BASIC DESIGN STUDY REPORT
ON
THE PROJECT FOR REPLACEMENT
OF
MEDIUM WAVE TRANSMITTER
OF
HIGH POWER TRANSMITTING STATION
IN
THE PEOPLE'S REPUBLIC OF BANGLADESH

MAY 1990

JAPAN INTERNATIONAL COOPERATION AGENCY

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PREFACE

In response to the request of the Government of the People's Republic of Bangladesh, the Government of Japan has decided to conduct a Basic Design Study on the Project for Replacement of Medium Wave Transmitter of High Power Transmitting Station and the Japan International Cooperation Agency carried out the study.

After the completion of work in Japan, the Japan International Cooperation Agency sent to Bangladesh a mission headed by Mr. Takao YAMAGUCHI, Assistant Director, Engineering Division, Broadcasting Bureau, Ministry of Posts and Telecommunications, from March 25 to April 1, 1990 in order to discuss a draft report and the present report was prepared.

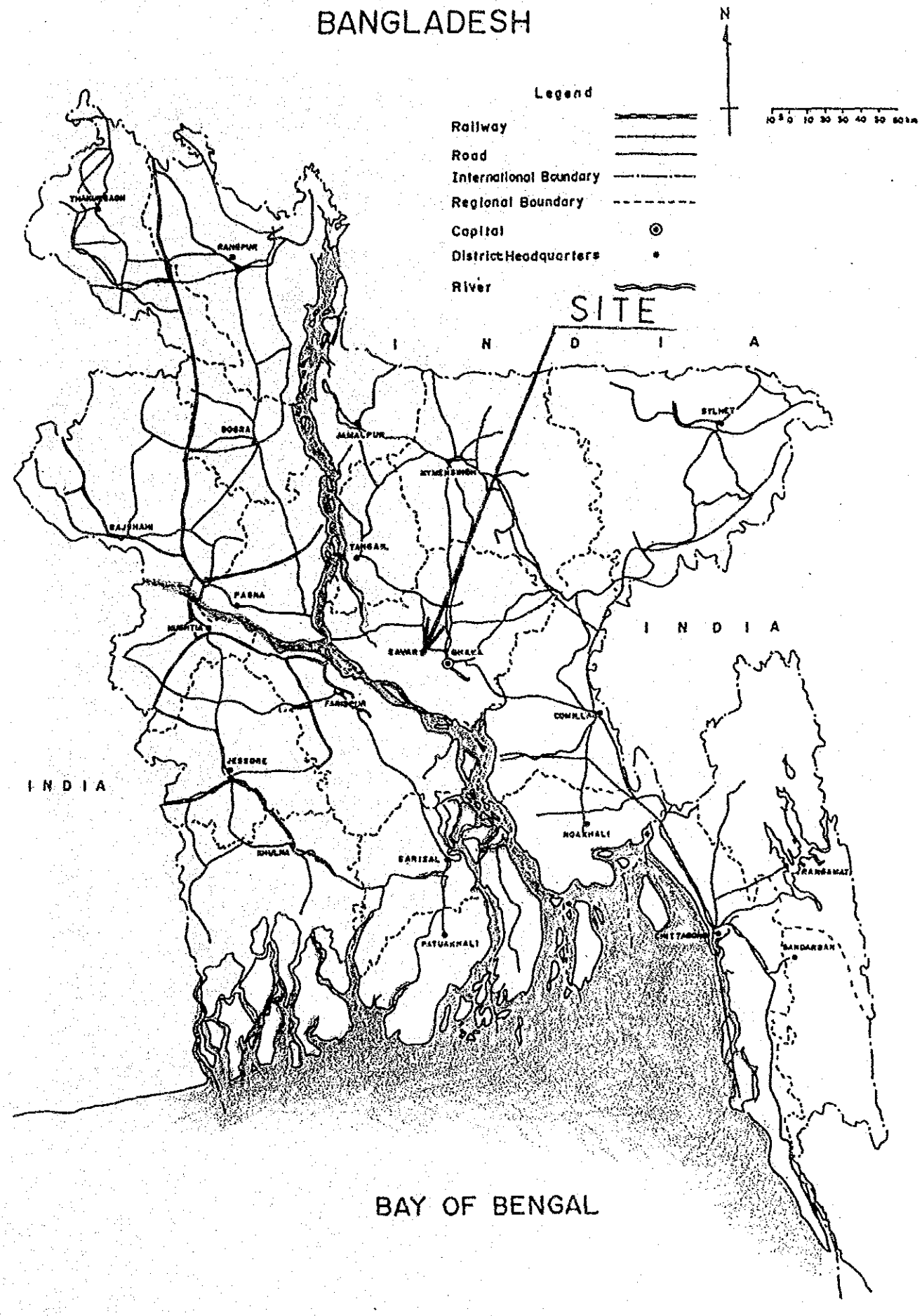
I hope that this report will serve for the development of the Project and contribute to the promotion of friendly relations between our two countries.

I wish to express my sincere appreciation to the officials concerned of the Government of the People's Republic of Bangladesh for their close cooperation extended to the mission.

May, 1990

Kensuke Yanagiya

Kensuke Yanagiya
President
Japan International Cooperation Agency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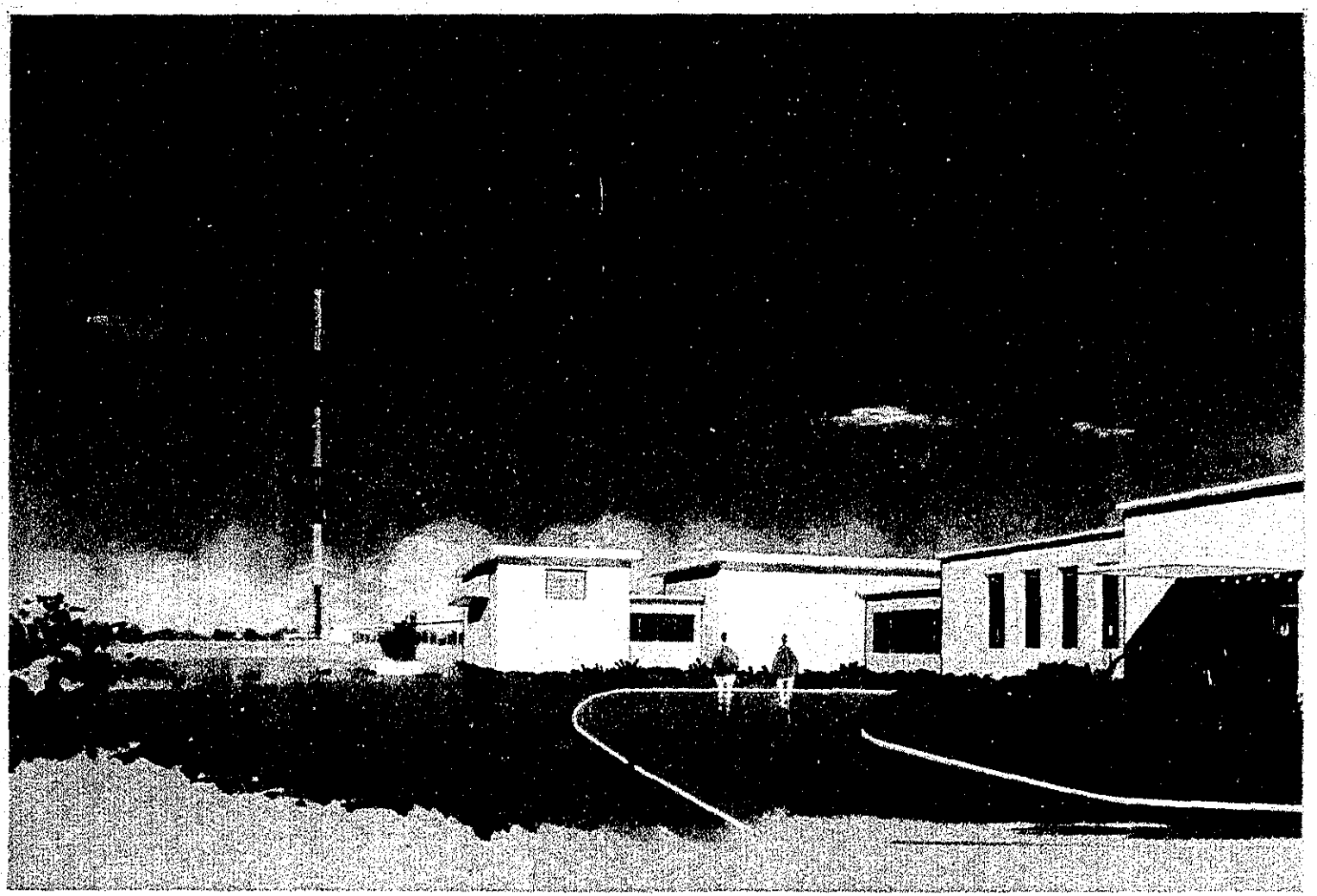

Perspective of Savar Transmitting Station

SUMMARY

Summary

At present the Government of the People's Republic of Bangladesh, a country which has been in existence has only a short period since its independence (1972), is implementing its Third Five Year Plan (1985 - 1990) for national the development. In order to promote the plan more effectively, various forms of mass media are essential to convey information to the whole nation, and consequently the importance of radio broadcasting has been emphasized. In accordance with this, Radio Bangladesh, the sole radio broadcasting organization, which belongs to the National Broadcasting Authority-NBA, has been contributing greatly to the development of the country by broadcasting programmes related to education, the promotion of agriculture, weather information, general news and regional developments.

Radio Bangladesh has been conducting nationwide broadcasting over a wide area including the capital city of Dhaka, which is located at the center of the country, from the Savar Transmitting Station situated in the suburbs of Dhaka.

However, more than 25 years have passed since 1963 when the present transmitter (100 kW) was installed in Savar Transmitting Station which has a wide coverage area centered on the metropolitan area of Dhaka City.

Therefore, the transmitting facilities are becoming superannuated, and in addition to this, as the manufacturers have stopped making the needed spare parts, it has been very difficult to execute proper maintenance.

Furthermore, because of interference from co-channel or adjacent channel frequencies emanating from the high-power transmitters of neighboring countries, the broadcasting area of Savar Transmitting Station is becoming progressively narrower.

In order to rectify such an acute situation and also to restore the full extent of the area in which broadcasts can be received, the Government of Bangladesh drew up a renewal plan to boost the transmission output from the present 819 kHz 100 kW to 630 kHz 500 kW, and requested the Government of Japan to provide grant aid.

Based on the above-mentioned request, the Government of Japan, on the premise that the Bangladesh side will obtain the approval of the neighboring countries regarding the plan of increasing its transmitter output (to 500 kW, 630 kHz), directed the Japan International Cooperation Agency (JICA) to send a study team to Bangladesh for 18 days from November 16 to December 3, 1988, in order to conduct a field survey. The results of this basic design survey were compiled into a report in March 1989.

The results of the field survey were as follows.

(1) It was confirmed that there is great fear that suspension of broadcasting services may be suspended in the very near future, because the transmitting facilities of Savar Transmitting Station are superannuated and also because it is impossible to obtain spare parts for maintenance.

(2) It was confirmed that there were interfering waves arriving from neighboring countries. In the field survey, considerable interference at nighttime was confirmed at Sylhet City (about 200 km to the northeast of Dhaka City) which is near the border with India, and slight interference was picked up also at Rajshahi City (about 200 km to the northwest of Dhaka City). In addition, as a result of a series of reception tests, it was confirmed that interference with a frequency of 630 kHz was less than with 819 kHz which is currently used.

As a result of the analysis and study conducted on the outcome of the field survey as outlined above, it has been concluded that the contents of the plan for which grant aid has been requested by the Government of Bangladesh would be effective in ensuring further development of Bangladesh's nationwide broadcasting service.

However, the Government of Bangladesh was unable, after all, to obtain the approval of the neighboring countries concerning its plan to increase the transmitter output. Accordingly, in order to achieve the more urgent objectives of securing national broadcasting services, the Government of Bangladesh modified its plan to target the renewal of the existing superannuated 100 kW transmitter and the changing of transmitting frequency (from the present 819 kHz to 630 kHz) in order to expand the

area of good reception. Having made this modification in its plan, the Government of Bangladesh has newly submitted its request for Japanese grant aid.

The following table shows a comparison between the original and the modified plans.

Item	Present Status	Original Plan	Modified Plan
Transmitter Output Power	100 kW	500 kW	100 kW
Transmitting Frequency	819 kHz	630 kHz	630 kHz

The Government of Japan subsequently decided to conduct, through the Japan International Cooperation Agency, a review of the basic design based on the new request from the Government of Bangladesh. Thus, JICA compiled a draft final report based on the results of the basic design study conducted in 1988 and sent a team headed by Mr. Takao YAMAGUCHI, Assistant Director, Engineering Division, Broadcasting Bureau, Ministry of Posts and Telecommunications, to Bangladesh from March 25 to April 1, 1990, for the purpose of explaining the contents of the draft final report to the officials concerned in Bangladesh, as well as conducting a supplementary study for the project.

The contents of the request made by the Government of Bangladeh to the Government of Japan are as follows:

Items	Quantity
Transmitting Equipment: Medium-wave radio transmitter 630 kHz, 100 kW (50 kW × 2 sets parallel operation) (Including dummy load and output power combiner)	1 set
Audio equipment	1 set
Antenna (The existing antenna to be modified)	1 set
Feeder line	1 set
Power-source facility	1 set
Measuring equipment	1 set
Engine generator	1 set
Installation material	1 set
Spare parts	1 set

The Study Mission had reviewed the Basic Design Report which was prepared in 1988 and restudied the project contents to formulate a draft final report in Japan.

The Study Mission then explained the draft final report in Bangladesh and also held a series of discussions on the report, in addition to a confirmation of related matters with the Bangladesh side. Through the above process, the Study Mission reached the conclusion that the required contents of this project are justified as a project to be carried out with Japanese grant aid, as described below.

① The equipment requested by the Government of Bangladesh (100 kW, 630 kHz) are considered to be of an appropriate scale to attain the objectives of this project.

② The scale (100 kW, 630 kHz) and the transmission conditions of Medium Frequency (Radio) broadcasting (operation time, etc.) under the project have been approved by the International Frequency Registration Board (IFRB, see 3-2-4), There fore no problems are expected in the execution of the project.

③ As for the height of the antenna, the 30-meter portion at the top of the existing antenna mast will be cut off and remodeled into a tower 122-meters in height as is registered with the IFRB, in order to use the existing antenna (152 m height) on 630 kHz.

④ Since the existing engine generator (250 kVA) is unable to supply enough power to meet the power consumption (350 kVA) of the 100 kW transmitter, it is necessary to newly install a 350 kVA engine generator as a standby power source to cope with failures of the commercial power source.
The existing engine generator (250 kVA) is now being examined for possible use as a standby power source for the MF 10 kW transmitter (for Dhaka local broadcasting), etc.

The construction work to be undertaken by the Bangladesh side at their expense will include such work as the construction of a new transmitter building, a new antenna tuning hut and an engine-generator hut, and also the work of relocating the existing power cables presently on the site where the transmitter building is to be newly constructed.

As Radio Bangladesh already has considerable experience and achievements in the operation and maintenance of a 1,000 kW-class transmitting station and 100 kW-class transmitting stations, it is considered that there will be no problem in the technical aspects of operations after implementation of this project.

When this project is implemented, the following improvement will be obtained:

① The superannuated transmitter will be renewed, the reliability of the transmitter will be vastly enhanced and, at the same time, the procurement of spare parts for repairs will become feasible, thus leading to the solution of the problems relating to maintaining the functions of the equipment.

② Through the adoption of the more reliable parallel-operation system (50 kW × 2 sets), it will become possible to continue broadcasting even in the case of failure of one transmitter. This, coupled with the effects of ① above, will enable the establishment of a system capable of ensuring unbroken continuation of broadcasting.

③ Savings can be expected to be achieved with regard to the maintenance and management costs which hitherto have had to be spent in maintaining the functions of the superannuated equipment.

④ The coverage when transmission is conducted at 100 kW would be about 22% less than that which would be achieved with the 500 kW transmission plan (the original plan). By changing the transmitting frequency from the present 819 kHz to 630 kHz, the coverage area will be about twice as large as the present coverage because both the propagation loss and the interference are less at 630 kHz than at 819 kHz.

At present, the broadcasting over the nationwide network is conducted by having the broadcasting stations in regional cities receive the signals from the key station and having those stations rebroadcast the signals received. Since the broadcasts are conducted either in one-hop relays (e.g., from Savar to Chittagong) or two-hop relays (e.g., from Savar to Rajshahi and then to Bokra), the expansion of coverage and the improvement of reliability of the key station will mean an enhancement of the quality of broadcast waves throughout Bangladesh.

Coverage	Existing 819 kHz, 100 kW	Original Plan 630 kHz, 500 kW	Planned 630 kHz, 100 kW
Population (Coverage rate vis-a-vis total population)	30%	71%	(compared with the original plan) 49% (22% reduction)
Area (Coverage rate vis-a-vis whole country)	20%	61%	39% (22% reduction)

It is expected that, after the concluding of the Exchange of Notes (E/N) between the two Governments, about 3.5 months will be needed for the signing of a consultant contract, detailed designing and tendering. The scheduled term of construction after the signing of the construction contract will be a total of about 11.5 months, including about 6 months for the manufacture of equipment, about 2.0 months for transportation of

the equipment, and about 3.5 months for the installation, adjustment and inspection of the equipment.

Therefore, as a result of implementation of this project related to radio broadcasting in Bangladesh, a perfect system will be established for securing all the necessary radio waves and the area in which reception of broadcasts is feasible will be expanded. In addition, and the Savar Transmitting Station, as the key station for nationwide broadcasts, will contribute greatly to the development of broadcasting in Bangladesh by fully utilizing its potential for undertaking a wide range of work including the promotion of education and agriculture, reporting of news and weather forecasts, issuing of warnings against cyclones and other natural disasters and assisting in regional development.

As outlined above, this project under Japanese grant aid can be expected to prove extremely effective and, therefore, early materialization of the project is desirable.

CONTENTS

CHAPTER 1 INTRODUCTION

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In 1971 Bangladesh achieved independence, as a result of the Third India-Pakistan war. After that, political power had changed hands several times, but at present the Government of Bangladesh is implementing the Third-Five Year Plan (1985-1990) on the basis of the following targets.

1) Annual economic growth rate of 5.4%.

2) To achieve a total food output of 20.7 million tons in 1990 and to thereby endeavour to attain the nation's self-sufficiency in food supply.

3) To hold down, by 1990, the nation's population increase rate per annum to 1.8% (the average rate of population increase during the period from 1980 to 1985 was 2.6%).

In Bangladesh, with only a short history since its independence the promotion of agriculture, construction of the nation through regional development, and establishment of the national economy are urgent necessities. A particular problem at present is the low literacy rate of 26%. Therefore, programmes related to the promotion of education and agriculture, advancement of the population plan, unification of the nation, information on weather and cyclones, etc., are presented through means of radio broadcasting and great expectations are placed on this form of media which conveys information simultaneously over a wide area.

Previously, National Broadcasting Authority (NBA) has devised a project to renew the existing 100 kW radio transmitting facilities of Savar Transmitting Station, and provide a 500 kW (250 kW × 2 sets) of transmitting power. The Government of Bangladesh requested for grant aid of the Government of Japan for this Project. In response to this request, the Government of Japan decided to execute a basic design study for the project through Japan International Cooperation Agency (JICA) and sent a study team to Bangladesh headed by Mr.Kenji Kamei, Deputy Director, Frequency Planning Division, Telecommunications Bureau, Ministry of Posts and Telecommunications, from November 16 through December 3, 1988.

On the premise that Bangladesh side will obtain the approvals of the neighbouring countries regarding the Project to change the transmitter output power, the survey team conducted consultation with Bangladesh side in respect to the contents requested, the confirmation of background and confirmation of the scope which is to be the burden of Bangladesh side, as well as carried out investigation on the main facilities of Radio Bangladesh (RB) including field surveys for the Project.

However, as Bangladesh side was unable to obtain the approvals of neighboring countries through IFRB regarding the change in transmitting output power, the Bangladesh Government had modified the above project into the replacement of the superannuated 100 kW transmitter of Savar Station and change the transmitting frequency (from the present 819 kHz to 630 kHz), and had requested for grant aid of the Government of Japan again.

In response to the new request, JICA has carried out analysis of the project using the data based on the previous survey, and studied the effects and the appropriateness of the Project as an item of grant aid.

Then, JICA drew a draft final report and explained the contents to the Bangladesh Government at the site, and after confirmation of the contents, the basic design survey report was drawn.

The Report was prepared as a basic survey report including basic design, construction plan, implementation plan, project evaluation and proposals, etc.

It is to be noted that the minutes of discussion, staffing of the basic design study team, study schedule, etc., are collected in the reference materials (Appendices No. 1 - No. 4).

CHAPTER 2 BACKGROUND OF THE PROJECT

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2-1 Outline of the People's Republic of Bangladesh and the Utilization of Radio Broadcasting

(1) Topography

The territory of Bangladesh is a plain with an area of 143,999 km^2 (about 0.38 times the area of Japan) situated at latitude 20°30' - 26°45' N and longitude 88°01' - 92°56' E. The territory is a large delta zone, the biggest in the world, formed by two rivers, the Ganges originating in the Himalayas, and the Brahmaputra originating in Tibet, which join together and become a large river flowing into the Bay of Bengal. The Brahmaputra River divides the territory in a east and west direction, and the Ganges River divides the territory in a south and north direction. Thus, the territory is divided in four large regions.

The rivers occupy as such as 10% of the territory of the country. The altitude of the rivers is almost 10 m above sea level excluding the hilly zone in the south-east part of Chittagong Hill Track and the north-east part of Sylhet, etc., and in the rainy season about half of the country's land is under water. The southern part of the country borders on the Bay of Bengal and the east, north and west parts are surrounded by India. The south-east part is the border zone with Burma. The majority of the territory is flat and it is an accumulation of alluvial soil.

(2) Weather

The temperature is uniform. In the winter season, the temperature is between 9.8°C ~ 13.4°C, and in the summer season it is between 25.5°C ~ 26.0°C. The highest average temperature in January is between 24.1°C ~ 25.8°C, and in July it is between 29.9°C ~ 31.8°C. The annual rainfall is 1270 mm in the western part, 2540 mm in the northern and eastern parts. In the mountainous zone of the Sylhet region, it rains as much as 5080 mm. The rainfall is frequently

accompanied by cyclones and typhoons of tropical atmospheric pressure.

1) The climatic conditions of Dhaka City are indicated in the following table.

Item \ Month		1	2	3	4	5	6	7	8	9	10	11	12
Humidity (%)	Min.	34	24	23	34	41	61	51	61	63	42	37	34
	Max.	92	89	85	89	88	91	94	92	92	92	89	93
Wind Velocity (m/s)	Max. record	7	16	20.1	19	24.5	10.8	10.7	6.7	12.3	23.2	10.3	6.5
	Average Velocity	7.6	1.7	2.2	2.7	2.5	2.2	2.1	2.0	1.8	1.7	1.3	1.2
Rainfall (m/m)	Max.	99	95	195	318	708	856	891	540	566	568	172	86
	Min.	0	0	0	17	69	161	140	92	91	29	0	0
	1986-87 average	4	0	33	230	169	297	526	462	363	104	7	33
Temper -- ature (°C)	Max.	34.2	36.6	40.6	42.3	40.6	38.2	35.2	35.9	35.3	38.8	33.3	31.2
	Min.	5.6	4.5	10.4	15.6	18.4	20.4	21.7	21.0	22.0	10.4	17.6	6.7
	1986-87 Max.	26.7	30.4	33.2	33.8	34.9	34.0	31.4	31.9	32.3	32.4	30.3	27.4
	1986-87 Min.	13.1	16.4	20.7	23.9	24.7	27.2	26.5	26.6	26.6	24.3	20.2	15.2

2) Cyclones

The atmospheric low pressure that is generated in tropical waters is called a tropical cyclone, and such cyclones with maximum wind velocity over 33 m/s occur above the Indian Ocean. These correspond to the so-called typhoons of Japan which occur most often in the rainy season between March and October, especially between May and June.

There is a record (received from Radio Bangladesh) of a cyclone in 1985 which had a wind velocity of 160 m/h (46 m/s), a flood-tide of 7.5 m, which caused over 15,000 deaths.

In 1988 there was a particularly unusual atmospheric phenomenon which occurred. In August two-thirds of the country's territory was covered with the worst flood which had ever occurred. As a result of this flood, some 40 million people lost their houses. Following this catastrophe, in the middle of November, a cyclone with a wind velocity over 30 m/s hit the coastal zone centered on the southern Bay of Bengal, and about 1500 people were killed or missing. Furthermore, in late November, a cyclone with a record-breaking wind velocity of 180 Km (50 m/s) hit the Bengali coast and the south-west region. Even in Dhaka City, a great number of houses collapsed and electric power lines and communication lines were cut off. More than 1000 people were killed and more than 6000 people were missing. There was also great damage to cereals, cattle, etc.

As for records of severe cyclones, the following are given. Atmospheric conditions in 1988 were particularly unusual.

- 1985-46 m/s (Data received from R.B.)
- August 1988-30 m/s (The Bangladesh Times)
- November 1988-50 m/s (The Bangladesh Times, The World News)

Most of the records given above are those of the southern region of Bangladesh including the Bay of Bengal, but in November 1988, even in Dhaka City there was a recorded wind velocity of about 30 m/s observed.

It is very important to broadcast weather information exactly and promptly, including cyclones, from the view point of saving lives of many people and to protect their properties. Therefore, a highly reliable broadcasting is desired.

As close contact is maintained between RB and Meteorological Bureau by means of telephone and tele-printer, RB is able to obtain the latest information for emergency broadcasting, and is ready to prepare for disasters.

(3) State of Population and Education

One well-known feature of Bangladesh is that it has a large population. On the basis of the National Census 1981, the population prediction which the Ministry of Health and Population Control made in the "Third Five-Year Plan is as follows (1984 ~ 1985 Statistical Yearbook of Bangladesh).

1981	87.1 million people	(National Census)
1985	99.2 million people	
1986	102.9 million people	
1987	104.1 million people	
1988	106.6 million people	
1989	109.1 million people	
1990	111.7 million people	

The average rate of increase per year is 2.8% and as the population density was 605 people/km^2 in 1981, it will become 775 people/km^2 in 1990. In respect to the composition according to age, the number of school age persons (age from 5 ~ 24) was 46.9% of the whole population.

The population density of Bangladesh is about more than twice of that of Japan. For this reason suppression of population is one of the important policies for the Third-Five year plan, aiming at 1.8% increase by the year 1990. To achieve this target, nationwide enlightenment programmes are being broadcast through Programmes A, B and C. Among the daily broadcasting hours, the rate of these programmes is between 3 ~ 7%.

In primary schools, five years are compulsory education. The rate of persons attending school is: primary school (age from 5-9) 72.8%; secondary school (age from 10 ~ 14) 22.17%; and college, institutes and university (age from 15 ~ 24) 2.03%.

The classification of kinds of schools/number of schools, and the ratio of teachers/students are as follows:

Classification of schools	Number of schools	Teacher/Students
Primary school	43,865	1 : 52
Secondary school	8,551	1 : 27
Professional school (Regular)	657	1 : 30
Institutes (Commerce & Industry, Professional and Religious, etc.)	3,548	
University	6	1 : 16

The literacy rate was 26% in 1985 (male : 40%, female : 18%). (Year-Book of South-East Asia)

Diffusion of education and development of human resources are the important policies for the Government's Third-Five year plan. The rate of educational budget of fiscal year 1983 corresponds to about 3.4% of the total budget. Programme-B from Savar Transmitting Station is a broadcast toward the whole country and the feature of the programme is education.

Of the daily broadcasting hours the rate of these programmes is about 12%.

Besides this programme, there is a Programme-C which is composed of educational programmes mainly for the metropolis.

(4) National Economy of Bangladesh

The outline is as follows:

1) Gross National Product (GNP) : 15,840 million dollars (1986)
2) Economic Growth Rate : 4.5% (1973 ~ 1985)
3) GNP per Person : 157 dollars (1986)
4) Rising Rate of Consumer Goods : 10.7% (1985)
5) International Balance of Payments

(unit : million dollars)

	1980	1986	1987		
Export	793	880	1077	Trade Balance	Current Account
Import	2353	2301	2458		
Receipt	288	427	304	Excluding Trade Balance	
Deficit	551	670	655		
	2451	3064	3151	Transfer Balance [Note]	

Note: Includes economic cooperation such as compensation, donations and grant aid (National Statistics Directory 1988)

6) Economic Cooperation : Total amount of Official Development Aid (ODA) 248.5 million dollars, of which 49.4 million dollars are grant aid (1986)

(5) National Development Plan

The present administration has converted the former administration's policy by returning the factories to the private ownership, and is promoting a new industrial policy which is mainly based on private enterprise.

In the Third Five-Year Plan (1985 ~ 1990), the amount of investment is 386,000 million TK (including about 210,000 million TK of foreign aid). The contents of the Plan are as follows:

1) Expansion of industrial employment
2) Limiting of the rate of increase of the population
3) Popularization of elementary education and development of human resources
4) Reform of structure and development of technical foundation for accomplishment of long-term plans
5) Self-sufficiency in food production
6) Meeting the fundamental requirements of the nation
7) Promotion of economic growth
8) Promotion of self-sufficiency

In order to accomplish the targets of the Government's development plan, it is necessary to notify the objectives exactly to the whole nation. Therefore, radio broadcasting is an essential medium. Especially for the accomplishment of self-sufficiency on food production, it is very important to provide proper information for people engaged in agriculture which occupies 65% of the total labour population. Therefore, RB is allocating about 5 ~ 10% of daily broadcasting hours of each of the Programmes-A, B, and C for this purpose. In addition to this, public information of the Government is also broadcast daily through each of these programmes in combination with news and programmes toward the whole nation.

2-2 State of Broadcasting in the People's Republic of Bangladesh

2-2-1 Radio Broadcasting

(1) History

The radio broadcasting service was commenced in 1939 during the rule of Great Britain, and the present Radio Bangladesh (RB) became the National Broadcasting Organization since in September 1972, after the era of East Pakistan (1947-1971).

From the recognition that broadcasting is indispensable for the security and development of the country, the Bangladesh Government is making every endeavor to enhance the radio broadcasting facilities through the First Five-Year Plan (1974-1979) and the Second Five-Year Plan (1980-1985).

(2) Organization and Staff

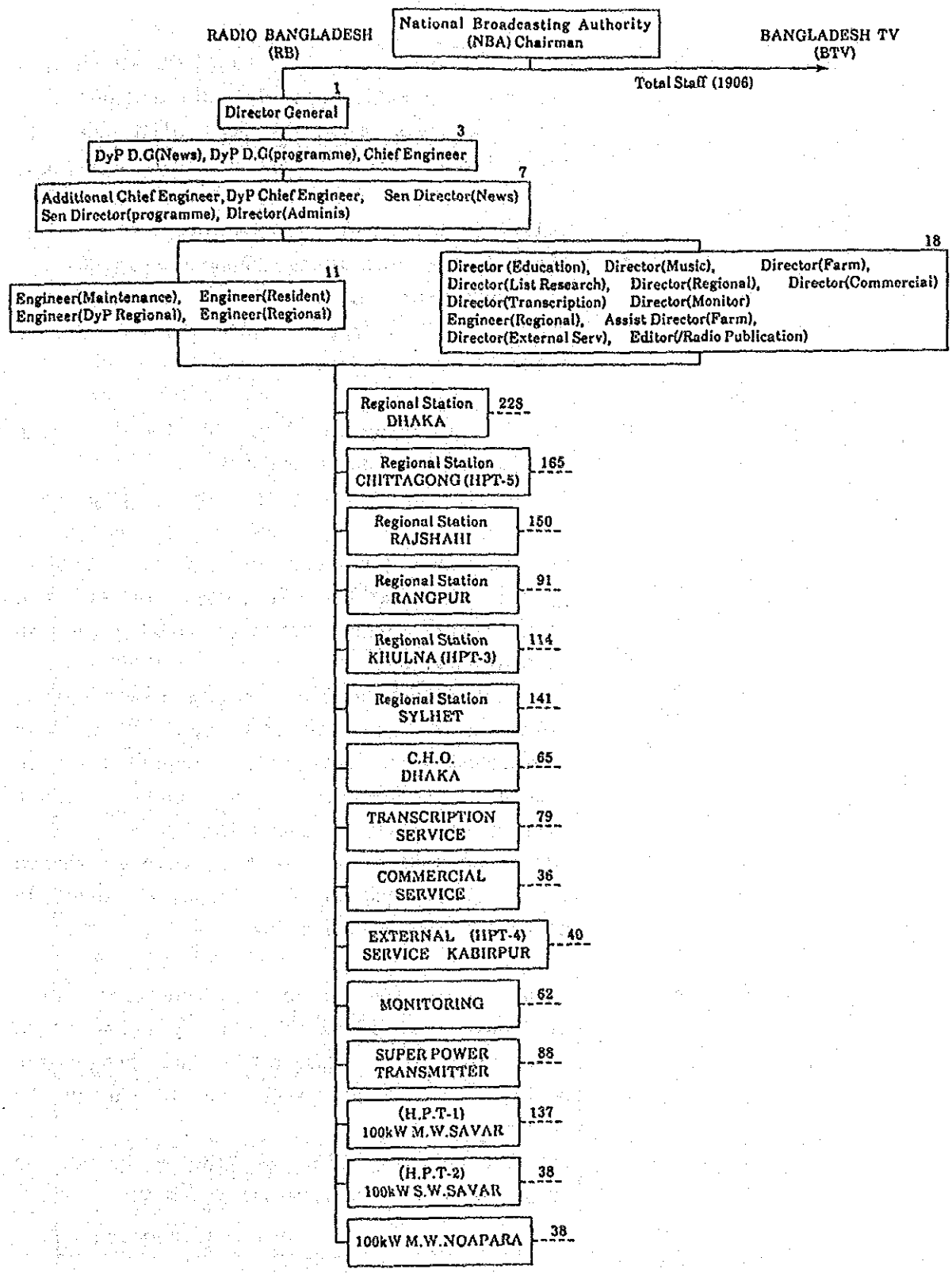
NBA is composed of two organizations, RB and Bangladesh Television (BTV), and the operation of broadcasting undertaking is unified. At present, three radio systems and one television system are in operation. The Ministry of Information had been directly controlling the broadcasting organizations, but based on the President's order in 1987, one independent "Board of Management" was established as the controlling organization.

Table 1 is the organization chart of the total staff of 1906 members of Radio Bangladesh.

(3) Programmes

RB as well as BTV is producing and transmitting programmes in accordance with the general programme principles established by NBA. In the general principles, four targets of the radio and television service as an intensive form of mass media are described. These are "Conveyance of Information", "Popularization of Education", "Enlightenment of Enterprise Development" and "Presentation of Healthy Entertainment".

Table 1 Organization Chart of NBA



At present, the three medium wave systems as follows are broadcasting to the entire country, and the details of transmissions are given in Table 2.

1) Dhaka Programme-A : This is a broadcast from the 1000 kW Dhamrai Transmitting Station to the entire country. The programmes broadcast deal with news (in Bengali and English), agriculture, religion, music, weather forecasts, family planning, military personnel information, etc., and the contents are given in Appendix No. 6-1. The broadcasting time is: 6:00(winter season, 6:30) ~ 10:30, and 17:00 ~23:30, or about 11 hours a day.

2) Dhaka Programme-B : This is a broadcast from the 100 kw Savar station to the entire country. The programmes deal with news (in Bengali and English, etc.), agriculture, religion, school and general education, weather forecasts, family planning, music and commercials. The contents are given in Appendix No. 6-2. The difference between Programme-A is that programmes related to education and commercials are composed. Especially, in respect to commercials, they occupy almost half of the daily broadcasting hours. The broadcasting time is 6:00 (winter season 6:30) ~7:30, and 10:30 ~ 23:30, or about 14 hours and 30 minutes a day.

3) Dhaka Programme-C : This programming is transmitted from Savar Station. It is local programming centered on Dhaka including commercials and programmes partly from Programme-A and B (Refer to Appendix 6-3). The broadcasting time is 7:30 ~ 22:00, or about 14 hours and 30 minutes a day.

Table 2 Broadcasting Hours & Breakdown of Broadcasting Programmes, Transmitted from Dhaka MW Radio Station

Programme	Broadcasting Hours	Ratio
Programme A		
Weather Forecast & Information	20min.	3%
News & Related Topics	2h 5min.	19%
Religious & Related Topics	1h 5min.	10%
Cultural Topics	1h	9.2%
Family Planning & Related Topics	20min.	3%
Music	3h 30min.	32%
For Army Personnel	35min.	5.3%
Agriculture	1h 15min.	11.5%
National Hook-up	15min.	2.3%
Others	30min.	5%
Programme B		
Weather Broadcast	15min.	1.72%
News & Related Topics	45min.	5.2%
Religious & Related Topics	1h 15min.	8.6%
Educational & Cultural Topics	1h 40min.	11.5%
Family Planning & Related Topics	55min.	6.3%
Commercial Programmes (Advertizements	6h 35min.	45.4%
/ Music)	2h 05min.	14.4%
Music	10min.	1.2%
For Regions	5min.	0.6%
Agriculture	45min.	5%
Other		
Programme C		
Weather Forecast	15min.	1.7%
News	1h45min.	12%
Religious & Related Topics	25min.	2.9%
Educational & Cultural Topics	2h10min.	15%
Family Planning & Related Topics	50min.	5.7%
Music	5h15min.	36.2%
Commercial (Advertizements / Music)	1h55min.	13.2%
For Army Personnel	35min.	4.1%
Agriculture	1h	6.9%
National Hook-up	20min.	2.3%

Hour : h, Minute : min.

(4) Broadcasting System

The broadcasting system for RB is as shown in Fig. 1.

1) Each of the local stations shown in Fig. 1 receives the signals transmitted from Dhamrai and Savar Transmitting Station and then, each local station converts the frequencies received and rebroadcasts them throughout the country by means of the broadcast wave relaying system.

These stations are equipped with programme production facilities, and produce programmes suitable for the local audience. The programmes produced are combined with Programme-A or Programme-B format for nationwide broadcast relaying and are broadcast to each region.
In respect to the origin of programmes, about 80% of them are produced at local stations.

2) The Programme-C format is for local broadcasting for the coverage of areas centered on Dhaka City.

(5) Coverage

In Fig. 2 the coverage of Programme-A, Programme-B and Programme-C are shown.

The coverage shown is the case of the daytime in the dry season, it is the condition of minimum coverage throughout the year.

ⓐ Curve 1 : In the area surrounded with this curve, it is possible to receive "Programme-A" broadcasting from Dhamrai Transmitting Station in a good condition. In this area, about 80% Of the total population of the country is dwelling. The area corresponds to 67% of the total area of the country.

ⓑ Curve 2 : In the area surrounded with this curve, it is possible to receive Programme-B broadcasting from Savar Transmitting Station in a good condition. In this

area about 30% of the total population of the country is dwelling. The area corresponds to 20% of the total area of the country.

© Curve 2 : In the area surrounded with this curve, it is possible to receive Programme-C broadcasting from Savar Transmitting Station.
In this area about 7% of the total population of the country is dwelling. The area corresponds to 3% of the total area of the country.

(6) Radio Broadcasting Facility

1) Programme Production Facility in Dhaka
The Radio Broadcasting House [Note] in Dhaka was constructed (1981 through 1983) under the Japanese Grant Aid. It is a standard facility consisting of 10 radio studios, one auditorium, a master control facility, power source facility and air conditioning facility.

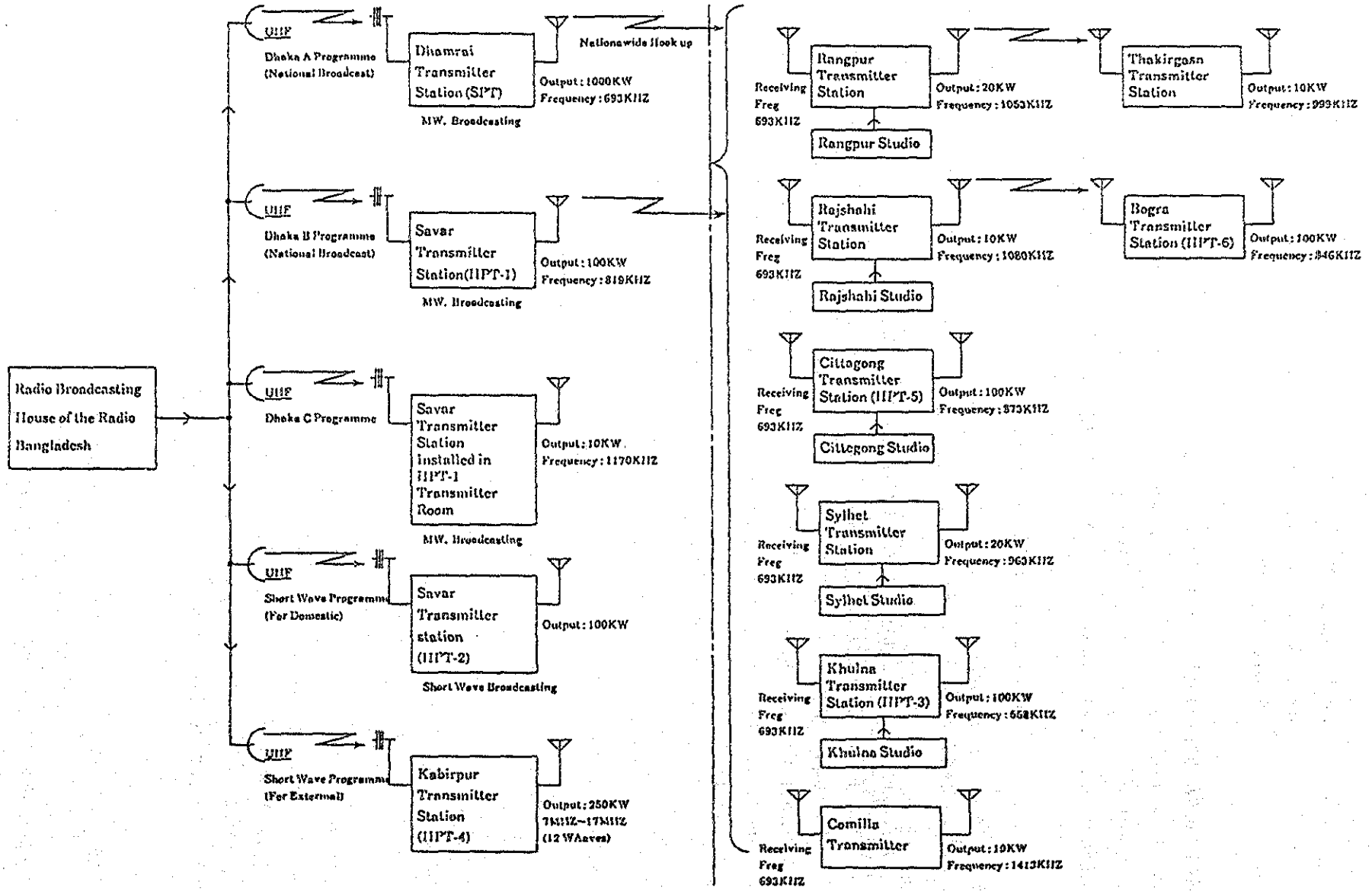


Fig. 1 Diagram of Broadcasting System of Radio Bangladesh

Programme	Frequency (kHz)	Power (kW)	Coverage (%)		Remarks
			Population	Area	
A	693	1000	80	67	Curve 1, Existing
B	819	100	30	20	Curve 3, Existing
C	1170	10	7	3	Curve 4, Existing

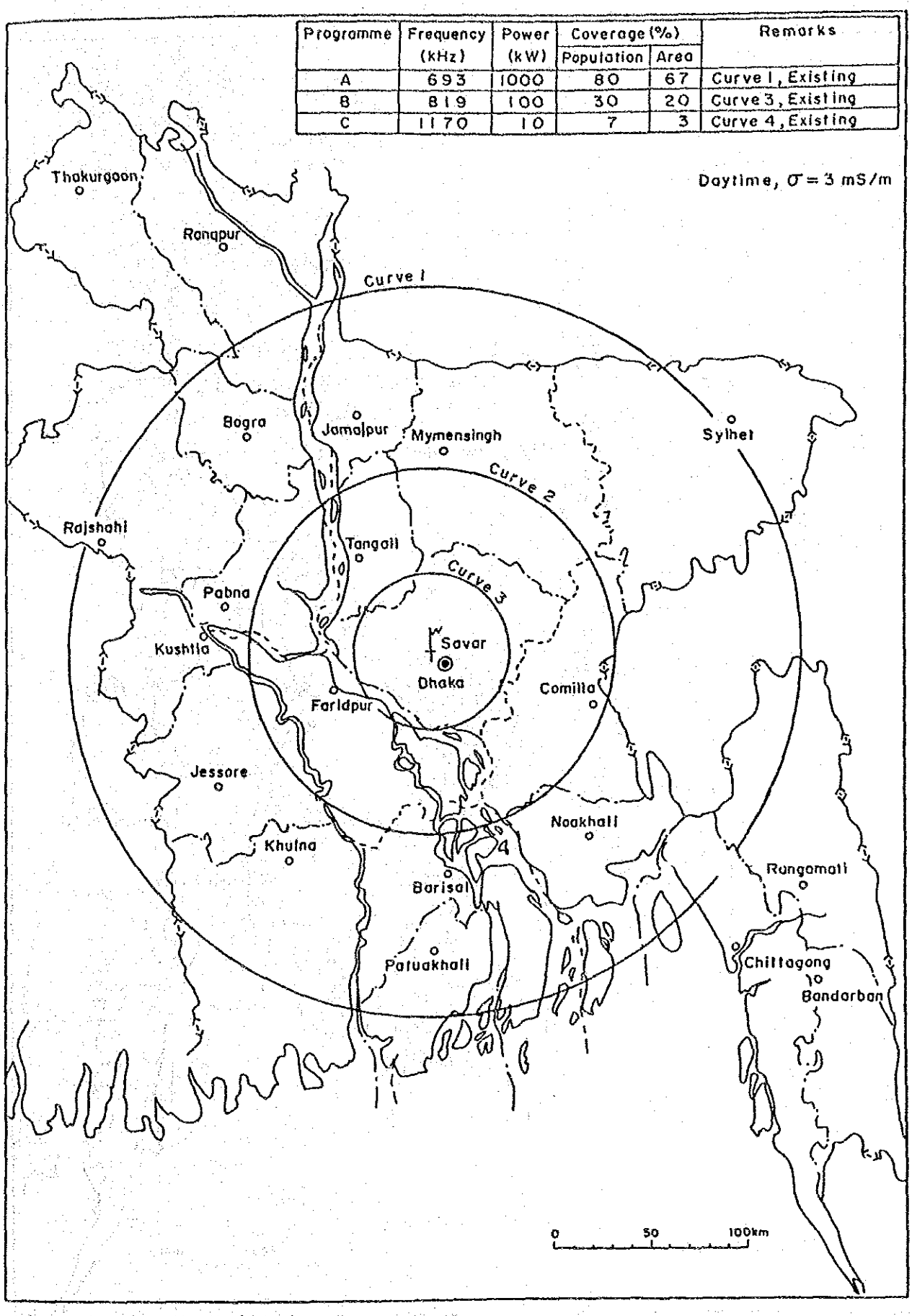


Fig. 2 Expected Coverage of Each Programme

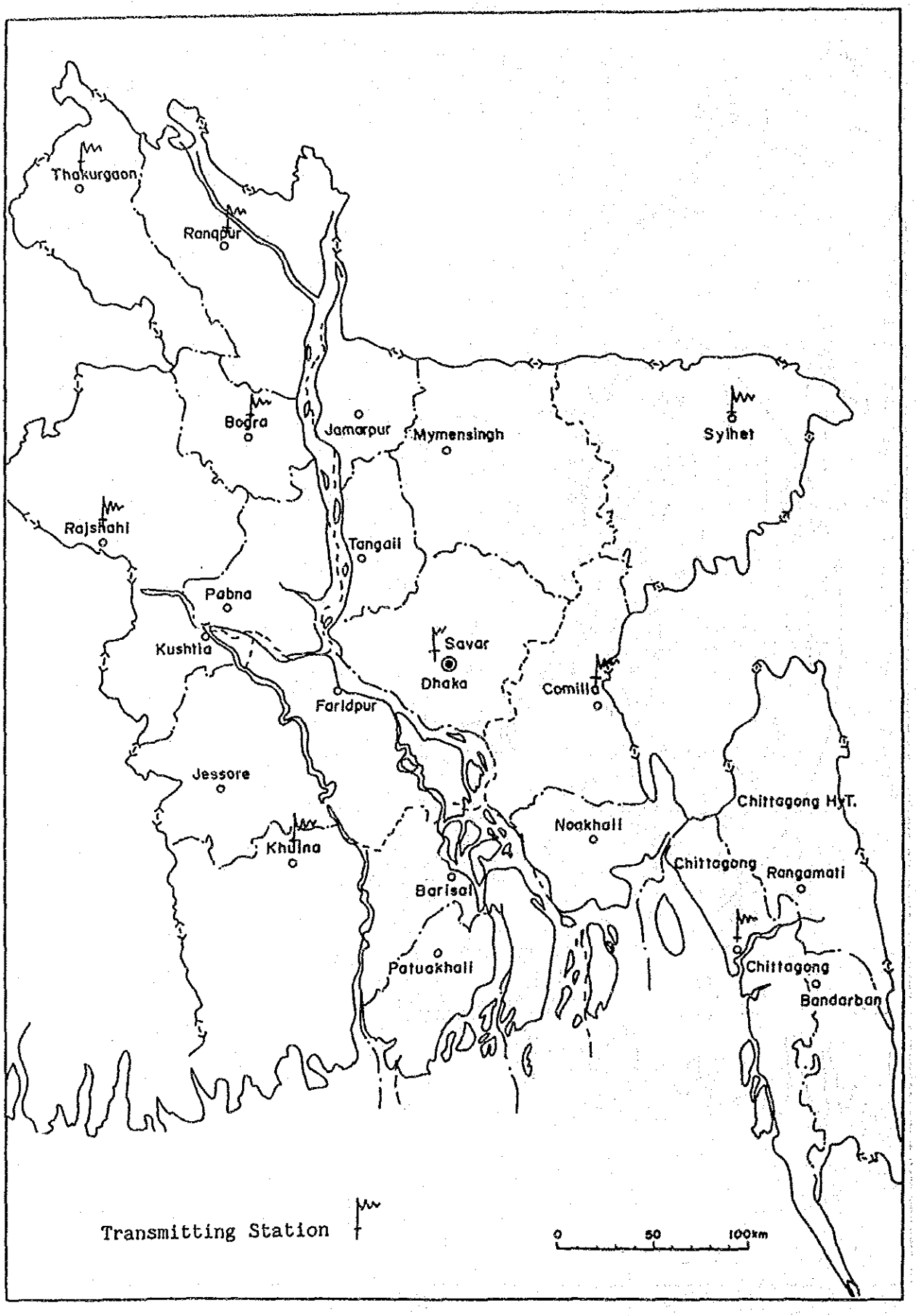


Fig. 3 Location of Transmitting Stations

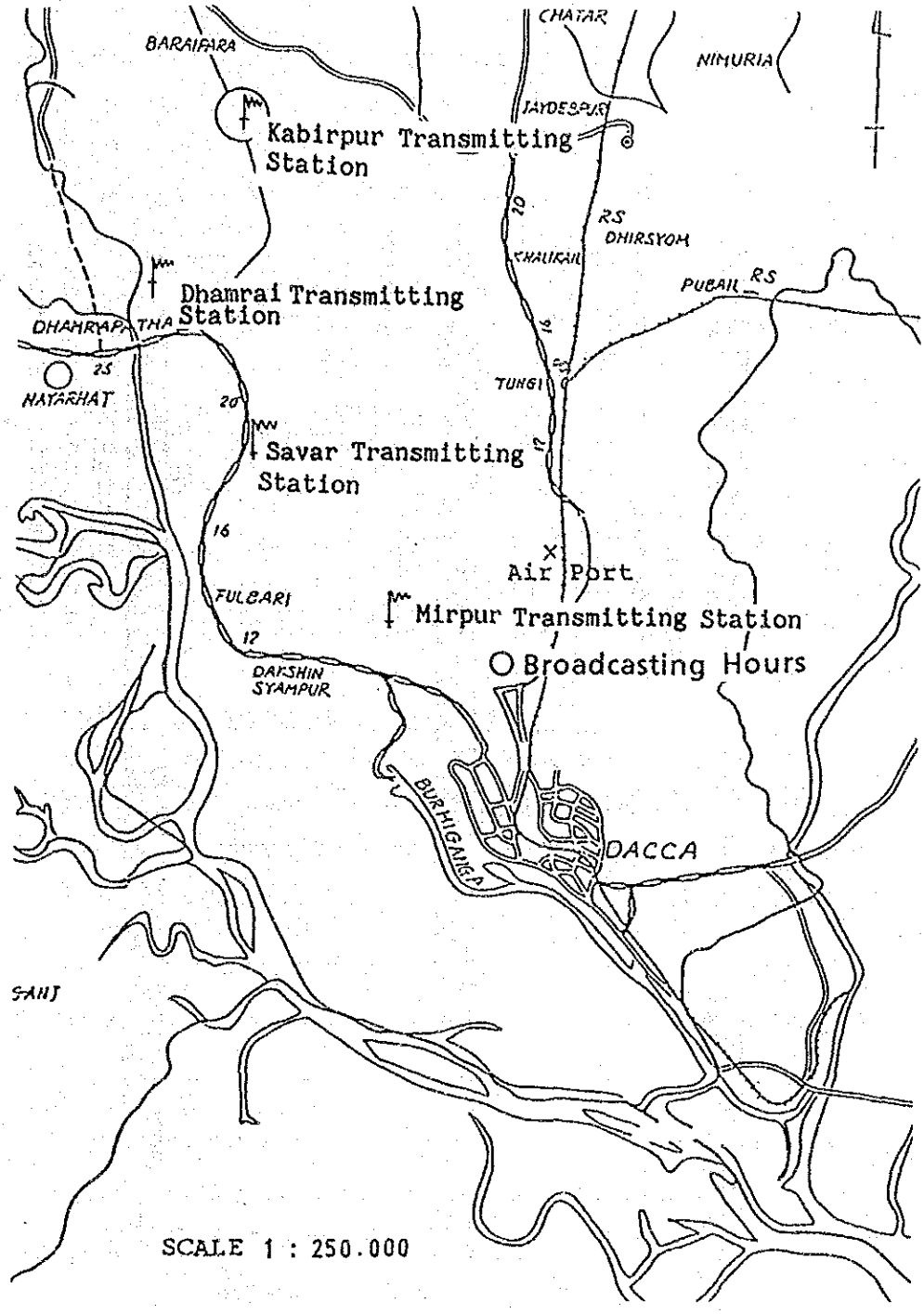


Fig. 4 Location of Transmitting Station (around Dhaka city)

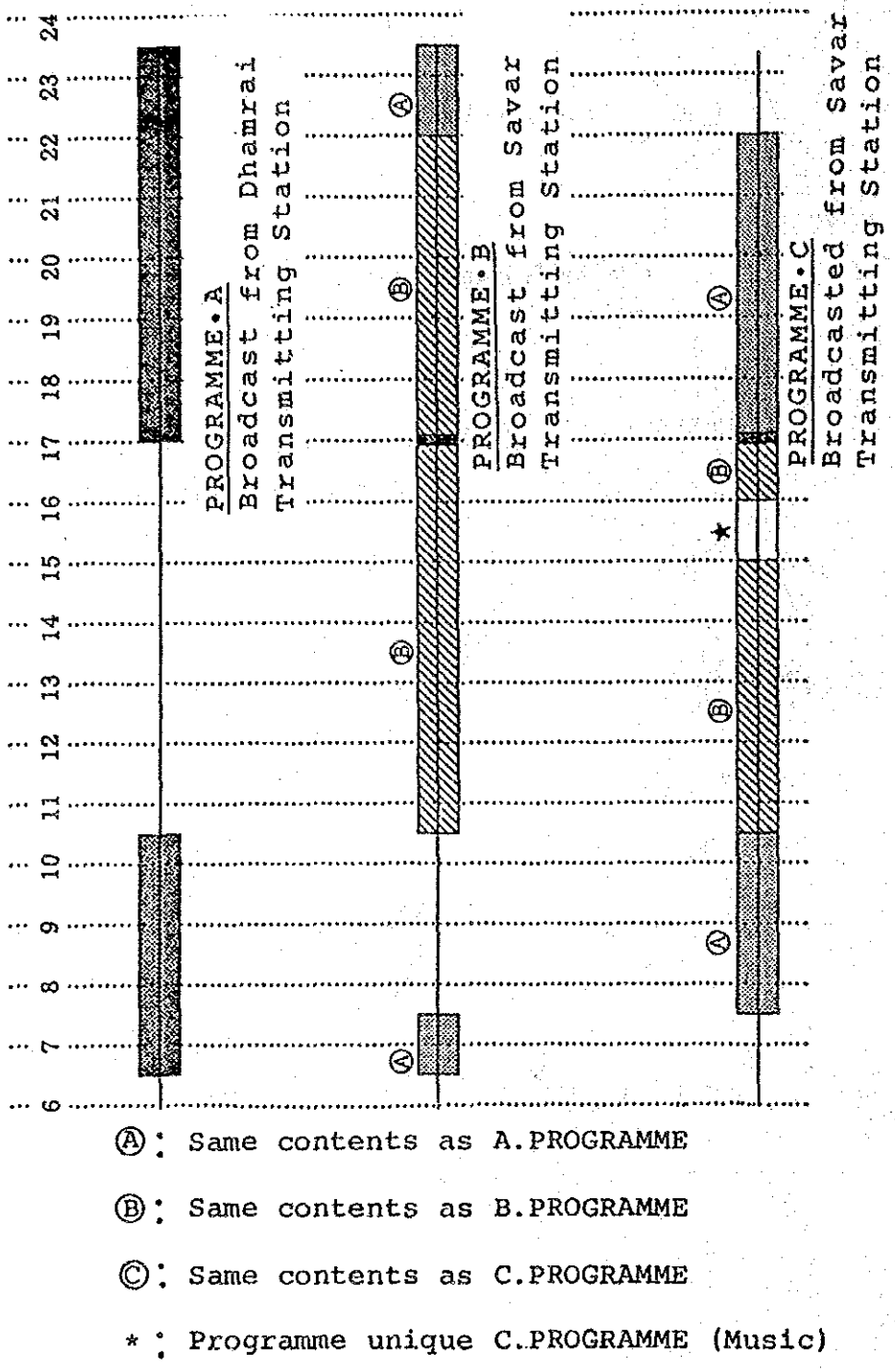


Fig. 5 Present State of Broadcasting Programme from Dhaka

The auditorium is used for multipurposes. At Dhaka Station, three programme systems are broadcast throughout the country, namely Programme-A (11 hours a day on the average), Programme-B (14.5 hours a day on the average) and Programme-C (14.5 hours a day on the average), as well as domestic shortwave service and shortwave service for foreign countries. The rate of use of the studio is extremely high; it is almost impossible to rehearse the programmes. Therefore, the programme composition is poor and the addition of studios is required to solve this problem.

Note : The programme production studios in the Broadcasting House are equipped with facilities to produce programmes (A, B, C and foreign service) and functions for sending the programmes to transmitting stations Savar, Dhamrai and Kabirpur.

2) Medium Wave Transmitting Facility

At present, the medium wave transmitting stations in operation are the 1000 kW super high-power Dhamrai Transmitting Station, 100 kW high-power Savar Transmitting Station and high-power transmitting stations such as Chittagong, Khulna and Bogra, for a total of 11 stations. In Table 3, the medium wave radio transmitting facilities in Bangladesh are shown. It is be noted that in Dhaka, there are medium wave transmitting stations as follows.

ⓐ 1000 kW Transmitting Facility

The transmitter is installed at Dhamrai in the suburbs of Dhaka City, operating on 693 kHz. The facility is a parallel operation system of two 500 kW transmitter sets, but only one set is in operation, and the other is a standby.

The nationwide broadcasting conducted by this station is called Dhaka Programme-A.

ⓑ 100 kW Transmitting Facility

The transmitter is installed at Savar Station in the suburbs of Dhaka City, operating on 819 kHz. It is the object of this project. The broadcasting conducted by this station is called Programme-B.

The details of installations are given in the items 3 of Chapter 2. The Fig. 7 shows the layout of the site of the Savar Transmitting station and the Fig. 8, the layout of the Savar Transmitting Station building.

© 10 kW Transmitting Facility

The transmitter is installed in the 100 kW transmitter room of the above-mentioned Savar Station, operating on 1170 kHz. It is for local broadcasting centered on Dhaka City and is using material from Programme-A and Programme-B for its broadcasts. This is called Programme-C. (See Fig. 5.)

3) Domestic Shortwave Transmitting Facility in Dhaka

A shortwave transmitter facility is installed in the Savar 100 kW medium wave transmitter room, and in the separate station building in the site of Savar Transmitting Station, for domestic service.

4) Shortwave Transmitter Facility for Foreign Service

Service for foreign countries is transmitted from the two 250 kW transmitters in Kabirpur Station at about 30 km north-northwest of the Broadcasting House. They are operating on 12 frequencies between 7MHz ~ 17MHz.

Table 4 shows the state of foreign broadcasting service conducted in Bangladesh.

Table 3 Medium Wave Transmitter Facilities in Bangladesh

Transmitting Station	Opening of Station	Frequency (kHz)	Output Power (kW)	Remarks
Dhamrai *1 (Dhaka)	1974	693	1000 (500kw×2 sets)	Programme-A (Furnished by USSR)
Savar *2 (Dhaka)	1963 1982	819 1170	100 10	Programme-B (RCA make) Programme-C (Japanese make)
Mirpur		819	10	Standby for Savar 100 kW
*4 Chittagong	1988	873	100 (50kw×2 sets)	Renewal, 10 kW to 100kW *6
Khulna *3	1981	558	100 (50kw×2 sets)	
Rajshahi	1951	1080	10	
Sylhet	1961	963	20	with standby 10kW
Rangpur	1967	1053	20	〃
Comilla	1984	1413	10	〃
Bogra *5	1988	846	100	with standby 100kW
Thakurgaon	1988	999	10	with standby 10kW

*1 Called SHPT (Super High-Power Transmitter Station)
*2 Called No.1 HPT (High-Power Transmitter Station)
*3 Called No.3 HPT (High-Power Transmitter Station)
*4 Called No.5 HPT (High-Power Transmitter Station)
*5 Called No.6 HPT (High-Power Transmitter Station)
*6 Japan's Grant Aid

It is to be noted that No.2 HPT Station is the Shortwave Transmitting Station in Savar for Domestic Service, and No. 4 HPT Station is the Shortwave Station in Kabirpur for Foreign Service.

Table 4 Present State of Foreign Broadcasting Service

Language, etc.	Broadcasting Hours	Transmitting Frequency(kHz)
Arabic	16:00 - 16:30	9945 / 13670
Bengali	06:30 - 08:00	15625 / 17670
	16:30 - 18:00	9945 / 13670
English	12:30 - 13:00	15525 / 17645
	18:15 - 19:00	9815 / 11553
	19:00 - 19:15	9815 / 11553
Hindi	15:15 - 15:45	9640 / 11745
Nepalese	13:15 - 13:45	7105 / 9775
Urdu	14:00 - 15:00	9640 / 11745
Voice of Islam	08:00 - 08:30	15625 / 17670

5) Radio Programme Transmission Facility

At present, RB does not use particular communication lines for the transmission of nationwide radio programmes, but mainly uses medium wave and shortwave broadcast wave relaying. For this reason, first of all there is a problem of noise and deterioration of sound quality, and especially fading and interference are remarkable.

To solve these problems, the only method is to lease communication lines from Bangladesh Telegraph and Telephone Board (T & T) for the transmission of programmes. Fortunately, T & T is operating a nationwide micro-wave link (Telephone 1800 channels, with standby) and all the links are installed at the locations of RB's regional stations. For the programme transmission of radio broadcasts, a band width of 10 kHz is necessary, but this requires only three

channels of telephone lines. The facilities to prepare are a modulator/demodulator for wide-band (10 kHz) transmissions and some transmission lines between the terminals of T & T and RB Broadcasting House.

A schematic diagram of the related transmission links for relaying programmes is shown in Figs. 6-1, 6-2 and 6-3.
The programmes produced at the studio of National Broadcasting House become audio signals, and after adjustment of signals at the master control room, they are converted into UHF signals at the STL (Studio to Transmitter Link) room, and then transmitted to the main transmitting stations, such as Savar and Dhamrai.

6) State of Popularization of Radio and Television in Bangladesh
According to the Bangladesh Bureau of Statistics, the number of radio receiving sets was estimated at 2,300,000 in 1981, but in the Southeast Asian Handbook 1986, it was indicated as 4,500,000, and so a dramatic increase can be seen. Assuming that the population is 100 million, about one in every 3~4 households will have a receiver (1986).

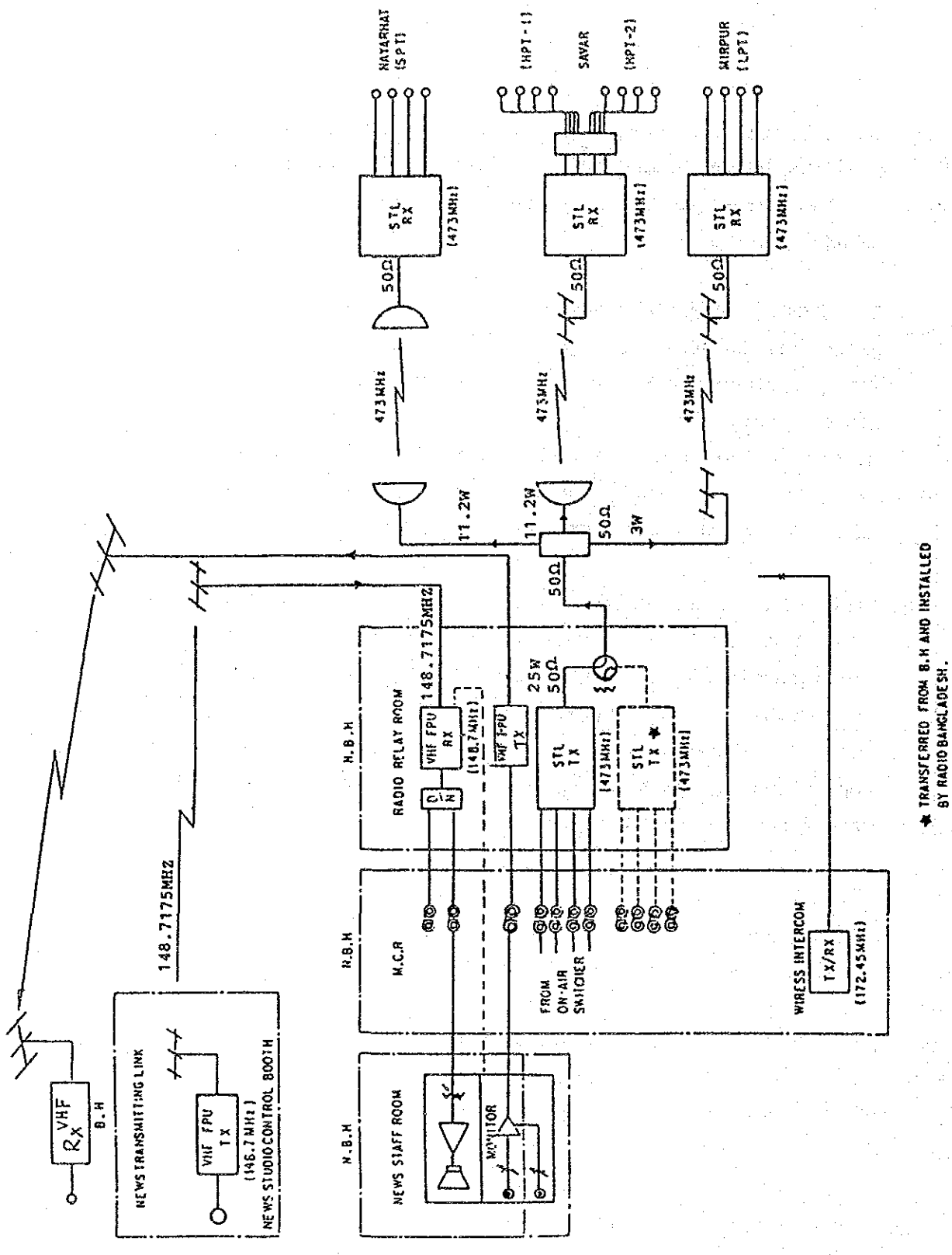
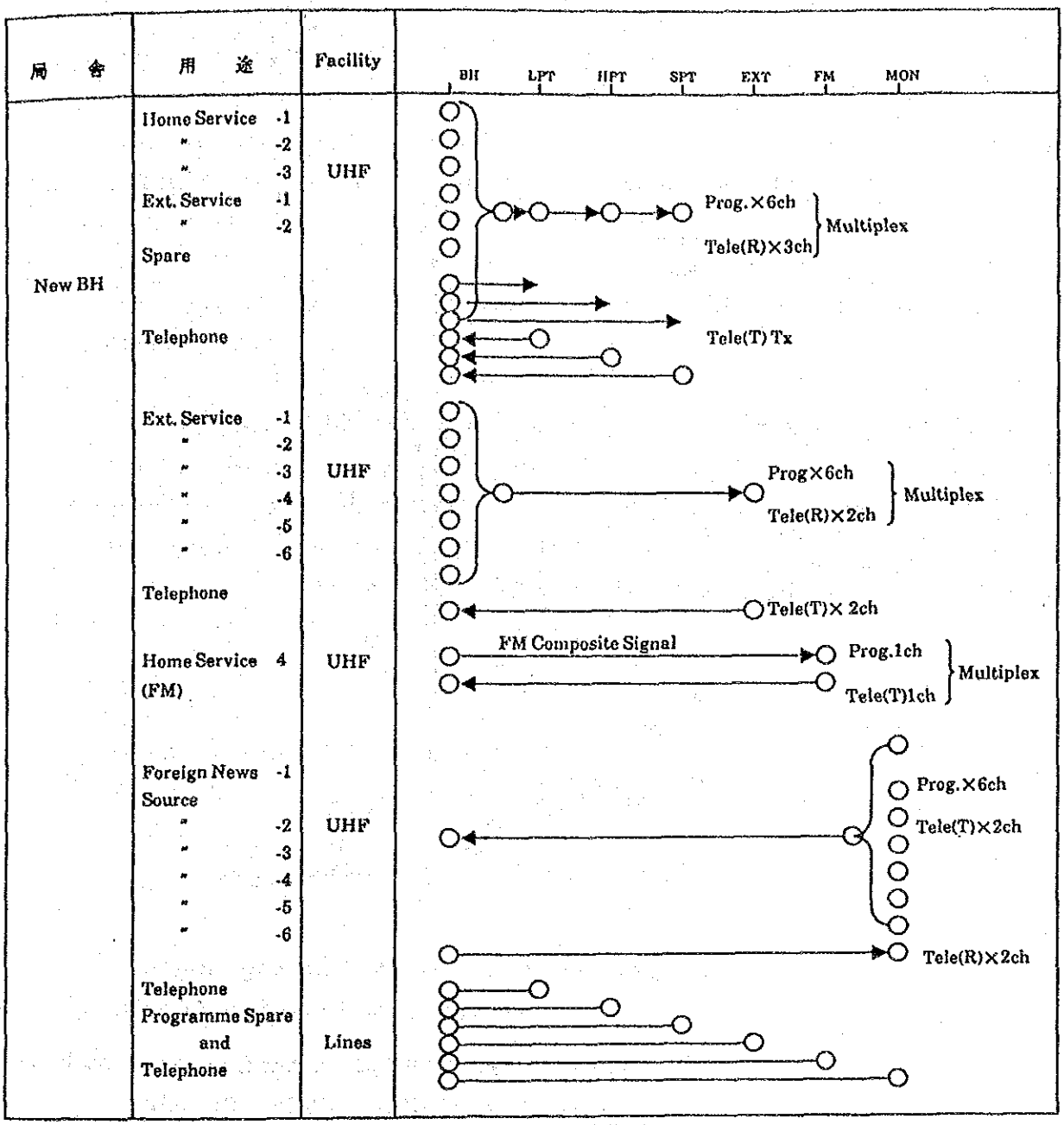
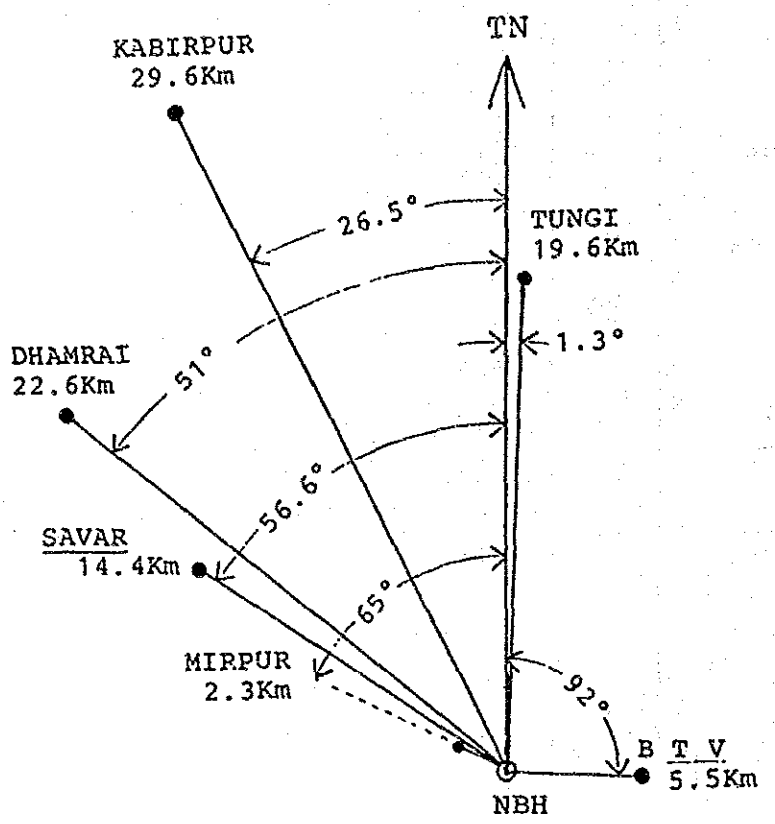


Fig. 6 - 1 Block Diagram of Programme Transmission System from NBA Broadcasting House to Main Broadcasting Facilities in Suburbs of Dhaka



Note: BH : Broadcasting House
LPT : Mirpur Transmitting Station
HPT : Savar Transmitting Station
SPT : Dhamrai Transmitting Station
EXT : Kabirpur Transmitting Station
FM : VHF FM Transmitting Station
MON : Tungi Monitoring Station

Fig. 6 -2 Block Diagramme of Programme Transmission System from NBA Broadcasting House to Main Broadcasting Facilities in Suburb of Dhaka



NBH: National Broadcasting House
(Radio Broadcasting Centre)

MIRPUR: 10kW,819KHZ (standby of SAVAR 100kW)
SAVAR:100kW,819KHZ, HPT-1 Station
DHAMRAI: 1000kW,693KHZ,SHPT Station
KABIRPUR: 250kW,7 17MHZ, HPT-4 Station
TUNGI: Monitoring Station

Fig. 6 -3 Relative Location of Main Transmitting Stations Centered around National Broadcasting House

2-2-2 Television Broadcasting

The television broadcasting service started in 1964, and following this, the commencement of colour programming was in 1980. The color standard adopted is PAL-B.

In 1984 BTV became an organization affiliated with the National Broadcasting Authority as did RB.

In the East Pakistan era of 1970, four television stations were constructed under the eighth yen loan from Japan. After that, based on the Japanese Grant Aid, BTV accepted a small TV van (1977), enhanced the Dhaka studio (1978) and constructed an auditorium (1978).

The state of television transmitting stations is as shown in the following table.

Table 5 List of Television Transmitting Stations

Name of Station	Channel	Output Power	Remarks
Dhaka	ch-9	10kW	-
Dhaka	ch-6	〃	Operation is Suspended
Rangpur	ch-6	〃	-
Natore	ch-8	〃	-
Mymensingh	ch-12	〃	-
Sylhet	ch-7	〃	-
Khulna	ch-11	〃	-
Noakhali	ch-12	〃	-
Chittagong	ch-5	〃	-
Satkhira	ch-7	1kW	-
Rangamati	ch-8	〃	-
Cox's Bazar	ch-10	〃	-

Broadcasting Times : Saturday ~ Thursday : 17:00 ~ 23:40 (6 hours 40 minutes), Friday : 15:00 ~ 23:40 (8 hours 40 minutes)
Total broadcasting hours a week: 48 hours and 40 minutes.

According to the data of the Bangladesh Bureau of Statistics, the number of television sets was estimated at 160,000 in 1981, and in the Southeast Asian Handbook (1988), it was indicated as 410,000 sets (one set for about every 40 households), a trend of rapid increase.

2-3 Present State of Savar Transmitting Station

2-3-1 Outline

In the 75 acre (304,000 m²) site, the station buildings of HPT-1 (the 1st High Power Transmitting Station) and HPT-2 (the 2nd High Power Transmitting Station) and antennas for the medium wave and shortwave transmitters are installed.

In the HPT-1 Transmitting Station, three transmitters—100kW, 819 kHz (the object of the Project); 10 kW, 1170 kHz and 100 kW shortwave (for domestic broadcasts)—are installed in the same transmitter room. The operation and maintenance are carried out by 138 persons (of these persons, about 56 are the technical staff).

The 100 kW, 819 kHz transmitter, which is the object of this Project, has been maintained quite well for a superannuated facility constructed more than 25 years ago.

The HPT-2 Transmitting Station has on its site a 100 kW shortwave transmitter installed for domestic service.

The programmes are all transmitted on UHF radio circuits from the Broadcasting House located in Dhaka city.

2-3-2 Transmitter Facility

(1) Transmitter

The medium wave transmitter in operation is an RCA make BTH-100 B type made in 1962. The rated output power of 100 kW has been maintained so far, but in general it is becoming superannuated and it is difficult to obtain spare parts, the manufacture of which is already suspended. The condition of maintenance is good but the residual life is considered to be only for about several years judging from the stock of spare transmitter tubes. And there is great danger of such a condition leading to a long-hour suspension of broadcasting service.

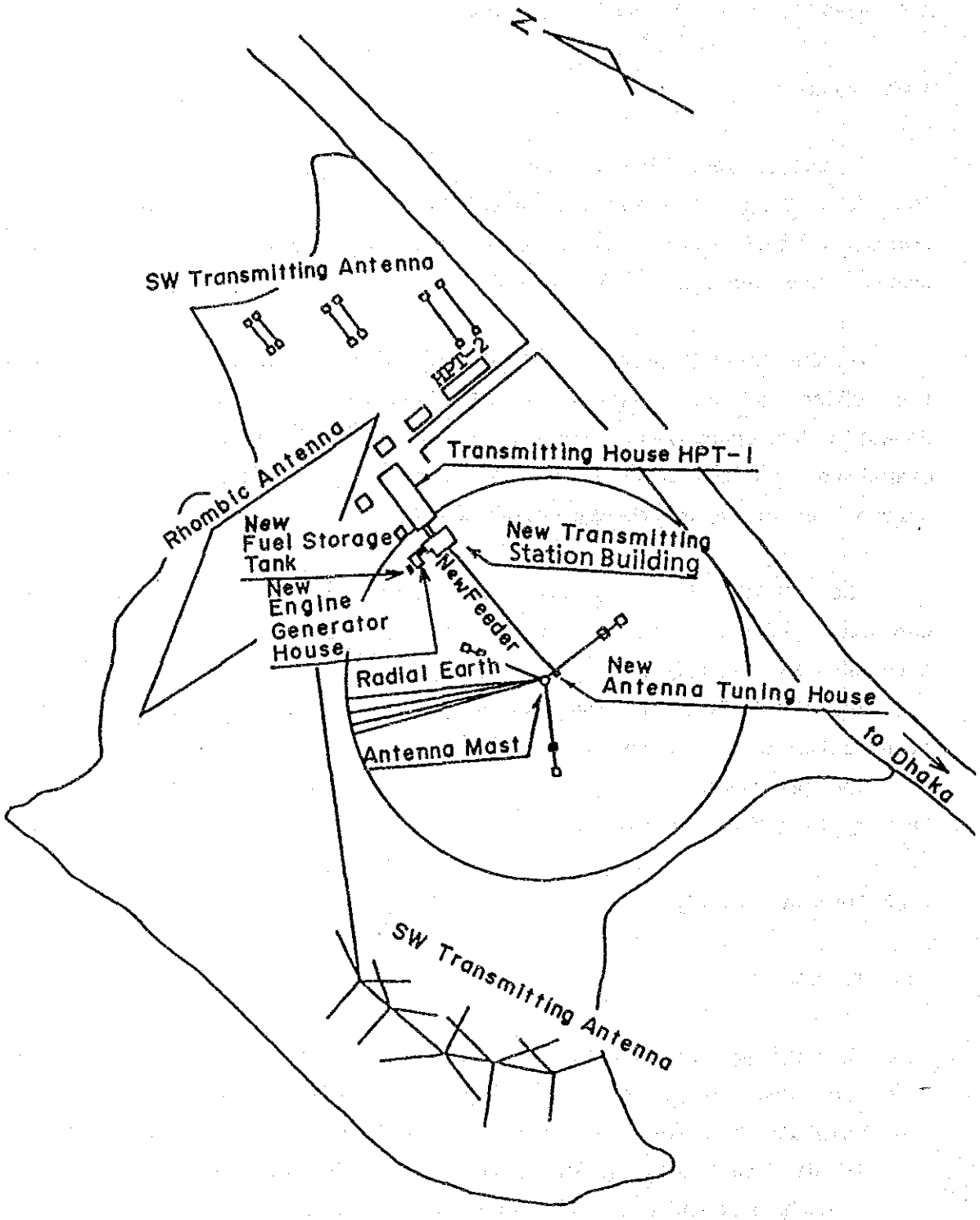


Fig. 7 Outline of Existing and Proposed Facilities in Savar Transmitting Station Site

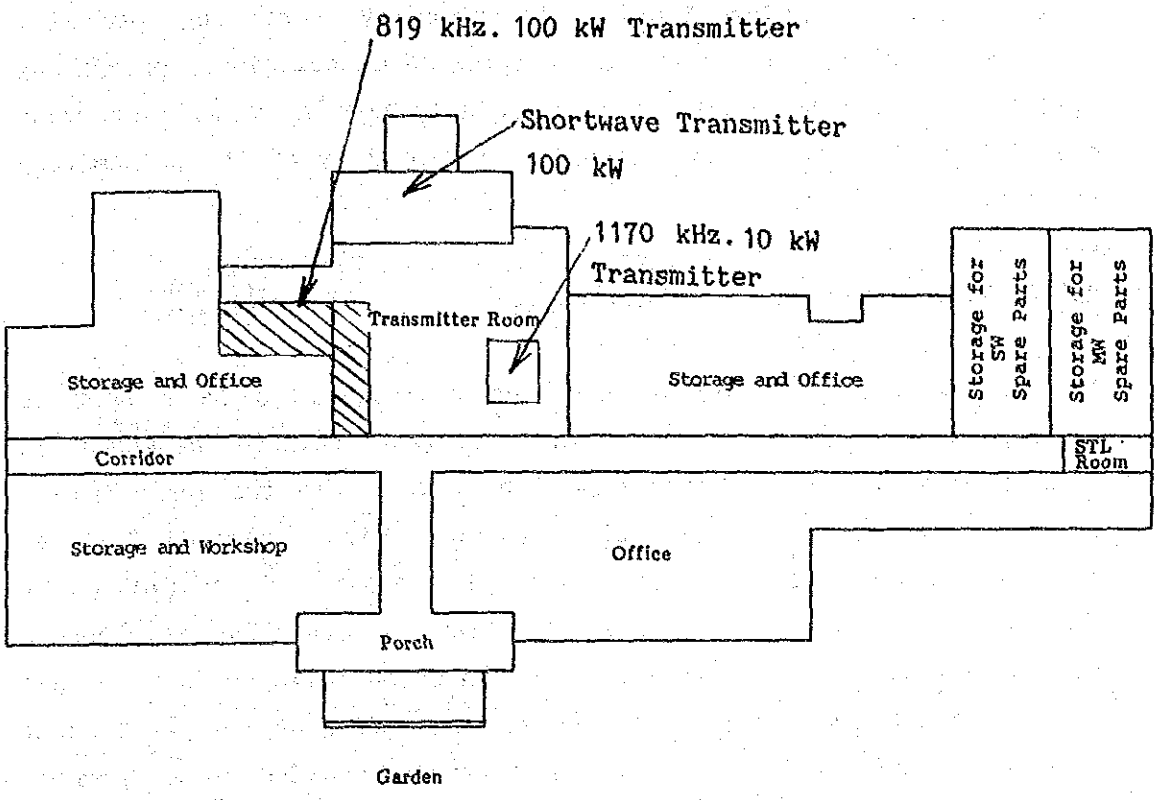


Fig. 8 Floor Layout of Savar Transmitting Station (Existing)

However, Savar Transmitting Station as well as Dhamrai Transmitting Station is graded as a transmitting station for nationwide broadcasting, and has a wide coverage centered on the capital city. Savar Station is steadily conveying official government reports, weather information and religious programmes directly related to daily life, to highly populated and important districts. For this reason, excellent reliability of the transmitter facility is desired.

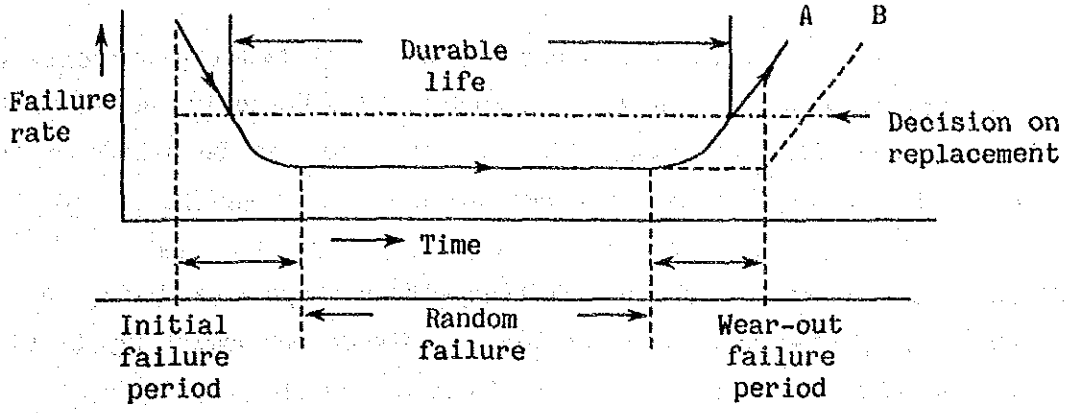
(2) Reliability of Transmitting Facility

As the transmitter equipment could be considered to be a sort of consumption goods, occurrences of equipment failure progress in accordance with the following "Bathtub Curve". In the early period of installation, for a short time (initial failure period) failures occur frequently due to weaknesses in the design and manufacture of the equipment. For these kinds of failures, corrective maintenance is appropriate. Next, a stable period in which failures do not occur much continues (random failure period). In this period, accidental failures do not occur much, but they can be avoided in advance by performing preventive maintenance (condition based maintenance).

Furthermore, if use of the equipment is continued, it will enter a period (wear-out failure period) when failures will increase gradually, and the number of times when maintenance is required will also increase rapidly. The relative expenses incurred will also increase accordingly, and finally, the need for replacement is recognized and the equipment is replaced.

It should be noted that if good maintenance (scheduled maintenance) is carried out, it would be possible to extend the stabilized period (random failure period) such as curve B. In general, if transmitter equipment is used for more than 20 years, it will enter the wear-out failure period, and then enter the stage of replacement. It is needless to say that the medium wave 100 kW transmitter facility of Savar Station is in the wear-out failure period.

The related material is indicated as Reference Material (Appendixes No. 8, No. 9).



(3) State of Coverage

The present state of coverage in Bangladesh by the medium wave broadcasting facilities of Radio Bangladesh is shown in Fig. 9 (daytime in dry season).

The population coverage of Programme-B from the Savar Transmitting Station in the daytime is about 30%, but at nighttime it tends to decrease to about 11% due to the recent co-channel interference from neighbouring countries.

Regarding the interference from neighboring countries, the waves were measured in the Sylhet district 200 km northeast of Dhaka City, and in the Rajshahi district about 200 km west of Dhaka City. As a result, in Sylhet city considerable interference was confirmed from neighboring countries at nighttime, and in Rajishahi city, slight interference was confirmed at nighttime.

(4) Countermeasures against Failure

1) Interruptions of commercial power for a few minutes may occur several times a month, but the output of the existing generator is 250 kVA, which is in sufficient to supply necessary power to the 100 kW transmitter. For that reason, as the time of commercial-power failure, transmission is conducted by reducing the output

power. As a result, it takes about several minutes to resume the broadcast after the power failure.

In this case, the motor generator power will be supplied only to the medium wave 100 kW (for Programme-B) and medium wave 10 kW transmitter (for Programme-C). It will not be supplied to the domestic 100 kW shortwave transmitter.

2) In case the medium wave 100 kW transmitter happens to fail, the 10 kW, 819 kHz standby transmitter at Mirpur Transmitting Station (about 12 Km south-east of Savar Station) will be used.

(5) Antenna

The conditions of the transmitting antennas were inspected by viewing and measurement, etc. The results were as follows. In Fig. 10 the outline of the antennas is shown.

1) Steel mast structure : Base insulator type, 3-direction 4-stage stay type, triangle truss tower, height about 152 m (Yugoslavian make)

2) Feeder line : 6-Wire type, length 180 m, impedance 236 Ω.

3) Measured value of antenna impedance : 451 Ω ~ j273 Ω (819 kHz)

4) Measured conductivity of ground : about 3 mS/m ~ 10 mS/m

5) Austin transformer : As superannuation is progressing, it is to be replaced.

6) Steel tower base-insulator : No cracking was observed.

7) Connection of steel tower base and radial earth :
The method of connection is somewhat incomplete (There is the possibility of loose contact). It is to be improved.

8) Ball-gap :

As superannuation is progressing, it is to be replaced.

9) Steel tower :

No rust was observed, and the structure is solid.

10) Guy wiresand stay insulators :

Rust was observed on stays, but no cracking was recognized in insulators.

11) Base block for stays : Slight cracks were discovered on the surface by viewing.

12) Aviation obstruction lighting : Replacement is required including the Austin transformer.

13) Antenna tuning unit : No deteriorated parts of the circuit were recognized.

14) Submergence of antenna base insulator :

No experience since the opening of station.

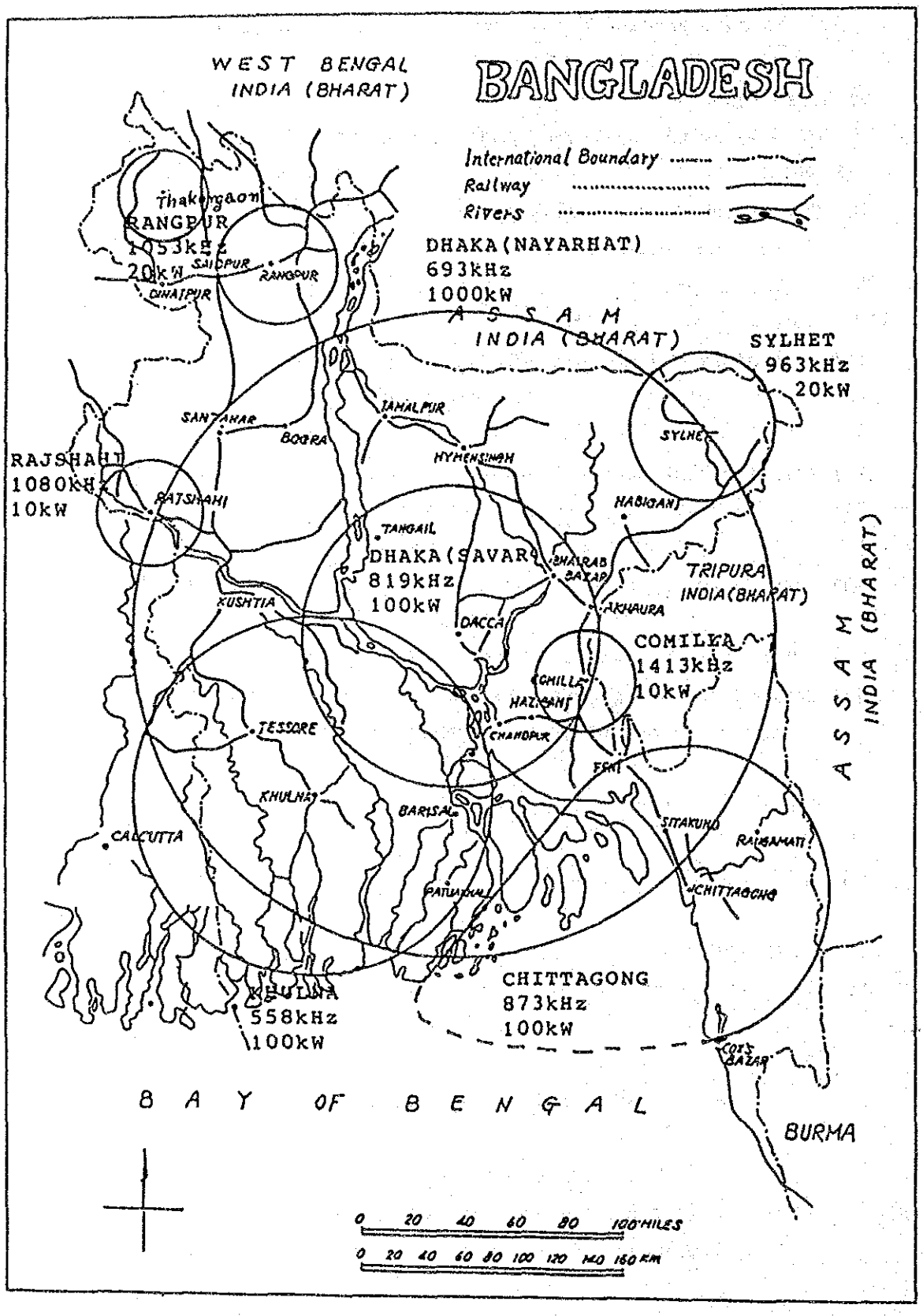


Fig. 9 Present State of Broadcasting Area of Radio Bangladesh

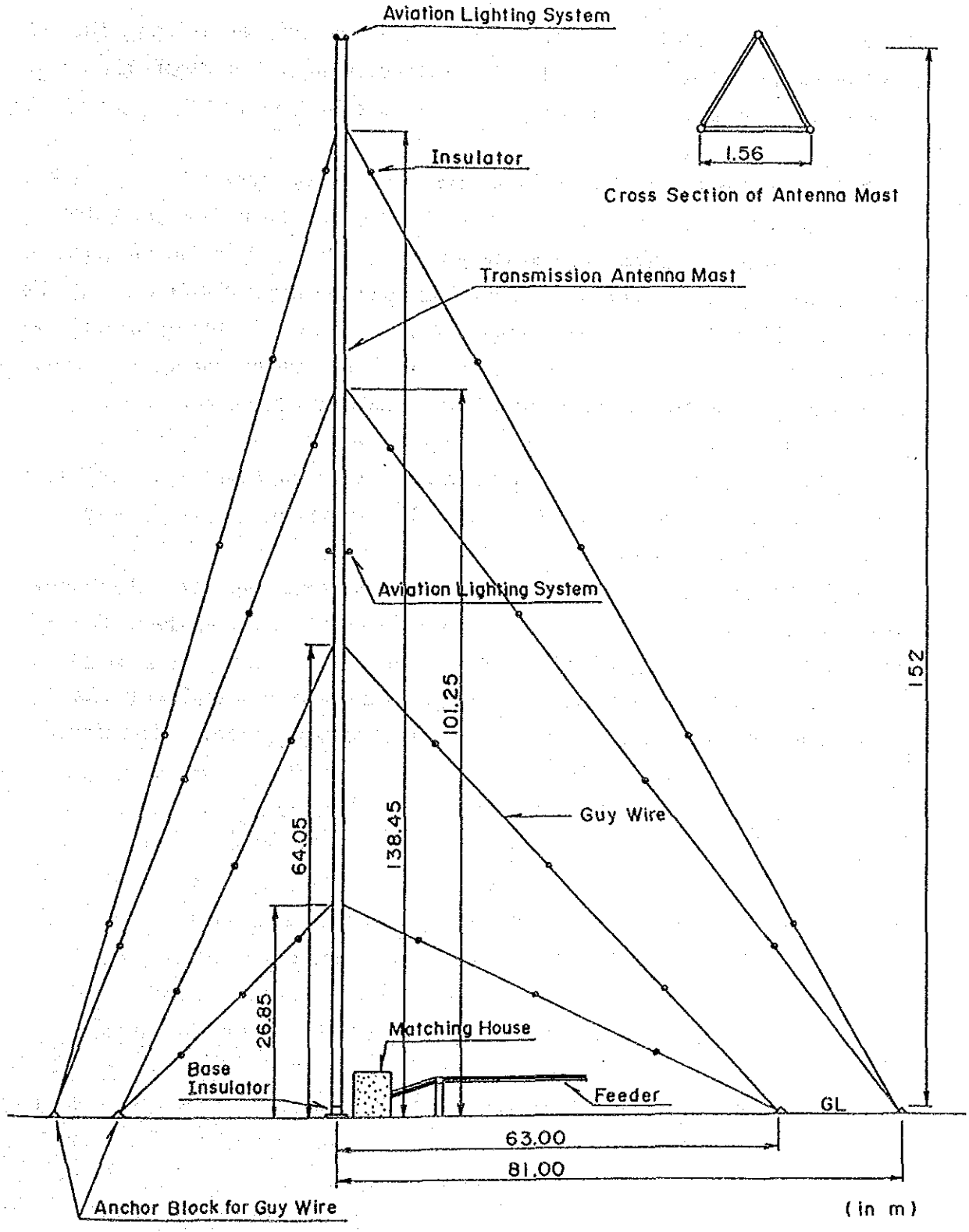


Fig. 10 Radio, Medium Wave Transmission Antenna at Savar Station. (100kW, 819kHz)

2-3-3 Present State of Station Building

The station building in the 75 acre site and the related position of the antennas are shown in Fig. 4-4-2. In Fig. 4-4-3, the floor layout of the HPT-1 Station Building is shown.

The floor layout of the transmitter room is as shown in Fig. 4-4-3 and is about 200 m^2 in floor space. In addition to the medium wave 100 kW transmitter (for Programme-B) which is the object of this Project, a medium wave 10 kW transmitter (for Programme-C) and shortwave 100 kW transmitter (for domestic broadcasts), for a total of three transmitter systems, are installed. The operation and maintenance of these transmitters are performed by means of concentrated management.

The maintenance parts are well arranged in each store room but some large spare parts and materials are stored in the corridor of the building. There is shortage of store room.

In addition, a power source house accommodating receiving power equipment, and an engine generator house are installed at a place 20 - 50m away from the station building.

In the case of installing the new transmitter facilities in the present station building, there will not be enough space. Therefore, a new station building is required.

2-4 Outline of Related Projects

As for the related projects under Japan's Grant Aid, there are the construction of the Broadcasting House of Dhaka City and Renewal of the MW Transmitter at Chittagong Broadcasting Station.

The outline is as follows. Both of the facilities are operating in good condition.

(1) Construction of Broadcasting House of the People's Republic of Bangladesh

1) Location : Dhaka City
2) Objective: As the Broadcasting House constructed in 1959 has become superannuated, and was small in scale, it was impossible to cope with the production of various programmes which are increasing year by year. Therefore it was necessary to construct new programme production studios to send various programmes to each transmitting station.
3) Term of Construction Work : 1980 ~ 1983
4) Descriptions of Project
   - 3-story, total floor area 4,800m²
   - Number of studios 9
   - Programme production equipment 1 set
   - Function of the Broadcasting house
     In each studio, programmes for Programme-A, B, and C and foreign service are produced, and are sent to Dhamrai, Savar and foreign service transmitting stations.

Then, they are broadcasted to the whole nation, regions and to foreign countries from the respective transmitters.

(2) Renewal of Medium Wave Radio Transmitting Station of the People's Republic of Bangladesh

1) Location : Chittagong City
2) Objective: As more than 20 years had elapsed since Chittagong Station was constructed, the facilities had become superannuated

remarkably, and in addition, the receiving area had become narrow according to interference from neighboring countries. To improve this superannuated condition and expand the coverage area the transmitter was renewed and power was increased.

3) Term of Construction work : June 1987 ~ March 1988

4) Descriptions of Project

Renewal of 10kW MW Transmitter → 100kW (50kW × 2) at Chittagong Broadcasting Station.

2-5 Description of Requirements

(1) Circumstance of Request

In Bangladesh, the same as in other countries, radio broadcasting is the most effective and constant form of mass communication. The broadcast of various programmes plays an important role in promoting the development plans of the country in areas such as education, agriculture and population problems which the Government of Bangladesh is executing.

Particularly, in order to minimize the serious damage from cyclones which frequently hit the country, the conveyance of accurate information through broadcasting is indispensable.

Thus, it is said that radio broadcasting is closely related to the daily life of the general public.

However, the present transmitter equipment of Savar Transmitting Station is becoming superannuated as more than 25 years have elapsed since it was installed.

In addition, as it is difficult to obtain spareparts for maintenance, there is a great risk of equipment failure that might lead to a long-term suspension of broadcasting services.

Furthermore, the areas which can receive the broadcasting services from Savar Station are becoming narrower due to the influence of high power broadcasting signals of neighboring countries.

Reception conditions at nighttime are particularly bad, and the signals can be received clearly only within a radius of about 52 km around the station.

In order to expand the coverage area, the Government of Bangladesh previously drew a project to increase the transmitting power of Savar Transmitting Station from 100 kW to 500 kW, together with the

replacement of the superannuated 100 kW transmitter equipment, as well as change the present frequency from 819 kHz to 630 kHz. The Government of Bangladesh had requested for Grant Aid of the Government of Japan for the project.

In response to the request, JICA prepared a basic design (Basic Design Survey, November 16, 1988 - December 3, 1988) on the premise that Bangladesh side will obtain the approvals of the neighboring countries regarding the change in transmitter output power.

However, as the approvals of neighboring countries were unable to obtain through IFRB, the project was modified as to replace the superannuated 100 kW transmitter and change the present frequency from 819 kHz to 630 kHz, and requested for the Grant Aid of the Government of Japan again for the project.

(2) Contents of Request

With the replacement of the superannuated 100 kW transmitter equipment in Savar Transmitting Station, the present transmitting frequency is to be changed from 813 kHz to 630 kHz, as well as the transmitting antenna height is to be reduced from 150 m to 122 m height as registered at the International Frequency Registration Board (IFRB). (Refer to 3-2-4 for information about IFRB registration.)

With the above changes, the Government of Bangladesh prepared an enhancement project to enlarge the coverage area by means of improving the reliability of transmitter equipment and by changing the transmitting frequency, and requested for Grant Aid of the Government of Japan for the project.

Table 6 Comparison of Coverages

	Present State	After Implementation of Project
Transmitting Frequency	819 kHz	630 kHz
Transmitter Output Power	100 kW	100 kW
Daytime Coverage Area	radius about 95 km circle	radius about 130 km circle
Nighttime Coverage Area	radius about 52 km circle	radius about 95 km circle

The outline of the equipment required for Savar Transmitting Station is as follows:

1) 100 kW (50 kW × 2 sets) medium wave transmitter, combiner, dummy load and peripheral equipment 1 set
2) Programme input/surveillance equipment 1 set
3) Measuring equipment 1 set
4) Antenna system 1 set
   (The existing antenna to be modified Including antenna tuning unit, aviation obstruction lighting system)
5) Feeder line 1 set
6) Power source equipment 1 set
7) Engine Generator (350KVA) 1 set
8) Installation materials 1 set
9) Spare parts 1 set

CHAPTER 3 DESCRIPTIONS OF THE PROJECT

CHAPTER 3 DESCRIPTIONS OF THE PROJECT

3-1 Objective

With the deterioration in functions of the transmitting facilities of the Savar Transmitting Station, as well as the recent increase in co-channel or adjacent channel interference from neighboring countries, the areas where the broadcasting signal could be received in a good condition becomes narrower. Thus interference is occurring to the reception environment of broadcasting signal, a mass media for the country of Bangladesh.

Thus, the objective of this Project is to overcome this interference and serve a high reliability broadcast signal to the whole country, as well as establish an excellent reception environment. To accomplish this objective, the transmitting facilities of Savar Transmitting Station which is the main transmitting station of Bangladesh, will be renewed and enhanced.

3-2 Consideration of Description of Requirements

3-2-1 Renewal of Transmitter Facility

As described in Chapter 2, Savar Transmitting Station is the main station having a role to broadcast programmes to the whole country. However, the present 100 kW mediumwave radio transmitter equipment is a make of 1962, and the equipment is becoming deteriorated as a whole.

In addition, as the spare parts are not manufactured now, it is becoming very difficult to maintain the functions of the transmitter.

As the residual life of the transmitter equipment is estimated only for several years, there is an urgent necessity to renew the superannuated transmitter, main feeder line, antenna tuning unit and power facilities, etc., to ensure the broadcasting service to the whole country.

3-2-2 Change in Transmitting Frequency

As the present 819 kHz which is used for broadcasting service, is interfered at nighttime by the co-channel or adjacent channel frequencies from neighbouring countries, the areas where reception is available is becoming narrower.

The frequencies allocated to Dhaka Transmitting Station for 100kW broadcasting service are the two frequencies, 819 kHz and 630 kHz (Refer to 3-2-4).

In comparing the two frequencies from the viewpoint of coverage area, the attenuation of radio wave (ground wave) of the lower 630kHz is less than the higher 819 kHz. Therefore, 630kHz is advantageous to use for expanding the coverge area. In addition, as the interfering waves from neighbouring countries are also less (Refer to 3-2-3), expansion of coverage area could be expected by changing the transmitting frequency from 819 kHz to 630 kHz.

Table 7 Registration of Mediumwave Frequency for Dhaka (IFRB)

Allocated Frequency (kHz)	Carrier Power (kW)	Transmitting Antenna Height (m)	Type of Antenna	Operating Hours	Remarks
630	100	122	Vertical base feed	UTC 0:00~18:00	unused
693	1,000	203	〃	〃	used
819	100	152	〃	〃	〃
1,170	20	92	〃	〃	〃
1,260	10	122	〃	〃	unused

Note : Time difference between UTC and local time is 6 hours
UTC 0:00~18:00 is local time 6:00~24:00

3-2-3 Change in Transmitting Antenna Height

The height of the present transmitting antenna is 152m, but according to the change in transmitting frequency (Refer to 3-2-2), the antenna height is to be changed to 122m (Refer to Table 7, 3-2-4) as registered at IFRB.

3-2-4 Frequency and Power

In respect to the frequency, power, scale of transmitting antenna and operation time zone, etc., of medium wave radio stations, they are determined at the Radio Administrative Conference on a world wide basis.

According to the Regional Radio Administrative Conference of Region I and Ⅲ related to "Long-wave and Medium wave", in respect to Bangladesh, the transmitting conditions such as the station site, transmitting power, transmitting frequency and height of antenna, etc., are registered with IFRB as shown in the Appendix (No. 11).

The registered power, frequency, etc. for medium wave radio broadcasting in Dhaka city are as shown in Table 7.

Of the frequencies registered, the one to be used for more coverage of broadcasting area by this project is either 819 kHz or 630 kHz.

3-2-5 Expansion of Broadcasting Area (coverage)

In Table 8, the coverages for the 630 kHz, 100 kW equipment of this Project, and of the present 819 kHz, 100 kW equipment are respectively indicated. In comparing both coverages, the coverage of this Project will be about 1.6 times larger in population and about 2 times wider in area than the present coverage. It is to be noted that if the field strength(Note) of signal is such as 54~60 dBμ/m (0.5 - 1 mV/m), it may satisfy reception almost throughout the country with an ordinary receiver.

The influence of interference from neighbouring countries upon coverage at nighttime was examined, and the results are shown briefly in Table 8 and Fig. 11~12.

(Note) : Field strength

This is the strength of electric wave and it is expressed in dBμ/m. The dB is a unit used to express the ratio of voltage (power), etc., and it indicates the ratio against the standard value by 20 times (or 10 times) in common logarithms.

In the case of field strength, the standard value is when the voltage which is induced in a unit length of one meter antenna is 1 μ V.

For reference, the condition of radio wave propagation is shown in the following figure.

The nature of radio waves is as follows:

① The waves propagate farther in the following order.
Mountain → hill → plain → humid zone → on the sea
In addition, the waves propagate better in the wet season than in the dry season.

② The distance the wave propagates increases as the frequency becomes lower.

③ The propagating waves in the daytime are almost all ground waves, and the sky waves attenuate in the ionization layer.

④ At nighttime, the sky waves do not attenuate in the ionization layer but reflect from it and propagate over a long distance. For this reason, there is a possibility of receiving interference from neighbouring countries.

⑤ In the daytime, the coverage is determined by ground waves, and at nighttime it is determined by the relation between ground waves (desired waves) and sky waves (interfering waves, co-channel or adjacent channel).

According to the above features, the coverage area of a certain frequency differs in the dry season, wet season and in daytime and at nighttime.

Table 8 Comparison between The Present State and After Implementation of The Project

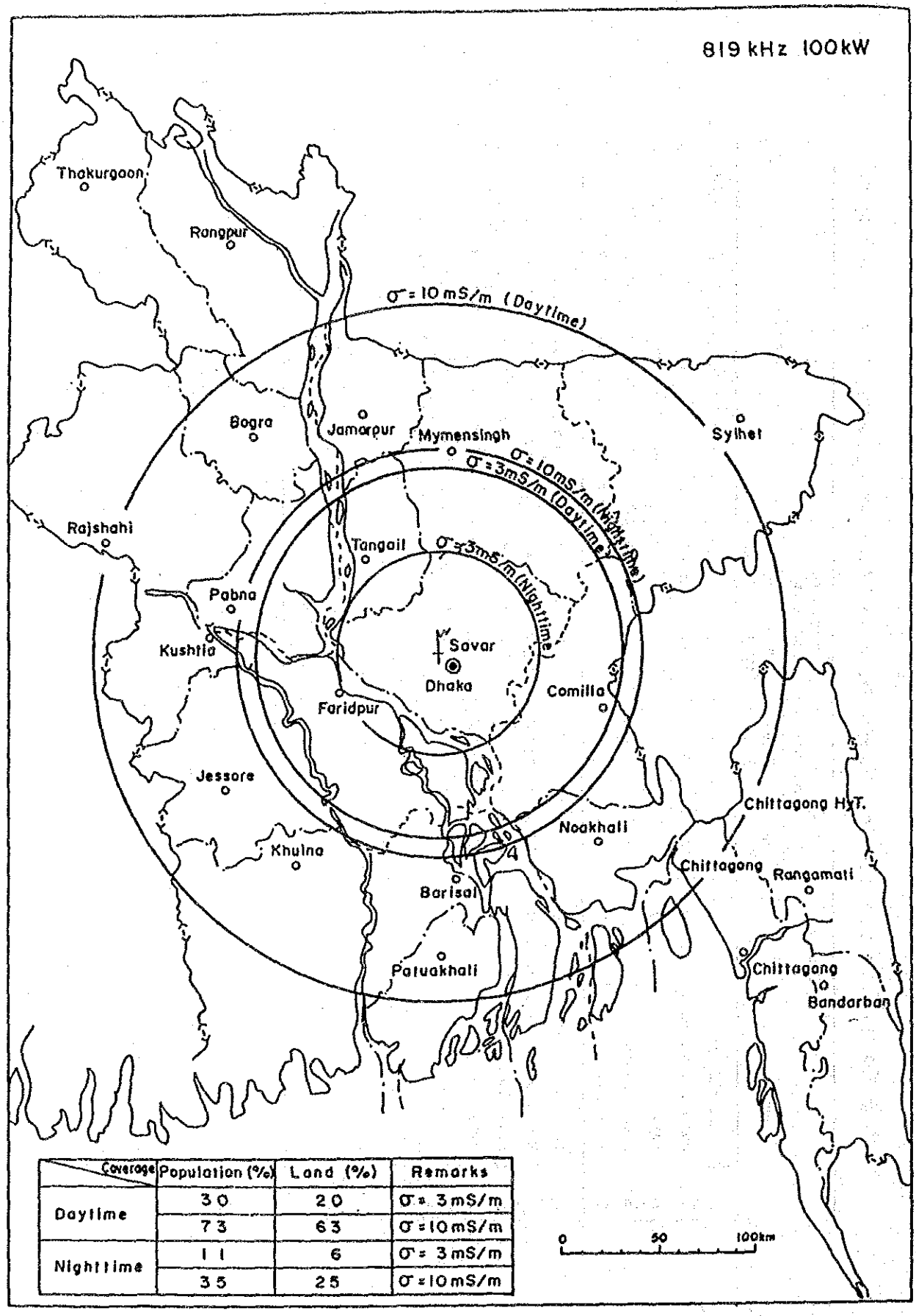
	Item		Daytime (no interference)		Nighttime (interference)		Remarks
	Coverage		dry Season	Rainy Season	dry Season	Rainy Season	
Present state	Radius of Coverage	(km)	95	180	52	105	Present state (819kHz, 100kW, antenna height : 152m). From the results of reception tests at Rajshahi and Sylhet, the reception evaluation in daytime was "3" (*3) by using a portable receiver.
	Population in Coverage (thousand)		31,100	74,600	11,400	36,300	
	Population Ratio (*1)	(%)	30	72	11	35	
	Area of Coverage	(km^2)	28,400	90,400	8,100	35,300	
	Area Ratio (*2)	(%)	20	63	6	25	
After implementation of the project	Radius of Coverage	(km)	130	230	95	200	After implementation of the project (630kHz,500kW, antenna height: 122m). According to the execution of this project, the coverage area will be expanded and the reception evaluation around the country borders is estimated to be over "3"(*3)in daytime.
	Population in Coverage (thousand)		50,000	89,500	31,100	81,300	
	Population Ratio (*1)	(%)	49	87	30	77	
	Area of Coverage	(km^2)	56,200	118,100	28,400	100,800	
	Area Ratio (*2)	(%)	39	82	20	70	

[Note] *1. The ratio of population in coverage area to total population. *2. The ratio of coverage area to the total area.

*3. To compare and judge the reception condition simply, the following common codes are for expression internationally.

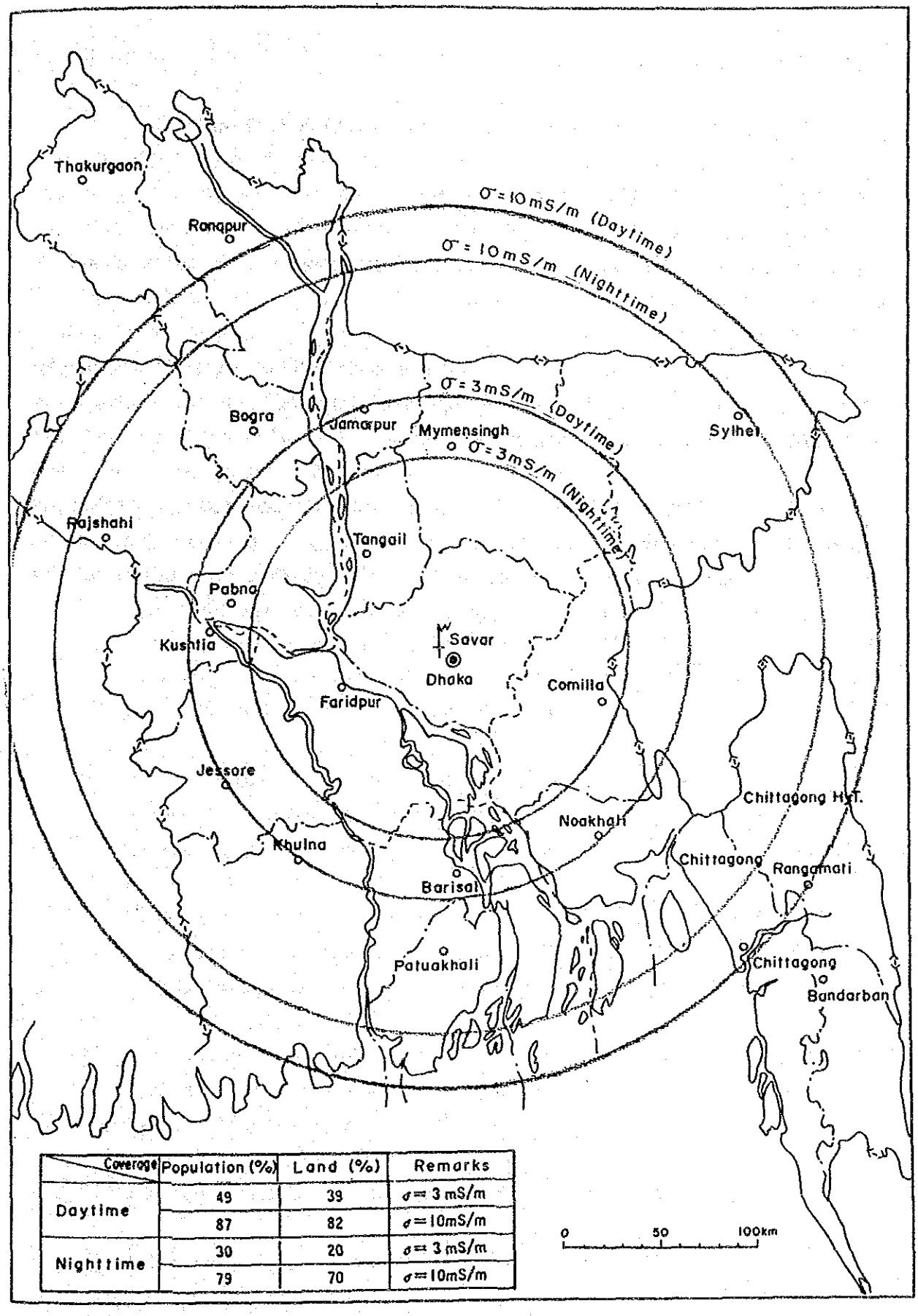
5 ・・・ Excellent 4 ・・・ Good 3 ・・・ Fair 2 ・・・ Bad 1 ・・・ Unpractical

- The conductivity in dry season is (o) =3mS/m, and that in rainy season is (o) = 10mS/m.
- Field strength in the coverages at daytime is more than 63 dBμ/m (1.4mV/ m) and at nighttime it depends on the relation of the desired and undesired radio wave.
- Protection ratio adopted for same frequency interference is 30 dB and for adjacent frequency interference is 9 dB. The estimated coverages (population and area) are the one of stations that are most interfered
- Total population : 102,900 thousand (1986)
- Total area : 143,999km



Coverage	Population (%)	Land (%)	Remarks
Daytime	30	20	σ = 3mS/m
	73	63	σ = 10mS/m
Nighttime	11	6	σ = 3mS/m
	35	25	σ = 10mS/m

Fig. 11 Expected Coverage of Savar MW Station (819kHz, 100kW)



Coverage	Population (%)	Land (%)	Remarks
Daytime	49	39	σ = 3 mS/m
	87	82	σ = 10mS/m
Nighttime	30	20	σ = 3 mS/m
	79	70	σ = 10mS/m

Fig. 12 Expected Coverage of Savar MW Station (630kHz、100kW)

3-2-6 Projected Site and Surroundings

The site for this Project is Savar Transmitting Station.
The location of Savar Station is

Latitude	North	23° 54' 08"
Longitude	East	90° 12' 12"

and it is situated almost in the centre of Bangladesh at a point about 15 km north-west of the Broadcasting House.

The traffic to the Broadcasting House in Dhaka City is about 20 minutes by car, and it is an appropriate site as for a transmitting station to serve the whole country.

In addition, as there will be no problem in the transportation of equipment and materials from Chittagong, the biggest port in Bangladesh, to the transmitting station site, nor in the storage of equipment and construction materials, it is an appropriate site for the Project.

3-3 Outline of the Project

The objective of this Project is to replace the superannuated and unstable 100 kW transmitter equipment in Savar Transmitting Station: the main station serving the whole country, to improve the reliability of transmitter equipment and secure the broadcasting service.

In addition, the transmitting frequency is planned to be changed to 630kHz, a frequency of which the propagation loss is small and the interference from neighbouring countries is less. Thus, the areas where the broadcasting service could be received in a good condition will be expanded. (As the radio wave frequency becomes lower, the wave propagates more over the ground surface where the attenuation is less. Therefore, it is advantageous to use low frequencies for expansion of coverage area)

The related facilities are as follows:

1) The superannuated 819 kHz, 100kW transmitter in operation is difficult to maintain, it will therefore be replaced by a 630 kHz, 100 kW transmitter (50 kW x 2 sets).

2) The transmitting antenna will be remodelled according to the change in transmitting frequency.
   a) The height of the transmitting antenna will be reduced from 152 m to 122 m. (Refer to Fig 13)
   b) To cope with the change in voltage distribution of antenna according to the change in transmitting frequency, the guy insulators will be replaced or remodelled. (Refer to Fig. 14)

3) The tuning unit of the transmitting antenna will be renewed according to the change in transmitting frequency and remodel of transmitting antenna.

4) The superannuated main feeder line will be renewed.

5) The receiving power switchboard will be renewed.

6) The power facility will be renewed. (Including engine generator as standby power source in case of interruption of commercial power)

The construction of the station building to accommodate the transmitter, the antenna tuning house and the engine generator house is to be the responsibility of the Bangladesh side.

The organization to implement this Project, the operational system after completion, management planning, staff planning and programme planning are as follows.

3-3-1 Implementation Organization and Operation System

The implementation organization of this Project is Radio Bangladesh which is under the control of the Ministry of Information. The organization of Radio Bangladesh, explained in Chapter 2, has experience in operating a total of four high-output power radio transmitting stations, for example, the 1000 kW Dhamrai Station and the Chittagong Station which was completed in 1988 under Japan's Grant Aid.

In Savar Transmitting Station, which is the site for this Project, there is a 100 kW medium wave transmitter (for Programme-B), a 10 kW medium wave transmitter (for Programme-C) and two 100 kW shortwave transmitters (for domestic broadcasts), of which the operation and maintenance are conducted by 138 persons, and the maintenance is well carried out. The level of technical ability is high, and sufficient for operating high-power transmitters.

3-3-2 Management Planning, Staff Planning

After completion of the Project, the management, operation and maintenance of the facility will be conducted for the entire station including the existing medium wave and shortwave transmitters.

(1) Working System

First shift	05:00~13:00
Second shift	11:00~19:00
Third shift	17:00~24:00

Staff composition for one shift

Regional Engineer	1 person
Radio Engineer	1 person
Assistant Radio Engineer	2 persons
Radio Technician	3 persons
Equipment Attendant	1 person

One shift will consist of 8 persons including the Regional Engineer as chief and considering the take over of duties, an overlap of two hours is set. In addition, regular maintenance work will be done between 7:30 and 10:30 when there are no broadcasts, and in the case special maintenance is required, it may be done also after termination of daily broadcasting (23:30).

(2) Staff Titles

Resident Engineer	1	person
Regional Engineer	3	persons
Radio Engineer	16	persons
Assistant Radio Engineer	9	persons
Administrative Officer	1	person
Head Assistant	1	person
Air Conditioning Supervisor	1	person
Accountant	1	person
Stenographer	1	person
UDA-cum-Cashier	1	person
LDA-cum-Typist	4	persons
Store Keeper	1	person
Radio Technician	19	persons
Car Driver	2	persons
Daftary	1	person
Equipment Attendant	5	persons
MLSS Worker	12	persons (Regular)
MLSS Guard	10	persons (Regular)
Farash	18	persons (Irregular)
Chowkider	10	persons (Irregular)
Gardener	13	persons (Irregular)
Sweeper	8	persons (Irregular)
Total	138	persons

3-3-3 Programme Planning

At present, the three programme formats produced at the Broadcasting House in Dhaka are; Programme-A, Programme-B and Programme-C (almost completely composed of Programme-A and Programme-B content, and broadcast simultaneously). Programme-A is transmitted from Dhamrai, Programme-B and Programme-C are transmitted from Savar Station (Composition of Programme-C is given in Fig. 5).

Programme-A and Programme-B are broadcast toward the whole country, but the coverage of Programme-B is somewhat insufficient. At present, the reception in the northeast part and in the northwest part near the border of India, is inferior. However, with the implementation of this Project, Programme-B will also be receivable throughout the whole country, and the whole country could be covered with two systems: Programme-A and Programme-B. Thus, school programmes, educational and cultural programmes, weather information and enlightenment programmes for the whole country will be enhanced.

3-3-4 Outline of Facilities and Materials

The overall block diagram of the broadcasting system for this Project is given in Fig. 4-4-1.

The main facilities and materials are as follows:

1) Medium Wave 100 kW Transmitter

The transmitter is a parallel operation system of two 630 kHz, 50 kW transmitter sets, and the output power of the two transmitter is combined by a combiner to obtain the rated 100 kW output power.

The circuit composition of each transmitter is the same, forced-air cooling tubes are used for modulated amplifier and modulator, and the rest of the portions use full solid-state circuits to raise the reliability.

The composition of the peripheral equipment of the transmitters are such as,

Programme Input Equipment

Control / Surveillance Console
Dummy Antenna

2) Electric Power Facility

The facility consists of a high-voltage power switchboard for switching between the two power receiving routes and a power receiving facility for the transmitter power source as follows:

Power Receiving Switchboard
Power Receiving Board
Transformer
Induction Voltage Regulator
Electric Power Distributing Board

The amount of power consumption varies according to the modulation degree of the transmitter, but the average is about 270 kW and the maximum is about 315 kW.

3) Engine Generator Facility

Diesel Engine Generator (350kVA, 3-phase, 50Hz)
Control Board
Battery and Battery Charger
Fuel Storage Tank (about 2000ℓ)

4) Main Feeder Line

An aerial 6-wire type feeder line is installed over a total distance of about 180m to supply the transmitter output power to the transmitting antenna.

5) Antenna Tuning Unit

The antenna tuning unit for matching the main feeder line impedance with the transmitting antenna input impedance, is renewed in the antenna tuning house adjacent to the transmitting antenna base, in relation to the change of transmitting frequency and the modification of the antenna mast.

6) Transmitting Antenna

The present 152m high, 3-direction and 4-stage stay type truss mast, and the base-insulator type transmitting antenna is remodelled into a 122 m high antenna as registered at IFRB.

7) Others

For the programme transmission link between the Broadcasting House and Savar Transmitting Station, the existing radio link (UHF band 6-multiplexed full solid-state) is used.

CHAPTER 4 BASIC DESIGN

CHAPTER 4 BASIC DESIGN

4-1 Establishment of Design Policy

In the drawing up of the design policy, the facts registered at the IFRB were reflected in the contents required and the results of the field survey.

In the design of the facility, the special situation of Bangladesh and the operation and maintenance system were taken into account so as to benefit the public and to create a system which is superior in operation, economical, easy to maintain and of high reliability over a long term. Moreover, sufficient consideration is to be paid so as to shorten the suspended time of broadcasting as much as possible.

With the above in mind, the necessary-equipment for the renewal of superannuated 100 kW transmitter equipment of Savar Trasmitting Station, including change in transmitting antenna height, renewal of antenna tuning unit, renewal of main feeder line and receiving power switchboard and engine generator as standby commercial power source etc., were designed.

The block diagram of the overall broadcasting system, which is the object of this Project is shown in Fig. 4-4-1.

4-1-1 Transmitting Facility

In the design for transmitting facilities, environmental conditions such as the weather are taken into account to provide facilities with excellent durability. In addition, sufficient attention is paid to high reliability, operability, maintainability and economy of operating cost from both aspects of hardware and software. In particular, as high voltage is handled, sufficient consideration is given to safety measures.

The transmitter ratings is 630 kHz and 100 kW (50kW transmitter × 2 sets) and the specifications for the equipment complies with the International Radio Consultative Committee (CCIR) technical standards.

In addition, in determining the method of executing the construction work, the suspension of broadcasting services due to the construction work will be shortened as much as possible, and overall consideration will be given to ensure that the construction work is carried out efficiently.

After completion of the transmitting station the operation of transmitting facility will be based on attended operation.

4-1-2 Transmitting Antenna Facility

The present transmitting antenna will be used after it is remodelled, but the height of the transmitting antenna will be changed to 122 m (630 kHz) to comply with the data registered at IFRB.

The insulators, etc., will be selected so that they will sufficiently endure the rated 100 kW power. According to the charge in transmitting antenna height and transmitting frequency, all the stays will be renewed (Refer to 4-2-1(2)). In the design for the stays, etc., the architectural standards, related regulations and various structure design standards established by the Japan Architectural Institute referred to so that they will be sufficiently strong even against cyclones. In addition, ball-gaps and choke-coils will be installed as countermeasures against lightning.

The existing radial earth conductors will be used, but they will be partly reinforced considering the increase in antenna base current according to the change in the transmitting frequency.

The aviation obstruction lighting system will be renewed. The facilities to use and position to mount them will comply with the regulations of the International Civil Aviation Organization (ICAO). The colour painting of mast will comply also with the ICAO regulations.

The superannuated Antenna Tuning Unit (ATU) will be renewed and a safety fence will be installed. The superannuated main feeder line will be renewed.

A fence will be installed at the antenna base to secure safety.

4-1-3 Power Source Facility

The power source for Savar Transmitting Station is received from two systems: Dhamrai Substation and Mirpur Substation. Interruption of power usually occurs several times a month, mainly in March through May, and October through December when there are many cyclones. An engine generator will be installed as a countermeasure against commercial power interruption.

The range of voltage variation in the power source is about ±10%, and the power source for the transmitter equipment is stabilized by an induction voltage regulator.

Equipment and wiring materials will comply with the Japanese Industrial Standards (JIS) and sufficient attention will be paid to ensure security.

4-1-4 Station Building

As it is impossible to accommodate the necessary facilities and equipment for this Project in the present station building because of insufficient space, it is necessary to remodel and enlarge the building. In addition, as three transmitters—medium wave 100 kW, 10 kW and shortwave 100 kW—are being operated in the same room, it will become necessary to temporarily remove the presently operating facilities for remodelling and enlarging the station building. The demerit of this method is that the construction term will become extended. Therefore, the new transmitting building is to be built adjacent to the present building, considering the relative position of the transmitting antenna and the line of movement of the people in executing their daily routine work.

The new station building consists of four rooms; the transmitter room, blower room, power room and control room. The new building should have sufficient durability against the nature and environmental conditions, and the structure should be such that the dust and dirt in the external air do not enter the rooms, and the heat radiated from the equipment is drawn outside by means of ventilation.

An engine generator house will be installed adjacent to the power room, and the power room and the engine generator house will be connected with a corridor.

Fig. 4-4-4 shows the layout plan of the new transmitting station building and the new engine generator house.

4-2 Basic Plan

4-2-1 Establishment of Scale

The scale of the plan is established as follows on the basis of the contents required, results of the field survey and agreements with IFRB so as to obtain the maximum effect with the minimum budget, and also to ensure economical and efficient operation after completion of the Project.

(1) Transmitting Facility

The transmitter output power is 100 kW (630 kHz). The transmitting facility is a parallel operation system consisting of two sets of 50 kW transmitters. The output of each transmitter is combined by a combiner to obtain the rated 100 kW output power.

The estimated coverage area for the 630 kHz 100 kW transmitter operation is shown in Fig. 12.

The merit of this system is such as that in case one of the two transmitter sets happens to break down, the system is able to continue broadcasting on 25 kW [Note] with no interruption and then to increase the output power to 50 kW at an intermission of the programming. As it is possible to restore the output power to 100 kW by means of a simple operation after the trouble is repaired, the reception quality in remote areas during failure of one transmitter set is degraded. Also, as there will be almost no reduction in reception quality within an 80 km area, it is a superior system from the viewpoints of broadcasting service and also ease of maintenance.

[Note] In the case of operating two sets in parallel, when one set fails, the functional output power of the combiner will become one-fourth of the combined output.

The economic merits of a 100 kW transmitter system consisting of two 50 kW sets, and that of a 100 kW main transmitter plus a spare 20 kW transmitter system are just about the same. However, at the time of failure, the 50 kW × 2 set system is advantageous from the viewpoint of security of coverage, and common use of spare units, etc.

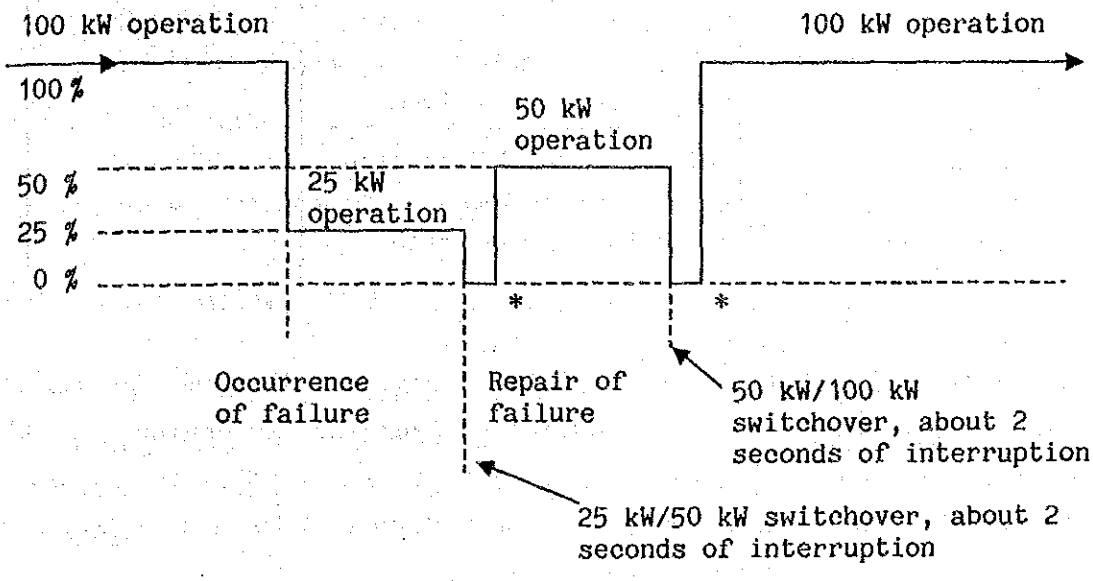
The peripheral equipment of the transmitter system include a programme input device, control console, transmitter tube cooling device and a dummy load, etc.

In the following table the estimated coverage for 100 kW, 50 kW and 25 kW operations are indicated.

Comparison of coverage for 630 kHz when operated on 100 kW, 50 kW and 25 kW (daytime, dry season)

	100 kW	50 kW	25 kW
Area	39 %	29 %	22 %
Population	49 %	41 %	35 %
Comparison against 100kW (area ratio/ population ratio)	1	0.74/0.84	0.56/0.71

The flow of transmitter output power from failure to restored rated output power is shown next.



* Switchover of programmes is performed at a time when the influence from it is small such as during pauses between programmes

(2) Transmitting Antenna

The height (Registered at IFRB) of transmitting antenna for the 630kHz Dhaka Transmitting Station is 122 m, and the antenna (630kHz) will be remodelled into a 122 m high antenna according to the change in transmitting frequency.

In the following table, the specifications for the new and old antennas are compared.

Comparison of New and Old Antenna

	Antenna height and type	Electrical ratings
Existing transmitting antenna	height 152 m, 3-direction 4-stage stay type Truss tower, base feed	819 kHz 100 kW
New transmitting antenna (after being remodelled)	height 122 m, 3-direction 4-stage stay type Truss tower, base feed	630 kHz 100 kW

The existing antenna is in operation. However, in order to shorten the suspended time of broadcasting service according to the construction work, it is desirable to erect a new 122 m high antenna. But as the station site is narrow, the antenna is to be remodelled at the present position as follows:

1) In respect to the antenna, 30 m of the top portion of antenna mast will be cut off and the height will be reduced to 122 m.

2) All the stays including insulators will be renewed according to the change in antenna height. The length of stays will be shorter according to the change in antenna height.

   In addition, as the voltage on insulators will become high according to the change in frequency, it is therefore necessary to change the composition of insulators. However, if this work is to be done at the station site, it will extend the construction term considerably. Therefore, all the stays will be exchanged with new ones made at a factory.

3) As for countermeasures against the discharge at antenna base insulator, devices such as rain-hat, corona-ring and ball-gap will be newly installed.

4) In order to reduce the antenna base current loss, as much as possible, which will increase according to the change in transmitting frequency and antenna height, the earth conductors will be partly reinforced.

5) The superannuated aviation obstruction lighting system will be renewed.

6) The safety fence at the antenna base will be renewed.

(3) Antenna Tuning Unit and Tuning House

In accordance with the change in transmitting frequency, the antenna tuning unit will be renewed, the rated input power is 100 kW. The antenna tuning unit is provided with measures against lightning damage.

The antenna tuning unit is accommodated in an antenna tuning house constructed at the antenna base. It is to be noted that the construction of the tuning house is a responsibility of the Bangladesh side.

As for security measures, a safety fence will be installed in the tuning house and an interphone device will be installed between the tuning house and the transmitter control console.

(4) Main Feeder Line

The main feeder line for supplying transmitter output power to the antenna is a 6-wire aerial type; the rating is 100 kW. The feeder line will be installed over a distance of about 180 m.

(5) Power Facility

The main equipment which will be enhanced by this Project are the receiving power switchboard, power transformer, power distribution board, voltage regulator and engine generator.

The range of in variation voltage that the induction voltage regulator can regulate is ± 15%, to meet the variation in the received power voltage.

The power consumption of this Project is as follows:

During broadcasting hours	Average value	about 270 kW
	Max. value	about 315 kW

Fig. 4-4-11 shows the diagram of the power supply system.

(6) Station Building

The structure of the new station building is reinforced concrete, it is a one-storied building, consisting of four rooms; transmitter room, control room, power room and blower room.

The layout of each room is arranged considering the line of movement of the work between the existing transmitter hall—control room, control room—transmitter room—power room, and transmitter room— and they are respectively arranged so that they could be connected mutually with the shortest path. As shown in Fig. 4-4-4, each room is located around the control room. As the floor area of each room is decided on the scale of equipment to accommodate, the equipment are arranged so that the line of movement of the work, such as for daily operation, periodical maintenance and repair of trouble is as short as possible, as well as working space for maintenance (space of 1.5m - 2m around each equipment) and space for carrying in and out equipment in case of breakdown is considered. In addition in the case of 100 kW transmitters, as there are many peripheral equipment dealing with high-voltage and large amount of current, the equipment layout is arranged so as to facilitate daily inspection of equipment.

Taking the above into consideration, the equipment layout is as shown in the Fig. 4-4-9.

The floor area of each room is as follows.

Transmitter room	about	120m²
Control room	〃	40m²
Power room	〃	25m²
Blower room	〃	20m²
Total	〃	205m²

The height of the floor surface above ground is the same as the present station building, and the new and old buildings are connected with a roofed passage.

To maintain the ambient temperature of the equipment lower than 45°C over a long-term, the heat capacity released from the equipment in the rooms is drawn outside by ventilation. An air filter is attached to the open-air intake to prevent dust from entering the room.

An engine generator house will be installed at adjacent to the power room, and the power room and the engine generator house will be connected with a corridor.

The floor area of engine generator house is about 35m².

The equipment layout is as shown in the Fig 4-4-15.

(7) Spare Parts

The following basic spare parts will be included in the Project at the least, so that the operation of facility will be available without any additional supply of spare parts for at least two years, after the installation of equipment.

Transmitter tube	100 % of the number of tubes in use
Relay, switch, etc.	One for each kind