the necessary number of personnel and for maintaining the technical level required.

The equipment and facilities to be introduced under the Project will be the latest technologies for Burma. Therefore, maintenance and operation training must be given to all personnel in charge of maintenance by those who would receive technical training in Japan and those who would receive technical training course before the construction work and on the job training in the course of the construction work.

There is a lead time of almost one year before actual telephone services are commenced with the connection of subscribers' lines. Then, after the completion of facilities at a new exchange office, it is most desirable for PTC to avail itself of the said period for the implementation of an effective training program aiming at upgrading its personnel's technical knowledge in relations to the exchange facilities.

(4) Future equipment plans

PTC must make efforts to recognize trends of demand for telephone services within individual exchange office areas as well as trends of traffic flow between townships in order to maintain a high level of telecommunications service.

The facilities introduced this time will be designed to have sufficient capacity to cover the demand for three years from commencement of service. However, in the future, should there be any prediction of "standstill" regarding the facilities introduced this time, prompt budgetary action must be taken without fail for the expansion of equipment and facilities.

Furthermore, during the study, the Burmese Authorities expressed their desire to have at least one engineer trained in Japan for each of the exchanges, outside plants, and transmission fields, for three months on the government to government basis. Upon execution of the Project, it is deemed most necessary that those engineers acquire technical knowledge on the facilities to be introduced in Burma, and capabilities for the effective and correct management of construction work. Therefore, it is desirable that Japan would positively study the matter upon receipt of such a request with concrete details.

BASIC DESIGN DRAWING

BASIC DESIGN DRAWING

(1) Exchange Facilities and Power Equipment

(2) Outside Plant

(3) Toll Transmission Facilities

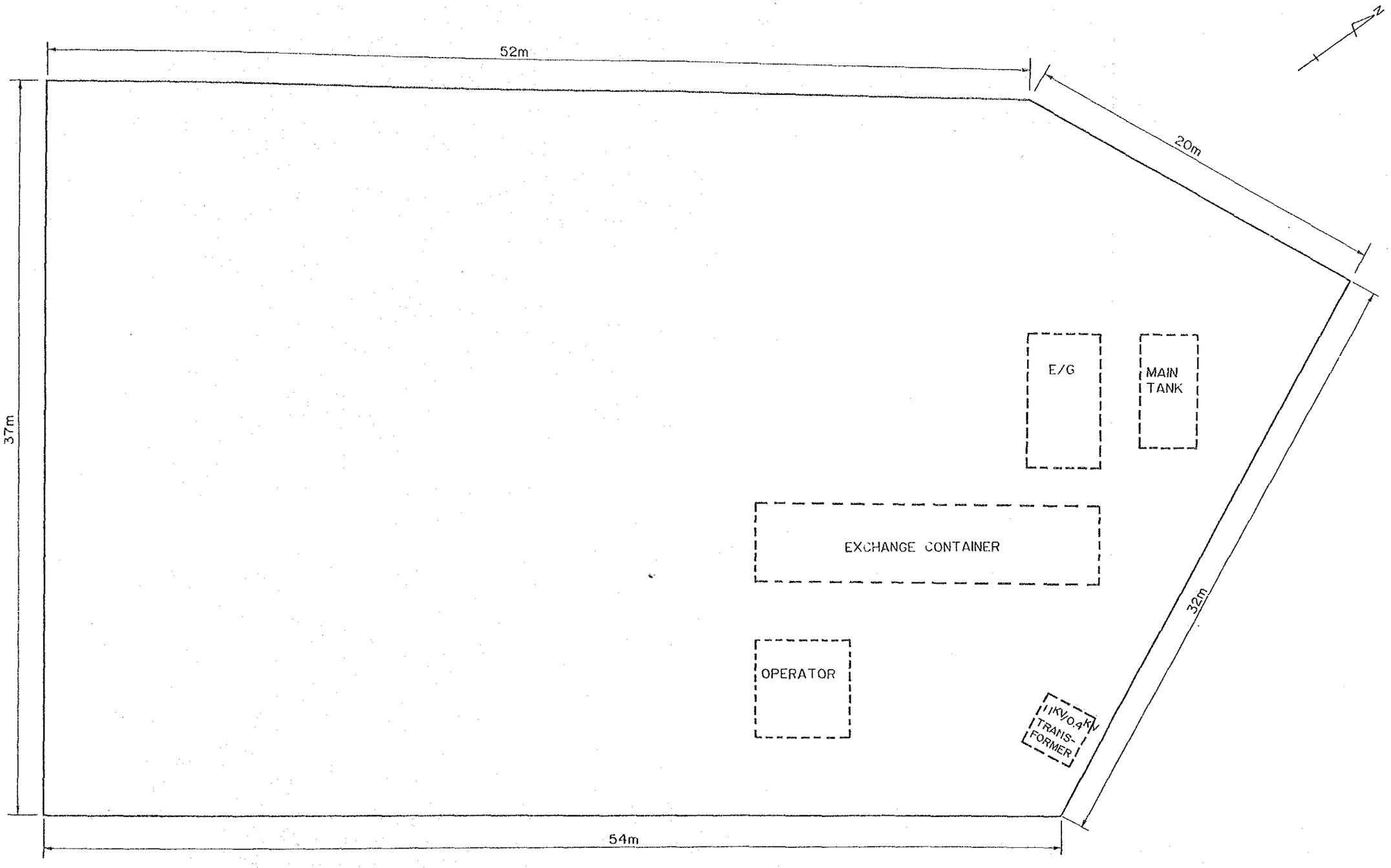


Fig. D.1.1 Site Layout Plan at Myaungmya New Exchange Office

TITLE	SITE LAYOUT
SITE NAME	MYAUNGMYA NEW EXCHANGE
SCALE	1/200

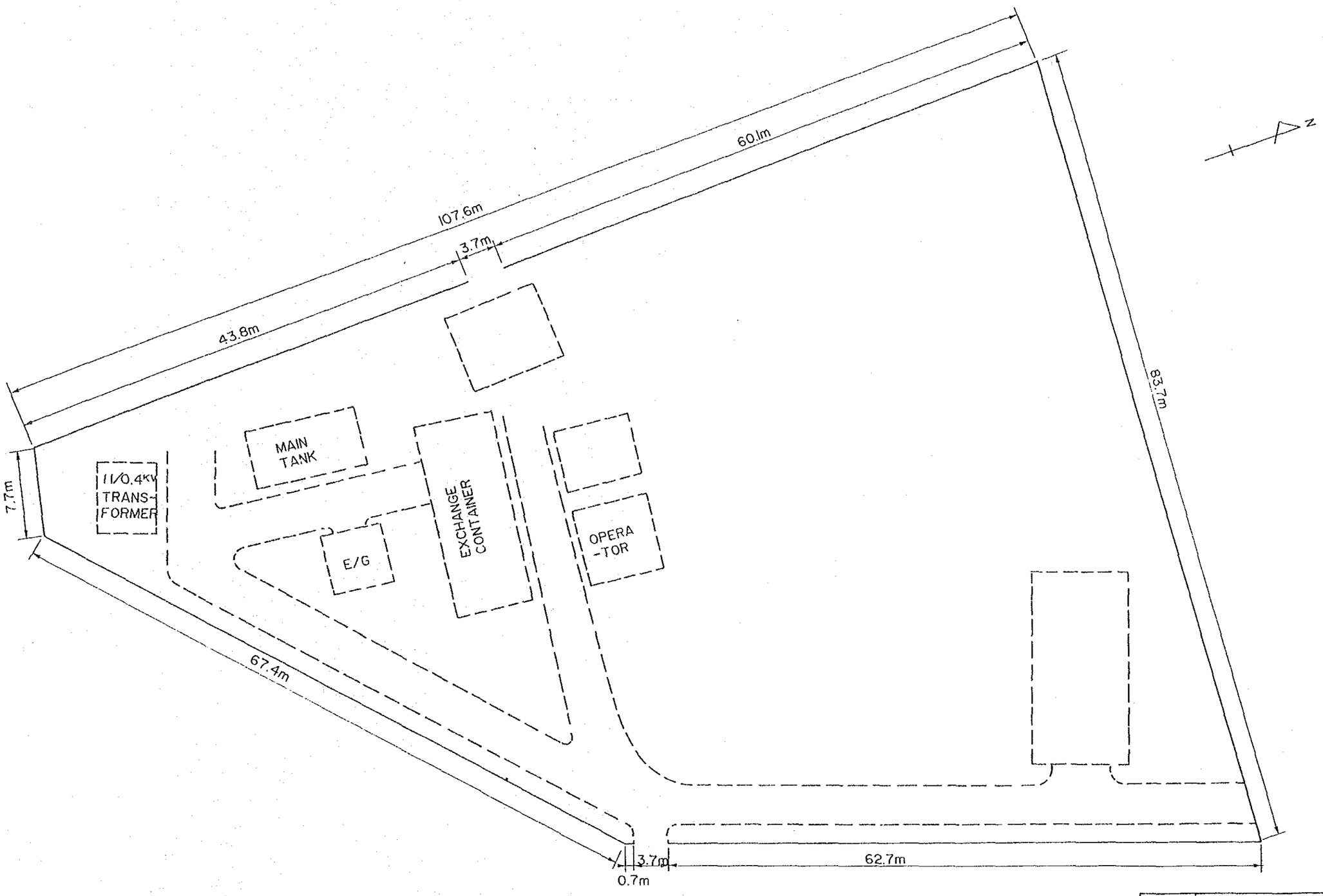


Fig. D.1.2 Site Layout Plan at Minbu New Exchange Office

TITLE	SITE LAYOUT
SITE NAME	MINBU NEW EXCHANGE
SCALE	1/400

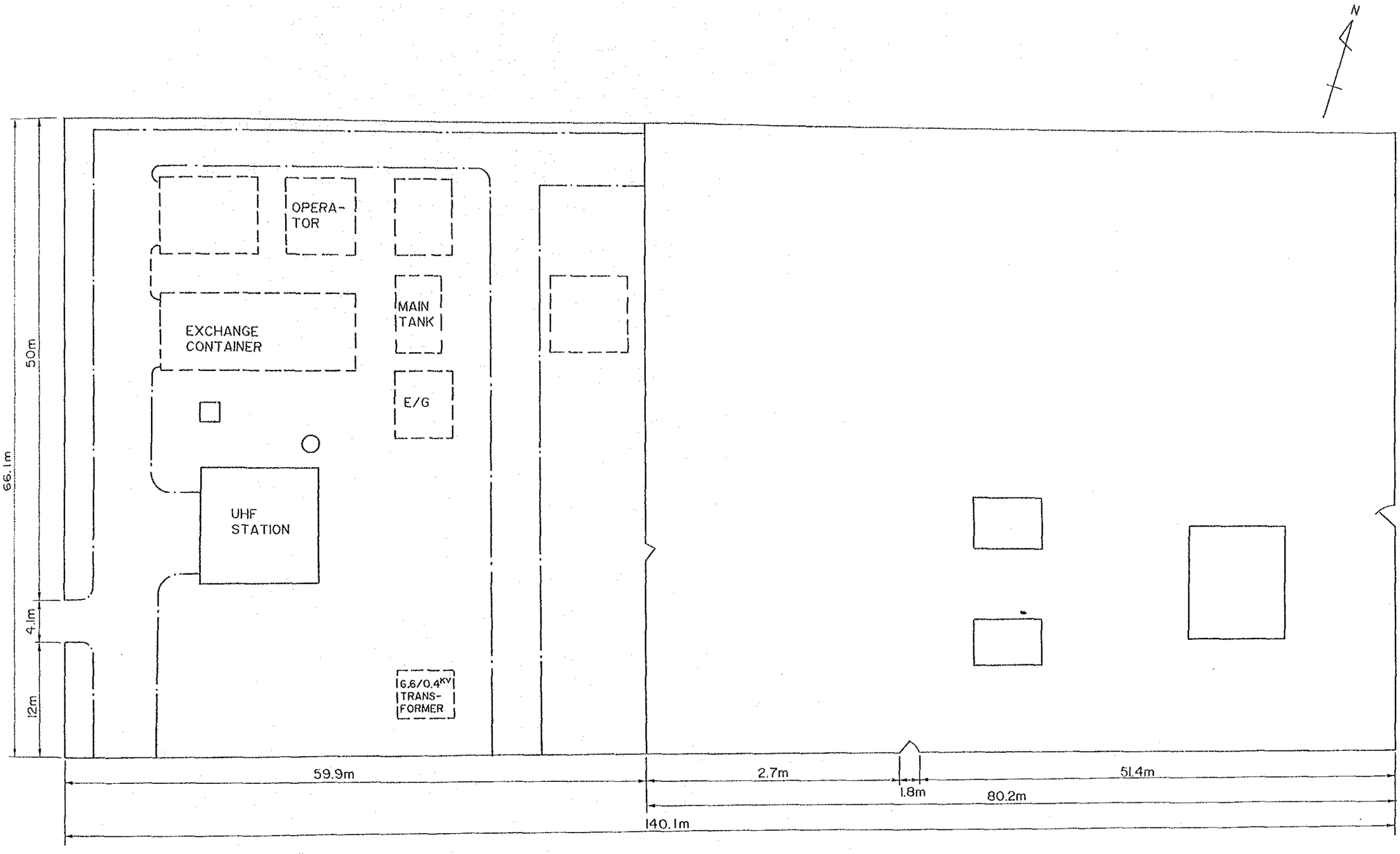
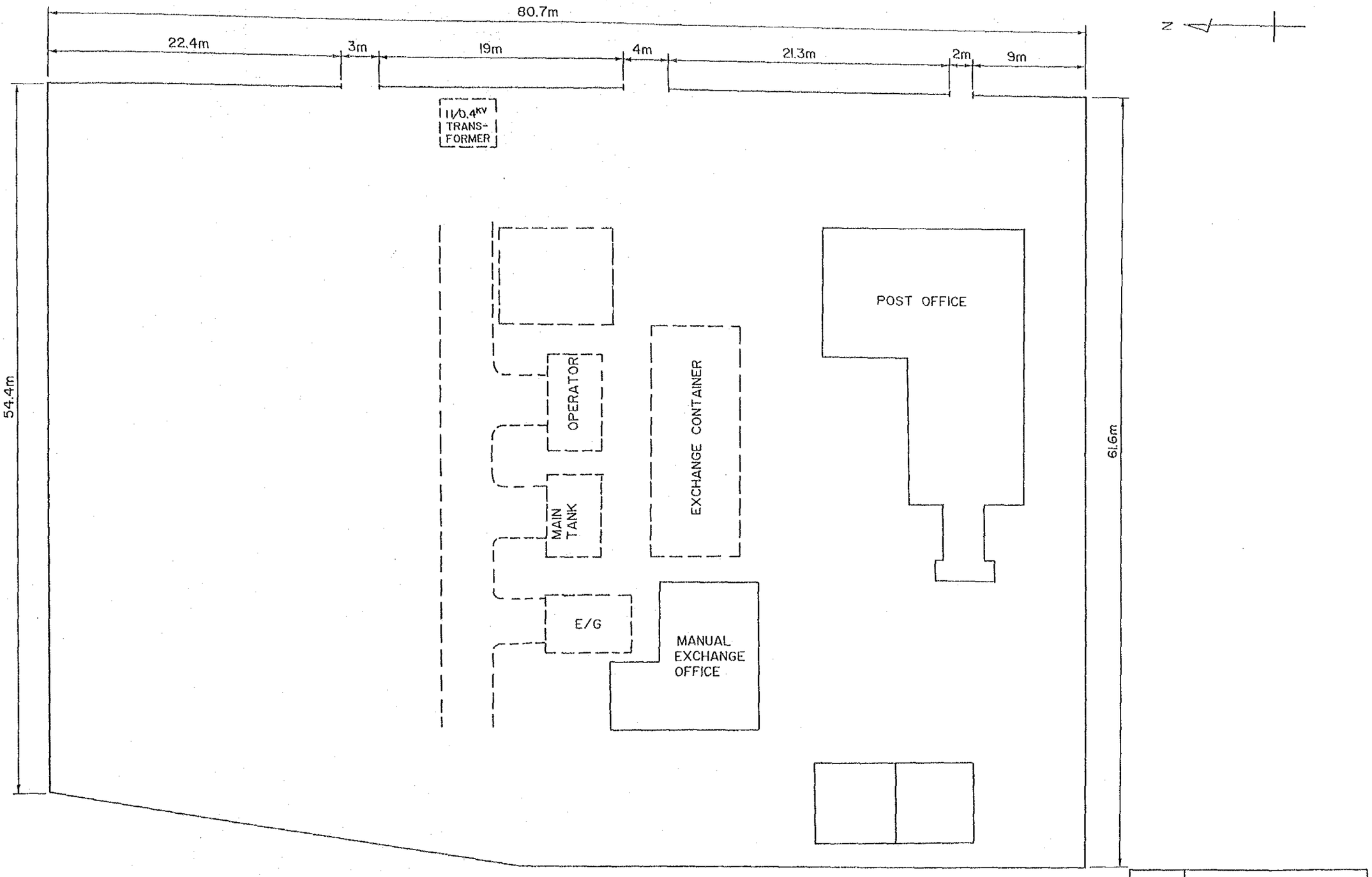


Fig. D.1.3 Site Layout Plan at Thayetmyo New Exchange Office

TITLE	SITE LAYOUT
SITE NAME	THAYETMYO NEW EXCHANGE
SCALE	1/400



TITLE	SITE LAYOUT
SITE NAME	YENANYAUNG NEW EXCHANGE
SCALE	1/300

Fig. D.1.4 Site Layout Plan at Yenangyaung New Exchange Office

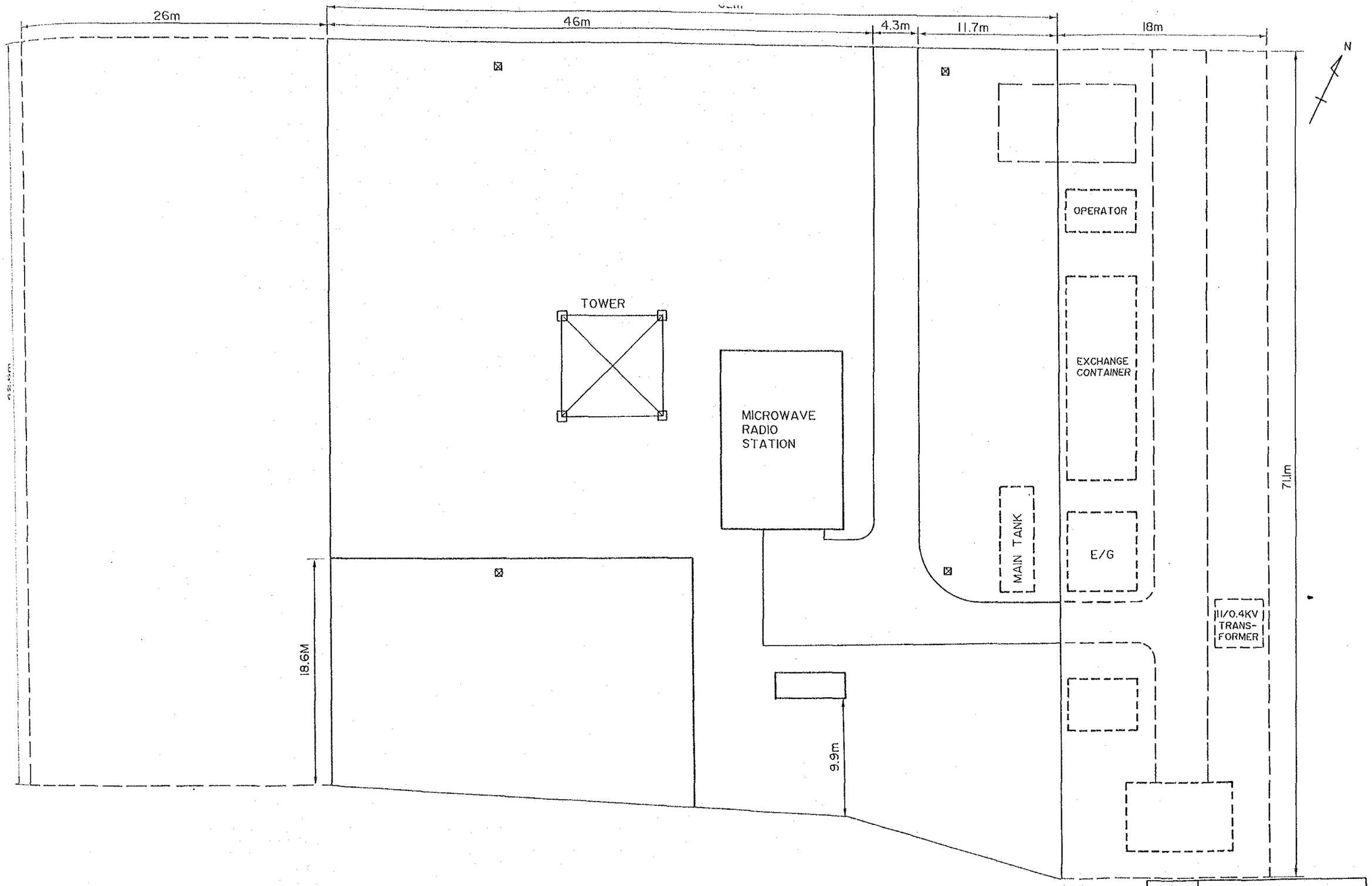


Fig. D.1.5 Site Layout Plan at Tharrawaddy New Exchange Office

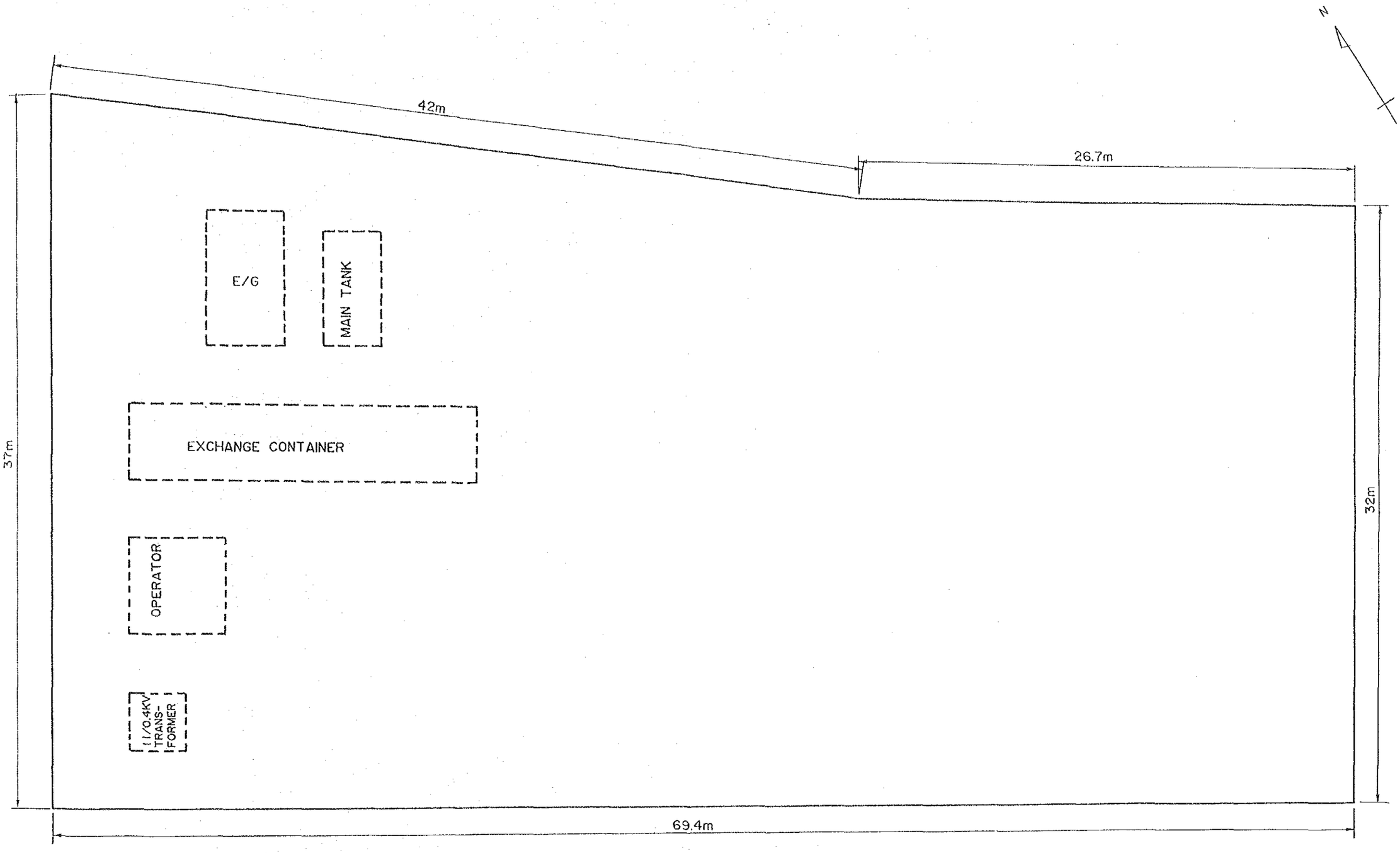


Fig. D.1.6 Site Layout Plan at Maubin New Exchange Office

TITLE	SITE LAYOUT
SITE NAME	MAUBIN NEW EXCHANGE
SCALE	1/200

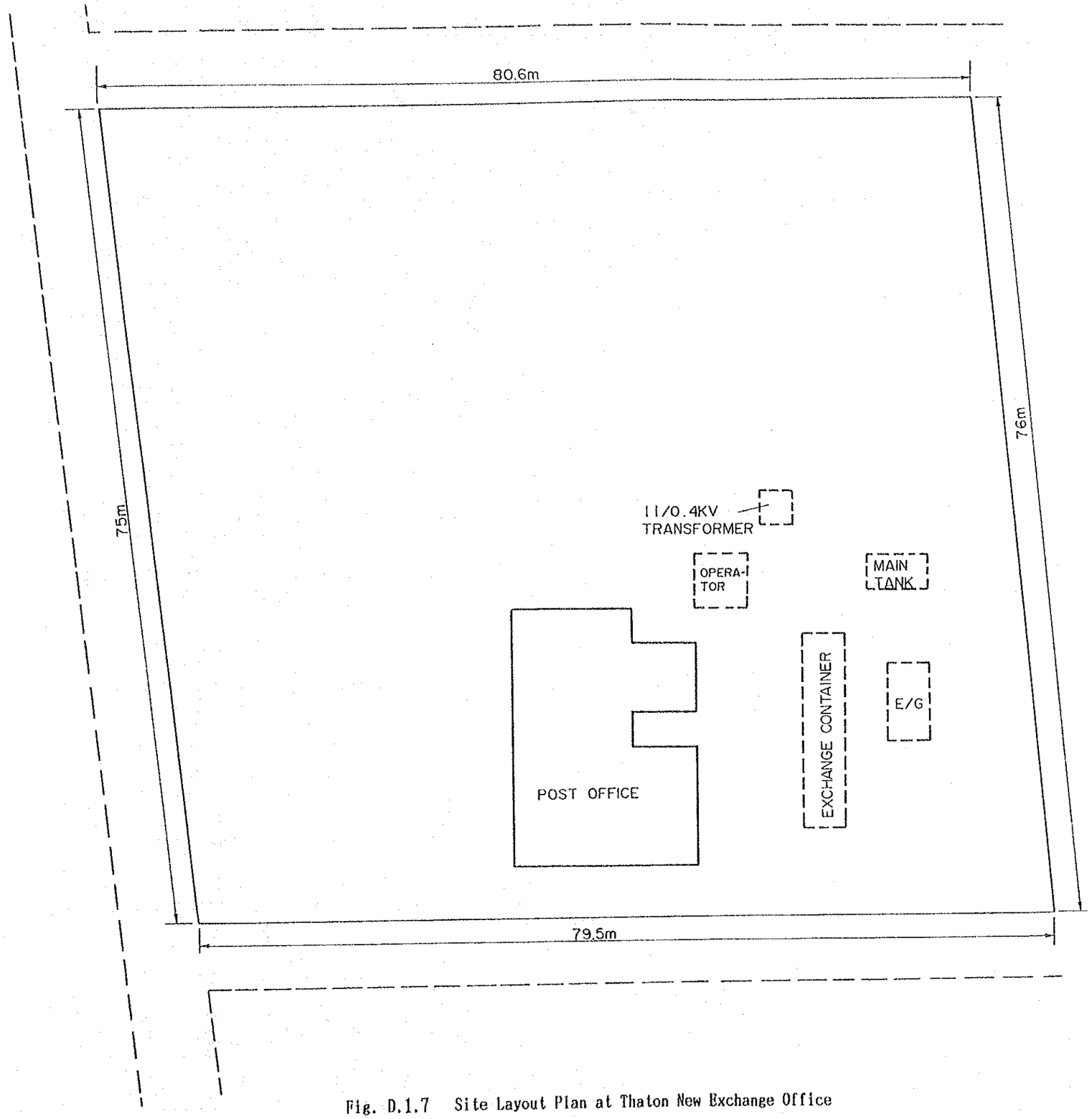
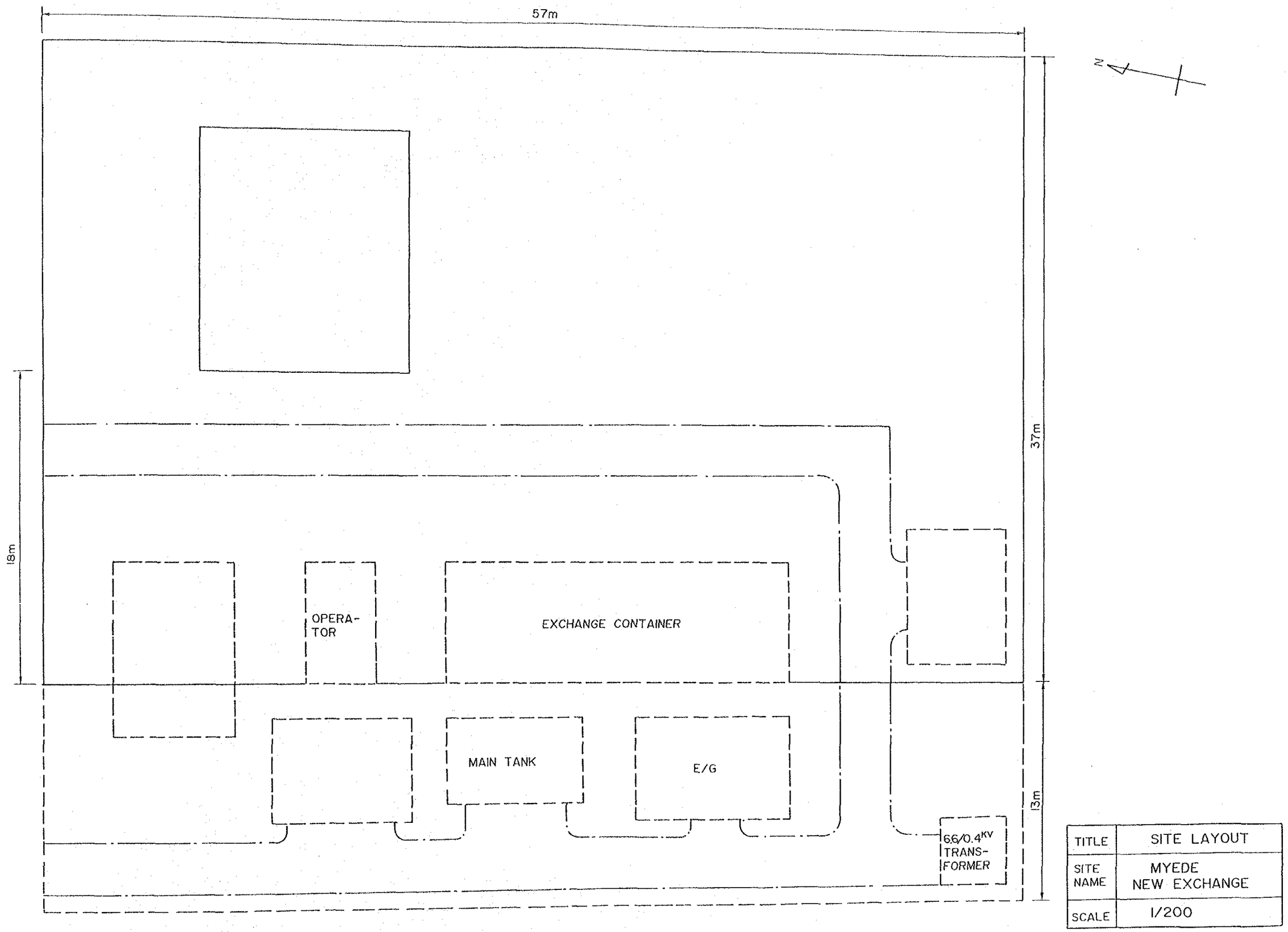


Fig. D.1.7 Site Layout Plan at Thaton New Exchange Office

TITLE	SITE LAYOUT
SITE NAME	THATON NEW EXCHANGE
SCALE	1/400



TITLE	SITE LAYOUT
SITE NAME	MYEDE NEW EXCHANGE
SCALE	1/200

Fig. D.1.8 Site Layout Plan at Myede New Exchange Office