No.

Uganda Broadcasting Corporation

The Republic of Uganda

BASIC DESIGN STUDY REPORT
ON
THE PROJECT FOR IMPROVEMENT OF THE MEDIUM WAVE RADIO BROADCASTING NETWORK FOR ENHANCEMENT OF EDUCATION, HEALTH AND ENLIGHTENMENT
IN
THE REPUBLIC OF UGANDA

March, 2007

JAPAN INTERNATIONAL COOPERATION AGENCY

NHK Integrated Technology Inc.

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PREFACE

In response to a request from the Government of the Republic of Uganda, the Government of Japan decided to conduct a basic design study on the Project for Improvement of the Medium Wave Radio Broadcasting Network for Enhancement of Education, Health and Enlightenment and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent to Uganda a study team from August 28 to September 22, 2006.

The team held discussions with the officials concerned of the Government of Uganda, and conducted a field study at the study area. After the team returned to Japan, further studies were made. Then, a mission was sent to Uganda in order to discuss a draft basic design, and as this result, the present report was finalized.

I hope that this report will contribute to the promotion of the project and to the enhancement of friendly relations between our two countries.

I wish to express my sincere appreciation to the officials concerned of the Government of the Republic of Uganda for their close cooperation extended to the teams.

March 2007

Masafumi KUROKI
Vice-President
Japan International Cooperation Agency

March 2007

Letter of Transmittal

We are pleased to submit to you the basic design study report on the Project for Improvement of the Medium Wave Radio Broadcasting Network for Enhancement of Education, Health and Enlightenment in the Republic of Uganda.

This study was conducted by NHK Integrated Technology Inc., under a contract to JICA, during the period from August 2006 to March 2007. In conducting the study, we have examined the feasibility and rationale of the project with due consideration to the present situation of Uganda and formulated the most appropriate basic design for the project under Japan's Grant Aid scheme.

Finally, we hope that this report will contribute to further promotion of the project.

Very truly yours,

Akira SHIRAI
Project manager,
Basic design study team on
The Project for Improvement of the
Medium Wave Radio Broadcasting
Network for Enhancement of
Education, Health and Enlightenment
NHK Integrated Technology Inc.

SUMMARY

① Overview of the Recipient Country

The Republic of Uganda (hereinafter referred to as "Uganda") is an inland country situated on the equator in the eastern part of Africa, stretching from 4 degrees north to 1 degree south and from 30 to 35 degrees east. The country shares its northern border with Sudan, eastern with Kenya, southern with Tanzania and Rwanda, and western with the Democratic Republic of Congo. The national territory covers a total of 241 thousand km^2, including 197 thousand km^2 above the sea, almost equal to the size of the main island of Japan. The average altitude is as high as 1,200m. It has the world's second largest lake, Victoria, which is also well known as the origin of the Nile River, in the south. At the western border lies the East Africa Great Rift Valley which is the largest in the world. The country is full of lakes and other waters such as swamps and marshes, which together account for approximately 15% of the entire national land. The national population is projected as 27.8 million in the statistics issued by the International Monetary Fund (IMF) for 2004.

Though being on the equator, it is generally warm owing to the plateau areas covering the land as a whole. The annual average temperature in the project sites mark around 23 degrees Celsius in capital Kampala, situated at an elevation of 1,170 m, and approximately 20 degrees Celsius in Mawagga (Mubende District, Mityana County), one of the construction sites for transmitting stations at an elevation of 1,330 m. The other transmitting station construction site, Kyeriba (Kabale District, Kabale County), is situated a way above at a 2,310 m altitude with an annual average temperature of about 18 degrees Celsius. In any of these places, the temperature fluctuates only minimally all the year around.

Uganda, after its independence in 1962, underwent chaotic situations in terms of politics and economy due to repeated coup d'etat, until the incumbent Museveni administration was inaugurated in 1986, which has been successfully ruling the entire land up to date. The Museveni administration proactively accepts structural adjustment programs by the World Bank and IMF, and has been carrying forward liberalization of producers' price in agricultural products, abolishment of oligopoly of exports by public corporations, privatization of state-owned enterprises, downsizing of ministries and agencies of the central government, and so forth, leading to a stabilized macro economy.

The country's efforts toward structural adjustment and economic reforms were highly appreciated at the donor coordination meeting held in November 1997. The country managed to keep a constant positive growth of its GDP (GDP growth ratio), which increased from US$ 3,990 million (6.4%) in 1994 to US$ 5,843 million (6.8%), US$ 6,255 million (4.7%) and US$ 6,822 million (5.7%) in 2002 to 2004, respectively. From now on, the country has to face with the issue of how to

revitalize general economic activities, including private investments, under the framework of free economy.

Its Gross Domestic Products (GDP) as of 2004 was composed of 34％ in the primary industry, 21％ in the secondary industry, and 45％ in the tertiary industry, according to the data issued by the World Bank in 2006, whereas agriculture still serves as the key industry, occupying approximately 80% of the whole exports with coffee, raw cotton, tea, etc.

In the meantime, Uganda is still rated as a low-income, poor country, with its GNI per capita being US$280, according to the World Bank in 2005. The Poverty Eradication Action Plan (PEAP) is a national plan formulated in 1997, which places emphasis on diversification of export items and creation of added values centering on agricultural products in the aspect of economic activities.

② Background, Circumstances and Outline of the Requested Project

In 1997, the government of Uganda formulated, with guidance from the World Bank, a comprehensive national plan “Poverty Eradication Action Plan (PEAP)”. This project bases on this plan as the overall goal. The PEAP was later revised for the first time in March 2000 and the second in 2003. The third revision of PEAP was completed in March 2004, designating five priority areas: i) economic management, ii) enhancing production, competitiveness and income, iii) security, conflict-resolution and disaster management, iv) good governance, and v) human development. Since then, the government has been implementing various poverty reduction measures, with the aim of achieving the final goal “to reduce the absolute poverty incidence down to below 10% by 2017”.

The radio receiver ownership in Uganda was approximately 4 million units as of 2002, according to the ITU data. The prevailing ratio on the household basis was quite high at 76.5%. On the other hand, the number of TV sets possessed by the nation was only about 390 thousand as of 2002, according to the ITU data, with the prevailing ratio on the household basis at 7.5%, a tenth of that of radio receivers. Furthermore, the Internet is spread among only more or less 200 thousand people, 1% of the entire national population (as of 2004).

Therefore, radio broadcasting is extremely important as an information medium. In fact, it is the only information medium available for the residents in some areas. That being the case, the government of Uganda proactively leverages radio broadcasting as a means to promote information distribution in implementing its poverty reduction measures in accordance with the PEAP, based on the recognition that radio broadcasting plays an extremely significant role in enhancing the effects of the poverty reduction measures. The PEAP highlights, as the roles to be played by radio broadcasting, i) Equitable access to education, ii) Improvement in agricultural activities and health management, iii) Raising the public awareness, and iv) Acquisition of technical skills in a variety of fields.

The government of Uganda instituted a new broadcasting policy in November 2005, whereby it founded "Uganda Broadcasting Corporation (UBC)" through separation of Radio Uganda and Uganda Television both from the Ministry of Information and National Guidance and then and merger of them, operating under jurisdiction of the Ministry. UBC is the sole public broadcaster that owns a nationwide radio network, and hence is greatly expected to serve as the most effective tool to execute activities in the fields of education and enlightenment, elimination of digital divide in rural areas, and more largely unification of the public awareness.

However, all seven MW transmitting stations and the main UBC's studio center in Kampala (hereinafter referred to as "Kampala Broadcast House") which are the key facilities of UBC's radio broadcasting network were constructed in 1970s and 1980s, and due to the heavy aging of the equipment and damage inflicted by domestic conflicts and lightning thereto, UBC often encounters with stoppage of broadcasting. The seven MW transmitting stations used to cover almost 90% of the entire population at the beginning. Today, however, the Butebo MW Transmitting Station and Bugolobi MW Transmitting Station are the stations that are operational, and the Butebo Station is the only one operating without trouble, covering only roughly 25% of the population.

Under such circumstances, UBC has posted as its basic policy for radio broadcasting the restoration of the MW broadcasting network most suitable for construction of a nationwide network. The government of Uganda, therefore, requested the government of Japan for a grant-aid assistance for development of the Mawagga MW Transmitting Station (Mubende District, Central Region) and Kyeriba MW Transmitting Station (Kabale District, Western Region), which combined potentially cover a large portion of the population, out of the five non-operational MW transmitting stations, and renewal of the studio equipment necessary for production and delivery of programs at the Head Studio in Kampala.

③ Overview of the Results of the Study and Contents of the Project

The government of Japan dispatched a Basic Design study team for the project for improvement of the radio broadcasting network in the Republic of Uganda (hereinafter referred to as the "study team") to the recipient country for 26 days between August 28th and September 22nd, 2006, in order to verify the relevance of the project and determine the contents of the project in an essential as well as appropriate manner. The study team reconfirmed the contents of the request of the Ugandan side with the related personnel, discussed the request in more depth, conducted site surveys at the project sites, and collected related information and data.

The original request consisted of the transmitters, peripheral equipment and maintenance vehicles for the Mawagga and Kyeriba stations and studio equipment for three on-air studios at

Kampala Broadcast House. As a result of discussion with the study team during the field survey, the Ugandan side revised the request so as to include the satellite receiving equipment, emergency engine generators, air-conditioning and ventilation systems, and other ancillary facilities together with equipment for production studios that harmonize with the three on-air studios at the Kampala Broadcast House as an additional request. Summary of the equipment finally requested by the Ugandan side is as follows.

List of the Requested Equipment

No.	Name of Equipment	Quantity	Remarks
Equipment for MW Transmitting Stations (Mawagga and Kyeriba MW Transmitting Station)			
1.	50kW MW Transmitter	1set each	Solid state, RF exciter, main/stand by system
2.	50kW Dummy Load	1set each	50Ω
3.	50kW 3 Port U-Link Panel	1set each	50Ω, 3-1/8 inches
4.	50kW Lightening Protector	1set each	50Ω
5.	Program Input and Monitoring Equipment (PIE)	1lot each	
6.	50kW MW Directional Antenna	1lot each	
7.	Satellite Receiving Equipment	1lot each	C-band
8.	Automatic Voltage Regulator	1set each	3-phase 415V/240V, 50Hz capacity 150kVA
9.	Isolation Transformer	1set each	3-phase 415V, 50Hz capacity 150kVA
10.	Emergency Engine Generator	1lot each	65kVA
11.	Air-Conditioning and Ventilation System	1lot each	
12.	Measuring Equipment	1lot each	
13.	Maintenance Tools	1lot each	
14.	Spare Parts	1lot each	
15.	Materials for Construction Work	1lot each	
Equipment for Radio Studios (Kampala Broadcast House)			
1.	Equipment for On-Air-Studios (Red, Blue, Butebo)	3 lots	For studios of Red, Blue and Butebo
2.	Equipment for Production Studios (D, E, F)	3 lots	For studios of D, E and F
3.	Maintenance Equipment	1 lot	Measuring equipment, spare parts, maintenance tool, etc.

After returning to Japan, the study team evaluated the necessity of the project and its social and economic effects, followed by optimization of the contents of the project and preparation of a Basic Design report which summarizes these results. The additional request for the satellite receiving equipment was accepted, in consideration of the facts that UBC changed the program transmission method from radio connection to satellite connection while the two transmitting stations have been out of service, transmission line is absolutely necessary to convey programs from the studios to the transmitting stations, and it is the most economical transmitting technique. Further, emergency engine generators needed for preventing broadcast interruption, air-conditioning equipment that protects the working environment for transmitters and other ancillary facilities were also deemed as vital equipment and to be included in the project. Renewal of equipment for production studios was also approved to be added to the project, considering that the studios should produce programs that are compatible with the three on-air studios that handle differently-configured programs in different languages.

The transmitting station buildings and the main and sub antenna tuning unit (ATU) huts, though use of the original buildings was initially assumed, shall also be included in the project as part of the equipment installation works, due to their significantly superannuated state, from the following three standpoints: (i) the construction of these facilities would impact the equipment installation schedule if not completed prior to the inception of the installation works; (ii) coordination with regard to requirements of the equipment will be important even during the construction of the facilities; and (iii) all of these buildings are quite small, ranging from 16 to 112m^2.

The study team visited the city of Kampala in Uganda again for nine days between February 12th and 20th, to explain about the draft report to the parties concerned on the Uganda side, and finalized the contents of the project through discussion with them. Listed hereunder is a summary of the project

(Outline of the Project Components)

1) Procurement and installation of MW radio broadcasting system equipment at the Mawagga and Kyeriba MW Transmitting Stations.
2) Procurement and installation of studio equipment at the Kampala Broadcast House
3) Installation work including construction of related buildings (transmitting station building, main and sub antenna tuning unit (ATU) huts) at the Mawagga and Kyeriba MW Transmitting Stations

The planned equipment to be procured is as follows.

List of the Planned Equipment to be Procured

No.	Name of Equipment	Quantity	Remarks
Equipment for MW Transmitting Stations (Mawagga and Kyeriba MW Transmitting Station)			
1.	50kW MW Transmitter	1set each	Solid state, RF exciter, main/stand by system
2.	50kW Dummy Load	1set each	50Ω
3.	50kW 3 Port U-Link Panel	1set each	50Ω, 3-1/8 inches
4.	50kW Lightening Protector	1set each	50Ω
5.	Program Input and Monitoring Equipment (PIE)	1lot each	
6.	50kW MW Directional Antenna	1lot each	
7.	Satellite Receiving Equipment	1lot each	C-band
8.	Automatic Voltage Regulator	1set each	3-phase 415V/240V, 50Hz capacity 145kVA
9.	Isolation Transformer	1set each	3-phase 415V, 50Hz capacity 150kVA
10.	Emergency Engine Generator	1lot each	65kVA
11.	Air-Conditioning and Ventilation System	1lot each	
12.	Measuring Equipment	1lot each	
13.	Maintenance Tools	1lot each	
14.	Spare Parts	1lot each	
15.	Materials for Construction Work	1lot each	
Equipment for Radio Studios (Kampala Broadcast House)			
1	Equipment for On-Air-Studios (Red, Blue, Butebo)		
(1)	Audio Mixer	3 sets	Analog 16CH
(2)	Audio Recorder and Player	3 lots	
(3)	Telephone Hybrid	3 sets	
(4)	Microphone	3 lots	With boom stand, for studios and sub-control rooms
(5)	Announcer Cough Box	3 lots	Including controller

No.	Name of Equipment	Quantity	Remarks
(6)	Graphic Equalizer	3 sets	
(7)	Digital Effecter	3 sets	
(8)	Monitor Speaker	3 lots	For studios and sub-control rooms
(9)	On Air lamp	3 lots	Indication = ON-AIR/STANDBY, for studios and sub-control rooms
(10)	Console Table	3 lots	For audio mixer
(11)	System Rack	3 lots	For audio equipment
(12)	Announcer Table	3 lots	
(13)	UPS	3 sets	3kVA
(14)	Other Peripheral Equipment	3 lots	Audio distribution amplifier, stereo headphone, patch panel and installation materials
2	Equipment for Production Studios (D, E, F)		
(1)	Audio Mixer	3 sets	Digital 24CH
(2)	Audio Recorder and Player	3 lots	
(3)	Digital Audio Workstation	3 sets	Including LAN interface
(4)	Microphone	3 lots	With boom stand
(5)	Announcer Cough Box	3 lots	Including controller
(6)	Graphic Equalizer	3 sets	
(7)	Digital Effecter	3 sets	
(8)	Monitor Speaker	3 lots	For studio and sub-control rooms
(9)	On Air lamp	3 lots	Indication = ON-AIR/STANDBY
(10)	Console Table	3 lots	For audio mixer
(11)	System Rack	3 lots	For audio equipment
(12)	Announcer Table	3 lots	
(13)	UPS	3 sets	3kVA
(14)	Other Peripheral Equipment	3 lots	Audio distribution amplifier, stereo headphone, patch panel and installation materials
3	Maintenance Equipment		
(1)	Audio Test Set	2 sets	
(2)	Maintenance Tool	2 lots	
(3)	Spare Parts	1 lot	

④ Schedule and Cost Estimation of the Project

If the project is to be implemented under Japan's grant-aid assistance scheme, 4 months for detailed design and 14 months for procurement and installation of the equipment, a total of 18 months, will be required. The total project cost is estimated at 1,142 million yen (1,108 million yen to be borne by Japan and 340 million yen by Uganda).

⑤ Validation of the Relevance of the Project

The followings are expected as direct effects of the project.

1) Expansion of Radio Service Area

The coverage of UBC's middle wave broadcasting service will expand from current 25% to 77% more or less, and a total of approximately 21.4 million Ugandans will be able to receive MW broadcast services. A population of roughly 14.15 million targeted in this project, consisting of 7.25 million in the Central Region and 6.9 million in the Western Region, will newly be enabled to receive MW broadcasting services.

2) Realization of Stable Broadcasting Services

The equipment at the radio studio of the Kampala Broadcasting Station will experience less trouble in the course of program production, leading to a stable production of programs that are called for by the Ugandan people. The programs created shall be broadcasted in a stable manner by the systemized middle wave broadcasting facilities.

The followings are expected as indirect effects of the project.

1) The renewed equipment in the production studios will realize production of diversified programs.
2) The systemized middle wave transmitting facilities will realize stable broadcasting services. Furthermore, real time delivery of emergency information in case of natural disasters, accidents and incidents, riots, etc. is expected to contribute to reduction of victims.
3) Residents in the Central and Western Regions will have greater opportunities for acquiring information, leading to correction of the digital divide among Ugandan people. Further, information on health and hygienics, education, agriculture, social and public welfare, etc., in addition to cultural and international information, will be made available to the citizens, which will contribute to improvement of their living environment. Further, economic and industrial activities will be stimulated and ripple to poverty reduction policies that the government is tackling with.

If the project is actually implemented, it is the Operation Bureau and the Department of Radio Program Planning and Production of the Radio Program Production Bureau that will play the central role in promoting the project. The Operation Bureau is in charge of the operation and maintenance of transmitting devices for radio and TV broadcasting, and studio equipment, as well as the implementation of new projects. Currently, a total of 29 staff members belong to the bureau, and all the engineers at leading posts have participated in JICA training programs conducted in Japan as well as the private sectors training programs carried out in such several countries as Europe (United Kingdom, Germany), Japan and United States, etc. In technical meetings held during the field survey, it was confirmed that they are well experienced and have certain technical knowledge, so that there are no particular technical problems in the operation and management of the equipment to be provided in the project.

Of the transmitting stations to be constructed under the project, there are no UBC personnel at the Mawagga MW Transmitting Station, where as there is only one administrative staff at the Kyeriba MW Transmitting Station at the moment. But UBC plans, if the project is to be implemented, to allocate a total 8 workers on two shifts by the latter half of 2008 at latest when the installation work of equipment is scheduled.

Although UBC has detached from the Ministry of Information to run as an independent organization on the self-supporting accounting basis, it is deemed that the government will continue to support UBC until the broadcaster become capable enough to operate with its own financial sources, in view of the facts that UBC is the only nationwide public broadcasting organization in Uganda, the project is recognized as a large contribution to the country's overall goal, PEAP, the coverage of MW broadcasting services will be tripled from current 25% to 77% of the nation, and other national benefits.

As a matter of fact, the government has granted UBC with subsidies worth 70% of UBC's budget this fiscal year (as of January 2007), and further assistance is expected to accumulate to 75% of the entire revenue by the fiscal year end. In addition, the Office of Prime Minister has issued a note promising to provide assistance to UBC in general and also to support the initial and maintenance costs to be incurred as a result of the project. Thus, it is deemed that there will be no problem in securing operation and maintenance cost after the implementation of the project.

Based on these evaluation results, it is deemed as appropriate to implement this project under Japan's grant-aid assistance scheme.

CONTENTS

Chapter 3 Project Evaluation and Recommendations

Appendices

Location Map

List of Figures & Tables

Abbreviations

AC	：Alternate Current
A/C	：Air Conditioner
ATU	：Antenna Tuning Unit
AVR	：Automatic Voltage Regulator
CCR	：Central Control Room
CD	：Compact Disk
CH	：Channel
CN	：Connector
DAW	：Digital Audio Workstation
E/G	：Engine Generator
EIA	：Electronic Industries Alliance
FL	：Floor Level
FM	：Frequency Modulation
FY	：Fiscal Year
ITU	：International Telecommunication Union
ITU-R	：International Telecommunication Union-Radio Communication Sector
JPY	：Japanese Yen
JIS	：Japan Industrial Standards
LAN	：Local Area Network
LNB	：Low Noise Booster
LPF	：Low Pass Filter
MD	：Mini Disk
MW	：Medium Wave
NEMA	：National Environment Management Authority
PEAP	：Poverty Eradication Action Plan
PIE	：Program Input and Monitoring Equipment
STL	：Studio to Transmitter Link
UBC	：Uganda Broadcasting Corporation
UCC	：Uganda Communications Commission
UPS	：Uninterruptible Power Supply
Ush.	：Uganda Shilling
VSWR	：Voltage Standing Wave Ratio

Chapter 1 Background of the Project

Chapter 1 Background of the Project

1-1 Background of the Request

The government of Uganda instituted a new broadcasting policy in November 2005, whereby it founded "Uganda Broadcasting Corporation (UBC)" through consolidation of Radio Uganda and Uganda TV, and gave them independence from the Ministry of Information, as an organization on a stand-alone basis but under jurisdiction of the Ministry. Being the sole public broadcaster that owns a nationwide radio broadcasting network in Uganda, UBC is greatly expected, in addition to its primary mission to report news and the role to provide entertainment, to serve as the most effective tool to execute activities in the fields of education and enlightenment, elimination of digital divide in rural areas, and more largely unification of the public awareness. Moreover, the Ugandans highly expect of the corporation as a nationwide broadcast service provider for improvement of broadcasting equipment and upgrading of the quality of programs. (Source: The State of Broadcasting in East Africa by Panos.)

However, all seven MW transmitting stations and the equipment at the Head Studio that are the key facilities of UBC's radio broadcasting network were constructed and installed in 1970s or 1980s, and the heavy aging of the equipment and damage inflicted by domestic conflicts and lightning thereto, together with the lack of spare parts of the old, discontinued equipment, seriously impede the broadcasting services. As for the studio equipment, live broadcast programs have quite frequently been disturbed by failure to the power supply circuit of the equipment caused by voltage fluctuation.

The seven MW transmitting stations used to cover almost 90% of the entire population at the beginning of MW radio broadcasting in 1980's. However, now Butebo and Bugolobi are the only MW transmitting stations that are operational, and further Butebo MW Transmitting Station alone is soundly working for the time being, as the transmitters at Bugolobi have been damaged by lightning and the output decreases. As a result, the coverage of MW broadcasting services has shrunk to roughly 25% of the population.

Under such circumstances, UBC has posted, as its basic policies for radio broadcasting, the restoration of the MW broadcasting network most suitable for construction of a nationwide network. The government of Uganda, therefore, requested the government of Japan for a grant-aid assistance for development of the Mawagga MW Transmitting Station (Mubende District, Central Region) and the Kyeriba MW Transmitting Station (Kabale District, Western Region), which combined potentially cover a large portion of the population, out of the five non-operational MW transmitting stations, and renewal of the studio equipment necessary for production and delivery of programs at the Head Studio in Kampala.

1-2 Circumstances and Outline of the Request

The request originally raised by the government of Uganda to the government of Japan in August 2005 consisted of, as listed hereunder, the transmitters and peripheral equipment, and 4WD vehicles for operation and maintenance for the Mawagga and Kyeriba MW Transmitting Stations plus studio equipment for three on-air studios at Kampala Broadcast House. However, as a result of confirmation and discussions between the parties concerned on the Ugandan side and the study team during the field survey of the Basic Design Study, which took place in August to September 2006, the details of this request have been modified, with new requests for satellite receiving equipment, emergency engine generators, air-conditioning and ventilation systems, and other incidental facilities at the Stations, and studio equipment for the three production studios that correspond to the three on-air studios of Kampala Broadcast House.

The revised request is outlined as follows;

(1) Original request

The original request as of August 2005 consisted of the following equipment:

1) Equipment for the Mawagga and Kyeriba MW Transmitting Stations (1 lot for each station)
   - Vacuum-tube-type 50kW MW transmitter (2 sets of 25kW MW transmitters)
   - 50kW RF combining and SW equipment (1 lot)
   - 50kW lightning protector (1 set)
   - 50kW dummy load (1 set)
   - 50kW MW directional antenna system (self-supporting tower) (1 lot)
   - Power feeder (open feeder) (1 lot)
   - Automatic voltage regulators (2 sets of 75kVA)
   - Program input and monitoring equipment (1 lot)
   - Measuring equipment (1 lot)
   - Installation materials (1 lot)
   - 4WD vehicle for operation and maintenance (1 unit)
2) Equipment for the on-air studios at Kampala Broadcast Station (1 lot each for Red, Blue and Butebo)
   - Microphone (with stand and cable) (1 lot)
   - Speaker (1 lot)
   - Audio mixer (1 set)

- CD recorder/player (1 set each)
- MD recorder (1 set)
- Cassette tape recorder (1 set)
- Graphic equalizer (1 set)
- Digital effector (1 set)
- Audio monitor (1 set)
- Headphone (5 nos.)
- Audio distribution amplifier (1 lot)
- System rack/ patch cable (1 lot)
- On-air lamp (1 lot)
- Chair (3 sets)

(2) Changes to the contents of the request

The following changes were made to the details of the requested equipment through confirmation and discussion between UBC and the study team during the field survey of the Basic Design Study. (The rationale for these changes and the account of evaluation shall be elaborated later in Chapter 2 Section 2-2-2-1 "Study on the Request".)

1) Equipment for the Mawagga and Kyeriba MW Transmitting Stations

(Changed items)

- The transmitters were changed from the vacuum-tube-type 50kW MW transmitter (two 25kW MW transmitters) to one solid-state-type 50kW transmitter.
- The request for 50kW RF combining and SW equipment was withdrawn, but a 3-port U-link panel, which switches the output of the transmitter to the antenna and dummy load, is alternatively requested.
- The self-supporting 50kW MW directional antenna system was changed to the guyed-mast type.

(Newly-added items)

- Emergency engine generator: To ensure continuous broadcasting in the poor electrical environment.
- Air-conditioning and ventilation system: To maintain an adequate operating environment for the equipment.
- Satellite receiving equipment: To receive programs transmitted from Kampala Broadcast House.

2) Studio equipment for Kampala Broadcast House

(Newly-added items)

- Audio recorder: It is indispensable for program production as it has the immediate start and cut-in control functions.
- Telephone hybrid: It is needed for communicating with listeners/viewers over the phone during live programs and incorporating news from outside.
- Announcer Cough box: To prevent unnecessary noise created by the announcer or other cast during live broadcasting of news or debating programs.
- Console table, announcer table: These tables for putting the audio mixer, microphones, scripts, etc. are vital in program production.
- Uninterrupted Power Supply (UPS): To ensure the program runs without break in case of a blackout during the few minutes until the generator starts to work.
- Patch panel: To bypass audio signals to other lines in case of maintenance or emergency.
- Production studio equipment: It is necessary to improve the production studio equipment so as to match with the three on-air studios included in the project.
- Digital Audio Workstation: This equipment is essential for a program production studio as it can efficiently record and edit programs and also store them in the library.

The final requests, with the above reflected, are as summarized in Table 1-1.

Table 1-1: List of the Requested Equipment

No.	Name of Equipment	Quantity	Remarks
Equipment for MW Transmitting Stations (Mawagga and Kyeriba MW Transmitting Station)			
1.	50kW MW Transmitter	1set each	Solid state, RF exciter, main/stand by system
2.	50kW Dummy Load	1set each	50Ω
3.	50kW 3 Port U-Link Panel	1set each	50Ω, 3-1/8 inches
4.	50kW Lightening Protector	1set each	50Ω
5.	Program Input and Monitoring Equipment (PIE)	1lot each	
6.	50kW MW Directional Antenna	1lot each	
7.	Satellite Receiving Equipment	1lot each	C-band
8.	Automatic Voltage Regulator	1set each	3-phase 415V/240V, 50Hz capacity 150kVA
9.	Isolation Transformer	1set each	3-phase 415V, 50Hz capacity 150kVA
10.	Emergency Engine Generator	1lot each	65kVA
11.	Air-Conditioning and Ventilation System	1lot each	
12.	Measuring Equipment	1lot each	
13.	Maintenance Tools	1lot each	
14.	Spare Parts	1lot each	
15.	Materials for Construction Work	1lot each	
Equipment for Radio Studios (Kampala Broadcast House)			
1	Equipment for On-Air-Studios (Red, Blue, Butebo)		
(1)	Audio Mixer	3 sets	Analog 16CH
(2)	Audio Recorder and Player	3 lots	
(3)	Telephone Hybrid	3 sets	
(4)	Microphone	3 lots	With boom stand, for studios and sub-control rooms
(5)	Announcer Cough Box	3 lots	Including controller
(6)	Graphic Equalizer	3 sets	
(7)	Digital Effecter	3 sets	
(8)	Monitor Speaker	3 lots	For studios and sub-control rooms
(9)	On Air lamp	3 lots	Indication = ON-AIR/STANDBY, for studios and sub-control rooms
(10)	Console Table	3 lots	For audio mixer
(11)	System Rack	3 lots	For audio equipment
(12)	Announcer Table	3 lots	
(13)	UPS	3 sets	3kVA
(14)	Other Peripheral Equipment	3 lots	Audio distribution amplifier, stereo headphone, patch panel and installation materials
2	Equipment for Production Studios (D, E, F)		
(1)	Audio Mixer	3 sets	Digital 24CH
(2)	Audio Recorder and Player	3 lots	
(3)	Digital Audio Workstation	3 sets	Including LAN interface
(4)	Microphone	3 lots	With boom stand
(5)	Announcer Cough Box	3 lots	Including controller
(6)	Graphic Equalizer	3 sets	
(7)	Digital Effecter	3 sets	
(8)	Monitor Speaker	3 lots	For studios and sub-control rooms
(9)	On Air lamp	3 lots	Indication = ON-AIR/STANDBY
(10)	Console Table	3 lots	For audio mixer
(11)	System Rack	3 lots	For audio equipment
(12)	Announcer Table	3 lots	
(13)	UPS	3 sets	3kVA
(14)	Other Peripheral Equipment	3 lots	Audio distribution amplifier, stereo headphone, patch panel and installation materials
3	Maintenance Equipment		
(1)	Audio Test Set	2 sets	
(2)	Maintenance Tool	2 lots	
(3)	Spare Parts	1 lot	

1-3 Natural Conditions

(1) Rainfall

The table below indicates the average annual rainfall, average monthly rainfall and the highest average rainfall between 2000 and 2005 in three areas to be covered in this project, namely Mubende District of Mityana County, Kabale District of Kabale County, and Kampala District in Central Region.

Area	Year of observation	Average annual rainfall (mm)	Average monthly rainfall (mm)	Maximum average rainfall	
				Rainfall (mm)	Month of record
Mityana	2000-2005	1,361	113	193	11
Kabale	2000-2005	983	81	231	9
Kampala	2000-2005	1,344	112	268	11

It rains most heavily in the period between September and November at the project sites. While transportation and installation of the procured equipment to and in the Kampala Broadcast House is not a problem, it is essential to pay particular attention to transportation of equipment to the Mawagga and Kyeriba Transmitting Stations and excavation works to construct the foundation of MW antennas at both sites during said period, because the access roads to both sites are unpaved and made of clay soil that can easily become muddy.

(2) Temperature

The table below indicates the average monthly temperature (maximum and minimum), the lowest average monthly temperature and the months of records in Mubende District of Mityana County, Kabale District of Kabale County, and Kampala District in Central Region between 2000 and 2005.

Area	Year of observation	Maximum monthly average		Minimum monthly average	
		Temp. (℃)	Month of record	Temp. (℃)	Month of record
Mityana	2000-2005	33.8	1	9.0	1
Kabale	2000-2005	27.3	2	8.6	7
Kampala	2000-2005	31.0	2	16.5	9

The temperature at the project sites is warm and comfortable on an average, and is quite stable throughout the year. The temperature, therefore, does not pose any concern over the implementation of the project.

(3) Humidity

The table below indicates the average annual humidity, the highest humidity and the months of records in Mubende District of Mityana County, Kabale District of Kabale County, and Kampala District in Central Region between 2000 and 2005.

Area	Year of observation	Average annual humidity (%)	Month of highest humidity	
			Humidity (%)	Month of record
Mityana	2000-2005	66.0	69	4
Kabale	2000-2005	59.8	70	11
Kampala	2000-2005	59.5	69	11

An annual average of humidity marks approximately 60 to 70%. Since there is no extreme fluctuation in humidity in all sites, it does not pose any concern over the implementation of the project.

(4) Lightning

There are records of frequent lightning at the two project sites for transmitting stations. Therefore, in order to avoid any damage by lightning and indirect lightning strokes, it is necessary to implement adequate protection measures onto the all-solid-state MW transmitters and other equipment to be procured.

(5) Wind Velocity

Unfortunately there is not sufficient data with regard to wind velocity in Uganda. Further, there are no documents left concerning the design wind velocity of the existing transmitting antennas. Therefore, in order to set adequate design wind velocities for the facilities and antennas, the standards for the wind velocity of a neighbor, Tanzania, shall be referred to.

(6) Earthquake

Similarly to wind velocity, there are no sufficient seismic data. Therefore, in designing buildings to accommodate the MW antennas and the MW transmitters, internationally-adopted architectural design standards shall be referred to and the design shear coefficient shall be determined accordingly.

1-4 Environment and Social Considerations

Since the project is planned to establish a 50kW MW radio transmitting antenna, which transmits high-frequency radio waves of high power, it is imperative to pay due consideration to the electromagnetic environment. As there are no villages nor any establishments, such as factories and hospitals, which handle electronic devices, in the vicinity of the premises of the two MW transmitting stations to be restored in Mawagga and Kyeriba under this project, it is considered that the project will have no adverse impact directly on health of residents or electronic circuits in computers and medical apparatus. However, since the Stations require high-voltage operations, entry of outsiders into the premises must be stringently controlled from the safety standpoint. The following matters must be taken into consideration in implementing the project.

(Measures and their effects)

In order to prevent outsiders from entering the premises, both stations need to have the existing broken fences at the border of the premise repaired. This complete repair work on the fences shall be borne by the Ugandan side. Meanwhile, the two (main and sub) MW directional antennas and the (main and sub) ATU huts to be constructed by the Japanese side will also require fences around them as a safety measure. These fences shall be constructed by the Japanese side as a part of the construction works of the antennas and ATU huts.

(Legal procedures concerning consideration for the environment and the society)

National Environment Management Authority (NEMA) under jurisdiction of the Ministry of Water, Lands and Environment is responsible for supervising considerations for the environment and the society in Uganda, and therefore conducts assessments based on the Environment Statute, 1995 (Cap 227). Although construction of a new transmitting station building or MW transmitting antenna requires application for protection of the environment to the NEMA, UBC has already obtained the license from the NEMA and therefore does not need to apply for new approval. However, UBC still needs to double-check with relevant authorities concerning all necessary procedures in association with this project.

Chapter 2 Contents of the Project

Chapter 2 Contents of the Project

2-1 Basic Concept of the Project

2-1-1 National Development Policy and Project Goals

In 1997, the government of the Republic of Uganda (hereinafter referred to as "Uganda") formulated, with guidance from the World Bank, a comprehensive national plan "Poverty Eradication Action Plan (PEAP)". This project bases on this plan as the overall goal. The PEAP was later revised for the first time in March 2000 and the second in 2003. The third revision of PEAP was completed in March 2004, designating five priority areas: i) economic management, ii) improvement in production, competitiveness, and income, iii) public security, resolution of conflicts, and disaster management, iv) good governance, and v) human development. Since then, the government has been implementing various poverty reduction measures, with the aim of achieving the final goal "to reduce the absolute poverty incidence down to below 10% by 2017".

The radio receiver ownership in Uganda was approximately 4 million units as of 2002, according to the ITU data. The prevailing ratio on the household basis was quite high at 76.5%. On the other hand, the number of TV sets possessed by the nation was only about 390 thousand as of 2002, according to the ITU data, with the prevailing ratio on the household basis at 7.5%, a tenth of that of radio receivers. Furthermore, the Internet is spread among only more or less 200 thousand people, 1% of the entire national population (as of 2004). Therefore, radio broadcasting is extremely important as an information medium. In fact, it is the only information medium available for the residents in some areas. That being the case, the government of Uganda proactively leverages radio broadcasting as a means to promote information distribution in implementing its poverty reduction measures in accordance with the PEAP, based on the recognition that radio broadcasting plays an extremity significant role in enhancing the effects of the poverty reduction measures. The PEAP highlights the following as the roles to be played by radio broadcasting:

- Equitable access to education
- Improvement in agricultural activities and health management
- Raising the public awareness
- Acquisition of technical skills in a variety of fields

The government of Uganda instituted a new broadcasting policy in November 2005, whereby it founded "Uganda Broadcasting Corporation (UBC)" through separation of Radio Uganda and Uganda Television both from the Ministry of Information and National Guidance and then and merger of them,

operating under jurisdiction of the Ministry. UBC is the sole public broadcaster that owns a nationwide radio network, and hence is greatly expected to serve as the most effective tool to execute activities in the fields of education and enlightenment, elimination of digital divide in rural areas, and more largely unification of the public awareness. Moreover, the Ugandans highly expect of the corporation as a nationwide broadcast implementing agency for improvement of broadcasting equipment and upgrading of the quality of programs. (Source: The State of Broadcasting in East Africa by Panos.)

Under such circumstances, UBC has posted as its basic policy for radio broadcasting the restoration of the MW broadcasting network most suitable for construction of a nationwide network. The government of Uganda, therefore, requested the government of Japan for a grant-aid assistance for development of the Mawagga MW Transmitting Station (Mubende District, Central Region) and Kyeriba MW Transmitting Station (Kabale District, Western Region), which combined potentially cover a large portion of the population, out of the five non-operational MW transmitting stations, and renewal of the studio equipment necessary for production and delivery of programs at the Head Studio in Kampala.

This project shall, therefore, be implemented in accordance with the basic policies of UBC, and its objective is set to provide the Ugandan nation with stable radio broadcasting services by recovering the functions of the two MW transmitting stations as well as renewing the superannuated program production equipment. The implementation of the project is expected to bring substantial outcomes of resuming radio broadcasting from the Mawagga and Kyeriba MW Transmitting Stations that cover a large segment of the population and thereby recovering the MW radio network service population from current 25% to nearly 77%. In addition, since the project will also renew the program production equipment, which is tremendously decrepit now, thereby enabling program productions in three streams (Blue, Red and Butebo) according to local languages, it is expected to bring an outcome in the form of stable quality broadcasting services in the country, which is strongly called for by the people of Uganda. These outcomes will not only help the government of Uganda carry out poverty reduction, rural digital-divide correction, educational development, and other actions in the PEAP, but also lead to indirect effects, such as capacity building of UBC in terms of operation and maintenance.

2-1-2 Outline of the Project

The following summarizes the investment, activities, and expected achievement of the project in order to fulfill the overall goal.

◆ Investment

Japanese side

[Equipment]

- Procurement and installation of MW radio broadcasting system equipment at the Mawagga and Kyeriba MW Transmitting Stations.
  : 1 set each, 2 sets in total
- Procurement and installation of studio equipment at on-air studios and production studios in the Kampala Broadcast House
  : 1 set each, 6 sets in total
- Construction of relevant buildings (transmitting station building, main and sub antenna tuning unit (ATU) huts) at the Mawagga and Kyeriba MW Transmitting Stations
  : 3 buildings each, 6 buildings in total

[Human Resources]

- Engineers in charge of initial training on the procured equipment

Ugandan side

[Construction]

- Introduction of commercial power into the transmitting stations buildings to be newly constructed in the Mawagga and Kyeriba MW Transmitting Stations
- Dismantlement of the existing antenna towers at the Mawagga and Kyeriba MW Transmitting Stations
- Construction of boundary fences at the Mawagga and Kyeriba MW Transmitting Station, etc.

[Human Resources]

- Personnel in charge of operation and maintenance of the Mawagga and Kyeriba MW Transmitting Stations (to be newly hired)
- Personnel in charge of production of radio programs at the Kampala Broadcast House (to be newly employed or to be incumbent staff)

◆ Activities

Japanese side

- To procure the equipment necessary for improvement of Mawagga and Kyeriba MW Transmitting Stations and studios of Kampala Broadcast House.
- To carry out the initial training for operation and maintenance staffs of Mawagga and Kyeriba MW Transmitting Stations and studios of Kampala Broadcast House.

Ugandan side

- To carry out the broadcasting services utilizing the procured equipment and newly constructed buildings introduced for Mawagga and Kyeriba MW Transmitting Stations and studios of Kampala Broadcast House.

With the above investment and activities, the following achievements are expected to be obtained.

◆ Achievements

- Expansion of Radio Service Area

  The coverage of UBC's middle wave broadcasting service will expand from current 25%to 77% more or less, and a total of approximately 21.4 million Ugandans will be able to receive MW broadcast services. A population of roughly 14.15 million targeted in this project, consisting of 7.25 million in the Central Region and 6.9 million in the Western Region, will newly be enabled to receive MW broadcasting services.

- Realization of Stable Broadcasting Services

  The equipment at the radio studio of the Kampala Broadcasting Station will experience less trouble in the course of program production, leading to a stable production of programs that are called for by the Ugandan people. The programs created shall be broadcast in a stable manner by the systemized middle wave broadcasting facilities.

2-2 Basic Design of the Requested Japanese Assistance

2-2-1 Design Policy

(1) Basic Policy on Design of Equipment

This project is based on UBC's basic policies for radio broadcasting, which includes restoration of a MW radio network most suitable for construction of a nationwide network, and thus focuses on recovery of the functions of two transmitting stations that used to belong to Radio Uganda, the former UBC, and covered a large number of listeners. Accordingly, in designing the equipment to be procured under the project, the basic policies will be to upgrade the existing functions to the initial level, instead of adding new functions, and to provide equipment on the minimal scale that the technical skills and maintenance capabilities of UBC allow.

(2) Policy on the Natural Conditions

1) Temperature and Humidity

The temperature at the project sites is warm and comfortable on an average, and it does not fluctuate much throughout the year. On the other hand, an annual average of humidity marks approximately 60 to 70 %. Since there is no extreme fluctuation in temperature and humidity in both sites, these two factors do not pose any concern over the implementation of the project.

2) Rainfall

It rains most heavily in the period between September and November at the project sites. While transportation and installation of the procured equipment to the Kampala Broadcast House in Kampala is not a problem, it is essential to pay particular attention to transportation of equipment to the Mawagga and Kyeriba Transmitting Stations and excavation works to construct the foundation of MW antennas at both sites during the same period, because the access roads to both sites are unpaved and made of clay soil that can easily become muddy.

3) Lightning

There are records of frequent lightning at the two project sites for transmitting stations. Therefore, in order to avoid any damage by lightning and indirect lightning strokes, it is necessary to install adequate lightning protection device for the solid state MW transmitters and other equipment to be procured.

4) Wind Velocity

Unfortunately there is not sufficient data with regard to wind velocity in Uganda. Further, there are no documents left with regard to the design wind velocity of the existing transmitting antennas. Therefore, in order to set adequate design wind velocities for the facilities and antennas, the standards for the wind velocity of a neighbor, Tanzania, shall be referred to.

5) Earthquake

Similarly to wind velocity, there are no sufficient earthquake data. Therefore, in designing MW transmitting antennas and buildings to accommodate the MW transmitters, internationally-adopted architectural design standards shall be referred to and the design shearing force coefficient shall be determined accordingly.

6) Geological Conditions

According to the result of geological surveys conducted at the Mawagga and Kyeriba MW Transmitting Stations, the soil conditions of both sites are favorable, requiring no foundation improvement or piling works. Therefore, a standard foundation design is sufficient for the project, and there are no elements that become problems in construction of facilities including the MW antennas and the transmitting station buildings.

(3) Policy on Socio-Economic Conditions

The electric power conditions in the areas where the Mawagga and Kyeriba MW Transmitting Stations exist are not favorable. In particular, at the Mawagga Transmitting Station, outage time (including planned outages) during broadcasting time windows occupies 52% of the entire broadcasting time in a year. (Approximately 13% at the Kyeriba Station.) Therefore, in order to achieve stable radio broadcasting, it is indispensable to introduce emergency engine generators. At the same time, it is necessary to design the equipment in such a manner that reducing output power of the transmitters during outage so as to minimize inflation of running costs.

(4) Policy on Licenses necessary for Implementation of the Project

In addition to the assessment by the NEMA in accordance with the Environment Statute, 1995 (Cap 227) mentioned above, the following licenses and approvals are needed for implementing the project in the country. The equipment shall be designed in compliance with all of these licenses and approvals.

- Frequency assignment

  Governing law: Communication Act (CAP 106)

  Authority: Uganda Communication Commission (UCC)
- Broadcasting license

  Governing law: Electronic Media Act (AP 104)

  Authority: Broadcasting Council
- Construction of antennas (height of antennas, installation of obstruction lights, etc.)

  Governing law: Civil Aviation Act, Revised Edition 1964

  Authority: Uganda Civil Aviation Authority
- License for construction of buildings

  Governing law: The Local Administration Act

  Authority: Mityana County Council (as to buildings to be constructed within the Mawagga MW Transmitting Station)
  Kabale District Council (as to buildings to be constructed within the Kabale MW Transmitting Station)

Of these licenses, UBC has already obtained frequency assignment, broadcasting license and license for construction of antennas, and hence a license for construction of buildings is the only license UBC has to acquire for this project. However, UBC must still make final confirmation on all the necessary licenses and approvals and report to the Japanese side on the necessary procedures and other detailed information as soon as possible.

(5) Policy on Utilization of Local Contractors

Since there are no broadcasting equipment manufacturers in Uganda, UBC and other private broadcasters import all necessary equipment from Europe, the U.S., Japan, etc. It has been confirmed that these equipment were installed by the engineers dispatched by the corresponding equipment manufacturers. Therefore, the broadcasting equipment to be procured under the project shall also be installed by skilled engineers to be dispatched by the equipment suppliers. On the other hand, as for skilled workers to help equipment installation works and workers for foundation works to install antennas shall be recruited from local workers who are in the know of the concerned works.

In the meantime, as for construction of the transmitting station buildings and ATU huts, all of these buildings are relatively small and simple, and hence they shall be designed based on an assumption to utilize local contractors as sub-contractors.

(6) Policy on Operation and Maintenance

As far as Butebo Transmitting Station and Kampala Broadcast House are concerned, the technical level of UBC engineers is proved high in the fact that some of MW transmitting equipment and studio equipment is still in good shape after 20 years or more in use. However, the transmitters are of a vacuum tube type, which is no longer manufactured today, and the studio equipment is, though of a high grade with broadcasting station specifications, an analogue type. On the contrary, the equipment to be procured under the project will be of all digital, whereas the UBC engineers are not well acquainted with any digital technology. As a result, the engineers to be dispatched from the equipment suppliers shall provide training on the operation of both MW transmitting equipment and studio equipment for 15 days after the completion of installation of the equipment.

(7) Policy on Setting the Grades of Facilities and Equipment

Broadcasting equipment is classified into three grades according to functions and performance: broadcasting station specifications, industrial specifications and consumer specifications. Whereas UBC's studios currently use expensive equipment designed for broadcasting stations, there are many industrial broadcasting systems that suffice for the broadcasting station purpose, thanks to the recent advancement of digital technology. In this project, therefore, the grades of equipment shall be determined in accordance with the applications, in view of enhancement of cost effectiveness. However, the specifications for broadcasting stations shall be adopted as for MW transmitters because it will contribute to reduction of operational cost, minimizing of broadcasting stoppage, and realization of stable services. Furthermore, in designing the buildings, the specifications shall be determined as minimal to satisfy the function of each building.

(8) Policy on the Methods of Procurement and Construction and the Implementation Schedule

1) Policy on the Method of Procurement of the Equipment

Japan's grant-aid assistance scheme designates Japan and the recipient country, in principle, as the most suitable source countries from which equipment is to be procured. However, as formerly mentioned, the broadcasting equipment to be procured under the project is not manufactured in Uganda. UBC procured the current equipment from Japan, U.K., Switzerland, and so forth. Of the equipment that UBC has procured, UBC highly appreciates the stability and liability of made-in-Japan equipment that are demonstrated in

the fact that the 50kW MW transmitters introduced at the Butebo MW Transmitting Station and other stations in early 1990 are still running in good shape, and also strongly relies on Japanese equipment from the perspectives of security of supply, follow-up system in which supply of spare parts is guaranteed for 10 years in general, and so on.

However, the equipment to be procured under the project includes equipment that is no longer produced in Japan or that Japanese ones are not necessarily most appropriate when comparing the functions, performances and prices. Therefore, in procuring the equipment in this project, the source country shall be selected after in-depth examination on the performance, cost performance, guarantee of supply of spare parts, ease of procurement, etc.

2) Policy on the Method of Construction of the Buildings

The traditional construction methods in Uganda shall be employed in the construction of buildings for which employment of local contractors is planned, whereas all of the materials for building frameworks and finishing shall be products of Uganda or imports that are available in the country.

3) Policy on the Implementation Schedule

The implementation schedule shall be drawn with the following points taken into account.

① Period for Fabrication and Transport of the Equipment to be procured

The equipment to be procured under the project consists of anchor materials for MW antenna that requires approximately three months for fabrication, MW antenna equipment and MW transmitting equipment six months, and studio equipment from three to six months. Since installation work for the MW antenna equipment must be completed prior to the start of installation work for the MW transmitting equipment, the MW transmitting antenna equipment shall be shipped as the first lot as soon as its fabrication is completed. The MW transmitting equipment and the studio equipment shall be transported as the second shipment, and an interval of roughly three months between the first and second shipments must be reflected in the implementation schedule.

② Schedule for Installation Works

The installation of the MW transmitting equipment requires about 13 months, including construction of transmitting station buildings and ATU huts, therefore, it is fairly difficult to complete the construction at the two sites in Mawagga and Kyeriba

by only one team within the implementation schedule predetermined by Japan's grant-aid scheme. For this reason, two teams shall be organized to proceed with the construction of the transmitting station buildings and ATU huts, radial earth works for the MW antennas, foundation works for MW antennas, erection of MW antennas and installation and adjustment of the MW transmitting equipment, in parallel. On the contrary, the installation and adjustment of studio equipment can be carried out alone, regardless of the MW transmitters or other factors, and therefore it shall be started as soon as the equipment arrives in the project site. The equipment shall be handed over to the Ugandan side as soon as the installation work is completed in each site. The project will be completed at the time of completion of operational training scheduled after the completion of the installation works at all sites.

③ Inspection and Acceptance

In this project, pre-shipment inspection shall be carried out by a third-party inspector in advance of loading of the equipment. As described earlier, the project plans two separate shipments to transport the equipment. Therefore, the pre-shipment inspection will also need to be conducted twice. The implementation schedule, therefore, shall reflect the time necessary for pre-shipment inspections, covering from preliminary preparation to inspection and approval, (approximately two weeks in total).

2-2-2 Basic Plan

2-2-2-1 Study on the Request

The original requests made by Uganda have been significantly modified through verification by the study team as well as discussion with UBC during the field survey. The following shows the results of evaluation of appropriateness of the requested equipment, while explaining the reason why the original requests were partly changed to the final requests as necessary.

(1) 50kW MW Transmitters and its Peripheral Equipment

- Original request: 25kW vacuum tube type MW transmitter × 2 units ＋ 50kW RF combining and SW equipment
  (*Note: The above quantities are for one transmitting station. The same applies to the followings.)
- Final request: 50kW solid state MW transmitter × 1 unit

The transmitters were changed from the vacuum tube type to the solid state type, and two 25kW MW transmitters were replaced by one 50kW MW transmitter, based on the recommendation by the study team. This is because the vacuum tube type is too old and no longer produced in any part of the world. Besides, since the solid state type is composed of multiple power amplifiers (50 to 100 units for 50kW), it is advantageous in realizing continuous broadcasting without much sacrificing output power, even in a case that a few units fail down. Moreover, the solid type is more economical than the vacuum type in that it requires less power consumption (about 60% of that of the vacuum-type). Due to these reasons, the changes made to the request can be deemed as appropriate. In addition, with a 50kW solid state type MW transmitter adopted, requested type of 50kW RF combining and SW equipment are no longer needed. The request for these devices has therefore been withdrawn.

An output of the transmitter must be as officially assigned by the ITU. 50kW is considerably appropriate, considering the frequency characteristics and the geographical features at both the Mawagga and Kyeriba Transmitting Stations. If the output was lower than that, the service areas covered by the two stations would shrink, whereas if it exceeded 50kW, it would be suspected to cause electromagnetic interference in neighboring countries, such as Congo, Rwanda, and Tanzania. Establishing MW transmitters with an output of 50kW will enable to cover nearly the whole Central and Western Regions in the country.

(2) Transmitting Antenna System

- Original request: Self-supporting antenna tower × 2 units (directional antenna)
- Final request: Guyed antenna mast × 2 units (directional antenna)

(Study on reuse of the existing antennas)

The existing antenna towers in both Mawagga and Kyeriba are self-supporting towers with heights of 130m and 75m respectively. Both were constructed by a British transmitter manufacturing company in 1970 - 71, and hence are already 35 years old after the construction. Furthermore, 8 years and 9 years have passed since the suspension of broadcasting at the Mawagga and Kyeriba Transmitting Stations respectively. Since the antennas were left out from necessary maintenance during the whole periods and due to other reasons, the tower bodies have enormously deteriorated over the time. It is deemed as impossible to restore and reuse the existing antennas because they have already lost the original functions as antennas, in that, for example, structural cracks have been discovered in the foundation of the antennas, most of obstruction lights and parts of insulator assembly have been removed, and the radial earth is cut in most parts. The field surveys reassured that provision of new antennas is a guyed mast in carrying out the project and the request for construction of new antennas is therefore appropriate.

(Change to guyed mast antennas)

MW antennas are generally categorized into the self-supporting type and the guyed mast type. The self-supporting type is only adopted if the construction site is limited such as on the roof of a building or in the middle of an urban area or if the site itself is small. Generally speaking, if the construction costs for building antennas of the same height are compared, the self-supporting tower is more costly than the guyed mast type in a range of 1.5 to 2 times. Accordingly, when selecting the antenna type, the guyed mast type antenna is generally more economical, but at the same time it requires a larger acreage, and cost for purchasing necessary land must be studied together. Considering that the project sites, or the Mawagga and Kyeriba Transmitting Stations, are large enough, the study team proposed a use of guyed mast antennas that have a more economical structure and are more widely adopted than the self-supporting type, and the change was made accordingly.

(3) Satellite Receiving System

- Original request: None
- Final request: Satellite receiving system (added)

Kampala Broadcast House and the Mawagga MW Transmitting Station are roughly 70 km apart, and the studio and the Kyeriba MW Transmitting Station approximately 420 km. Consequently, it is vital to procure equipment for program transmission to both MW transmitting stations. UBC newly requested a satellite receiving system for program transmission to the Mawagga and Kyeriba Stations. UBC currently employs satellite line to transmit TV, MW and FM programs to the local stations.

Programs used to be transmitted from the Kampala Broadcast House to the Mawagga MW Transmitting Station via STL (Studio to Transmitter Link: radio line to send programs from the studio to transmitting stations). Later, while the Station was at rest for eight or more years, the means for program transmission to rural areas has changed to the satellite line (Intelsat). However, no satellite line system was established at the Mawagga Station because it was not in service then. In order to restore the STL facilities at the Mawagga Station, a pair of new towers to accommodate sending and receiving antennas will be needed at the Kampala Studio and the Mawagga Station respectively, on top of the STL transmitting and receiving equipment. Therefore, adoption of a satellite receiving system, which allows reception of programs in any part of Uganda by purchasing only a parabola antenna and satellite receiving equipment and requires no additional line use charges, will be absolutely an economical solution. On the other hand, programs used to be sent to the Kyeriba MW Transmitting Station via telephone line, and similarly to the Mawagga Station, it stopped broadcasting 15 years ago and no satellite line system has sequentially been developed at the site. Therefore, similarly to Mawagga, a program receiving system using the satellite should be developed at Kyeriba.

(4) Studio Equipment

1) On-air Studio Equipment

- Original request: Microphone, audio mixer, CD recorder, MD recorder, cassette tape recorder, audio effector, graphic equalizer, etc.
- Final request: The following is added to the original request.
  - Cough box
  - Telephone hybrid
  - Console table
  - Uninterrupted power supply (UPS)
  - Installation materials

On-air studios are used during the entire on-air hours (18 hours/day) to broadcast live programs as well as sending recorded programs. Therefore, they need to be furnished

with the functions of both live program production and transmission of programs. The original request consisted of equipment minimally necessary for producing programs, which is capable of recording and sending small-scale programs such as talks, but is not sufficient for the basic function of an on-air studio, that is live broadcasting, such as (i) live broadcasting of news programs, (ii) listeners participation in live talk programs, (iii) continuation of sending live and recorded programs during outage, etc. All the equipment additionally requested is all vital for realizing live broadcasting at the on-air studio.

The existing on-air studios are equipped with high-grade special-ordered equipment with broadcasting station specifications. Since all of the equipment is accompanied by backup systems, in order to ensure that the broadcasting is not interrupted even in case of a partial failure, the equipment is still usable after 20 years in use. However, the equipment now experiences anomalies, such as malfunction, degradation of frequency characteristics, and noise due to loose contact, resulting from aged deterioration and moreover the equipment is no longer produced, making it difficult to procure spare parts. As a result, UBC is in a serious situation that they cannot produce programs in a stable manner. It was confirmed that renewal of the equipment was an urgent need.

2) Production Studio Equipment

- Original request: None
- Final request: On-air studio equipment excluding telephone hybrid and Digital Audio Workstation (DAW)

Kampala Broadcast House is composed of four on-air studios (Red, Blue, Butebo and Green) and six production studios (A to F). Of the four on-air studios, Green is not operational today since it has no programs to cover, and so the remaining three on-air studios that are actually operating are the target for the equipment listed in the original request. However, in the process of discussion, it was confirmed that on-air studios were positioned as studios to transmit live as well as recorded programs and improvement of equipment for productions studios corresponding to the three on-air studios was also required. In the light of interchangeability in the program production equipment, recording media, etc., equipment for production studios shall be renewed at the same time of renewal of the equipment for on-air studios, so that it is additionally requested by Ugandan side. The contents of the equipment are almost the same as the on-air studio equipment, except telephone hybrid, which is live-broadcasting equipment, is not included and Digital Audio Workstation, which utilizes computers to record and edit programs, is required.

Like the on-air studios, the existing production studios are installed with monaural-specifications, special-ordered equipment with the high grade targeted for broadcasting stations. All of the equipment has deteriorated due to the significant aging and difficulty to obtain spare parts. Further, though there is a sign of "Editing Room" in the studio building, there is no equipment inside. Editing work is carried out by very inefficient tape editing (linear editing) using superannuated equipment at the production studios currently in use. These pieces of equipment running now are an old type with analogue specifications and are not compatible with the digital equipment to be provided for the on-air studios. Therefore, in order to produce programs that are compatible with the three on-air studios, namely Red, Blue and Butebo, the additional request to upgrade the three production studios (Studio D, E and F) that are not operational today is a necessity and the requested contents of equipment are deemed to be appropriate. The details of evaluation of the necessity for the upgrading of the production studio are described as follows.

(Evaluation of the necessity for upgrading of the production studios)
Tabulated below are the time and type of programs that UBC currently provides in the three channels.

Channel	On-air time (daytime)	Live program time (daytime)	Recorded program time (daytime)
Red	18 hours (06:00 - 24:00)	14 hours - 15 hours	3 hours - 4 hours
Blue	18 hours (06:00 - 24:00)	14 hours - 15 hours	3 hours - 4 hours
Butebo	18 hours (06:00 - 24:00)	15 hours - 16 hours	2 hours - 3 hours

All the programs covering 18 hours/day in total are transmitted from the on-air studios. Thus, extra studios are needed for producing recorded programs apart from live programs. The number of studios necessary for program production is to be determined based on the type of programs and the on-air time. The time required for occupying a studio for producing one program is a few times more than that of the program time, including rehearsals and settings. The factor to express this occupation time is called Studio Utility Factor (S.U.F.), and differs among types of programs. A general idea of this factor is given below.

Program category	S.U.F.
News	2 times
Talk	2 - 4 times
General program	3 - 5 times
Music program	3 times (excluding rehearsals)
Drama	10 - 25 times

Most of the recorded programs produced by UBC are talks and music shows, constrained by the size of the current studios, and hence the S.U.F. is set as approximately three times. Consequently, producing all programs for broadcasting in Red, Blue and Butebo channels requires the following lengths of time to occupy the studios every day.

Channel	Studios to be used	No. of hours per day to occupy the studios
Red	D	9 hours - 12 hours
Blue	E	9 hours - 12 hours
Butebo	F	6 hours - 9 hours

Considering that the total studio-occupying hours of each channel is 33 hours at the maximum per day, it is necessary to develop a production studio dedicated to each channel.

3) Improvement of the Studios

The existing studios were constructed in 1970s; similarly to the equipment, all fixtures, such as interior parts and ancillary facilities, show chronological deterioration. However, the deterioration is not as serious as affecting the operation of the equipment to be procured, and hence it is not necessary to renovate the studios in accordance with the equipment upgrading. In the meantime, the existing equipment must be removed prior to the start of installation works in some cases, and partial repair works on the interior may sometimes be necessitated accordingly. These repair works, if needed, shall be undertaken by Uganda and will not be included in the scope of Japan's work.

(5) Construction of Related Facilities at the Transmitting Stations

Initially, the request from UBC did not include construction of total six buildings, i.e. the transmitting station building and sub and main ATU huts each for both the Mawagga and Kyeriba MW Transmitting Stations, based on an assumption that the existing structures are reusable. As a result of the field surveys at the Mawagga and Kyeriba Stations, the study team and UBC reached a shared conclusion that the existing buildings (transmitting station buildings and main and sub ATU huts) are too superannuated to accommodate the new transmitting equipment to be provided under the project, and therefore it is necessary to construct small-scale yet new buildings as the housing for the new equipment. Although UBC requested to include the construction of these buildings in Japan's undertakings, the study team advised that it should be kept as the scope of works to be done by Ugandan side, explaining that such building construction was not included in the original request and that UBC's improper maintenance has resulted the aging of the buildings. Later, UBC gathered cost estimations from local

construction companies, based on a set of rough design drawings of the buildings prepared by the study team, and has confirmed that the building construction is feasible in the spectrum of their own budgets. Finally, they agreed to construct these buildings as part of UBC's responsibility, once this project is approved by the government of Japan. However, UBC requested anew that the detailed designs of the buildings be undertaken by the Japan side, since they are closely associated with the design of the equipment. The study team promised to examine the request as part of the analytical work in Japan.

As a result of the analytical work in Japan, the study team decided to take over the detailed design, because the three buildings to be constructed at each site, a transmitting station building and main and sub ATU huts, must be completed for sure by the time Japan starts installation of the equipment, and also the buildings are important facilities to allow the equipment to fully function.

(6) Ancillary Facilities at the Transmitting Stations

Air-conditioning and ventilation system and emergency engine generators, which were not listed in the original request form, were newly added as ancillary facilities at the Transmitting Stations necessary for operation of the transmitting equipment. The request for each piece of the equipment was evaluated as follows:

1) Air-conditioning and Ventilation System

The MW transmitters to be provided by the project consist of transistors which constantly emit a large amount of heat from the joint parts. For this reason, it is essential to keep the room temperature within a certain range, otherwise an increased temperature may damage the transistors and also it will be difficult to conduct maintenance work in the room. Furthermore, dusts and dew drops are enemies of transistors; it is necessary to secure air circulation through adequate filters in the room. From these points of view, introduction of solid state MW transmitters and introduction of air conditioners are inseparable. With the outdoor air temperature at the project sites being warm throughout the year, the heat exhausted by the transmitters will further increase the room temperature to constantly indicate a high value. Therefore, only cooling equipment is necessary as an air-conditioning system together with a ventilation system as a backup in case of contingency. Since the capacity of the cooling equipment and the layout in the room have to be considered in close linkage with the transmitters, it is deemed appropriate to incorporate the introduction of the cooling equipment as a part of the transmitting equipment and hence as a part of Japan's undertakings.

2) Emergency Engine Generators

The power situation surrounding the Mawagga Station is extremely poor. Based on a survey conducted by UBC in the area, outage, including planned outages, take place for 282 hours, more than a half of a monthly radio broadcasting time (18 hours/day × 30 day ＝ 540 days/month). In addition, the power situation in the vicinity of the Kyeriba Station is not favorable, too. The study team conducted an interview with the power distributor in Kabale and found that there is a four-hour planned outage every other day (from 6:00p.m. to 10:00 p.m.) and three three-hour blackouts every month due to the maintenance work on the transmitting route from Kampala, totaling up to 69 hours per month. Based on the above, introduction of an emergency engine generator is a must at each of the Stations to secure continuous radio broadcasting. The capacity of generators must be carefully studied, in view of a requirement level to satisfy the operation of the transmitters and an estimated power requirement of the building. Moreover, connecting wire will be needed for transferring control signals between the transmitters and the generator control panel in order to automatically reduce the output of the transmitter in case of an outage, thereby minimizing the operational cost. Considering these altogether, it is preferred to introduce an emergency engine generator as part of the equipment to be procured by the Japan side. Based on these viewpoints, it is deemed appropriate to include an emergency engine generator in Japan's undertakings.

The above is an evaluation and verification of the changes made to the requested contents centering the primary equipment to be provided under the project. Table 2-1 below summarizes the comparison between the originally-requested contents and the finalized requests as to all the equipment.

Table 2-1: Comparison of the Requested Equipment between the Original Request and the Final Request

Original request	Q'ty	Final request	Q'ty	Reason for the change
Equipment for Mawagga MW Transmitting Station (Mubende District)				
Vacuum-tube-type 50kW MW transmitter (2×25kW MW transmitters)	1 lot	Solid-state 50kW MW transmitter	1 set	A solid-state 50kW MW transmitter is composed of more than 50 units of power amplifiers. Therefore, even if a few of the amplifiers break down, the output of the transmitter remains sufficient for retaining broadcasting. Further, power consumption can be saved compared to the vacuum-tube type.
50kW RF combining and SW equipment	1 lot	Not needed	-	This equipment combines the outputs of the two 25kW MW transmitters to output 50kW. It is not necessary any more as it is decided to introduce a 50kW MW transmitter. However, a 3-port (1 for input and 2 for output) U-link panel is still needed for switching the output of the transmitter to antenna and dummy load.
		3-port U-link panel	1 set	(Same as above)
50kW lightning protector	1 set	50kW lightning protector	1 set	No change
50kW dummy load	1 set	50kW dummy load	1 set	No change
50kW MW directional antenna system (2×130m self-supporting tower)	1 lot	50kW MW directional antenna system (2×130m guyed mast)	1 lot	The premise is large enough to accommodate a more economical guyed mast antenna.
Power feeder (aerial feeder 220Ω)	1 lot	Coaxial cable, dehydrator	1 lot	It is economical to use a 50Ω coaxial cable, which has the same output impedance as the transmitter. However, a dehydrator is also needed to protect the cable from insulation deterioration due to moist.
75kVA automatic voltage regulator (with distribution panel)	2 sets	150kVA automatic voltage regulator (with distribution panel)	1 set	One 150kVA unit is more economical than two 75kVA units.
Program input and monitoring equipment	1 lot	Program input and monitoring equipment	1 lot	No change
Measuring equipment	1 lot	Measuring equipment	1 lot	No change
Installation materials	1 lot	Installation materials	1 lot	No change
4WD vehicle for operation and maintenance	1 unit	(Withdrawn)	-	The staff will be stationed at the station; and they will not have to go out for the purpose of maintenance.
		Isolation transformer	1 set	This is a device indispensable for the transmitter, because it protects the equipment from lightning surge.

Original request	Q'ty	Final request	Q'ty	Reason for the change
		Emergency engine generator, changeover switch, fuel tank	1 lot	An emergency power system is needed to avoid interruption of broadcasting caused by outlage and to communicate control signal lines with the transmitter.
		Air-conditioning and ventilation system	1 lot	It is indispensable as a cooling device for the 50kW solid-state MW transmitter, and hence the capacity must be determined in accordance with the heat emission of the transmitter and related equipment.
		Satellite receiving equipment	1 lot	Although UBC distributes its programs to the regional stations via Intelsat, this station is not equipped with any necessary satellite receiving equipment.
		Spare parts	1 lot	Since no backup transmitter will be procured under the project, minimum numbers of extra power amplifier units, power units, etc. need to be secured, thereby minimizing the time length of broadcasting stoppage in case of an equipment failure.
		Tools set	1 lot	It is important to put in place tools minimally required for maintenance of the transmitter.
Equipment for Kyeriba MW Transmitting Station (Kabale District)				
Vacuum-tube-type 50kW MW transmitter (2×25kW MW transmitter)	1 lot	Solid-state 50kW MW transmitter	1 set	A solid-state 50kW MW transmitter is composed of more than 50 units of power amplifiers. Therefore, even if a few of the amplifiers break down, the output of the transmitter remains sufficient for retaining broadcasting. Further, power consumption can be saved compared to the vacuum-tube type.
50kW RF combining and SW equipment	1 lot	Not needed	-	This equipment combines the outputs of the two 25kW MW transmitters to output 50kW. It is not necessary any more as it is decided to introduce a 50kW MW transmitter. However, a 3-port (1 for input and 2 for output) U-link panel is still needed for switching the output of the transmitter to antenna and dummy load.
		3-port U-link panel	1 set	(Same as above)
50kW lightning protector	1 set	50kW lightning protector	1 set	No change
50kW dummy load	1 set	50kW dummy load	1 set	No change
50kW MW directional antenna system (2×75m self-supporting tower)	1 lot	50kW MW directional antenna system (2×75m guyed mast)	1 lot	The premise is large enough to accommodate a more economical guyed mast antenna.
Power feeder (aerial feeder 220Ω)	1 lot	Coaxial cable, dehydrator	1 lot	It is economical to use a 50Ω coaxial cable, which has the same output impedance as the transmitter. However, a dehydrator is also needed to protect the cable from insulation deterioration due to moist.

Original request	Q'ty	Final request	Q'ty	Reason for the change
75kVA automatic voltage regulator (with distribution panel)	2 sets	150kVA automatic voltage regulator (with distribution panel)	1 set	One 150kVA unit is more economical than two 75kVA units.
Program input and monitoring equipment	1 lot	Program input and monitoring equipment	1 lot	No change
Measuring equipment	1 lot	Measuring equipment	1 lot	No change
Installation materials	1 lot	Installation materials	1 lot	No change
4WD vehicle for operation and maintenance	1 unit	(Withdrawn)	-	The staff will be stationed at the station; and they will not have to go out for the purpose of maintenance.
		Isolation transformer	1 set	This is a device indispensable for the transmitter, because it protects the equipment from lightning surge.
		Emergency engine generator, changeover switch, fuel tank	1 lot	An emergency power system is needed to avoid interruption of broadcasting caused by outage (or planned outages) and to communicate control signal lines with the transmitter.
		Air-conditioning and ventilation system	1 lot	It is indispensable as a cooling device for the 50kW solid-state MW transmitter, and hence the capacity must be determined in accordance with the heat emission of the transmitter and related equipment.
		Satellite receiving equipment	1 lot	Although UBC distributes its programs to the regional stations via Intelsat, this station is not equipped with any necessary satellite receiving equipment.
		Spare parts	1 lot	Since no backup transmitter will be procured under the project, minimum numbers of extra power amplifier units, power units, etc. need to be secured, thereby minimizing the time length of broadcasting stoppage in case of an equipment failure.
		Tools set	1 lot	It is important to put in place tools minimally required for maintenance of the transmitter.
Equipment for Kampala Broadcast House (Red, Blue, Butebo on-air studios: 1 lot each, 3 lots in total)				
Microphone (with stand and cable)	1 lot	Microphone (with stand and cable)	1 lot	No change
Speaker	1 lot	Speaker (for studios)	1 lot	No change (place for installation clarified.)
Audio mixer	1 set	16CH analogue audio mixer	1 set	It is necessary to provide an audio mixer with analogue specifications suitable for live broadcasting, as UBC desires.
CD recorder/player	1 set each	CD recorder/player	1 set each	No change
MD recorder	1 set	MD recorder	1 set	No change

Original request	Q'ty	Final request	Q'ty	Reason for the change
Cassette tape recorder	1 set	Cassette tape recorder	1 set	No change
Graphic equalizer	1 set	Graphic equalizer	1 set	No change
Digital effector	1 set	Digital effector	1 set	No change
Audio monitor	1 lot	Audio monitor (for Studios and Sub Control Room)	1 lot	No change (place for installation clarified.)
Headphone	5 nos.	Headphone	5 nos.	No change
Audio distribution amplifier	1 lot	Audio distribution amplifier	1 lot	No change
System rack/patch cable	1 lot	System rack/patch cable	1 lot	No change
On-air lamp	1 lot	On-air lamp	1 lot	No change
Chair	3 sets	(Withdrawn)	-	To be borne by Uganda.
		Audio recorder	1 set	An audio recorder (using semiconductor memory) is vital for program production, because it can be activated immediately and has a cut-in control function for the sake of station-to-station call.
		Telephone hybrid	1 set	This machine allows production of live programs, in which listeners can participate in the program via telephone, and incorporation of news from outside. Currently Red Channel has only one such unit that is significantly decrepit and requires updating.
		Announcer cough box	1 lot	This box keeps unnecessary noise created by the announcer off during live news or debate programs. It is vital for production of programs.
		Console table	1 lot	The audio mixer, microphone, scripts, etc. are to be placed on the table. It is vital for production of programs.
		Announcer table	1 lot	The microphone stand, cough box, scripts for announcers and other people in the program, etc. are to be placed on the table. It is vital for production of programs.
		Uninterrupted power supply (UPS)	1 set	It is necessary for assuring the program to be continuously broadcast during the few minutes until the in house generator starts to operate in case of a outage. It is vital for production of programs.
		Patch panel	1 lot	It is needed for bypassing audio signals to other lines in case of maintenance or emergency. It is vital in terms of configuration of production equipment.
		Installation materials	1 lot	Needed for installing studio equipment.
Equipment for Kampala Broadcast House (Production studios D, E, F: 1 lot each, 3 lots in total) additionally requested				
(Common reason for the additionally-requested equipment for production studios)				The production studio equipment must be updated in order to create programs matching with the three on-air studios covered in the project.
		Audio mixer	1 set	It is necessary to provide a digital 24CH mixer for multi-recording, editing, etc., because the main task is to produce talk and music programs.

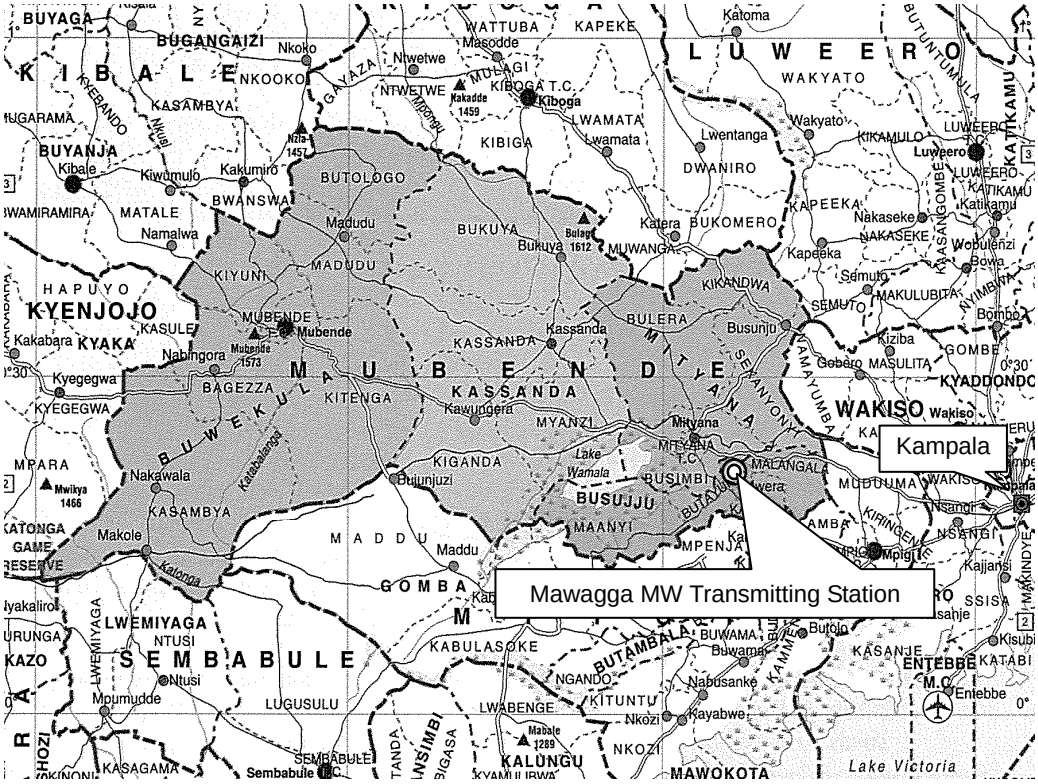
Original request	Q'ty	Final request	Q'ty	Reason for the change
		CD recorder/player	1 set each	These are needed to match with the on-air studio equipment.
		MD recorder	1 set	
		Cassette tape recorder	1 set	
		Audio recorder	1 set	
		Digital audio workstation (DAW)	1 set	It is necessary to set up a program editing system consisting of industrial computers, CD-RW drives, application software, etc. to match with the variety of equipment to be introduced to replace the current program editing method using the open reel tape recorder.
		Microphone	1 lot	It is necessary to secure the conformity to the on-air studio equipment.
		Announcer cough box	1 lot	
		Graphic equalizer	1 set	
		Digital effector	1 set	
		Monitor speaker	1 lot	
		On-air lamp	1 lot	
		Console table	1 lot	
		System rack	1 lot	
		Announcer table	1 lot	
		Uninterrupted power supply (UPS)	1 set	
		Audio distribution amplifier	1 lot	
		Headphone	5 nos.	
		Patch panel	1 lot	
		Installation materials	1 lot	
Equipment for Kampala Broadcast House (Maintenance Equipment)				
		Audio test set	4 sets	It is measuring equipment necessary for confirmation of the function of and maintenance of the equipment to be provided under the project.
		Maintenance tools	3 lots	These tools are minimally necessary for maintenance of the equipment.
		Spare parts	1 lot	Spare parts are necessary to prevent any disturbance to the operation, for at least the first year after the start of operation.

2-2-2-2 Overall Plan

(1) Current State of the Site

1) Mawagga MW Transmitting Station

① Location: Mubende District, Mityana County:
00°22' 42" N, 32°08' 18" E, 1,330m above sea-level



② Situation at the Site

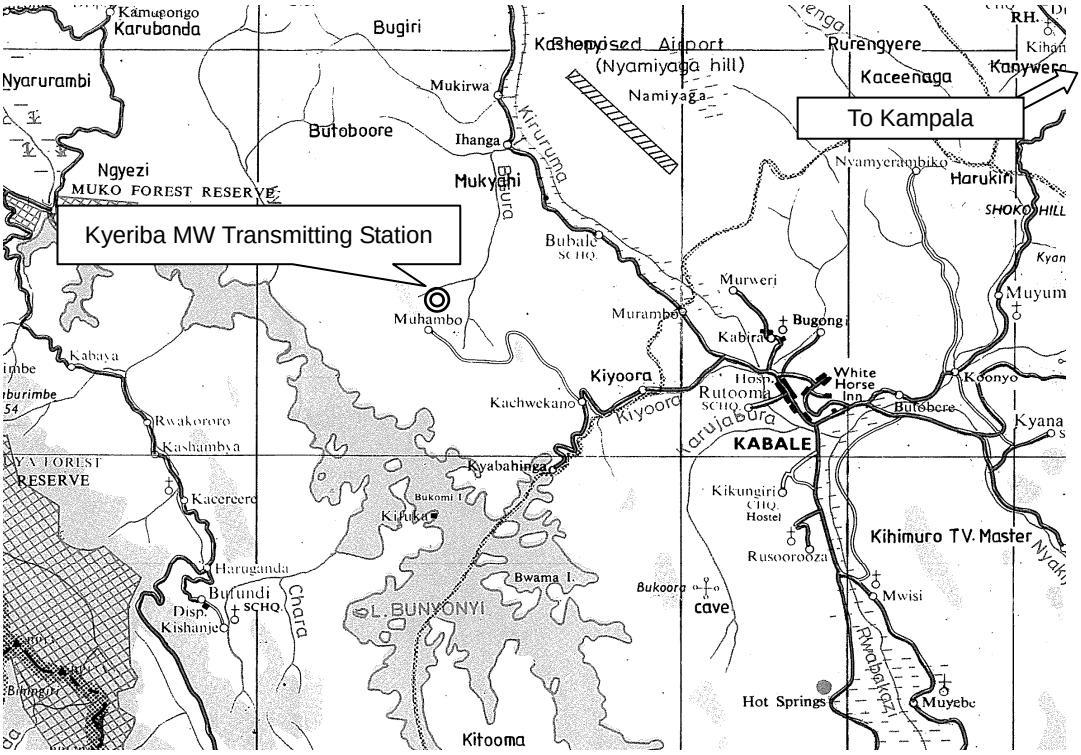
The Mawagga MW Transmitting Station is located in a hilly area approximately 2km to the left from an about 70km point (approximately 5km before the built-up area of the city of Mityana; a guide plate of the station is placed) on an arterial highway to the west (Fort Portal) from the city of Kampala. The arterial highway is well paved and there is no problem for transportation, but approach roads are not with some substantially undulating surfaces, so that thorough preliminary research will be necessary prior to the delivery of equipment. The difference of elevation between the lowest point in the premises, the boundary in the west, and the highest point which is at the center of the ground, is approximately 17m. The existing MW transmitting antenna, though currently shut down, is built at a slightly lower point from the highest point which is in the south-east from the center. The

land area totals 23.52 hectares, and the space for the construction of a new guyed directional antenna is sufficiently secured. Electronic power source for commercial use is available in the vicinity of the premises. A geological survey has found that the ground harder than the surface has emerged, and that a fairly solid bearing ground with the soil bearing capacity of 680 kN/m^{2}is distributed uniformly at 1m in depth in the premises. Therefore, it can be concluded that the Mawagga MW Transmitting Station has extremely good conditions for the construction of a MW transmitting antenna, that is, it satisfies the location requirements for this plan.

2) Kyeriba MW Transmitting Station

① Location: Kabale District, Kabale County:

01°15' 00" S, 29°55' 00" E, 2,310m above sea-level



② Situation at the Site

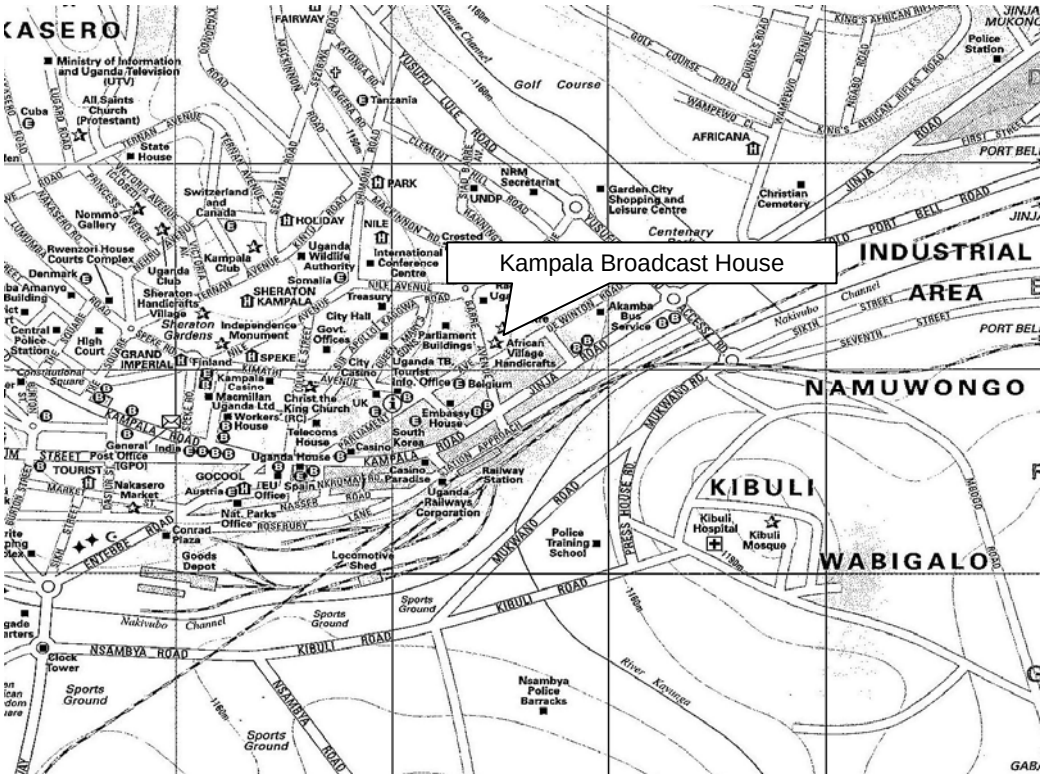
The Kyeriba MW Transmitting Station is located on a small hill approximately 20km away from the city of Kabale, which is about 420km south of the city of Kampala along the border with Rwanda, along an arterial highway to the direction of Lake Bunyonyi (to the west). Most access roads to the site are not unpaved, but there is no particular problem for the delivery of equipment to the premises. The land area totals 16.5 hectares, though it is not flat but takes the shape like the back of a horse. The existing MW transmitting antenna, though currently shut down, is

built at the highest point located at the center of the premises; the difference of elevation with the existing transmission building in the north-west of the land is some 20m. In the premises, there are quite a few trenches like a maze which were made during the time when armed forces were stationed; either way, none of these disturbs the construction work for a guyed antenna. As in the case of the Mawagga Station, electronic power source for commercial use is available in the vicinity of the premises. A geological survey has found that a layer with the soil bearing capacity of 50 – 90 kN/m^2 is distributed uniformly at 1m in depth, and a layer with the soil bearing capacity of 105 – 180 kN/m^2 at 3m in depth, so that the premises are considered to be appropriate with no particular problems for the construction of an antenna. Therefore, it can be concluded that the Kyeriba MW Transmitting Station has as extremely good conditions as the Mawagga Station for the construction of a MW transmitting antenna, that is, it satisfies the location requirements for this plan.

3) Kampala Broadcast House

① Location: Kampala District, Central Region

00°20' 13" N, 32°35' 24" E, 1,174m above sea-level



② Situation at the Site

The Kampala Broadcast House is at the center of the city where governmental buildings are located, and there is no problem for the delivery of equipment. The studio building, cylinder-shaped, consists of one-story on the ground and one underground level. The first floor consists of on-air studios to broadcast Red, Blue and Butebo MW programs; 3 production studios (Studios D, E and F for production of programs) linked to the above-mentioned 3-stream programs; and an "on-air" studio for FM broadcast. On the first basement level, there are the central control room (CCR), which intensively controls inputs and outputs of each on-air studio on the first floor, switches programs in accordance with purposes, and distributes programs to local broadcasting stations; a power source room; a maintenance room where equipment is repaired; and so on.

(2) Summary of the Systems Constituting Operations subject to the Cooperation

Operations subject to the cooperation under the Project focus on the recovery of functions of the two MW transmitting stations which have been shut down for 10 – 15 years, and will create direct and substantial beneficiary effects, making the public broadcasting available to people in the Central Region including Mubende District and the Western Region including Kabale District. At the same time, the studio equipment to be provided to the Kampala Radio Studio, together with the construction of the transmitting facilities, is expected to make it possible for the people of Uganda as a whole to access UBC programs stably. A series of the systems constituting the operations carried out under this cooperative Project – from the production of programs to the broadcasting – is summarized as follows:

[Program Production System]

The construction of 3 on-air studios to broadcast Red, Blue and Butebo programs currently provided by UBC, and the supply of program production systems for 3 production studios (Kampala headquarters and the radio studio)

[Program Reception System]

The construction of a satellite reception system to be used for receiving programs transmitted from the radio studio at the headquarters in Kampala via Intelsat, and inputting signals of programs to the 50kW MW transmitting equipment (The Mawagga and Kyeriba MW Transmitting Stations)

[50kW MW Transmitting System]

The construction of 50kW MW transmitting systems to provide local citizens with broadcasting programs (50kW MW transmitters, including peripheral devices; MW directional antennas; program input and monitoring equipment; emergency engine generators; buildings for broadcasting; etc.) (The Mawagga and Kyeriba MW Transmitting Stations)

The summary of all the systems subject to the cooperation Project is shown in the Fig. 2-1, and name, purpose and quantities for planned main equipment to be procured for the Project are listed in Table 2-2.

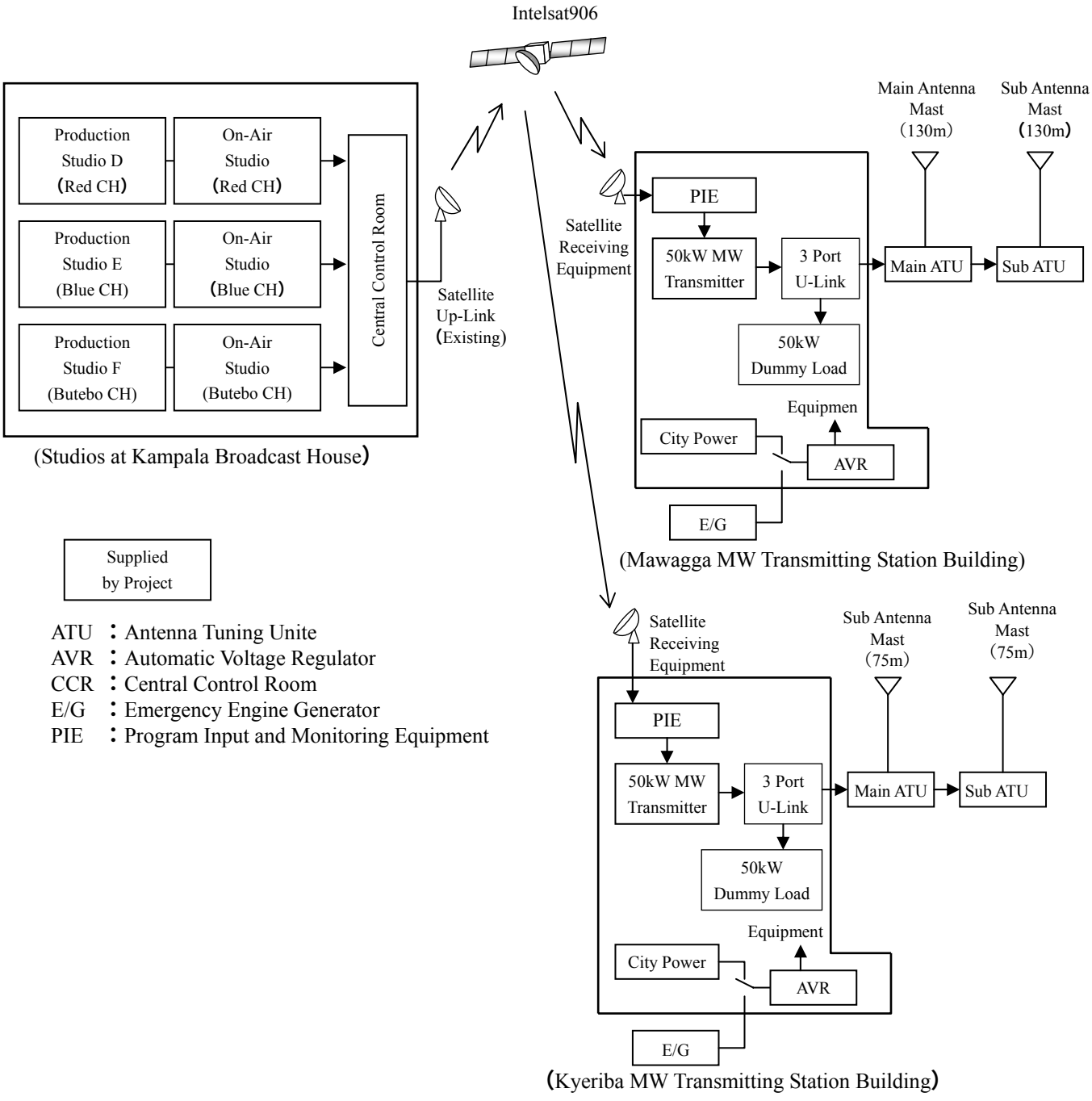


Fig. 2-1: MW Radio Broadcasting System of the Project

Table 2-2: Planned Main Equipment to be Procured for the Project

Group	Equipment	Purpose	Quantity
Equipment for MW Transmitting Stations	50kW MW Transmitter	Converts and amplifies the input signals of a program received by the satellite receiving equipment and transmits them.	2 sets
	50kW Dummy Load	Checks and adjusts the operational status and electric characteristics of the transmitter regularly, in order to ensure that the MW transmitter constantly operates in a stable state.	2 sets
	50kW 3 Port U-link Panel	Switches the output of the transmitter between the transmitting antenna (for sending) and the dummy load (for maintenance.).	2 sets
	50kW Lightening Protector	Protects the solid-state MW transmitter from lightning surges by attenuating lightning surges coming in from the antenna.	2 sets
	Program Input and Monitoring Equipment (PIE)	Automatically controls the signals of a program delivered from the studio to an adequate level and supplies them to the 50kW MW transmitter, while at the same time checking and monitoring the level and sound quality of the signals of a broadcast program.	2 lots
	50kW MW Directional Antenna	Radiates the output of the 50kW MW transmitter as airwaves.	2 lots
	Satellite Receiving Equipment	Recieves signals of a program transmitted from the Kampala studio via satellite line (Intelsat).	2 lots
	Automatic Voltage Regulator	Regulates voltage to be supplied to the equipment within a certain range, in order to prevent a failure to any equipment due to voltage variation.	2 sets
	Isolation Transformer	Protects the transmitting equipment from lightning surges, by attenuating lightning surges coming through the power supply line.	2 sets
	Emergency Engine Generator	Supplies power in case of a blackout.	2 lots
	Air-conditioning and Ventilation System	Protects an operating environment for equipment by keeping the temperature and humidity in rooms at an appropriate level. The ventilation system cools down the inside of rooms by taking air in from outside, in emergency cases such as breakdown of the air-conditioner.	2 lots
Equipment for Radio Studios	Equipment for On-Air-Studios	Delivers news, talk and other live programs and recorded programs created at production studios.	3 lots
	Equipment for Production Studios	Produces, records and edits music programs, talk shows, etc.	3 lots

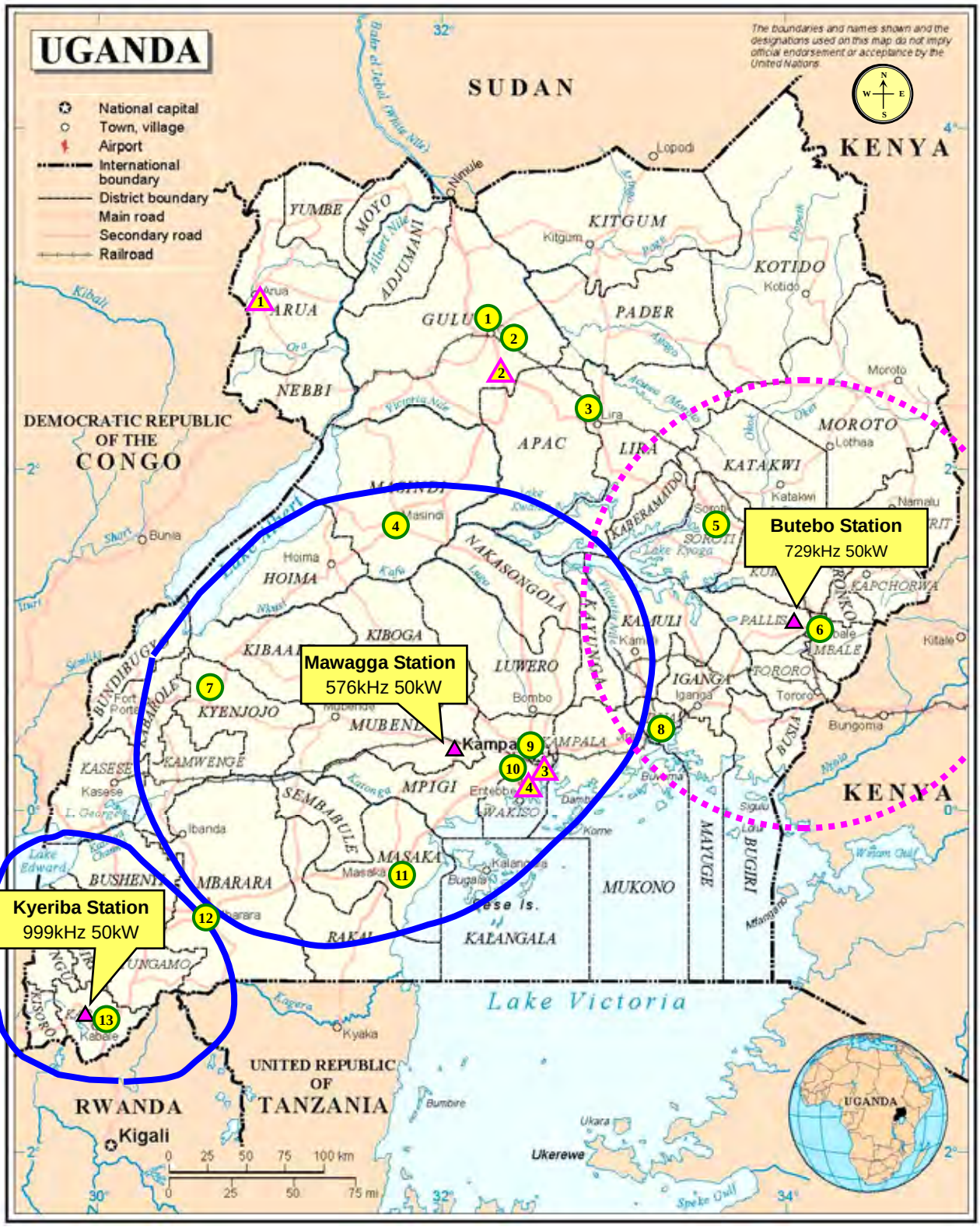
(3) MW Broadcasting Service Areas Probably Covered by the Implementation of the Cooperation Project

This section gives a possible coverage of the MW broadcasting and an estimated number of beneficiaries due to the restoration of the functions of the Mawagga and Kyeriba MW Transmitting Stations. The following conditions are adopted in setting the service area:

- Electrical field intensity of the service area: 60dBμV/m
- Radio property from the Mawagga MW Transmitting Station:
  Direction of directional antenna: TN+320°; output: 50kW; frequency: 576kHz; height of antenna: 2×130m; ground conductivity: multiple path of 3~8mS/m
- Radio property from the Kyeriba MW Transmitting Station:
  Direction of directional antenna: TN+32°; output of the transmitting machine: 50kW; frequency: 999kHz; height of antenna: 2×75m ground conductivity: multiple path of 3~5mS/m

Fig. 2-2 shows the results of examinations concerning the possible service coverage under the foregoing conditions. Currently, citizens of the Eastern Region of Uganda (approximately 7.08 million, or some 25 percent of the total population) benefit from the broadcasting services from the Butebo MW Transmitting Station, and the broadcasting service from the Mawagga MW Transmitting Station will be able to cover almost all areas in the Central Region (approximately 7.26 million people) and some parts of the Eastern Region (approximately 2.05 million people), as well as some parts of the Western Region (approximately 3.53 million people): thus the population covered by the service will total some 12.84 million (the population in 2006 estimated according to the 2002 national population census carried out by the Statistics Bureau of Uganda, the same applied hereinafter). On the other hand, the Kyeriba MW Transmitting Station will cover the remaining part of the Western Region near the boundaries, where the estimated population totals some 3.4 million. Therefore, as a whole, 16.24 million persons will be covered by the newly launched broadcasting services. Since the estimated population of the country in 2006 is some 27.36 million, 59 percent or so of the population as a whole, will benefit from the new radio broadcasting services.

Hence, the total service area will amount to 84 percent, but because some 2.05 million people out of some 7.08 million in the Eastern Region currently covered by the Butebo MW Transmitting Station will be also subject to the broadcasting services from the Mawagga Transmitting Station, the total number of people benefiting from the broadcasting services in the entire country will be 21.27 million (16.24 million + (7.08 million – 2.05 million)), that is, 77 percent of the total population of the country will be able to enjoy the MW broadcasting services.



*Note: An area circled with dotted line is the service area of existing MW transmission from Butebo.

Location of Other Existing Transmitting Stations

△n: [Medium Wave Transmitting Station] **1**: Arua (756kHz 10kW) **2**: Bobi (810kHz 50kW) **3** :Kibira (639kHz 10kW) **4**:Bugolobi (909kHz)*also operated by Short Wave Broadcasting

(n): [FM Transmitting Station] **1**: Gulu-Town (102.1MHz) **2**: Gulu-Moru (103.1MHz) **3**:Lira (99.4MHz) **4**: Masindi (105.0MHz) **5**: Soroti (96.7MHz) **6**: Mbale (96.9MHz) **7**: Kyenjojo (98.8MHz) **8**: Jinja (95.7MHz) **9**: Naguru (98MHz) **10**: Kololo (100MHz, 105.7MHz, 107.3MHz) **11**: Masaka (96.9MHz, 99.5MHz) **12**: Mbarara (97.4MHz) **13**: Kabale (93.7MHz)

Fig. 2-2: Expected Service Aria of 50kW MW Transmission from Mawagga and Kyeriba

2-2-2-3 Equipment Plan

Based on the design policies, the equipment plan was prepared in accordance with the relevance and necessity of the requested equipment as derived from the functions and roles of each piece of equipment identified during the field survey, and the technical level, financial capacity and operation and maintenance capabilities of the implementing agency.

(1) Conditions for Design, Policies, etc, Commonly Applied to All Pieces of Equipment

The conditions and basic policies for design of any piece of equipment for the transmitting stations and studios are as explained below:

1) Governed Recommendations and Standards

Recommendations and standards which are internationally adopted as codes in the electrical and telecommunication fields and provided by the following organizations will be adopted.

(i) International Telecommunication Union-Radio Communication Sector: ITU-R
(ii) International Electro-technical Commission: IEC
(iii) Japan Industrial Standard: JIS
(iv) Japan Electronics and Information Technology Industries Association: JEITA
(v) International Organization for Standardization: ISO
(vi) Audio Engineering Society: AES
(vii) Electronic Industries Alliance: EIA

2) Conditions for the Environment to Operate Equipment

Outside air temperature:	10℃～40℃
Room temperature:	10℃～40℃
Relative humidity:	95% or less
Altitude:	2500m or less
Maximum wind speed:	45m/sec.

3) Power Voltage / Frequency

Power source for equipment: 3-phase 415V/240V, 50Hz, 4-wire system
Allowable power voltage fluctuation for commercial use: 3-phase 415V+10/-15%

4) Frequency and Output Power of MW Transmitters

Those will be set in accordance with the allocation by ITU-R

The Mawagga Station:	576kHz, 50kW
The Kyeriba Station:	999kHz, 50kW

(2) Equipment for the Transmitting Stations

1) Objective Site

- Mawagga 50kW MW Transmitting Station
- Kyeriba 50kW MW Transmitting Station

2) Basic Specifications of the Equipment

The specifications for broadcasting stations shall be adopted as for MW transmitters because it will contribute to reduction of operational cost, minimizing of broadcasting stoppage, and realization of stable services. Since the Mawagga and Kyeriba Transmitting Stations in which engineers always stay for the operation and maintenance of equipment, the basic specifications of equipment – starting-up and shutting-down of the transmitters; selection and switches of inputting program; shift to emergency power generator in case of outage; shift from the emergency power source to the ordinary one for commercial use when the power supply is recovered; and so on –will be conducted in principle on a manual basis. The basic criteria for selection and design of equipment to be provided to the transmitting stations are as follows:

3) Approach to the Supply of Equipment

① MW Transmitting System Equipment and Related Facilities

a) 50kW MW Transmitter

Since the MW transmitters will be used stably for a long term, the specifications will be in accordance with the standard for which highly reliable parts are used and easily handled manually. It will be also a solid-state type without vacuum tubes, adopting either a digital modulator with high modulation efficiency or a multi-step modulator for the purpose of reducing the power charges which will account for substantial part of operational outlays. The solid-state type is known for its high operational stability and does not stop running even if 10 percent of the total number of power amplifiers installed has been broken, thus, backup transmitters will not be provided. However, where the high-frequency exciters comprising crystal controlled oscillators generating carrier waves and amplifier to amplify carrier signals to a certain level are concerned, the current-use/backup system (automatically changeable) will be adopted so as to avoid as much as possible the interruption of broadcasting due to the breakdown of the high-frequency exciters. In the meantime, a control system, whereby the output power for the MW transmitters will be automatically reduced from 50kW

to 10kW when the power supply is cut off and the systems are operated with emergency engine generators, and also automatically recovered to 50kW when the commercial-use power supply is recovered, will be adopted for minimizing operation costs of the generator.

b) 50kW Dummy Load

For consistent, stable operation of the MW transmitters, it is necessary to inspect and adjust the operational conditions and characteristics on a regular basis, thus 50kW dummy loads will be provided for maintenance of the transmitters. The output power of the MW transmitters is usually connected to antennas, but to the dummy loads when the transmitters are under maintenance. The frequency used for the 50kW dummy loads is set at the same as for the transmitters, the load capacity being set so as to respond 100% modulation.

c) 50kW 3-port U-link Panel

This is a device to switch the output of the MW transmitters between the transmitting antennas and the dummy loads in accordance with the purpose, that is, broadcasting and maintenance. However, in consideration of number of switching repetition between the antennas and dummy loads, a manually changeable system seems to be appropriate; thus, 3-port with U-link panel (1 input and 2 outputs) will be provided.

d) 50kW Lightning Protector

Lightning protectors are used to protect solid state MW transmitters from lightning surges by decaying the surges coming via the antennas. Since lightning surges contain quite a few of nearby 100kHz components, the circuits of the devices should be equipped with a high-pass filter (HPF) which is able to reduce the components of lightning surges but allows to pass MW frequency without losses.

e) Program Input and Monitoring Equipment (PIE)

Program input and monitoring equipment (PIE) to be provided has a function of controlling the incoming signal to the adequate level to the 50kW MW transmitters, and monitoring individual check points. A PIE consists of a audio processor, monitor switcher and monitor speakers, of which the audio processor is used to adjust program signals at an adequate level to the MW transmitters, process (compress or expand) audio signals digitally, and increase the average

modulation degree to create audio quality as good as FM broadcasting. To avoid temporary interruption of broadcasting due to malfunctioning, the processor will have two units for current use and backup. The monitor-switcher and monitor speakers are devices to check the level of signals of broadcast programs and sound quality are normally at input and output terminal of the 50kW MW transmitter.

f) Transmitting Station Building

Construction of transmitting station buildings, which accommodate the above a) to e) is also planned as a part of the installation works under the project. Details of transmitting station building are explained in the Section 2-2-2-4 (Related Facilities) in this report.

g) 50kW MW Directional Antenna System

(Overview of the System)

This is a device to radiate output power from the 50kW MW transmitter as electromagnetic wave, comprising antenna masts, a dehydrator, obstruction lights, radial earth, matching units (ATU), coaxial cables, etc. The antenna masts are iron towers to radiate output power from the MW transmitters as electromagnetic wave: in order to make the antennas have directional characteristics to check the radiation of waves to neighboring countries, the main and sub masts will be provided like the existing masts. Their heights will be set at the same level as the existing antennas (130m at the Mawagga Station, and 75m at the Kyeriba Station). The sub antenna mast at the Mawagga and Kyeriba Stations will be constructed to the direction of Tanzania (320° from north), and to the direction of Rwanda (32° from north), respectively. The radiation of electromagnetic wave to the directions of Tanzania and Rwanda will be reduced by making the sub masts serve as reflectors. While the existing antennas are self-supporting, newly provided masts will be guyed mast in consideration of the construction cost and the fact that the premises of the stations are sufficiently large. Obstruction lights will be installed on the top part of the antenna masts, and the masts will be painted with warning color for daytime.

ATU huts are architectural structures to match the output impedance of the transmitter and the impedance of the antenna masts so as to obtain the directional characteristics as designed, necessary for the main and sub masts,

respectively, and are installed at the base of the antenna masts. For securing the safety, base of the antenna masts shall be enclosed with the net fences as a part of the work for antenna system. For the connection between the MW transmitters and the matching equipment, coaxial cables of 3-1/8 inches will be used to minimize the losses of outputs from the 50kW transmitter and to realize efficient radiation: the cables will be buried underground since it is the most economical. The lengths of the cables will be approximately 400m for the Mawagga MW Transmitting Station, and approximately 250m for the Kyeriba Station. At the same time, to avoid the lowering of transmitting efficiency due to, say, excessively high humidity, dehydrator will be provided to fill dry air constantly. For higher radiation efficiency and to secure a larger service area, copper cables (radial earth) of the same length as the height of the antennas will be buried 30 – 50cm in depth radially from the antenna at intervals of three (3) degrees.

(Design of the Antenna)

i) Design of the Antenna Foundations

A geological survey for the Mawagga Transmitting Station has found that the ground harder than the surface has emerged, and that a fairly solid bearing ground with the soil bearing capacity of 680 kN/m^2 at 1m in depth is distributed uniformly in the premises, and a survey for the Kyeriba Station has found that at the ground at 1m in depth a layer with the soil bearing capacity of 50 – 90 kN/m^2 is uniformly distributed, and a layer with the soil bearing capacity of 105 – 180 kN/m^2 at 3m in depth. According to those findings of the geological surveys, and in consideration of dimensions of the foundations from the engineering viewpoint, costs, work schedules, safety of construction work, etc., the depths of earthwork will be set at 2m for the Mawagga Station and 3m for the Kyeriba Station, while the soil bearing capacities will be set, as recommended by boring companies, at 600 kN/m^2 (Mawagga) and 50 kN/m^2 (Kyeriba), respectively, for appropriate designs of the foundations.

ii) Structural Design of the Antenna

The structural design of the guyed-mast antenna shall conform to RS-222-C of the EIA standards, which is largely and globally adopted as the standards for structural analysis and structural design of steel towers.

iii) Setting of External Forces (seismic load, wind load)

Similarly to the setting of external forces for ancillary facilities, as described later in 2-2-2-3, pertaining to the seismic load, the design shearing force coefficient is set as 0.15 based on the regional coefficient of Uganda cited in the U.S. UBC standards issued in 1997. Also, the wind load is set as a velocity of 45m/sec. (v=162km/h), following the design condition at 10 m above the sea level where winds are strong in neighboring Tanzania.

iv) Steel Bars to be Used

Steel bars, such as angles and bolts, and guys to be used shall conform to the JIS standards. Further, the bars must be galvanized in compliance with the JIS, from the perspectives of rust proofing and weather resistance.

h) Main and Sub ATU Huts

Like the transmitting station buildings, construction of the main and sub ATU huts which accommodates ATU shall be implemented as a part of the installation works under the project. Details of main and sub ATU huts are explained in the Section 2-2-2-4 (Related Facilities) in this report.

i) Satellite Receiving Equipment

Transmission of all programs – television, FM, MW, and short-wave broadcastings – to regional broadcasting stations are made from a satellite transmission system (uplink) installed at the Kampala Broadcast House via Intelsat 906, thus a satellite receiving equipment (downlink) enables programs from Kampala to be received at any places within Uganda. This receiving device, currently not installed in the Mawagga and Kyeriba MW Transmitting Stations, will be provided to receive broadcasting programs. The device, which is manually switchable between the current use and backup, will be mounted to the PIE. The diameter of the receiving parabolic antenna will be set at 4.5m so as to receive stably radio waves from the Intelsat 906, and the direction and angle of elevation of the devices can be adjusted manually.

② Power Supply Equipment

a) Automatic Voltage Regulators

As a result of measuring the fluctuations of power voltages for commercial use and frequency for 24 hours at the radio studio in Kampala and the Mawagga and

Kyeriba Stations, it has been confirmed that the voltage fluctuates at the rate of ＋10/-15% against the rated voltage of 415/240V at each site. Thus, in order to avoid breakdown of equipment to be procured due to voltage fluctuations, automatic voltage regulators that can make up for the fluctuation rate of +10/-15% will be provided. The capacity of the regulators will be set at 145kVA so as to cover all the devices, such as the 50kW MW transmitters, the program input monitoring equipment, the measuring equipment, the dummy loads, air-conditioners, dehydrators, obstruction lights, ventilating fan, etc. The grounds for the calculated capacity of the automatic voltage regulators are shown in Table 2-3 below

Table 2-3: Grounds for Calculated Capacity of Automatic Voltage Regulators

Transmitting Devices	Capacity	3-phase / single-phase	Notes
50kW MW Transmitter	100kVA	3-phase	100% modulation
PIE	1kVA	Single-phase	
Measuring Equipment	1kVA	Single-phase	
50kW Dummy Load	3kVA	3-phase	
Air-conditioner (1)	12kVA	3-phase	
Air-conditioner (2)	12kVA	3-phase	
Air-drier	2kVA	Single-phase	
Main Matching System	5kVA	3-phase	
Sub Matching System	5kVA	3-phase	
Ventilating Fan (1)	2kVA	3-phase	
Ventilating Fan (2)	2kVA	3-phase	
Total	145kVA		

b) Isolation Transformers

Isolation transformers are devices to protect transmitters from lightning surges by decaying the surges coming in through the power lines, and essential for solid-state MW transmitters. The capacity of transformers to be provided will be set at 150kVA to cover all the devices related to the transmitters and the power sources for the radio stations.

c) Emergency Engine Generators

In Mawagga and Kyeriba regions, blackouts, including planned ones, occur frequently. In order to sustain broadcasting even under surges of electricity, emergency engine generator will be provided. Since both the stations are manned stations, generators which can be started up manually will be provided. However, the generators will be designed to shift the power source to the one for

commercial use automatically, when it has been recovered, after confirming that it is back to normal. The capacity of the generators will be set at 65kVA so as to cover both the 50kW transmitters in the state where the power has been reduced to 10kW, and their peripheral devices, and generators designed for use in mountainous area (2,500m) will be provided in consideration of the altitude of the two transmitting stations. They will be also for outdoor use in consideration of the size of the buildings to be built and noises. Apart from these, fuel tanks (1,500 ℓ) necessary for the emergency engine generators will be provided.

③ Air-Conditioning and Ventilation System

As coolant systems for the MW transmitters, air-conditioners will be adopted in order to avoid dusts and moist air from outdoor and to secure the environment enabling stable operation in a long term. In consideration of efficient operation and maintenance work, two air-conditioners will be operated, each being controlled by temperature regulators attached to them. The conditions for the design of air-conditioners are as follows:

[Conditions for Design]

- Conditions concerning outside air temperature and humidity for design
  Dry-bulb temperature: 35℃
  Relative humidity: 60%
- Conditions concerning indoor temperature and humidity of the rooms with air-conditioners
  Dry-bulb temperature: 27℃
  Relative humidity: 50%
- Rooms with air-conditioners
  Room with transmitters:area – 63m^2, cubic capacity – approx. 252m^3

Taking into account the conditions stated above and various factors, such as the heat quantity transferred from outdoor into the buildings, the quantity of heat generated by lighting fixtures, staff members and so on, the necessary capacity of the air-conditioners will be 28,000kcal/h. Also taking into account the operational and maintenance efficiency, two air-conditioners with the capacity of 25kW (21,500kcal/h) will be provided, so that one or two air-conditioners can be used at one time in accordance with the setting of a room temperature. At the same time, as

an emergency measure against breakdown of the air-conditioners, ventilating fans that cool the air taken in from outside will be installed. The control system using thermostats will be adopted to switch from the air-conditioners to ventilating fans.

④ Maintenance Equipment

a) Measuring Equipment

Appropriate routine maintenance work is essential for operation of the MW transmitting equipment in good conditions; thus, audio signal generators; distortion measures; oscilloscopes; variable resistance attenuators; and frequency counters will be provided as minimum requirements for the maintenance of the MW transmitting equipment, and are stored on 19-inch racks. Apart from these, multi-meters to gauge voltages and power current, clamp meters, and electromagnetic field intensity detectors to measure unnecessary signal radiated from the transmitters and the electromagnetic field intensity in the service areas will be also provided. The functions of each equipment are shown below:

[Measuring Equipment to be Stored on the Racks]

- Audio Testing Set

  Measuring equipment to monitor various electrical characteristics (signal-to-noise ratio, distortion rate, frequency characteristics, etc.) and readjust, if necessary, various devices for smooth operation and maintenance of the MW transmitters, PIE and other devices.

- Variable Resistance Attenuator

  Connected to the output of the audio testing set, a variable resistance attenuator is used to adjust appropriately the level of audio signals to put in the MW transmitters and PIEs.

- Oscilloscope

  °CMeasuring equipment to confirm the modulation degrees of the MW transmitters and PIEs, the wave patterns of high-frequency outputs, etc.

- Frequency Counter

  Equipment to measure the frequencies of carrier waves of the MW transmitters, satellite program receivers, etc. It is necessary to check frequencies regularly because substantial discrepancy of the frequencies of carrier waves from the transmitters may interfere with broadcasting from other transmitters and in neighboring countries.

- Audio Jack Panel

  Jack panels make it easier to conduct maintenance and operational work, such as monitoring the input/output levels of the above-mentioned devices and measuring various properties, by connecting satellite receivers, audio processors and other audio output devices, and the monitoring outputs of the transmitters through the panels.
- High-Frequency Patch Panel

  By connecting this device via coaxial cables to a number of high-frequency points which are set in advance to confirm the operational situation of the transmitters, the properties of the frequencies in individual points can be measured and monitored by oscilloscopes or other devices.
- Circuit Breaker Panel

  Panels to distribute power through a circuit breaker to the main device and monitoring devices. The panels are able to prevent combustion loss of the devices even if the power source has short circuited out at the load side and excessive current flowed.
- 19-inch Storage Rack

  Racks with 19 inches in width made of steel or aluminum for storage of the equipment listed above.

[Portable Measuring Equipment]

- Multi-Meter

  To be used to gauge power voltage, current, resistance value, etc.
- Clamp Meter

  To be used mainly to confirm the conditions of incoming commercial power. Since it is able to gauge line voltage and current simply by clamping power cables, it makes it possible to confirm the situation of power sources even while equipment is in use.
- Electromagnetic Field intensity Detector

  Equipment to gauge the strength of unnecessary electromagnetic wave radiated from the transmitters, and the electromagnetic field intensity in the service area.

b) Maintenance Tools

The minimum kinds of tools necessary for maintenance and operation of the MW transmitters, such as soldering irons, screwdrivers, long-nose pliers, spanners, etc. will be provided.

c) Spare Parts

The components of a solid-state MW transmitter are "unitized" into several parts, such as the exciter unit; the power amplifier unit; and stabilized power unit, and the inside of each unit takes the form of a printed board. Thus, if a transmitter breaks down for some reasons, the transmitter will be repaired by replacing either a unit or a printed board with new one. Spare power amplifier unit and power units, and printed boards for stabilization of the automatic voltage adjustment device will be provided. As stated above, since no backup transmitters will be provided in this project, the number of those units and printed boards will be determined so as to be sufficient enough not to cause any trouble in the operation for at least one year after the delivery of equipment.

[Spare parts for the MW Transmitting System Equipment]

- Power Amplifier

  A group of power amplifier produces a specified output power of the MW transmitters and is an important device because the breakdown of the power amplifier unit will lower the output level of the transmitters, resulting in a reduction in the service area.
- Stabilized Power for Exciter

  Stabilized power sources to be provided to the high-frequency drivers and the unit of analog/digital converters. The breakdown of this part will result in the failure to supply driving power to the group of power amplifier, thus shutdown of broadcasting services.
- Surge Absorber

  Equipment to absorb lightning surges coming in from the power lines of the 50kW MW transmitters to prevent them from breaking down.
- Air Filter

  Air filters will be used to take in air for the MW transmitters and air-conditioners, and need to be inspected, washed by water, and replaced with new ones on a regular basis, so as to avoid being clogged.
- LNB (Low-Noise Booster)

  This is a frequency converter/amplifier to be used for the satellite receivers. It is vulnerable to lightning surges, and if it breaks down, the signals from the satellite cannot be received.

[Spare Parts for the Electric Power Unit]

- Printed Board for Automatic Voltage Regulators (for AVR)
  The printed boards are for voltage regulators, the heart of a 145kVA automatic voltage regulators which will be provided to prevent the transmitter from being affected by the fluctuation of electric power. If a board is broken, the voltage will become unstable, resulting in the breakdown of all pieces of equipment at the load side.
- Printed Board for Automatic Voltage Regulators (for Emergency Engine Generator)
  Printed boards to be used to keep the voltage of the power generator for emergency use at a certain level
- Surge Absorber for Isolation Transformers
  Surge absorbers for 150kVA isolation transformers
- Surge Absorber for Emergency Engine Generators
  Surge absorbers for 65kVA emergency engine generators to be used for the voltage output interface
- Oil Filter
  Oil filters to be used for the emergency engine generators. Need to be replaced regularly with new ones.
- Fuel Filter
  Fuel filters to be used for the emergency engine generators. Need to be replaced regularly with new ones.

⑤ Materials for Construction Work

These are materials for construction work, including various power cables necessary to install transmitters and to install and construct antenna systems; various signal wires; materials used to install connectors, etc.; special tools, etc. Apart from these, materials for construction work include: indoor coaxial feeders to connect the MW transmitters to 3-port U-link panels, isolation transformers, and dummy loads; ladders for wiring work within the transmitting stations; sunshades for outdoor emergency engine generator; copper sheets to be used as shields within the main and sub ATU huts; and so on. In addition, it is important to earth equipment for the maintenance and operation, so that earth materials of Class A (10Ω or under) and boxes for earth terminals to bring in earth wires will be included in the materials for construction work. Individual work materials to be used are summarized as follows:

- 3-1/8" Indoor Coaxial Feeder

  These are coaxial feeders to connect the output terminal of the 50kW MW transmitters with SW equipment (3-port U-link panels), lightning surge protection device; and dummy loads, and are required to be able to withstand high voltages of 50kW plus 100% modulation with low losses.

- Various Cables and Wires

  These include power cables (for 3-phase and single-phase) to be used to connect transmitting equipment, coaxial cables for signals, 600Ω audio cables, and control cables.

- Installation Materials

  These include materials required to install equipment, such as anchor bolts, various screws, screw nuts, bolts, finishing of cable terminations, etc.; and doors of the station buildings which are to be built and need to secure air-tightness, together with other materials for construction work. Where the main and sub ATU huts to be built next to the MW antenna masts are concerned, the inner surface must be coated with copper sheets so as to protect matching devices from strong field intensity.

- Tools for Installation Work

  The tools to be used will be classified into two groups, that is, those for installation of transmitting devices and for construction of the MW antennas; and also divided into two groups, that is those which are brought in from and back to Japan and those which will be provided to UBC.

- Earth Materials of Class A and Boxes for Earth Terminals

  Earth for transmitting devices and to be buried near the stations will be earth of Class A with the impedance of 10Ω or under. Also boxes for earth terminals to bring the earth into the station buildings will be provided.

- Ladder for Wiring

  Power cables, signal cables, earth cables, control cables and other cables will be wired via ladders which will be hanged from the ceiling. The ladders for wiring will be installed in accordance with a layout plan of the station buildings.

- Sunshade

  While the emergency engine generators will be installed outdoors, sunshades need be placed to protect them from the exposure to direct sunlight for stable operations for a long term.

(3) Studio Equipment

1) Objective Site

- Kampala Broadcasting House: 3 on-air studios (Red, Blue, and Butebo studios) and 3 production studios (Studios D, E and F)

2) Basic Specifications of the Equipment

In consideration of the fact that institutional use of equipment with more or less the same functions and performance as expensive equipment for broadcasting stations are easily available thanks to the progress of digital technology, not just equipment for broadcasting stations but also institutional use of equipment will be taken into account in accordance with the purpose of use in procurement under the project. At the same time, while mainly digital machines will be provided as studio equipment, some analogue machines will be adopted as before for live broadcasting devices in consideration of experience and skills of UBC staff members, and the easiness of analogue machines to handle when devices are broken. As for audio format, the broadcasting stations currently have both monaural and stereo devices, but produce programs in a monaural format. However, since most equipment for monaural signals are no longer manufactured nowadays, the stations will be required to produce programs with stereo equipment, then convert the programs to the monaural signal at the master control room.

3) Approach to the Supply of Equipment

① Equipment for On-Air Studios

a) Audio Mixer

Since the stations produce mainly live broadcasting programs, analogue mixers will be provided, because they are relatively easy to take care of when they are broken, and UBC operators are familiar with them. While the existing audio mixer is 24-channel, those to be provided will be 16-channel in consideration of the number of microphone, audio recorders and players.

b) Audio Recorder and Player

At the existing on-air studios, record players, open-reel tape recorders, cassette tape recorders, and CD players are used as audio recording/playing devices. Programs are recorded on cassette tapes and CDs before transmission. Of these devices, record players, open-reel tape recorders are no longer manufactured, whereas cassette tape recorders, CD recorders/players, MD recorders, semiconductor memory recorders, DVDs, magneto-optic disk

recorders, etc. are currently available. In this project, (i) 1 cassette tape recorder to transmit already made programs, 1 each of CD recorder/player; (ii) 1 MD recorder which is used by private-run broadcasting stations to exchange programs with one another; and (iii) 1 audio recorder which has the functions of station-to-station calls, immediate start-up for emergency broadcasting and the interrupt control operation will be provided.

c) Telephone Hybrid System

1 set of the telephone hybrid system will be provided. This allows the production of radio programs in which listeners can participate through the telephone line, and to retrieve news sources from outside. Since each studio is already equipped with one telephone line, a 1-channel system will be provided.

d) Microphone

1 microphone (for DJ) for live broadcasting from the sub control room and 2 microphones (for talk and music) for live broadcasting from studios will be provided. Dynamic microphones will be procured for the uniform sound quality. Boom stands will be also provided for adjustment of the level of microphones.

e) Announcer Cough Box

1 announcer cough box each will be provided to the sub control room and the studios so as to control unnecessary noises, during live broadcasting, made by announcers and other cast members of news and discussion programs.

f) Graphic Equalizer

Graphic equalizers will be provided so as to equalize the sound quality of source materials brought in from outside to the quality of programs produced by UBC, and to broadcast programs without any discomfort to listeners by adjusting sound quality.

g) Digital Effector

Sound effect devices will be provided so as to digitally process sound materials essential for production of music programs and to create echoes and distorted sounds intentionally and add them to original sound materials.

h) Monitor Speaker

Monitors to confirm broadcasting programs will be provided. Monitoring

speakers will be also provided to the sub control room (for back talk) and the studios (for talk back) for staff meetings between the sub control room and the studios.

i) On-air Lamp

Indicators to show if the program is on air or if the studio is in use, and to restrict access of irrelevant persons will be provided. The display of the lamps will be "ON-AIR/STAND-BY," and lamps will be installed in three places: the entrance to the studio, the sub control room, and studios.

j) Console Table

A console table will be provided to place audio mixers, microphones (for DJ) for live broadcasting, scripts, communication devices within the buildings (intercom) which have been already used and continue to be used, and a device to select programs (source selector) for efficient operations. Since the communication devices and the source selector have been complicatedly connected to various pieces of equipment in other studios, it is difficult to replace them with new devices. Thus, the existing devices will continue to be used, but be placed in a special container on the console table.

k) System Rack

System racks will be provided so as to put in place audio recorders and players, digital effectors and other devices to make it easier for audio engineers to manipulate and maintain those devices.

l) Announcer Table

A table for a maximum of two persons will be provided, on which the microphone stand, cough boxes and scripts for performers will be placed. However, chairs will be procured by the Ugandan side.

m) Uninterruptible Power Supply System (UPS)

In order to continue broadcasting for several minutes after electrical power failure and before the emergency engine generator starts up, an uninterruptible power supply system will be provided. The capacity will be set at 3kVA, which is sufficient to cover the electrical power consumption of the studio equipment to be provided in this project.

n) Peripheral Equipment

As peripheral equipment necessary for the studio system, (i) audio distribution amplifiers (to amplify and distribute programs and various other audio signals); (ii) connector panels (i.e., terminal boards for microphone cables, speaker cables, etc.); and (iii) patch panels and cables will be provided.

o) Materials for Installation Work

Materials and equipment necessary for the installation of the studio equipment will be provided. Those include various cables, signal wires, connectors and other materials.

② Equipment for Production Studios

a） Audio Mixer

Since the studios are mainly not for live broadcasting but for the production of talk shows and music programs, the mixer to be provided will be digital with a various range of functions, such as multi-recording and editing. The number of input units is the same as the existing mixer, 24 channels.

b) Audio Recorder and Player

Similar to the case of the on-air studios, (i) 1 cassette tape recorder to transmit already made programs, 1 each of CD recorder/player; (ii) 1 MD recorder which is used by private-run broadcasting stations to exchange programs with one another; and (iii) 1 semiconductor memory recorder which has the functions of station-to-station calls, immediate-start-up for emergency broadcasting and the interrupt control operation will be provided.

c) Digital Audio Workstation (DAW)

A digital audio workstation (DAW), widely adopted in other countries in Africa, will be procured to enable efficient recording and editing of programs, and to create a library of programs. Where actual devices comprising the DAW are concerned, business-purpose personal computers, digital interfaces, CD-readers/recorders, application software, and other general purpose devices will be adopted for cost minimization. At the same time, the DAW installed in production studios D, E and F will be connected with a LAN for a more efficient base of program production by exchanging programs, materials, etc. among the studios.

d) Telephone Hybrid System

Since production studios are not used for live broadcasting, no telephone hybrid systems will be provided.

e) Microphone

In consideration of the nature of programs which can be made in accordance with the area of the studios, 2 dynamic microphones for talk shows and 3 dynamic microphones for music programs will be provided. Boom stands will be also provided for adjustment of the level of microphones.

f) Announcer Cough Box

1 announcer cough box will be provided for the studios so as to control unnecessary noises, during the production of programs, made by announcers.

g) Graphic Equalizer

Graphic equalizers will be provided so as to equalize the sound quality of source materials brought in from outside to the quality of programs produced by UBC, and to produce programs without any discomfort to listeners by adjusting sound quality.

h) Digital Effector

Sound effect devices will be provided so as to digitally process sound materials essential for production of music programs and to create echoes and distorted sounds intentionally and add them to original sound materials.

i) Monitor Speaker

Monitors to confirm broadcasting programs will be provided. Monitoring speakers will be also provided to the sub control room (for back talk) and the studios (for talk back) for meetings of staff members in the sub control room and the studios.

j) On-air Lamp

Indicators to show the studio is in use and to restrict access of irrelevant persons will be provided. The display of the lamps will be “ON-AIR/STAND-BY” and lamps will be installed in three places: the entrance to the studio, the sub control room, and studios.

k) Console Table

A console table will be provided for efficient operations of the audio mixers.

l) System Rack

System racks will be provided so as to put in place audio recorders and players, digital effectors and other devices to make it easier for audio engineers to manipulate and maintain those devices.

m) Announcer Table

A table for a maximum of three persons will be provided, on which the microphone stand, cough boxes and scripts for performers will be placed. However, chairs will be procured by the Ugandan side.

n) Uninterruptible Power Supply System (UPS)

In order to continue operating DAW and other equipment connected to computers during power outrages, and to avoid the loss of data concerning programs, an uninterruptible power supply system will be provided. The capacity will be set at 3kVA, which is sufficient to cover the electrical power consumption of the equipment to be provided under this project.

o) Peripheral Equipment

As peripheral equipment necessary for the studio system, (i) audio distribution amplifiers (to amplify and distribute programs and various other audio signals); (ii) connector (CN) panels (i.e., terminal boards for microphone cables, speaker cables, etc.); and (iii) patch panels and cables will be provided.

p) Materials for Installation Work

Materials and equipment necessary for the installation of the studio equipment will be provided. Those include various cables, signal wires, connectors and other materials.

③ Equipment for Maintenance

a) Audio Test Set

Audio test sets will be provided to test and maintain the performance of the studio equipment to be procured in this project. Although there was a request for 4 test sets, 1 set each for the on-air studio and the production studio – that is, the total of 2 test sets – will be provided.

b) Maintenance Tools

Maintenance tools will be provided for the maintenance of the studio equipment to be procured in this project. Although there was a request for 3 sets of maintenance tools, 1 set each for the on-air studio and the production studio – that is, the total of 2 sets of maintenance tools – will be provided.

c) Spare Parts

The concept on selection of to spare parts for maintenance equipment will be the same as that for MW transmitters: power supply modules for analog audio mixer, power supply modules for audio distribution amplifier and printed board for audio distribution amplifier will be provided.

As a result of studying the above, all the requested equipment was determined as indispensable for the project. Table 2-4 compares the finalized requested contents and the planned contents; basically there has been no major change, except for including related facilities in the project as part of installation works, with only slight changes made to the specifications and the quantity of some of the equipment.

Table 2-4: Comparison between the Requested Project Contents and Planned Contents

No.	Item	Difference between the requested items and proposed items
Equipment for Mawagga and Kyeriba MW Transmitting Stations		
1	MW transmitting system equipment	No change
2	Power unit	The capacity of the automatic voltage regulator alone was changed. <Requested> 3-phase 415/245V, 50Hz capacity 150kVA <Planned> 3-phase 415/245V, 50Hz capacity 145kVA
3	Air-conditioning and ventilation system	No change
4	Maintenance quipment	No change
5	Installation materials	No change
6	Contents of installation works	<Requested> Exept incidental facilities. <Planned> Including the related facilities of the three buildings, the transmitting station building and the main and sub ATU huts, at each station.
Equipment for Kampala Broadcast House		
1	On-air studio equipment	No change
2	Production studio equipment	No change
3	Maintenance equipment	Audio test set <Requested> 4 units →<Planned> 2 units Maintenance tools <Requested> 3 sets →<Planned> 2 sets

Table 2-5 is a planned equipment list reflecting all pieces of equipment to be procured.

Table 2-5: Planned Equipment List

A. Equipment for Mawagga MW Transmitting Station

No.	Equipment	Q'ty	Remarks
1	MW Transmitting System Equipment		
(1)	50kW MW Transmitter	1 set	Solid state type, RF exciter, main/standby
(2)	50kW Dummy Load	1 set	50Ω
(3)	50kW 3 Port U-Link Panel	1 set	50Ω, 3-1/8 inches
(4)	50kW Lightning Protector	1 set	50Ω
(5)	Program Input & Monitoring Equipment (PIE)		
1)	Audio Processor	2 sets	Main/standby system
2)	Changeover Switcher	1 set	Manual switcher
3)	Audio Jack Panel	1 set	
4)	Monitor Switcher	1 set	
5)	Monitor Amplifier & Speaker	1 set	
6)	Beaker Panel	1 set	
7)	19"Cabinet Rack	1 set	
(6)	50kW MW Directional Antenna System		
1)	Antenna Mast	2 sets	130m, guyed tower, triangle section's mast
2)	ATU	2 sets	For main and sub
3)	Radial Earth	2 sets	For main and sub
4)	3-1/8" Coaxial Cable	1 lot	50Ω,400m
5)	Dehydrator	1 set	
6)	OB Lighting System	2 sets	For main and sub
(7)	Satellite Receiving Equipment		
1)	Receiving Antenna	1 set	Diameter 4.5 m, including LNB and fixing materials
2)	Divider	1 set	
3)	Receiver	2 sets	Main/standby system
4)	Coaxial Cable	1 lot	100m
2	Power Supply Equipment		
(1)	Automatic Voltage Regulator	1 set	3 phase 415V/240V, 50Hz 145kVA
(2)	Isolation Transformer	1 set	3 phase 415V, 50Hz 150kVA
(3)	Emergency Engine Generator		
1)	Outdoor Type Engine Generator	1 set	3 phase 415V/240V, 50Hz 65kVA
2)	Changeover Switch	1 set	
3)	Oil Tank	1 set	1,500 litter
4)	AC Terminal Board	1 set	
3	Air-Conditioning and Ventilation System		
(1)	Air Conditioner	2 sets	
(2)	Duct Fan with Damper	1 lot	For 50kW dummy load
(3)	Ventilation Fan with Damper	1 lot	For emergency cooling
(4)	Temperature Control Panel	1 set	
(5)	Hood	4 sets	
(6)	Louver	1 set	1.5m×2m
(7)	Air Filter with Filter Frame	1 set	1.5m×2m

No.	Equipment	Q'ty	Remarks
4	Maintenance Equipment		
(1)	Measuring Equipment		
1)	Rack Mount Type Measuring Equipment		
a	Audio Test Set	1 set	600 Ω balanced
b	Variable Attenuator	1 set	600 Ω balanced
c	Oscilloscope	1 set	100MHz 2CH
d	Frequency Counter	1 set	3GHz
e	Audio Jack Panel	1 set	
f	RF Patch Panel	1 set	
g	Beaker Panel	1 set	
h	19"Cabinet Rack	1 set	
2)	Portable Measuring Equipment		
a	Multi Meter	1 set	
b	Clamp Meter	1 set	
c	Field Strength Meter	1 set	Including battery, tripod and loop antenna
(2)	Maintenance Tools	1 set	
(3)	Spare Parts		
1)	MW Transmitting System		
a	Power Amplifier (PA) Unit	5 set	For 50kW MW transmitter
b	Power Supply for Exciter	1 set	For 50kW MW transmitter
c	Surge Absorber	12 pcs.	For 50kW MW transmitter
d	Air Filter	1 set	For air-intake, air-conditioners and 50kW MW transmitter
e	LNB (Low Noise Booster)	1 set	For satellite receiving equipment
2)	Power Supply		
a	Printed Board for AVR	1 pc.	
b	Printed Board for Engine Generator	1 pc.	
c	Surge Absorber for Isolation Trans.	3 pcs.	
d	Surge Absorber for Engine generator	1 pc.	
e	Oil Filter fro Engine generator	4 pcs.	
f	Fuel Filter for Engine Generator	2 pcs.	
5	Installation Materials		
(1)	3-1/8"Indoor Coaxial Feeder	1 lot	
(2)	Wiring Cables	1 lot	
(3)	Installation Materials	1 lot	
(4)	Installation Tools for TX and Antenna	1 lot	
(5)	Class A Earthing Set & Terminal Box	1 lot	
(6)	Wiring Ladder	1 lot	
(7)	Sunshade	1 lot	For engine generator

B. Equipment for Kyeriba Transmitting Station

	Equipment	Q'ty	Remarks
1	MW Transmitting System		
(1)	50kW MW Transmitter	1 set	Solid state type, RF exciter, main/standby
(2)	50kW Dummy Load	1 set	50Ω
(3)	50kW 3 Port U-Link Panel	1 set	50Ω, 3-1/8 inches
(4)	50kW Lightning Protector	1 set	50Ω
(5)	Program Input and Monitoring Equipment (PIE)		
1)	Audio Processor	2 sets	Main/standby system
2)	Changeover Switcher	1 set	Manual switcher
3)	Audio Jack Panel	1 set	
4)	Monitor Switcher	1 set	
5)	Monitor Amplifier & Speaker	1 set	
6)	Breaker Panel	1 set	
7)	19"Cabinet Rack	1 set	
(6)	50kW MW Directional Antenna System		
1)	Antenna Mast	2 sets	75m, guyed tower, triangle section's mast
2)	ATU	2 sets	For main and sub
3)	Radial Earth	2 sets	For main and sub
4)	3-1/8" Coaxial Cable	1 lot	50Ω, 400m
5)	Dehydrator	1 set	
6)	OB Lighting System	2 sets	For main and sub
(7)	Satellite Receiving Equipment		
1)	Receiving Antenna	1 set	Diameter 4.5 m, including LNB and fixing materials
2)	Divider	1 set	
3)	Receiver	2 sets	Main/standby system
4)	Coaxial Cable	1 lot	100m
2	Power Supply Equipment		
(1)	Automatic Voltage Regulator	1 set	3 phase 415V/240V, 50Hz 145kVA
(2)	Isolation Transformer	1 set	3 phase 415V, 50Hz 150kVA
(3)	Engine Generator Set		
1)	Outdoor Type Engine Generator	1 set	3 phase 415V/240V, 50Hz 65kVA
2)	Changeover Switch	1 set	
3)	Oil Tank	1 set	1,500 litter
4)	AC Terminal Board	1 set	
3	Air-Conditioning and Ventilation System		
(1)	Air Conditioner	2 sets	
(2)	Duct Fan with Damper	1 lot	For 50kW dummy load
(3)	Ventilation Fan with Damper	1 lot	For emergency cooling
(4)	Temperature Control Panel	1 set	
(5)	Hood	4 sets	
(6)	Louver	1 set	1.5m×2m
(7)	Air Filter with Filter Frame	1 set	1.5m×2m

	Equipment	Q'ty	Remarks
4	Maintenance Equipment		
(1)	Measuring Equipment		
1)	Rack Mount Type Measuring Equipment		
a	Audio Test Set	1 set	600 Ω balanced
b	Variable Attenuator	1 set	600 Ω balanced
c	Oscilloscope	1 set	100MHz 2CH
d	Frequency Counter	1 set	3GHz
e	Audio Jack Panel	1 set	
f	RF Patch Panel	1 set	
g	Beaker Panel	1 set	
h	19"Cabinet Rack	1 set	
2)	Portable Measuring Equipment		
a	Multi Meter	1 set	
b	Clamp Meter	1 set	
c	Field Strength Meter	1 set	Including battery, tripod and loop antenna
(2)	Maintenance Tools	1 set	
(3)	Spare Parts		
1)	MW Transmitting System		
a	Power Amplifier (PA) Unit	5 set	For 50kW MW transmitter
b	Power Supply for Exciter	1 set	For 50kW MW transmitter
c	Surge Absorber	12 pcs.	For 50kW MW transmitter
d	Air Filter	1 set	For air-intake, air-conditioners and 50kW MW transmitter
e	LNB (Low Noise Booster)	1 set	For satellite receiving equipment
2)	Power Supply		
a	Printed Board for AVR	1 pc.	
b	Printed Board for Engine Generator	1 pc.	
c	Surge Absorber for Isolation Trans.	3 pcs.	
d	Surge Absorber for Engine generator	1 pc.	
e	Oil Filter fro Engine generator	4 pcs.	
f	Fuel Filter for Engine Generator	2 pcs.	
5	Installation Materials		
(1)	3-1/8" Indoor Coaxial Feeder	1 lot	
(2)	Wiring Cables	1 lot	
(3)	Installation Materials	1 lot	
(4)	Installation Tools for TX and Antenna	1 lot	
(5)	Class A Earthing Set & Terminal Box	1 lot	
(6)	Wiring Ladder	1 lot	
(7)	Sunshade	1 lot	For Engine Generator

C. Studio Equipment for Kampala Broadcast House

No.	Equipment	Q'ty	Remarks
1	On Air Studio for Red, Blue, Butebo Channel		
(1)	Audio Mixer	3 set	Analog 16CH
(2)	Audio Recorder and Player		
1)	CD Recorder/Player	3 sets each	
2)	MD Recorder	3 sets	
3)	Audio Cassette Tape Recorder	3 sets	
4)	Audio Recorder	3 sets	
(3)	Telephone Hybrid	3 sets	
(4)	Microphone	3 lots	With boom stand, for studios and sub-control rooms
(5)	Announcer Cough Box	3 lots	Including controller
(6)	Graphic Equalizer	3 sets	
(7)	Digital Effecter	3 sets	
(8)	Monitor Speaker	3 lots	For studios and sub-control rooms
(9)	On Air lamp	3 lots	Indication=ON-AIR/STANDBY, for studios and sub-control rooms
(10)	Console Table	3 lots	For audio mixer
(11)	System Rack	3 lots	For audio equipment
(12)	Announcer Table	3 lots	
(13)	UPS	3 sets	3kVA
(14)	Others		
1)	Audio Distribution Amplifier	3 sets	
2)	Stereo Headphone	15 pcs.	
3)	Patch panel	3 lots	Including cables
4)	Installation Materials	3 lots	
2	Production Studio (D, E, F)		
(1)	Audio Mixer	3 set	Digital 24CH
(2)	Audio Recorder and Player		
1)	CD Recorder/Player	3 sets each	
2)	MD Recorder	3 sets	
3)	Audio Cassette Tape Recorder	3 sets	
4)	Audio Recorder	3 sets	
(3)	Digital Audio Workstation	3 sets	Including LAN interface
(4)	Microphone	3 lots	With boom stand
(5)	Announcer Cough Box	3 lots	Including controller
(6)	Graphic Equalizer	3 sets	
(7)	Digital Effecter	3 sets	
(8)	Monitor Speaker	3 lots	For studios and sub-control rooms
(9)	On Air lamp	3 lots	Indication=ON-AIR/STANDBY
(10)	Console Table	3 lots	For audio mixer
(11)	System Rack	3 lots	For audio equipment
(12)	Announcer Table	3 lots	
(13)	UPS	3 sets	3kVA
(14)	Others		
1)	Audio Distribution Amplifier	3 sets	
2)	Stereo Headphone	15 pcs.	
3)	Patch panel	3 lots	Including cables
4)	Installation Materials	3 lots	
3	Maintenance Equipment		
(1)	Audio Test Set	2 sets	
(2)	Maintenance Tool	2 lots	
(3)	Spare Parts		
1)	Poser Supply Modules for Analog Audio Mixer	2 pcs.	
2)	Poser Supply Modules for Audio Distribution Amplifier	2 pcs.	
3)	Printed Boards for Audio Distribution Amplifier	2 pcs.	

2-2-2-4 Related Facilities

As a facility plan, this section gives main points of the basic plan concerning the transmitting station buildings, and main and sub ATU huts at the Mawagga and Kabale MW Transmitting Stations. Transmitting station buildings are designed to have materials for MW transmitters and peripheral equipment to be procured in this project. For the main and sub ATU huts, on the other hand, the impedance of coaxial cables and the antennas are matched. At the same time, antenna matching devices will be installed in the huts so as to obtain appropriate directional characteristics. Both the buildings and the huts will be essential facilities for this project.

(1) Site Layout Plan

1) Mawagga MW Transmitting Station

The transmitting station building will be built on an open area almost at the midpoint between the existing transmitting station building located in the north-west at the premises and the dormitory for staff members. More precisely, the open area is located approximately 200m north of the construction site of the main antenna mast to be newly built (See Fig. 2-3 Basic Design Drawing). The site is close to an approach leading to the north-west part of the premises and a power line for commercial use nearby, so that it has a great advantage as a construction site.

The main and sub ATU huts will be constructed right under the main and sub antenna masts which will be constructed more or less at the highest point located at the center of the premises.

* Note: If an ATU hut is constructed far from an antenna mast, "fading" (a phenomenon where the level of sounds vary unstably) occurs because the electrical wave radiated straight up from a lead wire connecting the hut and the base of the antenna, and the wave radiated from the antenna are synthesized. Moreover, electrical waves horizontally radiated from the lead wire have a negative impact on antennas, resulting in the shrinkage of service areas compared to the case where antennas are built in a normal manner.

2) Kyeriba MW Transmitting Station

Although the land around the existing transmitting station building is relatively flat, the difference of elevation between the land and the place where the existing antenna masts are built – some 200m south-east by horizontal measurement from the station building – is 20m or so, thus it is not appropriate to make use of the slope for the construction of the

transmitting stations. Thus, a flat open space approximately 20m east of the existing transmitting station building will be used for the construction of the new transmitting station building (see Fig. 2-4 Basic Design Drawing). The flat open space, as in the case of the Mawagga Station, is close to the approach leading to the north-west part of the premises and the power line for commercial use nearby, so that it has a great advantage as a construction site.

The main and sub ATU huts will be constructed right under the antenna masts to be built on the hillside.

(2) Architectural Plan

1) Floor Plan

The floor spaces for the transmitting station building, and the main and sub ATU huts will be minimum necessary for the operation and maintenance of devices to be installed in those structures, and any redundant spaces will be avoided. The functions of individual rooms of the architectural structures and the grounds for the calculated floor spaces are shown in Table 2-6. The dimensions of the facilities are the same in the Mawagga and Kyeriba Stations.

Table 2-6: Functions of Individual Rooms of the Transmitting Stations, and Grounds for Calculated Floor Spaces

Room name	Functions	Planned area (m^2)	Grounds for calculations
Transmitting Station Building			
Transmitter Room	To keep transmitting devices	56.0	Depends on the layout of equipment
Dummy Load Room	To keep dummy loads	22.0	Depends on equipment size
Maintenance Staff Room	To maintain and monitor transmitting devices	16.0	To accommodate 3 staffs at maximum. Approx. 5 m^2 per head.
Equipment Storage	To store materials, tools, etc.	12.0	50% or so of existing similar facilities from viewpoint of the facility size
Air-chamber	To remove dusts while air is ventilated	6.0	Minimum space required for work to remove sand and dusts
Total floor area of transmitting station building		112.0	
Main ATU Hut			
ATU Room	To keep antenna matching device	25.0	Depends on equipment size
Sub ATU Hut			
ATU Room	To keep antenna matching device	16.0	Depends on equipment size

2) Section Plan

① Transmitting Station Building

The transmitting station building will be equipped, in addition to MW transmitters, with an air-conditioning system at the expense of the Japanese side. In order to improve the efficiency of the air-conditioning system, and in consideration of the fact that devices related to the transmitters are susceptible to dusts, the transmitting station building should be sealed as closely as possible. Accordingly, the roof of the building will be covered with concrete slab.

As part of equipment installation work, anchor bolts will be directly planted in the slab ceiling of the transmitting machine room and dummy load rooms after the construction work of the building is completed. Then, cable ladders for the connection of power source and signals will be installed on top of the devices. Because of the necessity for the above-mentioned work to be done after the construction work, and because of no need to place an emphasis on comfort of the building in that it is not a residence building, any part of the ceiling of the buildings will not be covered by boards.

The concrete slab on the ceiling will require full-scale water proof and other treatment if it is flat roofs. In addition, it is not economically efficient to adopt upper roofs by setting a truss roof on the slab roof. In light of this, ridge roofs will be adopted so that the gradients are placed directly on the concrete slab. The height of the ceiling will be 3.5m at lowest in light of the heights of the transmitters and the cable ladders, and the space necessary for maintenance work.

② Main and Sub ATU Huts

As in the case of the transmitting station building, ridge roofs will be placed on concrete slab. In relation to the height of feeder connection to the antenna, the height of the ceiling of the huts will be 4.0m at the lowest point.

3) Structure Plan (applied to all buildings)

① Standard and Design Criteria

Currently in Uganda, there are no clear standards for structure calculations, decisions on safety measures concerning structures of facilities being left to individual architects. Thus, as methods of inspecting safety of architectural structures, this project will adopt the building codes in Japan, notifications of the Land, Infrastructure and Transportation Ministry, guidelines of the Architectural Institute of Japan, or else. However, where design loads and external forces requiring to take

into account the regional characteristics of Uganda are concerned, the Uniform Building Code of the U.S.A. which is regarded as an international design standards, and design loads and external forces in a neighboring country, Tanzania, together with design methods currently normally adopted in Japan, will be comprehensively referred to.

② Foundation Plan

Geological surveys have found that the ground harder than the surface has emerged at the premises of the Mawagga MW Transmitting Station, and that a fairly solid bearing ground with the soil bearing capacity of 680 kN/$m^2$is distributed uniformly at 1m in depth in the premises. At the premises of the Kyeriba MW Transmitting Station, on the other hand, the surveys have found that a layer with the soil bearing capacity of 50 – 90 kN/m^2 is distributed uniformly at 1m in depth, and a layer with the soil bearing capacity of 105 – 180 kN/m^2 at 3m in depth. In light of these survey results on one hand, and, on the other, dimensions of the foundation to be determined based on engineering judgments, cost, work schedule, safety measures and other factors, the depth of earth excavation for the construction of the Mawagga and Kyeriba MW Stations will be set at 1m or so. As for the soil bearing capacities, as recommended by boring companies, 600 kN/m^2 (Mawagga) and 50 kNm^2/ (Kyeriba) will be adopted for appropriate designs of the foundations.

③ Framing Plan

Where the structure of the facility buildings is concerned, reinforced-concrete structured one-storied building with moment frames will be adopted. As for the external walls, the single-layer brick construction (the long side of bricks will become the thickness of the walls) will be adopted in light of the cost, air-tightness, security and various other factors.

④ The Setting of Design Loads and External Force

The design loads and external force concerning the facilities will be set with reference to the design approach which is currently used widely in Japan, and the Uniform Building Code of the U.S.A., international design standards, for the wind load, and calculated values in a neighboring country, Tanzania, for the earthquake load.

a) Live Load

The concrete slab on grade will be adopted for the floor of the facility buildings. Since the weight of the slab itself and the weights of articles and persons above will directly reach the ground in this method, the live load does not become an issue in general. As for the live load on the roof, there is no plan to place any articles, though workmen may walk on it during the maintenance work. Thus, the live load of the room will be set at 1.0kN/m^2 as a design condition.

b) Seismic Load

Although there are some records of earthquakes having occurred in Uganda, neither data concerning magnitudes nor earthquake resistant design codes is available. Thus, based on the regional coefficient of Uganda cited in the 1997 Uniform Building Code of the U.S.A., the design shearing force will be set at 0.15.

c) Wind Load

There is no sufficient data concerning wind velocity in Uganda. The data available are records of wind gusts observed in the last 50 years by the Kampala Weather Bureau only, which say that there have been 1 wind gust of 30m/sec, 3 gusts of 25m/sec, 10 gusts of 20m/sec, 72 gusts of 15m/sec, and 285 gusts of 10m/sec. At the same time, requirements concerning wind loads for existing architectural structures at each project site cannot be confirmed because of the absence of the document at the time those were built. Thus, for the design wind velocity of the facility buildings, a wind velocity of 45m/sec (v=162km/h) which is the wind velocity at 10m above the ground in strong wind regions in a neighboring country, Tanzania, and is cited in the "Building Research Unit technical Guideline No.2" will be adopted as a design condition. This wind velocity will be adopted also for the structural calculation of MW antenna masts.

4) Building Equipment Plan

① Transmitting Station Building

As ancillary equipment, only electrical facilities such as lightings, power outlets and switches will be provided. A summary of the ancillary equipment is shown in Fig. 2-20 of the Basic Design Drawing. The engineering work concerning the power supply facilities including the air-conditioning and ventilation system and the emergency engine generator will be conducted as part of engineering work to install

equipment after the architectural structures have been constructed. The sanitary equipment such as water supply facilities and toilets will be excluded from the fixture plan, and, instead, the dormitory for staff members located within the premises will be taken advantage of.

② Main and Sub ATU Huts

Engineering work of electrical facilities as a whole – from the power supply units to lightings and ventilating fans – will be conducted as part of installation work of equipment after the huts have been constructed: no particular engineering work will be required.

5) Building Materials Plan

All construction materials to be used for the facilities will be locally manufactured products or import ones which can be procured locally. The major exterior and interior finish is summarized below:

① Transmitting Station Building

[Exterior]

- Roof: setting bed + asphalt roofing + roofing tiles
- Exterior walls: single-layer brick + mortar + synthetic-resin emulsion paint
- Outer side of doors: Steel airtight door (*)

  * Note: Since the steel airtight door is a specially customized product, its material will be provided as part of materials for equipment installation work.

[Interior: the case of the transmitter room]

- Floor: concrete with metal trowel finish + vinyl tiles
- Baseboards: (ready-made) vinyl boards
- Ceiling: concrete architectural
- Walls: Mortar trowel finish + synthetic-resin emulsion paint
- Inner side of doors: Wooden

② Main and Sub ATU Huts

[Exterior]

the same as the transmitting station buildings

[Interior]

- Floor: concrete with metal trowel finish + copper sheets (*)
- Baseboards: N.A.

- Ceiling: concrete architectural + copper sheets (*)
- Walls: concrete architectural + copper sheets (*)
- Door Steel airtight door (*)

  * Note: All the inner walls and ceilings will be covered with copper sheets as part of equipment installation work after the buildings have been constructed. And since the steel airtight door is a specially customized product, its material will be provided as part of materials for equipment installation work.