NO.

BASIC DESIGN STUDY REPORT

ON

THE PROJECT
FOR
IMPROVEMENT OF
THE METEOROLOGICAL RADAR SYSTEMS
AT COX'S BAZAR AND KHEPUPARA
IN
THE PEOPLE'S REPUBLIC OF BANGLADESH

MAY, 2005

JAPAN INTERNATIONAL COOPERATION AGENCY
JAPAN WEATHER ASSOCIATION

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PREFACE

In response to a request from the Government of the People's Republic of Bangladesh, the Government of Japan decided to conduct a basic design study on the Project for Improvement of the Meteorological Radar Systems at Cox's Bazar and Khepupara in the People's Republic of Bangladesh and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent to Bangladesh a study team from December 1, 2004 to January 5, 2005.

The team held discussions with the officials concerned of the Government of Bangladesh, 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 Bangladesh 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 People's Republic of Bangladesh for their close cooperation extended to the teams.

May, 2005

Seiji KOJIMA
Vice-President
Japan International Cooperation Agency

May, 2005

Letter of Transmittal

We are pleased to submit to you the basic design study report on the Project for Improvement of the Meteorological Radar Systems at Cox's Bazar and Khepupara in the People's Republic of Bangladesh.

This study was conducted by Japan Weather Association under a contract to JICA, during the period from November, 2004 to May, 2005. In conducting the study, we have examined the feasibility and rationale of the project with due consideration to the present situation of Bangladesh and formulated the most appropriate basic design for the project under Japan's grant aid scheme.

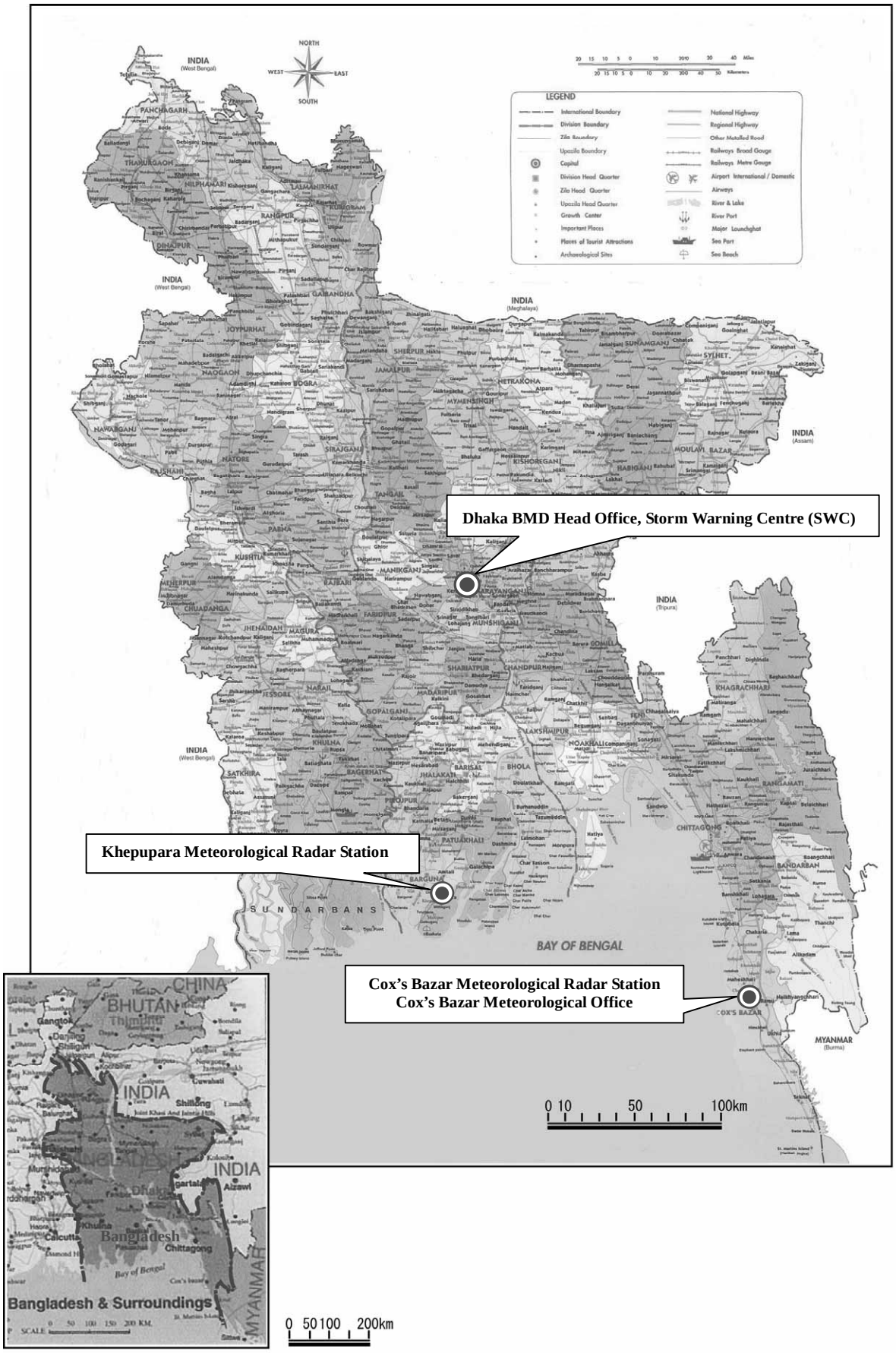
Finally, we hope that this report will contribute to further promotion of the project.

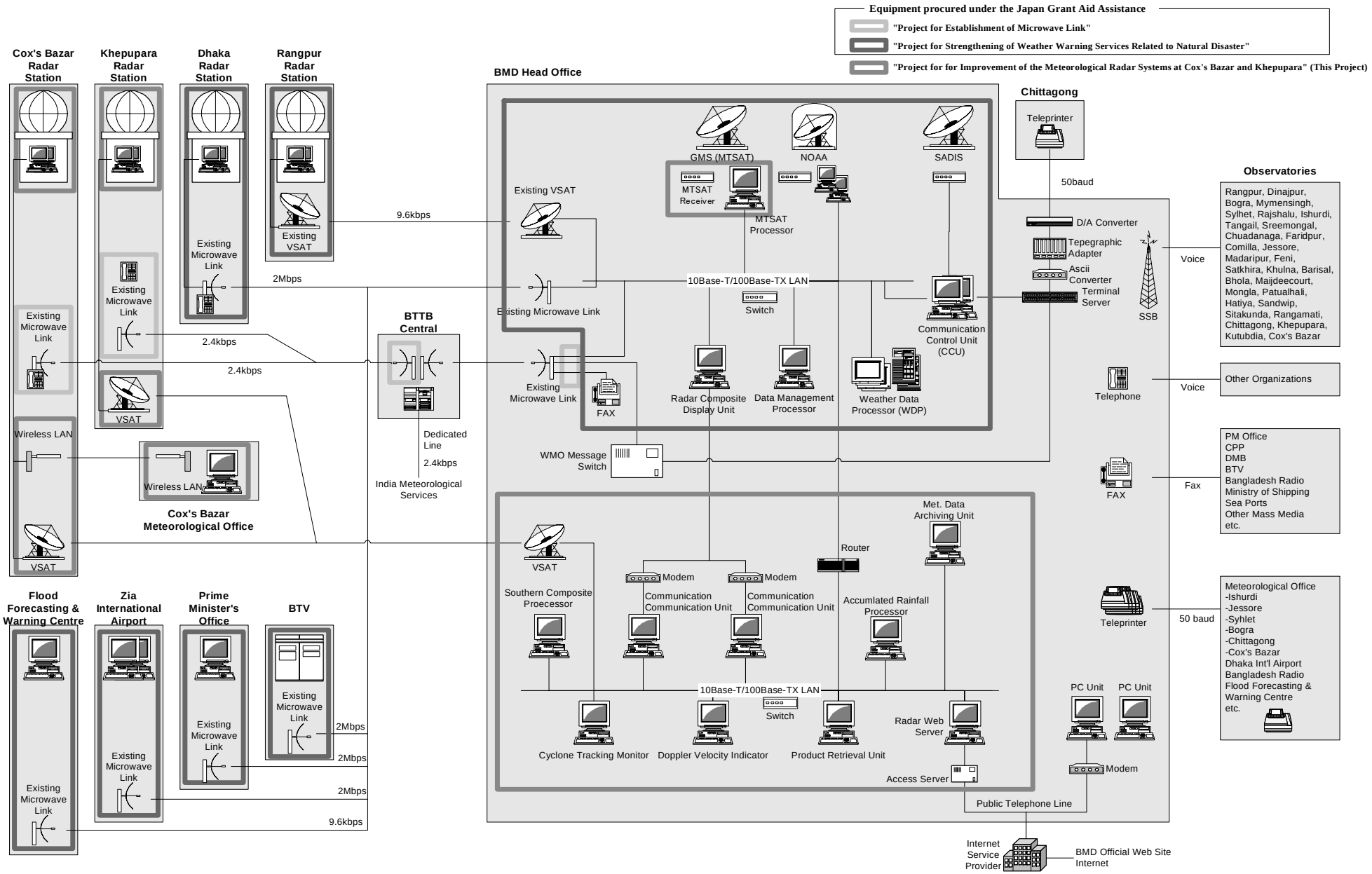
Very truly yours,

Yoshihisa UCHIDA
Project Manager
Basic design study team on
the Project for Improvement of the Meteorological
Radar Systems at Cox's Bazar and Khepupara
in the People's Republic of Bangladesh

Japan Weather Association

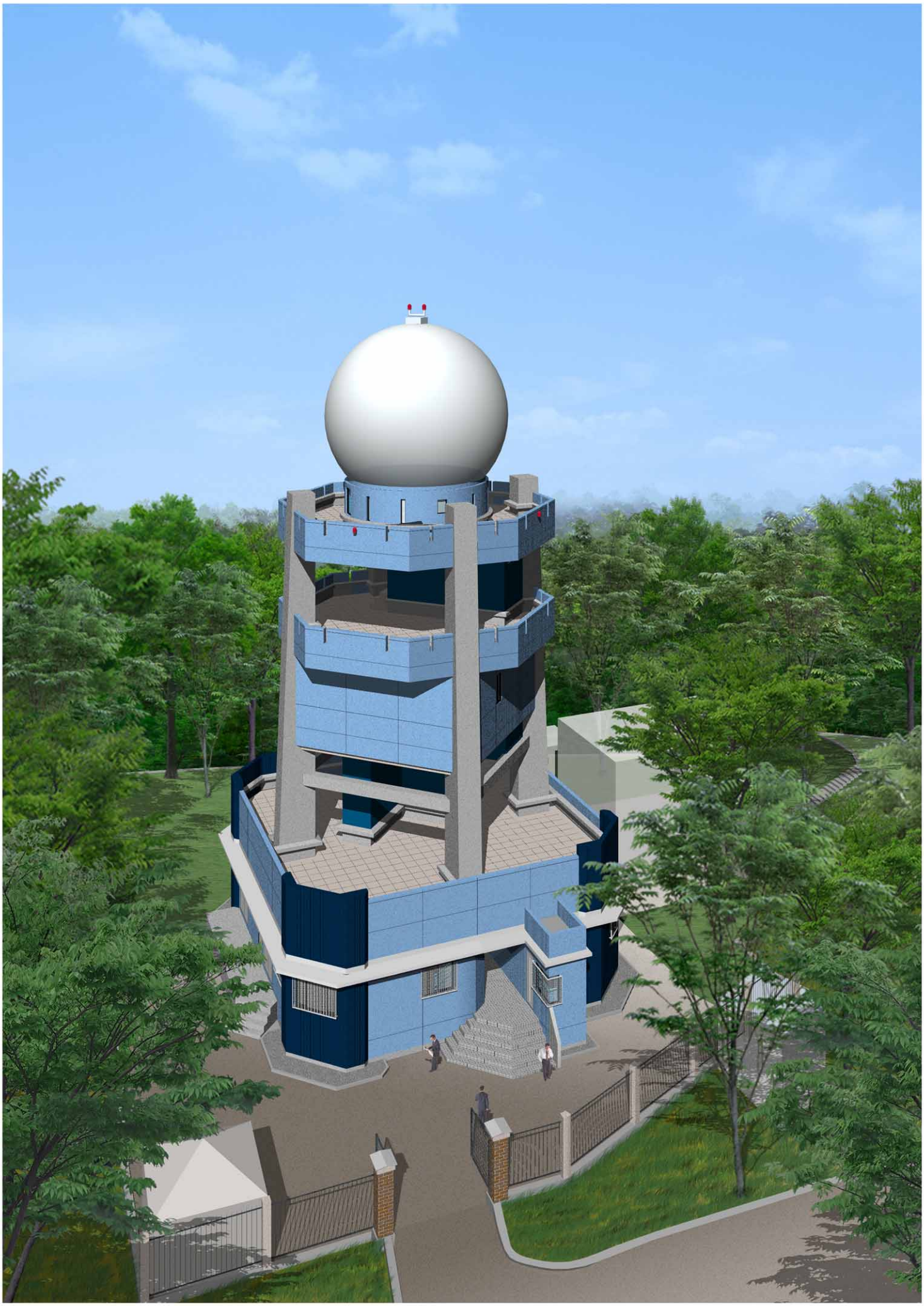
■ Bangladesh


Dhaka BMD Head Office, Storm Warning Centre (SWC)
Khepupara Meteorological Radar Station
Cox's Bazar Meteorological Radar Station
Cox's Bazar Meteorological Office
BAY OF BENGAL
SUNDARBANS
INDIA
MYANMAR
0 10 50 100km
Bangladesh & Surroundings
0 50 100 200km



Conceptual Diagram of the Communication Network of BMD

NOTE: This diagram shall be used only for understanding the conceptualcommunication network of BMD.
The computers and peripherals would be inaccurate compared to the "Schematic Diagram for the Project".



Cox's Bazar Meteorological Radar Tower Building

Khepupara Meteorological Radar Tower Building

List of Figures

List of Tables

Summary

Chapter 2 Contents of the Project

Chapter 3 Project Evaluation and Recommendations

ABBREVIATIONS

WMO:	World Meteorological Organization
ASEAN:	Association of Southeast Asian Nations
JICA:	Japan International Cooperation Agency
MTSAT:	Japanese Multi-functional Transport Satellite
GMS:	Japanese Geostationary Meteorological Satellite)
GOES:	American Geostationary Meteorological Satellite
VSAT:	Very Small Aperture Terminal
IEEE:	Institute of Electrical and Electronic Engineers
ITU:	International Telecommunication Union
PBX:	Private Branch Exchange
BMD:	Bangladesh Meteorological Department
SWC:	Storm Warning Centre
DMB:	Disaster Management Bureau
CPP:	Cyclone Preparedness Programme
BTRC:	Bangladesh Telecommunication Regulatory Commission
CPTU:	Central Procurement Technical Unit
DPI:	Department of Procurement and Inspection
TYRIP:	Three Years Rolling Investment Programme

Summary

Summary

Bangladesh is particularly affected by tropical cyclones and the associated storm surges. Tropical cyclones are the extreme manifestations of nature that lead to immense distress and deprivation for several hundred thousand of people, especially in the low-lying coastal area and off-shore islands.

The existing Cox's Bazar and Khepupara radar systems were replaced in 1988 under Japan's Grant Aid Assistance with two S-band weather radars. These two radar systems are located at the most strategic places for monitoring tropical cyclones on the coastal belt. These radar systems are now more than 16 years old. Because of the age of the radar systems, frequent repairs were required. During the last year (2004), both of the radar systems failed and it has not been possible to repair them, thus radar observations have stopped. Therefore, currently Bangladesh Meteorological Department (BMD) is not able to monitor the weather and can not locate cyclone centers or intensities of the frequent cyclones in the Bay of Bengal.

Because of this situation and as per the request of BMD to the Ministry of Defence and then to the Ministry of Planning, the Project was included in the "Three Years Rolling Investment Programme (TYRIP) 2004-2006" by the Ministry of Planning, as a project requiring urgent implementation. In addition, BMD included the Project in its 5 Year Strategic Plan, 2004-2009, which was approved and submitted to the Ministry of Planning by the Ministry of Defence.

BMD is the sole national meteorological service provider in Bangladesh and is under the supervision of the Ministry of Defence. Its main responsibility as a National Meteorological Service is to record meteorological observations around the clock and to provide weather information, forecasts, advisories and warnings necessary for the mitigation and prevention of meteorological disasters and improvement of socio-economic conditions.

Due to the present situation, BMD faces the following issues.

[1] The existing Cox's Bazar and Khepupara radar systems are no longer able to be repaired, therefore observations have stopped. As a consequence, BMD is not able to monitor the weather and can not locate cyclone centers or intensities of the frequent cyclones in the Bay of Bengal. The Cox's Bazar and Khepupara Meteorological Radar Stations can not transmit the required weather information to the Storm Warning Centre (SWC) in Dhaka as an input for the preparation of advisories and warnings for cyclone and other extreme events.

[2] The existing radar tower buildings at the Cox's Bazar and Khepupara Meteorological Radar Stations have deteriorated structurally and use of those buildings is now quite dangerous.

[3] Since GMS-5 had stopped functioning and the backup service is being provided by GOES-9, BMD has been unable to receive satellite data because the existing meteorological satellite data receiving system (GMS) supplied to BMD under the previous project financed by Japan's Grant Aid Assistance is not able to receive GOES-9. As a result, BMD can not monitor the development of remote cyclones at an early stage in the Bay of Bengal and Indian Ocean.

[4] There is no communications system to transmit meteorological radar data from the proposed Cox's Bazar and Khepupara Meteorological Radar Systems to the SWC.

[5] There is no system at Cox's Bazar Meteorological Office to receive the meteorological radar data which will be produced observed by the proposed Cox's Bazar Meteorological Radar System for the preparation of forecasts for the Cox's Bazar District, Cox's Bazar Airport, and for fisheries. At present, Cox's Bazar Meteorological Office can not issue timely warnings.

[6] Bangladesh is particularly affected by cyclonic storms and the associated storm surges. Tropical cyclones are the extreme manifestations of nature that lead to immense distress and deprivation for hundreds of thousand of people, especially in the low-lying coastal area and off-shore islands. BMD has presently no system to monitor cyclonic storms; therefore BMD can not provide information and warnings on cyclonic storms to the public or to disaster management agencies.

In order to protect life and property from cyclone damage, it is essential to rectify the current situation as soon as possible and establish the continuous and timely dissemination of cyclone forecasts and warnings to the public and disaster management agencies.

Because of financial problems, the Government of Bangladesh has requested the Government of Japan to replace the existing Cox's Bazar and Khepupara radar systems and to construct new radar tower buildings, etc. using Japan's Grant Aid Assistance.

In response to the request from the Government of Bangladesh, the Government of Japan decided to conduct a Basic Design Study for the Project and consequently the Japan International Cooperation Agency (JICA) sent the Basic Design Study Team to Bangladesh

from December 1, 2004 to January 5, 2005. The team had a series of discussions with Government of Bangladesh officials, conducted surveys and collected necessary information and data for the Project.

After returning to Japan, the team conducted further studies, including a feasibility study, justification study and scoping study for the Project, paying particular attention to the present situation in Bangladesh, including the operation and maintenance capabilities of BMD. From these studies, the team formulated the draft basic design for the Project. JICA then sent the team to Bangladesh again, from March 22 to March 30, 2005, in order to discuss the draft basic design study report, and following this, the basic design for the Project was finalized.

The finalized components in the basic design for the Project are as follows.

Table 1: Finalized Components for the Project

	Cox's Bazar Meteorological Radar Observation Station	**Cox's Bazar Meteorological Office**	**Storm Warning Centre, Dhaka**	**Khepupara Meteorological Radar Observation Station**
Equipment Procurement and Installation				
Meteorological Radar System	1			1
Meteorological Radar Data Display System	1	1	1	1
Meteorological Data Communication System	1	1	1	1
Meteorological Data Satellite Communication System	1		1	1
Meteorological Satellite Data Receiving System			1	
Facility Construction				
Radar Tower Building	1			1

The required implementation period of the Project, including the detailed design study and the tendering procedures, is approximately 32 months. The total project cost, as estimated in the basic design study, is 1,689 million JP Yen (grant aid: 1,682 million JP Yen, capital cost for the Project to be borne by BMD: approx. 4,326,500 Taka (7.9 million JP Yen)).

After completion of the Project, the following benefits and improvements can be expected.

[1] BMD will have the ability to provide near real time (within 15 minutes of observation time) cyclone information and warnings to the Prime Minister's Office, the Disaster Management Bureau (DMB), the Cyclone Preparedness Programme (CPP) and mass media, to enable those organizations to perform their roles more effectively in disaster management for Bangladesh, especially in relation to the quick evacuation of residents and in disaster prevention countermeasures.

[2] BMD will be able to perform its normal routine observations, and perform special

observations during cyclone events, for the effective monitoring of weather phenomena and cyclones.

[3] BMD will be able to monitor cyclones in the Bay of Bengal and Indian Ocean at an early stage, using a combination of meteorological satellite data and radar data from the new satellite and meteorological radar systems.

[4] BMD will receive all meteorological radar data at the SWC for quick and timely preparation of accurate advisories and warnings to the public and disaster management agencies since the radar operation availability will be enhanced from approximately 2000 to 4000 hours/year to monitor weather conditions by the meteorological radar systems around the clock during the passage of a cyclone and the monsoon season.

[5] BMD will be able to prepare forecasts for the Cox's Bazar District; improve the accuracy of the meteorological information for the Cox's Bazar Airport, fishing trawlers and small boats; and issue prompt warnings, as required.

BMD, the agency which will implement the Project, has quite a good organizational capability. In addition, BMD's engineers have sufficient experience and knowledge in the operation and maintenance of meteorological radar systems to perform daily operations, maintenance and repair work on the existing systems. Furthermore, BMD's budget is expected to be able to cover Bangladesh's portion of the capital cost and recurrent cost of the Project.

As a consequence of careful and comprehensive evaluation of the Project effects in consideration of the BMD's capabilities in reducing human loss and recurrent economic set-back by the cyclone, considerable benefits as mentioned above is expected to achieve. The Project would substantially contribute to the mitigation of cyclone disaster as the basic human needs for the people of Bangladesh, the appropriateness of carrying out the Project under a grant-aid has been amply confirmed. Therefore, the implementation of the Project is considered truly advisable.

Contents

Appendices

Chapter 1
Background of the Project

Chapter 1 Background of the Project

Japan's Grant Aid Assistance for the meteorological sector of Bangladesh started in 1986 and the existing Cox's Bazar and Khepupara radar systems were replaced in 1988 with two S-band weather radars, as the first project financed by Japan's Grant Aid Assistance. With 16 years of continuous use, those radar systems have deteriorated, making radar observation by the Bangladesh Meteorological Department (BMD) difficult. In order to adequately protect life and property from cyclone damage, it is essential to improve the current situation as soon as possible along and to provide continuous and timely dissemination of cyclone forecasts and warnings to the public.

To improve the existing situation and, due to local financial constraints, the Government of Bangladesh requested the Government of Japan to replace the existing Cox's Bazar and Khepupara radar systems, including construction of new radar tower buildings, etc., using Japan's Grant Aid Assistance.

During the last year (2004), both of the radar systems have failed and they are not able to be repaired, thus radar observations have stopped. Therefore, currently BMD is not able to monitor the weather and can not locate cyclone centers or intensities of the frequent cyclones in the Bay of Bengal.

The components requested by the Government of Bangladesh for the Project are as follows.

i) Replacement of the existing meteorological radar systems at Cox's Bazar and Khepupara Meteorological Radar Stations
ii) Satellite Communication Systems from Cox's Bazar and Khepupara Meteorological Radar Stations to the Storm Warning Centre (SWC) in Dhaka.
iii) Spare Parts for the existing meteorological microwave links
iv) Construction of radar tower buildings at Cox's Bazar and Khepupara Meteorological Radar Stations

Over the past 44 years (1960-2004), 52 major cyclones have made landfall on the Bangladesh coast and the total number of officially recorded dead and missing people is 716,648. To alleviate the problem, 3 projects have been implemented by Japan's Grant Aid Assistance for the reduction of natural disasters in Bangladesh.

According to the following table, "Number of Dead and Missing for each Cyclone in

Bangladesh", the number of dead and missing due to cyclones sharply decreased after the completion of the second Grant Assistance Project, in which the SWC in Dhaka was connected directly by micro-wave links with existing meteorological radar systems at Cox's Bazar and Khepupara, to receive radar imagery in real time. That project enabled BMD to closely monitor cyclones and thereby benefited BMD in updating and refining the forecasts and warnings for the time and place of cyclone landfall. Thus the communications links were a step towards improving the cyclone warning system, to reduce the loss of lives and destruction of property in Bangladesh. In the context of tropical cyclones, BMD was able to provide warnings and advisories to all administrative divisions, concerned agencies and the mass media.

As the second Grant Assistance Project, described above has proved successful in the reduction of the cyclone damage, the meteorological radar systems at the Cox's Bazar and Khepupara Meteorological Radar Stations and the data transmission network between the stations and the SWC have been identified as significant infrastructure which is indispensable for overall disaster management.

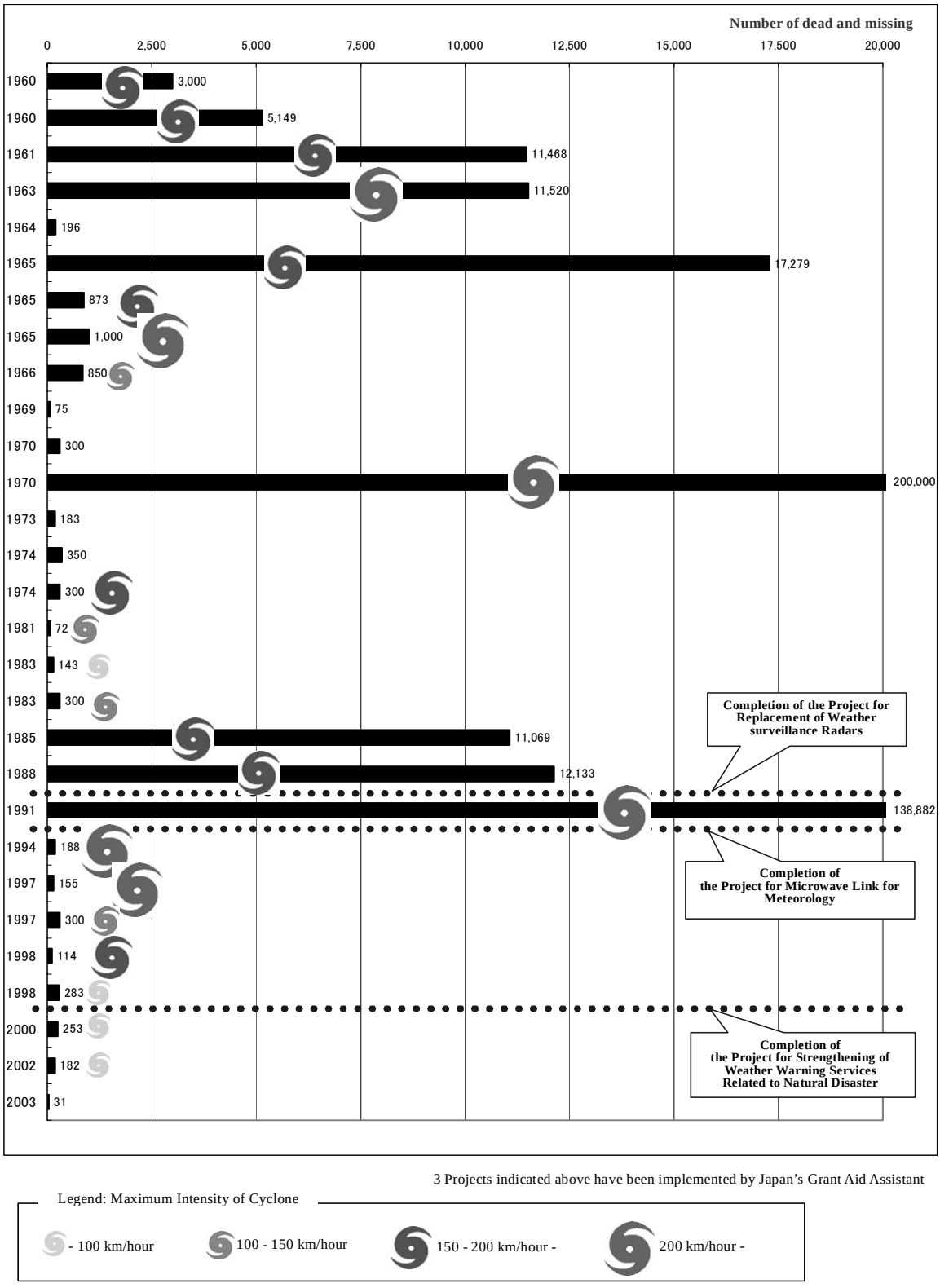


Figure 1: Number of dead and missing, from Cyclones, in Bangladesh

Prepared by Japan Weather Association

Chapter 2
Contents of the Project

Chapter 2 Contents of the Project

2-1 Basic Concept of the Project

Bangladesh is located in a sub-tropical zone and its climate is influenced by tropical cyclones from the Bay of Bengal and by the Southwest monsoon. The country is particularly affected by cyclonic storms and the associated storm surges. Tropical cyclones are the extreme manifestations of nature that have lead to immense distress and deprivation for several hundred thousand people, especially those in the low-lying coastal area and off-shore islands.

The existing Cox's Bazar and Khepupara radar systems were replaced in 1988 under Japan's Grant Aid Assistance with two S-band weather radars. These two radar systems are located at the most strategic places for monitoring tropical cyclones on the coastal belt. Those radar systems are mainly for storm warning purposes and are already more than 16 years old. Because of the age of the radar systems, frequent repairs were required, however, it was very difficult to procure the required spare parts, so it had become a very difficult job even for the experienced BMD engineers to operate, maintain and repair the radars. During the last year, both of the radar systems have failed and they are not able to be repaired, thus radar observations have stopped. Therefore, currently BMD is not able to monitor the weather and can not locate cyclone centers or intensities of the frequent cyclones in the Bay of Bengal.

The Activities of the Disaster Management Bureau (DMB), the Cyclone Preparedness Program (CPP) and the media, with their role in disaster management in Bangladesh (especially in relation to the quick evacuation of residents and disaster prevention countermeasures) depend almost entirely on special cyclone warning bulletins from BMD. Therefore, deterioration in the quality and accuracy of BMD's warnings and advisories creates significant obstacles for the disaster management system of Bangladesh. Under these circumstances, rehabilitation and strengthening of the cyclone monitoring capability of BMD by replacing the existing Cox's Bazar and Khepupara Meteorological Radar Systems has become and urgent task.

The overall objective of the Project is to reduce devastation caused by tropical cyclones by enhancing the cyclone monitoring capability of BMD, thereby allowing the production of accurate cyclone warnings & advisories. This capability will be realized through:

i) replacement of the existing Cox's Bazar and Khepupara Meteorological Radar Systems,

ii) establishment of VSAT communication systems for reliable and speedy transmission of precipitation and wind speed & direction data to the BMD Storm Warning Centre (SWC) in Dhaka from the proposed meteorological radar systems at Cox's Bazar and Khepupara, and

iii) strengthening of cyclone monitoring over the Indian Ocean by the introduction of a meteorological satellite receiving system.

2-2 Basic Design of the Requested Japanese Assistance

2-2-1 Design Policy

(1) Basic Policy for the Basic Design of the Project

a) To design a meteorological observation system to contribute to disaster prevention.
b) To enable BMD to contribute effectively to the protection of people's life and property for sustainable socioeconomic activities.
c) To enable BMD to monitor cyclones round-the-clock on a real time basis.
d) To enable BMD to issue more accurate cyclone warnings and advisories to the public promptly.
e) To satisfy the national development plan of the Government of Bangladesh project targets described in this report.
f) To set up the size and components of the Project to match the technical, operational and maintenance capabilities of BMD.

1) Design Policy

[1] Design Policy of the Equipment

a) To design the system so that it is within BMD's capability to operate, maintain and repair.
b) To ensure the equipment is compatible with and meets the technical requirements of the World Meteorological Organization (WMO).
c) To ensure the equipment is suitable for the routine observation and forecasting work of BMD.
d) To select equipment for which spare parts and consumables can be easily procured and replaced.
e) To select reliable and durable equipment suitable for the local environment.
f) To minimize the recurrent costs to BMD of the operation, maintenance and repair of the equipment.

g) To design the equipment by adjusting the accuracy of radar data through calibration.
h) To design the equipment to minimize lightning damage.
i) To design the equipment to operate using 440V±20%, 3 Phase, 50Hz or 220V±20% Single Phase, 50Hz, power.

[2] Radar Tower Building Design Policy

The design policy is to create a building suitable for use as meteorological radar facility and to become an operational base for weather observation and forecasting. The plan is to construct meteorological radar tower buildings that will ensure appropriate and effective operations and will accommodate the required systems, equipment and personnel. It is a basic policy that the designed Radar Tower Buildings satisfy the following requirements.

a. To be capable of carrying out a variety of meteorological services as the "Radar Tower Buildings."
b. To provide the necessary environment for meteorological work to be performed effectively and efficiently.
c. To be suitable for BMD's 24hours/day work schedule of observations and forecasting .
d. To have the necessary power supply back-up equipment (diesel generator, radar power backup unit, auto voltage regulator, etc.) for performing round-the-clock meteorological services 24 hours a day, 365 days a year.
e. To be sufficiently robust to withstand extreme weather and permit the performance of uninterrupted radar observation and the supply of weather forecast & warnings, even during a cyclone.
f. To be suitable for the installation of weather surveillance Doppler radar systems and other related equipment supplied under the Project.
g. To make use of local building materials for easy maintenance of the radar tower buildings by BMD.
h. To be designed to minimize lightning damage.

2) Design Requirements

[1] Design Requirements for the Equipment

I. Meteorological Radar System

a) To provide high resolution and timely observations of cyclones and other severe

weather conditions such as air-turbulence, heavy rain, thunderstorm, etc.

b) To be S Band (wave length: approximately 10 cm), suitable for precipitation observations over a very wide area, in real time.

c) To use the existing 2,850MHz, ±2MHz frequency allocated to BMD by the Bangladesh Telecommunication Regulatory Commission (BTRC) as "the radar frequency".

d) To have 256 levels of precipitation resolution, which upgrade the BMD cyclone monitoring capability.

e) To have a sensitivity enabling the detection of precipitation of 1mm/hr within a 300km radius.

f) To be a Doppler system suitable for both quantitative rainfall and air-turbulence observation, to accurately observe tropical cyclones and severe weather conditions in the Bay of Bengal area.

g) To have data processing and display capabilities suitable for accurate cyclone monitoring and weather forecasting.

II. Meteorological Radar Data Display System

a) To be suitable for the specific routine operations at the Cox's Bazar and Khepupara Meteorological Radar Observation Stations, Cox's Bazar Meteorological Office, and the SWC in Dhaka.

b) To be designed for durability and long time operation, minimizing heat production, the required space for installation, and the reduction of screen reflections.

III. Meteorological Data Communication System

a) To establish a high-speed radio data communication link between the radar tower building, to be constructed under the Project at the Cox's Bazar Meteorological Radar Observation Station and the Cox's Bazar Meteorological Office (1.5km distance). The service is to operate with no ongoing communications costs.

b) To make use of the frequency (2.4GHz band) allocated to BMD by the Bangladesh Telecommunication Regulatory Commission.

c) To be suitable for the connection of PCs or other digital devices.

IV. Meteorological Data Satellite Communication System

a) To establish a high-speed satellite communication link using C-band (which has minimal rain attenuation) via 400kHz bandwidth of a communication satellite transponder, at a data transmission speed of 32kbps or more, between both the Cox's Bazar and Khepupara Meteorological Radar Observation Stations and the SWC in Dhaka.

b) To enable SWC to receive all the observed data from the proposed Cox's Bazar

and Khepupara Meteorological Radar Systems every quarter hour.

c) To be suitable for the connection of PCs or other digital devices.

V. Meteorological Satellite Data Receiving System (MTSAT)

a) To utilize some parts/units of the existing GMS Data Receiving System.

b) To be able to receive the digital data from the Multi-functional Transport Satellite (hereinafter referred to as "MTSAT") every half an hour; display cloud distributions over the whole area of the Bay of Bengal and mainland Bangladesh; and to classify cloud types.

[2] Design Conditions of the Radar Tower Building

I. Facility Plan

a) To provide space to accommodate the equipment supplied under the Project and allow BMD's staff to work efficiently and make full use of the equipment.

b) To enable BMD to carry out meteorological radar observations, even during the passage of a cyclone.

c) To size the buildings based on staff allocation plans and the systems and equipment required for accurate weather observation and forecasting.

d) To take into consideration the existing building layout at each site with the aim of minimizing the disruption to the existing observation facilities.

e) To have the necessary lightning protection and UPS power.

f) To be designed to minimize any damage by cyclones and storm surges.

II. Building Equipment Plan

a) To determine the power supply requirements, taking into consideration the equipment to be installed under the Project, lighting and air-conditioning systems.

b) To include uninterrupted power supply equipment including a radar power backup unit and two diesel generator systems to ensure proper operation of the meteorological equipment, in order to allow around the clock operations throughout the year, and to allow the taking of radar observations and issue forecasts and warnings, even during power stoppages due cyclones.

c) To assess the capacity of air-conditioning systems, allowing for personnel, the equipment installed under the Project, lighting and other heat-generating items, and thereby to determine the type of air-conditioning system required.

d) To have suitable lightning protection and backup power.

(2) Design Policy on Environmental Conditions

1) Temperature

Meteorological data of Cox's Bazar and Khepupara for the last few years is as follows. Cox's Bazar and Khepupara have a high temperature and high humidity climate. The temperature increases from around March when the south wind blows and daily maximum temperatures are 30°C or more. This continues up to beginning of October. Between November and February, the wind blows from the north and the weather gets a little cooler; maximum temperatures are in the range 25-30°C and minimum temperatures 14-18°C.

Table 2: Monthly and Annual Mean Maximum and Minimum Temperature in Cox's Bazar and Khepupara

Monthly and Annual Mean Maximum Temperature in Cox's Bazar (°C)													
Year	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Annual
2001	27.6	30.4	33.6	34.8	32.9	30.5	31.2	32.2	32.4	32.6	30.4	28.2	31.4
2002	27.9	30.7	33.1	32.7	32.9	32.2	31.2	31.7	32.7	32.1	30.4	28	31.3
2003	26.4	30.2	30.9	33.9	33.3	30.1	32.1	32	32.3	33.1	31.3	29.2	31.2
Monthly and Annual Mean Minimum Temperature in Cox's Bazar (°C)													
Year	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Annual
2001	14.2	17.4	21	24.3	24	23.9	25.3	25.7	25.3	25.1	22	16.7	22.1
2002	16.8	17.5	21.6	23.9	25.1	25.8	25.7	25.5	25.4	24.4	21.7	16.9	22.5
2003	15.1	18.2	20.3	25.2	25.7	24.9	25.6	25.5	25.3	24.9	19.8	17.8	22.4

Monthly and Annual Mean Maximum Temperature in Khepupara (°C)													
Year	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Annual
2001	25.8	29.6	32.9	34.2	32.4	30	30.4	31.5	31.4	31.5	29.3	27.3	30.5
2002	26.5	29.7	32.8	31.8	32.5	31.7	31.9	30.7	31.6	31.6	29.7	27.6	30.7
2003	24.8	29.1	30.7	32.7	33.1	30.9	31.2	31	31.5	31.9	29.9	26.6	30.3
Monthly and Annual Mean Minimum Temperature in Khepupara (°C)													
Year	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Annual
2001	12.1	17	21.3	25.4	25	25.7	25.9	26.8	25.6	25	21.4	14.9	22.2
2002	14.8	16.1	21.7	24.2	25.4	26.4	26.7	25.9	25.9	24	20.5	15.5	22.3
2003	12.3	17.2	20.3	25.3	26.3	25.9	26.6	26.6	26	25	19.1	15.5	22.2

According to the meteorological data, air-conditioning systems are required for rooms where the equipment is to be installed.

2) Rainfall

The annual rainfall in Cox's Bazar and Khepupara is as follows. Most rain is concentrated between May and October, especially the 3 months of the monsoon season, in which more than a half of the annual rainfall falls.

Table 3: Monthly and Annual Rainfall in Cox's Bazar and Khepupara

	Dry Season		Pre-Monsoon Season			Monsoon Season			Post-Monsoon Season			Dry Season	
Monthly and Annual Rainfall in Cox's Bazar (mm)													
Year	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Annual
1999	0	0	0	8	578	853	919	1134	391	277	1	124	4285
2000	1	2	96	65	589	841	1300	870	503	424	16	0	4707
2001	0	26	0	6	379	1373	903	534	426	236	131	0	4014
2002	26	0	43	92	494	503	1236	658	316	330	219	1	3918
2003	0	4	68	10	574	1349	896	655	347	207	0	3	4113
Monthly and Annual Rainfall in Khepupara (mm)													
Year	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Annual
1999	0	0	1	27	458	734	768	535	520	260	5	6	3314
2000	26	13	2	109	526	419	797	411	360	259	19	0	2941
2001	0	41	1	24	381	1014	621	294	487	397	209	0	3469
2002	16	0	38	143	342	571	509	540	374	216	76	0	2825
2003	0	8	109	79	165	703	404	290	239	392	0	46	2435

The maintenance stair-case has been located at the center of the building, covered by the upper concrete slab, to enable BMD personnel to easily reach each room for regular maintenance of the radar equipment without getting wet during the Pre-monsoon, Monsoon and Post-monsoon seasons (May-October) and even during a cyclone. These are the busiest periods for the radar system.

3) Storm Surge

< Cox's Bazar>

There is no record of any damage by cyclonic storm surge because the Cox's Bazar Meteorological Radar Observation Station is on a small hilltop.

<Khepupara>

A cyclonic storm surge of 7m high has been recorded as the maximum in Khepupara and a 10.1m storm surge has been recorded as the maximum in Bangladesh. Therefore, the first floor of the radar tower building will be built high enough to avoid any damage by cyclonic storm surge.

4) Lightning

Bangladesh is in an areas with an average of 60 lightning days a year, according to the World Meteorological Organization (WMO) (Tokyo has one third of this number). The frequent lightning occurs especially during the rainy season. A lightning protector is, therefore planned, to prevent damage to the building and to the equipment.

5) Earthquakes

According to the "Bangladesh National Building Code 1993", Cox's Bazar is located in "Zone 2" and Khepupara is located in "Zone 1". The "Basic Seismic Coefficient" of each zone indicated in the Code will be incorporated into the structural design and

calculation for the radar tower buildings.

6) Load Bearing Layer

As a consequence of boring tests at the sites, the load bearing layer of each site is as follows.

<Cox's Bazar>

A suitable load bearing layer (silty, clayey gravel with sand) for the building construction (N value: 50) has been found at a depth of approximately 7m.

<Khepupara>

The suitable load bearing layer (silty, clayey gravel with sand) for the building construction (N value: 50) has been found at a depth of approximately 50m.

To ensure highly accurate radar observations, the maximum allowable horizontal movement angle of the building must be not more than 0.085 degree (5% of the designed radar beam angle). Therefore, cast-in-place concrete piles penetrating at least 0.5-1m into the load bearing layer will be necessary.

(3) Design Policy for Minimizing Operation & Maintenance Cost

In order for BMD to meet the increased ongoing costs of the system, such as operation and maintenance costs, after the completion of the Project, the following measures have been included in planning for the equipment and the radar tower buildings.

a) The ability to restrict the operation of air-conditioning systems and the electricity supply to the operational rooms in the radar tower buildings; and the utilization of natural light to reduce energy requirements by minimizing the hours of artificial lighting required.
b) The incorporation of solid-state parts into the radar systems as much as possible to reduce the cost and frequency of parts replacement.
c) Maximizing the use of construction materials and computer peripherals available in the local market.

(4) Design Policy for Construction Work

1) Building Construction Permission

The acquisition of a building permission is only required in 4 major cities, that is, Dhaka, Chittagong, Khulna and Rajshahi. Therefore there is no requirement for

construction permissions for the radar tower buildings to be constructed in the Project.

2) Environmental Regulation

Environmental restrictions will not be applied for construction of the radar tower buildings because the construction work of the Project is not large-scale. However, there must be appropriate consideration given to protecting the environment surrounding the sites of the construction work. Waste water discharged from the radar tower buildings must undergo initial treatment before filtering treatment into the soil at each site.

3) Use of Locally Procurable Materials

Gravel, sand, cement, blocks, bricks, floor materials, reinforced bars, etc. are produced in Bangladesh while other construction materials are imported from ASEAN (Association of Southeast Asian Nations) countries. Most of the construction materials are procurable in the local market. For the Project, durable maintainable materials will be selected from the locally procurable materials.

4) Use of Local Construction Methods and Local Workers

The common local construction method involves Reinforced Concrete (RC) columns, beams and slabs and concrete block walls, with a mortar trowel and paint finish. For the Project, this method will be used.

Laborers are classified by their skills, such as carpenters, plasterers, steel fitters, etc. However, there is currently a shortage of skilled laborers and the skill level is variable in Bangladesh. In order to utilize local laborers as much as possible, local construction methods with which local workers are familiar will be used.

(5) Policy for Use of Local Construction Companies

Generally in Bangladesh, the technical skills and competence of the major local construction companies are adequate, so they will be involved in construction of the radar tower buildings.

(6) Design Considerations to Simplify Operation and Maintenance for BMD

1) Easy to operate the equipment

The equipment to be supplied under the Project is to be used to support BMD's routine works as the national meteorological agency for the meteorological disaster prevention. A variety of data processing, analysis, display and communications capabilities must be readily available for BMD, using simple operational procedures.

2) Easy maintenance and affordable recurrent costs of the equipment

The equipment must be designed to minimize the spare parts and consumables required and to simplify regular maintenance. Replacement parts must be quickly and readily available. The biggest recurrent cost of the Project is expected to be electricity, therefore the equipment and facilities should be designed to minimize power consumption.

(7) Design Policy for Equipment & Building Grade

To allow the supply of uninterrupted forecasts & warnings to the public, even during cyclones, the equipment & buildings must be sufficiently robust to withstand cyclones, cyclonic surges and lightning strikes and enable the provision of meteorological services 24 hours per day.

(8) Design Policy regarding Construction/Procurement Method and Schedule

Locally procurable materials and the local construction methods must be used in the building design. The equipment to be installed in the radar tower buildings, such as specialized power backup systems and meteorological equipment, which is not available in the local market, will be mainly procured from Japan. This equipment must be durable, reliable, of a high technical level, and cost effective.

Where possible, outside installation work should not be carried out during the monsoon season (rainy season), which, in Bangladesh, is between June and August. Examples of this work include the radar antenna, radome, etcetera, which will be installed on the top of the radar tower buildings. In addition, installation of the radar system must also be completed in the dry season to avoid damage from rainwater. According to the climate records, 90% of the cyclones strike Bangladesh in April, May, October, November and December. During these periods, special consideration for safety must be given to the construction and equipment installation work. The project implementation schedule should make provision for interruptions due to cyclones.

2-2-2 Basic Plan

(1) Basic Plan of the Equipment

1) Meteorological Radar System

A meteorological radar system is the only system able to observe in real time the occurrence, movement, distribution and intensity of rainfall, and meteorological phenomena related to rainfall, and to provide quantitative measurements over a large area in real time.

The existing Cox's Bazar and Khepupara radar systems are S band radars (wave length: approx. 10cm) and the radar systems required in this project are also S band. S band radar is the most suitable type of radar for the observation of precipitation over a very wide area. It has been specified here because it must accurately observe rainfall from the Bay of Bengal to the central area of Bangladesh and the surrounding areas.

S band radar systems have several important characteristics, including lower attenuation by rain and the atmosphere than other types of radar, and the ability to transmit at high power, providing a "long range", "real time" system. The real time capability will allow BMD to issue warnings promptly. For these reasons, S band radar has been selected as the most suitable to monitor large-scale and distant phenomena such as cyclones, monsoons, etc. The Project therefore requires the supply of S band radar systems

The existing 2,850MHz ±2MHz frequency band of the existing radar systems at Cox's Bazar and Khepupara will be used for the proposed radar systems supplied under the Project. The S band meteorological radar systems are designed to be able to observe rain clouds within a 400km radius and to detect a precipitation rate of 1mm/h or more within a 300km radius.

In order to accomplish the project targets, the radar systems must meet the following requirements.

[1] Doppler Mode

Bangladesh is particularly affected by the tropical cyclones that come from the Bay of Bengal and they are normally accompanied by a storm surge created by a cyclonic storm with a strong pressure gradient. The cyclones have claimed huge numbers of lives and created enormously physical damage. For the reduction of cyclonic damage, it

is essential to monitor cyclonic storms and severe low pressure systems in the Bay of Bengal and the coastal area. BMD does not currently have that capability.

The meteorological radar system is designed to work in Doppler mode, which detects the wind motion and wind patterns of severe weather phenomena, fronts, etc., so that forecasters are able to monitor the movement and the development of storms, to prepare more accurate weather forecasts and warnings. The Doppler mode is essential to allow for more accurate forecasting and longer forecast prediction times.

[2] CAPPI (Constant Altitude PPI) Mode

CAPPI is a horizontal cross-section display at an altitude which can be specified by the user. It is derived from the interpolation volumetric data. Data from all azimuth and elevation points are used in the calculation of precipitation intensity in order to generate the display for a specified altitude. The product displays constant altitude information from 3-dimensional raw data obtained by scans at multiple elevations. To get 3 dimensional data, the radar antenna is operates in "volumetric scan" mode, changing the antenna elevation at regular time intervals.

For the estimation of rainfall from a cyclone and the preparation of composite pictures using multiple radar systems, accurate observed data, especially CAPPI data at an altitude of 2km or 3km, is required. An automatic multi-level CAPPI function will be provided with the proposed radar systems.

[3] Required Radar Display and Output Information Functions

The following functionality must be provided by the meteorological Doppler radar systems to enable BMD to accomplish its role as a national meteorological service.

Table 4: Required Radar Display and Output Information Functions

	Radar Display and Output Information Functions	Purpose of Observation	Necessary Data for Cyclone Monitoring	Necessary Data for Improvement of Forecast Accuracy
1	PPI Display	Rainfall	○	○
2	RHI Display			○
3	JPG Image Output		○	○
4	Cyclone Tracking Display and Forecast		○	○
5	Heavy Rainfall Warning Output		○	○
6	Accumulated Rainfall		○	○
7	Catchment Area Rainfall Amount Display and Warning		○	○
8	Surface Rain Display		○	○
9	Composite Picture Display	Wind Velocity and Direction	○	○
10	Wind Velocity and Direction		○	○
11	Wind Profile of the Upper Layer			○
12	Wind Shear Alert		○	○
13	CAPPI Display	3-dimensional	○	○
14	Echo Tops Display			○
15	Cross Section			○
16	Vertical Integrated Liquidation			○
17	3-dimensional data Display			○

A Comparison of the specifications of the proposed radar systems with the existing radar systems is as follows.

Table 5: Technical Comparison Table

	Existing Radar System	Proposed Radar System
Main Purpose	Cyclone Monitoring	Cyclone Monitoring
Band	S band	S band
Frequency	2,850MHz	2,850MHz
Rainfall Resolution	16 gradation level	256 gradation level
Detectable Range of Precipitation Intensity 1mm/h or more	200km	300km
Doppler Function	None	Available
Accumulated Rainfall	None	Available

Table 6: Comparison of Precipitation Detection Range
between the proposed radar systems and the existing radar systems
using Reception Power (dbm) Precipitation Intensity

Detection Range of the Existing Radar System							
Distance	Precipitation Intensity (mm/h)						
(km)	**0.50**	**1.00**	**5.00**	**10.00**	**20.00**	**40.00**	**100.00**
10	-79.5	-74.7	-63.5	-58.7	-53.9	-49.1	-42.7
50	-93.9	-89.1	-77.9	-73.1	-68.3	-63.5	-57.1
100	-100.4	-95.6	-84.4	-79.6	-74.8	-70.0	-63.6
150	-104.5	-99.7	-88.5	-83.7	-78.8	-74.0	-67.7
200	-107.5	-102.7	-91.5	-86.7	-81.8	-77.0	-70.7
250	-109.9	-105.1	-93.9	-89.1	-84.3	-79.5	-73.1
300	-112.0	-107.2	-96.0	-91.2	-86.4	-81.5	-75.2
350	-113.8	-109.0	-97.8	-93.0	-88.2	-83.4	-77.0
400	-115.5	-110.7	-99.5	-94.7	-89.9	-85.0	-78.7
450	-117.0	-112.2	-101.0	-96.2	-91.4	-86.6	-80.2
Detection Range of the proposed Radar System							
Distance	Precipitation Intensity (mm/h)						
(km)	**0.50**	**1.00**	**5.00**	**10.00**	**20.00**	**40.00**	**100.00**
10	-76.0	-71.2	-60.0	-55.2	-50.3	-45.5	-39.2
50	-90.4	-85.5	-74.4	-69.5	-64.7	-59.9	-53.5
100	-96.9	-92.1	-80.9	-76.1	-71.2	-66.4	-60.1
150	-100.9	-96.1	-84.9	-80.1	-75.3	-70.4	-64.1
200	-103.9	-99.1	-87.9	-83.1	-78.3	-73.4	-67.1
250	-106.3	-101.5	-90.3	-85.5	-80.7	-75.9	-69.5
300	-108.4	-103.6	-92.4	-87.6	-82.8	-78.0	-71.6
350	-110.3	-105.4	-94.3	-89.4	-84.6	-79.8	-73.4
400	-111.9	-107.1	-95.9	-91.1	-86.3	-81.5	-75.1
450	-113.4	-108.6	-97.4	-92.6	-87.8	-83.0	-76.6

Out of Range New Area of Detection Reliable Detection Range

The range of the existing radar systems for the detection of a precipitation intensity of 1mm/h or more is 200km radius and the range of the proposed radar systems will be increased to 300km radius.

Detection Range of the proposed radar systems is shown in the drawing attached in the next page.

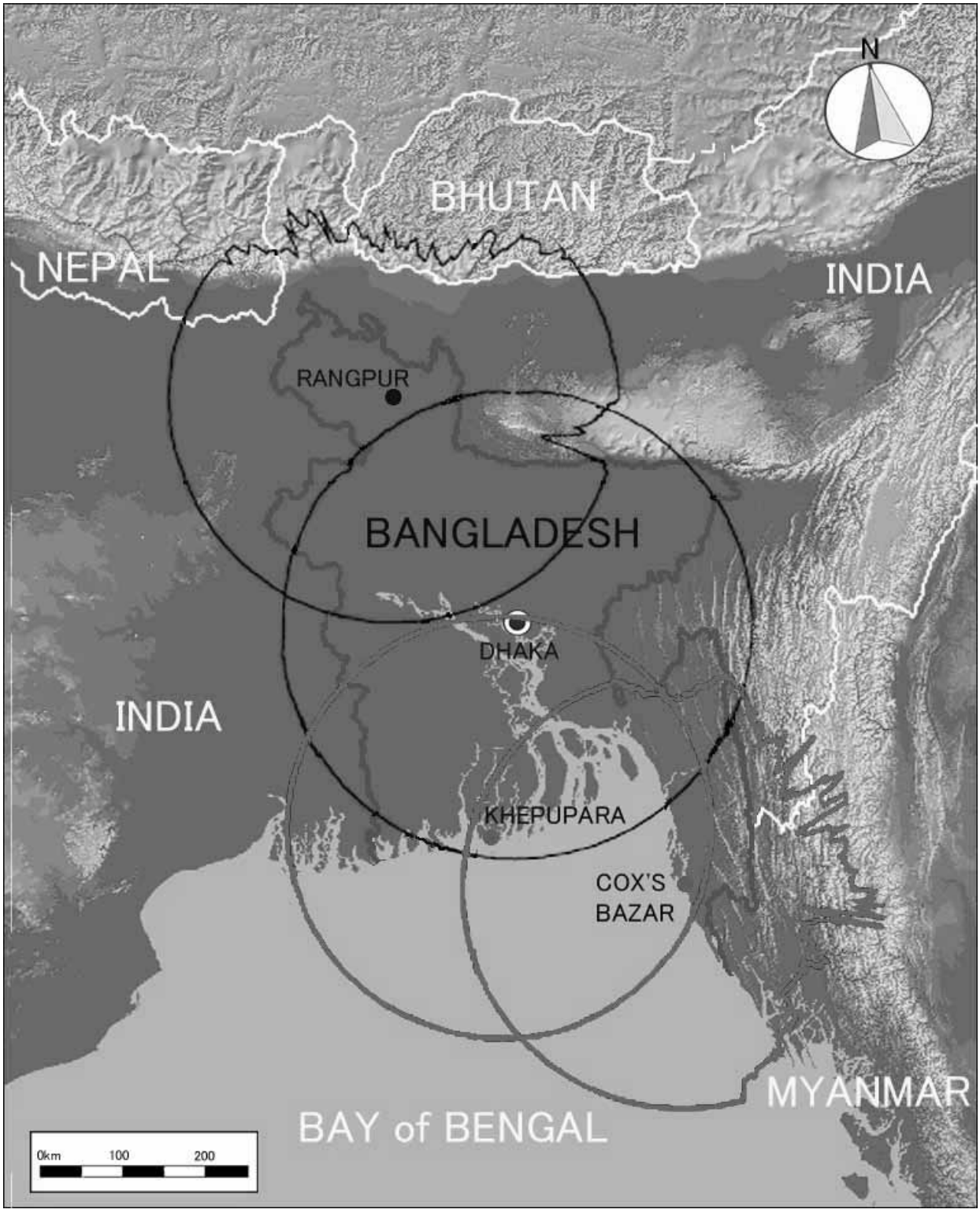


Figure 2: Detection Range of the Proposed Radar Systems

(The range indicates beam height of 3000m above sea level)

Note: The line of the range is calculated based on the altitude data of US Geological Survey

2) Meteorological Radar Data Display System

BMD's forecasters are required to do a substantial amount of work, at a number of locations, very rapidly, in order to produce the required outputs, therefore meteorological radar data display systems are to be installed at the following places. In addition, the system must have the ability to receive and display all the meteorological products in real time for routine weather forecasting & warning.

a) Observation Rooms of Cox's Bazar and Khepupara Meteorological Radar Tower Buildings which will be constructed as part of the Project.
b) Cox's Bazar Meteorological Office
c) BMD Head Office, Storm Warning Centre (SWC)

3) Meteorological Data Communication System

A high-speed communication link (digital spread spectrum system) is required to transmit radar data from the radar tower building at the Cox's Bazar Meteorological Radar Observation Station (which will be constructed as part of the Project) to the Cox's Bazar Meteorological Office. The radar tower building is located approximately 1,500m from the Meteorological Office.

Table 7: Features of Digital Spread Spectrum System

Items	**Spread Spectrum Radio Link**
Frequency	2.4GHz Band
Data Transmission Rate	56Mbps
Transmission Power	Not more than 3mW/MHz
Power Consumption	Not more than 5W
Communication Fee	Free
Reliability and Durability	High
Maintainability	Easy
Maintenance Cost	Low

The digital spread spectrum system of the 2.4GHz Band has the following advantages.

a) Very high data communication speed.
b) The specifications and modulation standard of spread spectrum radio equipment is based on the International Standard IEEE802.11g (IEEE: the Institute of Electrical and Electronic Engineers under the International Telecommunication Union, ITU).

c) The system has a 10Base-T Ethernet Interface (IEEE802.3) and runs the TCP/IP protocol for easy networking and expandability. It also allows the unification of all digital equipment signal interfaces.
d) The system has a two-way communication function for data collection and remote control & monitoring of the system.
e) Deploying a microwave system allows the use of, a high gain antenna which is smaller and lighter than an ordinary yagi antenna.
f) Attenuation of the radio signal by rain is 0.01dB per 1 km for rainfall rates of more than 100mm/h rain (that is, there is virtually no attenuation by rain).
g) The system has security based on the IEEE802.11 standard; the Wired Equivalent Privacy Algorithm (WEP), using Media Access Control ID (MAC) address and Set (ESS) ID.

4) Meteorological Data Satellite Communication System

In order to improve the cyclone monitoring and forecasting work, enabling the timely dissemination of products, all of the meteorological radar data produced by the proposed Cox's Bazar and Khepupara Meteorological Radar Systems must be delivered to the SWC, every 15 minutes. To do this, a data acquisition system is required, employing high-speed satellite communication links using C-band, because of its low attenuation by rain. The system will use a 400kHz bandwidth communication satellite transponder at a data transmission speed of 32kbps or more, between Cox's Bazar and the SWC; and between the Khepupara Meteorological Radar Observation Station and the SWC. The transmission times for the radar data streams to the SWC are as follows.

Table 8: Required Transmission Time at Transmission Speed 32kbps

	Meteorological Radar Data	**Transmission Time**
1	Data for the Existing Data Composite System (30kBytes)	9sec
2	Numerical Rainfall and Doppler PPI Data for a Fixed Elevation Angle (240kBytes)	1.3min
3	Numerical Rainfall and Doppler PPI Data for 10 Elevation Angles (2.4Mbytes)	12.5min

Transmission of all of the radar data from the proposed Cox's Bazar and Khepupara Meteorological Radar Systems to the SWC is required, especially during a cyclone, therefore, as previously mentioned, the most suitable band for high-speed satellite communication links is C-band, because of the low rain attenuation.

Table 9: Required Conditions of Meteorological Data Satellite Communication System

Bandwidth	C band
Data Transmission Speed	32kbps or more
Required Bandwidth of Transponder	400kHz or more Cox's Bazar Radar System – SWC: 150kHz or more Khepupara Radar System – SWC: 150kHz or more Existing Rangpure Radar System – SWC: 100kHz or more Total : 400kHz or more

For transmitting all of the meteorological radar data from the Cox's Bazar and Khepupara Meteorological Radar Observation Stations to SWC, the transponder to be selected for the Project must satisfy the following requirements.

1) Satellite Beam : C band regional beam for Southeast Asia area including Bangladesh
2) Frequency : Up Link 5925 - 6425 [MHz]
3) Down Link : 3700 - 4200 [MHz]
4) Polarizations : Orthogonal Linear
5) Satellite Maximum EIRP : more than 39.5 [dBW]
6) Satellite G/T : more than -2.2 [dB/K]
7) Satellite SFD : less than -86.5 [dBW/m^2]
8) Satellite Orbital Slot (longitude) : 60°E - 140°E

EIRP
Effective Isotropic Radiated Power - This term describes the strength of the signal leaving the satellite antenna or the transmitting earth station antenna, and is used in determining the C/N and S/N. The transmit power value in units of dBW is expressed by the product of the transponder output power and the gain of the satellite transmit antenna.

G/T
A figure of merit of an antenna and low noise amplifier combination expressed in dB. "G" is the net gain of the system and "T" is the noise temperature of the system. The higher the number, the better the system.

SFD - Saturation Flux Density
The power required to achieve saturation of a single repeater channel on the satellite.

5) Meteorological Satellite Data Receiving System (MTSAT)

Since GMS-5 (Japanese Geostationary Meteorological Satellite) stopped functioning, back-up services have been provided by the Japan Meteorological Agency (JMA), using the GOES-9 (American Geostationary Meteorological Satellite). Because of the different transmission characteristics and location of GOES 9, BMD is unable to utilize the existing meteorological satellite data receiving system (GMS), which was supplied to BMD under the previous aid project, that is, "the Project for Improvement of Weather Warning Services related to Natural Disasters", financed by Japan's Grant Aid Assistance. For monitoring the cyclones in the Bay of Bengal, meteorological satellite

data complements meteorological radar data. Consequently, for monitoring cloud movements over Bangladesh, the Bay of Bengal and neighboring countries, this Project design includes a meteorological satellite data receiving system, to be installed at the SWC for the reception of MTSAT-1R (Japanese Multi-functional Transport Satellite), which is the successor satellite to GMS. The analysis of hourly MTSAT data will provide information on cloud distribution and structure over the whole of Bangladesh and surrounding areas.

The “Schematic Diagram for the Project for Improvement of the Meteorological Radar Systems at Cox’s Bazar and Khepupara” showing the total system configuration of the Project is attached hereto.

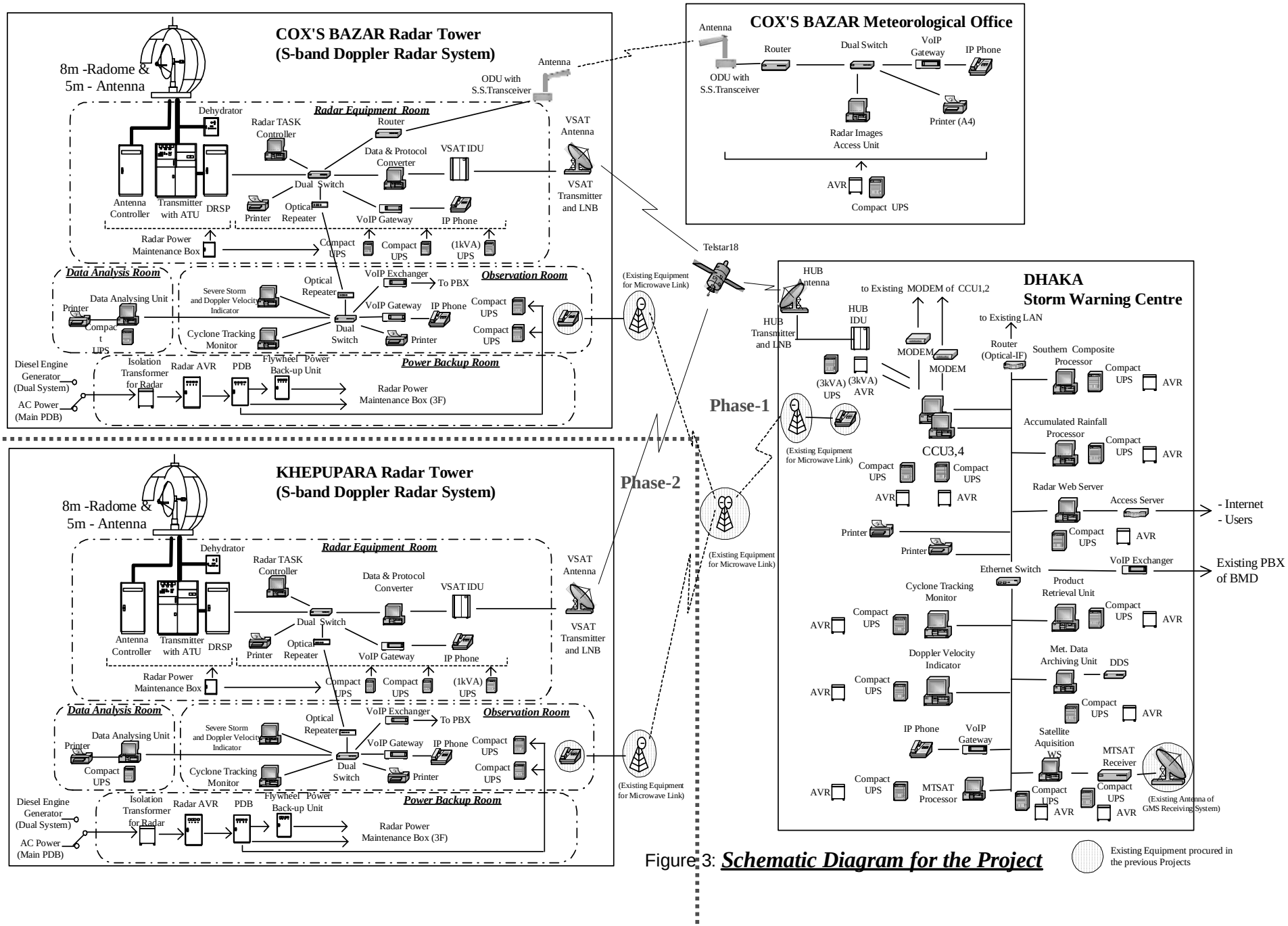


Figure 3: ***Schematic Diagram for the Project***

(2) Major Equipment List

As a consequence of the basic design study, the Project has been designed to be implemented in two phases: “Phase-1” and “Phase-2”. The major components of each phase are described below.

Table 10: Major Components of “Phase-1” and “Phase-2”

Name of System	**Phase-1**			**Phase-2**
	Cox’s Bazar Meteorological Radar Observation Station	Cox’s Bazar Meteorological Office	Storm Warning Centre, Dhaka	Khepupara Meteorological Radar Observation Station
Meteorological Radar System	○			○
Meteorological Radar Data Display System	○	○	○	○
Meteorological Data Communication System	○	○	○	○
Meteorological Data Satellite Communication System	○		○	○
Meteorological Satellite Data Receiving System			○	

Major Equipment List

<Phase-1>

Meteorological Radar System (Cox's Bazar Meteorological Radar Station)

Name of Site: Cox's Bazar Radar Tower Building (Radome Floor)			
Equipment	Specification	Quantity	Purpose
Radome	Type: Sandwich Type (Spherical surface) Dimension: Approx. 8m diameter Color: White Suitable non-observant and non-water stickling finish for making smooth surface Allowable velocity pressure: 7400 N/m^2 Suitable Frequency: 2,850MHz (+/-2MHz) Transmission loss: 0.5dB or less on one way path in dry Lightning Rod: Protecting angles of 60degree Obstruction light: Waterproof lightning system Base ring including necessary installation materials	1	For protecting the radar antenna assembly (a parabolic dish reflector) and maintenance personnel from severe weather conditions and lightning attacks.
Antenna	Type: Horn feed parabolic antenna Reflector: approx. 5m diameter Suitable Frequency: 2,850MHz (+/-2MHz) Beam width: not wider than 1.7 degree at -3dB point Antenna gain: 39dB or more without Radome Polarization: Linear, horizontal Side lobe level: not more than -25dB without Radome Driving range: Azimuth 360 degree, elevation -2 to +90 degree VSWR: not more than 1.4 without Radome Optical connection box: For converting electric control signal to optical one Directional coupler: Coupling coefficiency: forward –50dB +/-2dB backward –35dB +/-1dB VSWR: lass than 1.10 Rating power: not lass than 1MW	1	For radiating radar beam into the atmosphere and receiving scatter waves while rotating the parabola antenna as azimuth and elevation direction.
Name of Site: Cox's Bazar Radar Tower Building (Radar Equipment Room)			
Equipment	Specification	Quantity	Purpose
Antenna Controller	Control mode: Programming mode and manual control mode Driving range: Azimuth 360 degree, elevation –2 to +90 degree Rotation speed Azimuth: 0.5 to 6 rpm (6 rpm in operation) Elevation: not more than 17 second for each way scan between -2 and 60 degree Automatically and manually capable for clockwise and counterclockwise rotation in AZ and up & down in EL Accuracy of specified angle for both antenna calibration and digital readout: Azimuth: not more than +/-0.1 degree Elevation: not more than +/-0.1 degree	1	For rotation a parabolic dish reflector and for controlling the antenna in azimuth and elevation by both of horizontal and vertical drive motor units.

Transmitter	Transmitting frequency: 2,850MHz (S-band) Transmitting power: 500kW peak (at Tx output) Modulator: Solid state type Pulse width: from 0.4 μ s to 2.0 μ s Pulse repetition frequency (PRF): [Doppler Mode: Dual PRF] From 500Hz to 1,800Hz (Pulse width: 1.0 μ s) selectable [Intensity Mode: Single PRF] From 200 Hz to 300Hz (Pulse width: 2.0 μ s) selectable Condition Display: Transmission hour, pre-heat hour, status of Local/Remote control	1	For generation and emitting pulse-modulated power with stable frequency and transmitting the power to the antenna.
Amplifier Tube Unit (ATU)	Triple transmitting tube: klystron type (including ageing unit) Cooling: Forced air cooling Insulation system: Oil tank Exchange unit of tube system internally mounted	1	For generation pulse-modulated power with stable frequency.
Digital Receiver and Signal Processor (DRSP)	Noise figure of the high frequency circuit: 3dB or better at the input terminal of low noise amplifier (LNA) Receiver type: Coherent IF digitizer Sensitivity: -110dBm or better (at 10us plus) Dynamic range: 80dB or better from noise level to saturated level (depending on matched filter bandwidth) Quantization: 14 bits Range bin: 1024 Processing area: throughout 0 km to 400 km in range and 0 to 360 degree in azimuth Area: 800km x 800km (Intensity Mode) 240km x 240km (Doppler Mode) Data grid: 2.5km x 2.5km (Intensity Mode) : 1.0km x 1.0km (Doppler Mode) Intensity mode Ground clutter suppression: Chebyshev IIR digital high pass filter with minimum influence to precipitation intensity Logarithmic linearity: within +/-1dB throughout 80dB Range correction: depending on radar equation Air-attenuation correction: 0.005dB/km in Observation Range Velocity mode Processing type: Pulse Pair, FFT and Random Phase Velocity De-arising: Real-time processing by Dual-PRF Trigger control: PRF selectable (2:3, 3:4, 4:5) Averaging: Block averaging and/or sliding averaging Output data: Reflectivity (Z), Doppler velocity (V), Spectrum width (W) Output data resolution: 8bit or 16bit Output data indicating interval: within 1 minute after automatic scan Time adjustment: Automatically adjustment by GPS NTP server (including antenna)	1	For receiving and processing video echo signal from a RF receiver in the transmitter. For suppressing unnecessary echo such as clutter signals reflected from ground. For sending ingest data to radar TASK controller.
Dehydrator	-Capability of ventilation pressure: 3+/-1 liter/min, -Normal:200 hPa -Upper limit: 300 +/-30 hPa -Lower limit: 70+/-30 hPa	1	For supplying dried and pressurized air into the wave-guide to reduce wave propagation loss.
Wave-guide Configuration	-Wave-guide Type: S-band wave-guide (conformity with WR-284 or equivalent) -Circulator Allowable maximum power: at least 700 kW -TR limiter (x4) Type: Dual back up type	1	For feeder line for propagation wave traveling between the antenna and TX/RX.

Radar TASK Controller	CPU: Intel Pentium 4, 3.6GHz or equivalent Main memory (RAM): 1024Mbytes or more Hard disk unit: 160Gbytes or more x two (2) drives Floppy disk unit: one (1) drive for 3.5 inches disk (1.44Mbytes) CD-R/W drive: one (1) drive Monitor display: Color LCD type, 17 inches or more LAN interface: IEEE802.3, 10/100BASE-T,TCP/IP, two (2)ports or more LAN Arrester: for surge protection, RJ45 interface Input power: AC 220V, 50Hz, single phase Software Operation system: UNIX or LINUX-based Application software: -Radar local control and monitoring -Observation scheduling -Radar echo display -Radar data generation and dissemination	1	For operating the radar system, monitoring condition of the radar system and generating raw product data. Monitoring items: Radiate control/status Azimuth/elevation position control/status TX standby status Pulse width control/status Antenna local/maintenance mode status
Data & protocol converter	CPU: Intel Pentium 4, 3.6GHz or equivalent Main memory (RAM): 1024Mbytes or more Hard disk unit: 160Gbytes or more x two (2) drives Floppy disk unit: one (1) drive for 3.5 inches disk (1.44Mbytes) CD-R/W drive: one (1) drive Monitor display: Color LCD type, 17 inches or more LAN interface: IEEE802.3, 10/100BASE-T,TCP/IP, two (2)ports or more LAN Arrester: for surge protection, RJ45 interface Input power: AC 220V, 50Hz, single phase Software Operation system: UNIX or LINUX-based Application software: -Data receiving, converting and transfer -Parameter setting -Display processing -Web server feature	1	For sending Raw data to Strom Warning Center according to specified interval.
Peripherals	Compact UPS -Capacity: 500VA or more -Input power: AC 220V +/-15%, single phase, 50Hz -Output power: AC 220V +/-5%, single phase, 50Hz -Operation time: at least 5 minutes at full load	2	For supplying back-up AC power to computing equipment in order to keep the shutdown time of the system in case of power failure.
	1kVA UPS -Capacity: 1kVA or more -Input power: AC 220V +/-15%, single phase, 50Hz -Output power: AC 220V +/-5%, single phase, 50Hz -Operation time: at least 5 minutes at full load	1	For supplying back-up AC power to computing equipment in order to keep the shutdown time of the system in case of power failure.
	Dual Switch -LAN interface: IEEE 802.3 Ethernet -Connection port: 100BASE-T, eight (8)ports -Input power: AC 220V, single phase, 50Hz -Each ports and power supply shall be duplicated	1	For connecting all the computing equipment on LAN.
	Color printer -Color inkjet type, A3 size -At least 1200 dpi resolution, 7ppm of faster printing speed -Interface USB, SCSI or LAN -Input power: AC 220V, single phase, 50Hz	1	For printing radar image.
	Optical Repeater -LAN interface: IEEE 802.3 Ethernet -Connection port: 100BASE-T, one (1) port Optical fiber interface one (1) set Multi-mode (100Mbps) -Input power: AC 220V, single phase, 50Hz	1	For converting electrical signal and optical signal on LAN for surge protection.

	Radar Power Maintenance Box -Circuit breaker: no-fuse-breaker type -Main breaker -Power distribution: 5 outputs include 1 spare -Input power: AC 220V, single phase, 50Hz -Output power: AC 220V, single phase, 50Hz	1	For distributing and supplying AC power to radar system.
Name of Site: Cox's Bazar Radar Tower Building (Electricity Room)			
Equipment	Specification	Quantity	Purpose
Isolation Transformer	-Capacity: 35kVA or more -Input Power: AC 220V, single phase, 50Hz -Output Power: AC 220V, single phase, 50Hz -Insulation: Class B -Surge voltage: 30kV or more	1	For protecting each equipment from surge voltage in main power.
Radar AVR	-Capacity: 30kVA or more -Input Power: AC 220V +/-20%, single phase, 50Hz -Output Power: AC 220V +/-5%, single phase, 50Hz	1	For supplying the constant voltage to the radar system.
Name of Site: Cox's Bazar Radar Tower Building (Radar Power Backup Room)			
Equipment	Specification	Quantity	Purpose
Flywheel Power Back Up Unit	-Back up period: 4 minutes or more for radar equipment -Input voltage: AC 220V(single phase 50Hz) -Normal output: Direct output of input voltage -CVCF output: AC 220V +/-5%, single phase, 50Hz -Battery less type	1	For supplying the uninterrupted power by flywheel energy to the radar system when power failure is occurred.
Name of Site: Cox's Bazar Radar Tower Building (Maintenance Room)			
Equipment	Specification	Quantity	Purpose
Test Instruments and Materials	Test signal card	1 set	For maintenance of radar system.
	Power meter	1 set	
	Power sensor	1 set	
	Frequency counter	1 set	
	Detector	1 set	
	Attenuator set with terminator	1 set	
	Terminator for detector	1 set	
	Oscilloscope	1 set	
	Digital multi meter	1 set	
	CW Converter	1 set	
	Tool Kit	1 set	
	Extension cable	1 set	
	Leveler	1 set	
	Step ladder	1 set	
	Clump current meter	1 set	
	High voltage probe	1 set	
	Vacuum cleaner	1 set	

Spare Parts	Klystron	1 set	For maintenance of radar system.
	TR Limiter (x2)	1 set	
	RX Card for DRSP	1 set	
	Timing belt for Antenna	1 set	
	Encoder for Antenna	2 sets	
	Motor for Antenna	2 sets	
	Servo unit for Antenna Controller	2 sets	
	Control Card for Antenna Controller	1 set	
	Power Supply Unit for Antenna Controller	1 set	
	Timer Relay for Transmitter	1 set	
	Blower Unit for Transmitter	2 sets	
	Fan Unit for Transmitter	2 sets	
	Modulator Unit for Transmitter	1 set	
	Control Card for Transmitter	1 set	
	Power Supply Unit for Transmitter	1 set	
	HV Power Unit for Transmitter	1 set	
	Ion Pump Power Supply Unit	1 set	
	Hard Disk Unit for Computer (not less than 160GB)	1 set	
	LAN Arrester	1 set	
	CD-R/W Drive	2 sets	
	MPU (3.6GHz or equivalent)	1 set	
	Memory (not less than 1024MB)	1 set	
	Obstruction Light	2 sets	
	CD-R	20 discs	For storing of the observed data.
Consumables	Grease with pump and oil with jug for Antenna	1 set	For maintenance of radar system.
	Carbon Brush for Power	1 set	For maintenance of radar system.
	Carbon Brush for Signal	1 set	For maintenance of radar system.
	Printer Ink Cartridge	1 set	For printing radar image.
Service Manuals	Operation & Maintenance Hand Book	2 sets	For maintenance of radar system.

Meteorological Radar Data Display System (Cox's Bazar Meteorological Radar Station)

Name of Site: Cox's Bazar Radar Tower Building (Observation Room)			
Equipment	Specification	Quantity	Purpose
Severe Storm and Doppler Velocity Indicator	CPU: Intel Pentium 4, 3.6GHz or equivalent Main memory (RAM): 1024Mbytes or more Hard disk unit: 160Gbytes or more x two (2) drives Floppy disk unit: one (1) drive for 3.5 inches disk (1.44Mbytes) CD-R/W drive: one (1) drive Monitor display: Color LCD type, 17 inches or more LAN interface: IEEE802.3, 10/100BASE-T,TCP/IP, one (1) port or more LAN Arrester: for surge protection, RJ45 interface Input power: AC 220V, 50Hz, single phase Software Operation system: UNIX or LINUX-based Application software: -Basic data monitoring feature -Weather product processing -Map projection -Product display & retrieval	1	For monitoring and alerting of severe storm condition by various doppler radar products.
Cyclone Tracking Monitor	CPU: Intel Pentium 4, 3.6GHz or equivalent Main memory (RAM): 1024Mbytes or more Hard disk unit: 160Gbytes or more x two (2) drive Floppy disk unit: one (1) drive for 3.5 inches disk (1.44Mbytes) CD-R/W drive: one (1) drive Monitor display: Color LCD type, 17 inches or more LAN interface: IEEE802.3, 10/100BASE-T,TCP/IP, one (1) port or more LAN Arrester: for surge protection, RJ45 interface Input power: AC 220V, 50Hz, single phase Software Operation system: UNIX, LINUX-based or Microsoft Windows Application software: -Radar local control and monitoring -Observation scheduling -Basic data monitoring feature -Weather product monitoring and display -Map projection -Product display & retrieval	1	For tracking cyclone and predicting cyclone course and time.

Peripherals	Color printer -Color inkjet type, A3 size -At least 1200 dpi resolution, 7ppm of faster printing speed -Interface USB, SCSI or LAN -Input power: 220V, single phase, 50Hz	1	For printing radar image.
	Dual Switch -LAN interface: IEEE 802.3 Ethernet -Connection port: 100BASE-T, eight (8) ports -Input power: AC 220V, single phase, 50Hz -Each ports and power supply shall be duplicated	1	For connecting all the computing equipment with LAN.
	Optical Repeater -LAN interface: IEEE 802.3 Ethernet -Connection port: 100BASE-T, one (1) port Optical fiber interface one (1) set Multi-mode (100Mbps) -Input power: AC 220V, single phase, 50Hz	1	For converting electrical signal and optical signal on LAN for surge protection.
	Compact UPS -Capacity: 500VA or more -Input power: AC 220V +/-15%, single phase, 50Hz -Output power: AC 220V +/-5%, single phase, 50Hz -Operation time: at least 5 minutes at full load	2	For supplying back-up AC power to computing equipment for shutdown the system in case of power failure.
Name of Site: Cox's Bazar Radar Tower Building (Data Analysis Room)			
Equipment	Specification	Quantity	Purpose
Data Analyzing Unit	CPU: Intel Pentium 4, 3.6GHz or equivalent Main memory (RAM): 1024Mbytes or more Hard disk unit: 160Gbytes or more x two (2) drive Floppy disk unit: one (1) drive for 3.5 inches disk (1.44Mbytes) CD-R/W drive: one (1) drive Monitor display: Color LCD type, 17 inches or more LAN interface: IEEE802.3, 10/100BASE-T,TCP/IP, one (1) port or more LAN Arrester: for surge protection, RJ45 interface Input power: AC 220V, 50Hz, single phase Software Operation system: UNIX or LINUX-based Application software: -Basic data monitoring feature -Weather product processing -Map projection -Product display & retrieval	1	For analyzing weather phenomena by observed radar data.
Peripherals	Color printer -Color inkjet type, A3 size -At least 1200 dpi resolution, 7ppm of faster printing speed -Interface USB, SCSI or LAN -Input power: AC 220V, single phase, 50Hz	1	For printing radar image.
	Compact UPS -Capacity: 500VA or more -Input power: AC 220V +/-15%, single phase, 50Hz -Output power: AC 220V +/-5%, single phase, 50Hz -Operation time: at least 5 minutes at full load	1	For supplying back-up AC power to computing equipment for shutdown the system in case of power failure.
Spare Parts	Hard Disk Unit for Computer (not lass than 160GB)	1 set	For maintenance of the system.
	MPU (3.6GHz or equivalent)	1 set	
	Memory (not less than 1024MB)	1 set	
	LAN Arrester	1 set	
	CD-R	20 discs	For printing of the observed data.
Consumables	Printer Ink Cartridge	2 set	For printing radar image.
Service Manuals	Operation & Maintenance Hand Book	1 set	For maintenance of the system.

Meteorological Radar Data Display System (Cox's Bazar Meteorological Office)

Name of Site: Cox's Bazar Meteorological Observatory			
Equipment	Specification	Quantity	Purpose
Radar Image Access Unit	CPU: Intel Pentium 4, 3.6GHz or equivalent Main memory (RAM): 1024Mbytes or more Hard disk unit: 160Gbytes or more x two (2) drives Floppy disk unit: one (1) drive for 3.5 inches disk (1.44Mbytes) CD-R/W drive: one (1) drive Monitor display: Color LCD type, 17 inches or more LAN interface: IEEE802.3, 10/100BASE-T,TCP/IP, one (1) port or more LAN Arrester: for surge protection, RJ45 interface Input power: AC 220V, 50Hz, single phase Software Operation system: UNIX or LINUX-based Application software: -Web Browser feature	1	For indicating the Cox's Bazar Radar Image with Web style.
Peripherals	Color printer (A4) -Color inkjet type, A4 size -At least 1200 dpi resolution, 10ppm of faster printing speed -Interface USB, SCSI or LAN -Input power, 220V, single phase, 50Hz	1	For printing radar image.
	Dual Switch -LAN interface: IEEE 802.3 Ethernet -Connection port: 100BASE-T, eight (8)ports -Input power: AC 220V, single phase, 50Hz -Each ports and power supply shall be duplicated	1	For connecting all the computing equipment with LAN.
	Compact UPS -Capacity: 500VA or more -Input power: AC 220V +/-15%, single phase, 50Hz -Output power: AC 220V +/-5%, single phase, 50Hz -Operation time: at least 5 minutes at full load	1	For supplying back-up AC power to computing equipment for shutdown the system in case of power failure.
	AVR -Capacity: 600VA or more -Input power: AC 220V ±20%, single phase, 50Hz -Output power: AC 220V ±5%, single phase, 50Hz	1	For supplying the constant voltage to the computer.
Spare Parts	Hard Disk Unit for Computer (not lass than 160GB)	1 set	For maintenance of the system.
	MPU (3.6GHz or equivalent)	1 set	
	Memory (not less than 1024MB)	1 set	
	LAN Arrester	1 set	
	CD-R	20 discs	For printing of the observed data.
Consumables	Printer Ink Cartridge	2 set	For printing radar image.
Service Manuals	Operation & Maintenance Hand Book	1 set	For maintenance of the system.

Meteorological Radar Data Display System (Dhaka Head Office)

Name of Site: Dhaka Storm Warning Center			
Equipment	Specification	Quantity	Purpose
CCU(3)	CPU: Intel Pentium 4, 3.6GHz or equivalent Main memory (RAM): 1024Mbytes or more Hard disk unit: 160Gbytes or more x two (2) drives Floppy disk unit: one (1) drive for 3.5 inches disk (1.44Mbytes) CD-R/W drive: one (1) drive Monitor display: Color LCD type, 17 inches or more LAN interface: IEEE802.3, 10/100BASE-T,TCP/IP, one (1) port or more LAN Arrester: for surge protection, RJ45 interface Input power: AC 220V, 50Hz, single phase Software Operation system: UNIX, LINUX-based or Microsoft Windows Application software -Data Receiving for Cox's Bazar radar -Data Dissemination -Display of radar echo -Display of status	1	For receiving data from Cox's Bazar, and sending data to specified destination.
CCU(4)	CPU: Intel Pentium 4, 3.6GHz or equivalent Main memory (RAM): 1024Mbytes or more Hard disk unit: 160Gbytes or more x two (2) drive Floppy disk unit: one (1) drive for 3.5 inches disk (1.44Mbytes) CD-R/W drive: one (1) drive Monitor display: Color LCD type, 17 inches or more LAN interface: IEEE802.3, 10/100BASE-T,TCP/IP, one (1) port or more LAN Arrester: for surge protection, RJ45 interface Input power: AC 220V, 50Hz, single phase Software Operation system: UNIX, LINUX-based or Microsoft Windows Application software -Data Receiving for Khepupara radar -Data Dissemination -Display of radar echo -Display of status	1	For receiving data from Khepupara and sending data to specified destination.

Southern Composite Processor	CPU: Intel Pentium 4, 3.6GHz or equivalent Main memory (RAM): 1024Mbytes or more Hard disk unit: 160Gbytes or more x two (2) drive Floppy disk unit: one (1) drive for 3.5 inches disk (1.44Mbytes) CD-R/W drive: one (1) drive Monitor display: Color LCD type, 19 inches or more LAN interface: IEEE802.3, 10/100BASE-T,TCP/IP, one (1) port or more LAN Arrester: for surge protection, RJ45 interface Input power: AC 220V, 50Hz, single phase Software Operation system: UNIX, LINUX-based or Microsoft Windows Application software -Data Receiving -Data Dissemination -Display of radar echo -Display of status -Parameter setting and southern composite processing	1	For receiving data from Cox's Bazar and Khepupara, and creating southern composite image.
Accumulated Rainfall Processor	CPU: Intel Pentium 4, 3.6GHz or equivalent Main memory (RAM): 1024Mbytes or more Hard disk unit: 160Gbytes or more x two (2) drives Floppy disk unit: one (1) drive for 3.5 inches disk (1.44Mbytes) CD-R/W drive: one (1) drive Monitor display: Color LCD type, 19 inches or more LAN interface: IEEE802.3, 10/100BASE-T,TCP/IP, one (1) port or more LAN Arrester: for surge protection, RJ45 interface Input power: AC 220V, 50Hz, single phase Software Operation system: UNIX, LINUX-based or Microsoft Windows Application software -Data Receiving -Data Dissemination -Display of radar echo -Display of status -Parameter setting and accumulation calculating	1	For creating and sending accumulated rainfall data for Cox's Bazar and Khepupara.
Cyclone Tracking Monitor	CPU: Intel Pentium 4, 3.6GHz or equivalent Main memory (RAM): 1024Mbytes or more Hard disk unit: 160Gbytes or more x two (2) drives Floppy disk unit: one (1) drive for 3.5 inches disk (1.44Mbytes) CD-R/W drive: one (1) drive Monitor display: Color LCD type, 19 inches or more LAN interface: IEEE802.3, 10/100BASE-T,TCP/IP, one (1) port or more LAN Arrester: for surge protection, RJ45 interface Input power: AC 220V, 50Hz, single phase Software Operation system: UNIX, LINUX-based or Microsoft Windows Application software: -Basic data monitoring feature -Weather product monitoring and display -Map projection -Product display of cyclone tracking	1	For tracking cyclone course and predicting cyclone course and time.

Product Retrieval Unit	CPU: Intel Pentium 4, 3.6GHz or equivalent Main memory (RAM): 1024Mbytes or more Hard disk unit: 160Gbytes or more x two (2) drives Floppy disk unit: one (1) drive for 3.5 inches disk (1.44Mbytes) CD-R/W drive: one (1) drive Monitor display: Color LCD type, 17 inches or more LAN interface: IEEE802.3, 10/100BASE-T,TCP/IP, one (1) port or more LAN Arrester: for surge protection, RJ45 interface Input power: AC 220V, 50Hz, single phase Software Operation system: UNIX, LINUX-based or Microsoft Windows Application software: -Data Receiving -Basic data monitoring feature -Various weather products retrieving -Map projection -Product display & retrieval	1	For retrieving and monitoring various product.
Radar Web Server	CPU: Intel Pentium 4, 3.6GHz or equivalent Main memory (RAM): 1024Mbytes or more Hard disk unit: 160Gbytes or more x two (2) drives Floppy disk unit: one (1) drive for 3.5 inches disk (1.44Mbytes) CD-R/W drive: one (1) drive Monitor display: Color LCD type, 17 inches or more LAN interface: IEEE802.3, 10/100BASE-T,TCP/IP, two (2) ports or more LAN Arrester: for surge protection, RJ45 interface Modem: V92/56kbps, PCI interface Input power: AC 220V, 50Hz, single phase Software Operation system: UNIX, LINUX-based or Microsoft Windows Application software: -Data Receiving -Product output to Web -Display information -Radar Image output	1	For opening to the public various product with web based image.
Doppler Velocity Indicator	CPU: Intel Pentium 4, 3.6GHz or equivalent Main memory (RAM): 1024Mbytes or more Hard disk unit: 160Gbytes or more x two (2) drives Floppy disk unit: one (1) drive for 3.5 inches disk (1.44Mbytes) CD-R/W drive: one (1) drive Monitor display: Color LCD type, 19 inches or more LAN interface: IEEE802.3, 10/100BASE-T,TCP/IP, one (1) port or more LAN Arrester: For surge protection, RJ45 interface Input power: AC 220V, 50Hz, single phase Software Operation system: UNIX, LINUX-based or Microsoft Windows Application software: -Data Receiving -Doppler Product Processing -Map projection -Product display & retrieval	1	For creating various wind profile with each mesh by doppler data.

Meteorological Data Archiving Unit	CPU: Intel Pentium 4, 3.6GHz or equivalent Main memory (RAM): 1024Mbytes or more Hard disk unit: 160Gbytes or more x two (2) drive Floppy disk unit: one (1) drive for 3.5 inches disk (1.44Mbytes) CD-RW drive: one (1) drive DDS: one (1) drive (DDS-3) Monitor display: Color LCD type, 17 inches or more LAN interface: IEEE802.3, 10/100BASE-T,TCP/IP, one (1) port or more LAN Arrester: For surge protection, RJ45 interface Input power: AC 220V, 50Hz, single phase Software Operation system: UNIX, LINUX-based or Microsoft Windows Application software: -Data Receiving -Display feature -Storing to external storages	1	For storing of observed data to selected storage at an operator's command.
Peripherals	Color printer -Color inkjet type, A3 size -At least 1200 dpi resolution, 7ppm of faster printing speed -Interface USB, SCSI or LAN -Input power: AC 220V, single phase, 50Hz	2	For printing radar products.
	Ethernet Switch -LAN interface: IEEE 802.3 Ethernet -Connection port: 100BASE-T, twenty four (24) ports or more -Input power: AC 220V, single phase, 50Hz -Each ports and power supply shall be duplicated	2	For connecting all the computing equipment with LAN.
	MODEM -Data rate: From 2400bps to 9600bps -DTE interface: V.24 -Line interface: 4W -Input power: AC 220V, single phase, 50Hz	2	For converting data signal between analog and digital.
	Router (including two (2) optical interfaces) -LAN interface: IEEE 802.3 Ethernet -Connection port: 100BASE-T, two (2)ports -Routing: IP routing -Input power: AC 220V, single phase, 50Hz	1	For connecting and routing all the computing equipment on LAN.
	Access Server -WAN interface: ITU-TS BRI -LAN interface: IEEE 802.3 Ethernet -Connecting ports: 100BASE-T, two (2)ports, BRI one(1)port -Routing: IP routing -Input power: AC 220V, single phase, 50Hz	1	For sending of the radar image to outside server via the internet.
	Compact UPS -Capacity: 500VA or more -Input power: AC 220V +/-15%, single phase, 50Hz -Output power: AC 220V +/-5%, single phase, 50Hz -Operation time: at least 5 minutes at full load	9	For supplying back-up AC power to computing equipment for shutdown the system in case of power failure.
	AVR -Capacity: 600VA or more -Input power: AC 220V +/-20%, single phase, 50Hz -Output power: AC 220V +/-10%, single phase, 50Hz	9	For supplying the constant voltage to the computer.

Spare Parts	Hard Disk Unit for Computer (not less than 160GB)	4 sets	For maintenance of the system.
	MPU (3.6GHz or equivalent)	4 sets	
	Memory (not less than 1024MB)	4 sets	
	LAN Arrester	4 sets	
	DDS for Data Storage (5)	1 set	For recording of the observed data.
	CD-R	40 discs	For recording of the observed data.
Consumables	Printer Ink Cartridge	2 set	For printing radar image.
Service Manuals	Operation & Maintenance Hand Book	1 set	For maintenance of the system.

Meteorological Data Communication System (Cox's Bazar Meteorological Radar Station)

Name of Site: Cox's Bazar Radar Tower Building (Radar Equipment Room)			
Equipment	Specification	Quantity	Purpose
VoIP Gateway	-Type: H323 or SIP -Decoding method: G.723, G.729 or G.711 -VoIP Interface: phone-line (telephone, fax, etc.) -VoIP port : 4port -WAN interface: 10/100BASE-T	1	For converting voice packet signal. And exchange dial signal for telephone.
Telephone	Type: Analog 2wire, DTMF	1	For voice communication.
Spread Spectrum Transceiver with ODU	-Frequency: 2.4GHz ISM band -Radio Standard: IEEE802.11b/g -Output Power: 10mW/MHz or less -Wire Interface: 10/100BASE-T -Data Rate: 54Mbps -Modulation: DSSS/OFDM -Output Door standard: IP43 -LAN Arrester: For surge protection, RJ45 interface	1	High data rate transmission using radio of 2GHz band.
Antenna	-Frequency: 2.4GHz ISM Band -Type: Yagi Antenna -Gain: 19dBi -Impedance: 50ohm -VSWR: 1.3 or less -Polarization: Vertical -Beam width: Not more than 20 degree	1	Combination use with Spread Spectrum Transceiver.
Router	-LAN interface: IEEE 802.3 Ethernet -Connection port: 100BASE-T, two (2)ports -Routing: IP routing -Input power: AC 220V, single phase, 50Hz	1	For connecting and routing all the computing equipment on LAN.
Name of Site: Cox's Bazar Radar Tower Building (Observation Room)			
Equipment	Specification	Quantity	Purpose
VoIP Gateway	-Type: H323 or SIP -Decoding method: G.723, G.729 or G.711 -VoIP Interface: phone-line (telephone, fax, etc.) -VoIP port : 4port -WAN interface: 10/100BASE-T	1	For converting voice packet signal. Exchange dial signal for telephone.
VoIP Exchanger	-Type: H323 or SIP -Decoding method: G.723, G.729 or G.711 -VoIP Interface: PBX-line (FXO/2W) -VoIP port : 4ports -WAN interface: 10/100BASE-T -IP address: fixed type	1	For converting voice packet signal. Exchange existing PBX interface and LAN interface.
Telephone	Type: Analog 2wire, DTMF	1	For voice communication.
Spare Parts	LAN Arrester	1 set	For maintenance of the system.
Service Manuals	Operation & Maintenance Hand Book	1 set	For maintenance of the system.

Meteorological Data Communication System (Cox's Bazar Meteorological Office)

Name of Site: Cox's Bazar Meteorological Observatory			
Equipment	Specification	Quantity	Purpose
VoIP Gateway	-Type: H323 or SIP -Decoding method: G.723, G.729 or G.711 -VoIP Interface: phone-line (telephone, fax, etc.) -VoIP port : 4port -WAN interface: 10/100BASE-T	1	For converting voice packet signal. Exchange dial signal for telephone.
Telephone	Type: Analog 2wire, DTMF	1	For voice communication.
Spread Spectrum Transceiver with ODU	-Frequency: 2.4GHz ISM band -Radio Standard: IEEE802.11b/g -Output Power: 10mW/MHz or less -Wire Interface: 10/100BASE-T -Data Rate: 54Mbps -Modulation: DSSS/OFDM -Output Door standard: IP43 -LAN Arrester: For surge protection, RJ45 interface	1	High data rate transmission using radio of 2GHz band.
Antenna	-Frequency: 2.4GHz ISM Band -Type: Yagi Antenna -Gain: 19dBi -Impedance: 50ohm -VSWR: 1.3 or less -Polarization: Vertical -Beam width: Not more than 20 degree	1	Combination use with Spread Spectrum Transceiver.
Router	-LAN interface: IEEE 802.3 Ethernet -Connection port: 100BASE-T, two (2)ports -Routing: IP routing -Input power: AC 220V, single phase, 50Hz	1	For connecting and routing all the computing equipment on LAN.
Spare Parts	LAN Arrester	1 set	For maintenance of the system.
Service Manuals	Operation & Maintenance Hand Book	1 set	For maintenance of the system.

Meteorological Data Communication System (Dhaka Head Office)

Name of Site: Dhaka Storm Warning Centre			
Equipment	Specification	Quantity	Purpose
VoIP Gateway	-Type: H323 or SIP -Decoding method: G.723, G.729 or G.711 -VoIP Interface: phone-line (telephone, fax, etc.) -VoIP port : 4port -WAN interface: 10/100BASE-T	1	For converting voice packet signal. Exchange dial signal for telephone.
VoIP Exchanger	-Type: H323 or SIP -Decoding method: G.723, G.729 or G.711 -VoIP Interface: PBX-line (FXO/2W) -VoIP port : 4ports -WAN interface: 10/100BASE-T -IP address: fixed type	1	For converting voice packet signal. Exchange existing PBX interface and LAN interface.
Telephone	Type: Analog 2wire, DTMF	1	For voice communication.
Spare Parts	LAN Arrester	1 set	For maintenance of the system.
Service Manuals	Operation & Maintenance Hand Book	1 set	For maintenance of the system.

Meteorological Data Satellite Communication System (Cox's Bazar Meteorological Radar Station)

Name of Site: Cox's Bazar Radar Tower Building			
Equipment	Specification	Quantity	Purpose
VSAT Out-door Unit (ODU/Transmitter)	-Output Frequency Range: 5.925GHz～6.425GHz -Input Frequency Range: 950MHz～1450MHz -Output Power Level: +40dBm min -Linear Gain: 64dB nominal -External Reference: 10MHz(sin-wave) [Frequency] : -5 to +5 dBm [Input Power] -Input Dc power: +48 V DC(+38 to +60 V DC)	1	Transmitter for communicating meteorological service and radar data transmission via satellite.
VSAT Out-door Unit (ODU/LNB)	-Input Frequency Range: 3.700GHz～4.200GHz -Output Frequency Range: 950MHz～1450MHz -Noise Temp (Ta: +25 C): 35K typ. 45K max -Conversion Gain (Ta: +25 C): 60 dB min. 66 dB max -External Reference: 10MHz(sin-wave) [Frequency] : -10 to 0 dBm [Input Power] -Input Dc power: +13.5 to +24 V DC	1	Receiver for communicating meteorological service and radar data transmission via satellite.
VSAT Antenna	-Diameter: Approx 2.4m -Tx Frequency Range: 5.925GHz～6.425GHz -Rx Frequency Range: 3.700GHz～4.200GHz -Antenna Drive Method: Manual -Support Structure: Az - El mount	1	Antenna for communicating meteorological service and radar data transmission via satellite.
VSAT In-door Unit (IDU)	-Modulation Method: QPSK -Tx Output Frequency Range: (950MHz～1450MHz) -Rx Input Frequency Range: (950MHz～1450MHz) -Down-link Data Speed: 32kbps or 64kbps -Up-link data Speed: 32kbps or 64kbps -Number of Tx Channel: 1ch (Data, Voice) -Number of Rx Channel: 1ch (Data, Voice) -Output Reference : 10MHz(sin-wave) [Frequency] : -5 to +5 dBm [Output Power] (Tx Port) : 10MHz(sin-wave) [Frequency] : -10 to 0 dBm [Output Power] (Rx Port) -Output Dc power : +48 V DC (Tx Port) : +15 V DC (Rx Port) -Demodulation Method: Coherent Detection System -Data Interface: 10base-T or 100base-TX (Data, Voice) -Power Consumption: 300W or less including ODU	1	Modulator/Demodulator for communicating meteorological service and radar data transmission via satellite.
Test Instruments and Materials	Maintenance Terminal	1 set	For monitoring and controlling the system.
Spare Unit	Cooling Fan (for IDU)	1 set	For maintenance of the system.
Service Manuals	Operation & Maintenance Hand Book	1 set	For maintenance of the system.

Meteorological Data Satellite Communication System (Dhaka Head Office)

Name of Site: Dhaka Strom Warning Centre			
Equipment	Specification	Quantity	Purpose
HUB Out-door Unit (ODU/Transmitter)	-Output Frequency Range: 5.925GHz～6.425GHz -Input Frequency Range:(950MHz～1450MHz -Output Power Level: +40dBm min -Linear Gain: 64dB nominal -External Reference: 10MHz(sin-wave) [Frequency] : -5 to +5 dBm [Input Power] -Input Dc power : +48 V DC(+38 to +60 V DC)	1	Transmitter for communicating meteorological service and radar data transmission via satellite.
HUB Out-door Unit (ODU/LNB)	-Input Frequency Range: 3.700GHz～4.200GHz -Output Frequency Range: 950MHz～1450MHz -Noise Temp (Ta: +25 C): 35K typ. 45K max -Conversion Gain (Ta: +25 C): 60 dB min. 66 dB max -External Reference: 10MHz(sin-wave) [Frequency] : -10 to 0 dBm [Input Power] -Input Dc power : +13.5 to +24 V DC)	1	Receiver for communicating meteorological service and radar data transmission via satellite.
HUB Antenna	-Diameter: Approx 3.6m -Tx Frequency Range: 5.925GHz～6.425GHz -Rx Frequency Range: 3.700GHz～4.200GHz -Antenna Drive Method: Manual -Support Structure: Az - El mount	1	Antenna for communicating meteorological service and radar data transmission via satellite.
HUB In-door Unit (IDU)	-Modulation Method: QPSK -Tx Output Frequency Range: (950MHz～1450MHz) -Rx Input Frequency Range: (950MHz～1450MHz) -Down-link Data Speed: 32kbps or 64kbps -Up-link data Speed: 32kbps -Number of Tx Channel: 3ch (Data, Voice) -Number of Rx Channel: 3ch (Data, Voice) -Connectable with the Dhaka existing Comstream DT-8000 for communicating with Rangpur Meteorological Radar Station -Output Reference : 10MHz(sin-wave) [Frequency] : -5 to +5 dBm [Output Power] (Tx Port) : 10MHz(sin-wave) [Frequency] : -10 to 0 dBm [Output Power] (Rx Port) -Output Dc power : +48 V DC (Tx Port) : +15 V DC (Rx Port) -Demodulation Method: Coherent Detection System -Data Interface: 10base-T or 100base-TX (Data, Voice) -Equipment Rack: 19 inch Rack -Power Consumption: 800VA or less including ODU	1	Modulator/Demodulator for communicating meteorological service and radar data transmission via satellite.
Peripherals	AVR -Capacity: 3kVA or more -Input power: AC 220V ±15%, single phase, 50Hz -Output power: AC 220V ±10%, single phase, 50Hz	1	For supplying the constant voltage to the VSAT system.
	3kVA UPS -Capacity: 3kVA or more -Input power: AC 220V +/-15%, single phase, 50Hz -Output power: AC 220V +/-5%, single phase, 50Hz -Operation time: at least 5 minutes at full load	1	For supplying back-up AC power to VSAT system.

Test Instruments and Materials	Spectrum Analyzer	1 set	For maintenance of the system.
	Maintenance Terminal	1 set	
	Power Meter	1 set	
	Power Sensor	1 set	
	Frequency Counter	1 set	
	Protocol Analyzer	1 set	
	Bit Error Rate Analyzer	1 set	
Spare Unit	-Transmitter (10W)	1 set	For maintenance of the system.
	-LNB	1 set	
	-Modem (for HUB IDU)	1 set	
	-Modem (for VSAT IDU)	1 set	
	-Combiner/Divider (for HUB IDU)	1 set	
	-ODU PWR (for HUB IDU)	1 set	
	-Cooling Fan (for HUB IDU)	1 set	
	-Built-in type HDD (for HUB IDU)	1 set	
	-Built-in Type Cooling Fan (for Internal unit of HUB IDU)	1 set	
	-Battery (for AVR and UPS)	1 set	
Service Manuals	Operation & Maintenance Hand Book	1 set	For maintenance of the system.

Meteorological Satellite Data Receiving System (Dhaka Head Office)

Name of Site: Dhaka Strom Warning Centre			
Equipment	Specification	Quantity	Purpose
MTSAT Receiver	Input Impedance: 50ohms Input frequency: 140MHz Power output for LNA and Downconverter Demodulation modes: MTSAT HiRID, HRIT, LRIT Output: High speed computer interface (USB, 10-Base or backplane) Demodulation loss: < 1dB	1	For receiving signal from antenna and modulating it into data for ingest into the MTSAT Acquisition Workstation.
MTSAT Acquisition Workstation	Hardware Main processor: Intel Pentium4, 3.6GHz or better Main memory (RAM): 1024 Mbytes or more Hard disk unit: 160 Gbytes or more Floppy disk unit: one (1) drive for 3.5 inches disk (1.44Mbytes) CD-RW drive: >=32x, one (1) drive Monitor display: Color LCD type, 19 inches or more LAN interface: IEEE802.3/u, 10/100BASE-T, TCP/IP, one(1) port or more LAN Arrester: For surge protection, RJ45 interface Interface for Satellite Receiver Unit: one (1) port Input power: 220V AC, single phase, 50Hz Software Operating system: LINUX-based or Microsoft Windows Application software - Log system operation. - Receive data from the receiver and store raw data to disk. If there is a break in transmission, the software shall continue to store the remaining section of the transmission after the broadcast is resumed. - There shall be a “quick-look” display of the data as it is being received. - Dissemination of the pre-processed data to other users in real time shall occur as the data is being received. The destination computers shall be listed in a user defined dissemination list, which can be viewed and edited as required by the operator. - Monitoring and control of the antenna and reception process.	1	For processing raw data from the receiver and prepares it for processing by the Data Processor. It also provides an archive for raw data, allows users to monitor the system, and logs system operation.

Satellite Data Processor	Hardware Main processor: Intel Pentium4, 3GHz or better Main memory (RAM): 1024 Mbytes or more Hard disk unit: 250Gbytes, 7200 rpm Floppy disk unit: one (1) drive for 3.5 inches disk(1.44Mbytes) CD-RW drive: 48x32x48x, one (1) drive Monitor display: Color LCD type, 19 inches or more, supporting 1280x1024 resolution LAN interface: IEEE802.3/u, 10/100BASE-T, TCP/IP, one (1) port or more LAN Arrester: For surge protection, RJ45 interface Input power: 220V AC, single phase, 50Hz Software Operating system: LINUX-based or Microsoft Windows Application software For data processing - Receive data from the Acquisition Workstation. - Store raw and processed data for rapid retrieval - Act as database for satellite data, output products and textual information relating to processing of MTSAT data. - Monitor and control the reception process For data display - Input: HDF4, binary -Output: geo-referenced, calibrated imageries (channels: VIS, IR, WV) - Projection: Original view, stereographic, Mercator, equidistant cylindrical - Coast line overlay feature - Animation	1	For operators and forecasters to process and analyze the formatted data, producing high level meteorological output suitable for weather forecasting, dissemination to other sites, and research.
Peripherals	Compact UPS - Capacity: 500VA or more - Input power: 220V AC ±15%, single phase, 50Hz - Output power: 220V AC ±5%, single phase, 50Hz Operation time: at least 20 minutes	2	For power back-up to computers.
	AVR - Capacity: 600VA or more - Input power: AC 220V ±20%, single phase, 50Hz - Output power: AC 220V ±10%, single phase, 50Hz	2	For supplying the constant voltage to the computer.
Spare Parts	Hard Disk Unit for Computer (not less than 160GB)	1 set	For maintenance of the system.
	MPU (3.6GHz or equivalent)	1 set	
	Memory (not less than 1024MB)	1 set	
	LAN Arrester	1 set	
Service Manuals	Operation & Maintenance Hand Book	1 set	For maintenance of the system.

<Phase-2>

Meteorological Radar System (Khepupara Meteorological Radar Station)

Name of Site: Khepupara Radar Tower Building (Radome Floor)			
Equipment	Specification	Quantity	Purpose
Radome	Type: Sandwich Type (Spherical surface) Dimension: Approx. 8m diameter Color: White Suitable non-observant and non-water stickling finish for making smooth surface Allowable velocity pressure: 7400 N/m^2 Suitable Frequency: 2,850MHz (+/-2MHz) Transmission loss: 0.5dB or less on one way path in dry Lightning Rod: Protecting angles of 60degree Obstruction light: Waterproof lightning system Base ring including necessary installation materials	1	For protecting the radar antenna assembly (a parabolic dish reflector)and maintenance personnel from severe weather conditions and lightning attacks.
Antenna	Type: Horn feed parabolic antenna Reflector: approx. 5m diameter Suitable Frequency: 2,850MHz (+/-2MHz) Beam width: not wider than 1.7 degree at -3dB point Antenna gain: 39dB or more without Radome Polarization: Linear, horizontal Side lobe level: not more than -25dB without Radome Driving range: Azimuth 360 degree, elevation -2 to +90 degree VSWR: not more than 1.4 without Radome Optical connection box: For converting electric control signal to optical one Directional coupler: Coupling coefficiency: forward –50dB +/-2dB backward –35dB +/-1dB VSWR: lass than 1.10 Rating power: not lass than 1MW	1	For radiating radar beam into the atmosphere and receiving scatter waves while rotating the parabola antenna as azimuth and elevation direction.
Name of Site: Khepupara Radar Tower Building (Radar Equipment Room)			
Equipment	Specification	Quantity	Purpose
Antenna Controller	Control mode: Programming mode and manual control mode Driving range: Azimuth 360 degree, elevation –2 to +90 degree Rotation speed Azimuth: 0.5 to 6 rpm (6 rpm in operation) Elevation: not more than 17 second for each way scan between -2 and 60 degree Automatically and manually capable for clockwise and counterclockwise rotation in AZ and up & down in EL Accuracy of specified angle for both antenna calibration and digital readout: Azimuth: not more than +/-0.1 degree Elevation: not more than +/-0.1 degree	1	For rotation a parabolic dish reflector and for controlling the antenna in azimuth and elevation by both of horizontal and vertical drive motor units.
Transmitter	Transmitting frequency: 2,850MHz (S-band) Transmitting power: 500kW peak (at Tx output) Modulator: Solid state type Pulse width: from 0.4 μs to 2.0 μs Pulse repetition frequency (PRF): [Doppler Mode: Dual PRF] From 500Hz to 1,800Hz (Pulse width: 1.0 μs) selectable [Intensity Mode: Single PRF] From 200 Hz to 300Hz (Pulse width: 2.0 μs) selectable Condition Display: Transmission hour, pre-heat hour, status of Local/Remote control	1	For generation and emitting pulse-modulated power with stable frequency and transmitting the power to the antenna.

Amplifier Tube Unit (ATU)	Triple transmitting tube: klystron type (including ageing unit) Cooling: Forced air cooling Insulation system: Oil tank Exchange unit of tube system internally mounted	1	For generation pulse-modulated power with stable frequency.
Digital Receiver and Signal Processor (DRSP)	Noise figure of the high frequency circuit: 3dB or better at the input terminal of low noise amplifier (LNA) Receiver type: Coherent IF digitizer Sensitivity: -110dBm or better (at 10us plus) Dynamic range: 80dB or better from noise level to saturated level (depending on matched filter bandwidth) Quantization: 14 bits Range bin: 1024 Processing area: throughout 0 km to 400 km in range and 0 to 360 degree in azimuth Area: 800km x 800km (Intensity Mode) 240km x 240km (Doppler Mode) Data grid: 2.5km x 2.5km (Intensity Mode) : 1.0km x 1.0km (Doppler Mode) Intensity mode Ground clutter suppression: Chebyshev IIR digital high pass filter with minimum influence to precipitation intensity Logarithmic linearity: within +/-1dB throughout 80dB Range correction: depending on radar equation Air-attenuation correction: 0.005dB/km in Observation Range Velocity mode Processing type: Pulse Pair, FFT and Random Phase Velocity De-arising: Real-time processing by Dual-PRF Trigger control: PRF selectable (2:3, 3:4, 4:5) Averaging: Block averaging and/or sliding averaging Output data: Reflectivity (Z), Doppler velocity (V), Spectrum width (W) Output data resolution: 8bit or 16bit Output data indicating interval: within 1 minute after automatic scan Time adjustment: Automatically adjustment by GPS NTP server (including antenna)	1	For receiving and processing video echo signal from a RF receiver in the transmitter. For suppressing unnecessary echo such as clutter signals reflected from ground. For sending ingest data to radar TASK controller.
Dehydrator	-Capability of ventilation pressure: 3+/-1 liter/min, -Normal:200 hPa -Upper limit: 300 +/-30 hPa -Lower limit: 70+/-30 hPa	1	For supplying dried and pressurized air into the wave-guide to reduce wave propagation loss.
Wave-guide Configuration	-Wave-guide Type: S-band wave-guide (conformity with WR-284 or equivalent) -Circulator Allowable maximum power: at least 700 kW -TR limiter (x4) Type: Dual back up type	1	For feeder line for propagation wave traveling between the antenna and TX/RX.

Radar TASK Controller	CPU: Intel Pentium 4, 3.6GHz or equivalent Main memory (RAM): 1024Mbytes or more Hard disk unit: 160Gbytes or more x two (2) drives Floppy disk unit: one (1) drive for 3.5 inches disk (1.44Mbytes) CD-R/W drive: one (1) drive Monitor display: Color LCD type, 17 inches or more LAN interface: IEEE802.3, 10/100BASE-T,TCP/IP, two (2)ports or more LAN Arrester: for surge protection, RJ45 interface Input power: AC 220V, 50Hz, single phase Software Operation system: UNIX or LINUX-based Application software: -Radar local control and monitoring -Observation scheduling -Radar echo display -Radar data generation and dissemination	1	For operating the radar system, monitoring condition of the radar system and generating raw product data. Monitoring items: Radiate control/status Azimuth/elevation Position control/status TX standby status Pulse width control/status Antenna local/maintenance mode status
Data & protocol converter	CPU: Intel Pentium 4, 3.6GHz or equivalent Main memory (RAM): 1024Mbytes or more Hard disk unit: 160Gbytes or more x two (2) drives Floppy disk unit: one (1) drive for 3.5 inches disk (1.44Mbytes) CD-R/W drive: one (1) drive Monitor display: Color LCD type, 17 inches or more LAN interface: IEEE802.3, 10/100BASE-T,TCP/IP, two (2)ports or more LAN Arrester: for surge protection, RJ45 interface Input power: AC 220V, 50Hz, single phase Software Operation system: UNIX or LINUX-based Application software: -Data receiving, converting and transfer -Parameter setting -Display processing -Web server feature	1	For sending Raw data to Strom Warning Center according to specified interval.
Peripherals	Compact UPS -Capacity: 500VA or more -Input power: AC 220V +/-15%, single phase, 50Hz -Output power: AC 220V +/-5%, single phase, 50Hz -Operation time: at least 5 minutes at full load	2	For supplying back-up AC power to computing equipment in order to keep the shutdown time of the system in case of power failure.
	1kVA UPS -Capacity: 1kVA or more -Input power: AC 220V +/-15%, single phase, 50Hz -Output power: AC 220V +/-5%, single phase, 50Hz -Operation time: at least 5 minutes at full load	1	For supplying back-up AC power to computing equipment in order to keep the shutdown time of the system in case of power failure.
	Dual Switch -LAN interface: IEEE 802.3 Ethernet -Connection port: 100BASE-T, eight (8)ports -Input power: AC 220V, single phase, 50Hz -Each ports and power supply shall be duplicated	1	For connecting all the computing equipment with LAN.
	Color printer -Color inkjet type, A3 size -At least 1200 dpi resolution, 7ppm of faster printing speed -Interface USB, SCSI or LAN -Input power: AC 220V, single phase, 50Hz	1	For printing radar image.
	Optical Repeater -LAN interface: IEEE 802.3 Ethernet -Connection port: 100BASE-T, one (1) port Optical fiber interface one (1) set Multi-mode (100Mbps) -Input power: AC 220V, single phase, 50Hz	1	For converting electrical signal and optical signal on LAN.

	Radar Power Maintenance Box -Circuit breaker: no-fuse-breaker type -Main breaker -Power distribution: 5 outputs include 1 spare -Input power: AC 220V, single phase, 50Hz -Output power: AC 220V, single phase, 50Hz	1	For distributing and supplying AC power to radar system.
Name of Site: Khepupara Radar Tower Building (Electricity Room)			
Equipment	Specification	Quantity	Purpose
Isolation Transformer	-Capacity: 35kVA or more -Input Power: AC 220V, single phase, 50Hz -Output Power: AC 220V, single phase, 50Hz -Insulation: Class B -Surge voltage: 30kV or more	1	For protecting each equipment from surge voltage in main power.
Radar AVR	-Capacity: 30kVA or more -Input Power: AC 220V +/-20%, single phase, 50Hz -Output Power: AC 220V +/-5%, single phase, 50Hz	1	For supplying the constant voltage to the radar system.
Name of Site: Khepupara Radar Tower Building (Radar Power Backup Room)			
Equipment	Specification	Quantity	Purpose
Flywheel Power Back Up Unit	-Back up period: 4 minutes or more for radar equipment -Input voltage: AC 220V(single phase 50Hz) -Normal output: Direct output of input voltage -CVCF output: AC 220V +/-5%, single phase, 50Hz -Battery less type	1	For supplying the uninterrupted power by flywheel energy to the radar system when power failure is occurred.
Name of Site: Khepupara Radar Tower Building (Maintenance Room)			
Equipment	Specification	Quantity	Purpose
Test Instruments and Materials	Test signal card	1 set	For maintenance of radar system.
	Power meter	1 set	
	Power sensor	1 set	
	Frequency counter	1 set	
	Detector	1 set	
	Attenuator set with terminator	1 set	
	Terminator for detector	1 set	
	Oscilloscope	1 set	
	Digital multi meter	1 set	
	CW Converter	1 set	
	Tool Kit	1 set	
	Extension cable	1 set	
	Leveler	1 set	
	Step ladder	1 set	
	Clump current meter	1 set	
	High voltage probe	1 set	
	Vacuum cleaner	1 set	

Spare Parts	Klystron	1 set	For maintenance of radar system.
	TR Limiter (x2)	1 set	
	RX Card for DRSP	1 set	
	Timing belt for Antenna	1 set	
	Encoder for Antenna	2 sets	
	Motor for Antenna	2 sets	
	Servo unit for Antenna Controller	2 sets	
	Control Card for Antenna Controller	1 set	
	Power Supply Unit for Antenna Controller	1 set	
	Timer Relay for Transmitter	1 set	
	Blower Unit for Transmitter	2 sets	
	Fan Unit for Transmitter	2 sets	
	Modulator Unit for Transmitter	1 set	
	Control Card for Transmitter	1 set	
	Power Supply Unit for Transmitter	1 set	
	HV Power Unit for Transmitter	1 set	
	Ion Pump Power Supply Unit	1 set	
	Hard Disk Unit for Computer (not less than 160GB)	1 set	
	LAN Arrester	1 set	
	CD-R/W Drive	2 sets	
	MPU (3.6GHz or equivalent)	1 set	
	Memory (not less than 1024MB)	1 set	
	Obstruction Light	2 sets	
	CD-R	20 discs	For storing of the observed data.
Consumables	Grease with pump and oil with jug for Antenna	1 set	For maintenance of radar system.
	Carbon Brush for Power	1 set	For maintenance of radar system.
	Carbon Brush for Signal	1 set	For maintenance of radar system.
	Printer Ink Cartridge	1 set	For printing radar image.
Service Manuals	Operation & Maintenance Hand Book	2 sets	For maintenance of radar system.

Meteorological Radar Data Display System (Khepupara Meteorological Radar Station)

Name of Site: Khepupara Radar Tower Building (Observation Room)			
Equipment	Specification	Quantity	Purpose
Severe Storm and Doppler Velocity Indicator	CPU: Intel Pentium 4, 3.6GHz or equivalent Main memory (RAM): 1024Mbytes or more Hard disk unit: 160Gbytes or more x two (2) drives Floppy disk unit: one (1) drive for 3.5 inches disk (1.44Mbytes) CD-R/W drive: one (1) drive Monitor display: Color LCD type, 17 inches or more LAN interface: IEEE802.3, 10/100BASE-T,TCP/IP, one (1) port or more LAN Arrester: for surge protection, RJ45 interface Input power: AC 220V, 50Hz, single phase Software Operation system: UNIX or LINUX-based Application software: -Basic data monitoring feature -Weather product processing -Map projection -Product display & retrieval	1	For monitoring and alerting of severe storm condition by various doppler radar products.

Cyclone Tracking Monitor	CPU: Intel Pentium 4, 3.6GHz or equivalent Main memory (RAM): 1024Mbytes or more Hard disk unit: 160Gbytes or more x two (2) drive Floppy disk unit: one (1) drive for 3.5 inches disk (1.44Mbytes) CD-R/W drive: one (1) drive Monitor display: Color LCD type, 17 inches or more LAN interface: IEEE802.3, 10/100BASE-T,TCP/IP, one (1) port or more LAN Arrester: for surge protection, RJ45 interface Input power: AC 220V, 50Hz, single phase Software Operation system: UNIX, LINUX-based or Microsoft Windows Application software: -Radar local control and monitoring -Observation scheduling -Basic data monitoring feature -Weather product monitoring and display -Map projection -Product display & retrieval	1	For tracking cyclone and predicting cyclone course and time.
Peripherals	Color printer -Color inkjet type, A3 size -At least 1200 dpi resolution, 7ppm of faster printing speed -Interface USB, SCSI or LAN -Input power: 220V, single phase, 50Hz	1	For printing radar image.
	Dual Switch -LAN interface: IEEE 802.3 Ethernet -Connection port: 100BASE-T, eight (8)ports -Input power: AC 220V, single phase, 50Hz -Each ports and power supply shall be duplicated	1	For connecting all the computing equipment with LAN.
	Optical Repeater -LAN interface: IEEE 802.3 Ethernet -Connection port: 100BASE-T, one (1)port Optical fiber interface one(1)set Multi-mode (100Mbps) -Input power: AC 220V, single phase, 50Hz	1	For converting electrical signal and optical signal on LAN.
	Compact UPS -Capacity: 500VA or more -Input power: AC 220V ±15%, single phase, 50Hz -Output power: AC 220V ±5%, single phase, 50Hz -Operation time: at least 5 minutes at full load	2	For supplying back-up AC power to computing equipment for shutdown the system in case of power failure.

Name of Site: Khepupara Radar Tower Building (Data Analysis Room)			
Equipment	Specification	Quantity	Purpose
Data Analyzing Unit	CPU: Intel Pentium 4, 3.6GHz or equivalent Main memory (RAM): 1024Mbytes or more Hard disk unit: 160Gbytes or more x two (2) drive Floppy disk unit: one (1) drive for 3.5 inches disk (1.44Mbytes) CD-R/W drive: one (1) drive Monitor display: Color LCD type, 17 inches or more LAN interface: IEEE802.3, 10/100BASE-T,TCP/IP, one (1) port or more LAN Arrester: for surge protection, RJ45 interface Input power: AC 220V, 50Hz, single phase Software Operation system: UNIX or LINUX-based Application software: -Basic data monitoring feature -Weather product processing -Map projection -Product display & retrieval	1	For analyzing weather phenomena by observed radar data.
Peripherals	Color printer -Color inkjet type, A3 size -At least 1200 dpi resolution, 7ppm of faster printing speed -Interface USB, SCSI or LAN -Input power: 220V, single phase, 50Hz	1	For printing radar image.
	Compact UPS -Capacity: 500VA or more -Input power: AC 220V ±15%, single phase, 50Hz -Output power: AC 220V ±5%, single phase, 50Hz -Operation time: at least 5 minutes at full load	1	For supplying back-up AC power to computing equipment for shutdown the system in case of power failure.
Spare Parts	Hard Disk Unit for Computer (not lass than 160GB)	1 set	For maintenance of the system.
	MPU (3.6GHz or equivalent)	1 set	
	Memory (not less than 1024MB)	1 set	
	LAN Arrester	1 set	
	CD-R	20 discs	For printing of the observed data.
Consumables	Printer Ink Cartridge	2 set	For printing radar image.
Service Manuals	Operation & Maintenance Hand Book	1 set	For maintenance of the system.

Meteorological Data Communication System (Khepupara Meteorological Radar Station)

Name of Site: Khepupara Radar Tower Building (Radar Equipment Room)			
Equipment	Specification	Quantity	Purpose
VoIP Gateway	-Type: H323 or SIP -Decoding method: G.723, G.729 or G.711 -VoIP Interface: phone-line (telephone, fax, etc.) -VoIP port : 4port -WAN interface: 10/100BASE-T	1	For converting voice packet signal. Exchange dial signal for telephone.
Telephone	Type: Analog 2wire, DTMF	1	For voice communication.
Name of Site: Khepupara Radar Tower Building (Observation Room)			
Equipment	Specification	Quantity	Purpose
VoIP Gateway	-Type: H323 or SIP -Decoding method: G.723, G.729 or G.711 -VoIP Interface: phone-line (telephone, fax, etc.) -VoIP port : 4port -WAN interface: 10/100BASE-T	1	For converting voice packet signal. Exchange dial signal for telephone.

VoIP Exchanger	-Type: H323 or SIP -Decoding method: G.723, G.729 or G.711 -VoIP Interface: PBX-line (FXO/2W) -VoIP port : 4ports -WAN interface: 10/100BASE-T -IP address: fixed type	1	For converting voice packet signal. Exchange existing PBX interface and LAN interface.
Telephone	Type: Analog 2wire, DTMF	1	For voice communication.
Spare Parts	LAN Arrester	1 set	For maintenance of the system.
Service Manuals	Operation & Maintenance Hand Book	1 set	For maintenance of the system.

Meteorological Data Satellite Communication System (Khepupara Meteorological Radar Station)

Name of Site: Khepupara Radar Tower Building			
Equipment	Specification	Quantity	Purpose
VSAT Out-door Unit (ODU/Transmitter)	-Output Frequency Range: 5.925GHz～6.425GHz -Input Frequency Range: (950MHz～1450MHz -Output Power Level: +40dBm min -Linear Gain: 64dB nominal -External Reference: 10MHz(sin-wave) [Frequency] : -5 to +5 dBm [Input Power] -Input Dc power : +48 V DC(+38 to +60 V DC)	1	Transmitter for communicating meteorological service and radar data transmission via satellite.
VSAT Out-door Unit (ODU/LNB)	-Input Frequency Range: 3.700GHz～4.200GHz -Output Frequency Range: 950MHz～1450MHz -Noise Temp (Ta: +25 C): 35K typ. 45K max -Conversion Gain (Ta: +25 C): 60 dB min. 66 dB max -External Reference: 10MHz(sin-wave) [Frequency] : -10 to 0 dBm [Input Power] -Input Dc power: +13.5 to +24 V DC	1	Receiver for communicating meteorological service and radar data transmission via satellite.
VSAT Antenna	-Diameter: Approx 2.4m -Tx Frequency Range: 5.925GHz～6.425GHz -Rx Frequency Range: 3.700GHz～4.200GHz -Antenna Drive Method: Manual -Support Structure: Az - El mount	1	Antenna for communicating meteorological service and radar data transmission via satellite.
VSAT In-door Unit (IDU)	-Modulation Method: QPSK -Tx Output Frequency Range: (950MHz～1450MHz) -Rx Input Frequency Range: (950MHz～1450MHz) -Down-link Data Speed: 32kbps or 64kbps -Up-link data Speed: 32kbps or 64kbps -Number of Tx Channel: 1ch (Data, Voice) -Number of Rx Channel: 1ch (Data, Voice) -Output Reference : 10MHz(sin-wave) [Frequency] : -5 to +5 dBm [Output Power] (Tx Port) : 10MHz(sin-wave) [Frequency] : -10 to 0 dBm [Output Power] (Rx Port) -Output Dc power : +48 V DC (130 W max) (Tx Port) : +15 V DC (400mA max) (Rx Port) -Demodulation Method: Coherent Detection System -Data Interface: 10base-T or 100base-TX (Data, Voice) -Power Consumption: 300W or less including ODU	1	Modulator/Demodulator for communicating meteorological service and radar data transmission via satellite.
Test Instruments and Materials	Maintenance Terminal	1 set	For monitoring and controlling the system.
Spare Unit	Cooling Fan (for IDU)	1 set	For maintenance of the system.
Service Manuals	Operation & Maintenance Hand Book	1 set	For maintenance of the system.

(3) Basic Plan of the Facility

1) Site and Facility Layout Plan

< Cox's Bazar>

The Cox's Bazar Meteorological Radar Observation Station is located on a small hilltop facing the Bay of Bengal. It is a very suitable site for radar observations for monitoring cyclones in the Bay of Bengal. The existing radar building is located on the west side of the station, and it has become vulnerable to collapse because of landslides. Therefore, it is planned to put the new radar tower building on the east side of the station. The available open area on the east side is a bit small for construction of the proposed radar tower building, therefore the existing engine generator shed must be demolished. There are no obstructions which would cause installation problems in the area surrounding the station; however there are a lot of tall native trees and bamboo plants which may obstruct radar observations. The current station infrastructure includes commercial power, a water well and telecommunication lines, but drainage and sewerage facilities are not available.

Site Location: 21°26'03"N, 91°58'35"E

Site Conditions:

- Construction site : minimum required size of the building plot is available (demolition of the existing engine generator shed is required)
- Power supply : 150kVA transformer (output: AC 440V, 3 phase 4 wires, 50Hz) to be installed by BMD is required
- Water supply : well water is available in the premises
- Sewerage : not available (a septic tank and a seepage pit are required)
- Telephone : the existing lines or new lines are usable

<Khepupara>

The Khepupara Meteorological Radar Observation Station is located in a paddy field zone and is adjacent to an arterial road. In the area surrounding the station, there are no obstructive buildings, however, on the southwest side of the station, there is a Bangladesh Telegraph and Telephone Board (BTTB) guyed steel tower (67m high). It is estimated that the tower is not a serious obstruction to the radar observation.

During cyclones, 7-10m storm surges may affect the station, so the new radar tower building must be of an elevated floor design as is the existing radar observation building. The current station infrastructure includes commercial power, water well and telecommunication lines, but drainage and sewerage facilities are not available. The building plot in the station is sufficiently large to accommodate the radar tower building.

Site Location: 21°59’21”N, 90°13’07”E

Site Conditions:

- Construction site : sufficient flat space is available
- Power supply : 150kVA transformer (output: AC 440V, 3 phase 4 wires, 50Hz) to be installed by BMD is required
- Water supply : usable water supply pipe for the Project has been laid along the road on the north side of the premises and water supply service has recently started functioning (from March 2005)
- Sewerage : not available (a septic tank and a seepage pit are required)
- Telephone : the existing lines or new lines are usable

2) Architectural Design

[1] Floor Plan

The floor plan is virtually symmetrical, making possible a structural design that is safe and avoids any kind of eccentricity. The floor plan for the central portion of the radar tower buildings allows the various rooms to be arranged with great flexibility, since there are no structures such as columns and beams protruding into the internal staircase (which is also to serve as an evacuation route). Construction methods and materials follow local practice and the building is of standard grade in Bangladesh.

The floor area of each room, the number of working staff, the room’s function and the method of calculation of the size of each room are shown in the following tables.

Table 11: Calculation Base of Each Room
in Proposed Cox's Bazar Meteorological Radar Tower Building

Name of Room	Floor Area (m^2)	Number of Working Staff	Room Function	Calculation Base
Radome Room	30.17	–	Installation space for radar antenna apparatus.	Maintenance space for radar antenna apparatus. Room area depends upon radome base 6.2m in diameter.
Radar Equipment Room (including Spare Parts Storage: $1m^2$)	44.53	–	Installation space for antenna controller, transmitter, amplifier tube unit, digital receiver, signal processor, dehydrator, wave-guide configuration, radar task controller, power distribution box, optical repeater, VSAT terminal, maintenance box, maintenance cabinet, measuring instrument cabinet, air-conditioning units, etc.	Operation and maintenance space for all the apparatuses described in the left column. For installation of all the required equipment, at least $40m^2$ required.
Building Spare Parts Room	3.75	–	Storage for spare materials of the radar tower building	Approx. $4m^2$ secured as a storage space for spare materials of the radar tower building.
Observation Room	25.97	Shift Schedule Daytime: 4 Night Time: 2	For weather observation terminals (2) VoIP exchange, optical repeater, dual switch, printer, IP telephone, UPS for PCs, filing cabinets, white board, etc.	For radar observation space and installation space for all the equipment described in the left column, 6.5-$7m^2$/person is required. In daytime always 4 persons in operation, approx. $26m^2$ is required.
Maintenance Room	14.35	Daytime: 1 Night Time: 1	For maintenance instruments, measuring equipment, cabinets for operation & maintenance manuals and spare parts & consumables.	Maintenance space for various type of the equipment: $5m^2$ ($5m^2$/person). Keeping space for maintenance instruments, measuring equipment: at least $10m^2$. Cabinets for operation & maintenance manuals and spare parts & consumables: $5m^2$.
Data Analysis Room	15.12	Daytime: 2 Night Time: 1	For data analysis terminal (1), desk for the terminal and data storage cabinets (high type: 3).	Approx. $15m^2$ secured as a space for data analysis terminal (1), desk, data storage cabinets and also working space for day time staff.
Data Storage Room	8.99	–	For data storage cabinets (high type: 4) for keeping observation records and observed data of the radar system for analysis.	Necessary space for keeping all data secured.
Engine Generator Room	40.81	–	For 2 engine generators, service tank, accessories, etc	Approx. $40m^2$ required including installation, operation and maintenance space for 75kVA engine generators (2) with 1,000 liter service tank, automatic change-over switch, etc.
Electricity Room	11.69	–	For isolation transformers, power distribution boards, cable rack, test terminals, AVR, etc.	Installation, operation and maintenance space and cabling space for all the apparatuses described in the left column. Approx. $10m^2$ required.
Radar Power Backup Room	10.27	–	For radar power back-up unit and control rack.	Installation, operation and maintenance space for all the apparatuses described in the left column: approx. $10m^2$ required.
Toilet	6.37	–	Closet bow: 2, Wash basin: 1, Slop Sink: 1	–
Tea Kitchen	3.14	–	Kitchen: 1	–
Changing Room	2.80	–	Changing space for taking shower	–
Shower Room	2.33	–	Space for taking shower.	–
Storage	4.42	–	Storage space for spare materials and miscellaneous goods.	Approx. $4m^2$ secured as a storage space for spare materials and miscellaneous goods.
Pump Room	7.54	–	Well pump: 2 Pump for water reservoir tank: 2	For maintenance space and installation space for pumps: approx. $8\ m^2$ required.
Guard Room	3.24	–	Working desk for a guard man	For working space for a guard man: approx. $3m^2$ required.

Table 12: Calculation Base of Each Room
in Proposed Khepupara Meteorological Radar Tower Building

Name of Room	Floor Area (m^2)	Number of Working Staff	Room Function	Calculation Base
Radome Room	30.17	–	Installation space for radar antenna apparatus.	Maintenance space for radar antenna apparatus. Room area depends upon radome base 6.2m in diameter.
Radar Equipment Room (including Spare Parts Storage: 1m^2)	44.53	–	Installation space for antenna controller, transmitter, amplifier tube unit, digital receiver, signal processor, dehydrator, wave-guide configuration, radar task controller, power distribution box, optical repeater, VSAT terminal, maintenance box, maintenance cabinet, measuring instrument cabinet, air-conditioning units, etc.	Operation and maintenance space for all the apparatuses described in the left column. For installation of all the required equipment, at least 40m^2 required.
Building Spare Parts Room	3.71	–	Storage for spare materials of the radar tower building	Approx. 4m^2 secured as a storage space for spare materials of the radar tower building.
Observation Room	23.61	Shift Schedule Daytime: 3 Night Time: 2	For weather observation terminals (2) VoIP exchange, optical repeater, dual switch, printer, IP telephone, UPS for PCs, filing cabinets, white board, etc.	For radar observation space and installation space for all the equipment described in the left column, 6.5-7m^2/person is required. In daytime always 3 persons in operation, approx. 24m^2 is required.
Maintenance Room	15.27	Daytime: 1 Night Time: 1	For maintenance instruments, measuring equipment, cabinets for operation & maintenance manuals and spare parts & consumables.	Maintenance space for various type of the equipment: 5m^2 (5m^2/person). Keeping space for maintenance instruments, measuring equipment: at least 10m^2. Cabinets for operation & maintenance manuals and spare parts & consumables: 5m^2.
Data Analysis Room	10.09	Daytime: 1 Night Time: 1	For data analysis terminal (1), desk for the terminal and data storage cabinets (high type: 3).	Approx. 10m^2 secured as a space for data analysis terminal (1), desk, data storage cabinets and also working space for day time staff.
Data Storage Room	9.00	–	For data storage cabinets (high type: 4) for keeping observation records and observed data of the radar system for analysis.	Necessary space for keeping all data secured.
Engine Generator Room	39.33	–	For 2 engine generators, service tank, accessories, etc	Approx. 40m^2 required including installation, operation and maintenance space for 75kVA engine generators (2) with 1,000 liter service tank, oil pumps (2), automatic change-over switch, etc.
Electricity Room	9.02	–	For isolation transformers, power distribution boards, cable rack, test terminals, AVR, etc.	Installation, operation and maintenance space and cabling space for all the apparatuses described in the left column. Approx. 10m^2 required.
Radar Power Backup Room	10.19	–	For radar power back-up unit and control rack.	Installation, operation and maintenance space for all the apparatuses described in the left column: approx. 10m^2 required.
Toilet	5.95	–	Closet bow: 2, Wash basin: 1, Slop Sink: 1	–
Tea Kitchen	2.88	–	Kitchen: 1	–
Changing Room	3.00	–	Changing space for taking shower	–
Shower Room	1.92	–	Space for taking shower.	–
Storage	4.44	–	Storage space for spare materials and miscellaneous goods.	Approx. 4m^2 secured as a storage space for spare materials and miscellaneous goods.
Oil Storage	5.38	–	Storage space for fuel of the engine generators	For 1,000 liter service tank installation.
Pump Room	7.55	–	Well pump: 2 Pump for water reservoir tank: 2	For maintenance space and installation space for pumps: approx. 8 m^2 required.
Guard Room	3.29	–	Working desk for a guard man	For working space for a guard man: approx. 3m^2 required.

[2] Sectional Plan

I. Height of the Radar Tower Building

< Cox's Bazar>

The height of the existing radar tower building is approximately 13m to the top of the lightening rod located on the radome. In the area surrounding the station, there are a lot of tall native trees and bamboo plants which are about 16-19m high.

To avoid any interference from existing buildings, trees and bamboo plants and to provide approximately 2-3m clearance above them, the required height of the center of the antenna is 23m above ground level and the height of the top of the lightening rod is 29.3m.

<Khepupara>

The existing radar tower building has elevated floors (first and second floors) to avoid cyclonic storm surge damage. The height of the top of the lightening rod located on the radome is approximately 24m above ground level.

According to the past cyclone records, the maximum height of the storm surge on the west side of the Bay of Bengal is 8.5m and on the east side of the Bay 10.1m.

Therefore, the proposed radar tower building must have elevated floors, like the existing radar observation building. In addition, maintenance pits under the first floor, for the installation and maintenance of sanitary plumbing, and a service balcony for the operation and maintenance of the equipment rooms have been included in the design of the proposed radar tower building.

To avoid storm surge damage, the required height of the proposed building has been calculated as follows.

$H = Y - Yg + hf = 10.1 - 2.8 + 1 = 8.3m$

H : expected height of storm surge (m)
Y : 10.1m (maximum recorded height of storm surge)
Yg : 2.8m (above sea level)
hf : 1m (clearance)

The design therefore requires the height of the concrete slab for the service pit to be 8.5m (8.3m + 0.2m: the thickness of the slab) and the height of the first floor slab to be 9.7m. To avoid any interference from existing buildings, trees and bamboo plants and to provide approximately 2-3m clearance above them, the required height of the center of the antenna

is 32.3m above ground level and the height of the top of the lightening rod is 38.0m.

II. Ceiling

The radar equipment cable rack, which is located in the radar equipment room, and the observation room (the major rooms of the proposed radar tower buildings), must be protected against dust. In addition, so as to improve the air tightness of these rooms and to reduce equipment noise, the ceilings will be finished with acoustic boards. Since both of these rooms are to be air-conditioned, the use of ceiling boards will also improve the efficiency of this air-conditioning. Based on the dimensions of the intended equipment, the ceiling height of the radar equipment room has been set at 3.0m and the ceiling height of the observation room at about 2.6m.

III. External Walls

To combat the effects of local temperature and humidity, the external walls of the radar equipment room are designed as cavity walls in which glass wool is sandwiched for heat insulation. Because of the thermal insulation provided by the building design, the recurrent cost to BMD of power for air-conditioning systems will be minimized.

IV. Access Floor

The radar equipment room and the observation room will have an access floor with a clearance of 15cm for easy wiring of power and signal cables, easy maintenance and easy future expansion. An antistatic, heavy-duty access floor has been selected for the radar equipment room in which a high power radar transmitter weighting about 1 ton is to be installed.

V. Equipment Installation

In order to install all the equipment in the radar equipment room, a large opening would be necessary to allow equipment ingress. However, the large opening would be undesirable from the standpoint of air-tightness and dust proofing. The equipment will, therefore, be brought in via a loading balcony at the adjacent staircase room. For lifting the equipment, a lifting hook with a capacity of 2-tons will be installed on the upper part of this balcony.

The proposed Khepupara Radar Tower Building is designed with raised floors. All of the building equipment such as engine generators, power backup systems, etc. will be located on the first floor that is approximately 10m above ground level. For lifting the equipment, a lifting hook with a capacity of 2-tons will be installed on the upper part of the service balcony.

[3] Elevation Plan

The structural columns and beams will extend outside the building, enhancing the building design. Because of this, since columns and beams will not intrude into the staircase, the staircase will be able to comfortably handle traffic in both directions.

[4] Material Plan

Materials specified for both exterior and interior finishing are all available locally. They have been selected with a view to ease maintenance for BMD as follows.

Table 13: Finishing Materials of Proposed Cox's Bazar Meteorological Radar Tower Building

		Finishing Materials
Exterior Finishing	**Observation Deck**	Cement sand mortal base, Asphalt waterproofing, Insulation, Protection concrete, Base mortal, Cement tiles
	Roof Floor	Cement sand mortal base, Asphalt waterproofing, Insulation, Protection concrete, Base mortal, Cement tiles
	Walls	Concrete blocks Cement sand mortar base spray tile finish, Porcelain tiles
Interior Finishing	**Floors**	Carpet tiles Vinyl tiles Porcelain tiles Cement sand mortal base, Epoxy resin paint finish
	Skirtings	Wooden skirting, Synthetic resin oil paint finish Cement sand mortar, Vinyl paint finish Cement sand mortar, Epoxy resin paint finish
	Walls	Cement Sand mortal base, Vinyl paint finish Glazed ceramic tiles Glass wool with glass cloth
	Ceilings	Acoustic panels (Grid ceiling system) Cement board (Grid ceiling system) Cement sand mortar base Emulsion paint finish Glass wool with glass cloth
Window and Door	**Exterior**	Aluminum windows and doors Aluminum grilles Aluminum doors, Steel doors
	Interior	Aluminum doors, Steel doors, Wooden doors

Table 14: Finishing Materials of Proposed Khepupara Meteorological Radar Tower Building

		Finishing Materials
Exterior Finishing	**Observation Deck**	Cement sand mortal base, Asphalt waterproofing, Insulation, Protection concrete, Base mortal, Cement tiles
	Roof Floor	Cement sand mortal base, Asphalt waterproofing, Insulation, Protection concrete, Base mortal, Cement tiles
	Service Balcony	Cement sand mortal base, Epoxy resin paint finish
	Walls	Concrete blocks Cement sand mortar base spray tile finish, Porcelain tiles
Interior Finishing	**Floors**	Carpet tiles Vinyl tiles Porcelain tiles Cement sand mortal base, Epoxy resin paint finish
	Skirtings	Wooden skirting, Synthetic resin oil paint finish Cement sand mortar, Vinyl paint finish Cement sand mortar, Epoxy resin paint finish
	Walls	Cement Sand mortal base, Vinyl paint finish Glazed ceramic tiles Glass wool with glass cloth
	Ceilings	Acoustic panels (Grid ceiling system) Cement board (Grid ceiling system) Cement sand mortar base Emulsion paint finish Glass wool with glass cloth
Window and Door	**Exterior**	Aluminum windows and doors Aluminum grilles Aluminum doors, Steel doors
	Interior	Aluminum doors, Steel doors, Wooden doors

Table 15: Bases for Adoption of Materials
of Proposed Meteorological Radar Tower Buildings

		Bases for adoption of materials	Procurement
Exterior Finishing	**Roof Floor**	Due to external temperatures are high, reaching over 35 degrees, insulation board t=30mm will be required. Asphalt waterproofing is the most reliable waterproofing material to be protected by protection concrete, cement sand mortal and cement tiles.	To be procured locally
	Walls	Reinforced concrete blocks will be applied. Concrete blocks are generally used locally and are considered highly reliable in terms of both ease and accuracy of construction.	To be procured locally
Interior Finishing	**Floors**	Materials will be selected on the basis of superior durability and ease of maintenance. Vinyl tiles around offices, corridors and staircases will be applied. In rooms where dust must be avoided, a dust-proof paint finish will be specified.	To be procured locally
		In the offices where computer systems will be installed, access floors shall be applied for cabling under floor.	To be procured from the third countries
	Walls	Cement sand mortal (trowel-coated) will be applied primarily for its durability, and vinyl paint will be applied to avoid dirt. Glazed ceramic tiles will be laid in the toilets and the slop sink booth.	To be procured locally
	Ceilings	In order to enhance the environment and efficiency of air-conditioning, acoustic mineral boards will be used. Other rooms which will not require any ceiling board will be directly applied emulsion paint finish on cement and sand mortal.	To be procured locally
Windows and Door	**Exterior**	Aluminum and steel will be chosen throughout for reasons of durability, ease of handling and accuracy.	To be procured locally
	Interior	Wooden and steel with synthetic oil resin paint will be employed throughout for its handling ease during construction and from a maintenance standpoint.	To be procured locally

[5] Structural Plan

I. Structural Design Standard

Building standards and fire safety standards have not been firmly established yet in Bangladesh. However, the "Bangladesh National Building Code 1993", based on British Standards (BS) and American Society for Testing and Materials standards (ASTM), has been issued by the Government of Bangladesh. Thereby, it has been decided to design the proposed radar tower buildings in accordance with this code.

II. Structure Type

Reinforced concrete has been selected as the construction material for the proposed radar tower buildings because reinforced concrete construction is the most typical structural type in Bangladesh. The floor slabs are to be reinforced concrete while exterior walls and partition walls are locally made concrete blocks.

III. Foundation

As a consequence of the boring tests at each site, the availability of suitable load bearing layers for the building construction (N value: 50) at each site has been confirmed. To ensure radar observation accuracy, building robustness is important and the permissible horizontal deflection of the building must be not more than 0.085 degree. Cast-in-place concrete piles penetrating at least 0.5-1m into the load bearing layer are needed to meet the maximum permissible horizontal deflection requirement.

The ground floor slabs will be structural slabs, in order to prevent any damage to the building structure in case backfill and soft clay deposits under the ground sag due to consolidation.

[6] Design Load

I. Dead load

The weight of all the structural and finishing materials has been included in the dead weight calculation for the radar tower buildings. The estimated combined weight of the radome and radar antenna, to be mounted on the top of the radar tower building, is approximately 4.5 tons. The combined weight of the transmitter & receiver units, to be installed in the radar equipment room is approximately 3 tons, as a special dead load.

II. Live load

Since virtually most of all the major rooms in the radar tower building are equipment installation spaces, the live load of the radar tower buildings is deemed to be identical to

that of telecommunication equipment rooms in Japan.

III. Wind load

Since the designed height of the proposed Cox's Bazar Radar Tower Building is 29.3m and the proposed Khepupara Radar Tower Building is 38.0m and both proposed tower buildings are located in the coastal area which has quite a high probability of being hit by a cyclones, the following sustained wind pressure has been calculated in accordance with the "Bangladesh National Building Code 1993".

(Cc) = velocity-to-pressure conversion coefficient: 47.2×10^{-6}
(C1) = structure importance coefficient: 1.25 (essential facilities)
(Cz) = combined height and exposure coefficient: 1.846
(Vb) = basic wind speed in km/h obtained from the following map: 260km/h
(Qz) = sustained wind pressure: Cc x C1 x Cz x Vb^2 = 7,362N/m^2

The sustained wind pressure to be used for the Project = 7,400 N/m^2

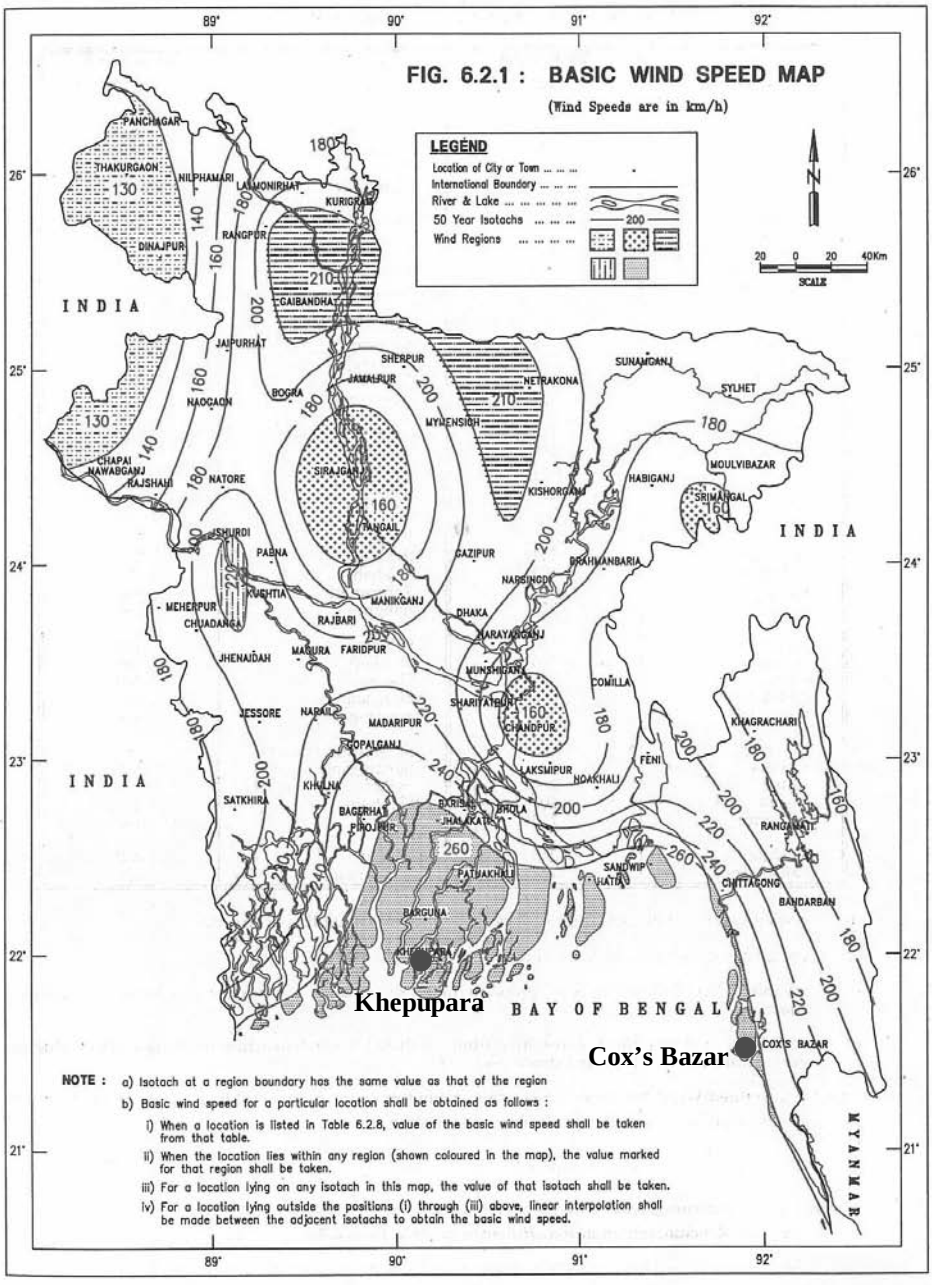


Figure 4: Basic Wind Speed "Bangladesh National Building Code 1993"

Seismic load

According to the "Bangladesh National Building Code 1993", Bangladesh is classified into three (3) seismic zones with seismic zone coefficients. Cox's Bazar is located in Zone 2 and Khepupara is located in Zone 1.

Zone 1 (south-west area) : Z=0.075
Zone 2 (north-west, central, south-east areas) : Z=0.15
Zone 3 (north area) : Z=0.25

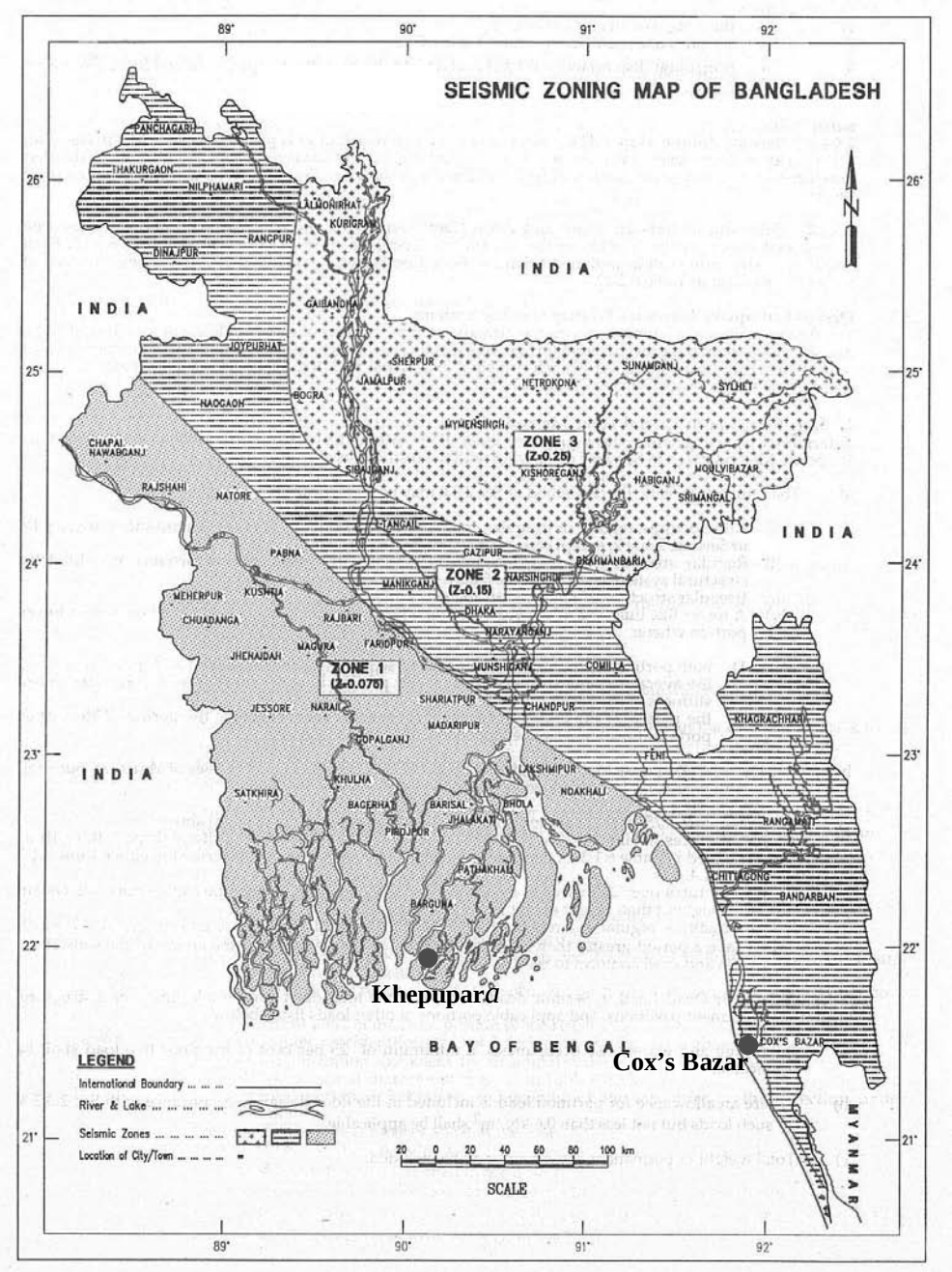


Figure 5: Seismic Zoning Map "Bangladesh National Building Code 1993"

IV. Structural building Material

All the materials for the building structure will be procured in Bangladesh.

- Concrete : conventional concrete
  specified concrete strength Fc= 21N/mm^2
- Cement : JIS or equivalent
- Deformed reinforcing bars : JIS or equivalent

JIS: Japan Industrial Standard

[7] Electrical Facility Design

I. Power intake facility

The required commercial power for the radar tower buildings will be stepped down to low-voltage by a new transformer (capacity: 150kVA, output: AC 440V, 3 phase 4 wires, 50Hz) to be installed by BMD at each radar observation station and will be connected through the existing BMD power meters to the radar tower buildings. In order to protect all of the equipment supplied under the Project against commercial power voltage fluctuation, a power voltage stabilizer will be installed in each radar tower building. The power inlet to the radar tower building, including wiring and power connection to a low-voltage switchboard, through a hand-hole to be installed under the Project, is one of the major scopes of work to be undertaken by BMD at its own expense.

II. Power generating facility

To ensure uninterrupted operation of the meteorological radar system and the other equipment, two engine generators with the following capacity are required for each proposed radar tower building, as a back-up power source during commercial power supply failures. During a cyclone, refueling for the engine generator is difficult. The longest continuous time a cyclone is expected to affect operations is 2.5 days. To ensure uninterrupted radar operation for 2.5 days a 1,000 liter service tank will be installed in the engine generator room of the building.

Capacity : 75 KVA
Output : 440V, 3 phase 4 wire, 50 Hz

III. Trunk line and power facility

Power will be distributed to the switchboard for lighting and to the electricity control panel from the distribution panel in the electrical room. The trunk line for distribution and the power line will use suitable cabling through conduits. An alarm for the power

equipment will be shown on an alarm panel in the observation room. The electrical systems for the trunk line and branch circuits are as follows.

- Trunk line for lighting and power : 440V/220V, 3 phase 4 wire
- Branch power circuits : 440V, 3 phase 4 wire
- Branch lighting circuits : 220V, single phase 2 wire
- Branch equipment circuits : 220V, single phase 2 wire

IV. Lighting and power outlet

The voltage required for lighting and power sockets is single-phase 220V and all the fixtures must be grounded. Steel pipes will be used for wiring conduits. Lighting fixtures will be mainly fluorescent, for their low power consumption, though incandescent fixtures will also be used to some extent, depending on the particular application.

The lighting levels in the various rooms will be approximately as shown below.

Radome Room:	200 Lx	Engine Generator Room	200 Lx
Radar Equipment Room:	300 Lx	Electricity Room:	200 Lx
Observation Room:	300 Lx	Pump Room:	200 Lx
Data Analysis Room:	300 Lx	Radar Power Backup Room:	200 Lx
Data Storage Room:	300 Lx	Entrance Hall:	200 Lx
Maintenance Room:	300 Lx	Other Rooms:	200 Lx

General-purpose power outlets will be equipped with switches. Dedicated power outlets are required in the radar equipment room, the observation room, the data analysis room, the data storage room and the maintenance room for the Project computing equipment.

V. Telephone system

The required lines will be extended to each site through the overhead cable lines available in the premises of each meteorological radar observation station. A service terminal box and a relay terminal box will be installed inside the radar tower buildings and telephone lines will be installed to outlets in those rooms requiring a telephone. The cabling work to the service terminal box will be conducted by BMD at its own expense. A private branch exchange (PBX) will be installed in the observation room and two telephone lines to be arranged by BMD will be required for each proposed building.

VI. Intercom system

In order to control night shift personnel and visitors, intercom systems will be installed in the various operating rooms (radar equipment room, observation room, maintenance room, data analysis room and guard room) and outside of the building entrance, as a security

measures.

VII. Alarm system

An alarm panel will be installed at the observation room. The following building equipment warnings will be provided.

- System failure of air-conditioning units in the radar equipment room
- System failure of radar power backup unit
- System failure and overheating of the engine generators
- Breaker tripping of the distribution boards

VIII. Grounding system

Grounding cables for the equipment installed on 1st and 6th floors will be connected to the terminal box for earthing. All the equipment to be installed in the electricity room and the radar power backup room will be grounded via the terminal box, while the telephone equipment will be grounded by erecting a grounding electrode and running a wire from there to the terminal box.

IX. Lightning protection system

A lightning rod will be installed on the top of the radome (included in the equipment portion of the Project), with roof conductors on the concrete handrails of parapets, the roof top, and the observation deck, to protect all the equipment and the radar tower buildings. A connection box will be placed at the radome room for the lightning rod. Inside the building structure, copper tapes will be laid in a vinyl pipe and grounded via the test terminal boxes.

X. Aviation obstruction light

A connection box for two obstruction lights on the top of the radome (which is part of the equipment portion of the Project) will be placed in the radome room. Four obstruction lights, to be installed at the observation deck, will be included in the building portion of the Project. For all of the obstruction lights, two power distribution boards will be installed on the first floor and in the radar equipment room and an automatic blinking switch will be installed on the first floor. All the aviation obstruction lights will be furnished with surge arresters. Connecting work between the obstruction lights on the top of radome and a connection box placed in the radome will be included in the equipment portion of the Project.

XI. Fire detection and alarm system

Fire detectors will be installed in the radar equipment room, the electricity room, the radar power backup room and the engine generator room, and an alarm system will be installed in the observation room.

[8] Water Supply, Drainage and Sanitary Fixture Design

I. Water supply system

< Cox's Bazar>

In the Cox's Bazar Meteorological Radar Observation Station, a well water supply system, located 200m from the station, already exists and the existing water supply pipe are available at the building site. To provide well water to the proposed radar tower building, a pump room (a small shed, separate from the radar tower) with a water reservoir tank and feed pumps is required. A gate valve for connecting the existing water supply pipe will be installed in the pump room, to be constructed under the Project. BMD will be responsible for connecting the plumbing to the gate valve.

<Khepupara>

The public water supply pipe (diameter: 8 inches) has been laid along the road on the north side of the premises of the Khepupara Meteorological Radar Observation Station. The public water supply service commenced operation in March 2005, so the public water supply can be used by the Project. For the water intake for the proposed radar tower building, a water supply gate valve will be installed in a scarcement of the building. BMD will be responsible for connecting the plumbing to a gate valve inside the scarcement.

II. Drainage system

Drainage will be divided into 2 systems - sewage and miscellaneous drainage. Sewage will primarily be treated in a septic tank and then be permeated by a seepage pit into the ground. Miscellaneous drainage will be fed directly into a seepage pit. A septic tank and a seepage pit must be constructed. The capacity of the septic tank and seepage pit for the radar tower building has been designed for 12 BMD personnel in the operations area and for some visitors.

III. Sanitary fixtures

- Closet bowl: Bangladesh local style
- Washbasin: wall-mounted type
- Slop sink: wall-mounted type

IV. Fire extinguisher

Fire extinguishers will be supplied in the following rooms.

Radome Room:	CO2 type	Engine Generator Room:	ABC type
Radar Equipment Room:	CO2 type	Electricity Room:	CO2 type
Observation Room:	CO2 type	Pump Room:	CO2 type
Data Analysis Room:	CO2 type	Radar Power Backup Room:	CO2 type
Data Storage Room:	CO2 type	Tea Kitchen:	ABC type
Maintenance Room:	CO2 type	Oil Storage (Kepupara only):	ABC type

[9] Air-conditioning and Ventilation System Design

Air-conditioning systems will be installed in the rooms listed below. It is essential to have a good operating environment, especially for the equipment in the radar equipment room and the observation room; therefore the plural number of air-conditioning systems is indispensable. Package type air-conditioning systems have been selected to minimize any impact to the operation of the radar system if an air-conditioning system fails.

- Radar Equipment Room
- Observation Room
- Data Analysis Room
- Data Storage Room
- Maintenance Room

Ceiling fan forced ventilation will be installed in the tea kitchen and the toilets. Due to the heat generated by the equipment in the radar equipment room, the engine generator room, the radar power backup room, the electricity room, pump room, etc., forced ventilation systems will be adopted. Furthermore, appropriate ventilation systems will be installed in other rooms to meet the following conditions.

<Environmental conditions>

- Outside condition: 35°C (maximum temperature)
- Indoor condition: temperature 26°C humidity 40-60%
  In the radar equipment room: temperature 25°C humidity 40-60%

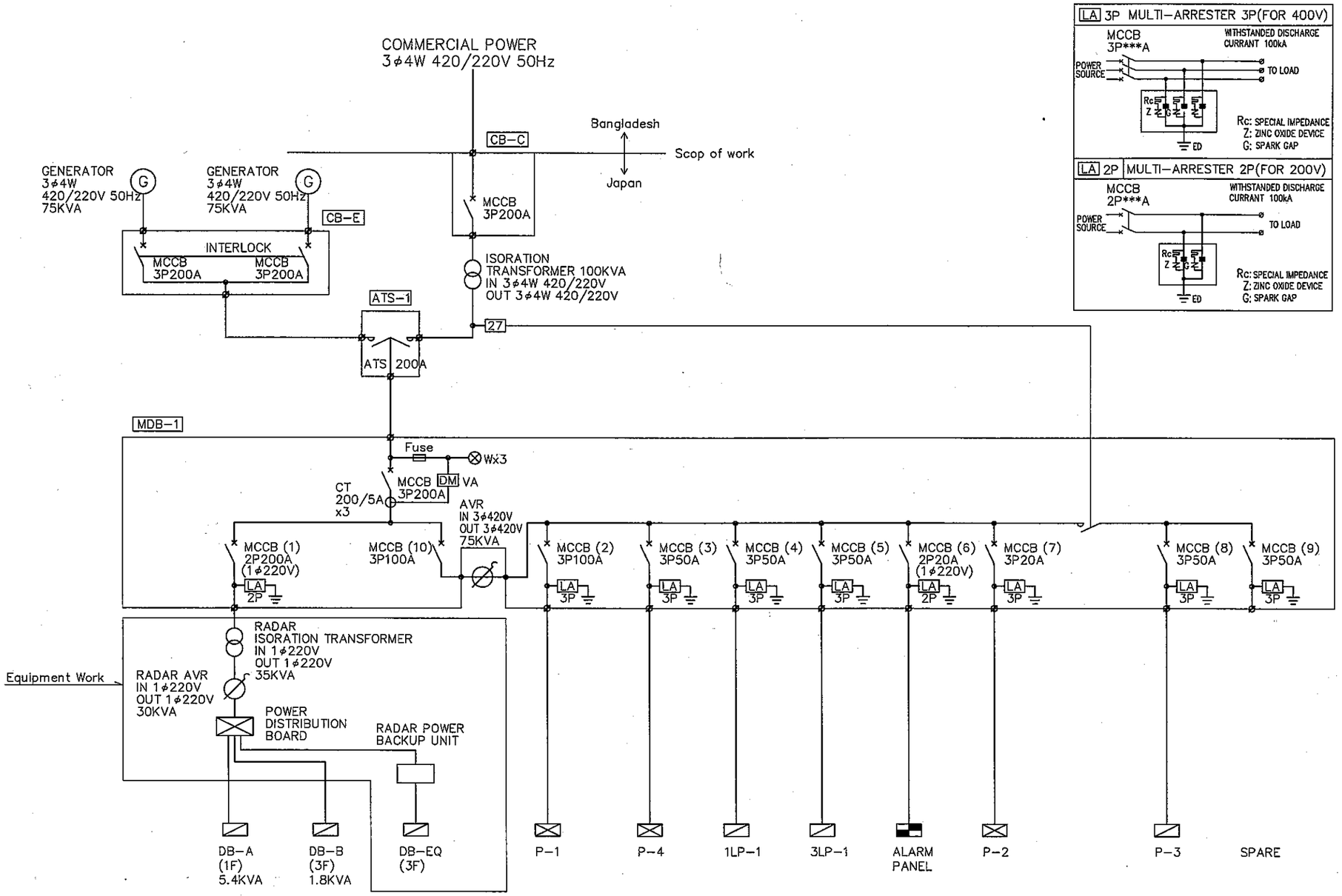
The following diagrams of the building equipment plan for the radar tower buildings are attached from the next page.

<Cox's Bazar Meteorological Radar Tower Building>

- Power Receiving System Diagram — Diagram 1 (ME-C01)
- Feeder & Power System Diagram — Diagram 2 (ME-C02)
- Telephone & Intercom System Diagram — Diagram 2 (ME-C02)
- Fire Detection System Diagram — Diagram 3 (ME-C03)
- Alarm System Diagram — Diagram 3 (ME-C03)
- Lightning Protection & Grounding System Diagram — Diagram 4 (ME-C04)
- Obstruction Light System Diagram — Diagram 4 (ME-C04)
- Water Supply & Sewage System Diagram — Diagram 5 (ME-C05)
- Air-conditioning & Ventilation System Diagram — Diagram 6 (ME-C06)

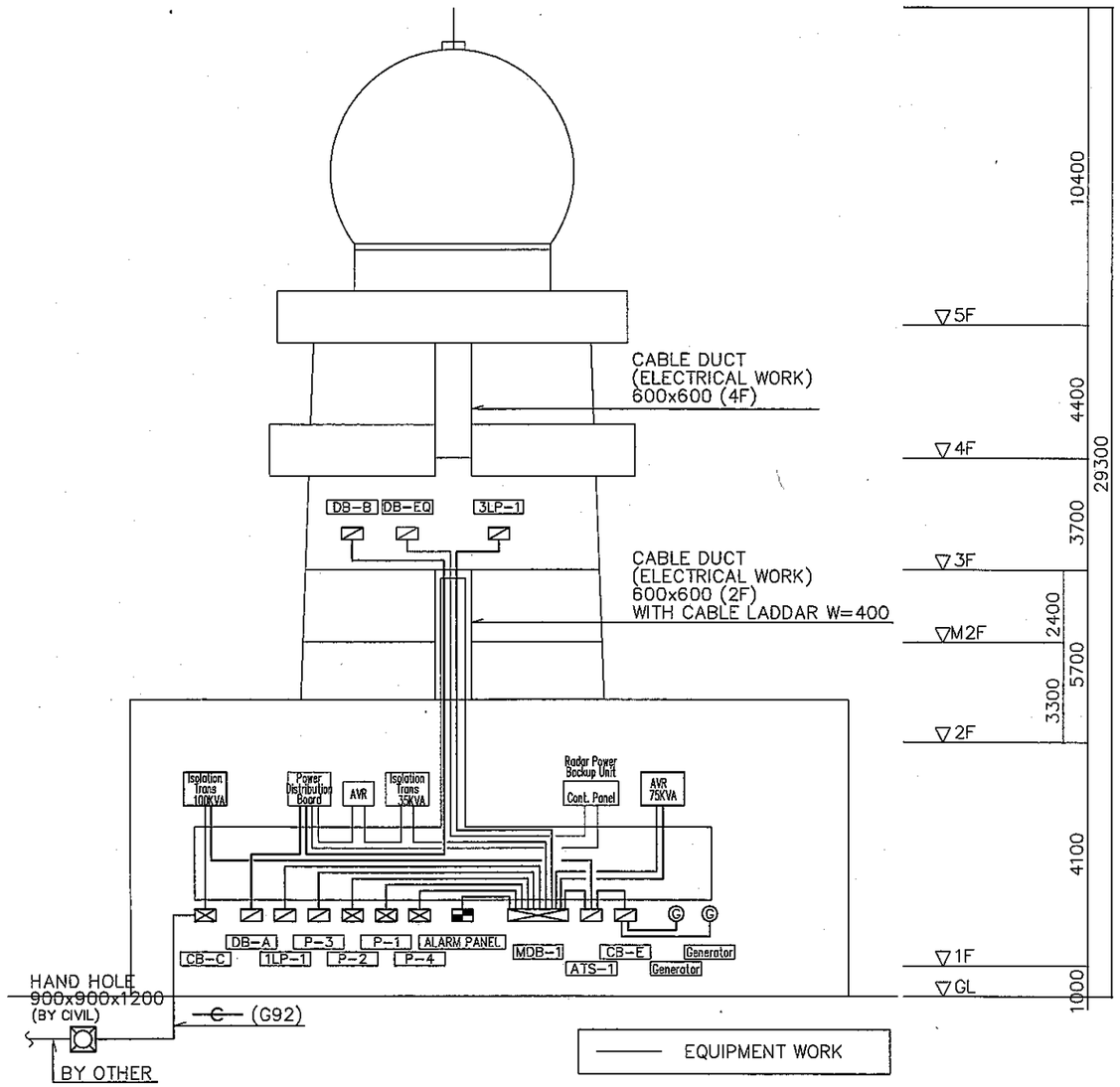
<Khepupara Meteorological Radar Tower Building>

- Power Receiving System Diagram — Diagram 1 (ME-K01)
- Feeder & Power System Diagram — Diagram 2 (ME-K02)
- Telephone & Intercom System Diagram — Diagram 2 (ME-K02)
- Fire Detection System Diagram — Diagram 3 (ME-K03)
- Alarm System Diagram — Diagram 3 (ME-K03)
- Lightning Protection & Grounding System Diagram — Diagram 4 (ME-K04)
- Obstruction Light System Diagram — Diagram 4 (ME-K04)
- Water Supply & Sewage System Diagram — Diagram 5 (ME-K05)
- Air-conditioning & Ventilation System Diagram — Diagram 6 (ME-K06)

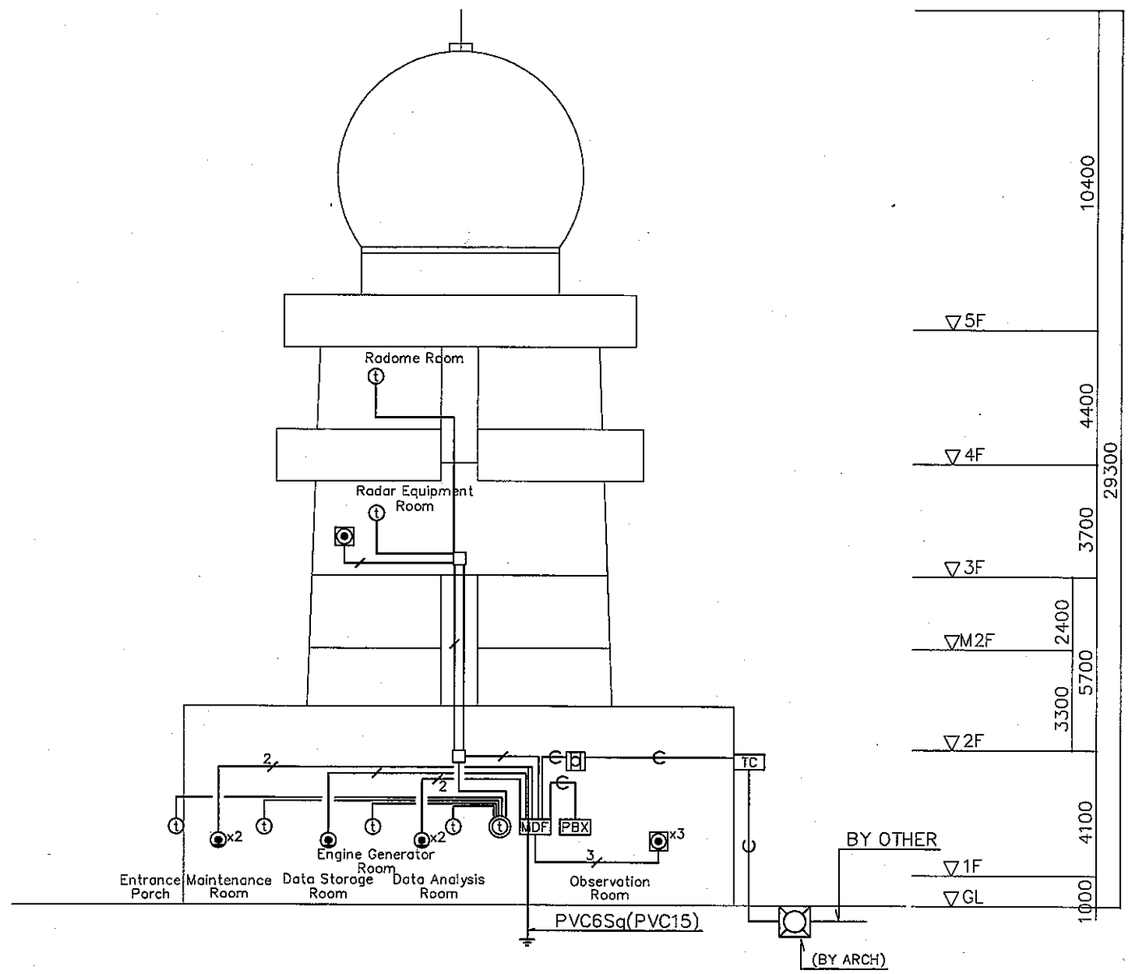


POWER FEEDER DIAGRAM

Japan Weather Association Sunshine 60 Bldg., 55F, 3-1-1, Higashi Ikebukuro, Toshima-ku, Tokyo, 170-6055 Japan Tel. +81-3-5958-8161 Fax. +81-3-5958-8162	COX'S BAZAR RADAR TOWER BUILDING	DRAWING TITLE DIAGRAM-1	SCALE NONE	DRAWING No. ME - C01



MAIN POWER SYSTEM DIAGRAM



PBX : PBX
MDF : MAIN DISTRIBUTION FRAME
: TELEPHONE OUTLET (MODULAR JACK)
: TELEPHONE OUTLET SLAB MOUNT
: ARRESTER
: INTERCOM (POWER SUPPLY FOR INTERCOM)
: INTERCOM
: HAND HOLE
TC : INCOMING TERMINAL FRAME

TELEPHONE , INTERCOM SYSTEM DIAGRAM

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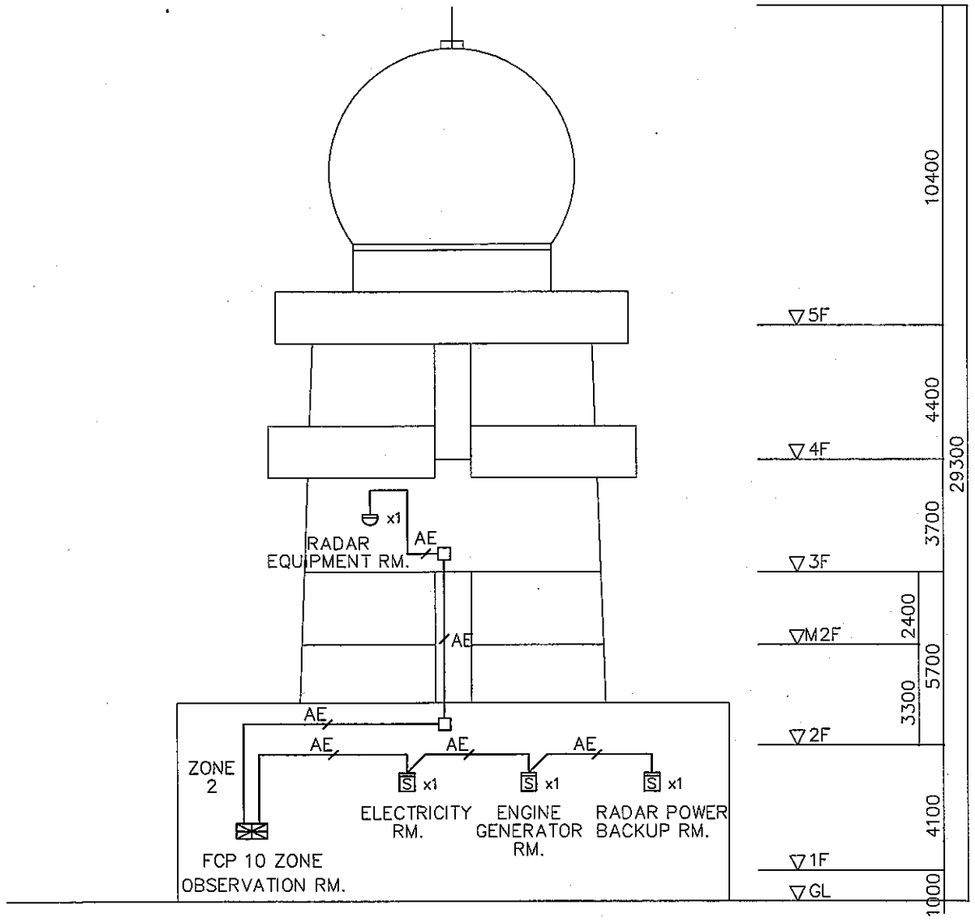
COX'S BAZAR RADAR TOWER BUILDING

DRAWING TITLE: DIAGRAM-2

SCALE: NONE

DRAWING No.: ME - C02

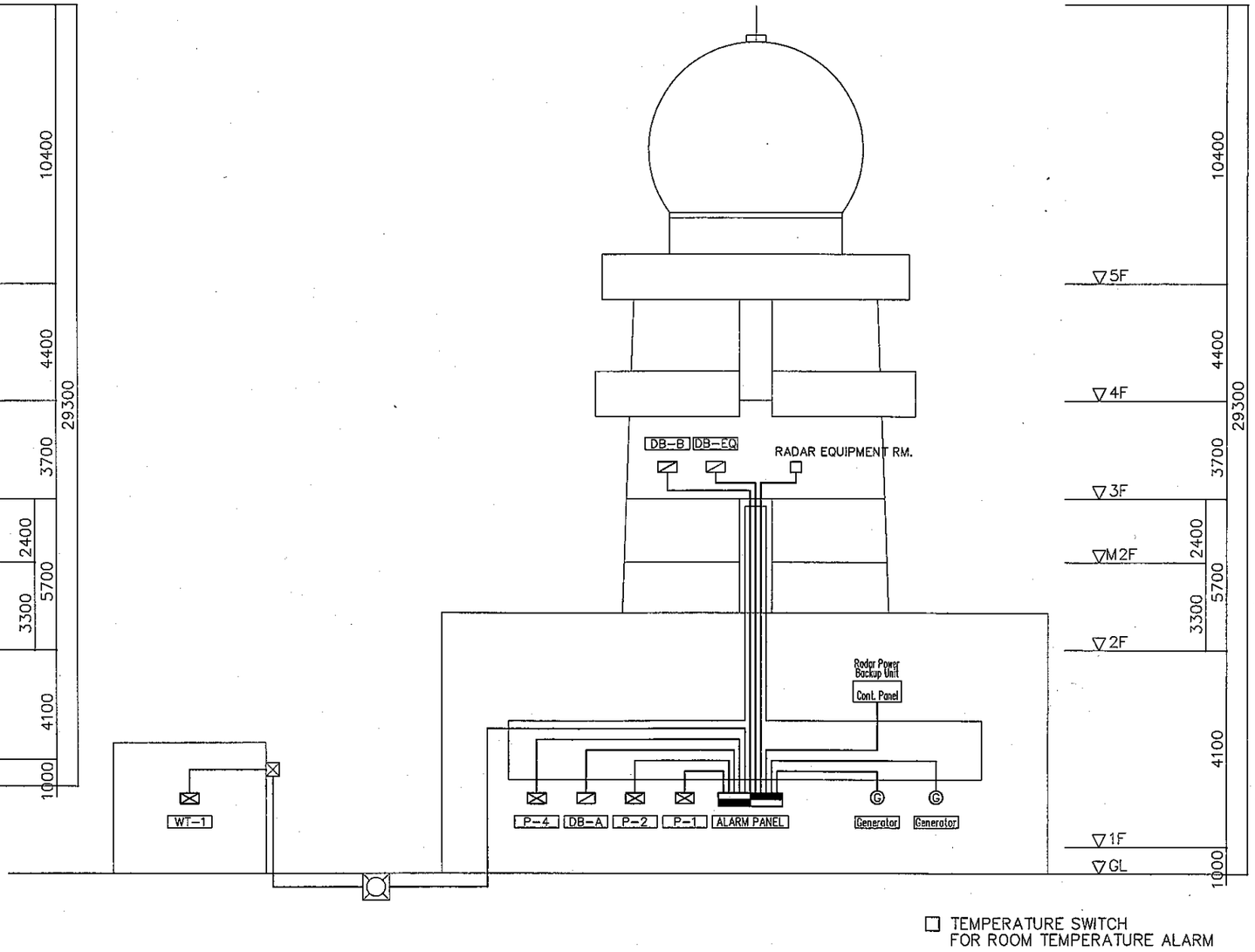


FIRE ALARM CONTROL PANEL 10 ZONE

SMOKE DETECTOR (PHOTO TYPE)

RATE OF RISE HEAT DETECTOR

FIRE ALARM SYSTEM DIAGRAM



TEMPERATURE SWITCH FOR ROOM TEMPERATURE ALARM

ALARM SYSTEM DIAGRAM

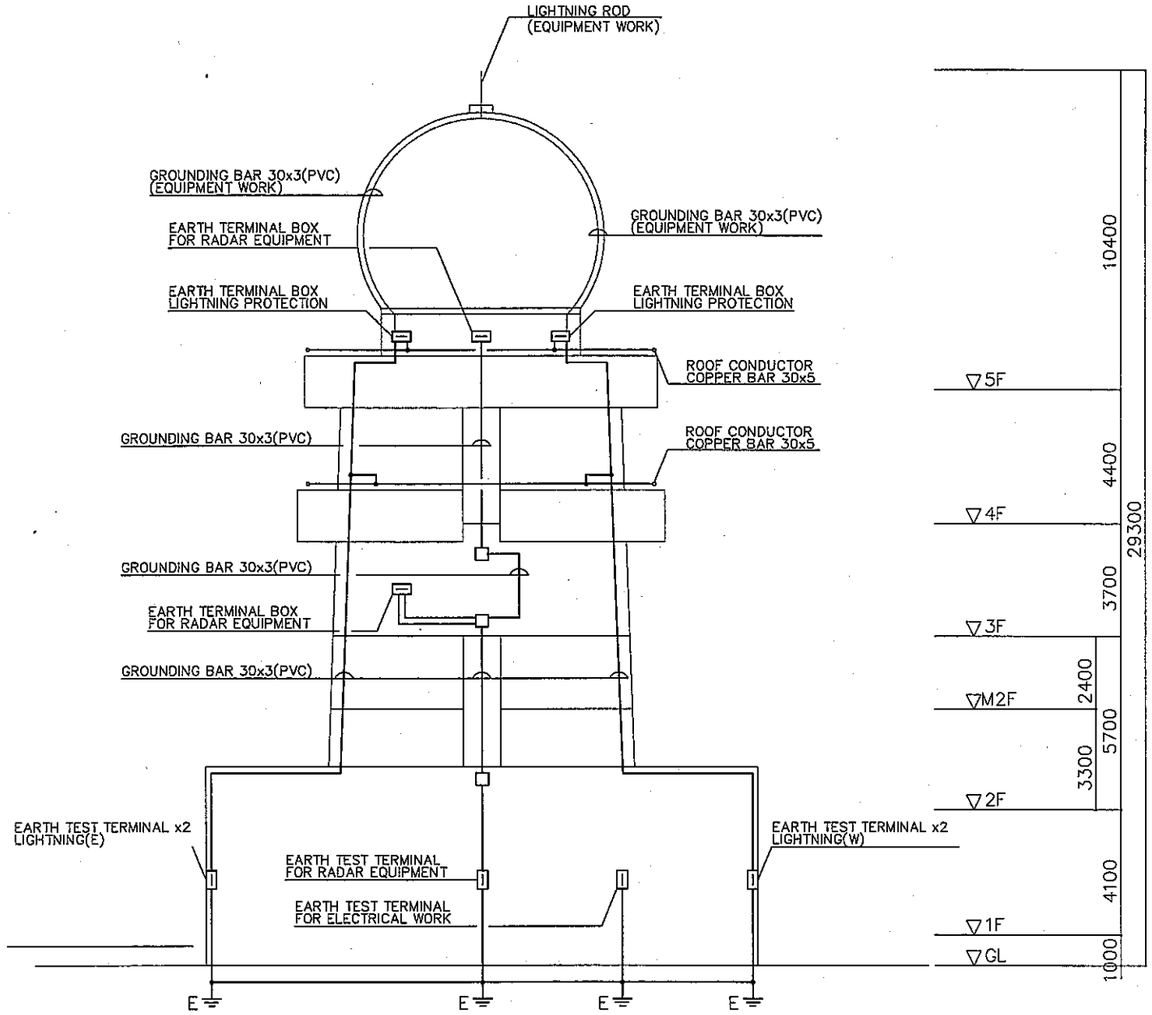
Japan Weather Association
Sunshine 60 Bldg., 55F, 3-1-1, Higashi Ikebukuro, Toshima-ku, Tokyo, 170-6055 Japan Tel. +81-3-5958-8161 Fax. +81-3-5958-8162

COX'S BAZAR RADAR TOWER BUILDING

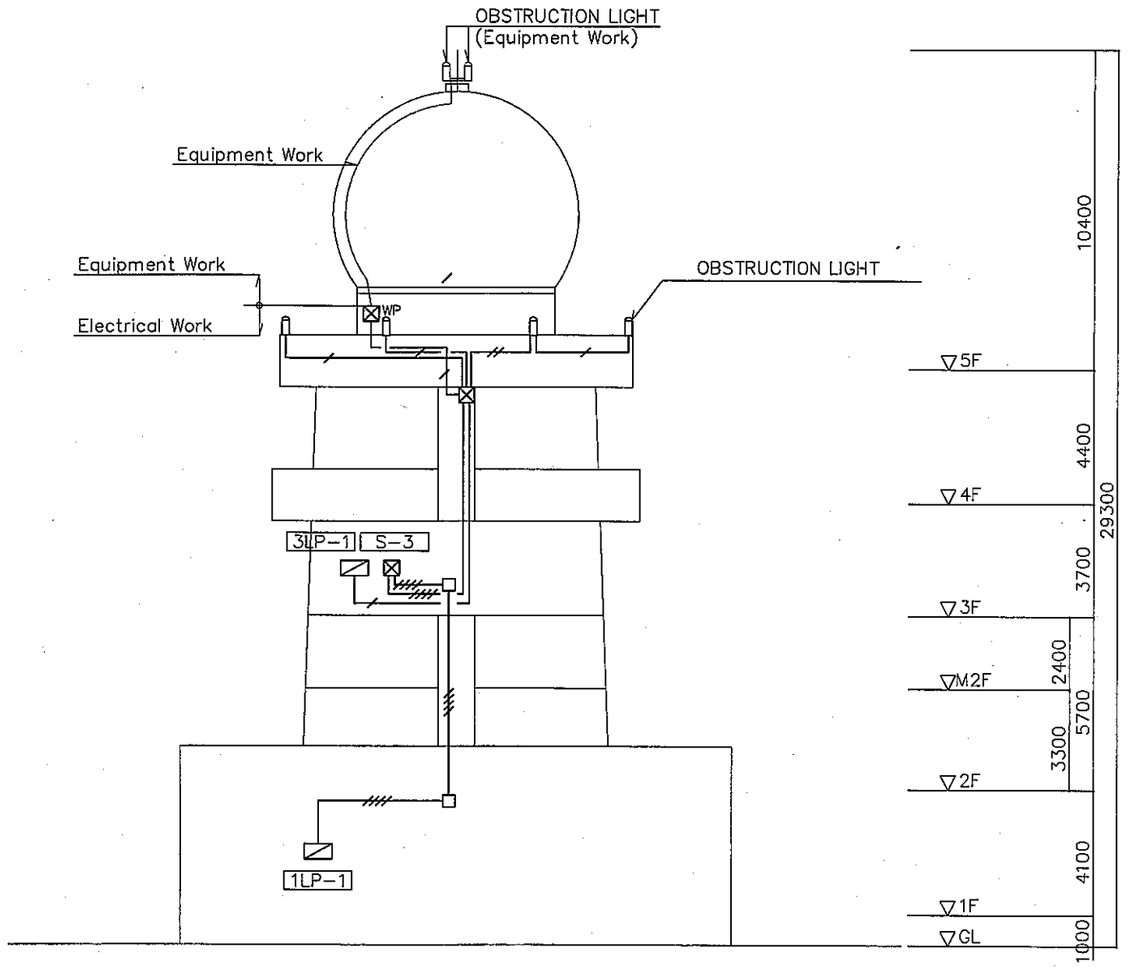
DRAWING TITLE: DIAGRAM-3

SCALE: NONE

DRAWING No.: ME - C03



LIGHTNING PROTECTION AND
GROUNDING SYSTEM DIAGRAM



OBSTRUCTION LIGHT
SYSTEM DIAGRAM

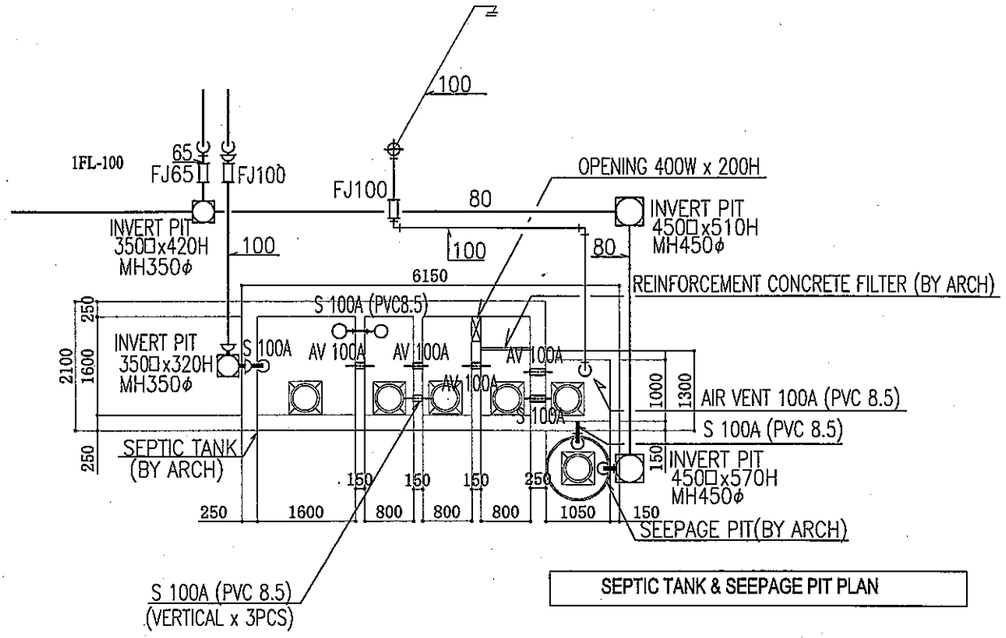
Japan Weather Association
Sunshine 60 Bldg., 55F, 3-1-1, Higashi Ikebukuro, Toshima-ku, Tokyo,
170-6055 Japan Tel. +81-3-5958-8161 Fax. +81-3-5958-8162

COX'S BAZAR RADAR TOWER BUILDING

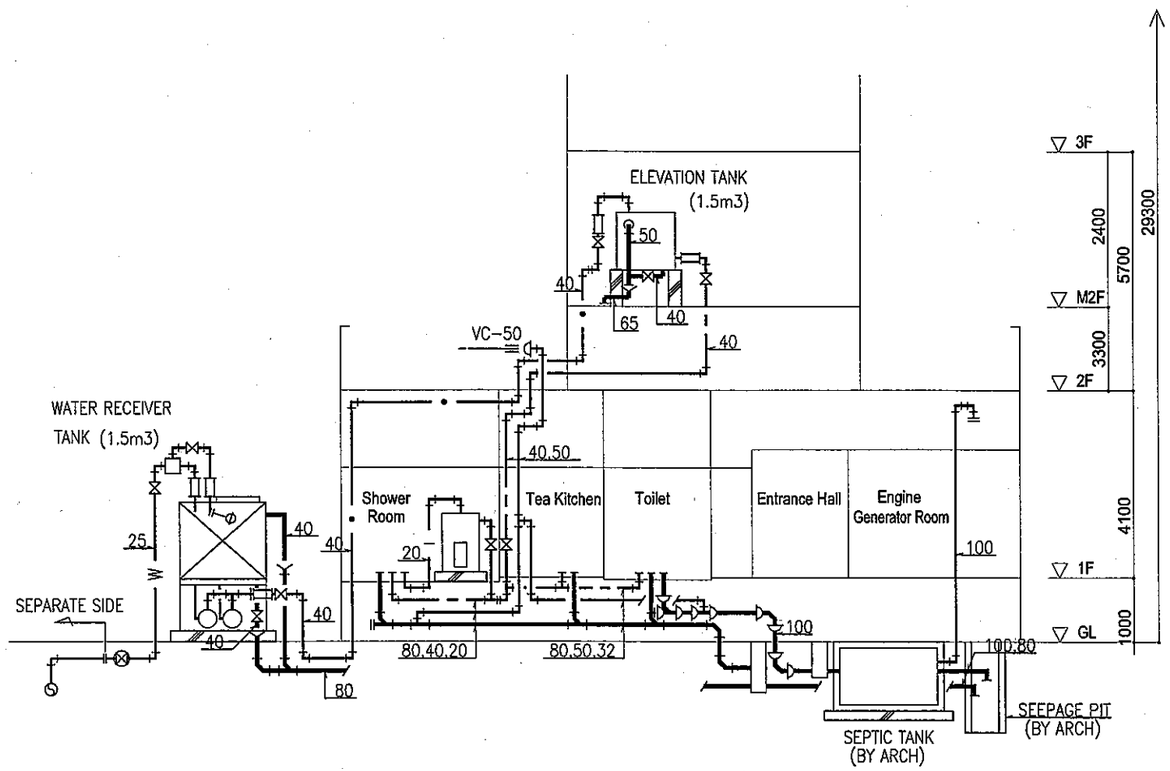
DRAWING TITLE: DIAGRAM-4

SCALE: NONE

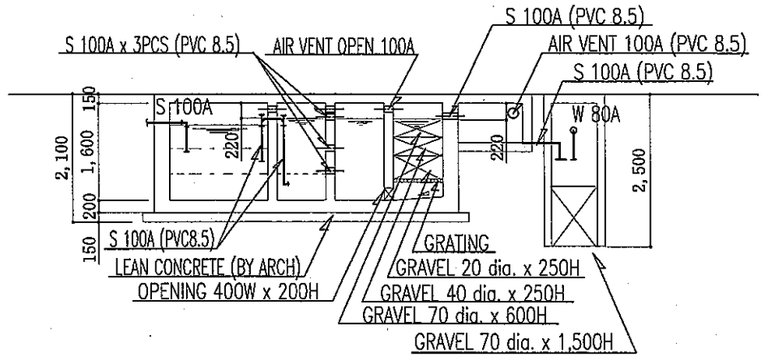
DRAWING No.: ME - C04



SEPTIC TANK & SEEPAGE PIT PLAN



PLUMBING SYSTEM DIAGRAM



SEPTIC TANK & SEEPAGE PIT SECTION

SEPTIC TANK & SEEPAGE PIT

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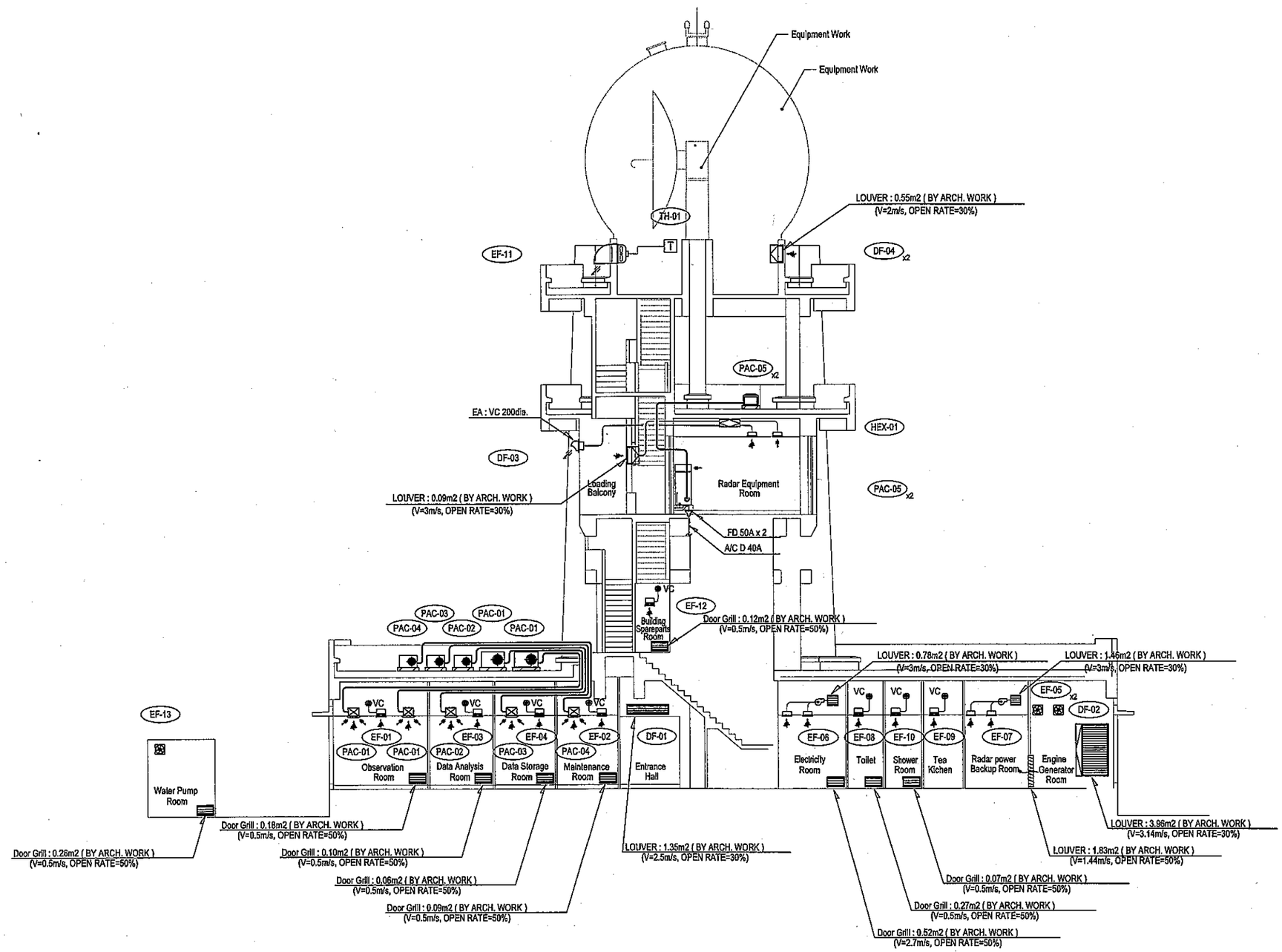
COX'S BAZAR RADAR TOWER BUILDING

DRAWING TITLE: DIAGRAM-5

SCALE: NONE

DRAWING No.: ME - C05



AIR-CONDITIONING & VENTILATION SYSTEM DIAGRAM

Japan Weather Association
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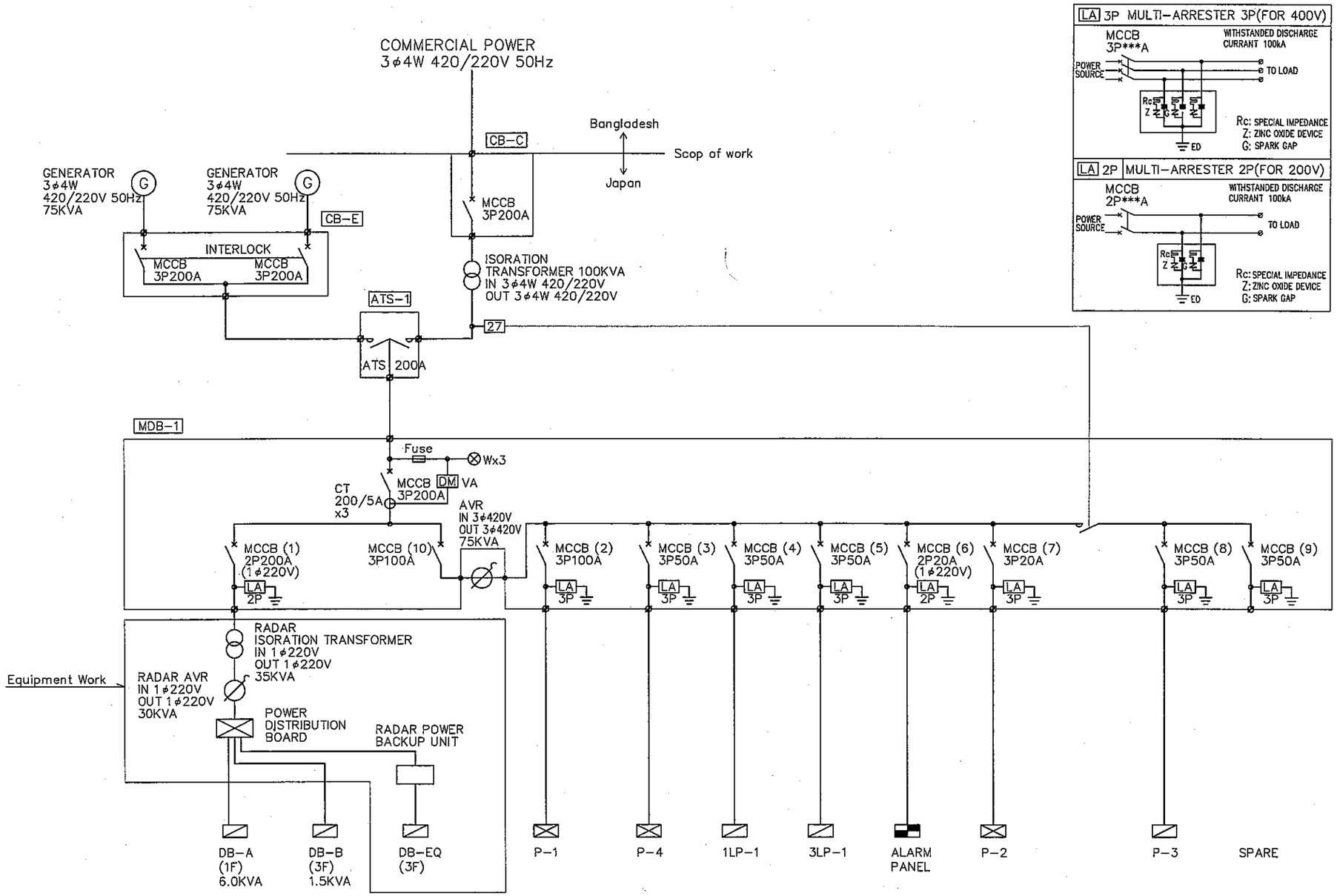
COX'S BAZAR RADAR TOWER BUILDING

DRAWING TITLE: DIAGRAM-6

SCALE: NONE

DRAWING No.: ME - C06



POWER FEEDER DIAGRAM

Japan Weather Association
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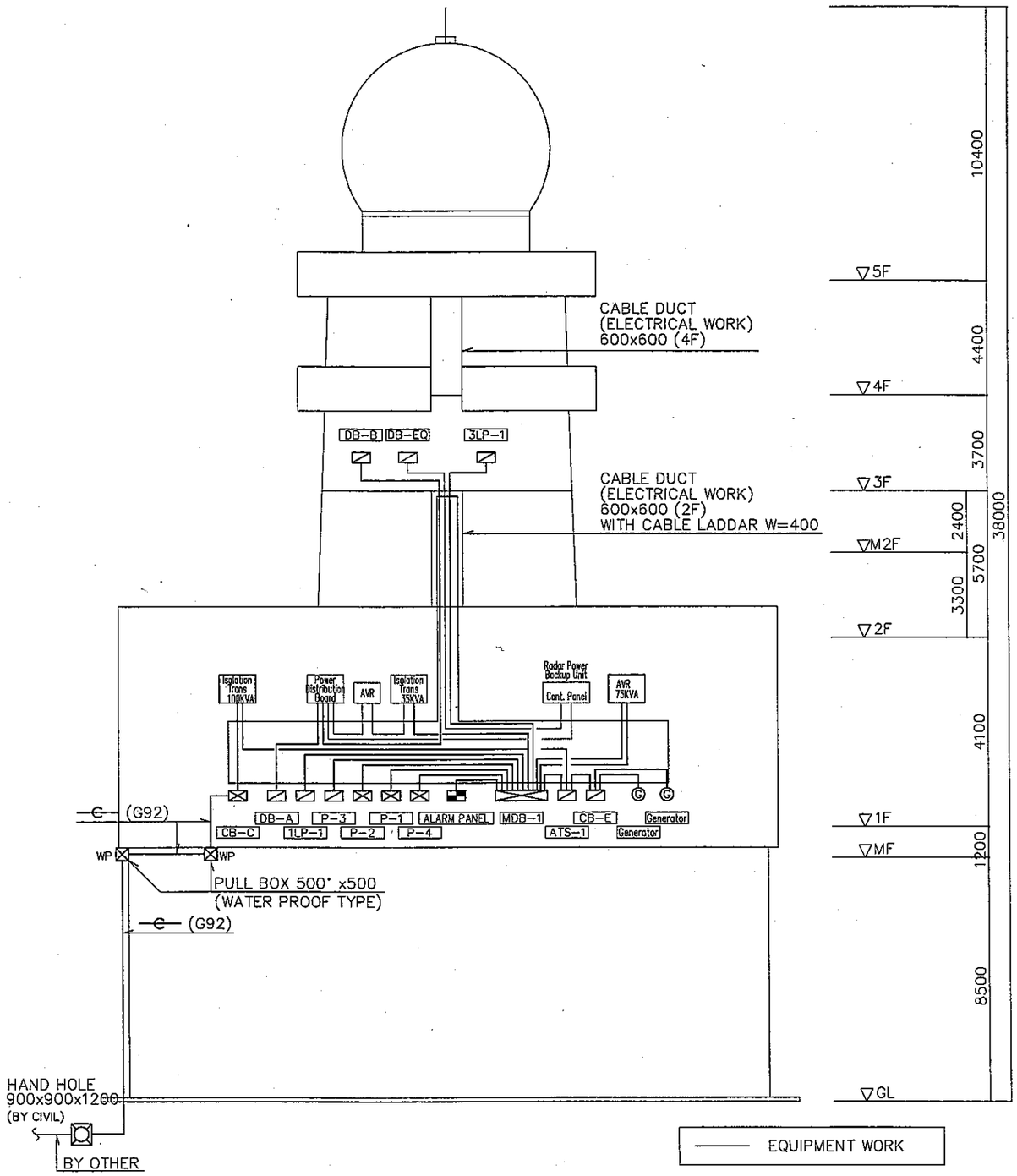
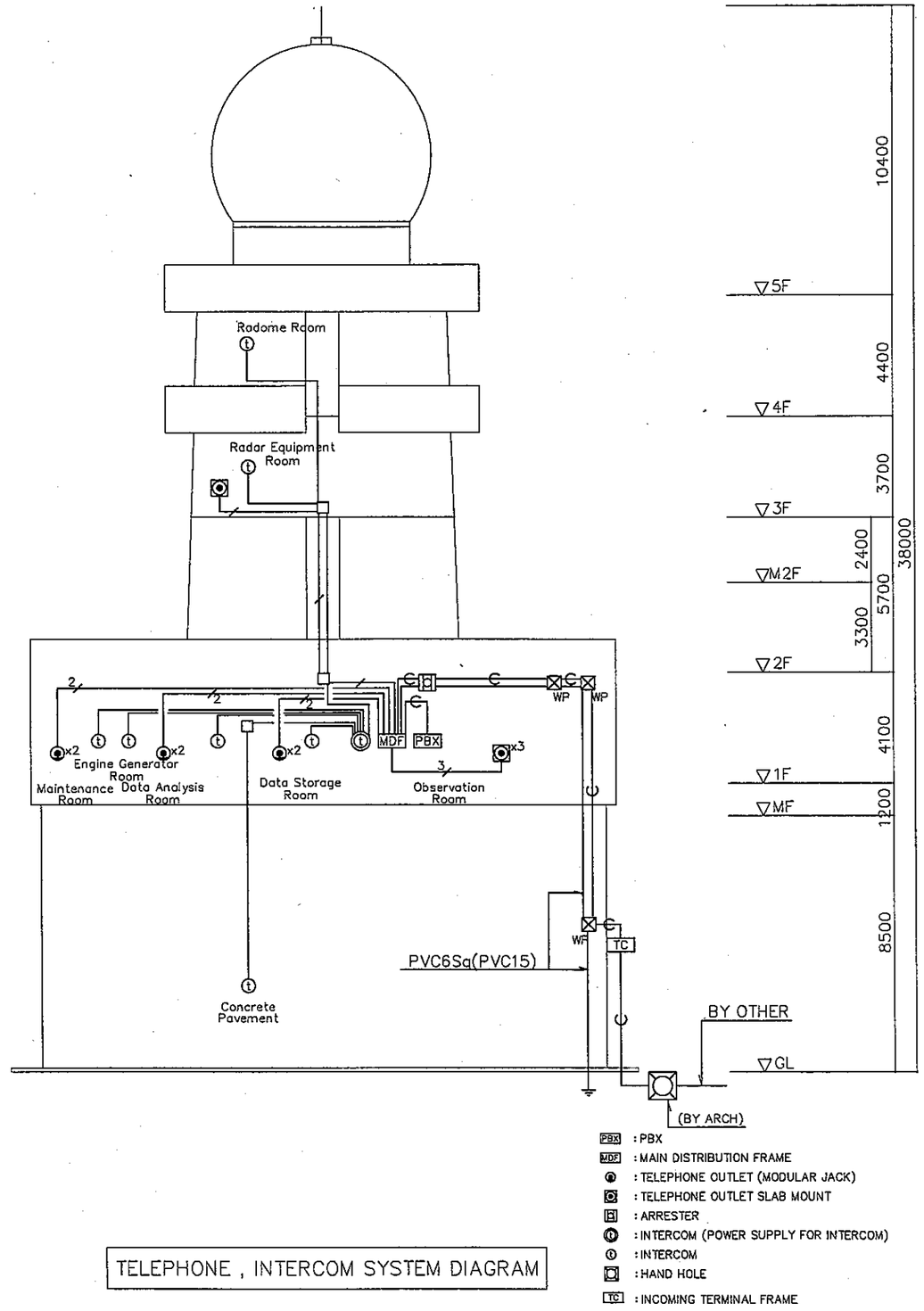
170-6055 Japan Tel. +81-3-5958-8161 Fax. +81-3-5958-8162

KHEPUPARA RADAR TOWER BUILDING	DRAWING TITLE: DIAGRAM-1	SCALE: NONE	DRAWING No.: ME - K01



MAIN POWER SYSTEM DIAGRAM



TELEPHONE , INTERCOM SYSTEM DIAGRAM

Japan Weather Association
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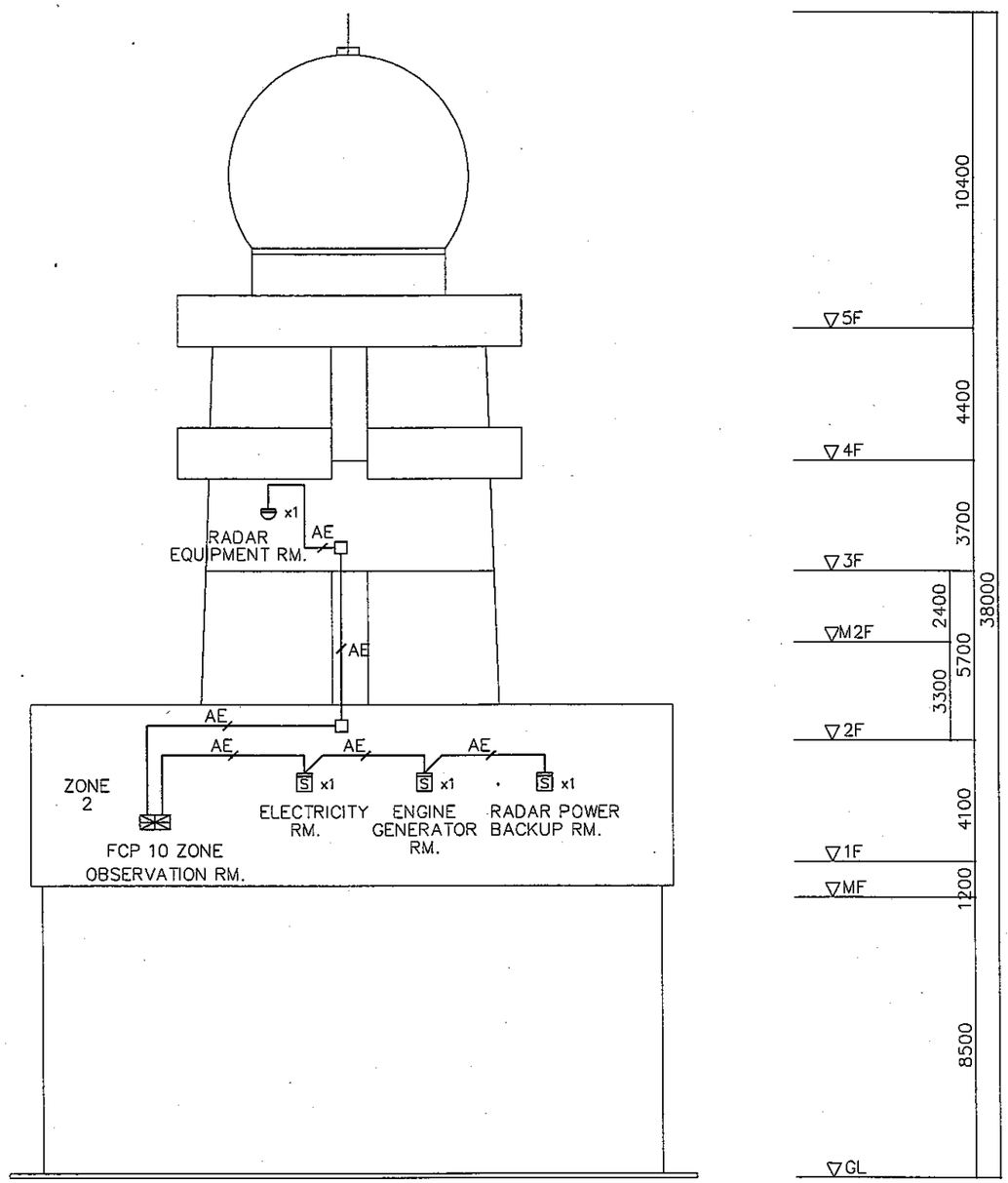
KHEPUPARA RADAR TOWER BUILDING

DRAWING TITLE: DIAGRAM-2

SCALE: NONE

DRAWING No.: ME - K02

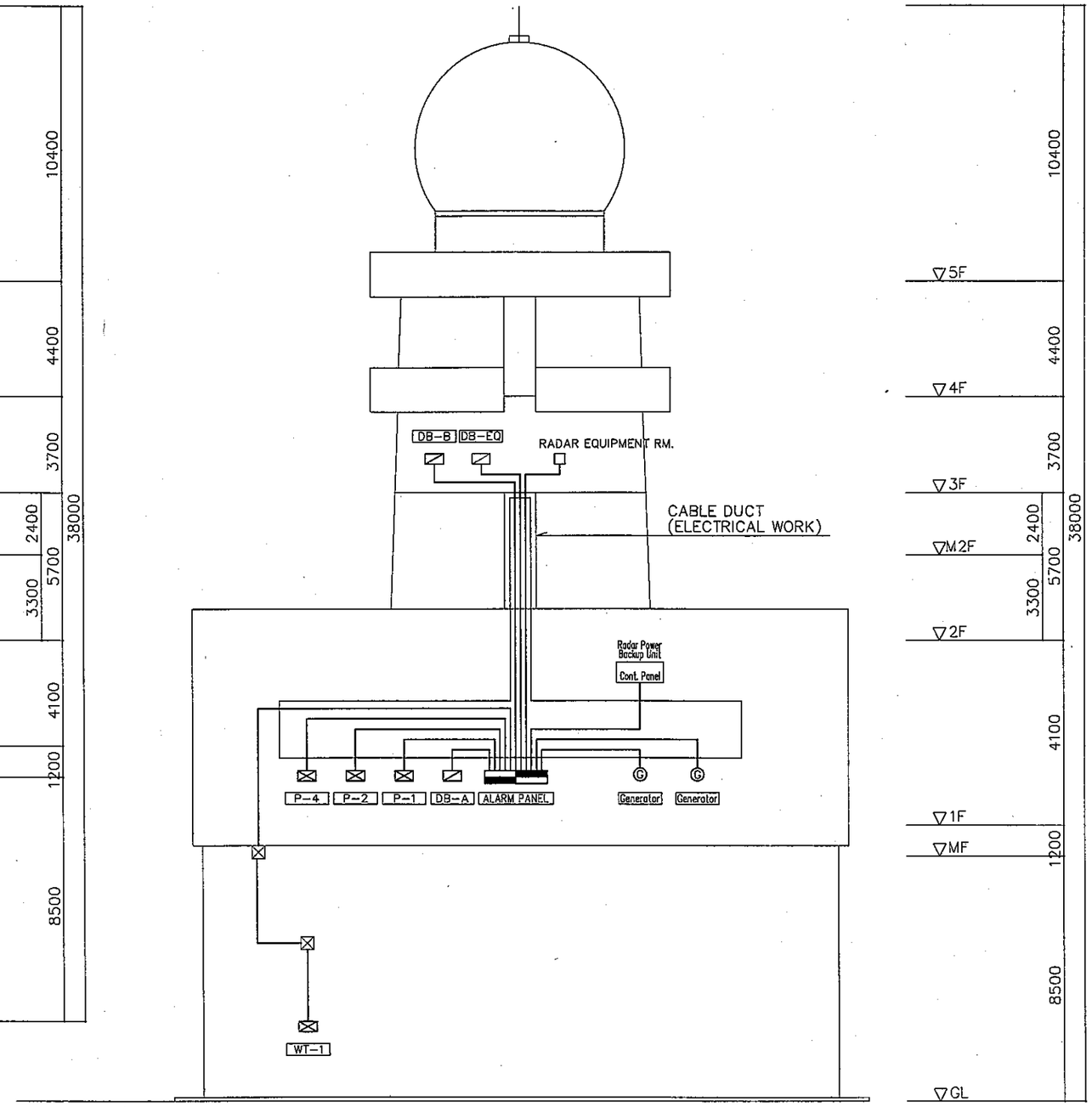


FIRE ALARM CONTROL PANEL 10 ZONE

SMOKE DETECTOR (PHOTO TYPE)

RATE OF RISE HEAT DETECTOR

FIRE ALARM SYSTEM DIAGRAM



TEMPERATURE SWITCH FOR ROOM TEMPERATURE ALARM

ALARM SYSTEM DIAGRAM

Japan Weather Association
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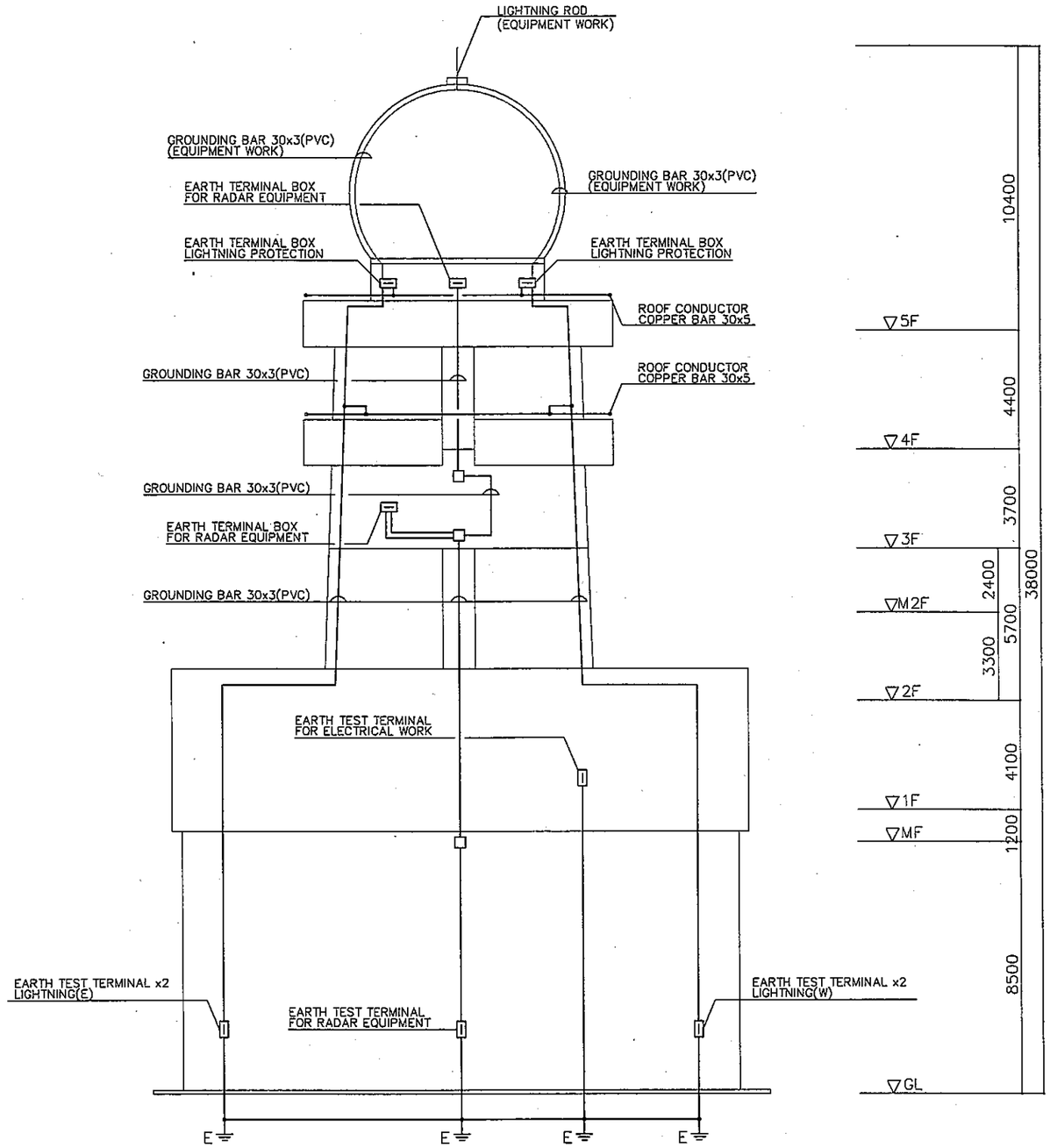
KHEPUPARA RADAR TOWER BUILDING

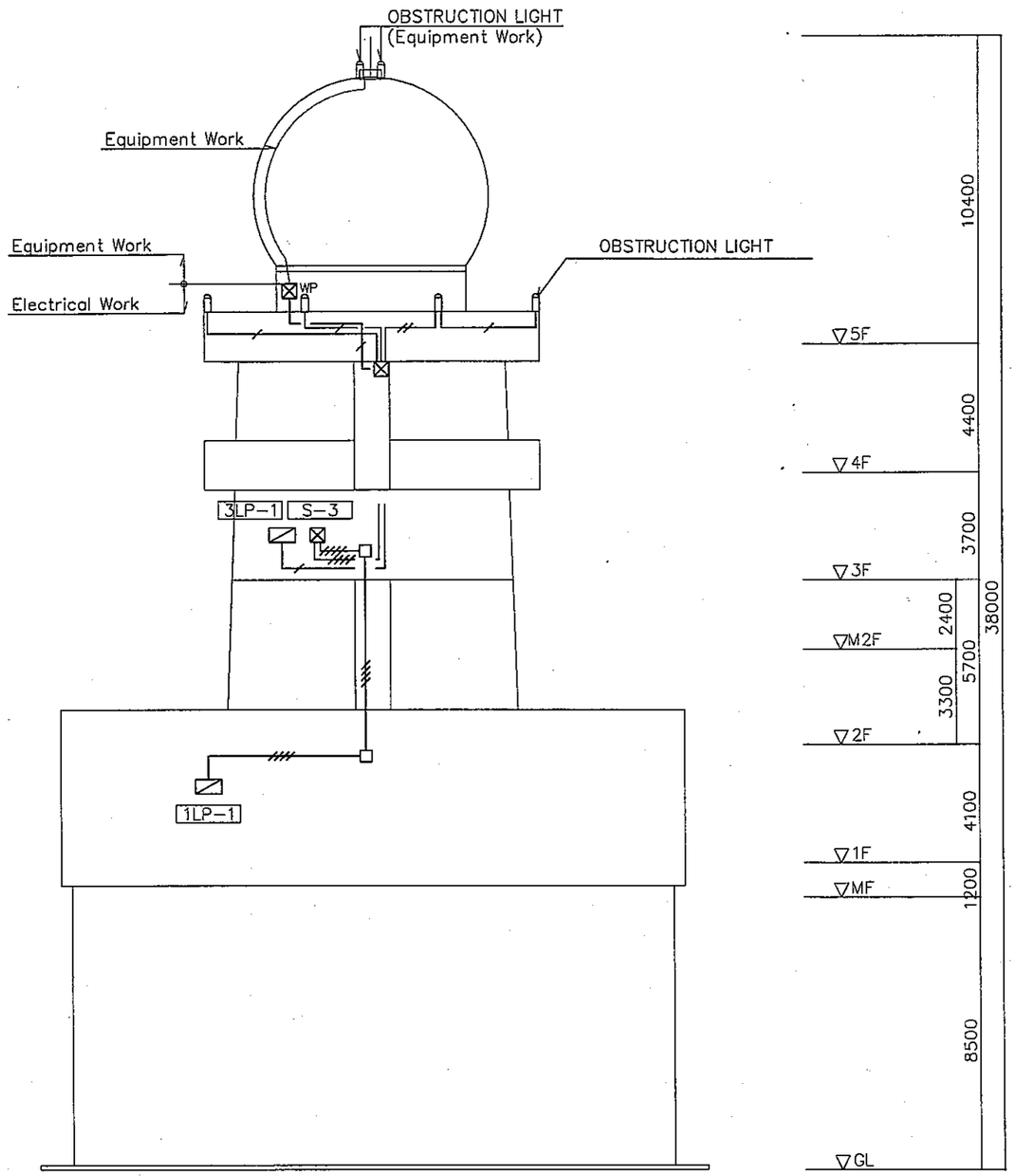
DRAWING TITLE: DIAGRAM-3

SCALE: NONE

DRAWING No.: ME - K03



LIGHTNING PROTECTION AND
GROUNDING SYSTEM DIAGRAM



OBSTRUCTION LIGHT
SYSTEM DIAGRAM

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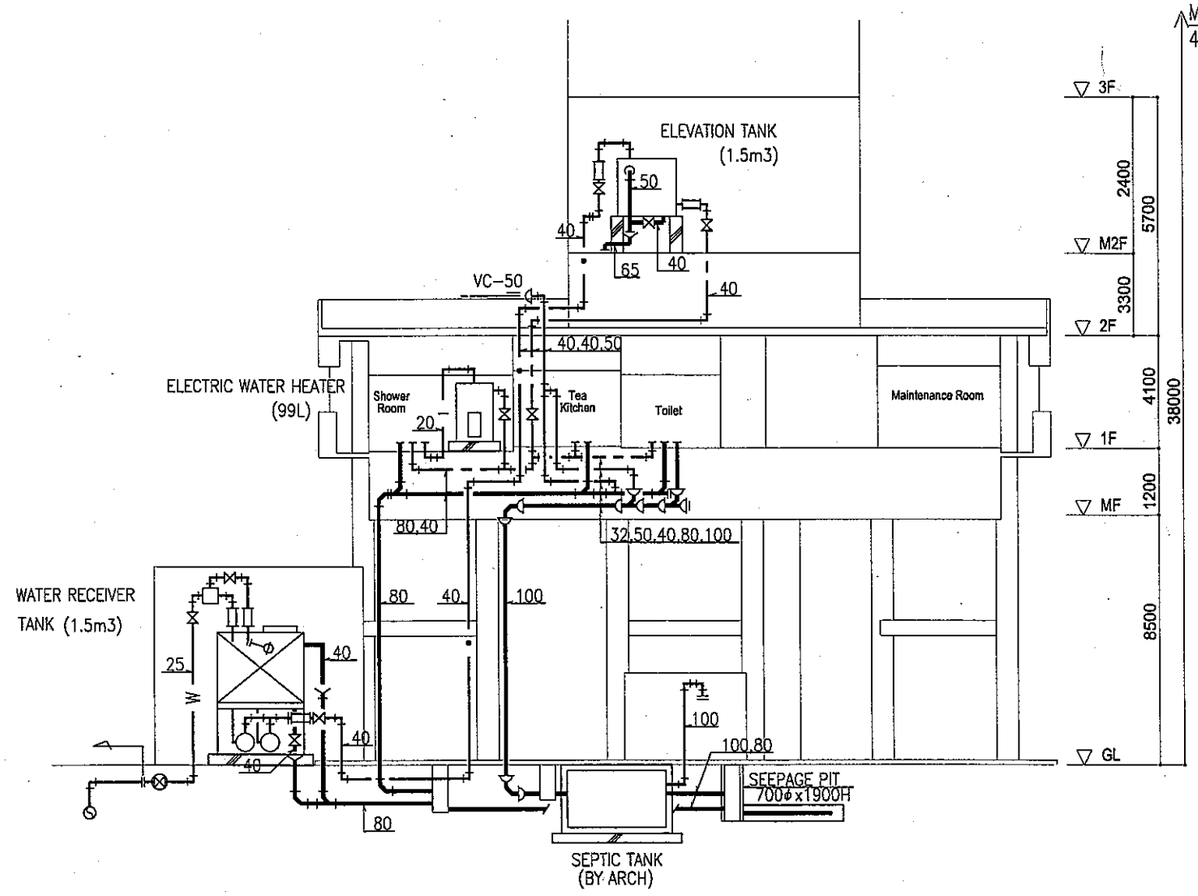
KHEPUPARA RADAR TOWER BUILDING

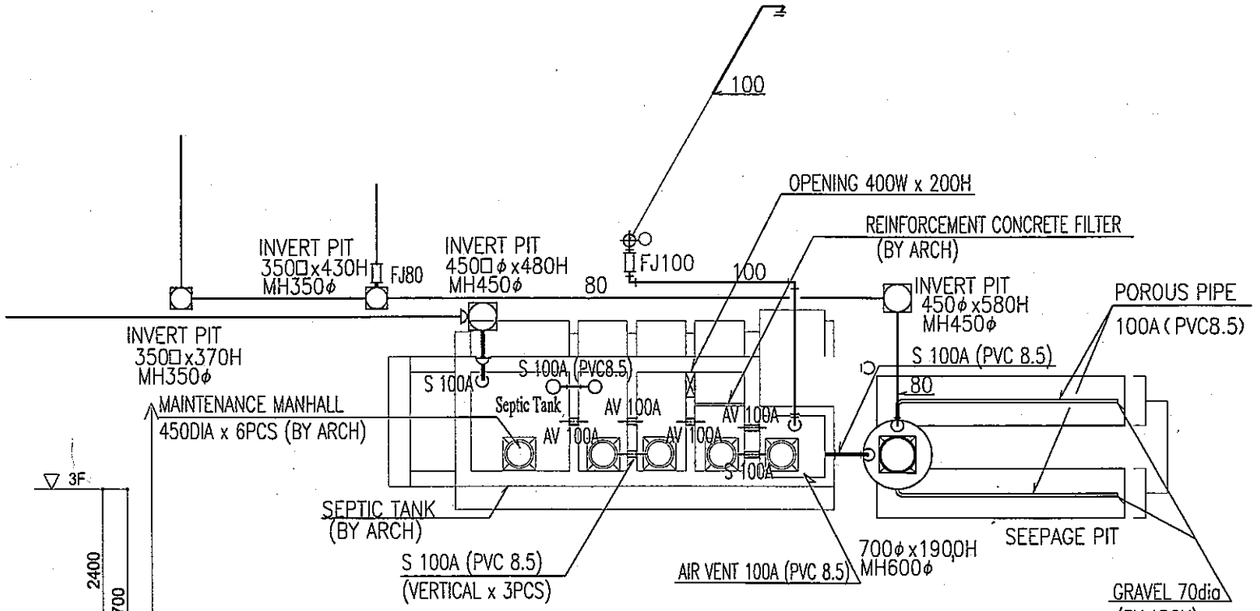
DRAWING TITLE: DIAGRAM-4

SCALE: NONE

DRAWING No.: ME - K04

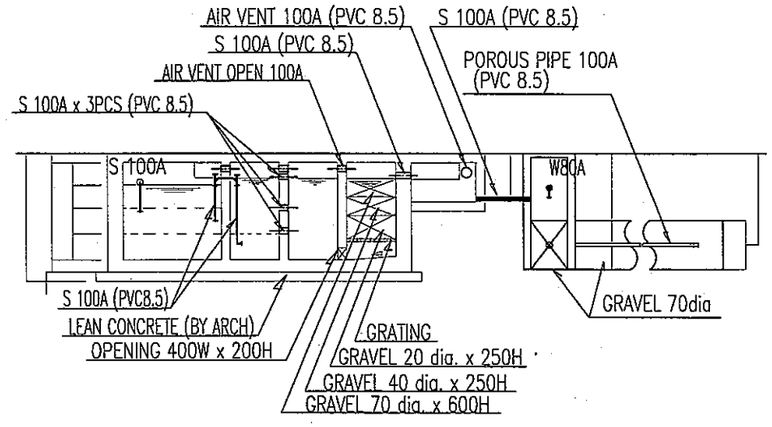


PLUMBING SYSTEM DIAGRAM



※WITHSTAND LOAD 50kN OF INVERT PIT MANHOLE
(DEODORIZATION TYPE)

SEPTIC TANK & SEEPAGE PIT PLAN



SEPTIC TANK & SEEPAGE PIT SECTION

SEPTIC TANK & SEEPAGE PIT

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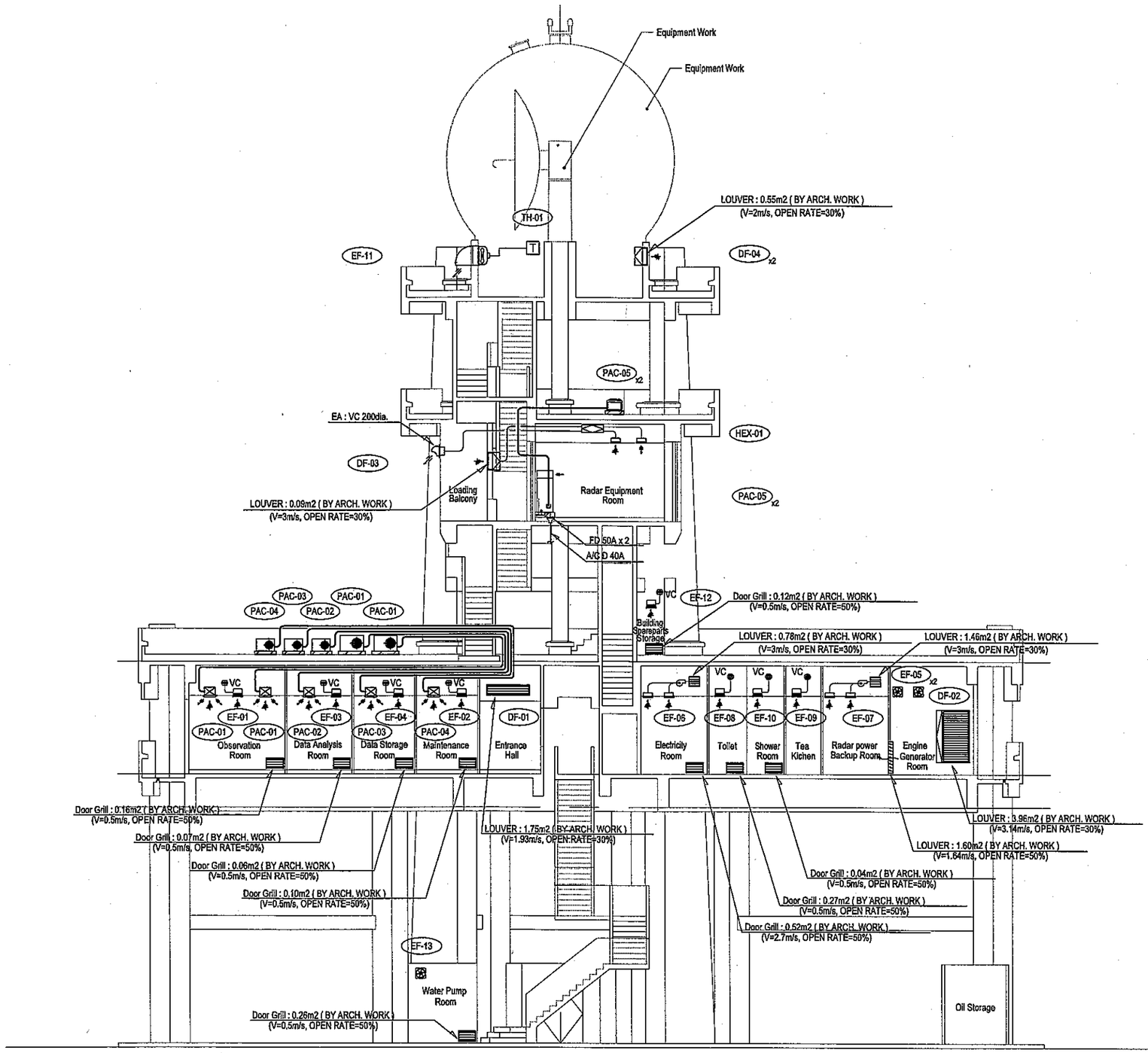
KHEPUPARA RADAR TOWER BUILDING

DRAWING TITLE: DIAGRAM-5

SCALE: NONE

DRAWING No.: ME - K05



AIR–CONDITIONING & VENTILATION SYSTEM DIAGRAM

Japan Weather Association
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KHEPUPARA RADAR TOWER BUILDING	DRAWING TITLE: DIAGRAM-6	SCALE: NONE	DRAWING No.: ME - K06

2-2-3 Basic Design Drawing

The following basic design drawings for the Project are attached from the next page.

<Cox's Bazar Meteorological Radar Tower Building>

- Site Plan : A-C01
- Floor Plan 1 : A-C02
- Floor Plan 2 : A-C03
- Floor Plan 3 : A-C04
- Floor Plan 4 : A-C05
- Elevation 1 : A-C06
- Elevation 2 : A-C07
- Section : A-C08

- Equipment Layout : EQ-C01
- Equipment Layout : EQ-C02

<Khepupara Meteorological Radar Tower Building>

- Site Plan : A-K01
- Floor Plan 1 : A-K02
- Floor Plan 2 : A-K03
- Floor Plan 3 : A-K04
- Floor Plan 4 : A-K05
- Floor Plan 5 : A-K06
- Floor Plan 6 : A-K07
- Elevation 1 : A-K08
- Elevation 2 : A-K09
- Section : A-K10

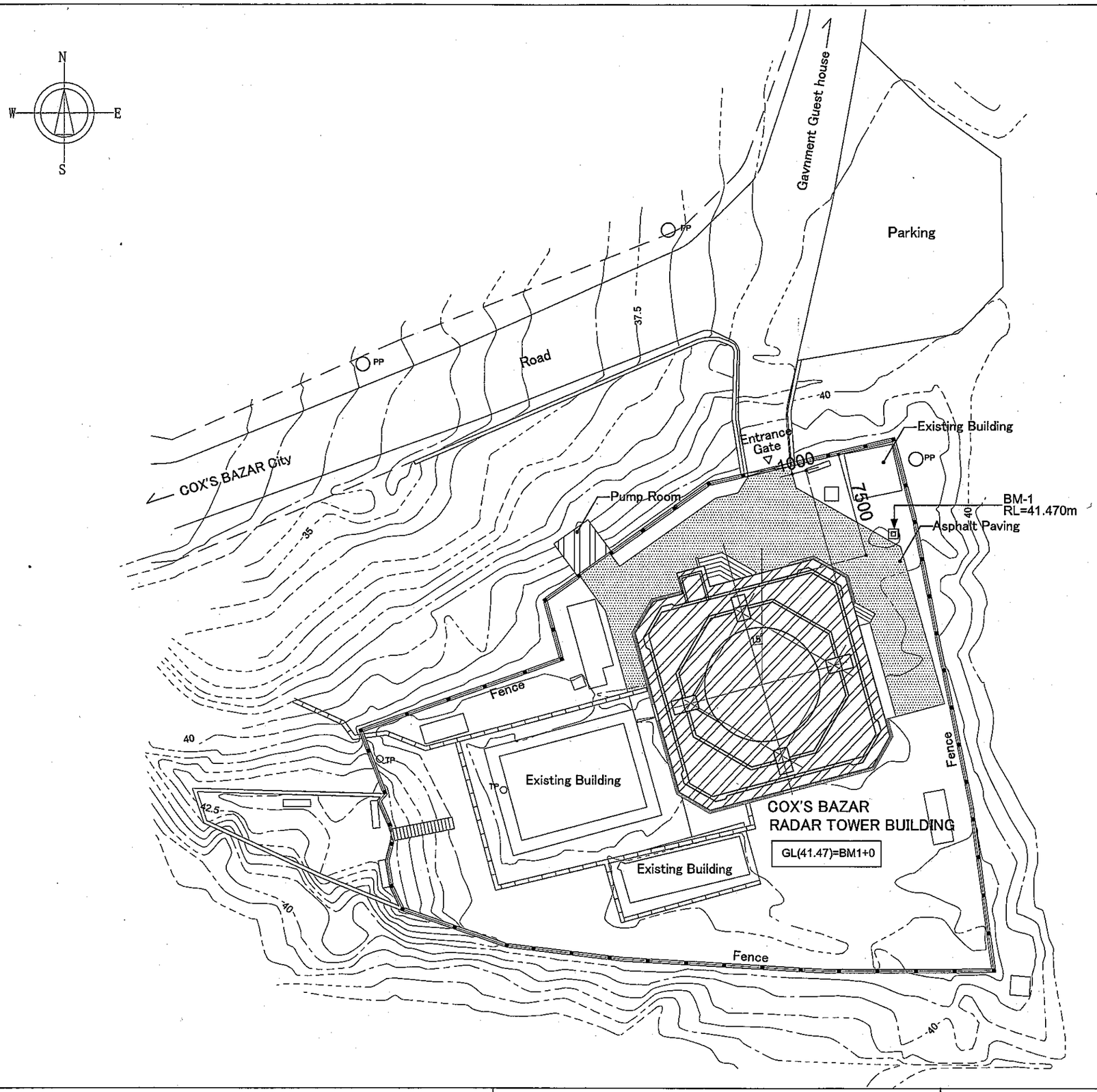
- Equipment Layout : EQ-K01
- Equipment Layout : EQ-K02

<Strom Warning Centre>

- Equipment Layout : EQ-SW01

< Cox's Bazar Meteorological Office>

- Equipment Layout : EQ-CM01



Area Calculations

Floor	Area
1F	193.75 ㎡
2F	14.00 ㎡
3F	69.19 ㎡
4F	16.24 ㎡
5F	30.17 ㎡
Total Floor Area	323.35 ㎡
Building Coverage Area	202.87 ㎡

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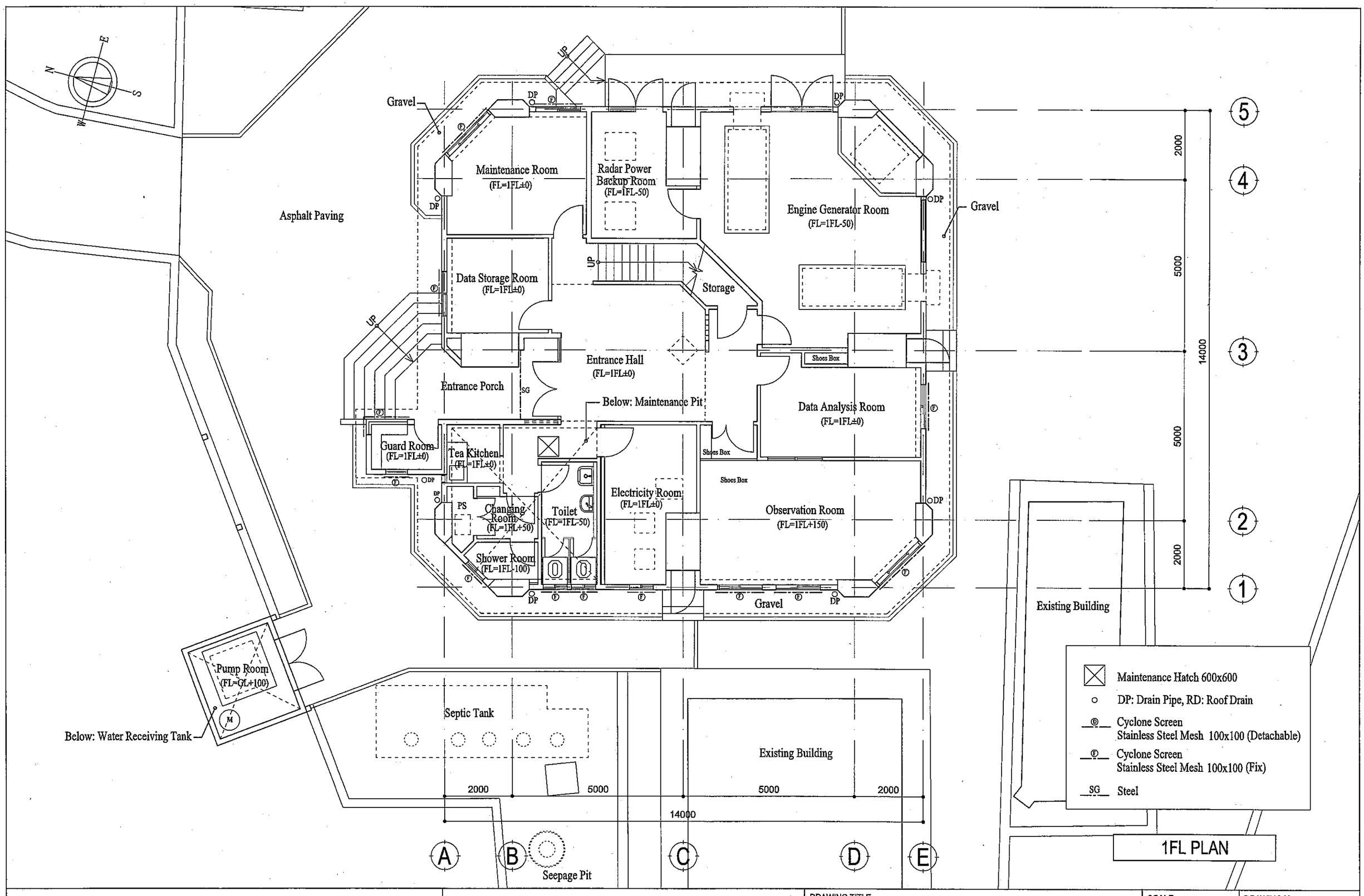
COX'S BAZAR RADAR TOWER BUILDING

DRAWING TITLE: SITE PLAN

SCALE: 1:300

DRAWING No.: A -C01



1FL PLAN

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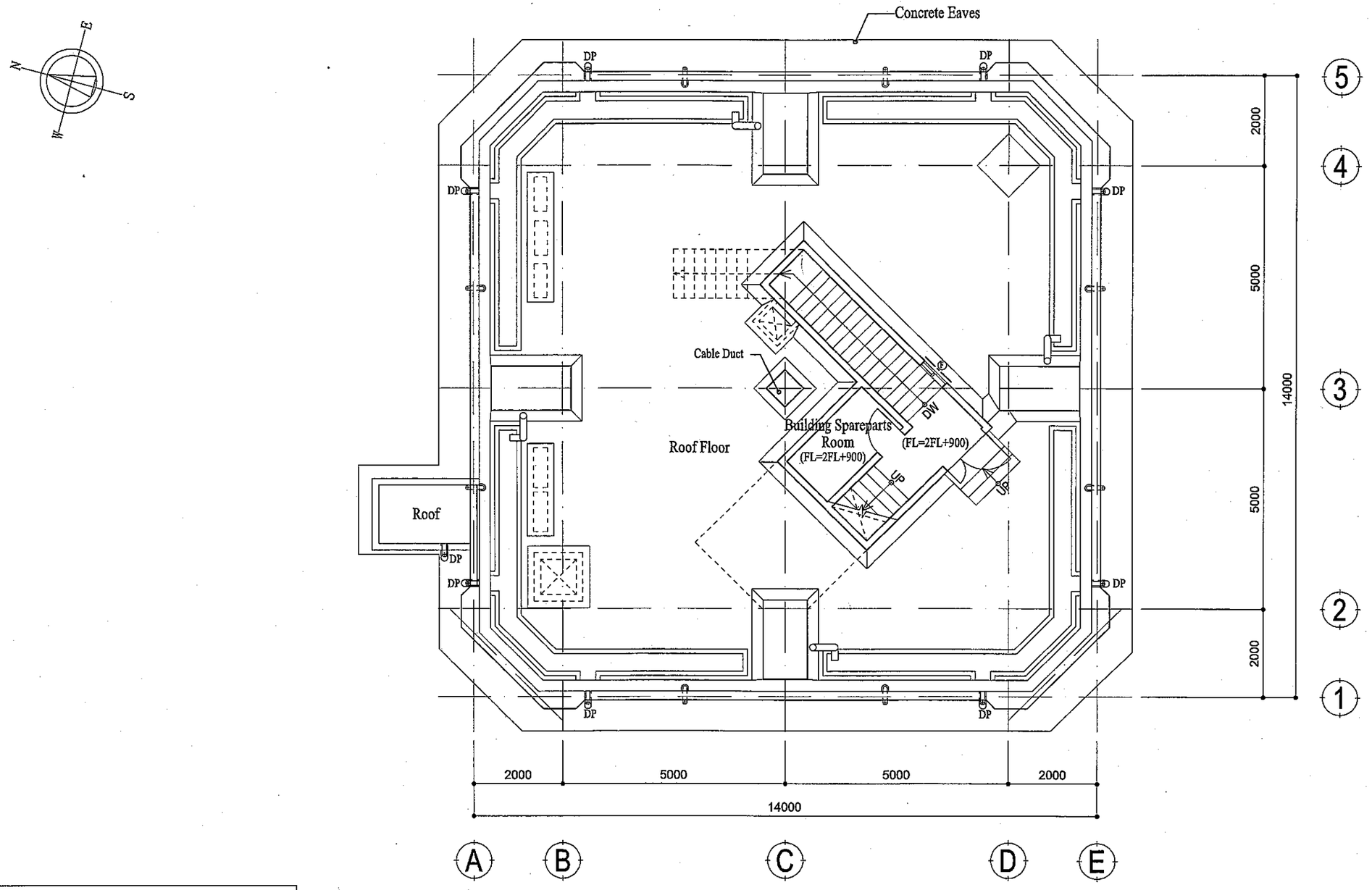
COX'S BAZAR RADAR TOWER BUILDING

DRAWING TITLE: FLOOR PLAN 1

SCALE: 1:200

DRAWING No.: A - C02



- DP: Drain Pipe, RD: Roof Drain
- Cyclone Screen
  Stainless Steel Mesh 100x100 (Fix)
- Overflow Pipe
- Parapet Hanger

2FL PLAN

Japan Weather Association
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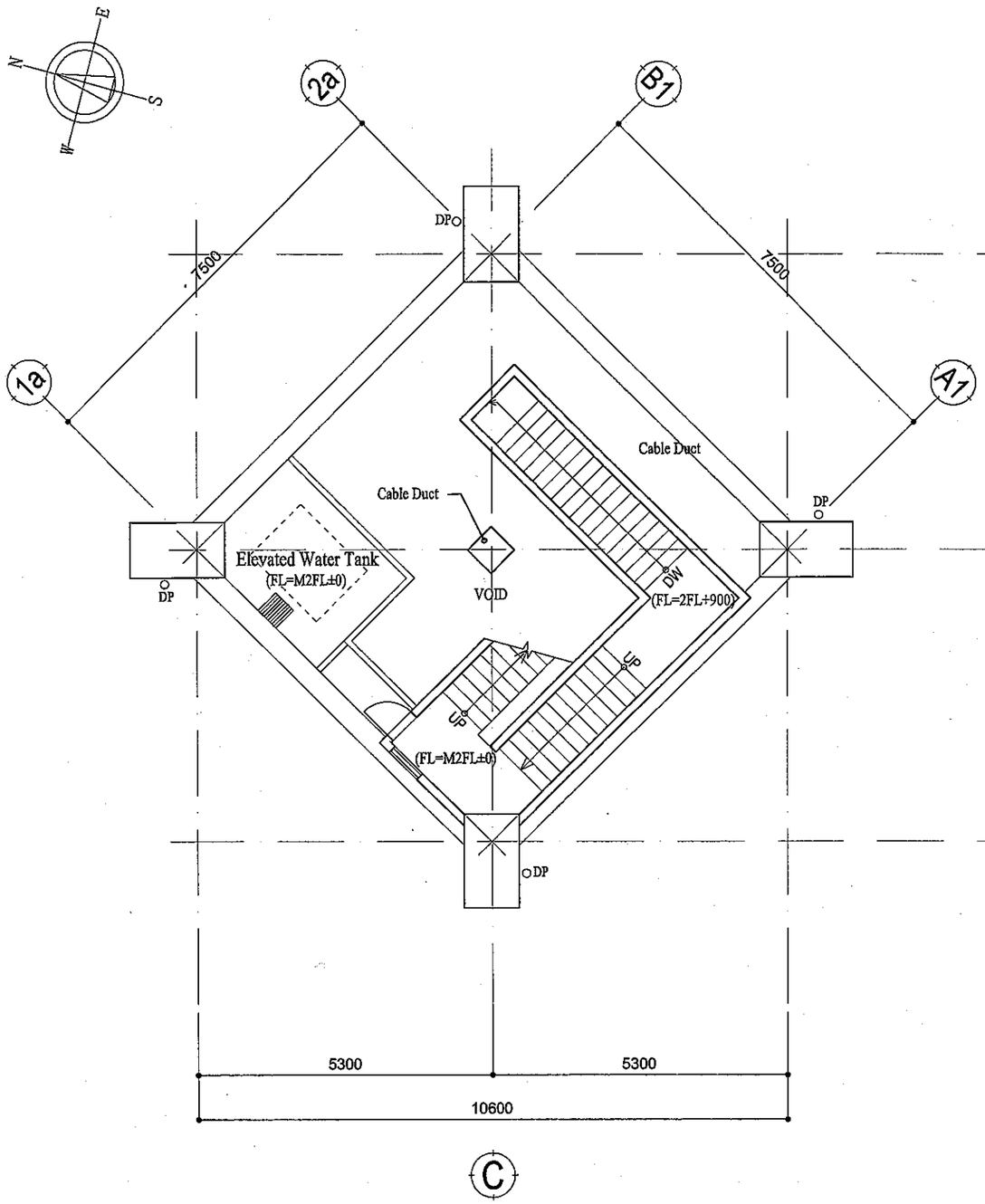
COX'S BAZAR RADAR TOWER BUILDING

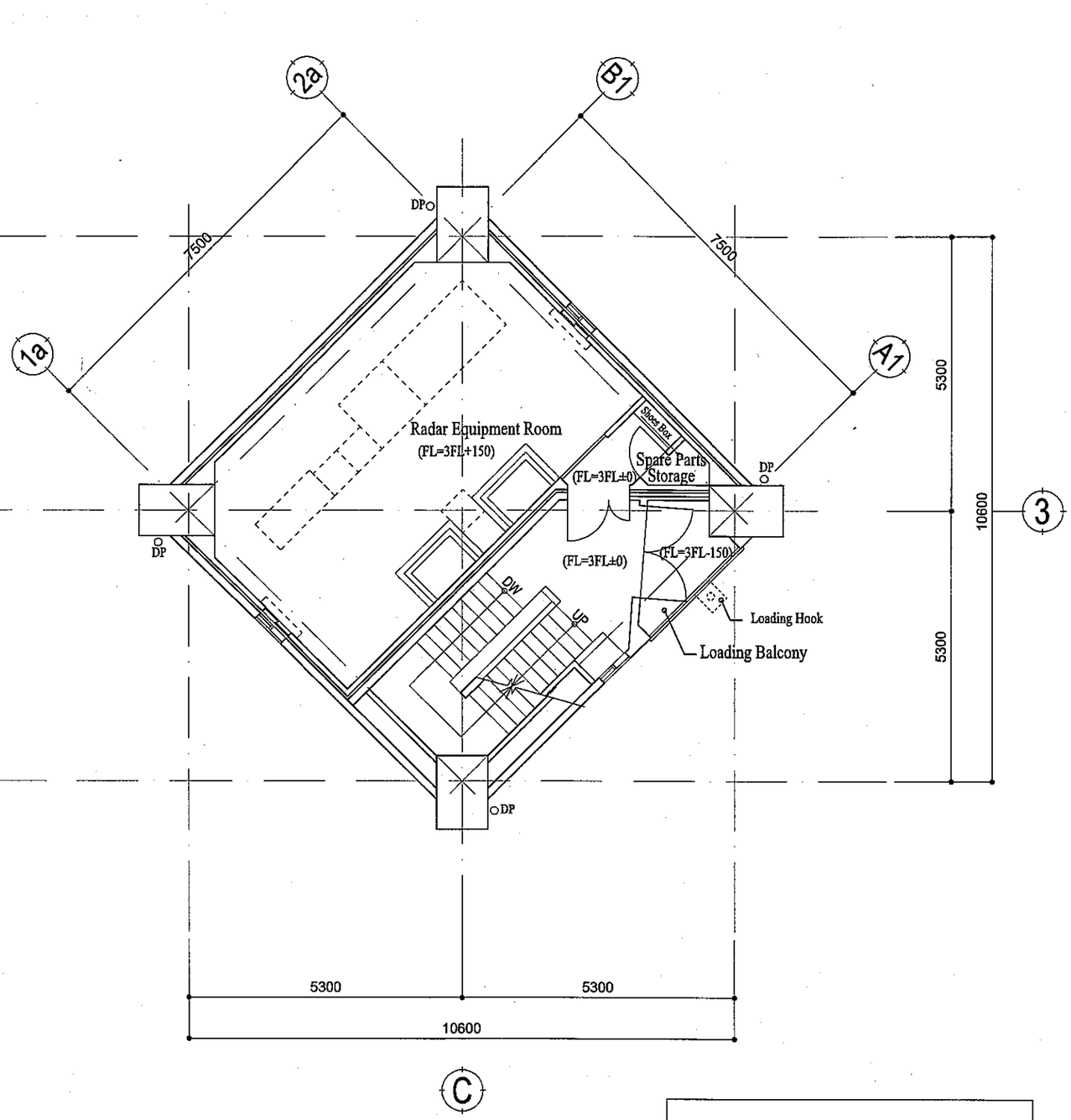
DRAWING TITLE: FLOOR PLAN 2

SCALE: 1:200

DRAWING No.: A - C03



M2FL PLAN



3FL PLAN

- DP: Drain Pipe, RD: Roof Drain
- Cyclone Screen
  Stainless Steel Mesh 100x100 (Fix)
- Overflow Pipe
- Parapet Hanger

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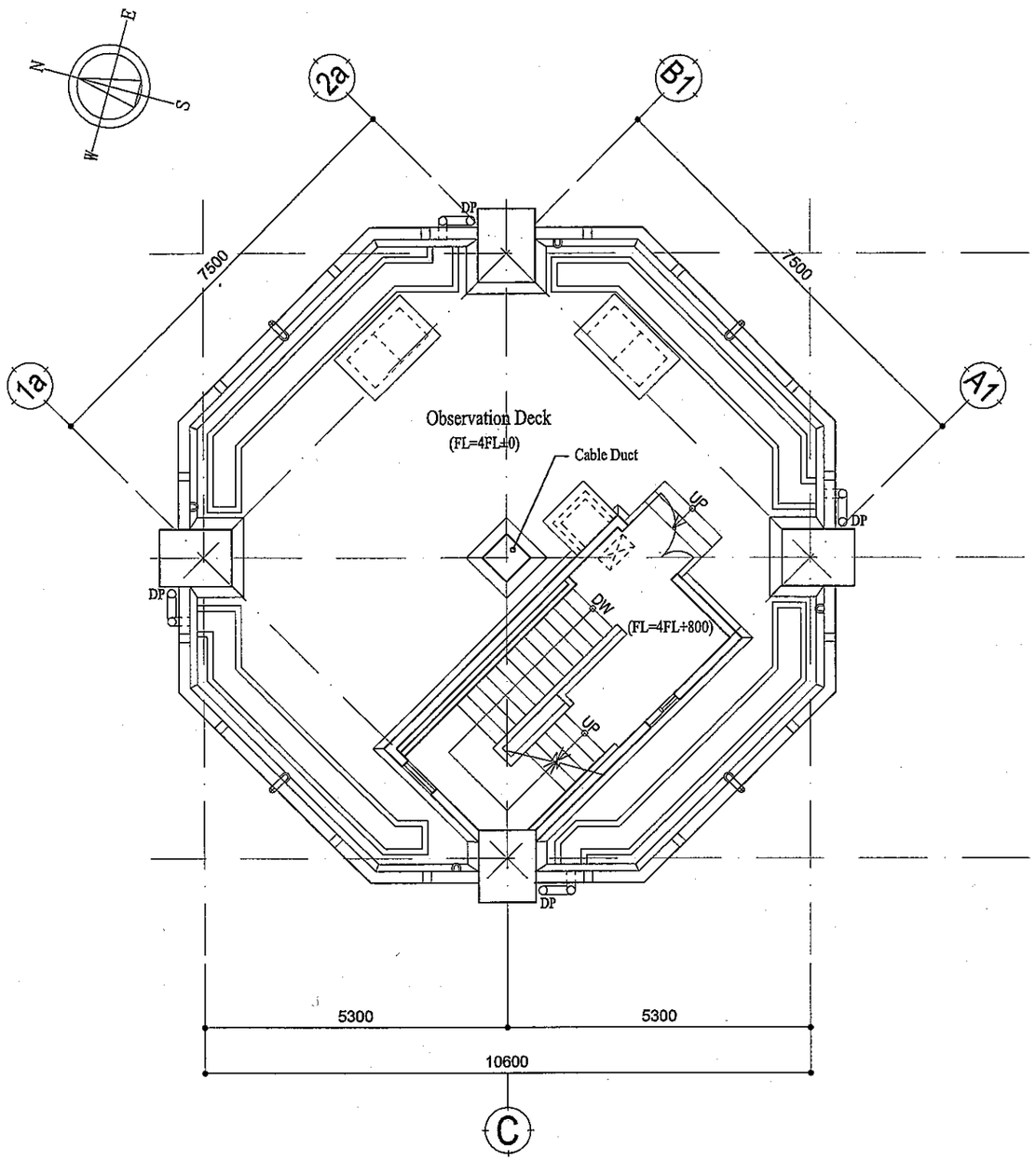
COX'S BAZAR RADAR TOWER BUILDING

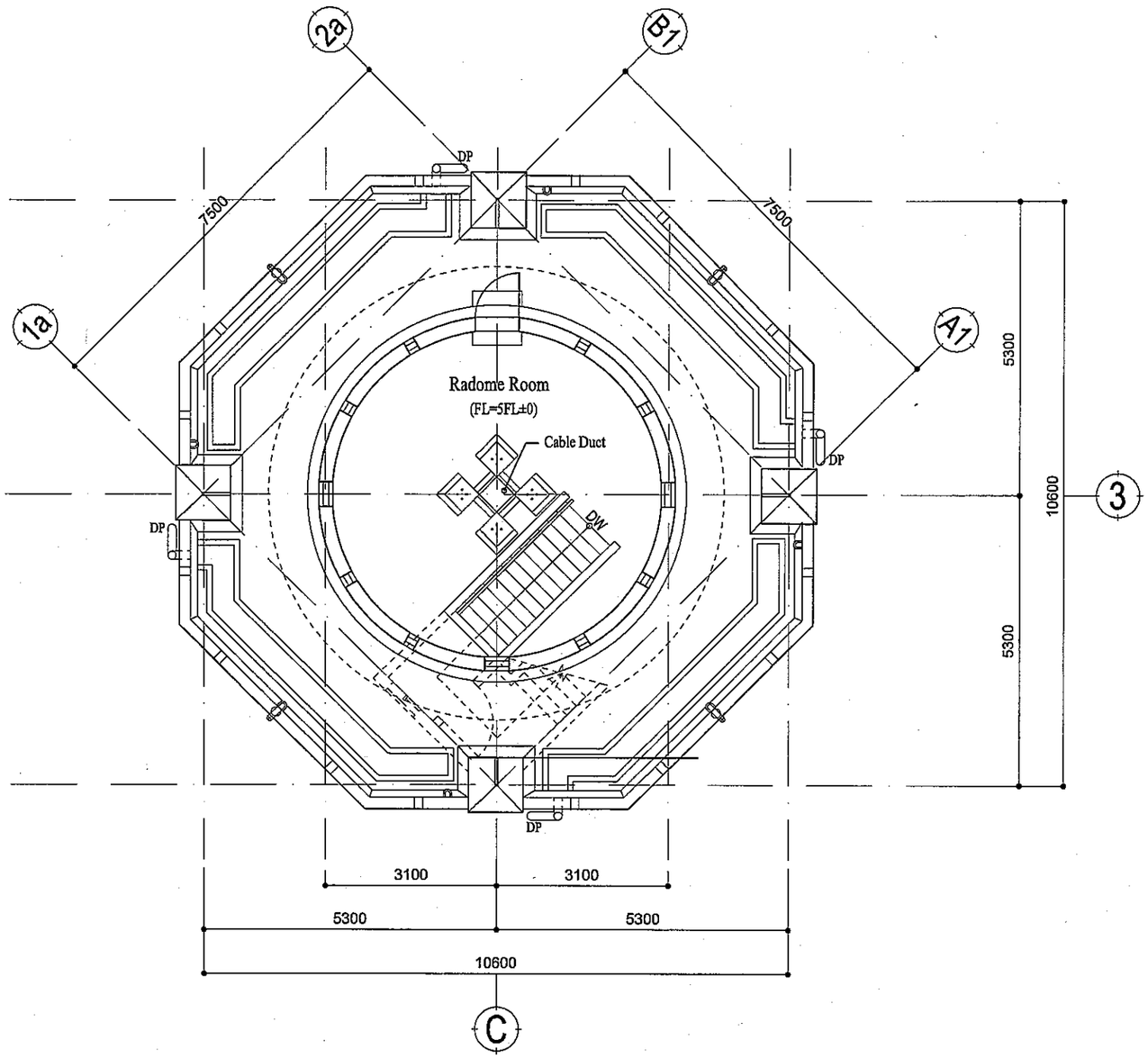
DRAWING TITLE: FLOOR PLAN 3

SCALE: 1:200

DRAWING No.: A - C04



4F PLAN (OBSERVATION DECK)



5F PLAN (RADOME FLOOR PLAN)

- DP: Drain Pipe, RD: Roof Drain
- Cyclone Screen
  Stainless Steel Mesh 100x100 (Fix)
- Overflow Pipe
- Parapet Hanger

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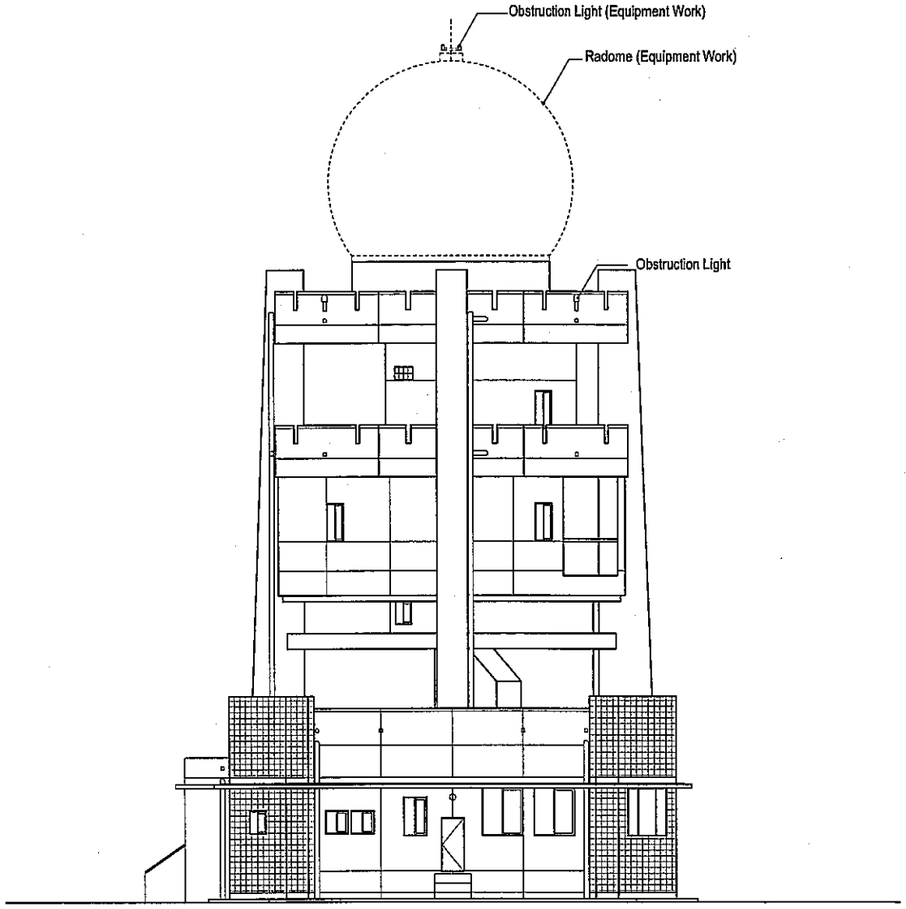
COX'S BAZAR RADAR TOWER BUILDING

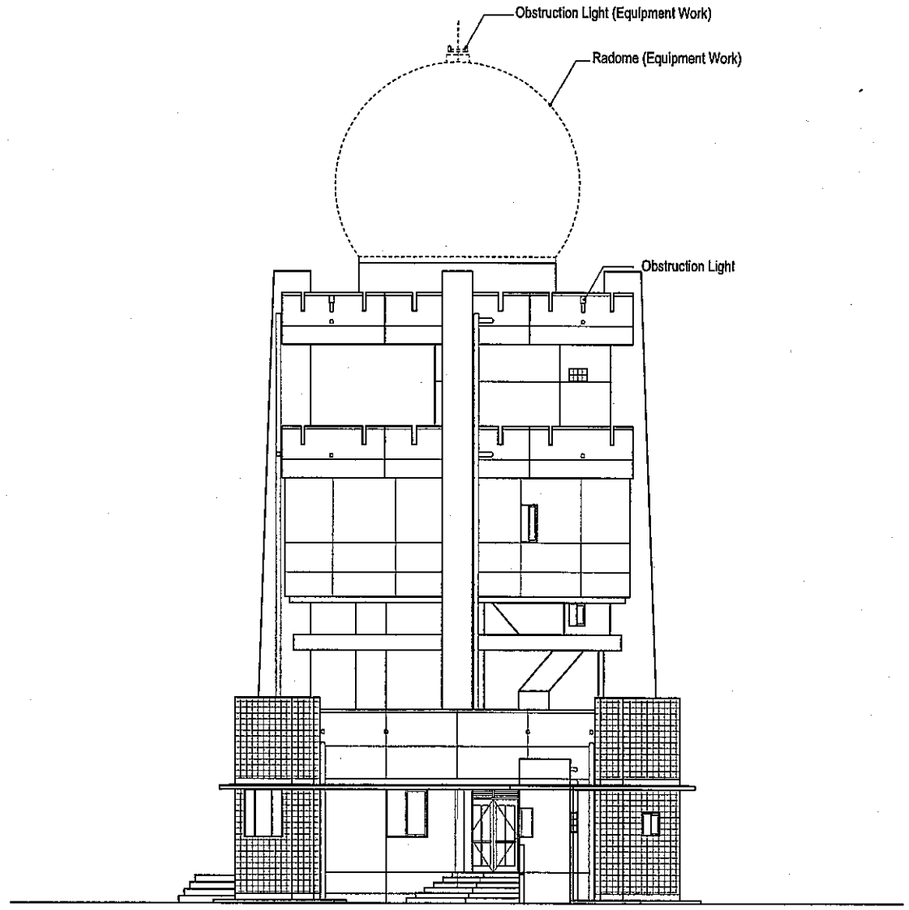
DRAWING TITLE: FLOOR PLAN-4

SCALE: 1:200

DRAWING No.: A - C05



WEST ELEVATION



NORTH ELEVATION

Japan Weather Association
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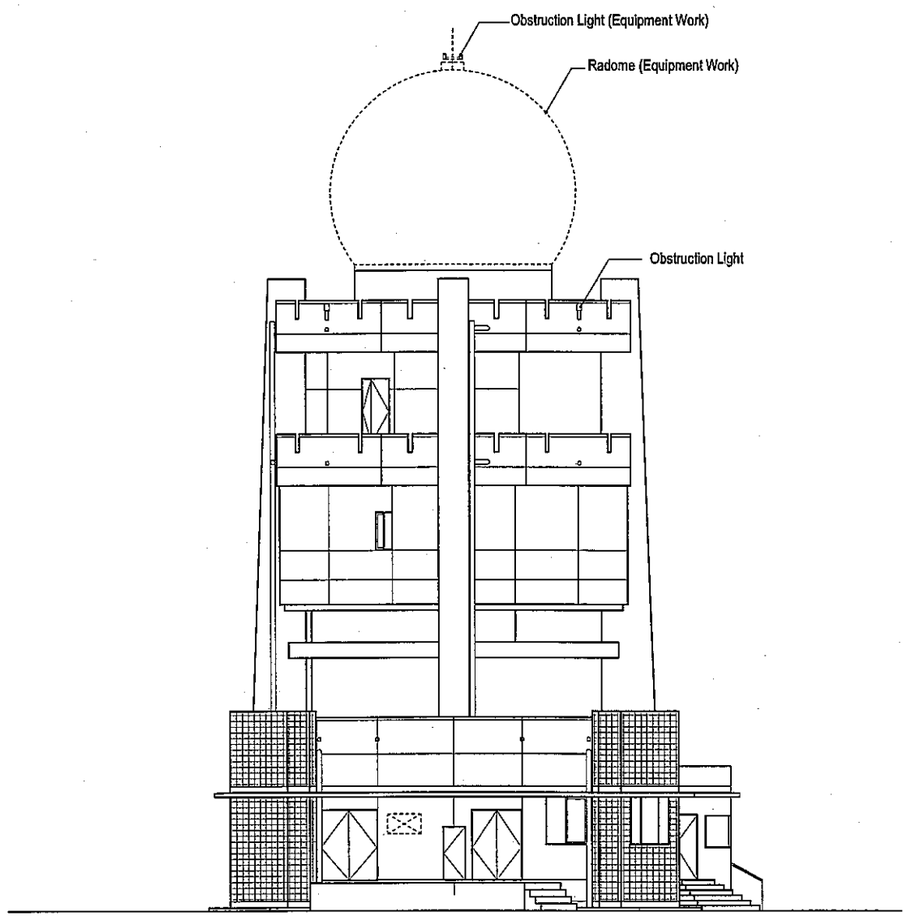
COX'S BAZAR RADAR TOWER BUILDING

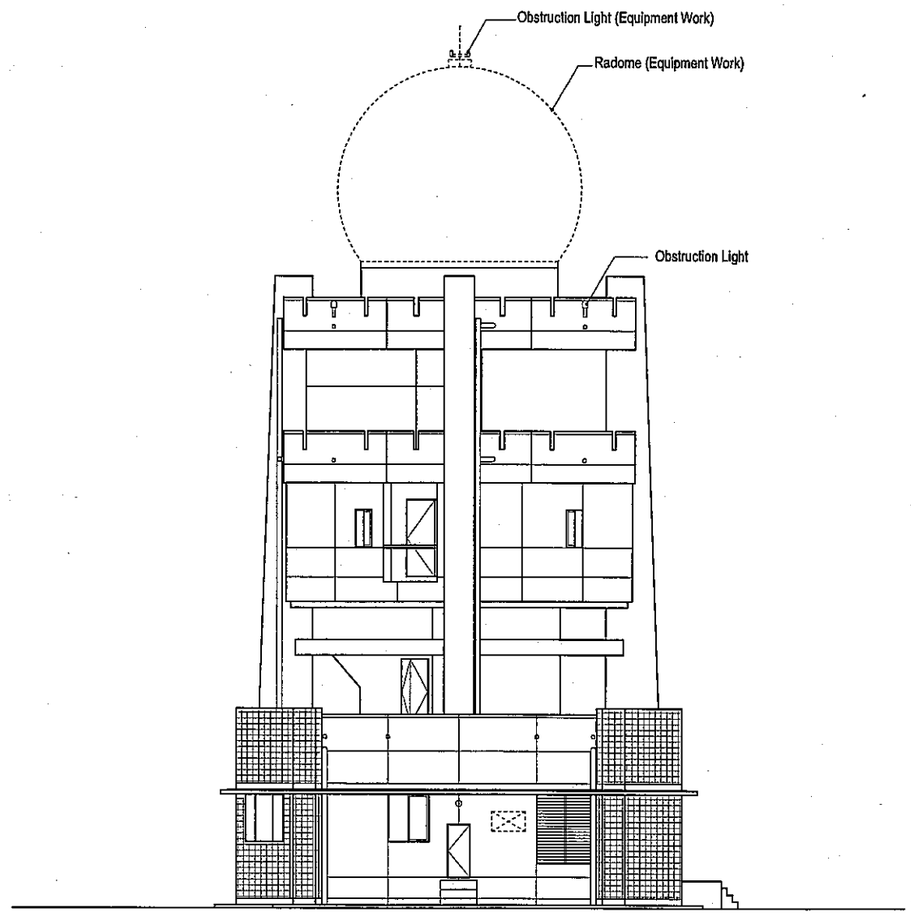
DRAWING TITLE: ELEVATION 1

SCALE: 1:200

DRAWING No.: A - C06



EAST ELEVATION



SOUTH ELEVATION

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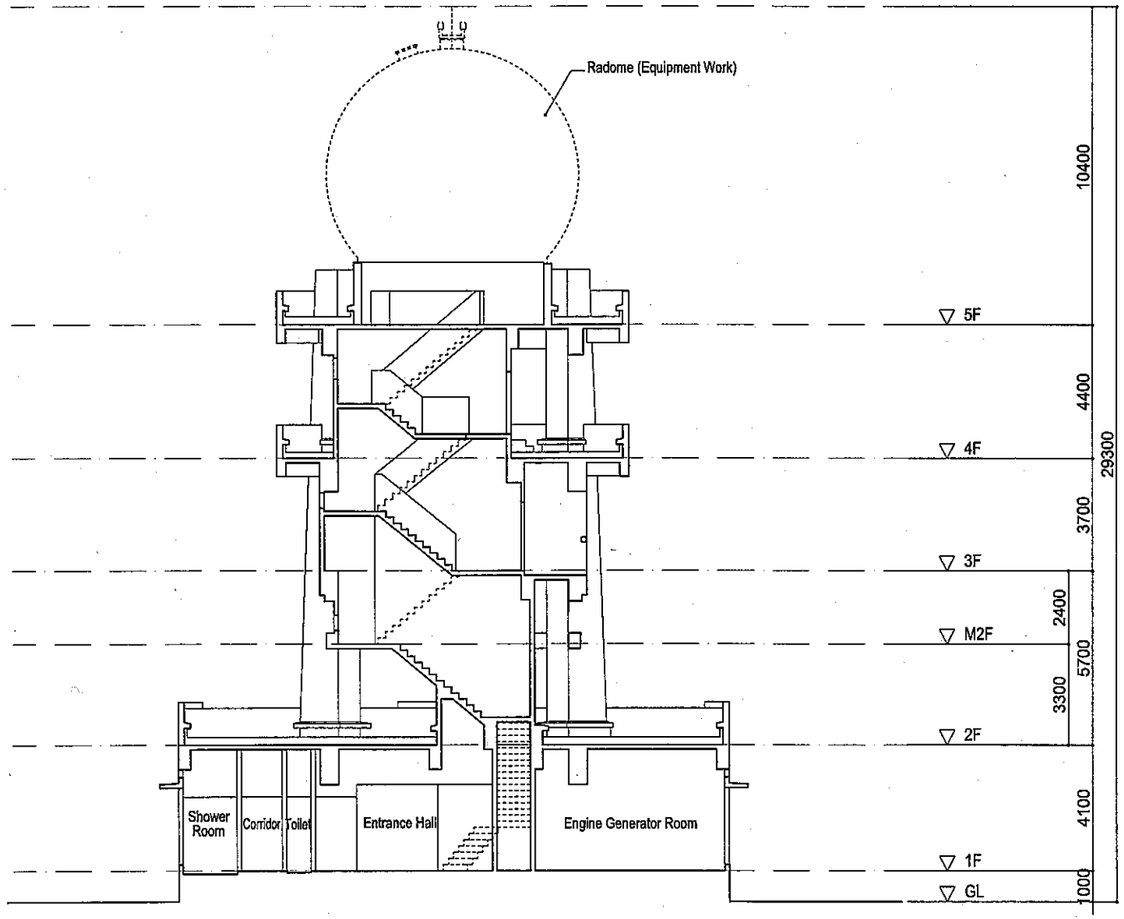
COX'S BAZAR RADAR TOWER BUILDING

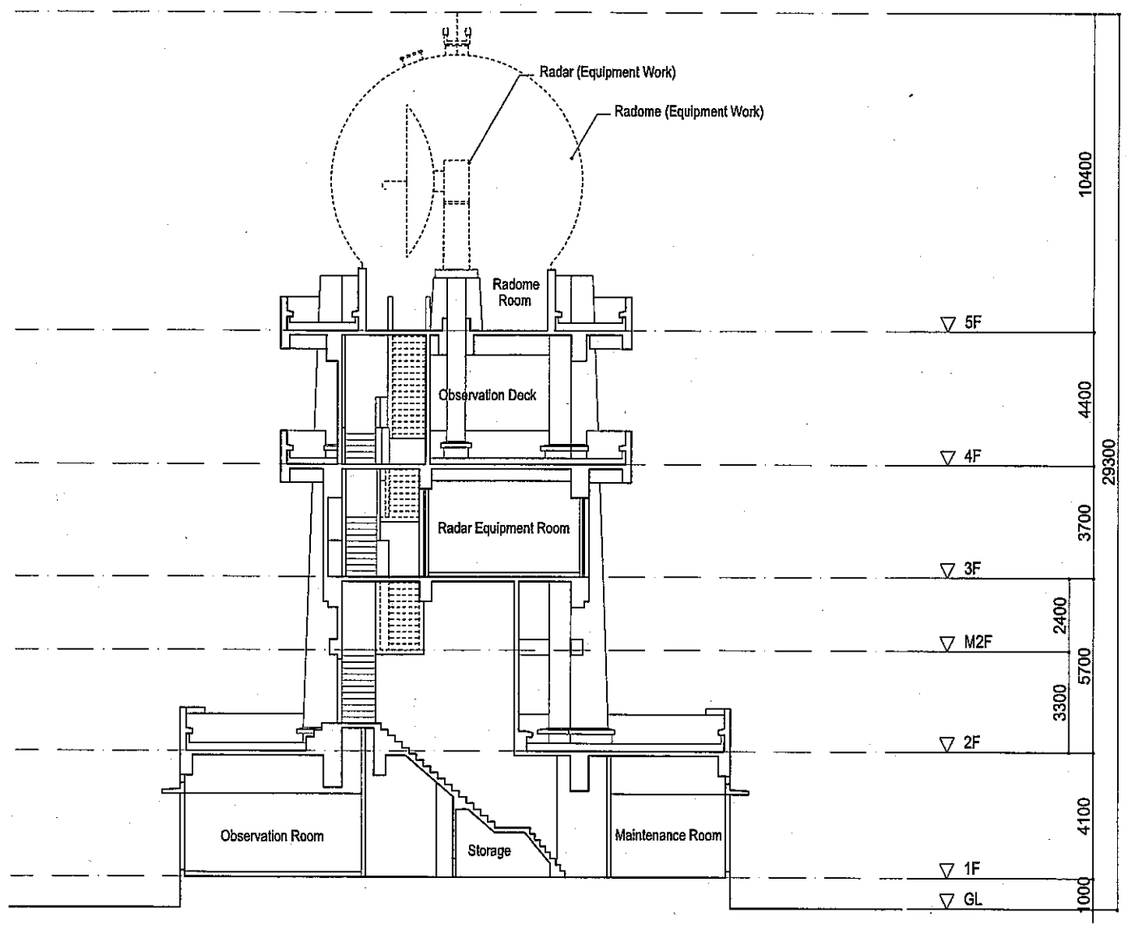
DRAWING TITLE: ELEVATION 2

SCALE: 1:200

DRAWING No.: A - C07



SECTION



SECTION

JWA Japan Weather Association
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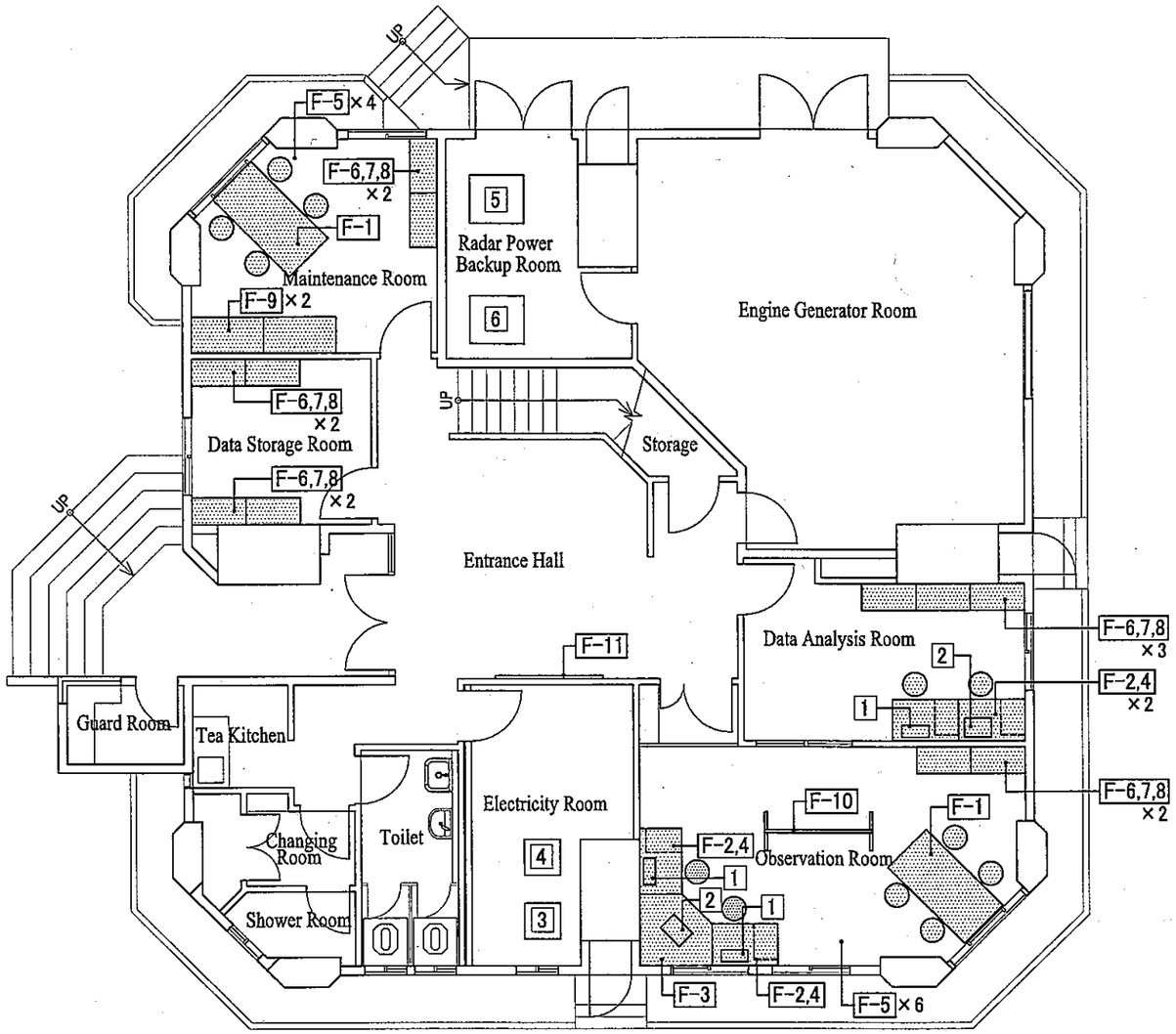
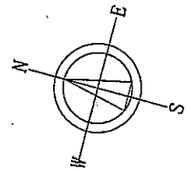
COX'S BAZAR RADAR TOWER BUILDING

DRAWING TITLE: SECTION

SCALE: 1:200

DRAWING No.: A - C08





EQUIPMENT

1	Indicator
2	Color Printer
3	Radar AVR
4	Isolation Transformer for Radar
5	Flywheel Power Back-up Unit
6	Flywheel Power Back-up Unit Controller

FURNITURE

F-1	Meeting Table
F-2	Pedestal Desk
F-3	Five-sided Corner Desk
F-4	Drawer Unit with Casters
F-5	Chair
F-6	Lateral Filling Cabinet
F-7	Cabinet with Double Hinged Door
F-8	Top Panel
F-9	Shelves with Double Hinged Door
F-10	White Board (Movable Type)
F-11	Pin Board (Wall Mounted Type)

1FL PLAN

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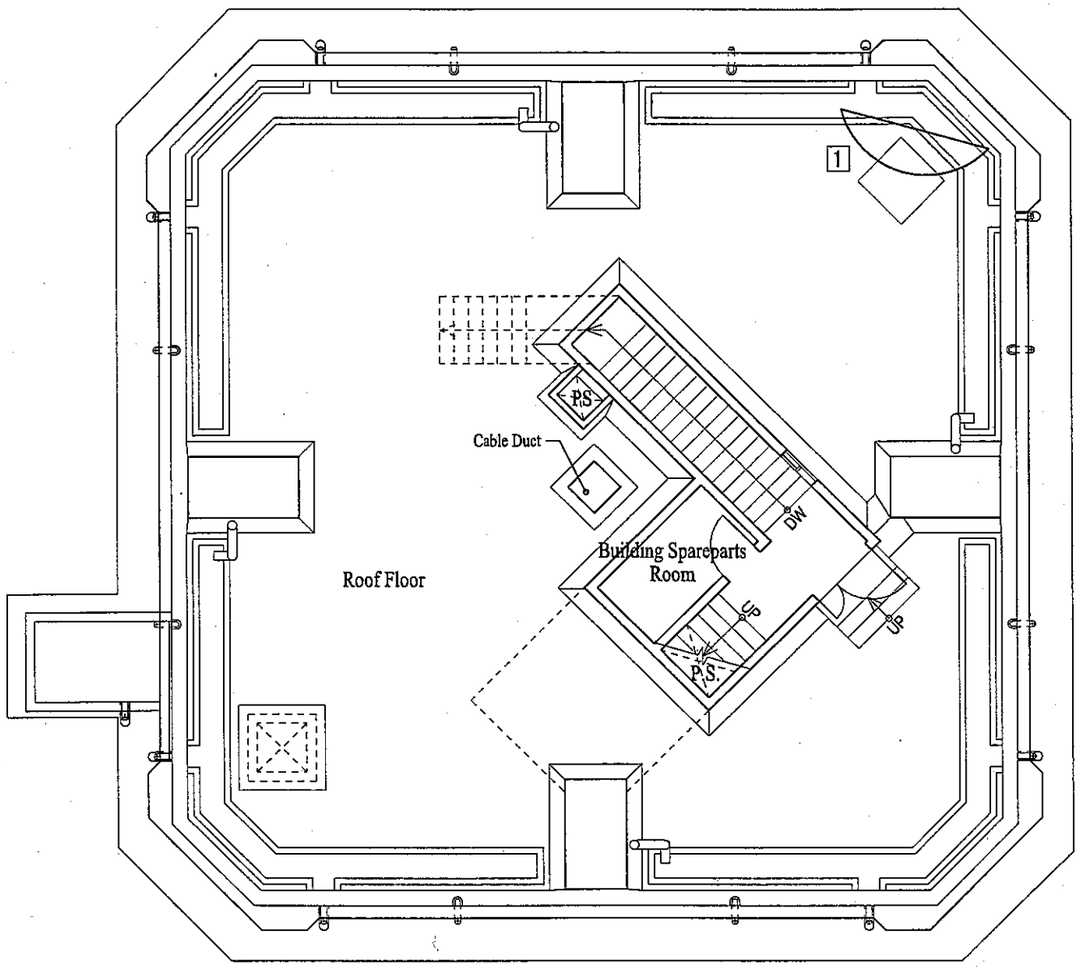
COX'S BAZAR RADAR TOWER BUILDING

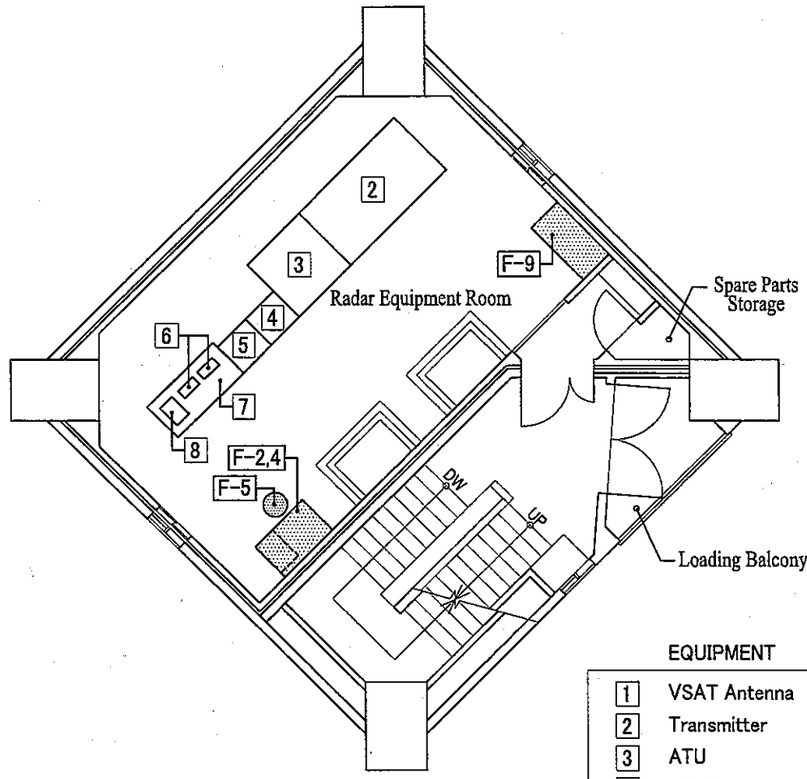
DRAWING TITLE: EQUIPMENT LAYOUT PLAN-1

SCALE: 1:100

DRAWING No.: EQ - C01



2FL PLAN



3FL PLAN

EQUIPMENT

1	VSAT Antenna
2	Transmitter
3	ATU
4	DRSP
5	Antenna Controller & Dehydrator
6	Indicator
7	Indicator Rack
8	VSAT IDU

FURNITURE

F-2	Pedestal Desk
F-4	Drawer Unit with Casters
F-5	Chair
F-9	Shelves with Double Hinged Door

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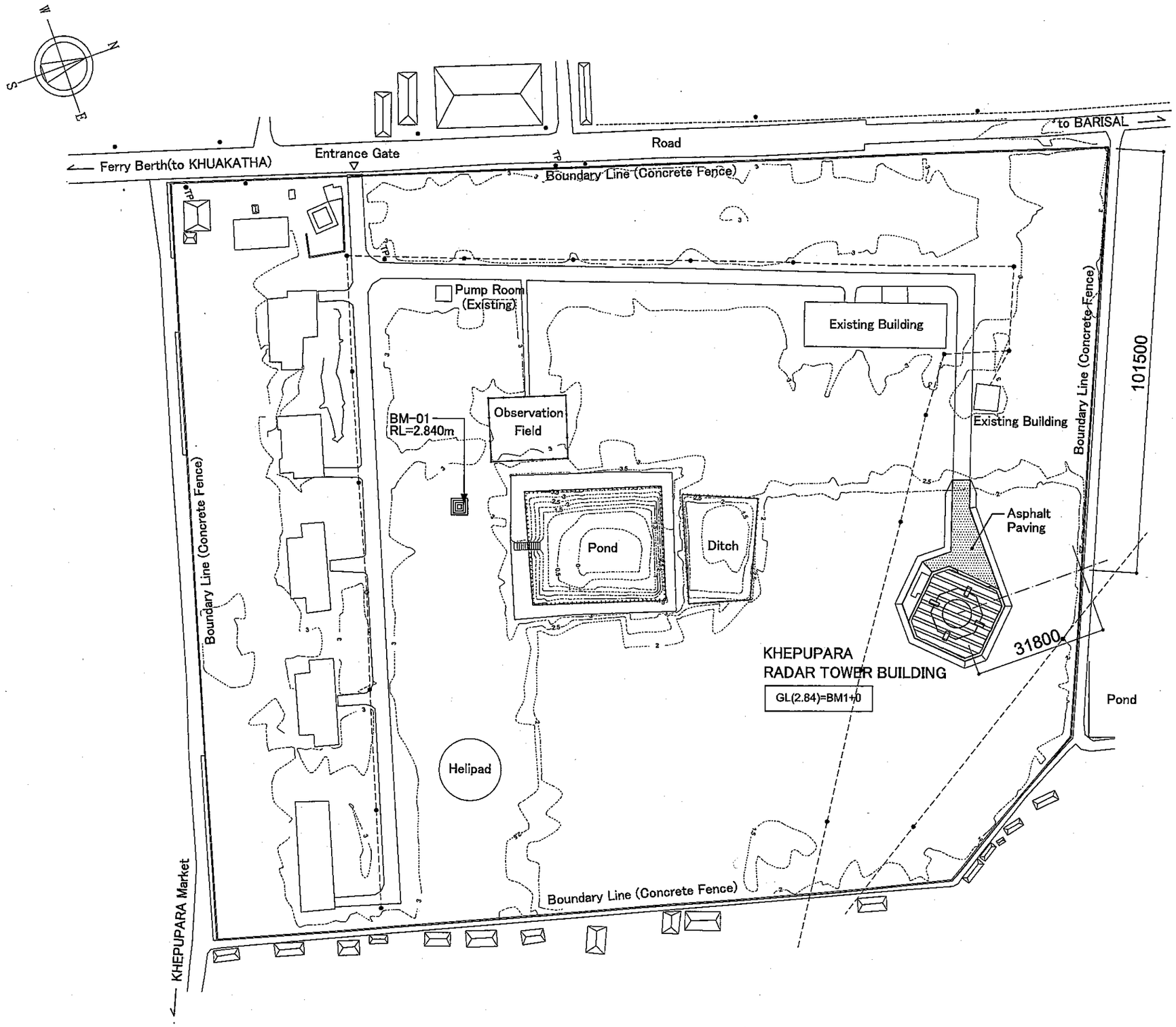
COX'S BAZAR RADAR TOWER BUILDING

DRAWING TITLE: EQUIPMENT LAYOUT PLAN-2

SCALE: 1:100

DRAWING No.: EQ - C02



Area Calculations

Floor	Area
1F	201.58 ㎡
2F	13.04 ㎡
3F	69.19 ㎡
4F	16.24 ㎡
5F	30.17 ㎡
Total Floor Area	350.81 ㎡
Building Coverage Area	298.71 ㎡

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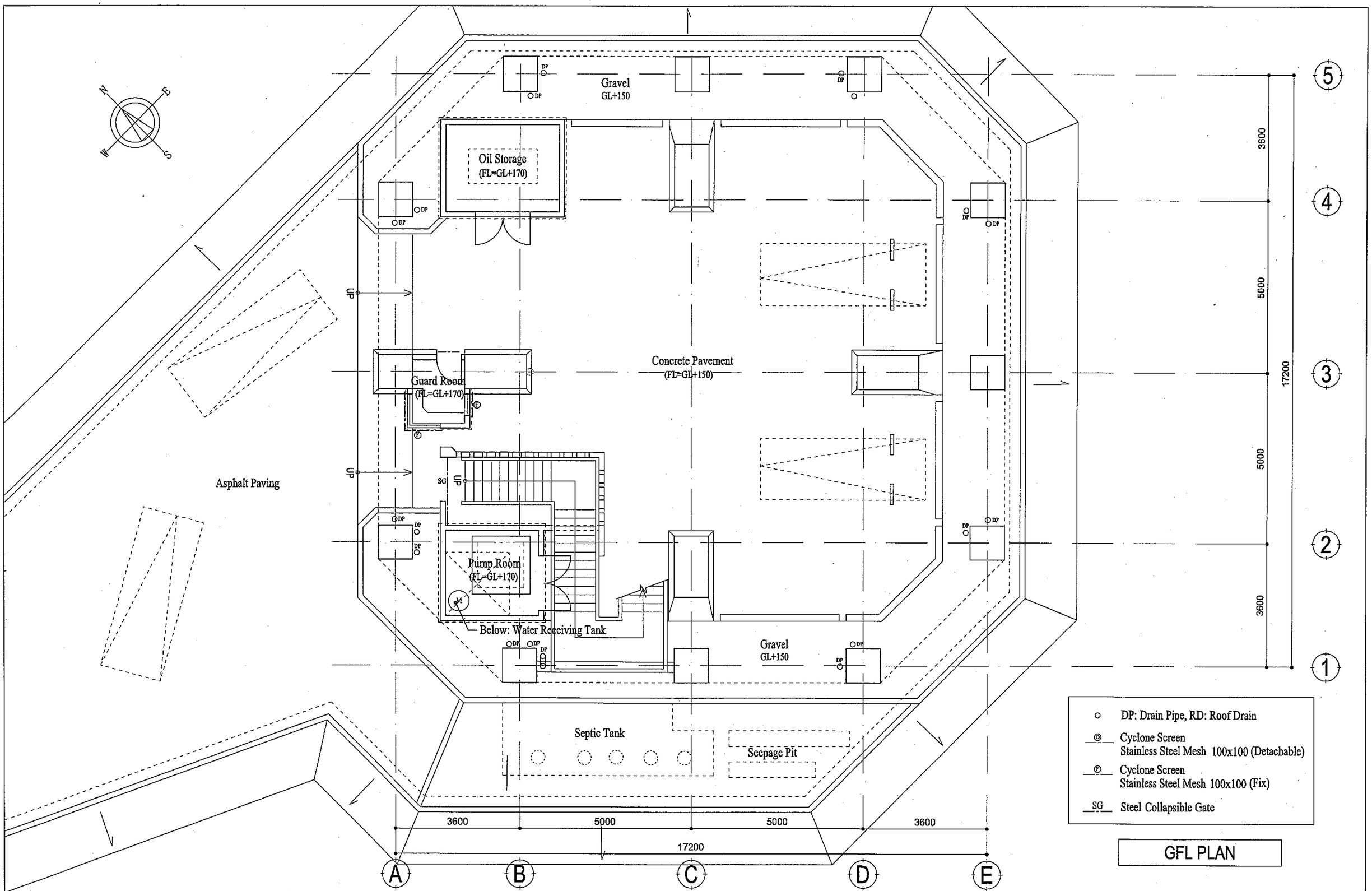
KHEPUPARA RADAR TOWER BUILDING

DRAWING TITLE: SITE PLAN

SCALE: 1:1000

DRAWING No.: A - K01



GFL PLAN

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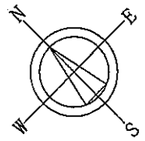
KHEPUPARA RADAR TOWER BUILDING

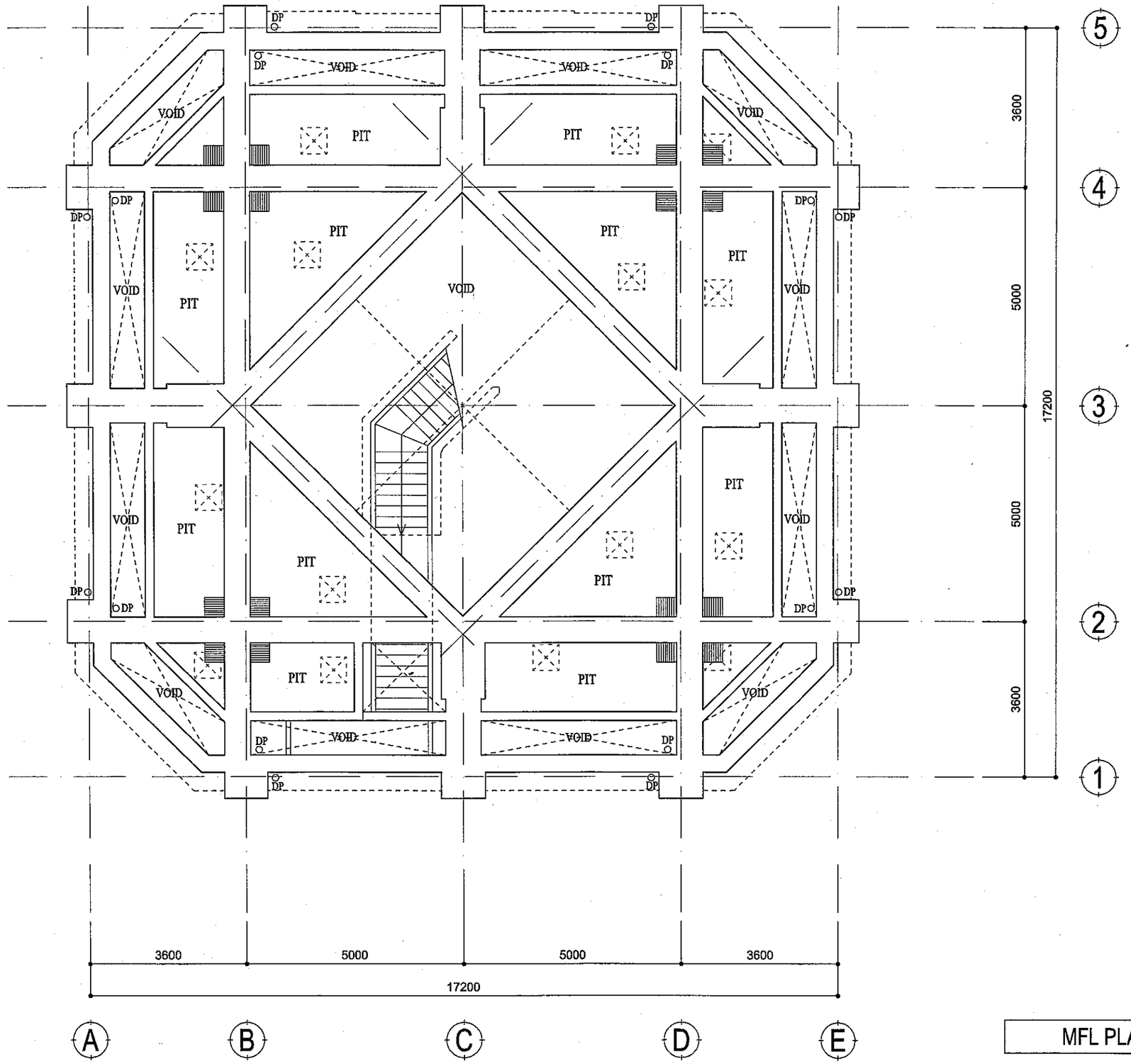
DRAWING TITLE: FLOOR PLAN-1

DATE: Dec.22, 2004

SCALE: 1:100

DRAWING No.: A - K02





- Above Maintenance Hatch 600x600
- DP: Drain Pipe, RD: Roof Drain
- Floor Louver
- Overflow Pipe
- Parapet Hanger

MFL PLAN

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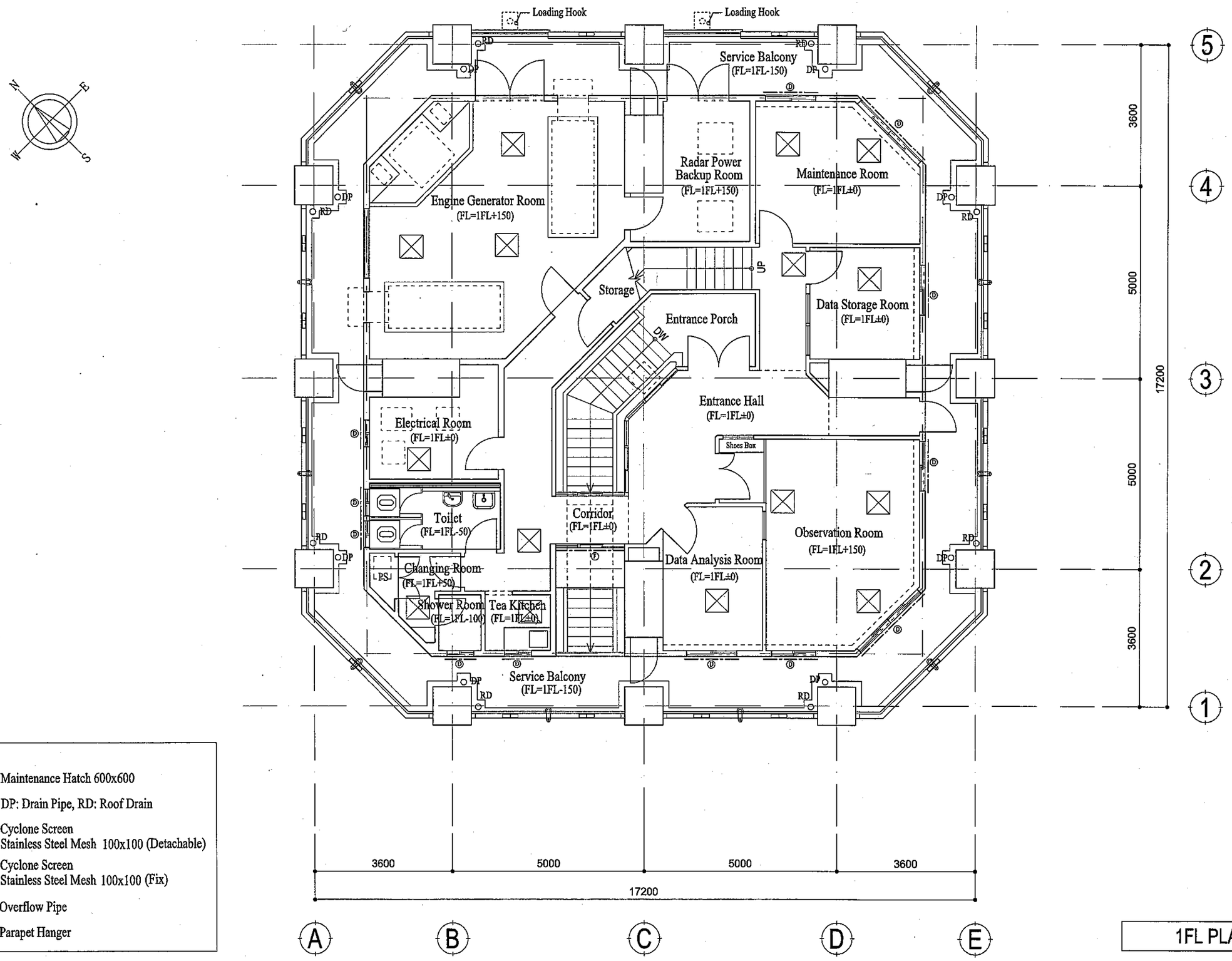
KHEPUPARA RADAR TOWER BUILDING

DRAWING TITLE: FLOOR PLAN-2

SCALE: 1:100

DRAWING No.: A - K03



- Maintenance Hatch 600x600
- DP: Drain Pipe, RD: Roof Drain
- Ⓓ Cyclone Screen Stainless Steel Mesh 100x100 (Detachable)
- Ⓕ Cyclone Screen Stainless Steel Mesh 100x100 (Fix)
- Overflow Pipe
- Parapet Hanger

1FL PLAN

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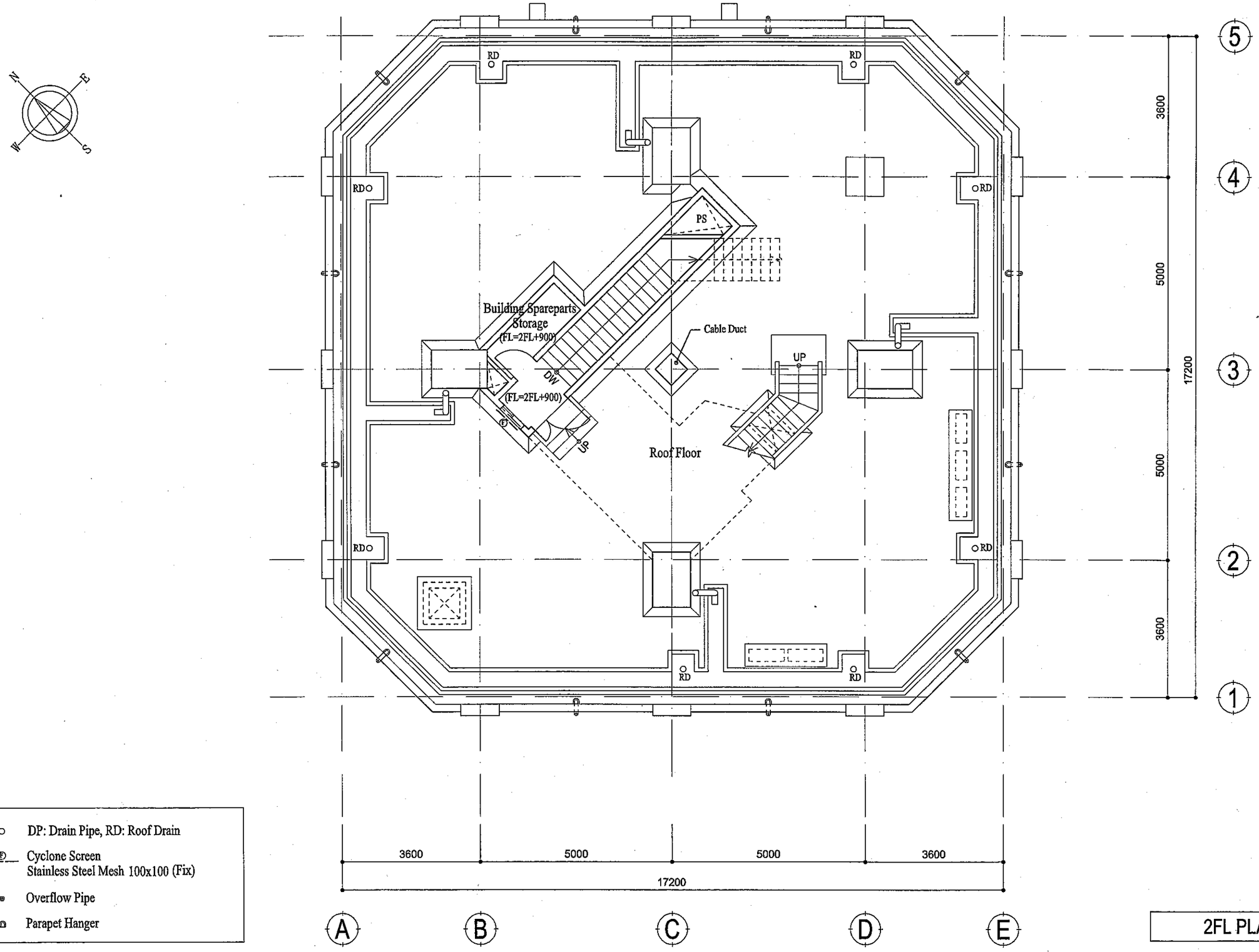

- DP: Drain Pipe, RD: Roof Drain
- Ⓒ Cyclone Screen
  Stainless Steel Mesh 100x100 (Fix)
- Overflow Pipe
- Parapet Hanger

2FL PLAN

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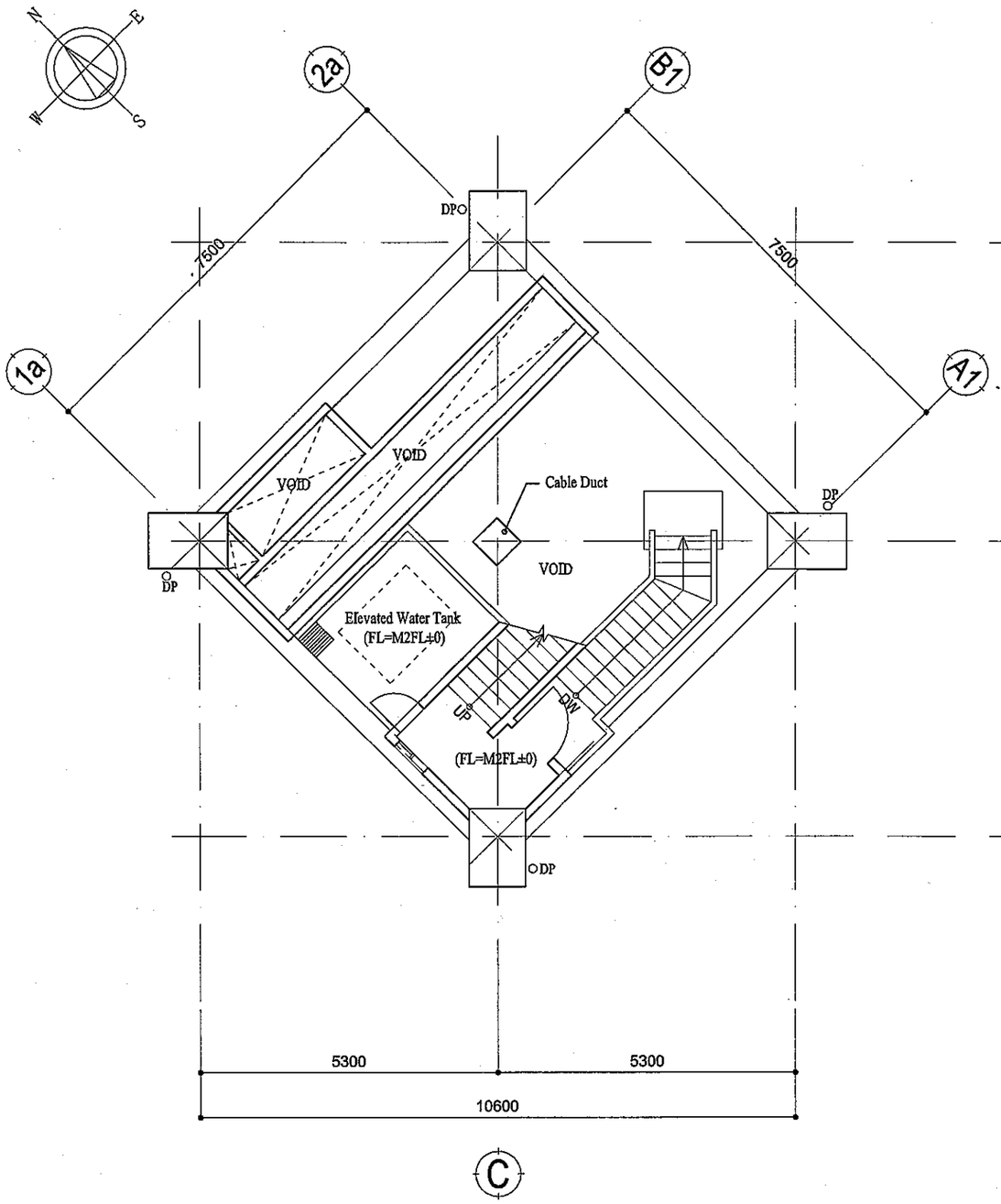
KHEPUPARA RADAR TOWER BUILDING

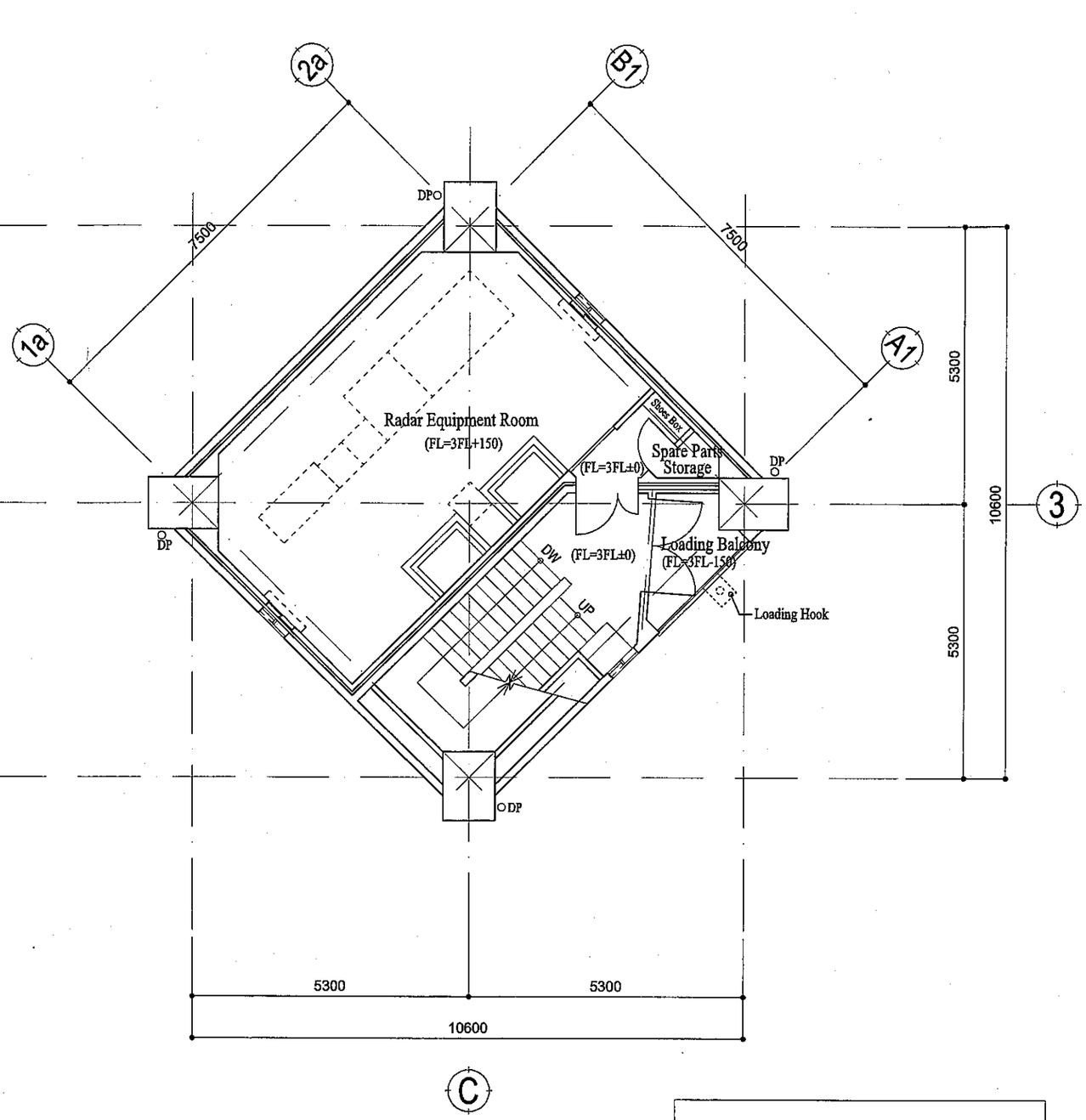
DRAWING TITLE: FLOOR PLAN-4

SCALE: 1:100

DRAWING No.: A - K05



M2FL PLAN



3FL PLAN

- DP: Drain Pipe, RD: Roof Drain
- Cyclone Screen
  Stainless Steel Mesh 100x100 (Fix)
- Overflow Pipe
- Parapet Hanger

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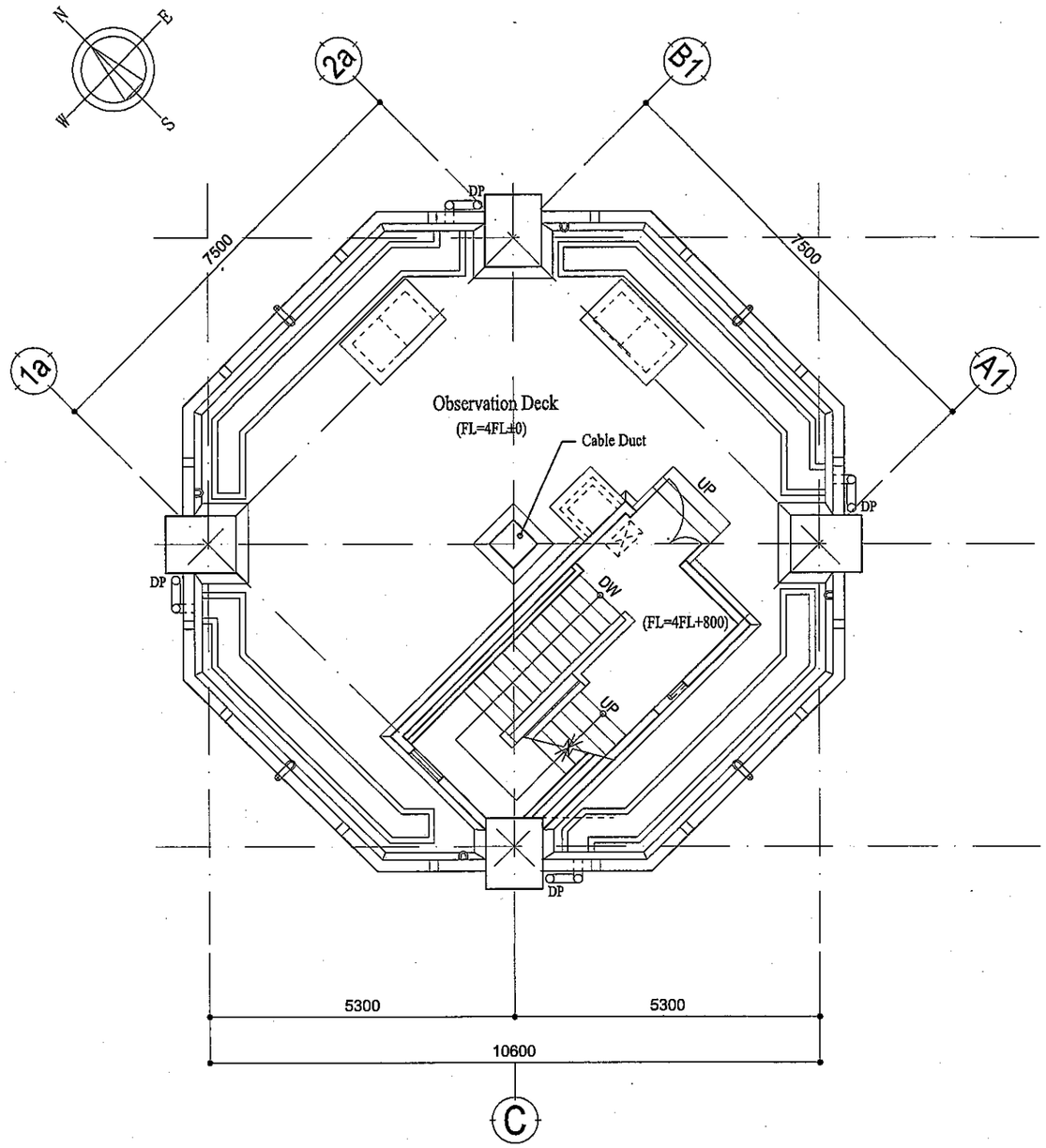
KHEPUPARA RADAR TOWER BUILDING

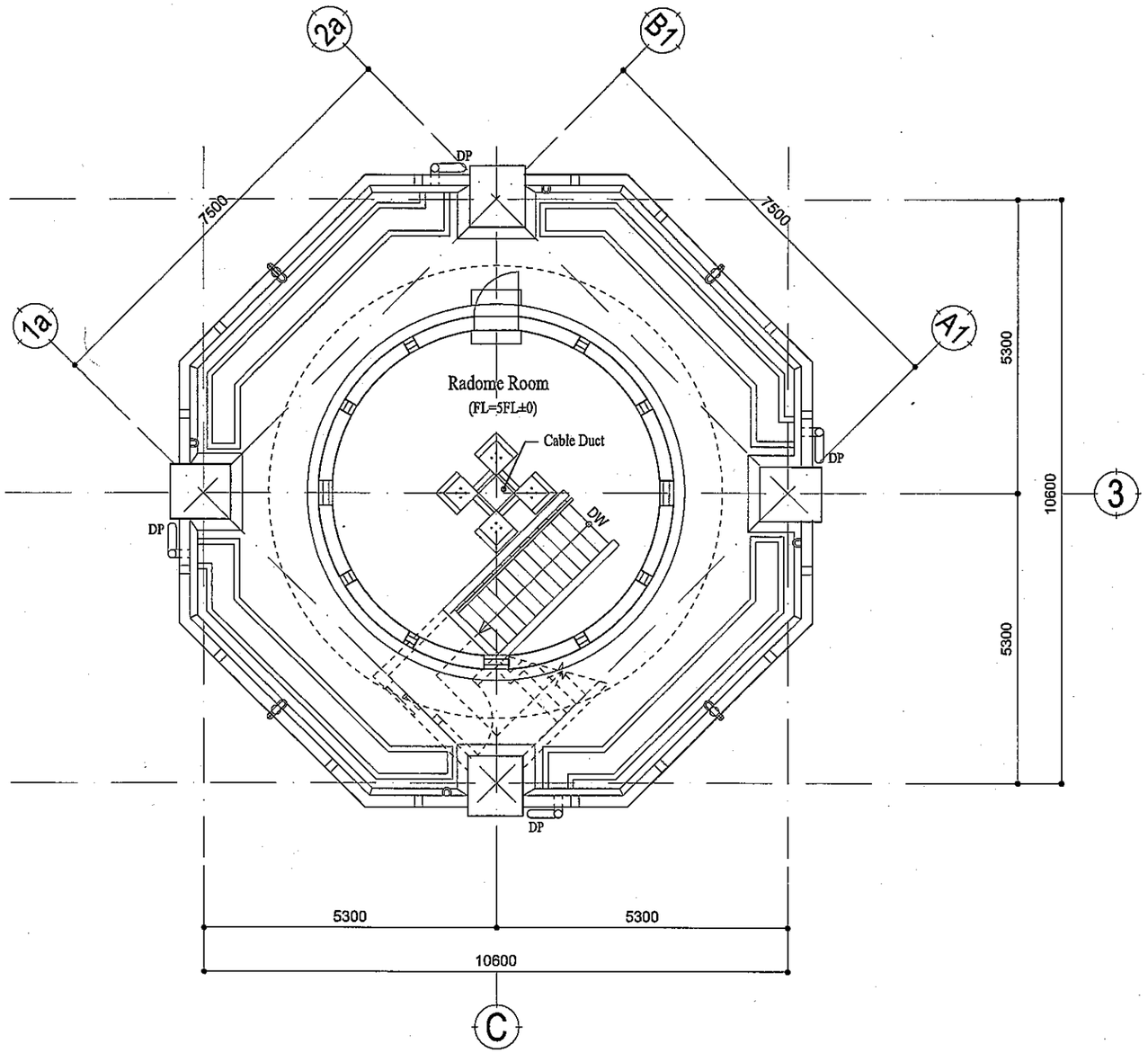
DRAWING TITLE: FLOOR PLAN-5

SCALE: 1:100

DRAWING No.: A - K06



4F PLAN (OBSERVATION DECK)



5F PLAN (RADOME FLOOR PLAN)

- DP: Drain Pipe, RD: Roof Drain
- Cyclone Screen
  Stainless Steel Mesh 100x100 (Fix)
- Overflow Pipe
- Parapet Hanger

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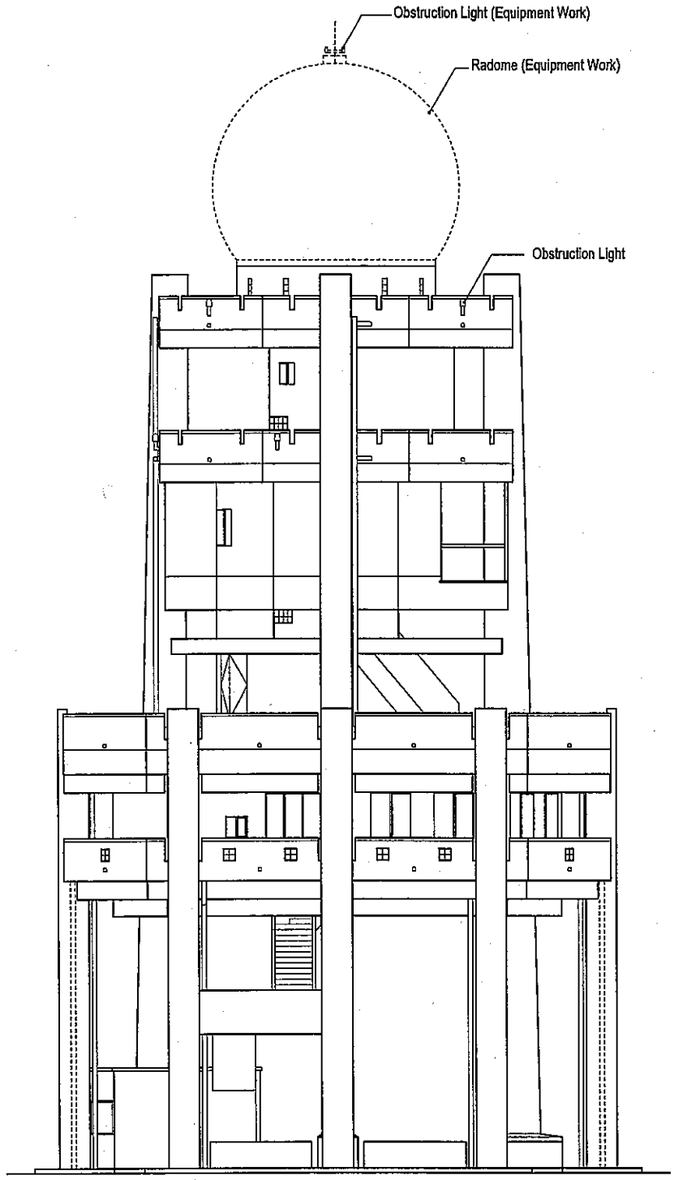
KHEPUPARA RADAR TOWER BUILDING

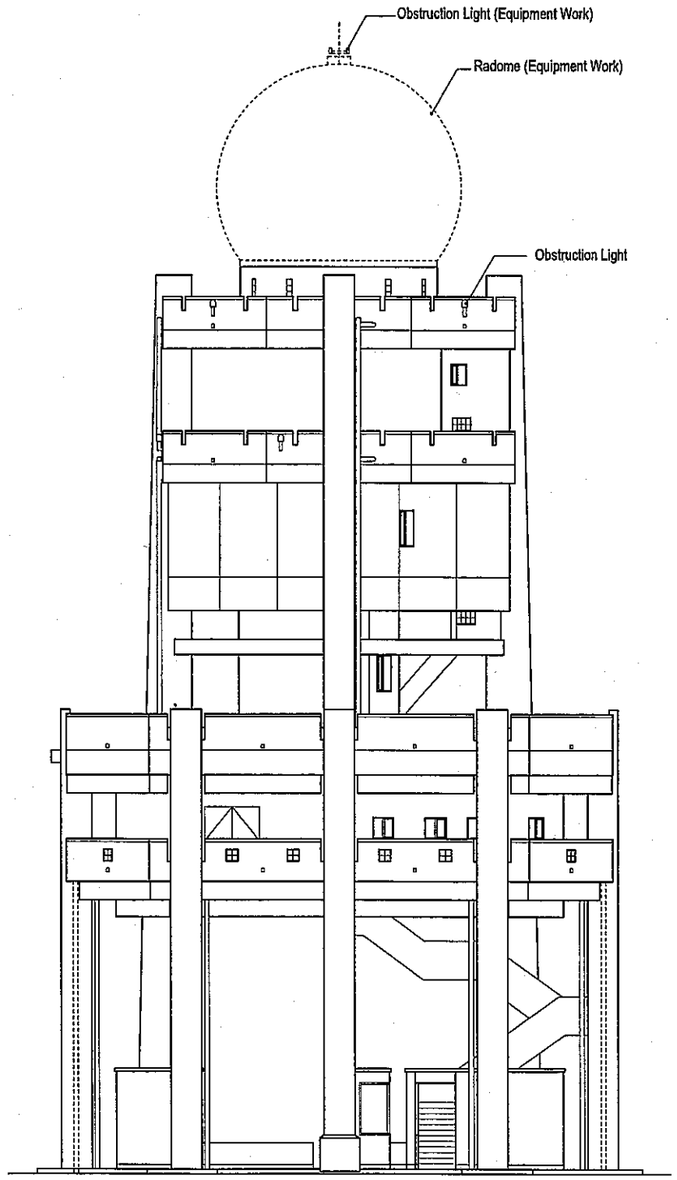
DRAWING TITLE: FLOOR PLAN-6

SCALE: 1:100

DRAWING No.: A - K07



SOUTH ELEVATION



WEST ELEVATION

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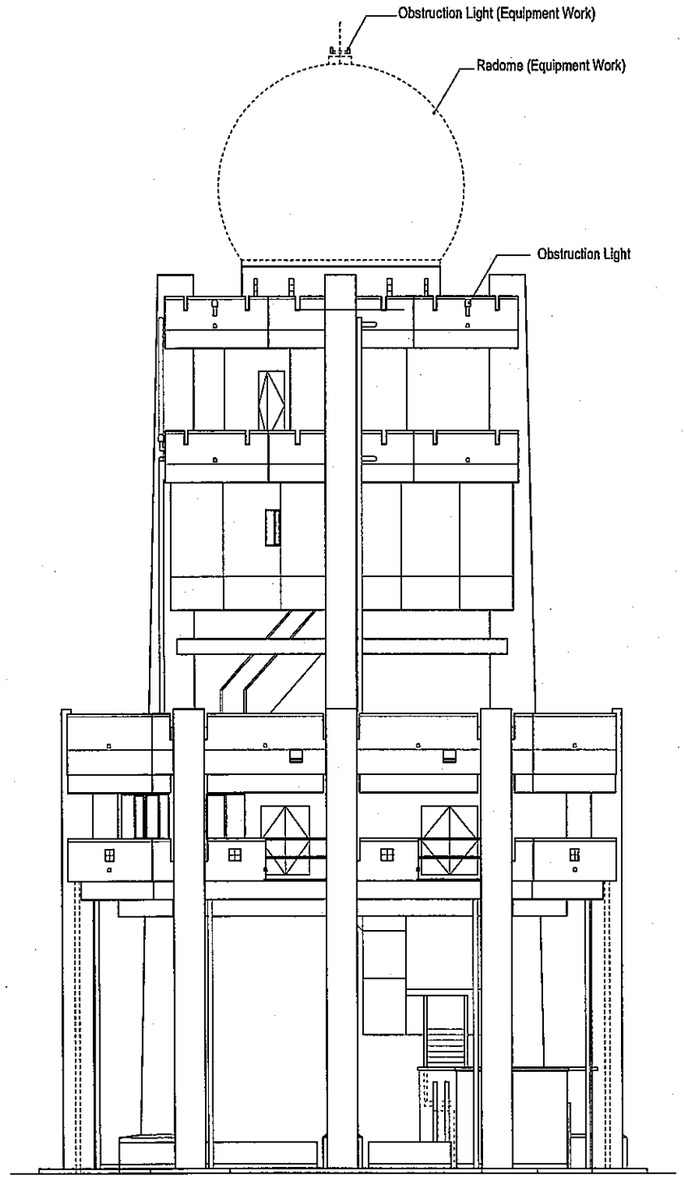
KHEPUPARA RADAR TOWER BUILDING

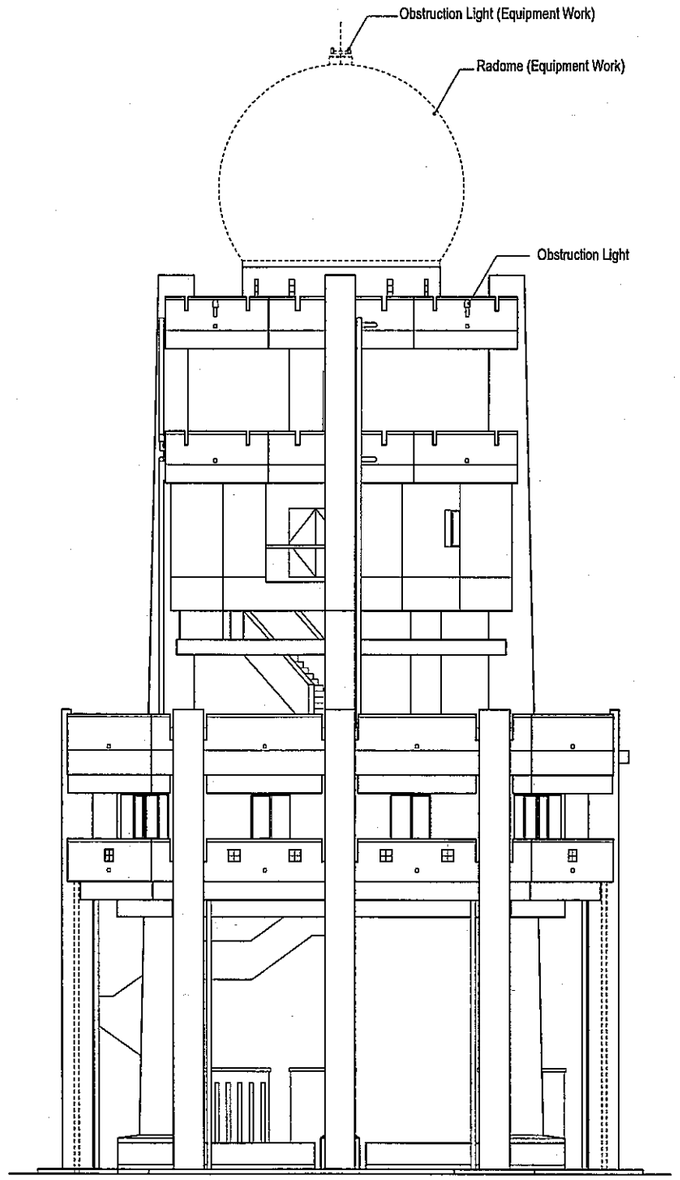
DRAWING TITLE: ELEVATION 1

SCALE: 1:200

DRAWING No.: A - K08



NORTH ELEVATION



EAST ELEVATION

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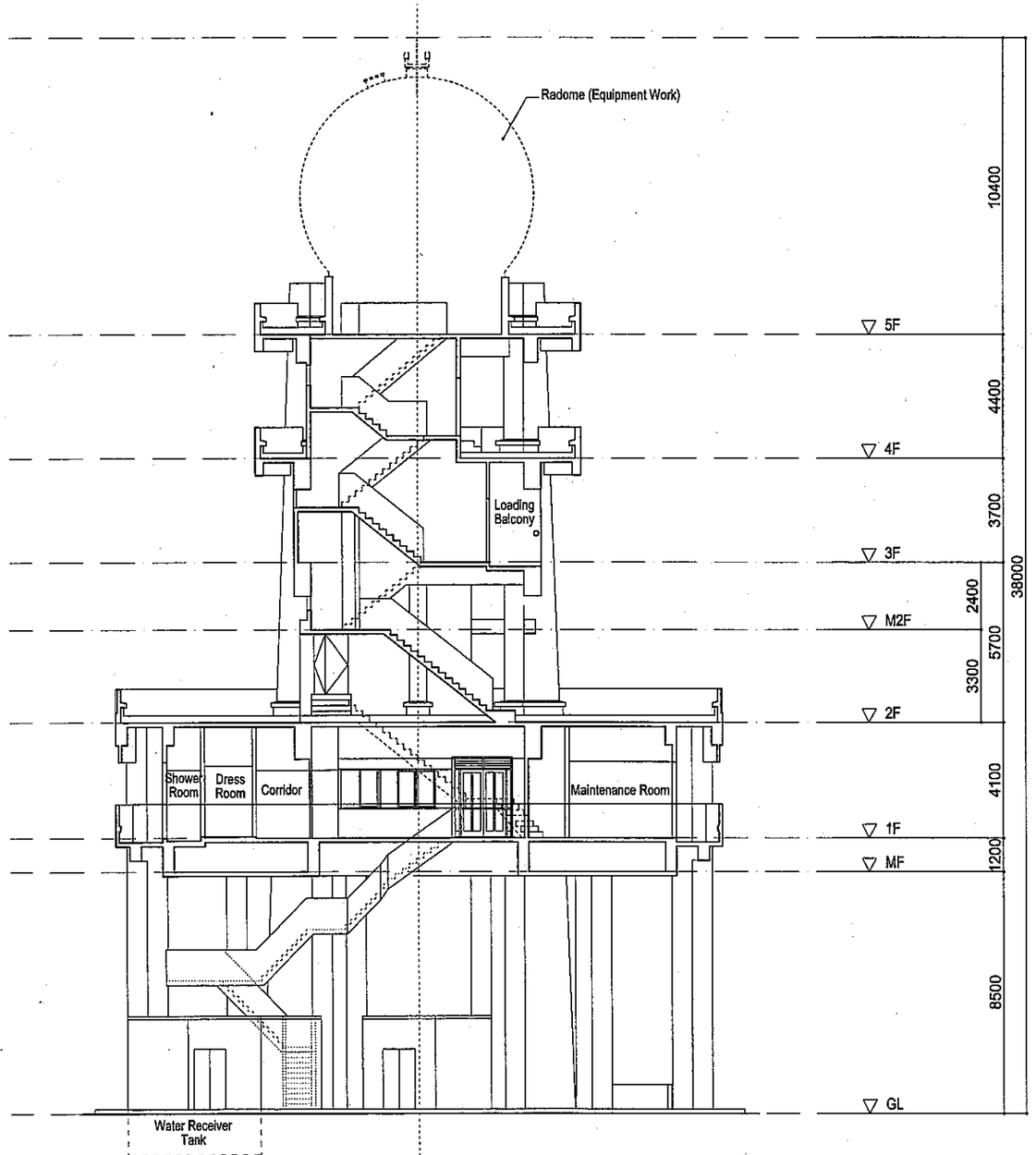
KHEPUPARA RADAR TOWER BUILDING

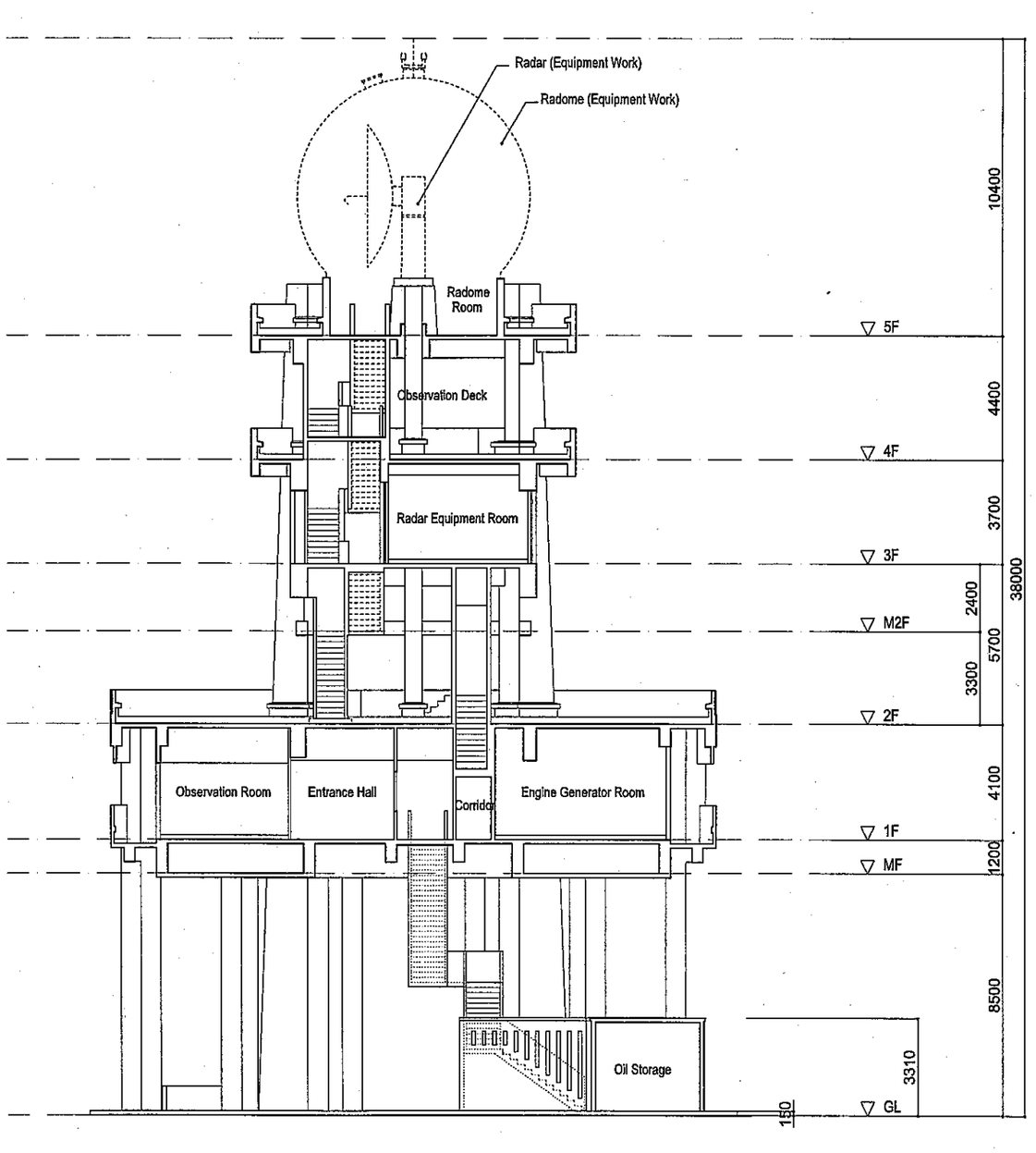
DRAWING TITLE: ELEVATION 2

SCALE: 1:200

DRAWING No.: A - K09



SECTION



SECTION

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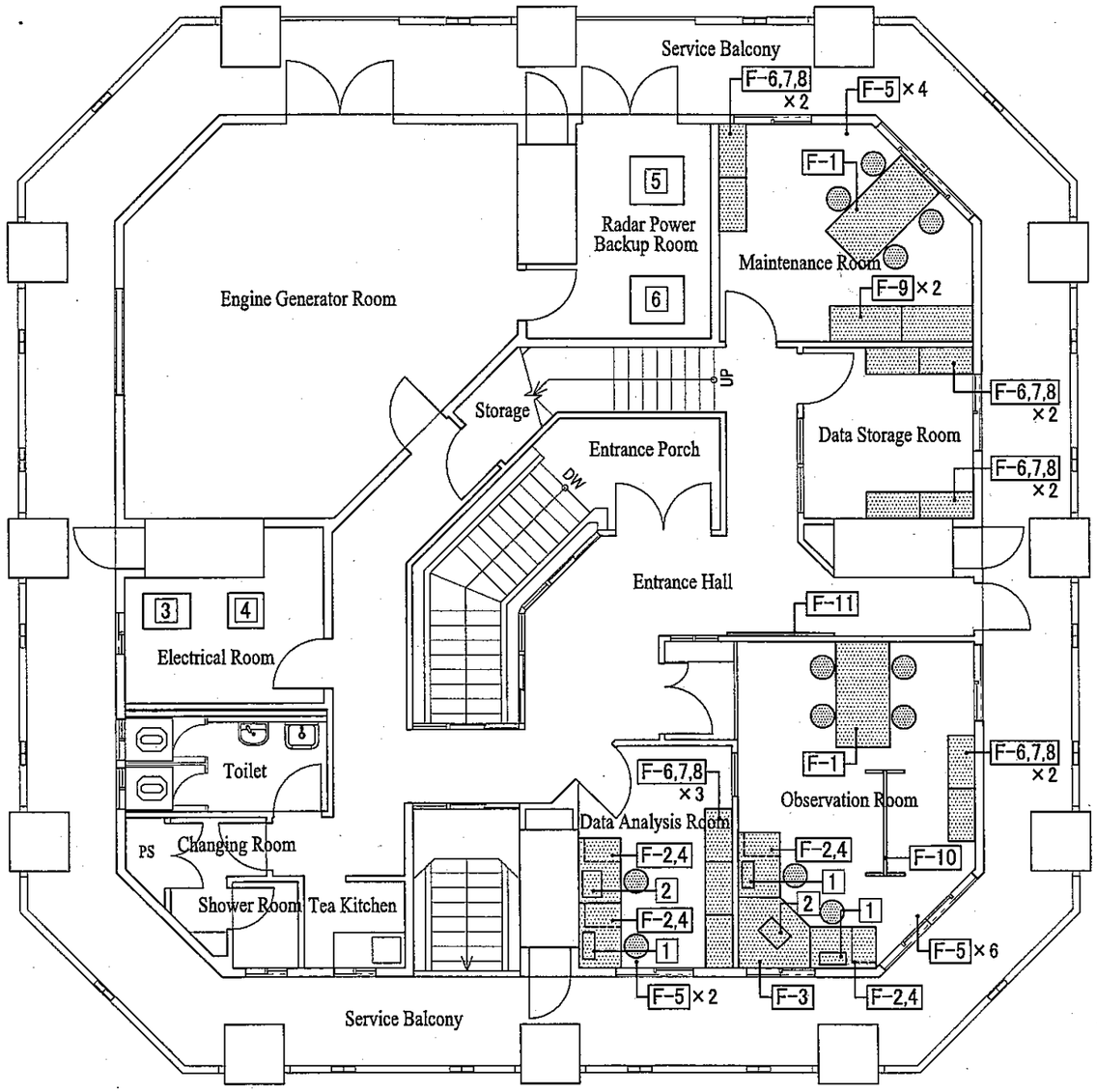
KHEPUPARA RADAR TOWER BUILDING

DRAWING TITLE: SECTION

SCALE: 1:200

DRAWING No.: A - K10



1FL PLAN

EQUIPMENT

1	Indicator
2	Color Printer
3	Radar AVR
4	Isolation Transformer for Radar
5	Flywheel Power Back-up Unit
6	Flywheel Power Back-up Unit Controller

FURNITURE

F-1	Meeting Table
F-2	Pedestal Desk
F-3	Five-sided Corner Desk
F-4	Drawer Unit with Casters
F-5	Chair
F-6	Lateral Filling Cabinet
F-7	Cabinet with Double Hinged Door
F-8	Top Panel
F-9	Shelves with Double Hinged Door
F-10	White Board (Movable Type)
F-11	Pin Board (Wall Mounted Type)

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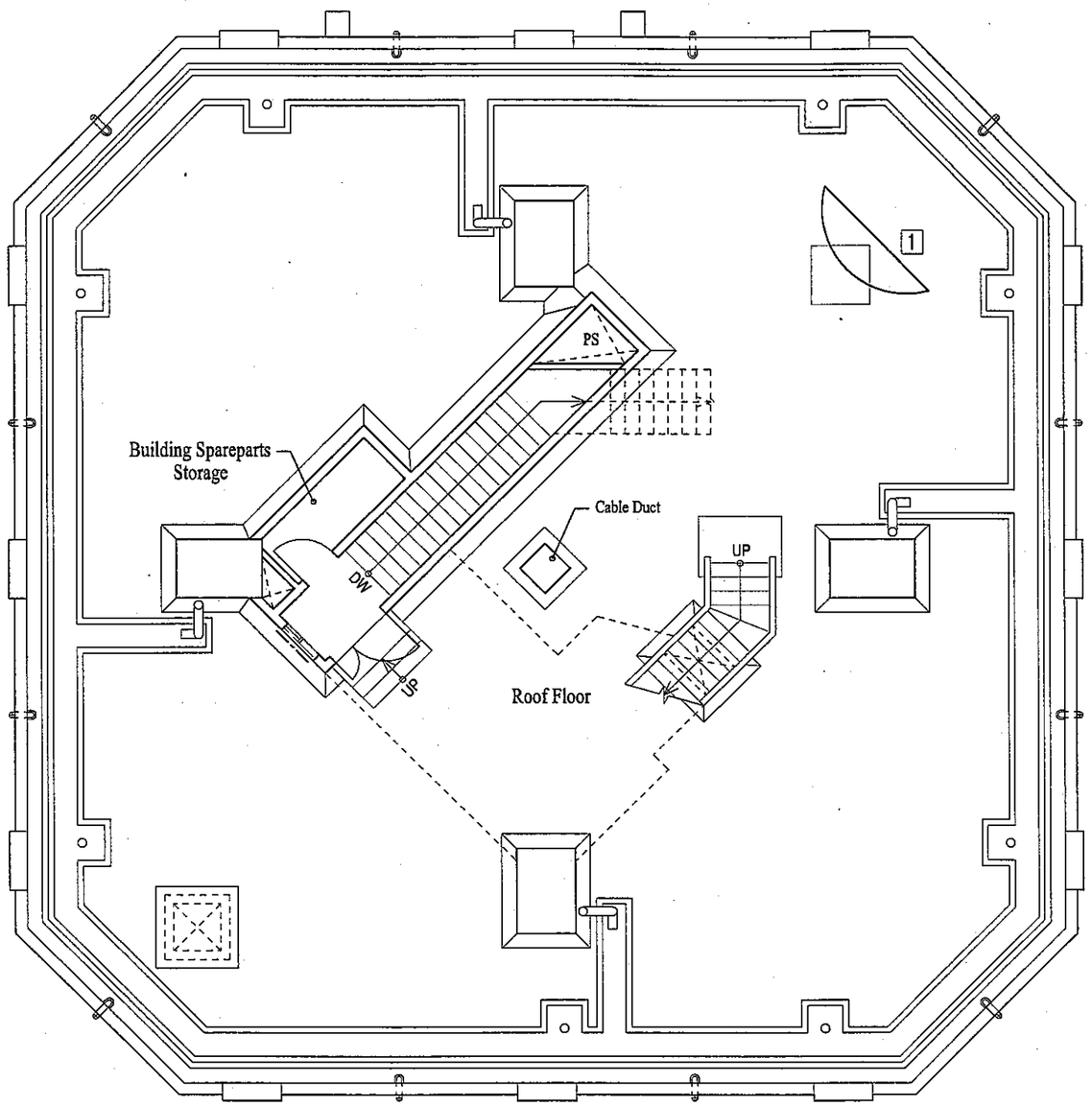
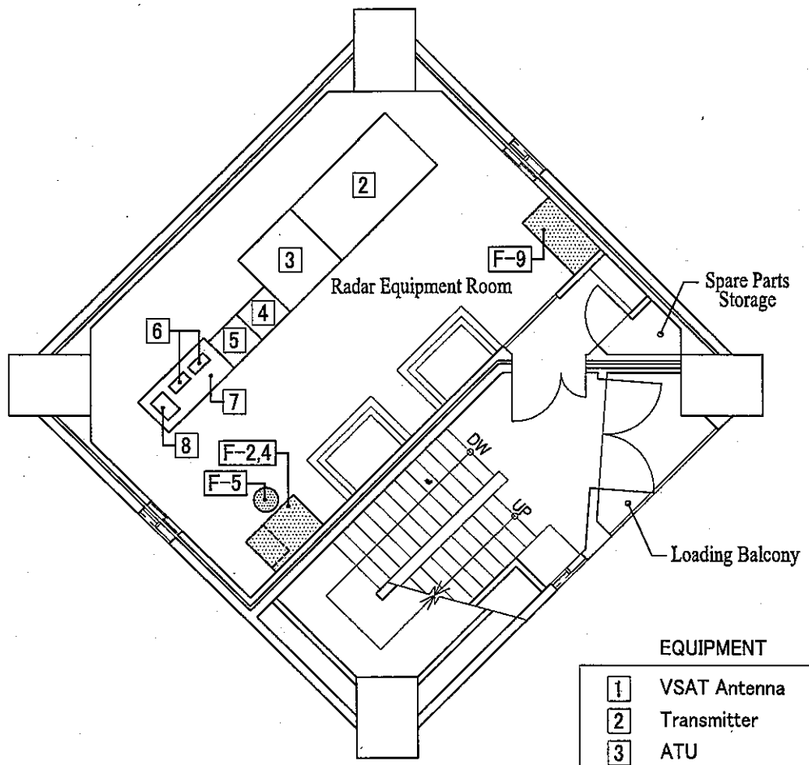
KHEPUPARA RADAR TOWER BUILDING	DRAWING TITLE	SCALE	DRAWING No.
	EQUIPMENT LAYOUT PLAN-1	1:100	EQ - K01



2FL PLAN



3FL PLAN

EQUIPMENT

1	VSAT Antenna
2	Transmitter
3	ATU
4	DRSP
5	Antenna Controller & Dehydrator
6	Indicator
7	Indicator Rack
8	VSAT IDU

FURNITURE

F-2	Pedestal Desk
F-4	Drawer Unit with Casters
F-5	Chair
F-9	Shelves with Double Hinged Door

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KHEPUPARA RADAR TOWER BUILDING

DRAWING TITLE: EQUIPMENT LAYOUT PLAN-2

SCALE: 1:100

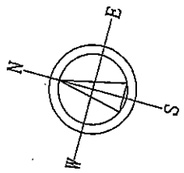
DRAWING No.: EQ - K02

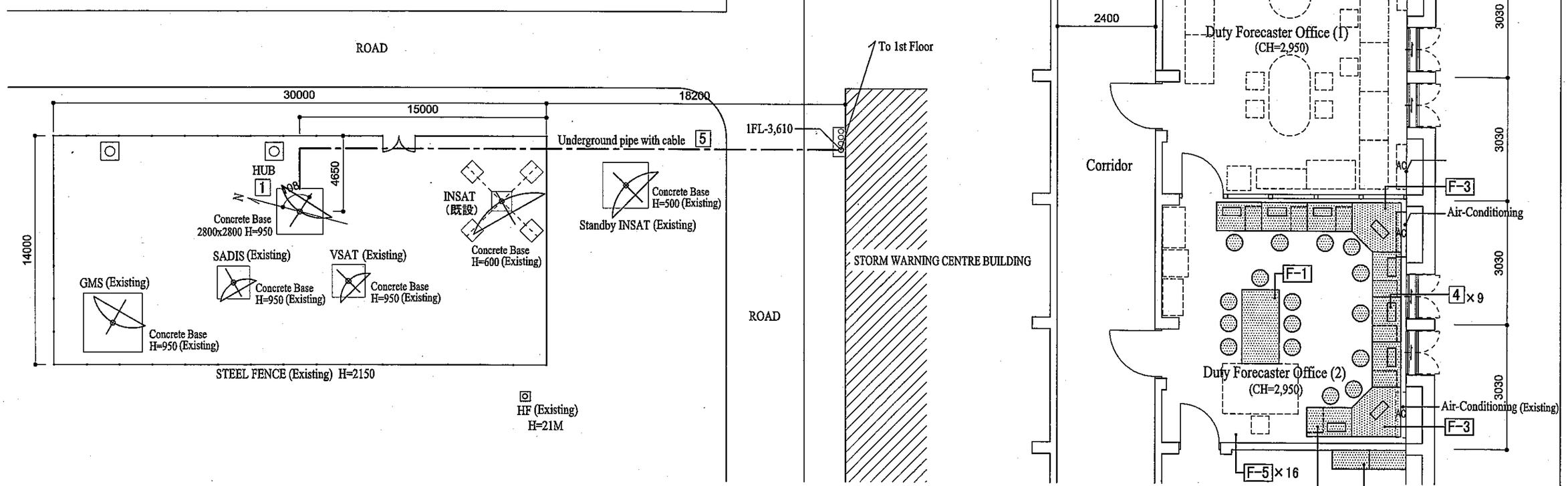
EQUIPMENT

1	HUB Antenna
2	HUB Controller
3	CCU
4	Indicator
5	Cable Wiring

FURNITURE

F-1	Meeting Table
F-2	Pedestal Desk
F-3	Five-sided Corner Desk
F-4	Drawer Unit with Casters
F-5	Chair
F-6	Lateral Filling Cabinet
F-7	Cabinet with Double Hinged Door
F-8	Top Panel





SITE PLAN S=1:250

1FL PLAN S=1:100

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DHAKA STORM WARNING CENTRE

DRAWING TITLE: EQUIPMENT LAYOUT PLAN

SCALE: 1:100 1:250

DRAWING No.: EQ -SW01

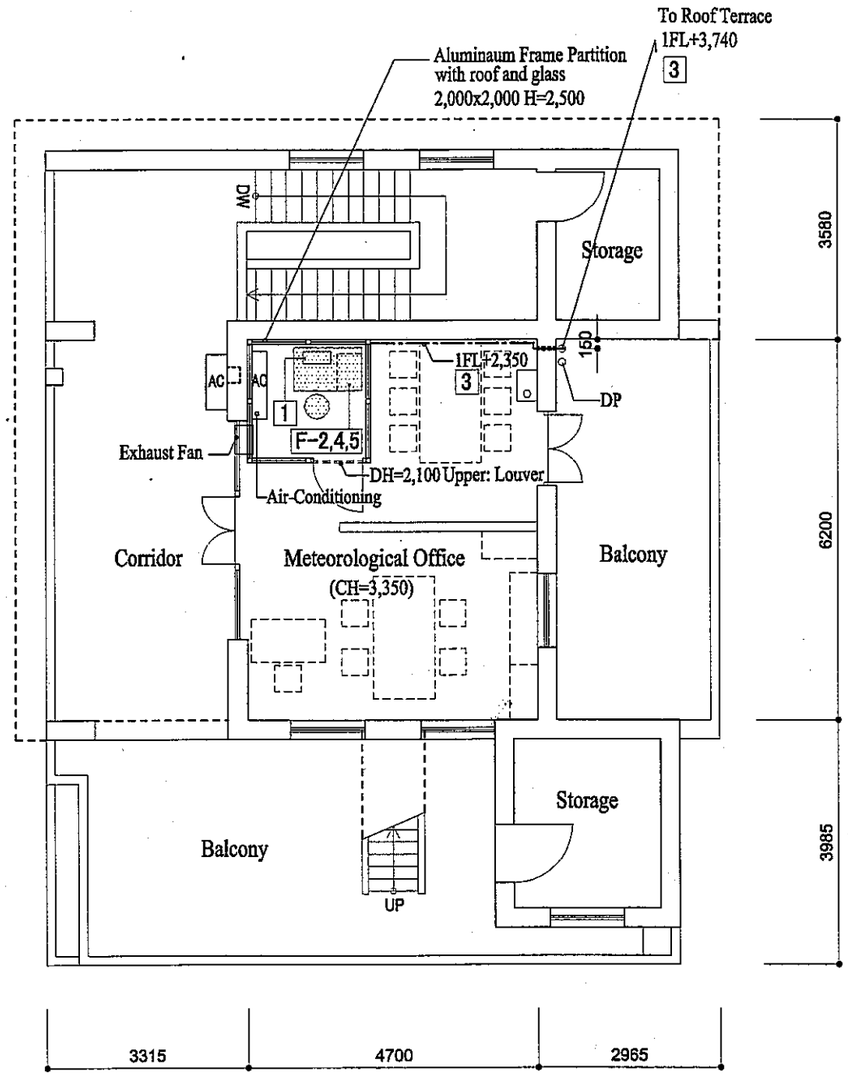
N
W E
S

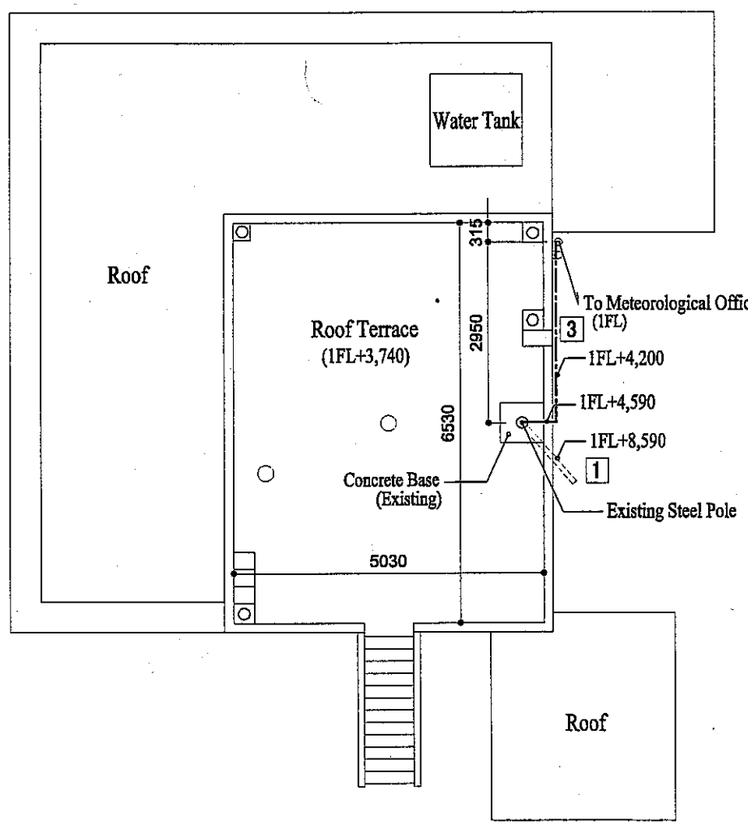
EQUIPMENT

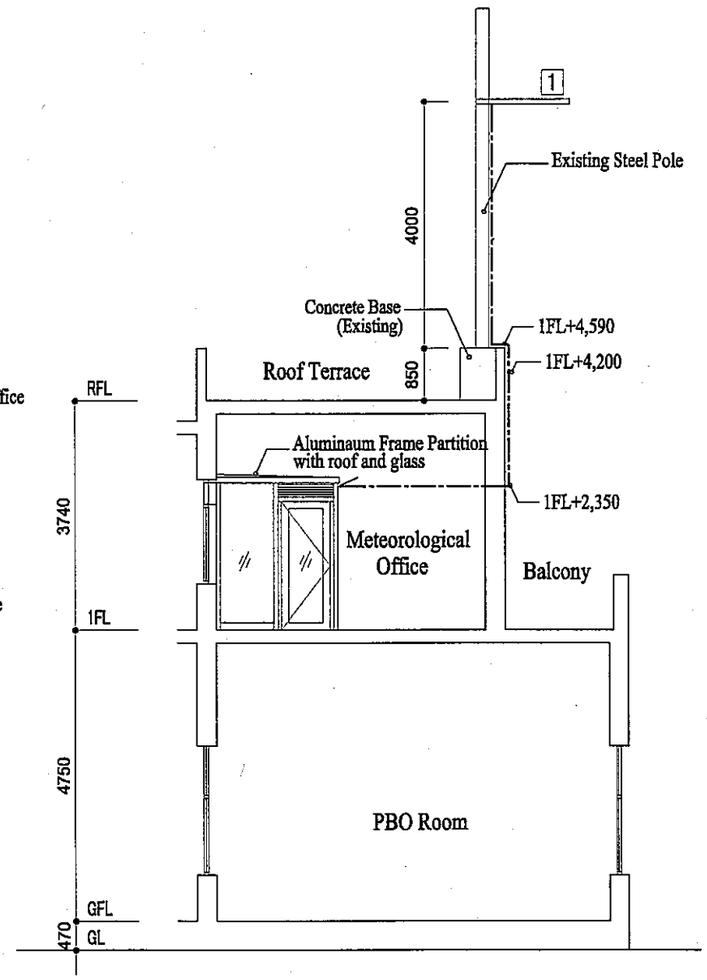
1	ODU Antenna
2	Indicator
3	Cable Wiring

FURNITURE

F-2	Pedestal Desk
F-4	Drawer Unit with Casters
F-5	Chair







1FL PLAN

ROOF PLAN

SECTION

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COX'S BAZAR METEOROLOGICAL OFFICE

DRAWING TITLE: EQUIPMENT LAYOUT PLAN

SCALE: 1:100

DRAWING No.: EQ - CM01

2-2-4 Implementation Plan

2-2-4-1 Implementation Policy

The Project covers many fields, including procurement and installation of meteorological and communication equipment, construction work, etc. For the successful completion of the Project, close coordination will be required between all parties. Since the periods April to May and October to December are the cyclone season in Bangladesh and because there are significant lead times in manufacturing meteorological equipment, the management of the implementation schedule should be given particular attention.

1) Executing agency for the Project

The responsible Bangladesh governmental agency of for the implementation of the Project is BMD under the supervision of the Ministry of Defence. BMD, as the Client, will be a signatory to the Consultancy Agreement and to the Contract.

2) Consultant

After the signing of the Exchange of Notes (E/N) for the Project between the Government of Bangladesh and the Government of Japan, it is important to finalize the Agreement of Consulting Services as early as possible. The Agreement of Consulting Services will be signed by BMD and a Japanese consulting firm, having its principal office in Japan, and recommended by JICA.

The consulting firm will become the Consultant for the Project by signing the Agreement. The Consultant then will conduct a detailed design study in Bangladesh with BMD, and in Japan, and prepare tender documents including technical specifications, drawings, diagrams, etc. In addition, the Consultant will conduct a tender and supervise the Project implementation for successful completion of the Project as a project of Japan's Grant Aid Assistance.

3) Contractor

A contractor with the required qualifications (an equipment supplier and a construction company) incorporated and registered in Japan, having its principal office in Japan, will be selected by an open public tender, in accordance with the tender documents prepared by the Consultant, in accordance with JICA guidelines, and approved by BMD.

4) Local Sub-contractors

Local firms may participate in the Project as sub-contractors, working together with engineer(s) of the Contractor for the construction of the radar tower buildings and installation of the planned equipment. Local sub-contractors are not allowed to take responsibility for the whole or the main part of the work.

2-2-4-2 Implementation Condition

1) Cyclones in Bangladesh

According to the following table showing the major cyclone records for the past 44 years, 52 massive cyclones struck Bangladesh during the period. Approximately 90% of the cyclones occurred in April, May, October, November and December (5 months a year). The annual average number of the cyclones to strike Bangladesh for the 44 year period is 1.2. The annual maximum number of the cyclones to strike Bangladesh is 4 and there was no year where there were no cyclones in Bangladesh.

Table 16: Monthly Records for the past 44 Years of Major Cyclone Arrived on Bangladesh

Season	**Dry Season**	**Pre-monsoon Season**			**Monsoon Season**				**Post-monsoon Season**			**Dry Season**	Cyclone arriving Bangladesh over 44 year period
Month	1	2	3	4	5	6	7	8	9	10	11	12	
Total Monthly Number of the Cyclone arrived on Bangladesh for 44 years			**1**	**4**	**14**	**2**		**1**	**2**	**10**	**13**	**5**	**52**

From the attached table, it is clear that careful attention must be paid to the implementation schedule of any works to be done in the coastal area of the Bay of Bengal.

2) Conditions for the Installation of Equipment

The meteorological radar systems, computing equipment and other sophisticated equipment with electric and electronic circuits will be installed in the radar tower buildings; therefore an electric power supply and power back-up equipment (engine generator system, AVR, radar backup unit, etc.) are essential for the uninterrupted operation of all the equipment. In accordance with the construction schedule, the dispatch of an electrical engineer is required at the time of the installation, adjustment and wiring of the electric power supply and power back-up equipment. A building equipment engineer is required during the installation of air-conditioning systems for the adjustment and acceptance testing of the systems. During the construction period, it is important that there should be a smooth procurement of required materials and hiring of skilled laborers to meet the construction schedule. In addition, specialized highly skilled engineers are needed for installation, adjustment and commissioning of the radar system, computing

equipment and the sophisticated meteorological equipment. They are essential to ensure the quality of the installation work necessary for accurate meteorological observations. Furthermore, as part of the technology transfer to BMD staff, specialized highly skilled engineers are required for on-the-job training to ensure BMD can operate and maintain the equipment efficiently.

2-2-4-3 Scope of Works

The scope of works to be undertaken by the Japan's Grant Aid Assistance and the Bangladesh side for the implementation of the Project is as follows.

1) Construction of the Radar Tower Building

<Scope of works to be undertaken by the Japan's Grant Aid Assistance>

a) Architectural and civil works
b) Electrical works
c) Air-conditioning and Ventilation works
d) Plumbing works

<Scope of works to be undertaken by the Bangladesh side>

a) Securing necessary permission for construction of the radar tower buildings
b) Securing the Project sites
c) Movement and relocation of any obstructions in the Project sites, if required
d) External and planting work, if necessary
e) Fencing work, if required
f) Power supply intake work
g) Water intake work
h) Telephone line connection work
i) Purchase of furniture which is not indicated in the drawings in this report, if required

2) Installation Work for the Equipment

<Scope of works to be undertaken by the Japan's Grant Aid Assistance>

a) Procurement of the required equipment
b) Transport of the equipment to the Project sites
c) Installation work for the equipment
d) Adjustment work of the equipment
e) Commissioning for the total system

<Scope of works to be undertaken by the Bangladesh side>

a) Provision of stable commercial power supply at the Project sites
b) Provision of public telephone lines at the Project sites
c) Obtaining necessary frequency allocations for the radar system and the meteorological data communication system
d) Renting the necessary space segment of a communication satellite for the meteorological data satellite communication systems
e) Shifting and removing any obstructions in the Project sites, if required
f) Protection against any damage and disappearance for the equipment & systems

2-2-4-4 Consultant Supervision

1) Principal Guidelines

a) To take the responsibility for expeditious project implementation and supervision, in accordance with the guidelines of Japan's Grant Aid Assistance and the basic design.
b) To communicate closely with responsible organizations and personnel of both countries, and complete the Project in time in accordance with the implementation schedule.
c) To provide appropriate advise to personnel of BMD and the contractor.
d) To provide instructions for construction, and installation methods and techniques to the BMD's staff and local contractors, as a technology transfer project, in order that those companies involved gain maximum benefit from the project.
e) To ensure the Project places top priority on public safety by improving BMD's ability to monitor cyclones and other sever weather phenomena.

2) Consultant Supervision

a) The Consultant will dispatch at least one responsible personnel to Bangladesh at each implementation stage in the Project.
b) Consultant technical specialists will be dispatched to Bangladesh for installation guidance, inspection work, etc. for the installation and configuration work of the major hardware, data communication equipment, computing equipment and system software.
c) The Consultant will attend factory performance tests, configuration verifications and inspections of the equipment on behalf of and instead of BMD.
d) Qualified engineer(s) will be dispatched for data transmission tests in Bangladesh.

3) Scope of Work for Supervision

a) The Consultant, in coordination with BMD, will prepare the contract in accordance with JICA standards; select a Japanese prime contractor through tendering; and recommend the nominated contractor to the Government of Bangladesh.
b) The Consultant will inspect and approve shop-drawings, system drawings & diagrams and material samples submitted by the contractor, and verify the performance and function of all equipment.
c) Based on a review of the implementation schedule, the Consultant will provide instructions to a contractor and submit progress reports on the implementation of the Project to BMD, the Embassy of Japan, the JICA local office, etc.
d) The Consultant will cooperate in certification of payment, such as through examination of notice of approval and invoices in connection with implementation cost to be disbursed during the implementation period and upon completion of the Project.
e) As required during the implementation period, the Consultant will perform inspections at each stage of the work to confirm completion of work and fulfillment of the contract conditions. The Consultant will be present at the handing over of the equipment, at which point, with the approval of BMD, the Consultant's tasks will be completed. Reports will also be made to appropriate personnel in the Government of Japan on all required issues, such as progress reports during the implementation period, payment procedures, completion and hand over.

2-2-4-5 Quality Control Plan

Cox's Bazar and Khepupara are subject to high temperatures and high humidity that, year round, reaches about 80%. In 2003, the annual mean temperature of Cox's Bazar was 31.2°C and Khepupara 30.3°C. Due to the severe environment, proper quality control is required in regard to the construction work. According to past local meteorological data, the monthly mean temperature can reach more than 30°C every month except January and December, necessitating measures to deal with a possible concrete temperature of more than 30°C. In view of this possibility, the ambient temperature and the concrete temperature will be measured during concrete pouring, to ensure the correct concrete quality.

The quality control plan for the main work is described in the table below.

Table 17: Quality Control Plan

Work	Work Type	Control Item	Method	Remarks
Structural Work	Concrete work	Fresh concrete Concrete strength	Slump, air volume, temperature Comprehensive strength test	Strength test at a public test institution
	Reinforcing work	Reinforcing bar Arrangement	Tensile test, mill sheet check Bar arrangement check	
	Pile work	Material, bearing capacity	Bearing capacity check	
Finishing Work	Roof work	Workmanship, leakage	Visual inspection, water spray test	
	Tile work	Workmanship	Visual inspection	
	Plastering work	Workmanship	Visual inspection	
	Door & window work	Products, Installation accuracy	Factory inspection sheet check Visual inspection, dimension check	
	Painting work	Workmanship	Visual inspection	
	Interior work	Products, workmanship	Visual inspection	
Electrical Work	Power Receiving & Transforming	Performance, operation installation check	Factory inspection sheet check; withstand voltage, megar, operation, visual inspection	
	Conduit work	Bending, support check	Visual inspection, dimension	
	Wiring and cable work	Sheath damage, loose connection check	Performance sheet check, cleaning before laying, marking after bolt fixing	
	Lightning work	Resistance, conductor support pitch check	Resistance measuring, visual inspection, dimension	
	Lighting work	Performance, operation, installation check	Performance sheet check, illumination measurement, visual inspection	
Mechanical Work	Water Piping Work	Support pitch, leakage	Visual inspection, leakage, water pressure test	
	Pump Installation	Performance, operation installation check	Performance sheet check, flow rate test	
	Air-Con. work	Performance, operation installation check	Performance sheet check, temperature measurement	
	Sanitary Fixture	Operation, installation, leakage check	Visual inspection, flow test	

2-2-4-6 Procurement Plan

(1) Equipment Procurement

1) Equipment Procurement Policy

Maintenance requirements and the availability of the necessary parts and consumables in Bangladesh are two of most important factors in selecting the equipment. The equipment procurement process must provide for continuing maintenance after the completion of the Project. None of the meteorological equipment to be supplied under the Project is produced in Bangladesh. Japanese meteorological radar systems and related equipment are considered to be most suitable for the Project, in terms of reliability, durability, accuracy and performance.

Important issues in determining the success of the Project will be the ability to ensure ongoing operations through good maintenance procedures and the availability of the necessary spare parts, long after the completion of the Project. The activities of the private sector in Bangladesh will be useful in the support of the computer systems and other

sophisticated systems. There are many computing equipment manufactures. The procurement plan for the equipment is designed with a view to achieving the maximum possible degree of standardization as well as facilitating the obtaining of spare parts and maintenance services for the chosen computing equipment.

2) Equipment Procurement Plan

Equipment procurement plan for the Project is classified as follows.

Table 18: Equipment Procurement Plan

Name of Equipment	Procurement Plan		
	Japan	Bangladesh	Third Countries
Meteorological Doppler Radar System	◎		
Meteorological Radar Data Display System	◎		
Meteorological Data Communication System	◎		
Meteorological Data Satellite Communication System	◎		
Meteorological Satellite Data Receiving System	◎		◎
Furniture for the equipment		◎	

◎ : Planned countries for the equipment procurement

(2) Procurement of Construction Material

1) Procurement Policy of Construction Material

As the main construction materials can be procured locally, they will, in principle, be procured in Bangladesh. However, the products produced in Bangladesh are limited to gravel, sand, fresh concrete, some secondary concrete products (blocks, floor materials, etc.) and timber for temporary works, etc. Other construction materials imported from the neighboring countries are marketed throughout Bangladesh. As these imported materials can be easily procured locally, they are considered as part of the procurement of local products. In order to ensure the easy maintenance of the radar tower buildings, locally available materials will be utilized for construction.

2) Procurement Plan of Construction Material

[1] Structural Work

The main materials for the structural work, such as fresh concrete, plywood for form works, etc., can be procured locally. Locally made concrete blocks are available and are a common material for building construction.

[2] Building Exterior and Interior Work

Timber, tiles, paint, glass, aluminum window frames, etc. used for the exterior and interior

of a building are imported from ASEAN countries and, in principle, are readily available in the local market. For the proposed buildings, airtight aluminum and steel doors & windows, treated for salt-corrosion, are required.

[3] Air-Conditioning and Plumbing Work

Imported air-conditioning equipment, exhaust fans, sanitary-fixtures, etc. are popular in Bangladesh. In principle, those products can be procured in the local market with a view to ease of repair and maintenance. However, large air-conditioning units, treated for salt-corrosion, and cyclone rated exhaust fans, which are unavailable in the local market, will be procured from ASEAN countries.

[4] Electrical Work

Imported and local Lighting fixtures, switches, lamps, electrical wires and cables, conduits and other items are available in the local market. They will, in principle, be procured in Bangladesh for ease of repair and maintenance. However, custom-made building equipment such as control panels, power distribution boards and switch boards will be procured from ASEAN countries.

Table 19: Major Materials Procurement Plan (Architectural Work)

Materials	Local Market		Procurement Plan		
	Condition	Import	Bangladesh	Third Country	Japan
Portland cement	○		○		
Sand, aggregate	○		○		
Reinforcing bar	○		○		
Form (plywood)	○		○		
Concrete block	○		○		
Asphalt waterproofing	○		○		
Wood	○		○		
Aluminum door & window	△		○		
Steel door & window	△		○		
Wooden door & window	○		○		
Door handle, lock	○		○		
Floor hinge	○		○		
Plane glass	○		○		
Laminated safety glass	○		○		
Access floor panel	X	ASEAN	X	○	
Access floor panel (heavy duty type)	X	ASEAN	X	○	
Paint	○		○		
Gypsum board (T-bar)	○		○		
Cement board	○		○		
Rockwool acoustic board (T-bar)	○		○		
Glass wool, glass cloth	○		○		
Carpet tile	X	ASEAN	X	○	
PVC tile	○		○		
Porcelain tile	○		○		
Ceramic tile	○		○		
Floor maintenance hatch	○		○		
Kitchen	○		○		
Roof drain	○		○		
Steel drainage pipe (galvanized)	○		○		
Concrete pavement block	○		○		
Spray tile	○		○		
Caulking	○		○		

Table 20: Major Materials Procurement Plan (Mechanical and Electrical Work)

Work type	Materials	Local Market		Procurement Plan		
		Condition	Import	Bangladesh	Third Country	Japan
Air-conditioning work	Air conditioner	△	ASEAN	△	○	
	Heat exchanger	X	ASEAN	X	○	
	Exhaust fan (salt-proof)	△	ASEAN	△	○	
Plumbing work	Sanitary fixture	○		○		
	Pipe	○		○		
	Fire extinguisher	○		○		
	Water lifting pump	○		○		
Electrical work	Lighting fixture	○		○		
	Obstruction light	X	Japan	X		○
	Power stabilizer	△	ASEAN	△	○	
	Panel	△	ASEAN	△	○	
	Wire, cable	○		○		
	Conduit (PVC)	○		○		
	Conduit (Steel)	○		○		
	Cable-rack	○		○		
	Telephone system	○		○		
	Fire alarm system	○		○		
	Diesel engine generator	○		○		
	Lightening protection	○		○		

*

○ : Easy to procure in Bangladesh

△ : Available in the local market in Bangladesh but model and quantity are limited

X : Difficult to procure in Bangladesh

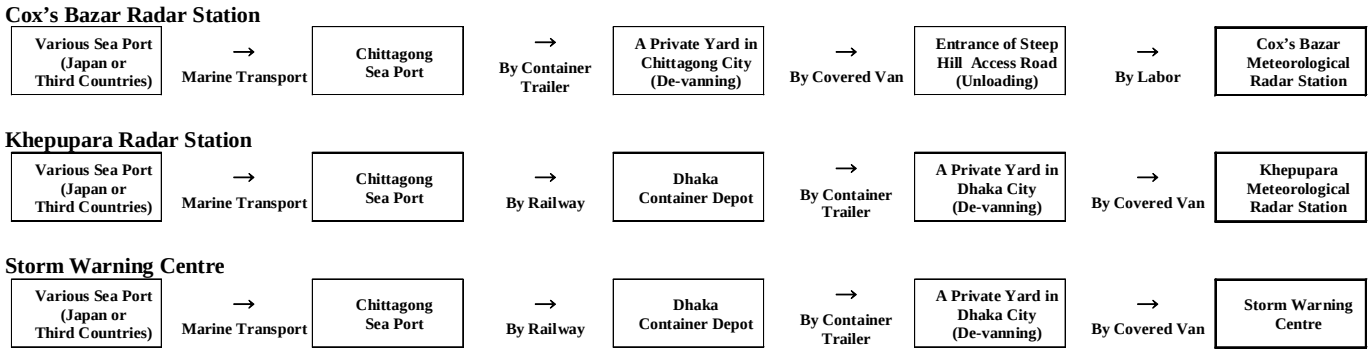
3) Transportation Plan

In principle, transportation of the equipment from outside of Bangladesh will use wooden crates or container shipment. The main disembarkation point for maritime cargo to Bangladesh is the Chittagong Seaport. There are 2 – 3 scheduled ships per week between Japan and Chittagong. Marine transport from Japan to Chittagong takes at least 1.5 months including all necessary procedures in Japan for exporting the equipment to Bangladesh and the customs clearance.

Figure 6: Route Map of Transport

In order to obtain tax exemptions in Bangladesh, BMD will submit each copy of the "Contract signed by BMD and a selected supplier for the Project" and each "Proforma Invoice" to the National Board of Revenue (NRB), and BMD will obtain the required permission for the tax exemptions 2 to 3 weeks after the submission.

Figure 7: Inland Transport Route to Each Project Site



Access (roads and bridges) to the Cox's Bazar and Khepupara Meteorological Radar Stations has been improved by the Government of Bangladesh, with the support of foreign assistance, and it is now much easier to get to the sites than before. The arterial roads connecting each principal city are adequate, even in the monsoon season. The roads in areas surrounding the stations are sometimes covered with flood water in the monsoon season. The transportation plan needs to allow for that.

Approximate time required to each destination by road is as follows.

Dhaka → Cox's Bazar: approx. 12 hours
Dhaka → Khepupara: approx. 14 hours (use of a ferry to cross rivers: 4 times)
Dhaka Container Depot → BMD Head Office (SWC): approx. 45 minutes

2-2-4-7 Implementation Schedule

Figure 8: Implementation Schedule, Phase-1

<Phase-1>

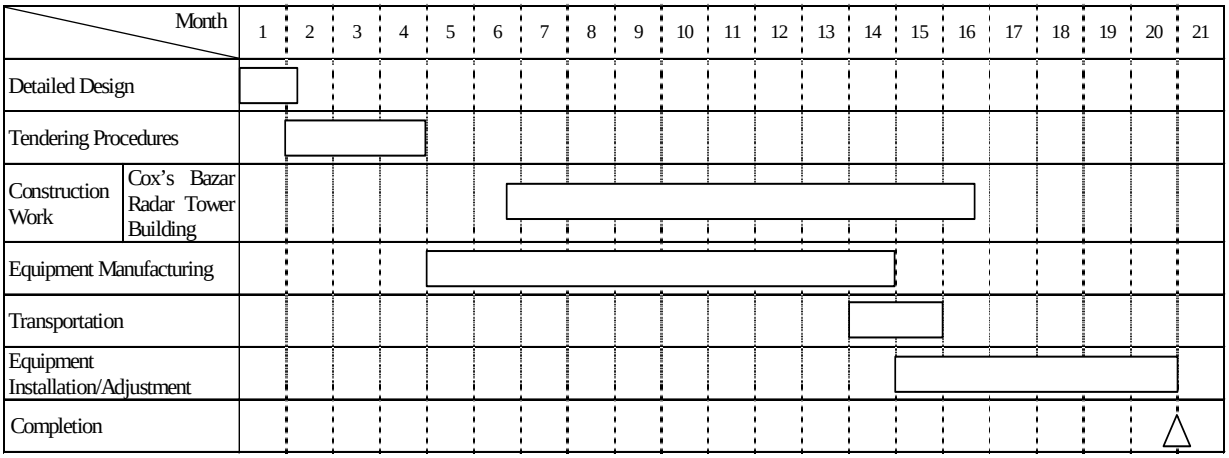
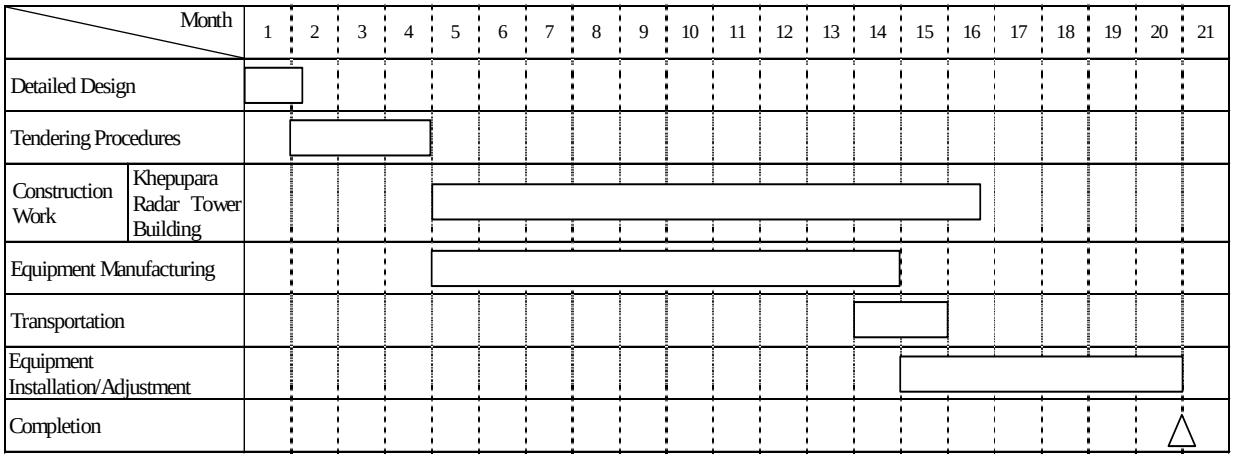


Figure 9: Implementation Schedule, Phase-2

<Phase-2>



2-3 Obligation of Recipient Country

In the implementation of the Project under Japan's Grant Aid Assistance, BMD is responsible for the following tasks.

1) General requirements
   a) To undertake all necessary institutional and juridical procedures in Bangladesh.
   b) To handle tax emption procedures and to take necessary measures for customs clearance at the port of disembarkation for the materials and equipment imported for the Project.

c) To accord Japanese nationals, whose services may be required in connection with the supply of products and services under verified contracts, such facilities as may be necessary for their entry into Bangladesh and stay therein for the performance of their work.
d) To provide necessary space at the BMD Head Office for the Consultant and the Contractor for the implementation of the Project, if required.
e) To allocate necessary personnel for meteorological observation and forecasting work.

2) Requirements for the Equipment

a) To remove and relocate the existing facilities for installation of the equipment at the expense of BMD, if required.
b) To provide appropriate frequencies for the meteorological radar systems and the meteorological data communication systems to be installed.
c) To obtain the VSAT user licenses for the use of satellite communication for the meteorological data satellite communication systems to be installed.
d) To secure effective space at the existing facilities for installation of the equipment to be supplied.
e) To provide suitable existing telephone links and interfaces to allow the correct operation of the systems.
f) To maintain, and properly and effectively utilize, the equipment purchased under the Grant Aid.

3) Requirements for Construction of Radar Tower Buildings

a) To obtain necessary permissions for construction of the radar tower buildings, if required.
b) To secure land necessary for the Project and to clear, level and reclaim the land prior to commencement of the construction.
c) To provide facilities for provision of electricity, water, telephone trunk lines, drainage, sewage and other incidental facilities at the Project sites.
d) To supply general use furniture such as carpets, curtains, tables, chairs and others, if necessary.
e) To undertake incidental outdoor works such as gardening, fencing, gates and exterior lighting in and around the sites, if necessary.
f) To provide temporary facilities for distribution of electricity, water, telephone, and other incidental facilities for the construction work.
g) To secure sufficient spaces at the Project sites for temporary facilities such as a contractor's office, workshop, building materials storage, etc. for the construction work.

h) To provide adequate maintenance of the buildings constructed under the Grant Aid Project, so they can function effectively.

2-4 Project Operation Plan

(1) Operation and Maintenance Plan for the Equipment

1) Operational Plan of Meteorological Radar System

Upon completion of the Project, the hours of operation of each meteorological radar system have been planned in accordance with annual transition of the climate in Bangladesh. BMD has agreed to meet the following operational plan.

Table 21: Estimated Annual Radar Operation Hours

	Terms	Cyclone Number of arrival/year	Number of Observation/Day	Observation Hours (h/day)	Observation Days	Observation Hours
Dry Season	Dec - Feb	0	8	4	90	360
Pre-monsoon Season	Mar - May	0	8	8	87	696
Cyclone		1	Round-the-clock	24	5	120
Monsoon Season	Jun - Aug	0	Round-the-clock	24	92	2,208
Post-monsoon Season	Sep - Nov	0	8	8	86	688
Cyclone		1	Round-the-clock	24	5	120
					365	**4,192**

Estimated Observation Hours/Year: approx. 4,200 hours

2) Operation and Maintenance Plan for the Equipment

In connection with equipment maintenance, consideration must be given to the followings.

- Technical training for BMD staff
- Establishment of appropriate measures against system failure
- A fully documented maintenance system, with proper document control
- Scheduled replacement of parts and overhauls
- Strengthening of the operation and maintenance structure of BMD
- Establishment of technical and financial self-reliance of BMD

3) Staff Allocation for Operation and Maintenance for the Equipment

Operation and maintenance of the meteorological radar systems is carried out mainly by BMD electronic engineers and technical staff, however, the number of engineers and technical staff to do this is not sufficient, so it is essential that the existing vacant positions be filled. In order to become a senior electronic engineer or an electronic engineer, the technical staff must have practical experience as an assistant electronic engineer for a

certain period. Therefore, as indicated in the following table, three (3) assistant electronic engineers are urgently required to fill the existing vacant positions. In 2004, one assistant electronic engineer was recruited, and plans call for recruiting another in 2005. BMD fully recognizes the need to fill the existing vacant positions and has made a firm commitment to recruiting capable technical staff.

In order for BMD to become self-reliance in technical areas such as the operation and maintenance of radar systems, it is essential that it make continuing efforts to fill vacancies and promote technology transfer for all staff levels, from entry level technicians to senior engineers.

Table 22: Required Number of Engineers and Engineering Staff in Electronic Division of BMD

Name of Post	Number of Positions	Existing Number	Number of Vacant Positions	Required Number of Promotions from lower positions	Required Number of external Recruits	Recruited Numbers in 2004	Scheduled Number of Recruits in 2005	Number of Promotion in 2005
Senior Electronic Engineer	1	1	0	0	-	-	-	-
Electronic Engineer	4	3	1	4	-	-	-	0
Assistant Electronic Engineer	6	1 by promotion	2	2	-	-	-	0
	3: Promotion Position 3: Recruiting Position	2 by recruiting	1	-	1	1	1	0
Electronic Assistant	42	29	13			3	10	3

<Required Number of Personnel at the Meteorological Radar Observation Stations>

The existing and required number of the personnel is shown in the following tables. For further improvement of the national meteorological radar network in Bangladesh, the following proposed personnel should be allocated to each radar observation station and, in particular, the proposed staffing levels for the Cox's Bazar and Khepupara Meteorological Radar Observation Stations should be achieved before 2008.

Table 23: Existing and Required Number of Personnel (Cox's Bazar and Khepupara)

Post	Cox's Bazar Meteorological Radar Station		Khepupara Meteorological Radar Station	
	Number of Staff		Number of Staff	
	Existing	***Proposed***	Existing	***Proposed***
Electronic Engineer	1	-	1	-
Assistant Meteorologist	1	-	1	-
Assistant Electronic Engineer	0	**1**	0	**1**
Electronic Assistant	4	**1**	4	**1**
Foreman	1	-	1	-
Mechanic- II	4	-	3	**1**
Driver	1	-	0	-
MLSS (Peon)	1	-	0	-
Guard	3	**2**	3	**2**

Table 24: Existing and Required Number of Personnel (Dhaka and Rangpur)

Post	**Dhaka Meteorological Radar Station**		**Rangpur Meteorological Radar Station**	
	Number of Staff		Number of Staff	
	Existing	***Proposed***	Existing	***Proposed***
Electronic Engineer	0	**1**	1	**-**
Assistant Meteorologist	0	**0**	0	**0**
Assistant Electronic Engineer	2	**-**	1	**-**
Electronic Assistant	6	**-**	4	**1**
Foreman	0	**-**	1	**-**
Mechanic- II	2	**2**	2	**2**
Driver	0	**-**	0	**-**
MLSS (Peon)	1	**-**	0	**-**
Guard	4	**1**	4	**1**

(2) Operation and Maintenance Plan for the Radar Tower Buildings

There are three key issues for the maintenance of the radar tower buildings: (i) daily cleaning; (ii) maintenance to cover wear and tear, damage and aging; and (iii) security measures to ensure safety and to prevent crimes.

The rigorous implementation of daily cleaning for the buildings gives a good impression to visitors/users and encourages people to respect the buildings and the equipment. Cleaning is also important to ensure the equipment continues to operate correctly, it helps in the rapid detection and repair damaged equipment and prolongs the life of the building equipment.

The main repair work will be refurbishing or replacement of exterior and interior materials protecting the building structure. The required inspections are outlined below.

Table 25: Outline of Regular Inspection for the buildings

	Items of Maintenance Work	Frequency
Exterior	Repair and repainting of external walls	Repair: every 5 years, Repaint: every 15 years
	Inspection and repair of roofs	Inspection: every year Repair: as required
	Regular cleaning of drain pipes and drainage systems	Monthly
	Inspection and repair of sealing of external windows and doors	Every year
	Regular inspection and cleaning of ditches and manholes	Every year
Interior	Renewal of interior finishing	As required
	Repair and repainting of partition walls	As required
	Adjustment of window and door fitting	Every year

It is important that regular preventive maintenance of the building equipment is carried out before the equipment fails, or requires repair or replacement of part(s). The life of the building equipment can be significantly extended by proper operation and regular

inspection, lubrication, adjustment and cleaning. These regular inspections can prevent equipment failure and accidents. Regular inspection, replacement of consumables and cleaning/replacement of filters for ventilation and air-conditioning units should be carried out in accordance with the maintenance manual.

It is essential to establish a proper maintenance structure in BMD, involving the rigorous implementation of regular inspection and maintenance procedures. This work may be assigned to the private sector (local agents), if required. The general life expectancy of the major building equipment is shown below.

Table 26: Life Expectancy of Building Equipment

System	Building Equipment	Life Expectancy
Electrical System	• Distribution panels • Fluorescent lamps • Incandescent lamps	20 – 30 years 5,000 – 10,000 hours 1,000 – 1,500 hours
Water Supply and Drainage Systems	• Pipes and valves • Sanitary fixture	15 years 25 – 30 years
Air-Conditioning System	• Pipes • Exhaust fans • Air-conditioning units	15 years 20 years 15 years

2-5 Project Cost Estimate

2-5-1 Estimate of Project Cost and Capital Cost to be borne by BMD

The Project cost to be financed by the Japan's Grant Aid Assistance and the required capital cost for the Project to be borne by BMD have been estimated and are shown in the following tables. However, the Project cost estimates are provisional and would be further examined by the Government of Japan for the approval of the Grant.

Project Cost Estimates of the Japan's Grant Aid

Total Project Cost Estimate (Phase-1 + Phase-2): 1,682 Million JP Yen

Table 27: Project Cost Estimate for Phase-1

Items		Estimate (JP Yen)	
Equipment	Meteorological Radar System Meteorological Radar Data Display System Meteorological Data Communication System Meteorological Data Satellite Communication System Meteorological Satellite Data Receiving system	JPY 624 Million	JPY 781 Million
Construction	Cox's Bazar Radar Tower Building	JPY 157 Million	
Consulting Services (Detailed Design, Supervision, Technical Guidance, etc.)		JPY 92 Million	
Total		JPY 873 Million	

Table 28: Project Cost Estimate for Phase-2

Items		Estimate (JP Yen)	
Equipment	Meteorological Radar System Meteorological Radar Data Display System Meteorological Data Communication System Meteorological Data Satellite Communication System	JPY 484 Million	JPY 727 Million
Construction	Khepupara Radar Tower Building	JPY 243 Million	
Consulting Services (Detailed Design, Supervision, Technical Guidance, etc.)		JPY 82 Million	
Total		JPY 809 Million	

Capital Cost to be borne by BMD

Total Capital Cost (Phase-1 + Phase-2): 4,326,500 Taka (approx. 7.9 Million JP Yen)

Table 29: Capital Cost of BMD for Phase-1

Items	Capital Cost (Bangladesh Taka)
Renovation Work of Forecasting Room in Storm Warning Centre	350,000 Taka
Demolishment of the existing engine generator building at the Cox's Bazar Meteorological Radar Observation Station	900,000 Taka
Installation of a 150kVA step-down transformer at the Cox's Bazar Meteorological Radar Observation Station	1,300,000 Taka
VSAT user forms for VSAT communication license (500 Taka x 2 sites)	1,000 Taka
Evaluation fee for VSAT user forms for VSAT communication license (5,000 Taka x 2 sites)	10,000 Taka
Telephone line laid down cost for 2 lines for the proposed building to be constructed at the Cox's Bazar Meteorological Radar Observation Station	30,000 Taka
Total	2,591,000 Taka

Table 30: Capital Cost of BMD for Phase-2

Items	Capital Cost (Bangladesh Taka)
Installation of a 150kVA step-down transformer at Khepupara Meteorological Radar Observation Station	1,300,000 Taka
VSAT user forms for VSAT communication license (500 Taka x 1 site)	500 Taka
Evaluation fee for VSAT user forms for VSAT communication license (5,000 Taka x 1 site)	5,000 Taka
Telephone line laid down cost for 2 lines for the proposed building to be constructed at Khepupara Meteorological Radar Observation Station	30,000 Taka
Public water pipe laid down and connecting works cost at Khepupara Meteorological Radar Observation Station	400,000 Taka
Total	1,735,500 Taka

2-5-2 Estimate of Recurrent Cost for the Project to borne by Bangladesh side

(1) Recurrent Cost to be borne by BMD

In case that the Project is financed by the Japan's Grant Aid Assistance, the annual recurrent costs to be borne by BMD for the first decade after the completion of the Project are attached hereunder. The recurrent costs have been calculated in accordance with the following fundamental conditions.

- Operation and maintenance to be carried out by BMD
- Appropriate operation in accordance with the operations manuals
- Regular and proper maintenance according to the maintenance manuals

The recurrent costs of all the project sites (Cox's Bazar and Khepupara Meteorological Observation Stations, the SWC and Cox's Bazar Meteorological Office), which consist of operation and maintenance costs of the equipment and the radar tower buildings, to be borne by BMD have been calculated as shown in the following tables.

Table 31: Recurrent Cost of Cox's Bazar Meteorological Radar Station

	Equipment	Item	Q'ty	1st year	2nd year	3rd year	4th year	5th year	6th year	7th year	8th year	9th year	10th year	Remarks
1.	Antenna	Grease (For AZ/EL)	1	0	0	0	0	12,000	0	0	0	0	12,000	1kg/can. Every year
		Timing belt (For AZ/EL)	2	0	0	0	0	10,000	0	0	0	0	10,000	
2.	Transmitter/Receiver	Timer relay for pre-heating	1	0	0	0	0	1,000	0	0	0	0	1,000	
		Blower unit	2	0	0	0	0	4,500	0	0	0	0	4,500	
		AC fan	2	0	0	0	0	4,100	0	0	0	0	4,100	
		Fuse for the power supply unit	1	0	0	0	250	0	0	0	250	0	0	
		Lamp for operation panel	1	0	0	0	500	0	0	0	500	0	0	
3.	Antenna controller	Fuse for the power supply unit	1	0	0	0	350	0	0	0	350	0	0	
4.	Product Monitor	Hard disk	3	0	0	0	22,500	0	0	0	22,500	0	0	Every 4 years
		CD for data storage	20	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	
5.	Compact UPS	Battery (about 500VA)	7	0	0	42,000	0	0	42,000	0	0	42,000	0	For the each PC connection
6.	VSAT UPS	Battery	1	0	0	6,000	0	0	6,000	0	0	6,000	0	For the each PC connection
7.	Printer	Printer ink cartridge	2	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	
8.	Radar Power Distribution Board	Relay for remote power control	1	0	0	0	0	1,050	0	0	0	0	1,050	
9.	Diesel Engine Generator	Oil seal and filter	2	0	0	2,000	0	5,600	2,000	0	0	2,000	5,600	
		Battery for Engine start	2	0	0	0	0	0	0	4,000	0	0	0	
		Subtotal (Taka)		**6,000**	**6,000**	**56,000**	**29,600**	**44,250**	**56,000**	**10,000**	**29,600**	**56,000**	**44,250**	

	Cost Item	Details	Q'ty	1st year	2nd year	3rd year	4th year	5th year	6th year	7th year	8th year	9th year	10th year	Remarks
1.	Electricity Charge		1	513,248	513,248	513,248	513,248	513,248	513,248	513,248	513,248	513,248	513,248	*1
2.	Fuel Cost	Diesel Engine Generator	1	24,423	24,423	24,423	24,423	24,423	24,423	24,423	24,423	24,423	24,423	*2 & *3
3.	Water Supply Charge	Water supply charge	1	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	*4
		Subtotal (Taka)		**552,671**	**552,671**	**552,671**	**552,671**	**552,671**	**552,671**	**552,671**	**552,671**	**552,671**	**552,671**	
		a: Total Amount (Taka)		**558,671**	**558,671**	**608,671**	**582,271**	**596,921**	**608,671**	**562,671**	**582,271**	**608,671**	**596,921**	

***1 Estimate of annual electricity charge**

Annual operation hours of Radar System: 4,192 hours (include 250 hours operated by Diesel Engine Generator)

Annual power consumption: 4,192 hours - 250 hours = 3,942 hours, 3,942 hours x 18.6kWh = 73,321.2kWh

Electrical charge: 73,321.2kWh x 7 = 513,248 Taka

***2 Estimated annual power to be generated by Diesel Engine Generator**

Annual operation hours of Radar System by Diesel Engine Generator due to power stoppage = 250 hours

Annual power consumption: 250Hours x 18.6kWh = 4,650kWh

***3 Estimate of annual fuel cost of Diesel Engine Generator**

Fuel consumption: approx. 0.25L/kWh

4,650kWh x 0.25L = 1,163L, 1,163L x 21Taka/L = 24,423Taka

***4 Estimate of annual water supply charge**

Annual water supply charge of Cox's Bazar Meteorological Radar Station = 15,000 Taka

Table 32: Recurrent Cost of Cox's Bazar Meteorological Office

	Equipment	Item	Q'ty	1st year	2nd year	3rd year	4th year	5th year	6th year	7th year	8th year	9th year	10th year	Remarks
1.	Product Monitor	Hard disk	1	0	0	0	7,500	0	0	0	7,500	0	0	Every 4 years
		CD for archiving product data	20	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	
2.	Pinter	Printer ink cartridge	1	2,500	2,500	2,500	2,500	2,500	2,500	2,500	2,500	2,500	2,500	
3.	Compact UPS	Battery	1	0	0	6,000	0	0	6,000	0	0	6,000	0	For the each PC connection
		Subtotal (Taka)		**3,500**	**3,500**	**9,500**	**11,000**	**3,500**	**9,500**	**3,500**	**11,000**	**9,500**	**3,500**	

	Cost Item	Details	Q'ty	1st year	2nd year	3rd year	4th year	5th year	6th year	7th year	8th year	9th year	10th year	Remarks
1.	Electricity Charge		1	36,792	36,792	36,792	36,792	36,792	36,792	36,792	36,792	36,792	36,792	*1
		Subtotal (Taka)		**36,792**	**36,792**	**36,792**	**36,792**	**36,792**	**36,792**	**36,792**	**36,792**	**36,792**	**36,792**	
		b: Total Amount (Taka)		**40,292**	**40,292**	**46,292**	**47,792**	**40,292**	**46,292**	**40,292**	**47,792**	**46,292**	**40,292**	

***1 Estimate of annual electricity charge**

Equipment operation: 24hours/day Power consumption: 0.6kWh

Annual power consumption: 8,760Hours x 0.6kWh = 5,256kWh

Electricity charge: 5,256kWh x 7 Taka/kWh = 36,792 Taka

		a+b: Total Amount (Taka)		**598,963**	**598,963**	**654,963**	**630,063**	**637,213**	**654,963**	**602,963**	**630,063**	**654,963**	**637,213**	

Table 33: Recurrent Cost of Khepupara Meteorological Radar Station

	Equipment	Item	Qty	1st year	2nd year	3rd year	4th year	5th year	6th year	7th year	8th year	9th year	10th year	Remarks
1	Antenna	Grease (For AZ/EL)	1	0	0	0	0	12,000	0	0	0	0	12,000	1kg/can. Every year
		Timing belt (For AZ/EL)	2	0	0	0	0	10,000	0	0	0	0	10,000	
2	Transmitter/Receiver	Timer relay for pre-heating	1	0	0	0	0	1,000	0	0	0	0	1,000	
		Blower unit	2	0	0	0	0	4,500	0	0	0	0	4,500	
		AC fan	2	0	0	0	0	4,100	0	0	0	0	4,100	
		Fuse for the power supply unit	1	0	0	0	250	0	0	0	250	0	0	
		Lamp for operation panel	1	0	0	0	500	0	0	0	500	0	0	
3	Antenna controller	Fuse for the power supply unit	1	0	0	0	350	0	0	0	350	0	0	
4	Product Monitor	Hard disk	3	0	0	0	22,500	0	0	0	22,500	0	0	Every 4 years
		CD for data storage	20	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	
5	Compact UPS	Battery (about 500VA)	5	0	0	30,000	0	0	30,000	0	0	30,000	0	For the each PC connection
6	VSAT UPS	Battery	1	0	0	6,000	0	0	6,000	0	0	6,000	0	For the each PC connection
7	Printer	Printer ink cartridge	2	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	
8	Radar Power Distribution Board	Relay for remote power control	1	0	0	0	0	1,050	0	0	0	0	1,050	
9	Diesel Engine generator	Oil seal and filter	2	0	0	2,000	0	5,600	2,000	0	0	2,000	5,600	
		Battery for Engine start	2	0	0	0	0	0	0	4,000	0	0	0	
		Subtotal (Taka)		**6,000**	**6,000**	**44,000**	**29,600**	**44,250**	**44,000**	**10,000**	**29,600**	**44,000**	**44,250**	

	Cost Item	Details	Qty	1st year	2nd year	3rd year	4th year	5th year	6th year	7th year	8th year	9th year	10th year	Remarks
1	Electricity Charge		1	426,314	426,314	426,314	426,314	426,314	426,314	426,314	426,314	426,314	426,314	*1
2	Fuel Cost	Diesel Engine Generator	1	87,413	87,413	87,413	87,413	87,413	87,413	87,413	87,413	87,413	87,413	*2 & *3
3	Water Supply Charge	Water supply charge	1	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000	*4
		Subtotal (Taka)		**527,727**	**527,727**	**527,727**	**527,727**	**527,727**	**527,727**	**527,727**	**527,727**	**527,727**	**527,727**	
		Total Amount (Taka)		**533,727**	**533,727**	**571,727**	**557,327**	**571,977**	**571,727**	**537,727**	**557,327**	**571,727**	**571,977**	

***1 Estimate of annual electricity charge**

Annual operation hours of Radar System: 4,192 hours (include 900 hours operated by Diesel Engine Generator)

Annual power consumption: 4,192Hours - 900 hours = 3,292 hours, 3,292 hours x 18.5kWh = 60,902.0kWh

Electricity charge: 60,902.0kWh x 7 = 426,314 Taka

***2 Estimated annual power to be generated by Diesel Engine Generator**

Annual operation hours of Radar System by Diesel Engine Generator due to power stoppage = 900 hours

Annual power consumption: 900 hours x 18.5kWh = 16,650kWh

***3 Estimate of annual fuel cost of Diesel Engine Generator**

Fuel consumption: approx. 0.25L/kWh

16,650kWh x 0.25L = 4,162.5L , 4,162.5L x 21Taka/L = 87,413Taka

***4 Estimate of annual water supply charge**

Annual water supply charge of Khepupara Meteorological Radar Station = 14,000 Taka

Table 34: Dhaka Storm Warning Centre (SWC)

	Equipment	Item	Q'ty	1st year	2nd year	3rd year	4th year	5th year	6th year	7th year	8th year	9th year	10th year	Remarks
1.	Product Monitor	Hard disk	5	0	0	0	75,000	0	0	0	75,000	0	0	Every 4 years
		CD for archiving product data	80	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	20GB/cartridge
2.	Pinter	Printer ink cartridge	2	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	
3.	Compact UPS	Battery (about 500VA)	10	0	0	50,000	0	0	50,000	0	0	50,000	0	For the each PC connection
4.	1kVA UPS	Battery	2	0	0	20,000	0	0	20,000	0	0	20,000	0	For VSAT
		Subtotal (Taka)		**9,000**	**9,000**	**79,000**	**84,000**	**9,000**	**79,000**	**9,000**	**84,000**	**79,000**	**9,000**	

	Cost Item	Details	Q'ty	1st year	2nd year	3rd year	4th year	5th year	6th year	7th year	8th year	9th year	10th year	Remarks
1.	Electricity Charge		1	323,155	323,155	323,155	323,155	323,155	323,155	323,155	323,155	323,155	323,155	*1
2.	Internet Connection Cost	Charges for Internet Web Hosting, Dial-up Connection, Virus Security	1	40,000	40,000	40,000	40,000	40,000	40,000	40,000	40,000	40,000	40,000	(If the existing dedicated line for Internet is available, this cost is not required)
		Subtotal (Taka)		**363,155**	**363,155**	**363,155**	**363,155**	**363,155**	**363,155**	**363,155**	**363,155**	**363,155**	**363,155**	
		Total Amount (Taka)		**372,155**	**372,155**	**442,155**	**447,155**	**372,155**	**442,155**	**372,155**	**447,155**	**442,155**	**372,155**	

***1 Estimate of annual electricity charge**

Equipment operation: 24hours/day Power consumption: 5.27kWh

Annual power consumption: 8,760Hours x 5.27kWh = 46,165kWh

Electricity charge: 46,165kWh x 7 Taka/kWh = 323,155 Taka

Table 35: Head Office, Dhaka

	Cost Item	Details	Q'ty	1st year	2nd year	3rd year	4th year	5th year	6th year	7th year	8th year	9th year	10th year	Remarks
1.	Communication Cost	Annual Licence Fee for VSAT Link	3	600,000	600,000	600,000	600,000	600,000	600,000	600,000	600,000	600,000	600,000	
		Annual Data Speed Fee for VSAT Link	3	90,000	90,000	90,000	90,000	90,000	90,000	90,000	90,000	90,000	90,000	
		Annual Space Segment Fee	1	1,750,000	1,750,000	1,750,000	1,750,000	1,750,000	1,750,000	1,750,000	1,750,000	1,750,000	1,750,000	
		Total Amount (Taka)		**2,440,000**	**2,440,000**	**2,440,000**	**2,440,000**	**2,440,000**	**2,440,000**	**2,440,000**	**2,440,000**	**2,440,000**	**2,440,000**	

(2) BMD Annual Budget Trends

The annual budgets of BMD between 1997/98 and 2003/04 are as follows.

Table 36: Movement of BMD Budget for Head Office (Taka)

Item	2000-2001	2001-2002	2002-2003	2003-2004	2004-2005	2005-2006 (Prospective)
Personnel Expenses	11,140,000	12,474,000	12,810,000	12,900,000	13,000,000	15,000,000
Consumable Cost	730,000	800,000	850,000	900,000	1,100,000	1,140,000
Electricity & Water Utilization Cost	1,387,000	2,599,000	2,700,000	2,800,000	3,000,000	3,040,000
Cost of Spare Parts	6,450,000	6,500,000	6,600,000	8,000,000	12,000,000	26,600,000
Telecommunication Cost	2,250,000	2,300,000	2,350,000	5,955,000	6,200,000	5,234,000
Space Segment	-	-	1,050,000	1,100,000	1,500,000	2,318,000
Total	**21,957,000**	**24,673,000**	**26,360,000**	**31,655,000**	**36,800,000**	**53,332,500**

Table 37: Movement of BMD Budget for Radar Stations & Storm Warning Centre (SWC) (Taka)

2002-03					
Item	**Dhaka Radar Station**	**Rangpur Radar Station**	**Cox's Bazar Radar Station**	**Khepupara Radar Station**	**SWC, Dhaka**
Personnel Expenses	1,250,000	1,626,000	2,013,000	1,330,000	27,225,000
Consumable Cost	75,000	100,000	70,000	63,000	850,000
Electricity & Water Utilization Cost	225,000	274,000	212,000	292,000	230,000
Radar Maintenance Cost	150,000	400,000	350,000	415,000	--
Total	**1,700,000**	**23,94,000**	**2,645,000**	**2,100,000**	**28,305,000**
2003-04					
Item	**Dhaka Radar Station**	**Rangpur Radar Station**	**Cox's Bazar Radar Station**	**Khepupara Radar Station**	**SWC, Dhaka**
Personnel Expenses	1,300,000	1,700,000	2,099,000	1,498,000	32,128,000
Consumable Cost	85,000	100,000	80,000	80,000	900,000
Electricity & Water Utilization Cost	215,000	280,000	213,000	272,000	200,000
Radar Maintenance Cost	200,000	500,000	400,000	450,000	--
Total	**1,800,000**	**2,580,000**	**2,792,000**	**2,300,000**	**33,228,000**
2004-05					
Item	**Dhaka Radar Station**	**Rangpur Radar Station**	**Cox's Bazar Radar Station**	**Khepupara Radar Station**	**SWC, Dhaka**
Personnel Expenses	1,400,000	1,440,000	2,373,000	1,696,000	30,000,000
Consumable Cost	85,000	205,000	85,000	90,000	1,000,000
Electricity & Water Utilization Cost	215,000	255,000	225,000	214,000	250,000
Radar Maintenance Cost	300,000	600,000	440,000	500,000	--
Total	**2,000,000**	**2,500,000**	**3,123,000**	**2,500,000**	**31,250,000**

The results of the study regarding the recurrent cost of the Project to be borne by BMD are as follows.

<Cox's Bazar Meteorological Radar Observation Station>
Since the estimated recurrent is lower than the existing budget and consists of the cost of consumables, electricity & water utilization cost and radar maintenance, it is felt that BMD can afford it.

<Khepupara Meteorological Radar Observation Station>
Since the estimated recurrent is lower than the existing budget and consists of the cost of consumables, electricity & water utilization cost and radar maintenance, it is felt that BMD can afford it.

<SWC>
According to the estimated recurrent cost, annually 400,000 Taka is required. Since the electricity & water utilization cost in the 2004-05budget is 1,080,000 Taka, this would be an increase of approximately 37%. The SWC budget for electricity & water utilization has constantly been increasing by about 15% per year. In addition, some components of the estimated recurrent cost can be covered by the BMD Head Office budget, therefore, it has been assessed that there is no serious problem.

<BMD Head Office>
After completion of Phases 1 and 2of the Project, the total satellite communication cost, which consists of the VSAT license fee, data speed fee and space segment cost, is estimated at 2,440,000 Taka/year.
Since the satellite communication link to be established in the Project will include the existing VSAT link, BMD plans to cover the recurrent cost by combining their existing space segment budget and part of their existing allocated telecommunication budget.

2-6 Other Relevant Issues

(1) Government Registration

According to government regulation, the organization implementing the project has to register all of the equipment and facilities of the project as government property, in order to obtain the necessary budget for continuing operations and maintenance, via the following procedure.
After completion of the Project, BMD applies to the Ministry of Finance for a budget (to cover operations, maintenance and salary expenses) to be included in the Government budget in the following way.

BMD → Ministry of Defence → Ministry of Establishment → Ministry of Finance

Upon receipt of this request, it normally takes 6 months to get approval from the Ministry of Finance.

(2) Procurement of Spare Parts

The Government of Bangladesh rules for the procurement of spare parts by a government agency are as follows.

i) The government agency which needs spare parts obtains the necessary budget.
ii) The agency prepares specifications for the required spare parts.
iii) The specifications are submitted by the agency to the Department of Procurement and Inspection (DPI), the Ministry of Commerce.
iv) Tendering procedures, tender execution and selection of a supplier are conducted by DPI.

However, in practice, these procedures create delays in spare parts procurement and a are a barrier to the smooth procurement of spare parts for government facilities.

Under there circumstances described above, in order to remove this barrier and improve the efficiency of Government procurement, the Central Procurement Technical Unit (CPTU) was established in the Ministry of Planning in April, 2003 and a document entitled "*the Public Procurement Regulations, 2003*" was issued and became effective on October 1, 2004. To implement the new regulations, CPTU issued "*the Public Procurement Processing and Approval Procedures (PPPAP)"*, which is the official gazette, as guidelines for procurement by government organizations. Since the regulations apply to all public procurement, all government organizations can procure required spare parts, technical services, etc. from a supplier/a manufacturer via the regulation guidelines. In the situation where the supplier/manufacturer who supplied the original equipment is the only organization that can supply the required spare parts and technical services, the government agency can make a direct procurement from that supplier/manufacturer. The meteorological radar system meets this condition, so a contract for spare parts procurement between BMD and the contractor who supplies the radar system is required. This contract must be in accordance with the procedures laid down in the PPAP. It has been confirmed, through discussions with CPTU, that the said regulation enables BMD to make direct procurement of necessary spare parts from the supplier / manufacturer of the radar systems to be supplied under the Project. BMD now has the authority to procure all spare parts directly.

(3) Satellite Communication

A VSAT user license issued by the Bangladesh Telecommunication Regulatory Commission (BTRC) will be required for the meteorological data satellite communication systems between the Cox's Bazar and Khepupara Meteorological Radar Observation Stations and the SWC.
The license includes,

i) Purchase of 3 VSAT user forms (500 Taka) available at BTRC for Cox's Bazar and Khepupara Meteorological Radar Observation Stations and the SWC
ii) Submission of the forms, to be addressed to the Chairman of BTRC
iii) Evaluation of the submitted forms by BTRC (Evaluation fee: 5,000 Taka/form)
iv) Provision of VSAT user licenses to BMD by BTRC (if there are no irregularities in the forms, it will take 2 months for issuance of the licenses to BMD)

BTRC will charge BMD for use of the meteorological data satellite communication systems to be supplied under the Project, according to the following table. Theses costs have been included in the recurrent cost of the BMD Head Office.

Table 38: Satellite Communication Charge

License Fee: annually 200,000 Taka/system	
Data Speed Fee:	
Less than 128Kbps	Annually 30,000 Taka/system
128 – 512 Kbps	Annually 50,000 Taka/system
More than 512Kbps	Annually 100,000 Taka/system

Chapter 3
Project Evaluation and Recommendations

Chapter 3 Project Evaluation and Recommendations

3 - 1 Project Effect

(1) Project Effect

Table 39: Project Effect

Present Situation and Existing Issue	Remedial Measures under the Project	Positive Effects and Degree of Improvement
The existing Cox's Bazar and Khepupara radar systems were replaced in 1988 under Japan's Grant Aid Assistance with two S-band weather radars. Those are now more than 16 years old. Because of the age of the radar systems, frequent repairs were required. During the last year (2004), both of the radar systems failed and they are not able to be repaired, thus radar observations have stopped. Therefore, currently BMD is not able to monitor the weather and can not locate cyclone centers or intensities of the frequent cyclones in the Bay of Bengal. Consequently, Cox's Bazar and Khepupara Meteorological Radar Stations can not transmit the required weather information to the Storm Warning Centre (SWC) as an input for the preparation of the advisories and warnings for cyclones and other extreme events. As such, currently the overall Bangladesh disaster mitigation system is substantially impaired.	• Renewal of the meteorological radar systems • Renewal of the meteorological radar data display systems • Installation of the meteorological data communication system	Will enable BMD to provide near real time (within 15 minutes) cyclone information and warnings to the Prime Minister's Office, the Disaster Management Bureau (DMB), the Cyclone Preparedness Programme (CPP) and mass media to allow them to perform their disaster management roles more effectively, especially in relation to quick evacuation of residents and disaster prevention countermeasure.
Since the existing radar tower buildings at the Cox's Bazar and Khepupara Meteorological Radar Stations have deteriorated structurally, further use of those buildings is quite dangerous.	• Construction of the meteorological radar tower buildings	Will enable BMD to monitor cyclones in the Bay of Bengal and Indian Ocean at an early stage. Meteorological satellite data complements meteorological radar data.
Since GMS-5 stopped functioning, back-up services have been provided by GOES-9. Because of the different characteristics of the two satellites, BMD is to unable to utilize the existing meteorological satellite data receiving system (GMS) supplied to BMD under the previous project financed by the Japan's Grant Aid Assistance. Therefore, BMD can not monitor remote cyclones at an early stage in the Bay of Bengal and Indian Ocean.	• Installation of the satellite data receiving system for MTSAT at SWC	Will enable BMD to monitor cyclones in the Bay of Bengal and Indian Ocean at an early stage. Meteorological satellite data complements meteorological radar data.

There is no data communications system to transmit the meteorological radar data from the proposed Cox's Bazar and Khepupara Meteorological Radar Systems to the SWC.	• Installation of the meteorological data satellite communication system	Will enable BMD to receive all meteorological radar data at the SWC for quick and timely preparation of accurate advisories and warnings to the public and disaster management agencies.
There is no system at Cox's Bazar Meteorological Office to receive the meteorological radar data observed by the proposed Cox's Bazar Meteorological Radar System for the preparation of forecasts for the Cox's Bazar District and Cox's Bazar Airport, to support aviation and fisheries. At present, the Cox's Bazar Meteorological Office can not issue timely warnings.	• Installation of the meteorological data communication system	Will enable BMD to prepare forecasts for the Cox's Bazar District; improve the accuracy of the weather information for the Cox's Bazar Airport, fishing trawlers and small boats; and permit the prompt issuance of warnings.
Bangladesh is particularly affected by cyclonic storms and the associated storm surges. Tropical cyclones are the extreme manifestations of nature that have lead to immense distress and deprivation for several hundred thousand of people, especially those in the low-lying coastal area and off-shore islands. However, BMD presently has no system to monitor cyclones, therefore BMD can not provide information and warnings of cyclones to the public and disaster management agencies.	• Installation of Doppler meteorological radar systems at Cox's Bazar and Khepupara Meteorological radar observation stations	Will enable BMD to provide information on cyclones to the Prime Minister Office, the Disaster Management Bureau (DMB), the Cyclone Preparedness Programme (CPP) and mass media, to contribute to the reduction of cyclone damage and loss of life.

(2) Achievement Indicators for the Project

Following discussions with BMD, Achievement Indicators for the Project have been set as follows.

Table 40: Achievement Indicator

Summary	Before failure of the existing radar systems	Present (Base Line)	Target	Expected Achievement Time
Enhancement of Cyclone Monitoring Capability	Detection range of precipitation intensity 1mm/h or more: 200km radius	Not operational due to system failures	Detection range of precipitation intensity 1mm/h or more: 300km radius	At the completion of the Project
	Impossible to monitor cyclonic wind velocity	Not available	Obtainable cyclonic wind velocity distribution data within the radar monitoring range	
Enhancement of Radar Operation Availability	Approximately 2,000 hours/year	Not operational due to system failures	Approximately 4,000 hours/year	1 year from the completion of the Project

(3) Population to directly benefit from the Implementation of the Project

Bangladesh is particularly affected by tropical cyclones that come from the Bay of Bengal. Tropical cyclones are the extreme manifestations of nature that lead to immense distress and deprivation for several hundred thousand of lives, especially those in the low-lying coastal area and off-shore islands. In addition, the extensive losses from cyclones are a significant set-back to the national economy and for development in Bangladesh.

The overall objective of the Project is to reduce devastation caused by tropical cyclones by improving cyclone monitoring and by earlier issuance of cyclone warnings & advisories by BMD. This will be achieved through the replacement of the existing Cox's Bazar and Khepupara weather surveillance radar systems. To estimate how the Project will benefit the disaster management sector, in terms of reduction in the loss of human lives, the number of the potentially affected people has been calculated using CPP's area risk assessment categories, based on the Population Census of 2001, National Report (Provisional), published by the Bangladesh Bureau of Statistics. The results are as follows.

Table 41: Population in Areas Affected by Cyclone

Areas Affected by Cyclone (Prepared by Cyclone Preparedness Programme, CPP)	Population
High Risk Area	6,365,020
Wind Risk Area	8,394,920
High Risk Area	25,348,762
Total	**40,108,702**

The population in the areas affected by cyclone which will directly benefit from the Project is approximately 40 million, which is 30% of the population of Bangladesh.

3 - 2 Recommendations

In order to further enhance the benefits of the Project, the following recommendations should be implemented.

a) The development of more qualified technical personnel.
b) Securing the necessary budget for the efficient operation & maintenance of the systems and the procurement of spare parts & consumables for all of the equipment to be supplied under the Project.
c) Protection of the equipment against damage and disappearance.

d) The creation of effective communications and collaboration with the various government agencies and international institutions, for better coordination of meteorological disaster prevention and management.

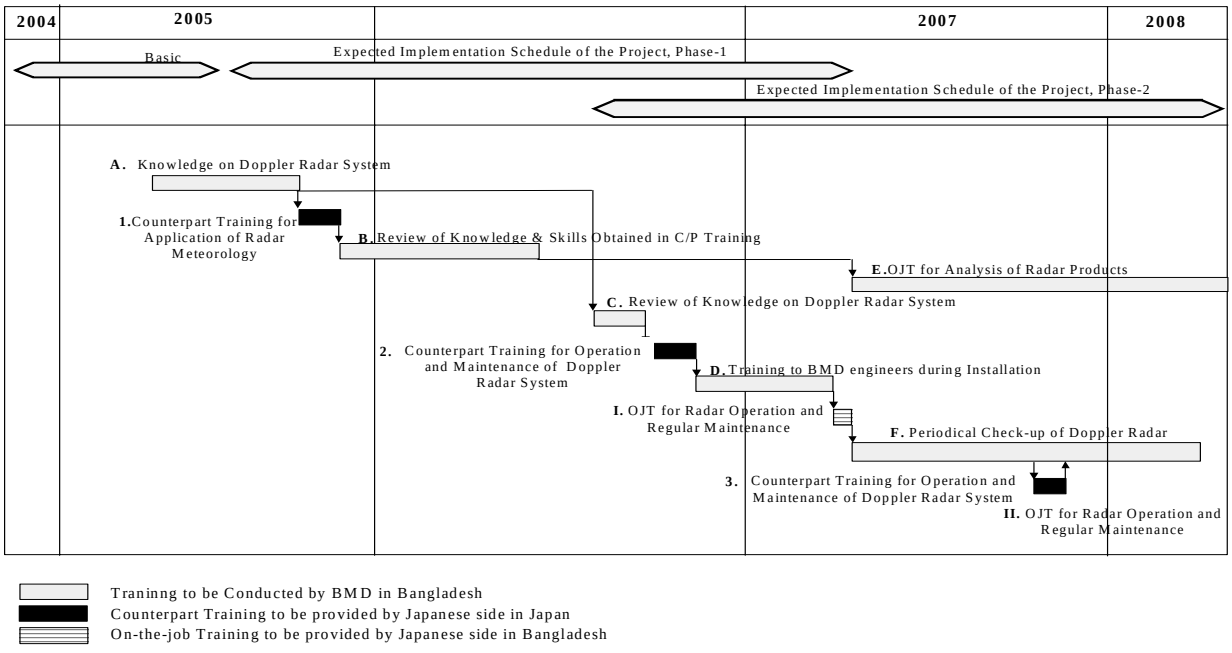
e) Quicker dissemination of information on hazardous weather conditions to the general public, government agencies and other organizations concerned with meteorological disaster mitigation and the preparation of more accurate reports.

f) Conducting of research to increase the level of understanding/knowledge about meteorological disasters and its impact on socio-economic activities.

g) The wide dissemination of knowledge and information on disaster-prevention activities to all sectors, including government disaster management agencies, the private sector and the population at risk.

Technical training and technology transfer are required for the staff of BMD, to enable the effective utilization of the meteorological radar systems for meteorological observation and forecasting work. The knowledge, technical skills and ability of BMD personnel can be improved by training in Japan in radar meteorology and the operation and maintenance of the meteorological radar systems, and this will be augmented by BMD's own training. The following training schedule has been prepared based on the above ideas.

Figure 10: Schedule of Training Programs



Appendices

Appendix 1. Member List of the Survey Team

(1) Basic Design Survey Team

Mr. Akio ARAI	Team Leader	Representative of JICA Bangladesh Office, Japan International Cooperation Agency (JICA)
Mr. Yoshihisa KIMATA	Technical Advisor	Observation Division, Observation Department, Japan Meteorological Agency (JMA)
Mr. Nobutaka KONDO	Project Coordinator	Living Conditions Improvement Team, Project Management Group II, Grant Aid Management Department, Japan International Cooperation Agency (JICA)
Mr. Yoshihisa UCHIDA	Project Manager / Operation and Maintenance Planning	Japan Weather Association (JWA)
Mr. Hiroaki MIZUKAMI	Meteorological Observation, Communication, Forecasting and Warning System Planning / Equipment Procurement Planning / Equipment Cost Estimate	Japan Weather Association (JWA)
Mr. Teruaki HIRAOKA	Construction Planning / Construction Material Procurement Planning / Construction Cost Estimate	Japan Weather Association (JWA) (Kume Sekkei Co., Ltd.)
Mr. Katsumi HAYASHI	Facility Planning / Natural Conditions Survey	Japan Weather Association (JWA) (Kume Sekkei Co., Ltd.)
Mr. Nasir Uddin Bhuiyan	Local Consultant (Meteorological Radar Operation and Maintenance)	Japan Weather Association (JWA)

(2) Second Basic Design Survey Team

Mr. Akio ARAI	Team Leader	Representative of JICA Bangladesh Office, Japan International Cooperation Agency (JICA)
Mr. Yoshihisa UCHIDA	Project Manager / Operation and Maintenance Planning	Japan Weather Association (JWA)
Mr. Hiroaki MIZUKAMI	Meteorological Observation, Communication, Forecasting and Warning System Planning / Equipment Procurement Planning / Equipment Cost Estimate	Japan Weather Association (JWA)
Mr. Nasir Uddin Bhuiyan	Local Consultant (Meteorological Radar Operation and Maintenance)	Japan Weather Association (JWA)

Appendix 2. Study Schedule

Study Schedule			Governmental Member			Consultant Member				
			Mr. Akio ARAI	Mr. Yoshihisa KIMATA	Mr. Nobutaka KONDO	Mr. Yoshihisa UCHIDA	Mr. Hiroaki MIZUKAMI	Mr. Teruaki HIRAOKA	Mr. Katsumi HAYASHI	Mr. Nasir Uddin Bhuiyan
			Team Leader	Technical Advisor	Project Coordinator	Project Manager / Operation and Maintenance Planning	Meteorological Observation, Communication, Forecasting and Warning System Planning / Equipment Procurement Planning / Equipment Cost Estimate	Construction Planning / Construction Material Procurement Planning / Construction Cost Estimate	Facility Planning / Natural Conditions Survey	Local Consultant (Meteorological Radar Operation and Maintenance)
1	2004 1 Dec.	Wed				Narita-Bangkok (TG641, 10:45-15:45)				
2	2 Dec.	Thu				Bangkok-Dhaka (TG321, 10:30-12:00)				
3	3 Dec.	Fri		Narita-Singapore (JL719, 11:10-17:35) Singapole-Dhaka (SQ436, 18:50-20:50)		Visit to local contractors for requesting a cost estimate of Topographic and Geotechnical Survey, Data Collection, Study for Unit Price of Constraction Materials				Data Collection, Study for Unit Price
4	4 Dec.	Sat	Preliminary Discussion with Bangladesh Meteorological Department (BMD)							Preliminary Discussion with BMD
5	5 Dec.	Sun	Preliminary Meeting with JICA Bangladesh Office, Courtesy call on BMD, Courtesy call on Ministry of Defence, Discussion with BMD Site Survey at Dhaka Radar Station, Courtesy call on Economic Relations Division, Courtesy call on Embassy of Japan							Courtesy call on BMD Discussion with BMD
6	6 Dec.	Mon	Site Survey at BMD Head Office and Storm Warning Centre (SWC), Discussion with BMD							Discussion with BMD
7	7 Dec.	Tue	Discussion with BMD							Discussion with BMD
8	8 Dec.	Wed	Discussion with BMD					Data Collection, Study for Unit Price of Constraction Materials		Discussion with BMD
9	9 Dec.	Thu	Moving to Cox's Bazar, Site Survey at Cox's Bazar Radar Station Dhaka-Cox's Bazar (BG635, 10:30-11:30)					Data Collection, Study for Unit Price of Constraction Materials		Moving to Cox's Bazar
10	10 Dec.	Fri	Site Survey at Cox's Bazar Radar Station and Cox's Bazar Meteorological Office Coming back to Dhaka Cox's Bazar-Dhaka (Z5 104, 12:20-14:00)					Data Collection, Study for Unit Price of Constraction Materials		Site Survey at Cox's Bazar Radar Station and Cox's Bazar Meteorological Office, Coming back to Dhaka
11	11 Dec.	Sat	Discussion with BMD Discussion with Economic Relations Division and Ministry of Defence, Signing on Minutes of Discussions	Dhaka-Singapore (SQ435, 22:05-04:05)				Study for Unit Price of Constraction Materials, Visit to local contractors of Topographic and Geotechnical Survey		Discussion with BMD
12	12 Dec.	Sun		Singapore-Narita (JL712, 08:20-15:55)	Report to Embassy of Japan and JICA Bangladesh Office, Discussion with BMD Dhaka-Singapore (SQ435, 22:05-04:05)			Data Collection, Quantity Surver		Discussion with BMD, Data Collection
13	13 Dec.	Mon			Singapore-Narita (JL712, 08:20-15:55)	Discussion with Bangladesh Telecommunication Regulatory Commission (BTRC) and BMD, Visit to Satelliet Space Segment Provider, Data Collection		Data Collection, Quantity Surver	Narita-Bangkok (TG641, 10:45-15:45)	Discussion with Bangladesh Telecommunication Regulatory Commission (BTRC) and BMD, Visit to Satelliet Space Segment Provider
14	14 Dec.	Tue				Discussion with Disaster Management Bureau (DMB) and Cyclone Preparedness Programme (CPP)		Data Collection, Quantity Surver	Bangkok-Dhaka (TG321, 10:30-12:00)	Discussion with Disaster Management Bureau (DMB) and Cyclone Preparedness Programme (CPP)
15	15 Dec.	Wed				Site Survey at BMD Head Office (Communication Room)		Data Collection, Study for Unit Price of Constraction Materials		Site Survey at BMD Head Office (Communication Room)
16	16 Dec.	Thu				Moving to Khepupara, Site Survey at Khepupara Radar Station				
17	17 Dec.	Fri				Station Survey at Khepupara Radar Station				
18	18 Dec.	Sat				Coming back to Dhaka				
19	19 Dec.	Sun				Discussion with BMD, Data Collection		Vist to Department of Civil Engineering, Banagadesh University of Engineering & Technology for Water Analysis		Discussion with BMD, Data Collection
20	20 Dec.	Mon				Site Survey at BMD Head Office (Dhaka Radar Station)		Data Collection, Quantity Surver	Site Survey at BMD Head Office (Dhaka Radar Station)	
21	21 Dec.	Tue				Discussion with BMD, Data Collection		Data Collection, Study for Unit Price of Constraction Materials		Discussion with BMD, Data Collection

Appendix 2. Study Schedule

22	22 Dec.	Wed				Discussion with BMD, Data Collection		Data Collection, Study for Unit Price of Constraction Materials		Discussion with BMD, Data Collection	
23	23 Dec.	Thu				Moving to Cox's Bazar	Data Collection, Study for Unit Price	Moving to Cox's Bazar			
24	24 Dec.	Fri				Site Survey at Cox's Bazar Meteorological Office and Cox's Bazar Radar Station	Data Collection, Study for Unit Price	Site Survey at Cox's Bazar Meteorological Office and Cox's Bazar Radar Station			
25	25 Dec.	Sat				Coming back to Dhaka	Data Collection, Study for Unit Price	Coming back to Dhaka			
26	26 Dec.	Sun				Intenal Meeting, Data Collection, Study for Unit Price					
27	27 Dec.	Mon				Report to JICA Bangladesh Office, Discussion with BMD, Data Collection		Vist to Department of Civil Engineering, Banagadesh University of Engineering & Technology for Water Analysis		Discussion with BMD, Data Collection	
28	28 Dec.	Tue				Discussion with Central Procurement Technical Unit (CPTU), Discussion with BMD, Data Collection		Site Survey at BMD Head Office and Storm Warning Centre, Data Collection, Study for Unit Price		Discussion with Central Procurement Technical Unit (CPTU), Discussion with BMD	
29	29 Dec.	Wed				Discussion with BMD, Data Collection		Dhaka-Bangkok (TG322, 13:10-16:25)	Discussion with BMD, Data Collection		
30	30 Dec.	Thu				Report to BMD, Data Collection		Bangkok-Narita (TG640, 11:20-19:00)	Follow-up for Topographic and Geotechnical Survey, Collection of Questionnaires	Report to BMD, Data Collection	
31	31 Dec.	Fri				Intenal Meeting, Data Collection			Intenal Meeting, Data Collection		
32	2005 1 Jan.	Sat				Dhaka-Bangkok (TG322, 13:10-16:25)			Data Collection		
33	2 Jan.	Sun				Bangkok-Narita (TG676, 08:20-16:00)			Vist to Department of Civil Engineering, Banagadesh University of Engineering & Technology for Water Analysis	Data Collection, Collection of Questionnaires	
34	3 Jan.	Mon							Follow-up for Topographic and Geotechnical Survey, Collection of Questionnaires		
35	4 Jan.	Tue							Dhaka-Bangkok (TG322, 13:10-16:25)		
36	5 Jan.	Wed							Bangkok-Narita (TG676, 08:20-16:00)		

(2) Explanation of Draft Report

Study Schedule			Governmental Member	Consultant Member		
			Mr. Akio ARAI	Mr. Yoshihisa UCHIDA	Mr. Hiroaki MIZUKAMI	Mr. Nasir Uddin Bhuiyan
2005年			Team Leader	Project Manager／Operation and Maintenance Planning	Meteorological Observation, Communication,Forecasting and Warnig, System Planning/ Equipment Procurement Planning/ Equipmet Cost/Estimate	Lacal Consultant (Meteorological Radar Operation and Maintenance)
1	22 Mar.	Tue		Narita-Bangkok (TG647, 10:45-15:45)		
2	23 Mar.	Wed		Bangkok-Dhaka (TG321, 10:30-12:00) Courtesy call on BMD, Explanation of Draft Report to BMD		
3	24 Mar.	Thu	Meeting with JICA Bangladesh Office, Courtesy call on Embassy of Japan, Courtesy call on Economic Relations Division and Ministry of Defence, Discussion with BMD, Explanation of Draft Report to BMD			Discussion with BMD, Explanation of Draft Report to BMD
4	25 Mar.	Fri	Discussion with BMD, Explanation of Draft Report to BMD			
5	26 Mar.	Sat	Intenal Meeting, Data Collection			
6	27 Mar.	Sun	Discussion with BMD, Explanation of Draft Report to BMD			
7	28 Mar.	Mon	Signing on Minutes of Discussions, Report to Embassy of Japan and JICA Bangladesh Office			Data Collection
8	29 Mar.	Tue		Dhaka-Bangkok (TG322 13:10-16:25)		
9	30 Mar.	Wed		Bangkok - Narita (TG676, 08:20-16:00)		

Appendix 3. List of Party Concerned in the Recipient Country

- **Ministry of Defence**

Mr. Mesbah Uddin Ahmed	Secretary
Mr. Ismat Ahmed Chowdhury	Joint Secretary

- **Economic Relations Division, Ministry of Finance**

Mr. M. Emdadul Haque	Deputy Secretary
Ms. Afsana Yeasmin	Assistant Secretary

- **Central Procurement Technical Unit (CPTU), Ministry of Planning**

Mr. AKM Fazlul Karim	Director General
Ms. ANM Mustafizur Rahman	System Analyst

- **Bangladesh Meteorological Department (BMD)**

BMD Head Office, Dhaka

Mr. Md. Akram Hossain	Director
Ms. Aujumand Habib	Deputy Director, Storm Warning Centre
Mr. Md. Shan Alam	Deputy Director, Climate
Mr. B. N. Podder	Senior Electronic Engineer
Mr. Md. Muzammel Haque Tarafder	Senior Communication Engineer
Mr. Ahmed Arif Rashid	Mechanical Engineer, Planning Division
Mr. Moin Uddin Ahmed	Assistant Mechanical Engineer
Mr. Md. Sozzad Hossain	Assistant Communication Engineer
Mr. Nur Mohammad Miah	Meteorologist

Zia International Airport

Mr. Md. Manzurul Hoque Khan	Meteorologist, Zia International Airport

BMD Cox's Bazar Radar Station

Mr. Khaza Md. Nazimuddin	Assistant Electronic Engineer

BMD Cox's Bazar Meteorological Observatory

Mr. Md. Abdur Rahman	Meteorologist

- **Bangladesh Telecommunication Regulatory Commission (BTRC)**

Mr. Khondaker Md. Abu Bakar	Commissioner
Mr. A. K. M. Shahiduzzaman	Director
Mr. Md. Mesbahuzzaman	Deputy Director

- **Bangladesh Red Crescent Society, Cyclone Preparedness Programme (CPP)**

Mr. Md. Nasir Ullah	Director
Mr. John Halder	Disaster Management Programme Officer

- **Disaster Management Bureau**

Mr. A. H. M. Shamsul Islam	Director General
Mr. Md. Mazibur Rahman	Director
Mr. M. Abu Toyeb Sikder	Director
Mr. Netai Chandra Dey Sarker	Assistant Director

Appendix 4. Minutes of Discussion

Minutes of Discussions
of the Basic Design Study
on the Project for Improvement
of the Meteorological Radar Systems at Cox's Bazar and Khepupara
in the People's Republic of Bangladesh

In response to the request from the Government of the People's Republic of Bangladesh, the Government of Japan decided to conduct a Basic Design Study on "The Project for Improvement of the Meteorological Radar Systems at Cox's Bazar and Khepupara" (hereinafter referred to as "the Project") and entrusted the study to the Japan International Cooperation Agency (hereinafter referred to as "JICA").

JICA sent the Basic Design Study Team (hereinafter referred to as "the Team") to Bangladesh, headed by Mr. Akio Arai, the Resident Representative of the JICA Bangladesh Office, and is scheduled to stay from December 2, 2004 to January 4, 2005.

The Team held discussions with the officials concerned of the Government of the People's Republic of Bangladesh. During the course of the discussions, both sides have confirmed the main items described in the attached sheets. The Team will proceed to further study and prepare the Basic Design Study Report. However, if anything comes up during the course of the study, JICA will further assess its appropriateness and will make necessary recommendation to the Government of Japan for approval.

Dhaka, December 11, 2004

Akio ARAI
Leader
Basic Design Study Team
Japan International Cooperation Agency

M. Emdadul Haque
Deputy Secretary
Economic Relations Division
Government of the People's Republic of Bangladesh

Md. Akram Hossain
Director
Bangladesh Meteorological Department
Government of the People's Republic of Bangladesh

ATTACHMENT

1. Objective

The objective of the Project is to improve the Meteorological Radar Systems at Cox's Bazar and Khepupara of the Bangladesh Meteorological Department (hereinafter referred to as "BMD") by constructing new Radar Tower Buildings and installing new Radar Systems in the premises of Cox's Bazar and Khepupara Meteorological Radar Stations, BMD.

2. Project Site

The sites of the Project is shown in **Annex-1**.

The sites for construction of Radar Tower Buildings

- Premises of Cox's Bazar Meteorological Radar Station, BMD
- Premises of Khepupara Meteorological Radar Station, BMD

The sites for installation of the requested equipment

- Cox's Bazar Meteorological Radar Station, BMD
- Khepupara Meteorological Radar Station, BMD
- Storm Warning Centre, BMD Head Office
- Cox's Bazar Meteorological Observatory, BMD

3. Responsible and Implementing Organizations

(1) The responsible ministry is the Ministry of Defense.

(2) The implementing organization is the BMD (the organization chart of implementing agency is shown in **Annex-2**).

4. Items Requested by the Bangladesh Government

After discussions with the Team, construction of Radar Tower Buildings and supply and installation of the equipment described in **Annex-3** (hereinafter referred to as "the Equipment") were finally requested by the Bangladesh side. JICA will further assess the appropriateness of the request and will make necessary recommendation to the Government of Japan for approval.

5. Japan's Grant Aid Scheme

(1) Bangladesh side understands the Japan's Grant Aid scheme and the necessary measures to be taken by the Government of Bangladesh as explained by the Team which is described in **Annex-4**.

(2) Bangladesh side will take necessary measures, as described in **Annex-5**, for smooth implementation of the Project, as a condition for the Japan's Grant Aid.

6. Schedule of the study

(1) The consultants will proceed to further study in Bangladesh by January 4, 2005.

(2) JICA will prepare the draft report in English and dispatch a mission to Bangladesh in order to explain its contents around the middle of March, 2004.

(3) In case, the contents of the report are accepted in principle by the Government of Bangladesh, JICA will complete the final report and send it to the Government of Bangladesh by the end of June, 2005.

7. Other Relevant Issues

(1) Bangladesh side shall arrange the budget allocation for undertakings to be done by the Bangladesh side described in Annex-5.

(2) Both sides agree that Bangladesh side will make maximum effort to improve equipment and facilities of BMD by its own budget in future from the viewpoint of self-reliance.

(3) Bangladesh side agrees to allocate sufficient budget and qualified staff for proper and effective operation & maintenance of the Equipment and the facilities to be provided under the Grant Aid.

(4) In case the project is adopted by Government of Japan, it takes at least 18 months to complete all the construction and procurement counting from the beginning of the work. Taking all the procedures prior to the work such as tendering and making contracts into account, Bangladesh side shall complete PCP (Project Concept Paper) and obtain approval of ECNEC (Executive Committee for National Economic Council) by 15th June, 2005.

(5) Bangladesh side shall complete the following works prior to commencement of the Project.

- To secure necessary lands and legal right for construction of the Radar Towers.
- To shift or remove the existing equipment and/or facilities, if it is required for the Project.
- To provide facilities for distribution of stable power supply enough to operate new Radar Systems, telephone and other incidental facilities to the project sites, if required.
- To secure sufficient spaces at the Storm Warning Centre in Dhaka and the Cox's Bazar Meteorological Observatory for installation of the Equipment.
- To obtain necessary permission and frequency allocation for data communication systems to be established.
- To provide necessary space segments for a satellite communication system to be

established.

- To ensure the availability of the existing radar frequencies of Cox's Bazar and Khepupara Meteorological Radars for the new Radar Systems to be installed.

(6) Bangladesh side shall ensure prompt tax exemption and customs clearance of the materials, equipment and miscellaneous brought for the Project at the port of disembarkation.

(7) Bangladesh side shall exempt the VAT concerning local procurement of goods and services under the Project to contractors to be selected through tendering procedures of the Japan's Grant Aid Scheme.

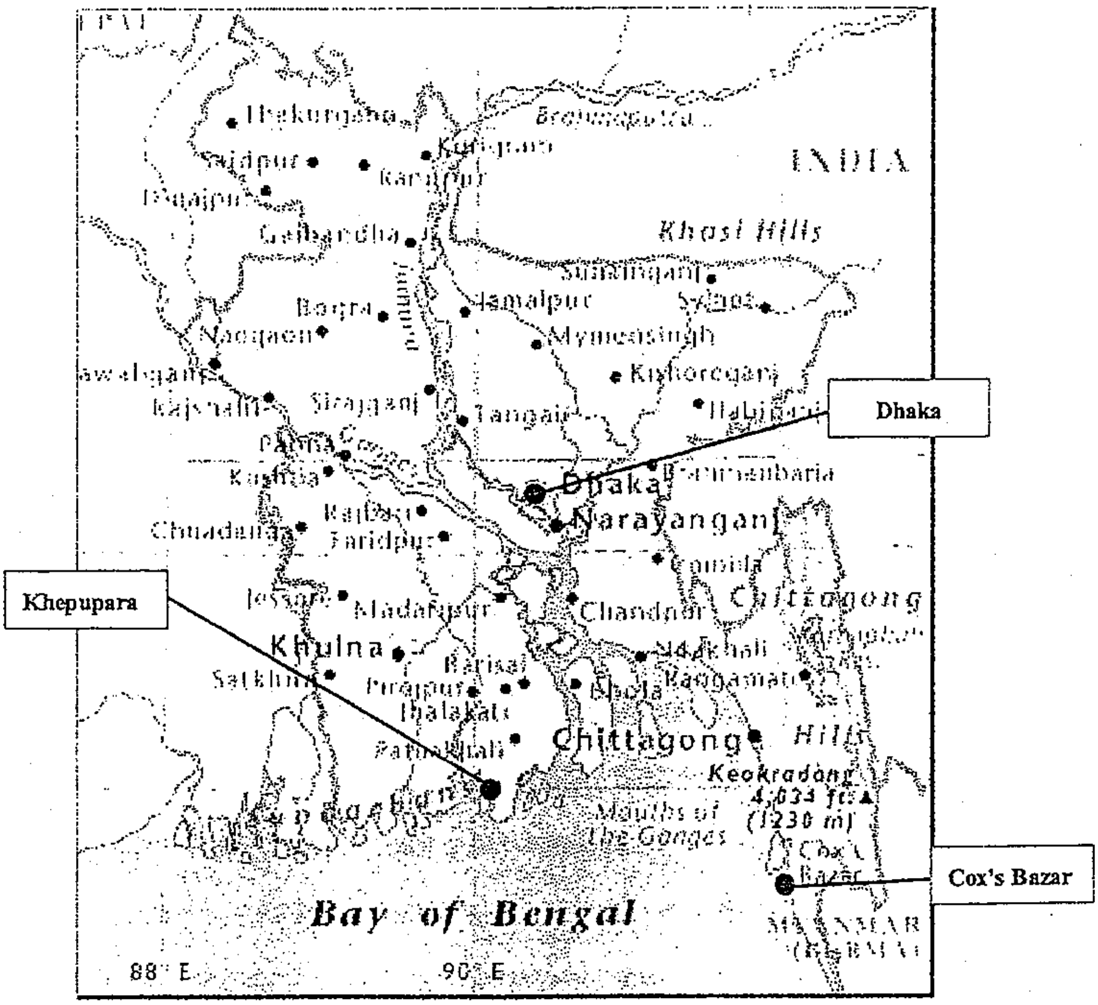
(8) Bangladesh side requested the counterpart training in Japan on radar meteorology and operation & maintenance of the Equipment as a technical cooperation by JICA, and Bangladesh side understands the submission of another official request from the Government of Bangladesh to the Government of Japan through JICA Bangladesh Office is required. The tentative schedule of training programs including the counterpart training is attached here with as **Annex-6**.

(9) Bangladesh side also understands the necessity of another official request on a technical cooperation program for upgrading the meteorological forecasting skill and radar technology development through diplomatic channels such as the Embassy of Japan and/or the JICA Bangladesh Office.

(10) Two Radar Towers and the Equipment shall be registered as property of the Government of Bangladesh immediately after completion of the project.

(11) Ministry of Defense has given consent on this Minutes of Discussions. (**Annex-7**)

Bangladesh


INDIA
Khasi Hills
Mymensingh
Tangail
Dhaka
Narayanganj
Chandpur
Khulna
Barisal
Bhola
Chittagong
Chittagong Hills
Keokradong
4,034 ft.
(1230 m)
Mouths of the Ganges
Bay of Bengal
88° E
90° E
Dhaka
Khepupara
Cox's Bazar

BANGLADESH METEOROLOGICAL DEPARTMENT
MINISTRY OF DEFENCE

ORGANIZATION

DIRECTOR 1057
PERS : 3
1xDirector
1xStenographer(PA)
1 x MLSS

MET. TRAINING INSTITUTE
PERS : 25
1 x Dy. Director
2 x Asstt. Director
3 x Meteorologist
3 x Prof. Asstt.
3 x Met. Asstt.
1 x Draftsman
1 x Assistant
2 x Sr. Observer
1 x Mech. Gr.-II
1 x Steno-Typist
1 x LDA-Cum-Typist
1 x Driver
1 x Gestetner Opir.
2 x Balloon Maker
2 x MLSS

CLIMATE
PERS : 31
1 x Dy. Director
1 x Meteorologist
2 x Asstt. Met.
3 x Prof. Asstt.
3 x Met. Asstt.
8 x Assistant
10 x Sr. Observer
1 x Steno-Typist
2 x MLSS

AGROMET
PERS 17
1 x Dy. Director
1 x Asstt. Met.
1 x Prof Asstt.
2 x Met. Assistant
3 x Assistant
6 x Sr. Observer
1 x Steno-Typist
1 x Driver
1 x MLSS.

ADMINISTRATION
PERS:3
1 x Asstt. Director
1 x Asstt. Met.
1 x MLSS

ESTABLISHMENT AND GENERAL ADMIN.
PERS : 26
1 x Admin Officer
1 x Prof. Asstt.
1 x Superintendent
1 x Accounts Officer
2 x UDA
1 x Accountant
1 x Security Officer
4 x L.D.A. (O.A.)
3 x O.A. Cum. Typist
1 x Care Taker
1 x Electrician
3 x Driver
3 x Chowkider
2 x MLSS
1 x Mali

CENTRAL MET. STORE
PERS: 10
1 x Store Officer
2 x Store Keeper
(1 for Tech)
2 x O.A.Cum Typist
1 x MLSS
4 x Chowkider

WORKSHOP & LABORATORY
PERS : 32
1 x Dy. Director
1x Sr. Mech. Engr.
1 x Meteorologist
1 x Asstt. Elec. Engr.
1 x Asstt. Mech Engr.
2 x Prof. Asstt.
4 x Elec. Asstt.
3 x Foreman
2 x Assistant
2 x Cheif Mech.
5 x Mech. Gr. -I
6 x Mech. Gr.- II
2 x Carpenter
1 x O.A. Cum Typist

HEAD QUARTER
PERS: 3
1 x Dy. Director
1 x Steno Typist
1 x MLSS

SYNOPTIC
PERS: 24
1 x Asst Director
2 x Meteorologist
2 x Asstt. Met.
4 x Prof. Asstt.
3 x Met. Asstt.
3 x Assistant
3 x Sr. Observer
3 x Observer
1x O.A. cum Typist
1 x Balloon Maker
1 x MLSS

FORECASTING
PERS: 16
1 x Asst Director
2 x Meteorologist
2 x Asstt. Met.
2 x Prof. Asstt.
2 x Met. Asstt.
1 x Draftsman
2 x Sr. Observer
1 x Photographer
1xO.A. cum Typist
1 x Balloon Maker
1 x MLSS

PLANNING
PERS: 12
1 x Asstt. Director
1 x Asstt. Met.
2 Prof. Asstt.
4 . Met. Asstt
1 x UDA
2xO. A. cum Typist
1 x MLSS

INTERNATIONAL METEOROLOGICAL
PERS: 9
1 x Asstt. Director
1 x Asstt. Met.
1x Prof. Asstt.
2 x . Met. Asstt.
1 x UDA
2 xO.A. cum Typist
1 x MLSS

ELECTRONIC & INSTRUMENT
PERS: 12
1 x Sr. Elec.Engr.
1 x Mech. Engineer
1 x Elec. Engineer.
1 x Asst. Met.
1 x Asstt.Elec. Engr.
1 x Chemist
1 x Elec. Asstt.
1 x Mech. Asstt
1 x Sr. Observer
1 x Mech. Gr. -II
1 x Lab. Atendant
1 x MLSS

COMMUNICATION
PERS: 10
1 x Sr. Comm. engr.
1 x Comm. Engineer
1 x Asstt. Met.
1xAsstt. Comm. Engr.
1x T.P Supervisior
1 x Assistant
1 x Observer
1 x Mech. Gr. II
1 x Lab. Attendant
1 x Balloon Maker

MAIN MET. OFF. Z.I.A.DHAKA
PERS: 83
1 x Asstt. Director
4 x Meteorologist
1 x Elec. Engineer
5 x Asstt. Met.
1xAsstt. Elec. Engr.
3 x Prof. Asstt.
4 x Elec. Asstt.
5 x Met. Asstt.
5 x Assistant
1 x T.P. Supervisor
17 x Sr. Observer
5 x T.P. Operator
3 x Radio Mech.
1 x Driver
6 x Observer
2 x Lab. Attendant
1 x O.A. Cum Typist
8 x Balloon Maker
9 x MLSS
1 x Sweeper

1ST CLASS MET. OBSY. RAJSHAHI
PERS: 7
1 x Met. Asstt
3 x Sr. Observer
3 x Balloon Maker

1ST CLASS MET. OBSY. FARIDPUR
PERS: 7
1 x Met. Asstt.
3 x Sr. Observer
3 x Balloon maker

SMO & P.B.O. ISHURDI
PERS: 20
1 x Asstt. Met.
1 x Met. Asstt.
5 x Sr. Observer
3 x Observer
1 x T.P. Superv.
5 x T.P. Operator
3 x Balloon Maker
1 x MLSS

NATIONAL MET. COMM. CENTRE. DHAKA
PERS: 98
1x Sr. Comm. Engr.
2 x Comm. Engr.
3xAsstt.Comm. Engr
5 x Elec. Asstt.
2 x Asstt.
10xT.P. Supervisor
40 x T.P. Operator
6 x Wireless Supvr.
10 x Wireless Opir.
2 x Sr. Observer
2 x Mech. Gr.-II
1 x O.A.Cum.Tipist
10 x MLSS
4 x Chowkider

FORCASTING & WARNING
PERS: 42
5 x Meteorologist
4 x Asstt. Met.
8 x Met. Asstt.
1 x Assistant
15 x Sr. Observer
1 x Observer
3 x Balloon Maker
5 x MLSS

S.M.O SAIDPUR.
PERS: 7
1 x Met. Asstt.
2 x Sr. Observer
3 x Observer
1 x Balloon Maker

WIND FINDING RADAR. PBO & AGROMET PILOT STATION. RANGPUR
PERS: 21
1 x Asstt. Met.
1 x Asstt. Elec. Eng.
3 x Elec. Asstt.
2 x Met. Asstt
1 x Assistant
1 x Mech Assistant
4 x Sr. Observer
5 x Balloon Maker
3 x Chowkider

STORM WARNING CENTRE
PERS: 3
1 x Dy. Director
1x Steno - Typist
1 x MLSS

ADMINISTRATION
PERS: 7
1 x Supdt
1 x Accountant
1 x UDA
2 x O.A. Cum-Typist
1 x Driver
1 x MLSS

1ST CLASS MET. OBSY. BINAIPUR
PERS: 7
1 x Met. Asstt.
3 x Sr. Observer
3 x Balloon Maker

RIC. RAWINSONDE, PBO. & AGROMET OBSY. BOGRA.
PERS: 35
1 x Asstt. Met.
3 x Prof. Asstt.
1 x Elec. Asstt.
1 x Assistant
5 x Sr. Observer
2 x Observer
1 x T.P. Supervisor
1 x Wireless super.
5 x Wireless Opir.
5 x T.P. Operator
3 x Mech. Gr. - I
3 x Balloon Maker
2 x MLSS
2 x Chowkider

1ST CLASS MET. OBSY. TANGAIL
PERS: 7
1 x Met. Assistant
3 x Sr. Observer
3 x Balloon Maker

RIC. RAWINSONDE & P.B.O. DHAKA.
PERS: 18
1 x Asstt. Met.
2 x Prof. Asstt.
1x Met. Assist.
5 x Sr. Observer
1 x Mech. Gr.- I
5 x Balloon Maker
1 x MLSS
1 x Chowkider
1 x Mali

WEATHER SURVEILLANCE RADER STATION. DHAKA
PERS:15
2 x Asstt. Elec. Engr.
6 x Elec. Assistant
2 x Mech. Gr. - II
4 x Chowkider
1 x MLSS

AGROMET PILOT STATION JOYDEBPUR.
PERS: 6
1 x Asstt. Met.
1 x Met. Asstt.
1 x Assistant
2 x Observer
1 x Balloon Maker

P.B.O. & AGROMET PILOT STATION . MYMENSING
PERS: 8
1 x Asstt. Met.
1 x Met. Asstt.
1 x Assistant
3 x Sr. Observer
2 x Balloon Maker

OBSERVATORY BRANCH
PERS:2
1 x Asstt. Met.
2 x Prof. Asstt.
1 x Met. Asstt.
1 X Asstt..
1 x Sr. Observer
1 x MLSS

ELECTROLYSER PLANT. DHAKA
PERS: 17
1 x Mech. Engineer
2 x Asstt. Mech. Engr.
1 x Chemist
1 x Foreman
1 x Chief Mech
2 x Mech. Gr. -I
1 x Mech Gr. - II
2 x Electrician
2 x Boiler Opir.
1 x Observer
1 x Messenger
1 x Chowkider
1 x Sweeper

1 ST CLASS MET. OBSY. MADARIPUR
PERS: 7
1 x Met. Asstt.
3 x Sr. Observer
3 x Balloon Maker

MET. & GEO CENTRE CHITTAGONG
PERS : 3
1 x Dy. Director
1 x Steno-Typist
1 x MLSS

GENERAL ADMIN
PERS : 16
1 x Admin. Officer
1 x Supdt.
1 x Accounts Officer
1 x Accountant
2 x UDA
2 x O A.Cum Typist
2 x Driver
2 x MLSS
3 x Chokider
1x Sweeper

D.MO. & P.B.O. COX'S BAZAR
PERS : 35
1 x Meteorologist
2 x Asstt. Met.
5 x Met. Asstt.
1 x Assistant
10 x Sr. Observer
3 x Observer
1 x T.P. Supervisior
5 x T.P. Operator
4 x Balloon Maker
3 x MLSS

R.I.C. RAWINSONDE & 1ST CLASS MET. OBSY. KHULNA
PERS : 18
1 x Asstt Met
3 x Prof. Asstt.
2 x Met. Asstt.
4 x Sr. Observer
1 x Mech. Gr - I
3 x Balloon Maker
2 x MLSS
2 xChokider

1ST CLASS MET. OBSY. SITAKUNDA
PERS : 7
1 x Met. Asstt.
3 x Sr. Observer
3 x Balloon Maker

HYDROMET
PERS: 13
1 x Meteorologist
1 x Asstt. Met.
3 x Prof. Asstt.
1 x Met. Asst.
3 x Sr. Observer
1 x Draftsman
3 x MLSS

1ST CLASS MET. OBSY. MAUDEE
PERS : 7
1 x Met. Asstt
3 x Sr. Observer
3 x Balloon Maker

RADAR STATION & P.B.O KHEPUPARA
PERS: : 22
1 x Elec. Engr.
1 x Asstt. Met.
4 x Elec. Asstt.
2 x Met. Asstt.
4 x Sr. Observer
1 x Foreman
3 x Mech. Gr. II
3 x Balloon Maker
3 x Chokider.

SUB STORE. CTG.
PERS: 6
1 x Store Keeper
2 x Store Asstt.
(1 x Tech)
2xO.A. Cum Typist
1 x MLSS

1ST CLASS MET. OBSY. CHANDPUR
PERS : 7
1 x Met. Asstt.
3 x Sr. Observer
3 x Balloon Maker

S.M.O., R.I.C. & 1ST CLASS MET. OBSY. COMILLA
PERS : 20
1 x Asstt. Met.
1 x Prof. Asstt.
3 x Met. Asstt.
5x Sr. Observer.
1 x Mech. Gr. - I
3 x Observer
3 x Balloon Maker
1 x MLSS.
2 x Chokider

GEOPHY. OBSY. CTG.
PERS :10
1 x Meteorologist
1 x Asstt. Met.
2 x Prof. Asstt.
1 x Met. Asstt.
1 x Assist.
2 x Sr. Observer
1 x Mech. Gr.-I
1 x MLSS

D.M.O. RAWINSONDE & P.B.O. SYLHET.
PERS: 39
1 x Meteorologist
2 x Asstt. Met.
2 x Prof Asst.
4 x Met. Asstt.
1 x Assistant
12 x St. Observer
1 x Elec. Asstt.
3 x Observer
1 x T.P. Supervisor
5 x T.P. Operator
1 x Radio Mech.
3 x Balloon Maker
3 x MLSS

RADAR STATION COX'S BAZAR
PERS: 16
1 x Elec. Engr.
1 x Asstt. Met.
4 x Elec. Asstt.
1 x Foreman
4 x Mech. Gr.-II
1 x Driver
1 x MLSS
3 x Chowkider

MMO & RIC CHITTAGONG
PERS:-103
2 x Meteorologist
4 x Asstt. Met.
2 x Asstt. Com. Engr
1 x Prof. Asstt.
5 x Elec. Asstt.
5 x Met. Asstt.
2 x Assistant
10x Sr. Observer
5 x Observer
6 x Wireless Super.
3 x T.P. Super.
15 x T.P. Operator
5 x Wireless Opir.
1 x Radio Mech.
3 x Balloon Maker
9 x MLSS

1ST CLASS MET. OBSY. RANGAMATI
PERS: 7
1 x Met. Asstt.
3 x Sr. Observer
3 x Balloon Maker

1ST CLASS MET OBSY SATKHIRA.
PERS: 7
1 x Met. Asstt.
3 x Sr. Observer
3 x Balloon Maker

AGROMET. RAWINSONDE & P.B.O.BARISAL
PERS: : 14
2 x Prof. Asstt.
1 x Met. Asstt.
1 x Assistant
5 x Sr. Observer
1 x Observer
3 x Balloon Maker
1 x Sweeper

1ST CLASS MET. OBSY. KUTUBDIA
PERS : 7
1 x Met. Asstt.
3 x Sr. Observer
3 x Balloon Maker

1ST CLASS MET. OBSY. SANDWIP
PERS: 7
1 x Met. Asstt.
3 x Sr. Observer
3 x Balloon Maker

RAWINSONDE & P.B.O CHITTAGONG
PERS: 14
1 x Met. Asstt.
2 x Sr. Observer
3 x Radio Mech.
4 x Balloon Maker

1ST CLASS MET. OBSY. PATUAKHALI
PERS : 7
1 x Met. Asstt.
3 x Sr. Observer
3 x Balloon Maker

1ST CLASS MET. OBSY. CHALNA
PERS : 7
1 x Met. Asstt.
3 x Sr. Observer
3 x Balloon Maker

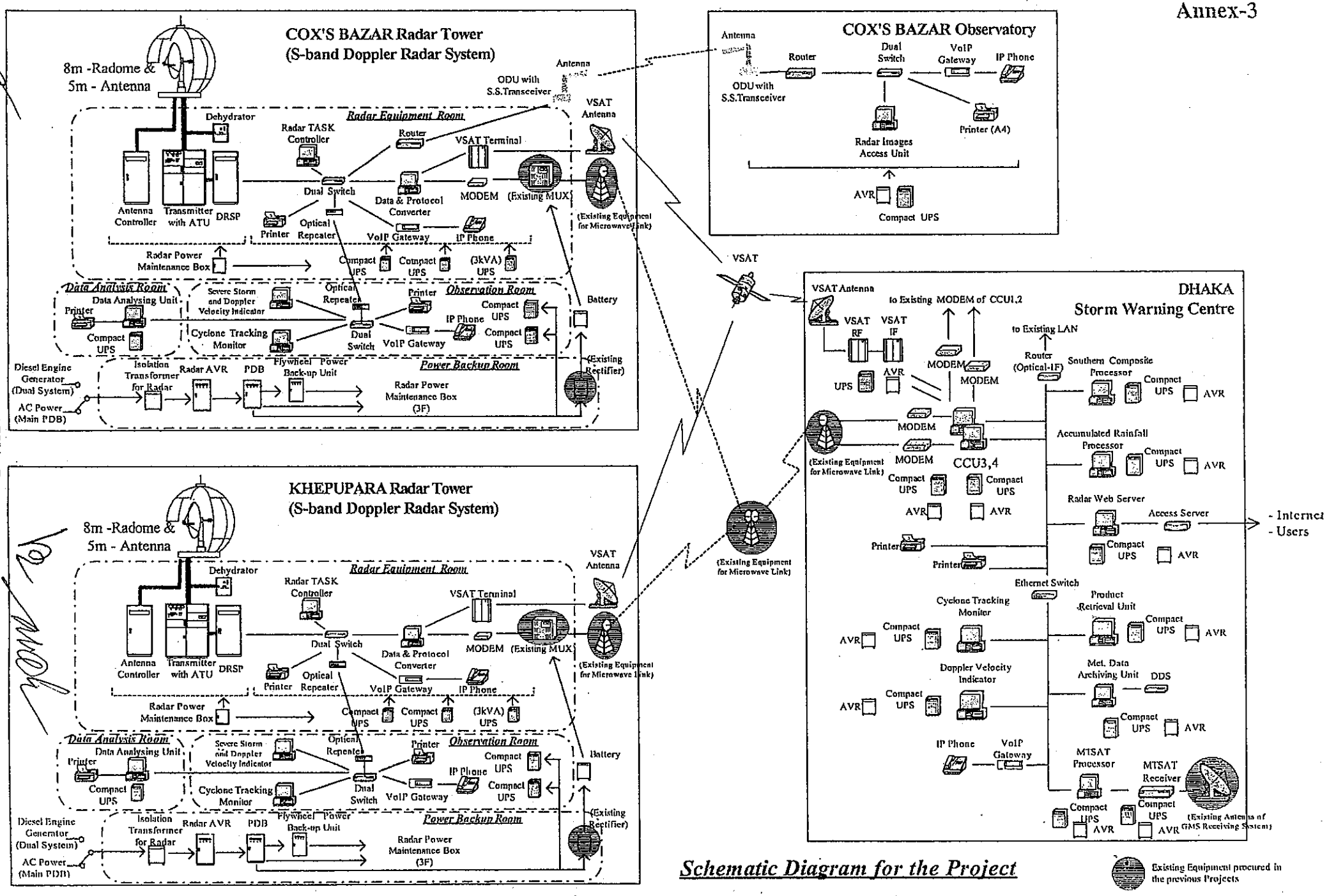
1ST CLASS MET. OBSY. BHOLA
PERS: 7
1 x Met. Asstt.
3 x Sr. Observer
3 x Balloon Maker

MARINE MET. OFFICE CHILIMPUR. CHITTAGONG.
PERS: 7
5 x T.P. Operator
1 x MLSS

1ST CLASS MET. OBSY. HATIYA
PERS : 7
1 x Met. Asstt.
3 x Sr. Observer
3 x Balloon Maker

1ST CLASS MET. OBSY. TEKNAF
PERS : 7
1 x Met. Asstt.
3 x Sr. Observer
3 x Balloon Maker

1ST CLASS MET OBSY. FENI
PERS: 7
1 x Met. Asstt.
3 x Sr. Observer
3 x Balloon Maker



Schematic Diagram for the Project

Existing Equipment procured in the previous Projects

APX4 - 7

JAPAN'S GRANT AID

The Grant Aid scheme provides a recipient country with non-reimbursable funds to procure the facilities, equipment and services (engineering services and transportation of the products, etc.) for economic and social development of the country under principles in accordance with the relevant laws and regulations of Japan. The Grant Aid is not supplied through the donation of materials as such.

1. Grant Aid Procedures

Japan's Grant Aid scheme is executed through the following procedures:

Application	(Request made by the recipient country)
Study	(Basic Design Study conducted by JICA)
Appraisal &Approval	(Appraisal by the Government of Japan and Approval by the Cabinet)
Determination of Implementation	(The Note exchanged between the Governments of Japan and recipient country)

Firstly, the application or request for a Grant Aid project submitted by a recipient country is examined by the Government of Japan (the Ministry of Foreign Affairs) to determine whether or not it is eligible for Grant Aid. If the request is deemed appropriate, the Government of Japan assigns JICA (Japan International Cooperation Agency) to conduct a study on the request.

Secondly, JICA conducts the study (Basic Design Study) using (a) Japanese consulting firm(s).

Thirdly, the Government of Japan appraises the project to see whether or not it is suitable for Japan's Grant Aid Scheme, based on the Basic Design Study report prepared by JICA, and the results are then submitted to the Cabinet for approval.

Fourthly, the project, once approved by the Cabinet, becomes official with the Exchange of Notes (E/N) signed by the Governments of Japan and the recipient country.

Finally, for the implementation of the project, JICA assists the recipient country in such matters as preparing tenders, contracts and so on.

2. Basic Design Study

(1) Contents of the study

The aim of the Basic Design Study (hereafter referred to as "the Study") conducted by JICA on a requested project (hereafter referred to as "the Project") is to provide a basic document necessary for the appraisal of the Project by the Government of Japan. The contents of the Study are as follows:

- Confirmation of the background, objectives, and benefits of the Project and also institutional capacity of agencies concerned of the recipient country necessary for the Project's implementation.
- Evaluation of the appropriateness of the Project to be implemented under the Grant Aid Scheme from a technical, social and economic point of view.
- Confirmation of items agreed on by both parties concerning the basic concept of the Project.
- Preparation of a basic design of the Project.
- Estimation of costs of the Project.

The contents of the original request are not necessarily approved in their initial form as the contents of the Grant Aid project. The Basic Design of the Project is confirmed considering the guidelines of the Japan's Grant Aid scheme.

The Government of Japan requests the Government of the recipient country to take whatever measures are necessary to ensure its self-reliance in the implementation of the Project. Such measures must be guaranteed even though they may fall outside of the jurisdiction of the organization in the recipient country actually implementing the Project. Therefore, the implementation of the Project is confirmed by all relevant organizations of the recipient country through the Minutes of Discussions.

(2) Selection of Consultants

For smooth implementation of the Study, JICA uses (a) registered consulting firm(s). JICA selects (a) firm(s) based on proposals submitted by interested firms. The firm(s) selected carry(ies) out a Basic Design Study and write(s) a report, based upon terms of reference set by JICA. The consultant firm(s) used for the Study is (are) recommended by JICA to the recipient country to also work on the Project's implementation after the Exchange of Notes, in order to maintain technical consistency.

3. Japan's Grant Aid Scheme

(1) Exchange of Notes (E/N)

Japan's Grant Aid is extended in accordance with the Notes exchanged by the two Governments concerned, in which the objectives of the Project, period of execution, conditions and amount of the Grant Aid, etc., are confirmed.

(2) "The period of the Grant Aid" means the one fiscal year, which the Cabinet approves, the Project for. Within the fiscal year, all procedures such as exchanging of the Notes, concluding contracts with (a) consultant firm(s) and (a) contractor(s) and final payment to them must be completed. However, in case of delays in delivery, installation or construction due to unforeseen factors such as national disaster, the period of the Grant Aid can be further extended for a maximum of one fiscal year at most by mutual agreement between the two Governments.

(3) Under the Grant Aid, in principle, Japanese products and services including transport or those of the recipient country are to be purchased. When the two Governments deem it necessary, the Grant Aid may be used for the purchase of the products or services of a third country. However, the prime contractors, namely, consulting, constructing and procurement firms, are limited to "Japanese nationals". (The term "Japanese nationals" means persons of Japanese nationality or Japanese corporations controlled by persons of Japanese nationality.)

(4) Necessity of "Verification"

The Government of recipient country or its designated authority will conclude contracts denominated in Japanese yen with Japanese nationals. Those contracts shall be verified by the Government of Japan. This "Verification" is deemed necessary to secure accountability to Japanese taxpayers.

(5) Undertakings required of the Government of the Recipient Country

In the implementation of the Grant Aid Project, the recipient country is required to undertake such necessary measures as the following:

a) To secure land necessary for the sites of the Project and to clear, level and reclaim the land prior to commencement of the construction,

b) To provide facilities for the distribution of electricity, water supply and drainage and other incidental facilities in and around the sites,

c) To secure buildings prior to the procurement in case the installation of the equipment,

d) To ensure all the expenses and prompt excursion for unloading, customs clearance at the port of disembarkation and internal transportation of the products purchased under the Grant Aid,

e) To exempt Japanese nationals from customs duties, internal taxes and other fiscal levies which will be imposed in the recipient country with respect to the supply of the products and services under the Verified Contracts,

f) To accord Japanese nationals, whose services may be required in connection with the supply of the products and services under the Verified contracts, such facilities as may be necessary for their entry into the recipient country and stay therein for the performance of their work.

(6) "Proper Use"

The recipient country is required to maintain and use the facilities constructed and the equipment purchased under the Grant Aid properly and effectively and to assign staff necessary for this operation and maintenance as well as to bear all the expenses other than those covered by the Grant Aid.

(7) "Re-export"

The products purchased under the Grant Aid should not be re-exported from the recipient country.

(8) Banking Arrangements (B/A)

a) The Government of the recipient country or its designated authority should open an account in the name of the Government of the recipient country in a bank in Japan (hereinafter referred to as "the Bank"). The Government of Japan will execute the Grant Aid by making payments in Japanese yen to cover the obligations incurred by the Government of the recipient country or its designated authority under the Verified Contracts.

b) The payments will be made when payment requests are presented by the Bank to the Government of Japan under an Authorization to Pay (A/P) issued by the Government of the recipient country or its designated authority.

(9) Authorization to Pay (A/P)

The Government of the recipient country should bear an advising commission of an Authorization to Pay and payment commissions to the Bank.

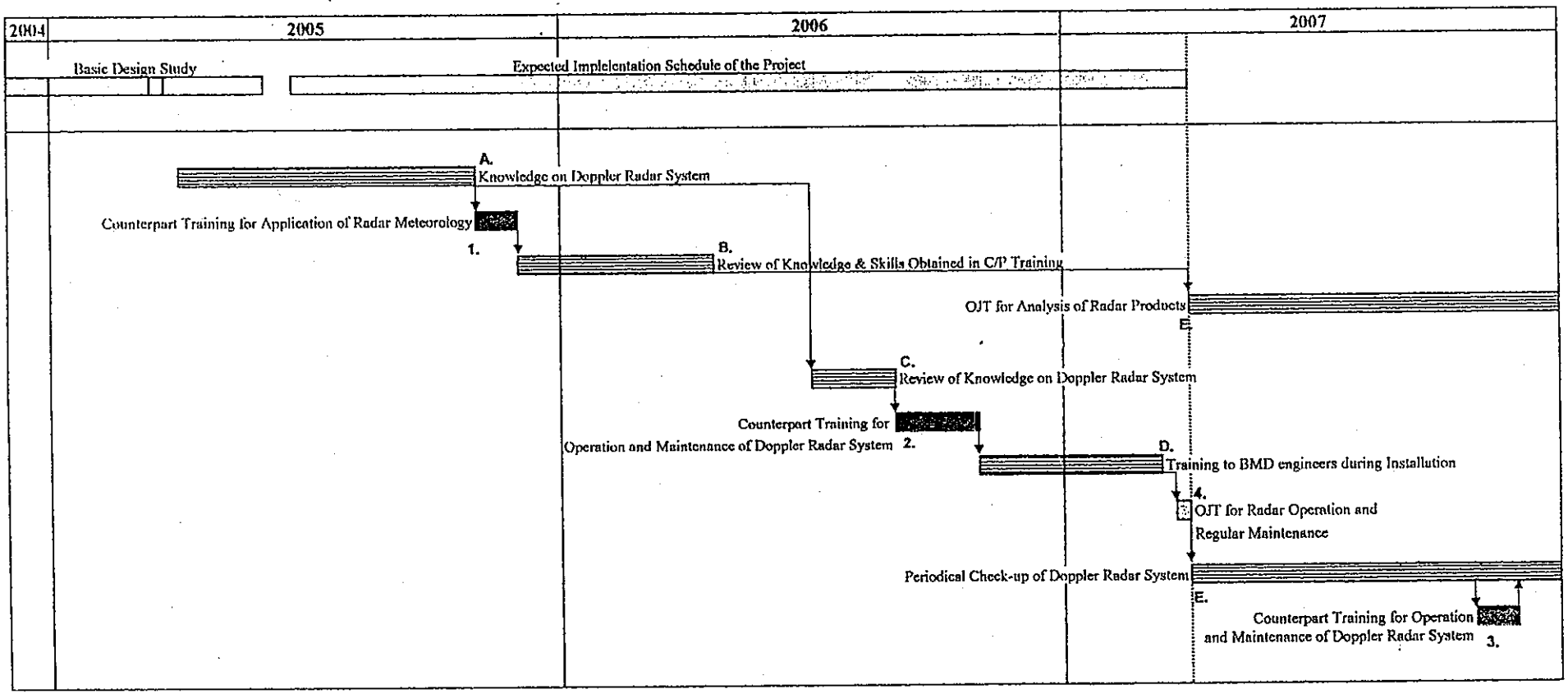
(End)

Major undertakings to be taken by each Government

No.	Items	To be covered by Grant Aid	To be covered by Recipient Side
1.	To secure land		●
2.	To clear, level and reclaim the site when needed *1)		●
3.	To construct gates and fences in and around the site *2)		●
4.	To construct the parking lot	●	
5.	To construct roads		
	1) Within the site	●	
	2) Outside the site *3)		●
6.	To construct the buildings	●	
7.	To provide facilities for the distribution of electricity, water supply, drainage and other incidental facilities		
	1) Electricity		
	a. The distributing line to the site		●
	b. The drop wiring and internal wiring within the site	●	
	c. The main circuit breaker and transformer	●	
	2) Water Supply		
	a. The city water distribution main to the site		●
	b. The supply system within the site (receiving and elevated tanks)	●	
	3) Drainage		
	a. The city drainage main (for storm, sewer and others) to the site		●
	b. The drainage system (for toilet sewer, ordinary waste, storm drainage and others) within the site	●	
	4) Gas Supply		
	a. The city gas main to the site		●
	b. The gas supply system within the site	●	
	5) Telephone System		
	a. The telephone trunk line to the main distribution frame/panel (MDF) of the building		●
	b. The MDF and the extension after the frame/panel	●	
	6) Furniture and Equipment		
	a. General furniture		●
	b. Project equipment	●	
8.	To bear the following commissions to the Japanese foreign exchange bank for the banking services based upon the B/A		
	1) Advising commission of A/P		●
	2) Payment commission		●
9.	To ensure unloading and customs clearance at port of disembarkation in recipient country		
	1) Marine (Air) transportation of the products from Japan to the recipient country	●	
	2) Tax exemption and custom clearance of the products at the port of disembarkation		●
	3) Internal transportation from the port of disembarkation to the project site	●	
10.	To accord Japanese nationals, whose services may be required in connection with the supply of the products and the services under the verified contact, such facilities as may be necessary for their entry into the recipient country and stay therein for the performance of their work.		●
11.	To exempt Japanese nationals from customs duties, internal taxes and other fiscal levies which may be imposed in the recipient country with respect to the supply of the products and services under the verified contracts.		●
12.	To maintain and use properly and effectively the facilities constructed and equipment provided under the Grant.		●
13.	To bear all the expenses, other than those to be borne by the Grant, necessary for construction of the facilities as well as for the transportation and installation of the equipment.		●

(B/A: Banking Arrangement, A/P: Authorization to Pay)

Tentative Schedule of Training Programs



Training to be conducted by BMD in Bangladesh

Counterpart Training to be provided by Japanese side in Japan

On-the-job Training to be provided by Japanese side in Bangladesh

NOTE: The Project and all trainings to be provided by Japanese side are subject to the Japanese Government's approval.

Annex – 7

গণপ্রজাতন্ত্রী বাংলাদেশ সরকার
প্রতিরক্ষা মন্ত্রণালয়
গণভবন কমপ্লেক্স
শেরে বাংলা নগর, ঢাকা

নং ৩ সা-৪/২০০১/পিসি/২৬২ তারিখঃ ১১-১২-২০০৪

বিষয়ঃ বাংলাদেশ আবহাওয়া অধিদপ্তরের আওতায় জাপানী সাহায্যে " কক্সবাজার ও খেপুপাড়াস্থ আবহাওয়া নিরীক্ষণ রাডারদ্বয় মিটিওরোলজিক্যাল-কাম-হাইড্রোলজিক্যাল এস ব্যান্ড ডপলার রাডার দ্বারা প্রতিস্থাপন" শীর্ষকপ্রকল্প বাস্তবায়ন প্রসংগে।

সূত্রঃ পত্র নং-পিএল-২ (৩৬)/২০০০/১৬৩৪ তারিখঃ ১১-১২-২০০৪

উপর্যুক্ত বিষয়ে সূত্র পত্রের মাধ্যমে প্রেরিত খসড়া মিনিটস অব ডিসকাশন বাংলাদেশ আবহাওয়া অধিদপ্তর, জাইকার বাংলাদেশ প্রতিনিধি এবং ইআরডির মধ্যে স্বাক্ষরের জন্য এ মন্ত্রণালয়ের অনাপত্তি এতদ্বারা নির্দেশক্রমে জ্ঞাপন করা হলো।

১১/১২/০৪

(কর্ণেল মোহাম্মদ সামছুল আলম খান)
প্রকৌশল উপদেষ্টা
ফোনঃ ৯১১১০২০

পরিচালক
বাংলাদেশ আবহাওয়া অধিদপ্তর
আগারগাঁও, ঢাকা।

জ্ঞাতার্থে অনুলিপিঃ সচিব, অর্থনৈতিক সম্পর্ক বিভাগ, শেরে বাংলা নগর, ঢাকা
(দৃঃআঃ জনাব এম এমদাদুল হক, উপ-সচিব)।

Minutes of Discussions
of the Basic Design Study
on the Project for Improvement
of the Meteorological Radar Systems at Cox's Bazar and Khepupara
in the People's Republic of Bangladesh
(Explanation of Draft Final Report)

In December 2004, the Japan International Cooperation Agency (hereinafter referred to as "JICA") dispatched the Basic Design Study Team on the Project for Improvement of the Meteorological Radar Systems at Cox's Bazar and Khepupara (hereinafter referred to as "the Project") to Bangladesh, and through discussions, field survey, and technical examination of the results in Japan, JICA prepared a draft final report of the study.

In order to explain and to consult with concerned officials of Bangladesh on the components of the draft final report, JICA sent to Bangladesh the Draft Final Report Explanation Team (hereinafter referred to as "the Team"), which is headed by Mr. Akio Arai, Resident Representative, JICA Bangladesh Office, from March 23 to March 29, 2005.

As a result of discussions, both sides confirmed the main items described on the attached sheet.

Dhaka, March 28, 2005

Akio ARAI
Leader
Basic Design Study Team
Japan International Cooperation Agency

M. Emdadul Haque
Deputy Secretary
Economic Relations Division
Government of the People's Republic of Bangladesh

Md. Akram Hossain
Director
Bangladesh Meteorological Department
Government of the People's Republic of Bangladesh

ATTACHMENT

1. Components of the Draft Final Report

The Bangladesh side agreed and accepted in principle the components of the draft final report and the draft detailed specifications of the equipment explained by the Team.

2. Japan's Grant Aid Scheme

The Bangladesh side understands the Japan's Grant Aid scheme and the necessary undertakings to be taken by Bangladesh Meteorological Department (hereinafter referred to as "BMD") as explained by the Team and described in Annex-4 and Annex-5 of the Minutes of Discussions signed by both sides on December 11, 2004.

3. Schedule of the Study

JICA will complete the final report in accordance with the confirmed items and send it to the Government of the Bangladesh by the end of June, 2005.

4. Other Relevant Issues

4-1. Bangladesh side understands the project has been designed to consist of two phases for its implementation according to the Japanese fiscal years.

4-2. Bangladesh side will make maximum effort to improve equipment and facilities of BMD by its own budget in future from the viewpoint of self-reliance.

4-3. Bangladesh side agrees to allocate enough budget and qualified staff for appropriate operation and maintenance of the equipment and the facilities to be supplied by the Project.

4-4. Bangladesh side completely recognizes the importance of the operation/maintenance plan and the necessity of the initial/recurrent costs to be borne by BMD for the project implementation described in the Draft Basic Design Study Report prepared by the Team.

4-5. Bangladesh side shall complete PCP (Project Concept Paper), but this naming may be changed to DPP (Development Project Proposal) and obtain approval of ECNEC (Executive Committee for National Economic Council) by 15th June, 2005.

4-6. Bangladesh side shall complete the following works by the end of September, 2005, if the Exchange of Notes for the project signed by both Governments.

- Removal of the existing generator shed in the Cox's Bazar Radar Site
- To secure the required space segment and obtain VSAT user licenses for the satellite communication systems to be established
- To ensure availability of the existing radar frequencies of Cox's Bazar and Khepupara Meteorological Radars for the new Radar Systems to be installed.

- To obtain necessary permission for frequency of the data communication system to be established

4-7. Bangladesh side agrees to install the required transformers for the Radar Systems described in the Draft Basic Design Report before completion of the construction work.

4-8. Bangladesh side shall exempt from VAT concerning local procurement of goods and services under the Project to a Japanese contractor or Bangladesh side shall pay the VAT.

4-9. Bangladesh side shall ensure prompt tax exemption and customs clearance of the products at the port of disembarkation or Bangladesh side shall pay the tax.

4-10. Bangladesh side requested the Team for the provision of the counterpart training in Japan on radar meteorology and operation & maintenance of the equipment as a technical cooperation by JICA and Bangladesh side understands the necessity of another official request to be submitted through the diplomatic channel of the Government of Bangladesh to the Government of Japan.

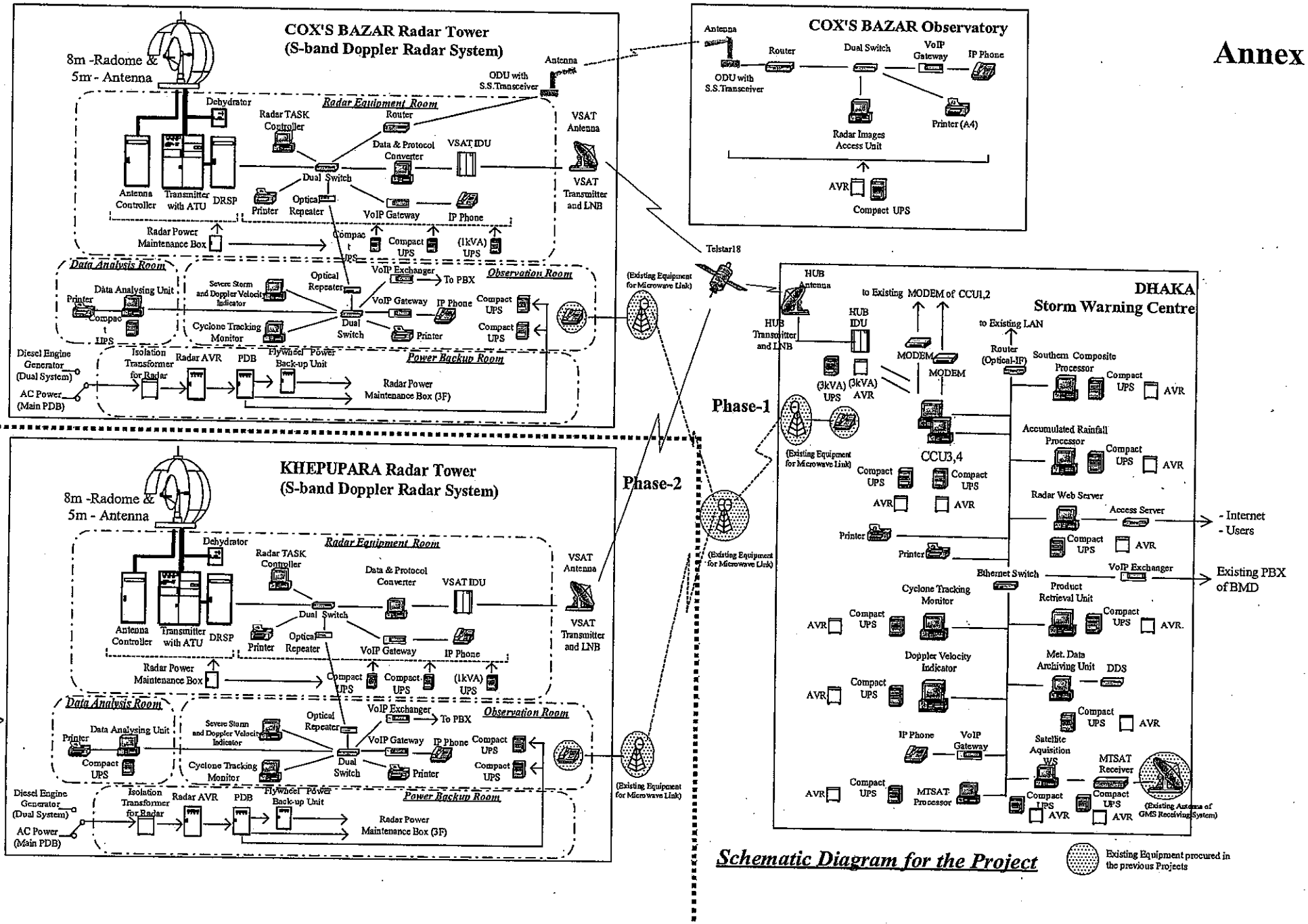
4-11. Bangladesh side will submit the official request on the Technical Cooperation Project for upgrading the meteorological forecasting skill and radar technology development through diplomatic channels such as the Embassy of Japan and/or the JICA Bangladesh Office.

4-12. The Team handed one (1) copy of the draft detailed specifications of the equipment to the Bangladesh side and stated that these draft specifications are confidential and shall not be duplicated or released to other parties in order to secure the fairness of the tender of the project.

Annex: "Schematic Diagram for the Project"

Consent Paper of the Ministry of Defence is also attached herewith.

Annex


COX'S BAZAR Radar Tower
(S-band Doppler Radar System)
8m -Radome &
5m - Antenna
Antenna
ODU with
S.S.Transceiver
Radar Equipment Room
Dehydrator
Radar TASK
Controller
Router
VSAT
Antenna
Data & Protocol
Converter
VSAT IDU
Dual Switch
Antenna
Controller
Transmitter
with ATU
DRSP
Printer
Optical
Repeater
VoIP Gateway
IP Phone
VSAT
Transmitter
and LNB
Radar Power
Maintenance Box
Compact
UPS
(1kVA)
UPS
Data Analysis Room
Data Analysing Unit
Printer
Compact
UPS
Severe Storm
and Doppler Velocity
Indicator
Optical
Repeater
VoIP Exchanger
To PBX
Observation Room
VoIP Gateway
IP Phone
Compact
UPS
Cyclone Tracking
Monitor
Dual
Switch
Printer
Compact
UPS
Diesel Engine
Generator
(Dual System)
AC Power
(Main PDB)
Isolation
Transformer
for Radar
Radar AVR
PDB
Flywheel Power
Back-up Unit
Power Backup Room
Radar Power
Maintenance Box (3F)
COX'S BAZAR Observatory
Antenna
ODU with
S.S.Transceiver
Router
Dual Switch
VoIP
Gateway
IP Phone
Radar Images
Access Unit
Printer (A4)
AVR
Compact UPS
Telstar18
(Existing Equipment
for Microwave Link)
HUB
Antenna
HUB
Transmitter
and LNB
HUB
IDU
to Existing MODEM of CCU1,2
MODEM
MODEM
(3kVA)
UPS
(3kVA)
AVR
to Existing LAN
Router
(Optical-IF)
Southern Composite
Processor
Compact
UPS
AVR
DHAKA
Storm Warning Centre
Phase-1
CCU3,4
Accumulated Rainfall
Processor
Radar Web Server
Access Server
- Internet
- Users
Printer
Printer
Ethernet Switch
VoIP Exchanger
Existing PBX
of BMD
Cyclone Tracking
Monitor
Product
Retrieval Unit
Doppler Velocity
Indicator
Met. Data
Archiving Unit
DDS
IP Phone
VoIP
Gateway
Satellite
Aquisition
WS
MTSAT
Receiver
MTSAT
Processor
(Existing Antenna of
GMS Receiving System)
KHEPUPARA Radar Tower
(S-band Doppler Radar System)
Phase-2
Schematic Diagram for the Project
Existing Equipment procured in
the previous Projects

গণপ্রজাতন্ত্রী বাংলাদেশ সরসকার
প্রতিরক্ষা মন্ত্রণালয়
গনভবন কমপ্লেক্স
শেরে বাংলা নগর, ঢাকা

নং-৩সা-৪/২০০১/পিসি/৮০৫ তারিখঃ ২৭-০৩-২০০৫

বিষয়ঃ কক্সবাজার ও খেপুপাড়াস্থ আবহাওয়া নিরীক্ষন রাডারদ্বয় মিটিওরোলজিকাল-কাম-হাইড্রোলজিকাল এস ব্যান্ড ডপলার রাডার দ্বারা প্রতিস্থাপন শীর্ষক প্রকল্প বাস্তবায়নের জন্য **Minutes of Meeting** স্বাক্ষরের অনুমতি প্রদান প্রসংগে।

সূত্রঃ বিএমডির পত্র নং-পিএল-২ (৩৬)/২০০০/৪৫৭৪ তারিখঃ ২৪-০৩-২০০৫।

উপর্যুক্ত বিষয় ও সূত্রানুযায়ী বাংলাদেশ আবহাওয়া অধিদপ্তর কর্তৃক পেশকৃত খসড়া Minutes of Meeting টি বিএমডি ইআরডি, এবং জাইকার মধ্যে স্বাক্ষরে জন্য এতদ্বারা নির্দেশক্রমে সম্মতি প্রদান করা হলো।

২। খসড়া Minutes of Meeting এর অনুলিপি এতদ্সংগে প্রেরণ করা হলো।

(মোঃ আলতাফ হোসেন)
সিনিয়র সহকারী প্রধান
৯১৩১৮৭

পরিচালক
বাংলাদেশ আবহাওয়া অধিদপ্তর
আগারগাঁও, ঢাকা।

অনুলিপিঃ সচিব, ইআরডি, শেরে বাংলা নগর, ঢাকা।
(দৃঃআঃ মিসেস ইয়াসমিন আফসানা, সিনিঃ সহঃ সচিব, জাপান-২ শাখা)

Appendix. 5. Cost Estimation Borne by the Recipient Country

The following major undertakings to be borne by Bangladesh side are necessary for the implementation under Japan's Grant Aid Assistance.

<Capital Cost of BMD for Phase 1>

Items	Capital Cost (Bangladesh Taka)
Renovation Work of Forecasting Room in Storm Warning Centre	350,000 Taka
Demolishment of the existing engine generator building at the Cox's Bazar Meteorological Radar Observation Station	900,000 Taka
Installation of a 150kVA step-down transformer at the Cox's Bazar Meteorological Radar Observation Station	1,300,000 Taka
VSAT user forms for VSAT communication license (500 Taka x 2 sites)	1,000 Taka
Evaluation fee for VSAT user forms for VSAT communication license (5,000 Taka x 2 sites)	10,000 Taka
Telephone line laid down cost for 2 lines for the proposed building to be constructed at the Cox's Bazar Meteorological Radar Observation Station	30,000 Taka
Total	2,591,000 Taka

<Capital Cost of BMD for Phase 2>

Items	Capital Cost (Bangladesh Taka)
Installation of a 150kVA step-down transformer at Khepupara Meteorological Radar Observation Station	1,300,000 Taka
VSAT user forms for VSAT communication license (500 Taka x 1 site)	500 Taka
Evaluation fee for VSAT user forms for VSAT communication license (5,000 Taka x 1 site)	5,000 Taka
Telephone line laid down cost for 2 lines for the proposed building to be constructed at Khepupara Meteorological Radar Observation Station	30,000 Taka
Public water pipe laid down and connecting works cost at Khepupara Meteorological Radar Observation Station	400,000 Taka
Total	1,735,500 Taka

Appendix 6. References

No	Name of References	Original/ Copy	Publisher	Data of Publication
1	Standing Order on Disaster, August 1999	Original	Ministry of Disaster Management and Relief, Disaster Management Bureau	1999
2	Population Census 2001, National Report (Provisional), July 2003	Original	Bangladesh Bureau of Statistics	2003
3	CPP at a Glance	Original	Cyclone Preparedness Programme, Bangladesh Red Crescent Society	-
4	The Public Procurement Regulation, Oct 01, 2003	Copy	Ministry of Planning, Government of Bangladesh	2003
5	The Public Procurement Processing and Approval Procedures (PPPAP), Oct 11 2004	Copy	Ministry of Planning, Government of Bangladesh	2004