

BASIC DESIGN STUDY REPORT
ON
RURAL BROADCASTING FACILITIES PROJECT
IN
THE DEMOCRATIC REPUBLIC OF THE SUDAN

MAY, 1984

JAPAN INTERNATIONAL COOPERATION AGENCY

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MAY, 1984

JAPAN INTERNATIONAL COOPERATION AGENCY

国際協力事業団	
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PREFACE

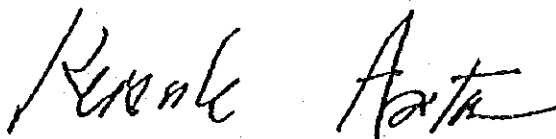
In response to the request of the Government of the Democratic Republic of the Sudan, the Government of Japan decided to conduct a Basic Design Study on the Improvement Project of Rural Broadcasting Facilities and entrusted the study to the Japan International Cooperation Agency (JICA). The JICA sent a survey team to Sudan headed by Mr. Mototsugu KANO, Deputy Director, Radio Monitoring Division, Ministry of Posts and Telecommunications, from February 3 to March 3, 1984.

The team had discussions with the officials concerned of the Government of Sudan and conducted a field survey in Khartoum area. After the team has returned to Japan, further studies were made and the present report has been prepared.

I hope that this report will serve for the development of the Project and contribute to the promotion of friendly relations between the two countries.

I wish to express my deep appreciation to the officials concerned of the Government of the Democratic Republic of the Sudan for their close cooperation extended to the team.

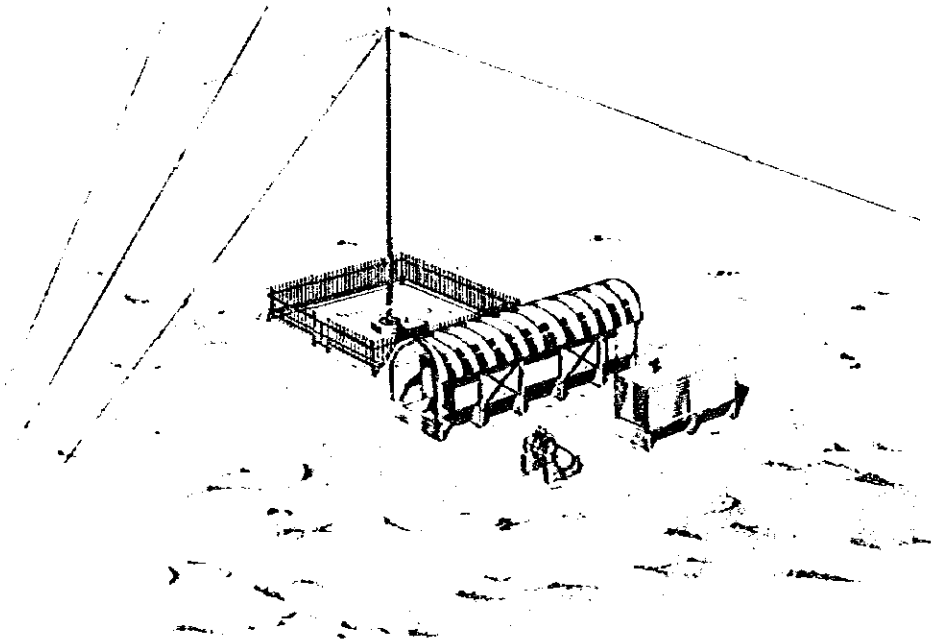
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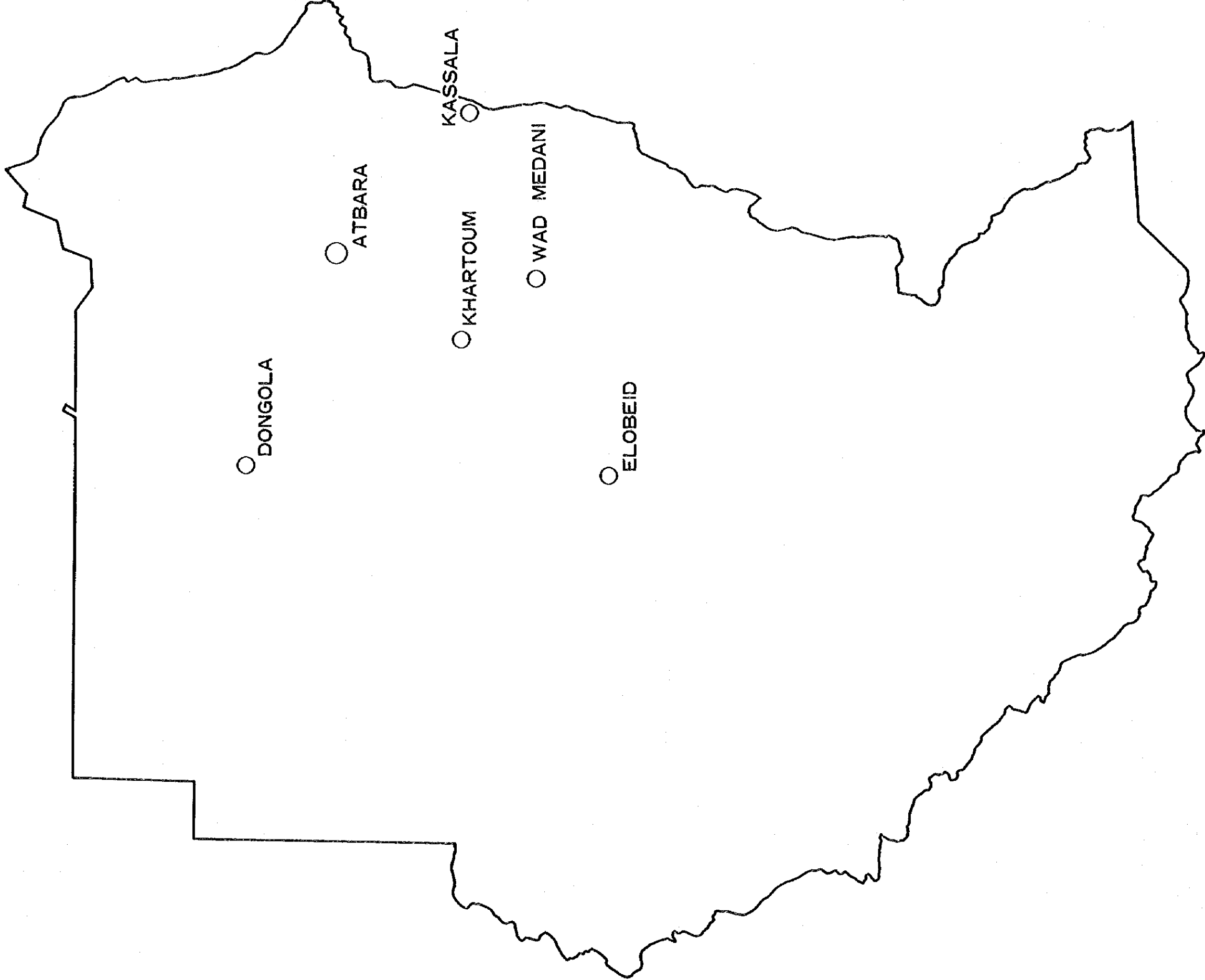
Keisuke ARITA

President

Japan International Cooperation Agency



NEW RADIO TRANSMITTING STATION
(El Obeid, Wad Medani, Atbara, Kassala, Dongola)
SUDAN NATIONAL BROADCASTING CORPORATION
THE DEMOCRATIC REPUBLIC OF THE SUDAN



○ DONGOLA

○ ATBARA

○ KASSALA

○ KHARTOUM

○ WAD MEDANI

○ ELOBEID

DEMOCRATIC REPUBLIC OF SUDAN

LIBYA

WESTERN DESERT

NORTHERN (ASH SHIMALIYYA)

NORTHERN DARFUR (SHIMAL DARFUR)

NORTHERN DARFUR (SHIMAL DARFUR)

SOUTHERN DARFUR (JANUB DARFUR)

NORTHERN KORDOFAN (SHIMAL KURDUFAN)

SOUTHERN KORDOFAN (JANUB KURDUFAN)

UPPER NILE (AN NIL)

EL BUHE YRAT (JUNGOOLE)

WESTERN EQUATORIA (SHARB AL ISTWAIYYA)

EASTERN EQUATORIA (SHARB AL ISTWAIYYA)

Heights in metres

4000
3000
2000
1000
500
300

Sandy desert
Rocky desert
Lava flows
Salt lake
Salt marsh or flat
Permanent marsh or swamp or waterfall

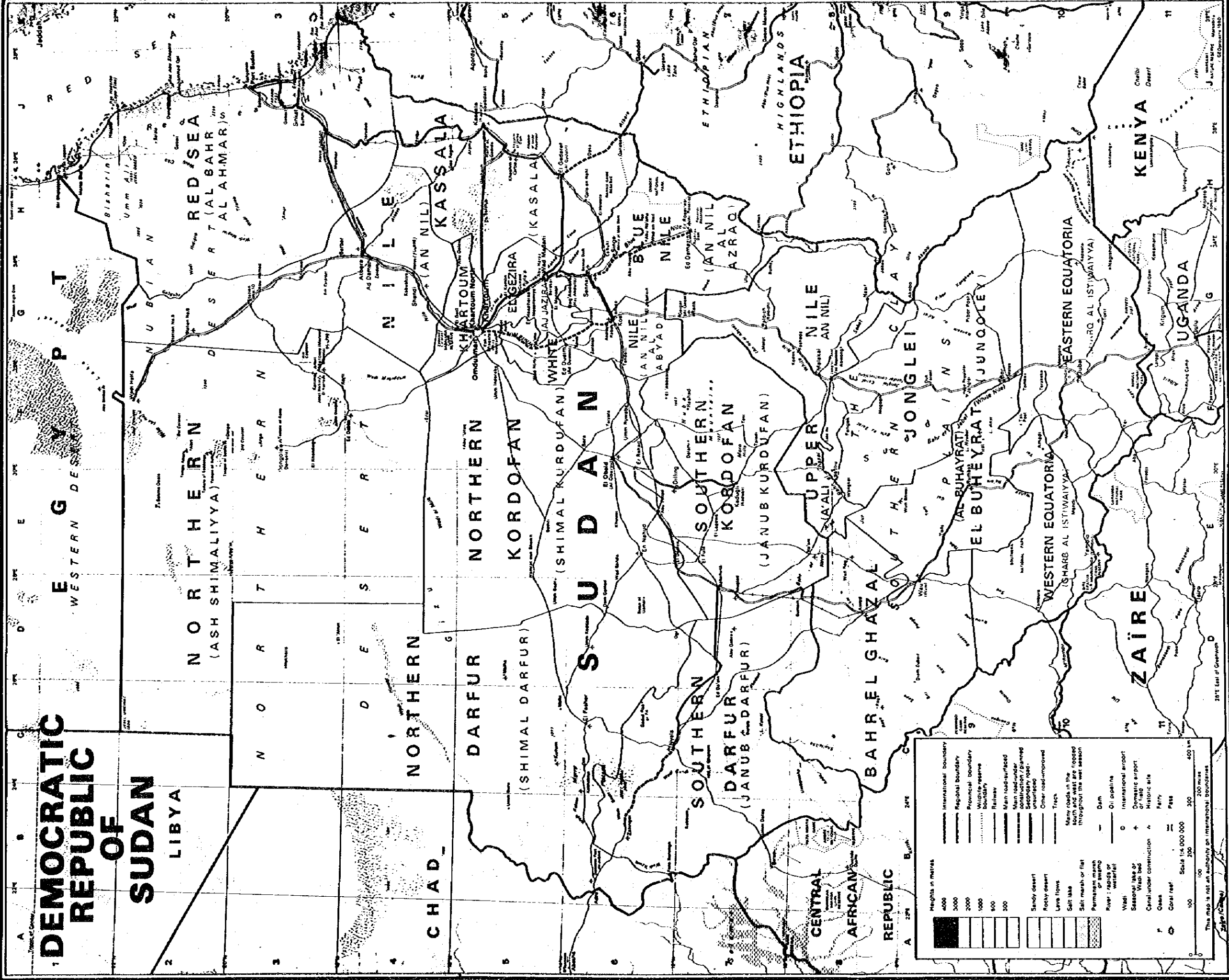
River: rapids or waterfall
Wash
Seasonal lake or wash bed
Canal under construction
Fairy
Coral reef

International boundary
Regional boundary
Provincial boundary
Wildlife reserve
Boundary
Railway
Main road/surfaced
Main road/unsurfaced
Seasonal/planned road
Secondary road
Other road/improved
Track
Many roads in the south and west are flopped throughout the wet season

Dam
Oil pipeline
International airport
Domestic airport
Historic site
Fairy
Pass

Scale 1:4,000,000
0 100 200 300 400 km
0 100 200 300 400 miles

This map is not an authority on international boundaries



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IN
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SUMMARY

SUMMARY

The country of the Democratic Republic of the Sudan has been spread over the vast land of 2,500,000 km² extending about 2,250 km from the north to the south and about 1,930 km from the east to the west.

Most of the northern part of the country is covered by desert zone and only 16 % of the territory is expected to become farmland if irrigation is applied suitably to these areas.

The total population of Sudan is about 22 million and most of the population is distributed in the rural area but about one-fifth of the total population is in the city areas of Khartoum, Omdurman, Port Sudan and others. Infrastructures such as railway, traffic road, electric power distribution system and others are still under developing stage.

To promote the national development plan for improving the living standard in rural areas and for developing the local society, a four-year plan has been established by the Government of Sudan to expand the radio broadcasting network as well as to reinforce the existing broadcasting facilities and the Government of Japan was requested to extend financial assistance in grant aid for the implementation of this project.

In response to this request, the Government of Japan decided to despatch a survey team and entrusted it to the Japan International Cooperation Agency (JICA). Then, the JICA sent a basic design survey team to Sudan from February 3 to March 3, 1984 to study the project.

The survey team has conducted site surveys and studies on the present situation of broadcasting service in the country and also on the contents of the four-year plan based on the results of site survey, and finally selected five prospective sites for the additional medium-wave radio transmitting stations to be constructed during this project period.

At present, the four major cities, Khartoum (capital), Sennar, Juba and Nyala and their suburbs are being covered by the medium-wave radio broadcasting service of the existing transmitting facilities, and its population coverage is about 38 %.

In considering the situation above, it will be necessary to construct some more transmitting stations in major cities or in the central cities of the agricultural area to expand the radio broadcasting network effectively in this project period. And then, it will be

possible to disseminate the necessary information for the inhabitants in the areas to improve the living standard and to further develop the local society. After the completion of this project, it is expected that the population coverage of radio broadcasting service will increase to approximately 53 %.

The survey team has carried out the site survey for El Obeid, Wad Medani, Atbara, Kassala and Dongola which proposed in the project.

The items which has been confirmed between the survey team and Sudanese officials are as follows:

- i) The transmitting stations shall be equipped with a 5-kW medium-wave radio transmitter with a stand-by transmitter and an emergency engine generator to avoid the interruption of broadcasting service caused by failure of transmitter or city power supply.
- ii) A shelter which is suitable for the environmental condition of the desert zone shall be used as a transmitter house.
- iii) The existing transmission lines of the Sudan Telecommunication Public Corporation (STPC) shall be used for programme transmission from Sudan National Broadcasting Corporation (SNBC) located in the suburb of Khartoum to each existing radio studio in the above five cities.
- iv) A Studio-to-Transmitter Link (STL) shall be newly installed to connect between each studio and the new medium-wave radio transmitting station.
- v) For the centralized maintenance and management of the facilities, a Maintenance Centre provided with necessary measurement equipment shall be established in Khartoum.
- vi) After completion of the construction work of the transmitting facilities, operation and maintenance staff for the facilities are to be positioned in the studio house located in each city and the Maintenance Centre. The operation of radio transmitting station are unattended and the start and stop of transmitters is remotely controlled from the studio house.

Concerning the implementation of the project, a duration of about twelve months is expected for the construction work of the five 5-kW medium-wave radio transmitting stations.

The cost for levelling of ground and extension of power distribution lines to the stations etc., shall be borne by Sudan side. The total cost estimated for the construction work is LSd. 411,000.

It is believed that the completion of the medium-wave radio broadcasting stations will contribute greatly to the development and progress of regional society, giving an expectation on the improvement of living standard in the region of these five cities.

Therefore, it might be deeply significant matter to cooperate in the project of the Democratic Republic of the Sudan by offering financial and technical assistance from Japan.

In conclusion, it is suggested that the organizational structures should be further strengthened to maintain and manage the broadcasting facilities and that training of operation staff is of importance.

In addition, successive implementation of the four-year plan would expand the coverage to improve the life of local communities.

CHAPTER 1

INTRODUCTION

CHAPTER 1 INTRODUCTION

The Democratic Republic of the Sudan has a possibility of producing sufficient food to become a storehouse of food for other African countries, in accordance with the reclamation of its vast territory and development of agricultural technology in the future.

However, in concerning the infrastructures such as traffic, communication, and electricity, etc., it can be said that the present state is yet insufficient and the literacy rate of adults is comparably low.

In order to improve the living standard of inhabitant, develop the social structure in the regions, improve the female's status and children's education, elevate the knowledge on health and sanitation, elevate the knowledge on agriculture and stock-farming etc., the government of Sudan established a new four-year plan (1984/85---1987/88) regarding the improvement of the radio broadcasting network and superannuated equipment and requested the financial assistance in grant aid from Japanese Government.

The requirement submitted at the initial stage are as follows:

(1) First Year Plan

Construction of five 5-kW medium-wave radio transmitting stations and renewal of superannuated existing radio programme production facilities in Juba broadcasting station.

(2) Second Year Plan

Construction of five 10-kW medium-wave radio transmitting stations.

(3) Third Year Plan

Construction of two 300-kW short-wave transmitting station.

(4) Fourth Year Plan

Renewal of superannuated studio equipment.

Expansion of regional medium-wave radio transmitting stations.

In response to the request, the Government of Japan has decided to conduct the survey on the project and entrusted it to the Japan International Cooperation Agency (JICA). The JICA despatched a survey team headed by Mr. Mototsugu KANO, Deputy Director, Radio Monitoring

Division, the Ministry of Posts and Telecommunications. (The member list and the schedule of the survey team are shown in the attached APPENDIX I and II respectively).

As a result of the discussions held with Sudan officials, a final conclusion was derived and the first year construction plan has been selected as the object to construct five medium-wave radio transmitting stations in five regional cities (El Obeid, Wad Medani, Atbara, Kassala and Dongola).

Basic items agreed on both sides regarding the objectives of the project, were summarized in the form of minutes, successively approved and signed by the both representatives. (Minutes is APPENDIX-III)

After returning from Sudan to Japan, the survey team analysed the results of the study, and the basic design of the project was prepared and summarized herein under the title of;

Basic Design Study Report on Rural Broadcasting Facilities Project in the Democratic Republic of the Sudan.

CHAPTER 2

BACKGROUND OF THE PROJECT

CHAPTER 2 BACKGROUND OF THE PROJECT

2-1 General Condition

The medium-wave radio broadcasting service in Sudan started in April 1940 under the joint sovereignty by U.K. and Egypt. While an experimental TV broadcasting service started in December 1962, which was shifted to regular broadcasting service in November 1963. Also, an experimental FM broadcasting service is currently being conducted. Those of the broadcasting services are carried out by SNBC (Sudan National Broadcasting Corporation), a unique broadcasting organization under the control of the Ministry of Information. The TV broadcasting network has been widely expanded via communication satellite "SUDOSAT" and terrestrial microwave links. However, only about 100,000 TV receivers are being used because the city power is limited to urban area and the price of TV set (LSd. 2,000 to 3,000) is expensive as compared with the average national income. While low priced radio sets (Simple type for medium-wave: about LSd. 10, for short wave: LSd. 30 to 40) are well popularized all over the country, thus the importance of radio broadcasting is extremely high. Information and educational programmes disseminated by medium-wave broadcasting network will supply useful information and knowledge to the nation by virtue of its stable propagation. However, medium-wave broadcasting service is still needed to expand over the whole territory.

To improve the current condition mentioned above, the four-year plan described below was made.

In the four year plan, it is planned to further expand radio broadcasting network in tied with the development project and to upgrade the living standard of rural inhabitants. It is expected that the development of rural society will be remarkably and effectively promoted by penetrating much more information on the social activities and instructive information on the agriculture, cattle breeding, health, sanitation, nursing and so on into every communities scattered all over the country by the aid of the broadcasting service.

(1) First Year Plan

Construction of 5-kW medium-wave radio transmitting station:

A 5-kW medium-wave radio transmitting station will be constructed in the major five cities (El Obeid, Wad Medani, Atbara, Kassala and Dongola) to broadcast the nationwide programmes sent from SNBC Omdurman Station as well as local programmes produced the local studio existing in each city. In addition to the construction of new radio broadcasting stations, spare parts, consumable goods and measuring equipment will be supplied for the maintenance service. Training of staff will also be carried out in tied with the above.

(2) Second Year Plan

1) Construction of 10-kW medium-wave radio transmitting station:

A 10-kW medium-wave radio transmitting station will be constructed in the remote cities which are located near the border (Kadugli, Halfa, El Fasher, Ed Damazin and Port Sudan) to expand the service areas in addition to the first year plan. As a result of this construction, the area which has been covered by only foreign radio signals will be covered by domestic radio programmes.

2) Renewal of the superannuated programme production facilities in the Juba Station:

Audio Control Console
Tape Recorder/Reproducer
Monitoring Equipment
Microphone

(3) Third Year Plan

Construction of short-wave transmitting station:

Two sets of 300-kW short-wave transmitters with antennas and related facilities will be installed in the premises of existing Soba radio transmitting station. The planned frequencies are 5,039, 6,150, 7,200, 9,505 and 11,835 kHz.

During the discussion on this plan held in Sudan, though the Minister of Information earnestly requested to execute this plan in the second year.

(4) Fourth Year Plan

1) Renewal of the studio facilities in the Omdurman Station:

The superannuated studio facilities will be renewed.

2) Expansion of local transmitting station:

Table 2-1-1 shows the estimated growth in population coverage and land coverage.

Table 2-1-1 Land and Population Coverage of MW Radio Broadcasting

Occasion		Present	End of 1st Year Plan	End of 4th Year Plan
Population Coverage	Population (million)	8.34	11.71	12.38
	Covered Ratio (%)	37.9	53.2	56.3
Land Coverage	Covered Area (x 1,000 km ²)	304	378	465
	Covered Ratio (%)	12.2	15.1	18.6

Total Population in Sudan: 22,000,000

Total Land Area in Sudan: 2,500,000 km²

2-2 Organization of SNBC

The SNBC is consist of three departments, that is Department of Radio, Television and Administration under the chairman of Board of Directors and Director General.

Radio Department has three divisions in charge of general radio programme, special programme (religions programme, public voice programme and so on) and programme production.

Television Department has five divisions in charge of TV programme production and planning Film, Local TV programme and educational programmes and administration, TV news and so on.

Department of Administration has seven divisions in charge of technical affairs, commercial, marketing, planning & research, Finance, political programmes and corporation council.

The total number of SNBC staff are now approximately 730 persons as listed below;

The outline of staff composition are as follows:

Managing staff	Approx.	10 persons
Programme planning	"	200 "
Technical staff	"	200 "
Researching staff	"	20 "
Others	"	300 "
Total	"	730 "

Fig. 2-2-1 shows the organization chart of SNBC.

2-2-1 Broadcasting Programme and Broadcasting Network

Radio nationwide programmes are broadcast from 6:00 to 24:00 for eighteen hours daily in the cities such as Khartoum (Soba Broadcasting Station), Sennar, Juba and Nyala. Also, People's Broadcasting Service and other programmes are broadcast from 12:00 to 24:00 for twelve hours daily only in Khartoum.

While, the TV nationwide programmes are broadcast from 16:00 to 23:30 for seven and half hours TV in Khartoum and other twenty four cities in the country. In addition, educational programmes are broadcast from 18:00 to 21:00 for three hours daily only in Khartoum.

The FM broadcast is being carried out on a trial basis only in Khartoum from 7:00 to 9:00 and from 15:00 to 18:30 daily for five and half hours.

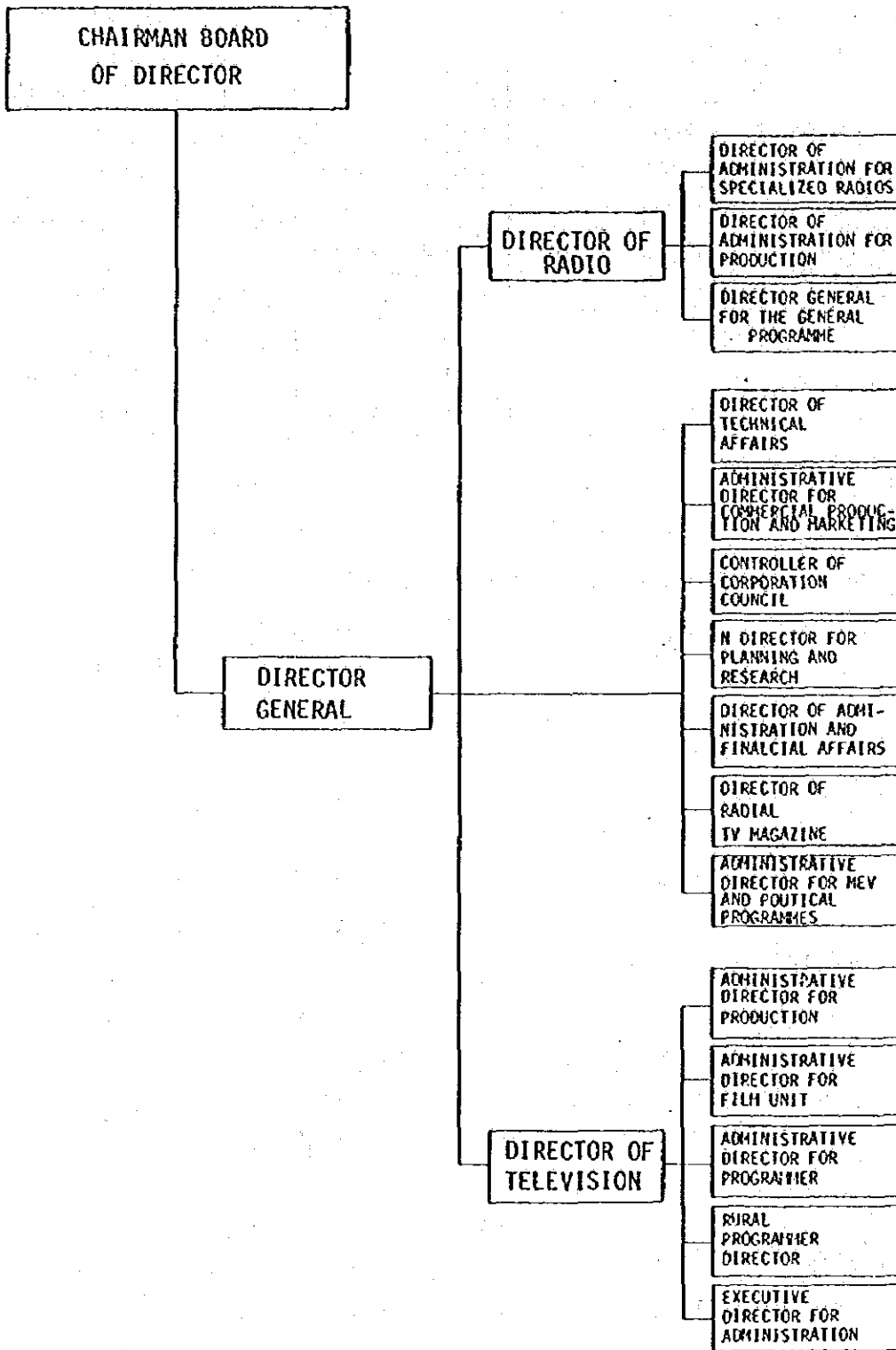


Fig. 2-2-1 Organization of SNBC

Table 2-2-1 shows the broadcasting media and programmes

Media	Programme	Time	Hours	Remarks
TV	Nationwide Programme	16:00 - 23:00	7.5	Nationwide
	Educational Programme	18:00 - 21:00	3	Khartoum
Radio	Nationwide Programme	06:00 - 24:00	18	Nationwide
	People's Broadcasting Service	12:00 - 15:00	3	Khartoum
	Holy Koran Service	15:00 - 18:00	3	
	Voice of the Sudanese Nations	18:00 - 24:00	6	
FM	Voice of Music	07:00 - 09:00	2	Test transmission
		15:00 - 18:30	3.5	Khartoum

Contents of programmes are as follows:

General radio programmes	Ratio
News	24 %
Education, Culture	24 %
Politics	3 %
Religion	13 %
Agriculture, Livestock farming	2 %
Entertainment	34 %

General TV programmes	Ratio
News	23 %
Education, Culture	22 %
Politics	11 %
Entertainment	42 %
Others	2 %

Educational TV programmes	Ratio
Education, Sports	100 %

FM Voice of Music	Ratio
Music	100 %

At present, short-wave broadcasting is out of service because the facilities are superannuated and unusable. In the past, programmes were broadcast daily in Arabic, English and other nine foreign languages for three hours from Soba Broadcasting Station for the South Sudan, and Koran programmes were broadcast daily for two hours in Arabic language.

The current land coverage of general service by medium-wave radio transmission is only approximately 8.34 million, or 37.9% of the total population. However, it is urgently required to expand service area by executing this expansion plan.

2-2-2 Current Conditions of Radio Broadcasting Facilities

The radio programmes are produced at SNBC Omdurman and Juba Broadcasting Stations and some of the programme materials are produced at studios of regional station.

Programme production and continuity facilities in SNBC Omdurman are as follows:

Production studio	Small	4
do	Large	5
Continuity studio		4

Fig. 2-2-2 shows the floor layout of SNBC Omdurman.

Large studios except Studio A are not being used because the facilities are already superannuated.

Though site survey on Juba Broadcasting Station was not carried out, the current status equipment are look like similar to the status of Omdurman Station according to the information given by the staff of SNBC. Each regional information department in El Obeid, Wad Medani, Atbara, and Kassala is provided with a small radio studios and control room respectively. In the control room, an audio console, tape recorders/reproducers, and monitoring equipment are provided to for producing local radio programmes.

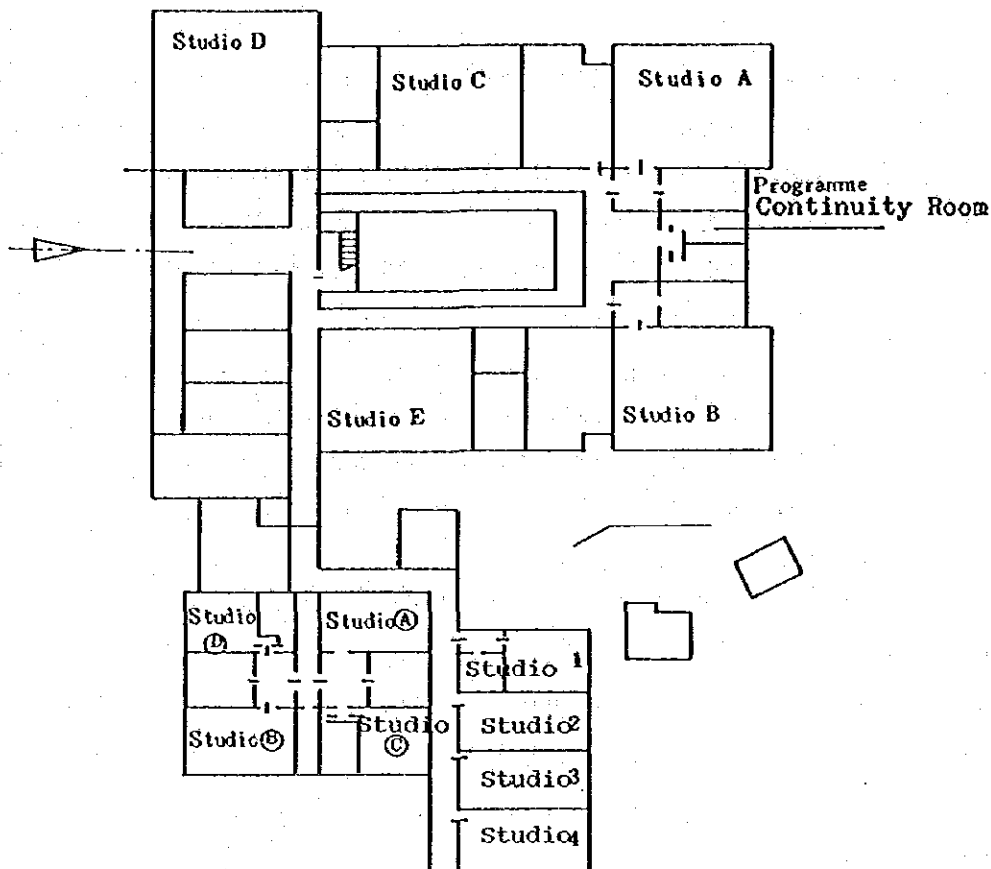


Fig. 2-2-2 Floor layout of SNBC Omdurman

The studios in the Information Department of regional States, are operated by the staff of its Department. Programmes of 10 to 30 minutes long containing local news, agricultural programmes, and special event programmes are produced once to four times per month.

As there is no transmitting facility in each city, recorded tapes are transported to SNBC Omdurman and then, it is disseminated throughout the country.

However, these programmes can not be well received by the regional people living in El Obeid, Atbara, Kassala and Dongola area. Though the production facilities such as an audio console, tape recorders/reproducers are already on site. Dongola studio building is still under construction.

Fig. 2-2-3 shows the current coverage area served by nationwide medium-wave radio broadcasting programmes.

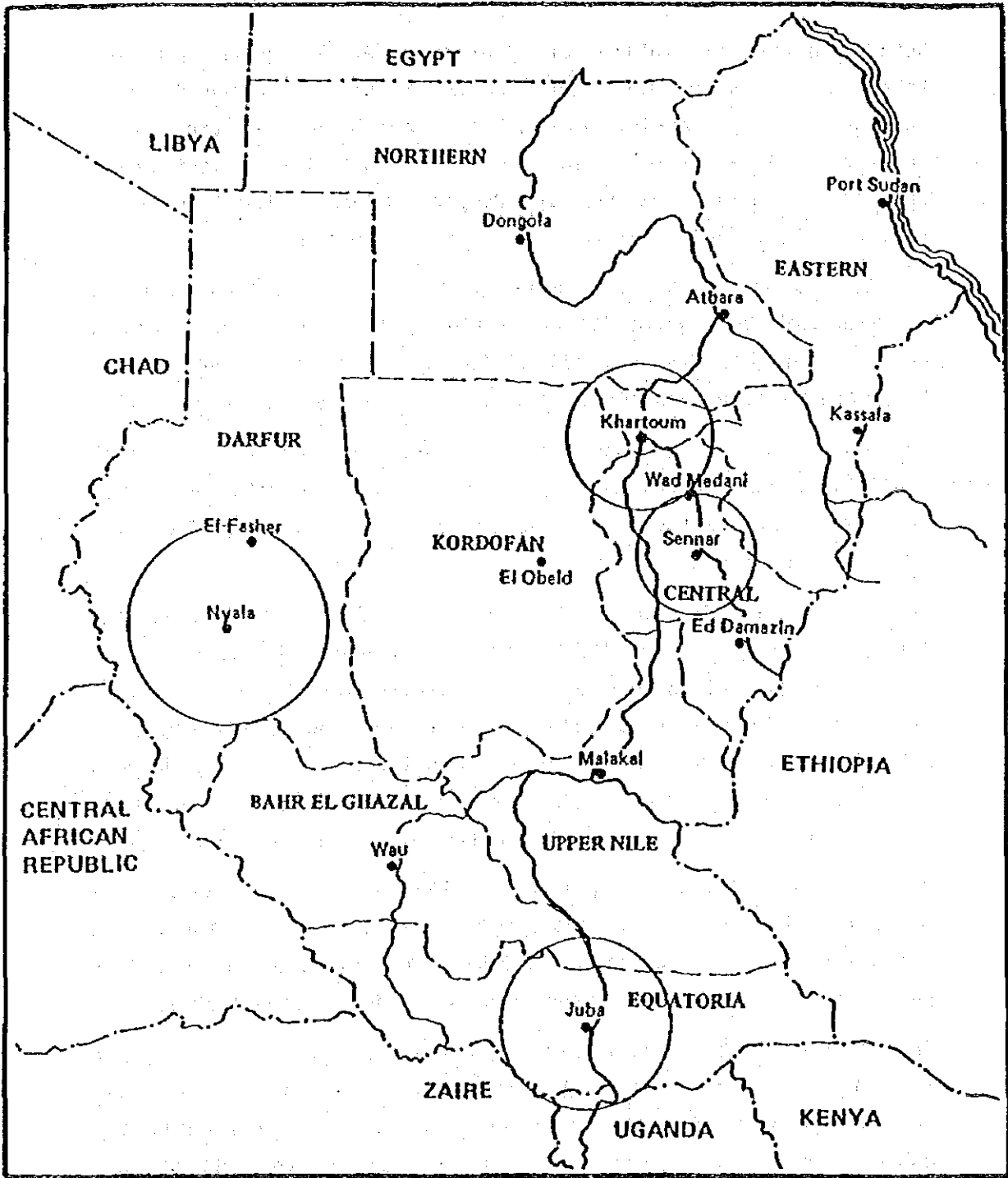


Fig. 2-2-3 Current Coverage Area of Nationwide Medium-Wave Radio Broadcasting Programme

Soba Transmitting Station is located at 20 km south-east of Khartoum. There are two 100-kW transmitters which were manufactured by Harris, U.S.A. and has been operating since February of 1982. One is used for the transmission of nationwide programmes and other is used for People's Broadcasting Service and others. These facilities seem to be well maintained.

In 1961, a set of short-wave transmitter was installed by Gates Co. in this Soba Transmitting Station and it has been operating until recently. However, all of these facilities except antenna tower has already been turned down when survey team visit here.

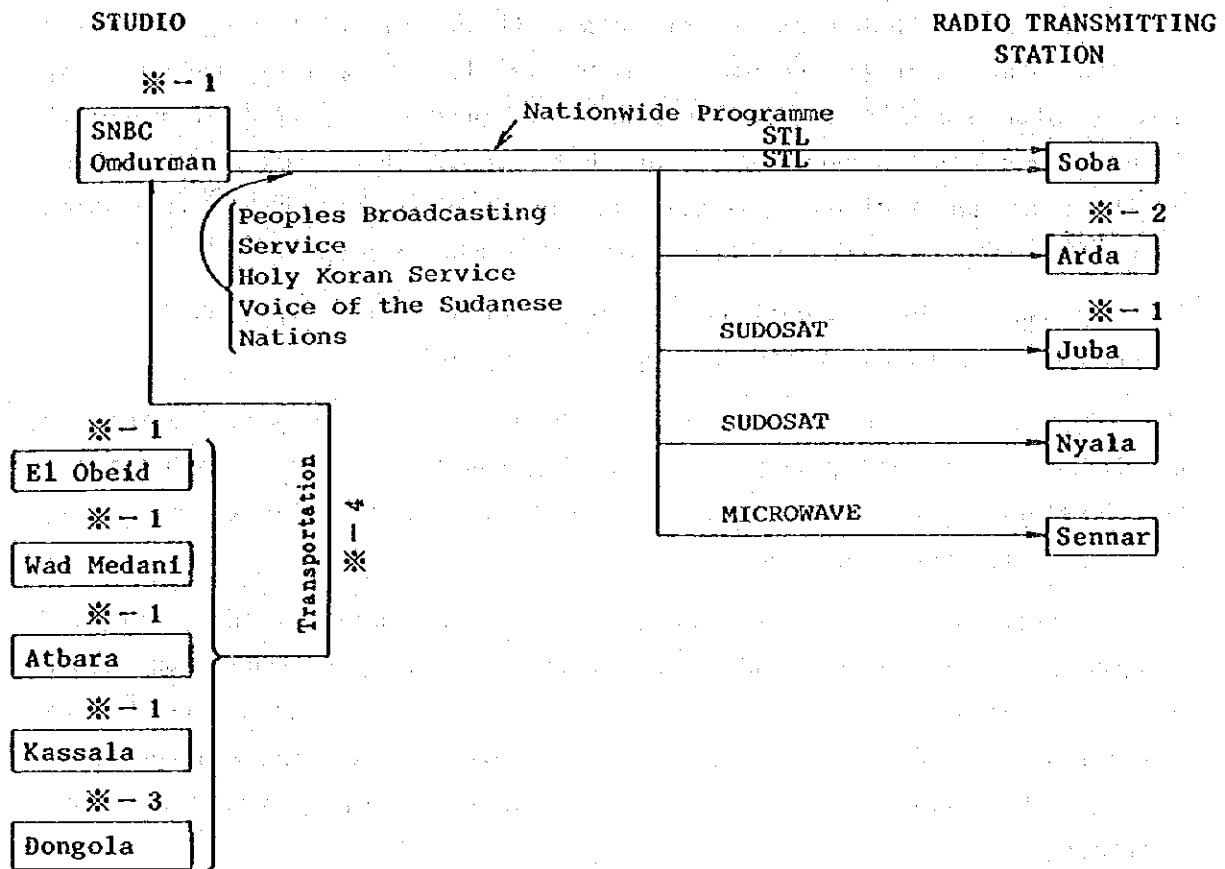
To resume the short-wave radio broadcasting service from this station, it has been planned to installed two sets of 300-kW short-wave transmitters in the third year of the four-year construction plan.

In relation to this plan, it will be needed to survey on the strength of antenna supporting tower before deciding the re-use of these towers. At Arda transmitting station which is located on the outskirts of Khartoum and operating as standby station for Soba Station, a 50-kW medium-wave transmitter supplied by Marconi has been operating since 1953. However, now its power output is reduced to about 5-kW due to the facilities are so much aged.

On the other hand, a 1,500-kW radio transmitting station is operating at Sennar located at 250 km south-east of Khartoum. The transmitter is composed of two 750-kW transmitters and operated as parallel running system manufactured by TESLA, Czechoslovakia.

This station is broadcasting nationwide programmes which is relaid from SNBC Omdurman. This station has been operating since 1978 for the purpose of the nationwide service. But, currently the output power of transmitter is decreased to 750-kW and broadcasting hour is limited to 8 hours in total from 06:00 to 07:35 and 17:30 to 24:00 due to the shortage of city power supply capability.

Fig. 2-2-4 shows the medium-wave radio network.



- *-1 Studio equipment (Operating)
- *-2 Standby transmitting station for Soba station
- *-3 Under construction
- *-4 As El Obeid, Wad Medani, Atbara, Kassala and Dongola have no transmitting station, the recorded programmes produced in those cities are being transported to SNBC Omdurman.

Fig. 2-2-4 Medium-Wave Radio Network

2-3 Current Utilization and Future Prospect of Radio Broadcasting

Radio receiving sets are popularized throughout the country in spite of the insufficient condition of broadcasting.

This means that most of the people living in rural area are eager for listening their own country's programmes including news, information, ethnic culture and entertainment programmes produced by SNBC in stead of foreign broadcast programmes. In this sense, this project should be realized at an earliest possible opportunity to improve broadcasting service by SNBC to meet with the desire of Sudanese people.

In response to the national policy and national request, SNBC has been planned to compose the following type of programmes.

The contents of nationwide programmes are aimed at enlightening the knowledge of national policy and promoting the sense of responsibility to the development of own country by giving more information on the news, social, agricultural programmes.

While, the contents of local programmes is consist of informational programmes on the development of local industries, agriculture and cattle breeding which is closely related to the area. Local programmes transmitting is planned of a medium-wave radio transmitting station to be set up under this project for two hour per day. The programmes are as follows:

(1) Campaign programmes by Local Government

Notice and diffusion of local government policy, daily activity and event.

(2) Emergency Broadcasting for Disaster

Urgent notice or information to ensure the safety in case of accidents or disasters.

(3) Local News

Offering of daily information or news which closely related to the local people.

- (4) Agricultural Programme
Diffusion of the agricultural knowledge to improve productivity of the agricultural products.
- (5) Social Educational Programme
Promoting of living standard by propagation of sanitary knowledge, general and social knowledge for the nomadic people.
- (6) Programme for Housewife
Offering of living information according to the actual situation in each region.
- (7) Children's Programme
Creating the children's culture of sentiments according to each region.

CHAPTER 3

LAYOUT OF PLAN

CHAPTER 3 LAYOUT OF PLAN

3-1 Objective of Plan

With the objective of improving the living standard of the regional people and acceleration the development of the regional society, medium-wave radio transmitting stations will be newly installed at the regional five major cities (EL Obeid, Wad Medani, Atbara, Kassala and Dongola) where the population density is comparatively high, to broadcast the nationwide programmes produced at SNBC Omdurman as well as the local programmes produced at each existing studio in the above five major cities.

3-2 Construction of Radio Transmitting Stations

At present, radio programmes are being broadcast from five existing stations and the area and population served are insufficient. In the outside area of the coverage, it is difficult to receive their own programmes with sufficient quality due to the interference or incoming signals from foreign countries.

The survey have been carried out on the proposed five cities, El Obeid, Wad Medani, Atbara, Kassala and Dongola.

With regard to the proposed sites, measurement of the field strength of undesired incoming signal and ground conductivity, survey of soil and circumstances etc., were conducted.

As the result, it was concluded that all of the sites are appropriate for the construction of medium-wave transmitting stations as explained in the following:

- (1) The coverage area of all stations under planning includes mostly populated areas, such as capital city of State, central cities of agriculture and industry. Present population coverage of existing stations is 37.9 % and it will be improved to about 53 % by the completion of the five transmitting stations.

- (2) The radio studios in the above cities have been already constructed except Dongola. The studio in Dongola is under construction and will be completed until the transmitting station is constructed. In addition, every proposed site is located within a line-of-sight from each studio ranging from 5 to 10 km and the transmission of programme by wireless link is easy.
- (3) City power supplies are easily available for all transmitting stations, and access roads to them are also provided.
- (4) Sufficient land area have been already reserved for all stations.

CHAPTER 4

OUTLINE OF PROPOSED SITES

CHAPTER 4 OUTLINE OF PROPOSED SITES

This chapter describes the outlines of the five major cities, El Obeid, Wad Medani, Atbara, Kassala and Dongola which are proposed sites for the transmitting stations.

4-1 Location of Proposed Sites and its Circumstances

4-1-1 Location of Proposed Sites

Table 4-1-1 shows the location of proposed sites.

Table 4-1-1 Location of Proposed Sites

Name of City	Region	Latitude (North)	Longitude (East)	Altitude
El Obeid	Kordofan	13°12'10"	30°19'17"	568 m
Wad Medani	Central	14°28'51"	33°27'51"	405 m
Atbara	Northern	13°12'10"	30°17'17"	350 m
Kassala	Eastern	15°26'37"	36°21'53"	495 m
Dongola	Northern	19°06'00"	30°28'21"	227 m

4-1-2 Climate

From April to October, it is the rainy season and rains much from July to August and the distribution of rainfall in the country is depicted in Fig. 4-1-1, showing gradual increase from northern to southern regions. Annual rainfall at El Obeid is about 360 mm at the most and 20 mm at Dongola at the minimum among the proposed sites.

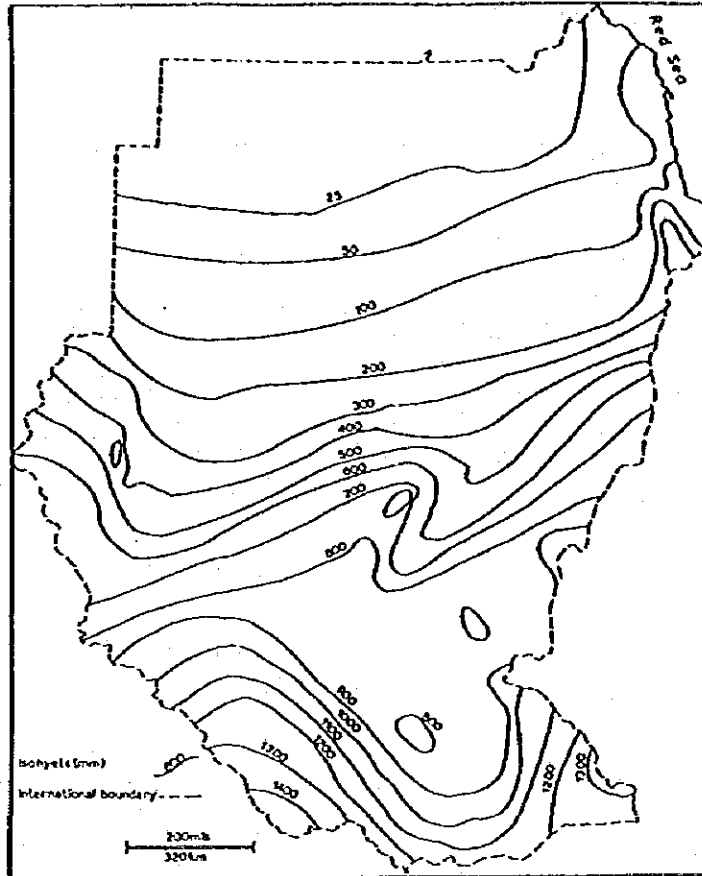


Fig. 4-1-1 Mean Annual Rainfall in Sudan (quoted from Sudan Yearbook, 1983)

It reaches the highest temperature of about 40 to 42°C in the daytime during the period from May to July in the year.

Average annual humidity in Sudan is fairly low. During the dry season, it is the order of 20 to 30 %, and goes up to about 70 % at the most in April even in the rainy season.

Half of the country has been occupied with desert and savanna zone, especially in the northern region and the ground surface is covered with fine grain soil. In some cases, the soil is whirled up by the strong wind blow and it becomes sand storm prevailing mostly from May to July. Lightning is rare throughout the country.

4-1-3 Soil

Black-cotton-soil distributing from the central to the south-east area of Sudan is a special soil. The soil is called Badole in Sudan, it shows significantly swelling according to the variation of amount of water contained. The average depth of the soil layer is about 1 to 2 m, accordingly it is necessary to put the foundation of building in the depth beneath the layer.

The soil test was performed by boring at the five proposed sites and many samples were collected. The Dutch Cone Penetration Test (C.P.T.) was carried out in Kassala by Khartoum University.

The allowable bearing strength of soil at each proposed site was examined by the analysis of the samples and physical tests (JIS A1202--A1206) referring the results of C.P.T. conducted by Khartoum University. The allowable bearing strength is shown in Item 4 -2.

4-1-4 General Construction Circumstances

The main structure of existing buildings in Khartoum and local cities are mostly made of reinforced concrete and brick. In ordinary houses, small stores, medium and multistoried buildings, the method of laying bricks as wall and separation wall upon the reinforced concrete with rahmen grid-frames is mostly popular.

The construction materials available in Sudan are such as cement, sand, gravel, reinforcing bar, terrazzo block, concrete block, paint and corrugated iron plate, etc., and the other materials are imported.

Cement is manufactured by the factory in Atbara, but their products are not enough to meet the national consumption of amounting for about one million tons, and the cement made in Rumania and Bulgaria are imported. The Chinese made reinforcing bars can be obtained, but their kinds are limited. Sand and gravel can be obtained from River Nile.

4-1-5 Regulations and Acts on Building Construction

As there is no regulation on the construction of building, the British Standard (BS) are generally used for structure design.

In the basic design, Japanese Building Standard Law is used by referring the conditions of Sudan.

4-1-6 Transportation

The transportation routes of construction materials are as follows.

Port Sudan	→	Kassala	629 km	Road
do	→	Wad Medani	1,087 km	do
do	→	El Obeid	1,639 km	do
do	→	Atbara	516 km (Note-1)	Railway
do	→	Khartoum	1,264 km	Road
do	→	Dongola	1,811 km (Note-2)	do

The road conditions around each site are explained in Item 4-2.

(Note-1) As allowable total weight of car passing the bridge over River Atbara between Port Sudan and Atbara is limited, railway transportation shall be used between Port Sudan and Ed Damer Station.

(Note-2) For the transportation of large size materials between Khartoum and Dongola, it is recommended to carry them on the road via Buhad rather than the road along River Nile.

Fig. 4-1-2 shows the railways and roads.

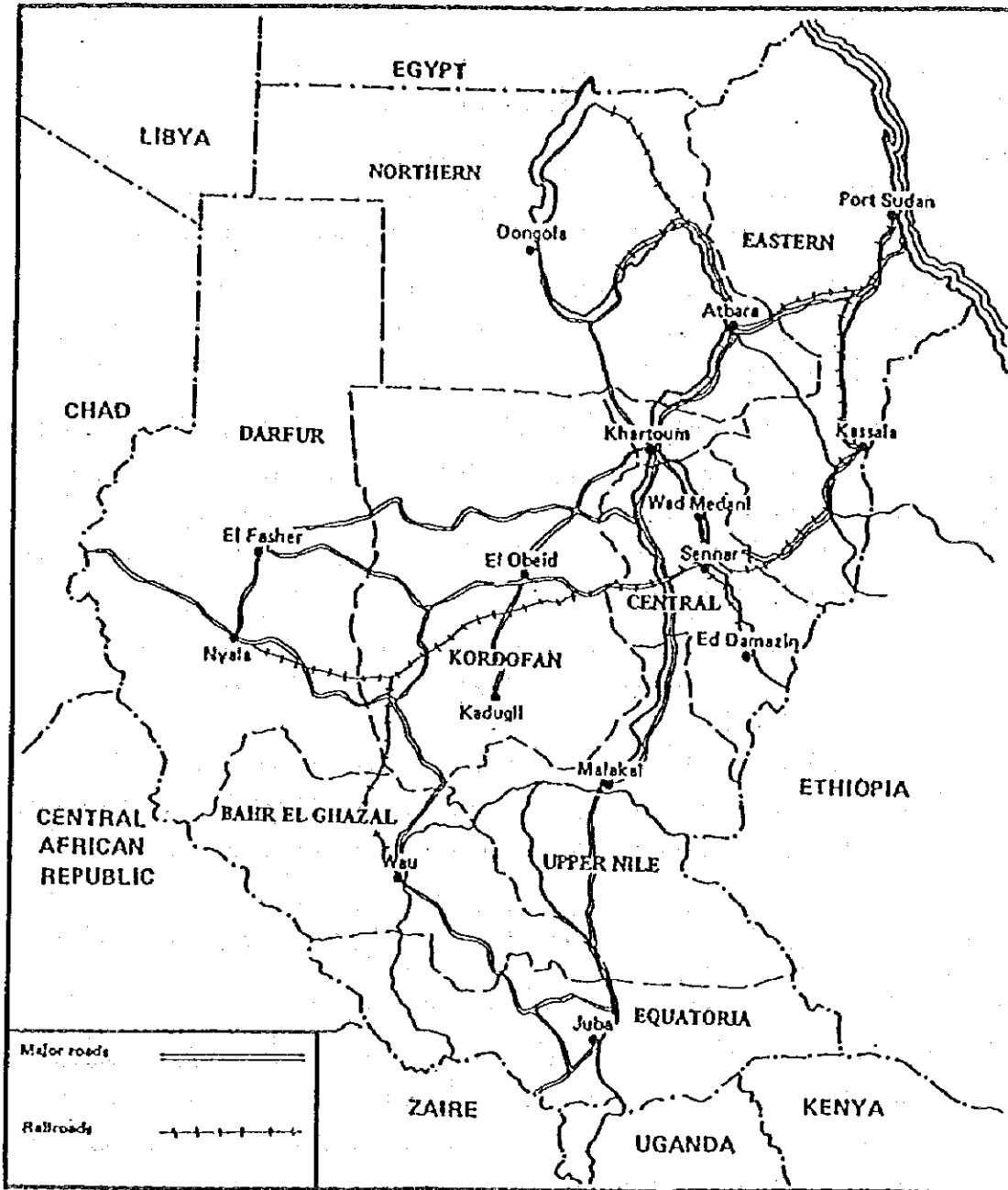


Fig. 4-1-2 Railways and Roads

4-2 Circumstances of Each Proposed Site

(1) El Obeid

1) Circumstances of Site and Location of Studio

El Obeid is the capital city of Kordofan State (3,500 thousands population) with a population of 120,000. It is the centre for cattle breeding, a collecting place of the crops such as cereals, sesames etc.

Fig. 4-2-1 shows the outline of El Obeid city.

The proposed site is located about 9 km east-north-east from the central part of the city with an area of approximately 82,000 m².

There is a Nurse School and two houses near the site. The surroundings of the site is almost flat savanna zone inclining to the south with some trees and shrubs.

Unpaved 50 m width road is existing to the site. Large trailer can be used for transportation of construction materials. However, as many small water streams flow temporarily at lower places during the rainy season (June---September), use of trailer becomes difficult.

Fig. 4-2-2 shows the outline of the site (El Obeid).

The studio equipped with an audio mixing console, tape recorders/reproducers, monitoring speakers and related facilities, is available to produce radio programmes.

Fig. 4-2-3 shows the layout of the equipment and other facilities (El Obeid).

The distance between the proposed site and the studio is approximately 9 km and the land is almost flat. The site is in line-of-sight from the studio, and no obstruction is existing for the installation of STL.

There is an airstrip located 8 km south-east from the proposed site. But there is no navigation obstruction.

2) Soil

The soil at GL-1 m (one meter below ground level) is a laterite layer, and under the layer is clay soil or silty sand. From the results of survey, it is concluded that the long-term allowable bearing strength of the foundation is $10.5 Bt/m^2$ for the depth of GL-2 m. (Where B = Minimum width of the foundation.)

3) Climate

At El Obeid, the temperature change during the year is least among the five proposed sites. The maximum amount of rainfall is approximately 100 mm/day in the rainy season and small water streams appear everywhere in savanna zone. Northerly wind prevails in the dry season and Southerly wind prevails in rainy season.

(2) Wad Medani

1) Circumstances of Site and Location of Studio

Wad Medani, located in the fertile Gezira region between the Blue Nile and the White Nile, is the centre of agriculture producing raw cotton and sugar canes.

The current population is approximately 170,000 and it is expected to increase by development of surrounding vast farming area in future.

Fig. 4-2-4 shows the outline of Wad Medani City.

The proposed site is located at approximately 10 km north-north-west from the city with an area of $82,500 m^2$.

The site is located on a plateau along the Blue Nile, surrounded by flat savanna with slight undulations inclining to the east.

The Blue Nile flows in the east side of the site at a distance of 1 km, and the highest water level of the Nile in the rainy season is about 6 to 7 m lower than the site level.

The site faces the highway connecting Khartoum and El Obeid (via Kosti) and transportation of construction materials is easy.

In addition, 11 kV power distribution lines are existing along the highway, and the receiving of city power is easy.

Fig. 4-2-5 shows the outline of the site (Wad Medani).

The studio equipped with an audio mixing console, tape recorders/reproducers, monitoring speakers and related facilities, is available to produce radio programmes.

Fig. 4-2-6 shows the layout of the equipment and other facilities (Wad Medani).

The distance between the proposed site and the studio is approximately 10 km and the topography is almost flat. The site is in line-of-sight from the studio, and no obstruction is existing for the programme transmission by STL.

An airstrip is located 12 km from the proposed site. But there is no navigation obstruction.

2) Soil

According to the results of boring test, the earth is covered with black-cotton-soil to the depth of GL-2 m, however it is necessary to reexamine the depth of the layer prior to the base construction. It is requested to remove the black-cotton-soil to set the base of foundation. However, in case the depth of layer is extremely deep and is used as a supporting layer, the long-term allowable bearing strength of the soil is assumed to 25 t/m^2 as the sharpness ratio of clay soil is 1/10 and the depth of the base of foundation is at GL-2 m.

3) Climate

Average temperature rises to 41.5°C in the rainy season and falls to 14°C in the dry season. The annual average rainfall is about 343 mm. The suburb is a savanna zone. Northerly wind prevails in the dry season and strong southerly wind prevails in the rainy season.

(3) Atbara

1) Circumstances of Site and Location of Studio

Atbara is one of the industrial cities in Sudan where Headquarters of Sudan National Railway is located and a large cement factory is in operation.

The capital city of the Northern State Ed Damer is located approximately 14 km in the south from the city.

Population of Atbara and Ed Damer are 80,000 and 10,000 respectively.

Fig. 4-2-7 shows the outline of Atbara City.

The proposed site is located 5 km south from the centre of the city, neighboring the training centre of Sudan National Railway. The site is a savanna zone and its area is approximately 89,000 m². There are small undulations of 1--2 meters in the site which partly require ground levelling work.

The River Atbara is flowing at the distance of about 1 km north from the site, and the highest water level of the river is about 8--10 m lower than the site level.

For the transportation of construction materials, railway have to be used between Port Sudan and Ed Damer as the weighting capacity of bridge over River Atbara is limited.

The road between Ed Damer and the proposed site is partly paved, however transportation of construction materials by a large trailer is possible. As 11 kV power distribution lines are existing near the site, reception of city power is easy.

Fig. 4-2-8 shows the outline of the site (Atbara).

The studio equipped with an audio mixing console, tape recorders/reproducers, disk players, monitoring speakers, is available for radio programmes production.

Fig. 4-2-9 shows the layout of Equipment and other facilities (Atbara).

The distance between the proposed site and the studio is approximately 5 km and the topography is almost flat. The site is in line-of-sight from the studio.

No obstruction is existing between them for the transmission of programme by STL. An airstrip is located approximately 7 km north-north-east from the proposed site. But there will be no navigation obstruction.

The influence of floods of River Atbara and the Nile have been investigated. According to the State officials there seems to be no problem. No special measure against flood is provided even for the large cement factory and electric power plant (diesel engine operated) located nearby.

2) Soil

The soil at the level of GL-1 m--2 m in the site is silty or clayish sand. In case the base of foundation is set at GL-2 m, the long-term allowable bearing strength is $10.5 Bt/m^2$. (Where B = Minimum width of foundation.) Soil of the site is almost similar as of El Obeid.

3) Climate

Average temperature rises to $42.8^{\circ} C$ in rainy season and falls to $4.4^{\circ} C$ in dry season. Annual average rainfall is 67 mm. The south-south-west wind prevails in rainy season and northerly wind prevails in other seasons. Sand storm occurs frequently in the dry season.

(4) Kassala

1) Circumstances of the Site and Location of Studio.

Kassala is the capital of Eastern State near the border of Ethiopia. It is a producing district of grape fruit, bananas and vegetables etc., with a population of about 170,000.

Fig. 4-2-10 shows the outline of Kassala city.

The proposed site is located 5 km south-east from the centre of Kassala city. It is at the southern end of the agricultural zone spreading 3-4 km along River Gash which flows at the southern part of the city from south-east to north-west. The site had been used as farm land however it is not used now and the area is approximately $89,000 m^2$.

The site faces a paved road of 7 m width which connect Port Sudan and Khartoum, therefore there is no problem for the transportation of construction materials.

In addition, as 11 kV power distribution lines are existing along the site, reception of city power is easy.

Fig. 4-2-11 shows the outline of the site (Kassala).

The studio equipped with an audio mixing console, tape recorders /reproducers, disk players, monitoring speakers, is available to produce radio programmes.

Fig. 4-2-12 shows the layout of equipment and other facilities (Kassala).

The distance between the proposed site and the studio is approximately 5 km and the topography is almost flat. The site is in line-of-sight from the studio, and also no disturbance is existed among them.

An airstrip is located 4 km south-west from the proposed site. But there is no navigation obstruction.

2) Soil

The soil at the level of GL-1 m---2 m is sandy clay or silt, it can be considered as clayish soil, toward the deep layer at the level of GL-10 m to 15 m, the proportion of sand increases gradually.

According to the results of the Dutch Cone Penetration Tests, in case the base of foundation is set at the level of GL-2 m, the long-term allowable bearing strength becomes 172 t/m^2 . However, value of 50 t/m^2 is used in the design considering the decrease of bearing strength due to submergence at rainy seasons.

3) Climate

The average temperature rises to 41.8°C in the rainy season and falls to 16°C in the dry season. Annual average rainfall is 290 mm. North-north-east wind prevails in the dry season and southerly wind prevails in the rainy season.

The record of instantaneous maximum wind velocity was 37 m/sec, sand storm frequently occurs in the dry season.

(5) Dongola

1) Circumstances of Site and Location of Studio

Dongola is located at the centre of Northern Region with a population of about 10,000. It is a main cereal producing district facing River Nile, and a large scale agricultural development plan is going on.

Fig. 4-2-13 shows the outline of Dongola city.

The proposed site is located along the River Nile approximately 7 km south from the city.

The surroundings is a flat desert. The site is approximately 90,000 m².

The road from the city to the proposed site is not yet completed but transportation of construction materials by a large trailer is possible.

In addition, as the construction project of 11 kV electric power transmission lines along River Nile will be realized this year, receiving of city power can be done easily.

Fig. 4-2-14 shows the outline of the site (Dongola).

The studio is under construction, the mixing console and its related facilities are already imported and stored in a storage room, however as the storing condition is not good, it is necessary to recheck the equipment before hand.

Fig. 4-2-15 shows the outline of studio (Dongola).

Distance between the proposed site and the studio is approximately 7 km and the topography is almost flat. The site is in line-of-sight from the studio, enabling the direct transmission of programme by STL.

An airstrip is located about 5 km north-west from the proposed site. But there is no navigation obstruction.

The studio is an independent building with area of 5 m x 10 m, consisting of three rooms, i.e. studio, sub-control and sound-lock room.

The brick walls are completed at present but the roofing is not yet finished. It was confirmed that the studio will be completed until the transmitting station is constructed.

2) Soil

The surface of the ground is covered with fine clay of a thickness of about 20 cm similar to black-cotton-soil, beneath it layer of puddle stones mixed with sand is laid. This is a good layer to support the foundation.

In case the base of foundation is set at the level of GL - 2 m, the long-term allowable bearing strength is 25.6 Bt/m^2 . (Where B = Minimum width of foundation.)

3) Climate

Dongola is located in the northeast among the five. Weather is very dry, annual average rainfall is less than 19 mm and humidity varies from 20 to 37 % throughout the year. The average temperature rises the highest in July, and usually it falls to about 8° C in January.

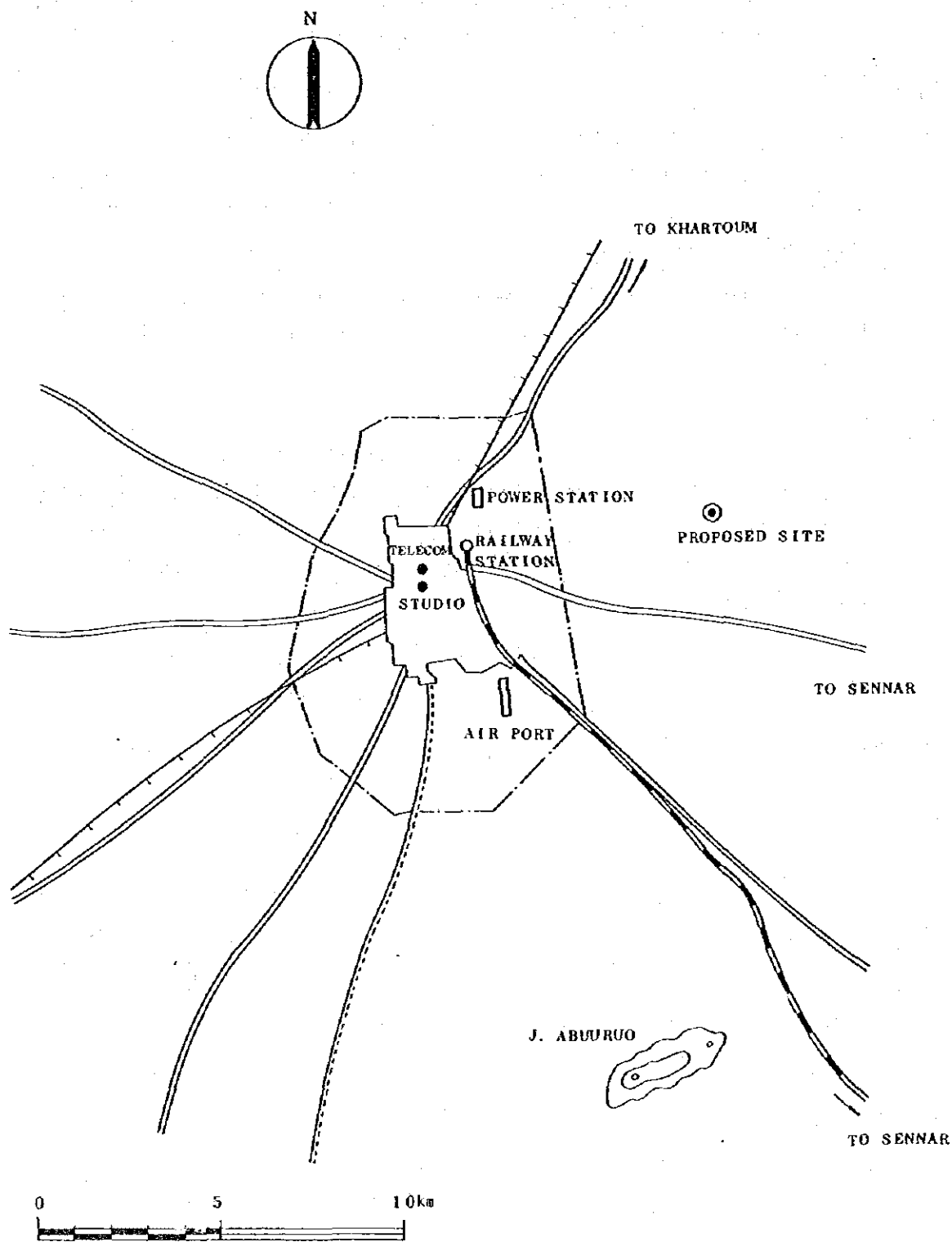


Fig. 4-2-1 Outline of El Obeid City

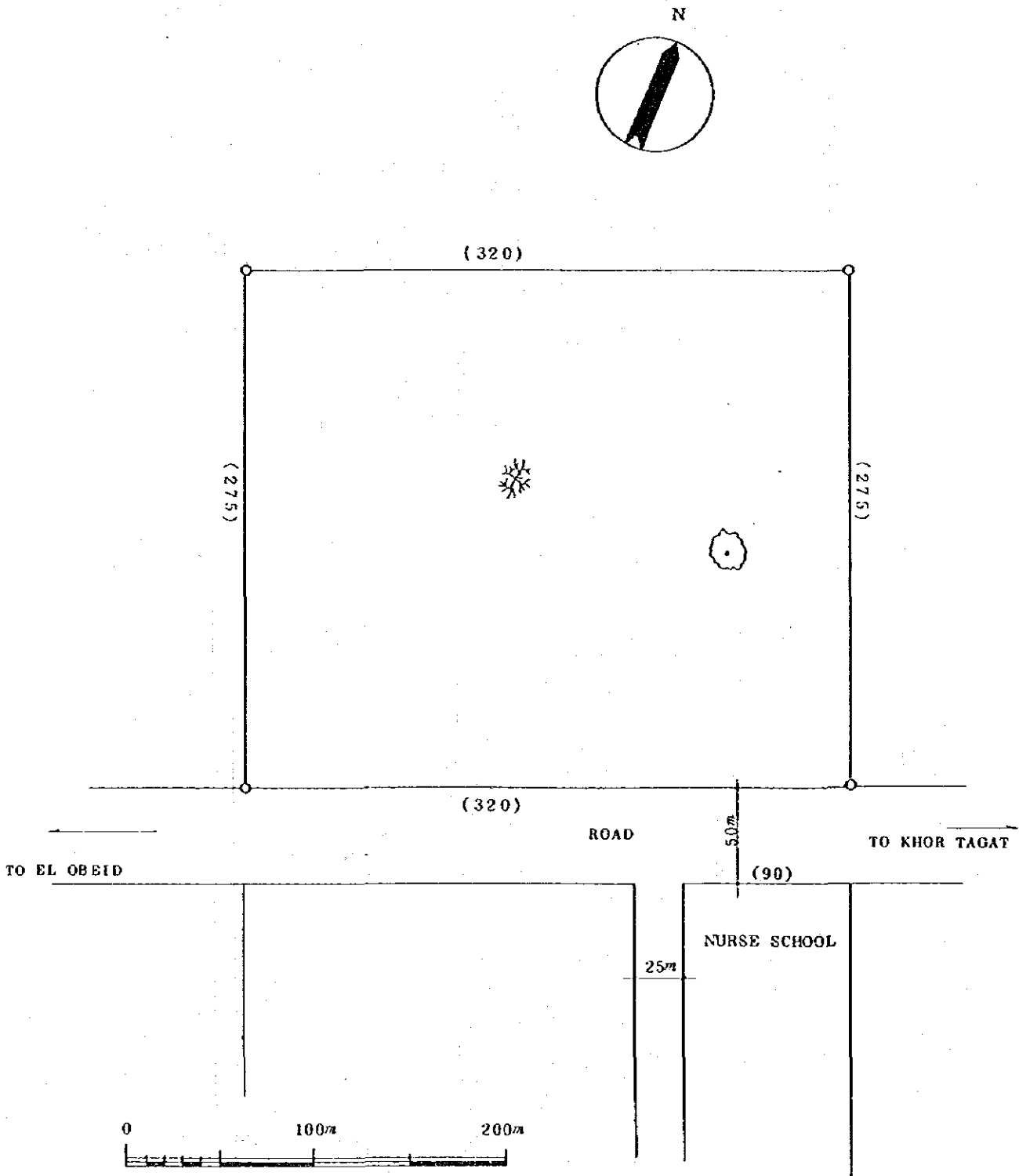


Fig. 4-2-2 Outline of the Site (El Obeid)

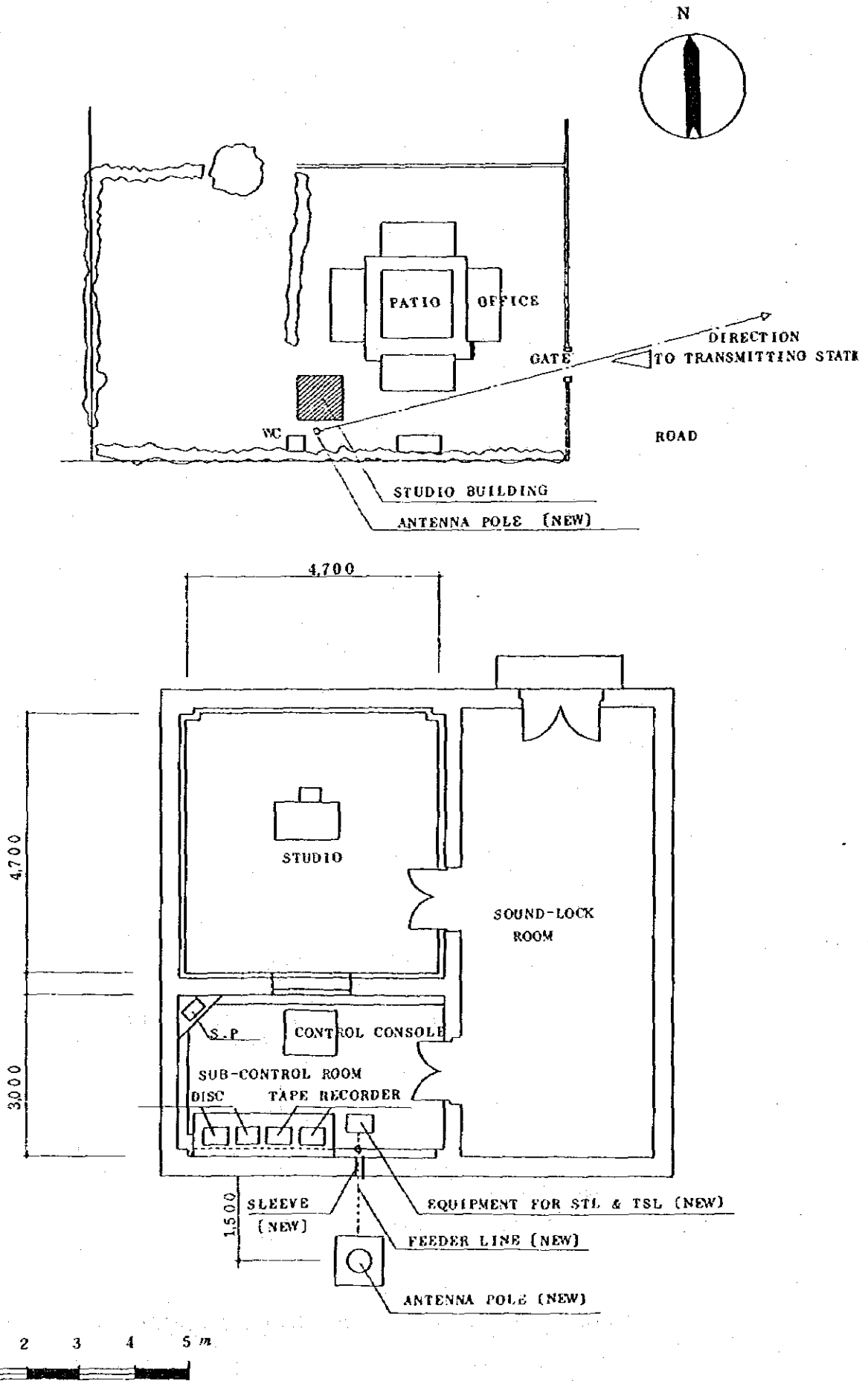


Fig. 4-2-3 Layout of the Equipment and Other Facilities (El Obeld)

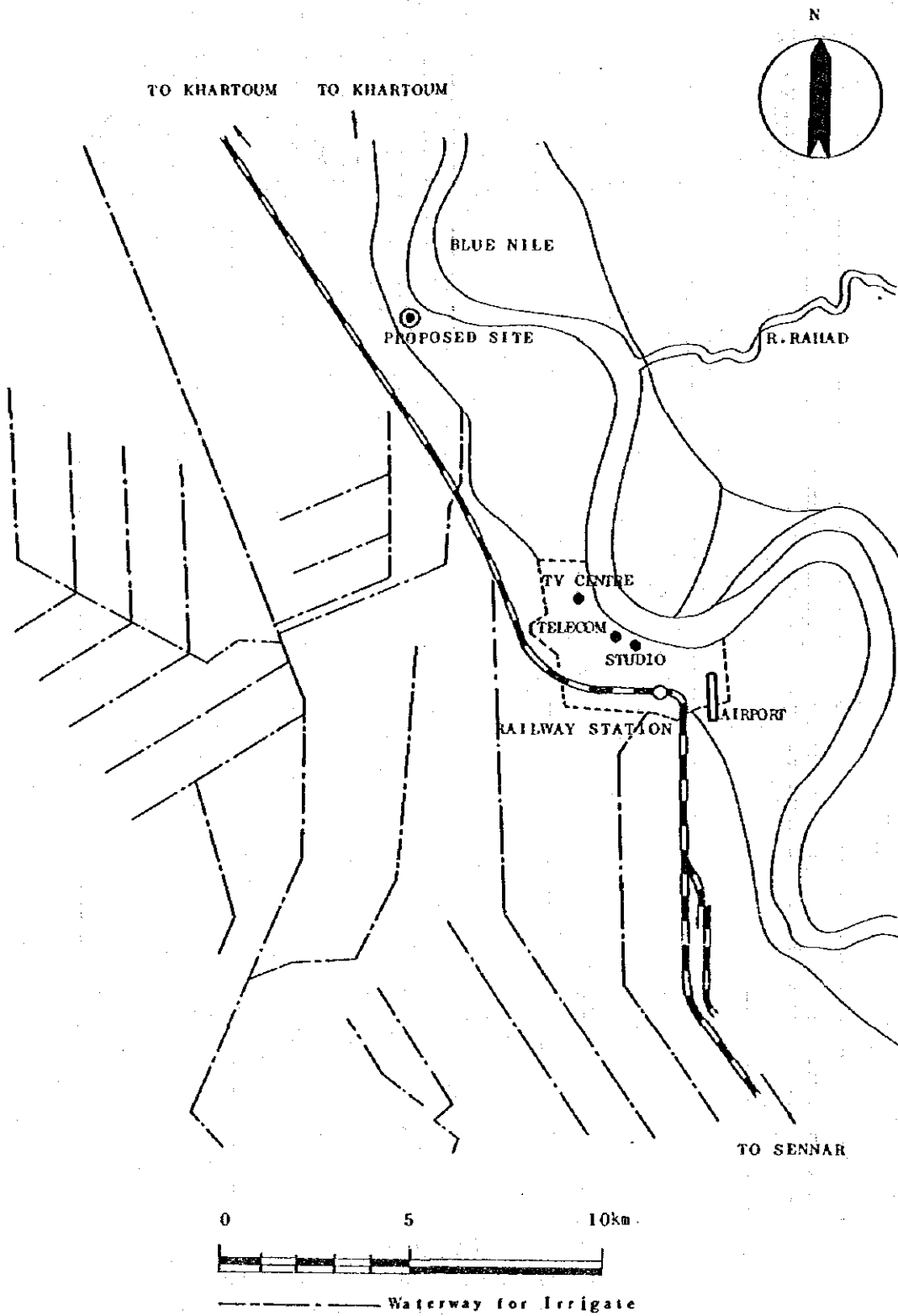


Fig. 4-2-4 Outline of Wad Medani City

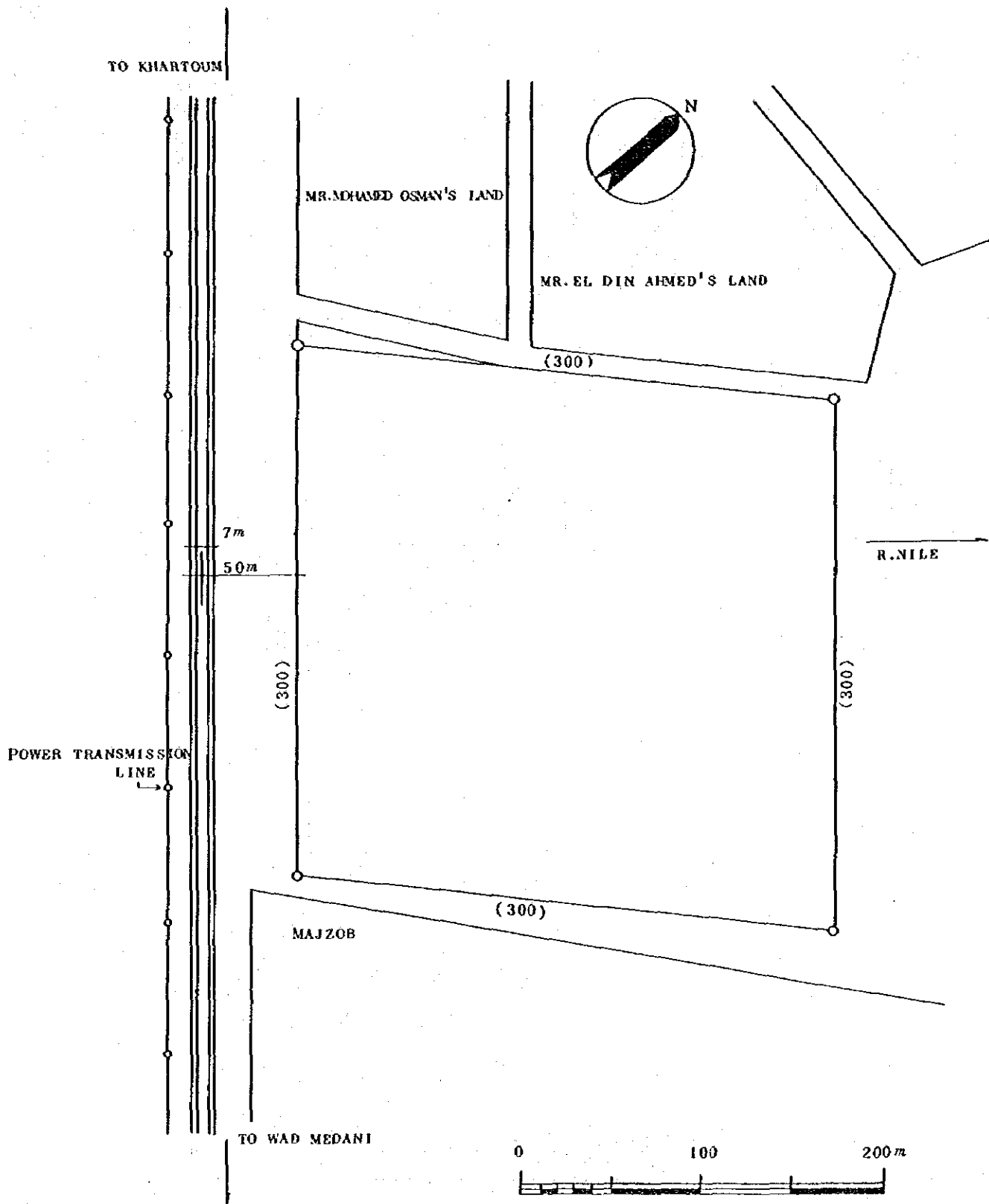


Fig. 4-2-5 Outline of the Site (Wad Medani)

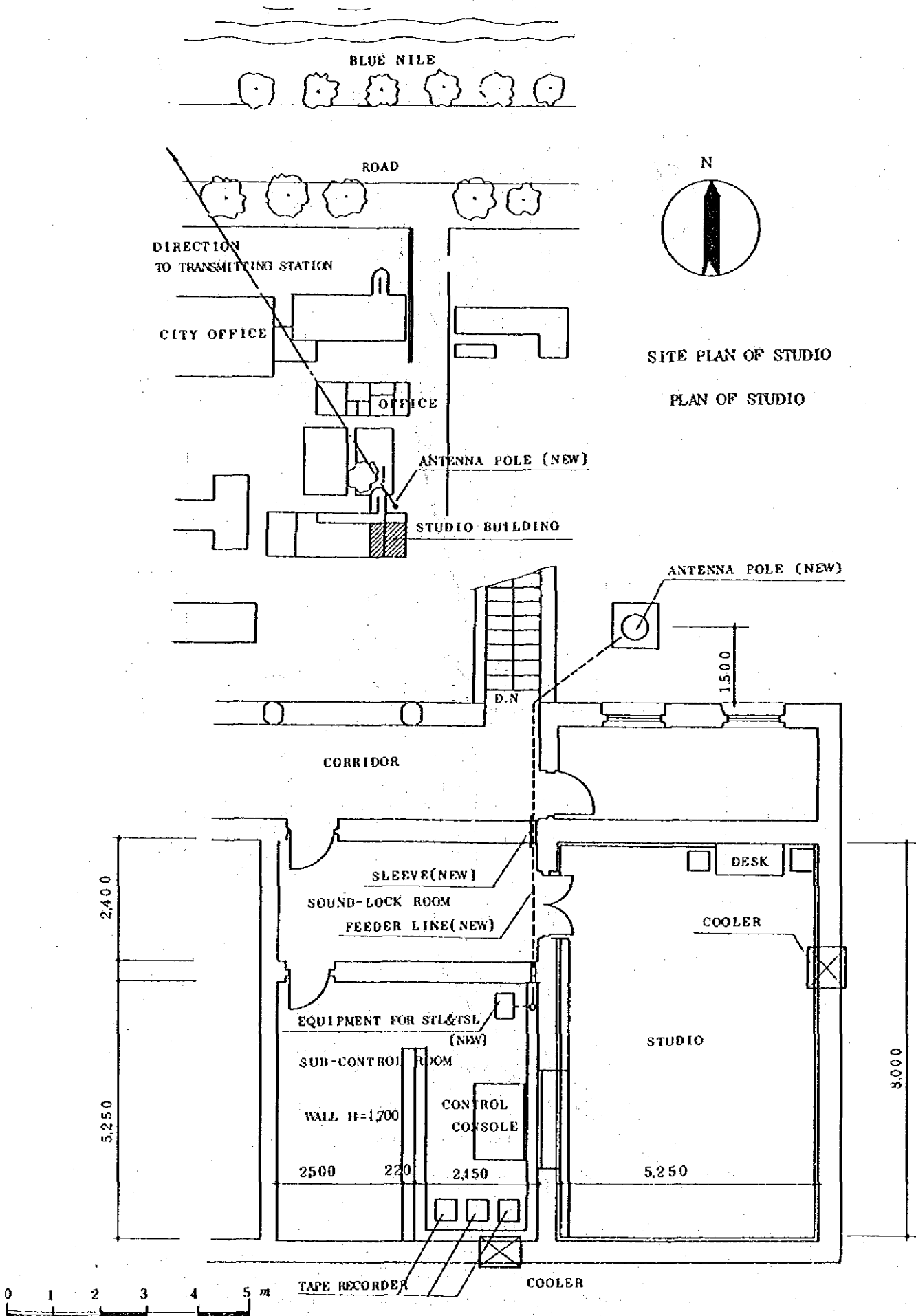


Fig. 4-2-6 Layout of the Equipment and Other Facilities (Wad Medani)

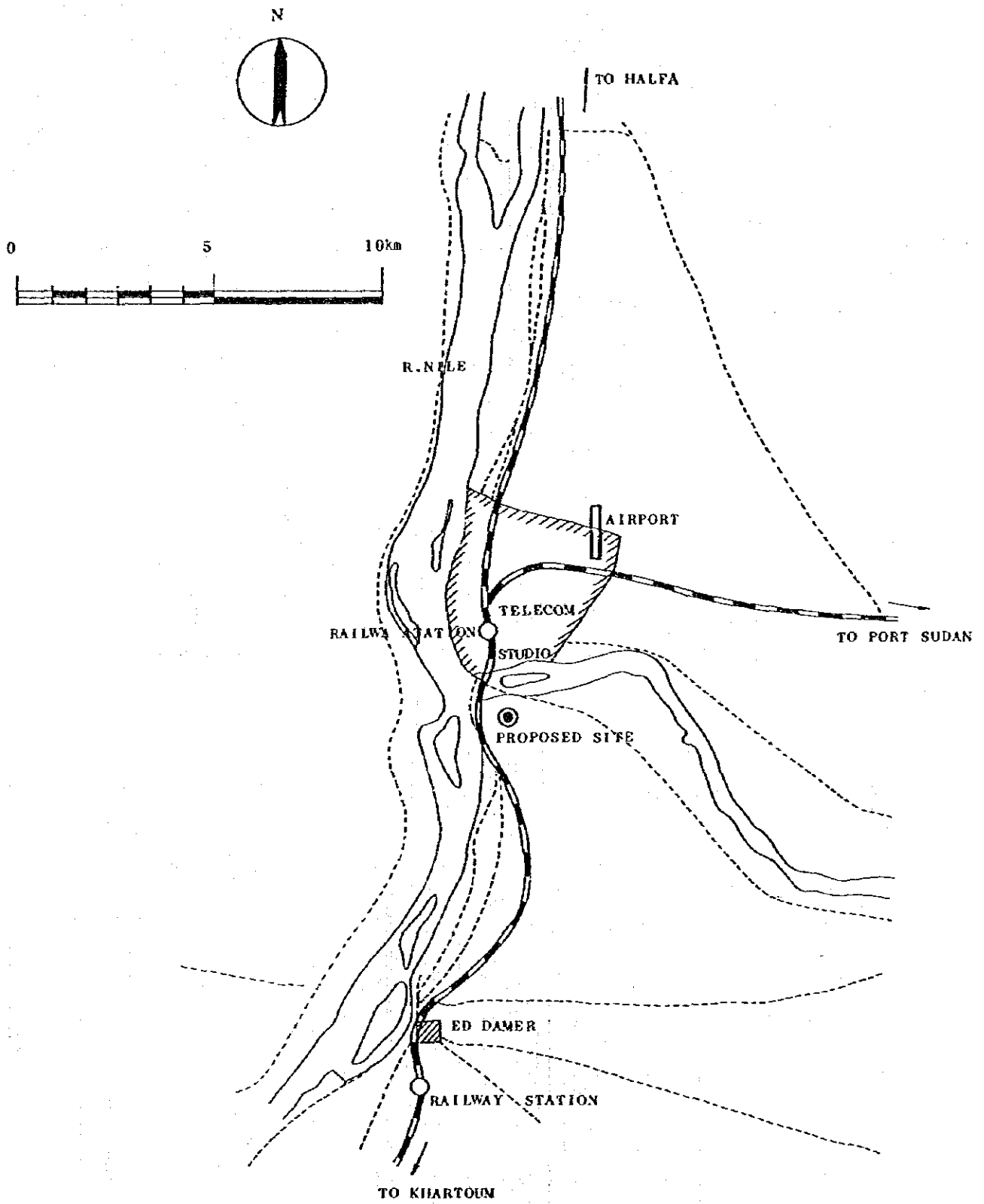


Fig. 4-2-7 Outline of Atbara City

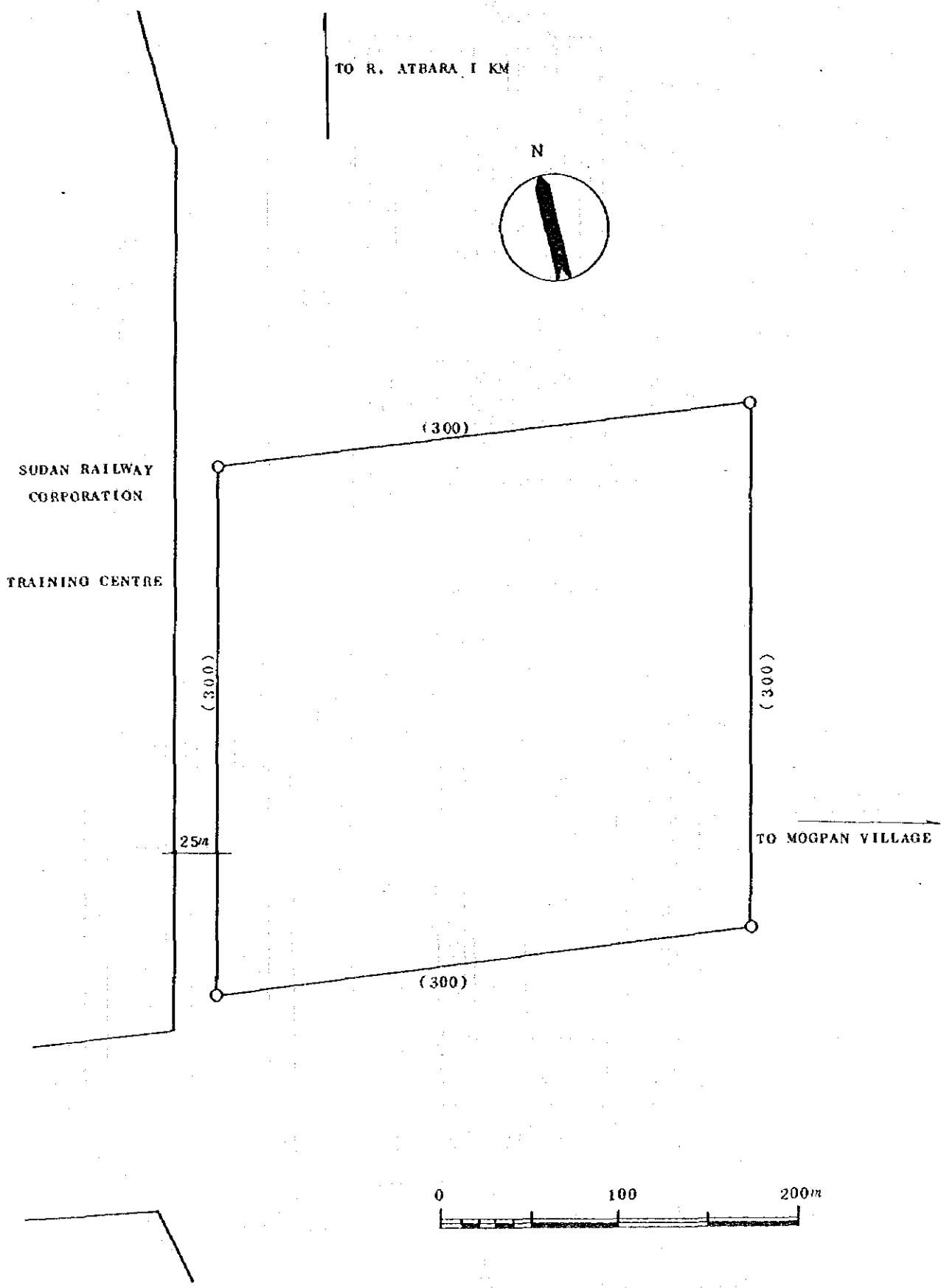


Fig. 4-2-8 Outline of Site (Atbara)

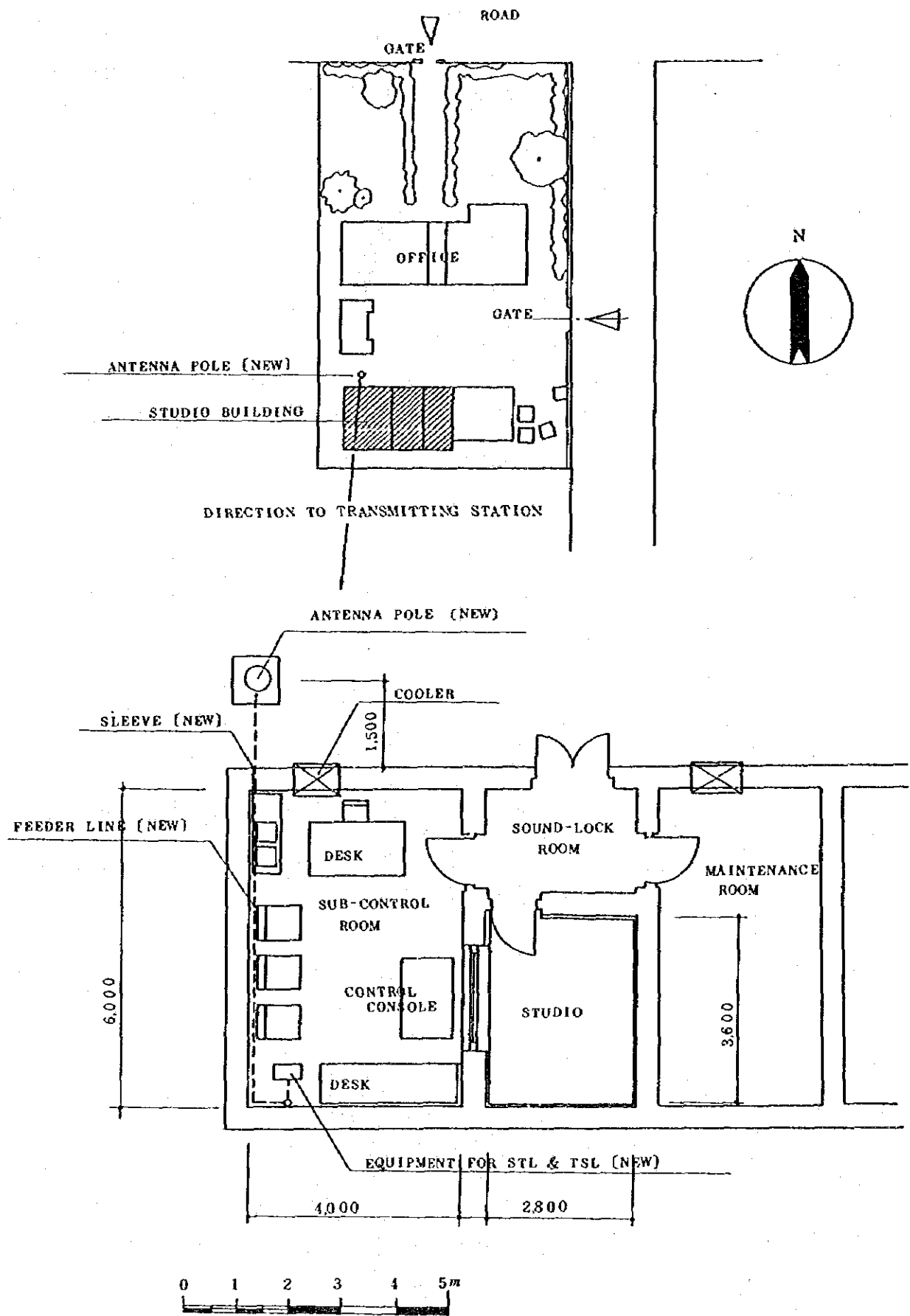


Fig. 4-2-9 Layout of Equipment and Other Facilities (Atbara)

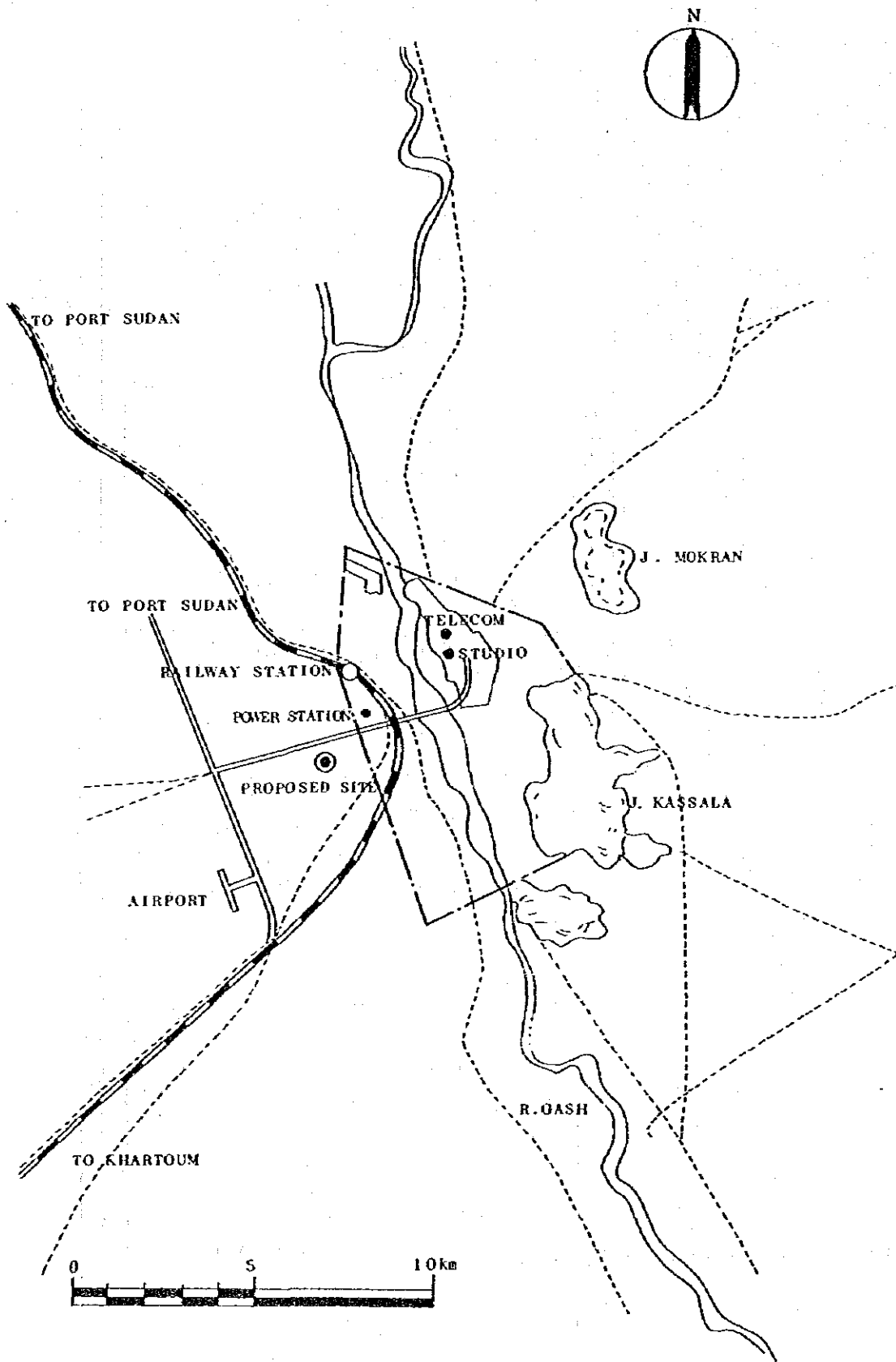


Fig. 4-2-10 Outline of Kassala City

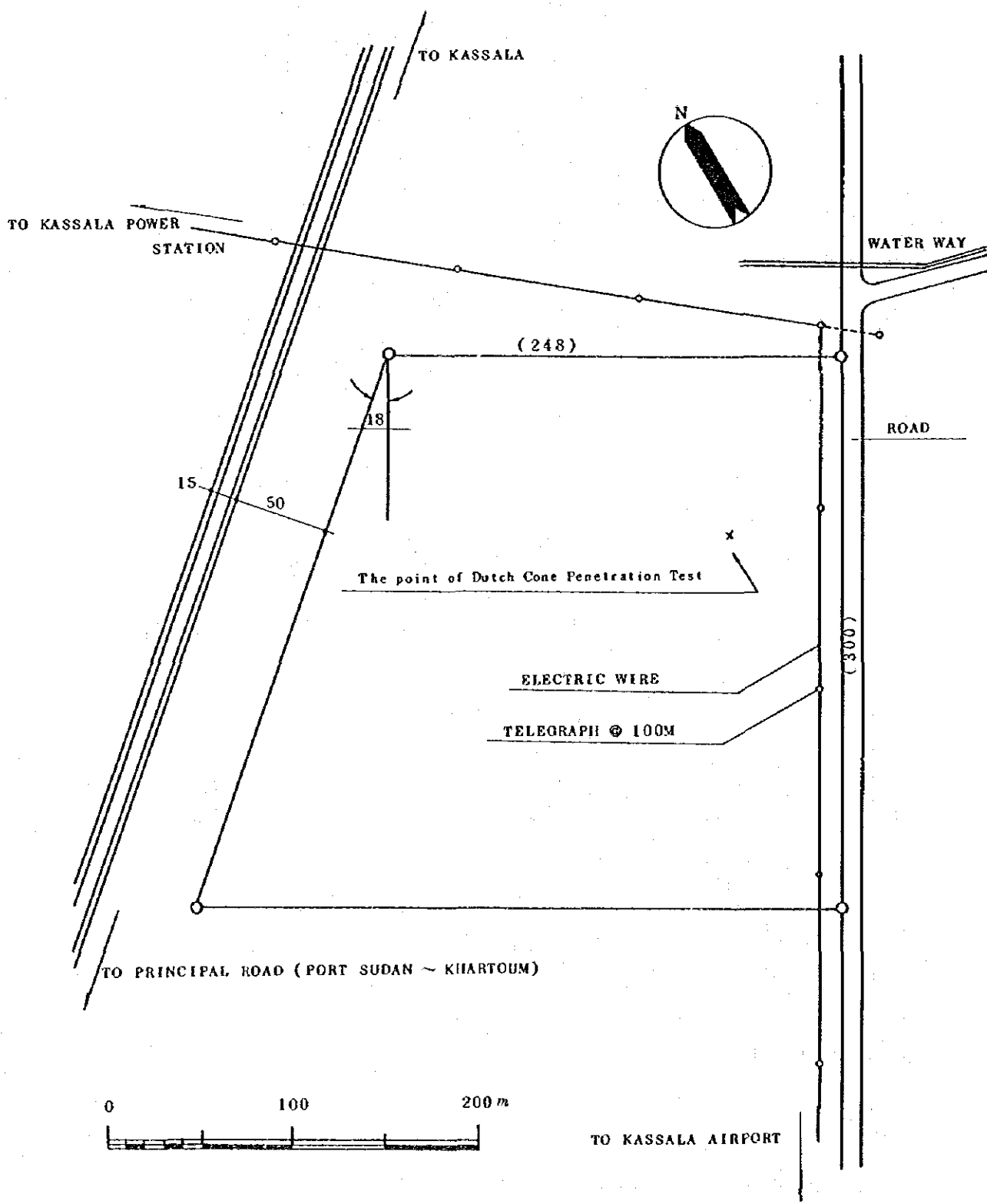


Fig. 4-2-11 Outline of the Site (Kassala)

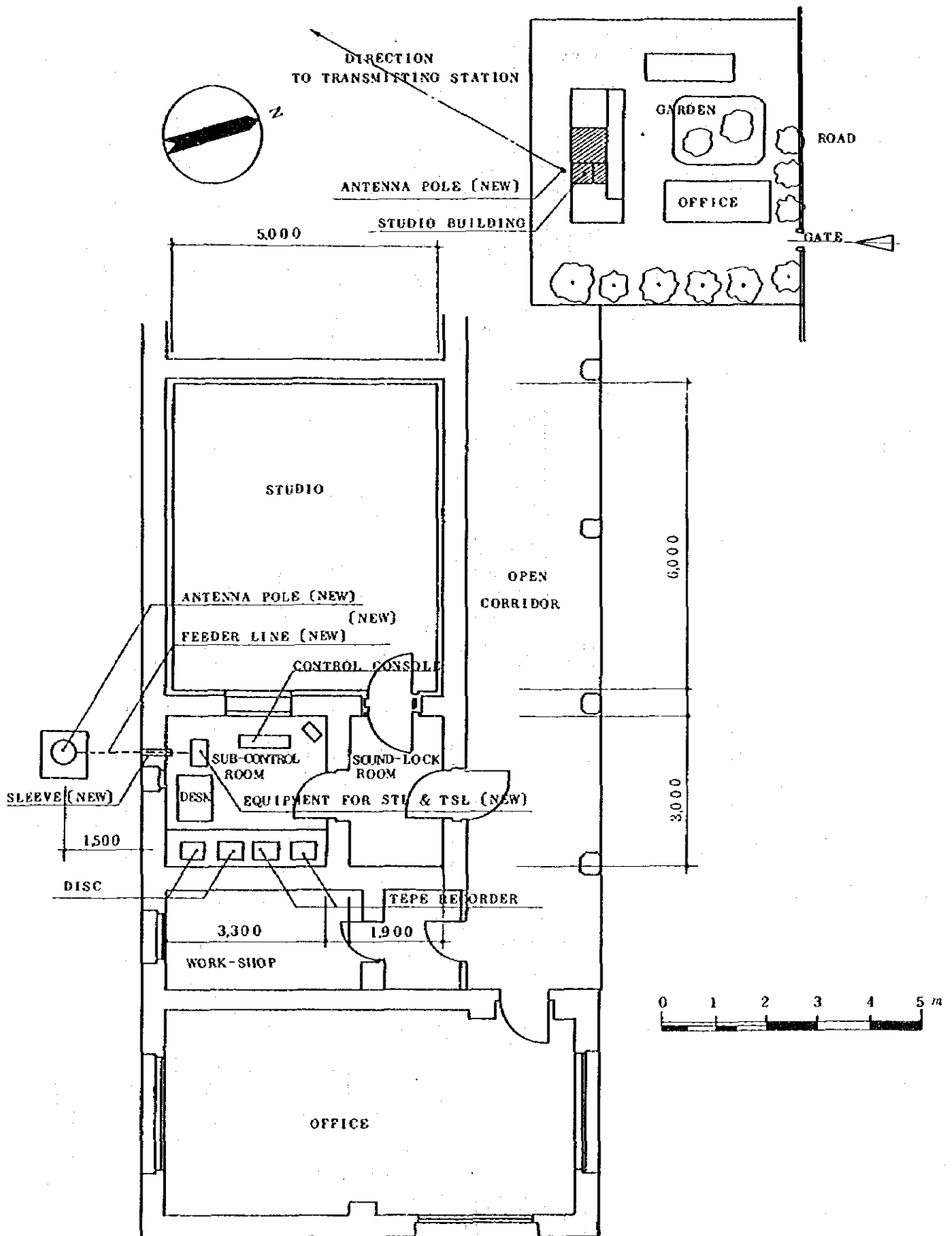


Fig. 4-2-12 Layout of Equipment and Other Facilities (Kassala)

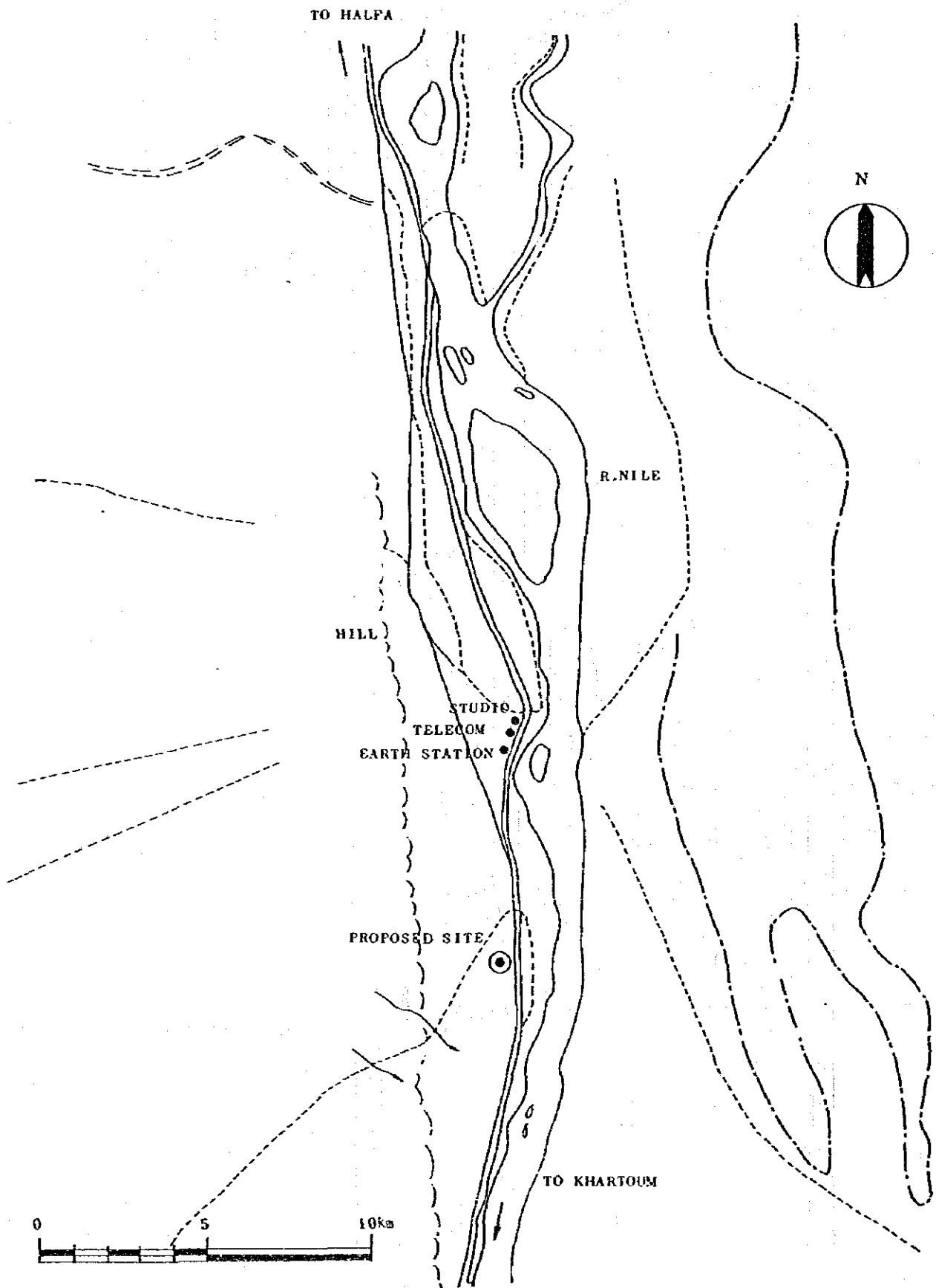


Fig. 4-2-13 Outline of Dongola City

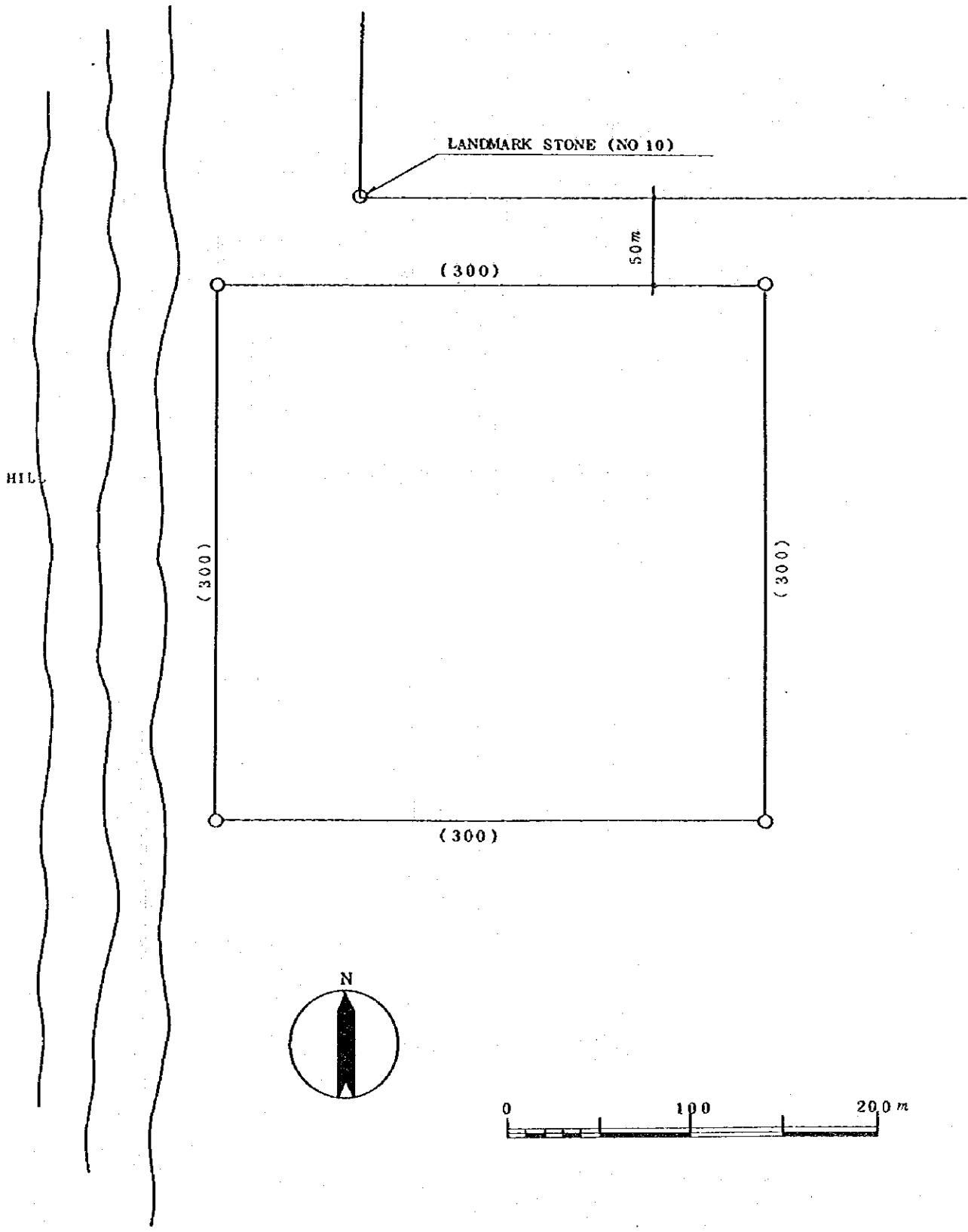


Fig. 4-2-14 Outline of the Site (Dongola)

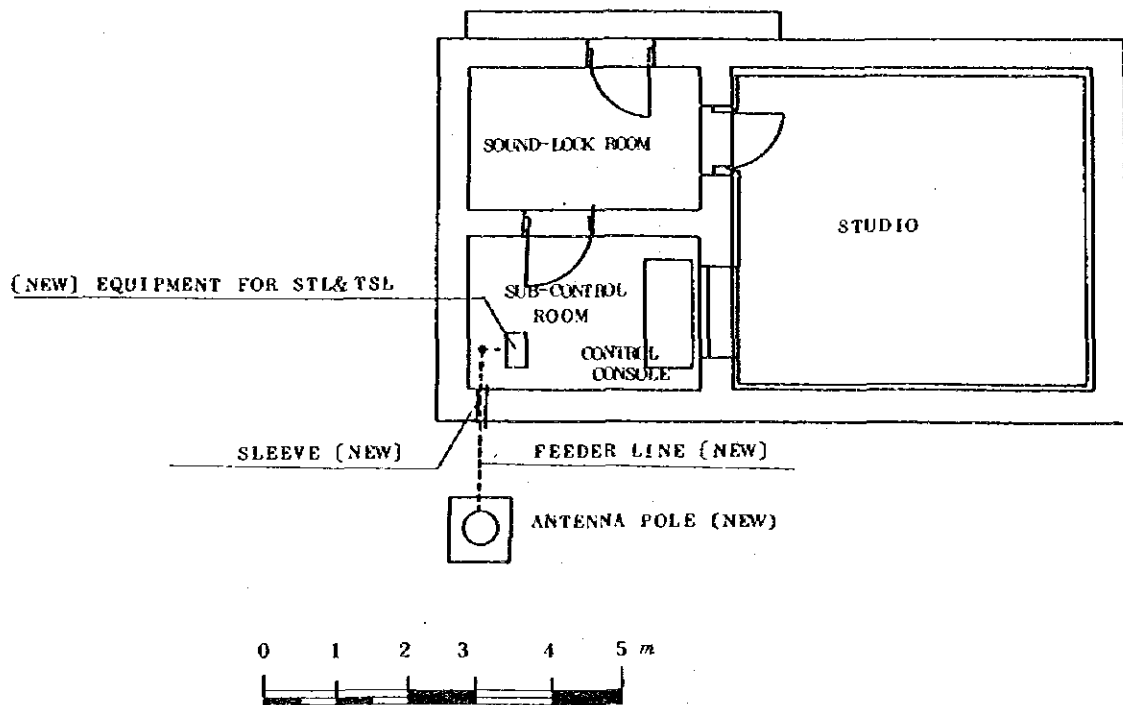
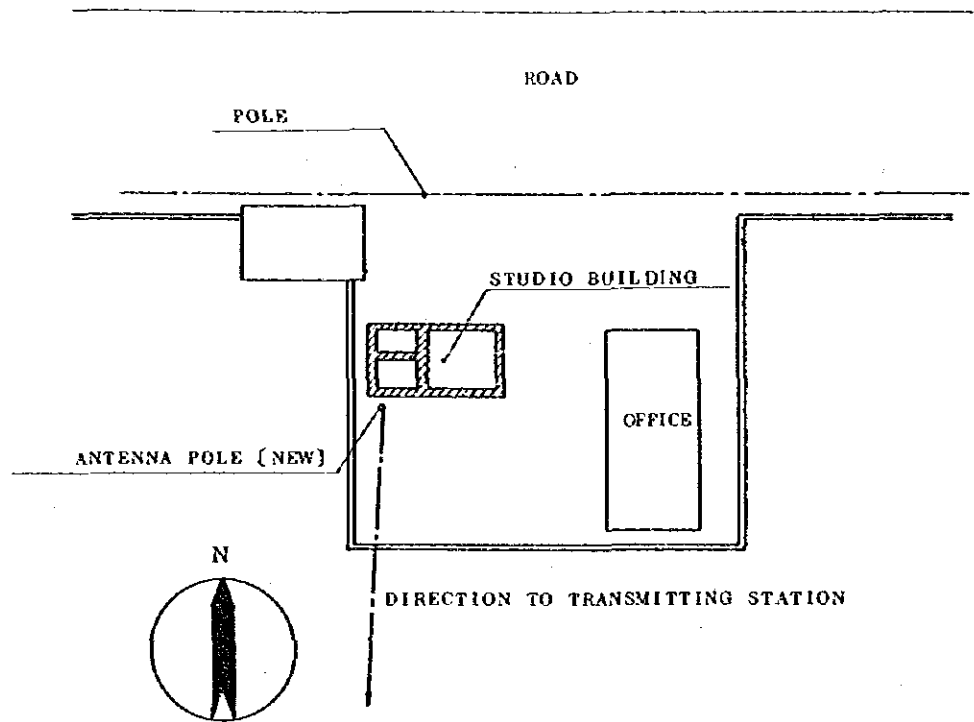


Fig. 4-2-15 Outline of Studio (Dongola)

CHAPTER 5

BASIC DESIGN

CHAPTER 5 BASIC DESIGN

5-1 Scope of Design

The scope of this basic design covers the construction of medium-wave radio transmitting stations at the proposed construction sites for El Obeid, Wad Medani, Atbara, Kassala and Dongola, which were confirmed by the basic design survey, and the design of switching facilities to switch between the nationwide programmes sent from SNBC Omdurman and local programmes produced at each station.

- (1) The transmitting station is a completely unattended type, it will be remotely controlled and supervised from the studio side.
- (2) The transmitter is a full-solid-state type with standby in order to avoid interruption of service due to failure and to carry out the maintenance work smoothly.
- (3) The transmitter building is a shelter type suitable to endure the severe desert condition.
There are two separate shelters, one for the transmitter and the another for the engine generator.
The shelter fabricated and integrated with above assembled and adjusted equipment inside is transported from Japan to Sudan as a complete block of container station at the factory. Accordingly, the period of construction work at the site will remarkably be shortened and the highly reliable operation of the equipment will be expected.
- (4) A diesel engine generator is used as standby of city power.
Start/stop of engine generator is controlled remotely from the studio side.
- (5) An STL (studio-to-transmitter link) and TSL (transmitter-to-studio link) is installed to connect the transmitting station with the existing studio in each city for multiplex transmission of broadcast programmes, remote controlling signals, monitoring signals and telephone signals.

- (6) An input signal switching facility is installed in the existing studio to switch between the nationwide programmes sent from SNBC Omdurman and local programmes produced at each city.

5-1-1 Frequency Allocation Plan

The frequencies for medium-wave broadcasting stations are decided by the World Administrative Radio Conference. According to the World Administrative Radio Conference on Long and Medium Wave Frequency (WARC-LF, MF) for Region I, II, held in 1975, the frequency allocation for Sudan is shown in APPENDIX VI.

The frequencies of the five transmitting stations for the first year plan are as follows.

El Obeid	639 kHz
Wad Medani	873 kHz
Atbara	783 kHz
Kassala	666 kHz
Dongola	819 kHz

The measured data at each proposed site in the daytime and nighttime on the incoming signals of co-channel and adjacent channel and other frequencies to be checked are given in APPENDIX VIII.

At any site, no interfering signal was receivable in the daytime but radio signals from foreign countries were strongly received in the nighttime by means of the propagation characteristics of the medium-wave signal. Therefore, interference is unavoidable in the nighttime.

Regarding the interference problem, there is a method of changing the allocated interfered frequency to other cleared frequency. However, according to the results of the survey, there are few cleared frequencies but it will be very difficult to change the allocated frequency, to get the consent of each related country and registration of IFRB.

5-1-2 Transmitting Power

In considering the distribution of population around the city and the coverage area of the transmitting signal, 5-kW power will be sufficient for the broadcasting stations, El Obeid, Atbara, Kassala and

Dongola. With regard to Wad Medani, the surrounding of the city is included in the coverage areas of Soba and Sennar Transmitting Stations (nationwide programme). However, as Wad Medani area is a producing centre of raw cotton and sugar canes, information of water for cultivation and agricultural instructions is necessary, therefore transmitting power of 5-kW is suitable.

In case the transmitting power of stations El Obeid, Wad Medani, Atbara, Kassala and Dongola is 5-kW, the estimated service area are as shown in Table 5-1-1, the details are given in APPENDIX VII.

Table 5-1-1 Estimated Service Area

	Transmit. Power (kW)	Transmit. Freq. (kHz)	Co-freq. Undesirable Signal Field Strength (dBu)		Distance (km) (Field Strength 60 dBu)
			Incoming Daytime	Incoming Nighttime	
El Obeid	5	639	un-receivable	48	80
Wad Medani	5	873	do	48	57
Atbara	5	783	do	52	65
Kassala	5	666	do	57	77
Dongola	5	819	do	53	60

"The factor of Service Area Estimation"

In the daytime, the incoming signal of the co-channel was insensible, and as the urban noise field strength was also lower than 20 dB, the required field strength for reception was set at 60 dB. In the nighttime, as there were interfering signals of co-channel with field strength exceeding 50 dB at the proposed site and urban areas, the D/U ratio (ratio of desired and undesired signal) was set at 26 dB to determine the required field strength.

Fig. 5-1-1 shows the estimated service areas of the five transmitting stations.

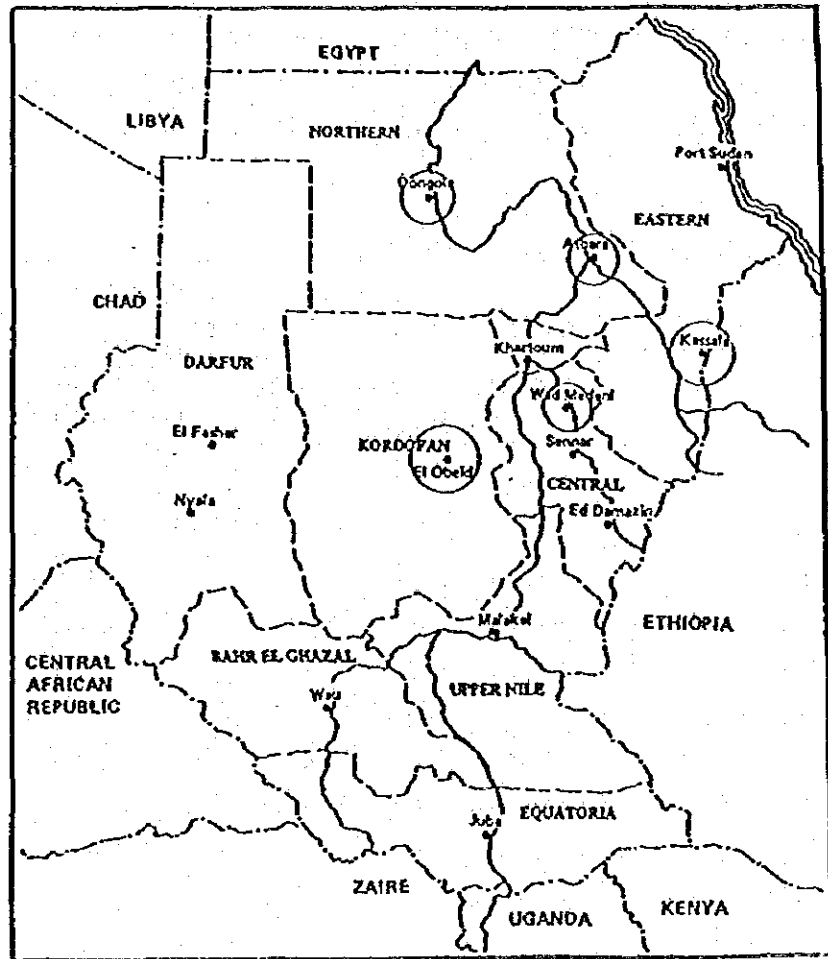


Fig. 5-1-1 Estimated Service Areas of Five 5-kW Stations

For the estimation of field strength, the CCIR Calculation Chart (Rec. 368-4) was used. In addition, the ground conductivity was set at 3 mS/m referring to CCIR Report (Rep. 717-1).

5-2 Site and Equipment Layout

5-2-1 Selection of Site

The proposed sites of which were surveyed this time, were decided on the basis of the extent of flatness of the land, relation with access road, relation with studio building and city facilities such as electric power plant, airport, telephone office, and relative location of rivers, mountains or hills.

The land to be selected was aimed at an area which a 150 m radius circle could be inscribed. The site for Wad Medani has the largest undulation. However, the level of antenna tower support can be adjusted by the setting of anchor blocks.

With regard to the roads there is no problem in transportation and access because all the proposed sites are in a desert in the suburbs. However, with regard to Atbara, as transit of large vehicles is difficult because of the limitation of capacity of bridge over the River Atbara, it is necessary to transport the equipment and materials by railway.

As the distance between the proposed sites for each transmitting station and existing studio building is almost within 5---10 km, the sites are considered suitable because there are no high-rise obstructions in between them.

5-2-2 Layout of Facilities

With regard to the layout plan of broadcasting facilities in the proposed sites for each transmitting station, they will be designed in considering the shape of land, access to road, climatic conditions (especially the direction of wind) and relative position of each facility.

The transmitting antenna tower is installed almost in the centre part of the site. The transmitter shelter, engine generator shelter and oil tank facility are installed at a position close to the transmitting antenna which is about 100 m in height. The radius of radial earth is about 130 m and the number of earth conductors to be buried is more than 120 wires, in considering the ground conductivity.

The 4 m width road is constructed between the front gate and the transmitting facilities. The base of transmitting antenna is surrounded by a fence to prevent danger. In addition, Sudan side is to build a fence around the site to keep out cattle and unauthorized people.

5-3 Broadcasting Facility

5-3-1 Transmitting Facility of Each Station

The composition and basic function of facilities for transmitting stations are as follows.

(1) Transmitter

In considering the high reliability and high efficiency as well as the high maintainability, the transmitter is a 5-kW full-solid-state type with standby.

The necessary equipment and switches for monitoring and operation are mounted on the main front panel of transmitter.

(2) Accessory Equipment with Transmitter

- 1) Operation and Monitoring Panel
- 2) Programme Input Equipment
- 3) Dummy Load
- 4) Surge Protector

(3) City Power Receiving System and Engine Generator System

Generally city power will be used for transmitting station. Emergency engine generator should be provided to ensure the broadcasting service in case of city power failure. The city power is the priority in use.

1) Power Distribution Facility

The power facility consists of automatic voltage regulators, power boards and transformers.

2) Engine Generator

The engine is a diesel with starter battery, battery charger and oil tank.

The generator capacity of each transmitting station is such as 90 kVA, 415 V, 3-phase 50 Hz.

The start/stop of engine generator can be operated at the transmitting station as well as remotely controlled from the studio side.

The starter battery and charger are installed in the engine generator shelter.

(4) Transmitting Antenna System

The transmitting antenna is about 100 m in height a guided tower with the insulated base mount in considering the cost. The electric earth is a radial formation with more than 120 conductors about 130 m radius buried around the antenna tower.

The feeder impedance is 50 ohms, the feeder between the transmitter shelter and the antenna tuning unit is buried.

The antenna tuning unit is closely installed to the antenna tower base.

(5) Shelter

The transmitter shelter accommodates two 5-kW medium-wave broadcast transmitters, input equipment, STL/TSL system, 5-kW dummy load, surge protector, lightning protector and relative devices.

The engine generator shelter accommodates the engine generator, control device, starter battery, automatic voltage regulator, etc.

(6) Air Conditioner

The quantity of heat exhausted from the transmitters in the shelter is processed by the air conditioner. The air conditioner is required to be operated during the broadcast time, two air conditioner systems are installed in considering the maintenance work.

(7) Communication Facilities

Communication between studio site and transmitting station is made by STL and TSL.

(8) Measuring Equipment

The following measuring equipment are provided to each transmitting station for routine maintenance work.

Rack mount type

Audio signal measuring equipment

Oscilloscope

Others

Multi-meter (Circuit tester)

Insulation resistance tester (Megger)

5-3-2 Studio Facilities

A small size studio about (5 m x 5 m) has been provided in each of El Obeid, Wad Medani, Atbara and Kassala station used for radio programme production with a subcontrol room composed of audio mixing console, tape recorder/reproducer, monitor speaker etc.

Fig. 4-2-3, Fig. 4-2-6, Fig. 4-2-9 and Fig. 4-2-12 show the outline of studios in El Obeid, Wad Medani, Atbara and Kassala.

The studio in Dongola is not yet completed (building is still under construction, the size is almost same as other studios). Studio facilities are already supplied and stored however, the mixing console must be rechecked in advance of usage according to stored condition. It is considered that SNBC will complete the studio until the transmitting station will be built.

Fig. 4-2-15 shows the outline of Dongola studio.

(1) STL and TSL System

One set of UHF (960MHz band) STL and TSL with standby including automatic changeover devices are newly installed for transmission of signals between each studio and its transmitting station. Broadcasting programme, remote control and monitoring signal of the transmitting station and telephone are transmitted in multiplexed mode.

These equipment are mounted in one rack. Arrangement of the rack in each station is shown in Fig. 4-2-3, 4-2-6, 4-2-9, 4-2-12 and 4-2-15 respectively.

(2) Switching panel of Input Signal

The nationwide programme sent from SNBC Omdurman Station or the local programme produced at each station is switched by the newly installed switching panel in the control room of each studio, and the programme is sent to the transmitting station through the STL.

Four inputs are provided in the switching panel in consideration of the possibility of off-air relay in the future, and two outputs are available to send the programme to the STL and the monitoring devices.

(3) The Remote Control and Monitoring Equipment for transmitting facilities are newly installed.

5-3-3 Programme Transmission Circuit

The nationwide programme is relayed from SNBC Omdurman studio to telephone stations in each city by the microwave or the satellite link, and connected to each studio by the wired circuit.

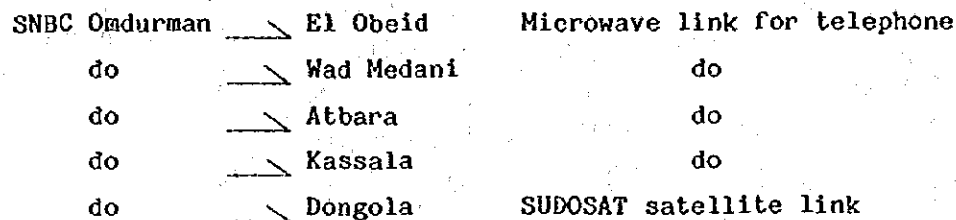


Fig. 5-3-1 and Fig. 5-3-2 show the microwave network in Sudan and the Satellite link (SUDOSAT), respectively.

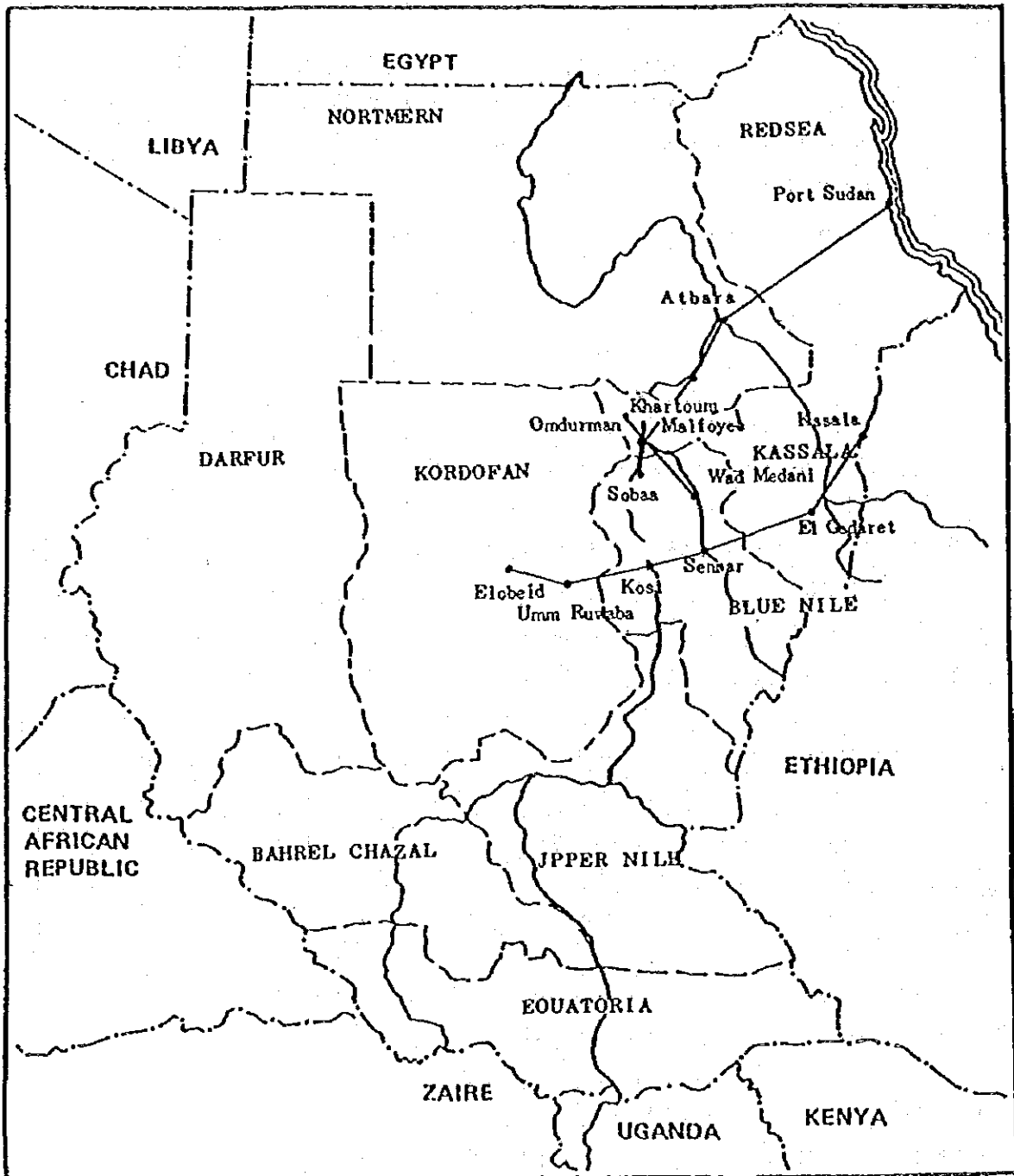


Fig. 5-3-1 Terrestrial Microwave Network in Sudan

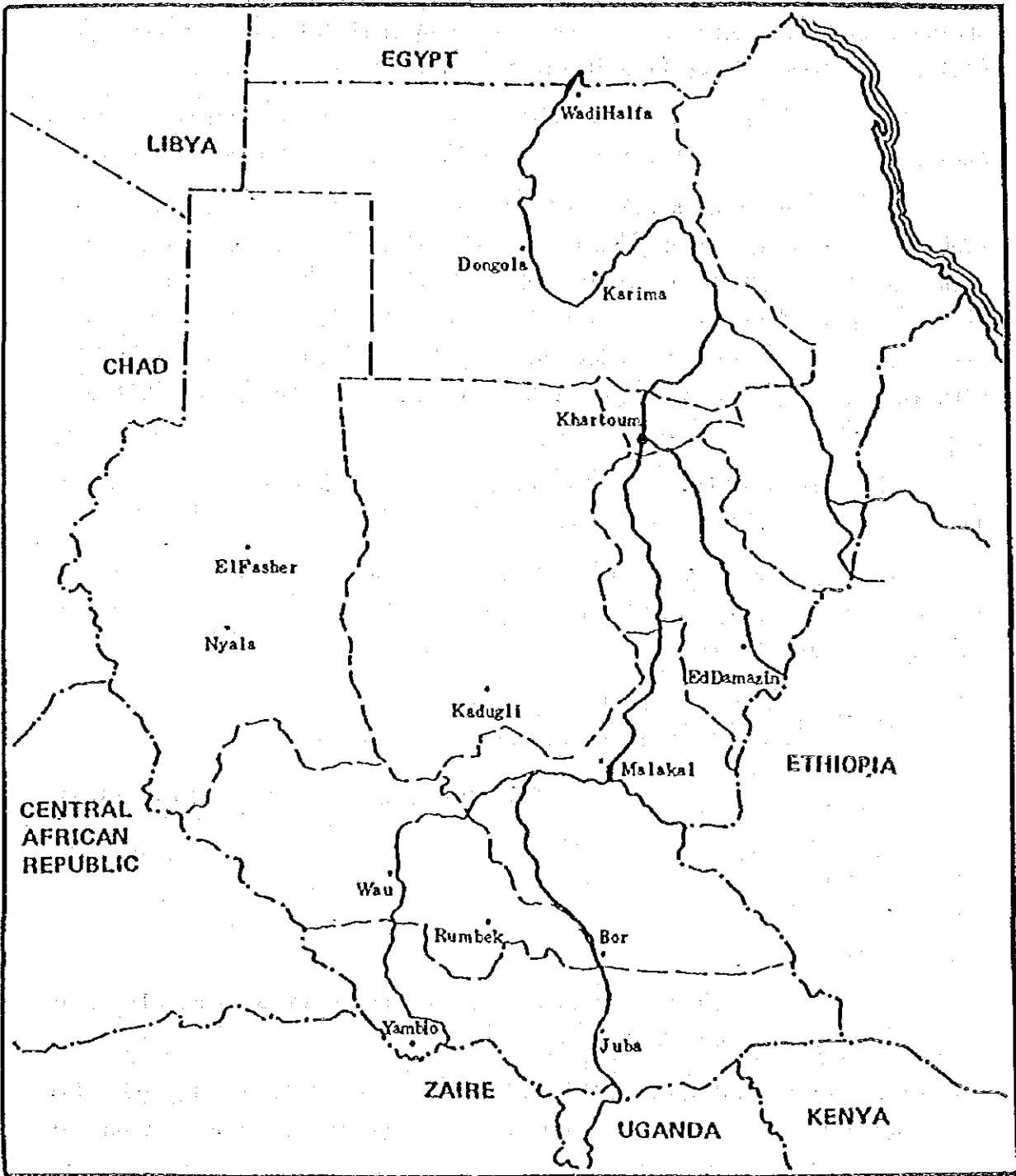


Fig. 5-3-2 Satellite Link (SUDOSAT)

5-4 Tower and Station Building

All of the foundation of transmitting antenna tower, transmitting shelter, engine generator shelter, oil tank and STL/TSL antenna poles will be the direct foundation of reinforced concrete.

Analysis and design of structure will be made by referring various standards and related regulations established for structures in Japan.

The design of guys will be based on the method usually used in NHK (Japan Broadcasting Corporation). In the structure design against wind pressure, instantaneous maximum wind velocity of 50 m/sec (10 m above ground level) is adopted and an extra margin will be set at sites of high attitude. In addition, the depth of ground foundation is at GL-2 m, but with regard to Wad Medani transmitting station, it will be at GL-3 m to avoid the black-cotton-soil.

The reinforcing bars are used products (SD 30) satisfied of Japanese Industrial Standard (JIS).

The four weeks aged strength of concrete is required to have the strength of 180 kg/cm². In addition, in the design of foundations, following bearing strength of soil is adopted.

El Obeid	10.5 Bt/m ²	
Wad Medani	25 t/m ²	
Atbara	10.5 Bt/m ²	(B: Minimum width of foundation)
Kassala	50 t/m ²	
Dongola	26.6 Bt/m ²	

(1) Tower

100 metres height cylindrical antenna tower is erected almost in the central part of the site.

The specification of the antenna tower is same for all five transmitting stations. The tower is guyed at five portions in three directions.

The base of antenna is supported with a base-insulator and placed on a reinforced concrete foundation.

The guy wires are fixed on three reinforced concrete anchor blocks at a distance of 70 m from the antenna centre. In each guy wire, insulators are inserted at appropriate intervals and choke-coils are attached to the position of uppermost guy insulations.

Two navigation obstruction lights are mounted on the top portion and two intermediate portions of antenna, respectively. The whole tower will be painted in zebra mark with white and red colour alternately. In addition, halfpases are made on the top and at two intermediate portions of the antenna and a simple ladder built along the antenna from the bottom to the top.

- a) Materials : Materials and products complying with Japanese Industrial Standard (JIS) is used.
- b) Guy wire : Products complying with Japanese Steel Structure Standard (JSS) is used.
- c) Base insulator, guy wire insulator, navigation obstruction light and other necessary components:
Products complying with Japanese Industrial Standard (JIS), Broadcast Technical Standard (BTS) and NHK Broadcast Specific Standard (BSS) are used.

Antenna masts for STL and TSL will be constructed at transmitting station and studio side. Reinforced concrete foundations are used for them.

(2) Transmitter Shelter

The transmitting station building is an unattended shelter, it is installed on reinforced concrete foundation with anchor bolts. The air conditioning unit (outdoor equipment) is installed closely to the transmitter shelter. In addition, a roof is built over the transmitting shelter as a sunshade. The structure of the sunshade roof is made of iron frame. As much wind blows from south to north at all the proposed sites, the shelter is installed in the south-north direction in considering the relative position of entrance, air intake, etc.

(3) Engine Generator Shelter

The engine generator is installed in a separate shelter to prevent the transmitting shelter from vibration and noise. The shelter is fixed on a reinforced concrete foundation and located in south-north direction same as the transmitter shelter.

(4) Oil Tank

The oil tank of engine generator (capacity 2,000 liters, available for about one week operation in emergency) is fixed on a mount which is built on a reinforced concrete foundation. The oil tank is located at a place of tank lorry can access easily.

5-5 Equipment and Devices

The equipment and devices related to each transmitting station, studio and maintenance centre are as follows.

5-5-1 Transmitting Station (per one station)

1) 5-kW medium-wave broadcast transmitter	2 sets
2) 5-kW dummy load	1 set
3) Input equipment	1 set
4) Transmitting antenna system	1 set
5) Power distribution board	1 set
6) Diesel engine generator	1 set
7) Starter battery and charger	1 set
8) Automatic voltage regulator	1 set
9) Measuring equipment	1 set
10) STL receiver	1 set
11) TSL transmitter	1 set
12) Lightning protecting transformer	1 set
13) Accessories	1 set
14) Construction materials	1 set

5-5-2 Studio (per one station)

1) STL transmitter	1 set
2) TSL receiver	1 set
3) Remote control and supervisory system	1 set

- 4) Input switching panel 1 set
- 5) Construction materials 1 set

5-5-3 Maintenance Centre

- 1) Spare parts for transmitting station 1 set
- 2) Measuring equipment 1 set
- 3) Vehicle for maintenance 1 set
- 4) Tools and jigs for maintenance 1 set

5-6 Basic Design Diagram

- Fig. 5-6- 1 Overall Block Diagram of Broadcasting System
- Fig. 5-6- 2 Block Diagram of Power Supply in Transmitting Station
- Fig. 5-6- 3 Outline of Tower
- Fig. 5-6- 4 Layout of Tower and Earth of El Obeid
- Fig. 5-6- 5 Layout of Tower and Earth of Wad Medani
- Fig. 5-6- 6 Layout of Tower and Earth of Atbara
- Fig. 5-6- 7 Layout of Tower and Earth of Kassala
- Fig. 5-6- 8 Layout of Tower and Earth of Dongola
- Fig. 5-6- 9 Outline of Shelter
- Fig. 5-6-10 Outline of Oil Tank
- Fig. 5-6-11 Site Plan of El Obeid
- Fig. 5-6-12 Site Plan of Wad Medani
- Fig. 5-6-13 Site Plan of Atbara
- Fig. 5-6-14 Site Plan of Kassala
- Fig. 5-6-15 Site Plan of Dongola

5-7 Cost Estimation

The budget which shall be prepared by Sudan side in this Project are as follows.

(1) Construction work which shall be carried out by Sudan side as the results of the minutes.

1)	City power receiving work:	Lsd.	9,600
2)	Fence construction work:	Lsd.	55,760
3)	Land levelling work:	Lsd.	2,750
4)	Guard house construction:	Lsd.	14,100

Five Stations:	Total	x 5	Lsd.	411,000
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(2) Operation, maintenance and programme production cost after completion of this project per year in five stations totality.

1)	Power supplying charge:	Lsd.	243,000
2)	Maintenance cost:	Lsd.	678,000
3)	Programme production cost:	Lsd.	113,000

Total:	Lsd.	1,034,000
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5-8 Technical Cooperation

In order to train managing staffs and the engineers of new maintenance centre which hold responsible for the maintenance of five stations, participation of the above trainee in the Training Course is requested and conducted annually as a part of Overseas' Technical Cooperation Project under the auspices of the Government of Japan.

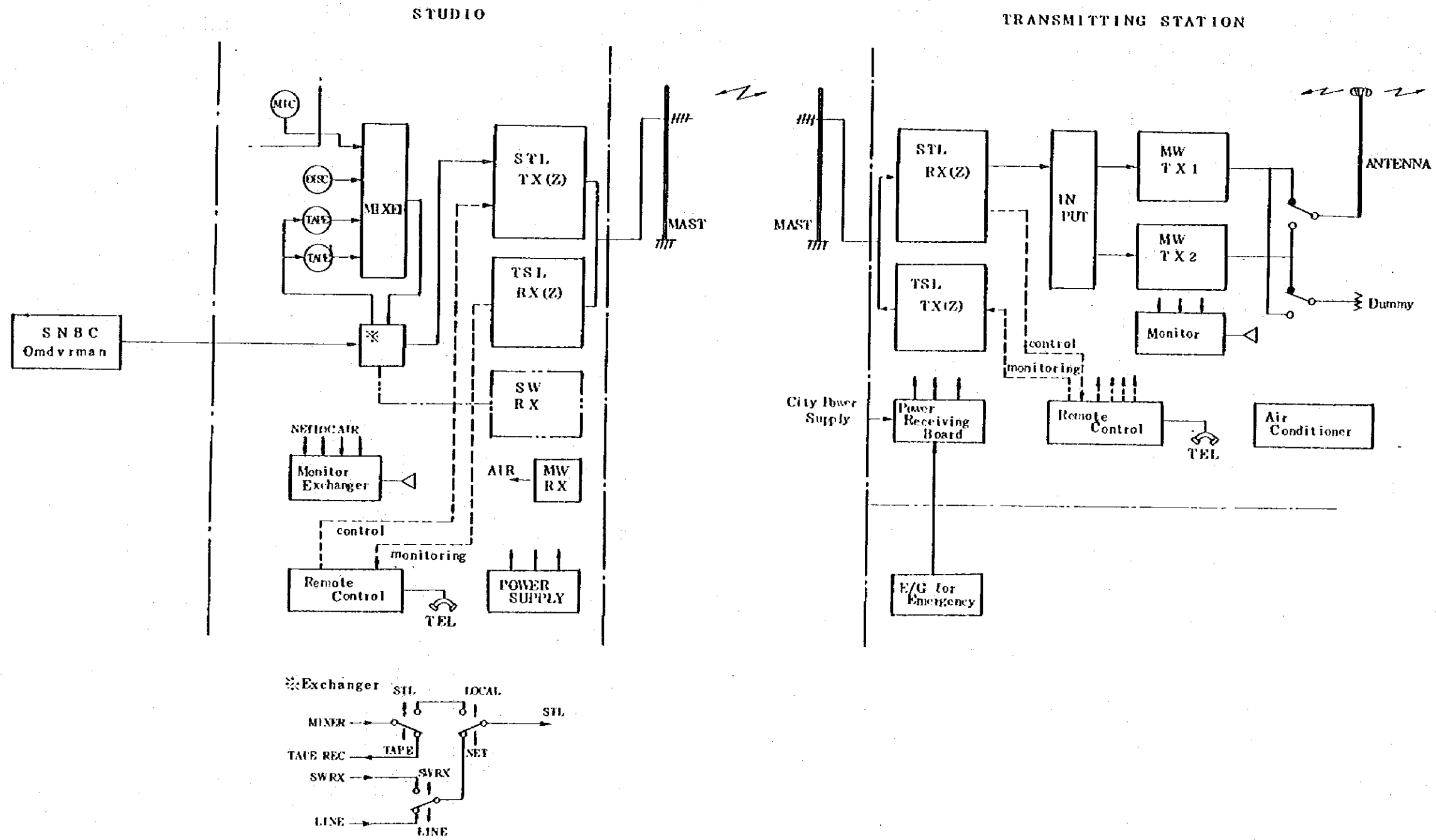


Fig. 5-6-1 Overall Block Diagram of Broadcasting System

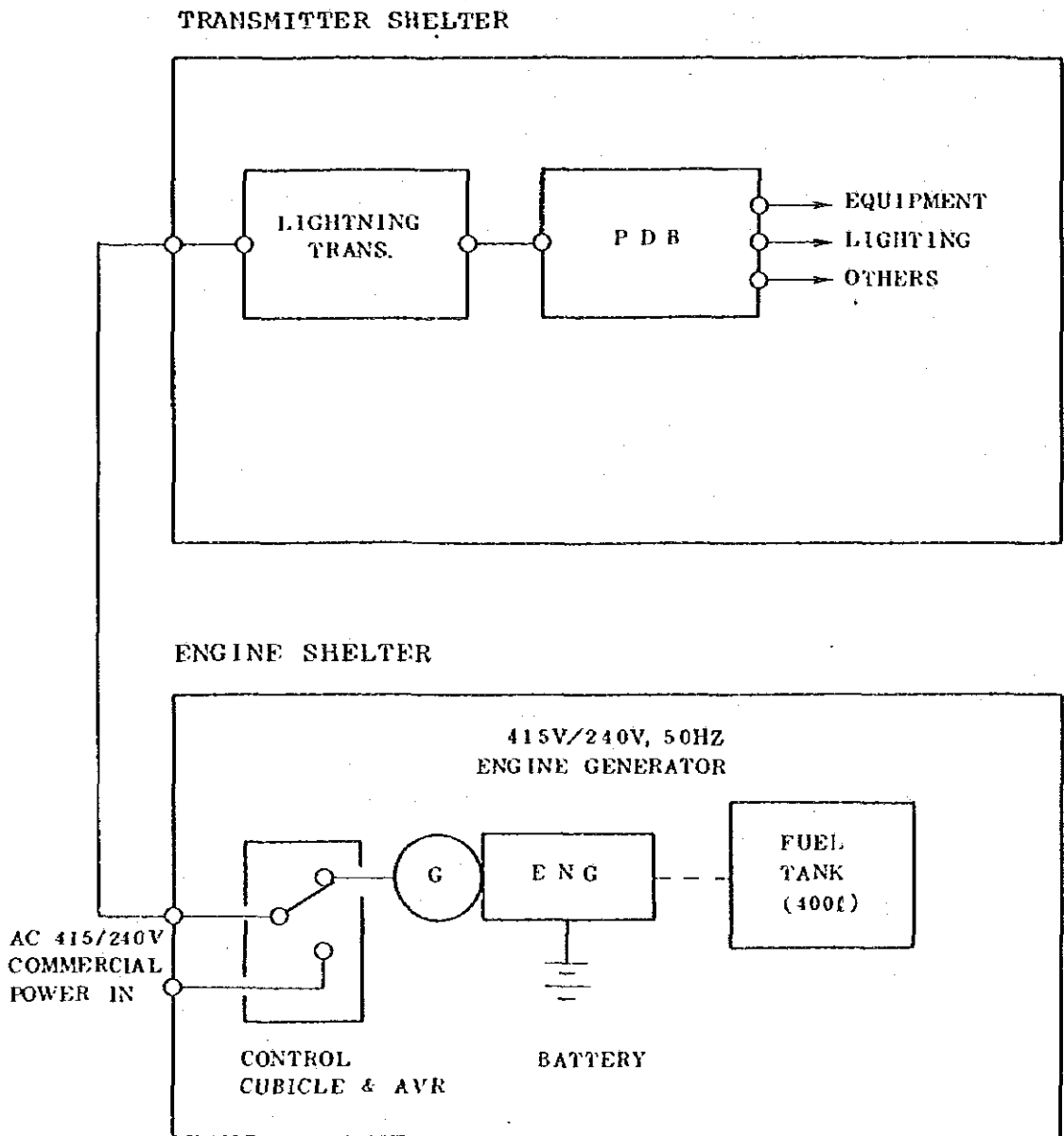


Fig. 5-6-2 Block Diagram of Power Supply in Transmitting Station

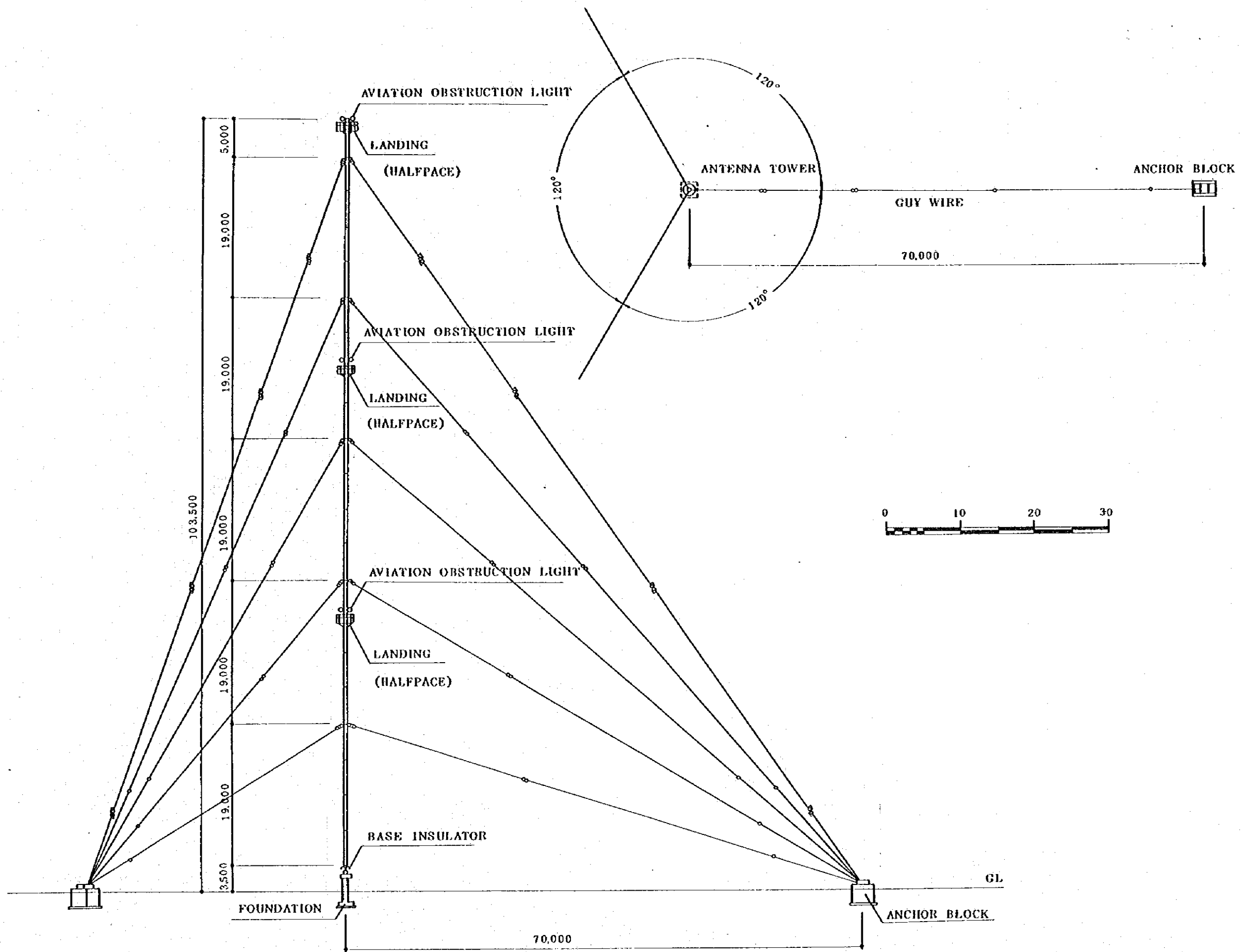
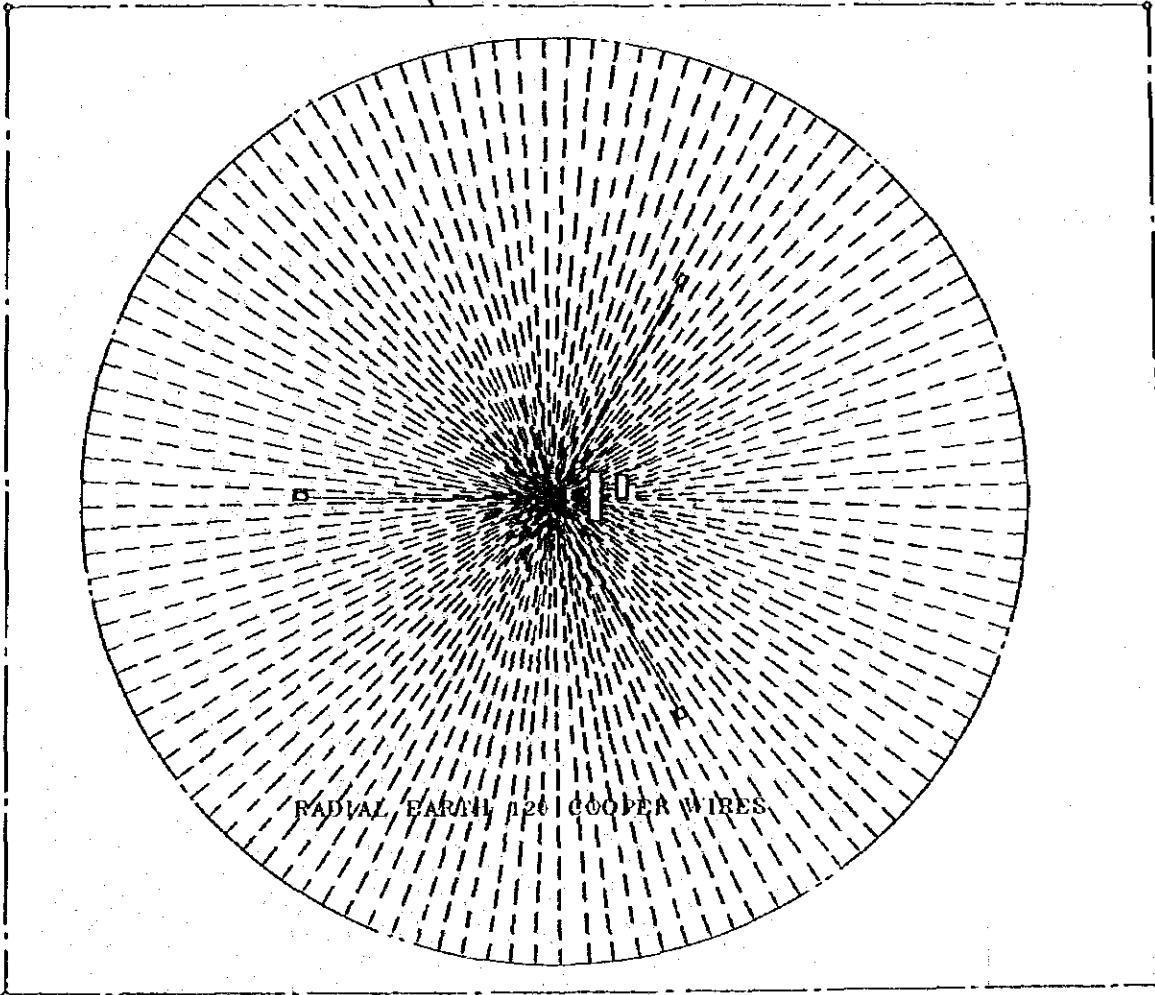


Fig. 5-6-3 Outline of Tower

BORDER LINE OF SITE



RADIAL EARTH AND COOPER WIRES

ROAD

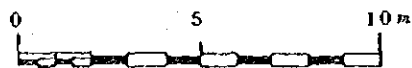


Fig. 5-6-4 Layout of Tower and Earth of El Obeid

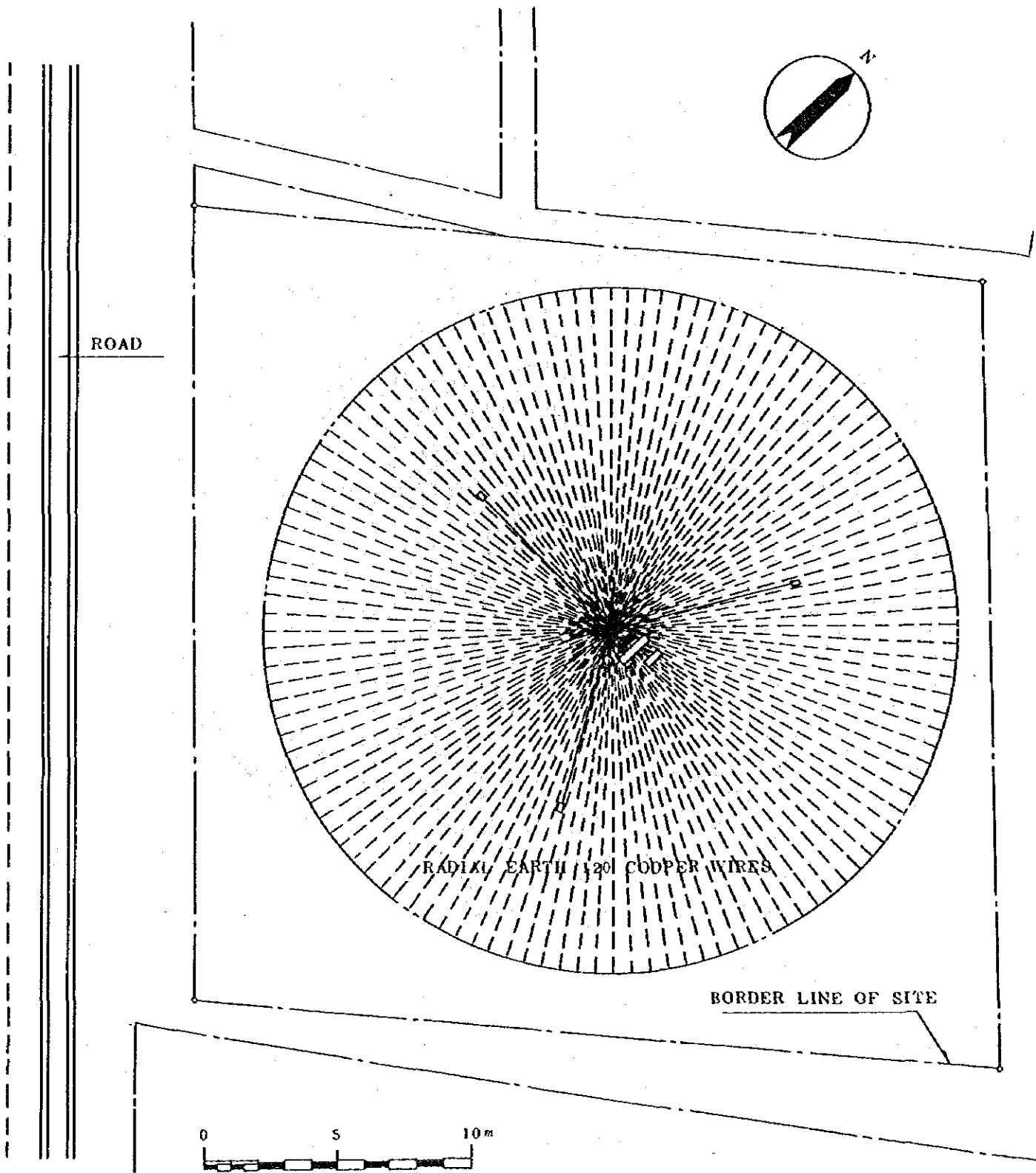


Fig. 5-6-5 Layout of Tower and Earth of Wad Medani

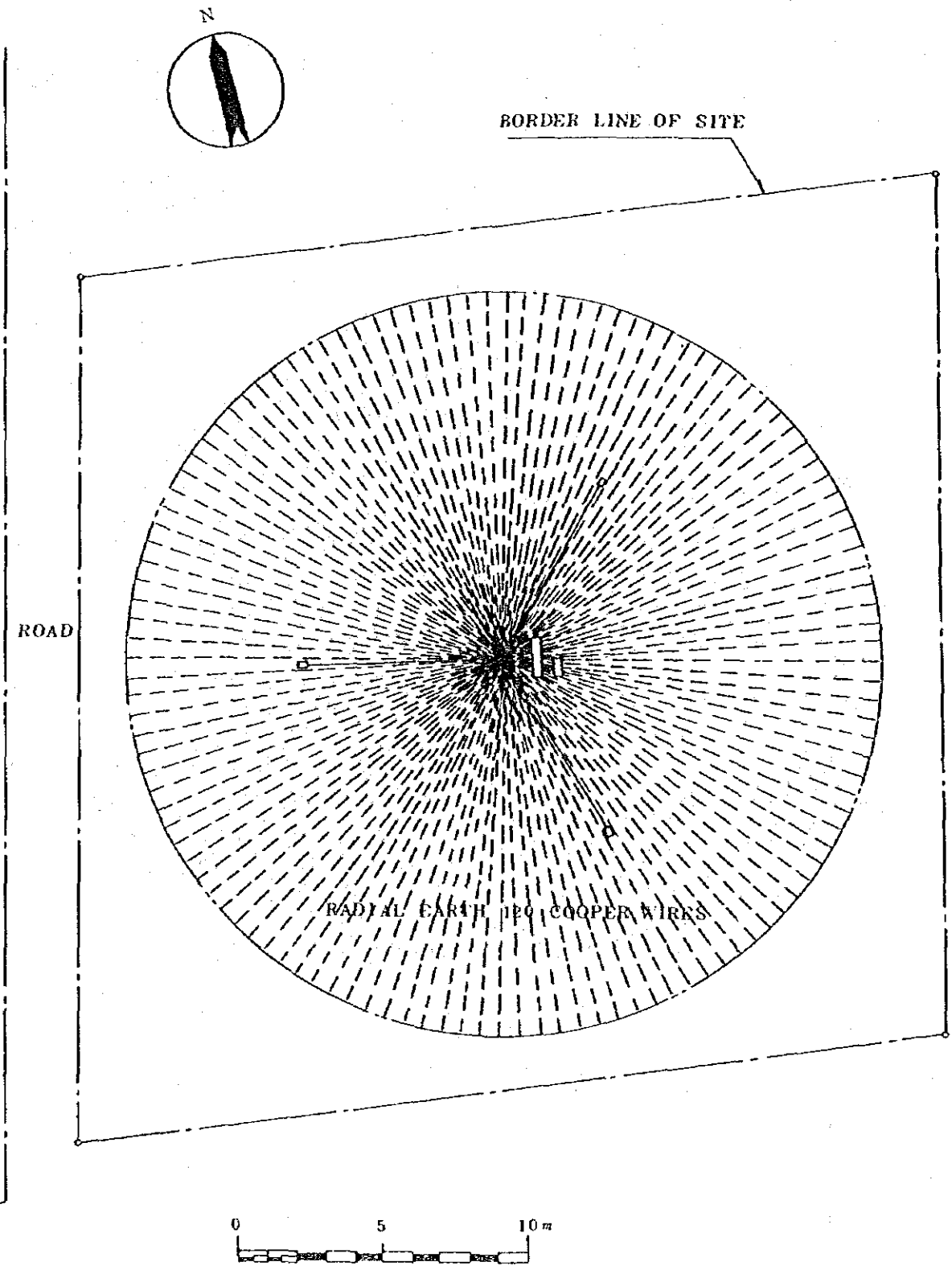


Fig. 5-6-6 Layout of Tower and Earth of Atbara

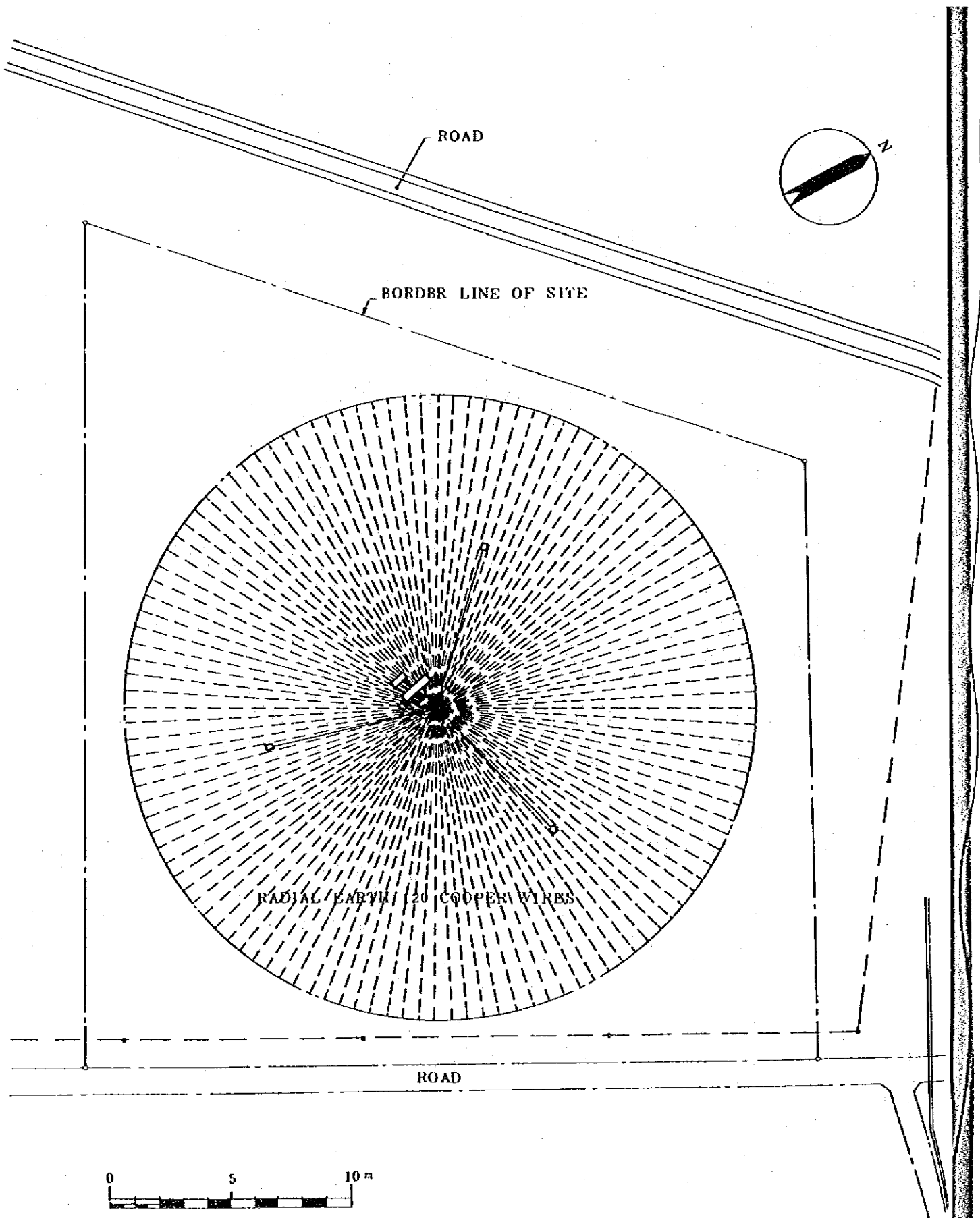
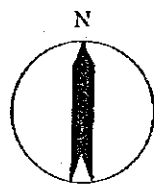
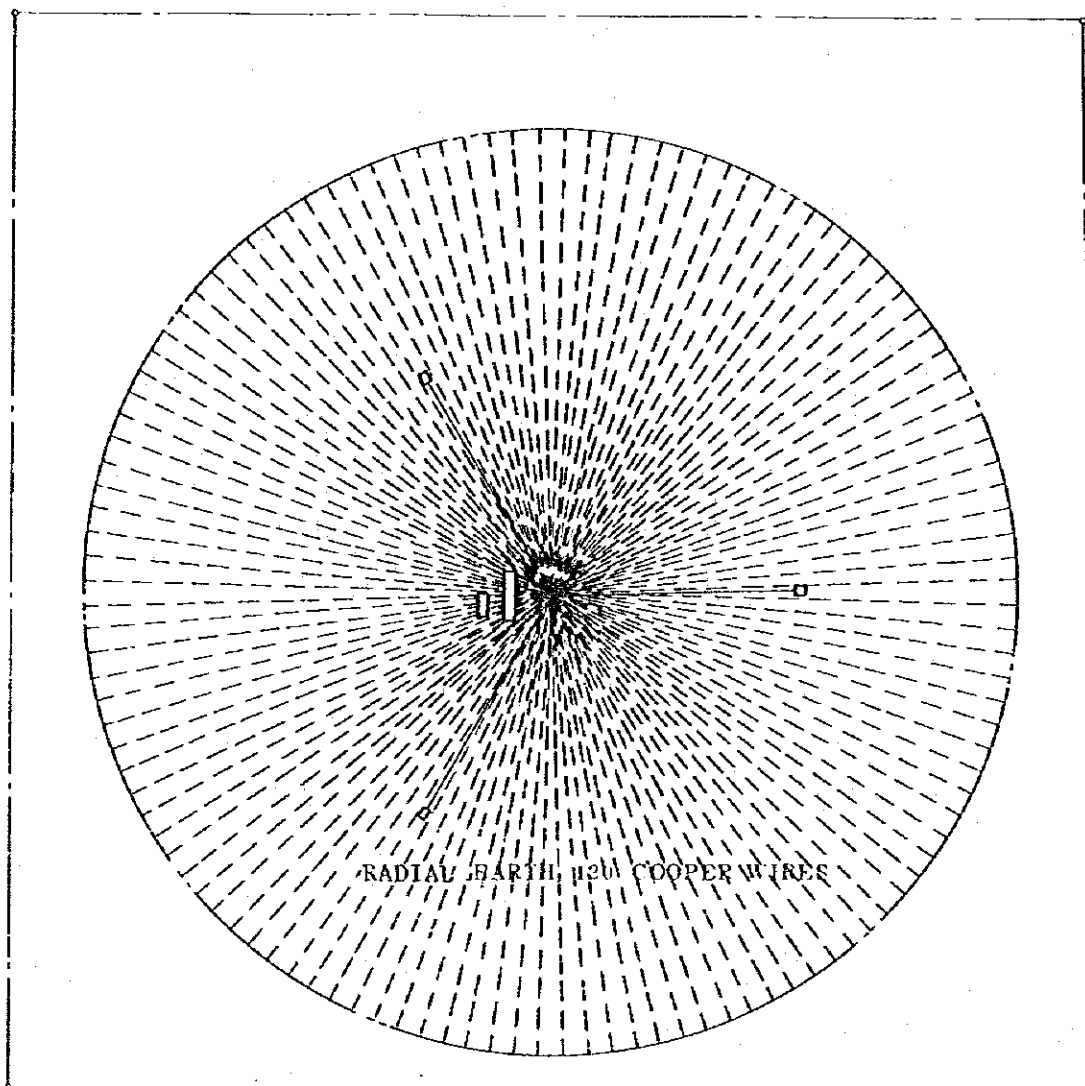


Fig. 5-6-7 Layout of Tower and Earth of Kassala



ROAD

MOUNTAINS

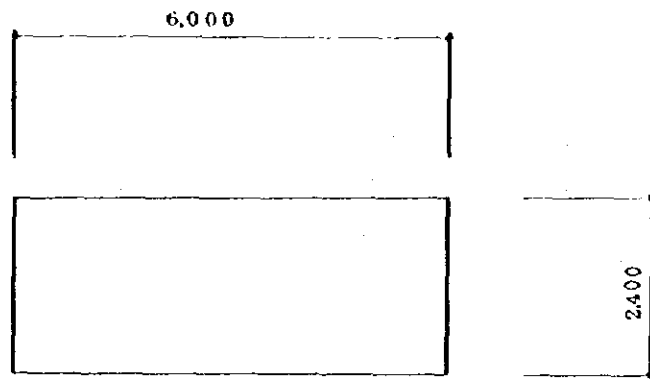


RADIAL EARTH 120μ COOPER WIRES

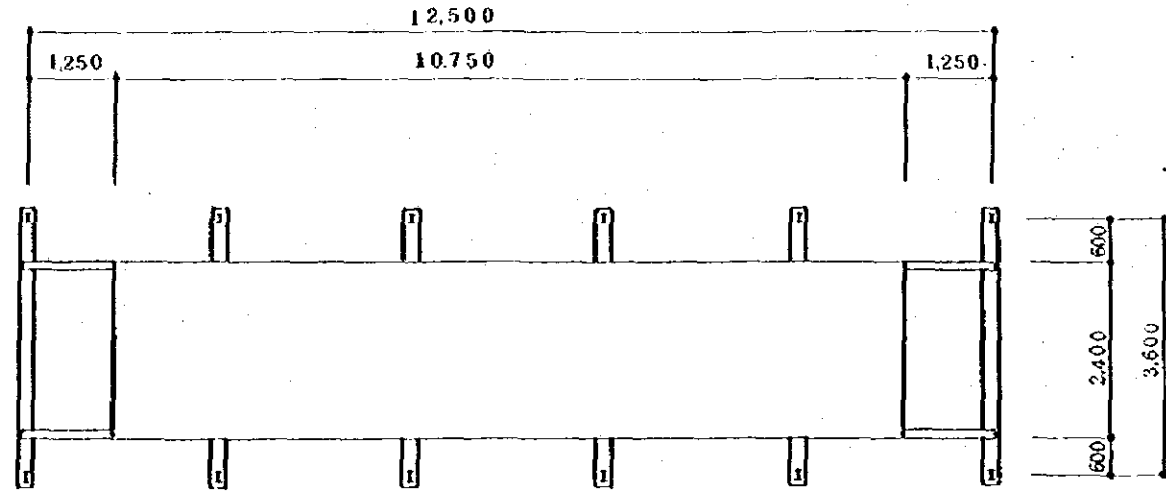


BORDER LINE OF SITE

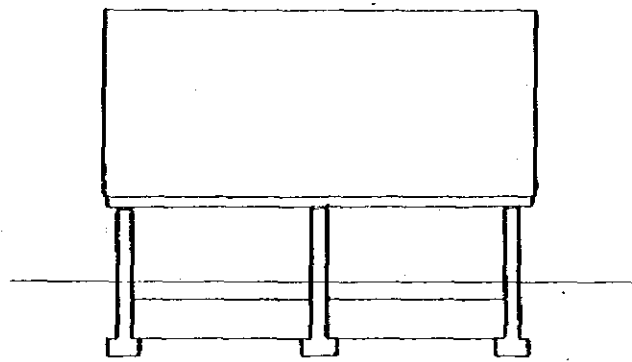
Fig. 5-6-8 Layout of Tower and Earth of Dongola



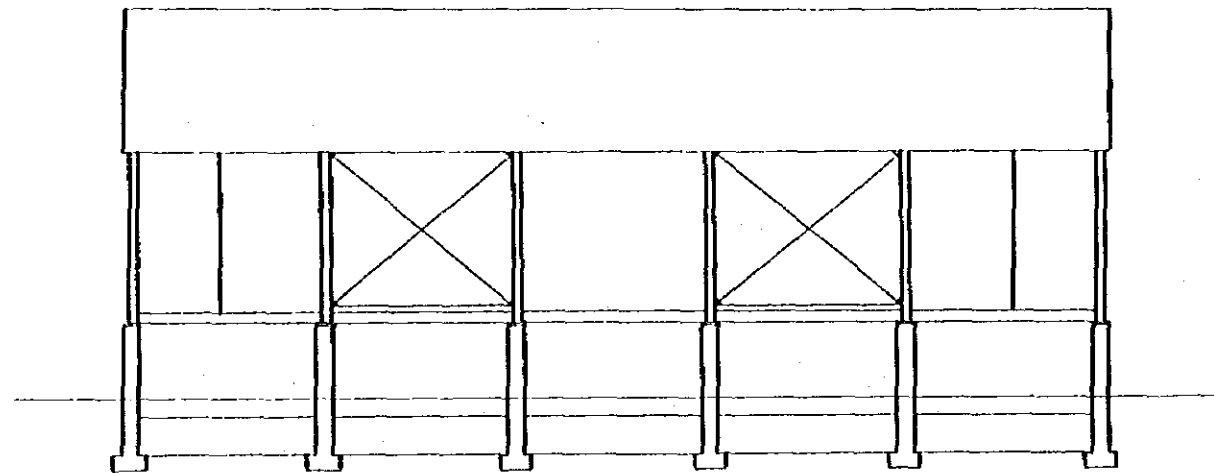
PLAN OF POWER SUPPLY SHELTER



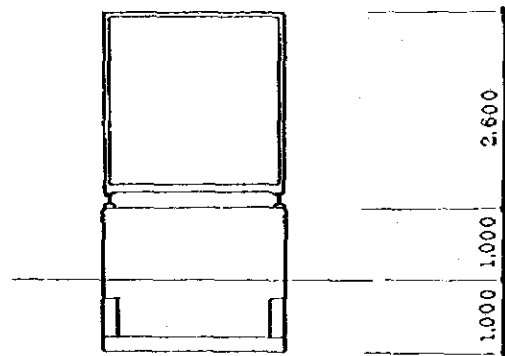
PLAN OF TRANSMITTER SHELTER



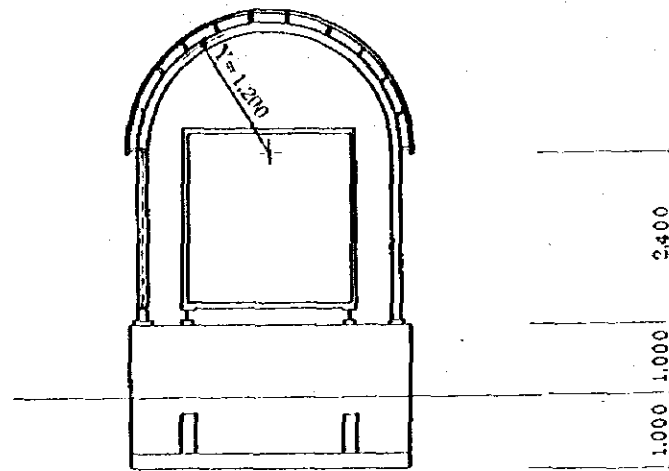
ELEVATION OF POWER SUPPLY SHELTER



ELEVATION OF TRANSMITTER SHELTER



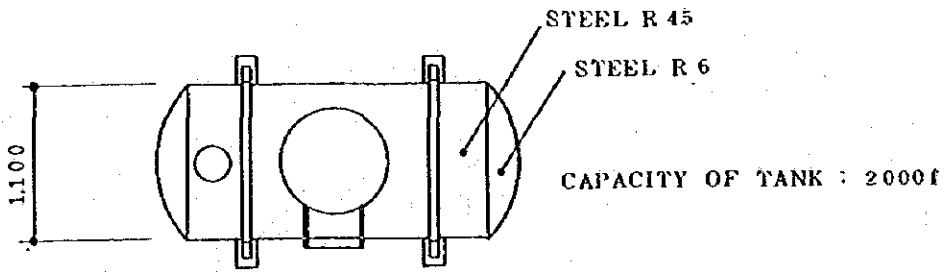
SECTION OF POWER SUPPLY SHELTER



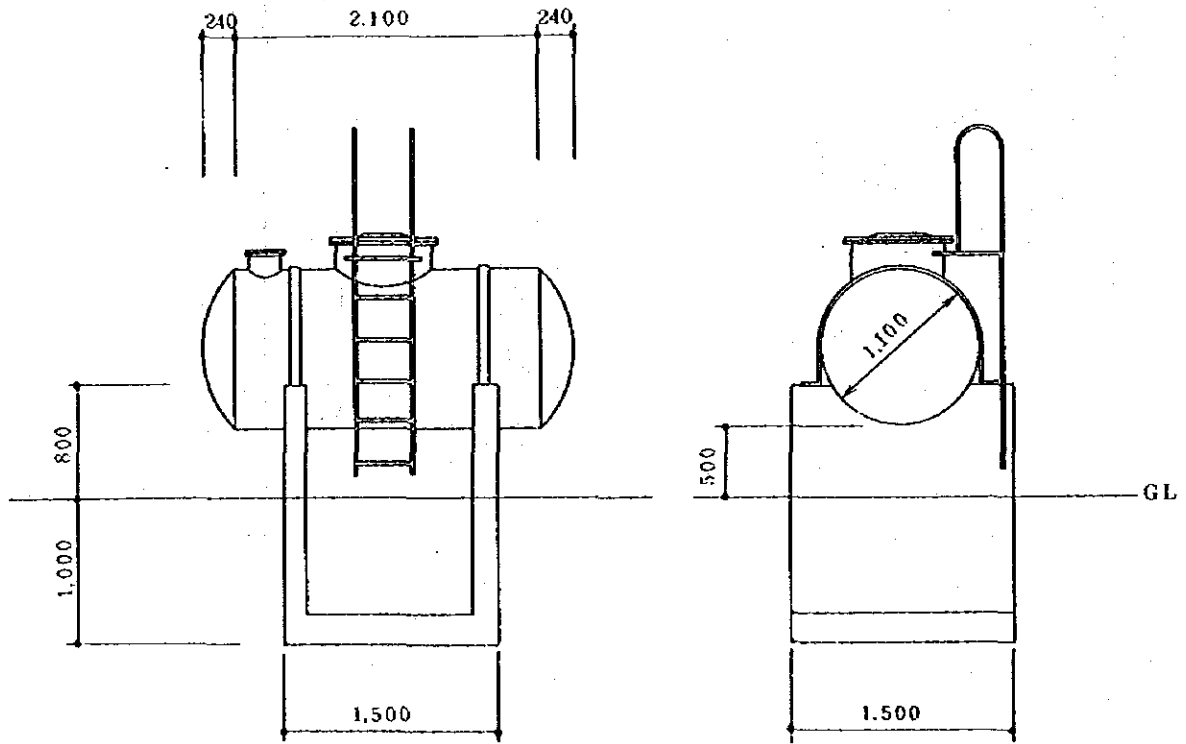
SECTION OF
TRANSMITTER SHELTER



Fig. 5-6-9 Outline of Shelter



PLAN OF OIL TANK 1 : 50

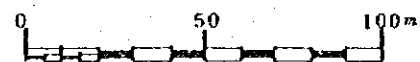
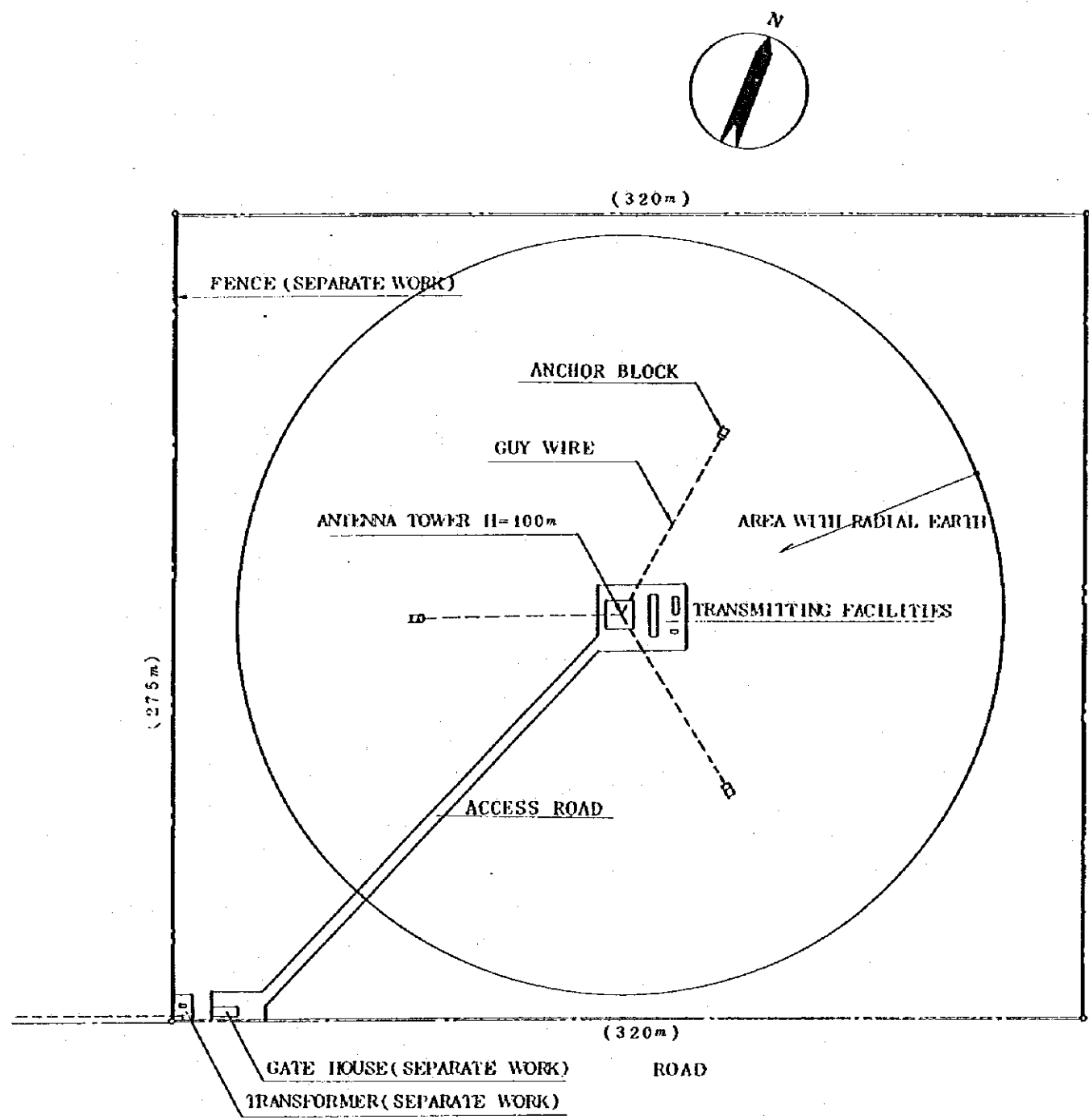


ELEVATION 1 : 50

SECTION 1 : 50



Fig. 5-6-10 Outline of Oil Tank



NORTH SCHOOL

SITE PLAN

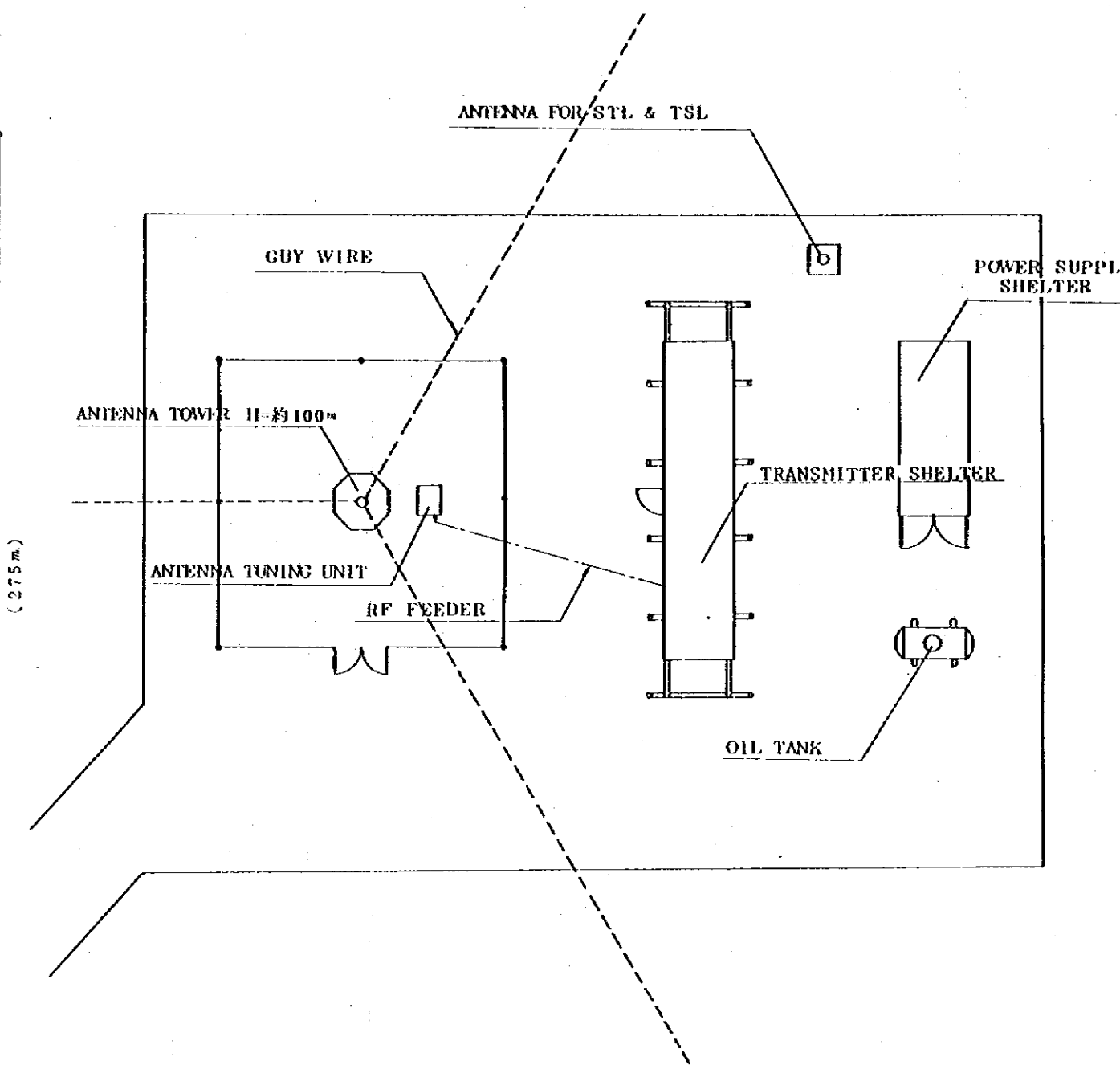
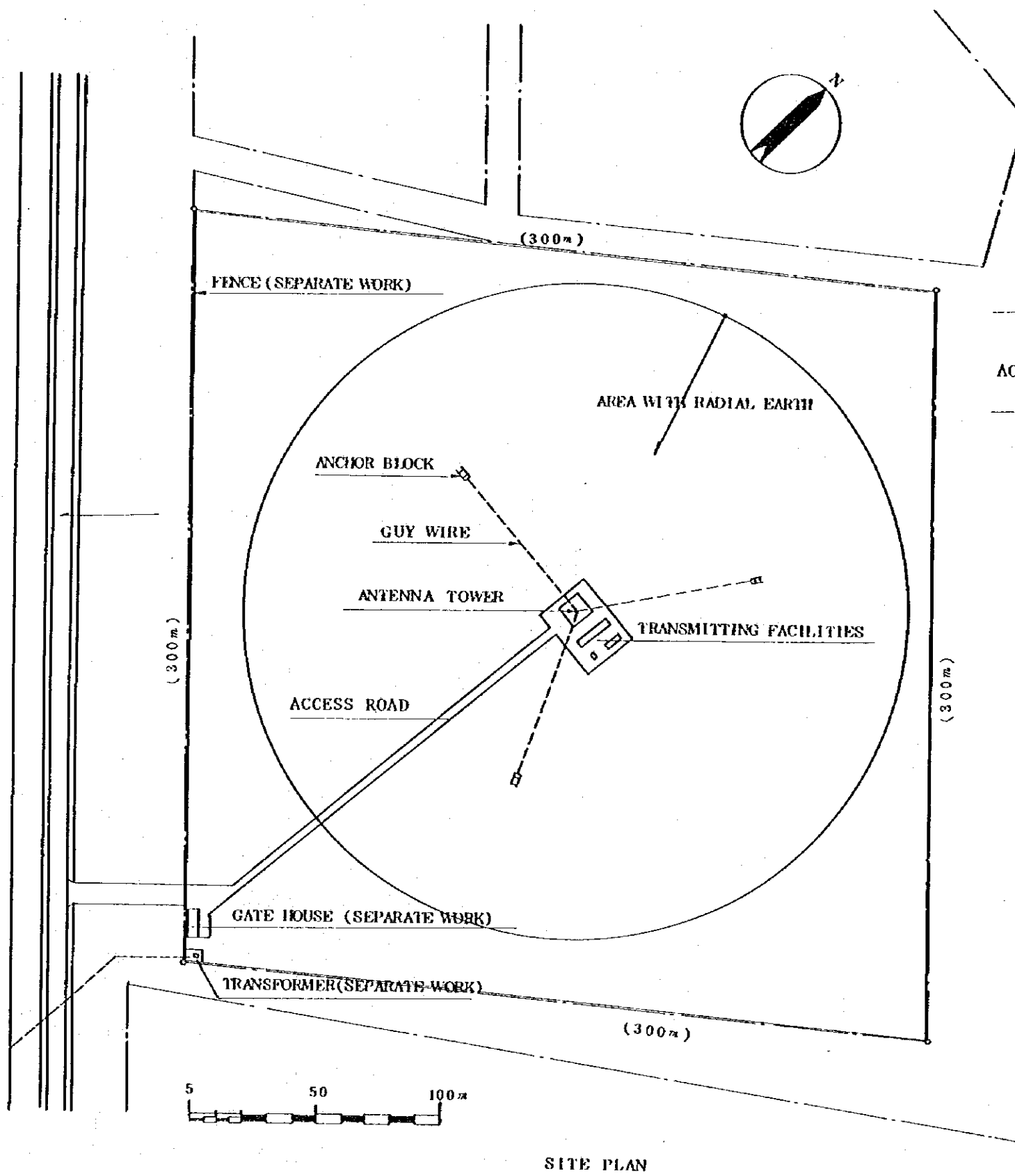


Fig. 5-6-11 Site Plan of El Obeld



SITE PLAN

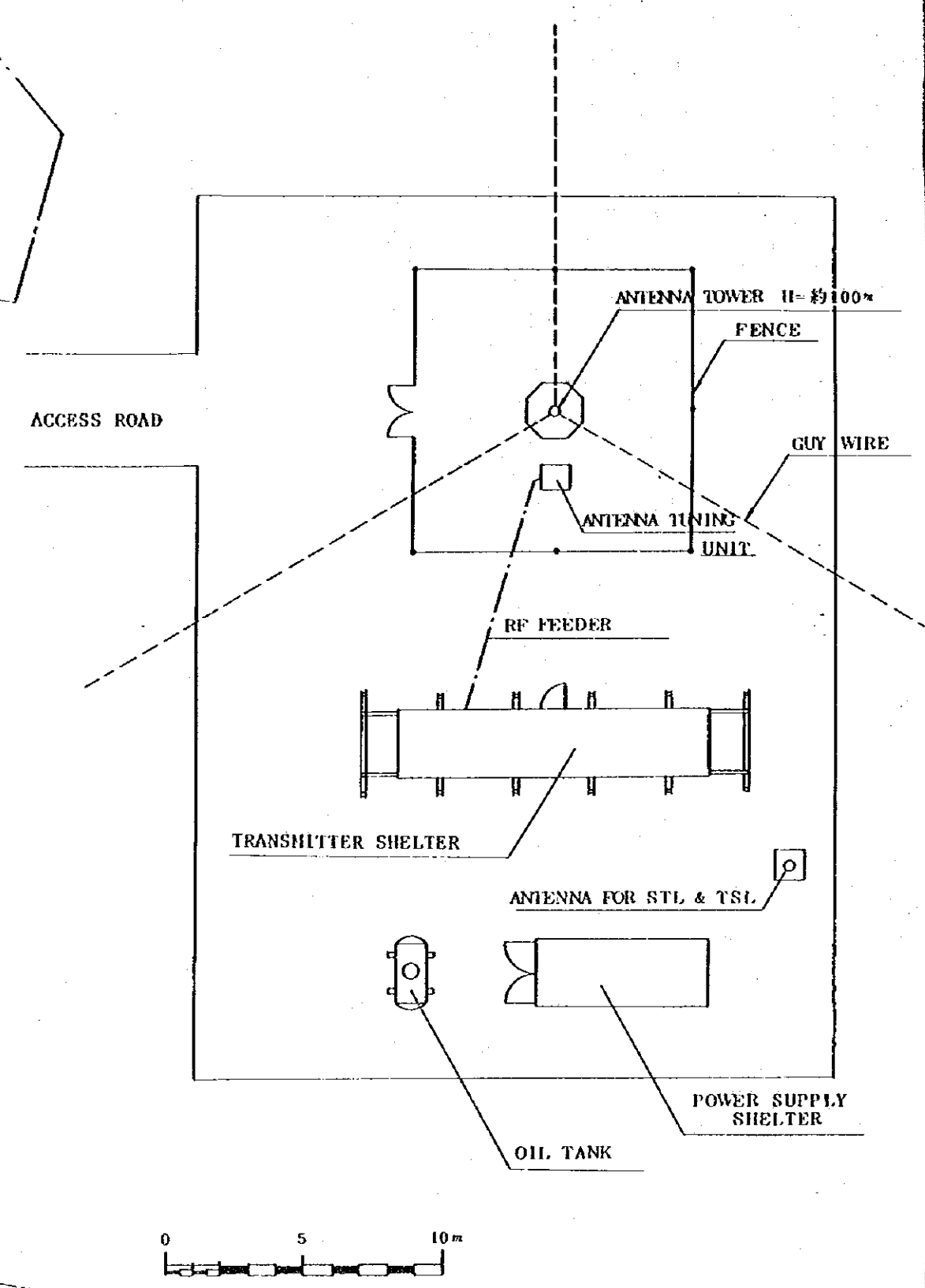
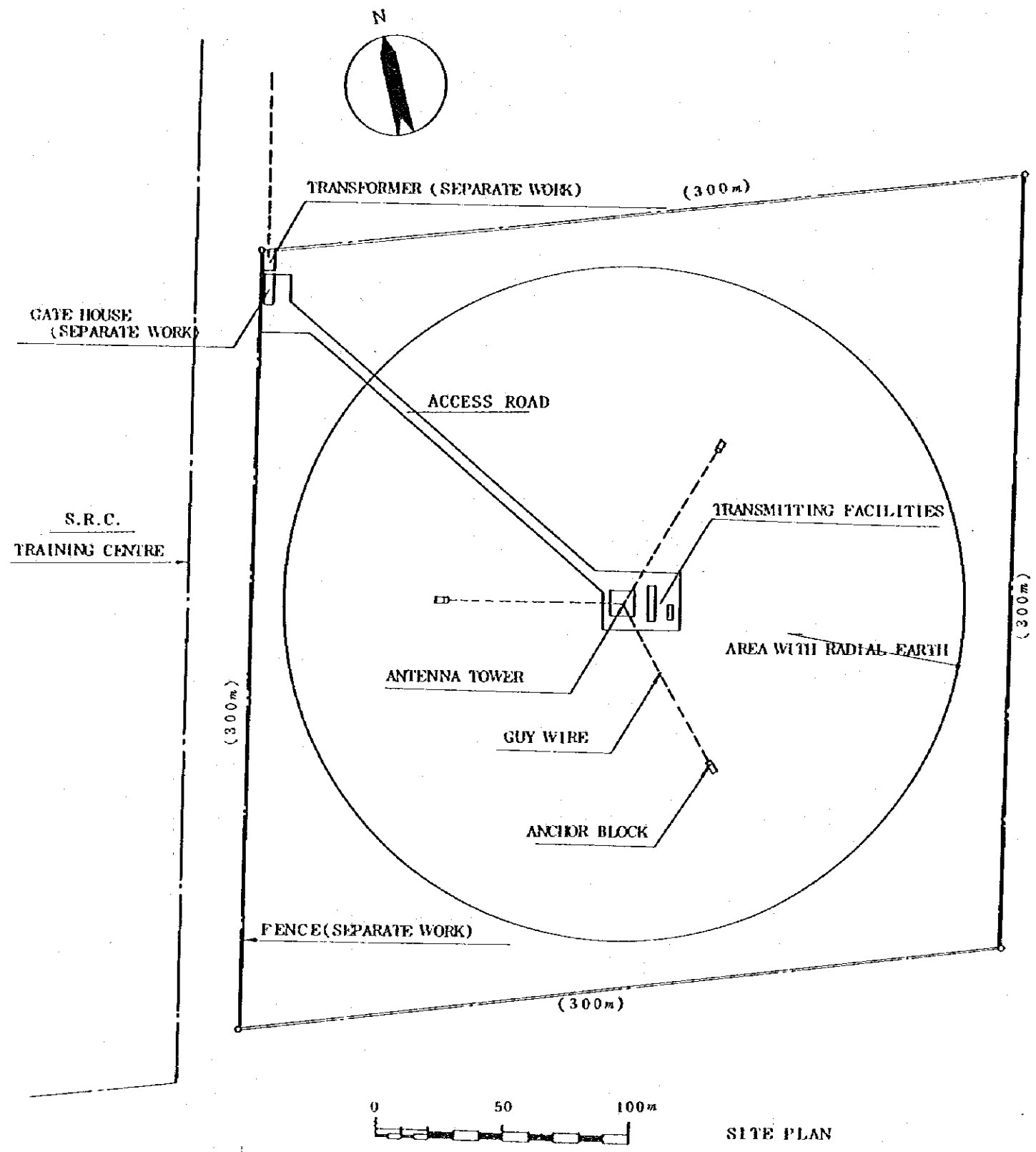
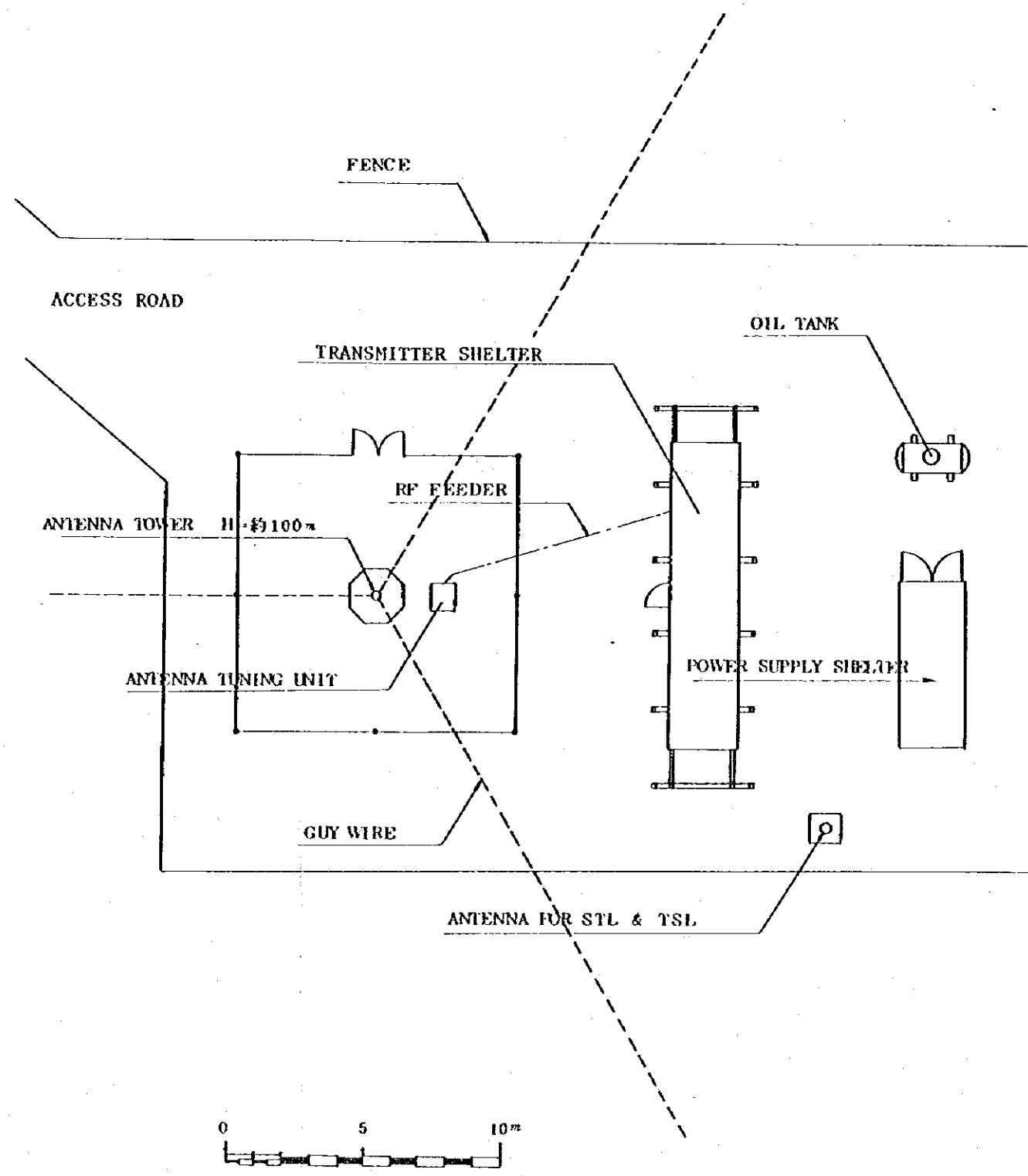


Fig. 5-6-12 Site Plan of Wad Medani

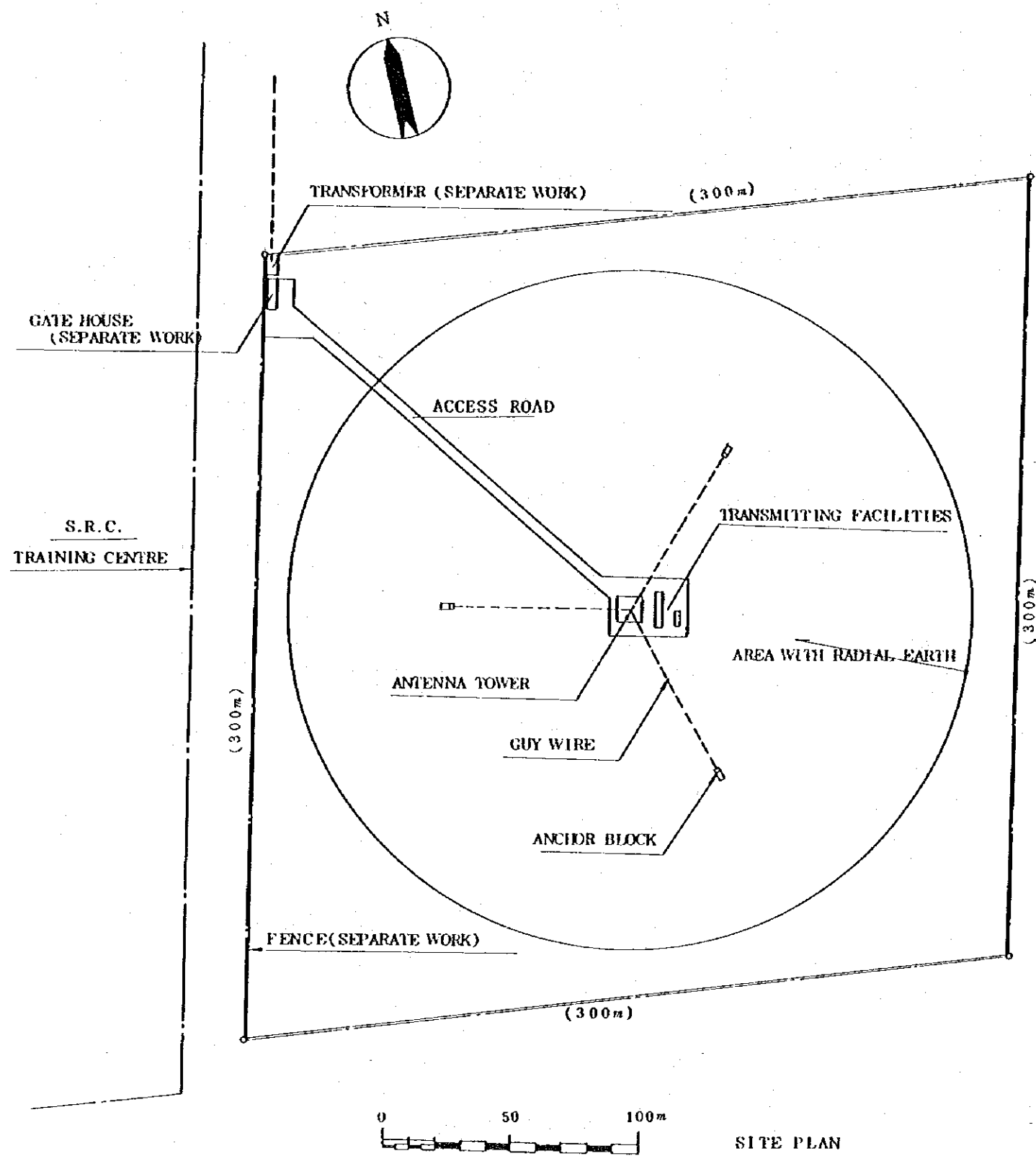


SITE PLAN

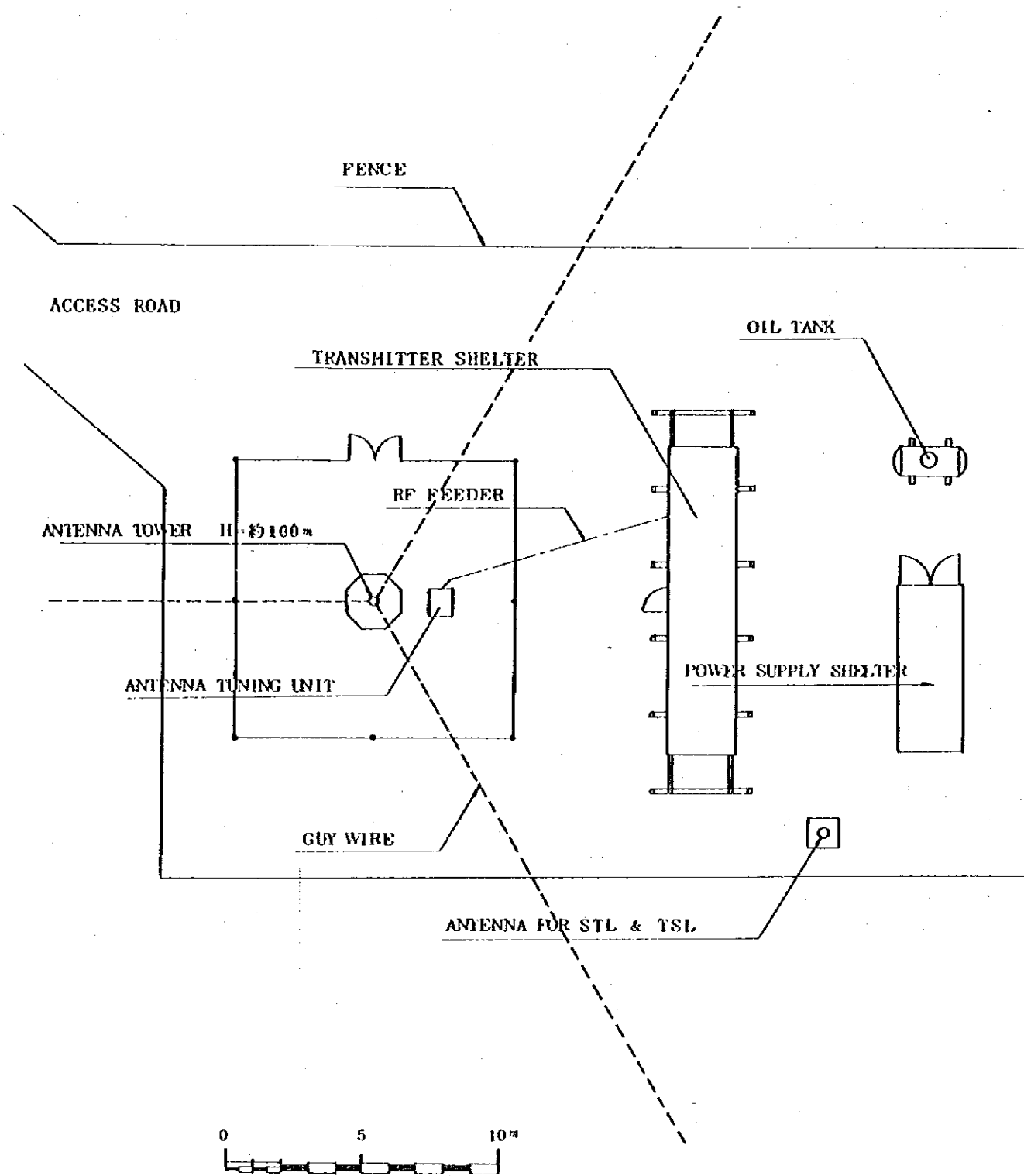


LAY-OUT OF TRANSMITTING FACILITIES

Fig. 5-6-13 Site Plan of Atbara



SITE PLAN



LAY-OUT OF TRANSMITTING FACILITIES

Fig. 5-6-13 Site Plan of Atbara

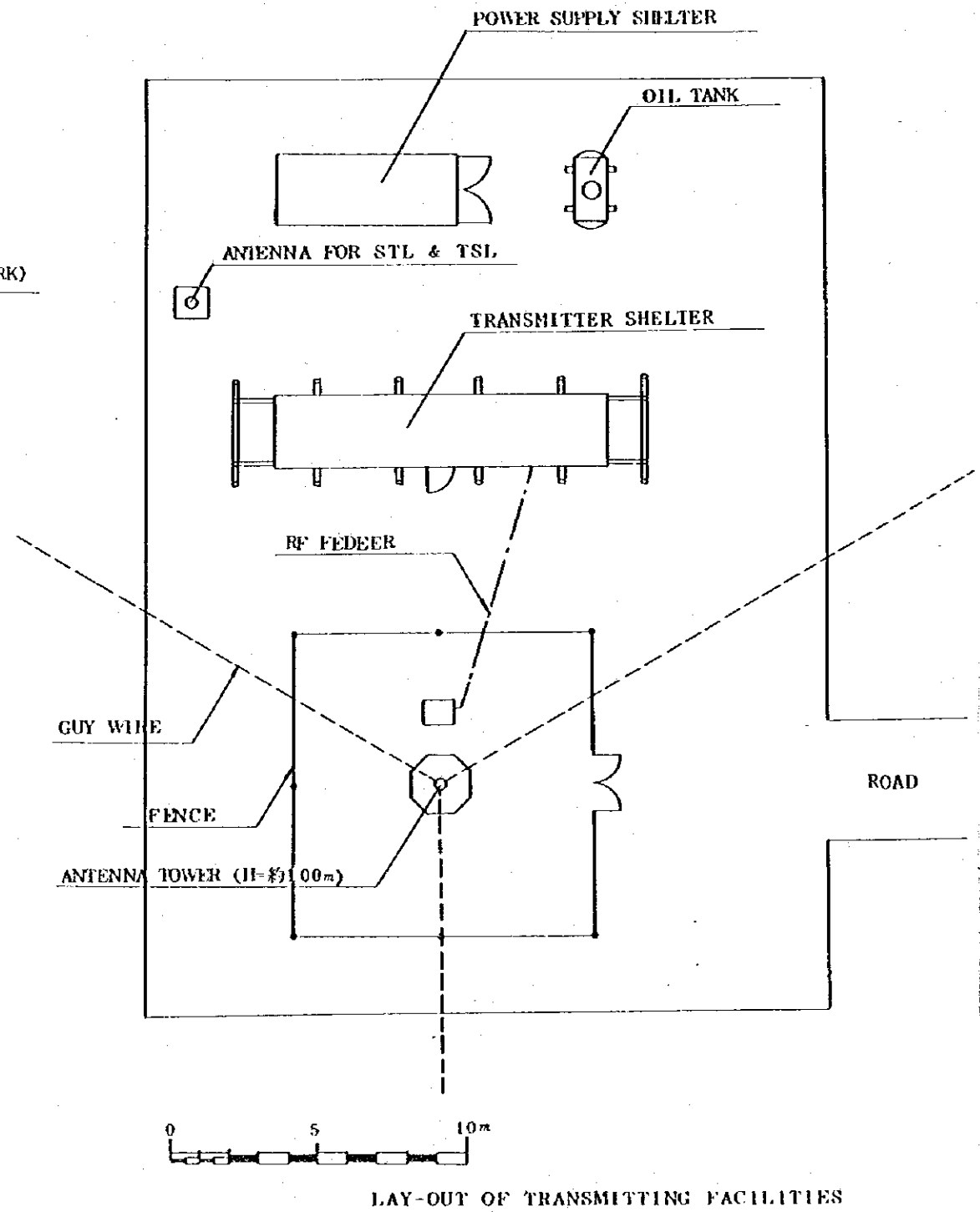
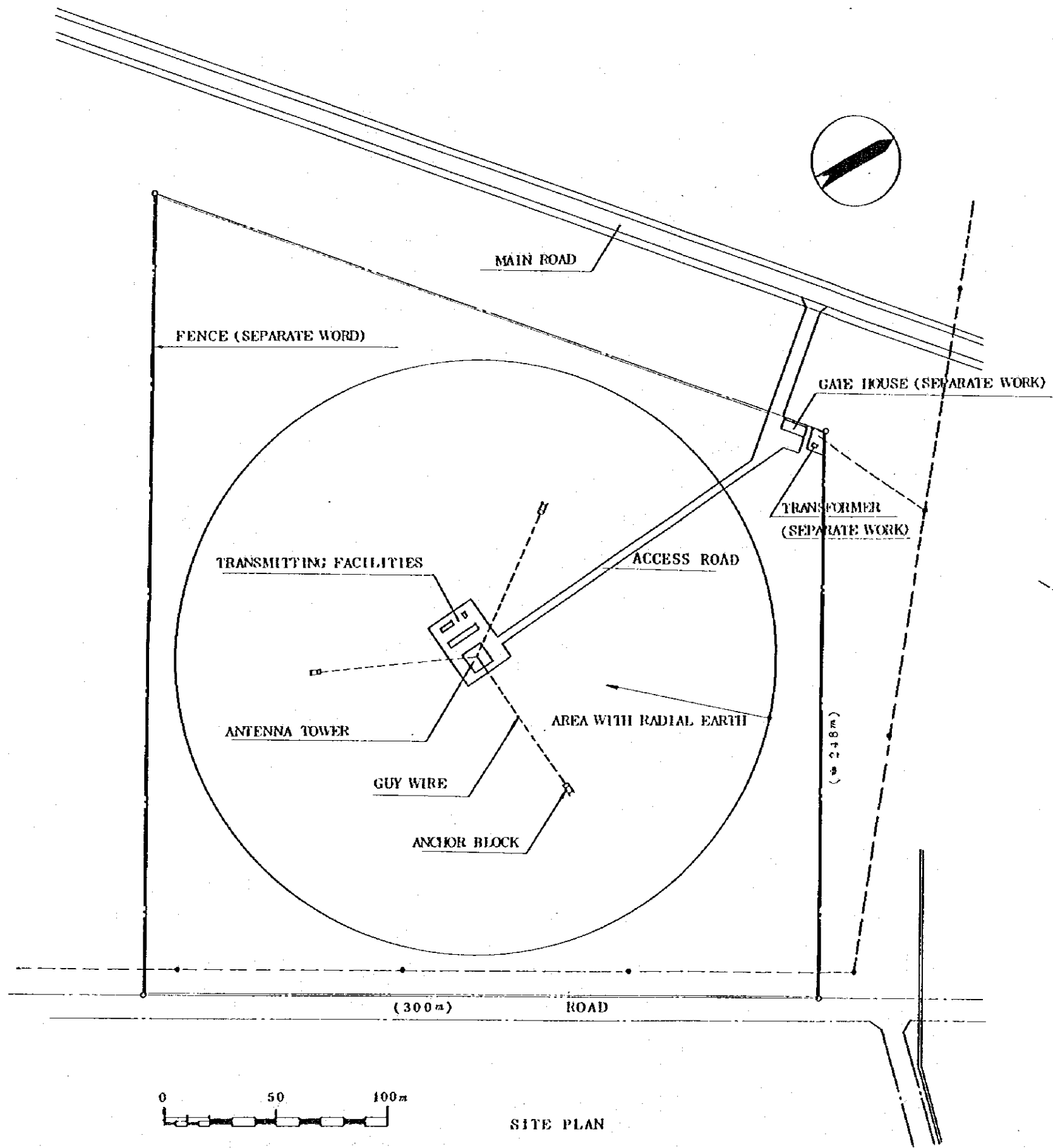


Fig. 5-6-14 Site Plan of Kassala

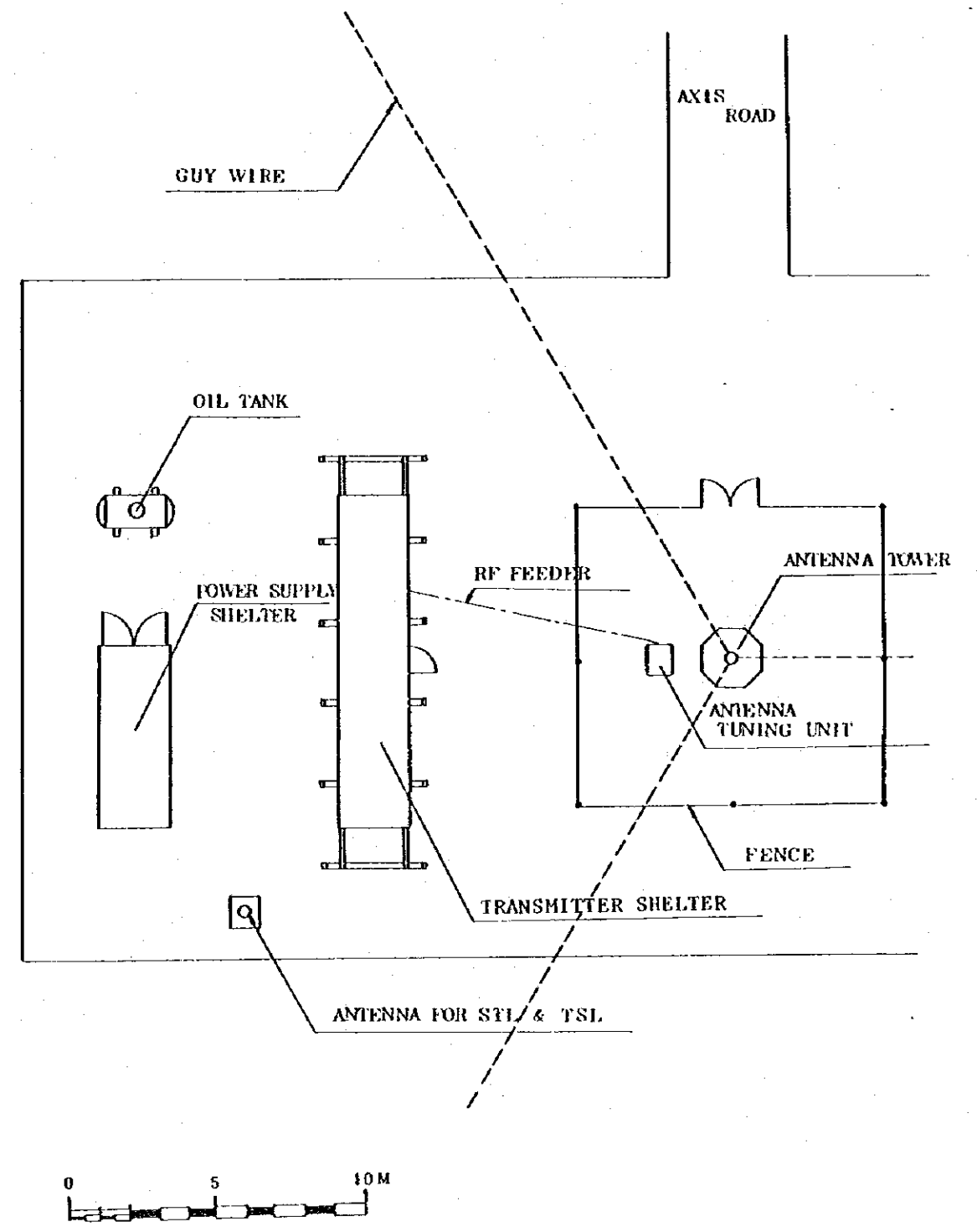
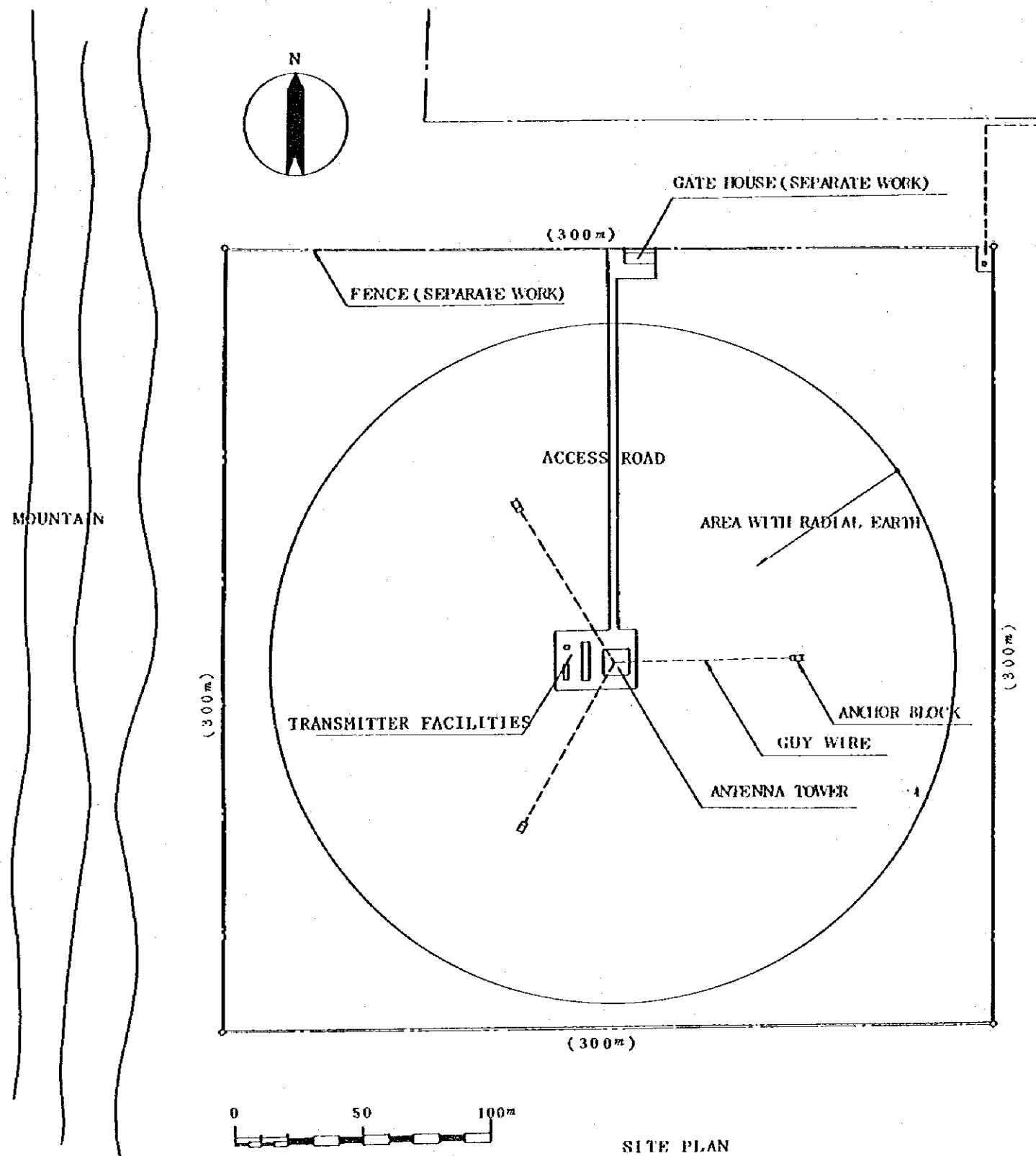


Fig. 5-6-15 Site Plan of Dongola

CHAPTER 6

PROJECT IMPLEMENTATION SYSTEM

CHAPTER 6 PROJECT IMPLEMENTATION SYSTEM

6-1 Main Body of Execution

The SNBC, with a consolidated organization and staff engaged in the management of the broadcasting service, has a sufficient qualification as an organization for implementation of the project.

With respect to the management of the construction work and personnel required, these duties will be carried out by the Technical Affairs Division in SNBC.

In addition, after the conclusion of E/N, the Japanese consultant shall conclude a agreement with SNBC, then carry out the implementation planning and consulting related construction work in trust for the SNBC.

6-2 Construction Plan

The contents of the implementation plan shall be specified in the consultant agreement and construction agreement.

As for the implementation plan and the construction supervising for the project, the consultant shall carry out them, and as for the construction including supply of construction materials, the Japanese contractor shall execute it.

6-3 Scope of Work

The items of this project which the Sudanese Government shall deal with are as follows.

(1) Procedures for permissions and licences of the authorities concerned, customs procedures and others.

(2) Construction items to be dealt by the Sudanese Government.

The following construction items shall be dealt and implemented by the Sudanese Government with respect to the five transmitting stations to be newly installed in El Obeid, Wad Medani, Atbara, Kassala and Dongola.

1) Clearance and levelling of the proposed sites before the start of the construction work.

- 2) Water and city power supply for the construction work.
- 3) Construction of peripheral fence at the site.
- 4) Preparation of guardhouse.
- 5) City power supply for transmitting station.
- 6) Construction of programme transmission line.

SNBC shall prepare one programme transmission line from SNBC Omdurman to studio of El Obeid, Wad Medani, Atbara, Kassala and Dongola, respectively.

- SNBC Omdurman to El Obeid telephone exchange office
: Microwave circuit for telephone
- SNBC Omdurman to Wad Medani telephone exchange office
: Microwave circuit for telephone
- SNBC omdurman to Atbara telephone exchange office
: Microwave circuit for telephone
- SNBC Omdurman to Kassala telephone exchange office
: Microwave circuit for telephone
- SNBC Omdurman to Dongola telephone exchange office
: SUDOSAT satellite circuit
- Each telephone exchange office to each studio
: Wired circuit

6-4 Construction Schedule

The construction schedule of this Project is given in Table 6-4-1. The main points taken into consideration upon the determination of this construction schedule are as follows:

- (1) In order to reduce the duration of construction work as short as possible, the construction work of the five transmitting stations shall be divided into two groups, such as three stations and two stations, and be implemented in parallel.
- (2) Broadcasting equipment shall be installed in each transmitting station and studio simultaneously during the same period.
- (3) The foundations of shelters for transmitter and engine generator shall be constructed simultaneously with the foundation work of transmitting antenna.

- (4) The overall adjustment and tests of each station shall be carried out at the final stage of the construction work.

TENTATIVE SCHEDULE		-5	-4	-3	-2	-1	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
EXCHANGE OF NOTICE																									
DETAILED DESIGN																									
CONTRACT/HANDING OVER																									
CONSTRUCTION:																									
KASSALA EQUIPMENT																									
WAD MEDANI EQUIPMENT																									
EL OBEID EQUIPMENT																									
DONGOLA EQUIPMENT																									
ATBARA EQUIPMENT																									
CONSTRUCTION:																									
KASSALA TOWER																									
WAD MEDANI TOWER																									
EL OBEID TOWER																									
DONGOLA TOWER																									
ATBARA TOWER																									
TRANSPORTATION OF ANTENNA																									
1. TENDERING																									
2. CONSTRUCTION CONTRACT																									
3. TRANSMITTER MANUFACTURE																									
4. SHIPMENT																									
5. EQUIPMENT INSTALLATION																									
6. ANTENNA MANUFACTURE																									
7. FOUNDATION & RADIAL EARTH																									
8. ERECTION OF TOWER																									

Table 6-4-1 Tentative Schedule of this Project

6-5 Procurement

After broadcasting equipment and engine generator are assembled the wiring and adjustment in the shelter in Japan, then they shall be transported and installed in the site.

Transmitting antenna and sunshade of transmitter shelter manufactured in Japan shall be transported and installed in the site. Reinforcing bars to use for the foundation shall be brought from Japan.

Inland transportation from Port Sudan to each transmitting station, processing of reinforcing bars for the foundation and labour at the site shall be procured in Sudan.

Also construction materials such as cement, sand for foundation, gravel and wood supporting for shape frames shall be procured in Sudan.

6-6 Maintenance and Management Plan

It is required to consolidate the management system in order to maintain broadcasting facilities in good condition, and it deem that section of Maintenance Centre should be established in charge of the maintenance and technical management in Omdurman. Maintenance Centre shall engage with managements of five new stations and take charge of staff training.

6-6-1 Organization and Performance

As for new local radio broadcasting facilities, management and maintenance sections in SNBC shall be consolidated.

(1) Local Transmitting Station

Technical staff in each station shall engage with:

- 1) Operation and monitoring for broadcasting system;
- 2) Production and transmission of local broadcasting programme in each station;
Daily maintenance of broadcasting equipment and Urgent repair works;

It is necessary to organize a duty-system with more than two persons always from the start (6:00) to the end (24:00) of broadcasting. In case two persons are on two-shift every day, it will be necessary to arrange at least six persons for each station.

(2) Maintenance Centre

Maintenance Centre shall be established in SNBC Omdurman and be engaged in the five medium-wave radio transmitting stations of 5-kW output power newly established under the first year plan with:

- 1) Determination of facility maintenance plan (long term and annual);
- 2) Periodic inspection, and checking;
Urgent repair works in failure of broadcasting facilities;
- 3) Repair of failed unit, etc.;
- 4) Technical management;
- 5) Training of staff;

It is required to post at least six persons.

6-6-2 Arrangement of Devices and Spare Parts

Measuring equipment and tools for maintenance of broadcasting facilities shall be arranged in Maintenance Centre intensively from the view point of efficient disposition. Spare parts and spare modules shall be supplied to each station in response to their requirements.

Devices to be intensively arranged in Maintenance Centre are as follows:

Measuring equipment for maintenance	1 lot
Parts and spare parts for maintenance, spare modules	1 lot
Tools for maintenance and jigs	1 lot
Vehicle for maintenance	1 lot

CHAPTER 7

PROJECT EVALUATION

CHAPTER 7 PROJECT EVALUATION

Radio broadcasting has an outstanding feature with capability of disseminating information rapidly and simultaneously over a vast area, and be received by an inexpensive simple radio receiver operating on battery power. In addition, the radio programmes can be produced by using simple and inexpensive facilities with few staff in comparison with those of television.

In the vast territory of Sudan, as the condition of telecommunications is insufficient, the use of radio broadcasting will be an important method for offering information.

In Sudan, the radio medium-wave broadcasting commenced in 1940 on a small scale at the capital Khartoum, Sennar, Juba and Nyalá; the land coverage is only about 12.2 % and the population coverage is yet about 38 %. With the installation of radio transmitting stations and its broadcasting network for the five cities of the first year plan, the land coverage will be improved to 15.1 % and population coverage rate will be improved to 53.2 %.

By broadcasting the programmes produced at SNBC Omdurman through this network to a wider area, it will be helpful to unify the nation of Sudan. In addition, the information of central administrations can be offered to the nation promptly. Moreover, it will be possible to further enhance the effectiveness of radio broadcasting not only by broadcasting programmes of central administrations but also by broadcasting local programmes produced at each local station closely related to the peoples.

By producing programmes at each station, for example in Kassala, Eastern States of Sudan where fruits such as grapes, mangos, bananas are cultivated and some of them are exported to the Arabian Gulf countries, timely broadcast of agricultural guidance will be made effectively for increasing the productivity. In Wad Medani region, the main producing area of raw cotton and sugar canes, information related to supply of water for cultivation and timely suggestions on harvest work will be useful for increasing the productivity. In Atbara and Dongola regions, the main cereal producing area, agricultural information and guidance to new cultivation methods will be beneficial for increasing the

productivity. In El Obeld where livestock farming of such as sheep, goats, cattle are carried out on a large scale, information related to livestock including countermeasures against infections will also be useful for increasing the productivity.

In addition, as the sanitary circumstances are not sufficient, popularization of sanitary knowledge by publications is difficult and population of nomads is high, improvement of the foregoing matters is expected by means of radio broadcasting.

As described above, construction of the radio transmitting stations in this project will greatly contribute to the improvement of living standard of the Sudanese nation and development of regional society, accordingly the financial assistance in grant aid from Japan will be of meaningful.

After the implementation of the first year plan, as the second year through the fourth year plans, the expansion of broadcasting network with the renewal of superannuated facilities and consolidation of the system should be further executed. This project is therefore to be implemented in order to perform the mission of broadcasting in Sudanese society.

This plan, as a financial assistance in grant aid from the Government of Japan to enhance the necessary medium-wave broadcasting network facilities for accomplishing the initial objective, is to impose no overburden to Sudan in construction of facilities and continuance of operation. For example, as the proposed sites are all public-owned or semipublic-owned estates, there will be no trouble in acquisition of sites. In addition, the length of electric power lines to be newly installed for these transmitting stations is totally only about 16 km. Moreover, in respect to the necessary programme transmission lines, the existing lines can be used and the terminal equipment are only to be modified.

The acquisition of sites, water supply, enhancement of programme transmission lines, are ensured by Sudan side.

In addition, SNBC will be responsible for the operation system, the acquisition of personnel for the new transmitting stations and the Maintenance Centre. Thus, there is confidence in materialization of this plan and the successive second year through fourth year plans.

With regard to the project cost, the broadcasting facilities are designed economically as far as possible. The height of transmitting antenna is determined on the basis of economy and effectiveness. The plan is also devised that the period of construction work will be shortened greatly.

The population which will be served by the proposed five transmitting stations in good condition, is estimated at 3.4 to 4 millions under the assumption that urban noise level at MF band of the related reception area is sufficiently low. In addition, considering the fact that the radio receiver have been used already, extended radio broadcasting service by the plan will be received immediately by the nation of Sudan.

CHAPTER 8

CONCLUSION AND SUGGESTION

CHAPTER 8 CONCLUSION AND SUGGESTION

8-1 Conclusion

Expansion of radio broadcasting network, planned by the Government of Sudan is one of the most effective measures to raise the living standard of local residents and to develop the local communities, which enables the promotion of news and information service for the regional society, flourishing of agriculture and cattle breeding, diffusion of knowledge on health and sanitation, education of children, etc.

The survey team confirmed the feasibility, reasonability and usefulness of the proposed project together with the Sudan officials concerned.

Furthermore, each city which has been selected and proposed for the first year plan, El Obeid, Wad Medani, Atbara, Kassala and Dongola satisfy the above objectives, without causing any hindrance for the construction work and operation of transmitting stations.

As for the maintainability of the facilities, existing and future installations, the survey team concluded that it would be possible to keep them in good conditions with the staff engaging now, however to keep the continuation of good maintenance, training of staff is inevitably required. In this sense, participation of trainees from the SNBC in the "Group Training Course for Radio Broadcasting Engineering" held annually in Japan under the auspices of the Government of Japan is effective.

By the reason, the survey team derived the conclusion that the first year plan is worthwhile to project by offering the financial assistance in grant aid from the Government of Japan to the Government of Sudan.

8-2 Suggestion

After the completion of the project, it might be necessary to strengthen the maintenance and technical management system to establish the ways of management and operation.

For this purpose, SNBC is necessary to prepare a long-term-plan on the positioning of personnels with sufficient ability and the arrangement of training.

In order to promote the utilization of broadcasting to raise the living standard of the regional inhabitants, further expansion of broadcasting network is required. To cope with the requirements, successive materialization of the second through the fourth year plans is desirable, following the completion of the first year plan.

To ensure the continuation of broadcasting service, stable city power supply to each transmitting station is required.

APPENDIX I

MEMBERS OF THE BASIC DESIGN STUDY TEAM

APPENDIX-I

MEMBERS OF THE BASIC DESIGN SURVEY TEAM

Mr. Mototsugu KANO Ministry of Posts & Telecommunications	Team leader
Mr. Toyoo TANAKA Japan Broadcasting Corporation	Planning of broadcasting
Mr. Tatsuo SUZUKI Japan International Cooperation Agency	Coordinator
Mr. Takashi MIYAGI All Japan Radio & Television Engineering Services Co., Ltd.	Planning of broadcasting network
Mr. Mitsuru AIHARA All Japan Radio & Television Engineering Services Co., Ltd.	Transmission facilities
Mr. Yoshiichi FUJII All Japan Radio & Television	Power-source equipment

EX-II

APPENDIX II

SCHEDULE OF THE BASIC DESIGN TEAM

APPENDIX-II

SCHEDULE OF THE BASIC DESIGN SURVEY TEAM

(30 days, from Feb. 3 to Mar. 3, 1984)

<u>Date</u>	<u>Place of Study</u>	<u>Contents of Study</u>
February 3 (Fri)		Leave Narita.
5 (Sun)		Arrive in Khartoum.
6 (Mon)	Khartoum	Courtesy call to the Department of Information and Culture. Presentation and explanation of Inception Report to SNBC officials and discussion with them. Inspection of TV broadcasting station in Omdurman and transmitting broadcasting station in Ardah.
7 (Tue)	Khartoum	Inspection of radio broadcasting station in Omdurman. Courtesy call on chairman of SNBC and governor of Cordofan region.
8 (Wed)	El Obeid	Meeting with broadcasting staff concerned. Study of the proposed site. Inspection of transmitting facilities.
9 (Thu)	El Obeid	Inspection of Telecommunication Corporation and power plant.
10 (Fri)	El Obeid	Inspection of water works facility. Meeting with SNBC staff.
11 (Sat)	El Obeid	Study of broadcasting studio. Meeting with the Minister of Information in Cordofan region.
12 (Sun)	El Obeid	Study report to governor of Cordofan region.
13 (Mon)	Khartoum	Visit Japanese Embassy and submit interim report. Request the geological research in Kassala to Khartoum University.

<u>Date</u>		<u>Place of Study</u>	<u>Contents of Study</u>
February	14 (Tue)	Khartoum	Inspection of the construction site of Khartoum Training Hospital Project. Collection of reference materials from the government office.
	15 (Wed)	Khartoum	Review of collected data.
	16 (Thu)	Atbara	Study of the proposed site. Inspection of Telecommunication Corporation and TV broadcasting station.
		Kassala	Measurement of field strength.
	17 (Fri)	Atbara	Study of the proposed site. Inspection of power plant. Measurement of field strength.
		Kassala	Study of the proposed site. Inspection of power plant. Implementation of geological research. (C.P.T.)
	18 (Sat)	Atbara Kassala	Study of proposed site. Inspection of broadcasting studio and Telecommunication Corporation. Restudy of the proposed site.
	19 (Sun)	Khartoum	Arrival of team leader and Mr. SUZUKI in Khartoum. Review of collected data. Meeting of the team.
	20 (Mon)	Khartoum	Courtesy call to SNBC by the team. Study of construction materials market. Collection of various kinds of map.
	21 (Tue)	Khartoum	The team visits Japanese Embassy. Inspection of Repairing Centre of Telecommunication Corporation.
	22 (Wed)	Khartoum	Courtesy call on the Minister of Information and Culture by the team.

<u>Date</u>		<u>Place of Study</u>	<u>Contents of Study</u>
February	23 (Thu)	Dongola	Meeting with broadcasting staff. Inspection of Telecommunication Corporation. Measurement of field strength.
	24 (Fri)	Dongola Wad Medani	Study of the proposed site. Inspection of TV broadcasting station and transmitting station. Measurement of field strength.
	25 (Sat)	Dongola Wad Medani	Study of the proposed site. Inspection of Earth Station for Communication Satellite. Measurement of field strength. Inspection of radio broadcasting station and Telecommunication Corporation. Study of the proposed site.
	26 (Sun)	Dongola Sennar	Inspection of radio broadcasting station. Inspection of Sennar transmitting station.
	27 (Mon)	Khartoum	Collection of reference materials from the government office.
	28 (Tue)	Khartoum	Collection of reference documents. Signing to the Minutes.
	29 (Wed)	Khartoum	Collection of reference documents from SNBC. Report to Japanese Embassy.
March	1 (Thu)		Leave Khartoum.
	2 (Fri)		Arrival of Narita.

