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

MARCH, 1988

JAPAN INTERNATIONAL COOPERATION AGENCY

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PREFACE

In response to the request of the Government of the Republic of the Sudan, the Government of Japan has decided to conduct a Basic Design Study on the Project for the Expansion of Rural Radio Broadcasting Network and entrusted the study to the Japan International Cooperation Agency (JICA). JICA sent to Sudan a study team headed by Mr. Satoru Ito, Special Advisor, International Cooperation Division, Communications Policy Bureau, Ministry of Posts and Telecommunications, from November 21 to December 25, 1987.

The team had discussions on the Project with the officials concerned of the Government of Sudan, and conducted a field survey in the Project areas. After the team returned to Japan, further studies were made, a draft report was prepared and a mission to explain and discuss it was dispatched to Sudan. As a result, the present report has been prepared.

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

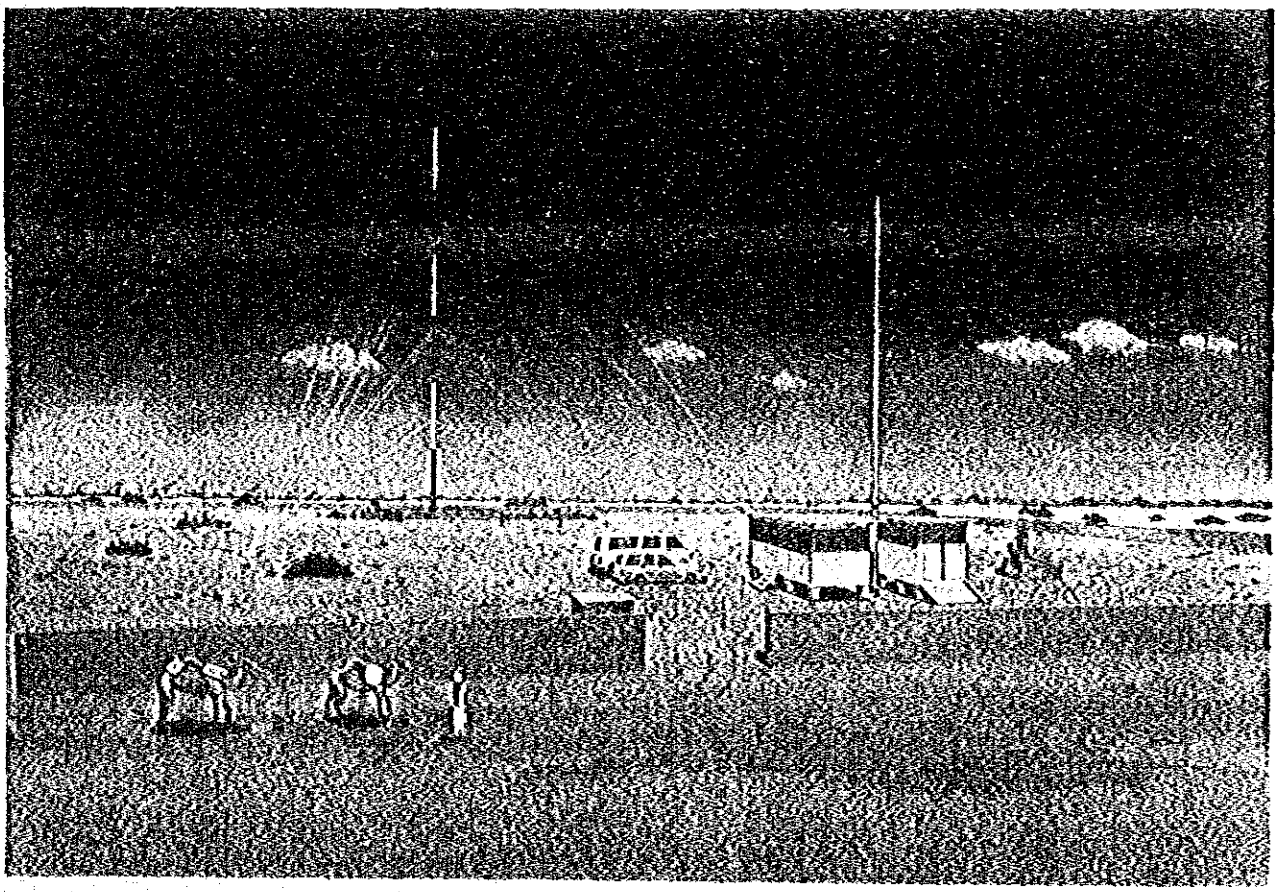
I wish to express my deep appreciation to the officials concerned of the Government of the Republic of the Sudan for the close cooperation extended to the team.

March, 1988

Kensuke Yanagiya

Kensuke Yanagiya
President
Japan International Cooperation Agency

			avoiding the rainy season.	



PERSPECTIVE
OF
NEW RADIO TRANSMITTING STATION
(PORT SUDAN, WADI HALFA, EL FASHER, KOSTI)

SUMMARY

SUMMARY

The Government of Sudan has been making massive efforts for the national development ever since independence. Despite various difficulties including the economic recession in recent years, mainly caused by droughts, the Government of Sudan is endeavoring to upgrade the living standard of the rural population and develop regional societies through improvement of their infrastructures and the promotion of education.

As an effective way to attain the above-mentioned goals, the Government planned to utilize radio broadcasts for disseminating various kinds of information regarding the people's daily lives, agriculture and livestock breeding, education, health and hygiene, etc. A new Four Year Plan was drawn up in 1983 with an aim to expand the medium wave and shortwave radio broadcasting network and improve facilities of the Sudan National Broadcasting Corporation (SNBC). The Government of Sudan requested grant aid from the Government of Japan for implementation of the Four Year Plan.

In response to the request the first year plan (Phase 1) which constructed 5 kW medium wave radio transmitting stations at five locations, namely, El Obeid, Wad Medani, Atbara, Kassala and Dongola was implemented with Japanese grant aid in fiscal 1984. Phase 1 was completed in February 1986. Along with the services of the already established stations (in Soba, Arda, Sennar, Juba and Nyala), the population coverage of the broadcasting network has reached 50%.

The five stations constructed under Phase 1 have been well maintained and successfully operated, contributing greatly to prompt dissemination of information from the central cities. They also serve to provide the people, through about three hours of local programmes, with information useful in their everyday lives and knowledge on agriculture and other fields particularly relevant to each locality. The programmes often provoke a great response from listeners.

The number of radio sets distributed throughout Sudan amounts to as many as four million. Nevertheless, half of the nation's population

is still unable to listen to domestic radio programmes because of the insufficient area served by the limited number of broadcasting stations, and relies on foreign radio broadcasts for information and entertainment.

In view of the above circumstances and with the understanding that radio broadcasts will greatly serve the nation's development as an effective form of mass media, the Government of Sudan decided to proceed with the expansion of its radio broadcasting network and endorsed this as a top priority project for national development. A plan for constructing 10 kW medium wave radio transmitting stations at Port Sudan, Ed Damazin, Wadi Halfa, El Fasher and Kosti was drawn up as Phase 2 (the second year plan of the said Four Year Plan). A request for grant aid was subsequently extended to the Government of Japan.

In response to the request from the Government of Sudan, the Government of Japan decided to conduct a Basic Design Study on the Project for Expansion of Rural Radio Broadcasting Network and the Japan International Cooperation Agency (JICA) executed the said Basic Design Study.

Of the five transmitting stations requested, both governments agreed to exclude Ed Damazin from the scope of the Project due to the unstable security conditions in the town. As a result of the study of the remaining four proposed sites, it was decided to construct a 10 kW transmitting station at each of the four locations. The Project aims to increase the population coverage from 50% to 59%. In other words about 1.8 million people will benefit from the Project.

The outline of the facilities to be constructed under Phase 2 is as follows. A 10 kW medium wave radio transmitter with a 100 m high transmitting antenna will be installed at each project site. All the four stations will be constructed on land which has already been secured by SNBC.

As for each studio facility, the equipment required for programme production and transmission control will be supplied in a studio (about 50 m^2) and an attached control room which will be provided by SNBC along with the studio building.

From these production facilities, programmes will be broadcast by switching as necessary from nationwide programmes received from SNBC Omdurman to local production programmes and vice versa.

The outline of the principal facilities and equipment of each broadcasting station is shown in the following table.

Item	Principal Facilities and Equipment
1. Transmitting station	
Transmitter	- 10 kW set with changeover system
Power supply	- Power distribution facility
	- Engine generator (Diesel engine generator 90 kVA 415 V 3 P)
Transmitting Antenna	- Omnidirectional Antenna
	- Cylindrical mast of guyed type
Station building	- Shelter type
2. Studio	
Programme production facilities	- Audio mixing equipment
	- Programme production and transmission control equipment
3. Maintenance center	- Spare units, spare parts
	Measuring equipment

The project cost to be borne by the Government of Sudan is estimated at ₤S787,000. Project implementation will take 4.5 months from detailed design after signing of the Exchange of Notes by both governments to completion of tender procedures and 14 months for construction work.

SNBC is responsible for implementing the Project. SNBC has proved its capability in the implementation and operation of Phase 1. All the expenses to be borne by the Sudanese side will be defrayed out of the national treasury; therefore no problem is anticipated in this regard. Furthermore SNBC also has adequate experience in maintenance and

operation of the facilities. Hence no problem is anticipated with regard to the technical skills of maintenance personnel and the qualifications of programme production personnel. Operation of broadcasting stations, however, requires highly specialized knowledge and skills. The Government of Sudan should make continuous efforts to improve technology and programme production skills of those staff concerned with radio broadcasting, in order to secure further expansion of broadcasting services and to upgrade programme quality.

The objectives of Phase 2 are: 1) to expand the radio broadcasting network, which is the most effective form of mass media in Sudan, so as to serve an additional 1.8 million people, and 2) to benefit the people's lives and facilitate development of local societies through improved local radio programmes.

With completion of the Project, inhabitants of the expanded service areas will be able to receive information from central cities and various kinds of local information more promptly. The Project is thus expected to contribute greatly to the upgrading of the people's living standards, socioeconomic development and the strengthening of the unity of the nation.

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CHAPTER 1

INTRODUCTION

CHAPTER 1 INTRODUCTION

The Republic of the Sudan has the largest territory of any country in Africa; the area covers about 2.5 million km^2, accounting for 8% of the African continent. The country has a population of 21,550 thousand as of the middle of 1985. Its geography and climate, together with its racially variety, have caused great diversity in the living conditions of the people.

Sudan is an agricultural country where 80% of the population are engaged in farming. It has the potential to produce sufficient food to become a storehouse of food for other African countries, depending on the development of its agricultural technology in the future. It also has various mineral resources including on shore oil reserves.

In spite of the continuous efforts of the Government of Sudan in developing the nation, the situation still requires further acceleration in social and economic development and improvement of people's living standard. This state is attributable to insufficient infrastructure reflected in such sectors as transportation and communications, the delayed spread of education causing a high rate of adult illiteracy, as well as recent economic difficulties.

Radio broadcasting is one of the most effective forms of mass media because it can transmit necessary information instantly, simultaneously, and economically over a broad area. Sudan National Broadcasting Corporation (SNBC), the sole broadcasting organization in Sudan, has been contributing to the improvement of culture and the promotion of education in Sudan especially through its radio broadcasts. However, the coverage of the radio network is still poor, and its limited number of facilities cannot effect sufficient service over the whole country.

In order to improve the living standard of its people and develop the social structure in rural areas by conveying various information dealing with such matters as farming and stock-farming, education, health and hygiene, etc., the Government of Sudan established a new Four Year Plan (1984/85---1987/88) aiming at the improvement of the radio broadcasting network and upgrading superannuated equipment, and

requested financial assistance in the form of grant aid from the Japanese Government.

Requirements submitted at the initial stage were as follows:

(1) First year plan (Phase 1)
Construction of five 5 kW medium wave radio transmitting stations

(2) Second year plan (Phase 2)
Construction of five 10 kW medium wave radio transmitting stations

(3) Third year plan (Phase 3)
Construction of a 300 kW shortwave transmitting station

(4) Fourth year plan (Phase 4)
Rehabilitation of studio facilities, and
Expansion of rural medium wave radio transmitting stations

In response to the request, the Japanese Government extended grant aid in 1984 for the first year plan (Phase 1) of the four-year plan, and the construction of five 5 kW medium wave radio transmitting stations was completed in February 1986. The population coverage ratio of radio broadcasting was improved from 38% to about 50%, making it possible to convey information from the central cities much more speedily and to furnish people with information on living and agriculture useful to each community. The construction of the five radio transmitting stations has contributed to communications, the spread of education and culture, and agricultural development.

The fact is, however, that nearly half of the people cannot yet receive the radio broadcasts of their own country. The Government of Sudan requested assistance from the Japanese Government in building five 10 kW medium wave radio transmitting stations as Phase 2.

The Japanese Government decided to execute a Basic Design Study for Phase 2. The Japan International Cooperation Agency (JICA) dispatched a Basic Design Study team to Sudan from 21 November to 25 December 1987. The team was headed by Mr. Satoru Ito, Special Advisor, International Cooperation Division, Communications Policy Bureau, the Ministry of Posts and Telecommunications.

The team conducted a survey in the capital, Khartoum on general conditions in Sudan and the state of SNBC, and had discussions with the Sudanese officials concerned. The team conducted a survey at the proposed project sites in four cities, namely Port Sudan, Wadi Halfa, El Fasher, and Kosti. The proposed project site in Ed Damazin was not surveyed by mutual agreement between the Governments of Sudan and Japan because public peace is not maintained in the city. The site will not be included in the Phase 2.

The items fundamentally agreed upon by the Study Team and the officials concerned of Sudan were compiled into minutes, which were signed by the representatives of both parties.

After the Study Team returned to Japan, the Project was analyzed based on the results of the survey, its appropriateness for grant aid was confirmed, and concurrently the basic design, rough estimate of construction expenses, execution plan, project evaluation and recommendations were collected under one report, the Basic Design Study Report. In order to discuss the report with the Sudanese officials concerned, the Study Team headed by Mr. Satoru Ito of the Ministry of Posts and Telecommunications was dispatched again to Sudan during the period from March 8 to 17, 1988. After the discussions, the fundamental items confirmed by both sides were compiled in the minutes which were signed by the respective parties. The present report has been drawn up based on the results of the process described above.

CHAPTER 2

BACKGROUND OF THE PROJECT

CHAPTER 2 BACKGROUND OF THE PROJECT

2-1 Situation of the Project

The Republic of the Sudan has the largest territory on the African continent, with a population of 21.55 million. Sudan is an agricultural country where 80% of the population is engaged in farming. The country has 7.8 million ha of potential farmland. However, in most of its rural areas, the people are engaged in traditional self-subsistent farming, with a variety of ways of life according to the geographical locations, climatic conditions, racial and religious variations, etc.

In these circumstances, the Government of Sudan is carrying out its four year economic salvation programme which began in July of 1987. This programme gives the first priority to rehabilitation of the agriculture and industry of the country.

The programme also aims at establishment of a system that can meet the needs of the people and contribute to improvement of the social infrastructure that is so important for the country. The target growth rate for GDP is 5%.

As an effective way to attain the above-mentioned goals, the Government has set the top priority on utilizing radio broadcasts which are an excellent form of mass media for disseminating various kinds of information for improving the productivity of agriculture and consequently establishing an economic foundation.

The Government also plans to improve the people's living standard and promote regional development in rural areas by disseminating various information closely related to the respective communities through radio programmes dealing with local news and social information, health and sanitation, education for women and children, etc.

To improve coverage of areas insufficiently served by its limited number of broadcasting stations, the Government constructed five stations under Phase 1 with grant aid from Japan. The stations have been well maintained and successfully operated.

Based on the result of the Phase 1 stations, the objective of this Project is to effect similar results by further expansion of the radio broadcasting network in rural areas in Sudan.

2-1-1 Present State of the Mass Media in Sudan and its Role

As for the printing media, about 20 newspapers are published now; they include daily papers, biweekly papers, and weekly papers. There are several weekly and monthly magazines. Some of them are mentioned below.

Al-Ayam	Arabic, daily
Al-Sahafa	Arabic, daily
Sudan News Agency (SUNA)	Arabic, English, daily
Sudan Times	English, daily
Sudanow	English, monthly
Al.Izaa Wal Television wal Masrah	Arabic, weekly, a magazine on broadcasting and theater

Circulation is estimated at about 60,000 each for the first two dailies, 40,000 for Al.Izaa, and less than 10,000 for the others. The greatest problem is the imperfect means of transportation, especially by air, in sending those publications to cities throughout the country.

There are also other small-scale papers published in main cities. Some of the regional governments publish a bulletin to furnish residents with information through the news gathering base of SUNA (Sudan News Agency under the control of the Ministry of Information and Culture).

SNBC carries out radio and television broadcasting under the control of the Ministry of Information and Culture. It broadcasts radio programmes 18 hours a day, and television programmes 6.5 hours a day, on the national network from its studios in Omdurman.

Unlike printed matter, broadcasting is an excellent medium in that it can send sound information or audio-visual information, by means of radio wave, to a large number of receivers over an extensive area

instantly, simultaneously, and economically. The characteristics of radio wave require a number of transmitting stations in expanding the service area, but broadcasting has established itself in most countries as a mass medium inseparable from human life.

Television broadcasting is carried out in 24 cities in Sudan through ground microwave networks and domestic satellite networks. The number of television sets is about 110 thousand units according to the 1982 UN statistics. This low spread rate is attributable to the high price of television sets considering the low national income, and to the fact that television sets can be used only in cities where commercial power sources are available.

To listen to the radio, people can get cell-powered transistor radios at a comparatively low price. There are about 4 million radios spread throughout the country, according to a survey by SNBC. Radio broadcasting services are now extended from ten medium wave transmitting stations in the country. But the population coverage is only about 50%, and the remaining people must receive radio broadcasts from other countries.

Medium wave for radio broadcasting and VHF wave for television and FM broadcasting offer stable service. But their characteristics limit service area to a certain range around a transmitting station. This limitation makes it possible to serve only its own service area with carefully produced local programmes relevant to the communities.

Short wave broadcasting can offer service over a broad area, though it is a little unstable in quality. In Sudan, such broadcasting is not carried out because of the overage facilities.

Sudan has been improving the radio and the television broadcasting network, with effective results in speedier communication of news and information in the spread of education and culture, and in offering information on everyday life. The network, however, is not yet sufficient in either quality or quantity. Above all, it is necessary to accelerate construction of the radio broadcasting network which is more economical and effective as mass media, in due order of priority.

2-1-2 Spread of Radios

The Study Team could not obtain accurate statistical data on efforts to spread radios, but the number of radios is estimated at about 4 million in the whole country.

1) Radio and television sets are all imports in Sudan. There are no sets of domestic make. The Annual Report by the Bank of Sudan has statistics on the total value of imported radios, television sets, and video recorders, but how many were imported is not known. The imports are valued at LS610 thousand for 1985, and LS2,118 thousand for 1986.

2) According to the 1983/84 Statistical Yearbook published by the UN Statistics Bureau, the number of radios in the country is as follows.

1975	1,150 thousand
1980	1,380 thousand
1982	1,450 thousand

The UNESCO Statistical Yearbook estimates the number as follows.

1983	5,000 thousand

3) SNBC estimates the number of radios at not less than 4 million in the whole country, based on its survey.

4) At electric appliance stores in Sudan, medium wave receivers made by the NICs are sold at LS80 to 130, medium wave and shortwave receivers of Japanese make are sold at LS400, and all-band radio cassettes are sold at LS655 to 880. Retail shops could not say how many were sold, but said even expensive radio cassettes were good sellers.

Presumably people can buy items around 100 Sudan pounds if they want to, judging from the national income level. A good number of people who had been abroad seems to have brought those products from abroad. It is said that barter markets and black markets are

established in the country. Those which do not appear in statistical data would amount to a considerable value.

5) During the site inspection for the present project, the team heard many persons who were responsible for the Project say most households have a radio now. The number is estimated at not less than 400 million as of the end of 1986.

6) There are no data on the number of households, but it is estimated at 3 million to 3.5 million based on the ILO survey (According to the ILO 1974 Socioeconomic Survey, one household has 5.9 family members on the average in cities). One household is supposed to have more than one receiver on the average.

2-2 Present State of Broadcasting in Sudan

2-2-1 Brief History of Broadcasting in Sudan and the Organization of SNBC

(1) Brief history and present state of broadcasting in Sudan

In the Republic of the Sudan, radio broadcasting was commenced in 1940, when the country was ruled under the Anglo-Egyptian Condominium. Broadcasting was carried out 30 minutes a day in a small room in the premises of the old post office of Omdurman. The broadcasting, though small in scale, was gradually expanded from World War II until the independence of Sudan, and permeated among the people.

In 1954 Arda Transmitting Station was opened in Omdurman, and began broadcasting with a 50 kW transmitter. The service area was thereby considerably widened.

In 1962 Soba Transmitting Station was built on a site 20 km south of Khartoum. It began broadcasting with two 100 kW medium wave transmitters and two 50 kW shortwave transmitters.

In 1957, four studios were built at the Omdurman Broadcasting Station. More studios were constructed from 1976 to 1977. The

broadcasting station now has 13 production and continuity studios of several sizes.

Broadcasting hours were 10 hours a day in 1956 when the country became independent; and 18 hours a day in 1962 (from six in the morning to twelve midnight).

In Khartoum and its vicinities, broadcasts included the People's Broadcasting Service, the Holy Koran Service, and the Voice of the Sudanese Nations on one programme channel, and general programmes on the other, when the survey for Phase 1 was carried out in 1984. The first three programmes are not put on the air because of the overage transmitter and spare parts shortage. Now programming is limited to the general programmes.

The shortwave transmitters of Soba Transmitting Station are not used on account of old age. There only remains the structure including an antenna tower.

Local broadcasting stations are located in Sennar, Juba, and Nyala. The completion of Phase 1 opened five broadcasting stations in El Obeid, Wad Medani, Atbara, Kassala, and Dongola in February 1986. Each station produces local programmes, though the scale differs among the stations. They communicate local information and furnish people with programmes on education and culture through programmes of their own production for more than three hours a day, in addition to the general programmes relayed from the central Omdurman Radio Station.

Television broadcasting was commenced in 1963 with technical cooperation from Germany. Two TV studios, one is large and the other is small, were built at the site adjacent to the radio studios of the Omdurman Broadcasting Station. A 5 kW transmitter sends television broadcasts on the air in Khartoum and its vicinity. The programmes are relayed at 24 cities in the country through ground microwave networks and domestic satellite networks (SUDOSAT) operated by the Sudan Telecommunications Corporation (STC). Broadcasting is from 17:00 (from 10:10 on Fridays) to 23: 30. The PAL-B system has been adopted.

(2) Organization of SNBC

SNBC is the sole broadcasting organization that carries out broadcasting in Sudan in compliance with the SNBC Act of 1981 (revised in 1986). Under the direct control of the Minister of Information and Culture, it is a corporation independent of the other departments and bureaus of the Ministry.

The organization of SNBC has, under the Director General, directors general of radio, television, and engineering and technical affairs, and a director of administration and financial affairs. The supreme organ is the Managing Council. It consists of the Chairman (now the Minister of Information and Culture holds the post), the Director General of SNBC, the Vice-Ministers of Information and Culture, and Finance and Economic Planning, and representatives of telecommunications, banking, culture, art, education, religion, and employed people. Comprising more than 20 members, the council has a meeting every three months. The post of the Director General is vacant at present; important matters are submitted for the Minister's approval.

SNBC has about 1,500 personnel in the whole country. A post level classification system has been adopted; staff members are divided into 18 levels, and laborers into nine levels. Each class has an annual fixed salary.

SNBC has local organizations in El Obeid, Atbara, Wad Medani, Dongola, Kassala Nyala, and Juba, each of which has its respective radio studio.

Television transmissions of the local stations except for Atbara and Wad Medani are operated by STC. In cities that do not have an SNBC local organization, the information and culture department of the local administration is in charge of news gathering and programme production. Some of those cities have full-scale studios from which two or three recorded tapes a week are sent to Omdurman or neighboring stations for broadcasting.

For four of the projected transmitting stations of Phase 2, SNBC is going to build studios and station the necessary number of personnel (a radio studio has already been completed in El Fasher).

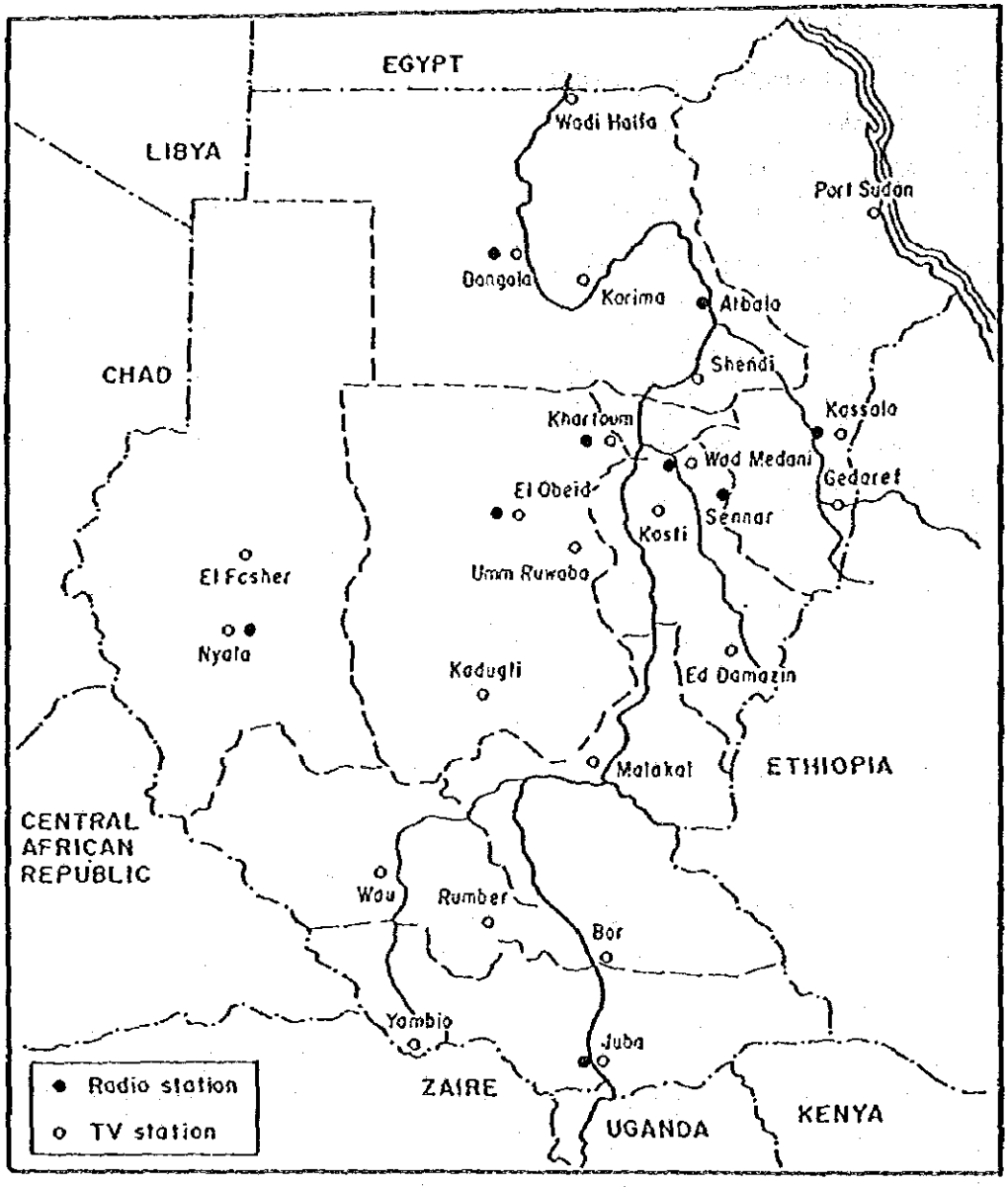

Fig. 2-2-1 Location of Radio and Television Broadcasting Stations

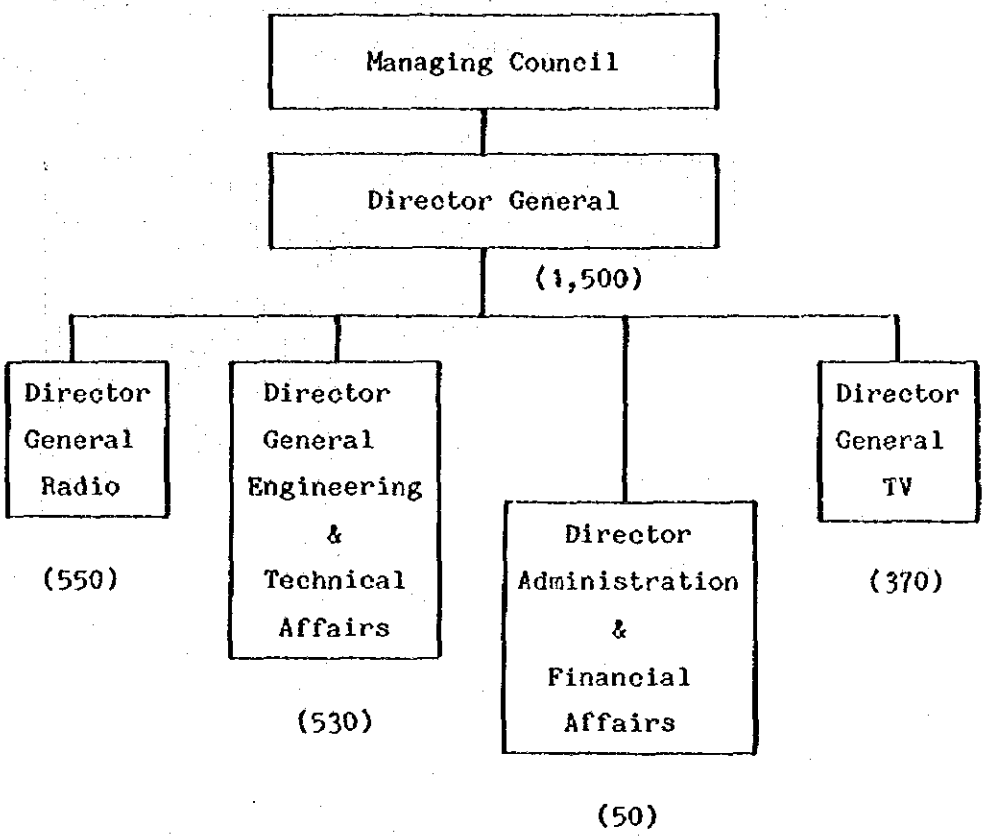

Fig. 2-2-2 SNBC Organization
Figures in the parentheses are round numbers.
For details of the Organization, see the Appendices

2-2-2 Broadcasting Programmes

As already referred to, general radio programmes are put on the air 18 hours a day from the ten stations located in the capital Khartoum (Soba and Arda Transmitting Stations), Sennar, Juba, Nyala, El Obeid, Wad Madani, Atbara, Kassala, and Dongola.

FM broadcasting, which was being carried out on an experimental basis, has been discontinued because of transmitter trouble.

The percentage of broadcasting hours is shown in the following table. The programming pays attention to news, education and culture, religion, and entertainment. For details of programmes, see the Appendices 8.

Table 2-2-1 Percentage of radio broadcasting hours by programme contents

Programme Category	%
News	17.6
Talk	8.9
Education	12.7
Programmes for Women	4.2
Programmes for Children	1.7
Religion	8.5
Music	17.0
Sports	6.6
Entertainment	17.8
Commercial	2.0
Special Event	3.0
Total	100.0

Local broadcasting stations produce local programmes of their own. For example, Wad Medani Station puts on the air programmes of its own production from 5:00 to 6:30, and from 16:00 to 19:00. They consist of a variety of topics closely related to the region, such as education, health and hygiene, news, voice of listeners, etc. They are beyond the scope of the general broadcasts from the central station, and have received great public response.

Television broadcasts are put on the air six and a half hours a day (13 hours and 20 minutes on Friday which is a holiday). The percentage of broadcasting hours is shown in the following table. For details of programmes, see the Appendices 9.

In addition to news, religious programmes, and educational programmes, imported movies are put on the air as entertainment programmes. Local programmes are produced at Atbara Station and Wad Medani Station.

Table 2-2-2 Percentage of television broadcasting hours by programme contents

Programme Category	%
News	22.8
Education	6.5
Programmes for Women	2.7
Programmes for Children	4.3
Religion	9.2
Sports	4.3
Entertainment	48.0
Commercial	2.2
Total	100.0

2-2-3 Radio broadcasting facilities and network

Radio broadcasts are produced in SNBC Omdurman. Local broadcasting stations produce local programmes at their studios.

The production and continuity facilities of SNBC Omdurman are as follows.

Small production studio	4
Large production studio	5
Continuity studio	4

The floor layout is shown in Fig. 2-2-3.

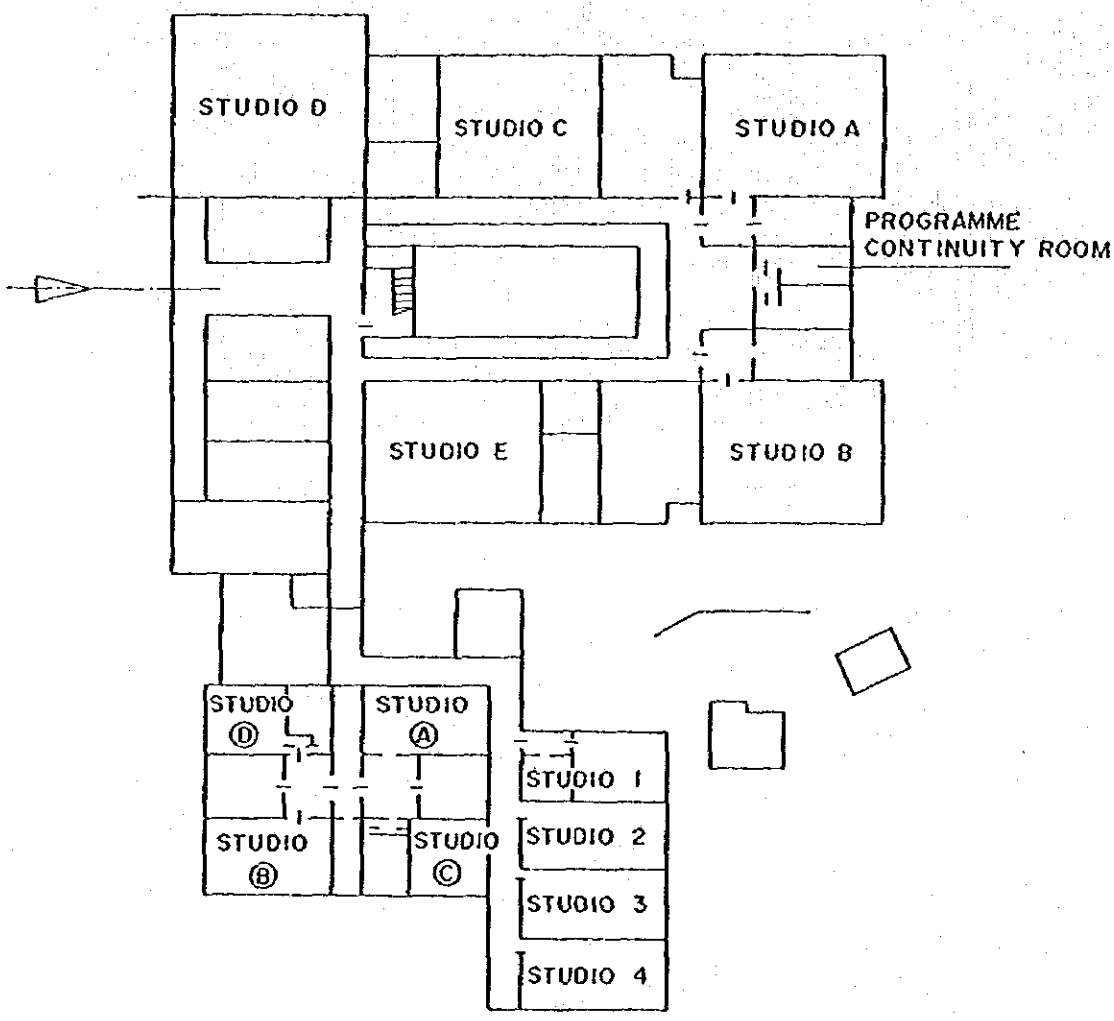

Fig. 2-2-3 Floor layout of SNBC Omdurman

The large studios are not used now because of the overage equipment, except Studio A.

The local stations of Juba, Wad Medani, Kassala, El Obeid, Atbara, Dongola, and Nyala each have one small studio and one control room. The control room is equipped with an audio console, tape recorders, and

monitor speakers. Recording, editing, and sending of programmes can be carried out there.

In El Fasher, the regional information and culture department has a radio studio. 15 to 30 minute radio programmes of local news, agriculture, special events, and so on are produced there three times a week. They are sent to the Nyala Station and put on the air during local broadcasting hours. Radio wave from Nyala, however, are too weak to be received in El Fasher.

The nationwide radio broadcasting network is shown in Table 2-2-3. In the metropolitan area, general programmes are transmitted from Soba and Arda Station sharing the broadcasting hours according to the transmission schedule, because of the overage equipment and spare parts shortage. Sennar Transmitting Station is equipped with two 750 kW transmitters made by Tesla of Czechoslovakia. But one is out of order, and broadcasting is carried out with reduced power, on account of the parts shortage and insufficient electric power.

Population coverage is 50% at present.

Soba Transmitting Station was equipped with two 100 kW shortwave transmitters; they are not being used on account of old age, but the antenna tower is left.

SNBC considers it efficient to use shortwave, though it is perhaps disadvantageous in quality and local service, in order to extend broadcasting services to the remote areas of Sudan left unserved by the medium wave radio network. From this point of view, the Government of Sudan plans to build a shortwave transmitting station in the near future.

The Government gives the first priority to extending its broadcasting service to the South and the West of Sudan, and second priority to extending service to Sudanese people living in the gulf countries, neighboring countries and Europe.

Table 2-2-3 Radio broadcasting facilities of SNBC

Station	Frequency (kHz)	Output power (kW) (Nominal)	Remarks (Manufacturer)
Soba	576	100	Harris
	963	100	Harris/Gates
Arda	765	50	Harris
	567	50	Marconi
Senner	1296	750	Tesla
Juba	693	100	Harris
Nyara	540	25	Tesla
Atbara	783	5	NEC
Wad Medani	873	5	NEC
Kassala	666	5	NEC
El Obeid	639	5	NEC
Dongola	819	5	NEC

Nationwide broadcasting programmes are transmitted from SNBC Omdurman to each station through the microwave networks and domestic satellite networks (SUDOSAT) of STC.

Fig. 2-2-4 shows nationwide radio networks.

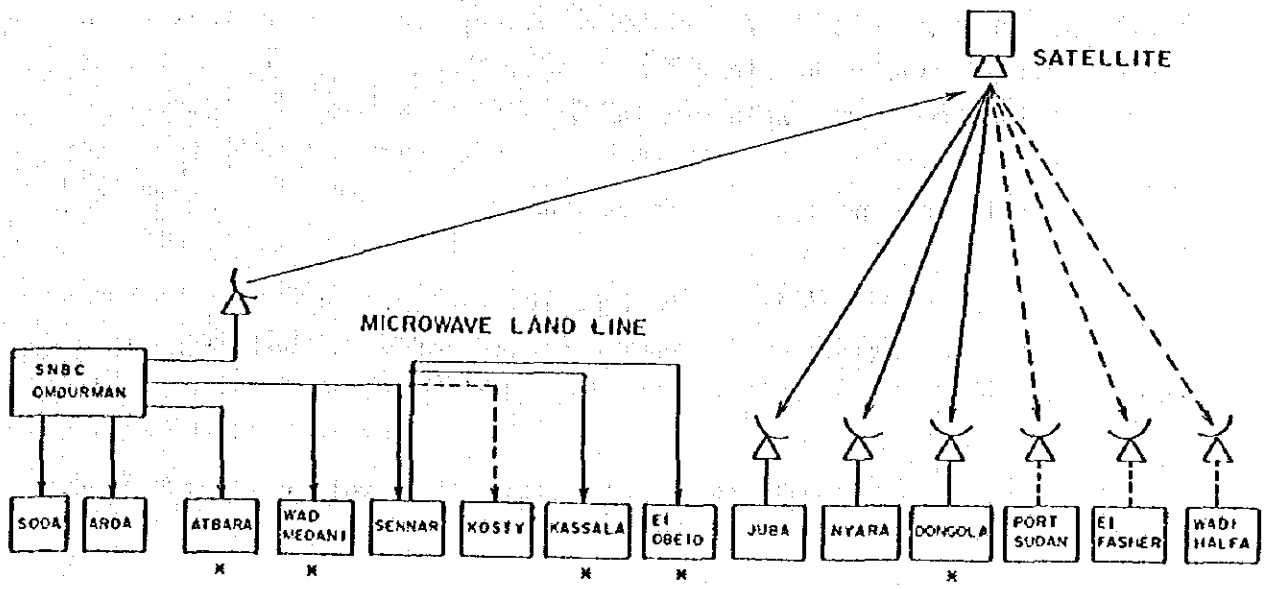

Fig. 2-2-4 Nationwide radio networks of SNBC

2-2-4 Budget and Operational Expenses of SNBC

Radio and television fees are not charged in Sudan. An SNBC budget is entirely defrayed out of the national treasury. The budget year begins on July 1 and ends on June 30 of the next year. The corporation makes a budget and submits it to the Ministry of Finance and Economic Planning for approval.

The total budget for the 87/88 budget year is £S32 million, of which £S8.8 million is for wages, £S2.85 million is for radio programme production, £S4.2 million is for television programme production, £S3 million is for engineering and technical affairs and £S12 million is for running of the STC networks and transmitting.

Expenses for programmes of local radio broadcasting amount to about £S0.2 million for each station.

The £S3 million for engineering and technical affairs includes expenses for spare parts, electric power, fuel, and general and administrative expenses for the radio stations, the television stations, and the local radio stations.

2-2-5 Recruitment and training of personnel

Sudan has the 6-3-3 educational system, and colleges and universities for higher education. A variety of vocational schools are also established.

SNBC technical staff is divided into four categories as listed below.

(1) University graduates or equivalents
(2) Polytechnic graduates
(3) Technical institution graduates
(4) Technical operators

Each category has a job description specified by the nature of the post and qualification requirements. Recruitment of technical personnel needs to comply with the Government regulations. The Employment Committee of the Government's Civil Service Department is entrusted with the employment of persons who have graduated from a university or a polytechnic. In selecting applicants for such recruitment, representatives of SNBC take part. SNBC can employ personnel mentioned in (3) and (4) above within its discretion.

Personnel training is normally carried out through OJT. Training in domestic and foreign training institutions is arranged and conducted by the Civil Service Department of the Government; such training includes training under technical cooperation.

SNBC plans to give training with cooperation from the Telecommunications Training Center of STC, and the Mass Media Training

Center. The latter is a training institution established with the cooperation of Germany for broadcasting programme staff.

Overseas training of SNBC technical personnel has been conducted in Japan, West Germany, Egypt, England, Holland, the U.S., etc. Eleven persons have received technical training at JICA for radio and television broadcasting since 1966. Nine other persons have received JICA training on programming and administration.

As for the broadcasting stations constructed under Phase 1, two or three engineers were appointed for the operation of the studio and transmitter in each station upon their completion. Under them, four to eight operators were attached respectively according to the scale of programme production.

Key persons appointed to the new stations consisted of qualified engineers who had gained sufficient knowledge and experience at the SNBC Headquarters and the transmitting station. For the stations to be built under Phase 2, key persons have already been secured at the SNBC Headquarters, with a similar personnel plan.

As for personnel expenses such as wages, SNBC asks the Ministry of Finance and Economic Planning for necessary posts and an appropriation for them, with budget requests for the new project.

2-2-6 Results and Benefits of the Stations built under Phase 1

(1) Results

Under Phase 1, five 5 kW medium wave radio transmitting stations were built and started operation in El Obeid, Atbara, Wad Medani, Dongola, and Kassala in the end of February 1986.

These stations produce and transmit their own local programmes, as well as programmes on the nationwide network from Omdurman.

Operation and maintenance are carried out by qualified persons who have experience in working for the SNBC Headquarters. Daily maintenance is carried out in accordance with data and manuals provided

by the manufacturer of the equipment. Equipment of the stations is maintained in good conditions.

The maintenance system is like this: easy troubleshooting is carried out by the job-site staff; equipment which has become out of order to the extent that troubleshooting requires advanced techniques and additional measuring instruments is sent to the maintenance center of the SNBC Headquarters for repair.

Once there was some trouble at Wad Medani Station. Treatment on the job-site and clearing up of the cause through repairs of faulty circuit modules in the maintenance center were adequate.

The maintenance center is set up temporarily in a radio studio of Omdurman with two engineers. It takes custody of spare parts, and can conduct performance tests of circuit modules.

SNBC plans to build a new structure for the maintenance center in the radio studio site. The budget for the construction (LS450 thousand) has been approved. Designing has been started by engineers of the Ministry of Construction. Construction work is to be shortly started. SNBC is also planning to reinforce the maintenance center in both personnel and equipment.

(2) Benefits

The five stations built under Phase 1 have widened the service area of SNBC's radio broadcasting. Population coverage has been raised from 38% to 50%. It may be concluded that the Project has been of much benefit to Sudan because of the reasons listed below.

1) The construction of the stations have made it possible for people to receive stable and high-quality broadcasting in the regions unserved by radio broadcasting and, as a result, communication of information through radio programmes of their own region has been much facilitated.

2) Local broadcasting produced by each station has greatly contributed to the improvement of the living and educational

standard of the community through a variety of programmes closely related to the region, such as news, education, health and hygiene, agriculture and stock-farming and entertainment. This benefit would never be expected from the general programmes produced by the central station. Public response including letters from audience shows such broadcasting has been widely appreciated by the people of the community.

Some letters from audience sent to those stations are shown in Appendices 10.

3) The number of radios is estimated at about 4 million in the whole country. It is also estimated that most households have a radio even in the rural regions. This fact indicates the construction of the new stations give a direct benefit to the people.

2-3 Expansion Project for Broadcasting Service and Contents of the Request

SNBC has greatly contributed to the culture and education of Sudan through broadcasting media, since it started broadcasting in 1940. Limited broadcasting facilities, however, prevent it from expanding its service area throughout the country, especially in radio broadcasting. In order to improve the present situation and to set up a true nationwide radio broadcasting network, SNBC has worked out a four year plan as mentioned below.

First year plan (Phase 1)

Construction of five 5 kW medium-wave radio transmitting stations

Second year plan (Phase 2)

Construction of five 10 kW medium-wave radio transmitting stations

Third year plan (Phase 3)

Construction of a 300 kW shortwave transmitting station

Fourth year plan (Phase 4)

Rehabilitation of studio facilities and expansion of rural medium wave transmitting stations

As for the Phase 1, the Japanese Government extended grant aid in 1984 to construct five 5 kW medium wave transmitting stations in five cities. The construction work was completed in February 1986.

In order to expand further radio broadcasting service in the rural areas, the Government of Sudan has requested another grant aid from Japan for Phase 2 of the above-mentioned Four Year Plan..

The contents of the request are as follows.

(1) Object and scale of the Project

In connection with Phase 1, further construction work on radio transmitting stations is most desirable when considering the merit of the continuous operation of the previous similar construction work.

Based on the results of feasibility and cost effectiveness surveys, the following rural cities will be the most promising locations for the effective improvement of radio broadcasting service in this country.

Port Sudan, Ed Damazine, El Fasher, Wadi Halfa and Kosti.

The power output of each transmitting station will be 10 kW in consideration of common use of spare parts with the facilities of Phase 1.

The composition of each station will also be the same as the stations at the five previous locations, which are composed of a prefabricated system and a vertical tower antenna of a quarter wavelength in height.

(2) Effect of the Project

When Phase 2 is materialized, the radio broadcasting service of SNBC will be further improved in population coverage as well as in sound quality.

Most of the major cities in the rural area will be covered by this Phase 2.

(3) Particulars of facilities

(a) 10 kW transmitter
(b) Programme input equipment
(c) Control equipment for transmitting system
(d) Remote control and supervision equipment
(e) ST link for programme transmission
(f) Power supply system
(g) Engine generator system
(h) Shelter for transmitter and engine generator
(i) Air conditioning equipment
(j) Antenna system

CHAPTER 3

CONTENTS OF THE PROJECT

CHAPTER 3 CONTENTS OF THE PROJECT

3-1 Objective of the Project

The Government of the Republic of the Sudan intends to promote the more active use of radio broadcasting to accelerate regional development and improvement of the people's living standard which are basic for the growth of the country. Consequently it set up a Four Year Plan for expanding its medium and shortwave radio broadcasting networks and improving the broadcasting facilities. Under Phase 1, construction work was carried out with grant aid from Japan, five radio broadcasting stations were completed in February, 1986, and they are operating satisfactorily.

However, about a half of the inhabitants of this vast country cannot yet enjoy domestic radio broadcasting. The objective of the present plan, as Phase 2, is to establish radio broadcasting networks that serve four main cities and their surrounding areas which are now receiving poor radio service.

3-2 Examination of the Contents of the Request

3-2-1 Effects and Necessity of the Radio Broadcasting

Broadcasting is the means of mass media that transmits visual and aural information through radio waves and has the special characteristic that it can transmit various information immediately and simultaneously to the general public scattered over a wide area. Its social influence is immeasurably large compared with that of the printed media like newspapers and magazines. Above all, radio broadcasting is an economically superior form of mass media due to the convenience and cheapness of radio sets. It is the most important form of mass media in a country like Sudan where the infrastructure sectors such as transportation and telecommunications are not adequately developed and the literacy rate is low.

Further, Sudan is a multiracial country. Various regions in the vast country differ greatly in geography, climate, industry and living

environment with life-styles also varying by regions.

In Sudan, at present, various radio programmes are broadcast over the nationwide networks from SNBC Omdurman. The programmes contain newscasts and topics related to religion, education, culture, health, sanitation, sports and music, and contribute greatly to the development and unification of the country as well as social and economic progress and improvement of the people's living standard. At the same time, local radio broadcasts provide programmes useful to the daily lives of regional inhabitants and contribute to the diffusion of social information closely related to each region; the provision of industrial information on agriculture and cattle breeding; education including schooling, adult education and teacher training; knowledge of health and sanitation for mothers and children; and notice of preventive inoculations. All these programmes have a great influence on the people.

At present, the rate of population coverage by SNBC's broadcasting service is 50%. The remaining inhabitants of the country live in areas where they can barely receive programmes through weak radio waves and with much interference or cannot receive any broadcasts at all. Besides, most of the people enjoy information and entertainment programmes coming in on the strong radio waves from neighboring countries. Radio sets are widely popularized in Sudan and are estimated to amount to about 4 million sets (a little more than 1 set per household on an average). Radio sets are also common even in areas that SNBC radio waves cannot reach and almost all families in these areas have a radio set, and this fact manifests the strong desires of the people for radio broadcasting service.

At the proposed sites surveyed this time, both local officials and people have great hopes on the realization of their respective radio broadcasting stations.

Therefore, the provision of four radio stations under Phase 2 is indispensable to further the effective use of radio broadcasting in Sudan.

3-2-2 Proposed Sites for Transmitting Stations

In four cities, Port Sudan, Wadi Halfa, El Fasher and Kosti, which are the locations requested from the viewpoint of maximizing the effects of expanded radio broadcasting networks, an examination was done concerning the estimated population within the coverage area of the proposed stations, the condition regarding receiving domestic radio broadcasts, and the general situation of the cities. The examination found that favorable effects can be expected by locating transmitting stations in these cities and no obstructions were recognized to placing of the stations. Based on this, these cities were judged to be suitable as proposed sites for locating the stations. However, Ed Damazin, a city which was included in the initial survey programme, was excluded by agreement between the governments of the Sudan and Japan because public peace is not maintained in the city.

The general condition of the cities is described in the following, and outlines of the comparison between the Proposed Sites are shown in Table 3-2-1.

(1) Port Sudan

Port Sudan facing the Red Sea is the largest port town in Sudan and is an important center of transportation linked by roads, railways and air liners to Khartoum, the capital city. It is also a large commercial center.

Port Sudan is a remote city at a distance of about 650 kilometers in a straight line from the capital city. Since such remoteness makes it impossible to receive domestic radio broadcasts, both local officials and people have placed great hopes on the plan.

No problems seem to be posed by conditions at the proposed site regarding the construction of a transmitting station, power supply to the station, relay circuits for nationwide broadcasting programmes sent from SNBC Omdurman, the construction of radio link circuits between the studio and transmitting station, nor by the operation of these facilities after completion.

Construction materials are transported by trucks over a distance of less than 10 km from Port Sudan without any need to improve access roads.

(2) Wadi Halfa

Wadi Halfa is a city situated at the extreme north end of the country and borders on Egypt. Packet boats navigating to and from Egypt through Aswan High Dam and the National Railways terminate in this city which provides the gateway to Egypt. Also, the city is on the route of the trade with Egypt in camels, sheep and cattle and is the distribution center of cattle and cereals.

Although a part of the inhabitants moved to the Egyptian side of the border when the central part of Wadi Halfa was inundated by the construction of Aswan High Dam, it is said that about 500 thousand Sudanese still remain in the vicinity of the border. Wadi Halfa, which was once the second largest city in Sudan has been ranked as an important area for development in order to rehabilitate the city. At present, a large-scale fishery project has already completed, and some projects in various fields such as port facilities, electrification and agriculture at five different areas in the vicinity are on-going or under planning.

Wadi Halfa is about 700 km away to the north of the capital city and cannot receive domestic radio broadcasts. Both local officials and people have placed great hopes on the radio expansion plan to further such restoration.

The local power plant is closed due to its superannuated facilities. A 2 MW power station being constructed with the aid of West Germany is scheduled to start service in October, 1989.

Since the proposed site for constructing the transmitting station is near to the city center, a building for a studio is constructed in a corner of the site at the expense of the Sudanese side.

No problem will be posed by conditions at the site of the transmitting station or the composition of relay circuits for nationwide broadcasting programmes.

The transportation of construction and other materials uses the National Railways from Port Sudan to Wadi Halfa.

(3) El Fasher

El Fasher, the capital city of Darfur Region (of which the population is about 3.1 million), is near the mountain district. Various fruits and vegetables including oranges and apples are cultivated there and it is the center of agriculture and cattle raising.

The inhabitants of this region live a unique life style due to the natural features there which differ from those in other regions. The city is the center of regional development for promoting cattle breeding and agriculture.

The Local Administration Information and Culture Department has a studio for producing radio programmes and it currently produces news and information programmes. However, since there is no transmitting station, these tape-recorded programmes are sent to the Nyala radio station in the southern part of the Region or to the SNBC Omdurman Station for broadcasting but the state of reception is not good. Therefore, both local officials and people have placed their great hopes on the construction of a transmitting station.

No problem related to construction work seems to be posed by conditions at the proposed site of the transmitting station, the power supply to the station, relay circuits for nationwide broadcasting programmes sent from SNBC Omdurman Station or radio link circuits between the studio and the station. Also, no problem will be raised by the maintenance and operation of the station after completion.

Construction materials are transported by the National Railways from Port Sudan to Nyala from which trucks are used to carry them to the construction site over a distance of about 200 km. The transportation of these materials should avoid the rainy season (from mid-May to mid-October) since the traffic may be disturbed by rainfall.

(4) Kosti

Kosti, which is near Gezira, is noted for its irrigation cultivation, embraces broad fertile farmlands bordering the White Nile,

Table 3-2-1 Comparison between the Proposed Sites for Stations to be Located

	Port Sudan	Wadi Halfa	El Fasher	Kosti
Priority given by Sudan side in locating station	1	2	3	4
Location	Eastern Region facing the Red Sea	Western Region bordering on Egypt	Darfur Region in the western district near the border of Chad	Central Region at about 300 km to the south of the capital
General condition of the cities	The largest port town in Sudan; commercial center.	Center of trade with Egypt; distributing center of cattle and cereals; important region for development planned by the country.	Capital of Darfur State; cattle breeding and agriculture is active; center of regional development.	Embraces wide and fertile farmland bordering on the White Nile, where agriculture and cattle breeding is active; has a sugar refinery and a cement factory which being the largest ones in Sudan; industry is active.
Reception of native radio broadcasting	Since it is located at about 650 km away from Khartoum, the capital, with mountains being on its backside, reception of native radio broadcasting is impossible.	Since it is located at about 700 km away from Khartoum, the capital, and at about 370 km away from the adjacent Dongola station, reception of native broadcasting is impossible.	It is situated at about 810 km away from Khartoum, the capital, and the radio waves from the adjacent Nyala station is so weak making it difficult to receive them.	Although reception of the broadcasting from Sennar station is possible, the time zone for SNBC nationwide broadcasting (for 18 hours) is restricted to about 10 hours a day.
Expectation of inhabitants for station to be located	Broadcasting of public and familiar information through their native radio is desired and both officials and people place their large hope on it.	Both officials and people place their large hope on the regional development to be promoted by the broadcasting of public and familiar information through their native radio.	Both officials and people place their large hope on the promotion of cattle breeding and agriculture through the improvement in reception of their native broadcasting and the provision of timely technical guidance and information.	Both officials and people place their large hope on the promotion of cattle breeding and agriculture by the provision of timely technical guidance and information on cattle breeding and agriculture closely related to the region.
Site of transmitting station	A flat public land of 300m x 300m in area has been secured.	A flat public land of 350m x 260m in area has been secured.	An approximately flat public land of 300m x 200m in area has been secured.	A flat public land of 300m x 300m in area has been secured.
Programme relay circuit: - between SNBC Omdurman and the respective telephone exchanges of each city (work at the expense of the Sudan side) - between telephone exchange of each city and studio (work at the expense of the Sudan side)	Microwave circuit New construction for a section of about 0.3 km (a part of the existing circuit is utilized).	Satellite circuit New construction for a section of about 2.5 km.	Satellite circuit New construction for a section of about 1 km.	Microwave circuit New construction for a section of about 0.6 km.
Power reception: Power circumstances. Section requiring new construction of high-tension transmission line (works at the expense born by Sudan side)	Power reception is possible. -----	The power plant is not operating due to its superannuated facilities. A 2 MW plant is scheduled to be completed in October, 1989, with the aid of West Germany. Since power sonsumption of the city is estimated at 1 MW, power reception is possible. If the construction plan is delayed, the station can be operated by an SNBC-owned 70 kVA portable generator. About 1.2 km	Power reception is possible. About 1.5 km	Power reception is possible. About 4.5 km
Connecting circuit between studio and transmitting station	Wireless circuit (UHF band) Length of propagation path - about 7 km	Wire circuit Length of line - about 100m	Wireless circuit (UHF band) Length of propagation path - about 3.7 km	Wireless circuit (UHF band) Length of propagation path - about 5 km
Transportation of equipment and materials	Trucking about 10 km from Port Sudan.	Transportation for about 1,100 km by National Railways from Port Sudan to Wadi Halfa.	Transportation by National Railways for 2,100 km from Port Sudan to Nyala. Trucking for about 200 km from Nyala to El Shafer, which is difficult due to bad road condition (rainy season being from July to September).	Trucking for about 1,200 km (paved road) from Port Sudan to Kosti.
Suitableness as proposed site for the location of the station	Since many effects can be expected from the station in improving the living standard of local inhabitants and the acceleration of socioeconomic development, without any obstruction to the construction works, the proposed site is judged to be suitable to locate the station.	Since the site is an important development area of the country and both officials and people place great hopes on regional development through radio broadcasting and many effects can thus be expected from effective utilization of the broadcasting, without any obstruction to the construction, works, the proposed site is judged to be suitable to locate the station.	Since production activities of radio programmes are already carried on vigorously and many effects can be expected for the promotion of cattle breeding and agriculture and for regional development from the station being located there, without any obstruction to the construction works, the proposed site is judged to be suitable to locate the station. Materials and equipment should be transported avoiding the rainy season.	Since the surrounding area is broad farmland, many effects can be expected from the station in promoting cattle breeding and agriculture, without any obstruction to the construction works, the proposed site is judged to be suitable to locate the station.

has flourishing agriculture and cattle breeding, and is densely populated. It is an important focus of transportation which has the terminals of the National Railways and national trunk roads connecting Khartoum and Port Sudan with the principal cities in Kordofan and Darfur States and of steamboats navigating the White Nile. Radio broadcasting is expected to promote agriculture and cattle breeding.

No problem related to construction work are expected due to conditions at the proposed site of the transmitting station, the power supply to the station, relay circuits for nationwide broadcasting programmes sent from SNBC Omdurman or radio link circuits between the studio and the station. Also, no problem is expected with the operation of the station after its completion.

Construction and other materials are transported by trucks from Port Sudan to Kosti (over paved roads of about 1,300 km).

3-2-3 Frequencies and Power used by the Transmitting Stations

Radio waves of the medium wave band used for radio broadcasting propagate over a great distance and may, particularly during night, cause radio interference to radio broadcasting in neighboring countries or conversely, they may be interferred with by foreign broadcasting stations.

Although radio waves are in general an effective means of telecommunication including radio broadcasting, their disorderly use will make it impossible to receive radio broadcasts or transmit telecommunication of good quality due to the radio interference caused by the said characteristic, that is, their ability to propagate over a wide range.

The frequencies and transmitting power for medium wave broadcasting stations are decided by the international convention adopted by the World Administrative Radio Conferences on Long Wave and Medium Wave Broadcasting held by the International Telecommunication Union(ITU) in 1974 and 1975.

The frequencies by cities allocated to Sudan are shown in the Appendices 14. For Kosti which has been allocated 1602 kHz (1 kW), since use of 10 kW can possibly cause radio interference to neighboring stations in the future, the necessary procedure is being taken with the competent authorities for the use of 891 kHz which has been allocated to the neighboring city, Babanusa.

The field strength survey made in each city did not find any strong radio interference and these frequencies were judged to be usable.

In deciding transmitting power, a comprehensive examination was done on various problems such as conditions of the locations in each city, the spread of the population in these cities and their outskirts, the relationship between construction expenses and population coverage for each station, and operation and maintenance of the facilities. Based on the examination as given below, the use of 10 kW was judged to be suitable.

(1) Conditions of the locations in each city and the spread of the population

The five stations constructed under Phase 1 are located comparatively near the capital, Khartoum with a distance of about 320 km on the average. But the three proposed sites, Port Sudan, Wadi Halfa and El Fasher are located far from Khartoum with a distance of 635 km on the average, and people in these project areas do not have access to their country's domestic radio service. In each area, 61% of the population lives in the outskirt of the city, and in addition, nomads account for 16% of the population, on the average. The population is spread over a wide area to the extent of 100 km to 150 km from the city. Therefore, the Phase 2 stations will require considerably higher transmitting power over 10 kW, to obtain wider coverage. (The coverage area is estimated to be about 140 km in radius under the conditions that the frequency is 819 kHz on the average for the four proposed stations, transmitting power is 10 kW and the permissible S/N is 30 dB.)

Kosti, located about 265 km from Khartoum, is an active city in agriculture, cattle breeding and industry and the outskirt around the city are densly populated. The population is uniformly distributed over a wide area to the extent of more than 100 km from Kosti City. It will be necessary to cover such a wide area with higher transmitting power.

From above considerations, the Phase 2 stations will require a higher transmitting power than those of the Phase 1 stations.

(2) Operability and Maintainability of the Facilities

Generally speaking, transmitters of more than 10 kW in output power adopt the electron tube type. Transmitters of this type have a disadvantage in that their reliability is low compared with that of the full solid-state type, tubes need to be replaced and replenished and power consumption increases due to low overall efficiency. Also, common use of spare parts and similarity of maintenance and operation are unattainable between facilities using the tube type and those installed under Phase 1.

The present situation in Sudan will not permit regular replenishment of the transmitting tubes. Also, the increase of operational expenses including electric power charges will be undesirable. Therefore, transmitters with an output over 10 kW will be inadequate for the Project.

Summarizing the above-mentioned reasons, it is desirable to use higher transmitting power to obtain wider coverage. From the viewpoint of the technical and economic aspects, however, it is judged to be most practical to use 10 kW transmitting power which can cover the main part of the target areas at each proposed location.

Fig 3-2-1 shows the areas covered by the existing transmitting stations and those proposed for 10 kW transmitting stations under Phase 2.

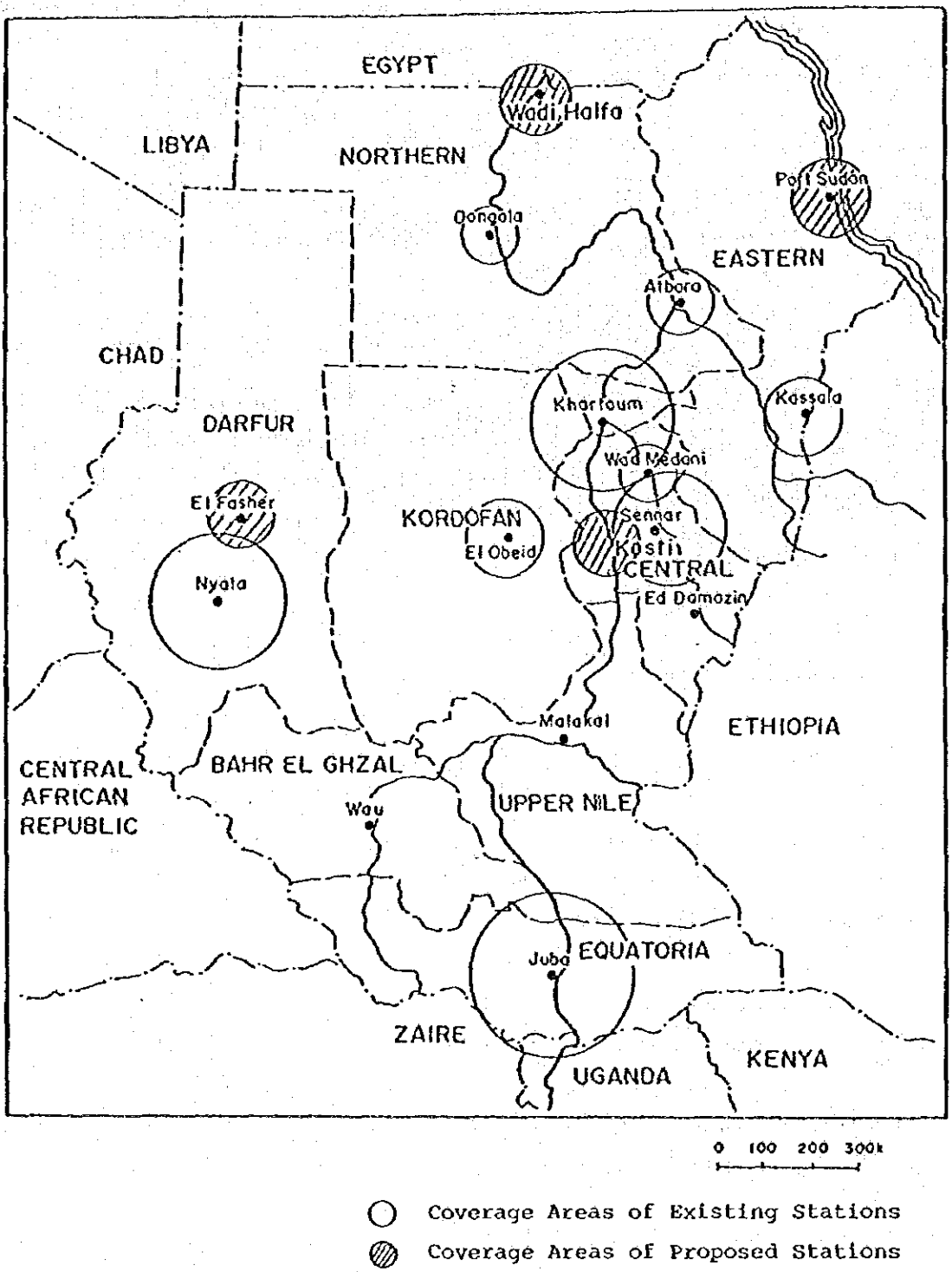

Fig. 3-2-1 Coverage Areas of Radio Broadcasting

3-2-4 Studio Facilities

In the studio of each station, facilities for producing local programmes and for control and switching between the nationwide programmes from SNBC Omdurman and the local programmes are provided.

The local programmes produced by each station will amount to about 3 hours every day and mainly consist of news and information programmes closely related to daily life in each region.

The studio is composed of one small studio room and one control room and these buildings will be provided at the expense of the Sudanese side.

Facilities in this project include an audio mixing equipment, tape recorders, and other related equipment for producing and sending out programmes to the transmitter.

3-3 Outline of the Plan

3-3-1 Function and Scale

With the object of expanding radio networks and providing nationwide programmes as well as local programmes closely related to each region, 10 kW medium wave radio transmitting stations are to be constructed in Port Sudan, Wadi Halfa, El Fasher and Kosti. Along with this, each station will be provided a studio with an attached control room using the studio building arranged by the Sudan side, to produce local programmes. The studio contains a control and switching facility for broadcasting the nationwide programmes relayed from SNBC Omdurman and the local programmes produced by each station.

Broadcasting hours are 18 hours a day of which about 3 hours are to be assigned to local radio programmes.

3-3-2 Organization and Management

A standard local radio station organization is shown in Figure 3-3-1.

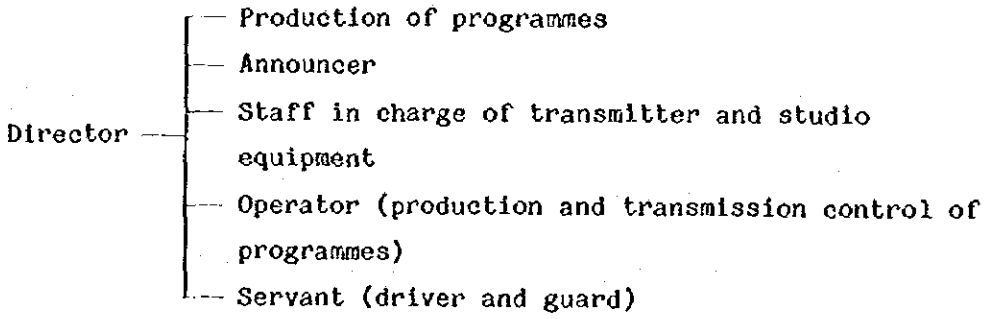

Fig. 3-3-1 Standard Organization of Local Radio Station

The station is managed under the general control of its director in accordance with the basic policy, established by SNBC Headquarters, for the production of programmes, broadcasting, and operation and maintenance of the facilities.

In producing local news programmes, cooperation to some extent is

obtained from local agencies of the Ministry of Information and Culture.

3-3-3 Programme Plan

Broadcasting hours are 18 hours every day, of which about 3 hours are scheduled to broadcast local programmes.

Programmes intended for local broadcasting are those closely related to each region as listed in the following.

(1) Campaign programmes by local government

Diffusion and announcement of local government policies, daily activities and events, and communication of other administrative information.

(2) Emergency broadcasting for disaster

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

(3) Local news

Offering of daily information or news closely related to the local people, and sportscasting by relay.

(4) Agricultural and cattle breeding programmes

Timely guidance adapted to the actual conditions in each region including diffusion of knowledge to improve the productivity of agriculture and cattle breeding.

(5) Social educational programmes

Improvement of living standards, in particular, propagation of hygienic knowledge, and general and social knowledge for nomadic people having no settlements.

(6) School educational programmes

Guidance for school children, students and teachers.

(7) Programmes for housewives

Offering information related to daily life according to the actual conditions in each region.

(8) Children's programmes

Cultivating of children's sentiments and fostering of their intellectual interest.

(9) Music programmes

(10) Audience participation programmes

3-3-4 Staff Plan

(1) Staff Plan

The size of the staff to operate the radio station to be constructed in each local city may differ according to the news gathering system and volume of local programmes to be produced; however, it is equal to that of the stations completed under Phase 1.

Required staff members number about 31 and they are recruited by the relocation of SNBC staff members, transfer from the local agency of the Ministry of Information and Culture and employment from among the public. However, the required key members have been secured already. The composition of staff is shown in Table 3-3-1.

Table 3-3-1 Composition of Staff of Local Station

Classification	Number of staff
Director	1
Programme-production staff	10
Announcer	2
Technical staff (Studio & Transmitter)	13
Servant and driver	5
	31

In addition to the above members, about two engineers are required to strengthen the maintenance center. These engineers take charge of maintaining the functioning of the equipment of the transmitting station and studio to be constructed. They inspect the operational

condition of each piece of equipment about once a year as well as take charge of repairing any failed modules and administering spare modules.

In order to carry out the smooth operation and maintenance of the four stations, OJT of the required staff including the maintenance staff is conducted at the time of the construction work at each site.

3-3-5 Operational Expenses of the Facilities

Operational expenses of each broadcasting station are roughly classified into programme production cost, facilities maintenance and management cost, charges for leasing programme links, power cost and personnel expenses.

The operational expenses of SNBC are paid from the national budget and the charges for leasing programme circuits are paid in a lump sum to STC. Expenses for other items are distributed to each station from SNBC Headquarters.

The total budget of SNBC for the 87/88 budget year is £S32 million.

For the new stations to be constructed under Phase 2, annual operational expenses for each station are estimated as follows:

	£S
Programme production	20,000
Facilities maintenance and management	50,000
Power cost	110,000
Personnel expenses	90,000
Others	20,000
Total	470,000

3-3-6 Examination of Location

A broadcasting station is generally composed of a transmitting station and a studio where broadcasting programmes are produced. The transmitting station and the studio are linked with a wireless or wire circuit to convey broadcasting programmes.

Desirable conditions of the location for a studio are that the site be situated in the central part of a city convenient for transportation and communication in order to gather news and secure performers.

A transmitting station requires a flat site of about 300 m x 300 m in area since the transmitting antenna mast which is about 100 meters high must be erected and the radial earth of about 130 meters in radius must be laid. Moreover, the site must not pose any problem related to its foundation and soil and there must not be any fear of inundation during the rainy season. Conditions of areas around the site are that locational relation between the site and any airport does not conflict with the ICAO regulations; that reception of power and construction of an access road are easy; and that a link circuit between the transmitting station and the studio can be easily constructed.

In each of the four cities covered by the present Phase 2, a building or site for the studio has been secured in the central part of the city. For the transmitting station sufficient area has also been secured and the conditions of the surrounding area are nearly satisfactory. Thus the implementation of the Project is judged to be appropriate.

3-3-7 Outline of Facilities and Equipment

The overall block diagram of the broadcasting system is shown in Figure 5-4-1 and the outline of the principal facilities and equipment of each broadcasting station is shown in Table 3-3-2.

Table 3-3-2 Outline of Principal Facilities and Equipment of Each Broadcasting Station

Principal Facilities and Equipment	Qty	Remarks
1. Transmitting station		
(1) Transmitter 10 kW set with standby	1 set	
(2) Link circuit between studio to transmitting station UHF MHz band wireless or wire circuit	1 set	In Wadi Halfa to use wire circuit
(3) Air conditioner	1 set	
(4) Power distribution facility	1 set	
(5) Intercom system Between studio and transmitting station	1 set	
(6) Transmitter shelter To accommodate broadcasting equipment	1 set	
(7) Transmitting antenna Cylindrical mast of guyed type, about 100 m in height Radial earth of about 130 m in radius	1 set	
(8) Engine generator Diesel engine generator 90 kVA 415 V 3 ϕ	1 set	
(9) Fuel tank About 8,000 liter capacity	1 set	
(10) Engine shelter To accommodate generator About 2.5m x 6m x 2.6m = 39m^3 in volume	1 set	
(11) Measuring equipment	1 set	

2. Studio		
(1) Audio mixing equipment 8 input, 3 output	1 set	
(2) Programme production and transmission control equipment	1 set	
Tape recorder	2 sets	
Microphone	3	
Monitor system	1 set	
Intercom system	1 set	
Signal changeover panel	1 set	
(3) Studio to transmitting station link circuit UHF MHz band wireless or wire circuit Transmitter and receiver	1 set	
(4) Remote control and monitor system	1 set	
(5) Intercom system	1 set	
(6) Power facilities	1 set	
(7) Monitor receiver	1 set	
3. Maintenance center		
Spare modules, spare parts	1 set	
Measuring equipment	1 set	

3-4 Technical Cooperation

SNBC has been achieving positive results for many years and has extensive experience in radio broadcasting starting in 1940. It has shown an excellent record in operating the broadcasting stations constructed under Phase 1 in recent years. Staff required for the present phase will be qualified persons having experience in each task and who have been assigned to SNBC Headquarters and the transmitting

station as nucleus staff. Also, thorough field training of staff members will be conducted concerning the operation and maintenance of equipment when these are installed in the course of the construction work under the present phase. Therefore, the operation of facilities and equipment after completion is expected not to cause any problem.

However, the operation of a radio station requires knowledge and abilities of a high degree in each specialized field. In particular, the rapidly progressing area of broadcasting technique demands continuous improvement in knowledge and abilities.

Japan has accepted many trainees from Sudan to train in various fields such as administration, programme production and broadcasting engineering including seminars for executives. SNBC eagerly hopes to have its staff members trained in Japan concerning the radio engineering and the production of programmes for the future.

CHAPTER 4

OUTLINES OF THE PROPOSED SITES

CHAPTER 4 OUTLINES OF THE PROPOSED SITES

This chapter describes outlines of the proposed sites for constructing radio transmitting stations under the Project.

4-1 Locations of the Proposed Sites

Table 4-1-1 shows the latitude, longitude and altitude of the proposed sites.

Table 4-1-1 Location of Proposed Sites

Name of station	Latitude (North)	Longitude (east)	Altitude
Port Sudan	19°39'45"	37°10'08"	28 m
Wadi Halfa	21°48'55"	31°25'23"	188 m
El Fasher	13°37'36"	25°23'07"	753 m
Kosti	13°07'30"	32°36'11"	378 m

4-2 Natural Conditions

In Sudan, the northern half of the country is a semi-desert zone which is very dry throughout the year. Rainfall gradually increases from the northern to the southern region continuing to the rain forest area.

Fig. 4-2-1, Fig. 4-2-2 and Fig. 4-2-3 show the distribution of mean annual rainfall, mean rainfall by month and mean maximum temperature by month, respectively.

Wadi Halfa which is the most northerly situated of the four cities surveyed this time has almost no rainfall.

The rainy season is from May to October in Kosti and El Shafer and

from October to December in Port Sudan.

The highest temperatures occur between May and September in Wadi Halfa and Port Sudan and between May and June in Kosti and El Fasher, with the monthly average being over 40°C. The lowest temperatures are recorded in December and January. They were 2°C in Wadi Halfa and 0.7°C in El Fasher. The difference in temperature during the day sometimes amounts to as much as 30°C.

Haboob occurs frequently between May and July and so much sand dust enters buildings as to pile up in them.

The highest wind velocity among the four cities, is experienced in Port Sudan and the record velocity in the past ten years was 43.3 m/s.

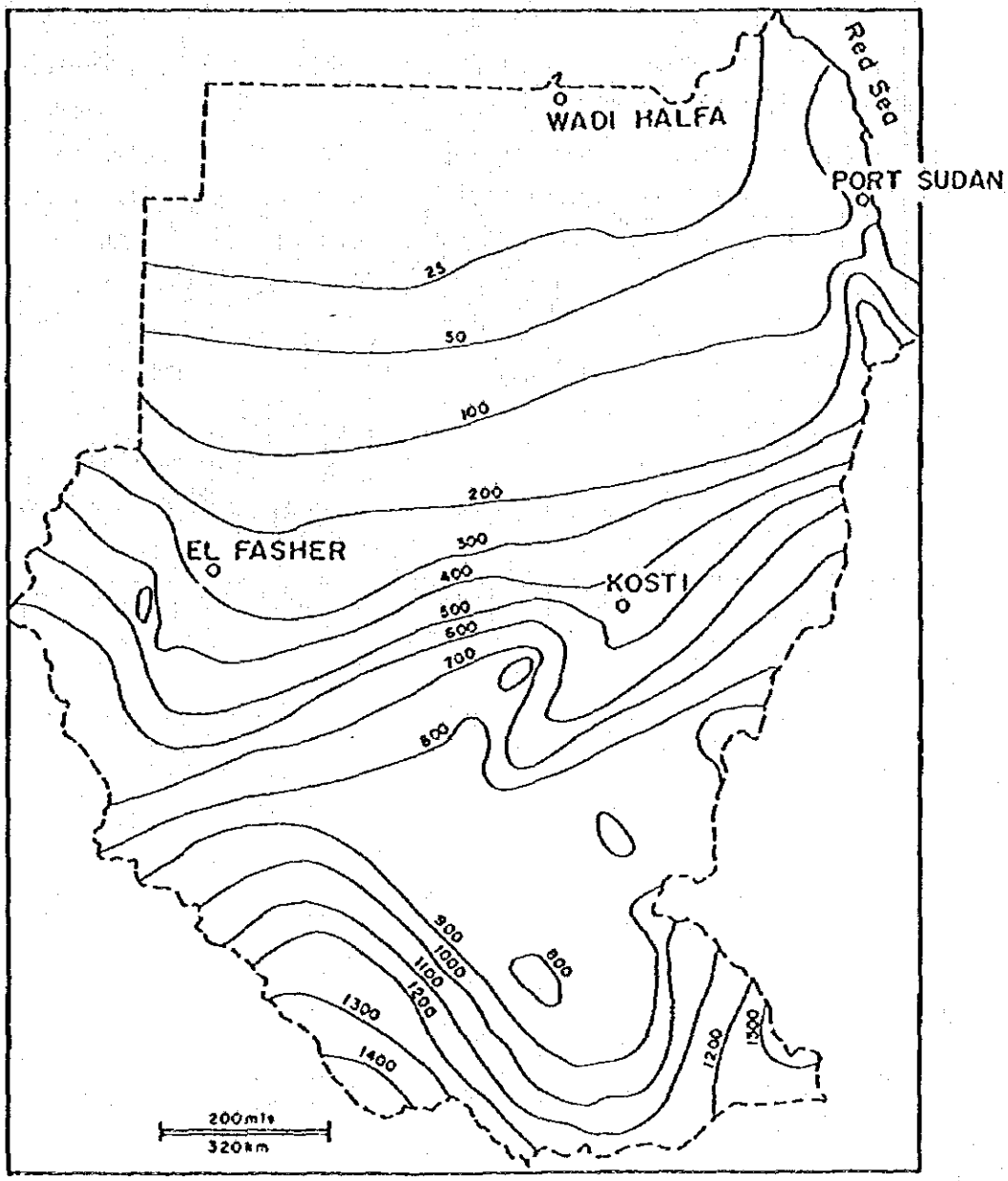

Fig. 4-2-1 Distribution of Mean Annual Rainfall

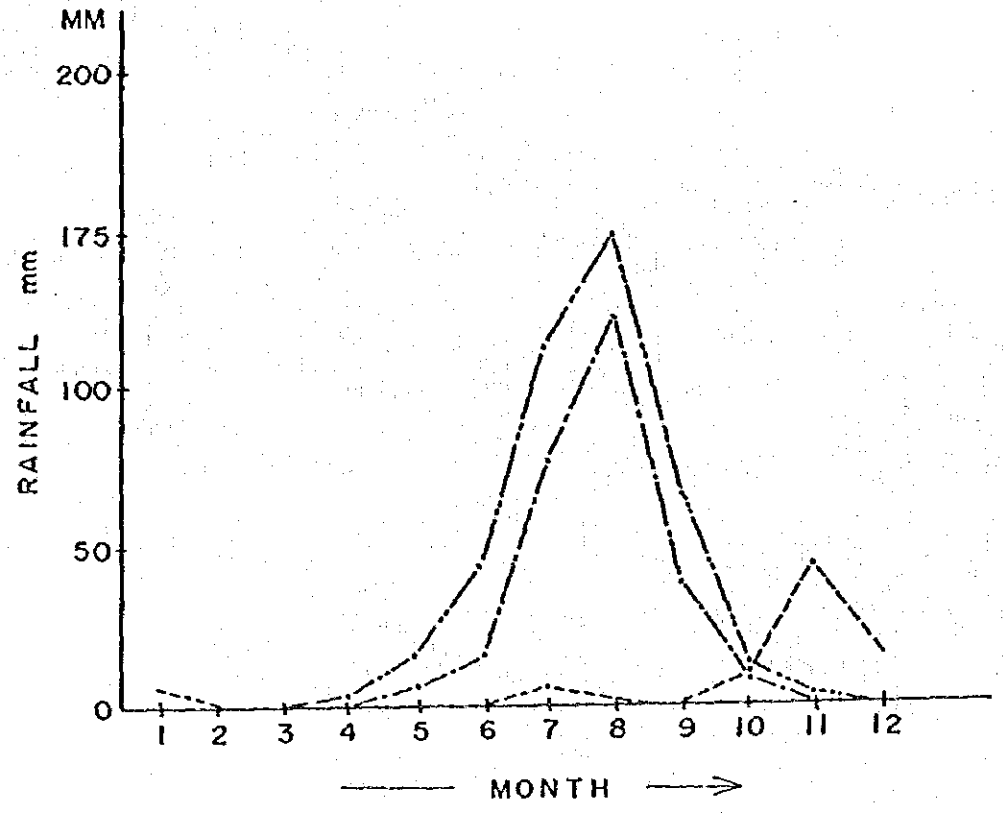

Fig. 4-2-2 Mean Rainfall by Month (for past 30 years)

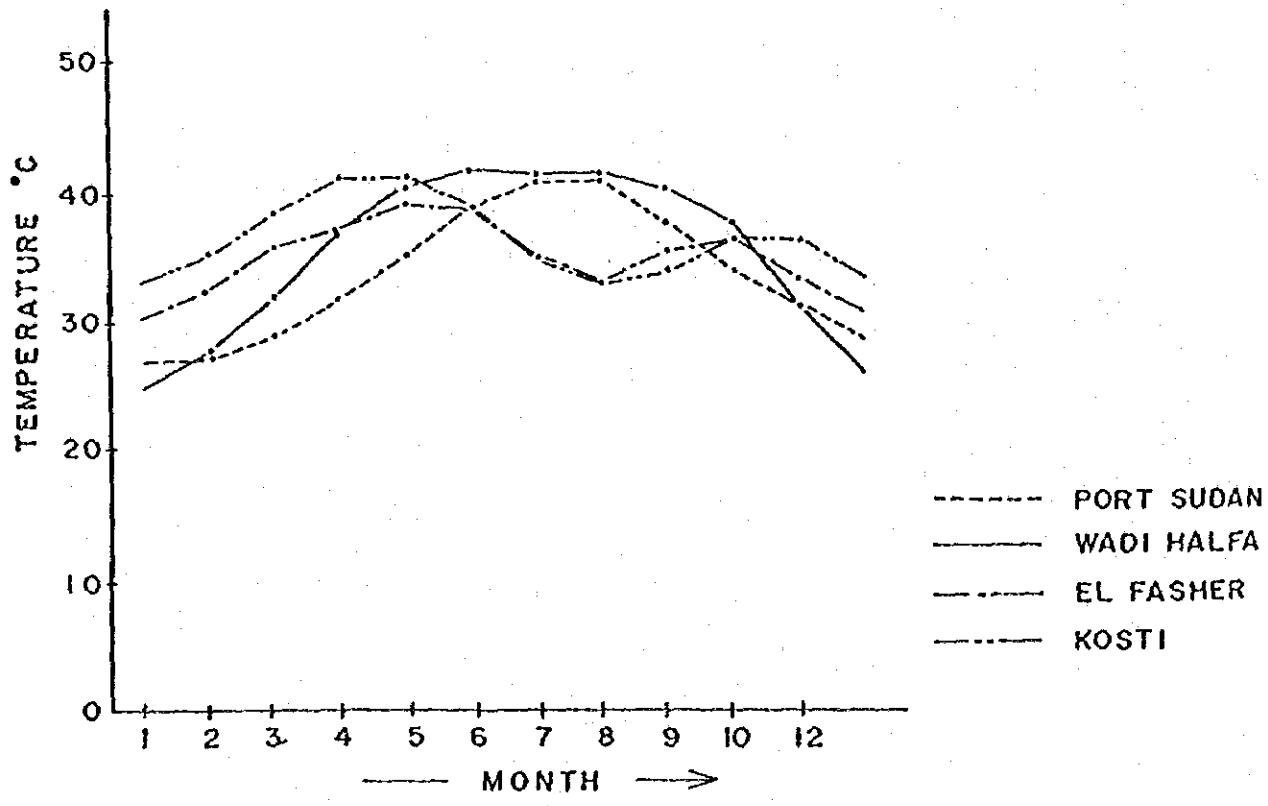

Fig. 4-2-3 Mean Daily Maximum Temperature by Month (for past 30 years)

4-3 Soil

Black cotton soils distributed from the central to the southeastern area of Sudan contain clayey mineral composed of montmorillonite. This clayey mineral causes remarkable swelling with a change in its water content. The thickness of this layer is said to be 1 to 2 meters on an average and this necessitates determining the depth of foundation structures so as to penetrate such a layer.

During this survey, test pitting was conducted at the proposed site of each transmitting station. At the same time, Khartoum University was requested to carry out a boring test at Kosti where the existence of black cotton soils is greatly suspected.

According to the results of these tests, a soil layer like black cotton soil was found in the Kosti site.

To determine a depth of the foundation, careful inspection should be made for confirmation of the black cotton soil layer, so that the bottom of the excavation comes below the layer.

Results of the boring test are shown in Appendices 6. Soil bearing capacity (long-term) at each proposed site is shown in Table 4-3-1.

Table 4-3-1 Soil Bearing Capacity at each proposed site

Proposed Site	Soil Bearing Capacity (long-term) (Bt/m^2)
Port Sudan	10.5
Wadi Halfa	10.5
El Fasher	7.2
Kosti	10.5

4-4 Circumstances of Each Proposed Site

Circumstances of each proposed site are outlined in Table 4-4-1, the details are described as below:

(1) Port Sudan

1) Circumstances of the Site and Location of Studio

Fig. 5-4-2 shows the outline of the city of Port Sudan indicating the locations of the proposed site of the radio transmitting station, studio, telephone exchange and airport.

The proposed site of the transmitting station is located about 7 km to the northwest of the city center of Port Sudan and its surroundings are almost flat desert having no obstruction to radio wave service.

Reception of commercial power is very easy without necessitating construction of a new high-tension power transmission line since such a line (11 kV main trunk line) exists along the site.

Fig. 5-4-3 shows the site plan for the Port Sudan transmitting station.

For the studio, two office rooms of the Local Administration Information and Culture Department existing in the central part of the city are to be remodelled to use as one studio room and one control room.

Remodelling work of the studio will be completed at the expense of the Sudanese side before the start of the construction work. The contents of the remodelling work are as follows:

Sound insulation (Sound-lock doors on the corridor side).
Fitting of sound absorbing materials to studio and control rooms.
Others.

Table 4-4-1 Proposed Sites for Locating the Broadcasting Stations

Item		Port Sudan	Wadi Halfa	El Fasher	Kosti
(1) Conditions of locating station	Location	Located in the eastern part facing the Red Sea, being the largest trading port in Sudan (Eastern Region).	Located on the northern border facing Egypt (Western Region).	Located near the western border (Darfur Region).	Located about 300 km south of Khartoum, the capital city (Central Region).
	Industry	Trading port, cattle breeding, agriculture.	Fishery, cattle breeding.	Agriculture, cattle breeding.	Agriculture, cattle breeding, industry.
	Population in broadcasting service area	About 530,000 (by estimation).	About 100,000 (by estimation).	About 600,000 (by estimation).	About 580,000 (by estimation).
	Condition of radio reception	Impossible to receive domestic radio broadcasting. Much affected by waves from neighboring countries.	Impossible to receive domestic radio broadcasting. Much affected by waves from neighboring countries.	Possible to receive waves from the existing Nyala Station in some parts of the city, but the waves are weak and insufficient. Much affected by waves from neighboring countries.	Possible to receive waves from the existing Sennar Station, but the broadcasting hours are limited to about 8 hours a day.
	Power availability	Sufficient capacity of commercial power.	Construction of 2 MW power plant is planned. Scheduled to start work early in 1989 and to be in service in Oct., 1989.	Sufficient capacity of commercial power.	Sufficient capacity of commercial power.
	Transportation of equipment and materials	All equipment and materials arrive in Port Sudan, needing only cartage service to the site.	Transportation by rail from Port Sudan (about 1,000 km).	Transportation by rail from Port Sudan to Nyala (about 2,100 km) and trucking to El Fasher (about 200 km).	Transportation by rail from Port Sudan (about 1,100 km).
(2) Handling of the plan by Sudan	Site for transmitting station	Already secured (300m x 300m).	Already secured (350m x 350m).	Already secured (300m x 300m).	Already secured (300m x 300m).
	Studio	One room of Information Dept. to be altered to studio, work to be started in June, 1988.	New construction at a corner of transmitting station premise, work to be started in June, 1988.	Remodelling of one room of the existing studio in the Information Dept., work to be started in June, 1988.	New construction in the central part of the city, work to be started in June, 1988. Site already secured.
	Degree of endeavor by local government	Great	Great	Great	Great
(3) Equipment	Broadcasting programme relay circuit	Possible to use ground microwave circuit. Possible to use satellite circuit.	Possible to use satellite circuit.	Possible to use satellite circuit.	Possible to use ground microwave circuit.
(4) Others	Soil	Results of the soil survey conducted at the site of transmitting station: Ground is hard and good and causes no problem.	Results of the soil survey conducted at the site of transmitting station: Ground is hard and good and causes no problem.	Results of the soil survey conducted at the site of transmitting station: Ground is hard and good and causes no problem.	Results of the soil survey conducted at the site of transmitting station: Ground is hard and good and causes no problem.

Fig. 5-4-4 shows the outlines of the studio and control rooms.

A radio link circuit (UHF band, STL/TSL) is provided between the studio and the transmitting station for the multiplex transmission of broadcasting programmes and remote control/monitor and intercom telephone signals. Transmission distance is about 6.9 km. Height above the ground of the transmission/reception antenna is 30 m on the studio side and 20 m on the station side, which can clear obstructions on the wave propagation path.

Fig. 5-4-5 shows the line of sight between the transmitting station and the studio.

For the relay circuit of nationwide broadcasting programmes, both the ground microwave circuit and the satellite circuit (SUDOSAT) can be used from Omdurman Station to the Port Sudan Telephone Exchange. The circuit between the telephone exchange and the studio can be easily provided by extending the existing spare circuit between the former and the stadium adjacent to the latter.

Locational relation between the airport and the transmitting station is as shown in Fig. 5-4-2, Outline of the City of Port Sudan, and the transmitting antenna mast of about 100 m high does not conflict with ICAO regulations.

2) Soil

According to the results of the test pitting done at the site to a depth of about 2 m, the surface is covered with soft sand to a depth of 30 cm below which sand, gravel and a hydrogenous layer lie.

Foundation is designed applying the permissible soil bearing capacity of 10.5 Bt/m^2.

3) Natural Conditions including Climate

The city faces the Red Sea and is high in humidity. Rainfall is

about 84 mm on annual average and much rainfall comes between October and December. High temperatures are experienced in August and September and the highest is over 45°C. The greatest wind velocity recorded during the past ten years is 43 m/s.

(2) Wadi Halfa

1) Circumstances of the Site and Location of Studio

Fig. 5-4-6 shows the outline of the city of Wadi Halfa, indicating the locations of the proposed site for the radio transmitting station, the telephone exchange and airport.

The proposed site for the transmitting station is located at almost the center of the city along the National Railways line and its surroundings are flat desert where no obstruction exists to hinder radio wave service.

Fig. 5-4-7 shows the site plan for the Wadi Halfa transmitting station.

At present, the public power plant is not operating due to its superannuated facilities. However, construction of a 2 MW thermal power plant (with the aid of West Germany) has been planned and the plant is scheduled to be in full service by October, 1989.

Since the power demand of the city is estimated at 1 MW, power supply will cause no problem after the completion of the said power plant.

The section of about 1.2 km from the power plant to the transmitting station requires construction of a new power transmission line.

The studio will be completed in a corner of the transmitting station premises at the expense of the Sudan side before the start of the construction work under this project.

Since the distance between the studio and the transmitting antenna is short, the studio building needs to be sufficiently shielded to prevent the influence of waves from its own station.

The studio control room and the transmitter shelter are linked with multipair cable (underground) which is used for transmitting control/monitor and intercom telephone signals. Distance of the circuit buried underground is about 150 m.

For the relay circuit for nationwide broadcasting programmes, the satellite circuit (SUDOSAT) is used from SNBC Omdurman Station to the Wadi Halfa Telephone Exchange.

The section of about 2.5 km between the telephone exchange and the studio is provided with a new overhead wire circuit.

The locational relation between the transmitting station and the airport is as shown in Fig. 5-4-6, Outline of the City of Wadi Halfa, and the transmitting antenna mast about 100 m high to be erected in the station does not conflict with ICAO regulations.

2) Soil

According to the test pitting to a depth of about 2 m conducted at the site, the surface is covered with sand, but the soil more than 50 cm below the surface is so hard that it is difficult to excavate even with a pick.

Foundation is designed applying the permissible soil bearing capacity of 10.5 Bt/m^2.

3) Natural Conditions including Climate

Wadi Halfa is located at the northernmost end of the country and has very little rainfall with mean annual rainfall being about 1 mm. High temperatures occur between May and September with the highest being over 47°C. During the cold season from November to March the lowest temperature goes down to 2°C. It is hot in the

daytime and the temperature falls at night causing a great change in temperature.

(3) El Fasher

1) Circumstances of the Site and Location of Studio

Fig. 5-4-8 shows the outline of the city of El Fasher, indicating the locations of the proposed site for the transmitting station, studio, telephone exchange and airport.

The proposed site for the transmitting station is located about 4 km east of El Fasher City and its surroundings are flat desert where no obstruction is found to hinder radio wave service.

Reception of commercial power necessitates construction of a high-tension transmission line for a distance of about 1.5 km.

At present, the power plant is generating approximately 1,950 kVA which can sufficiently meet the maximum power consumption. Moreover, since a 750 kVA generator is scheduled to start working next year the power supply will cause no problem.

Fig. 5-4-9 shows the site plan for the El Fasher transmitting station.

To use for the studio, a part of the existing studio building annexed to the Local Administration Information and Culture Department is to be remodelled; this building is situated at almost the center of the city.

The remodelling work will be completed at the expense of the Sudan side before the start of the construction work, the contents of which are as follows.

Partial removal of control room and wall
Extension of a sound lock room (protective wall and sound insulation)
Others.

Fig. 5-4-10 shows the outline of the El Fasher studio.

A radio link circuit (UHF band, STL/TSL) is provided between the studio and the transmitting station for the multiplex transmission of broadcasting programmes and remote control/monitor and intercom telephone signals, of which the transmission distance is about 6.9 km. The transmission/reception antenna which is 30 m high above the ground on the studio side and 20 m high on the station side can clear obstructions on the wave propagation path.

Fig. 5-4-11 shows the line of sight between the studio and the transmitting station.

For the relay circuit of nationwide broadcasting programmes, the satellite circuit (SUDOSAT) is used from SNBC Omdurman Station to the El Fasher Telephone Exchange. The section of about 1 km between the telephone exchange and the studio necessitates construction of an overhead cable.

The locational relation between the transmitting station and the airport is as shown in Fig. 5-4-8, Outline of the City of El Fasher, and the transmitting antenna mast about 100 m high to be erected on the transmitting station premises does not conflict with ICAO regulations.

2) Soil

The test pitting to a depth of about 2 m conducted at the site found that the soil is of uniform sand.

Foundation is designed applying the permissible soil bearing capacity of 10.5 Bt/m^2.

3) Natural Conditions including Climate

Mean annual rainfall is approximately 263 mm and the rainfall predominates from July to September. Maximum temperatures come between April and June and in October, being over 40°C. Due to

the high altitude (753 m), temperatures in the cold season once recorded as low as 0.7°C.

The wind velocity of 31.6 m was the highest in the past ten years.

(4) Kosti

1) Circumstances of the Site and Location of Studio

Fig. 5-4-12 shows the outline of the city of Kosti, indicating the locations of the proposed sites for the transmitting station and studio and the location of the telephone exchange.

The proposed site of the transmitting station is located about 5.5 km southwest of the center of Kosti City. It borders on the trunk road connecting the cities of Kosti and El Obeid.

Reception of commercial power necessitates construction of a transmission line for a distance of about 4.5 km from the substation.

Although there is no power plant in Kosti City, the sufficient surplus power supply does not pose any problem to supply the transmitting station and the studio.

Fig. 5-4-13 shows the site plan for the Kosti transmitting station.

The site of the studio is located in almost the center of the city with a sufficient area and is adjacent to a school in the school zone. It is near to the telephone exchange and the reception of power is easy.

No building exists on the site, which is public owned land, causing no trouble in acquisition. It is ideal as a candidate for the studio.

The studio building will be completed at the expense of the Sudanese side before the start of the construction work.

A radio link circuit (UHF band, STL/TSL) is provided between the studio and the transmitting station for the multiplex transmission of broadcasting programmes and remote control/monitor and intercom telephone signals, with the transmission distance being about 5.2 km. The transmission/reception antenna which is 30 m in height above the ground on the studio side and 20 m on the station side can clear obstructions on the wave propagation path.

Fig. 5-4-14 shows the line of sight between the studio and the transmitting station.

For the relay circuit of nationwide broadcasting programmes, the ground microwave circuit is used from SNBC Omdurman Station to the Kosti Telephone Exchange. The section of about 0.6 km from the telephone exchange to the studio to be newly constructed is provided with about five circuits including telephone.

2) Soil

The site, which is located near the White Nile, stands on the Nile river drift. According to the result of test pitting and boring carried out at the two points in the site, a soil layer like black cotton soil was found as shown in the Appendices 6.

To determine a depth of the foundation, careful inspection should be made for confirmation of the black cotton soil layer, so that the bottom of the excavation comes below the layer. Foundation is designed applying the permissible soil bearing capacity of 10.5 Bt/m^2.

3) Natural Conditions including Climate

Mean annual rainfall is 404 mm which is the largest among the four cities. The rainfall predominates between June and September. High temperatures occur between March and July and in October and November. The average highest temperature is over $35^{o}C$.

CHAPTER 5

BASIC DESIGN

CHAPTER 5 BASIC DESIGN

5-1 Fundamental Policy of the Basic Design

This project intends to provide new medium wave radio transmitting stations in four major local cities in Sudan. It also intends to arrange small-scale studio equipment for producing local broadcasting programmes in those studio buildings which are prepared by the Sudanese side in the said four cities.

The basic design should be the most suitable one for the purpose of the Project and the environmental conditions of Sudan. The design should be made so as to achieve high reliability, easy operation and maintenance and high economical efficiency, as well as efficient construction work.

Basically the radio transmitting stations shall be operated in unmanned conditions.

Expected population coverage after the completion of the four new stations is estimated at 59% of the total.

5-2 Design Policy of the Facilities

When taking public significance and the social mission into consideration, the broadcasting facilities should be designed to assure solidity and durability so that they may withstand influences exerted by the occurrence of disasters and disorder. They should be constructed in a manner to assure high weatherability by taking the severe natural environmental conditions into consideration. Top priority should be given to always maintaining the broadcasting capabilities of the facilities to fulfill their mission as the only mass medium in the country to efficiently transmit correct information throughout the vast domain of Sudan whatever events may occur.

5-2-1 Frequency Allocation Plan

As described in section 3-2-3, the frequencies to be used in the

four stations Phase 2 are listed in table 5-2-1.

Table 5-2-1 Frequency Allocation Plan

Name of city	Frequency
Port Sudan	747 kHz
Wadi Halfa	837 kHz
El Fasher	801 kHz
Kosti	891 kHz

5-2-2 Transmission Power

The transmission power of the respective transmitting stations is determined to be 10 kW, based on the conditions as described in Section 3-2-3.

Estimated service areas of the respective stations are listed in Table 5-2-2 based on the transmission power of 10 kW.

Table 5-2-2 Estimated Service Area

Station	Transmit. Power (kW)	Transmit. Freq. (kHz)	Co-freq. Undesirable Signal Field Strength (dBμ)		Distance (km) (Field Strength) (60 dBμ)
			Incoming Daytime	Incoming Nighttime	
Port Sudan	10	747	unreceivable	unreceivable	77
Wadi Halfa	10	837	-do-	-do-	68
El Fasher	10	801	-do-	-do-	70
Kosti	10	891	-do-	-do-	66

The conditions on which the service areas are estimated are described as below: