In the daytime, the incoming signal of the co-channel was inaudible, and as the urban noise field strength was also lower than 20 dBμ, the required field strength for reception was set at 60 dBμ. In the nighttime, as no incoming signal of the co-channel was audible, the required field strength for reception was set at the same figure as in the daytime.

Fig. 5-4-22 to Fig. 5-4-25 show the estimated service areas of the four stations.

For the estimation of field strength, the CCIR Calculation Chart (Rec. 368-4) was used. In addition, the ground conductivity was set at 3×10^{-3} S/m referring to CCIR Report (Rep. 717-1).

5-2-3 Broadcasting Equipment

In designing the broadcasting equipment, priority should be given to easy operation and maintenance and the reduction of running expenses by improving total system reliability.

The below-mentioned basic policies apply to the design of the broadcasting equipment:

1) Broadcasting facilities meet the objectives of the Project in the most appropriate manner.

2) Materials and engineering methods that are most suitable for the application of the facilities and the limited construction period are selected.

3) Consideration is given to realizing high reliability and power saving as well as operability, maintainability, and economic merits.

4) Technical standards of CCIR are referred to for the specifications of the equipment so that electrical and mechanical safety as well as durability may be assured for the equipment, and possible expansion of the facilities in the future and merits of continuity with Phase 1 are taken into consideration.

5) Appropriate measures are taken to assure safety of operating and maintenance personnel.

5-2-4 Transmission Antenna

The basic policy for designing the transmission antenna is described below:

1) It has a structure which assures sufficient strength against wind pressure and other natural conditions.

2) It is designed to increase economic merits and to efficiently assure wide coverage.

3) Consideration is given to ease of operation and maintenance.

4) Measures are taken against being struck by lightning.

5-2-5 Station Building

The station building is to house transmitters, engine generators, and other required equipment and facilities and it should be suited to the severe environmental conditions in deserts or similar districts.

The basic policy for designing the station building is described below:

1) It satisfies those functional requirements which meet the objectives, and due care should be taken as to weatherability, heat insulation, and dustproofness.

2) Operation and administration are carried out economically and easily.

3) Maintenance and inspection are carried out economically and easily.

4) It ensures well-balanced durability as a whole.

5) It assures maximum safety against any types of accidents.

The station building is of a shelter type which can meet all the requirements described above.

There are two separate shelters, one for the transmitters and another for the engine generator, so that transmitters may be protected from vibration and noises caused by the engine generator.

By adopting these shelters, it is now possible to assemble the required equipment into them in the manufacturer's plant in Japan, to deliver and install the shelters containing the equipment to the construction sites after completion of the required adjustments, and it is expected that the construction period at the sites can be remarkably reduced and that reliability also can be assured for the equipment.

In designing the station buildings of the shelter type, transportation requirements regarding their weights and dimensions are considered in addition to the strength, weatherability and heat insulation.

5-3 Basic Plan

5-3-1 Scales and Functions of the Facilities

In planning the Project, the scales and functions of the facilities should be determined so that the maximum benefits will be achieved with minimum cost and also so that efficient and economical operation will be possible after completion, on the basis of the site survey.

Particulars are described in the following sections.

5-3-2 Facilities for Transmitting Stations

The composition and functions of the facilities of the respective transmitting stations in Port Sudan, El Fasher, Wadi Halfa and Kosti are as follows. The main equipment of each station is shown in Table 5-3-2.

(1) Transmitter

1) The transmitter is of the changeover system which uses two units -- a 10 kW transmitter of the full-solid-state type to be in service and a standby unit -- to protect the broadcasting service from suspension due to failure and secure the broadcasting service for the radio audience.

The system to provide a 10 kW transmitter may be roughly divided into two, that is, changeover and multiple systems. For the changeover system, two units of the same rating (10 kW) are operated as one set with one unit being in service and one unit being on standby. For the multiple system, the output of two 5 kW transmitters is combined so that 10 kW output is obtainable. In general, the changeover system is used where high reliability is required.

As regards the transmitter to be adopted in Phase 2, comparison between the changeover and multiple systems shows that equipment costs for the former system are higher by about 2% than those for the latter system. However, the changeover system will be adopted since it is superior to the multiple system in reliability and adaptability to maintenance and operation.

Table 5-3-1 shows the comparison between the changeover and multiple systems regarding operation and costs.

Table 5-3-1 Comparison between the Changeover and the Multiple Systems for Radio Transmitter

	Changeover System	Multiple System
Operation	o Composition of the system is simple and thus maintenance on the spot is easy. o If any failure occurs, changeover to the standby unit is automatically effected, with the output power of 10 kW secured after changeover. o Practically, all the standby unit in the mounted form are arranged on the spot and periodical changeover operation enables confirmation of their working condition, thus resulting in very high reliability. o Facilities used in common for both units enables to expect operation for a long period through changeover operation between in service and standby units.	o Facilities for parallel operation are necessary, which require advanced techniques for their maintenance. o If any failure occurs, changeover to one unit operation is automatically effected with the output power reduced to 2.5 kW after changeover. o Since at the time of failure the output power is decreased to 2.5 kW, the rapid recovery of 10 kW requires retaining spare parts and other materials on the spot.
Cost	———	o The system is cheaper by about 2% compared with the transmitter system of the changeover type.

The multiple system makes it possible to save about 2% in cost per one station. However, the changeover system is a simple system composed of two transmitters, one in service and one for standby, of the same type and thus its reliability is high. Easy maintenance on the spot and thus possibility of carrying out good maintenance work can also enhance the reliability. Periodial changeover operation of the unit in service and one for standby enables the system to operate for a longer period. Accordingly, from the long-term viewpoint, the changeover system seems to have larger investment effects even if it costs a little higher.

2) The necessary equipment and switches for monitoring and operation are mounted on the main front panel of the transmitter to assure easy operation.

3) The transmitting antenna which is a high-erected structure on the ground may often be affected by lightning flashes. Measures have to be taken so that no damages may occur in the transmitter connected to the antenna, by installing a protection circuit at the output of the transmitter.

(2) Ancillary units for the transmitter

1) Operation and monitoring panel
2) Programme input equipment
3) Output switching unit
4) Dummy load unit
5) Surge protector

(3) Link circuit between studio and transmitting station

STL and TSL of radio waves or a wired circuit is arranged between each studio and transmitting station so that broadcasting programmes, remote control and monitoring signals of the transmitting station and telephone may be transmitted between them.

The radio link system is provided to the stations in Port Sudan, El Fasher and Kosti. The radio link system employs two UHF frequencies of the band from 950 MHz to 960 MHz and it is composed of two radio

sets having an automatic changeover system which enables one for operating and the other for a standby.

The antenna is 30 m in height at the studio and 20 m high at the transmitting station above the ground level.

A wired circuit shall be employed at Wadi Halfa with multi-paired cables (to be embedded under the ground) connecting the studio control room and the transmitter shelter.

(4) Remote-control and monitoring equipment

The operation to start and stop the transmitter and power generator in the transmitting station is remote controlled from the studio so that the station may be put on unmanned operation. The studio is provided with a panel unit to display the operating conditions of the equipment and to transmit alarms when trouble happens with the equipment.

Controlling and monitoring signals (between the studio and the transmitting station) shall be transmitted by means of the STL and TSL in the stations in Port Sudan, El Fasher, and Kosti and by means of the wired circuit in the Wadi Halfa Station.

(5) Air conditioner

An air conditioner unit is provided in the transmitter shelter to keep the environmental temperature for the transmitter within an allowable ranges. Since the air conditioning unit should always be operated during broadcasting hours and it incorporates mechanical rotary parts in it, two air conditioning systems are provided including an outdoor unit, so that periodic maintenance may be carried out without any inconvenience.

(6) Power distribution facility

The power distribution facility is composed of a power distribution board, an automatic voltage regulator and an isolation transformer.

(7) Intercom system

This is an intercom system for communication between the studio and the transmitting station. In each station in Port Sudan, El Fasher and Kosti, the telephone signals shall be transmitted through the STL and TSL by multiplexing the signals onto the broadcasting programmes together with the remote control and monitoring signals for the transmitter operation. In Wadi Halfa, the intercommunication is made through the wired circuit.

(8) Transmitting antenna system

1) Transmitting antenna

The transmitting antenna is composed of a guyed mast made of a steel cylinder about 100 m high and about 35 cm in diameter having an insulated structure at the basement. To ensure economic merits, the same size of transmitting antenna is used for all stations, but a part of the top guyed wires will be used according to the assigned frequency as top loading, in order to obtain high efficiency of radiation.

The base of the antenna mast is insulated with a base insulator and a spherical bearing is installed under the base insulator so as not to apply a detrimental force to it. These are placed on top of an independent base made of concrete about 2 m above the ground. The guys of 5 stacks in 3 directions are fixed to 3 anchor blocks made of reinforced concrete placed 70 m from the mast center. Insulators are inserted into each guy at an appropriate interval, and the guys of the highest stack are provided with choke coils.

Two navigation obstruction lights are mounted on the top portion and two intermediate portions of the mast respectively. The whole mast will be painted with white and red stripes alternately, dividing the total into 7 sections.

Structural analysis and design are to be made with reference to the Building Standard Law, its related regulations and various structural design standards specified by the Architectural Institute of Japan.

Fig. 5-4-15 shows an outline of the transmitting antenna.

2) Radial earth

The earth plays an important role in the radiation of medium frequency radio waves. In other words, the earth acts to return the antenna's current, and its efficiency deteriorates due to the loss taking place there (ground loss). Accordingly, a radial earth is installed so as to minimize ground loss as much as possible. It is preferable that the scale in radius be 0.3 wavelengths (about 150 m) to 0.5 wavelengths (about 250 m), but in actual practice (radius) = (antenna height) is taken in many cases in view of the dimensions of the site area and economy. In this project also, the radial earth is taken as 130 m, and 120 copper wires are buried in the earth radiating about 30 cm below GL.

Fig. 5-4-16 shows a layout of the radial earth.

3) Antenna tuning unit

An antenna tuning unit is provided near the base of the transmitting antenna to assure electrical tuning between the transmission antenna and the feeder.

4) Feeder

A coaxial feeder with surge impedance of 50 ohms is connected between the transmitter output and the antenna tuning unit.

The feeder will be embedded under the ground from the transmitter shelter to the antenna tuning unit to the depth of about 60 cm.

5) Ancillary facilities

(a) Austin Transformer

In order to supply power to the navigation obstruction lights installed on the base insulation type antenna, medium wave high frequency power should be able to be fed without any

trouble. Therefore, an Austin transformer (insulated transformer) should be employed with its primary and secondary coils insulated for high frequency.

(b) Choke coil and ball gap

In order to protect the equipment from lightning, a choke coil and ball gap are inserted. A choke coil is to provide a ground in terms of direct current while a ball gap is to decrease electric potential by discharging when the potential goes too high.

(9) Engine generator

Commercial power is usually used for operating the transmitting stations. To assure broadcasting capabilities even when the commercial power fails, an engine generator should be provided to each transmitting station. A changeover switch to select either the commercial power or the engine generator's power should be designed to give priority to the commercial power side.

The engine generator should be composed of a diesel engine-driven generator, a starter battery, a battery charger, and a fuel tank (with a capacity of about 8,000 liters which allows broadcasting for a month).

The capacity of the generator for each transmitting station should be about 90 kVA, supplying 415 V, 3-phase, 50 Hz power.

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

The fuel tank for the engine generator should be mounted on the ground level and be fixed on a frame mounted on a reinforced concrete foundation.

Table 5-3-2 Transmitting Station Facilities

Item \ Transmitting Station	Port Sudan	Wadi Halfa	El Fasher	Kosti
1) Transmitter	10 kW changeover system Programme input equipment Output switching unit Dummy load unit Surge protector	Same as left	Same as left	Same as left
2) Transmitting frequency	747 kHz	837 kHz	801 kHz	891 kHz
3) Link circuit between Studio & Transmitting Station	Studio - Transmitting Station (STL) UHF band, radio receiver, multiplexed transmission of Programmes, Remote control signals and intercom signals Antenna mast : 20m height Transmitting station - studio (TSL) UHF band radio transmitter, multiplexed transmission of broadcasting-monitoring, Remote control signals and intercom signals Antenna mast : same as the STL above	wired	Same as Port Sudan	Same as left
4) Remote-control and monitoring equipment	Control signal receiver monitoring signal transmitter	Same as left	Same as left	Same as left
5) Air conditioner	For controlling temperature inside the transmitter shelter Two sets including an outdoor unit	Same as left	Same as left	Same as left
6) Power distribution facility	Power distribution board Automatic voltage regulator Isolation transformer	Same as left	Same as left	Same as left
7) Intercom system	Studio - Transmitting station: Intercom signals multiplexed to STL and TSL equipment	wired	Same as Port Sudan	Same as left
8) Transmitter shelter	One shelter: For housing transmitter equipment and ancillary equipment, STL receiver, TSL transmitter, Air conditioner, Power distribution facility	Same as left	Same as left	Same as left
9) Transmitting antenna	Steel cylinder mast 100m height: Base insulated with three-way, five-stage guys Navigation obstruction light: At top and two intermediate portions of the mast Radial earth: 130m in radius and 120 earthing wires Antenna tuning unit: Installed near the base of antenna mast Lightning arrestor	Same as left	Same as left	Same as left
10) Engine generator	Diesel engine generator: 90 kVA 415 V 3 ø 4 W 50 Hz Starter battery and battery charger: For starting the engine generator Indoor fuel tank 150 l, Fuel tank 8,000 l	Same as left	Same as left	Same as left
11) Engine shelter	One shelter: For housing diesel engine generator and ancillary equipment	Same as left	Same as left	Same as left
12) Measuring equipment	Each transmitting station: Audio signal measuring equipment Oscilloscope Others Circuit tester Insulation resistance meter	Same as left	Same as left	Same as left

5-3-3 Studio Facilities

The below-mentioned studio facilities should be provided in the studio building which the Sudanese side prepares in the four cities of Port Sudan, Wadi Halfa, El Fasher and Kosti. The functions of the studio facilities should be for producing local broadcasting programmes and for switching between the nationwide programmes relayed from SNBC Omdurman and local programmes as well as the control and monitoring of the respective transmitting station. The major equipment in the studio is shown in Table 5-3-3.

(1) Programme production/transmission facilities

A set of equipment required for the production of local radio programmes and transmission control of the programmes is installed in each studio control room.

(2) Switching panel of input signal

The nationwide programme sent from SNBC Omdurman station or the local programmes produced at each station are switched by the newly installed switching panel in the control room of each studio, and the programmes are sent to the transmitting station through the link circuit between studio and transmitter.

Four inputs and one output are provided in the switching panel in consideration of the possibility of off-air relay in the future.

(3) Link circuit between studio and transmitting station

Either a radio system or a wired circuit is provided between the studio and the transmitting station as the link circuit for transmitting broadcasting programmes, remote controlling and monitoring signals and intercom telephone signals.

The radio system is used in the stations in Port Sudan, El Fasher and Kosti. The radio system employs the output power of 5 W operated at two UHF frequencies in the 960 MHz band and is composed of two radio sets including a stand-by set having an automatic change-over system.

Table 5-3-3 Studio Facilities

Item \ Studio	Port Sudan	Wadi Halfa	El Fasher	Kosti
1) Audio control equipment	Portable type at 8 inputs & 3 outputs ..... 1 set For mixing and controlling audio signals in producing programmes	Same as left	Same as left	Same as left
2) Microphone	Moving coil type microphone ..... 4 sets With a desk stand Microphone box ..... 2 sets	Same as left	Same as left	Same as left
3) Tape recorder	..... 2 sets For programme recording & reproducing	Same as left	Same as left	Same as left
4) Switching panel	..... 1 set For switching between national and local programmes	Same as left	Same as left	Same as left
5) Monitor speaker	..... each 1 set For control room and studio	Same as left	Same as left	Same as left
6) Intercom system	..... 1 set Between studio and control room			
7) Link circuit between studio and transmitting station	Studio - transmitting station (STL) ..... 1 set UHF band radio transmitter, multiplexed transmission of programmes, remote control and intercom signals. Antenna mast 25m high + 5m ..... 1 set Transmitting station - studio (TSL) ..... 1 set UHF band radio receiver Antenna mast: ..... 1 set same as STL above	wired	Same as Port Sudan	Same as left
8) Remote control and monitoring equipment	..... 1 set	Same as left	Same as left	Same as left
9) Intercom system	..... 1 set Intercom signals multiplexed to STL & TSL	wired	Same as Port Sudan	Same as left
10) Power supply unit	Battery floating system ..... 1 set	Same as left	Same as left	Same as left
11) Monitoring receiver	All wave radio receiver ..... 1 set Receiving antenna ..... 1 set	Same as left Attached with trap circuit against own transmitting signal	Same as left	Same as left

A wired circuit is employed at Wadi Halfa station with multi-paired cable (to be embedded under the ground) connecting the studio control room and the transmitter shelter.

(4) Remote control and monitoring equipment

Remote control and monitoring equipment is provided at the control room in each studio to assure unmanned operation of the respective transmitting stations. The equipment is provided with functions which enable operations to start/stop the transmitters and an engine generator, monitoring operational conditions of the equipment and reception of the alarm signals sent back to the studio from the transmitting station.

(5) Intercom system

An intercom system is provided in each studio for communicating between the studio and the transmitting station. In the stations of Port Sudan, El Fasher and Kosti, the intercom signals are transmitted through the STL and TSL by multiplexing the signals onto broadcasting signals and the remote control / monitoring signals. In Wadi Halfa, the intercom signals are transmitted through a wired circuit.

(6) Power facilities

A battery floating system is employed for the STL/TSL and the remote control and monitoring equipment.

(7) Monitor receiver

An all-wave radio receiver and an inclined receiving antenna are provided for monitoring the transmitting station.

5-3-4 Equipment for Maintenance

(1) Maintenance center and maintenance system

The maintenance center was established in the SNBC Headquarters as a nucleus of the maintenance system for the five local stations

constructed under Phase 1. The center plays an important role in centralized administration of spare parts, repair for failed equipment and modules, and training of technical staff.

The maintenance for the four stations to be newly constructed under Phase 2 will be carried out in the similar system as that of the Phase 1 stations. Therefore, functions of the maintenance center should be reinforced by supplying further necessary maintenance equipment, along with the SNBC's own programmes to construct a new building and to increase a number of the staff for the center.

The maintenance for the local broadcasting stations adopts a system that shares maintenance work between the local station and the maintenance center, according to contents of the work and the technical level required. The daily operation and maintenance including simple troubleshooting are carried out by technical staff at each local station. The maintenance center carries out maintenance patrols to give an overall inspection and maintenance to the station facilities in accordance with the schedule. In case of failure which requires repair at the site, the maintenance center despatches a maintenance crew with necessary equipment and materials including spare modules to the station. The failed modules are repaired at the maintenance center, since it requires advanced techniques and additional measuring equipment to repair.

From this viewpoint, adequate items and quantity of spare parts, tools, and measuring equipment to meet the respective maintenance work are supplied to each station and the maintenance center.

When the maintenance center despatches its staff to the local stations for maintenance, it is indispensable to use a vehicle to carry staff persons, measuring equipment and spare parts required for the maintenance. Since no vehicles are available for that purpose at present, a vehicle for maintenance is supplyed to the maintenance center under the Project.

(2) Contents of the facilities for maintenance

1) Spare parts

Spare parts are supplied to each station and the maintenance center to enable proper repair work for equipment failure, in order to secure broadcasting service to audience.

Expendable parts like fuse and lamp valve and some mechanical parts which are possible to estimate their life are supplied to each station. Other items including spare modules which are hard to forecast their failure beforehand are supplied to the maintenance center.

The items and the quantity to be supplied will be decided so that they will assure proper maintenance work for the facilities, in consideration of the operational experience of the Phase 1 stations and the difficult situation of replenishing spare parts in Sudan.

2) Measuring equipment

(a) Measuring equipment for daily maintenance at each transmitting station

Rack-mounted type

Audio signal measuring equipment

Oscilloscope

Others

Circuit tester

Insulation resistance tester

(b) Measuring equipment for the maintenance center

Transmitter module tester

Audio signal measuring unit

Oscilloscope

Field intensity meter

High frequency voltage meter

Frequency counter

Pen recorder

Audio signal attenuator

High frequency signal attenuator

Thermometer
Clamp meter
Circuit tester
Test power supply
Logic circuit tester

3) Tools for maintenance

(a) Tools for daily maintenance at each station

A set of tools is supplied to each transmitting station and studio.

(b) Tools for the maintenance center

A set of tools for maintenance work and repair work including a hand drill is supplied to the maintenance center.

4) Vehicle for maintenance

A vehicle for maintenance is supplied to the maintenance center.

5-3-5 Station Building Facility

(1) Station building of the transmitting station

1) Sites

As a result of the survey as to whether or not the proposed construction sites of the transmitting stations at Port Sudan, Wadi Halfa, El Fasher, and Kosti are appropriate for the objectives of the Project, it has been concluded that all of them are suitable as construction sites since they are free from any problems concerning the area, shape, ground, power supply, access road, obstacles, acquisition of land, and geographical relationship with airports.

Each site has been outlined in Chapter 4.

2) Layout plan

(a) At each transmitting station at Port Sudan, Wadi Halfa, El Fasher, and Kosti, a 100-meter-high transmitting antenna (guyed steel cylinder mast) is constructed almost at the center of the site and a radial earth system of 130 m in radius is embedded radially, centered at the base of the transmitting antenna. The transmitter shelter, engine shelter, fuel tank, and STL/TSL antenna-supporting pole (about 20 m high) are functionally arranged near the front gate. Their locations have been determined by considering the locations of main roads and the final pole to receive commercial power supply. The antenna tuning unit is mounted at the base of the transmitting antenna, and a feeder (embedded in the ground) is used to connect the transmitting shelter and the antenna tuning hut.

Safety fence is to be provided along the outer perimeter of the site on the Sudanese account.

Facility layout plans for the sites of the transmitting stations at Port Sudan, El Fasher, and Kosti are shown in Fig. 5-4-3, 5-4-9, and 5-4-13, respectively.

(b) Since the Wadi Halfa Transmitting Station is located near the city, the studio building will be constructed at a corner of the transmitting station site on the Sudanese account.

Multi-paired cables are used to connect the transmitter shelter and the control room which is to be newly built in the studio building.

The facility layout plan of the Wadi Halfa transmitting station is shown in Fig. 5-4-7.

3) Station building plan

The building of each transmitting station is composed of a transmitter shelter which houses the transmitter and an engine shelter which houses an engine generator. The engine shelter is separated from the transmitter shelter to protect the latter from the vibrations and noises of the engine generator.

The station building is so near the transmitting antenna that it is easily affected by radio waves transmitted by itself. It is necessary, therefore, to provide a sufficient shield to the building so that such influences may be minimized, and full reliability is required over a long period as to the connections of the shields.

All the sites are located in desert or semidesert, and the outdoor temperatures often exceed 45°C during the daytime. It is very dusty around the sites. Since the temperature of the broadcasting equipment should be controlled during operation in these environments and since dust exercises unfavorable influences upon reliability and service life of the equipment, it is required that the station buildings should be of a sealed and heat-insulated structure.

Therefore, a shelter is adopted as a station building which is expected to display excellent performance as regards the above-mentioned requirements.

It is not only possible that, by adopting shelters manufactured in Japan, the reliability of the station buildings is ensured, but also it is possible to assemble the required equipment within them at a manufacturer's plant in Japan and to deliver and install the sheltered equipment after completion of the adjustments to the construction sites. So, it is expected that the local construction period can be remarkably reduced and that the reliability will be assured for the equipment as it is adjusted at manufacturers' plants.

4) Arrangement of equipment in the shelter

Equipment should be arranged in the shelter interior in a manner to assure safety and operational ease after studying safety in terms of operation and maintenance and performance lines.

(a) Transmitter shelter

The transmitter shelter is fixed with anchor bolts on the base made of reinforced concrete. The transmitter shelter contains two 10 kW transmitters, output switching unit, programme input equipment, STL receiver, TSL transmitter, automatic voltage regulator, insulation transformer, and air conditioning unit.

The equipment is arranged in a manner to meet the requirements of unmanned operation and be distributed in as compact a space as possible to reduce the burden on the air conditioner.

(b) Engine shelter

The engine shelter is fixed with anchor bolts on the base made of reinforced concrete, separating from the transmitter shelter so as not to exert the influence of vibration and noise on the transmitter equipment.

The engine shelter contains a 90 kVA diesel engine generator, a controller, a starting battery, and a battery charger.

The equipment is arranged taking into consideration safety during operation and maintenance, as well as protection from dust and dirt.

(2) Studio building

Studio buildings are prepared by the Sudanese side and they will have been constructed or repaired by the commencement of local construction work of the Project.

The studio is composed of a small studio room of 7 m x 5 m and a control room, mainly producing local news and talk programmes.

The studio building preparation plan for the four cities as implemented by the Sudanese side is outlined as follows:

- o Port Sudan : An existing building is utilized and is partially improved by providing sound-insulating and absorbing materials.
- o Wadi Halfa : To be newly constructed
- o El Fasher : An existing studio is utilized and is partially improved by removing a control room door and expanding a sound lock.
- o Kosti : To be newly constructed.

5-4 Basic Design Drawing

Fig. 5-4-1 Overall Block Diagram of Broadcasting System

Fig. 5-4-2 Outline of Port Sudan City

Fig. 5-4-3 Site Plan for Port Sudan Transmitting Station

Fig. 5-4-4 Outline of Studio & Control Room in Port Sudan City

Fig. 5-4-5 Line of Sight of STL in Port Sudan

Fig. 5-4-6 Outline of Wadi Halfa City

Fig. 5-4-7 Site Plan for Wadi Halfa Transmitting Station

Fig. 5-4-8 Outline of El Fasher City

Fig. 5-4-9 Site Plan for El Fasher Transmitting Station

Fig. 5-4-10 Outline of Studio & Control Room in El Fasher City

Fig. 5-4-11 Line of Sight of STL in El Fasher

Fig. 5-4-12 Outline of Kosti City

Fig. 5-4-13 Site Plan for Kosti Transmitting Station

Fig. 5-4-14 Line of Sight of STL in Kosti

Fig. 5-4-15 Outline of Tower

Fig. 5-4-16 Layout of Radial Earth, Antenna Mast

Fig. 5-4-17 Outline of Transmitter Shelter

Fig. 5-4-18 Layout Plan of Transmitter Shelter

Fig. 5-4-19 Outline of Engine Shelter

Fig. 5-4-20 Layout Plan of Engine Shelter

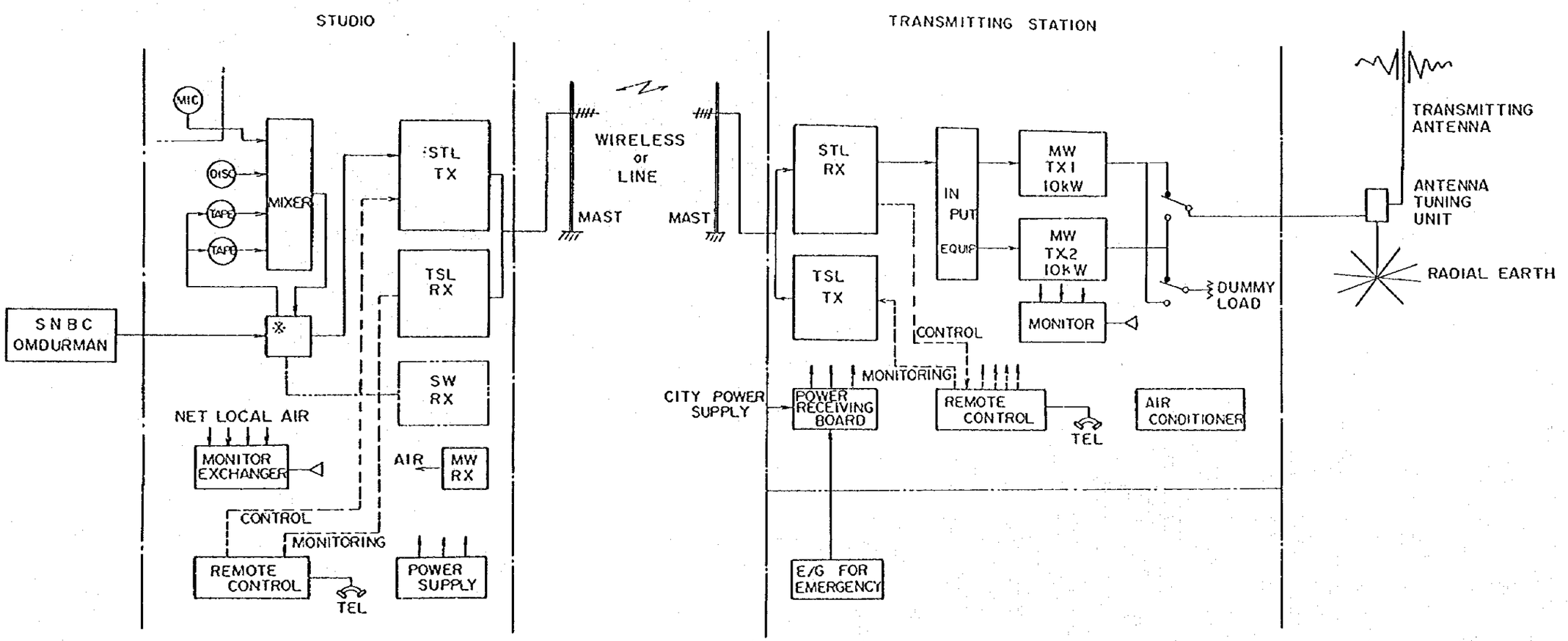
Fig. 5-4-21 Out line of Oil Tank

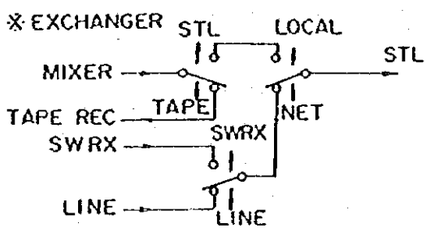
Fig. 5-4-22 Calculated Service Area of Port Sudan

Fig. 5-4-23 Calculated Service Area of Wadi Halfa

Fig. 5-4-24 Calculated Service Area of El Fasher

Fig. 5-4-25 Calculated Service Area of Kosti





TX : TRANSMITTER

RX : RECEIVER

STL : STUDIO TO TRANSMITTER LINK

TSL : TRANSMITTER TO STUDIO LINK

Fig. 5-4-1 Overall Bolck Diagram of Broadcasting System

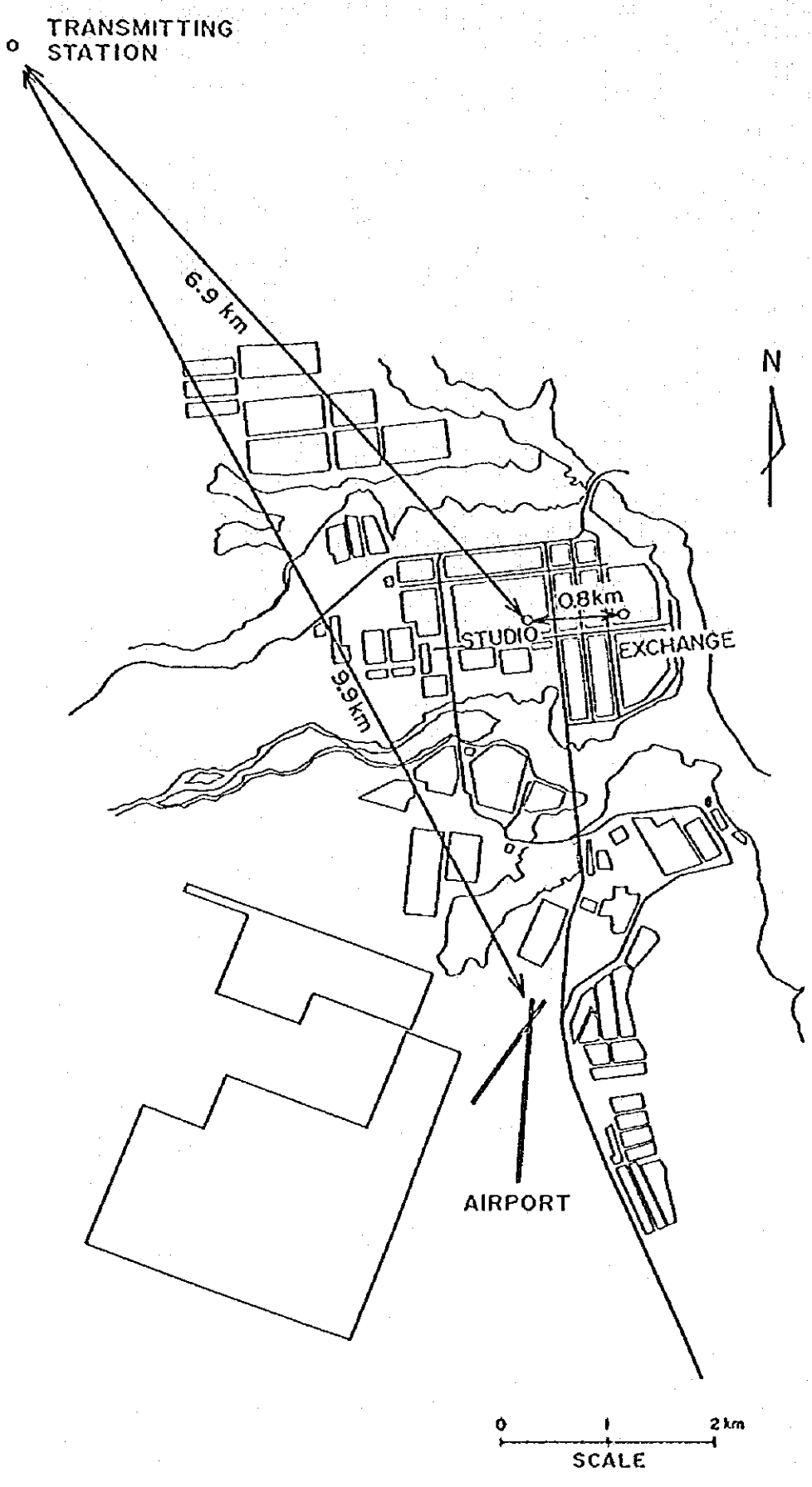


Fig. 5-4-2 Outline of Port Sudan City

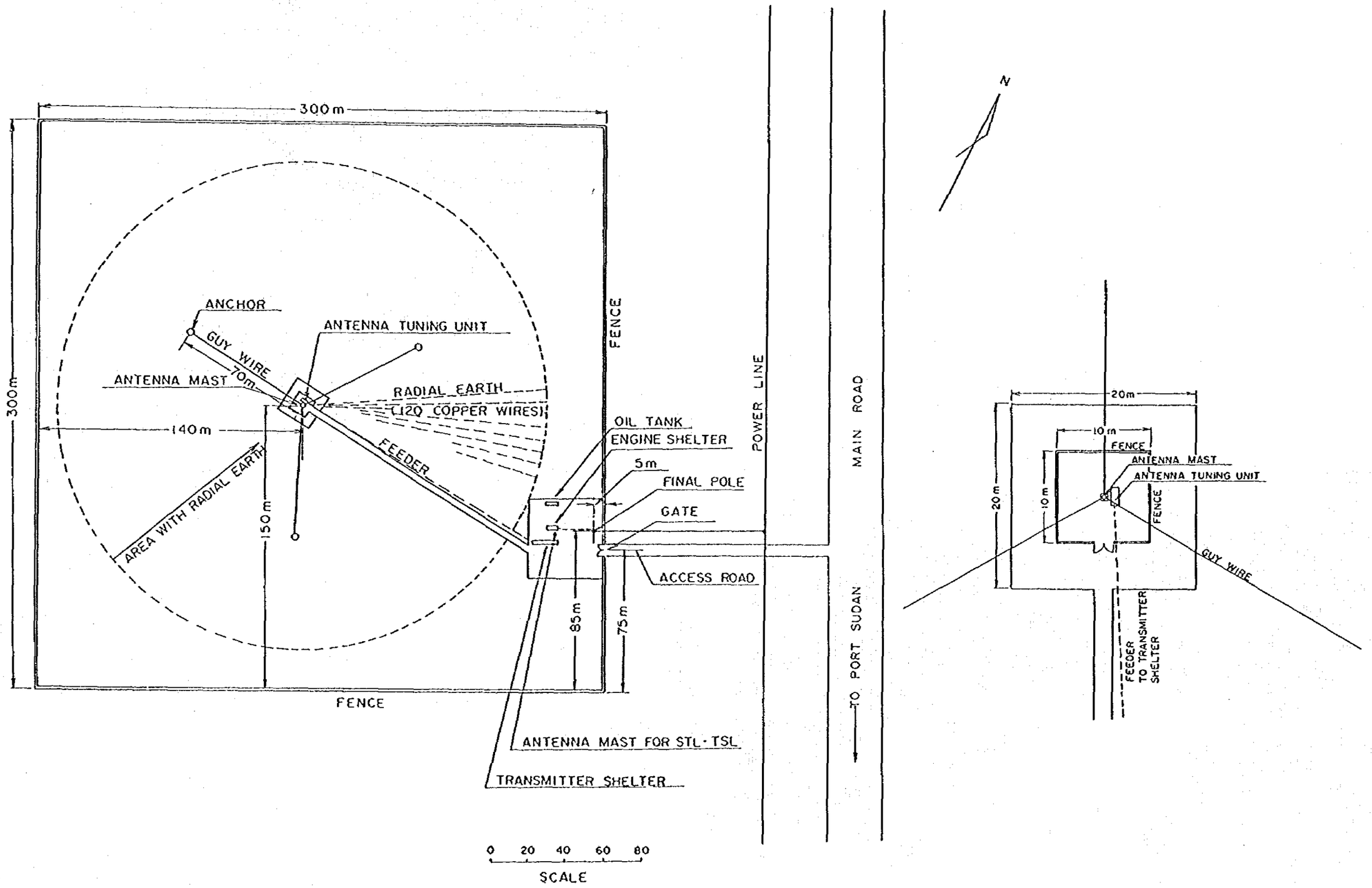
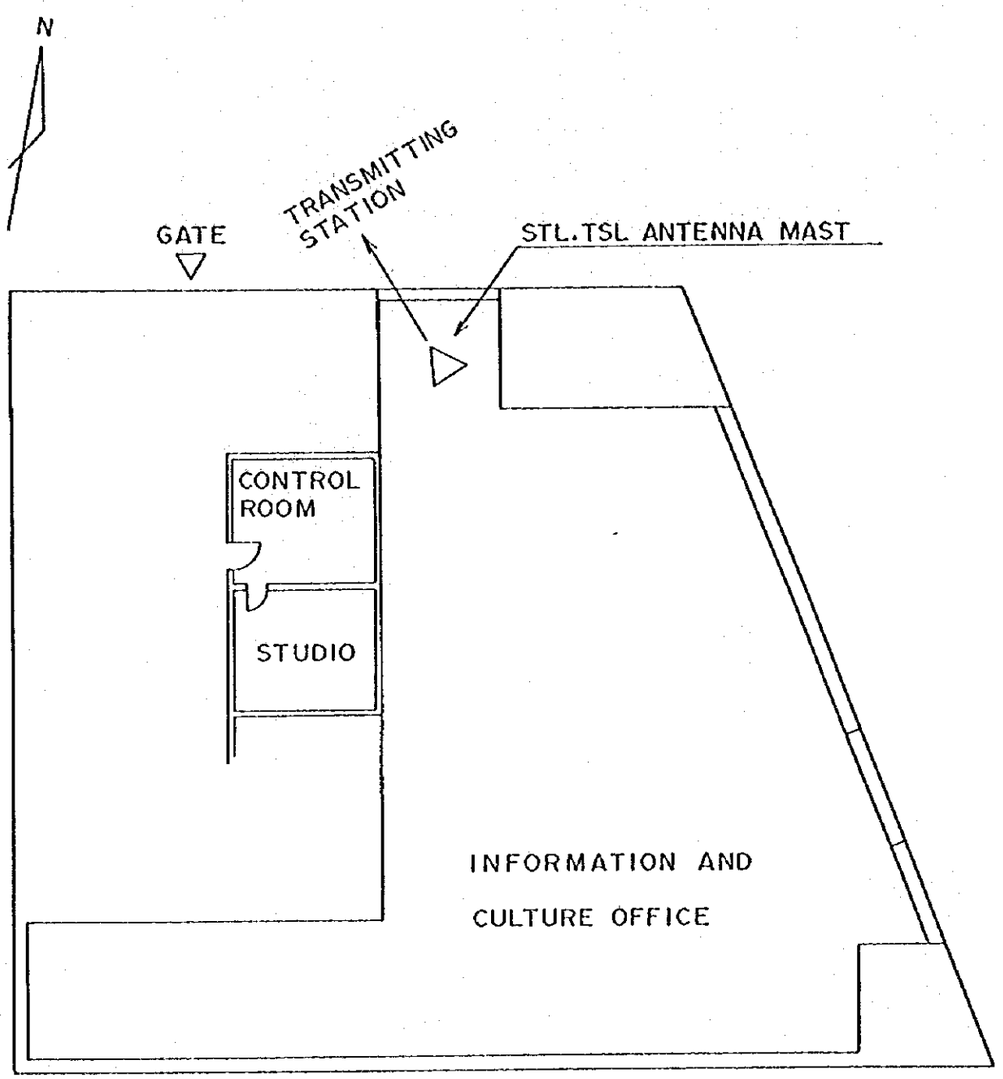
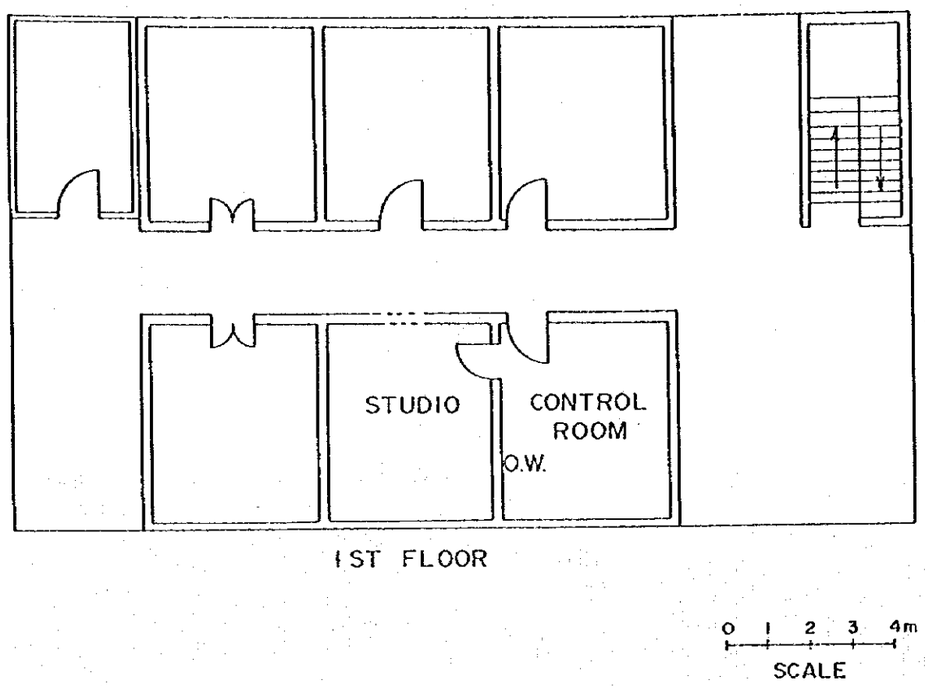


Fig. 5-4-3 Site Plan for Port Sudan Transmitting Station





O.W. : OBSERVATION WINDOW

Fig. 5-4-4 Outline of Studio & Control Room in Port Sudan City

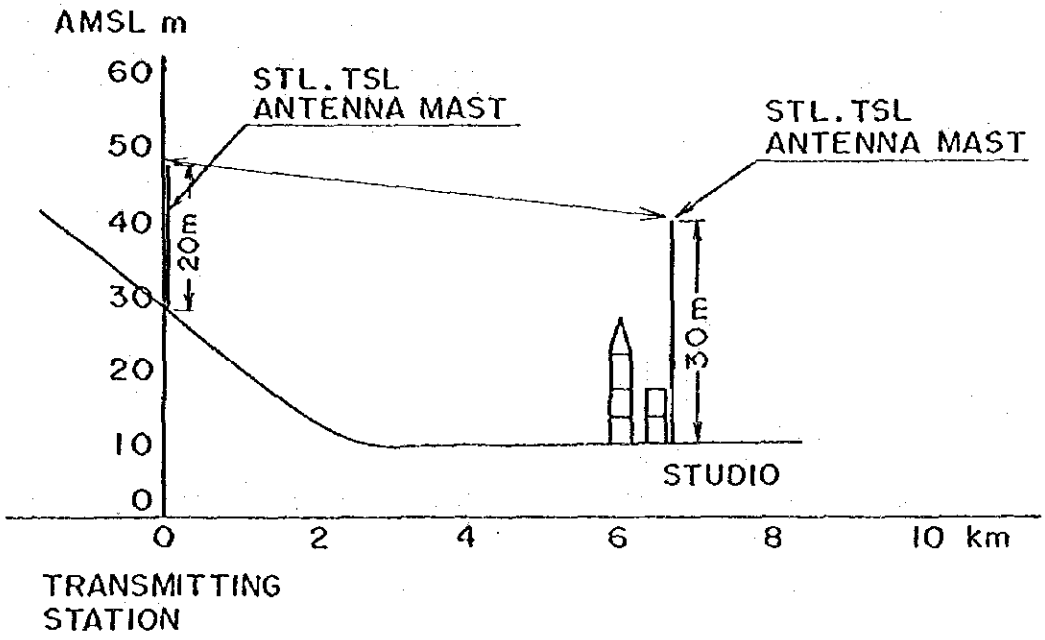


Fig. 5-4-5 Line of Sight of STL in Port Sudan

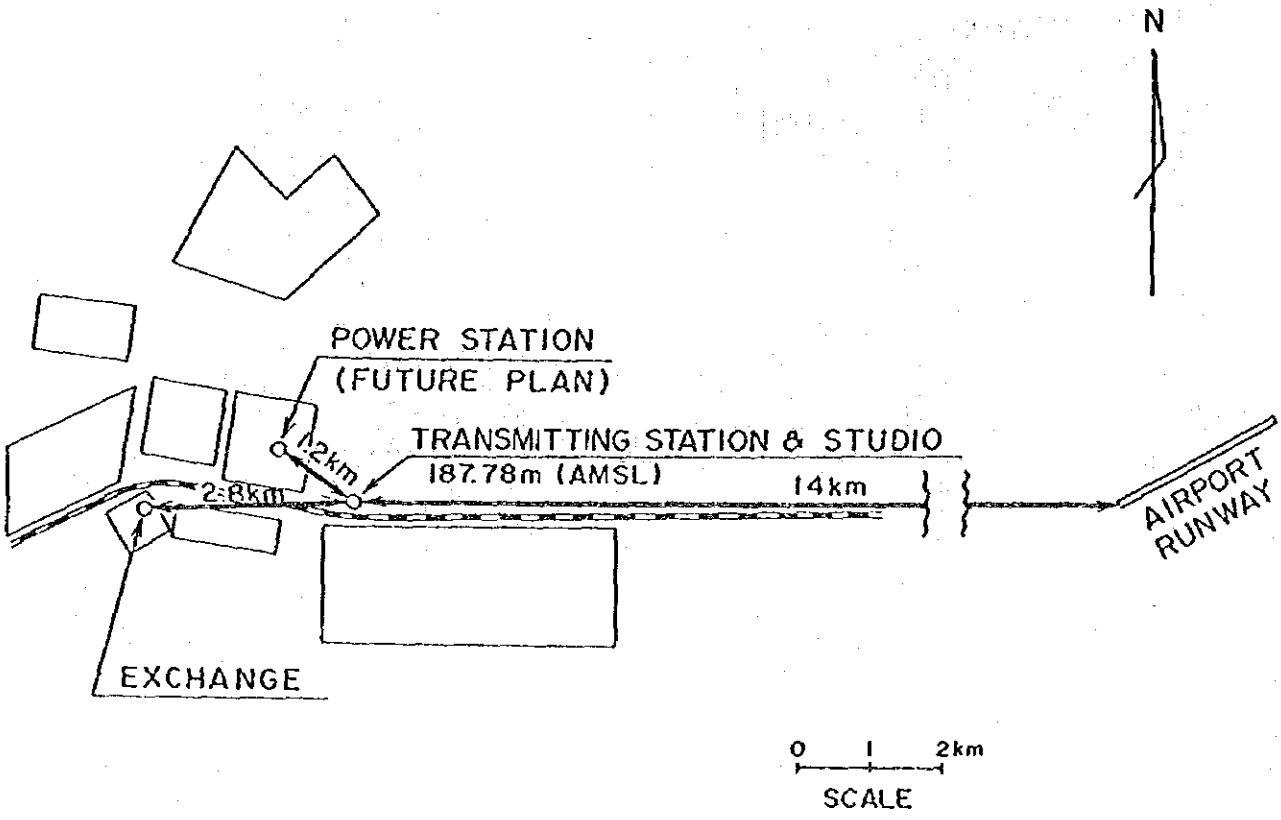
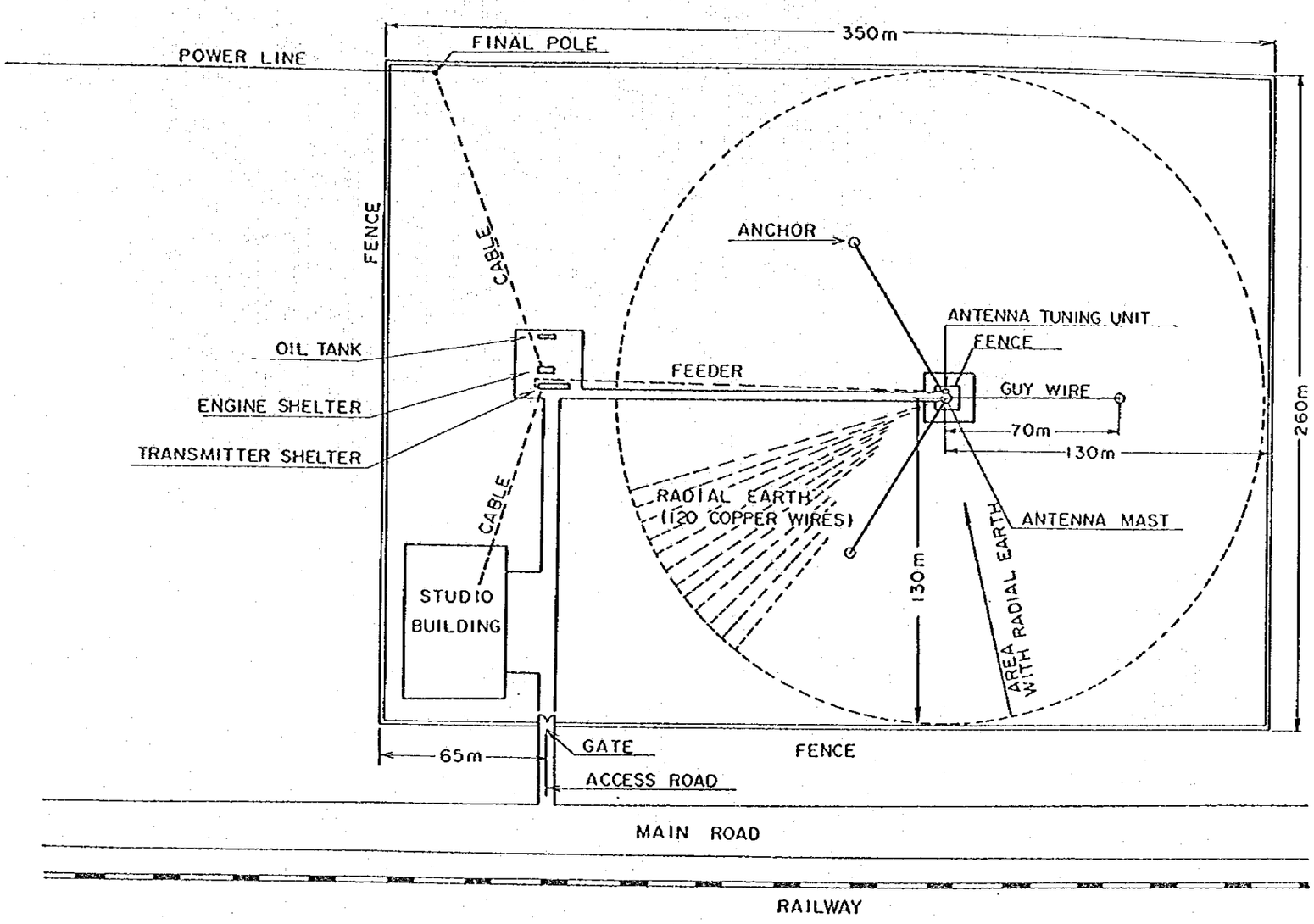
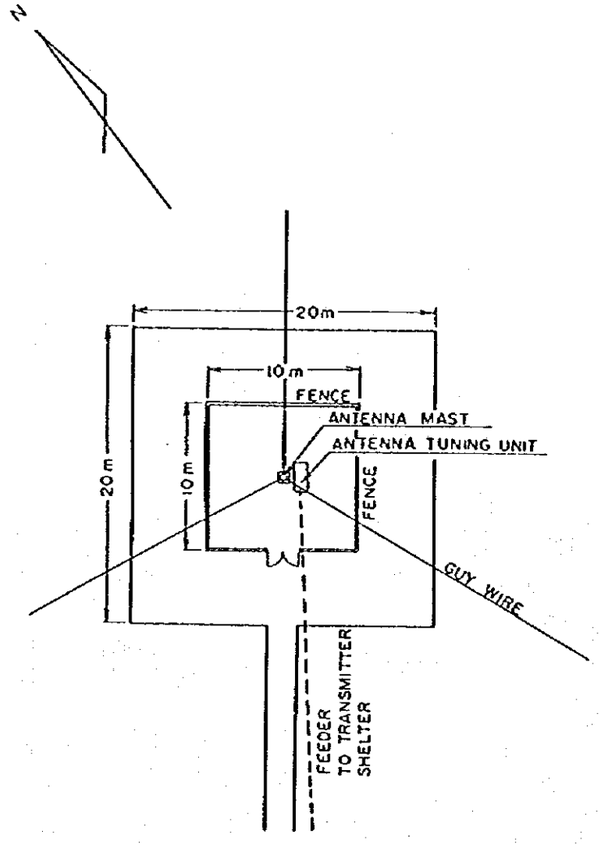


Fig. 5-4-6 Outline of Wadi Halfa City





0 20 40 60 80 100m

SCALE

Fig. 5-4-7 Site Plan for Wadi Halfa Transmitting Station

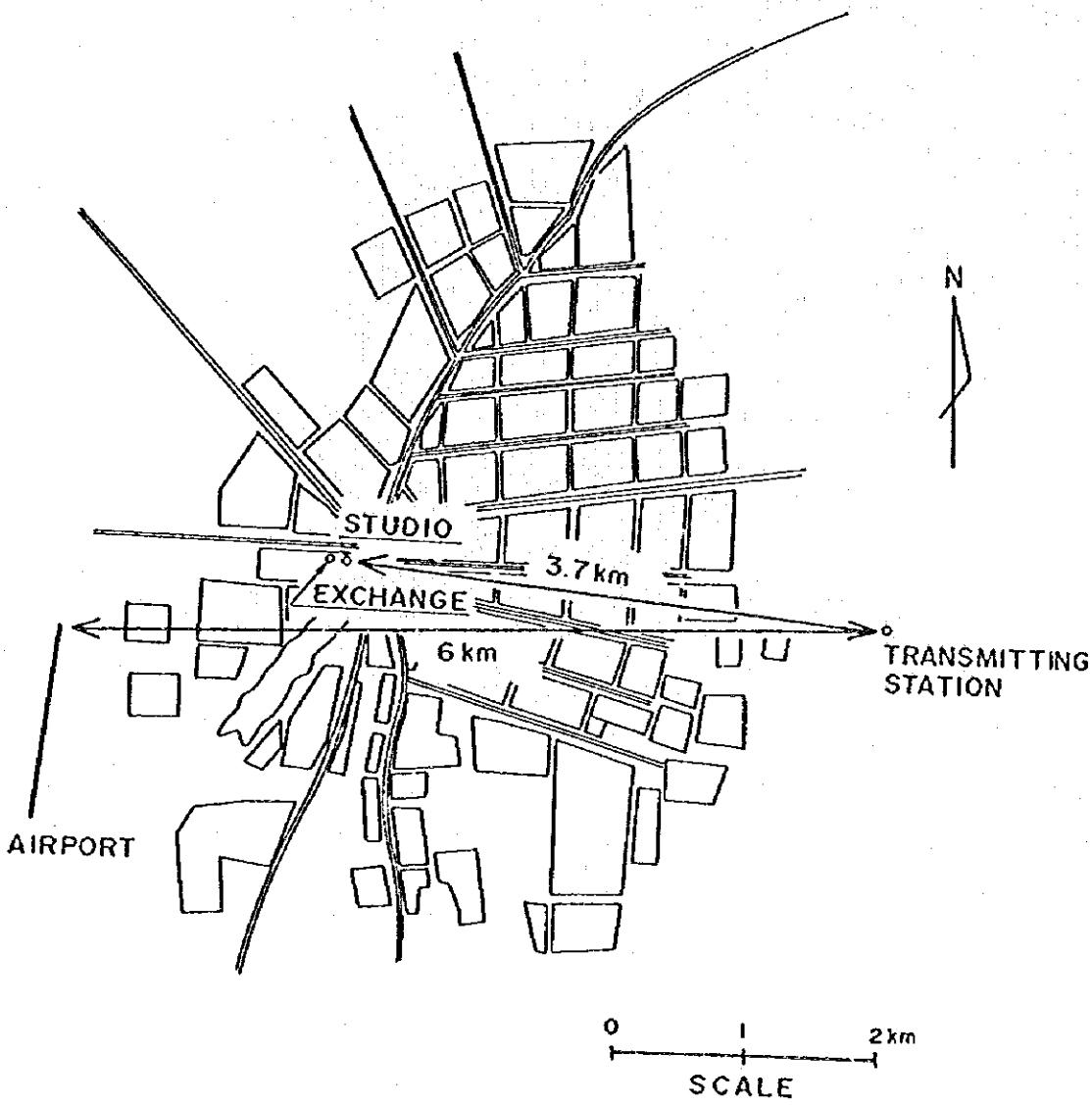
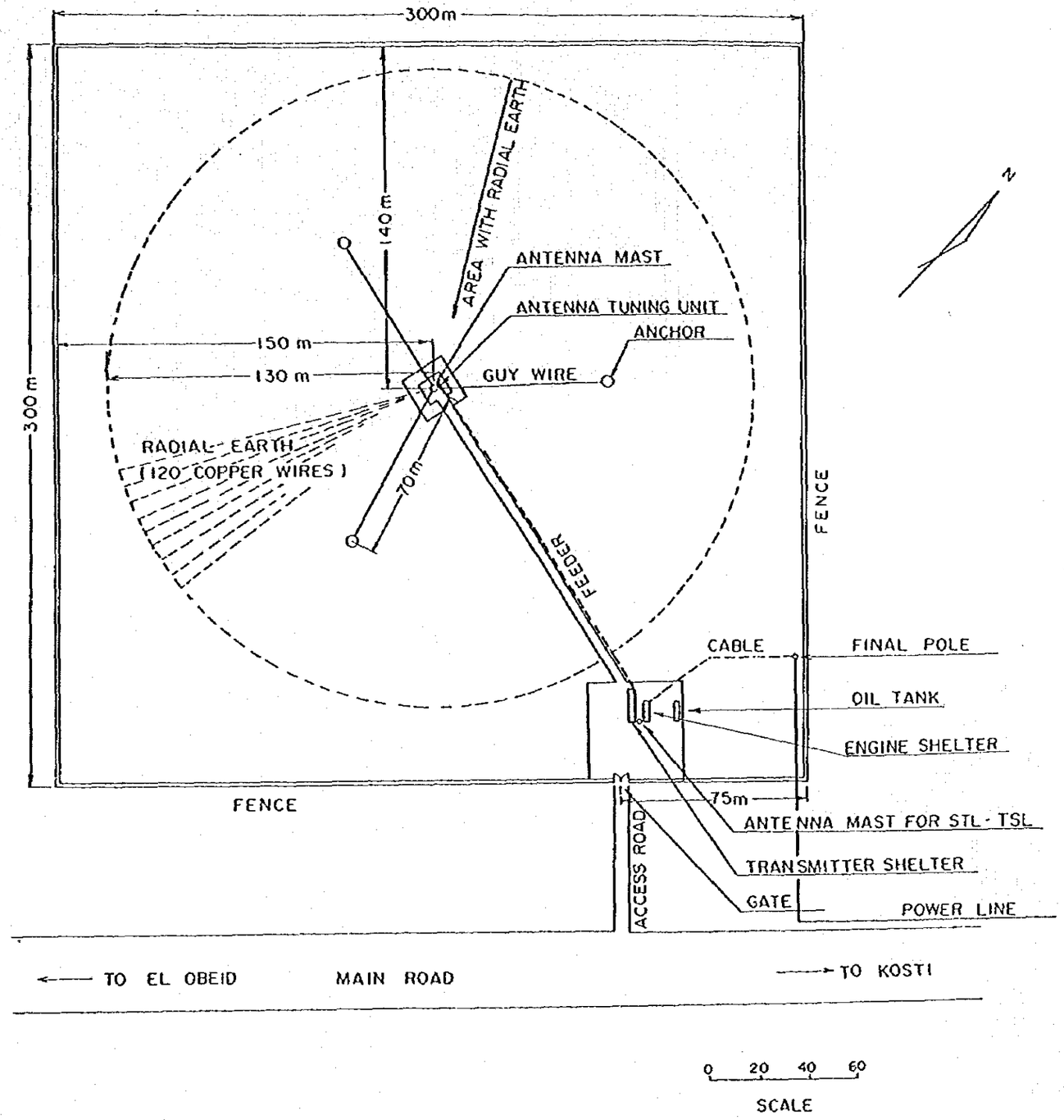


Fig. 5-4-8 Outline of El Fasher City



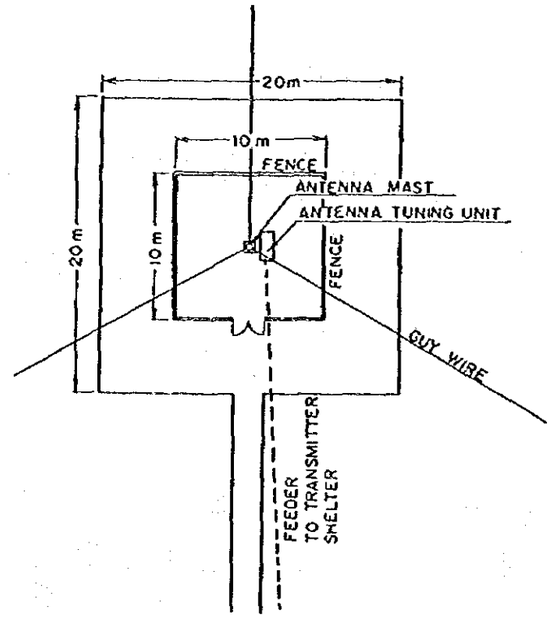
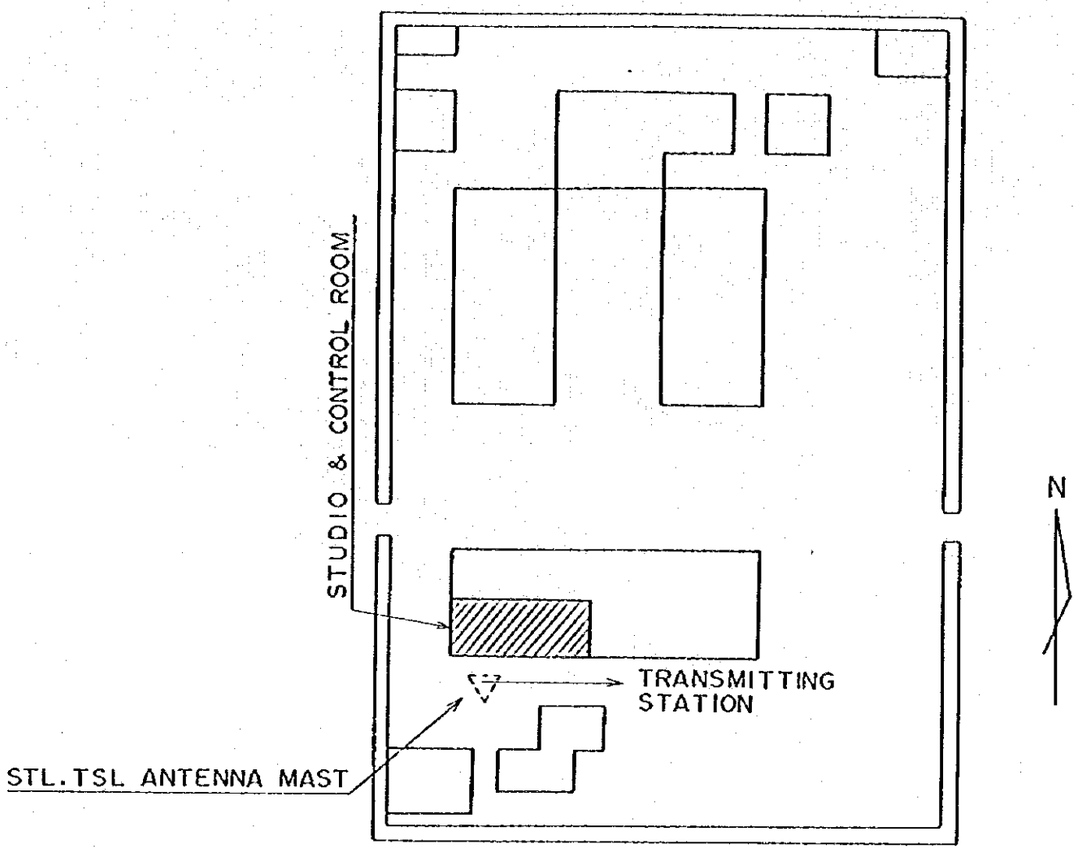
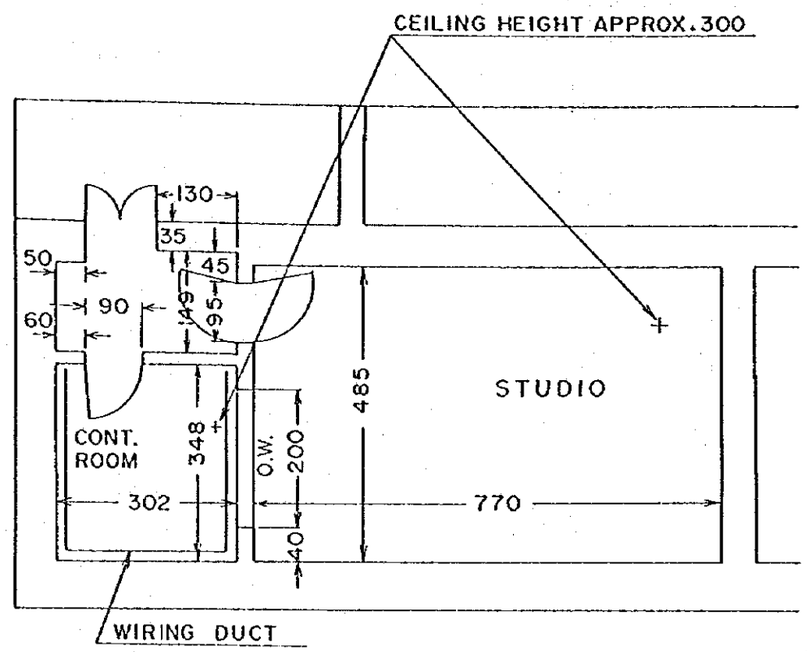


Fig. 5-4-9 Site Plan for El Fasher Transmitting Station



INFORMATION AND CULTURE OFFICE

0 4 8m
SCALE



0 1 2m
SCALE

O.W. : OBSERVATION WINDOW

Fig. 5-4-10 Outline of Studio & Control Room in El FASHER

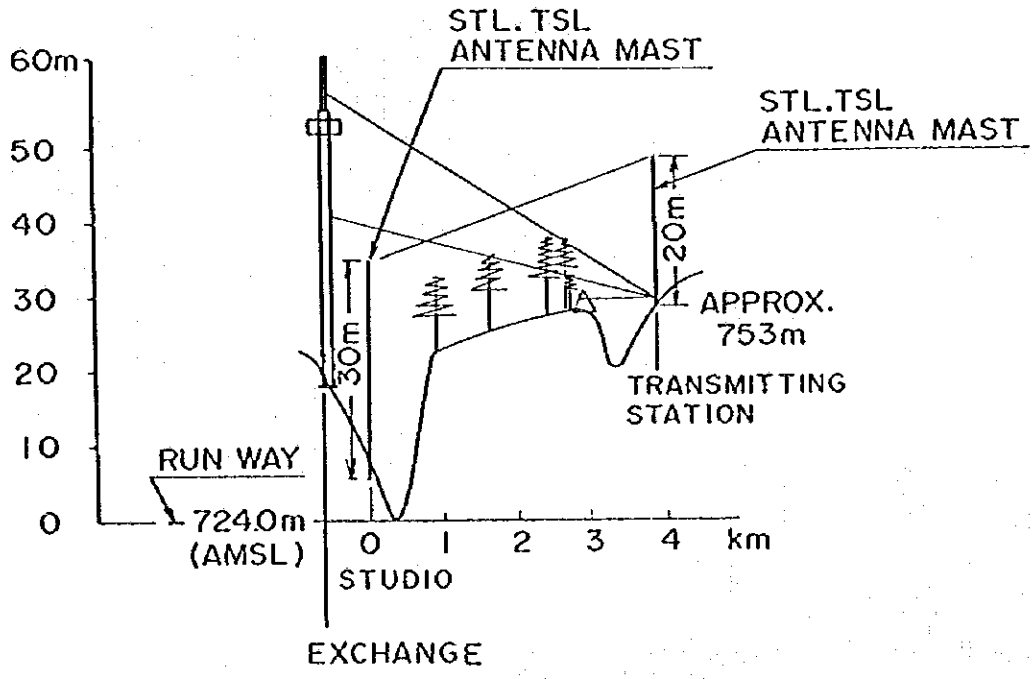


Fig. 5-4-11 Line of Sight of STL in El Fasher

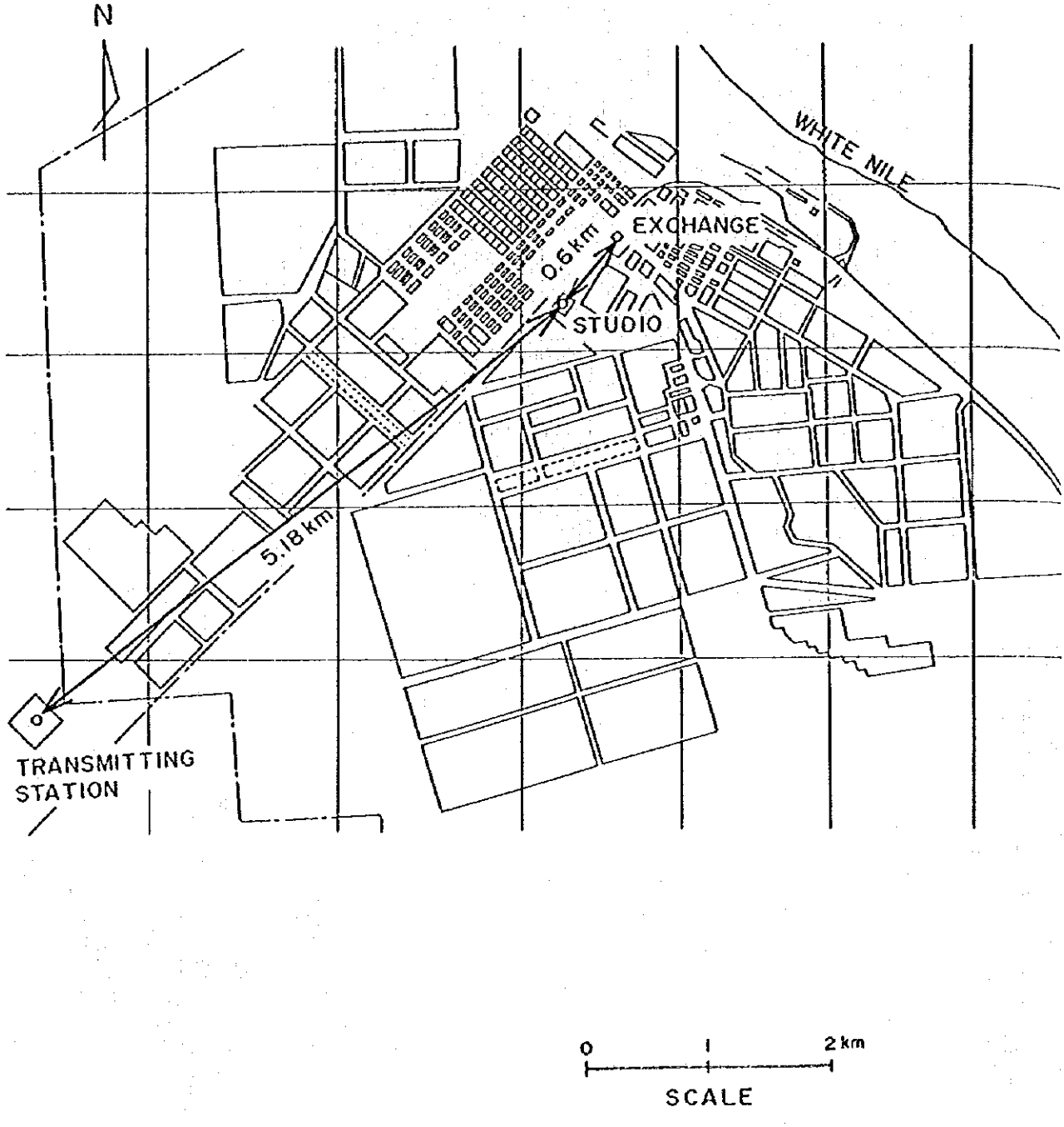
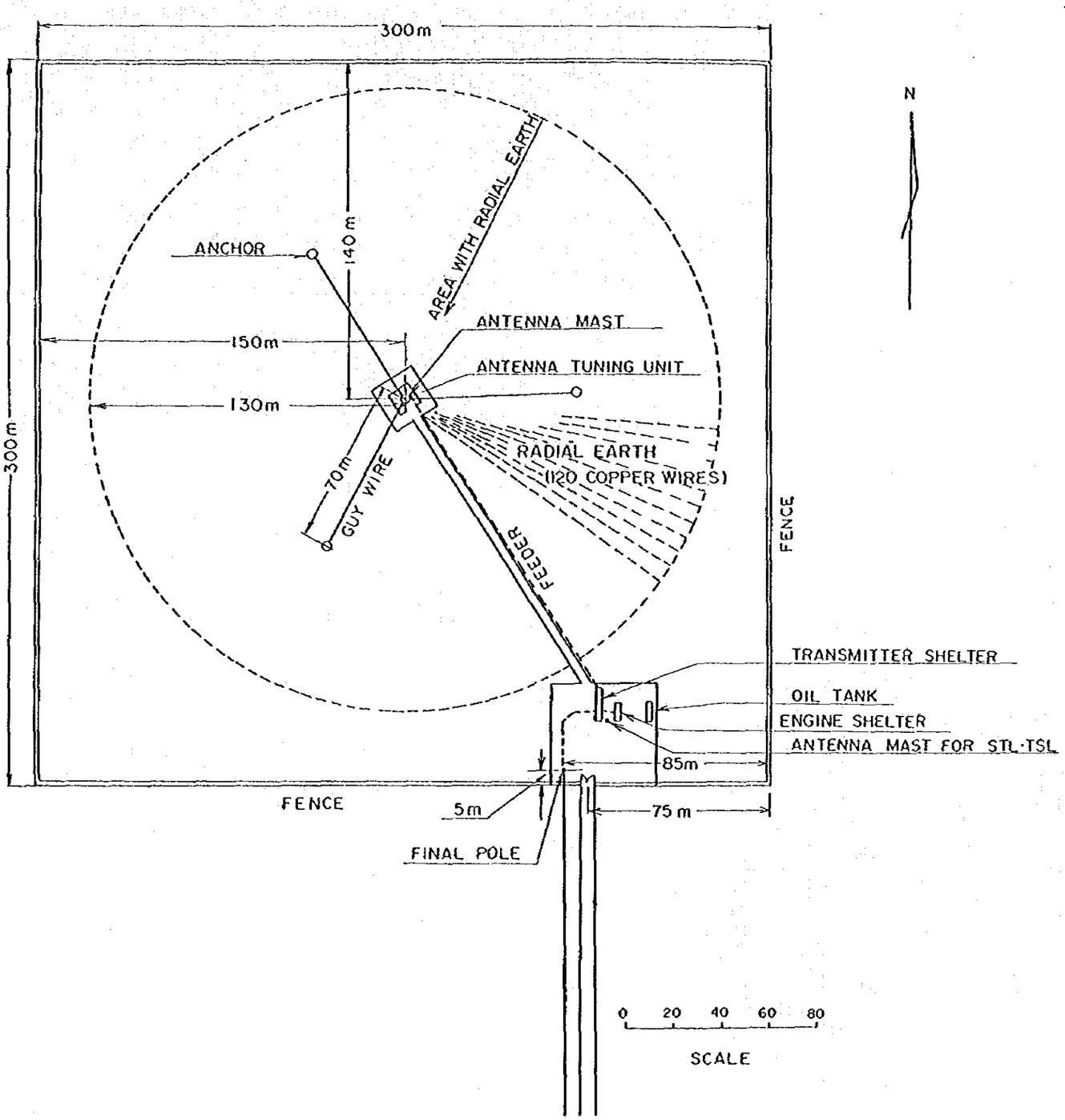


Fig. 5-4-12 Outline of Kosti City



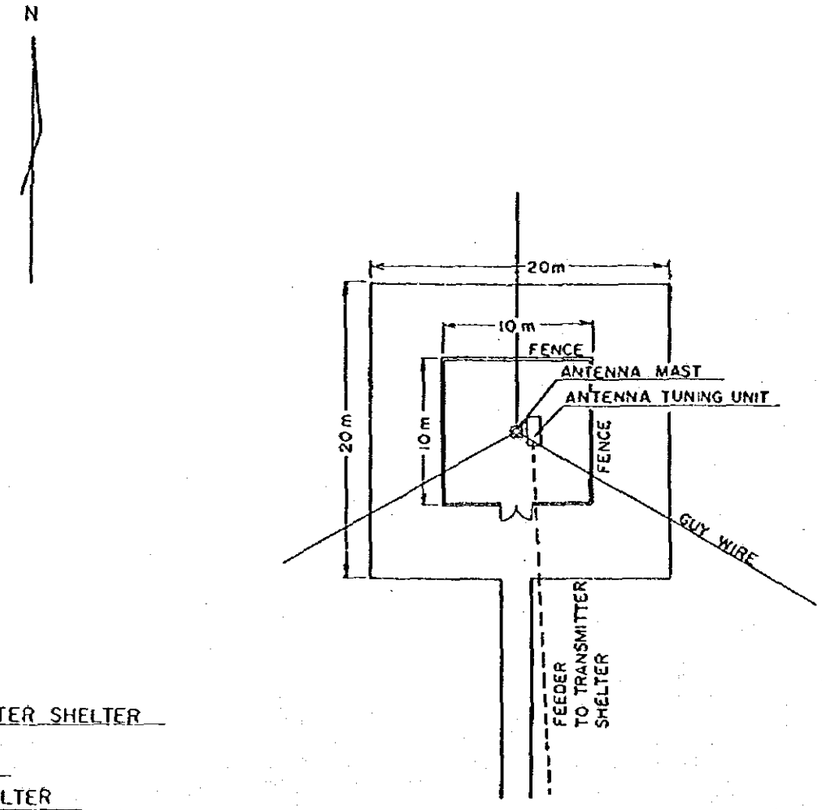


Fig. 5-4-13 Site Plan for Kosti Transmitting Station

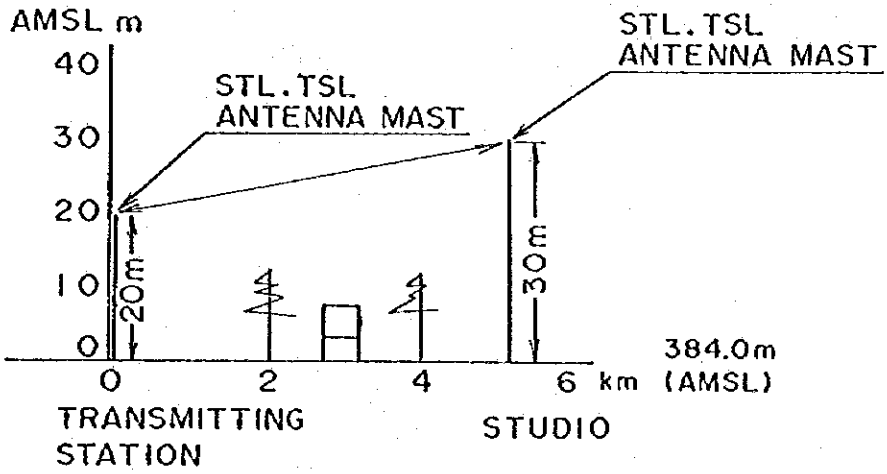


Fig. 5-4-14 Line of Sight of STL in Kosti

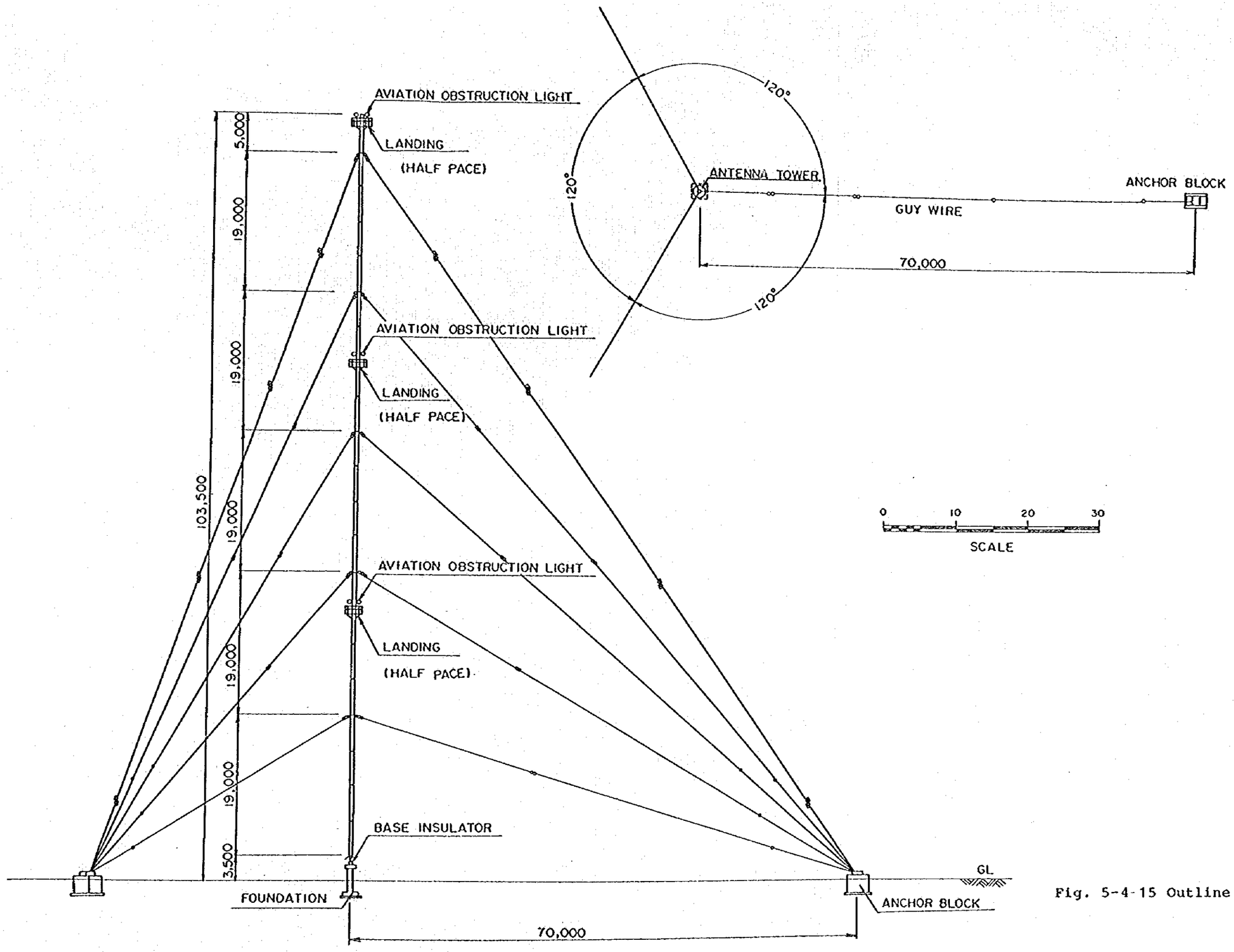


Fig. 5-4-15 Outline of Tower

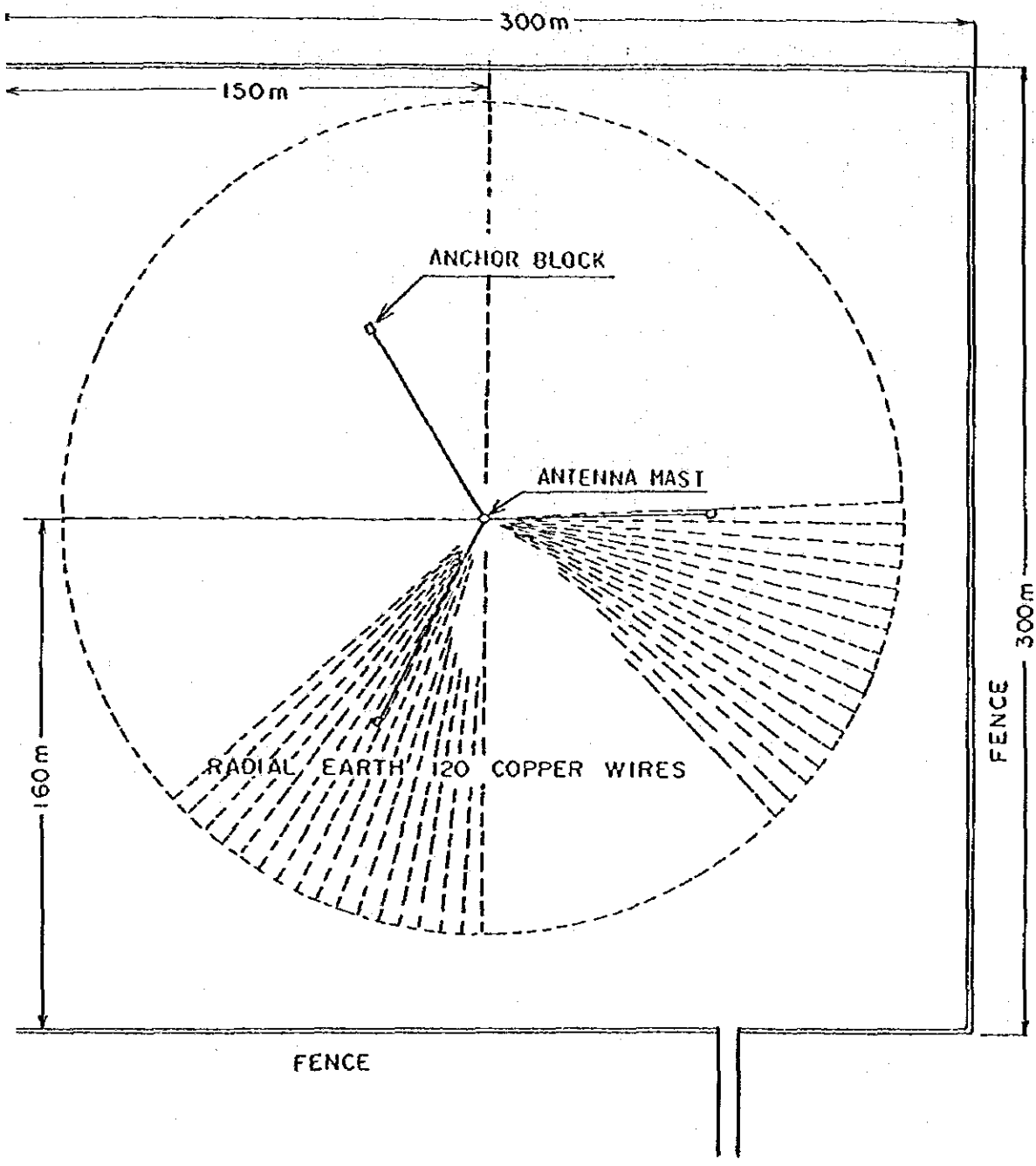
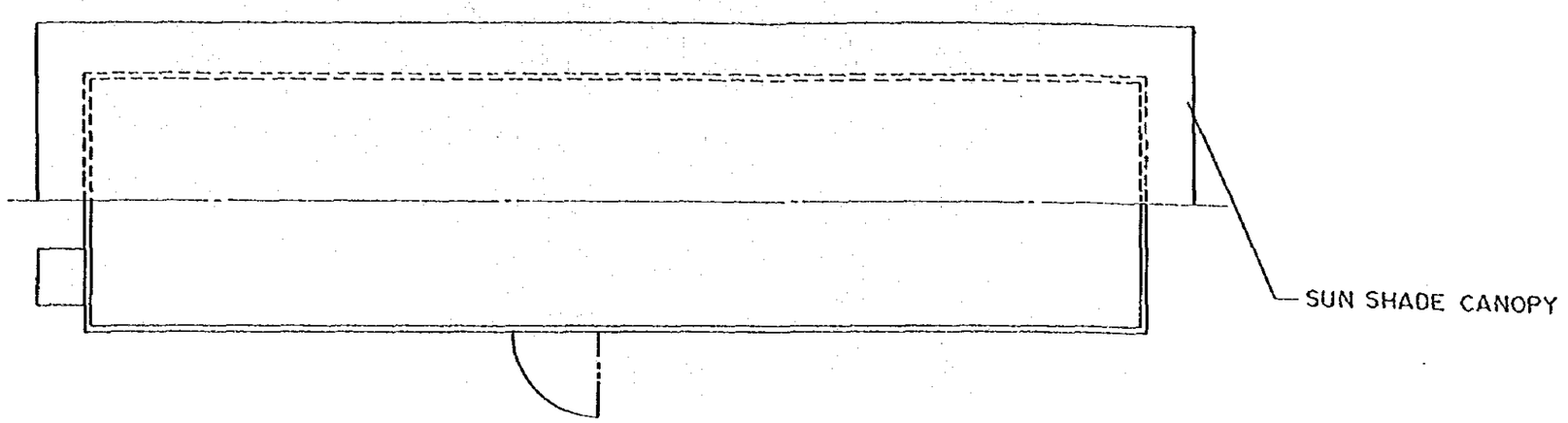
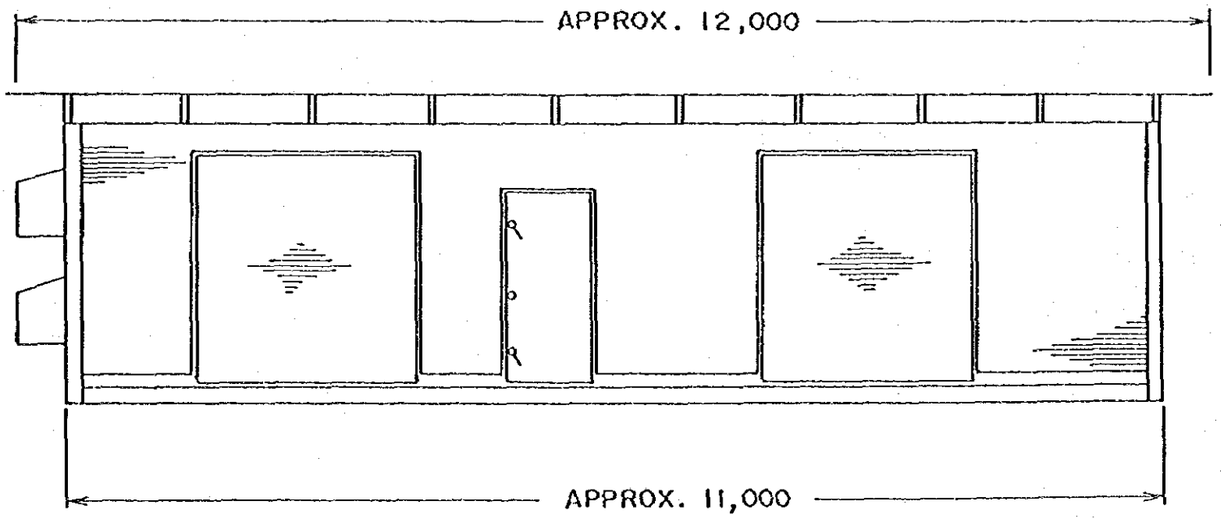


Fig. 5-4-16 Layout of Radial Earth, Antenna Mast





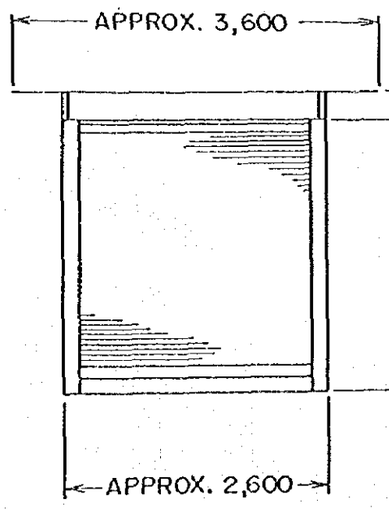
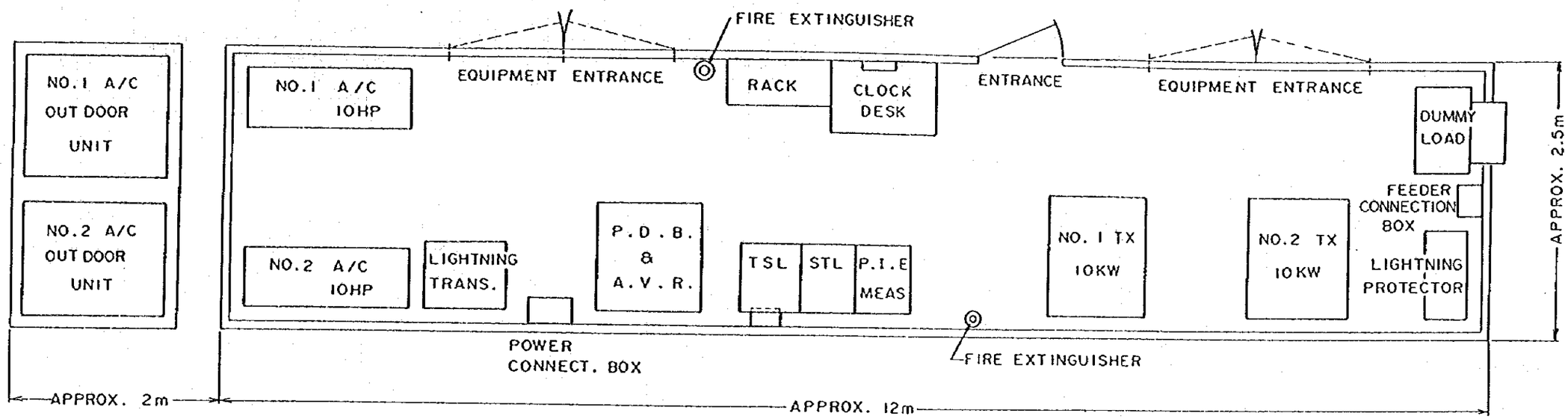


Fig. 5-4-17 Outline of Transmitter Shelter



0 1 2 3 4m

SCALE

A/C : AIR CONDITIONER

Fig. 5-4-18 Layout Plan of Transmitter Shelter

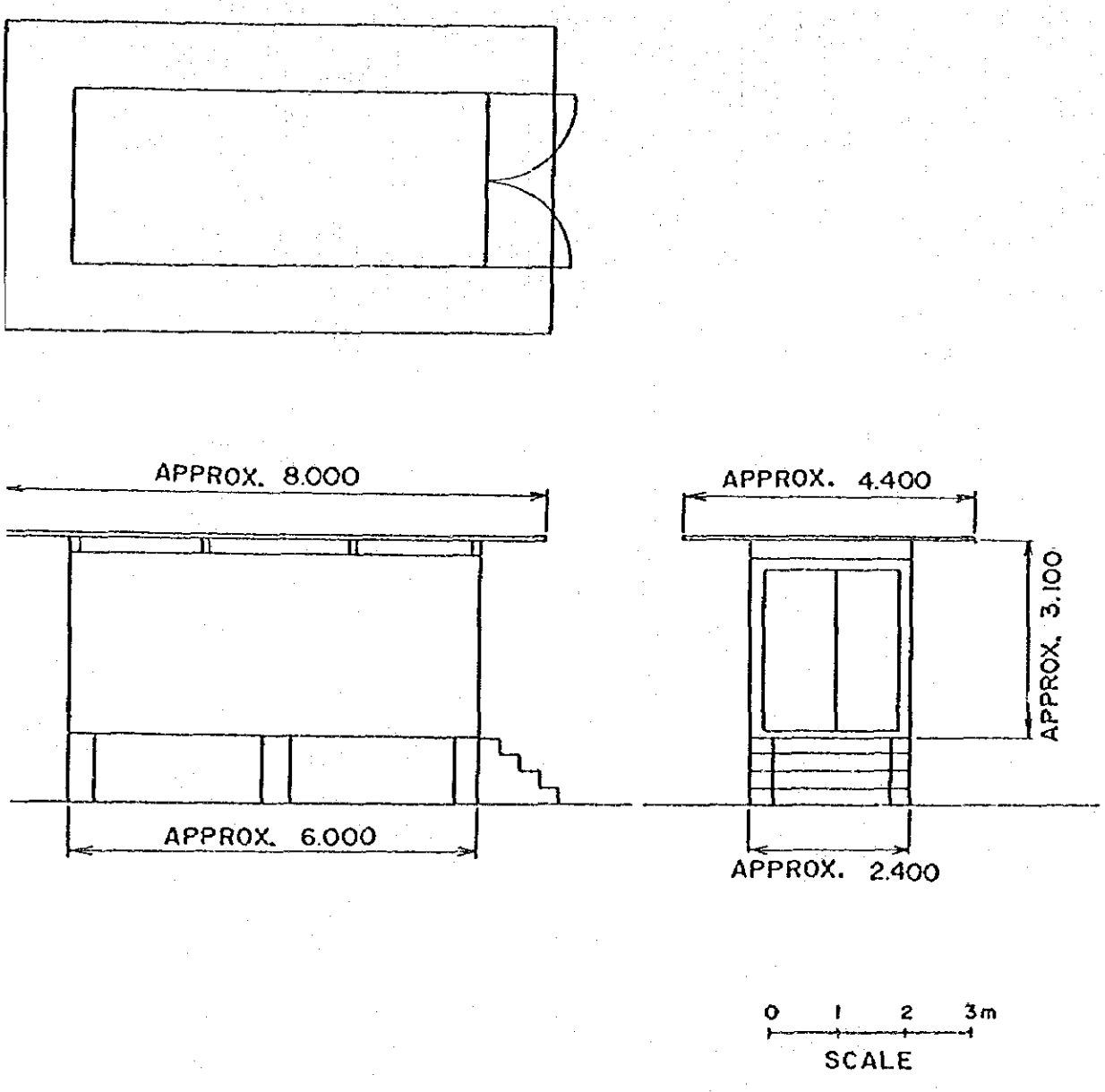


Fig. 5-4-19 Outline of Engine Shelter

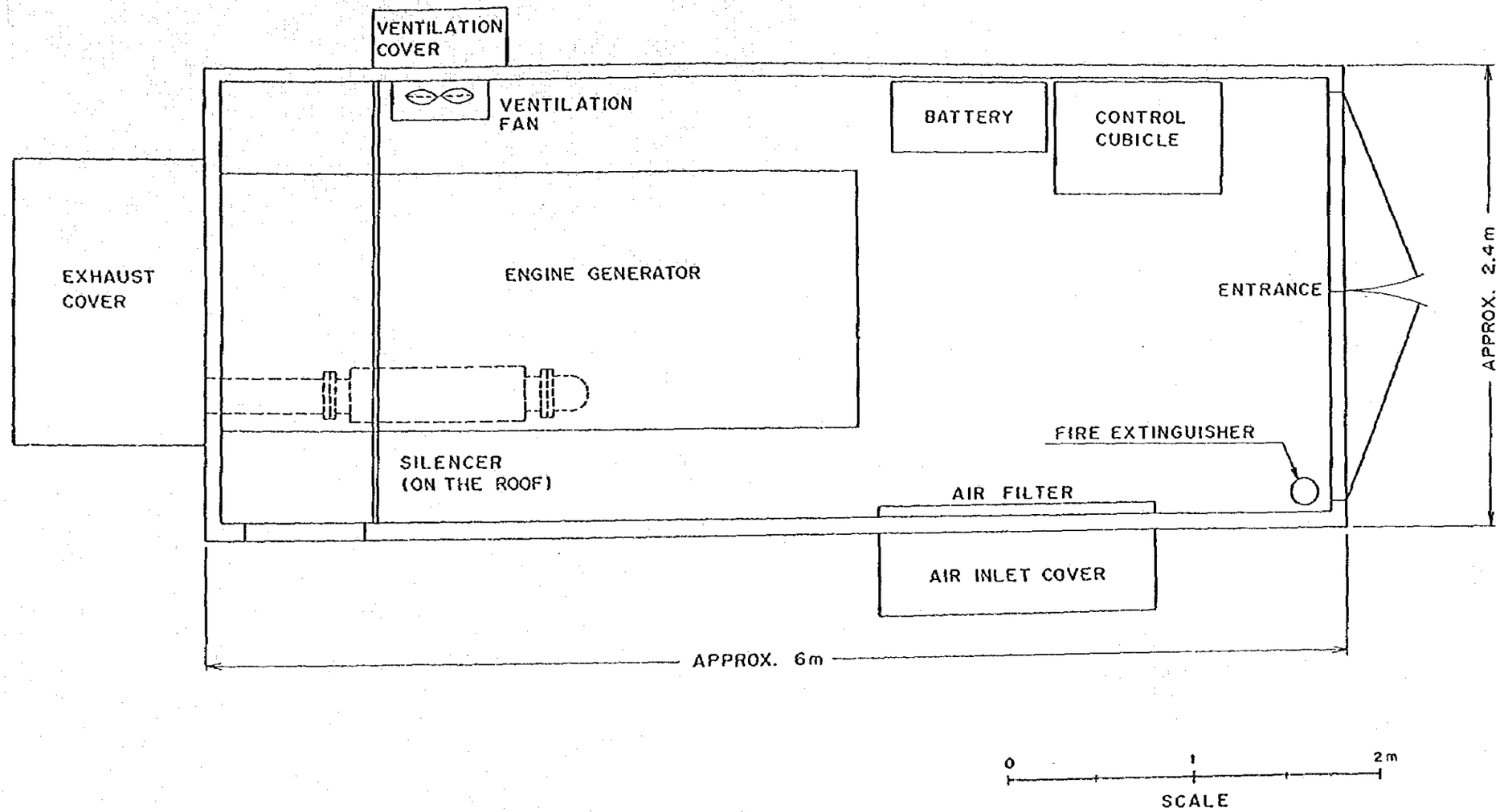


Fig. 5-4-20 Layout Plan of Engine Shelter

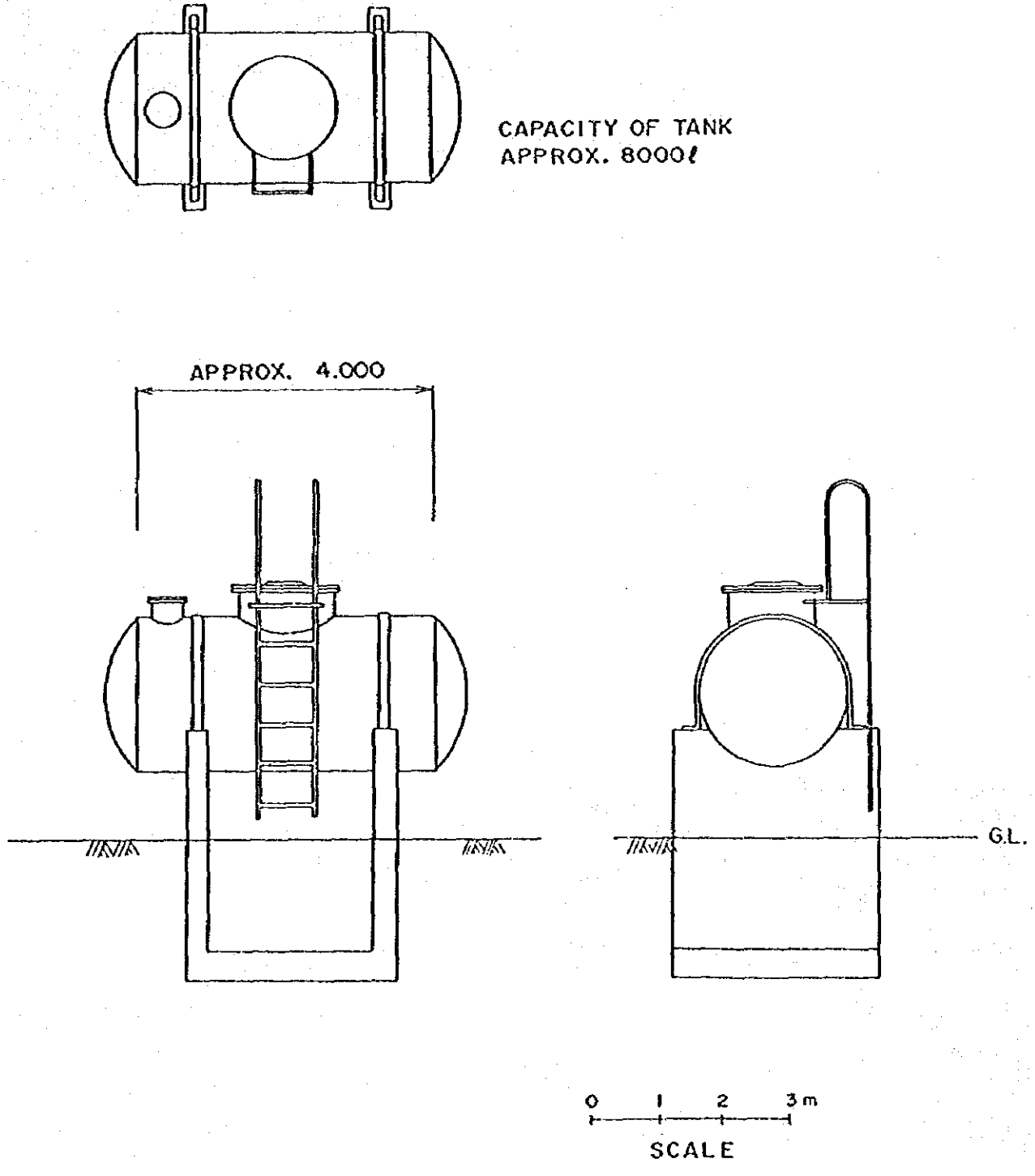


Fig. 5-4-21 Out line of Oil Tank

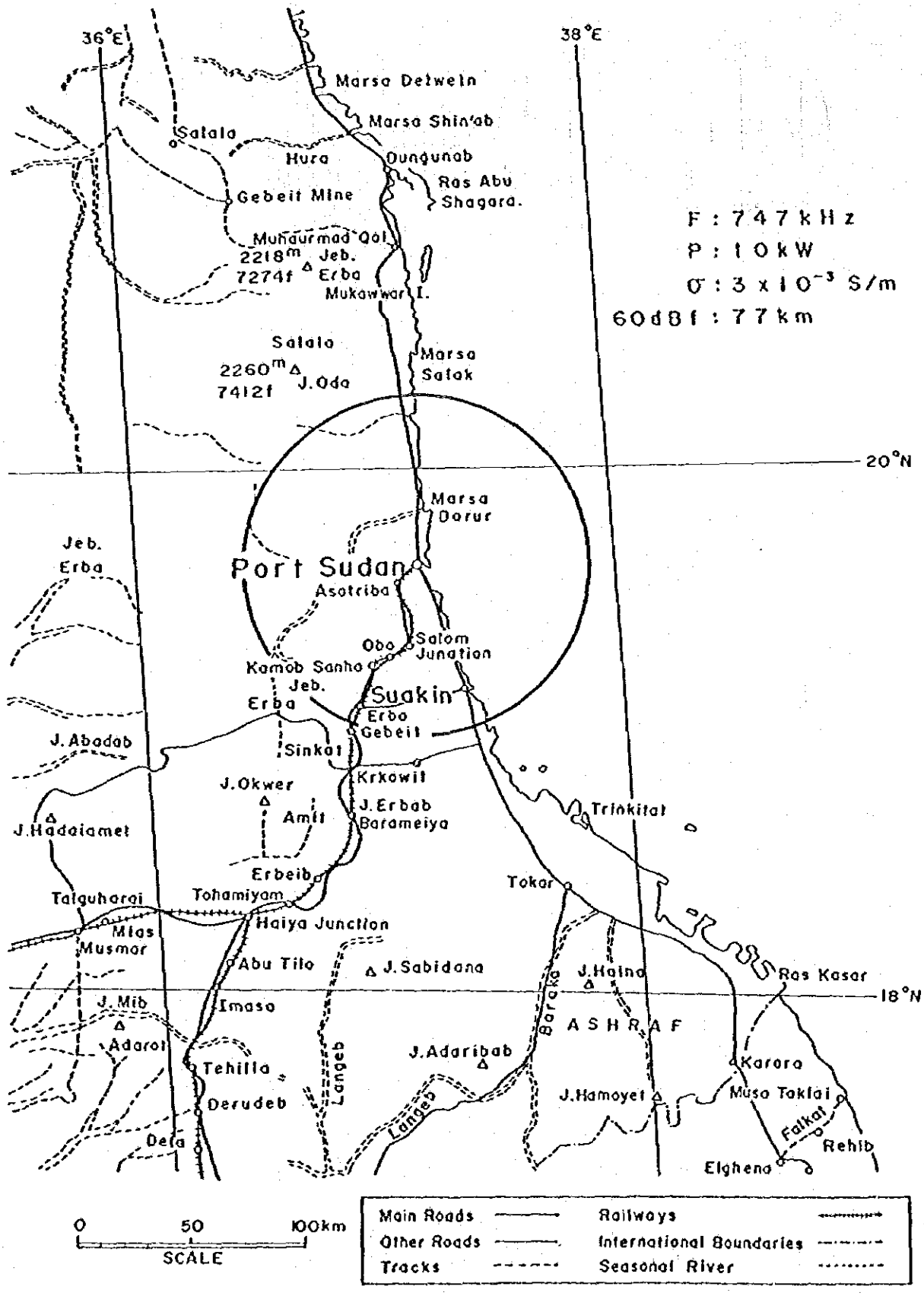


Fig. 5-4-22 Calculated Service Area of Port Sudan

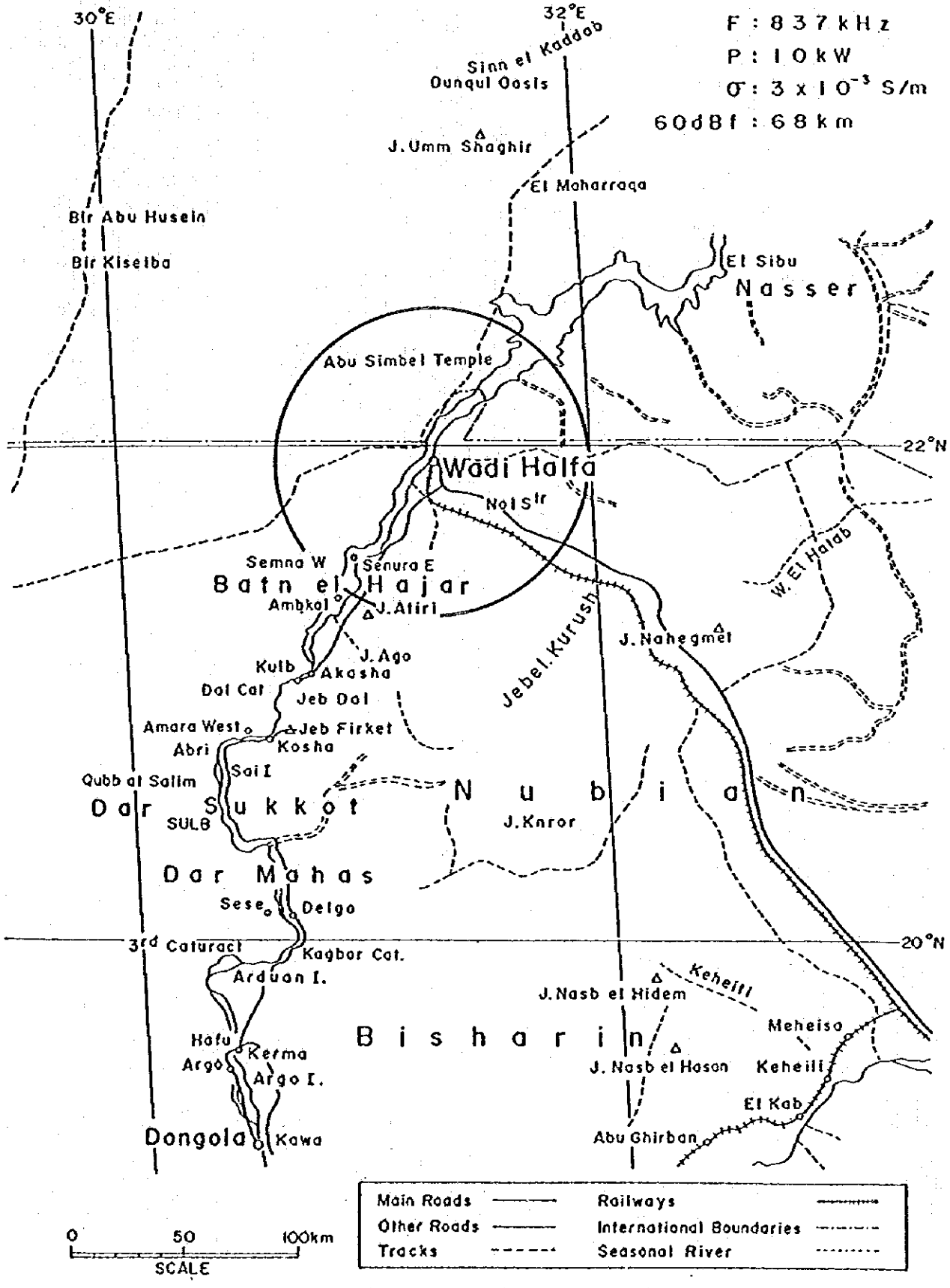


Fig. 5-4-23 Calculated Service Area of Wadi Halfa

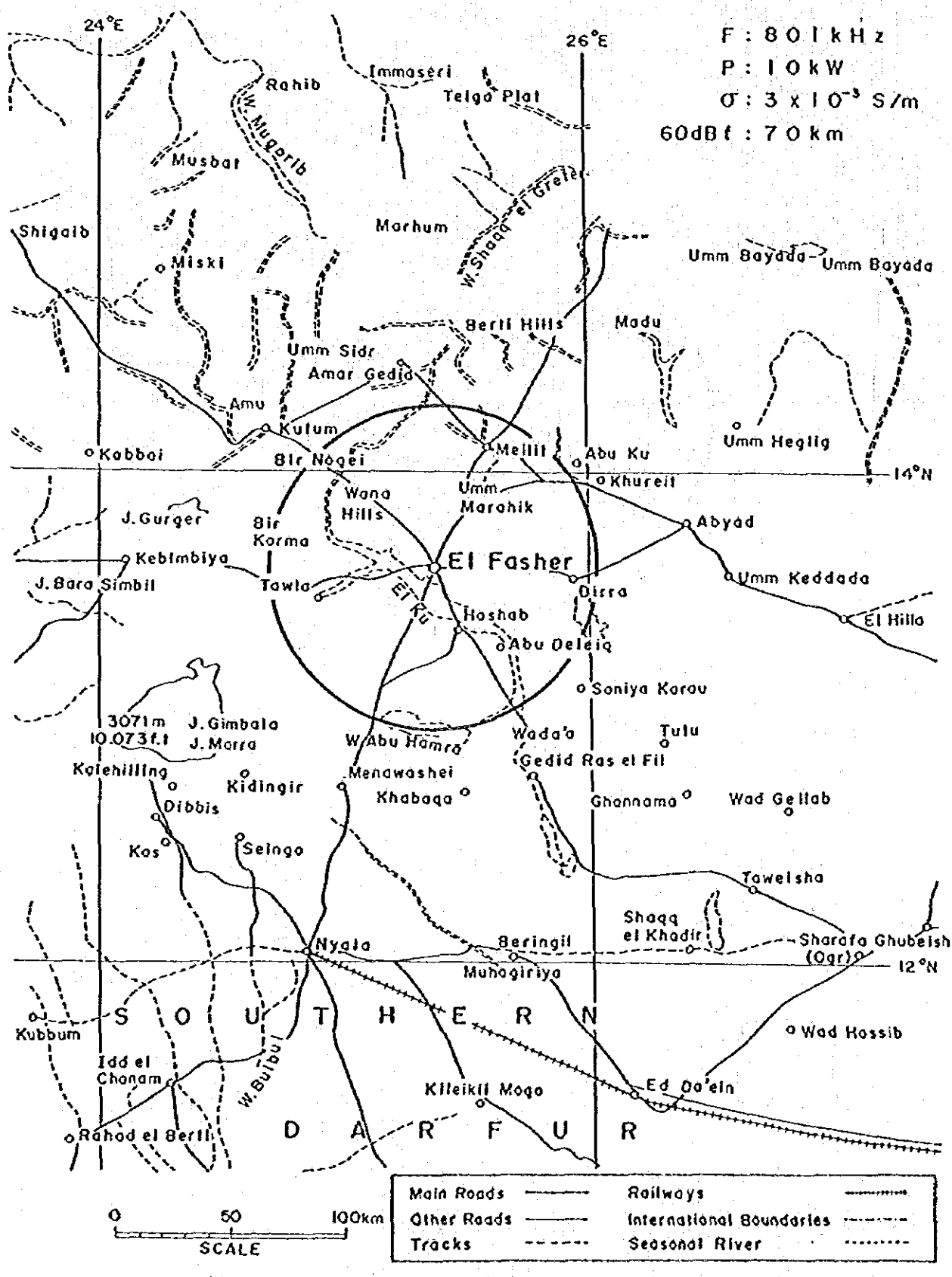


Fig. 5-4-24 Calculated Service Area of El Fasher

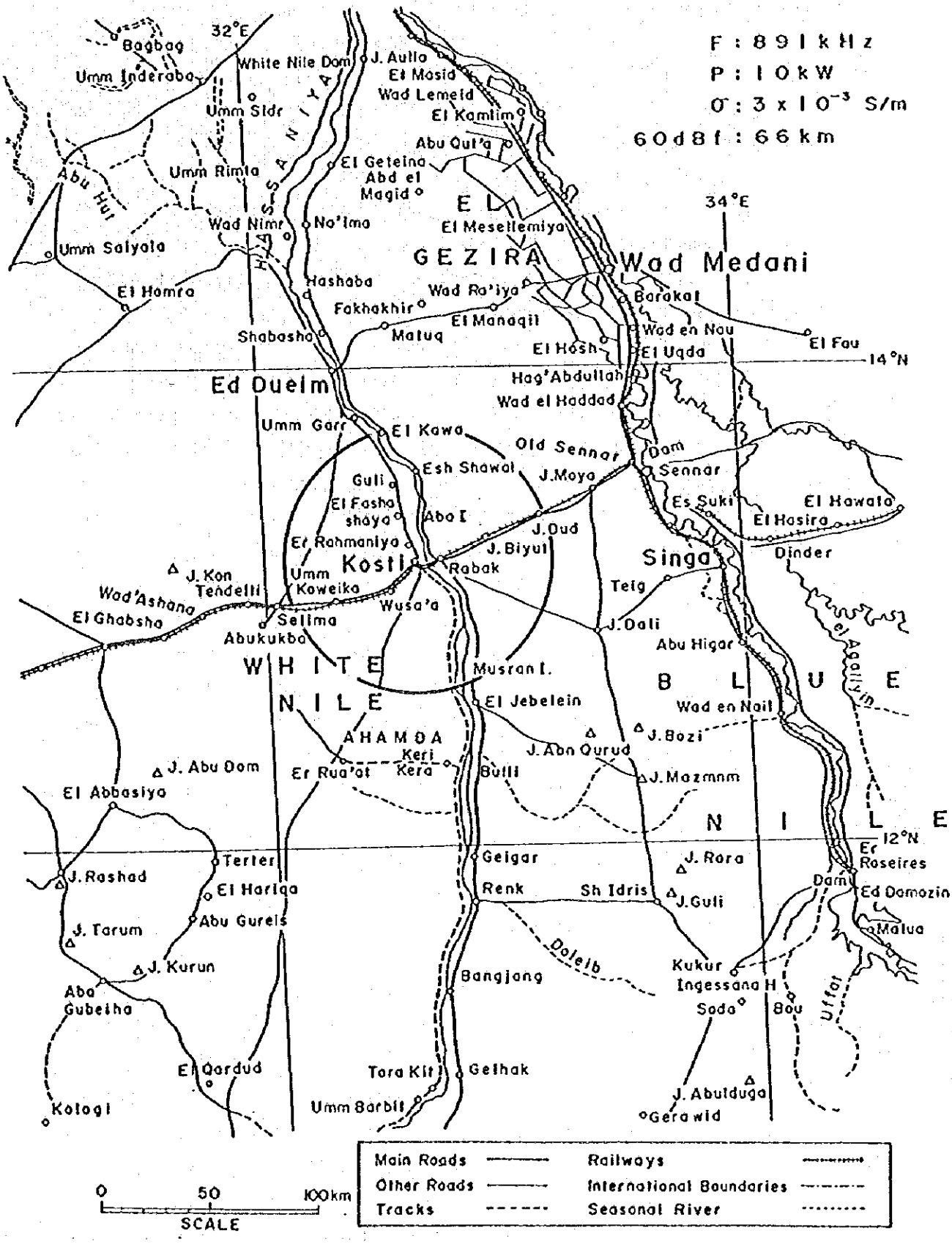


Fig. 5-4-25 Calculated Service Area of Kosti

5-5 Execution Plan

5-5-1 Current State of Building Industry and Construction Guidelines

(1) Construction industry

The Government of Sudan has been making continuous efforts to mature its industries since independence. The Government has encouraged promotion of public investments in the industrial sectors from domestic and foreign sources by enacting and putting into action the basic legislation for industrial policy. These acts were 'The Approved Enterprises (Concessions) Act, 1956'; 'The Organization and Promotion of Industrial Investment Act, 1967'; 'The Development and Encouragement of Industrial Investment Acts' of 1972 and 1974 and 'The Encouragement of Investment Act, 1980'. Consequently, there are a large number of construction enterprises ranging from leading companies backed by foreign capital (of the U.S.A., the Netherlands, and so on) to local small-sized subcontractors.

However, construction activities are rather sluggish due to the recent dampened economy. Presently, large-scale building construction is implemented by a foreign construction company. Some local construction companies have acquired capabilities by contracting the construction of public buildings, but they have not fully grown up in terms of construction capacity, procurement of materials, and possession of materials for temporary construction.

(2) Construction workers

As for construction workers in local cities, currently, the number of experienced workers is short in every job field, as many of them have stayed in foreign countries to work. It seems that the number of skillful carpenters of wood forms is considerably small. As for tower/mast erection work, some Sudanese specialized teams have a capability to handle a high antenna mast like one in this project.

Wages of the construction workers are rather low. However, the construction costs may sometimes become higher, to assure a certain

level of quality and accuracy because of the shortage of skillful workers.

The working hours are normally from 0700 to 1400 hours each day including a breakfast time from 0900 to 1000 hours, thereby the actual working hours a day amount to six hours. Holidays include every Friday and national holidays, and working efficiency should be considered to be lower during Ramadan.

(3) Construction materials and their procurement plan

As may be guessed from the construction situations described above, construction materials which can be easily procured in the Sudanese market are limited. Those construction materials which can be locally procured include cement, sand, gravels, iron rods, bricks, terrazzo blocks, concrete blocks, paints, corrugated iron sheets, and so on. Other materials have to be imported as required.

Cement is produced by plants at Atbara and Kosti, but their production does not keep up with the annual domestic consumption of one million tons. Cement imported from Rumania and Bulgaria is available in the market. It is concluded that such cement may be used in this project as to quality and production volume.

Reinforcing bars of Chinese make are available in Sudan. However, their sizes and shapes are less diversified and their supply is rather unstable despite their prices. So, it is advisable that they should be imported from Japan.

Aggregates which are produced along the Nile River are procurable here in Sudan.

Concerning bricks, it is preferable that they should be used only for curing, since they are not of high quality.

(4) Laws and standards

No laws and regulations have been established for construction and

building facilities, and the British Standard is generally used for designing purposes.

It is required that confirmation of construction should be applied for with the competent authorities prior to starting construction work.

The basic design under the Project should be carried out by considering Japanese construction standards and the local situations.

(5) Inland transportation (from the harbor of Port Sudan to the respective construction sites)

The harbor of Port Sudan is the only trade port in Sudan and handles almost all the commodities imported and exported by means of ocean freight.

As a result of the increased and expanded capability of unloading machines and facilities, the handling capacity of the harbor is presently 850 million tons a year, and railway services are available from this harbor to the respective construction sites. Since each construction site is more than 1,000 km from the harbor, however, it is necessary to account for sufficient transportation time.

5-5-2 Scope of Work

The scopes of work to be implemented under the grant aid of the Japanese Government and by the Sudanese Government at its own expenses are described below:

(1) Scope of work of the Japanese Government

1) Broadcasting equipment and expendable items, including installation and wiring

2) Antenna and expendable items, including foundation and construction work

3) Engine generator and expendable items, including installation and wiring

4) Station building (shelter), supply and foundation work for transmitter shelter and engine generator shelter

(2) Scope of work of the Sudanese Government

1) Construction sites

Already acquired by the Sudanese Government. The scope includes the leveling and removal of obstacles on the sites before the start of the construction work.

2) City power supply

Power supply should be connected to the construction sites from the nearest available points of the city power lines.

3) A programme transmission circuit from SNBC Omdurman to the studio building in each city should be provided through the respective telephone exchange stations.

4) Fences, gates, and any related work

Fences should be built along the four sides of the site boundary.

5) Construction of studio buildings (at Wadi Halfa and Kosti)

6) Expansion and improvement of studio buildings (at Port Sudan and El Fasher)

7) Exemption from all taxes and customs clearance of equipment and materials related to the construction of the facilities under the Project.

8) Exemption from all domestic taxes in Sudan (including customs duties and income taxes) to be levied upon Japanese personnel engaging in the construction of the facilities under the Project.

9) Provision of conveniences necessary for the said Japanese personnel to enter and stay in Sudan for executing the said work.

10) Expenses related to banking arrangements

11) Expenses related to authorization and approval

12) All other items which fall outsides the scope of the grant aid should be borne by the Sudanese side.

5-5-3 Execution Supervision Plan

(1) Execution plan

After signing of the Exchange Notes, the consultant who took part in the basic design survey should conclude a consulting agreement with SNBC, and should carry out a detailed discussions and a full adjustment of opinion on detailed designs, tenders, contracts of construction work, and so on, in line with the basic design.

This project aims at the construction of medium wave radio transmitting station systems of highly advanced technology including components such as transmitter, studio equipment, engine generator, etc.. Various work will be conducted such as fabrication and adjustment of the equipment, erection of 100-meter-high antenna masts and the construction of station buildings.

In order to carry out the above various work smoothly and efficiently within the specified time frame, it is necessary to send in appropriate specialists. Also it is common to all projects that transportation influences the time period of the work. Much sophisticated equipment is to be transported in this project, thus requiring much attention.

From these points, it is necessary to examine and set the stages of execution of the work very carefully. It is also necessary to exchange information sufficiently with the Sudanese side so that this project can be executed smoothly.

Furthermore, since each construction site is located at remote city apart from the capital, Khartoum, with a distance of some hundred kilometers or more, it will be difficult for those specialists engaged

in the construction work to expect adequate convenience for transportation, health and other services in daily lives at the site.

Safety measurement should be taken to secure the construction work. Attention should be paid to securing health in their living including drinking water, food and environmental sanitation. Also, it is necessary to arrange in advance emergency communication and transportation so that prompt action can be taken in an emergency such as an accident or sudden illness.

(2) Supervision plan

Under the grant aid policy of the Japanese Government, the consultant should establish an integral personnel plan for preparation of detailed design documents and supervision of construction work based on the tenor of the basic design.

1) Principal policy

(a) To keep close contacts with the SNBC and other authorities concerned of the two countries, to make opportune reports whenever they are required, and to endeavor to complete the facilities in accordance with the construction programme.

(b) To exert efforts to prevent problems and accidents from occurring among the parties related to the construction work and to give them appropriate and prompt instructions and advice for the purpose of attaining the goal of the Project.

2) Contents of business

The consultant should carry out the below-mentioned items under the discussion with the Owner, acting for him:

(a) Business related to work contracts

(b) Dispatching of site supervising technicians

(c) Approval of design drawings and execution of factory inspection and approval of products completed

(d) Work report to the Owner and approval of items on his behalf

(e) Preparation of process reports and reporting on present state of work at site process meetings

(f) Acceptance inspection at sites

(g) Administration of instructions to be given at sites, memorandums of meetings, and testing and inspection documents

(h) Cooperation with procedures to approve payment

Upon confirmation of completion of the work and fulfillment of the contract conditions, the consultant should witness delivery of the subject of the contracts and complete this business by obtaining the Owner's approval of the completed work. The consultant should report to the competent authorities of the Japanese Government any required information on the progress of the construction work, payment procedures, and completion and delivery of the facilities.

5-5-4 Equipment and Material Procurement Plan

All of the broadcasting facilities and related equipment and construction materials are procured in Japan.

The broadcasting equipment and facilities are inspected (factory inspection) in Japan after they are assembled as a single unit or in a form of the system, and then they are transported, if necessary, by disassembling them. After they arrive at the sites, they are reassembled and installed to the initial form.

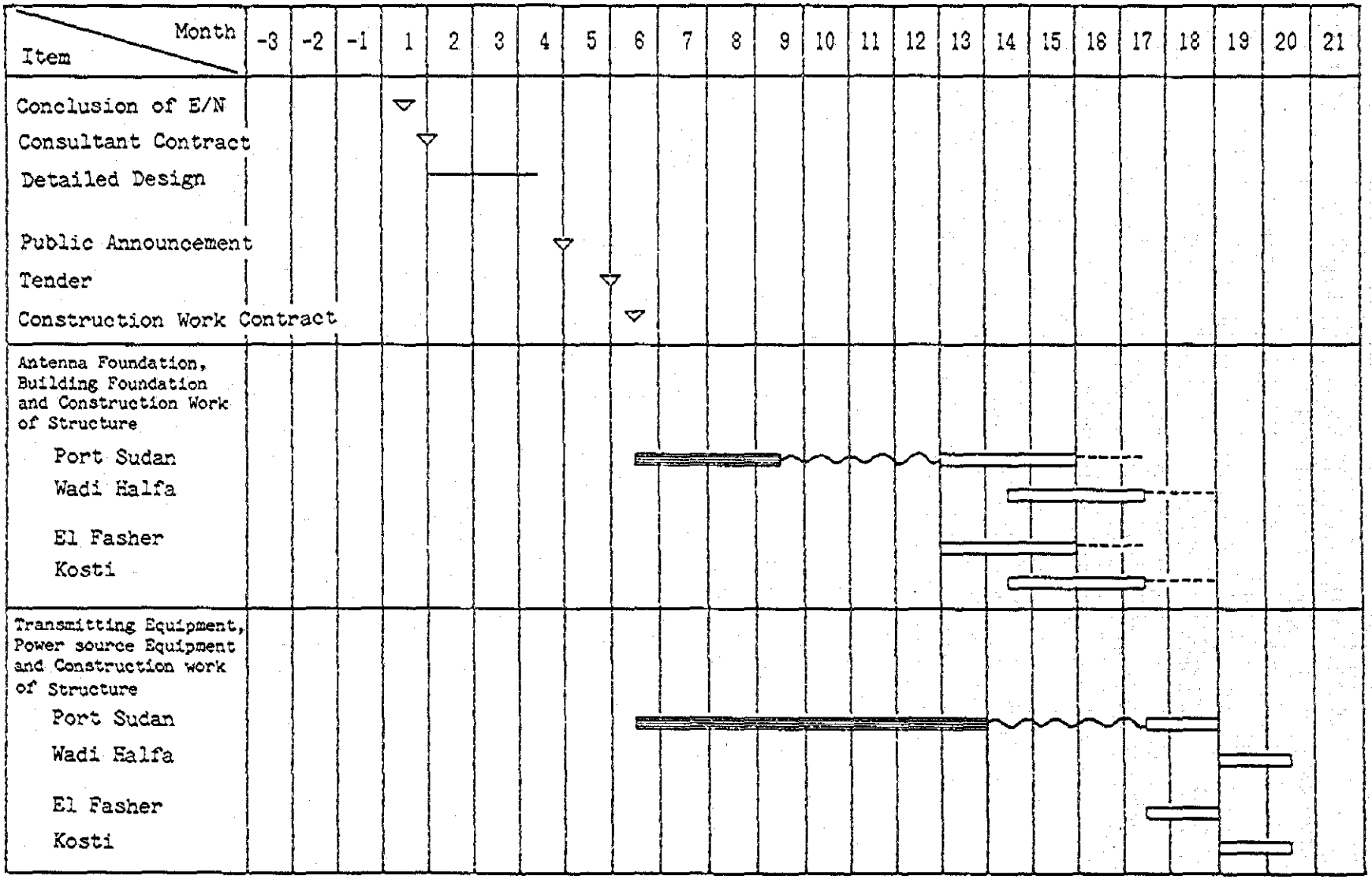
However, the transmitter equipment and engine generator are inspected in the form as it is mounted in each shelter at the factories concerned, and then they should be transported, as mounted, to the sites.

Foundations for the shelters and the antenna mast are constructed at the sites. Cement and aggregates are locally procured, but reinforcing bars are procured in Japan.

5-6 Implementation Schedule

The Implementation Schedule is shown in Table 5-6-1.

Table 5-6-1 Execution Schedule



5-7 Maintenance and Management Plan

It is necessary to reinforce the maintenance and management plan for the purpose of keeping the broadcasting facilities which are arranged in order under the Project workable over a long period.

SNBC established a maintenance center in the SNBC Headquarters in Phase 1, and has efficiently conducted the maintenance and operation of broadcasting facilities in newly constructed stations.

This project increases the network by four broadcasting stations and attaches more importance to the functions of the maintenance center.

The operational expenses for each station under the Project are those for programme production, maintenance and management of the facilities, lease of programme links, power charges and personnel expenses. In addition to above-mentioned items, expenses for the maintenance center are required.

Table 5-8-1 shows the estimated operational expenses for the Phase 2 stations.

Table 5-8-1 Estimated Operation Expenses for the Phase 2 Stations

Item	Total Operation expenses for Phase 2 Stations LS	Maintenance Center LS	Total LS
Programme production	800,000	-	800,000
Facilities maintenance and management	200,000	200,000	400,000
Power cost	440,000	-	440,000
Personnel expenses	360,000	6,000	366,000
Others	80,000	10,000	90,000
Total	1,880,000	216,000	2,096,000

Increasing of the operational expenses is estimated at approximately LS2,100 thousand, which is 6.6% of the total budget of SNBC for the 87/88 fiscal year.

SNBC should prepare the necessary budget in the fiscal year concerned, so that the four new stations built under the Project commence immediately full-scale operation.

5-8 Approximate Estimate of the Project Costs

Approximate estimate of the project cost to be covered by the Sudanese side is £S 787 thousand, as shown in Table 5-8-2.

In response to the request from the Sudanese Government, some parts of construction materials for the power line and of accoustic materials for the studio which are difficult to be procured through import in Sudan will be supplied by the Japanese Government.

Table 5-8-2 Breakdown of the expenses to be borne by the Sudanese side

Unit: £S

Station / Item	Port Sudan	Wadi Halfa	El Fasher	Kosti	Total
Studio Building	78,000	85,000	69,000	85,000	317,000
Connection of power line	10,000	30,000	35,000	75,000	150,000
Connection of relay circuit	10,000	25,000	15,000	15,000	65,000
Land levelling	10,000	10,000	20,000	15,000	55,000
Fence and Gate	50,000	50,000	50,000	50,000	200,000
Total	158,000	200,000	189,000	240,000	787,000

Note: Excluding the expenses for materials to be supplied by the Japanese Government

CHAPTER 6

PROJECT EVALUATION

CHAPTER 6 PROJECT EVALUATION

6-1 Benefits of the Project

Medium wave radio broadcasting is an effective form of mass media that can send sound information, by means of radio waves, to a large number of receivers over an extensive area instantly, simultaneously and economically. Compared with television broadcasting, it is highly economical since radio signals can be received by inexpensive cell-powered transistor radios, and the cost of facilities and personnel required for programme production is considerably low.

In Sudan, the nation's main infrastructure development including transportation and communication networks is still under developing stage and insufficient to cover its vast territory which is the largest in area on the African continent. For this reason and due in part to low literacy rate in rural areas, it is difficult to disseminate information through printing media such as newspapers, magazines, etc.

The Government of the Republic of the Sudan, in view of the above circumstances, drew up a Four Year Plan for expanding its radio broadcasting network with the aim of promoting regional development as well as enhancing educational and living standards of the rural population. As Phase 1, five radio transmitting stations were constructed and began operation in February 1986 with grant aid from Japan.

Despite remarkable expansion of the broadcasting service by addition of these five stations, the total coverage of the medium wave radio broadcasting in Sudan still remains at 50% of the nation's population. When the four new transmitting stations are completed under Phase 2, the population coverage will reach 59%. In other words, an additional 1.8 million Sudanese people will have access to SNBC programmes.

Broadcasts through the new radio network relayed from the central station will make it possible to convey to more people in rural areas

various information about central administration, education and culture, industry, health and hygiene, etc. This will effectively contribute to developing a feeling among the Sudanese people of belonging to one nation.

In addition to nationwide programmes, the Project will make it possible to broadcast programmes produced at each local station. These programmes will particularly serve for improvement of the welfare of the local inhabitants.

Proposed contents of the programmes to be locally produced include regional administrative information, local news, emergency notices, agricultural and livestock breeding programmes, social and school education, programmes for women and children, sports, music, etc.

These local programmes will meet the needs of each locality taking into consideration regional characteristics in geography, climate, industry and living environment. Therefore they are expected to contribute to the improvement of productivity, the people's livelihood, educational and cultural standards as well as the diffusion of health and sanitation knowledge.

As described above, the Project for the Expansion of Rural Radio Broadcasting Network (Phase 2) will greatly contribute to the improvement of the living standard of the Sudanese nation and development of its regional society. Accordingly, Japan's grant aid for this project is highly significant.

6-2 Project Implementation by the Sudanese Side

The purpose of this project is to improve the medium wave radio broadcasting network in Sudan. Due consideration has been given in the design of facilities so that the construction and operation of the Project will be executed without imposing too much financial burden on the part of Sudan. For instance, the sites for constructing transmitting stations are selected from among government-owned land, each site having the minimum necessary land area. The cost for fencing

work is reduced to a minimum. Connection of the electric line to the site is secured at the nearest place possible to the existing power line. Construction and renovation of studios are designed to function with minimum cost. As a result of these cost-saving measures, the project cost to be borne by the Sudanese side is set at LS787,000.

To cover the above project cost, the Government of Sudan has approved appropriating a special development budget as it did for Phase 1, apart from its annual budget allocation for SNBC. (Fiscal year begins July 1 and ends June 30.) Hence, there will be no problem in this regard.

Lack of power supply was anticipated in Wadi Halfa. However, the Sudan Electric Corporation announced in El Garreeda Daily dated December 18, 1987 that a budget for a 2 MW power station was approved and that construction will begin in fiscal 1988 and be completed at the end of 1989. Even if the completion of the power station is delayed for some time, SNBC will be able to make up any power shortage by utilizing its two mobile generators (70 kVA). Hence, there will be no problem in this regard.

6-3 Operation and Maintenance

For the operation of the new transmitting stations to be constructed in Phase 2, SNBC plans a staff allocation similar to that of Phase 1. The staff will consist of those to be transferred from SNBC's other posts and from the local agency of the Ministry of Information and Culture and those to be newly recruited. The key positions will be filled with qualified experts who are now serving in the SNBC Headquarters and transmitting stations.

The maintenance work which requires a high level of technology and sophisticated measuring apparatuses for the new transmitting stations will be entrusted to the Maintenance Center of the SNBC Headquarters, in a similar way as in Phase 1. Furthermore, SNBC plans to construct a new building of the Maintenance Center, to improve facilities and equipment for the center and to increase its staff. It is accordingly

expected that the maintenance of the Phase 2 facilities will be carried out smoothly.

Judging from the operation and programme production activities at existing broadcasting stations, SNBC's staff quality is satisfactory. Also, no difficulty is anticipated for SNBC to ensure the required number of staff by the completion of Phase 2.

SNBC will allocate the budget for operational expenses for Phase 2 including personnel expenses, programme production and technical expenses upon completion of the new stations. The Government has sufficient understanding of the necessity of the operational expenses, since it has already had similar experience during Phase 1.

6-4 Appropriateness of the Project

About four million radio receiving sets are distributed in Sudan. This figure is quite high compared with the rate of population coverage (50%) of radio broadcasting services. It is estimated that most Sudanese households have radio sets, regardless of their accessibility to their country's national broadcasting service. People in remote areas rely on unstable foreign radio signals for useful information and entertainment. There is a strong desire among the people of these areas for the radio broadcasting service of their own country.

Upon completion of this project, 1.8 million people in four cities and their vicinities, Port Sudan, Wadi Halfa, El Fasher and Kosti, will be able to benefit readily from their country's broadcasting service. Through radio broadcasts, those inhabitants living in rural areas will have opportunities to acquire information and culture from central cities as well as knowledge and local information useful for their daily lives in the communities. It will contribute greatly to the enhancement of living standards of the people and development of the regional society.

The investment cost per beneficiary is estimated to be only about ¼S37. From the viewpoint of the benefits to cost, the Project is considered to be effective and appropriate.

This project is highly significant as successive project from Phase 1 for expansion of the radio network, and it is considered to be appropriate to be implemented with grant aid from the Japanese Government.

CHAPTER 7

CONCLUSION AND RECOMMENDATIONS

CHAPTER 7 CONCLUSION AND RECOMMENDATIONS

7-1 Conclusion

The radio broadcasting service in Sudan is virtually the only effective means to convey information throughout its vast territory.

The national plan for expanding the radio broadcasting network in Sudan aims to improve living standards in rural areas and promote regional development by means of a broadcasting service which provides various kinds of information from the central government and from local communities.

Completion of the plan will bring about great progress in the national development of Sudan.

Following Phase 1 in which five local transmitting stations were constructed, Phase 2 incorporates the construction of transmitting stations at four locations. The need for a transmitting station in each of these places is very high. The population to be benefitted by Phase 2 is estimated to reach 1.8 million.

To summarize, the Project is feasible in all its critical aspects; namely, site conditions, executing capability and operational system. The proposed construction sites present no problematic conditions. SNBC, as the project implementing agency, has sufficient experience and capability in programme production, facility operation and staff arrangement to cope with the planned expansion of the radio broadcasting network.

7-2 Recommendations

(1) Programme production after completion of Phase 2

Upon completion of Phase 2, four local radio broadcasting stations will start programme production and transmission. These stations will serve as a center of information exchange and cultural enlightenment in their respective regions.

To maximize the project effect, it is of vital importance to provide programmes that cater to listeners. Continuous efforts should be made to improve programmes. Such efforts may include research on listeners' demands, attainment of cooperation from concerned organizations such as municipal bodies, schools, citizens' groups and health/sanitation agencies, and systematic program utilization by these organizations.

Regarding programme production facilities, the studios to be provided by the Sudanese side under this project will be able to produce most of the talk and information programmes except for those that require sophisticated performances. However, it is recommended that facilities and equipment be improved so that they can cope with any future increase in the volume and qualitative improvement of the programmes.

(2) Staff arrangement and training

To produce a broadcasting programme means to create culture. From a technical viewpoint, broadcasting requires a comprehensive technology including highly developed electronics.

Staff of a broadcasting station must, therefore, be equipped with highly specialized knowledge and techniques. It is also necessary to improve their ability through training.

The staff plan prepared by SNBC is adequate particularly in that all key positions are assigned to qualified incumbent staff of SNBC headquarters and transmitting stations. It is recommended that staff training, as well as recruitment and in-house transfer, be conducted systematically and actively, through OJT, and at overseas and domestic organizations.

From this point of view, further continuation of participatory training courses provided by Japan is desirable.

(3) Maintenance and operation budget

Measures should be taken to allocate, as necessary, an adequate budget to cover programme production, operation and maintenance, administration and personnel expenses.

(4) Construction work to be implemented by the Sudanese side

The scope of work to be implemented by the Sudanese Government is as shown in 5-5-2. Above all, the connection of commercial power lines to the transmitting stations and construction and renovation of studio buildings are essential for smooth implementation of the Project. It is strongly requested that the Government of the Republic of the Sudan take necessary budgetary measures for above construction work and commence the work upon official approval of the Project.

APPENDICES

APPENDICES

1. Minutes of Discussions (Basic Design Study)

2. Minutes of Discussions (Draft Report)

3. Member List of the Study Team

3-1. Basic Design Study Team
(November 21 - December 25)

3-2. Draft Final Report Explanation Team
(March 8 - March 17)

4. Itinerary of the Study Team

4-1. Basic Design Study Team
(November 21 - December 25)

4-2. Draft Final Report Explanation Team
(March 8 - March 17)

5. List of Interviewees

6. Result of the Soil Investigation

7. Organization Chart of SNBC

8. Transmission Schedule of SNBC Radio

9. Transmission Schedule of SNBC Television

10. Letters from Audience of the Phase 1 Stations

11. Statistics of the Population

12. Statistics of Meteorological Data

13. Market Survey

14. Plan for the Assignment of Frequencies to Broadcasting Stations in the Medium Frequency Bands of the Republic of the Sudan

15. List of Collected Materials

16. Photograph

1. Minutes of Discussions (Basic Design Study)

MINUTES OF DISCUSSIONS
ON
THE PROJECT FOR THE EXPANSION OF
RURAL RADIO BROADCASTING NETWORK
IN
THE REPUBLIC OF THE SUDAN
(SECOND PHASE)

In response to the request of the Government of the Republic of the Sudan, the Government of Japan decided to conduct a basic design study on the Project for the Expansion of Rural Radio Broadcasting Network (Second Phase) and entrusted the study to the Japan International Cooperation Agency (JICA). JICA sent to the Republic of the Sudan the study team headed by Mr. SATORU ITOH, Special Advisor, International Cooperation Division, Communications Policy Bureau, Ministry of Posts and Telecommunications, from 23rd November to 23rd December, 1987.

The team had a series of discussions on the Project with the officials concerned of the Government of the Republic of the Sudan headed by Mr. ABBAS SIDDIG IBRAHIM, Director General of Engineering and Technical Affairs, Sudan National Broadcasting Corporation and conducted a field survey in the four proposed sites and other areas.

As a result of the study, both parties agreed to recommend to their respective governments that the major points of understanding reached between them, attached herewith, should be examined towards the realization of the Project.

Khartoum, 22nd December, 1987

SATORU ITOH
Team Leader
Study Team
J I C A

Dr. ELSAYED A. A. ZAKI
Undersecretary of Planning
Ministry of Finance and
Economic Planning

ABBAS SIDDIG IBRAHIM
Director General of
Engineering and Technical
Affairs
Sudan National Broadcasting
Corporation

ATTACHMENT

1. The objective of the Project is to provide facilities and equipment for the medium wave radio broadcasting transmitting stations in order to improve the radio broadcasting service with a view to promoting education activities and improving living standards in rural areas.

2. Sudan National Broadcasting Corporation (hereinafter referred to as "SNBC") is responsible for the implementation of the Project on Sudanese side.

3. According to priority, the proposed sites and the output power for the transmitting stations are as follows;

1)	Port Sudan	10kW
2)	Wadi Halfa	10kW
3)	El Fasher	10kW
4)	Kosti	10kW

4. The Japanese Study Team will convey to the Government of Japan the intention of the Government of the Republic of the Sudan that the former takes the necessary measures to cooperate in implementing the Project and provide the facilities and equipment listed in Annex 1 for the four radio broadcasting transmitting stations as stated in the paragraph 3 under Japan's Grant Aid programme.

5. The Government of the Republic of the Sudan will take the necessary measures listed in Annex 2 on condition that the grant aid by the Government of Japan is extended to the Project.

6. Both sides confirmed that the Japanese Study Team explained the Japanese Grant Aid Programme and Sudanese side understood it.

ANNEX 1

1. Medium Wave Radio Broadcasting Transmitter	2 sets
2. Transmitting Antenna	1 set
3. Dummy Load	1 set
4. Input Equipment	1 set
5. Transmission Control Equipment	1 set
6. Remote Control/Supervisory System	1 set
7. Studio-to-Transmitter Link	1 set
8. Measuring Equipment	1 set
9. Engine Generator	1 set
10. Shelters 1 each for transmitter and engine generator	
11. Monitoring Receiver	1 set
12. Other related equipment, spare parts and tools	1 set

ANNEX 2

1. To provide data and informations necessary for detailed design.

2. To secure the lands necessary for the radio broadcasting transmitting stations.

3. To take necessary steps to ensure the reliable programme transmission to the studios of the proposed transmitter sites.

4. To carry out site preparation such as clearing, leveling and access road before commencement of construction works.

5. To provide facilities for distribution of electricity, drainage, communications and security.

6. To ensure prompt unloading, tax exemption, customs clearance at the ports of disembarkation in Sudan and prompt internal transportation of the products purchased under the grant.

7. To exempt the Japanese nationals concerned from custom duties, internal taxes and other fiscal levies imposed in Sudan with respect to the supply of the products and other authorizations for carrying out the Project.

8. To provide necessary permissions, licences and other authorizations for carrying out the Project.

9. To establish necessary operation and maintenance organizations in time for the completion of the radio broadcasting transmitting stations

2. Minutes of Discussions (Draft Report)

MINUTES OF DISCUSSIONS
THE DRAFT FINAL REPORT OF THE BASIC DESIGN STUDY
ON
THE PROJECT FOR THE EXPANSION OF
RURAL RADIO BROADCASTING NETWORK
IN
THE REPUBLIC OF THE SUDAN
(SECOND PHASE)

In response to the request of the Government of the Republic of the Sudan for Grant Aid for the Project for the Expansion of Rural Radio Broadcasting Network (Second Phase)(hereinafter referred to as "the Project"), the Government of Japan decided to conduct a basic design study on the Project and entrusted to study to the Japan International Cooperation Agency (JICA). JICA sent to the Republic of the Sudan the team headed by Mr. SATORU ITOH, Special Adviser, International Cooperation Division, Communications Policy Bureau, Ministry of Posts and Telecommunications, from November 23rd to December 23rd, 1987.

As a result of the study, JICA prepared a draft report and dispatched a draft final report explanation team to explain and discuss it from March 11th to March 15th, 1988.

Both parties had a series of discussions on the report and have agreed to recommend to their respective Governments that the major points of understanding reached between them, attached herewith, should be examined towards the realization of the Project.

Khartoum, March 14, 1988

SATORU ITOH
Team Leader
Study Team
JICA

DR. ABDALLA AL ABOUDI
Acting Undersecretary of
Planning
Ministry of Finance and
Economic Planning

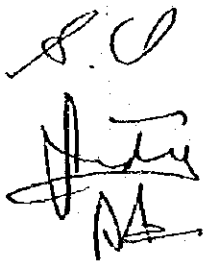
ABBAS SIDDIG IBRAHIM
Director General of
Engineering and Technical Affairs
Sudan National Broadcasting
Corporation

ATTACHMENT

1. The Sudanese side has principally agreed to the basic design proposed in the Draft Final Report.

2. The Final Report (10 copies in English) on the Project will be submitted to the Sudanese side by the end of May, 1988.

3. The Sudanese side understood the system of Japan's Grant Aid Programme and confirmed the measures to be taken by the Sudanese side towards the realization of the Project.



3. Member List of the Study Team

3-1. Basic Design Study Team (November 21 - December 25)

Name	Assignment	Present Post
Mr. Satoru ITOH	Team Leader	Special Advisor, International Cooperation Division, Communications Policy Bureau, Ministry of Posts and Telecommunications(MPT)
Mr. Toshiki YOKOMAKU	Administration planning	Section Chief, Engineering Office, Monitoring and Examination Division, Radio Department, Telecommunications Bureau, Ministry of Posts and Telecommunications(MPT)
Mr. Makoto KASHIWAYA	Project Coodinator	Second Basic Design Study Division, Grant Aid Planning and Survey Department Japan International Cooperation Agency(JICA)
Mr. Hiroo SUZUKI	Network planning	Acting Director International Department, All Japan Radio & Television Engineering Services Co., Ltd. (AJTS)
Mr. Takashi MIYAGI	Transmitting Facilities	Chief Engineer International Department, AJTS
Mr. Masami DOUCHI	Power Facilities	Chief Engineer International Department, AJTS
Mr. Takashi INOUE	Facilities Planning	Senior Architect Matsuyama Branch, AJTS
Mr. Hiroshi SONODA	Cost Estimate	Engineer International Department, AJTS

3-2. Draft Final Report Explanation Team (March 8 - March 17)

Name	Assignment	Present Post
Mr. Satoru ITOH	Team Leader	Special Advisor, International Cooperation Division, Communications Policy Bureau, Ministry of Posts and Telecommunications(MPT)
Mr. Masashi FUJITA	Project Coodinator	Second Basic Design Study Division, Grant Aid Planning and Survey Department Japan International Cooperation Agency(JICA)
Mr. Hiroo SUZUKI	Network planning	Acting Director International Department, All Japan Radio & Television Engineering Services Co., Ltd. (AJTS)
Mr. Takashi MIYAGI	Transmitting Facilities	Chief Engineer International Department, AJTS

4. Itinerary of the Study Team

4-1. Basic Design Study Team
(November 21 - December 25)

Date	Government Members	Network Planning / Power Equipment	Transmitting, Equipment / Facilities Planning	Cost Estimate
Name	Mr. S. ITO, MR. T. YOKOMAKU Mr. M. KASHIWAYA	Mr. H. SUZUKI, MR. T. MIYAGI Mr. M. DOUCHI, MR. T. INOUE		MR. H. SONODA
NOV. 2 SAT		Lv. Tokyo at 21:30 by KL868		
22 SUN		Via Anchorage & Amsterdam		Lv. Tokyo at 11.45 by AF269
23 MON		Ar. Khartoum at 19:45 by KL561 Countesey Call to Embarsy of Japan		Via Moscow, Paris & Cairo Ar. Khartoum at 00:15 by AF108
24 TUE		Courtesey Call to Ministry of Information and Culture, SNBC		
25 WED		Presentation and explanation of the Inception Report Discussion with SNBC on the Questionnaire		
26 THU		Discussion with SNBC on the basic concept of survey		
27 FRI		Team meeting		Market Survey
28 SAT		Discussion with SNBC		Ditto
29 SUN		Preparing of Site Survey		
30 MON		Shift to Port Sudan, Survey at Port Sudan		
DEC. 1 TUE		Survey at Port Sudan		
2 WED		Shift to Khartoum		
3 THU		Team meeting		
4 FRI		Shift to Wadi Halfa, Survey at Wadi Halfa		
5 SAT		Survey at Wadi Halfa		
6 SUN		Shift to Khartoum		
7 MON		Shift to El Fasher, Survey at El Fasher		Survey at Khartoum
8 TUE		Survey at El Fasher		Lv. Khartoum at 08:55 by KL562
9 WED		Shift to Khartoum		Via Athens, Amsterdam & Ancharage
10 THU		Meeting at Embassy of Japan and SNBC		Ar. Tokyo at 17:15 by KL867
DEC. 11 FRI		Meeting with SNBC & Team meeting		
12 STA	Lv. Tokyo at 21:30 by KL868	Ditto		
13 SUN	Via Anchorage & Amsterdam	Ditto		
14 MON	Ar. Khartoum at 19:45 by KL561	Ditto		
15 TUE	Courtesy-call to Embassy of Japan, Ministry of Information and Culture, SNBC	Ditto		
16 WED	Discussion with SNBC, Shift to Kosti			
17 THU	Survey at Kosti			
18 FRI	Survey at Kosti, Inspection of Wadmedani Radio Transmitting Station Shift to Khartoum			
19 SAT	Meeting with SNBC and Inspection of Soba Radio Transmitting Station			
20 SUN	Meeting with SNBC and Ministry of Finance and Economic Planning			
21 MON	Preparation of Minutes of Discussions with SNBC, Signing of Minutes of Discussion			
22 TUE	Reporting to the Embassy of Japan and Minister of Information			
23 WED	Lv. Khartoum at 04:10 by LH595			
24 THU	Via Cairo, Frankfurt, Dusseldorf and Anchorage			
25 FRI	Ar. Tokyo at 15:45 by LH702			

4-2 Draft Final Report Explanation Team
(March 8 - March 17)

Date	Day	Morning	Afternoon
Mar. 8	Tue.		Departure for Tokyo at 21:00 by AF 271 (Team Leader and 3 members)
9	Wed.	Via Ancharage & Paris	
10	Thu.	Departure for Paris at 16:35 by AF 118	
11	Fri.	Arrival Khartoum at 01:25	
12	Sat.	- Courtesy Call to Embassy of Japan Explanation of the Draft Final Report - Courtesy Call to Ministry of Finance and Economic Planning - Courtesy Call to Ministry of Information and Culture	Meeting at SNBC - Presentation of Draft Final Report - Discussion on itinerary
13	Sun.	Meeting with SNBC	Meeting with SNBC
14	Mon.	- Meeting with SNBC - Signing of the minutes of discussions	Reporting to the Embassy of Japan
15	Tue.	Departure for Khartoum at 4:30 by BA 152, Via Cairo	
16	Wed.	Departure for London at 12:20 by BA 005	
17	Thu.	Via Ancharage	Arrival Tokyo at 14:40

5. List of Interviewees

Ministry of Information and Culture

Eltom Mohamed Eltom	Minister

Ministry of Finance and Economic Planning

Mohamed Ali Omer	Deputy Undersecretary
Elfaih M. Khalid	Assistance Undersecretary
Mohamed Saeid Abdala	Assistance Inspector
Nadir Elrayah	

Ministry of Construction

A.H. Ziada	Senior Quantity Surveyor

Sudan National Broadcasting Corporation (SNBC)

Hamti Badr Eldien	Director of Television
Saleh Mohamed Saleh	Director or Radio
Abbas Sidoing Ibrahim	Director General of Engineering and Technical Affairs
Mahmoud Said Badri	Director of Planning
Ahmed Dafalla	Director of Radio Transmission
Sala Taha Ismail	Director Engineering and Director of Radio Wad Medani
Alawia Hassan Fadd	Director Engineering and Operation of Gazera T.V.
Osman El Sadig	Engineer

Regional Government (Port Sudan)

Osman El Tahir	Red Sea Province Commissioner
Mustana Zein	Red Sea District Manager Telecom. Corporation
El Ziber Ahmed	Sudan Salt Company
Yousif Ali Ahmed	Vehicle Assy. Plant
Mohmed Aushi	Housing Department
Abdel Rahman	Survey Department
Ahmed Babiker Gabani	Senior Councilor
Mohmed Hashim El Laisi	Land Department

Regional Government (Wadi Halfa)

Mohamed Hassan Moh.	Administrative Officer
El Walid Mohd Omar Mohd	Administrative Officer
Obeid T. Dris	Administrative Assistant Officer
Alhameed Khateeb	Surveyor in Charge

Regional Government (El Fasher)

Adam Mohmed Ahmed	Covernor Deputy
Mohmed Mahamoud Hemida	Regional Manager
Ahmed Omar Eliman	Director of Information
Gaafar Hamed Elteanie	Senior Engineer of Power Supply
Osman Mohmed Osman	Studio Officer

Regional Government (Kosti)

Elamin Ibrahim Elamin	Executive Director
Shiek Aldin Yousif	Executive Officer
Min Alla	
Musa Elagab	Microwave Engineer Telecommunication
Murtada Abd El Mageed	Nec Department Managaer
Mamoun A. Elmagid	Culture and Information
Mahasin M. Osman	Culture and Information
Osman Mohd Medani	Area Council Engineer
Barakat Ahmed	Telecommunication
Hassan Ahmed Siddig	Local Government Inspector
Yousif Salman	Chief Survey Officer
Abd Ellah Elbushra	Water Co. Department
Tag Elsir Hassab	Sand Department

Bank of Sudan

Ibrahim Adam Habib	Manager, Statistics Department

National Railroad

Salah Mohamed	Invoices Office, New Station

Embassy of Japan, Sudan

His Excellency Hikaru Oka	Ambassador Extraordinary and Plenipotentiary
Mr. Hirozo Ushida	Counsellor
Mr. Toshio Kaneko	First Secretary
Mr. Yoshihiko Sato	Second Secretary

6. Result of the Soil Investigation

REPORT ON SOIL INVESTIGATION

1. Foreword

This report deals with the result of the examination of soil bearing capacity of the proposed sites for the Project for the Expansion of Rural Broadcasting Network (Phase 2) in the Republic of Sudan. The examination was carried out based on findings of the field survey conducted 21, November to 25 December, 1987 for a Basic Design Study of the Project. Analysis was made on the findings, after the study team returned to Japan.

The team was able to carry out standard penetration tests in one of the four proposed sites. In the other sites, visual inspection was carried out by test pit drilling, with the results of 1984 as reference.

2. Inspection method

Inspection was conducted at four sites in Wadi Halfa, Port Sudan, Kosti, and El Fasher as shown in Fig. Inspection items were as follows.

1) Outcrop inspection and collection of disturbed soil samples

At each site, a test pit about two meters deep was drilled for outcrop inspection and collection of disturbed soil samples.

2) Standard penetration test

At the site of Kosti, four standard penetration tests were carried out with test pits ten meters deep under the land surface, according to the B.S. and disturbed soil samples were collected. The tests were carried out with the cooperation of Khartoum University.

3) Inspection of samples

Inspection was made for the samples collected at each site.

4) Examination after returning to Japan

Examination of soil bearing capacity was conducted for each site, based on the results of 1) to 3) above, and with the data of 1984 as reference.

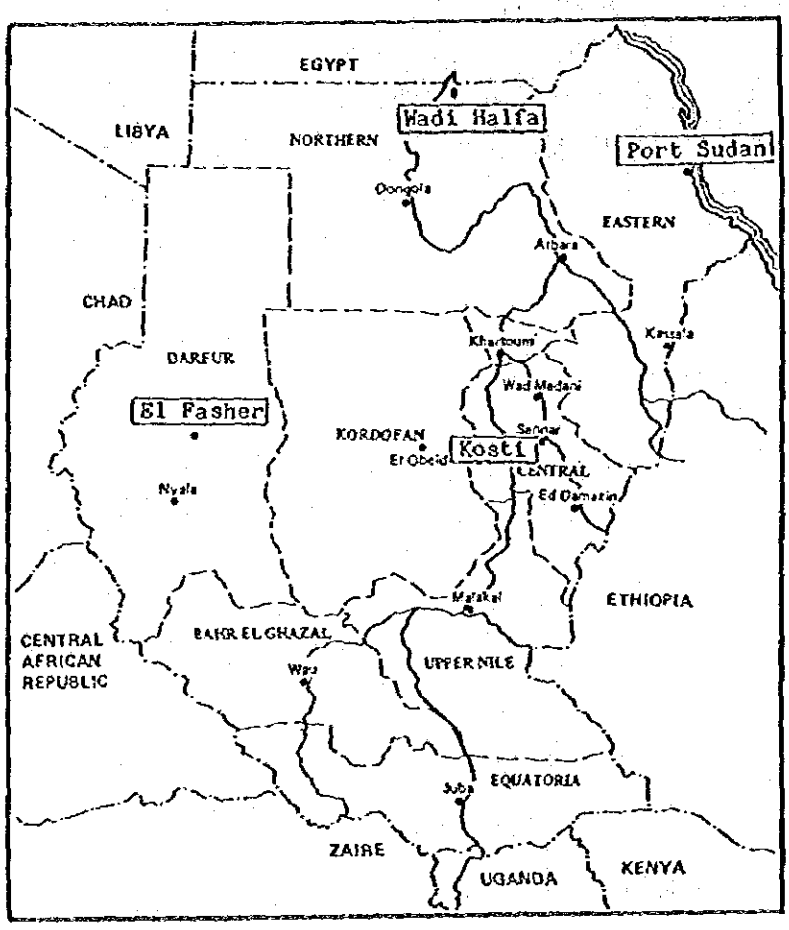


Fig. 1 Survey Spot

3. Findings

1) Wadi Halfa

The investigation site was situated in almost level land 5 km from the Nile, with an altitude of 188 m. The land was covered with soft sand with a mingling of pebbles up to a depth of 50 cm under the land surface. In deeper parts, the soil was so hard that drilling was difficult even by a pickax. The entire soil seemed to form sandstone. Judging from the outcrop inspection and the observation of the samples, this site had the hardest soil of the four sites investigated.

2) Port Sudan

The investigation site was situated in an almost level tableland about 8 km inland from the shoreline of the Red Sea, with an altitude of 28 m. The land was covered with soft sand up to a depth of 30 cm under the land surface. In deeper parts, the soil consisted of a sandy layer with a mingling of gravel and silt. Judging from the form of the gravel, the soil seemed to form a heaped tableland. The test pit did not collapse on the borehole surface. A drilling of 2 m required half a day.

3) Kosti

The investigation site was situated on the left bank of the White Nile. The soil was a river drift of the Nile, and very hard. Over the broad site of an area of 300 m x 300 m, the soil consisted of very hard whity-ocher sandstone or mudstone at an average depth of 1.5 or more, under the upper black layer with different depths. An N value of the sandstone or mudstone was 50 or more. For the report on the core observation and standard penetration test by drilling, see Annex 1.

4) El Fasher

The investigation site was situated on an almost level tableland with an altitude of 758 m. The site was a half desert, sparsely wooded. The soil was sandy, consisting of fine sand. However deep the ground might be dug, it was only sand that came out, just like the digging in a sandbox.

4. Examination of soil bearing capacity

1) The sites of Wadi Halfa, Kosti, and Port Sudan

Examination of soil bearing capacity of those sites is dealt with here, because the comparison between the outcrop inspection in Wadi Halfa and the core observation in Kosti showed the sites were similar in geophysical characteristics.

Since both sites consist of hard sandy soil,

$q_a = 1/3(cN_c + \beta\gamma_1 BN_\gamma + \gamma_2 D_f N_q)$.....(1)

Substitute the following figures for the formula above:

$c = 0$, $\phi = \sqrt{20N} + 15 = \sqrt{20 \times 50} + 15 = 46.6° - 40°$

$= 0.4$, $\gamma = 0.69$ t/m^3, $D_f = 0$

Calculate to the safety side, and you will get

$q_a = 1/3 \times 0.4 \times 0.69 \times B \times 114 = 10.5\ B$ (t/m^2)

q_a (long-term) = 10.5 B t/m^2

q_a (short-term) = 21.0 B t/m^2

(B = minimum width of the foundation)

2) The site of El Fasher

If the site is regarded as consisting of sandy soil,

$c = 0$, $\phi = \sqrt{20 + 15} = \sqrt{20 \times 30} + 15 = 39°$

$= 0.4$, $\gamma = 0.69$ t/m^3, $D_f = 0$

Substitute these figures for the formula (1) above, calculate to the safety side, and you will get

$q_a = 1/3 \times 0.4 \times 0.69 \times 78\ B = 7.2\ B$

q_a (long-term) = 7.2 B t/m^2

q_a (short-term) = 14.4 B t/m^2

5. Conclusion

1) It is suggested that long-term soil bearing capacity be as follows for each site

Wadi Halfa	10.5 B t/m^2
Kosti	10.5 B t/m^2
Port Sudan	10.5 B t/m^2
EL Fasher	7.2 B t/m^2

B = minimum width of the foundation

Long-term soil bearing capacity shall be double the short-term soil bearing capacity. Such figure, however, shall apply only to direct foundation with the depth of about two meters.

2) This report does not refer to the amount of land subsidence. It is necessary to examine such amount with E = 28 N (kg/cm^2) for the sandy ground of the proposed sites.

3) In the Kosti site, a soil layer like black cotton soil was found. It is expansible, special soil. The way the ground is covered with water can lead to decreased bearing capacity and increased subsidence of the ground. Bearing on this layer, therefore, need to be avoided. The presence of such layer should be confirmed before excavating to determine the excavation bottom.

4) The depth of ground of the foundation must be carefully determined, with the reports on floods in the regions as reference.

Black Cotton Soils

This is a special soil, noteworthy in SUDAN. It is black clay soil, and called Badole. It's distribution in Africa is shown in Fig. 2.

It is clearly observed that the soil is distributed from centre to south-east, as well as south in Sudan.

This soil belongs to the special soil and shows remarkable swelling according to the change of the water content percentage. This black-gray soil becomes clay-like by rain, and is very trouble something, which obstructs the automobile traffic. Accordingly, the season of field survey in INGESANA HILLS area, east-southeast of EL OBEID, is limited from around October to March. This soil is deposited on the surface course in the area. The layer thickness of the soil is about 1 M in average, when the basic layer is shallow. Consequently, the depth of embedment base should be decided avoiding this soil.

The reason of swelling is Montmorillonite the main component of the clay minerals in the soil.

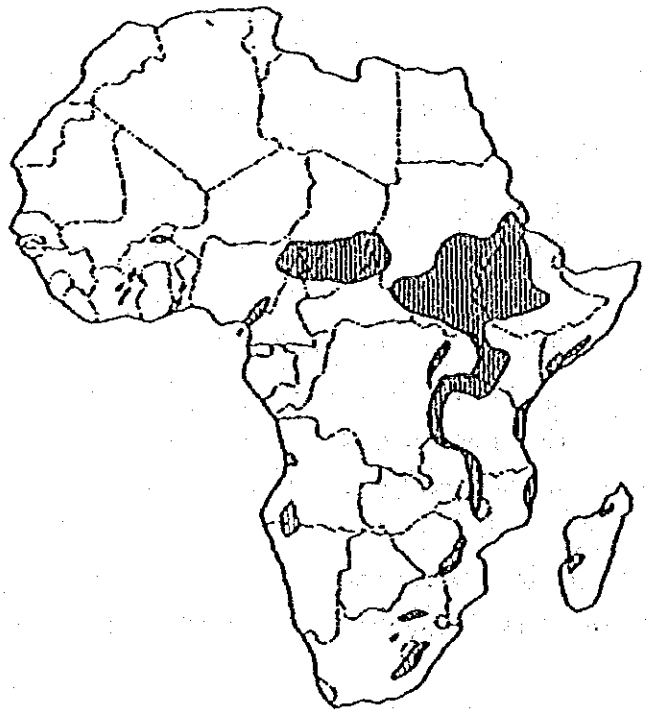


Fig. 2 Distribution of Black Clay Soils In Africa

BUILDING AND ROAD RESEARCH INSTITUTE
UNIVERSITY OF KHARTOUM

REPORT ON SOIL INVESTIGATION FOR THE DAMAZEEN AND KOSTI RADIO BROADCASTING SITES

CLIENT:

ALL JAPAN RADIO AND TELEVISION
ENGINEERING SERVICES CO., LTD.,

FOR

SUDAN NATIONAL BROADCASTING
CORPORATION

JANUARY 1988

REPORTED BY:

DR. HAMID AHMED EL HAG ISMAIEL
ASSOCIATE PROFESSOR
BUILDING AND ROAD RESEARCH INSTITUTE
KHARTOUM UNIVERSITY

LABORATORY TESTS BY:

AHMED KHALIL AHMED
HEAD TECHNICIAN
SOIL MECHANICS AND FOUNDATION DIVISION
BUILDING AND ROAD RESEARCH INSTITUTE
KHARTOUM UNIVERSITY

1. INTRODUCTION:

The following report is the result of a site investigation work programme carried out by BRRI on behalf of All Japan Radio and Television Engineering Services Co., Ltd., represented by their chief engineer Mr. Takashi Miyagi. The All Japan radio are representing Sudan National Broadcasting Corporation.

The client requested that only borehole logs and standard penetration test data be carried out.

An Acker AD II continuous flight auger machine was used to advance the borehole, carry out standard penetration tests and take disturbed soil samples.

2. FIELD INVESTIGATION:

2.1 General:

Four boreholes were drilled at each site. A central borehole, fifteen metres deep was first drilled. Each of the other three boreholes was located at ten metre distances from the the central borehole at 120 degrees orientations.

A preliminary borehole log was prepared at each site during the borings.

2.2 Disturbed Soil Samples:

Disturbed soil samples were obtained from all depths at half metre intervals from each borehole. These samples were stored in labelled plastic bags and transported to the BRRI laboratory for visual inspection and final borehole logs prepared. These are given in Appendix (1).

2.3 Standard Penetration Test (S.P.T.) :

Standard penetration testing were carried out according to the British Standard, B.S. 1377 : 1975 at one metre depth intervals. The number of blows required to drive the standard sampler thirty centimetres into the cleaned borehole as recorded at the site are given in Appendix (1). It is to be noted that depth and other correction factors are to be carried out on these figures according to the standards or practices of the geotechnical engineer analysing the results.

2.4 Ground Water Table:

No ground water table was struck at either site.

APPENDIX (1)

SOIL PROFILES AND STANDARD PENETRATION TEST RESULTS

Damazeen

B.H. No. (1)

Depth range in metres	Description
0.0 - 1.0	Dark grey very plastic hard clay
1.0 - 2.0	Dark grey very plastic hard clay with some white calcareous matter.
2.0 - 2.5	Greyish brown plastic hard clay with some white calcareous matter.
2.5 - 3.0	Brown plastic hard sandy clay with some white calcareous matter.
3.0 - 4.5	Brown plastic sandy clay with some white calcareous matter.
4.5 - 5.0	Brown plastic silty clay with some white matter as before.
5.0 - 5.5	Brown firm plastic sandy silt
5.5 - 6.0	Brown firm plastic sandy silt with some white matter as before.
6.0 - 6.5	Brown slightly plastic sandy silt with very slight amounts of white calcareous matter.
6.5 - 7.0	Light brown slightly plastic silt.
7.0 - 7.5	Light brown silty fine sand.
7.5 - 8.0	Light brown micaceous fine sand
8.0 - 10.0	Light brown micaceous fine to medium sand
10.0 - 10.5	Light brown micaceous medium sand with some gravel size calcareous fraction.

Damazeen

Borehole No. (1) cont.

Depth range in metres	Description
10.5 - 11.0	brown micaceous medium sand with Light/some gravel size calcareous fraction with some gravel and stone size calcareous fraction.
11.0 - 12.0	Light brown medium to coarse micaceous sand with very slight amounts of gravel size fractions.
12.0 - 12.5	Brown sandy fine gravel.
12.5 - 13.0	Brown slightly sandy fine gravel
13.0 - 13.5	Light brown coarse sand.
13.5 - 14.0	Light brown coarse sand with very slight amounts of very fine gravel.
14.0 - 14.5	Light brown moist medium to coarse sand.
14.5 - 15.0	Light brown moist coarse sand.

Damazeen

Borehole No. (2)

Depth range in metres	Description
0.0 - 1.0	Dark grey very plastic hard clay
1.0 - 2.0	Dark grey very plastic hard clay with some white calcareous matter.
2.0 - 2.5	Greyish brown plastic hard clay with some white calcareous matter.
2.5 - 3.0	Brown plastic hard sandy clay with some white calcareous matter.
3.0 - 4.5	Brown plastic sandy clay with some white calcareous matter.
4.5 - 5.0	Brown plastic silty clay with some white matter as before.
5.0 - 5.5	Brown firm plastic sandy silt
5.5 - 6.0	Brown firm plastic sandy silt with some white matter as before.
6.0 - 6.5	Brown slightly plastic sandy silt with very slight amounts of white calcareous matter.
6.5 7.0	Light brown slightly plastic silt.
7.0 - 7.5	Light brown silty fine sand.
7.5 - 8.0	Light brown micaceous fine sand
8.0 - 10.0	Light brown micaceous fine to medium sand.
10.0 - 10.5	Light brown micaceous medium sand with some gravel size calcareous fraction.

Damazeen

Borehole No. (3)

Depth range in metres	Description
0.0 - 1.0	Dark grey very plastic hard clay
1.0 - 2.0	Dark grey very plastic hard clay with some white calcareous matter.
2.0 - 2.5	Greyish brown plastic hard clay with some white calcareous matter.
2.5 - 3.0	Brown plastic hard sandy clay with some white calcareous matter.
3.0 - 4.5	Brown plastic sandy clay with some white calcareous matter.
4.5 - 5.0	Brown plastic silty clay with some white matter as before.
5.0 - 5.5	Brown firm plastic sandy silt
5.5 - 6.0	Brown firm plastic sandy silt with some white matter as before.
6.0 - 6.5	Brown slightly plastic sandy silt with very slight amounts of white calcareous matter.
6.5 - 7.0	Light brown slightly plastic silt.
7.0 - 7.5	Light brown silty fine sand.
7.5 - 8.0	Light brown micaceous fine sand
8.0 - 10.0	Light brown micaceous fine to medium sand.
10.0 - 10.5	Light brown micaceous medium sand with some gravel size calcareous fraction.

Damazeen

B.H. No. (4)

Depth range in metres	Description
0.0 - 1.0	Dark grey very plastic hard clay
1.0 - 2.0	Dark grey very plastic hard clay with some white calcareous matter.
2.0 - 2.5	Greyish brown plastic hard clay with some white clacareous matter
2.5 - 3.0	Brown plastic hard sandy clay with some white calcareous matter.
3.0 - 4.5	Brown plastic sandy clay with some white calcareous matter.
4.5 - 5.0	Brown plastic silty clay with some white matter as before.
5.0 - 5.5	Brown firm plastic sandy silt.
5.5 - 6.0	Brown firm plastic sandy silt with some white matter as before.
6.0 - 6.5	Brown slightly plastic sandy silt with very slight amounts of white calcareous matter.
6.5 - 7.0	Light brown slightly plastic silt.
7.0 - 7.5	Light brown silty fine sand.
7.5 - 8.0	Light brown micaceous fine sand
8.0 - 10.0	Light brown micaceous fine to medium sand.
10.0 - 10.5	Light brown micaceous medium sand with some gravel size calcareous fraction.

Standard Penetration Test
Results

Damazeen

Depth Metres	S.P.T. Blows/ foot			
	B.H.(1)	B.H.(2)	B.H.(3)	B.H.(4)
1.0	20	17	20	19
2.0	31	22	28	28
3.0	30	24	27	29
4.0	35	29	31	32
5.0	42	37	>50	>50
6.0	>50	>50	>50	>50
7.0	50	33	48	>50
8.0	30	36	34	28
9.0	24	25	27	33
10.0	23	26	25	32
11.0	22	not taken	not taken	not taken
12.0	16	"	"	"
13.0	not taken	"	"	"
14.0	"	"	"	"
15.0	"	"	"	"

Kosti

Borehole No. (1)

Depth range in meters	Description
0 - 0.5	Dark sandy clayey silt
0.5 - 1.0	Brown compact sandy clayey silt
1.0 - 1.5	Yellowish brown decomposed sandstone
1.5 - 2.0	Yellowish brown decomposed sandstone with some white gypsite matter.
2.0 - 6.0	Yellowish brown decomposed sandstone in a mud cementing material with some white gypsite and calcareous matter.
6.0 - 8.0	Yellowish brown sandy mudstone with white gypsite and calcareous matter.
8.0 - 9.5	Yellowish brown muddy sandstone with white matter as above.
9.5 - 10.5	Yellowish brown sandy mudstone with white matter as above.
10.5 - 11.50	Yellowish brown mudstone.
11.5 - 12.0	Brown very plastic clay with some white matter as before.
12.0 - 12.5	Brown highly plastic clay.
12.5 - 13.0	Brown highly plastic clay with some white matter as before.
13.0 - 13.5	Brown hard plastic clay.
13.5 - 15.0	Dark brown hard plastic clay with some white matter as before.

Kosti

Borehole No. (2)

Depth range in meters	Description
0 - 0.5	Dark sandy clayey silt
0.5 - 1.0	Brown compact sandy clayey silt
1.0 - 1.5	Yellowish brown decomposed sandstone
1.5 - 2.0	Yellowish brown decomposed sandstone with some white gypsite matter.
2.0 - 6.0	Yellowish brown decomposed sandstone in a mud cementing material with some white gypsite and calcareous matter.
6.0 - 8.0	Yellowish brown sandy mudstone with white gypsite and calcareous matter.
8.0 - 9.5	Yellowish brown muddy sandstone with white matter as above.
9.5 - 10.0	Yellowish brown sandy mudtone with white matter as above.

Kosti

Borehole No. (3)

Depth range in metres	Description
0.0 - 0.5	Dark sandy clayey silt
0.5 - 1.0	Brown compact sandy clayey silt
1.0 - 1.5	Yellowish brown decomposed sandstone
1.5 - 2.0	Yellowish brown decomposed sandstone with some white gpysite matter.
2.0 - 6.0	Yellowish brown decomposed sandstone in a mud cementing material with some white gypsite and calcareous matter.
6.0 - 8.0	Yellowish brown sandy mudstone with white gypsite and calcareous matter.
8.0 - 9.5	Yellowish brown muddy sandstone with white matter as above.
9.5 - 10.0	Yellowish brown sandy mudstone with white matter as above.

Kosti

Borehole No. (4)

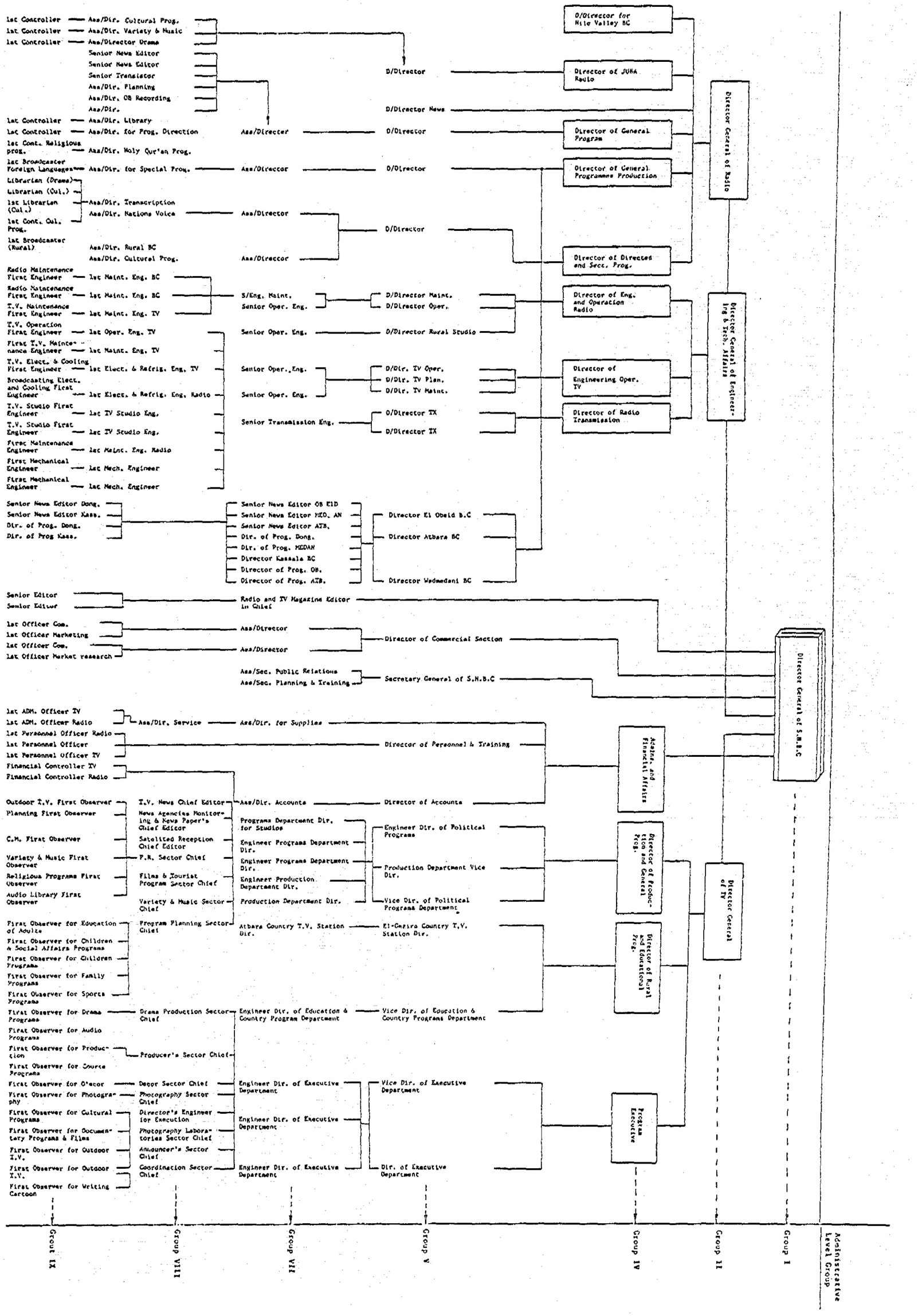
Depth range in meters.	Description
0.0 - 0.5	Dark sandy clayey silt
0.5 - 1.0	Brown compact sandy clayey silt
1.0 - 1.5	Yellowish brown decomposed sandstone
1.5 - 2.0	Yellowish brown decomposed sandstone with some white gypsite matter.
2.0 - 6.0	Yellowish brown decomposed sandstone in a mud cementing material with some white gypsite and calcareous matter.
6.0 - 8.0	yellowish brown sandy mudstone with white gypsite and calcareous matter.
8.0 - 9.5	Yellowish brown muddy sandstone with white matter as above.
9.5 - 10.0	Yellowish brown sandy mudstone with white matter as above.

Standard Penetration Test
Results

Kosti

Depth metres	S.P.T. Blows/foot B.H. No(1)	B.H. No.(2)	B.H. No. (3)	B.H. No.(4)
1.0	17	23	27	16
2.0	30	>50	>50	>50
3.0	>50	>50	>50	>50
4.0	>50	>50	>50	>50
5.0	>50	>50	>50	>50
6.0	>50	>50	>50	>50
7.0	>50	>50	>50	>50
8.0	>50	>50	>50	>50
9.0	>50	>50	>50	>50
10.0	not taken	>50	>50	>50
11.0	>50	not taken	not taken	not taken
12.0	not taken	"	"	"
13.0	46	"	"	"
14.0	not taken	"	"	"
15.0	>50	"	"	"

7. Organization Chart of SNBC



8. Transmission Schedule of SNBC Radio

SATURDAY		SUNDAY		MONDAY		TUESDAY		WEDNESDAY		THURSDAY		FRIDAY	
6:00	AM Opening	6:00	AM Opening	6:00	AM Opening	6:00	AM Opening	6:00	AM Opening	6:00	AM Opening	6:00	AM Opening
6:01	Qur'an Karim	6:01	Qur'an Karim	6:01	Qur'an Karim	6:01	Qur'an Karim	6:01	Qur'an Karim	6:01	Qur'an Karim	6:01	Qur'an Karim
6:15	Nafahaat Al Imaan	6:15	Nafahaat Al Imaan	6:15	Nafahaat Al Imaan	6:15	Nafahaat Al Imaan (Religious)	6:15	Nafahaat Al Imaan	6:15	Nafahaat Al Imaan	6:15	Nafahaat Al Imaan
6:30	News	6:30	News	6:30	News	6:30	News	6:30	News	6:30	News	6:30	News
6:45	From the Agenda	6:45	From the Agenda	6:40	From the Agenda	7:00	Good morning Sudan	7:00	Good morning Sudan	7:00	Good morning Sudan	7:00	Good morning Sudan
7:00	Good morning Sudan	7:00	Good morning Sudan	7:00	Good morning Sudan	7:30	News summary	7:30	News summary	7:30	News summary	8:00	News summary
7:30	News summary	7:30	News summary	7:30	News summary	7:35	Cont Good morning Sudan	7:35	Cont Good morning Sudan	7:35	Cont Good morning Sudan	8:05	Children's corner
7:35	Cont Good morning Sudan	7:35	Cont Good morning Sudan	7:35	Cont Good morning Sudan	8:00	Technical magazine	8:00	Songs	8:00	Selections	8:30	Words selection
8:00	Songs	8:00	Drama program	8:00	Universal country songs	8:30	Songs	8:45	Cultural magazine	8:30	Songs	9:00	Listener's choice
8:15	Songs and melodies	8:30	Lecture	8:30	Social affairs	8:45	Family doctor	8:45	Song	8:45	Nutrition program	10:00	News
8:45	Wednesday night (Varieties)	9:30	Literary workers of amateures	9:00	(Night) Cultural program	9:15	Sunday night varietie	9:00	Animal world	9:00	Variety magazine	10:15	Weekly lecture
9:30	The new literary amateurs	10:00	News	9:45	Songs	10:00	News	9:15	Varieties	9:45	Cooperation	11:15	Cultural review program
10:00	News	10:15	Friday panel discussion	10:00	News	10:15	Family program	10:00	News	10:00	News	11:45	Ancient songs program
10:15	Family affairs	10:45	Songs	10:15	Topic for discussion	10:45	Songs	10:15	Story our country	10:15	Songs	12:30	Religious talks
10:45	Local songs	11:00	Diplomatic passport (interview)	10:45	Popular songs	11:00	Cultural program	10:45	Local songs	10:45	Knowledge pioneer	12:45	Friday prayer
11:00	Lectures	11:45	Songs	11:00	Friday night party	11:30	Songs	11:15	African cultures	11:00	Years after	13:30	Chronicles of prophets
11:30	Speech selections	12:00	A.M. News	12:00	P.M. News	11:45	Agriculture program	11:45	Health magazine	11:45	Religious program	13:45	Good afternoon
12:00	P.M. News	12:10	Noon prayer call	12:00	Noon prayer call	12:00	P.M. News	12:00	News	12:00	News	14:30	Sports discussions
12:15	Drama series	12:15	Drama series	12:15	Drama series	12:10	Noon prayer call	12:10	Noon prayer call	12:10	Noon prayer call	15:00	News desk
12:30	Good afternoon	12:30	Good afternoon	12:30	Good afternoon	12:15	Play of the week	12:15	Drama series	12:15	Drama series	15:15	Radio conference
12:45	Montage selections	12:45	Digest from knowledge	12:45	The world of women	12:30	Good afternoon	12:30	Good afternoon	12:30	Good afternoon	16:00	(interview) Diplomatic passport
13:30	Music	13:00	Songs	13:00	Islamic magazine	12:45	Legal discussion	12:45	Songs	12:45	Listener's of the radio	16:45	Drama series
13:35	Soldiers request (music)	13:20	Educational issues	13:35	"Echo" Cultural program	13:00	Songs	13:00	Armed forces program	13:15	Songs	17:00	News
14:20	Sports round up	13:35	Listener's choice	14:00	Songs	13:20	Nutrition program	13:30	Listener's request	13:35	Composition	17:10	The world of women
15:00	News desk	14:20	Sports round up	14:20	Sports round up	13:35		14:20	Sports round up	14:20	Sports round up	17:30	Singer of the week
15:30	Songs	15:00	News desk	15:00	News desk	14:20	Sports round up	15:00	News desk	15:00	News desk	18:00	Islamic magazine
15:45	Public service	15:30	Songs	15:30	Songs	15:00	News desk	15:30	Songs	15:30	Songs	18:30	Lecture
16:00	Topic for discussion	15:45	Drama	15:45	Question from public	15:30	Listener's of the radio	15:45		15:45	Weekly discussion	18:45	Religious talks
16:30	Songs	16:00	Arts magazine	16:00	A story from our land	16:00	A story from our land	16:00		16:00	Dukan wad el bestir Drama series	16:00	(interview) Diplomatic passport
16:45	Drama series	16:30	(drama) Island of poetry	16:30	Songs	16:30	Songs	16:30	Songs	16:30	Songs	16:45	Drama series
17:00	News desk	16:40	Songs	16:45	Drama series	16:45	Drama series	16:45	Drama series	16:45	Drama series	17:00	News desk
17:15	Radio news reel	16:45	Drama series	17:00	News desk	17:00	News desk	17:00	News desk	17:00	News desk	17:10	The world of women
17:45	Universal country songs	17:00	News	17:15	Radio news reel	17:15	Radio news reel	17:15	Radio news reel	17:15	News country	17:30	The singer of the week
18:00	Family doctor	17:15	Radio report	17:30	Animal resources	17:30	Animal resources	17:30	Songs and poems	17:30	Cinema	18:00	Islamic magazine
18:30	Religious viewpoint	17:30	Medical advice	18:00	Cultural magazine	18:00	Cultural magazine	18:00		18:00	Lecture	18:30	Sacrifice to god
18:45	Qur'an Karim	17:45	Armed forces grogram	18:30	Religious viewpoint	18:30	Religious opinion	18:30	Religious opinion	18:30	From the light of the Qur'an	18:45	Evening recollections
19:00	News	18:30	Religious songs	18:45	Qur'an Karim	18:45	Religious songs	18:45	Religious songs	18:45	Religious songs	19:00	News
19:10	Evening magazine	18:45	Qur'an Karim	19:00	News	19:00	News	19:00	News	19:00	News	19:10	Evening magazine
19:30	Our Greenland	19:00	News	19:10	Evening magazine	19:10	Evening magazine	19:10	Evening magazine	19:10	Evening magazine	19:30	Weekly talks
19:45	Songs	19:10	Evening magazine	19:30	Family affairs	19:30	Our Greenland	19:30	Songs	19:30	Family program	20:00	Local news
20:00	Home news	19:30	Agricultural program	20:00	Local news	19:40	Songs	19:45	Cooperation	20:00	Local news	20:30	Round the sudan
20:15	Legal questions	19:45	Cooperation program	20:15	The animal world	20:00	Local news	20:00	Local news	20:15	Digest from knowledge	21:15	From the Arab dictionary
20:30	Program exchange	20:00	Home news	20:30	African literature	20:15	Workers program	20:15	Songs	20:45	Songs	21:30	News
21:00	Songs	20:15	Cultural club	21:00	Songs	20:30	Religious songs	20:30	To the microphone	21:15	From the Arab dictionary	21:45	World events
21:15	From the Arab dictionary	20:45	Songs	21:15	From the Arab dictionary	21:00	Songs	21:00	Songs	21:30	News	22:00	Night drama
21:30	News	21:15	From the Arab dictionary	21:30	News	21:30	News	21:15	From the Arab dictionary	21:45	Sudan this week	22:30	Friday variety
21:45	Educational issues	21:30	News	21:45	International press review	21:45	Islamic magazine	21:30	News	22:00	Expatriates program	23:30	News headline
22:00	Social Affairs	21:45	Arab world magazine	22:00	Interview	22:00	Songs	21:45	African affairs magazine	22:30	News headline	23:45	Night varieties
22:30	Songs	22:00	Old and new varieties	22:45	Variety program	22:15		22:00	Montage	23:45	Night varieties	23:50	Contemplations
22:45	Cultural night program	22:45	Night varieties	23:30	News	22:45	Variety magazine	22:45	Wednesday variety	23:50	Contemplations	23:55	Qur'an Karim
23:30	News	23:30	News	23:45	Poetry	23:30	News headline	23:55	News headline	23:55	Qur'an Karim	24:00	Close down
23:45	Poetry (Romantic)	23:45	Poetry (Romantic)	23:50	Religious contemplations	23:45	Night variety	23:45	Night variety	24:00	Close down		
23:50	Religious contemplations	23:50	Religious contemplations	23:55	Qur'an Karim	23:50	Spiritual thought	23:50	Spiritual thought				
23:55	Qur'an Karim	23:55	Qur'an Karim	24:00	Close down	23:55	Qur'an Karim	23:55	Qur'an Karim				
24:00	Close down	24:00	Close down			24:00	Close down	24:00	Close down				

9. Transmission Schedule of SNBC Television

DAY / TIME	SAT.	SUN.	MON.	TUES.	WED.	THURS.	FRI.
10:00							OPENING AND KORA'AN
:10							FRIDAY'S TALK MEETING
11:00							CHILDREN PARADISE
12:00							FAMILY MAGAZINE
:40							
13:00							KORA'AN EXPLAINING
14:00							STOPPING FOR FRIDAY'S PRAYER
15:00							SPORTS TIME
16:00							
17:00	OPENING AND KURA'AN						
:15	DAILY RELIGION PROGRAM						SPOTS TIME
:20	SUNSET PLAYERS CALL TIME						
:35	CHILDREN DRAMA SERIES	OUR BEAUTIFUL LETTER	CHILDREN DRAMA SERIES	CHILDREN'S PARADISE	CHILDREN DRAMA SERIES		
18:00	EVENING NEWS						
:10	UNDER THE MICRO SCOPE	SUNDAY MEETING	OUR ARMY	SPOT LIGHT	ANIMAL WORLD	CULTURE HORIZONS	ECONOMICS
:15							
:25	WORLD OF SCIENCE						DRAMA PROGRAM
:40	EVENING PLAYERS						
19:00	FIRST NEWS TIME LOCAL NEWS BULLETIN & ENG. BULLETIN						
:20	EMERGENCY	SONG LAW PROBLEM	AGRICULTURE & SCIENCE	VOICES & FINGERS	MY COUNTRY	DEAR VIEWER	YOUR LIFE
:50	COMMERCIAL						
20:00	ARABIC DAILY DRAMA SERIES						
:55	COMMERCIAL						
21:00	SECOND EVENING NEWS. MAIN NEWS BULLETIN						
22:00	KING IN THE FIELD	FOREIGN FILM	ASIAN EXIPITION IN FRENCH	SUADNESE DRAMA	NEWS IN OUR LIFE	THIS EVENING	CINEMA
			ART PROGRAM				
23:00			TV NET WORK	ARVIC DRAMA	FOREIGN DRAMA SERIES		
:30	CLOSE DOWN						

SUDAN T.V. PROGRAMME