2-4-7 Long Range Expansion Plan for Radio Broadcasting

RTD maintains a long range plan consisting of 5 stages as listed in Table 2-4-7 with the scheduled construction of the Dodoma and Kigoma transmitting stations as the second stage. The frequency allocation plan was accordingly already registered with the International Frequency Registration Board (IFRB) in 1975.

In the meantime, RTD has a long range plan to build studios near the transmitting stations as program production centers. There are plans to build them in Lindi, Songea, Arusha, Mwanza and Mbeya in addition to those under construction in Dodoma and Kigoma.

Table 2-4-7 Long Range Plan to Construct Transmitting Stations and Program Production Centers

Transmitting station construction program	2nd stage	3rd stage	4th stage	5th stage
	Dodoma, Kigoma	Nachingwea, Songea	John's Corner, Tabora	Morogoro, Bukoba, Msoma
Construction fund (all through foreign grant aid)	$10.0 million	$10.5 million	$11.2 million	$12.0 million
Program production center construction plan	1st stage	2nd stage	3rd stage	4th stage
	Dodoma, Kigoma	Arusha, Mwanza, Mbeya	Songea, Lindi	Morogoro, Tabora
Construction fund: Tanzanian Government fund	15 million TSh	75 million TSh	50 million TSh	50 million TSh
Foreign fund	1.6 million TSh	3 million TSh	2 million TSh	2 million TSh

(1) Long Range Expansion Plan for Medium Wave Network

It is estimated that about 7.76 million people (37% of the entire population) live within the medium wave service areas in Tanzania. This is considered to be not sufficient yet.

Most of the areas are covered by short wave broadcasts which use reflected waves from the ionosphere. Thus, this short wave broadcasting is not always good in terms of its propagation because ionospheric conditions are unstable. Also, short wave receivers are expensive compared with the medium wave receivers. On the other hand, medium wave broadcasts use ground wave mostly and thus receiving conditions are stable. In addition, the receivers are less expensive, and wider use of them is expected.

Consequently, RTD strongly favors development and improvement of the medium wave radiobroadcasting network.

At a request of the Medium Wave Network Expansion Plan of Tanzania, an agreement was concluded at the Regional Administrative LF/MF Broadcasting Conference (2nd session) held in Geneva in October, 1957. Under the agreement, eleven 100 kW stations in seven areas and eight 50 kW stations in six areas were allocated to Tanzania. (Refer to Table 2-4-8.)

Presently, RTD is planning the construction of 100 kW class transmitting stations, securing sites and started the construction of studio buildings, emphasizing the following 4 regions: Kigoma along Lake Tanganyika near the west border, Dodoma now under new-capital development, Nachingwea which covers the port cities such as Lindy and Mtwara near the south-east border, and Songea in the center of the south.

Table 2-4-8 50 kW - 100 kW Station Construction Plan

Site	Frequency	
	100 kW station	50 kW station
Dar es Salaam	531 kHz 657 kHz	
Dodoma	603 kHz 891 kHz	
Mbeya	1467 kHz	621 kHz
Nachingwea	648 kHz	
Morogoro	693 kHz	
Kigoma	711 kHz 1440 kHz	
Mwanza		720 kHz 1377 kHz
John's Corner		945 kHz
Songea,	990 kHz	
Tabora,		1008 kHz
Kibaha	1034 kHz	
Arusha		1215 kHz 1413 kHz
Chumbuni		585 kHz

Note 1. _____ Transmitting stations constructed at 2nd and 3rd stages
------- Existing stations.

2. Dar es Salaam 531 kHz and Kibaha 1034 kHz are now operating at 10 kW

3. In addition to the stations listed in the above Table 28 stations with transmitters of less than 20 kW output are registered.

(2) Long Range Development Plan for Program Production Centers

By dividing the country into seven zones as a program gathering network i.e., i) East zone, ii) South zone, iii) South height zone, iv) West zone, v) Lake zone, vi) North zone and vii) Central zone, RTD has been assigning staff to 2 or 3 main cities in each zone, a total of 20 places for news gathering and program production.

In the future, they are going to establish program production centers at Dodoma, Kigoma, Arusha, Mwanza, Mbeya, Songea, Lindi, Morogoro and Tabora as zonal centers during 4 stages so as to produce local programs. As listed in Table 2-4-7, the Dodoma and Kigoma program production centers are scheduled during the 1st stage.

As a result, it will be possible to provide more closely related information to local people and produce programs, thus enabling radio broadcasting to play an important role in promoting socio economic development in local areas.

(3) Long Range Plan of the Construction Fund for Transmitting Stations and Program Production Centers

In order to execute the aforementioned long range plan, RTD is taking budgetary actions every year to meet the expenses of studio facilities construction as well as land acquisition (1 million TSh for Dodoma and 1.4 million TSh for Kigoma have been appropriated in the '86/'87national budget.) However, a great amount of funds is required for the construction of radio stations, thus fund assistance from overseas is greatly required.

2-5 Situation behind the Request and its Contents

Tanzania developed the second stage expansion plan of its medium wave radio broadcasting network as a means to disseminate information effectively throughout her vast land, and the country expects the following effects after realization of this plan:

* Expansion of medium wave radio broadcasting network with emphasis on Central zone and border areas.

* Dissemination of farming related information, guidance in farming techniques and strengthening of farmers' education to push forward the agriculture promotion and development program

* Establishment of an information system to spread health and hygiene knowledge to the people and to carry out health and hygiene education.

* Wider adult education to develop local areas.

* Facilitation of manpower development plan by improving the quality of school education and teacher training education.

* Increase of information dissemination and production of zonal programs in conjunction with the progress of the New Capital Development.

In 1986, a plan was made to construct 3 stations: one in Kigoma having a 100 kW transmitter and a frequency of 711 kHz, one in Dodoma having a 100 kW transmitter and a frequency of 603 kHz, and one in Nachingwea having a 100 kW transmitter and a frequency of 648 kHz so as to increase the service area from less than 37% to more than about 60 % in terms of population i.e., by approximately 4.76 million people. Then the Government of Tanzania made a request for grant aid from the Government of Japan.

In Table 2-5-1 and Table 2-5-2 are listed the specific equipment required at the Kigoma Station and the Nachingwea Station.

Table 2-5-1 Broadcasting Facilities

Eq't & facilities name	Dodoma station	Kigoma station	Nachingwea station
100 kW/10 kW transmitter	1 set	1 set	1 set
Antenna system	1 set	1 set	1 set
Program transmission link between studio and transmitting stations	1 set	1 set	1 set
Standby program receiving system	1 set	1 set	1 set
Studio equipment	3 studios	1 studio	1 studio
UHF program transmission link (from the nearest TPTC station to studio building)	-	-	1 set
Power supply equipment for transmitting station	1 set	1 set	1 set
Power supply equipment for studio building	1 set	1 set	
Outside broadcast van	-	-	1 set
Measuring equipment	1 set	1 set	1 set
Maintenance tools	1 set	1 set	1 set
Spare parts	1 set	1 set	1 set
construction materials	1 set	1 set	1 set

Table 2-5-2 Floor Plan for Transmitting Station

Room name	Dodoma station	Kigoma station	Nachingwea station
Transmitter room	136 m^2	136 m^2	129 m^2
Blower room for transmitter	20	20	18
Dummy load room	24	24	24
Transmitter control room	36	36	27
Air conditioning equipment room	30	30	-
Studio	-	-	18
Sub-control room	-	-	22.5
Power supply room	42	42	36
Office	56	56	40.5
Storage	72	72	18
Repair and workshop	24	24	-
Rest room	16	16	13.5
Off duty room	-	-	13.5
Kitchenette	-	-	13.5
Entrance hall & corridor	84	84	58.5
Tuning unit hut (Annex building)	36	36	10
Total	576 m^2	576 m^2	442 m^2

CHAPTER 3. CONTENTS OF THE PROJECT

CHAPTER 3 CONTENTS OF THE PROJECT

3-1 Objectives

A medium wave radio broadcasting network should be developed as the best means to widely disseminate necessary information on important subjects to push forward socio-economic development. The promotion of agriculture which is essential to economic restructuring, permeation of health and hygiene knowledge which is related to the people's lives, and the improvement of the quality of adult education and school education to train capable persons and provide equal opportunity are some examples.

3-2 Study of the Contents of the Request

3-2-1 Effects of Radio Broadcasting

In developing countries, radio broadcasting is a very important means to disseminate information. In the 51 countries of Africa, radio broadcasting is conducted in every country. Television broadcasting is conducted in 38 countries but the diffusion rate of television sets is still low in relation to the population, thus dependence on radio is high.

In addition, developing countries have many problems on the development of agriculture, the promotion of medical care and the expansion of education, etc., and radio broadcasting is deeply involved in setting these problems.

In Tanzania radio broadcasting is actively utilized for the promotion of the regional socio-economic development and furthermore a continued effort is being made in utilization of radio broadcasting..

Ministry of Agriculture and Livestock Development has been producing radio programs conducive to the promotion of the agriculture and stockbreeding and thus far this effort by the Ministry has greatly contributed

to the improvement in the farmer's and the stockbroader's managerial skill. Furthermore, the Government of Tanzania is giving priority to the establishment of self-sufficiency in food through an increase in production of major farm products and the acquisition of foreign currency through an increase in production of cash crop for the purpose of boosting the nation's economic reconstruction, and in this connection it will make even greater efforts to utilize radio broadcasting for the purpose of guiding agricultural technologies, educating peasants and so on.

Also, Ministry of Health and Social Welfare has been producing and broadcasting programs under the themes of prevention of diseases, public sanitation, family planning and child and maternal health care for the purpose of disseminating health and hygiene knowledge. The Ministry's long-term program up until 2000 is aimed at extending the people's average life span from 50 years to 60 years by improving preventive measures against various diseases. And the establishment of a well-organized information system through expansion of the radio broadcasting network is essential to the efficient promotion of this long-term program. In this context, the Ministry is planning to improve the quality of radiobroadcasting programs for health and hygiene education by implementing necessary projects on a case-by-case basis.

The Adult Education Department of the Ministry of Education has been implementing group education using broadcasting programs as well as textbooks, newspapers and other teaching materials, for the purpose of abolishing illiteracy. This effort by the Ministry led to a very high literacy rate of 79% in 1980. The Ministry's ultimate goal in this effort is 100% literacy rate. The Ministry is also making strenuous efforts to produce radio broadcasting programs for adult education under a broad range of themes including agricultural education and health/hygiene education.

The Ministry of Education and the Ministry of Labor and Manpower Development, on the other hand, are in the process of promoting a program to increase the number of junior secondary school students who are expected to form the basis of the nation's labor force and improving the educational system for training teachers to engage in teaching at primary schools,

secondary schools and various kinds of colleges. As part of this effort, the Ministry of Education's School Education Department had implemented a program to produce school education programs for pupiles of primary schools and secondary schools up until last year. But the Department stopped broadcasting these programs this year with a view to producing new programs that will meet the above-mentioned objective. The Department is now in the process of working out a new curriculum to be started on next year.

As stated above, radio broadcasting has been greatly contributing to the promotion of the socio-economic development and it will continue to do so.

Presently, the medium wave radio service areas cover approximately 37% of the population, and people in outside these areas cannot help but rely on short wave broadcasting from the capital, Dar es Salaam. Moreover, receiving these short wave broadcasts is difficult because of the poor propagation peculiar to this wave.

Under these circumstances, medium wave radio broadcasting is superior to short wave broadcasting in its stable reception and simple receiver, in addition to the wide coverage, simultaneous and instantaneous nature of radio broadcasting as a whole. By expanding such medium wave radio broadcasting, one single effective information dissemination means can be established throughout vast Tanzania, thus raising expectations of a great effect.

3-2-2 Proposed Sites for Stations

From the viewpoint of an efficient expansion of the service area, advance studies were made not only on the proposed sites of Dodoma, Kigoma and Nachingwea but also on Songea, John's Corner, Tabora and Morogoro.

The locations of these proposed stations and a comparison of them are shown in Fig. 3-2-1 and Table 3-2-1.

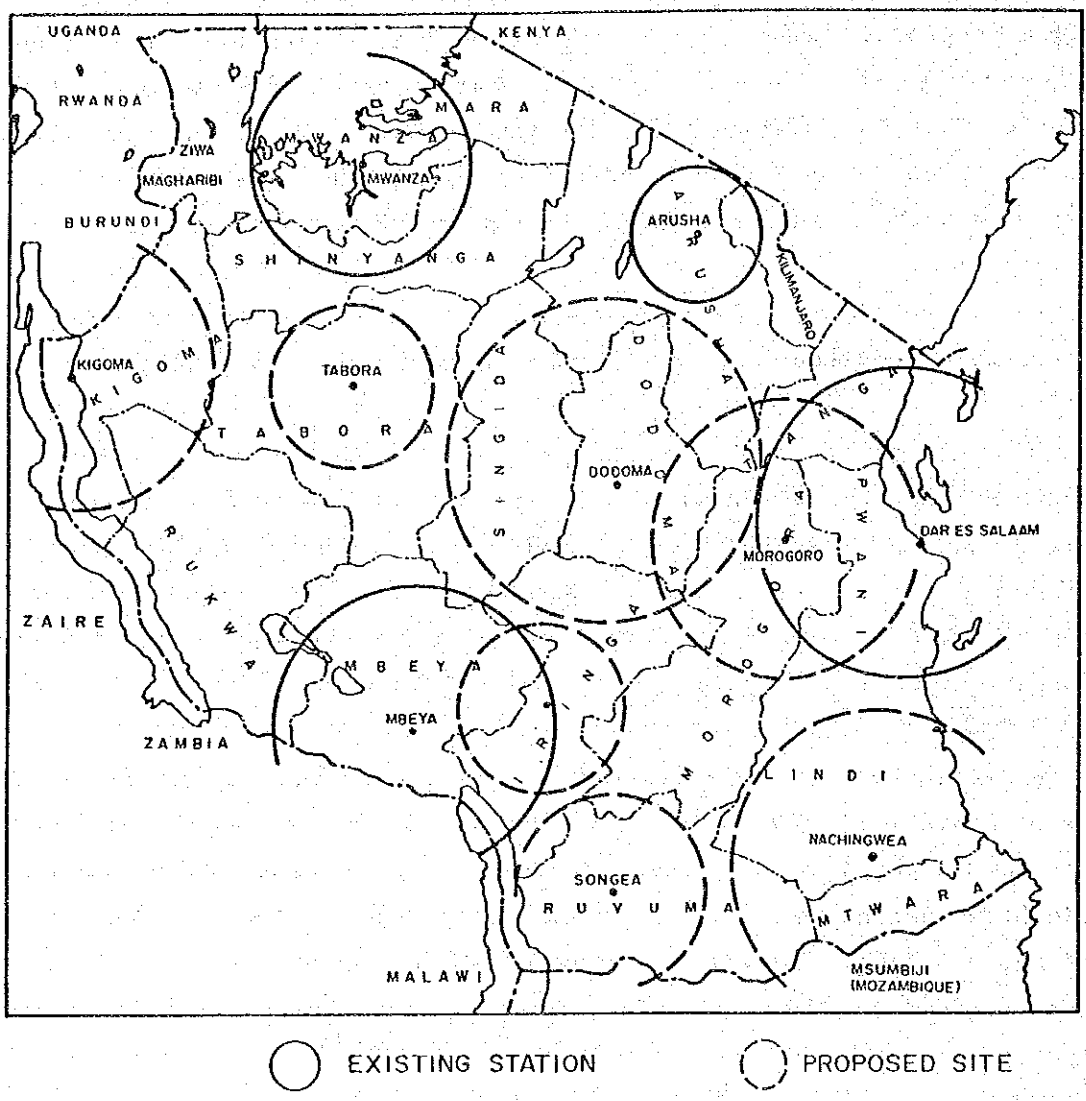

Fig. 3-2-1 Proposed Sites of Stations

Table 3-2-1 Comparison of Proposed Sites

	Geographical location	Population distribution	Overlap of service areas	Evaluation
Dodoma	o	o	o	A
Kigoma	o	o	o	
Nachingwea	o	o	o	
Songea	o	x	o	B
John's Corner	o	o	x	
Tabora	o	x	o	
Morogoro	x	o	x	C

Note: Geographical location : good o and poor x

Population distribution : high o and low x

Overlap of service areas : no o and yes x

From the above evaluation, it is considered that the three stations of Dodoma, Kigoma and Nachingwea requested and proposed by Tanzania are reasonable and appropriate.

In Table 3-2-2 is listed a comparison of the three requested sites in regard to site conditions, administrative actions by the Government of Tanzania and so forth based on the preexamination and the result of field survey.

Table 3-2-2 Proposed Sites

Item		Dodoma	Kigoma	Nachingwea
(1) Site conditions	Location	* almost in the center of the country * wide service area expected by establishing a station	* west border * great influence from foreign radio waves and at present a lack of domestic information due to the great distance from the capital	* close to south border * great influence from foreign radio waves
	Receiving conditions	* domestic medium wave broadcasting unavailable	* domestic medium wave broadcasting unavailable	* domestic medium wave broadcasting unavailable
	Population coverage	* about 2,390,000 (probable)	* about 730,000 (probable)	* about 1,640,000 (probable)
(2) Administrative actions	Long range program	* capital transfer project under way (1980) * RTD station construction project: 2nd stage	—— * RTD station construction project: 2nd stage	—— * RTD station construction project: 3rd stage
	Present status	* transmitting site already acquired by RTD * studio building under construction also	* transmitting site already acquired by RTD * studio building under construction also	* transmitting site already acquired by RTD * studio lot yet undecided
	Proposed priority	* No. 2	* No. 1	* No. 3
(3) Facilities	Program link	* telephone network to TPTC in Dodoma available	* telephone network to TPTC in Kigoma available	* installation of UHF radio network from TPTC in Masasi required
(4) Execution of construction	Soil conditions	* ground hard and no problem as a result of soil condition; survey conducted in proposed transmitting site	* ground hard and no problem as a result of soil condition; survey conducted in proposed transmitting site	* soil condition survey in proposed transmitting site made yet
	Transportation	* road conditions good and no problem with equipment transportation	* road conditions good and railway also available thus no problem with material transportation	* about 50 km unpaved section thus material transportation is required to be done except rainy season, resulting in interference with the execution of construction

Considering that the project is advancing substantially and that the various conditions for construction are relatively acceptable, as well as in consideration of the request made by the Tanzanian side, Dodoma and Kigoma were selected.

As far as Nachingwea is concerned, the 50 km unpaved section of the road to the site makes material transportation difficult in the rainy season, thus requiring construction at a time other than during this season, with the result that the construction execution period would be limited.

As for facilities, enough TPTC telephone lines for program transmission lines from Dar es Salaam are available halfway up to Masashi, but only a few lines are available beyond Masashi. Thus it is difficult for RTD to get the exclusive lines. For this program relay, it will be necessary to newly install UHF wave radio relay link between Masasi and Nachingwea for about 40 km in order to connect them.

The concept of an establishment plan for Nachingwea station and the site situation became clear in the field survey of this time. However, the plan of the Tanzanian side has not specifically made any progress except the acquisition of the transmitting station site. For these reasons, further study and review will be required for the plan's materialization. Thus Nachingwea Station was excluded at this time. (See Appendix VII-3-2.)

From a functional viewpoint, a broadcasting station is generally made up of a transmitting station to broadcast programs and a studio building to produce programs. As for the location of a transmitting station, it is preferable to construct it in the suburbs with few houses around and in a flat and damp area in view of efficiency. Whereas from the viewpoint of news gathering and securing the cast for programs a studio building is preferably located in a city convenient for traffic and communications.

In this project, the transmitting stations both for Dodoma and Kigoma will be constructed at the sites acquired by RTD, which nearly meet the above conditions and are not so crowded by houses.

RTD is now constructing a studio block with 2 studio rooms adjacent to its existing office block in the city of Dodoma. When completed they will have 3 studio rooms altogether including the one studio room in the existing block. And in Kigoma, an office block and a studio block with one studio room are now under construction. Under this project, these blocks will be used as studio buildings.

3-2-3 Frequencies and Power of Transmitting Stations

Electric waves of the medium band used for radio broadcasting may propagate too far away at night, and thus may interfere with the broadcasting of neighboring countries, or may be interrupted by foreign stations.

Electric waves are an effective means for communication including all broadcasting in general. If they are not used in disorder, interference may occur and good quality reception and transmission may not be possible. This is due to the wave characteristics of wide range propagation.

From this point of view, frequencies and broadcasting powers for medium wave stations are regulated by the international agreement concluded at the Regional Administrative LF/MF Broadcasting Conference held twice in 1974 and 1975 by the International Telecommunication Union (ITU).

These frequencies and powers are all registered at the International Frequency Registration Board (IFRB).

As for the frequencies and powers of the areas in this project, three waves are registered for Dodoma and two waves for Kigoma.

Dodoma 603 kHz/100 kW, 891 kHz/100 kW, 1395 kHz/20 kW

Kigoma 711 kHz/100 kW, 1440 kHz/100 kW

As the installation plan of stations in this project is to be an integral part of the expansion plan for the radio broadcasting network program in Tanzania, it is desired that the service areas will be increased as effectively as possible. Medium wave radio broadcasting uses waves propagating over the ground i.e., ground waves, therefore the lower the frequencies, the less attenuated and the further propagated the broadcasts.

Accordingly, it is ideal to use the lowest frequency out of those assigned to an area and the largest power permissible. Therefore, by using 603 kHz/100 kW for Dodoma and 711 kHz/100 kW for Kigoma, the Tanzanian radio broadcasting network is to be expanded effectively.

3-2-4 Program Production Equipment in the studio building

(1) Equipment in Dodoma Studio Building

In the prospective station at Dodoma it is expected to produce 15% of the total number of the radiobroadcasting programs as a big program production center second only to RTD headquarters in Dar es Salaam, in light of the new capital development project. It is also necessary to produce programs of various categories in line with the programming of the national service in terms of content.

Accordingly the number of studios necessary for the production of programs in Dododoma station can be determined in the process of calculation as discribed below.

i) If a production rate of each category of program is assumed 15%, the programs to be produced at Dodoma station will become 18 hours and 54 minutes per week in terms of broadcasting hours.

ii) The production hours or each program are estimated on the basis of a magnification of studio use (production hours divided by broadcasting hours) with consideration given to the complexity of the content, the number of equipment used, and technical level required in each program. As a result, each magnification of

Table 3-2-3 Programs to Be Produced by the Dodoma Station and Number of Hours for Program Production in the Studio

Type of program	Broadcasting time	Magnification of studio use	Number of hours for program production
News	2 hr 00 min	4	8 hr 00 min
Current topics/general information	3 hr 10 min	5	15 hr 50 min
Documentary	0 hr 10 min	5	0 hr 50 min
Adult education	2 hr 10 min	5	10 hr 50 min
Drama	0 hr 10 min	30	5 hr 00 min
Women's program	0 hr 30 min	5	2 hr 30 min
Children's program	0 hr 30 min	20	10 hr 00 min
Religious program	0 hr 30 min	5	2 hr 30 min
Sports program	0 hr 24 min	5	2 hr 00 min
Folk music	1 hr 00 min	10	10 hr 00 min
Music/light entertainment	8 hr 20 min	10	83 hr 20 min
Total	18 hr 54 min	-	150 hr 50 min

studio use in Dodoma station is estimated as shown in Table 3-2-3. The magnification is settled on the basis of the current frequency of studio use in RTD and also taking into account the reference value used in Japan.

iii) The result of the above estimation is that the weekly production hours in the studio is 150 hours and 50 minutes (21 hours and 30 minutes a day), which compares to the weekly broadcasting hours of 18 hours and 54 minutes. Accordingly, if a studio is to be used for 8 hours a day, at least 3 studios are necessary.

It should also be noted that the nature and scale of the sounds to be picked up through microphones in the studio vary according to the content of each program. In the case of speech, for example, it includes narration by a single narrator and conversations by plural people as in a drama and talks. A music program may feature a small music band or a big one. There are also two methods for packing up sounds by the microphones used in the studio -- picking up from one point and picking up from multipoints.

For the above-mentioned reasons, the size of the studio varies from one program to another.

Announcement	10	-	20 m^2
Talk	20	-	50 m^2
Drama (speech/sound effects)	50	-	200 m^2
Music (small and medium band)	100	-	200 m^2
(big band)	300	-	600 m^2

In consideration of the above, it is necessary to include 3 studios -- a big studio, a medium studio and a small studio -- in the Dodoma Station building.

Big studio (126 m^2, for music and drama)	1
Medium studio (31 m^2, for talk, educational program)	1
Small studio (16 m^2, for news/general information)	1

(2) Equipment in Krgoma Studio Building

At present, staff members who are arranged in the office block of Dodoma station are in charge of gathering program materials and producing programs as a base of the program gathering network.

If a studio block is installed and its program production capabilities are improved, it will be able to function as a program gathering center. Because the stuff members will be able to produce and broadcast news and general information programs closely related to the everyday needs of the residents in this area and also regional programs on agricultural technologies and health/sanitation which are relevant to the particular climatic conditions in this area.

In consideration of the above, it will be necessary to install at least a studio for production of information programs mentioned aboove in the Kigoma station.

3-3. Project Synopsis

3-3-1 Executing Agency and Administration System

The agency responsible for the execution of this project is the Office of the Prime Minister and First Vice President. RTD is in charge of the operation under the control of the above Office.

Since the Office of the Prime Minister and First Vice President, which is the next higher organ to RTD, becomes the executing agency directly responsible for this project, smooth cooperation with other ministries and agencies can be expected.

3-3-2 Basic Plan

(1) Service Area

According to the technical standards applied by the aforementioned Regional Administrative Conference, it is specified that nominal field strength in Tanzania (field strength as a guide in the service areas in the broadcasting network expansion plan) should be 73 dB (μV/m) in the daytime.

In this project, however, by referring to the receiver's sensitivities by type in Japan and through actual listening results at each proposed

site, the service area was set to be within the range of 60 dB field strength. (dB: This is a unit to represent the ratio of electric power, voltage and so on in terms of 10 (or 20) times the common logarithm of the ratio to the reference value. In the case of electric field strength, the reference value is based on the case that the voltage generated on the antenna with a unit length of 1 meter is 1 μV.

Receiver sensitivities by type are shown in Fig. 3-3-1. This was made based on the Receiver's Performance Survey for Standard Broadcasting (Radio Engineering and Electronics Association, Survey Committee, May 1977). The minimum field strength is shown when the ratio of audio signal (50 mW output) to noise is 30 dB (practically available value).

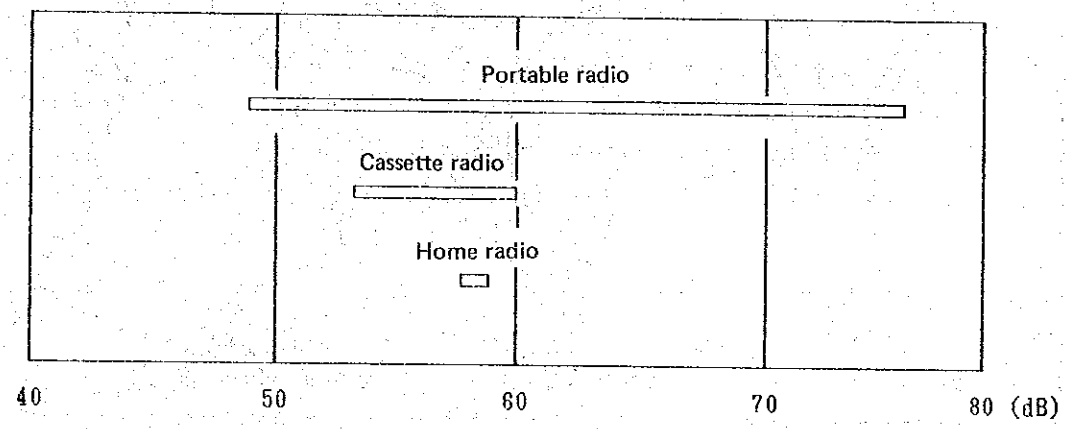

Fig. 3-3-1 Receiver Sensitivities by Type

When the two stations in Dodoma and Kigoma are completed with the service areas as stated above, the medium wave radio service area will be 40% of the entire land, or increased by 18% from the present 22%. Presently the service is provided for about 7.66 million people (about 37% of the entire population), and the served population will be increased by about 3.12 million to about 10.88 million people (about 52% of the entire population) after completion.

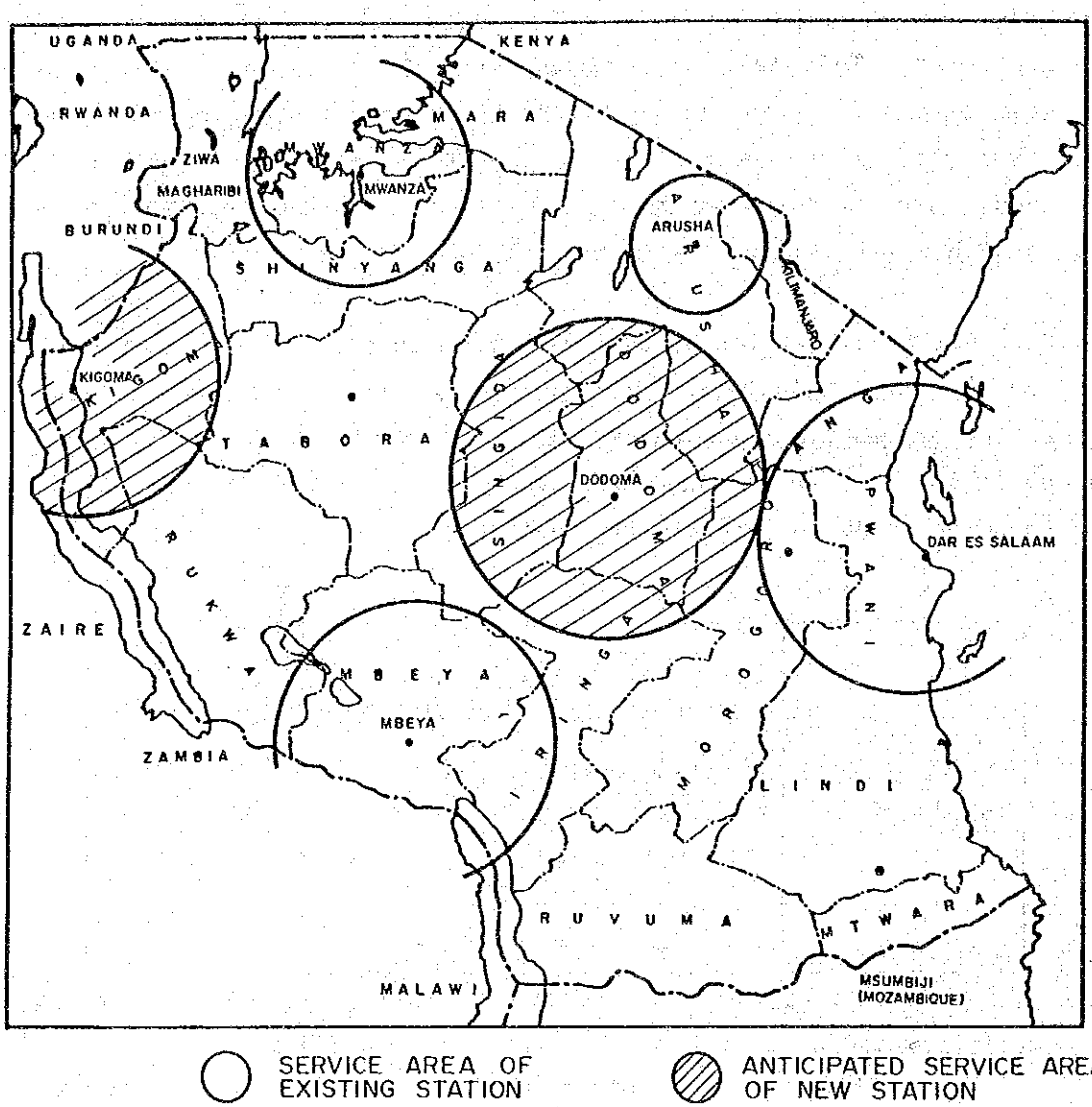

Fig. 3-3-2 Anticipated Service Areas

(2) Transmitting Station

Each station will construct a transmitting house at a site acquired by RTD. The transmitting house is provided with a transmitting system, program receiving system (Receiving FM waves from the studio), power distributing and receiving system and standby generator and a medium wave antenna mast and a tower for receiving program circuit.

1) Transmitter

Based on the aforementioned frequencies and power arrangement, each station is provided with a 100 kW transmitter and a 10 kW standby transmitter.

A 100 kW transmitter is the less troublesome equipment in view of its reliability, but even if there is an electric power drop in the vacuum tubes or damage to parts occurs, it is possible to continue broadcasting by switching to the standby transmitter.

If a 100 kW standby transmitter is employed the cost of standby system, including transmitter and house area for these equipment should be increased. Thus a 10 kW transmitter was decided to be used for a standby.

As the output of the standby transmitter is just 10 kW, its coverage is decreased from that of the 100 kW transmitter (distance between transmitting station and the fringe of coverage is about 65%), but as quick repair is possible for attended stations in the case of a failure of a 100 kW transmitter, running time of the standby equipment is short, hence no problem is expected.

2) Transmitting Antenna

Generally, the antenna height should be about the wave-length. However medium waves are as long as 560 m to 180 m, thus an antenna with 1/2 to 1/4 wavelength is used and the antenna is erected vertically to the ground.

When broadcasting was commenced in Japan, various types of antennas such as the inclined type, the inverted L-type and the T-type using copper wire were used. However a steel tower or a steel mast itself used as a transmitting antenna is widely used presently in view of construction costs, operation and maintenance. Consequently cylindrical steel mast is employed in this project also.

Efficiency gets better if the antenna height is close to 1/2 the wavelength, but this antenna height is also registered at IFRB and the registered height is to be employed in this project. Directional gain of antenna is also registered and the IFRB instruction is to be observed for the directivity also.

The antenna of Dodoma Station is 125 m high and of a non-directional type, and that of Kigoma Station is 125 m high and of a directional type so as to supress wave emission to Burundi and Zaire in the west.

In order to give directivity to the Kigoma Station antenna, it is necessary to install sub-antenna in addition to the main antenna. A down lead system (system to wire down a copper wire from the top of the main antenna) is employed for this sub-antenna because of its simple structure and less expense.

3) Program Reception

Transmission of broadcast programs from the studio building to the transmitting station 15 to 30 km away is accomplished by using an FM radio link which is also used for FM broadcasting. For this, a receiving antenna is installed on the top of a tower as high as about 30 m on the transmitting side and the broadcast programs recieved by the FM receiver are sent to the transmitter.

Two FM receivers should be provided so as to be switched over to the standby one automatically in case of a failure of the other.

4) Power Source

A standby generator having the capacity required for the continuation of broadcasting is provided in addition to a receiving and distributing system of commercial power to cope with troubles such as service failure.

A power source system for the broadcasting equipment should be provided with an automatic voltage regulator having the necessary capacity to cope with a wide voltage fluctuation (more than $\pm$10%) in the commercial power supply.

5) Engineering Link

VHF transceivers are provided for each station to exchange information on changes in broadcasting times, emergency actions, etc., between the studio building and the transmitting station.

(3) Studio Building

In this project, the studios under construction at two places are to be used as studio buildings and each room in the studio building is to be provided with program production equipment in compliance with its broadcasting contents. Receiving equipment for program relay from Dar es

Salaam and equipment to send these broadcast programs to the transmitting station of its own station are to be provided, and in addition to this equipment power receiving equipment and a standby generator are to be provided.

Also, a tower for use as a transmitting antenna to send broadcast programs to the transmitting station of its own station through an FM radio link is to be constructed adjacent to these buildings.

1) Program Production Equipment

a) Dodoma Station

The following these studios, large, medium and small, are to be provided with equipment suitable for each production program:

Studio 1 (126 m^2) Used to produce music and drama programs as a large studio

Studio 2 (31 m^2) Used as a medium studio to produce round-table talks and educational and cultural programs

Studio 3 (16 m^2) Used as small studio to produce news, commentaries, and daily life information programs

b) Kigoma Station

Studio is to be used to produce news, commentaries, daily life information programs, and is to be equipped with the same equipment as at Studio 3 at Dodoma Station.

2) Master Control equipment

Each station receives broadcast programs sent from RTD in Dar es Salaam through the telephone lines of TPTC, and daily broadcasting is thus made. In case of a failure of these lines, short wave receivers capable of receiving the broadcasting directly from RTD are provided so as to continue the radio broadcasting. Two receivers are provided so as to receive each frequency and select the better output.

In addition, equipment is provided to select the output of the above equipment (programs from Dar es Salaam) and the studio output (programs produced by the station itself) and transmit the selected programs to its own transmitting station and other stations.

3) Transmission of Broadcasting Programs

Transmission of broadcast programs from the studio building to the transmitting station is made by using the FM radio link. Consequently, a low power FM transmitter is to be provided in the studio building and a transmitting antenna is to be installed on the top of a tower about 30 m high. Two FM transmitters, one for main and the other for standby, are to be provided, and the transmitting power should be 100 W for 30 km in Dodoma and 50 W for 15 km in Kigoma taking into consideration the distance between the transmitting station and the studio building.

4) Power Source

In addition to a receiving and distributing system of commercial power, a standby generator having the capacity required for the continuation of broadcasting is provided to cope with troubles such as service failures.

The power source system for the broadcasting equipment should be

provided with an automatic voltage regulator having the necessary capacity to cope with a wide voltage fluctuation (more than ±10%) in the commercial power.

5) Engineering Link

VHF transceivers are provided for each station to exchange information on changes in broadcasting times, emergency actions, etc., between the studio building and the transmitting station.

In addition, one portable transceiver set is arranged so as to be used for the gathering of news and programs.

3-3-3 Location and Conditions of the Project Sites

(1) Dodoma

The city of Dodoma is about in the center of the country, located approximately 400 km west of Dar es Salaam and is 1,100 m above sea level. In Dodoma, the new capital development project is under way, and some ministries and agencies have started moving. The national assembly has been held there already for a certain period.

The present city is about 4 km x 4 km in four directions with a population of about 456,000. Dodoma is connected with the present capital, Dar es Salaam by a relatively good paved road and railroad and air service are also available.

Incoming radio waves from neighboring countries and existing stations were measured in the city of Dodoma, but practically no audible medium waves exist in the daytime. Short wave broadcasts from RTD fluctuate greatly even in the daytime in terms of field strength and time. At the same time a deep fading takes place which makes the radio broadcasting inaudible. In the nighttime, relatively high level waves come in from both domestic stations and neighboring countries, but the strength of the waves fluctuate greatly in time due to deep fading, and there exists much wave interference, thus resulting in their being inaudible.

Incoming waves of 603 kHz, the same as the scheduled transmission frequency, were not received.

Location map of the project site is shown in Fig. 3-3-3.

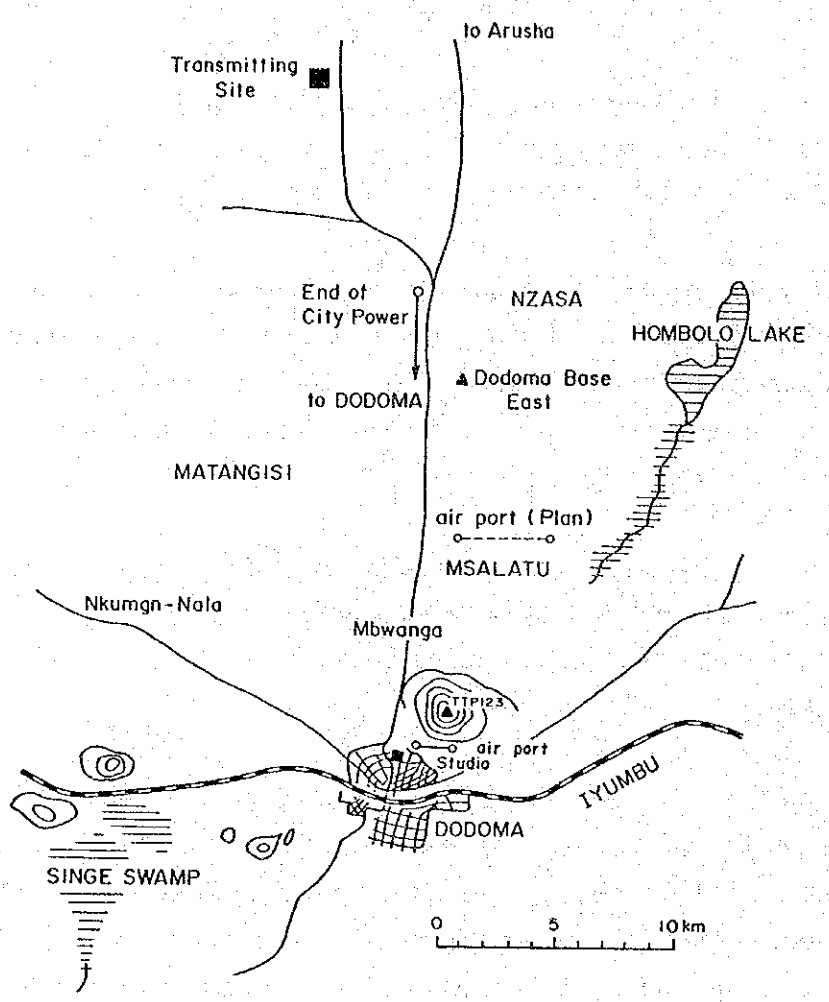

Fig. 3-3-3 Location Map of Dodoma Project Site

1) Proposed Site of Transmitting Station

The proposed site is located about 30 km north of the city of Dodoma, on a vast savanna west of the state highway to Arusha, and a one square kilometer flat site has been secured. The site is surrounded with barbed wire about 2 m high.

As a result of test borings made at two places, it became clear that there exists a hard layer about 1 meter below GL with N value of about 60 (See appendix VII-3-3). The studio building is out of line of sight from the proposed transmitting site, but it was reaffirmed by studying a profile of the terrain using a map scaled 1 to 50,000 that there would be no trouble with program transmission if both receiving and transmitting antennas at the

studio building and transmitting site are made sufficiently high.

The present airport is located just 500 m north of the studio building, and the new airport in the capital transfer project will be positioned about 20 km south of the transmitting station. However, it is estimated that there would be no problems in transmission.

2) Studio Building

The studio building is in the north of the city and presently the studio block (about 439 m^2) adjacent to the existing RTD office block (about 145 m^2) is under construction. Structure work, part of the interior finish work, and the duct work are finished.

The studio block comprises two studios, a master control room, a sub-control room and a power source room. Also, a small studio is in the existing office block and it is being used.

3) Climatic Conditions, etc.

Both temperatures and humidities around the city of Dodoma are lower than those around the coastal area, and the difference in temperature between day and night is high, about 12° C on an annual average, and it reaches as high as about 25° C in October. Temperatures are high from October through December and low from June through August. The difference in humidity between day and night is also high, about 90% at around 10 a.m., and about 40% around 2 p.m. This is related to the strength of sunshine in the daytime, and a rising current due to evaporation generates tornados in some cases. A tornado which has damaged buildings has not been reported yet but the situation requires paying attention to. Rainy season is December through March, and rainfall is heaviest in January when it is about 400 mm/month. Annual rainfall is less than 1,000 mm. It is recorded that about 10 thunderbolts a day have fallen at a maximum during the rainy season.

The Dodoma transmission site in Tanzania belongs to an area where few earthquakes take place, thus there is no problem if Japanese design standards are applied to the station.

(2) Kigoma

The city of Kigoma is close to the west border of Tanzania and is the capital of the Region of Kigoma, thus playing an important role the nation's socio-economic development and also in respect to traffic and communications.

The center of the city lies in a valley leading to the port, and the railroad running north of the city is connected to the port terminal.

The city itself seems energetic and its population is about 50,000.

Measurement was made of incoming radio waves from neighboring countries as well as those of existing domestic stations, but there exist practically no audible medium waves. Short wave service from RTD is too low in the daytime for receiving the field strength and thus is not practical at all.

In the nighttime, a relatively high level of radio waves come in from domestic stations as well as neighboring countries, but they experience deep fading and interference.

Incoming waves of 711 kHz, the same as the scheduled transmission frequency, were not received.

Location map of the proposed site is shown in Fig. 3-3-4.

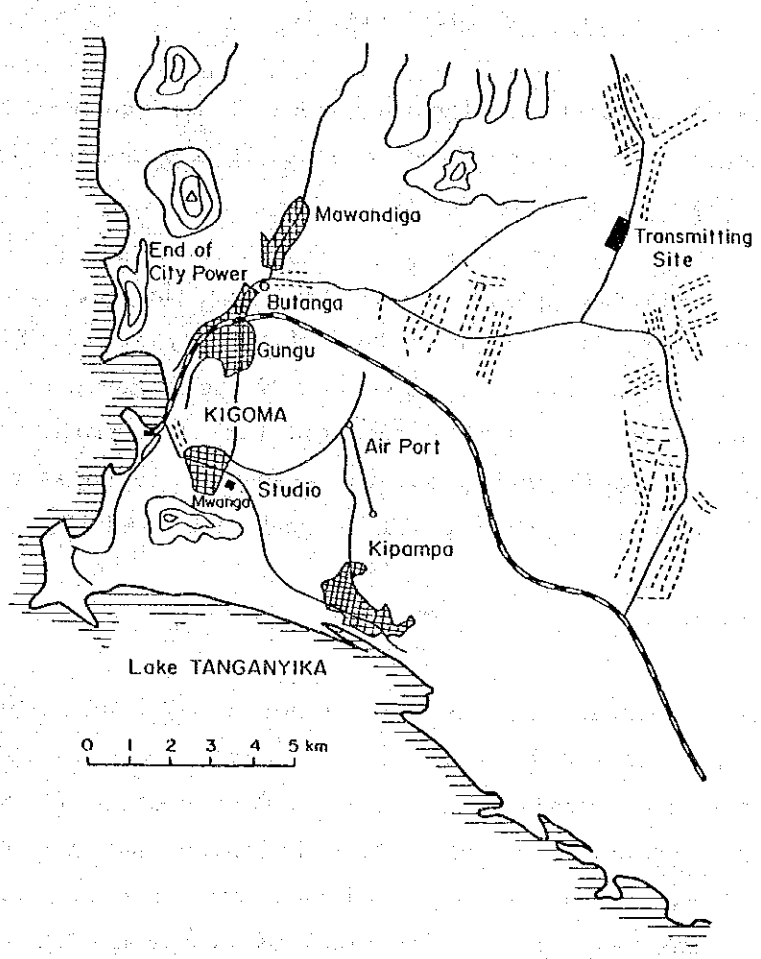

Fig. 3-3-4 Location Map of Kigoma Project Site

1) Proposed Site of Transmitting Station

The site is on a ridge running from north to south of the plateau located about 15 km north-east of the receiving site, and is a narrow site extending 1 km south to north and 400 m east to west.

In the site, mango trees are growing. Casabas are also growing on some parts of the site, but it has already been secured as the construction site and boundary markers are already set. As a result of test borings made at two places on the site, it became clear that there exists a hard sandy silt with gravel 1.5 m to 2 m below GL with an N value of more than 50 (See appendix VII-3-3). The house on the receiving site is visible from this

site in a south-eastly direction.

The present airport is located about 8 km south-west of this site, hence there is no problem even if a transmitting mast as high as 100 m or more is erected.

Commercial electric power can be led into the site by extending the power lines for about 16 km. Moreover, in the Kigoma district, the power demand is about 1.3 MW to a generating capacity of 1.5 MW. Thus the 0.5 MW required for this project cannot be supplied. An additional generator is necessary so as to generate at least 0.3 MW, and this is to be handled by TANESCO.

2) Studio Building

The studio building stands on the north slope of hills running east to west at the back of Lake Tanganyika, and is located 2 km away from the center of the city. Construction of the studio building consisting of an office building and a studio block (about 156 m^2) is under way, and the structure work and roofing work are finished. The studio block is provided with a studio, a sub-control room, a maintenance room, an air-conditioning power room etc.

3) Climatic Conditions, etc.

Compared with Dodoma, the annual temperatures in Kigoma change less and the temperature difference between day and night is on the average 8° C lower than that of Dodoma. Humidities in August and September are relatively low and the difference between day and night is 10 to 15 %. Since Kigoma faces Lake Tanganyika, annual rainfall is 1,000 to 1,300 mm, higher than that in Dodoma by 400 mm. The rainy season lasts long from December to April.

The area on the east side of Lake Tanganyika is where earthquakes

take place most frequently in Tanzania, and Kigoma is located at the northern tip of this area.

But their frequency is just about three times a year, and damage to buildings has not been reported. Accordingly, design standards for the buildings and antenna are to be in accordance with those of Japan as in the case of Dodoma.

3-3-4 Outline of Facilities and Equipment

The outline of main facilities and equipment is listed in Table 3-3-1 and Table 3-3-2, and the total system diagrams in Fig. 3-3-5 and Fig. 3-3-6.

Table 3-3-1 Main Facilities & Equipment of Dodoma Station

Main facilities & equipment	Quantity
1. Transmitting station	
1) Transmitter 100 kW, 10 kW (standby)	1 set
2) Transmitting antenna guyed type cylindrical steel mast antenna (125 m high)	1 set
3) Program link receiving equipment 2 FM receivers, receiving antenna, tower for receiving antenna	1 set
4) Power source equipment electric power receiving/distributing equipment, automatic voltage regulator, standby generator	1 set
5) Engineering link equipment VHF tranceiver	1 set
6) Transmitting house	1 set
2. Studio building	
1) Program production system Studio #1 (large), Studio #2 (middle) and Studio #3 (small)	3 sets
2) Master control equipment TPTC circuit, short wave receiver, program assignment switch	1 set
3) Program transmission equipment 2 FM transmitters, transmitting antenna, tower for transmitting antenna	1 set
4) Power source equipment electric power receiving/distributing equipment, automatic voltage regulator, standby generator	1 set
5) Engineering link equipment VHF transceiver	2 sets

Table 3-3-2 Main Facilities & Equipment of Kigoma Station

Main facilities & equipment	Quantity
21. Transmitting station	
1) Transmitter 100 kW, 10 kW (standby)	1 set
2) Transmitting antenna (with directivity) guyed type cylindrical steel mast antenna (125 m high)	1 set
3) Program link receiving equipment 2 FM receivers, receiving antenna, tower for receiving antenna	1 set
4) Power source equipment electric power receiving/distributing equipment, automatic voltage regulator, standby generator	1 set
5) Engineering link equipment VHF transceiver	1 set
6) Transmitting house	1 set
2. Studio building	
1) Program production system Studio (small)	1 set
2) Master control equipment short wave receiver, program assignement switch	1 set
3) Program transmission equipment 2 FM transmitters, transmitting antenna, tower for transmitting antenna	1 set
4) Power source equipment electric power receiving/distributing equipment, automatic voltage regulator, standby generator	1 set
5) Engineering link equipment VHF transceiver	2 sets

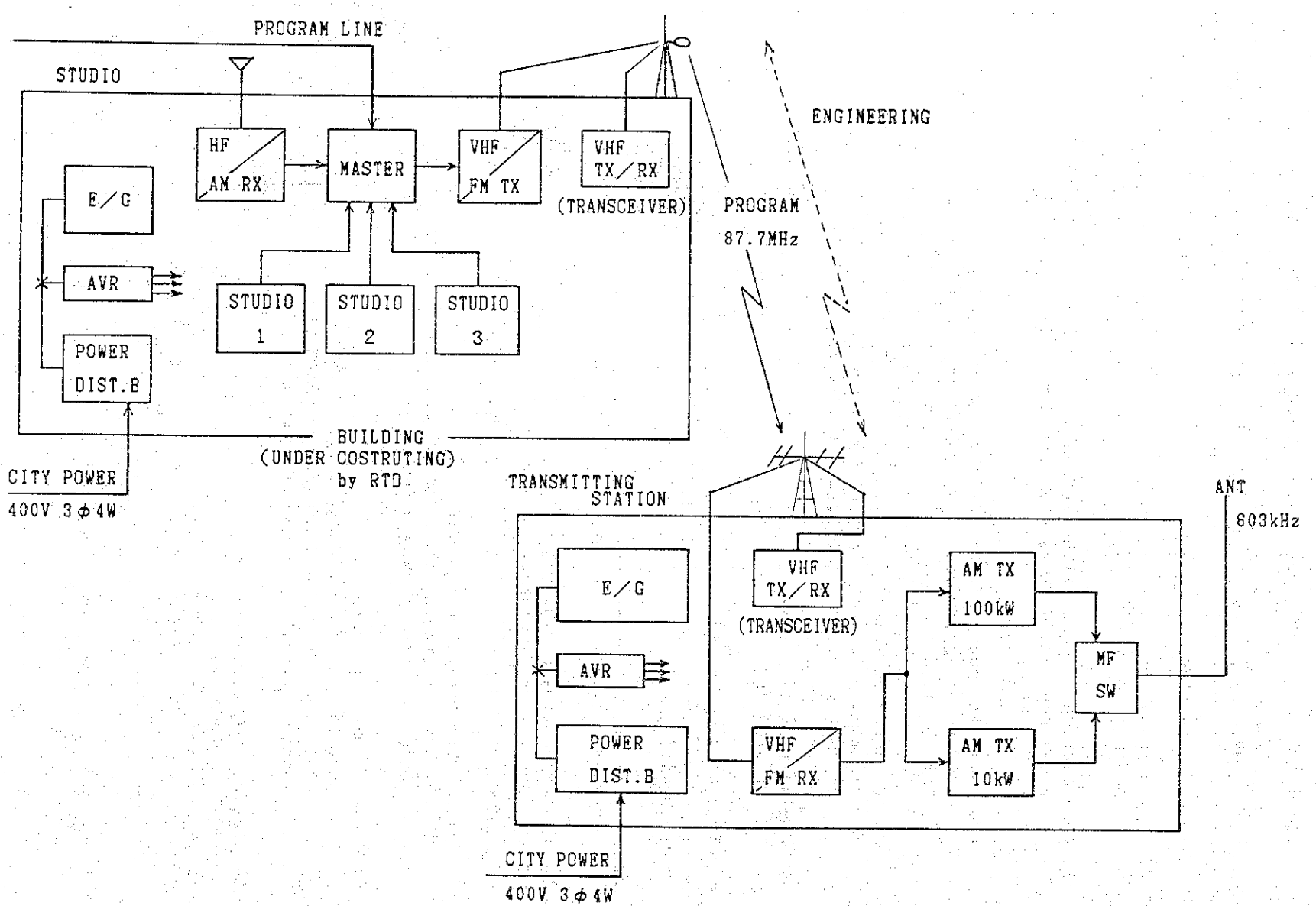

Fig.3-3-5 Total System Diagram of DODOMA

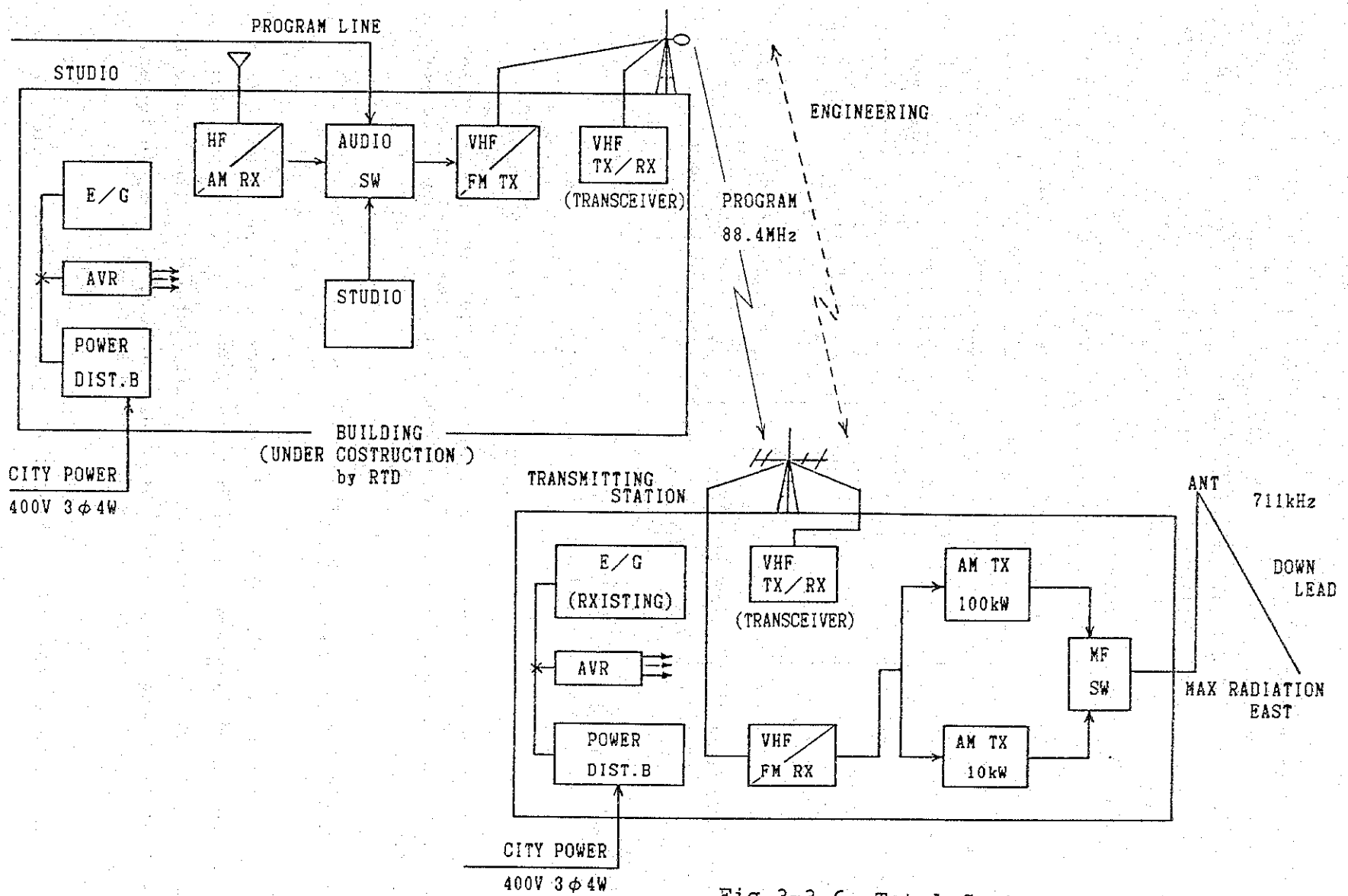

Fig.3-3-6 Total System Diagram of KIGOMA

3-3-5 Personnel Formation

Personnel to staff Dodoma Station and Kigoma Station after completion of this project are scheduled as follows taking the existing Arusha Station as a model:

Table 3-3-3 Personnel Plan

(Unit: person)

Work assignment	Present status		Project		
	Entire RTD	Arusha*** Station	Dodoma Station	Kigoma Station	Sub-total
Engineering*	186	13	19	16	35
Program production	70	1	4	2	6
News	52	1	2	2	4
Administration**	273	25	25	25	50
Total	581	40	50	45	95

* Including studio staff
** Including drivers, watchmen, typists, janitors, etc.
*** Indicated again

Approximately 95 persons are required for RTD. The studios of Dodoma Station and Kigoma Station are under construction, thus about 20 persons are already secured.

(1) Manning of Engineering Staff

As listed in Table 3-3-3, it is necessary to assign 13 staff members for the transmitting station and 6 staff members for the studio building totaling 19 for Dodoma Station, and 13 staff members for the transmitting station and 3 staff members for the studio building totaling 16 for Kigoma Station.

The 13 staff members required for each transmitting station at both

Dodoma Station and Kigoma Station (1 manager + operators (2 staffs x 4 shifts and 3 mechanics) + 1 staff for electric power/engine = 13) seem to be just enough to operate the transmitting station based on the actual operating results of the existing Mwanza and Arusha Transmitting Stations.

Also, assigning 6 staff members to the Dodoma Studio building with its 3 studio rooms and 3 staff members to the Kigoma Studio building with its 1 studio room seems to be also reasonable based on the fact that the 8 studio rooms in Dar es Salaam head quarters are operated by a staff of 25. 1 staff member has already been assigned to each (Dodoma and Kigoma) Station.

(2) Recruitment of Engineering Staff

1) Actual Past Results

When 3 transmitting stations in Mbeya, Mwanza and Arusha were constructed, it was possible to secure more than 30 staff members.

2) Securing Staff

Necessary staff can be secured by attracting recruits and trainees both domestic and overseas.

a) Recruits

It seems sufficiently possible to employ 25 persons for this project out of the 16,000 graduates from the following courses:

* Junior secondary school graduates — about 13,000/yr

* Senior secondary shool gradiates — about 2,300/yr

*	Vocational training center (electricity)	40/yr
*	Technical colleges (electric/communication course: FTC)	105/yr
*	Technical college (electric/communication course: Diploma)	35/yr
*	Dar es Salaam Univ. Eng. Dep't (electric/communication course)	20/yr

b) Training System in RTD

For those who have finished the junior secondary school, senior secondary shool and vocational training center but still have insufficient technical knowledge, RTD is conduting further training in accordance with the national education system so that they can become technical staff members. Trainees number about 10 to 20 every year.

c) Long-Term Trainees, Domestic or Overseas

As shown in Fig. 2-4-5, 17 long-term trainees were secured in 1986. Accordingly, it is possible to secure highly skilled personnel immediately after they finish their training. (Assuming about half of them)

(3) Securing Other Staff

Program production staff and news staff can be recruited from the persons now undergoing training, and persons in other work assignments can easily be secured based on the employment situation.

3-4 Technological Cooperation

RTD, which has many achievements and ample experience in radio broadcasting, for long years since the start of radio broadcasting in the nation in 1951, is currently operating the radio station of the same scale as those to be constructed in this project. Since RTD's key staffers are going to receive on-the-job training on composition of system, adjustment of equipment and machinery and operation of systems during the implementation of this project, there will be no problem on the part of Tanzania in operating and managing the facilities and equipment after completion of this project.

Japan has been accepting many trainees from Tanzania to seminars and training courses on management, administration, program production and broadcasting technologies which are organized and implemented in Japan for them. RTD strongly hopes that Japan will continue to accept Tanzanian trainees to receive in-service training in program production and radio broadcasting technology.

Such seminars and training courses to be organized and implemented in Japan is not a necessary condition for operation and management of the facilities and equipment after completion of this project, but these will serve as a factor to increase the effect of this assistance project if they help RTD staffers to acquire advanced broadcasting and program production technologies and thereby contribute to the broadening of the scope of radio broadcasting and the qualitative improvement of radio programs broadcast in Tanzania.

CHAPTER 4. BASIC DESIGN

CHAPTER 4 BASIC DESIGN

4-1 Basic Design I. Broadcasting Facilities

4-1-1 Design Policy

It is necessary to design the broadcasting facilities in a manner that will ensure that they are strong and durable enough to withstand disasters and disturbances considering their social missions.

In Tanzania, the emphasis should be placed on establishing a broadcasting system that will be the only form of mass media capable of disseminating information efficiently throughout the vast land.

In designing the broadcasting equipment, it is necessary to effect easy operation and economical operation and maintenance while also taking into consideration improvement of system reliability.

Thus the following should be the basic policy in design:

(1) Broadcasting facilities most suitable for the project shall be provided.

(2) Equipment and construction work execution, methods most suitable for the purpose of the facilities and a limited completion period shall be employed.

(3) Consideration shall be given not only to easy operation, maintainability, and economization but also to high reliability and power saving.

(4) Equipment specifications shall be in accordance with the technical standards of the International Radio Consultative Committee (CCIR), and equipment shall be designed so as to be safe and solid both mechanically and electrically. The future expansion of the system shall also be considered.

4-1-2 Equipment for Transmitting Stations

(1) Transmitter

Vacuum tubes are employed this time for the last stage high power section of the transmitter used, but solid-state circuits shall be employed for the other sections, thus attempting to improve the reliability.

Heating sections of the vacuum tubes, etc., shall be cooled down by a forced air cooling system, thus making its maintenance easier.

Lightning may be attracted to the transmitting antenna often since it protrudes high into the air. Since the transmitter is connected to this antenna, the output section shall be provided with a protective circuit so as to avoid the influence of the lightning.

(2) Program Link Receiving Equipment

This equipment shall be a solid-state type FM receiver equipped with a high gain receiving antenna having directivity of the VHF band, capable of receiving programs from the studio with a good noiseless sound quality.

(3) Equipment for Transmitting Stations

Equipment for each station are listed in Table 4-1-1.

Table 4-1-1 Equipment for the Transmitting Stations

Item	Equipment	Quantity	Remarks
Dodoma Transmitting Station			
1) Transmitter	100 kW transmitter	1	603 kHz
	10 kW transmitter	1	603 kHz standby
	Output exchange switcher	1	
	Dummy load	1	
	Monitor and control equipment	1	
	Clock	3 sets	
2) Program link receiving equipment	FM receiver	2 sets	For program transmission between studio and transmitting station
	FM receiving antenna	1 set	
	FM receiving antenna tower	1 set	40 m high
3) Power supply equipment	Receiving/distributing equipment	1 set	
	Automatic voltage regulator	1	
	Standby generator	1 set	
4) Engineering link equipment	VHF transceiver	1	For engineering communication between studio and transmitting station
Kigoma Transmitting Station			
1) Transmitter	100 kW transmitter	1	711 kHz
	10 kW transmitter	1	711 kHz standby
	Output exchange switcher	1	
	Dummy load	1	
	Monitor and control equipment	1 set	
	Clock	3 sets	
2) Program link receiving equipment	FM receiver	2 sets	For program transmission between studio and transmitting station
	FM receiving antenna	1 set	
	FM receiving antenna tower	1 set	30 m high
3) Power supply equipment	Power receiving/distributing equipment	1 set	Existing generator to be used as standby
	Automatic voltage regulator	1	
4) Engineering link equipment	VHF transceiver	1	For engineering communication between studio and transmitting station

4-1-3 Equipment for Studios

(1) Program Production Equipment

The main equipment for each station is shown in Table 4-1-2.

Table 4-1-2 Main Program Production Equipment

	Quantity			
	Mixing console	Disc player	Open reel tape machine	Cassette tape machine
(Dodoma Station)				
Studio #1	(16 input channels) - 1	3	3	2
Studio #2	(12 input channels) - 1	2	2	2
Studio #3	(8 input channels) - 1	2	2	2
(Kigoma Station)				
Studio	(8 input channels) - 1	2	2	2
Remarks	For mixing and level adjusting of electric audio signals: Number of inputs to be decided according to contents and scale of production programs	For playback of various commercial discs: 3 speeds (33, 45 and 78) for both LP/SP	For recording and playback of programs: 2 speeds (19 & 38): open reel type	For playback of various commercial soft tapes: 1 speed (4.8): compact cassette type

1) Dodoma Station

The following three studio rooms are available:

* Studio #1 (126 m^2): Used as large studio for music and drama program production

* Studio #2 (31 m^2): Used as medium studio for production of round-table talks and educational programs

* Studio #3 (16 m^2): Used as small studio for production of news, commentary and daily life information programs

a) Studio #1

* Mixing console 1 set, 16 input channels (8 for microphones, 3 for discs, 3 for open reel tapes and 2 for cassette tapes)

When producing a music program in an ordinary studio, sound recording is normally done by connecting a microphone to each musical instrument. Accordingly, the number of inputs in mixing console should be maximized, thus a 16 channels model is adopted.

* Disc player 3 sets

At least 2 sets of disc players are necessary to play other records continuously if required. However, if it is necessary to reproduce just one SP disc of a different system while playing LP discs continuously, a cartridge must be replaced. This requires a certain amount of time, thus continuous replay becomes impossible. Therefore, the contents of an SP disc should be recorded onto tape in advance and then replayed with a tape player, which takes more time

than operating 3 disc players. In addition, in consideration of cases where many records are used as background music, in dramas for example, 3 disc players shall be provided for this studio so as to make radio broadcasting smooth.

* Open reel tape machine 3 sets

At least 2 sets are required for tape editing (one for playback and one for recording), but in the case of a drama an effective sound and background music should be recorded with the dialog, thus requiring 2 sets of tape playback equipment to be used at the same time.

Thus, 3 sets of open reel tape machine are provided.

* Cassette tape machine 2 sets

2 sets are required to reproduce other cassette tapes, continuously if necessary.

b) Studio #2

* Mixing console 1 set, 12 channels (6 for microphones, 2 for discs, 2 for open reel tapes and 2 for cassette tapes)

Many microphones are used with a cast of 5 or 6 in round-table talks or educational programs, thus 12 inputs are employed for the mixing console.

* Disc player 2 sets

2 sets are necessary for continuous play

* Open reel tape machine 2 sets

2 sets are necessary for tape editing. (one for playback and the other for recording)

* Cassette tape machine 2 sets

2 sets are necessary for tape editing. (one for playback and the other for recording)

c) Studio #3

* Mixing console 1 set, 8 input channels (2 for microphones, 2 for discs, 2 for open reel tape, and 2 for cassette tapes)

Talk programs such as news shows or interviews will be the main programs, thus requiring a smaller number of microphones, hence 8 channels shall be provided for the mixing control console.

* The number of disc players, open reel tape machines and cassette tape machines shall be the same as in Studio #2.

2) Kigoma Station

Just one studio room ($38m^2$). The contents and scale of the programs produced are almost the same as those of Studio #3 in Dodoma Station, thus its equipment and scale shall be the same.

(2) Master Control Equipment

1) Dodoma Station

Switching function for the following systems shall be provided:

* Input system 5 (TPTC line receiving 1, short wave receiving 1 and studio receiving 3)

* Output system 2 (Own transmitting station send. 1, other stations send. 1)

2) Kigoma Station

Switching function for the following systems shall be provided:

* Input system 3 (TPTC line receiving 1, short wave receiving 1 and studio 1)

* Output system 2 (Own transmitting station send. 1 and other stations send. 1)

(3) Program Link Transmission Equipment

A transmitting antenna shall be of omni-directional type, and FM broadcasting service to neighboring area shall be considered.

A transmitter shall be of solid-state type, thus increasing its reliability.

(4) Studio Equipment

Equipment for each station is listed in Table 4-1-3.

Table 4-1-3 Studio Equipment

Item	Equipment	Quantity	Remarks
Dodoma Studio			
1) Program production equipment	(Studio #1)		
	16-channel mixing console	1	
	Disc player	3	
	Open reel tape machine	3	
	Cassette tape machine	2	
	Microphone	1 lot	
	Monitor speaker	1 set	
	(Studio #2)		
	12-channel mixing console	1	
	Disc player	2	
	Open reel tape machine	2	
	Cassette tape machine	2	
	Microphone	1 set	
	Monitor speaker	1 set	
	(Studio #3)		
	8-channel mixing console	1	
	Disc player	2	
	Open reel tape machine	2	
	Cassette tape machine	2	
	Microphone	1 set	
	Monitor speaker	1 set	
2) Master control equipment	Master control console	1	
	Open reel tape machine	2	
	All wave receiver	2	
	Clock system	1 set	
	Slave clock	10 sets	
	Monitor speaker	1 set	
3) Program link equipment	100 W FM transmitter	2	For program transmission between studio & transmitting station
	FM transmitting antenna	1 set	
	FM transmitting antenna tower	1 set	30 m high
4) Power supply equipment	Power receiving /distributing equipment	1 set	
	Automatic voltage regulator	1	
	Standby generator	1 set	

Item	Equipment	Quantity	Remarks
5) Engineering link	VHF transceiver	2	For engineering communications between studio and transmitting station, 1 set is portable type
6) Maintenance tools & vehicles (To be used together with transmitting station)	Tools for broadcasting equipment	1 set	
	Tools for standby generator	1 set	
	Maintenance vehicle	2	
Kigoma Studio			
1) Program production equipment	(Studio)		
	8-channels mixing console	1	
	Disc player	2	
	Open reel tape machine	2	
	Cassette tape machine	2	
	Microphone	1 lot	
	Monitor speaker	1 set	
2) Master control system	Master control equipment	1 set	
	All wave receiver	2	
	Clock	4 sets	
	Monitor speaker	1 set	
3) Program link transmission equipment	50 W transmitter	2	For program transmission between studio and transmitting station 30 m high
	FM transmitting antenna	1 set	
	FM transmitting antenna tower	1 set	
4) Power supply equipment	Power receiving/distributing equipment	1 set	
	Automatic voltage regulator	1	
	Standby generator	1 set	
5) Engineering link equipment	VHF transceiver	2	For engineering communications between studio and transmitting station, 1 set is protable type
6) Maintenance tools & vehicles	Tools for broadcasting equipment	1 set	
	Tools for standby generator	1 set	
	Maintenance vehicle	2	

4-2 Basic Design II. Antenna

4-2-1 Design Policy

In designing the antenna, the following matters are taken as basic policy:

(1) Matters registered by the International Frequency Registration Board (IFRB) are observed.

(2) The most effective results should be obtained within the scope of the assistance by taking economics into consideration.

(3) Ease of operation and maintenance should be considered.

(4) Consideration is given to the flashing of lightning.

4-2-2 Antenna Mast

The same antenna mast in structure and scale shall be used for both Dodoma Station and Kigoma Station.

The antenna mast is 125 m high and is made of a steel cylinder of about 36 cm diameter, and supported with guys in 3 directions and at 6 points. The base is insulated with a base insulator and a spherical bearing is installed under the base insulator so as not to apply a detrimental force to it. These are placed on top of an independent base made of concrete about 2 m from the ground. The guys of 6 stacks in 3 directions are fixed to 3 anchor blocks made of reinforced concrete placed 90 m from the tower center. Insulators are inserted into each guy at an appropriate interval, and the guys of the highest stack are provided with choke coils.

To mark the antenna as an aeronautical obstruction at night, 2 aeronautical obstruction lights are fitted to the tower top and 2 other points of the tower. To mark it as an aeronautical obstruction in the daytime, the antenna tower is painted red and white dividing it into 7 sections.

The tower top is provided with a top hat having an 8 m diameter to extend the effective length of the transmitting antenna.

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

4-2-3 Radial Earth

The earth plays an important role in the radiation of medium frequency radio waves. In other words, the earth acts to return the antenna's current, and its efficiency gets worse due to the loss taking place there (ground loss). Accordingly, a radial earth is installed so as to minimize ground loss as much as possible. It is preferable that the scale in radius be 0.3 wavelengths (about 150 m) to 0.5 wavelengths (about 250 m), but in actual practice (radius) = (antenna height) is taken in view of demensions of site area and economy in many cases. In this project also, a radial earth is taken as 125 m, the same length as the antenna height, and 120 copper wires are buried in the earth radiately about 30 cm below GL.

As for Kigoma Station, a sub-antenna is provided to give directivity and to further enhance its effect, a radial earth made up of 60 copper wires is buried overlapping the aforementioned radial earth of the main mast over an area as wide as 30 m in radius from the base of the sub-antenna.

4-2-4 Ancillary Equipment

(1) Feeder Line

Feeder lines are of 2 types: aerial feeder and coaxial cable. Advantages of the coaxial cable are that it has no external wave radiation, and no fluctuation of impedance and output likewise such as the aerial feeder has due to wind. Also the circuit component for removing higher harmonics is simple. But the coaxial cable has major drawbacks such as its high price and difficulty to repair in case of trouble. Hence, in this project,

6-wire aerial feeder is employed which is superior in cost and maintenance.

(2) Tuning Unit Hut

A circuit is required for electrical matching between the transmitting antenna and transmitter, and a tuning hut to accommodate the above is installed around the antenna base. The tuning unit hut is electrically shielded inside and outside, thus its inside is lined with aluminum. The hut should be of the minimum required size to accommodate the matching device, thus being 2 m x 5 m.

(3) Sub-antenna

Kigoma station faces Rwanda, Burundi and Zaire in the west, and it is necessary to restrict the electric wave radiation in these directions so as to avoid electrical interference.

IFRB, in its registration, specified that the service is to be mainly from 10 degrees to 170 degrees clockwise with north as zero degrees. Therefore, it is necessary to use a directive antenna, and there are 2 methods of accomplishing the above: 1) sub-antenna by erecting an additional antenna mast, and 2) an sub-antenna by the copper wire, so-called down lead.

The erection of 2 antenna masts makes the effects of directivity greater but it costs much. Luckily various countries adjacent to Kigoma Station are not using the same frequency as that for Kigoma Station. Thus it will be enough if the wave is restrained to about 8 to 10 dB, which can be attained by the down lead system. Accordingly, in view of economics and ease of adjustment, directivity is given by a single output power feeding and down lead system.

(4) Austin Transformer

In order to supply power to the aeronautical obstruction lights instal-

ed on the base insulation type antenna, medium wave high frequency power should be able to be fed without any trouble. Therefore, an Austin transformer (insulated transformer) should be employed with its primary and secondary coils insulated for high frequency.

(5) Choke Coil and Ball Gap

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

4-2-5 Antenna Equipment

Antenna equipment for each station is listed in Table 4-2-1.

Table 4-2-1 Antenna Equipment

Item	Equipment	Quantity	Remarks
(1) Dodoma Station			
1) Transmitting antenna	Guyed type cylindrical mast 125 m	1	With 8 m top hat
2) Radial earth	125 m radius and 120 wires	1 set	
3) Feeder line	6-wire aerial feeder	1 set	
4) Tuning unit hut	Shelter type	1 set	With matching circuit
5) Other ancillary equipment	Aeronautical obstruction light, Austin transformer, etc.	1 set	
(2) Kigoma Station			
1) Transmitting antenna	Guyed type cylindrical mast 125 m	1	With 8 m top hat
Sub-antenna	Down lead	1 set	For directivity
2) Radial ground	125 m radius and 120 wires	1 set	
Radial ground	30 m radius and 60 wires	1 set	For sub-antenna
3) Feeder line	6-wire aerial feeder	1 set	
4) Tuning unit hut	Shelter type	1 set	With matching circuit
5) Other ancillary equipment	Aeronautical obstruction lights, Austin transformer, etc.	1 set	

4-3 Basic Design III. Station Building

4-3-1 Design Policy

The transmitting station has a simple mission i.e., to transmit stabilized electric waves continuously according to a specified schedule, and the maximum consideration should be given to formulating a design that contributes to the success of this simple mission under any circumstances. The following 6 points should be considered in the design:

(1) The building accommodates the necessary functions and purpose.
(2) Operation and service are economical and easy.
(3) Maintenance and inspections are economical and easy.
(4) Well-balanced durability as a whole is kept.
(5) Maximum safety is maintained to deal with any disaster.
(6) Flexibility for future plans is secured.

The most effective design concept for realizing the above points one with simple form which accommodates the required functions. In designing the building, a simple and understandable system should be introduced in the plans, structural design, sectional design, interior design and equipment design.

In order to construct a building of good quality within a specified period, it was decided that production should be carried out to complete various building parts and units in Japan and only have the final assembly done on the site, which is the so-called prefabricated system. This would minimize the site work.

4-3-2 Block Planning

As proposed sites for the transmitting stations have already been secured by RTD, the survey was made on their various elements. In conclusion, it was concluded that the sites for both Dodoma Station and Kigoma Station are appropriate for this project in terms of size, shape and ground characteristics as well as city facilities such as approach roads and

electric power, and locational relations between the studios and airports.

The main elements to be arranged on the sites are the transmitting antenna masts, 125 m high, and the transmitting houses. It is necessary to make a block plan so that these 2 elements can be reasonably arranged on the site while keeping the necessary positional relations. This present plan should also sufficiently allow for any future plans. Luckily, both sites are wide enough for this project, thus sufficient space can be kept for future plans.

A transmitting antenna mast has a circular high level electrical field with its radius equal to the mast's height, hence it is necessary to shield the whole transmitter building if it is located within that electrical field. Since the site is wide enough, the transmitting house should be situated outside the high level electrical field, and the tuning unit hut is placed beside the antenna mast. Connections between the transmitting house and the tuning unit hut are made with feeder line.

Construction of the studio buildings at both Dodoma Station and Kigoma Station are under way by RTD and the buildings are almost completed. Interior work is not finished yet but the expenses for this have been secured.

(1) Dodoma Transmitting Station

The site is 1 km x 1 km, 100 ha and spacious enough, and located in a flat savanna area. Since the capital is now moving to Dodoma from Dar es Salaam, Dodoma will be a very important city for this country. Thus, RTD is planning to expand the transmitting facilities for medium and short waves. The site planning was done bearing this in mind and discussing it with the staff concerned.

According to the basic policy for the site planning by RTD, multiple transmitting facilities will be developed and expanded to radiate from the center of the square site in the future for short wave service, commercial service and external service, etc. In other words, as illustrated in Fig.

4-3-1, the buildings of the station will be concentrated in the center and the antennas will be installed on the site's periphery. Hence, the feeder lines will be laid from the center to each corner of the site.

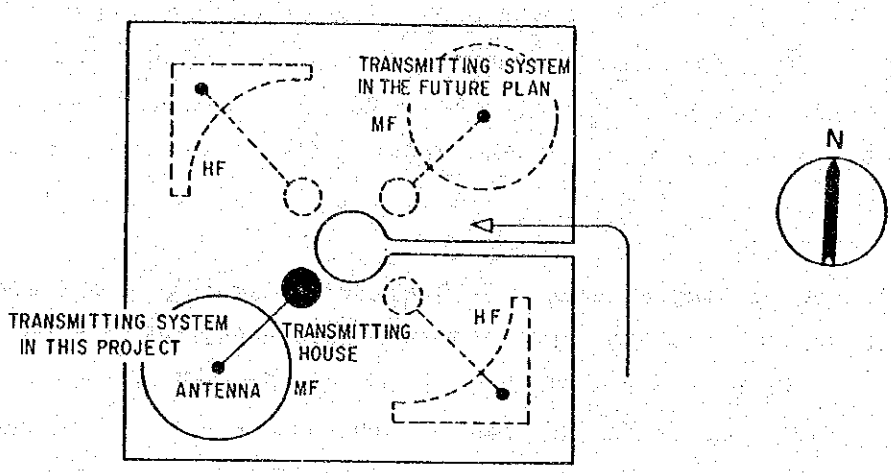

Fig. 4-3-1 Facility Arrangement of Dodoma Transmitting Station

Based on this basic policy, the station being constructed in this project is situated at a deep place viewed from the approach road so as not to hinder the future expansion plan. The transmitting house is arranged in the center zone and the transmitting antenna faces in the south-west direction.

The front of the transmitting house is arranged so as to face east, and an entrance turn and a parking space are situated at the front and south side of the building. A 6 m wide on site road is being constructed for 500 m from the center of the east side of the site to the front of the house.

(2) Dodoma Studio

The buildings under construction by RTD north of the city as Dodoma Local Station are to be used as studio buildings.

In the studio, an FM transmitting tower (H=30m) for program transmission and a mast to support the short wave receiving antenna (H=15m)

should be constructed. Since the short wave receiving antenna must be constructed almost perpendicular to the direction of Dar es Salaam, it was planned that the antenna would be extended parallel to the studio building in a northerly direction.

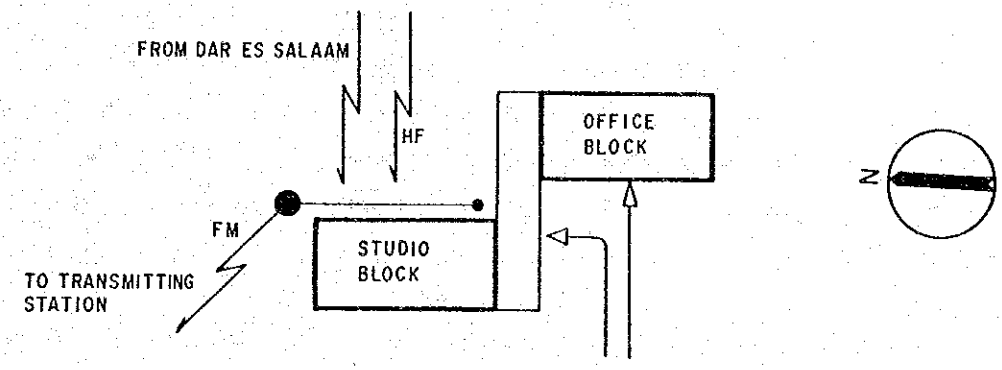

Fig. 4-3-2 Facility Arrangement of Dodoma Studio

(3) Kigoma Transmitting Station

The site is long and narrow along a slope running south to north, and the northern tip is the highest position where the transmitting antenna is to be constructed. The station house is being constructed south of the mast. The rest of the space, equivalent to 3/4 of the site area, will be kept for future expansion. There exists some difference in height between the center of the antenna tower and the anchor blocks (±11.500 m).

The transmitting house is arranged to face south with the transmitting antenna at its back, and an entrance turn and parking lot are provided as at Dodoma Station. A 6 m wide road is provided on the site up to the east side access road, perpendicular to the transmitting antenna direction.

Since the transmitting house is constructed on a slope, consideration is given to drainage around the house in the rainy season.

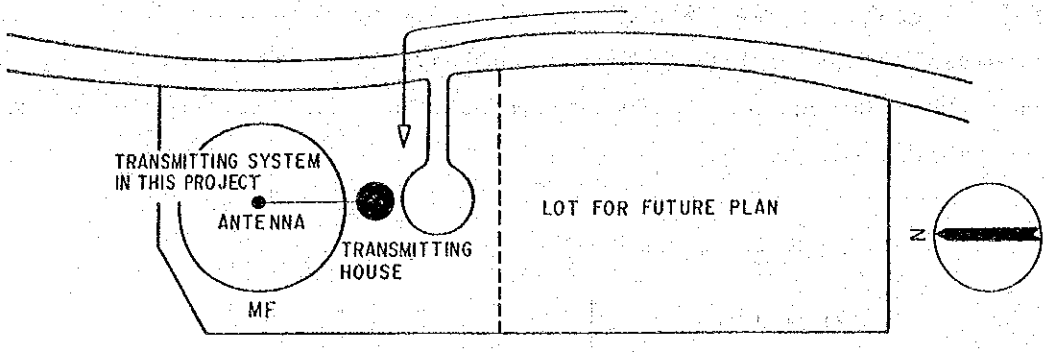

Fig. 4-3-3 Facility Arrangement of Kigoma Transmitting Station

(4) Kigoma Studio

The buildings, consisting of the office block and studio block, both now under construction as a local station by RTD, are to be used as Studio building.

An FM transmitting tower for program transmission (H=30m) is to be installed at the southern tip of the office building, and a mast (H=15m) is to be installed at a position north-east of the office building.

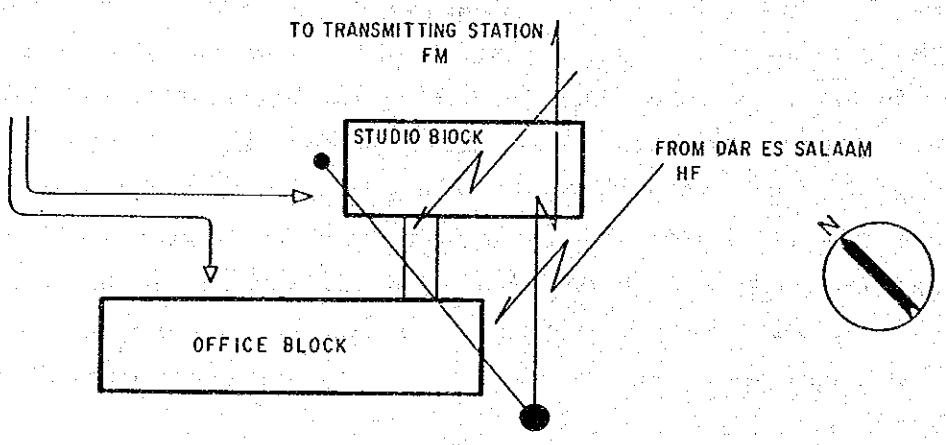

Fig. 4-3-4 Facility Arrangement of Kigoma Studio

4-3-3 Architectural Plan

(1) Floor Plan

As for the block plan of the various functions in the station building, based on the basic policy of the building project, i.e., aiming at simple feature with explicit functions, the functions required for the building are divided into 4 zones: a transmitting function zone, a transmitting function auxiliary zone, an administration zone and a communication passage zone. First, the transmitting function zone is deployed linearly for the convenience of monitoring, maintenance and inspection. The transmitting function administration zone is arranged at the back parallel to the above zone. The communication passage zone is placed in front and then finally the administration zone is arranged opposite to the communication passage zone. Such a parallel deployment of functional zones means a floor plan which indicates a clear direction to the future expansion plans to cope with linearly.

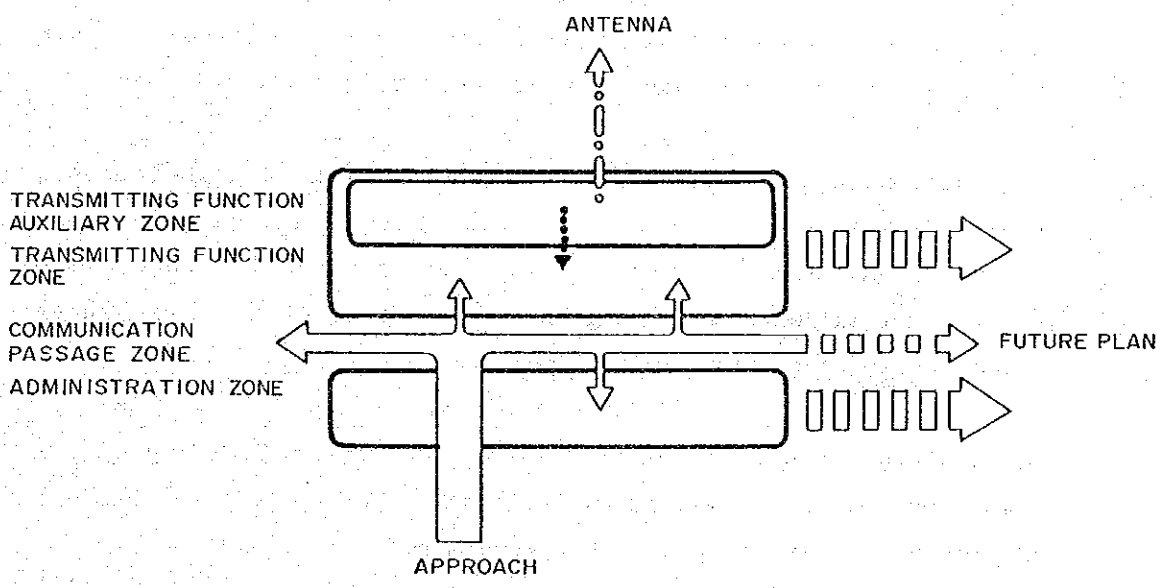

Fig. 4-3-5 Concept of the floor plan of the building

1) Transmitting functional zone and transmitting functional auxiliary zone

Transmitting equipment rooms include a transmitter room for both the 100 kW and 10 kW transmitters, a console room for monitoring and control, a blower room for cooling down the transmitters, a dummy load room for the dummy load device of the transmitting antenna, a generator room for a standby generator, etc. The floor plan for these rooms was made by taking into account the functional and organic arrangement of the transmitting equipment first, and then their scale, shape and mutual locations were decided by taking into account maintenance and safety. Many transmitting equipment are charged with high voltage, thus sufficient space surrounding the equipment should be kept. For dangerous equipment in particular, it should be put together in one place and surrounded with a fence. Moreover, sufficient space outside the equipment to be used for inspections is secured in the project. Surrounding spaces required for equipment vary with the type of equipment, but it is necessary to reserve at least 60 cm or more for maintenance and inspection, and at least 100 cm or more for equipment having doors opening to the front.

The various equipment installed form one system as a whole, thus locations are mutually important, requiring the layout to be connected organically. Moreover, the blower, dummy load and generator, etc., require air charging and exhausting, so their locational relation to outside is important.

Taking into account the installation of a commercial power panel and an automatic voltage regulator, and to minimize space besides that used for the equipment, the generator room is set as 36 m^2.

In order to secure stable transmissions, space for daily maintenance and inspection work is secured at a corner of the transmitter room. This space of 3 m x 4 m with a bench (1 m x 2m) at

its center is used for such work.

By taking the above various conditions into consideration, the arrangement of equipment was decided to be as illustrated in Fig. 4-3-6

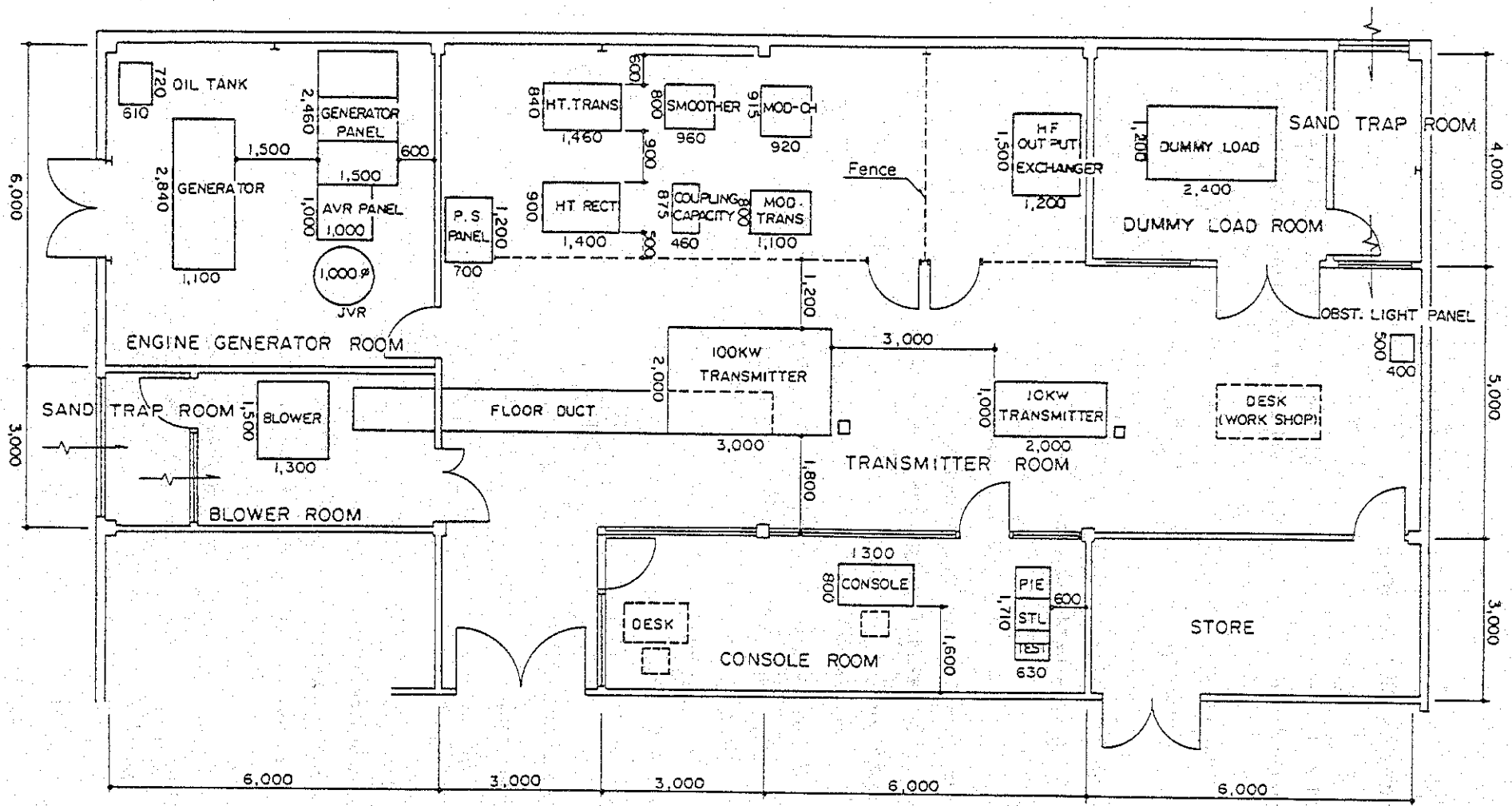

Fig. 4-3-6 Arrangement of Main Equipment and Spaces around the Equipment

2) Administration Zone

4 office rooms and a night-duty room are included in this zone.

The manning plan for a local transmitting station scheduled by RTD is listed below. And the manpower seems sufficient for this scale transmitting station.

Manning for transmitting station

Engineer		4
Assistant staff	typist	1
	driver	2
	watchmen, etc.	5
Total		12

Of the total of 12 persons, 5 persons need an office work space, 4 engineers and a typist. Four office rooms are provided with a spare room included for staff assistant.

Office 1	13.5 m^2	Engineer (Chief)
Office 2	13.5 m^2	Engineer (staff) 2 persons
Office 3	13.5 m^2	Staff assistant & receptionist
Office 4	27.0 m^2	Engineer (director) typist

The three shift system is employed because transmitting hours last from 06:00 hours to 24:00 hours. Thus, a night duty room is necessary for two persons. A 12.6 m^2 space has been set aside taking as a standard sick ward space for 1 person in hospital (more than 6.3 m^2/person by Japanese medical law) and then doubling this. A hot water service room is also to be installed next to the night duty room and lockers are also provided. A shower room is provided in a corner of the rest room.

3) Communication Passage Zone

Common sections such as a corridor, rest room, shower room, hot water service room, etc., are included in this zone.

In general architecture such as that of office buildings, about 20% of the total floor area is taken up by common area. This station house is where a total of 12 persons will work continuously, thus it is reasonable to provide the same amount of common section as with an office building. A corridor which functionally connects the various rooms runs throughout the building so as to allow for future expansion. As for the rest room since, the maximum number of persons working at any time is five (4 engineers and 1 typist), one closet booth, one urinal stall and two wash basins are provided. A shower booth is also provided for the duty staff. Area standards of Japan are employed for these space sizes.

4) Stockroom

Spaces for storing parts for transmitting equipment and the transmitting antenna and antenna tower, plus tools, various measuring equipment, maintenance and repair equipment, etc. are required and 7% is set aside for that purpose based on experiences in Japan. 5.6% is normally taken as the average for general buildings, but 7% is employed taking into consideration the functions of a transmitting station.

5) Determination of Building Scale as a whole

The total scale is determined by arranging the various zones having the aforementioned areas onto a simple plane in accordance with the basic policy regarding station's building arrangement. A 9 m span in the span direction and a 6 m span in the ridge direction are employed so that columns don't protrude into the transmitter room which is the most spacious and the smaller unit

rooms such as office rooms can be reasonably accommodated. The external wall is designed so as to be of an economical rectangle shape. Thus, it has been decided to employ a one-storied building having 2 spans in the span direction, 4 spans in the ridge direction or 18 m x 24 m, i.e., a 432 m^2 floor area.

Areas required for each room are listed in Table 4-3-1.

Table 4-3-1 Areas Required for Each Room

Zone	Room	Scale determined	Remarks
Transmitting function zone & transmitting function auxiliary zone	Transmitter room	129 m^2	Functional arrangement and organic locations of transmitting equipment
	Console room	27 m^2	
	Blower room	18 m^2	
	Dummy load room	24 m^2	
	Generator room	36 m^2	
	Sub-total	234 m^2	54.2%
Administration zone (Various rooms for staff)	Office (4 rooms)	total 67.5 m^2	(3m x 4.5m unit) x 5 span = 67.5m^2 about the size of the space for 2 in a hospital ward 6.3 x 2 = 12.6m^2
	Night-duty room	13.5 m^2	
	Sub-total	81 m^2	19%
Communication passage zone (Common section)	Front hall	13.5 m^2	about 20% of the total
	Corridor	45 m^2	
	Rest room	11.1 m^2	
	Shower room	2.4 m^2	
	Hot water service room	13.5 m^2	
	Sub-total	85.5 m^2	19.8%
Stockroom	Stockroom	31.5 m^2	7% of the total
			7%
Total		432 m^2	100%

(2) Section Plan

The scheduled sites for both the Dodoma and Kigoma Transmitting Stations are on hill tops and flooding has not been reported, but the possibility of a temporary flood due to a localized torrential downpour should be taken into consideration. Thus, the floor shall be 400 mm higher than the average GL. And the floor of each room shall be the same level to facilitate taking in and out the equipment. Exceptions are the floors of the rest room and the shower room.

As for the room height, some tall equipment is about 2,400 mm high and some additional space of about 1,500 mm for ducts, piping and wiring is required above the 2,400 mm, thus a total height of 3,900 mm shall be allowed for below the girders.

(3) Building Structural Plan

As a result of boring conducted on the sites of Dodoma and Kigoma, it is confirmed that the ground at both sites is hard enough. More than 50 t/m^2 of long time bearing capacity of the soil can be expected 1 m below the GL in Dodoma, and more than 50 t/m^2 of long time bearing power of the soil can be expected 1.5 m below the GL in Kigoma.

Therefore, in the basic design, 50 t/m^2 shall be employed as the value of long-time allowable bearing capacity of the soil.

The base shall be a spread foundation with footing, and reinforced concrete for the base shall be cast in place.

As stated in 4-3-1 Design Policy, a prefabricated system shall be employed for the main structure above the GL. This system is one in which autoclaved light-weight concrete panels (ALC panels) are fixed to pin-braced construction frames with a structural steel as the external wall, and in which the roof is covered with galvanized sheet iron plates utilizing of a folded plate structure (double). Partition walls are of light-weight steel frames with backing boards fixed.

With some exceptions, all of the main structures are of dry construction, and plaster work requiring drying time shall be limited to the rest room and shower room.

It was confirmed that cement made in Tanzania would be sufficient for the project in terms of strength, quality and amount of supply, but the four week aged strength of the concrete is to be 180 kg/cm^2 taking account of additional safety.

(4) Interior and Exterior Finishing Plan

To fully realize the basic policy that the main structure is to be of prefabricated construction and to improve its merit, a dry finish system shall be employed for both interior and exterior work.

Floors shall be covered mainly with plastic tiles which make maintenance easier and minimize dust due to wear. Porcelain tiles shall only be used for places where there is running water.

The console room, office rooms, night-duty room, and water-related rooms shall be provided ceilings so as to limit room capacity and to secure comfortable living, but other rooms are not provided with ceilings.

Paint shall be applied to both interior and exterior surfaces as a final finishing material. Paints made in Japan which are stable in quality shall be used taking durability of the building into consideration.

4-3-4 Building Equipment Plan

Equipment systems suitable for the climatic conditions on the sites and which are easy to maintain and control as well as the least expensive to operate shall be employed. In addition, systems shall be employed which employ expendable parts or spare parts that have high durability, can easily be supplied, and can be kept long also.

(1) Electric Equipment

The main electric power, 3-phase 4-line 400V/230V, shall be obtained from a distribution board in the generator room and supplied to 3 channels of power, lighting fixtures and receptacle outlets.

Fluorescent lamps, which are economical for lighting shall be mainly used, and the intensity of illumination shall be 400 luxes for the office rooms and console room, 300 luxes for the transmitter room and 100 luxes for other rooms.

(2) Plumbing Equipment

Tanzania is responsible for laying the water supply pipe up to the boundary line of the site. Piping shall be led in from this point, and water shall first be put into a 2 m^2 tank with a fixed gauge, and then distributed to each faucet with automatic water supply units. Water supply points shall be the hot water service room, rest room, shower room and outside sprinklers.

General drain and waste water should be divided into different systems in drainage, and they are to be accumulated at a drainage basin outside the building. A sewerage system can not be expected in the future, thus on the assumption that there will be on-site disposal, a septic tank and an infiltration tank shall be installed at an appropriate spot on the site.

(3) Ventilating Equipment

Sufficient ventilation is required for the transmitter room, generator room, dummy load room, etc., which are heated by their equipment. Hence, the necessary number of propeller fans shall be installed on the outside walls.

Air is supplied from air supply louver fitted on the outside walls and air chambers shall be provided to prevent dust, sand, withered leaves, insects etc., from coming in. Forced ventilation shall be provided for the

100 kW transmitter by installing a blower in particular.

Ventilation in the console room shall be provided by installing a ventilating louver and fan between the room and the transmitter room. A forced ventilation system shall also be provided for the rest room, shower room and hot water service room.

(4) Air Conditioning Equipment

Maximum temperatures in the daytime exceed 30°C for 3 months of the year in Dodoma, and 1 month in Kigoma. High humidity averaging 70 to 80% lasts more than half the year both in Dodoma and Kigoma, and humidity in the morning reaches as high as 80 to 90%. Accordingly, for the rooms where desk work is continuously conducted, air conditioning equipment should be installed. The console room shall be provided with a split type cooler, package-type air conditioner, and the off-duty room and offices (4 rooms) with window-type coolers.

The transmitter room is so designed as to function correctly at temperatures below 40°C, thus a specific blower for the transmitter shall be provided so as to restrict the rise of temperatures in the room or in the transmitter itself by heat generation. A large size propeller fan shall also be provided to vent the room air to the outside. Forced ventilation shall be provided for the dummy load room and generator room only when they are in use to prevent a rise in room temperatures.