BASIC DESIGN STUDY REPORT
ON
THE PROJECT
FOR
UPGRADE OF TYPHOON OPERATION OF THE HYDROMETEOROLOGICAL SERVICES
IN
THE SOCIALIST REPUBLIC OF VIETNAM

MARCH, 2001

JAPAN INTERNATIONAL COOPERATION AGENCY
JAPAN WEATHER ASSOCIATION

PREFACE

In response to a request from the Government of the Socialist Republic of Vietnam, the Government of Japan decided to conduct a basic design study on the Project for Upgrade of Typhoon Operation of the Hydrometeorological Services and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent to Vietnam a study team from April 3 to May 15, 2000 and July 13 to July 20, 2000.

The team held discussions with the officials concerned of the Government of Vietnam, 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 the Vietnam 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 Socialist Republic of Vietnam for their close cooperation extended to the teams.

March, 2001

Kunihiko SAITO
President
Japan International Cooperation Agency

March, 2001

Letter of Transmittal

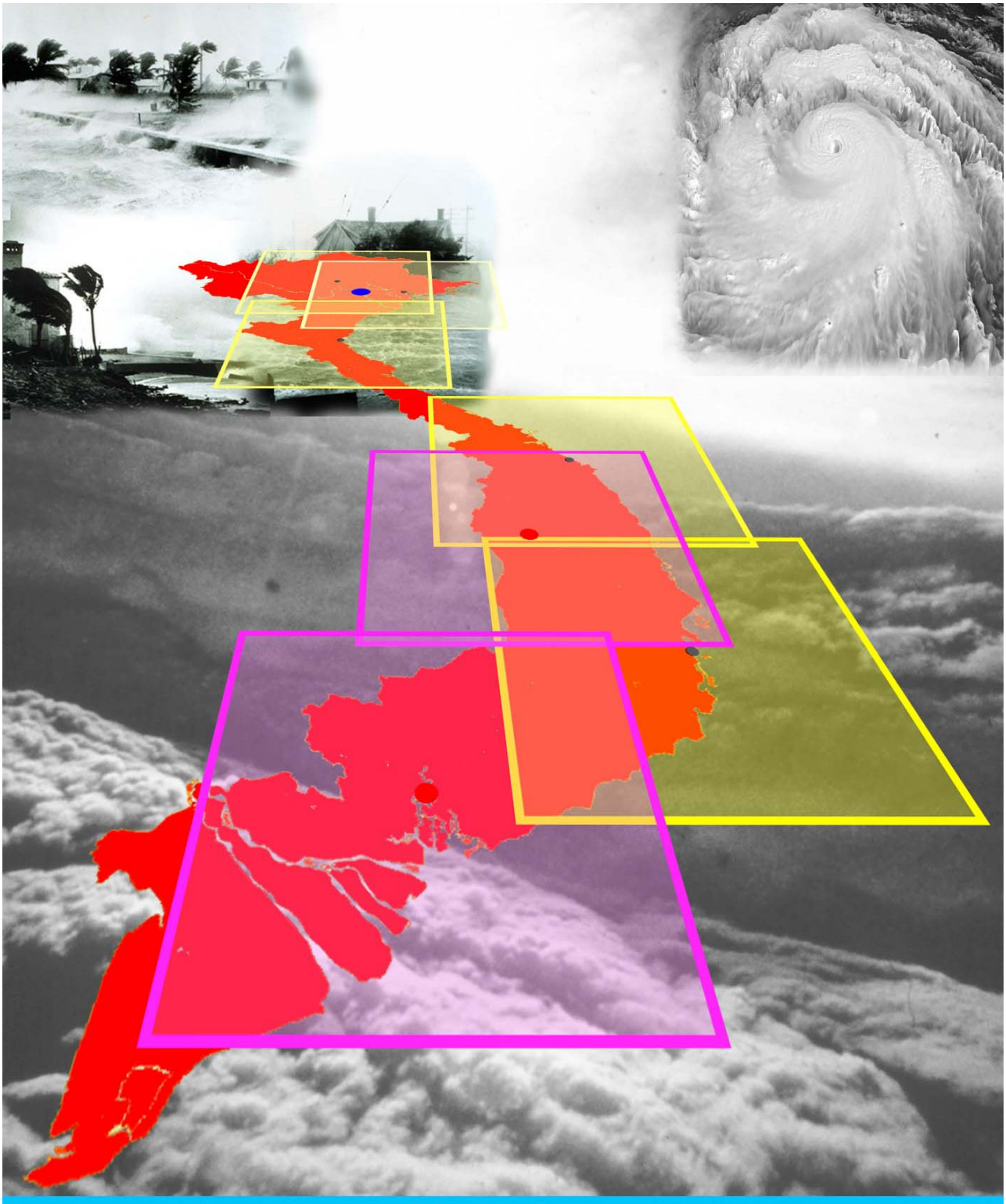
We are pleased to submit to you the basic design study report on the Project for Upgrade of Typhoon Operation of the Hydrometeorological Services in the Socialist Republic of Vietnam.

This study was conducted by Japan Weather Association, under a contract to JICA, during the period from March 13 to March 13, 2001. In conducting the study, we have examined the feasibility and rationale of the project with due consideration to the present situation of Vietnam 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,

Kunio AKATSU
Project manager,
Basic Design Study Team on the Project for
Upgrade of Typhoon Operation of
the Hydrometeorological Services
Japan Weather Association



The Project
for
Upgrade of Typhoon Operation for Hydrometeorological Services
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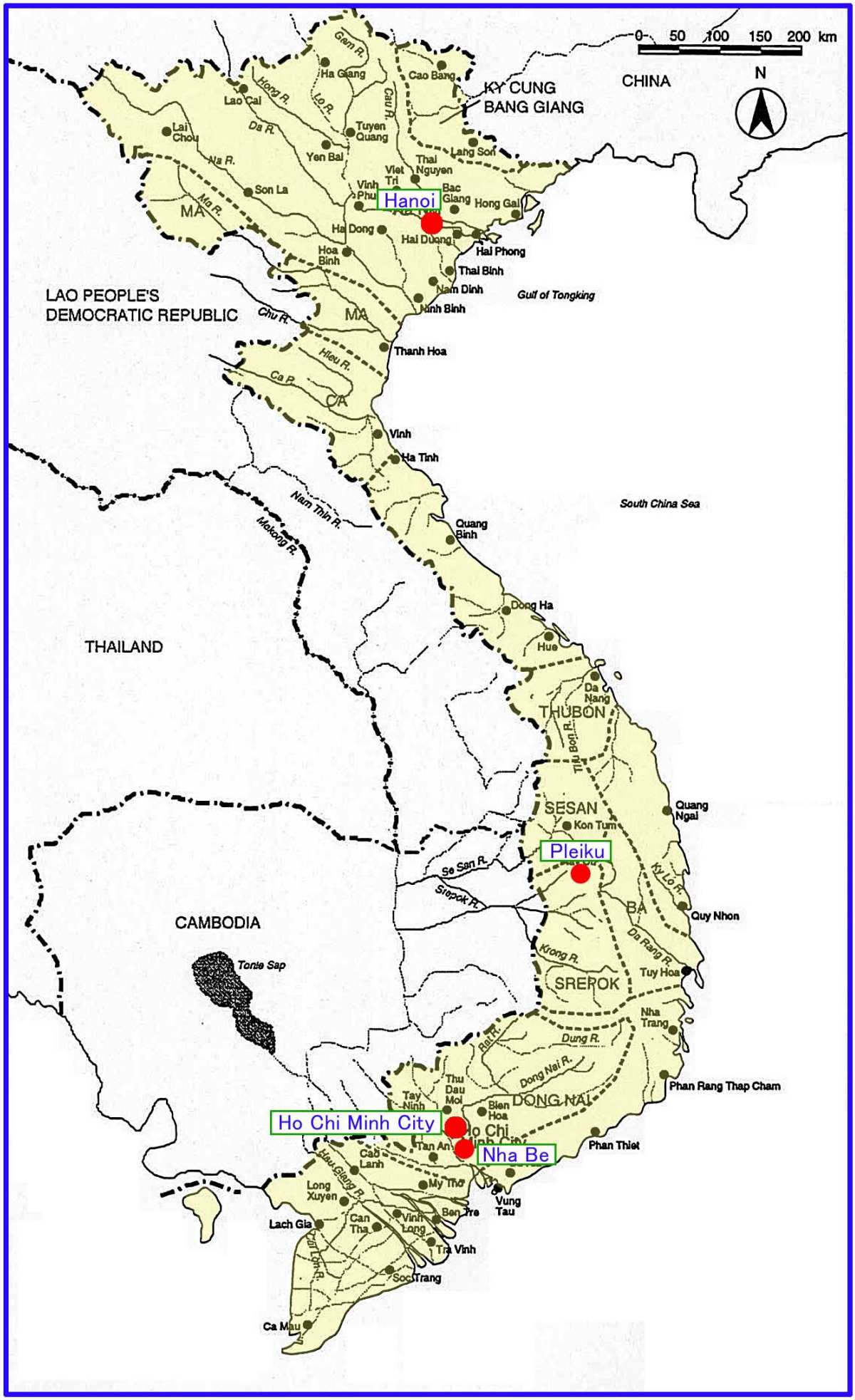
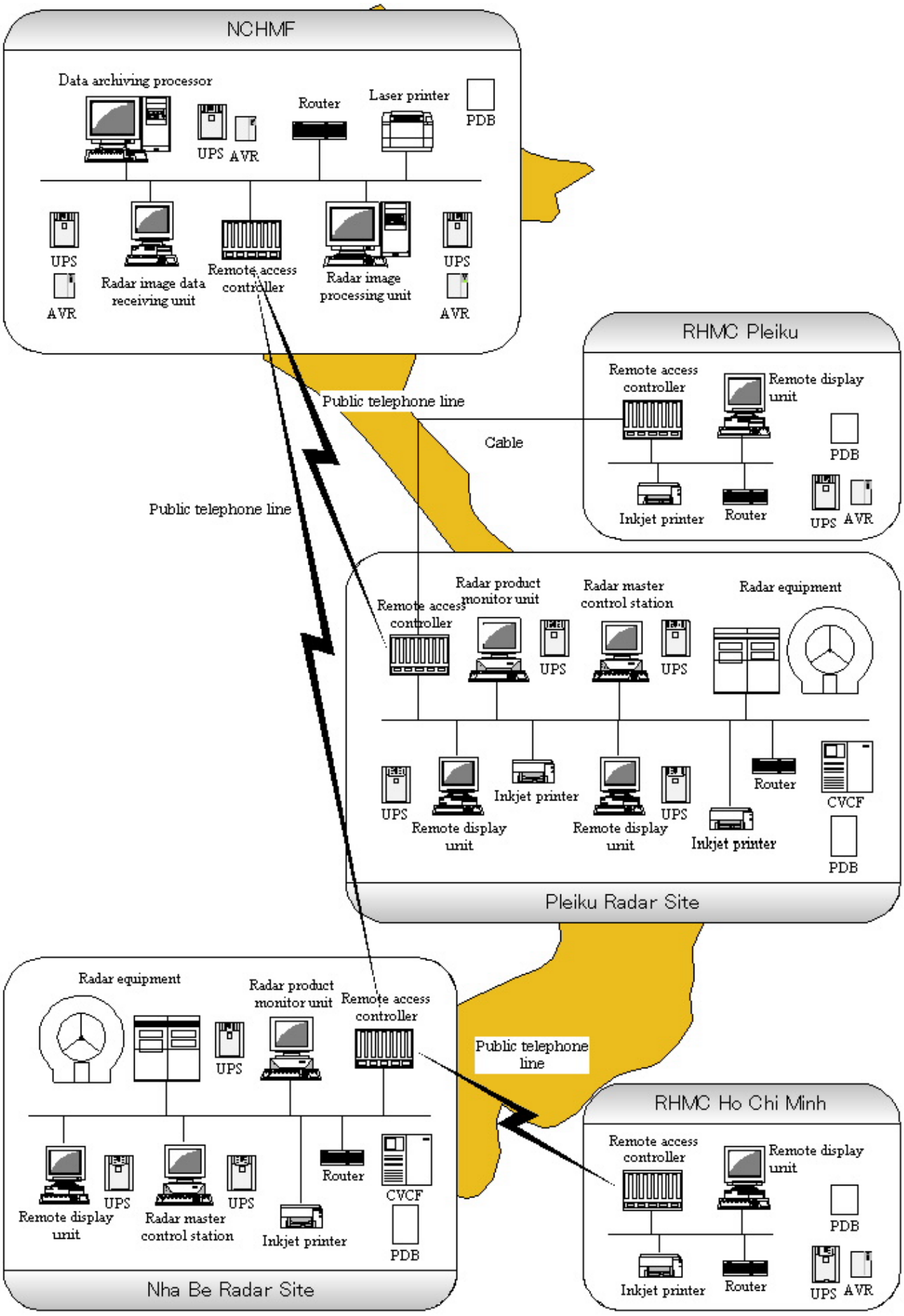
the Socialist Republic of Vietnam

The Socialist Republic of Vietnam

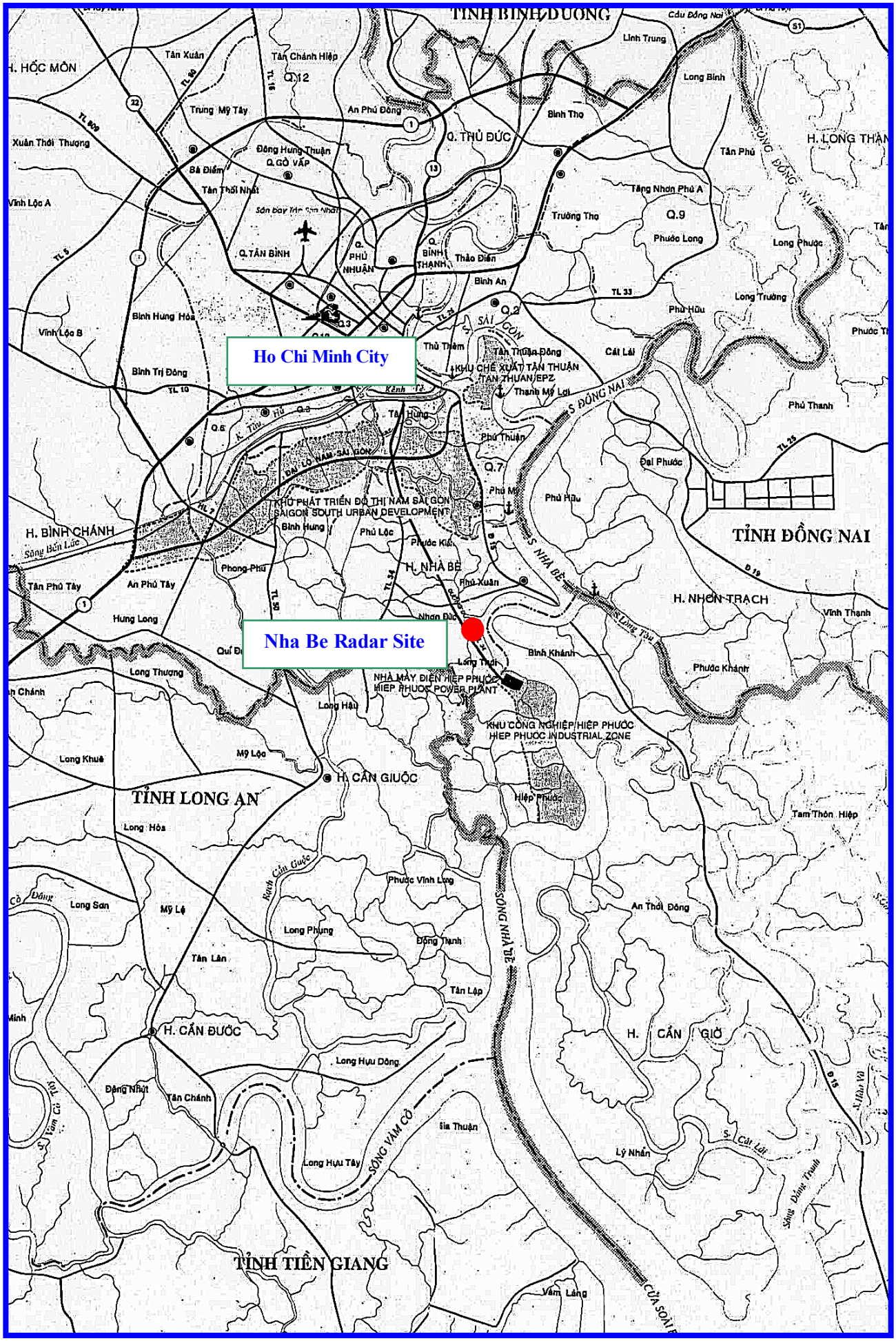




Weather Radar Network Configuration

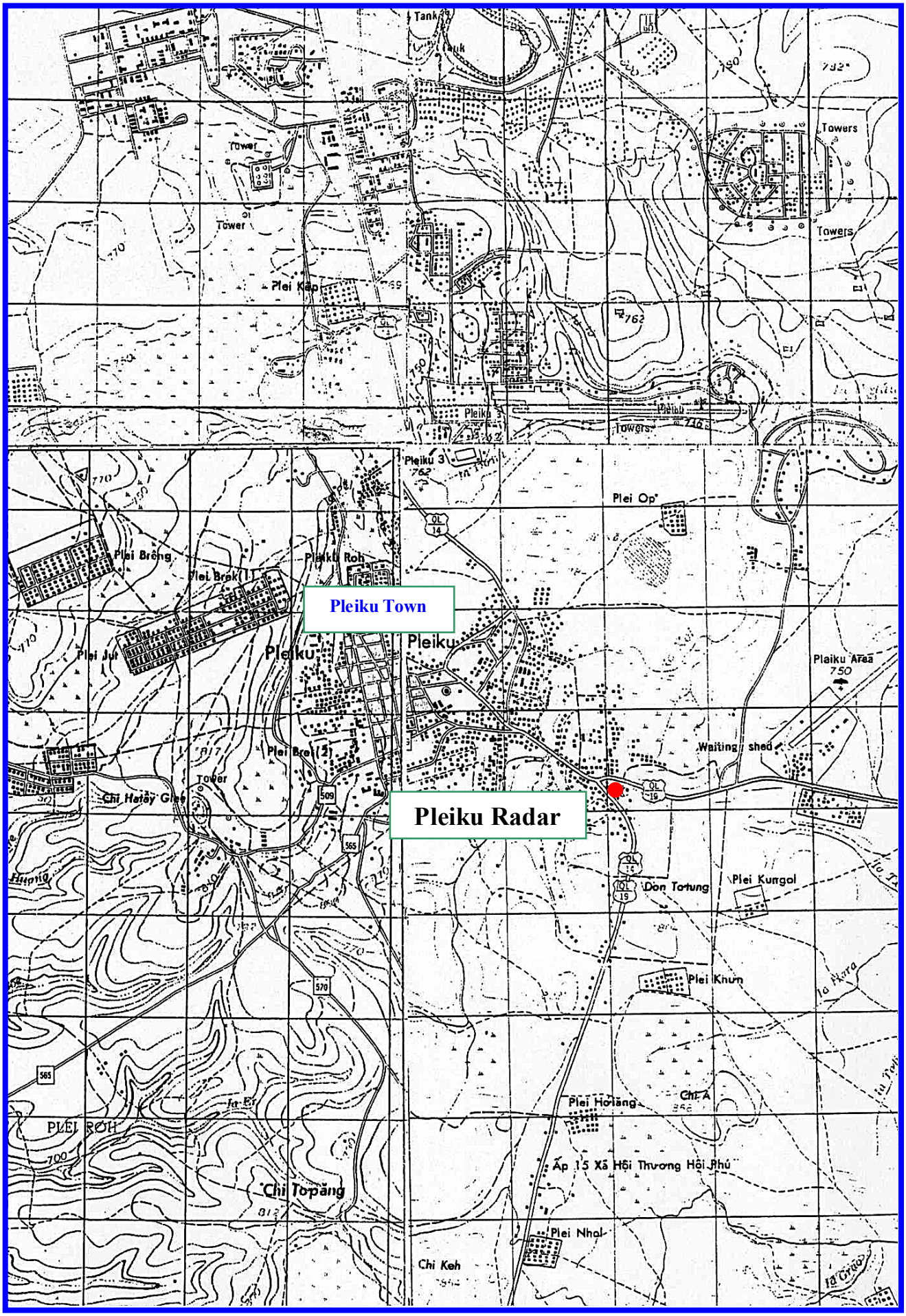
Nha Be Site Location Map

0 5 10km



Pleiku Site Location Map

0 1 2km



Abbreviations

1. General

E/N	Exchange of Notes
EOJ	Embassy of Japan
JICA	Japan International Cooperation Agency
VND	Vietnamese Don
AIJ	Architectural Institute of Japan
BS	British Standard
UBC	United Building Code
GNP	Gross National Product
GDP	Gross Domestic Product
MO	Magnetic Optical Disk
G.L	Ground Level
UPS	Uninterrupted Power Supply System
AVR	Auto Voltage Regulator
AC	Air-conditioning System
FRP	Fiber Reinforced Plastic

2. Vietnamese Organizations

MPI	Ministry of Planning and Investment
HMS	Hydrometeorological Service
NCHMF	National Center for Hydrometeorological Forecasting in Hanoi
RHMC	Regional Hydrometeorological Center
CCFSC	Central Committee for Flood and Storm Control

3. Meteorology

WMO	World Meteorological Organization
GTS	Global Telecommunication System
TD	Tropical Depression
TS	Tropical Storm Force
AWOS	Automatic Weather Observation System

LRIT	Low Rate Information Transmission
MTSAT	Multi-functional Transportation Satellite
GMS	Geostationary Meteorological Satellite
WAN	Wide Area Network
VSAT	Very Small Aperture Terminal

4. Unit

Hz	Hertz
kVA	Kilovolt-ampere
Lx	Lux
V	Volt
m	Meter
mm	Millimeters
m/s	Meter per second
W	Watt
A	Ampere
dB	Decibel
hPa	Hecto-pascal
MHz	Megahertz
Kcal	Kilo-calorie
%	Percent

Contents

Chapter 1 Background of the Project

Vietnam is one of the most disaster-prone countries in the world. Every year monsoon rains, typhoon storms, floods, flash floods, drought and other calamities cause death, injury, crop loss, property loss and infrastructure damage. Most of the disasters are water related.

Vietnam is located in the monsoon tropical zone of Southeast Asia. At the same time, it is situated in the typhoon center of the Western Pacific, which is one of the five most typhoon-prone areas of the world. Given the coincidence of typhoon and monsoon seasons with heavy rains, and the complicated topography of narrow and low plains to steep and high mountains, floods occur annually in Vietnam.

There are five principle disaster hazard zones in Vietnam. Each zone has different topography, population type, internal transport and principle types of disaster hazards. Through this regional zonation it is possible to group the provinces of Vietnam into 5 classifications to simplify disaster management and planning.

Disaster Zone	**Principle Water Hazards**
North Mountain	Flash floods, landslides
Red River Delta	Monsoon river floods, typhoon storms
Central Province	Typhoon storms, flash floods
Central Highlands	Flash floods, landslides
Mekong Delta	Typhoon storms, River flooding from upstream

Vietnam has one of the most abundant water resources in the world and water is very important resource for the Vietnamese's. Much of what constitutes Vietnamese society emerged from centuries of struggle to capture the annual rains to irrigate paddy rice. At the same time, water is also the most destructive force for Vietnamese people.

With a long coastline, backed by high mountains on the one hand and broad & flat flood plains on the other hand, over 70% of Vietnam population is at a risk from typhoons, floods, storm surges, flash floods, landslides and mud flows. One reason that water disasters are so serious is that most of the population lives in areas susceptible to flooding. This is because Vietnam has developed as a nation by exploiting the low-lying river deltas and coastal lands for wet-rice agriculture. Thus both the broad Red River and Mekon Deltas and the narrow connecting coastal strip of the country are prone to flooding from typhoon storms and monsoon rains. Further, the remaining three-quarters of the country is mountainous and suffers from flash flooding.

The worst of these water disasters are caused by typhoons which raise sea levels many meters and send storm surges up estuaries to inundate valuable croplands. Further, these typhonic rains, particularly when added to rivers already swollen because of the annual monsoon rains, create floods which threaten devastation to millions of households. On average, 4 to 6 typhoons reach Vietnam each year causing regular and substantial suffering, loss of life and economic damage. Annually Vietnam suffers 467 casualties and the economic loss amounted to $136 million on average for the last ten years due to floods and typhoons. Regrettably, the extensive damage from water disasters caused by typhoons is the determining factor for significant set-back of national economy and development activities of Vietnam.

Over the past 25 years, more than 14,000 people have been killed by such disasters. The recent statistics show that the losses by such natural disasters have been drastically increasing in Vietnam, which can largely be attributed to the rapidly developing economies.

Due to global ecological and environmental changes at the end of the 90s, Vietnam was hit by many disasters that seriously affected their development and socio-economy stability. Two years (1996-1997) saw the largest number of people dead as a consequence of natural disaster in many decades. In 1998 and 1999, disasters occurred on a large scale. During this decade drought also caused much damage and affected the overall activities of the country's society and economy. According to data supplied by the Central Committee for Flood and Storm Control, damages caused by natural disasters from 1991-1999 are as follows.

- ✧ Number of dead or missing people: 7,495 people
- ✧ 0.75 million of ha paddy was lost causing the loss of 2.3 million ton of food
- ✧ 8,823 boats and ships were sunk
- ✧ 5.5 million houses were destroyed and damaged
- ✧ The total loss accounted for over US$ 2 billion

Recent Disasters by Typhoons

1996

In 1996 flood season was particularly devastating; a series of typhoons, tropical storms, whirlwinds, landslides and floods from June to November impacted almost every province of Vietnam causing damage that will take years to rehabilitate, more than one thousand people died and the total economic loss amounted to US$657 million. A tropical depression off the coast of central province Thanh Hoa in 1996 caught thousand of fisherman at sea; over 600 lost their lives. In the same year, in Mountainous province of Lai Chau a village of Lo Le was literally washed off the map by flash flood that resulted in the lives of 89 people.

1997

Severe typhoon storm ZITA (21-23 August 1997)

ZITA developed into a tropical storm from a tropical depression located about 500 km east of Hainan Dao in the morning of 21 August 1997. It moved steadily westnorthwestwards at about 15 km/h and intensified gradually. ZITA reached its peak intensity of minimum pressure of 985 hPa and maximum sustained wind of 55 knots few hours before landing over Loizhow peninsula by noon of 22 August. Without losing intensity, ZITA entered the Beibu Gulf in the same afternoon. It made landfall between Baichay and Haiphong on the morning of 23 August where maximum sustained wind of 30 m/s and gust 33 m/s were recorded at Haipong and minimum sea pressure of 978.0 hPa was recorded at Baichay. During the passage of ZITA, 9 people were killed and 18 others were injured.

Severe typhoon storm FRITZ (23-25 September 1997)

FRITZ was formed from a tropical depression located about 170 km of the Central Vietnam in the late afternoon of 23 September 1997. After its formation, FRITZ moved westerly then westsouthwesterly at a speed of about 5 km/h and intensified gradually. It gained its peak intensity of 55 knots just about 100 km southeast of Danang on the early morning of 25 September and made landfall between Danang and Tamky by noon of the same day. Maximum sustained wind of 15 m/s, gust 24 m/s and minimum sea pressure of 997.2 mb was recvorded at Danang. Due to FRITZ's passage, 10 people were killed and 39 others were injured. Total damage was estimated at US$ 10 million.

Severe typhoon storm LINDA (1-2 November 1997)

LINDA developed into a tropical storm from a tropical depression in the southern part of the South China Sea, about 50 km south of Truong Sa station at noon of 1 November 1997. It initially took a westnorthwesterly track at about 27 km/h and intensified gradually. Then it turned slightly to the westsouthwest and reached intensity of minimum pressure of 985 hPa and maximum sustained wind of 50 kts on the morning of 2 November just about 100 km east of Con Dao. Moving westwards, by noon of the same day, LINDA passed very close to Con Dao where maximum sustained winds of 30 m/s, gust 42 m/s and minimum pressure of 989.1 hPa were recorded. Six hours later, it made landfall on Ca Mau province (the southern extreme of Vietnam) then continued its way in the Gulf of Thailand.

Formed in a relatively low latitude in the South China Sea at the beginning of November, developed rapidly into a severe tropical storm and its life lasted for only 30 hours from the formation to the landfall, LINDA was an unusual event in the data set in this region. LINDA inflicted great suffering and economy loss to the people of southern province of Vietnam and earned the distinction of being the most disastrous tropical storm in the 1997's tropical storm season in Vietnam. Along its path, LINDA left 941 people dead, 2,123 missing and 1,232 others injured. Total damage amounted to US$ 595 million.

1998

Typhoon storm DAWN (19-20 November 1998)

An area of low pressure developed into a tropical depression (TD) at night of 17 November over the southern part of the South China Sea. The TD moved westward then northwestward at the speed of 15km/h. Support by good upper level outflow and strong low-level energy input, gradual intensification occurred and on the morning of 19 November, the TD developed into the TS with the name of DAWN at 11.3°N, 111.2°E just about 200 km of Nha Trang. Continued its movement, DAWN maintained the same speed until it landed Phu Yen – Khanh Hoa provinces on the early morning of 20 November. Weakening gradually due to the interaction with terrain, DAWN turned into a low pressure area over Cambodia. Due to DAWN, 197 people were killed, 10 missing and 82 others injured. Total damage amounted to US$66 million.

Typhoon storm ELVIS (24-25 November 1998)

ELVIS was originated from a tropical depression formed over the southern part of the Philippines. Under good upper level outflow in the South China Sea, ELVIS gained tropical storm force in the late afternoon of 24 November, just about 100 km north of Son Tu Tay. After formation, ELVIS moved steadily towards the west-northwest at about 20 km/h and intensified slightly. But at just about 80 km east of the coastal lines, it weakened considerably and landed on Binh Dinh province (north of Nha Trang) on the early morning of 26 November 1998. Due to ELVIS, 17 people were killed, 1 missing and 5 others injured. Total damage amounted to US$4 million.

Severe typhoon storm FAITH (10-14 December 1998)

FAITH upgraded into a tropical storm on the morning of 10 December over the water off the eastern part of the Philippines. Moving westnorthwestly at a speed of 30 km/h, FAITH rapidly crossed central Philippines and entered the South China Sea in the afternoon of 11 December then it regained its strength of maximum sustained winds of 60 knots. From then, FAITH moved steadily towards west-southwest at a speed of 25 km/h then slow downed. Early morning of 12 December, it slightly turned to the west then northwest and gradually began to lose its intensity. Early morning of 14 December, when approaching Ninh Thuan – Khanh Hoa coast, FAITH downgraded considerably and landed on Ninh Thuan – Khanh Hoa provinces on the morning of the same day. Due to the interaction with the terrain, FAITH dissipated rapidly over Tay Nguyen highland. Due to FAITH, 47 people were killed and 4 people were missing. Total damage amounted to US$21 million.

Typhoon storm GIL (8-11 December 1998)

In the evening of 8 December 1998, a low pressure area upgraded into a tropical depression (TD) over the southern part of Truong Sa islands. The TD moved westward at a speed of 10 – 15 km/h. In the afternoon of 9 December, the TD turned to the west northwest at a speed of 15 – 20 km/h and gradually intensified. In the early morning of 10 December the TD gained tropical strom force (TS) and was named as GIL. The tropical storm GIL continued moving

west northwestward at a speed of 15 km/h. When located at 80 km south of Con Dao islands, GIL turned to the west. In the early morning of 11 December, approaching Hon Khoai island GIL downgraded into TD and slowed down. In the afternoon of 11 December, the TD reached the southern water of Ca Mau – Kien Giang provinces and then entered the Thailand Gulf.

Thus, within only a month (from 11 November to 14 December 1998) there were 5 typhoons, which affected the South of the Central zone of Vietnam. Heavy rains and floods occurring in the central and southern provinces of the Central zone caused big losses in human lives and properties. There were 397 people were killed, 26 missing and 121 others were injured. The total estimated loss was about US$118 million.

Targets of the International Decade for Natural Disaster Reduction of Vietnam

- Reduce losses of people (death, injury, missing)
- Reduce losses of property (of the State and citizens)
- Reduce stagnancy in socio-economic activities caused by natural disasters

In Vietnam, there is, therefore, increasing requirement for meteorological and hydrological services in support of basic human needs such as safety of life and realization of direct economic benefit as well as the protection of physical environment. Increased emphasis is therefore given on the development of meteorological services in Vietnam towards the promotion of sustainable economic and social development of the country.

Hydrometeorological Service (hereinafter referred to as "HMS") is mainly responsible for recording meteorological observation round the clock and providing weather information necessary for mitigation and prevention of meteorological disasters and development of socio-economic activities. HMS also provides meteorological information for shipping and country boats, and daily weather forecasts to the general public. Concerning impending typhoons in the area, HMS provides forecasts, warnings and advisories to as many as all administrative divisions, concerned agencies and mass media. To meet such social demands, HMS is now striving to modernize current services for upgrading its monitoring and warning capabilities against hazardous meteorological events. However, HMS has encountered serious difficulties in raising financial resources to tackle those problems. This situation urgently requires that HMS should upgrade the weather forecasting, warning and observation facilities to match with people's demand and to meet the function and responsibility as the national meteorological organization in Vietnam under World Meteorological Organization (hereinafter referred to as "WMO").

It is necessary that HMS monitor actual weather conditions throughout Vietnam and provide accurate and timely meteorological information for the preparedness against anticipated

natural disasters and then mitigation of the loss of people and property. In order to monitor meteorological phenomena such as typhoon, heavy rain, etc. on real time over the entire area of Vietnam, a networking of meteorological radar systems is indispensable. Aiming at reduction of water disasters caused by typhoons in Vietnam, meteorological radar network to ensure continuous supply of rainfall distribution, intensity and movement, cloud echoes and other necessary information was essential. A weather radar can detect the occurrence, movement and intensity of rainfall within a radius of 400km, and therefore is the only equipment to observe rainfall distribution, intensity and movement and also to provide precipitation information for large areas on real time. In conclusion for reduction and mitigation of natural disasters in Vietnam, it is necessary to establish the radar observation network in Vietnam incorporating with the 5 existing radar systems for monitoring typhoon, heavy rain and other meteorological phenomena in the whole area of Vietnam. For detecting and monitoring natural calamities at frequent intervals and to forecast their intensity and land-fall more accurately, the meteorological radar network is able to ensure continuous supply of rainfall distribution, intensity and movement, cloud echoes and other necessary information to HMS and other organizations related to typhoon and flood forecasting for use in their day to day issuance of forecasts and warnings.

It is most imperative that HMS should provide accurate and timely meteorological information to the users as the national meteorological service in order to reduce water disasters caused by severe weather phenomena including typhoon and flood. From a long-term point of view, it is also necessary to improve meteorological activities of HMS as the national meteorological organization in Vietnam so as to play effective role as a member of WMO. For reaching the principal goal of HMS, implementation of the Project is indispensable.

Since the facilities of HMS are likely to be improved greatly by the Project, HMS will be capable of contributing effectively to the mitigation and prevention of water disasters caused by typhoon, flood damages and losses by other natural calamities like tornadoes, severe thunderstorm etc. in Vietnam. Further, the improvement of observing and forecasting system as a result of this project will highly enhance HMS's activities and will put HMS in a position to play its due role in the economic development of Vietnam.

Due to these circumstances described above, the Government of the Vietnam has officially requested for obtaining the following equipment and systems for implementation of the Project.

<Equipment Supply>

1) Weather Surveillance Radar Systems (2 sets) at the Pleiku Radar Site and the Nha Be Radar Site.

Pleiku Radar Site :	RHMC Highland in Central VN; 451 Hung Vuong Road, Play Cu Town, Gia Lai Province
Nha Be Radar Site :	RHMC South VN; 19 Nguyen Thi Minh Khai Str., Dist. 1, Ho Chi Minh City, Nha Be

2) VSAT System (1 set) at Nha Be Radar Site as a backup of the public telephone line between the Nha Be Radar Site and the Regional Hydrometeorological Center (RHMC) in Ho Chi Minh City in case of emergency.

3) Radar Image Composition Processor System (1 set) at the National Center for Hydrometeorological Forecasting (NCHMF) in Hanoi for consolidating the data of all the weather surveillance radar systems of HMS to make a composite image in real time.

4) Radar Composite Image Display Systems (9 sets) at the NCHMF in Hanoi and 8 Regional Centers to display a variety of radar composite images which are produced by the radar image composition processor at the NCHMF.

5) Message Switching System (1 set) at the NCHMF in Hanoi to be connected with WAN of HMS and GTS of WMO and controls domestic collection/dissemination of data and international exchange of data with other countries.

6) Weather Information Systems (9 sets) at the NCHMF in Hanoi and 8 Regional Centers to control exchange of data with the NCHMF and to acquire products generated by the computer system at the NCHMF for the use of forecasting/warning operations at RHMC.

7) Automatic Weather Observation Systems (AWOS) (10 sets) at the existing synoptic stations for replacing the obsolete instruments and updating the surface observations.

8) LRIT Receiving Systems (9 sets) at the NCHMF in Hanoi and 8 Regional Centers to receive/process the Low Rate Information Transmission (LRIT) data to be disseminated by Multi-functional Transportation Satellite (MTSAT), successor to GMS-5.

9) Telecommunication Systems (2 microwave radio links) for transmitting weather information, meteorological data, composite radar imagery and satellite imagery between the following sections.

NCHMF and Central Committee for Flood and Storm Control (CCFSC)
NCHMF and Vietnam Television

<Building Construction>

10) Radar towers & sheds with engine generator at the Play Cu Radar Site and the Nha Be Radar Site.

In accordance with the policy and scheme of Japan's Grant Aid Assistance, the Basic Design Study Team has decided the following scopes of the Basic Design Study for the Project in Vietnam through the discussion with HMS according to the original request from the Government of Vietnam as described above. Basically, the policy enables the team to include only urgent and indispensable request(s) in an original request for a project from a recipient country to the scope of Japan's Grant Aid Assistance. In addition, the Project must provide appropriate and effective benefit and effects to the nation of Vietnam. Due to such unavoidable circumstances, main components as itemized below have been included in the scopes of the Basic Design Study for the Project.

The Basic Design Study for the Project mainly aims at establishing a meteorological radar network in Vietnam by the proposed 2 weather surveillance radar systems at at the Play Cu Radar Site and the Nha Be Radar Site together with the 5 existing weather surveillance radar systems.

1) Weather Surveillance Radar Systems (2 sets) at the Play Cu Radar Site and the Nha Be Radar Site.

2) Radar Image Composition Processor System (1 set) at the National Center for Hydrometeorological Forecasting (NCHMF) in Hanoi.

3) Automatic Weather Observation Systems (AWOS) (10 sets) at the existing synoptic stations.

4) Microwave System (1 link) between the Nha Be Radar Site and the Regional Hydrometeorological Center (RHMC) in Ho Chi Minh City.

<Building Construction>

5) Radar tower buildings with power back-up system at the Play Cu Radar Site and the Nha Be Radar Site.

Chapter 2 Contents of the Project

2 - 1 Objectives of the Project

The objective of the Project is to reduce devastation caused by water disasters and to protect people's life and property through strengthening and enhancing of observing activities of HMS. Water disasters caused by typhoons and floods rank highest among natural disasters affecting Vietnam. Over 70% of the population of Vietnam is at risk. Up to now, Vietnam has been affected seriously by the frequent visits of water disasters carrying the highest potential for loss of life and property. Regrettably, the extensive damage from the water disasters are the determining factor for significant set-back of national economy and development activities of Vietnam. Therefore, adequate and accurate forecasts and warnings are important, providing vulnerable communities an opportunity to minimize the impacts of impending hazards and, more fundamentally, to prevent loss of life. In deed, the Government of Vietnam attaches significant considerable importance to improved monitoring, forecasting and warning systems in mitigating the effects of typhoons and floods. For preparing adequate and accurate forecasts and warnings, the Project implementation is exceedingly necessary. In addition, the Project is exactly in line with the objectives of the Strategy and Action Plan Disasters in Vietnam on disaster mitigation which provides for the enhancement of disaster preparedness and management. To meet the social demands in Vietnam, HMS is now striving to modernize current services for upgrading its monitoring and warning capabilities against hazardous meteorological events.

For detecting and monitoring natural calamities at frequent intervals to forecast the intensity and location of natural disasters occurring more accurately, an establishment of weather surveillance network in Vietnam together with 5 existing radar systems is indispensable to more accurately and promptly issue and provide weather forecasts and warnings. A weather surveillance radar can detect the occurrence, movement and intensity of rainfall within a radius of 400km from the radar site. The radar is the only equipment to be able to observe rainfall distribution, intensity and movement and also to provide precipitation information for large geographic areas on real time basis.

Since the facilities of HMS are to be improved greatly by the Project, HMS will be capable of contributing effectively to the mitigation and prevention of water disasters caused by typhoons and floods in Vietnam. These improvements by the Project will enable HMS to specify the nature, severity and imminence of threats, and the location of threatened areas in warnings according to relevant promulgated warning stages or phases,

and thereby to provide community at risk with enough lead-time to take preparedness measures against impending disasters.

2 - 2 Basic Concept of the Project

The Government of Vietnam has officially requested for obtaining the following equipment and systems for implementation of the Project.

♦ Requested Components

<Equipment>

- Establishment of Meteorological Radar System (2 sets) at Nha Be and Pleiku
- Establishment of VSAT System (1 set) at Nha Be and RHMC Ho Chi Minh City
- Supply of Radar Image Composition Processor (1 set) at NCHMF, Hanoi
- Establishment of Radar Composite Image Display System (9 sets)
- Establishment of Message Switching System (1 set) at NCHMF, Hanoi
- Establishment of Weather Information System (9 sets)
- Establishment of Automatic Weather Observation System (AWOS) (10 sets)
- Establishment of LRIT Receiving System (9 sets)
- Establishment of Telecommunication System for Dissemination (2 links)

<Facility>

- Construction of radar towers & sheds with engine generators at Nha Be and Pleiku

According to the policy and scheme of Japan's Grant Aid Assistance, the Basic Design Study Team has decided the following targeted components for the Basic Design Study for the Project in Vietnam through the discussions with HMS.

♦ Targeted Components for the Basic Design Study

<Equipment>

- Establishment of Meteorological Radar System (2 sets) at Nha Be and Pleiku
- Supply of Radar Image Composition Processor System (1 set) at the National Center for Hydrometeorological Forecasting (NCHMF) in Hanoi
- Establishment of Automatic Weather Observation Systems (AWOS) (10 sets) at the existing synoptic stations
- Establishment of Microwave System (1 link) between the Nha Be Radar Site and the Regional Hydrometeorological Center (RHMC) in Ho Chi Minh City

<Facility>

- Construction of radar towers & sheds with engine generators at Nha Be and Pleiku

In connection with the targeted components for the Basic Design Study as described above, the Basic Design Study and investigation have been held in Vietnam and Japan. For contributing effectively to the mitigation and prevention of water disasters caused by typhoon, flood damages and losses by other natural calamities, it is necessary to improve observing disastrous weather condition and to highly enhance HMS's activities by the Project. HMS should be in a position to play its due role in the reduction of water disasters and in the economic development of Vietnam as a result of this Project. In accordance with the result of the Study, the Project has been designed and fixed as follows.

♦ Project Components

<Equipment>

(1) 2 Weather Surveillance Doppler Radar Systems, Radar Product Monitor Units, Remote Display Units, Radar Master Control Stations at the Nha Be and the Pleiku Radar Sites
(2) Remote Display Units at RHMC Ho Chi Minh and RHMC Pleiku with power back-up system
(3) Data Archiving Processor, Radar Image Data Receiving Unit and Radar Image Processing Unit with radar image composition function for 2 radar pictures of the Nha Be and the Pleiku Radar Systems (including a special technical consideration and flexibility to enable the HMS to connect this System to a radar image composition system of the existing radar systems to be established by the HMS in a future) with power back-up system

<Facility>

(1) Construction of 2 radar tower buildings with power back-up systems at the Nha Be and the Pleiku Radar Sites.

1. Basic Concept of the Project

The Project aims to upgrade the HMS's capability of weather monitoring by establishing weather surveillance network for more accurate and timely weather forecasts and warnings, and also to contribute to protect the loss of people's life and property from water disasters caused by typhoons and floods.

The Mekong Delta is seriously affected by heavy rains which are brought by typhoons.

- In 1996, the number of death due to floods in the Mekong Delta area were summed up to 197, or more than 20% of total calamities due to natural disasters which occurred in Vietnam this year.

- 0.83 million families in this area were damaged, the number was 2/3 of total number of damaged families throughout Vietnam

- The loss of properties in this area was 1.8 U.S. dollars, which was 1/4 of total loss of properties in Vietnam.

On the other hand, Pleiku is located in Central Highland Region, which are frequently damaged by flood, flash flood, landslides, mudflows and lightning due to heavy rain and thunderstorms.

- The number of death due to floods or storms in Central Highland Region in 1996 was around 10% of total calamities due to natural disasters which occurred in Vietnam this year.

- The loss of properties was about 3% of total loss of properties in Vietnam. This fact shows that saving people's life should be prioritized more highly than saving loss of properties.

Under these circumstances described above, the 2 Weather Surveillance Doppler Radar Systems will newly be installed in the central highland area (Pleiku) and the southern region (Nha Be) of Vietnam under the Project. These areas have annually been affected by flood, flash flood, lightning, mudflow, strong wind, etc. caused by typhoons, monsoon and other tropical storms. Using these the Weather Surveillance Doppler Radar Systems and the 5 existing meteorological radar systems as the weather surveillance network in Vietnam to cover most of the country, HMS will be able to monitor typhoon, heavy rain and other disastrous meteorological phenomena more timely, accurately and appropriately. Also HMS will be able to issue weather forecasts and warnings more promptly. Furthermore, a radar composition imagery of 2 radar image data from the Weather Surveillance Doppler Radar Systems will be made by the radar image composition function in the Radar Image Processing Unit at NCHMF in Hanoi and will be utilized for issuing more accurate and prompt weather forecasts and warnings.

2. Basic Concept of the Equipment and the Facilities

(1) Establishment of the Weather Surveillance Doppler Radar Systems

In order to monitor hazardous weather condition air turbulence and to quantitatively observe rainfall in the Central Highland Region and the Southern Region of Vietnam, establishment of the Weather Surveillance Doppler Radar Systems at the following sites.

Pleilu Radar Site: RHMC Highland in Central VN; 451 Hung Vuong Road, Pleiku Town, Gia Lai Province

Nha Be Radar Site: RHMC South VN; 19 Nguyen Thi Minh Khai Str., Dist. 1, Ho Chi Minh City, Nha Be

Unfortunately, the Central Highland Region and the Southern Region of Vietnam which are the targeted areas of the Project are not covered by observation range of the 5 existing meteorological radar system.

Information of the 5 existing meteorological radar systems (3 French and 2 American meteorological radar systems) of HMS is as follows.

<French meteorological radar system (C band, 5,625MHz, wavelength: 5.3 cm)>

1) Site name: Phu Lien (Haiphong)
   Year of installation: 1997
2) Site name: Viet Tri
   Date of installation: Feb. 2000.
3) Site name: Vinh (Nghe An)
   Date of installation: by Feb 2000

<American meteorological radar system (C Band, 5,630MHz, wavelength: 5.6cm)>

4) Site name: Tam Ky
   Date of installation: 1998
5) Site name: Nha Trang
   Date of installation: 1999

The Nha Be Radar Site is located in the Southern Region of Vietnam, which consists of the Mekong Delta and the other river basin flowing into Ho Chi Minh City. The Weather Surveillance Doppler Radar System at the Nha Be Site will monitor raining areas in the lower-middle reaches of the Mekong River basin and the other rivers. In addition, for ensuring the safety of aircraft taking-off and landing at the International Airport in Ho Chi Minh City, the System is necessary to detect heavy rain and atmospheric turbulence around the Airport.

The Pleiku Radar Site, on the other hand, is located in Central Highland Region, which will be able to monitor rainfall causing flood, flash flood, landslides, mudflows and lightning in the mountainous area. Thus, the Weather Surveillance Doppler Radar System at the Pleiku Radar Site will track storms accompanied by typhoons coming from the east and monsoon mostly moving in from the west.

For detecting natural calamities caused by typhoon, heavy rain and atmospheric turbulence at frequent intervals for forecasting their intensity and land-fall more accurately, the Weather Surveillance Doppler Radar Systems together with the 5 existing meteorological radar systems as the national weather surveillance network will be able to ensure continuous supply of rainfall distribution, intensity and movement, cloud echoes and other necessary information to HMS and other organizations related to reduction of water disasters in Vietnam.

- C-band type radar

C band type is suitable to monitor rainfall within the wide covering area of radar surveillance. And also the existing meteorological radar systems are all C band (wave length: approx. 5cm) type. For keeping the characteristics of radar image data as the same as data of the existing radar systems, the Weather Surveillance Doppler Radar Systems must be C band type. In addition, the frequencies of the Systems must be between 5,600 and 5,650MHz which has already been allocated for the existing radar systems.

- Doppler mode

The new radar systems will apply Doppler mode, which detect wind motions and wind patterns of severe weather phenomena such as typhoons, front lines, etc. so that forecasters can monitor movement and development of typhoons and storms for making more accurate weather forecasts and warnings. Therefore, Doppler function must be furnished to the Systems.

Since local weather forecasts and warnings are issued by the Regional Hydrometeorological Centers (RHMC), displaying the radar images by the Remote Display Units are indispensable at RHMC Highland in Central VN in Pleiku and RHMC South VN in Ho Chi Minh City for their routine works.

- Required Height of the Radar Antenna Center

<Nha Be Radar Site>
The height of the radar antenna center from the ground level is designed at 30m including a consideration on a future situation of the Nha Be industrial area. At the present, there is no obstruction around the Site. However, in the last recent years, the Nha Be industrial area has been developed very much and quickly. Even after the completion of the industrial area development, it is necessary to keep any obstruction must be less than the required height of radar antenna center for continuous appropriate observation by the Weather Surveillance Doppler Radar System.

<Pleiku Radar Site>
The required height of the radar antenna center from the ground level is designed at 55m to technically cover possible maximum area and to make the best observation range for minimizing shade area (angle). Because in the South of the Site, there is the highest hill in the Pleiku City and on the hill, buildings, high trees and other facilities are existing as obstructions for the Weather Surveillance Doppler Radar System to be installed under the Project. These obstructions can not be by-passed for fixing the required height and for appropriate radar observation.

Results of vertical height and horizontal distance survey are summarized as follows.

	Distance from the Site	*Height Difference from the ground level (G.L) of the Site*
Highest Building at the hill top (Height of the building from G.L: 16.9m)	840m	50.4m

(50.4m + 2.5m (antenna size: 5m in diameter/2 = 2.5m)) × 1.05 (factor of clearance: 5%) = 55m

Thereby, 55m is necessary for the height of the radar antenna center from the ground level at the Site for avoiding all the existing obstructions for the radar observation.

(2) Radar Image Composition Function at NCHMF

NCHMF in Hanoi Head Office is in charge of issuing and providing general forecasts and warnings on typhoons, tropical depressions, rains, floods, storms in the entire country. Each local forecast is prepared in accordance with the general forecasts issued by NCHMF. Therefore, NCHMF have to monitor severe weather conditions in order to make more accurate and timely weather forecasts and warnings and also to provide them to CCFSC and the other agencies concerning to disaster management and relief action. For making accurate and timely weather forecasts and warnings, all radar images and

observed data should be available in NCHMF. Under these circumstances, the Radar Image Composition Function will be installed in the Radar Image Processing Unit at NCHMF under the Project.

Due to the following technical reasons, the radar image composition function is to make only a composite imagery of the Weather Surveillance Doppler Radar Systems to be supplied under the Project. However, a special technical consideration and flexibility should be given to the Radar Image Composition Function to enable the HMS to connect this System to a radar image composition system of the existing radar systems to be established by the HMS in a future. This Radar Image Composition Function will accept radar images converted to its required format of the existing radar systems for radar image composition.

1) No availability of the radar image at the NCHMF except the radar image of the existing French radar system in Phu Lien.
2) No concrete schedule to transmit the radar images of Viet Tri and Vinh to NCHMF.
3) No availability of data format structure, data ingesting interfaces and manufacturer's official authorization for data ingestion and transmission of the 2 existing American radar systems in Tam Ky and Nha Trang.
4) Due to a scrutinized analysis for radar data of the 2 existing American radar systems in Tam Ky and Nha Trang provided by HMS, it was confirmed as "Universal Format" which can be processed for radar composition.
5) HMS has a plan to make a composition system for the 3 existing French radar systems in Phu Lien, Viet Tri and Vinh.
6) No concrete schedule to transmit the radar images of Viet Tri and Vinh to NCHMF.
7) No designation of the Project Sites at Tam Ky, Nha Trang, Phu Lien, Viet Tri and Vinh.

In consideration of the present HMS's situation mentioned above and a future posture of HMS, the radar image data from the 2 Weather Surveillance Doppler Radar Systems and the composite radar image data at NCHMF must be unified as the radar echo reflectivity. Because all the 5 existing radar systems are presently applied the radar echo reflectivity. So that HMS will be able to convert the reflectivity to rainfall intensity by the radar equation with algorithm and coefficient of HMS.

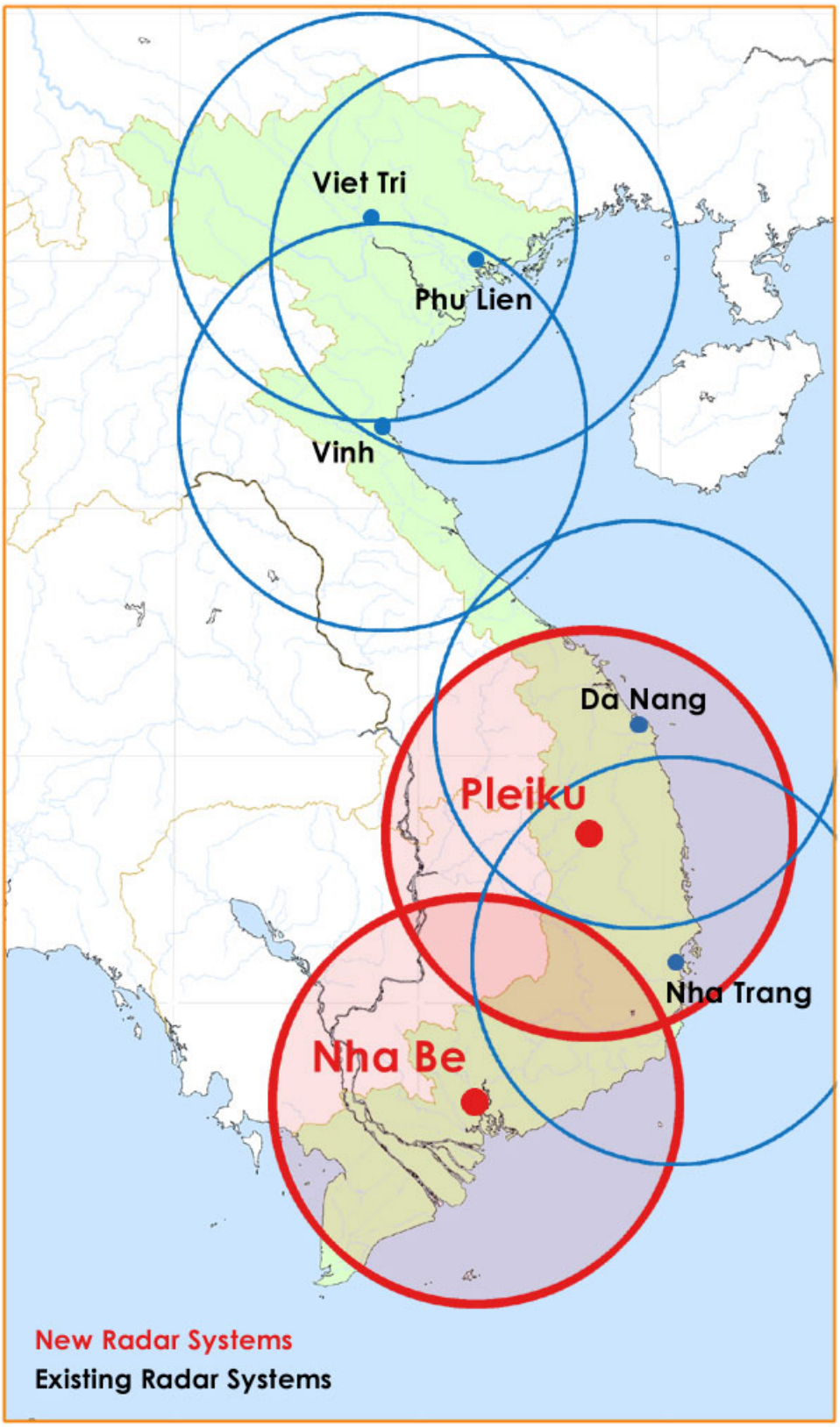
(3) Construction of Radar Tower Buildings with Power Back-up Systems

For the installation of the Weather Surveillance Doppler Radar Systems, construction of radar tower buildings is indispensable under the Project.

<Nha Be Radar Site>
In the Nha Be Radar Site, HMS has already secured the land for the construction of a radar tower building. However, due to the existing soil condition, appropriate piling work for the construction of the building will be required against the ground subsidence. In addition, clear, leveling and reclaiming the site prior to commencement of the construction will be necessary by HMS. Utilization of the existing piles for the radar tower building made by the HMS should be considered to basic design of the Nha Be Radar Tower Building as much as possible.

<Pleiku Radar Site>
In the Pleiku Radar Site, a radar tower building will be constructed in the premises of RHMC Pleiku. The required height of the radar antenna is designed at 55m from the ground level to the center of the radar antenna for covering technically as maximum area as possible. The soil condition of the site has been confirmed quite suitable and no difficulty for construction of the Radar Tower Building by a result of the geotechnical survey.

"Covering Range of the Weather Surveillance Radar Systems in Vietnam (including the existing systems)" for showing the location of each radar system is attached hereunder.



Covering Range of Weather Surveillance Radar Systems in Vietnam (including the existing systems)

2 - 3 Basic Design

2 -3 - 1 Design Concept

1. Design Concept of the Equipment

The basic design concept of all the Equipment to be supplied under the Project is as follows.

a. To design all the Equipment to conform operation and maintenance systems and technical capabilities of HMS.
b. To consider HMS's technical level and structure of operation & maintenance for the systems.
c. To attempt to make appropriate compatibility and suitability between the Equipment and the technical requirements of the World Meteorological Organization (WMO).
d. To give a special consideration to the Equipment to be suitable for the local data communication environment in HMS.
e. To implement appropriate selection of the Equipment for easy procurement and replacement of spare parts and consumables.
f. To take reliability and durability in to account for the selection of the Equipment to be suitable for the natural condition of Vietnam.
g. To minimize recurrent costs of operation & maintenance for the Equipment at HMS.

2. Design Concept of the Buildings

(1) Building Plan: "Radar Tower Building"

Based on the future plans of the HMS, the design concept is to make buildings and facility plans for achieving duties as meteorological radar facility which are to become operating bases for weather radar observation. The Plan is to construct meteorological radar tower buildings at the Nha Be and the Pleiku Radar Sites that will ensure appropriate and effective operations and will accommodate the required systems, equipment and manpower.

The basic concept is to design the Radar Tower Buildings incorporating with the following seven functions.

a. To be capable of carrying out various meteorological services as the "Radar Tower Building."

b. To provide necessary environment where services to be performed effectively and efficiently in accordance with the flow of the meteorological services.
c. To be capable of responding to the service curriculum, with forecasting and observation sections on 24 hour shifts.
d. To be furnished with suitable power supply back-up equipment (Uninterrupted Power Supply system: UPS and Auto Voltage Regulator: AVR, etc.) for performing the meteorological services of 24 hours a day, 365 days a year, in round-the-clock operation.
e. Having the mission of supplying uninterrupted radar observation and weather forecast & warning even during heavy rain, flooding, etc., the radar tower building is to be sufficiently robust with adequate countermeasures taken against natural disasters.
f. To be capable of adapting to the Weather Surveillance Doppler Radar Systems and other related equipment to be supplied under the Project.
g. To be capable of adapting to the meteorological services as duties of the national meteorological organization and the staff members.

(2) Structural Plan

In order to withstanding natural disasters (especially strong wind, heavy rain and flooding), the safe and economical structural design is to be applied, and local structural materials are selected wherever possible. For design and selection of the foundation structure, results of accurate soil investigations at the Project sites of Pleiku and Nha Be are applied.

(3) Building Equipment Plan

Building equipment required for the round-the-clock operation throughout the year, and the implementation of uninterrupted radar observation and forecasting & warning even during typhoon attacking, heavy raining and flooding, are to be planned. The equipment is to be selected from the viewpoint of easy operation and maintenance, taking safety and economy into consideration.

(4) Construction Plan

By using the materials available in the local markets in Vietnam and applying local construction methods, an appropriate and economical construction plan is to be established.

(5) Reduction of Operation, Maintenance and Administration Cost

The size and grade of the Radar Tower Buildings is to be appropriately decided so as to avoid imposing any undue technical or financial burdens on the HMS with respect to ongoing operations and maintenance after the completion of the Project. Therefore, reliable and economical construction materials should be selected for the Radar Tower Buildings and also easy local procurement of the materials should be considered for the future maintenance.

3. Design Conditions

(1) Primary Condition for the Project

♦ Data Ingestion Rule of HMS

The present data ingestion rule in the HMS is a data user side must access the existing data server in Hanoi NCHMF for required data ingestion. This data ingestion rule of HMS must be applied for the Project. Thereby, a radar image user and a data & information user in HMS have to access the existing data server and new server(s) to be supplied under the Project for ingestion of radar image, data and information.

♦ Utilization of the Existing Public Telecommunication Link

For transmission of receiving radar images of the Weather Surveillance Doppler Radar Systems and also for minimizing the recurrent cost of HMS after the completion of the Project, the existing public telecommunication link will be utilized for the Project due to the following reasons.

a. Telephone Companys in Ho Chi Minh and Pleiku have recommended use of the existing telephone link for the Project.
b. The existing telephone link is suitable and acceptable to transmit a radar image to the Regional Center on dial-up basis.
c. Recurrent cost of a dial-up base transmission through the public telephone line is payable by HMS and it is the cheapest technical solution.
d. Technical maintenance for a dial-up base transmission system is quite easy and the HMS has sufficient experiences.
e. The public telephone lines are sometimes not stable in case of extremely natural disasters, however, the public telephone network in Vietnam is being developed and upgraded very quickly as the top priority program of the Government of Vietnam.

f. If the HMS require obtaining a dedicated line, the Telephone Company(s) can provide such requirement.

(2) Meteorological Equipment

♦ Weather Surveillance Doppler Radar System

i) The detecting capability of meteorological radar is determined by such factors as height of installed radar antenna, angle of radar beam transmitted from the antenna (radar beam angle), curvature of the earth and height of meteorological phenomena bearing precipitation (height of cumulonimbus cloud normally is 6~12km). For surveillance and monitoring of hazardous meteorological phenomena, the meteorological radar will be designed to have 400km radius observation range.

ii) The meteorological radar system is designed to have two functions of rain surveillance and atmospheric turbulence surveillance, individually. And for purposes of radar imageries composite processing, the observation data must be made uniform. Due to suitability on the local meteorological condition, C band (wave length: approx. 5cm, frequency: 5,600MHz band) radar system will be adopted to the Systems to be supplied for both the Nha Be and the Pleiku Radar Sites. For more accurate observation and monitoring of precipitation, microburst, wind shear and atmospheric turbulence and also small size meteorological phenomena, recommendable radar beam angle must be not wider than 0.8 degree. For precipitation, microburst, wind shear and atmospheric turbulence surveillance, Doppler function is necessary for the Systems.

♦ Radar Image Composition Function

The following capabilities will be provided to the Radar Image Composition Function.

i) Producing capability for a composite image of the 2 Weather Surveillance Doppler Radar Systems to be supplied under the Project.

ii) Displaying capacity for the radar image display on a display monitor.

iii) Future expansion capability for increasing the number of meteorological radar systems, volume of transmitted data and expanded data processing requirements in Vietnam.

iv) Acceptable capability for radar image composition of the existing radar systems to be established by the HMS in a future.

(3) Radar Tower Building

The following design conditions will be considered in connection with the facility and equipment plans.

♦ Facility Plan

In connection with the meteorological radar building plan, sufficient space must be provided to allow HMS's staff for working efficiently and also to appropriately accommodate and utilize the equipment. The appropriate size and scale of the Radar Tower Buildings will be determined on the basis of the staff, system and equipment required to carry out the functions, role and operations of a meteorological radar system for accurate weather observation. The number of rooms and necessary floor areas will be designed on the basis of the administration structure, personnel requirements, systems, equipment, and operating space established under the Project, taking into account the future posture of HMS.

♦ Building Equipment Plan

The power supply requirements for the Radar Tower Buildings must be sufficient to support the systems and equipment needs established under the Project, along with general lighting, air-conditioning systems, and other equipment. In assessing the capacity of air-conditioning systems, the heating values of the personnel using the space, the newly established systems and equipment, lighting and other heat-generating items and thereby determine the methods and types of air-conditioning systems.

With regard to the power supply systems, in order to carry out the role of the building to operate around the clock throughout the year, conducting radar observation and issuing forecasts and warnings even during natural disasters, the power supply system must include an uninterrupted power supply system and engine generator system to ensure proper operation of the meteorological systems and equipment.

2 - 3 - 2 Basic Design

For make accurate monitoring of hazardous weather and effective reduction of water disasters in the Southern and Central Regions of Vietnam, the Project must be implemented and the Project should be aiming at water disaster prevention. Because the abundant water resources in Vietnam makes water disasters rank as the most serious of all events affecting the country especially in the Southern and Central Regions of Vietnam.

In addition, in order to disseminate the Project effect and benefit to the Vietnam nation as soon as possible through improvement of HMS's capability of meteorological services and strengthening the meteorological forecasting and warning for reduction of natural disasters, it is necessary to provide the following equipment and facilities.

1. Equipment Plan

- Weather Surveillance Doppler Radar System

a. Nha Be Radar Site
   - Radar equipment
   - Radar master control station
   - Radar product monitor unit
   - Remote display unit
   - Printer
   - Router
   - Remote access controller
   - Power supply equipment

b. Pleiku Radar Site
   - Radar equipment
   - Radar master control station
   - Radar product monitor unit
   - 2 Remote display units
   - 2 Printers
   - Router
   - Remote access controller
   - Power supply equipment

c. NCHMF in Hanoi
   - Data archiving processor
   - Radar image data receiving unit

- Radar image processing unit (with radar image composition function)
- Printer
- Router
- Remote access controller
- Power supply equipment

d. RHMC Ho Chi Minh City
   - Remote display unit
   - Printer
   - Router
   - Remote access controller
   - power supply equipment

e. RHMC Pleiku
   - Remote display unit
   - Printer
   - Router
   - Remote access controller
   - power supply equipment

Regarding the equipment designation, specifications, quantity and purpose of all the meteorological equipment to be supplied under the Project are described in "Major Equipment Lists" attached hereunder.

WEATHER SURVEILLANCE DOPPLER RADAR SYSTEM

Name of Site: Nha Be and Pleiku Radar Sites

Equipment	Specification	Quantity		Purpose
		Nha Be	Pleiku	
Radome (with Base Ring)	Type: Sandwich type or other equivalent material	1	1	For protecting the radar antenna assembly (a parabolic dish reflector) and maintenance personnel from severe weather conditions and lightning attacks.
	Dimension: approx. 9m diameter			
	Suitable frequency :5,600 to 5,650MHz			
	Transmission loss: <0.5dB or less on one-way path in dry			
	Allowable wind speed: max. 70m/s in gust, max. 50m/s in average			
	Lightning rod: Protecting angles of 60degree for the radar system			
	Obstruction light: Waterproof lighting system for aviation			
	Accessory: Zenith hatch			
Antenna	Antenna Assembly	1	1	For radiating radar beam into the atmosphere and receiving scatter waves.
	Type: Horn-feed parabolic antenna			
	Reflector: approx. 5m diameter			
	Beam width: not wider than 0.8 degree (not wider than 0.9 degree with radome)			
	Antenna gain: >44dB or more			
	Polarization: Linear, horizontal			
	Side lobe level: less than -26dB			
	VSWR: less than 1.4 (5,650MHz)			
	Antenna Servo Controller	1	1	For rotating a parabolic dish reflector and for controling azimuth and elevation antenna by horizontal and vertical drive motor unit.
	Control system: Programming & manual control system			
	Driving system: Independent azimuth & elevation drive			
	Driving range: Azimuth 360 degree, elevation –2 to +90 degree			
	Rotation speed Azimuth: 0.5 to 6 rpm (6 rpm in operation) Elevation: less than 17 seconds for each way scan between –2 to 60 degree			
	Accuracy of specified angle: Azimuth: less than +/-0.1 degree, Elevation: less than +/-0.1 degree			
Transmitter & Receiver	Transmitter assembly	1	1	For generating and emitting stable pulse frequency and transmitting the pulse to the antenna.
	Transmitting frequency: One of 5,600 MHz-band			
	Transmitting power: >250 kW, -10% to +50%			
	Pulse width:0.4μs- 3.0μs (2 pulses selectable by users between 0.4μs to 3.0μs)			
	Pulse repetition frequency: 896/1120 Hz +/-2% adjustable (Pulse width: 1.0μs), 260 Hz +/-2% (Pulse width: 2.0μs)			
	Transmitting device: Klystron			
	Modulator: Full solid state type			
	Receiver Assembly	1	1	For receiving returned echo signal.
	Noise figure: Less than 3dB at the input-output terminal of low noise amplifier			
	Sensitivity: Better than -110dBm at the input terminal of low noise amplifier			
	Stability of STALO: Better than 10^{-9}			
	Intermediate frequency: 30 MHz +/-2 MHz			
	Stability of COHO: Better than 10^{-7}			
	COHO frequency: 30 MHz +/-2 MHz			
	Logarithmic linearity: Within +/-1dB more than 75dB			
	Dynamic range: >70 dB (depending on matched filter bandwidth), >90 dB (intensity signal), >80 dB (velocity signal)			

Major Equipment List 2 / 8

Signal Processor	Input signal: IF 30 +/-7 MHz, COHO 30 MHz Quantization: 12 bits Video sampling rate: 0.83 μs (in increments of 125 m range) Processing area: throughout 0 km to 400 km in range and 0 to 360 degree in azimuth Azimuth resolution: 1.0 degree Area: 600km x 600km Data grid: 2.5km x 2.5km Intensity mode Ground clutter suppression: Chebyshev IIR digital high pass filter Stopband: 50 dB stopband attenuation Velocity mode Processing type: Pulse Pair or FFT Stopband: 50 dB stopband attenuation Resolution: Velocity 1.0 m/s, Spectrum width 1.0 m/s Accuracy: Velocity 1.0m/s, Spectrum width 1.0m/s	1	1	For primarily processing video echo signal from the receiver.
Dehydrator	Capability of ventilation pressure: 3 +/-1 liter/min., Upper limit: 300 +/-30 gf/cm2, Lower limit: 70 +/-30 gf/cm2	1	1	For supplying dried and pressurized air into the wave-guide to reduce wave propagation loss.
Wave-guide Configuration	Wave-guide type: C band wave-guide Power rating: at least 350 kW TR limiter: Solid type (power rating: at least 100kW) Circulator Power rating: at least 350 kW, Insertion loss: <0.5 dB Directional coupler Coupling factor: transmitting port fixed and with 45 +/-2 dB range, receiving port fixed and with 35 +/-1 dB range, accuracy +/-0.5 dB, VSWR <1.1 Power rating: at least 350 kW Insertion loss: <0.1 dB	1	1	For connecting between the antenna and TX/RX for the wave propagation.
Operation Console with PPI / RHI Indicator	CRT: 21 inch Display video: RAW video (Log video) PPI indication Display ranges: 50, 100, 200, 300 and 400 km Range marks: 10, 20, 50 and 100 km, corresponding to the display range respectively RHI Indication Display ranges & height Range & height marks A-scope indication Display Vertical axis: Processed video Horizontal axis: Range Display range: 50, 100, 200, 300 and 400 km Range marks: 50, 100, 200, 300 and 400 km	1	1	For indicating position and intensity of radar echo.

Major Equipment List 3 / 8

Radar Master Control Station	Hardware	2	2	For operating the radar system and monitoring condition of the radar system.
	Main processor: Intel Pentium III 700MHz or equivalent			
	Main memory (RAM): 256 Mbytes			
	Hard disk unit: 20 GB			
	Floppy disk unit: 1 drive for 3.5 inches disk (1.44Mytes)			
	CD-ROM drive: 1 drive			Monitoring items:
	Tape drive: One (1) 4mm digital audio tape drive			Radiate control/status
	Monitor display: Color CRT type, 19 inches, 16-24 bit colors, 1280 x 1024 dots resolution			Azimuth/elevation position control/ status
	Communication interface: SCSI-II or equivalent, one (1) port			Azimuth/elevation scan control/ status
	LAN interface: IEEE802.3, 10BASE-T, TCP/IP, one (1) port			Wave guide pressure status
	Input power: 220V AC, 50Hz, single phase			TX standby status
	Software			Pulse width control/status
	Operation system: UNIX or LINUX-based			Antenna local/maintenance mode status
	Application software : Scheduling observation operating task and radar product : Producing observation data : Switching operation mode and archiving observation data			

Major Equipment List 4 / 8

Radar Product Monitor Unit	Hardware	1	1	For generating radar products for monitoring and forecasting severe weather conditions.
	Main processor: Intel Pentium III 700MHz or equivalent			
	Main memory (RAM): 256 Mbytes			
	Hard disk unit: 20 GBytes			
	Floppy disk unit: 1 drive for 3.5 inches disk (1.44Mytes)			
	CD-ROM drive: 1 drive			
	Tape drive: One (1) 4mm digital audio tape drive			
	Monitor display: Color CRT type, 19 inches, 16-24 bit colors, 1280 x 1024 dots resolution			
	LAN interface: IEEE802.3, 10BASE-T, TCP/IP, one (1) port			
	Input power: 220V AC, 50Hz, single phase			
	Software			
	Operation system: UNIX or LINUX-based			
	Application software (function) : Plan position and range height indicator (PPI & RHI) : Constant altitude plan position indicator (CAPPI) : Low Altitude Reflectivity : Height of Maximum Z : Layer Reflectivity Average : Column Maximum with Horizontal Max : Vertical Integrated Liquid : Bright Band Detection : Echo tops : Accumulated Rainfall : Arbitrary Vertical Cross Section : Wind velocity (Azimuth, Vertical Section) : Boundary Layer Winds : Storm Motion : Storm Tracking with Strike Warnings : Severe Weather Warning : Hail Probability : Clutter Map : Wind shear (Horizontal Shear, Combined Shear, Shear CAPPI), Microburst detection and Gust Front Detection, Mesocyclone production : Combined Moment : Product project function : Multi screen display : 3-D display including cross section display : Radar calibration with actual rainfall data : Rain Gauge : Subcatchment : Flash Flood Alert			

Major Equipment List 5 / 8

Remote Display Unit	Hardware	1	2	For displaying radar products and radar pictures for radar observation and forecasting.
	Main processor: Intel Pentium III 700MHz or equivalent			
	Main memory (RAM): 256 Mbytes			
	Hard disk unit: 20 GBytes			
	Floppy disk unit: 1 drive for 3.5 inches disk (1.44Mytes)			
	CD-ROM drive: 1 drive			
	Tape drive: One (1) 4mm digital audio tape drive			
	Monitor display: Color CRT type, 19 inches, 16-24 bit colors, 1280 x 1024 dots resolution			
	LAN interface: IEEE802.3, 10BASE-T, TCP/IP, one (1) port			
	Input power: 220V AC, 50Hz, single phase			
	Software			
	Operation system: UNIX or LINUX-based or Microsoft Windows			
	Application software: Data communication, radar image display			
CVCF (Constant Voltage Constant Frequency)	Automatic voltage regulating function	1	1	For supplying stable constant voltage and constant frequency power to all the radar equipment for smooth and uninterrupted radar operation.
	Maximum capacity: 30kVA			
	Surge protection: Surge protection against lightning			
	Uninterrupted power supply function			
	Capacity: not less than 15 kVA			
	Operating time by battery: At least 30 minutes			
	Inverting function			
	AC to DC converter			
Peripheral Equipment	Inkjet Printer : Color inkjet type, A4 size (210 x 297mm) : at least 300 dpi resolution, 2 ppm of faster printing speed	2	3	For printing radar products.
	Phone Line Protection (RJ-11 connector type)	1	1	For shutting off abnormal high voltage due to electrical surge coming from a public telephone line for the radar system.
	UPS : Capacity: 1 kVA : Input power: 220V AC, ±2%, single phase, 2wires 50Hz ±2% : Output power: 220V AC, ±2%, single phase, 2wires 50Hz ±2% : Operating time: at least 15 minutes	3	4	For supplying back-up AC power to computing equipment in case of power stoppage for shutdown the system.
	Remote Access Controller : Telephone line interface: RJ-11, 2 wires : Digital data interface: RS-232C : Modulation mode: ITU V.32bis and V34 : LAN interface: IEEE 802.3, 10BASE-T, TCP/IP : Input power: 220V, 50 Hz, single phase	1	1	For data exchange and transmission through a public telephone line.
	Router : LAN interface: IEEE 802.3 Ethernet : Connections: 10BASE-T, ten (10) ports : Routing: IP routing : Input power: 220V AC, 50 Hz, single phase	1	1	For connecting all the computing equipment on LAN.
Power Supply Peripheral	Power Distribution Board : Circuit breaker: No-fuse-breaker type : Output power: 220V AC, single phase, 50Hz	1	1	For distributing AC power inverted by CVCF to the radar system and the comuting equipment.
	Power Supply Unit for Radar System : Circuit breaker: No-fuse-breaker type : Output power: 220V AC, single phase, 50Hz : TX Power Supply Transformer	1	1	For transforming AC power received from the main power distribution board for the radar transmitter and distributing transformed AC to the transmitter and ordinary AC to the radar system individually.
	Breaker Box : Circuit breaker: No-fuse-breaker type : Input power: 220V AC, single phase, 50Hz : Output power: 220V AC, single phase, 50Hz	1	2	For distributing AC to the Operation console and the computing equipment.

Major Equipment List 6 / 8

Name of Site: RHMC Ho Chi Minh (H.C.M) and RHMC Pleiku				
Equipment	Specification	Quantity		Purpose
		H.C.M	Pleiku	
Remote Display Unit	Hardware	1	1	For displaying radar products and radar pictures for radar observation and forecasting.
	Main processor: Intel Pentium III 700MHz or equivalent			
	Main memory (RAM): 256 Mbytes			
	Hard disk unit: 20 GBytes			
	Floppy disk unit: 1 drive for 3.5 inches disk (1.44Mytes)			
	CD-ROM drive: 1 drive			
	Tape drive: One (1) 4mm digital audio tape drive			
	Monitor display: Color CRT type, 19 inches, 16-24 bit colors, 1280 x 1024 dots resolution			
	LAN interface: IEEE802.3, 10BASE-T, TCP/IP, one (1) port			
	Input power: 220V AC, 50Hz, single phase			
	Software			
	Operation system: UNIX or LINUX-based or Microsoft Windows			
	Application software: Data communication, radar image display			
Peripheral Equipment	Inkjet Printer : Color inkjet type, A4 size (210 x 297mm) : at least 300 dpi resolution, 2 ppm of faster printing speed	1	2	For printing radar products.
	Phone Line Protection (RJ-11 connector type)	1	1	For shutting off abnormal high voltage due to electrical surge coming from a public telephone line for the radar system.
	AVR : Capacity: 1 kVA : Input power: 220V AC ± 20%, 50 Hz ± 3%, single phase, 2 wires : Output power: 220V AC ± 20%, 50 Hz ± 3%, single phase, 2 wires	1	1	For automatically regulating commercial AC power for UPS.
	UPS : Capacity: 1 kVA : Input power: 220V AC, ±2%, single phase, 2wires 50Hz ±2% : Output power: 220V AC, ±2%, single phase, 2wires 50Hz ±2% : Operating time: at least 15 minutes	1	1	For supplying back-up AC power to computing equipment in case of power stoppage for shutdown the system.
	Remote Access Controller : Telephone line interface: RJ-11, 2 wires : Digital data interface: RS-232C : Modulation mode: ITU V.32bis and V34 : LAN interface: IEEE 802.3, 10BASE-T, TCP/IP : Input power: 220V, 50 Hz, single phase	1	1	For data exchange and transmission through a public telephone line.
	Router (Hub) : LAN interface: IEEE 802.3 Ethernet : Connections: 10BASE-T, ten (10) ports : Routing: IP routing : Input power: 220V AC, 50 Hz, single phase	1	1	For connecting all the computing equipment on LAN.
Power Supply Peripheral	Power Distribution Board : Circuit breaker: No-fuse-breaker type : Output power: 220V AC, single phase, 50Hz	1	1	For distributing AC power to the comuting equipment.

Major Equipment List 7 / 8

Name of Site: NCHMF			
Equipment	Specification	Quantity NCHMF	Purpose
Data Archiving Processor	Hardware	1	For archiving and storing radar products and radar pictures and also for programming.
	Main processor: Intel Pentium III 700MHz or equivalent		
	Main memory (RAM): 256 Mbytes		
	Hard disk unit: 20 GBytes		
	Floppy disk unit: 1 drive for 3.5 inches disk (1.44Mytes)		
	CD-ROM drive: 1 drive		
	Tape drive: One (1) 4mm digital audio tape drive		
	Monitor display: Color CRT type, 19 inches, 16-24 bit colors, 1280 x 1024 dots resolution		
	LAN interface: IEEE802.3, 10BASE-T, TCP/IP, one (1) port		
	Input power: 220V AC, 50Hz, single phase		
	Software		
	Operation system: UNIX or LINUX-based or Microsoft Windows		
	Application software: Data archiving, storage and programming		
Radar Image Data Receiving Unit	Hardware	1	For deceiving radar products and radar pictures from Nha Be and Pleiku Radar Systems.
	Main processor: Intel Pentium III 700MHz or equivalent		
	Main memory (RAM): 256 Mbytes		
	Hard disk unit: 20 GBytes		
	Floppy disk unit: 1 drive for 3.5 inches disk (1.44Mytes)		
	CD-ROM drive: 1 drive		
	Tape drive: One (1) 4mm digital audio tape drive		
	Monitor display: Color CRT type, 19 inches, 16-24 bit colors, 1280 x 1024 dots resolution		
	LAN interface: IEEE802.3, 10BASE-T, TCP/IP, one (1) port		
	Input power: 220V AC, 50Hz, single phase		
	Software		
	Operation system: UNIX or LINUX-based or Microsoft Windows		
	Application software: Radar image data receiving		
Remote Image Processing Unit	Hardware	1	For processing radar image and producting radar image composition of Nha Be and Pleiku Radar Systems for forecasting.
	Main processor: Intel Pentium III 700MHz or equivalent		
	Main memory (RAM): 256 Mbytes		
	Hard disk unit: 20 GBytes		
	Floppy disk unit: 1 drive for 3.5 inches disk (1.44Mytes)		
	CD-ROM drive: 1 drive		Radar image composition
	Tape drive: One (1) 4mm digital audio tape drive		Data grid: 2.5km x 2.5km
	Monitor display: Color CRT type, 19 inches, 16-24 bit colors, 1280 x 1024 dots resolution		Individual radar image & composite radar image display
	LAN interface: IEEE802.3, 10BASE-T, TCP/IP, one (1) port		Display mode: Horizontal distribution of
	Input power: 220V AC, 50Hz, single phase		Display area
	Software		Original: 800Km x 800Km
	Operation system: UNIX or LINUX-based or Microsoft Windows		Composite image: 1,000Km x 1,000Km
	Application software: Radar image processing and producting radar image composition of Nha Be and Pleiku Radar Systems.		

Major Equipment List 8 / 8

Peripheral Equipment	Laser Printer : Color laser type, A4 size (210 x 297mm) : 600 dpi resolution, 2 ppm of faster printing speed : Connection: Ethernet 10Base-T, TCP/IP, one (1) port	1	For printing radar products.
	Phone Line Protection (RJ-11 connector type)	1	For shutting off abnormal high voltage due to electrical surge coming from a public telephone line for the radar system.
	AVR : Capacity: 1 kVA : Input power: 220V AC ± 20%, 50 Hz ± 3%, single phase, 2 wires : Output power: 220V AC ± 20%, 50 Hz ± 3%, single phase, 2 wires	3	For automatically regulating commercial AC power for UPS.
	UPS : Capacity: 1 kVA : Input power: 220V AC, ±2%, single phase, 2wires 50Hz ±2% : Output power: 220V AC, ±2%, single phase, 2wires 50Hz ±2% : Operating time: at least 15 minutes	3	For supplying back-up AC power to computing equipment in case of power stoppage for shutdown the system.
	Remote Access Controller : Telephone line interface: RJ-11, 2 wires : Digital data interface: RS-232C : Modulation mode: ITU V.32bis and V34 : LAN interface: IEEE 802.3, 10BASE-T, TCP/IP : Input power: 220V, 50 Hz, single phase	1	For data exchange and transmission through a public telephone line.
	Router : LAN interface: IEEE 802.3 Ethernet : Connections: 10BASE-T, ten (10) ports : Routing: IP routing : Input power: 220V AC, 50 Hz, single phase	1	For connecting all the computing equipment on LAN.
Power Supply Peripheral	Power Distribution Board : Circuit breaker: No-fuse-breaker type : Output power: 220V AC, single phase, 50Hz	1	For distributing AC power to the comuting equipment.

2. Basic Facility Plan

1) Site Layout Plan

In the Radar Tower Buildings, when radar observers and forecasters work at the display monitors and radar operating consoles, they typically face north, since this direction is considered optimum in terms of operating efficiency and directional sense. This direction clearly facilitates the efficient conduct of radar operations, since the screen surface on which radar images are displayed on monitors and consoles is oriented to the north, which coincides with the facing direction preferred by operators and forecasters. Accordingly, the layout plans for the Radar Tower Buildings at the Nha Be and Pleiku Radar Sites will have the backs of the radar display monitors and operating consoles facing north.

- Nha Be Radar Site

The Nha Be Radar Site is located in the Nha Be industrial area which is still under reclaiming and developing. HMS has already prepared a development master plan of the Nha Be Radar Site and requested the State Government of Vietnam to allocate the required budget for the development work. However, the altitude of the Site is just 1.5m high from the sea level and it is located in a flood high potential affecting area in the Ho Chi Minh City. Therefore, a height of the ground floor of the Radar Tower Building should be given a special consideration against water disasters.

Regarding the site infrastructure, power supply, water supply and telephone line are available. However, drainage (rain water) and sewage disposal system is not available in the area, thereby, rain water will directly be sunk from drainage pit into the ground and also the sewage primarily treated by septic tank will pass into the ground in the Site. At the Site, a step down transformer (250 kVA, 15~22kV/0.4kV) for the development of the Nha Be Radar Site has been installed by HMS, which is quite useful and suitable for power supply to the Radar Tower Building.

- Pleiku Radar Site

As already noted, Pleiku Radar Site is located in the premises of RHMC Pleiku. The Site is sufficiently large to accommodate a radar tower building construction and the area where the new building is planning to construct is a gentle slope up toward the back of the Site. Regarding the site infrastructure, power supply and telephone line are available, however, there is no water supply facility, so that the existing facility must presently rely on well water. For this reason, after completion of the building construction, a well for

the building construction work will be used as water supply facility for obtaining water for the Radar Tower Building.

With regard to drainage (rain water) and sewage disposal in the Site, rain water will directly be sunk from drainage pit into the ground and also the sewage primarily treated by septic tank will pass into the ground.

2) Architectural Design

a) Floor Plan

The floor plan will be virtually symmetrical, making possible a structural design that is safe and avoids eccentricity. The floor plan for the central portion of the Radar Tower Buildings will allow the various rooms to be arranged more flexibility, since all structures such as columns and beams will not protrude into the internal staircase, which is also to serve as evacuation routes. Construction methods and materials have been employed in common local use and the buildings will be of standard grade in Vietnam.

Outline of the Room and Equipment Layout for the Nha Be Radar Tower Building

Name of Room	Floor Area (m^2)	No. of Staff	Equipment and Room Function
Radar Observatory Deck	(159.57)	—	Radar antenna and radome, maintenance space for radome
Maintenance Hall	52.24	—	Space for wave guide duct, cable duct and repairing work for radar antenna
Roof Floor	(52.64)	—	Outside units for AC system and water tank (w/concrete foundations)
Radar Equipment Room	37.09	—	2 AC (15,000Kcal), radar transmitter/receiver, signal processing equipment and power distribution board
Store (Radar Equipment Room)	8.80	—	Storage space for spare parts for transmitter/receiver of the radar system
Radar Observation Room	36.11	Daytime: 4 Night: 2	2 AC (10,000Kcal), radar operating console & display monitor, telecommunication equipment, UPS
Maintenance Room	13.75	1	For repairing works of equipment and for storage of tools and measuring equipment
Analysis Room	11.00	1	Analysis of radar echo sketches for areas unable receive radar data on-line, preparation of telegraphic massage
Data Store	6.41	—	For analyzed data and floppy disk & MO disk storage
Toilet	3.48	—	—
Engine Generator Room	28.20	—	Standby generator, peripheral devices and service tank
Electricity Room	22.57	—	Main power board, distribution board and cable racks, UPS and AVR for equipment
Pump Room	6.93	—	Water-intake tank, pumps and inspection space
Equipment Spare Parts Store	7.02	—	For storage of equipment spare parts
Building Spare Parts Store	6.93	—	For storage of building spare parts
Tea kitchen	2.60	1~2	Kitchen facilities and cupboard
Toilet & Shower Room	7.01	—	—
Common Area	83.16	—	Entrance Hall, Corridor, Staircase, E.P.S, P.S, etc.
Total	333.30		

Outline of the Room and Equipment Layout for the Pleiku Radar Tower Building

Name of Room	Floor Area (m^2)	No. of Staff	Equipment and Room Function
Radar Observation deck	(131.90)	—	Radar antenna and radome to be installed
Maintenance Deck	(60.32)	—	Space for wave guide duct, cable duct and repairing work for radar antenna
Roof Floor	(63.17)	—	Outside unit for AC system (w/concrete foundations)
Radar Equipment Room	37.04	—	2 AC (15,000Kcal), radar transmitter/receiver, signal processing equipment and power distribution board
Store (Radar Equipment Room)	9.40	—	Storage space for spare parts for transmitter/receiver of the radar system
Second Floor Roof	(47.78)	—	Outside units for AC system and water tank (w/concrete foundations)
Radar Observation Room	37.04	Daytime: 3 Night: 2	2 AC (10,000Kcal), radar operating console & display monitor, telecommunication equipment, UPS
Store (Radar Observation Room)	9.40	—	For storage of radar operating equipment spare parts
Forecasting Room	33.24	Daytime: 4 Night: 2	Space for weather observation and forecasting
Maintenance Room	14.39	—	For repairing works of equipment and for storage of tools and measuring equipment
Analysis Room	25.15	2	Analysis of radar echo sketches for areas unable receive radar data on-line, preparation of telegraphic massage
Data & Weather Chart Store	15.32	—	For analyzed data and floppy disk & MO disk and weather charts storage
Toilet	3.24	—	—
Engine Generator Room	30.26	—	Standby generator, peripheral devices and service tank
Electricity Room	26.15	—	Main power board, distribution board and cable racks, UPS and AVR for equipment
Pump Room	8.47	—	Water-intake tank, pumps and inspection space
Building Spare Parts Store	8.65	—	For storage of building spare parts
Equipment Spare Parts Store	15.80	—	For keeping spare parts, measuring equipment and maintenance tools for equipment to be supplied under the Project and existing equipment from existing office building
Tea kitchen	2.60	1~2	Kitchen facilities and cupboard
Toilet & Shower Room	17.79	—	—
Common Area	128.31	—	Entrance Hall, Corridor, Staircase, E.P.S, P.S, etc.
Total	422.25		

Calculating Bases for Determining Room Area for the Nha Be Radar Tower Building

Name of Room	Floor Area (m^2)	Calculation Bases for Room Area
Radar Observatory Deck	(159.57)	Installation space for radar antenna and radome, and maintenance space for radome
Maintenance Hall	52.24	Installation space for wave guide duct and cable duct, and repairing work for radar antenna
Roof Floor	(52.64)	Installation space for outside units for AC system and FRP water tank
Radar Equipment Room	37.09	Installation and maintenance space for radar transmitter/receiver and power supply equipment of the radar system and working space
Store (Radar Equipment Room)	8.80	Storage space for spare parts for transmitter/receiver of the radar system
Radar Observation Room	36.11	Space for installation of radar operating console & display monitor, telecommunication equipment and working space (9～10㎡/person×4 persons ≒ 36㎡)
Maintenance Room	13.75	Mechanical repairing space (10㎡/person×1 person＋tools storage space≒14㎡)
Analysis Room	11.00	Working space (8～9㎡/person×1 person＋ storage space≒11㎡)
Data Store	6.41	Storage space for meteorological radar observation data for 10 years
Toilet	3.48	—
Engine Generator Room	28.20	Installation space for 50kVA standby generator, service tank and automatic switch board
Electricity Room	22.57	Installation space for main power board, distribution board and cable racks, UPS and AVR for equipment
Pump Room	6.93	Installation and maintenance space for pump, switches and FRP water tank
Equipment Spare Parts Store	7.02	Storage space for spare parts for equipment
Building Spare Parts Store	6.93	Storage space for spare parts for building and maintenance gears
Tea Kitchen	2.60	Space for kitchen sink, shelf and preparation of drinks
Toilet & Shower Room	7.01	—
Common Area	83.16	Entrance Hall, Corridor, Staircase, E.P.S, P.S, etc.

Calculating Bases for Determining Room Area for the Pleiku Radar Tower Building

Name of Room	Floor Area (m^2)	Calculation Bases for Room Area
Radar Observatory Deck	(131.90)	Installation space for radar antenna and radome, and maintenance space for radome
Maintenance Deck	(60.32)	Installation space for wave guide duct and cable duct, and repairing work for radar antenna
Roof Floor	(63.17)	Outside unit for AC system and FRP water tank (w/concrete foundations)
Radar Equipment Room	37.04	Installation and maintenance space for radar transmitter/receiver and power supply equipment of the radar system and working space
Store (Radar Equipment Room)	9.40	Storage space for spare parts for transmitter/receiver of the radar system
Second Floor Roof	(47.78)	Installation space for outside units for AC system (w/concrete foundations)
Radar Observation Room	37.04	Space for installation of radar operating console & display monitor, telecommunication equipment and working space (9～10㎡/person×4 person ≒ 37㎡)
Store (Radar Observation Room)	9.40	For storage of radar operating equipment spare parts
Forecasting Room	33.24	Working space for weather observation and forecasting (8～9㎡/person×4 persons≒33㎡)
Maintenance Room	14.39	Mechanical repairing space (10㎡/person×1 person＋tools storage space≒14㎡)
Analysis Room	25.15	Working space (8～9㎡/person×2 persons + storage space≒25㎡)
Data & Weather Chart Store	15.32	Storage space for meteorological radar observation data and weather charts for 10 years
Toilet	3.24	—
Engine Generator Room	30.26	Installation space for 50kVA standby generator, service tank and automatic switch board
Electricity Room	26.15	Installation space for main power board, distribution board and cable racks, UPS and AVR for equipment
Pump Room	8.47	Installation and maintenance space for pump, switches and FRP water tank
Building Spare Parts Store	8.65	Storage space for spare parts for building and maintenance gears
Equipment Spare Parts Store	15.80	Storage space for spare parts, measuring equipment and maintenance tools for equipment to be supplied under the Project and existing equipment from existing office building
Tea kitchen	2.60	Space for kitchen sink, shelf and preparation of drinks
Toilet & Shower Room	17.79	—
Common Area	128.31	Entrance Hall, Corridor, Staircase, E.P.S, P.S, etc.

b) Sectional Plan

- Structure of Radar Tower Buildings

<Nha Be Radar Site>

The height of the radar antenna center from the ground level is fixed as 30m by the radar observation requirement. Therefore, the height of the Radar Tower Building from the ground level to the observatory deck level is designed as approximately 25m and a suitable structural form of the Building is reinforced concrete construction. Considering heavy rainfall and potential flood damage and also due to the flood record, the height from the ground level to the ground floor slabs has been set at 1.5m.

<Pleiku Radar Site>

The height of the radar antenna center from the ground level is fixed as 55m by the radar observation requirement. Therefore, the height of the Radar Tower Building from the ground level to the observatory deck level is designed as approximately 51.5m. Due to the required height and a result of structural calculation, suitable structural form of the Building from the ground level to approximately 27m high is reinforced concrete construction and from 27m high to the observatory deck level is steel construction.

- Ceilings

In the radar equipment and observation rooms, the radar equipment must be protected against dust collecting above the cable rack. In addition, so as to improve the airtightness of these rooms as well as to reduce the equipment noise, the ceilings will be finished with acoustical boards. And, since both of these rooms are to be air-conditioned, the use of ceiling boards will be also be effective in terms of raising the efficiency of cooling operations. Ceiling height has, accordingly, been set at about 2.7 m, based on the dimensions of the intended equipment.

- Equipment Installation Method

In order to install all the equipment directly from outside into the radar equipment and observation rooms, a large opening will be necessary for bringing the equipment from outside. However, the large opening would be undesirable from the standpoint of airtightness and dust proofing. The equipment will, therefore, be brought in via a loading balcony at the adjacent staircase room. For lifting the equipment, 2-tons lifting hook will set at the upper part of this balcony.

c) Elevation Plan

The columns and beans will protrude to the outside, with an appealing elevation plan that enhances the structural design. In this way, since columns and beams will not protrude into the staircase, therefore, the staircase will be able to comfortably handle traffic in both directions.

d) Material Plan

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

		Material and method of finishing
Exterior Finishings	**Radar Observatory Deck**	Cement sand mortal base, Asphalt waterproofing, Insulation, Protection concrete, Cement sand mortal, Cement tiles (Nha Be) Concrete base, Waterproofing mortal, and Gratings (Pleiku)
	Roof Floor (2nd Floor Roof)	Mortal base asphalt proofing, Insulation, Protection concrete, Base mortal, Cement tiles
	Walls	Concrete blocks Cement sand mortar base spray tile finish
Interior Finishings	**Floors**	Vinyl tiles Porcelain tiles Cement sand mortal base, 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 sand mortar base Emulsion paint finish Glass wool with glass cloth
Windows and Doors	**Exterior**	Aluminum windows and doors Aluminum grilles Steel doors
	Interior	Wooden doors

		Bases for adoption of materials	**Procurement**
Exterior Finishings	**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 Finishings	**Floors**	Materials will be selected on the basis of superior durability and ease of maintenance. Vinyl tiles around offices, stores, corridors and staircases will be applied. In rooms where dust must be avoided, a dust-proof paint finish will be specified. In the offices where computer systems will be installed, access floors shall be applied for cabling under floor.	To be procured locally
	Walls	Cement sand mortal (trowel-caoted) 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 shower rooms.	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 Doors	**Exterior**	Aluminum and steel will be chosen throughout for reasons of durability, ease of handling and accuracy.	To be procured locally
	Interior	Wooden with synthetic oil resin paint will be employed throughout for its handling ease during construction and from a maintenance standpoint.	To be procured locally

3) Structural Design

a) Structural Design Standards

The Building Code of Vietnam have been determined in conformity with the building codes of Japan, U.K. standards (BS), UBC (United Building Code), etc. Design of the Radar Tower Buildings have to meet all the requirements and instructions of the Building Code of Vietnam.

Accordingly, with respect to the structural design for the Radar Tower Buildings will adopt these standards. Moreover, reference has been made, as required, to the building codes of Japan as well as the standards of the Architectural Institute of Japan (AIJ).

b) Structural Type

Reinforced concrete has been nominated as structural type for the Radar Tower Buildings because, locally reinforced concrete construction is most typical structural type in Vietnam. The floor slabs are to be reinforced concrete while exterior walls and partition walls are local made concrete blocks.

However, the upper part of the Radar Tower Building at the Pleiku Radar Site is designed using steel construction due to the required height of the radar antenna center. Such steel structures are fabricated in a factory and the quality of materials and fabrication are quite suitable for the technical requirements for the Building.

c) Foundations

<Nha Be Radar Site>
Large turned moment will occur because the height of the Radar Tower Building including radome is 34.5m high from the ground level. Based on geological surveys at the Site, a suitable foundation bed for the Building is available approximately 50m in depth from the ground level. Since above these reasons, 50m-length cast-in-place concrete piles will be required against the ground subsidence and for safely to support the Building. However, the ground reforming work is not included in the Project because it is expected that the ground subsidence will be very small and slow and there is no affection to the building structure from the ground subsidence.

<Pleiku Radar Site>
Large turned moment will occur because the height of the Radar Tower Building including radome is 59.5m high from the ground level. Based on geological surveys at the Site, a suitable foundation bed for the Building is available approximately 3m in depth from the ground level and the soil condition is quite suitable for a building construction.

d) Structural design standards

- Stress calculations

Calculated based on an elasticity analysis.

• Section design

The reinforced concrete structural design and the steel structural design have been based on the calculation standards of the building codes of Japan and the Architects Institute of Japan (AIJ), applying the elastic design method.

e) Design loads and external pressure

• Dead load

Dead load calculation will include all of the structural and finishing materials. The estimated combined weight of the radome and radar antenna, which are to be mounted on the observation deck of the radar tower building as a special dead load, is approximately 4.5 tons.

• Live loads

Since virtually all the rooms in the radar tower building will have a storage function, either as equipment room or store room, live loads, with the exception of live loads of the roof and observation deck, will all be uniform and be deemed to be identical to those for telecommunication equipment rooms in Japan.

In estimating loads of the observatory deck, an allowance has been made for the moving space of the maintenance workers servicing the radar radome. Based on the Building Standard Law of Japan, the above values have been reduced for these roof surfaces.

• Wind load

According to the Building Cord of Vietnam III, standard TCVN 2737-95, the standardized wind pressure for the Nha Be and the Pleiku Radar Sites is 83 daN/m^2 for appropriate structural design of the Radar Tower Buildings and radar antenna & radome. In addition, appropriate safety factor shall be added to the structural design. The zoning map of wind pressure and the table of zoning of wind pressure, of the Building Cord of Vietnam III, are attached in the Appendices.

• Seismic force

According to the Building Cord of Vietnam III, the Nha Be and the Pleiku Radar Sites are located in Earthquake Level Scales of Vietnam between 5 and 7 which is as the same as Japanese Intensity Scale of 3 and 4. In accordance with the Japanese Construction Code, a basic seismic coefficient of Co=0.07 is applied for structural design of the Buildings. The shake zoning map and the table of relationship between earthquake level scales, of the Building Cord of Vietnam III, are attached in the Appendices.

• Soil bearing capacity

< Nha Be Radar Site>

Due to results of the boring tests, the ground water appeared approximately depth of 1m from the ground level. Between 46 ~ 60m in depth from the ground level, there is a suitable foundation bed for the Radar Tower Building. The foundation bed is dense silty sand and fine grained deposit with 30 ~ 35 N value. Since above these reasons, 50m-length cast-in-place concrete piles are essential safely to support the Building against large turned moment occurrence due to the height of Radar Tower Building including radome.

<Pleiku Radar Site>
Due to results of the boring tests, the soil condition is quite suitable and there is no problem for the construction of the required height of the building. 3m in depth from the ground level, there is a suitable foundation bed which is very stiff sandy elastic silt deposit with 15 N value.

Result of the boring tests in Nha Be and Pleiku is attached in the Appendices.

f) Structural materials and strength

• Concrete

Ordinary concrete will be used, with a design strength of Fc=210kgf/cm^2 (with a 28-day compression strength).

• Reinforced concrete

Reinforcing bars	*Standard*	*Yield strength (*kgf/cm^2*)*
Deformed bars	SD295A	3,000
	SD345A	3,500

4) Electrical Facilities Design

a) Power intake facility

Power intake up to the Radar Sites including wiring and power connection to a low-voltage switch board are major scope of works to be taken by the Government of Vietnam on his responsibility. In connection with the 380V and 50Hz low-voltage facilities, aerial cable will be installed at the Nha Be Radar Site while a hand-hole will be installed at the Pleiku Radar Site. At the Pleiku Radar Site, an underground pipe will be installed from the hand-hole to the low-voltage switchboard on the ground floor of the Radar Tower Building.

The required power will be 2 circuit, 380V, 3-phase, 4-wire, 50 Hz.

The power receiving system diagram is shown in the Diagram-1 (Nha Be & Pleiku).

b) Generating facility

To ensure uninterrupted operation of the Weather Surveillance Doppler Radar Systems, an engine generator will be installed at each Radar Site, as follows, as a back-up power source during the commercial power supply failure. For supporting the radar system on 12 hours operation, a service tank of 600 liters will be supplied.

Capacity : 50 KVA
Voltage : 3 PH 4 W, 380V and 50 Hz

c) Trunk line and power facility

Both the exterior and underground pipes will be of polyethylene pipes against saline rot. Inside the building, steel piping will be employed. Air conditioning units will be individually controlled, while ceiling and ventilating fans will be manually operated.

The feeder & power system diagrams are shown in the Diagram-2 (Nha Be) and Diagram-3 (Pleiku).

d) Lighting and wall sockets

Wiring work will conform to the Vietnam technical standards for electrical facilities and using voltage will be single-phase 220V, with all the equipment to be grounded. Steel pipes will be specified, as generally used in Vietnam. 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. Obstruction lighting system for aviation will be placed on the top of radome.

The illuminance standard in the various rooms will be approximately as shown below.

Radar Equipment Room	200 Lx	Generator Room	200 Lx
Radar Observation Room	300 Lx	Pump Room	200 Lx
Data Store	100 Lx	Electricity Room	200 Lx
Analysis Room	200 Lx	Maintenance Room	200 Lx
Forecasting Room	200 Lx	Other Rooms	200 Lx

General-purpose sockets will be equipped with switches, with a 2-pronged socket to be placed at 8m ~ 10m intervals and also a separate socket will be provided for the wall ventilating fan.

e) Hollow pipes for telephone lines:

Hollow vinyl piping will be installed from the hand-hole to be provided in the project site to the terminal board installed at the building. Hollow steel pipes will be laid between the terminal board and the various telephone outlets, with lead wires to be installed in the pipes. The wiring and related works will be implemented by a telephone company, with costs to be borne by HMS.

The telephone system diagrams are shown in the Diagram-4 (Nha Be) and Diagram-5 (Pleiku).

f) Intercom equipment

Intercom equipment will be installed at the ground floor, outside entrance and in the various meteorological operating rooms (radar equipment room, observation room, etc.) as a security measure to permit night personnel to screen visitors.

The intercom system diagrams are shown in the Diagram-4 (Nha Be) and Diagram-5 (Pleiku).

g) Alarm facilities

Alarm will be equipped with 20 terminals, the following warnings of the building equipment will be indicated.

No. 1	System failure and overheating of air-conditioning units
No. 2	System failure and overheating of an engine generator facilities
No. 3	System failure and overheating of the low voltage switch boards
No. 4	Tank water levels at full, low and empty

The alarm system diagrams are shown in the Diagram-6 (Nha Be) and Diagram-7 (Pleiku).

h) Grounding facilities

Grounding facility terminals for the equipment will be installed on each floor. PVC grounding wires will be connected to the terminal board located on the ground floor. The building equipment in the electricity room will be grounded via the terminal board, while the telephone equipment will be grounded by erecting a grounding pole and running a wire from there to the terminal board.

i) Lightning rod facilities

A connection box will be placed on the observation deck floor. Inside the building, copper wire will be laid in a vinyl pipe and grounded via the test terminal board. The connection from the lighting rod that is incidental equipment of the radome on top of the radome to the connection box will be a portion of the equipment installation work.

The lightning protection system diagrams are shown in the Diagram-8 (Nha Be) and Diagram-9 (Pleiku).

j) Aviation obstruction lights system

< Nha Be Radar Site>
A connection box will be placed on the observation deck floor and a distribution panel and a photo-cell switch for the obstruction light will be placed on the ground floor. The connection from the obstruction lights that is incidental equipment of the radome on top of the radome to the connection box will be a portion of the equipment installation work.

< Pleiku Radar Site>
Two connection boxes will be placed on the observation deck floor and on the roof floor respectively. A distribution panel and a photo-cell switch for the obstruction lights will be placed on the ground floor. Four sets of obstruction lights will be installed on the columns at the height of 30m from the ground level and connected to the distribution panel on the ground floor via the connection box on the roof. The connection from the obstruction lights that is incidental equipment of the radome on top of the radome to the connection box will be a portion of the equipment installation work.

The aviation obstruction lights system diagrams are shown in the Diagram-8 (Nha Be) and Diagram-9 (Pleiku).

k) Fire detection and alarm system

Automatic fire detection and alarm system is to be installed for the early warning of fires and protection of human life. The receiving set is to be installed in the Radar observation room in Nha Be and in the Forecasting room in Pleiku.

The fire detection and alarm system diagrams are shown in the Diagram-10 (Nha Be) and Diagram-11 (Pleiku).

5) Water Supply, Drainage and Sanitary Fixture Design

a) Water supply system

<Nha Be Radar Site>
Water intake into the site will be via a water meter. HMS will be responsible for the intake works up to a gate valve inside the Site. The water will be raised to a water reservoir tank located at the pump room on the ground floor to be stocked and pumped up to the elevated tank on the roof floor.

<Pleiku Radar Site>
For obtaining water for the Radar Tower Building, the new deep well will be constructed. The well water will be raised to a water reservoir tank located at the pump room on the ground floor to be stocked and pumped up to the elevated tank on the roof floor.

The water supply system diagrams are shown in the Diagram-12 (Nha Be) and Diagram-13 (Pleiku).

b) Drainage system

Drainage will be divided into 2 systems as sewage and miscellaneous drainage. Rainwater drainage work will be included in the portion of building construction work. Sewage will primarily be treated in a septic tank and then permeated by a percolation pit into the ground. Miscellaneous drainage including rain water will be fed directly into a drainage pit.

The drainage system diagrams are shown in the Diagram-12 (Nha Be) and Diagram-13 (Pleiku).

c) Sanitary fixtures

Toilet seats, washbasins, and other types of sanitary fixtures will be installed where required.

d) Fire-fighting equipment will be installed as required

A fire extinguisher is to be provided in each room required.

6) Air-conditioning and Ventilation Facility Design

Large size of air-conditioners will be installed in the radar equipment room and radar observation room. Air-conditioning system will also be provided in the forecasting, maintenance, spare parts, data and analysis rooms.

a) Environmental conditions

- Exterior condition
  Hot season 35°C D.B MAX

- Interior condition
  Hot season 27°C D.B 50% R.H.

b) Air-conditioning equipment

The air conditioning equipment to be installed in the Radar Tower Buildings will be package systems. They can be separately controlled due to the interest of energy conservation and from the standpoint of their intended use. The outside units for the air-conditioning systems will be installed on the roof of the Buildings.

The air conditioning system diagrams are shown in the Diagram-14 (Nha Be) and Diagram-15 (Pleiku).

c) Ventilating equipment

Ceiling fans providing forced ventilation will be installed in tea-kitchen, lavatory and other rooms emitting offensive odors. Ventilation systems will also be installed in other rooms where it is deemed necessary to maintain an appropriate environment.

The ventilation system diagrams are shown in the Diagram-14 (Nha Be) and Diagram-15 (Pleiku).

d) Basic Design Drawing

The basic design drawings of the Radar Tower Buildings are as follows.

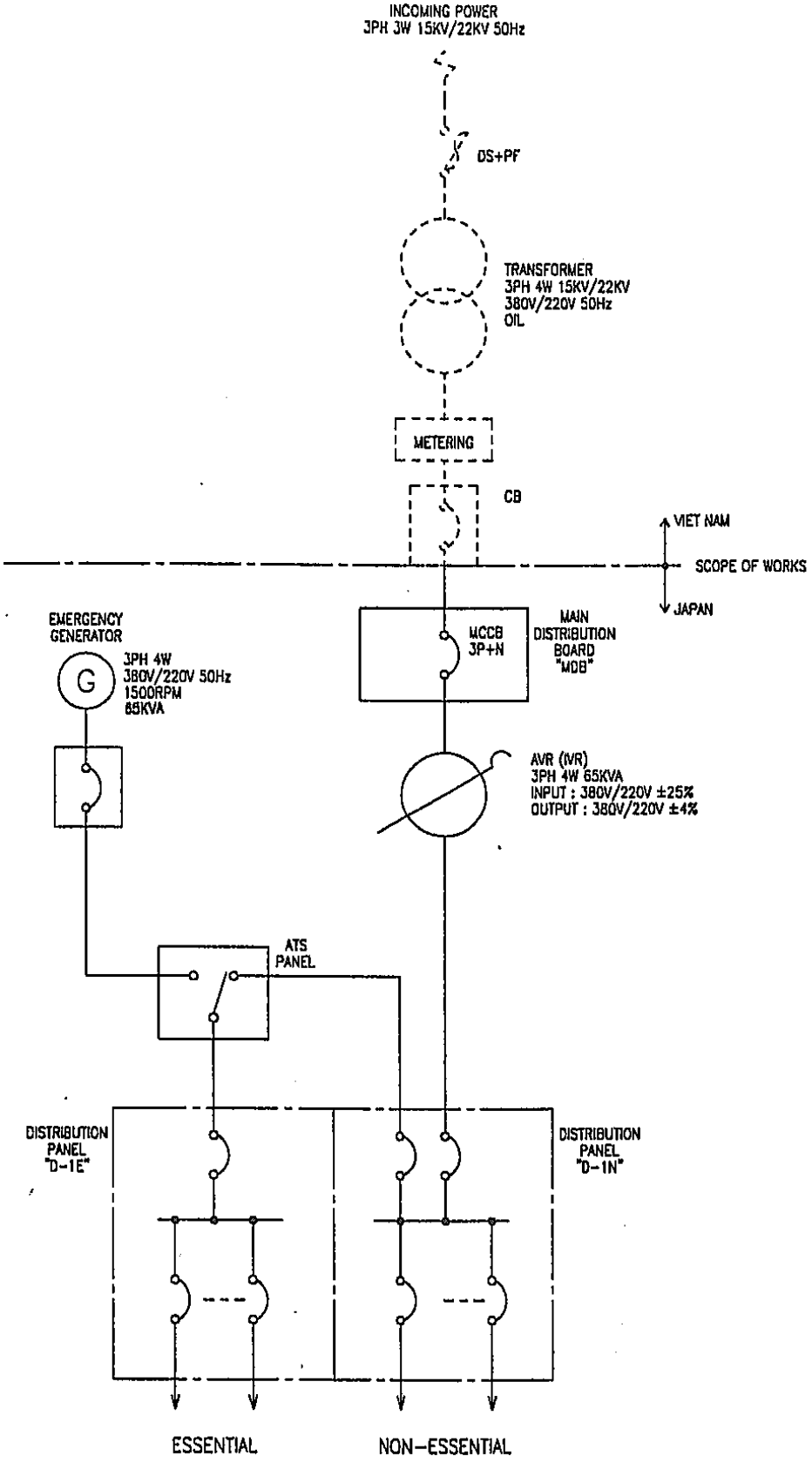
- NHA BE RADAR SITE

SITE LAYOUT PLAN	NA-01
FLOOR PLAN	NA-02
ELEVATION AND SECTION	NA-03
EQUIPMENT LAYOUT PLAN	NA-04

- PLEIKU RADAR SITE

SITE LAYOUT PLAN	PA-01
FLOOR PLAN	PA-02
ELEVATION AND SECTION	PA-03
EQUIPMENT LAYOUT PLAN	PA-04

Diagram-1



POWER RECEIVING DIAGRAM

NHA BE & PLEIKU

Diagram-2

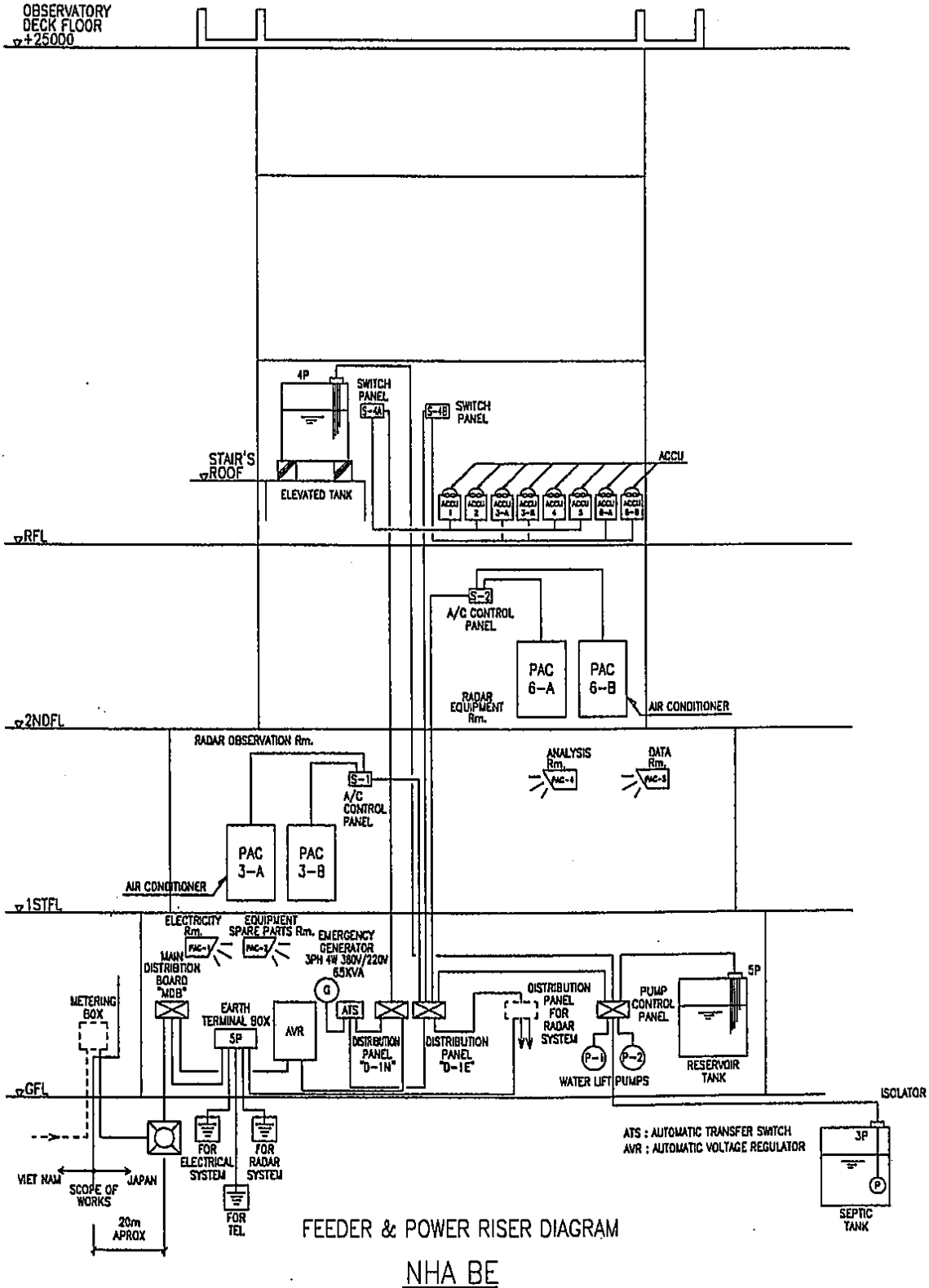

OBSERVATORY DECK FLOOR
+25000
4P
SWITCH PANEL
S-4A
S-4B
SWITCH PANEL
STAIR'S ROOF
ELEVATED TANK
ACCU
RFL
S-2
A/C CONTROL PANEL
PAC 6-A
PAC 6-B
RADAR EQUIPMENT Rm.
AIR CONDITIONER
2NDFL
RADAR OBSERVATION Rm.
ANALYSIS Rm.
DATA Rm.
S-1
A/C CONTROL PANEL
PAC 3-A
PAC 3-B
AIR CONDITIONER
1STFL
ELECTRICITY Rm.
EQUIPMENT SPARE PARTS Rm.
EMERGENCY GENERATOR 3PH 4W 380V/220V 65KVA
MAIN DISTRIBUTION BOARD "MDB"
METERING BOX
EARTH TERMINAL BOX
5P
AVR
G
ATS
DISTRIBUTION PANEL "D-1N"
DISTRIBUTION PANEL "D-1E"
DISTRIBUTION PANEL FOR RADAR SYSTEM
PUMP CONTROL PANEL
5P
P-1
P-2
WATER LIFT PUMPS
RESERVOIR TANK
GFL
ISOLATOR
ATS : AUTOMATIC TRANSFER SWITCH
AVR : AUTOMATIC VOLTAGE REGULATOR
3P
P
SEPTIC TANK
FOR ELECTRICAL SYSTEM
FOR RADAR SYSTEM
FOR TEL
VIET NAM
JAPAN
SCOPE OF WORKS
20m APROX
FEEDER & POWER RISER DIAGRAM
NHA BE

Diagram-3

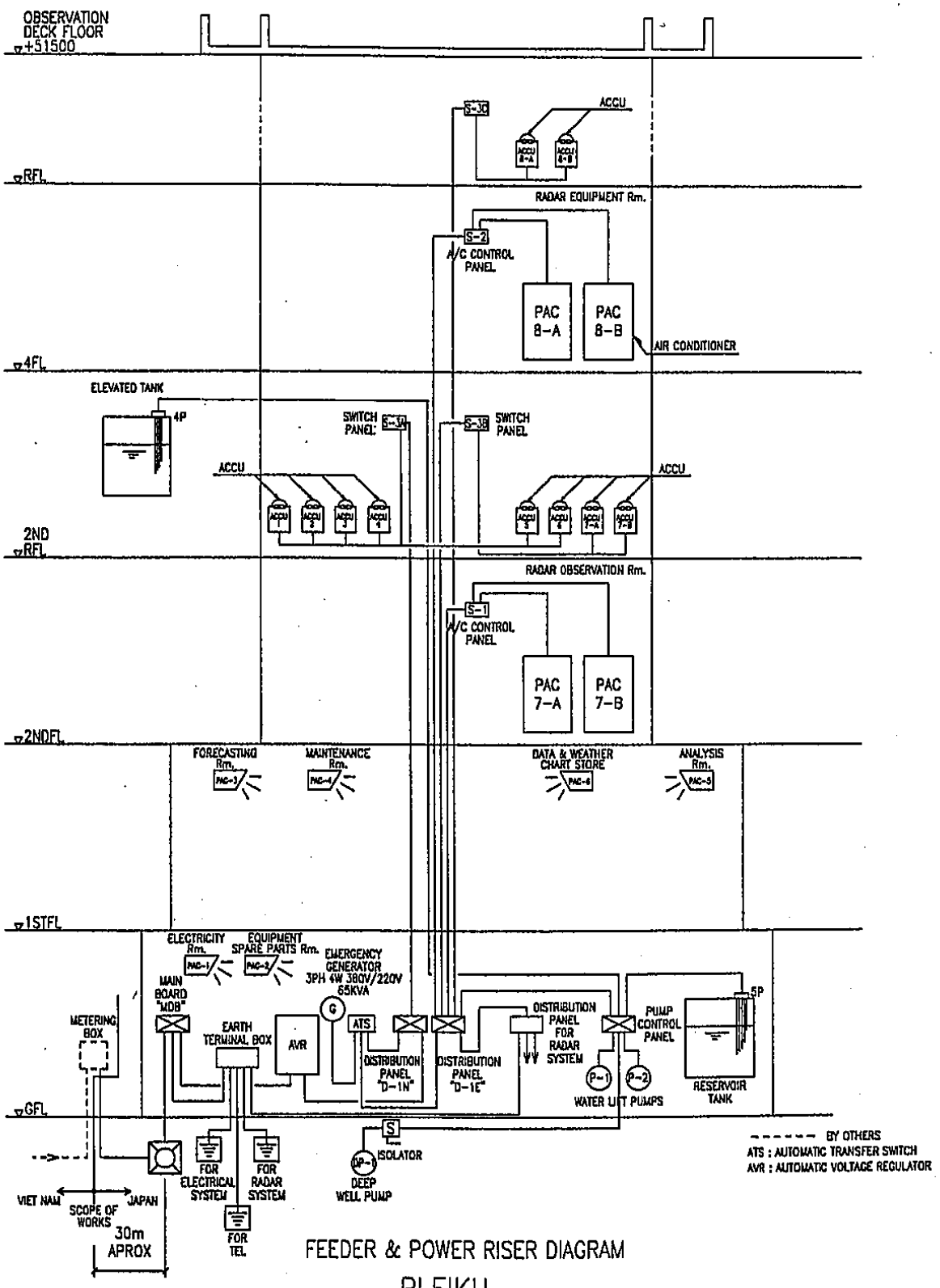
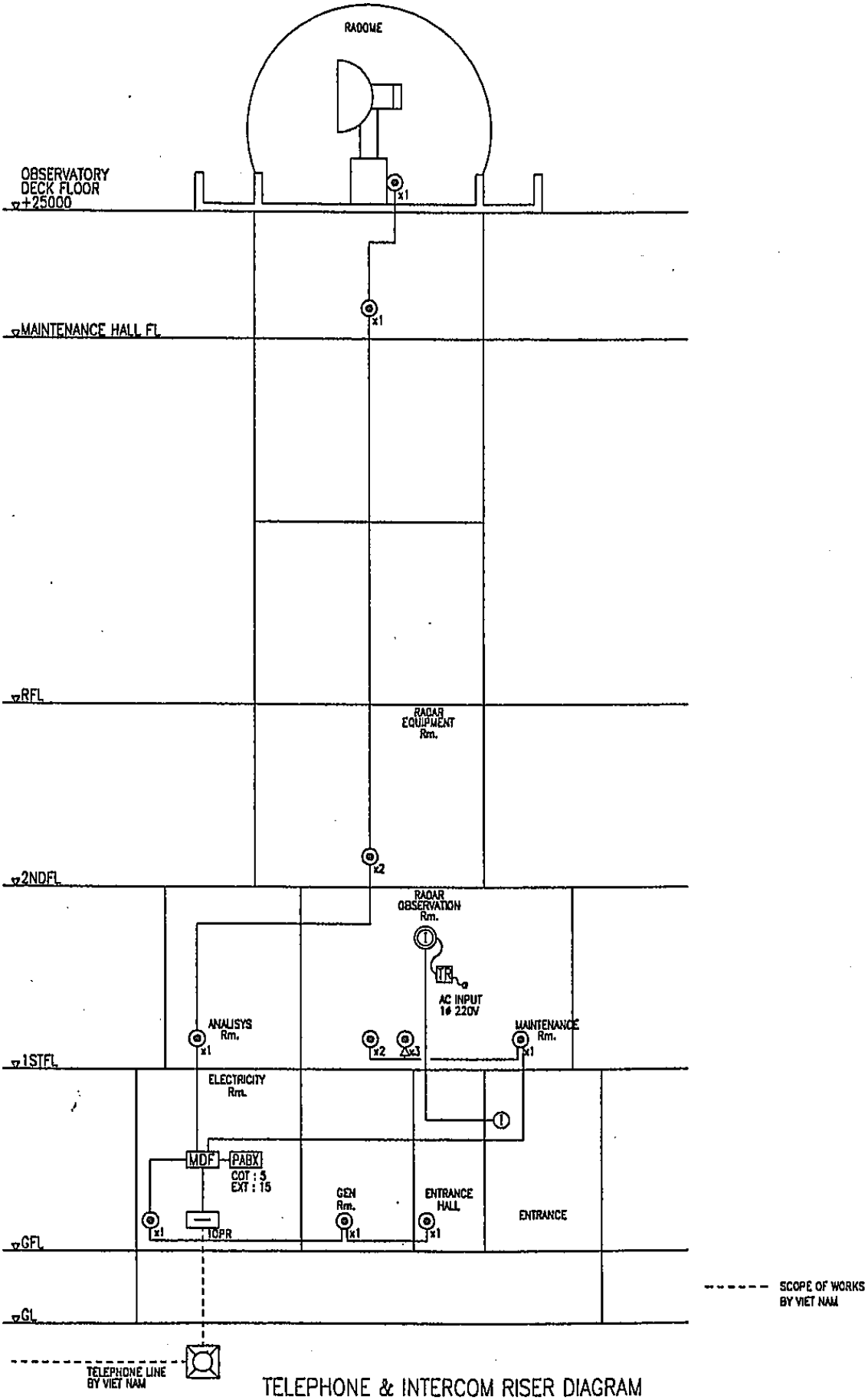

OBSERVATION DECK FLOOR +51500
RFL
4FL
2ND RFL
2NDFL
1STFL
GFL
S-3C
ACCU
RADAR EQUIPMENT Rm.
S-2
A/C CONTROL PANEL
PAC 8-A
PAC 8-B
AIR CONDITIONER
ELEVATED TANK
4P
SWITCH PANEL
S-3A
S-3B
SWITCH PANEL
ACCU
ACCU
RADAR OBSERVATION Rm.
S-1
A/C CONTROL PANEL
PAC 7-A
PAC 7-B
FORECASTING Rm.
MAINTENANCE Rm.
DATA & WEATHER CHART STORE
ANALYSIS Rm.
ELECTRICITY Rm.
EQUIPMENT SPARE PARTS Rm.
EMERGENCY GENERATOR 3PH 4W 380V/220V 65KVA
MAIN BOARD "MDB"
METERING BOX
EARTH TERMINAL BOX
AVR
ATS
DISTRIBUTION PANEL "D-1N"
DISTRIBUTION PANEL "D-1E"
DISTRIBUTION PANEL FOR RADAR SYSTEM
PUMP CONTROL PANEL
5P
RESERVOIR TANK
WATER LIFT PUMPS
ISOLATOR
DEEP WELL PUMP
FOR ELECTRICAL SYSTEM
FOR RADAR SYSTEM
FOR TEL
VIET NAM
JAPAN
SCOPE OF WORKS
30m APROX
BY OTHERS
ATS : AUTOMATIC TRANSFER SWITCH
AVR : AUTOMATIC VOLTAGE REGULATOR
FEEDER & POWER RISER DIAGRAM
PLEIKU

Diagram-4



TELEPHONE & INTERCOM RISER DIAGRAM

NHA BE

Diagram-5

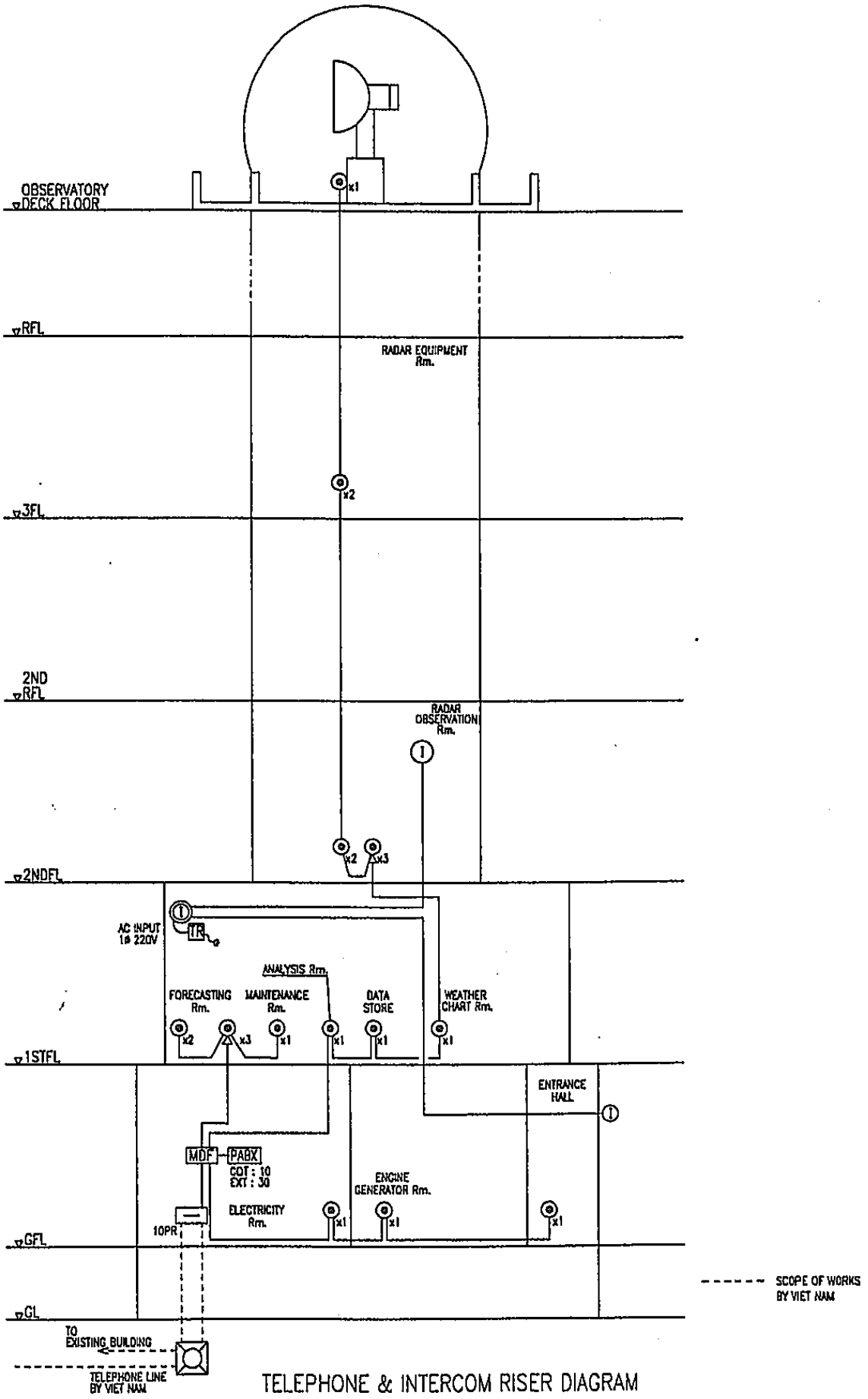
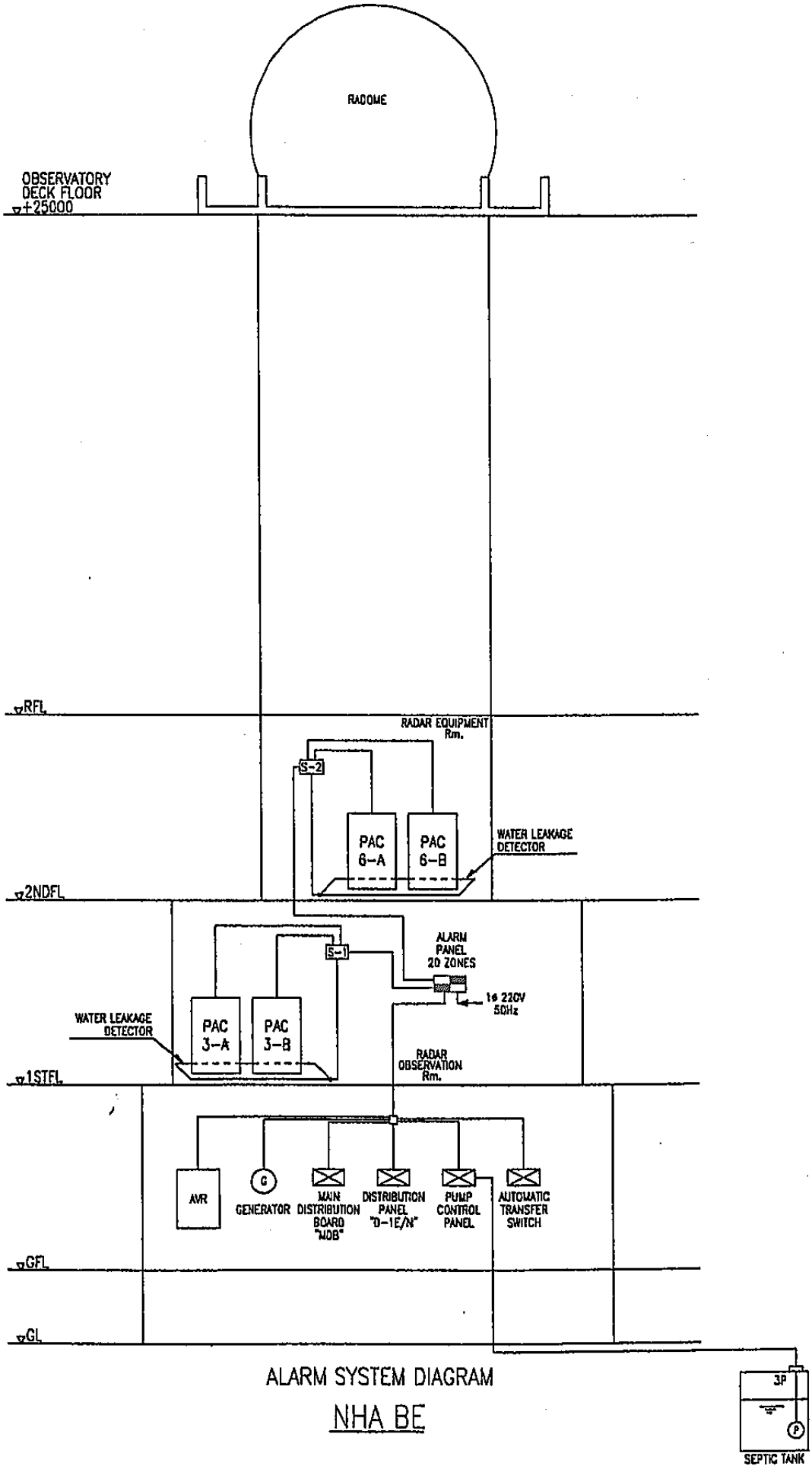

OBSERVATORY DECK FLOOR
RFL
RADAR EQUIPMENT Rm.
3FL
2ND RFL
RADAR OBSERVATION Rm.
2NDFL
AC INPUT 1ϕ 220V
TR
ANALYSIS Rm.
FORECASTING Rm.
MAINTENANCE Rm.
DATA STORE
WEATHER CHART Rm.
1STFL
ENTRANCE HALL
MDF
PABX
COT : 10
EXT : 30
ENGINE GENERATOR Rm.
ELECTRICITY Rm.
10PR
GFL
GL
TO EXISTING BUILDING
TELEPHONE LINE BY VIET NAM
SCOPE OF WORKS BY VIET NAM
TELEPHONE & INTERCOM RISER DIAGRAM
PLEIKU

Diagram-6



ALARM SYSTEM DIAGRAM

NHA BE

Diagram-7

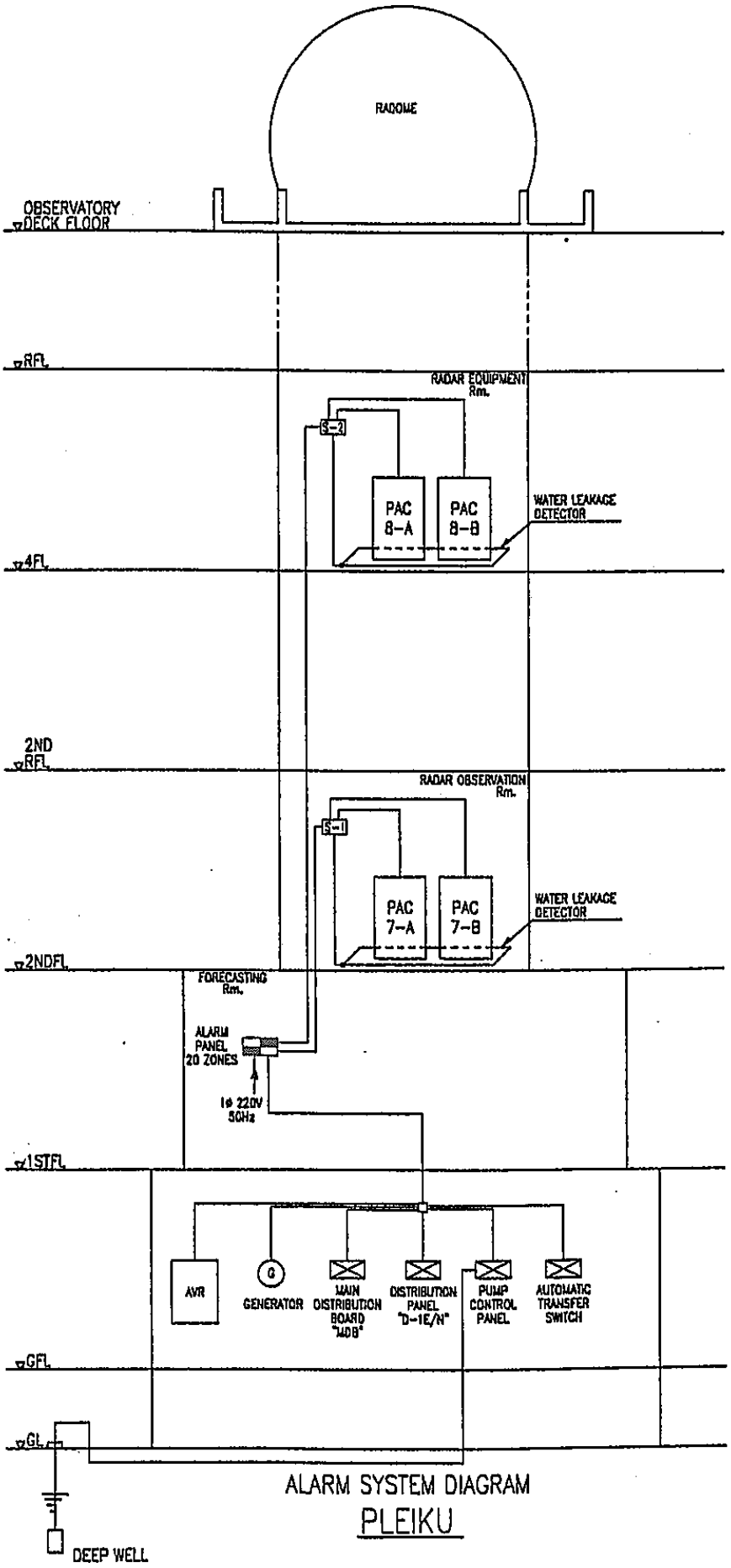

RADOME
OBSERVATORY DECK FLOOR
RFL
RADAR EQUIPMENT Rm.
S-2
PAC 8-A
PAC 8-B
WATER LEAKAGE DETECTOR
4FL
2ND RFL
RADAR OBSERVATION Rm.
S-1
PAC 7-A
PAC 7-B
WATER LEAKAGE DETECTOR
2NDFL
FORECASTING Rm.
ALARM PANEL 20 ZONES
1φ 220V 50Hz
1STFL
AVR
G
GENERATOR
MAIN DISTRIBUTION BOARD "MDB"
DISTRIBUTION PANEL "D-1E/N"
PUMP CONTROL PANEL
AUTOMATIC TRANSFER SWITCH
GFL
GL
DEEP WELL
ALARM SYSTEM DIAGRAM
PLEIKU

Diagram-8

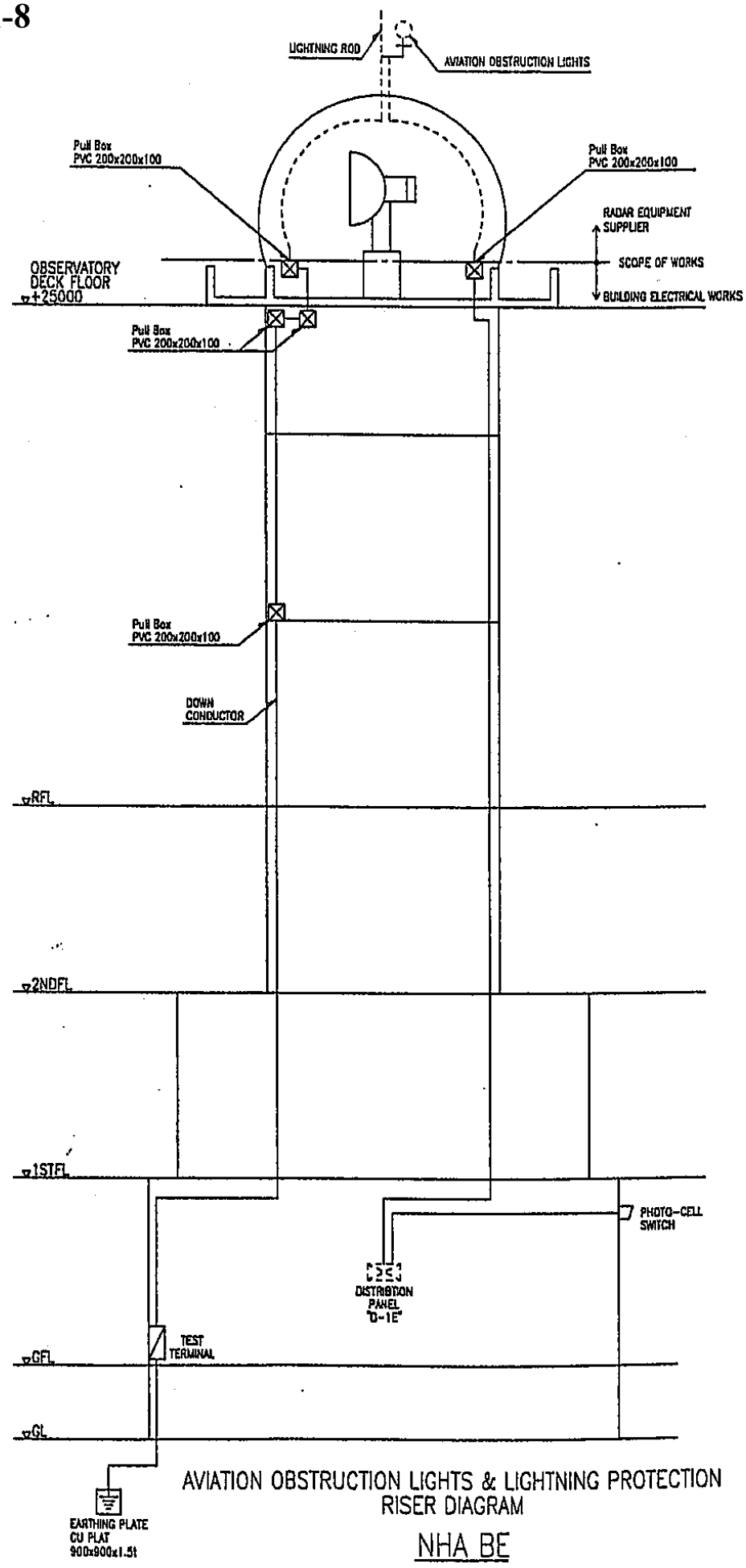
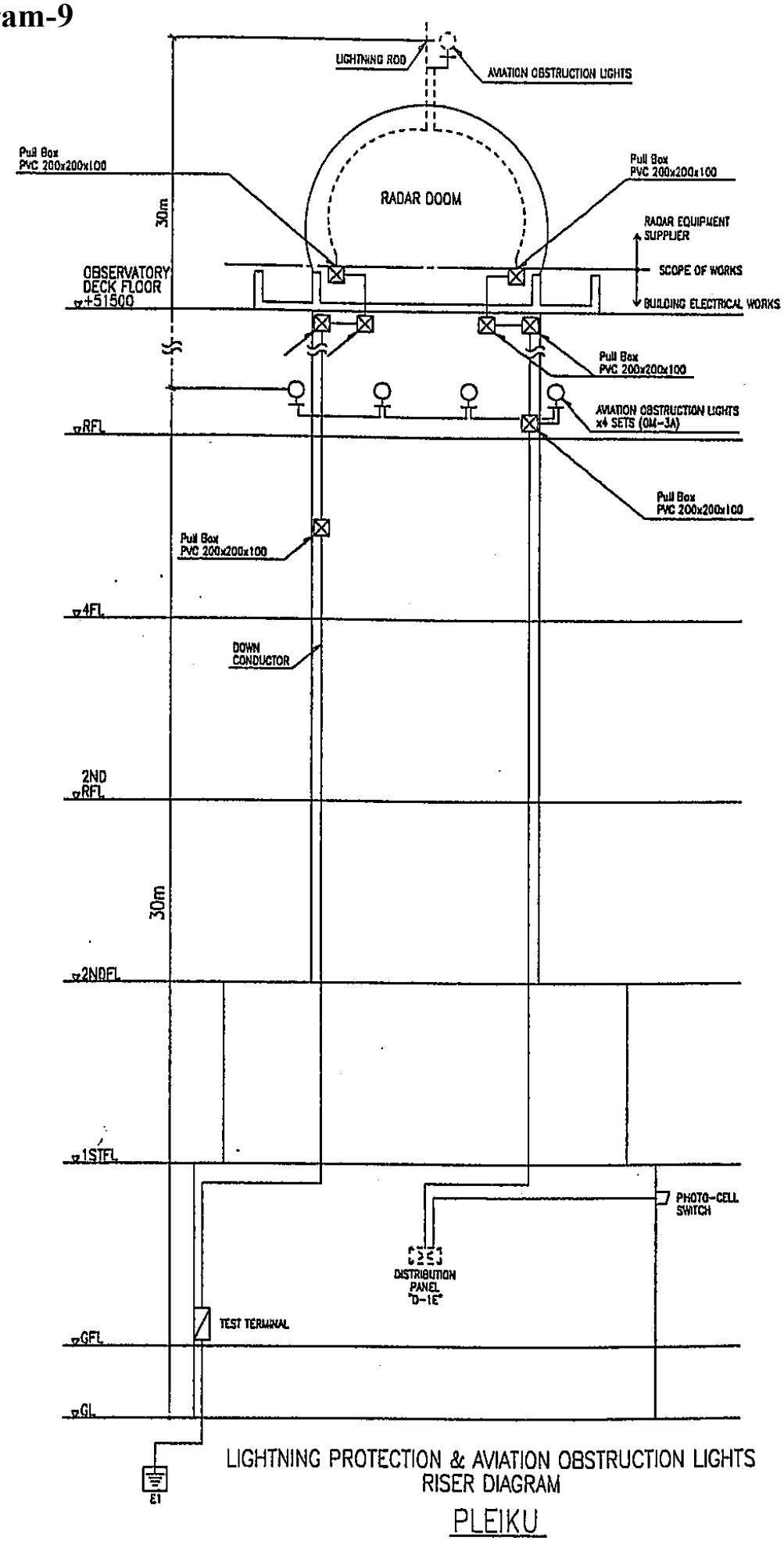

LIGHTNING ROD
AVIATION OBSTRUCTION LIGHTS
Pull Box PVC 200x200x100
Pull Box PVC 200x200x100
RADAR EQUIPMENT SUPPLIER
SCOPE OF WORKS
BUILDING ELECTRICAL WORKS
OBSERVATORY DECK FLOOR
+25000
Pull Box PVC 200x200x100
Pull Box PVC 200x200x100
DOWN CONDUCTOR
RFL
2NDFL
1STFL
PHOTO-CELL SWITCH
DISTRIBUTION PANEL "D-1E"
TEST TERMINAL
GFL
GL
EARTHING PLATE CU PLAT 900x900x1.5t
AVIATION OBSTRUCTION LIGHTS & LIGHTNING PROTECTION RISER DIAGRAM
NHA BE

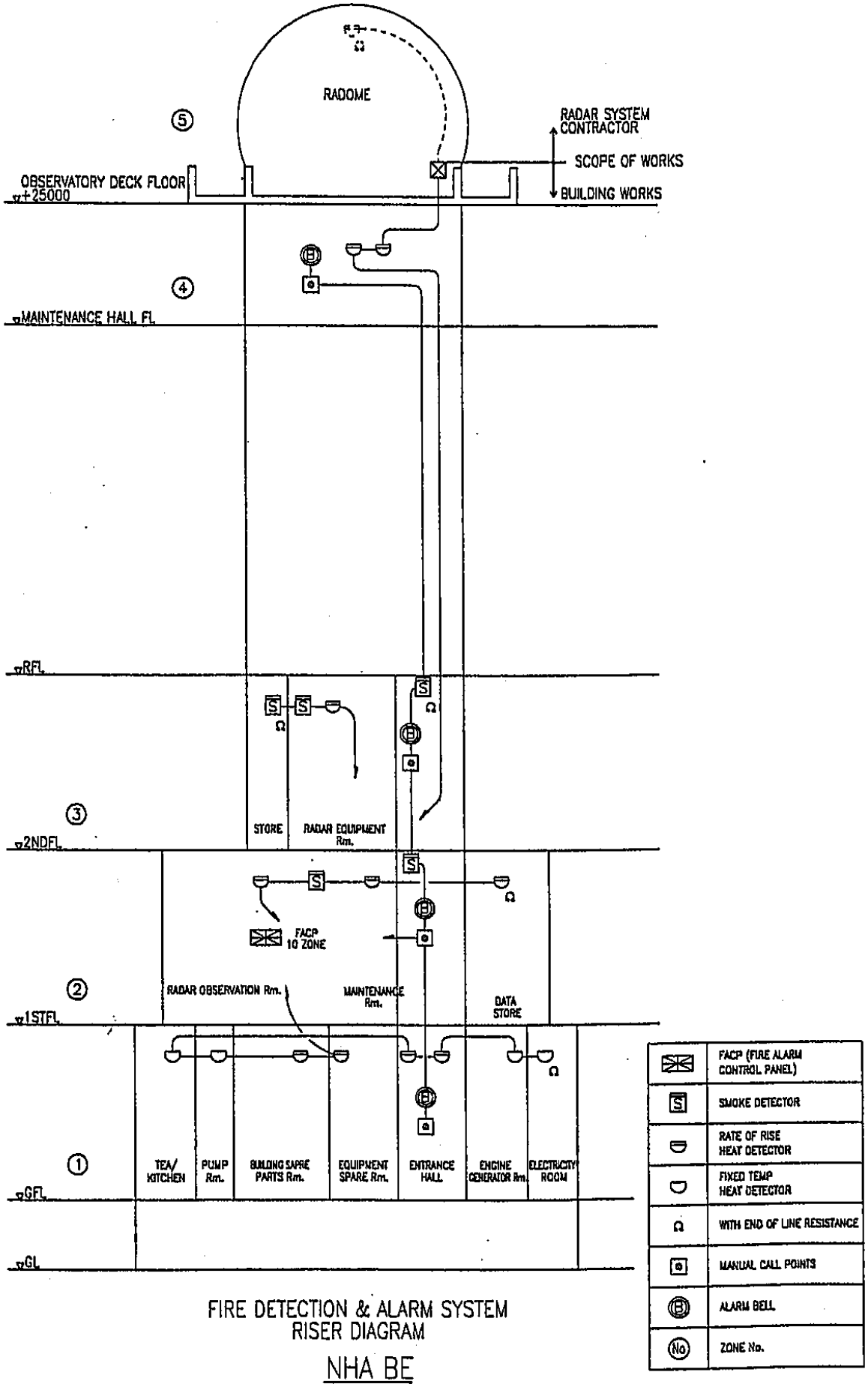
Diagram-9



LIGHTNING PROTECTION & AVIATION OBSTRUCTION LIGHTS
RISER DIAGRAM

PLEIKU

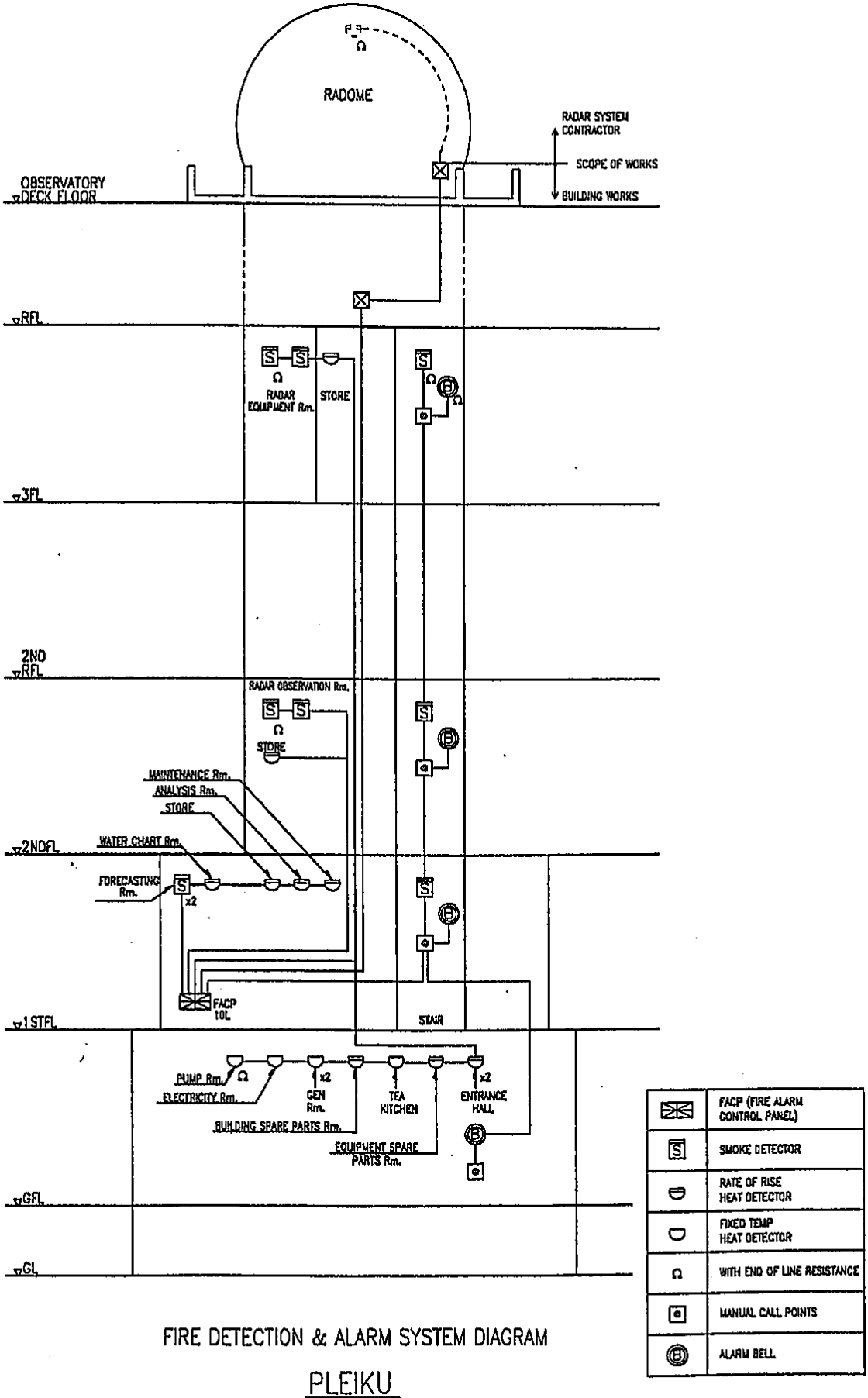
Diagram-10



FIRE DETECTION & ALARM SYSTEM
RISER DIAGRAM

NHA BE

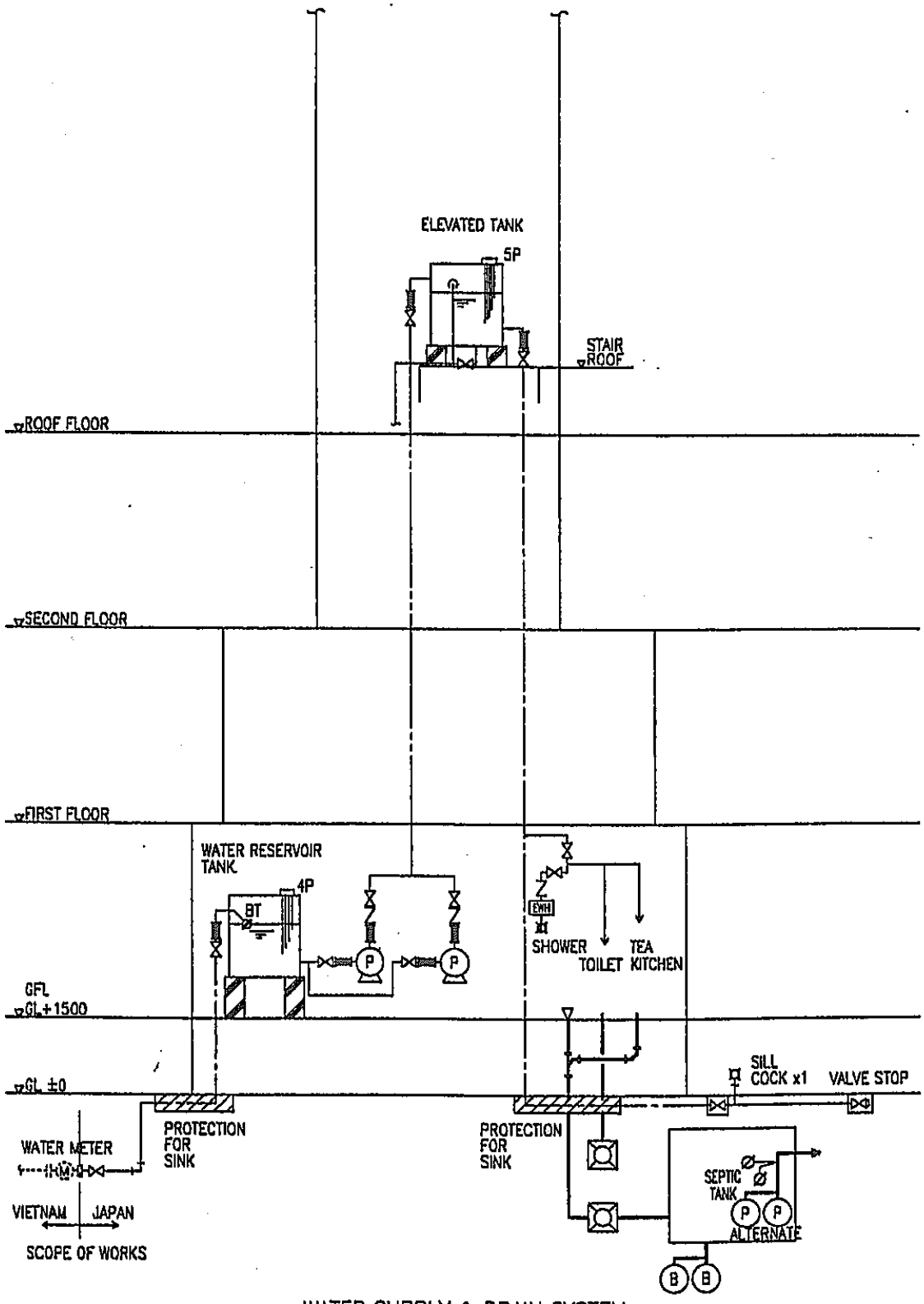
Diagram-11



FIRE DETECTION & ALARM SYSTEM DIAGRAM

PLEIKU

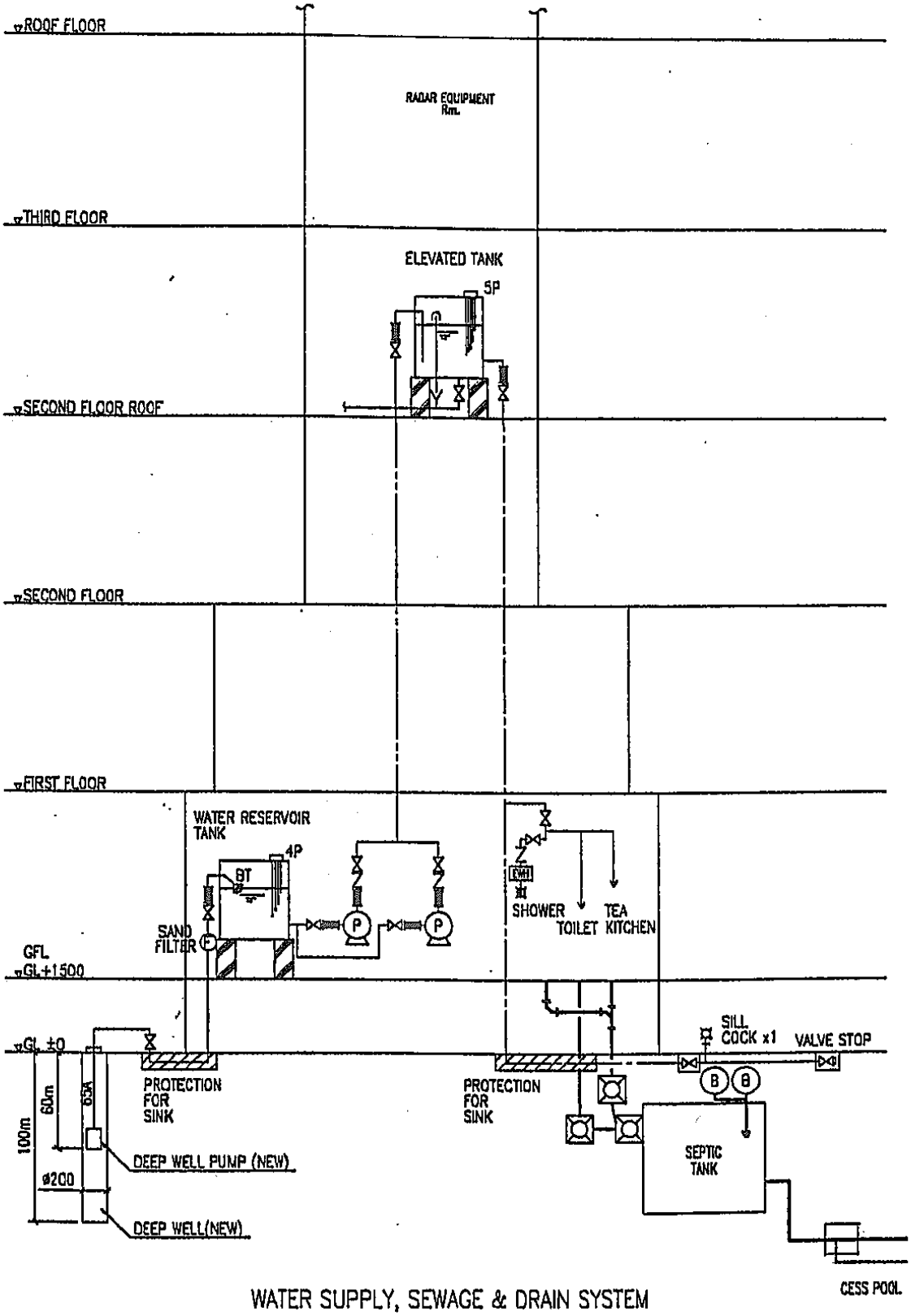
Diagram-12



WATER SUPPLY & DRAIN SYSTEM

NHA BE

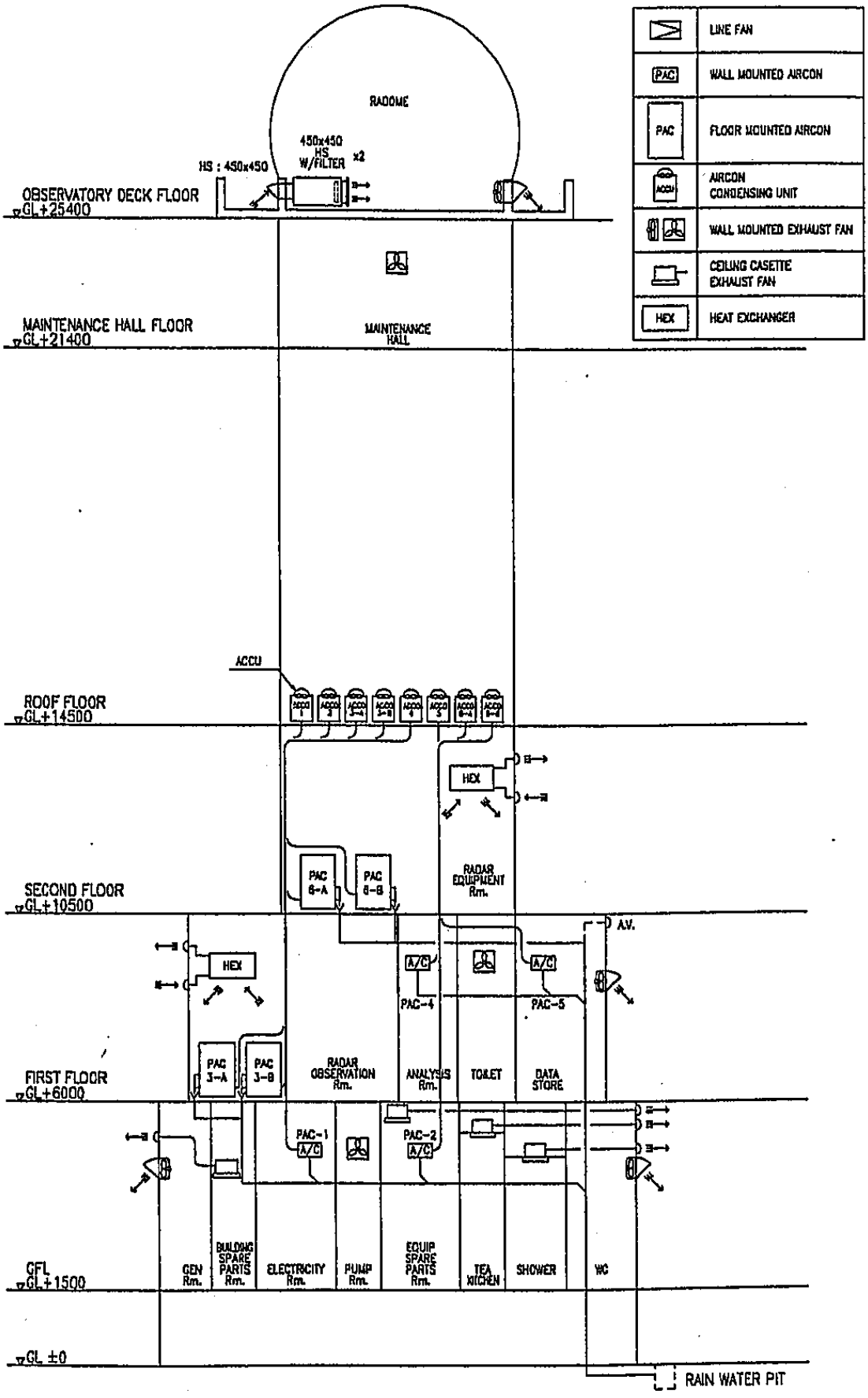
Diagram-13



WATER SUPPLY, SEWAGE & DRAIN SYSTEM

PLEIKU

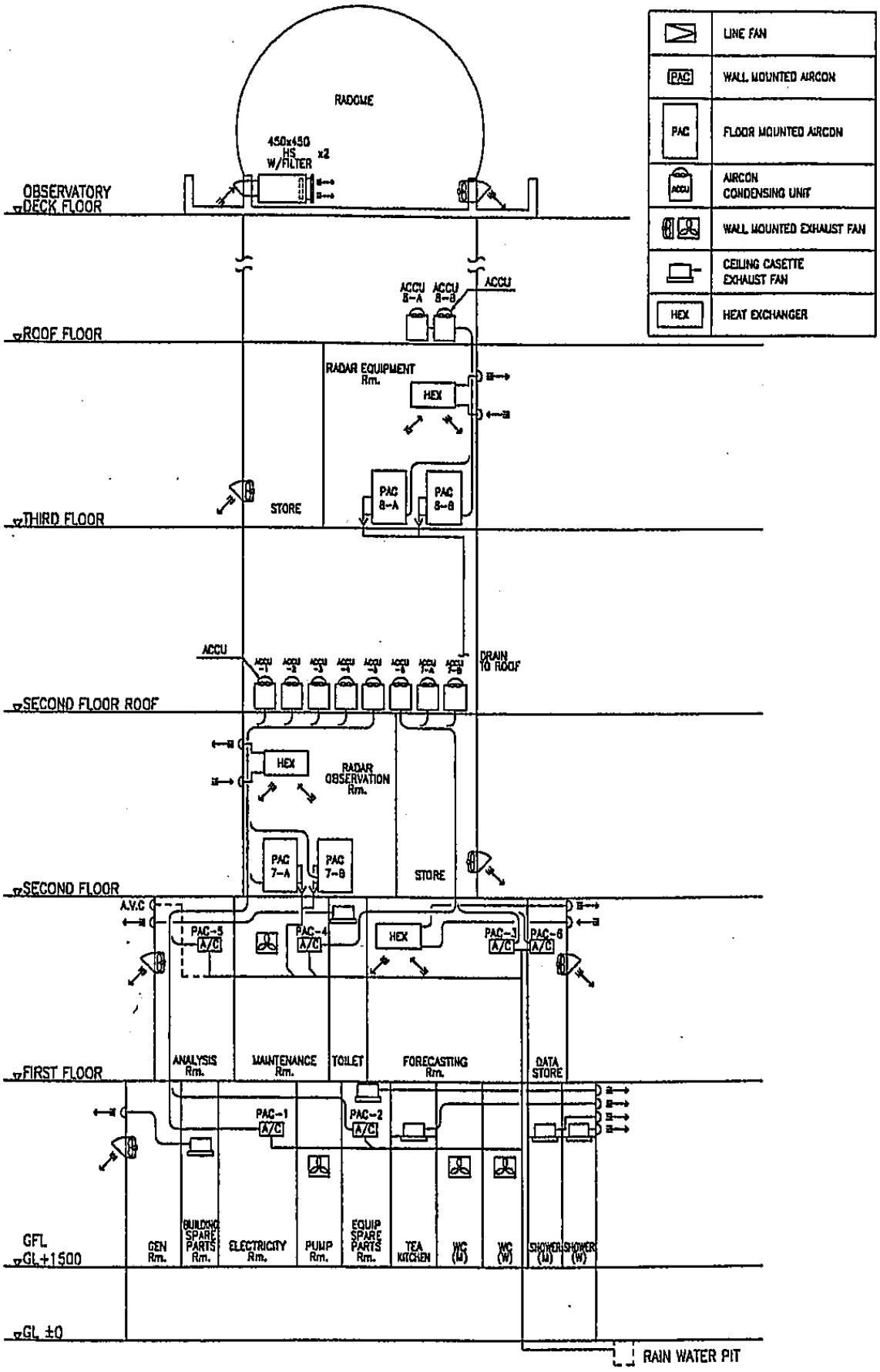
Diagram-14



VENTILATION & AIR CONDITIONING SYSTEM

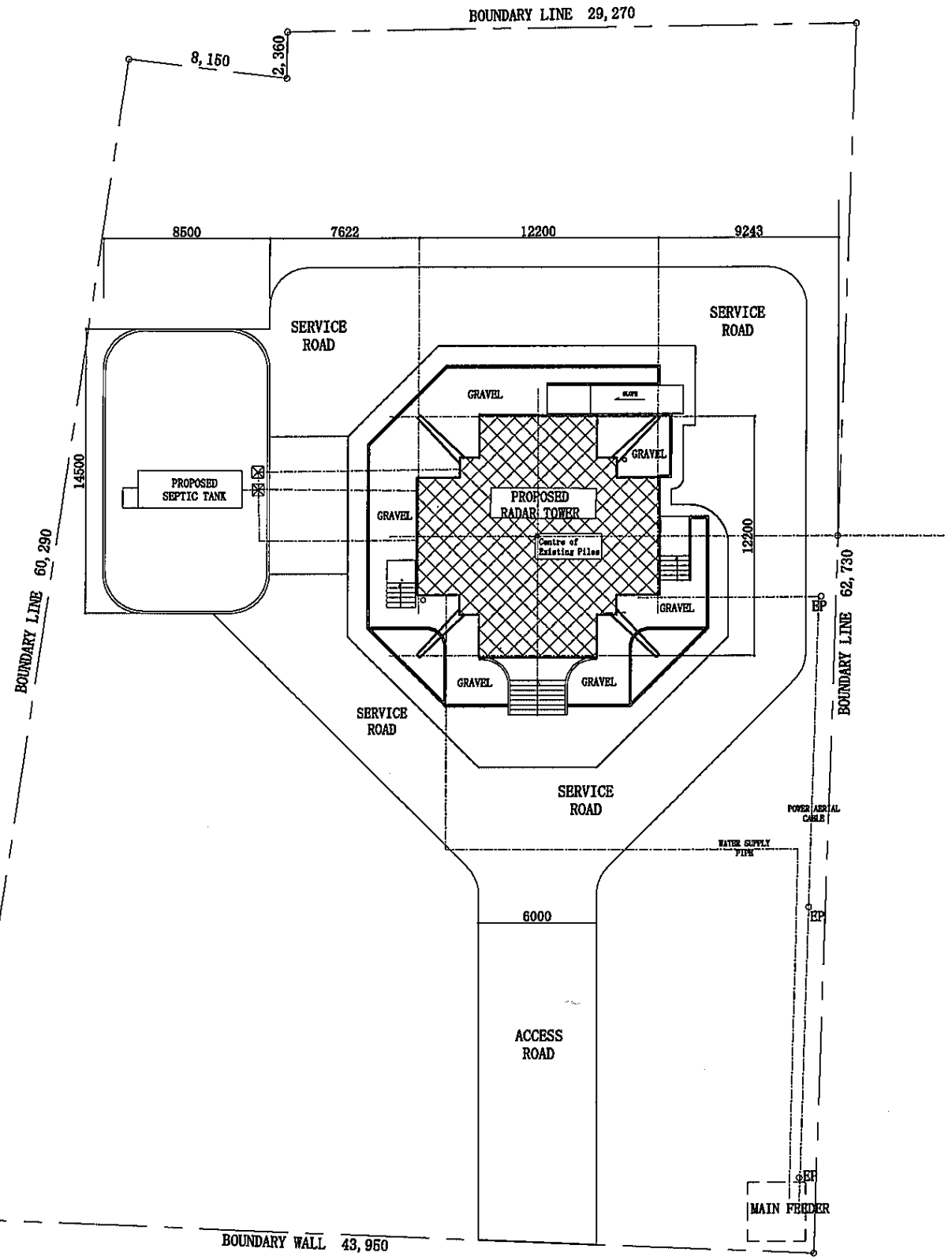
NHA BE

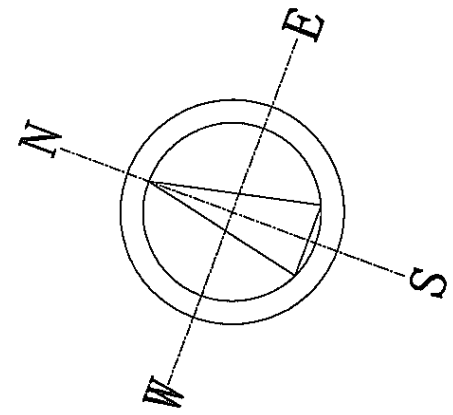
Diagram-15



VENTILATION & AIR CONDITIONING SYSTEM

PLEIKU

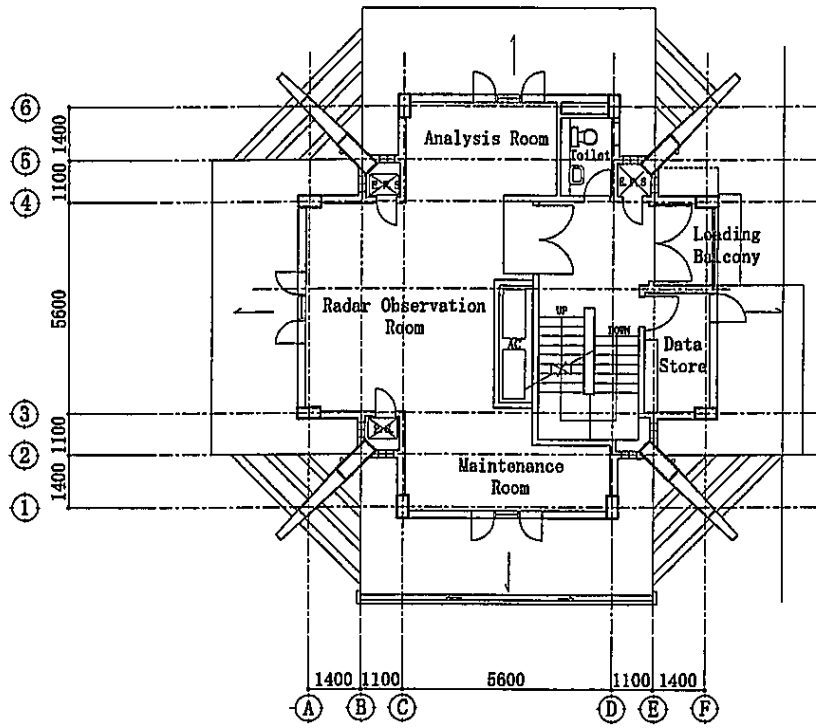




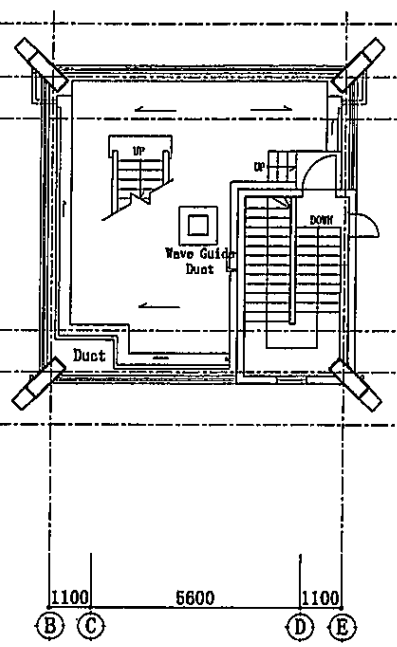
LAYOUT PLAN

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

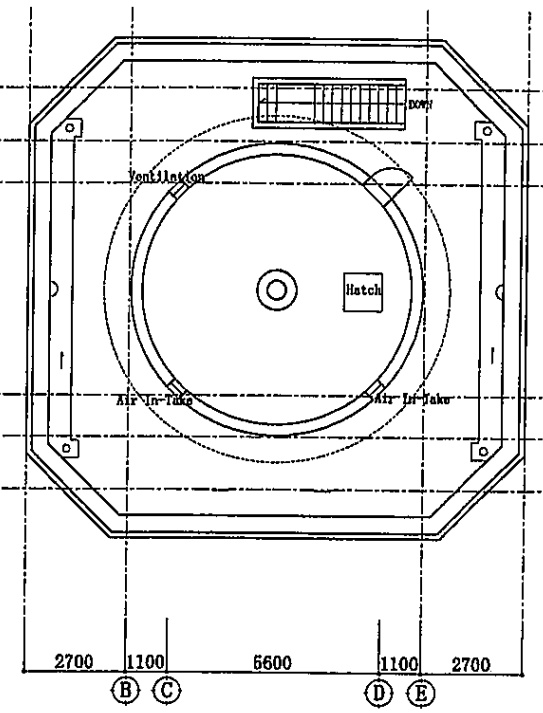
PROJECT	DRAWING TITLE	SCALE	DRAWING No.
NHA BE RADAR TOWER	SITE LAYOUT PLAN	1:300	NA-01



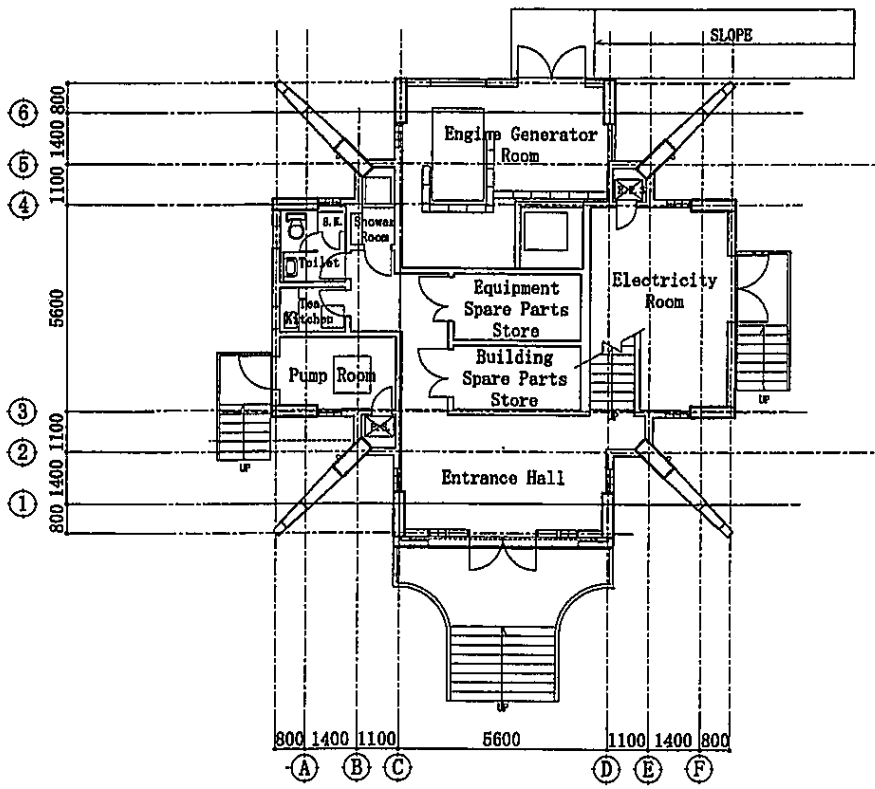
FIRST FLOOR PLAN



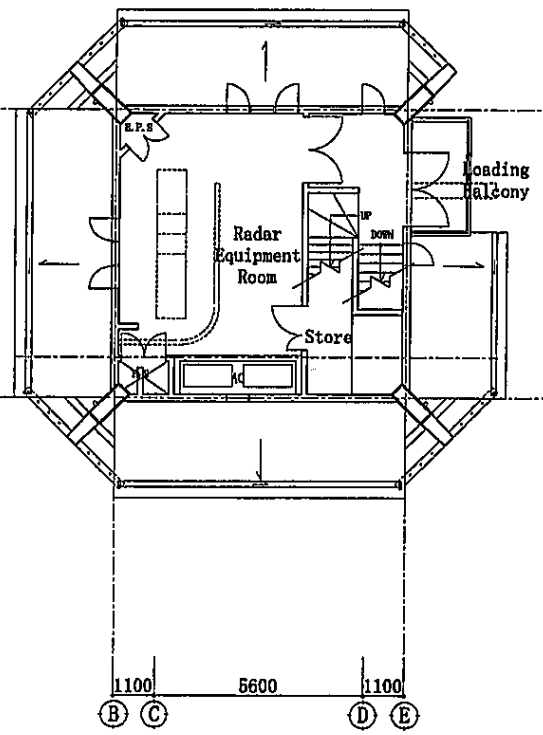
ROOF FLOOR PLAN



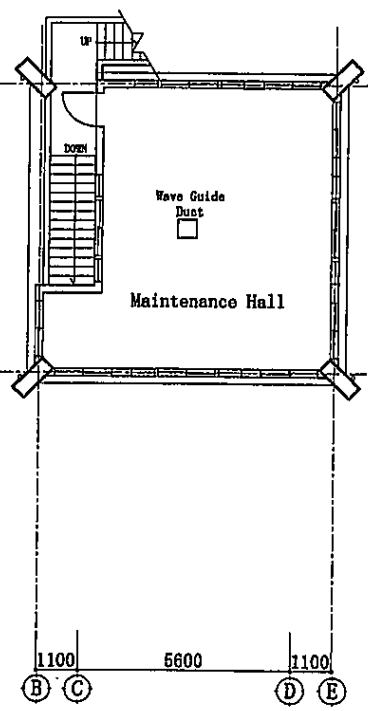
OBSERVATORY DECK PLAN



GROUND FLOOR PLAN



SECOND FLOOR PLAN



MAINTENANCE HALL FLOOR PLAN

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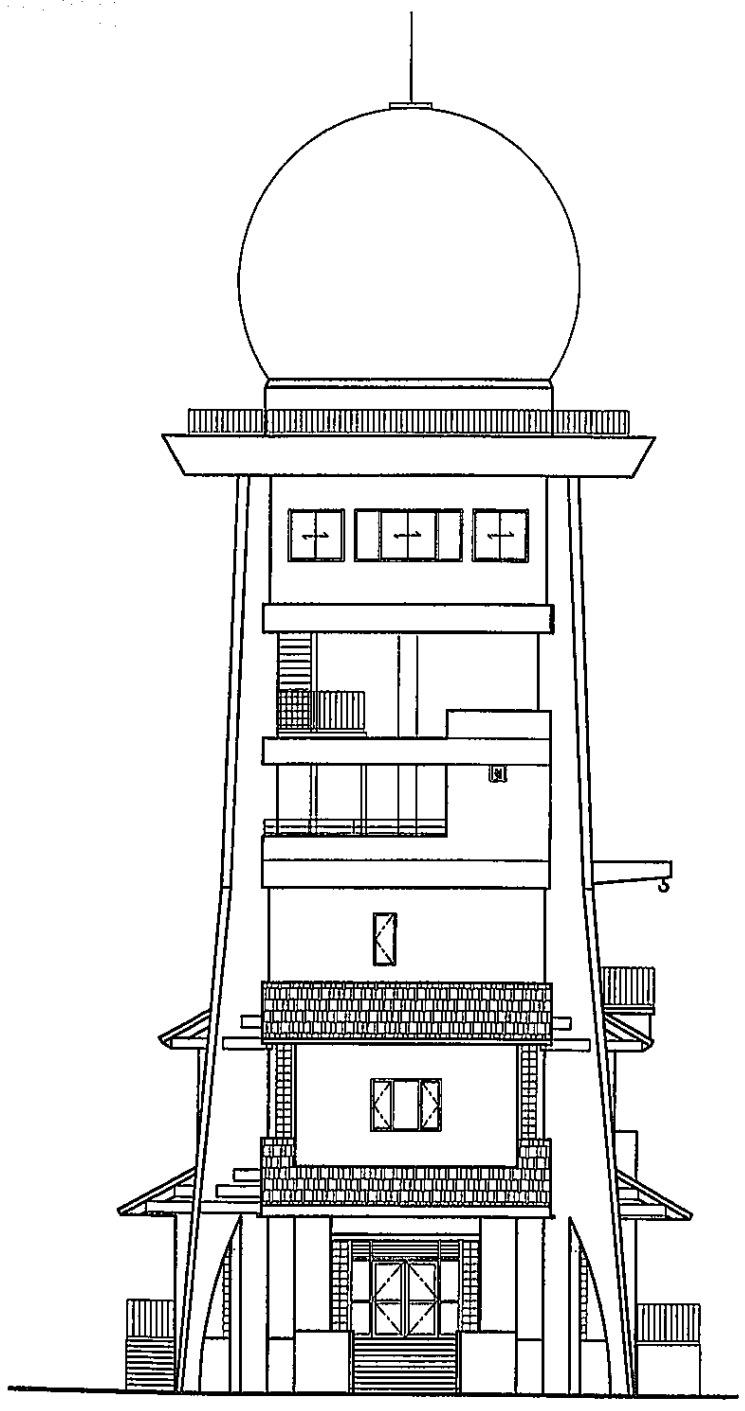
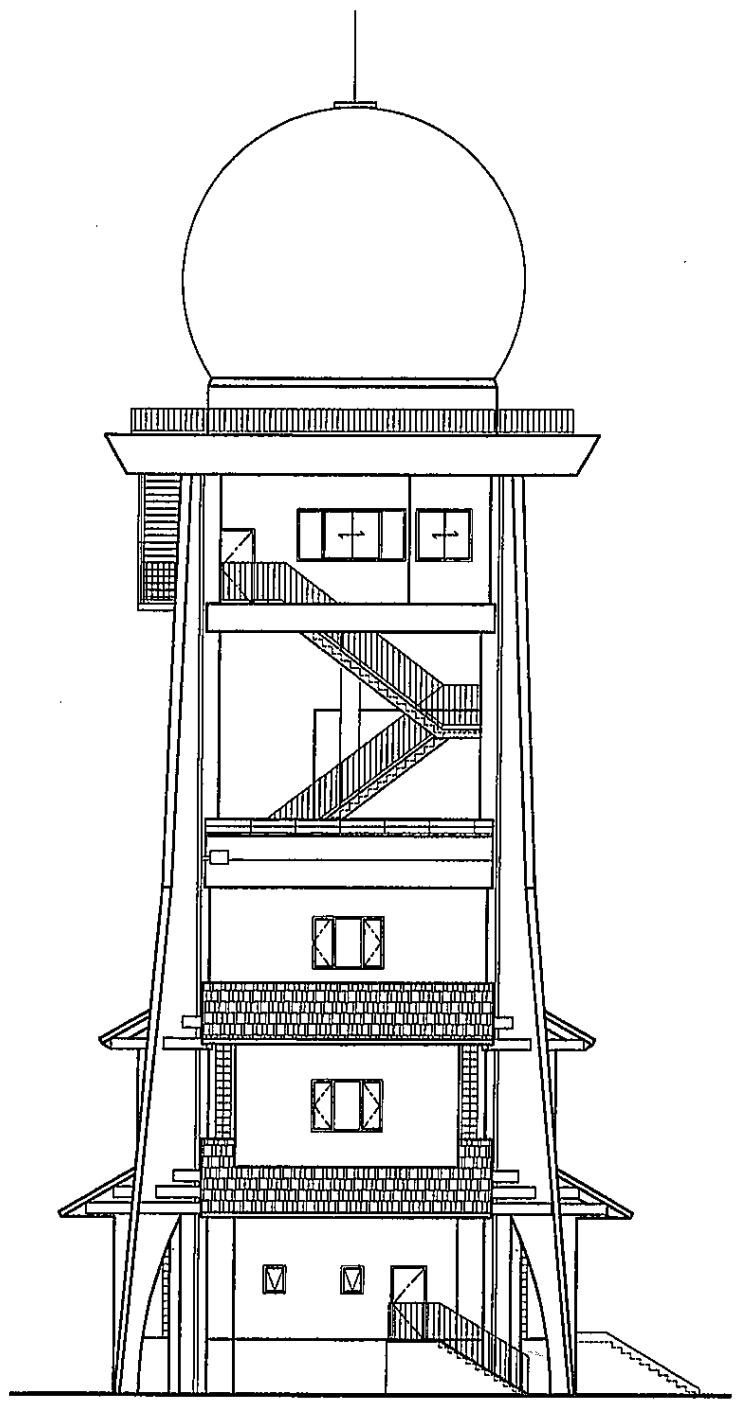
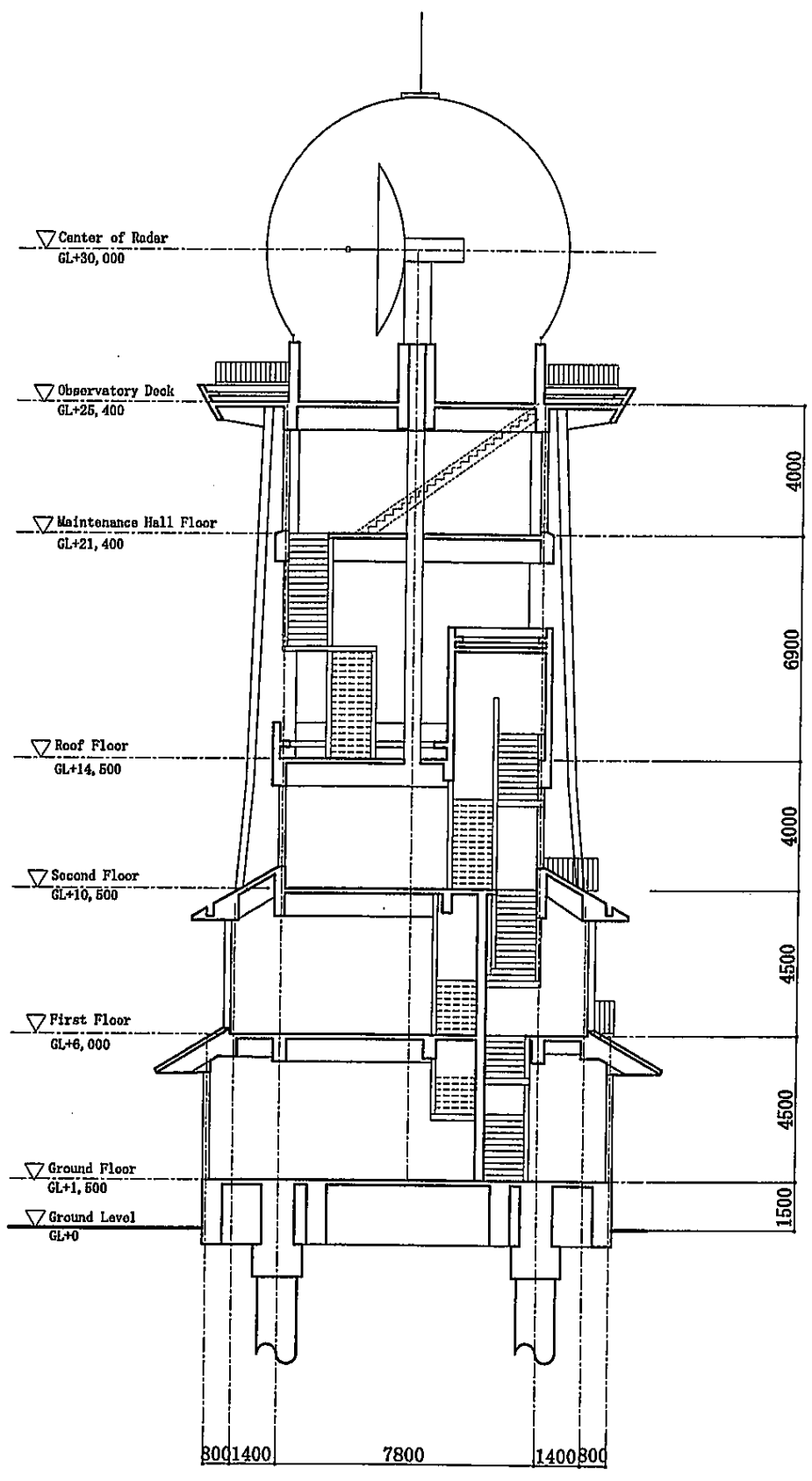
PROJECT	DRAWING TITLE	SCALE	DRAWING No.
NHA BE RADAR TOWER	FLOOR PLAN	1:200	NA-02



WEST ELEVATION



NORTH ELEVATION



SECTION

Japan Weather Association
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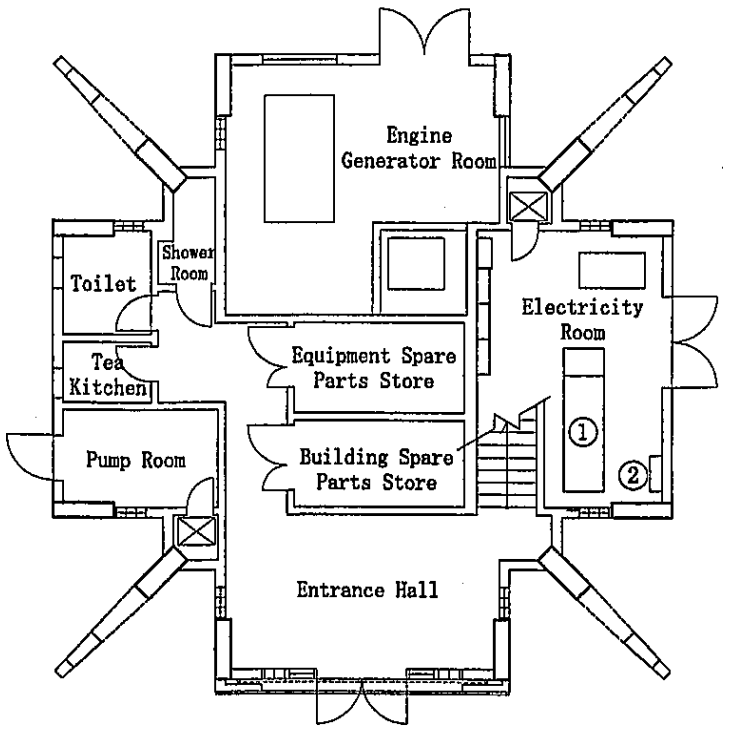
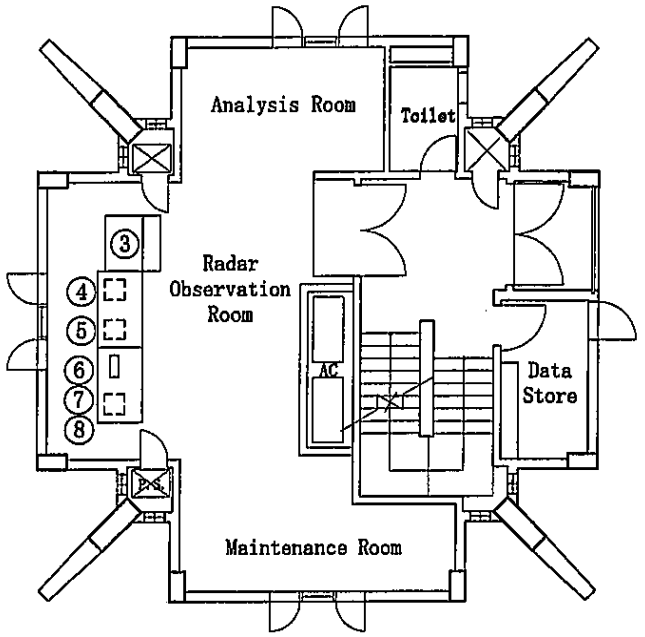
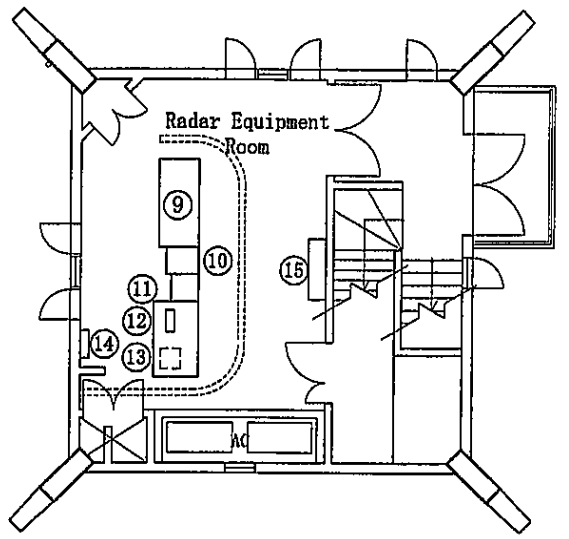
PROJECT	DRAWING TITLE	SCALE	DRAWING No.
NHA BE RADAR TOWER	ELEVATION & SECTION	1:200	NA-03







GROUND FLOOR PLAN

① CVCF
② Power Distribution Board

FIRST FLOOR PLAN

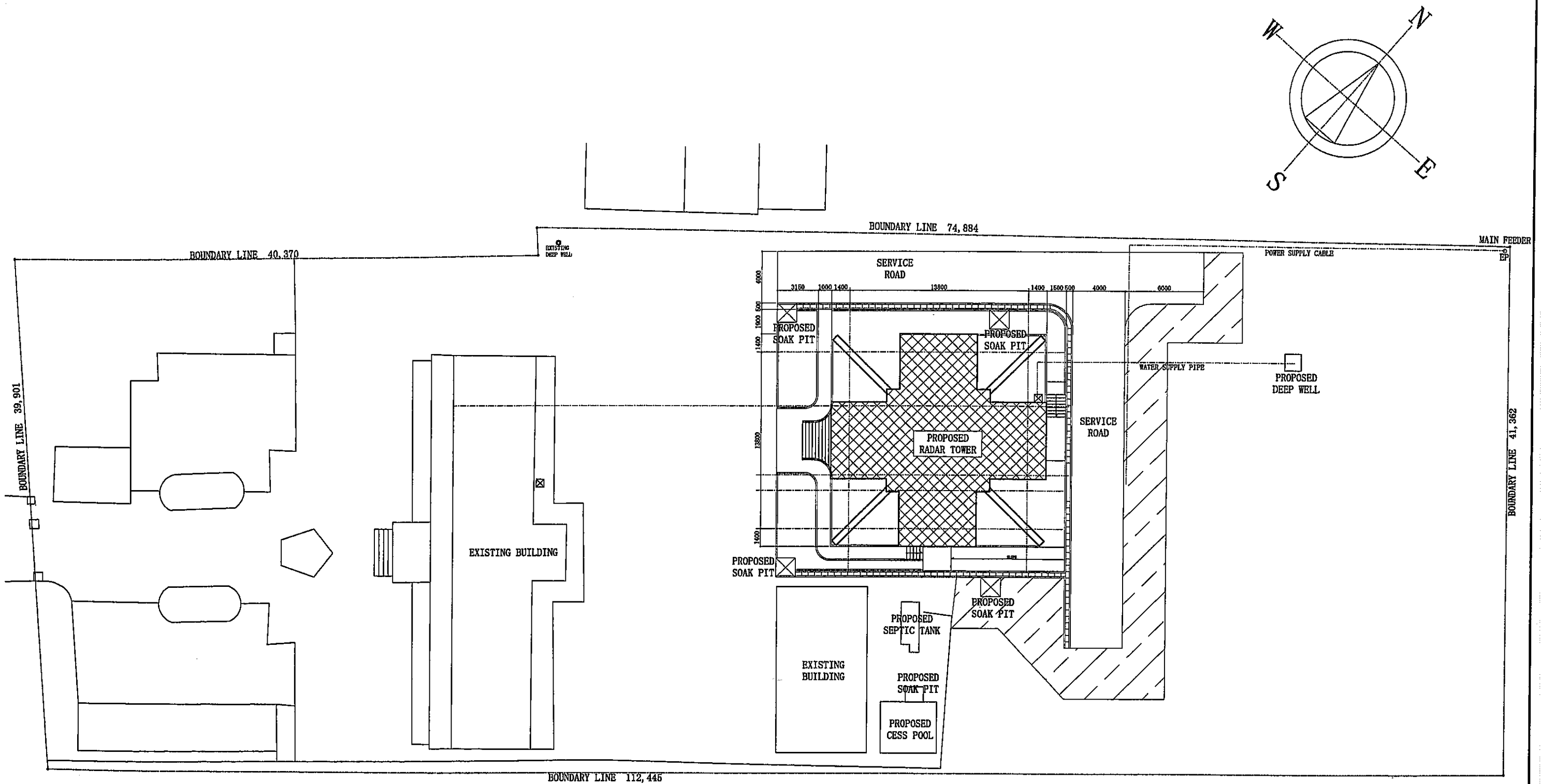
③ PPI/RHI Indicator
④ Radar Product Monitor Unit
⑤ Remote Display Unit
⑥ Inkjet Printer
⑦ Remote Access Controller
⑧ Router

SECOND FLOOR PLAN

⑨ Transmitter
⑩ Receiver & Signal Processor
⑪ Antenna Servo Controller
⑫ Inkjet Printer
⑬ Radar Master Control Station
⑭ Dehydrator
⑮ Power Distribution Unit

JWA Japan Weather Association
Sunshine 60 Bldg., 55F, 3-1-1, Higashi Ikebukuro, Toshima-ku, Tokyo, 170-6055 Japan Tel. +81-3-5958-8101 Fax. +81-3-5958-8102

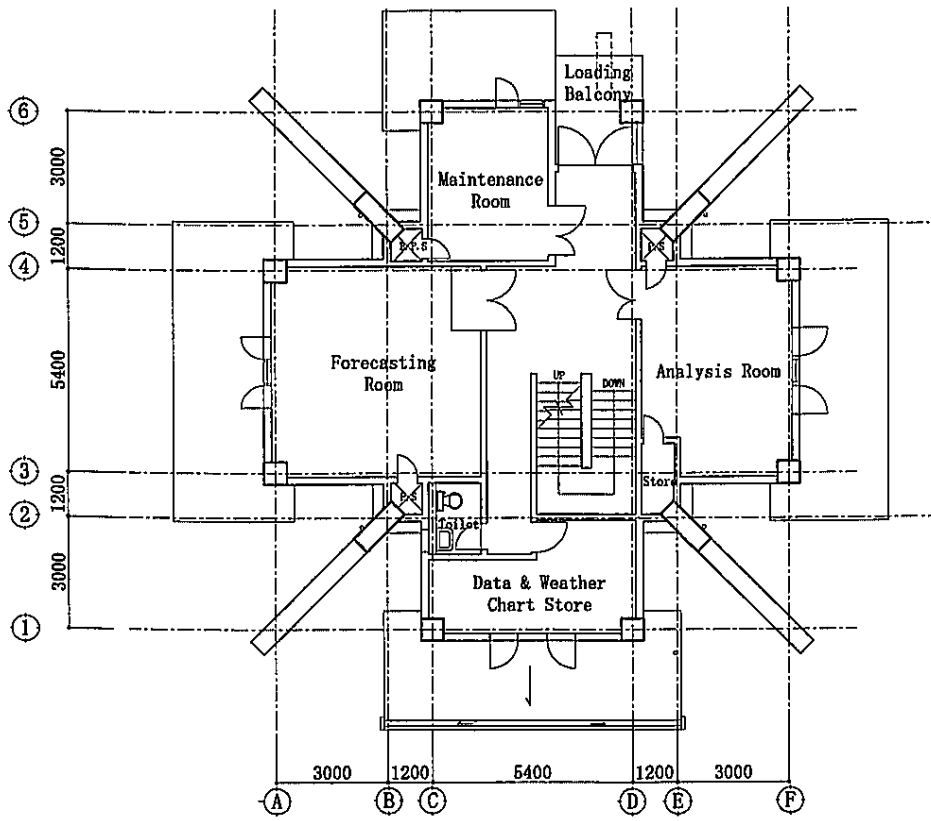
PROJECT	DRAWING TITLE	SCALE	DRAWING No.
NHA BE RADAR TOWER	EQUIPMENT LAYOUT PLAN	1:150	NA-04



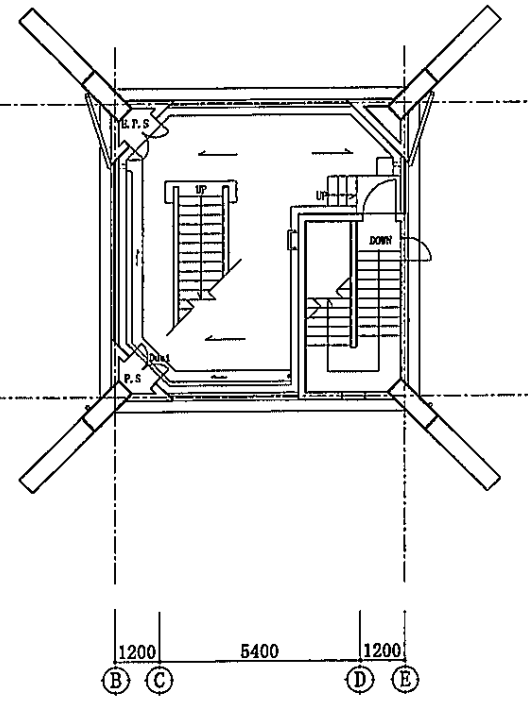
LAYOUT PLAN

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

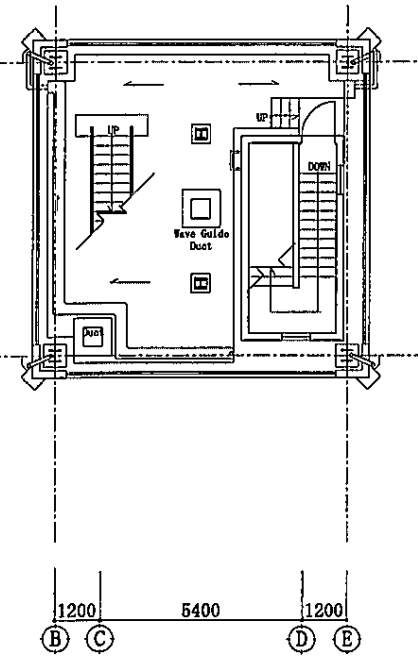
PROJECT	DRAWING TITLE	SCALE	DRAWING No.
PLEIKU RADAR TOWER	SITE LAYOUT PLAN	1:300	PA-01



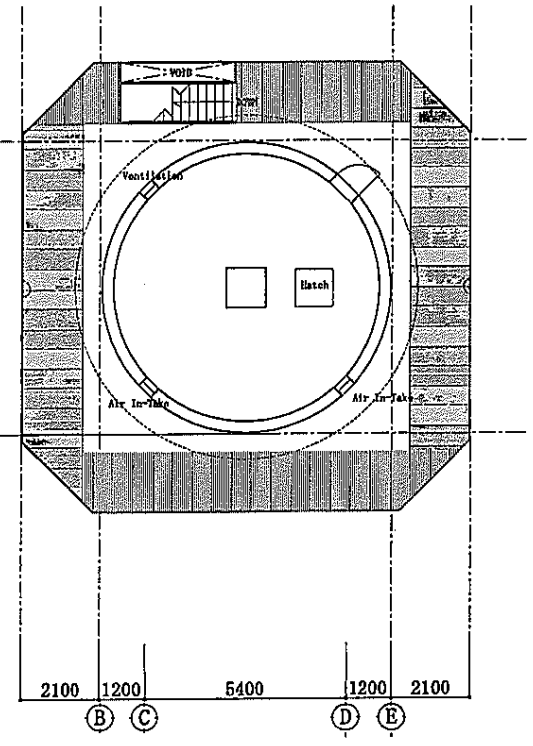
FIRST FLOOR PLAN



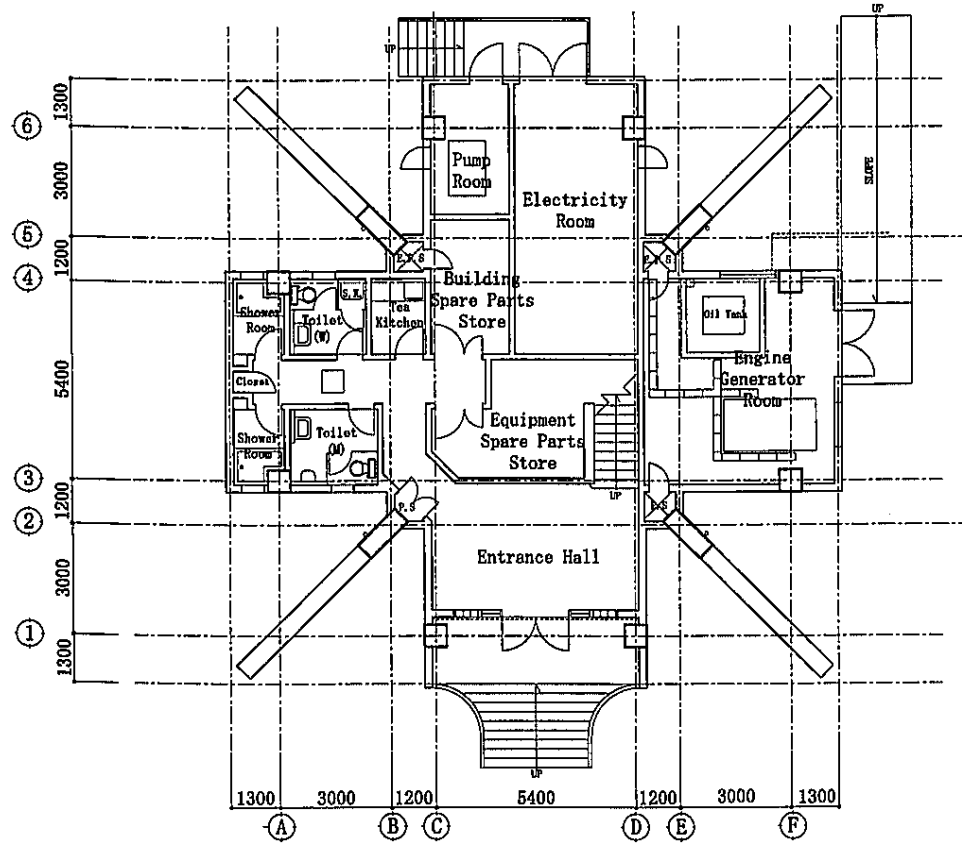
SECOND FLOOR ROOF PLAN



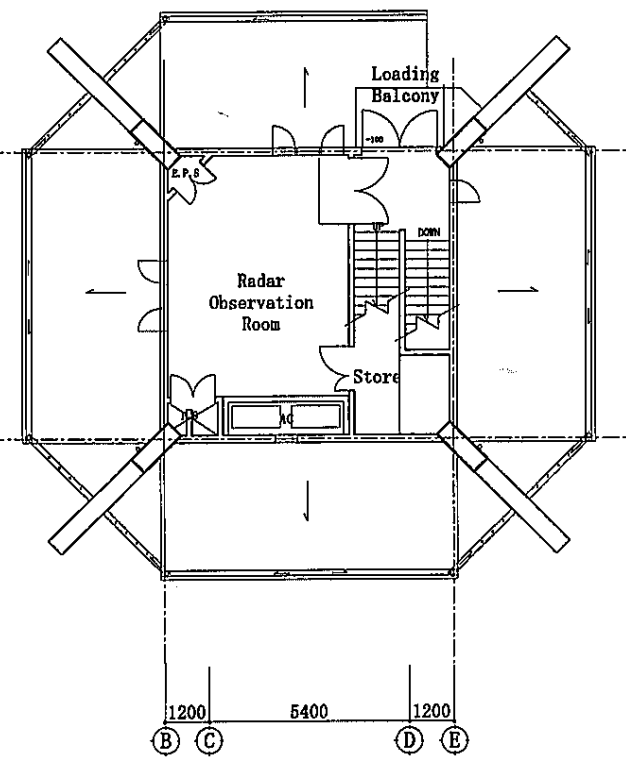
ROOF FLOOR PLAN



OBSERVATORY DECK PLAN



GROUND FLOOR PLAN



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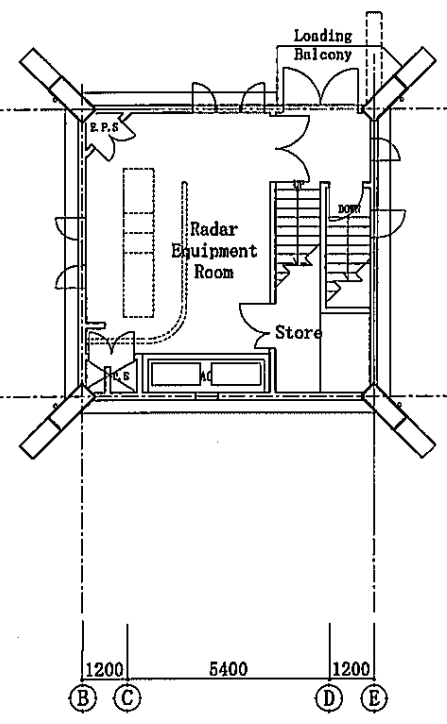
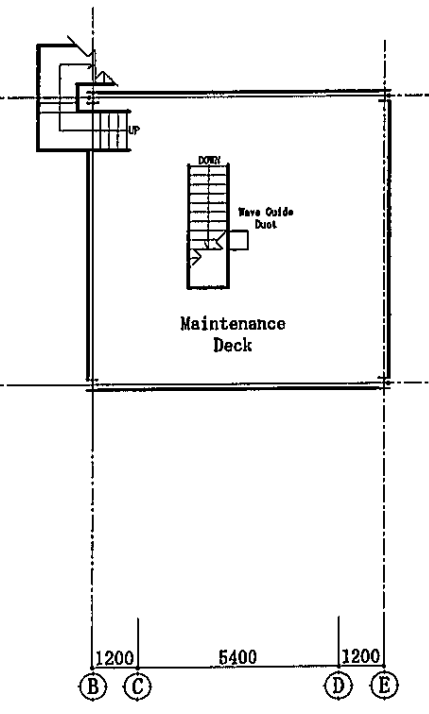


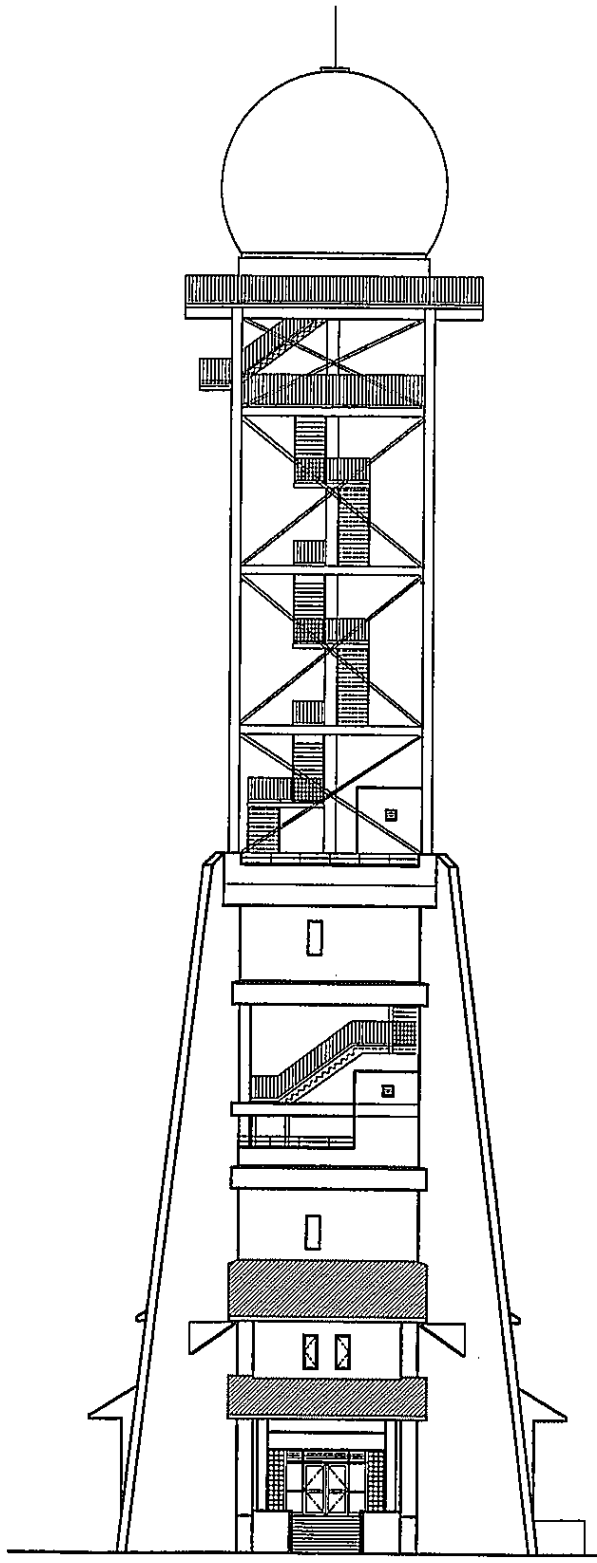
THIRD FLOOR PLAN



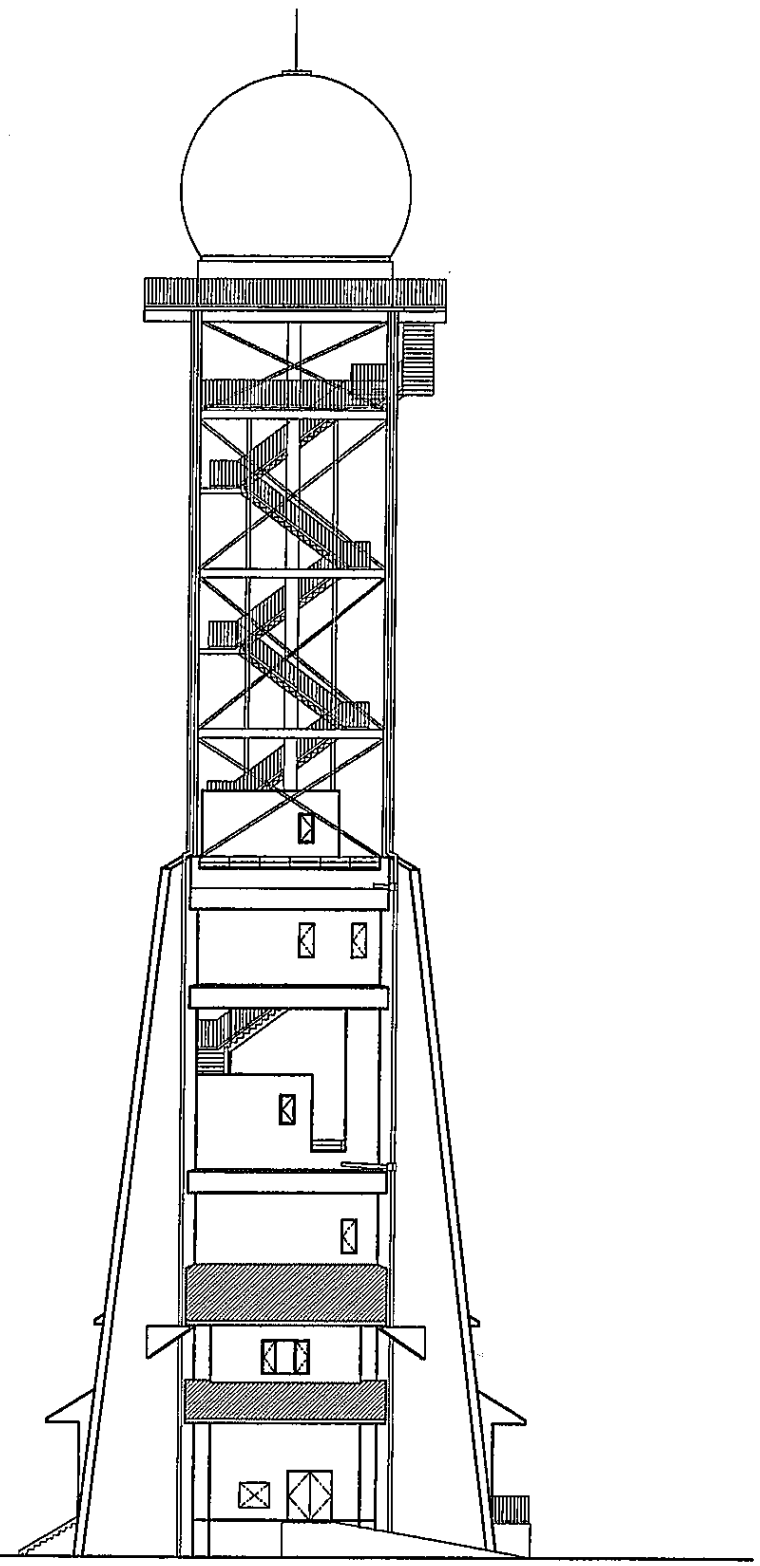
MAINTENANCE DECK PLAN

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

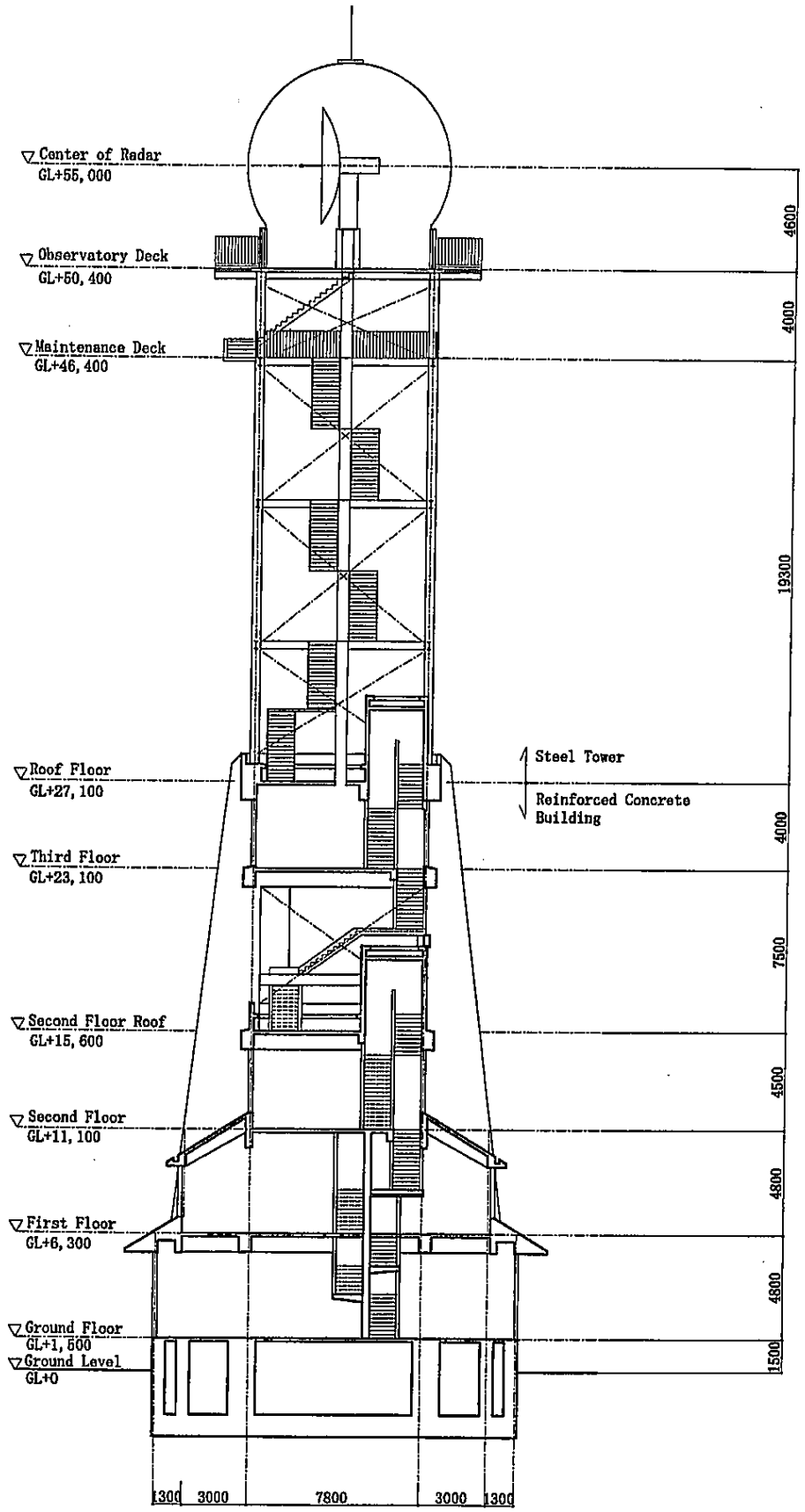
PROJECT	DRAWING TITLE	SCALE	DRAWING No.
PLEIKU RADAR TOWER	FLOOR PLAN	1:200	PA-02



WEST ELEVATION

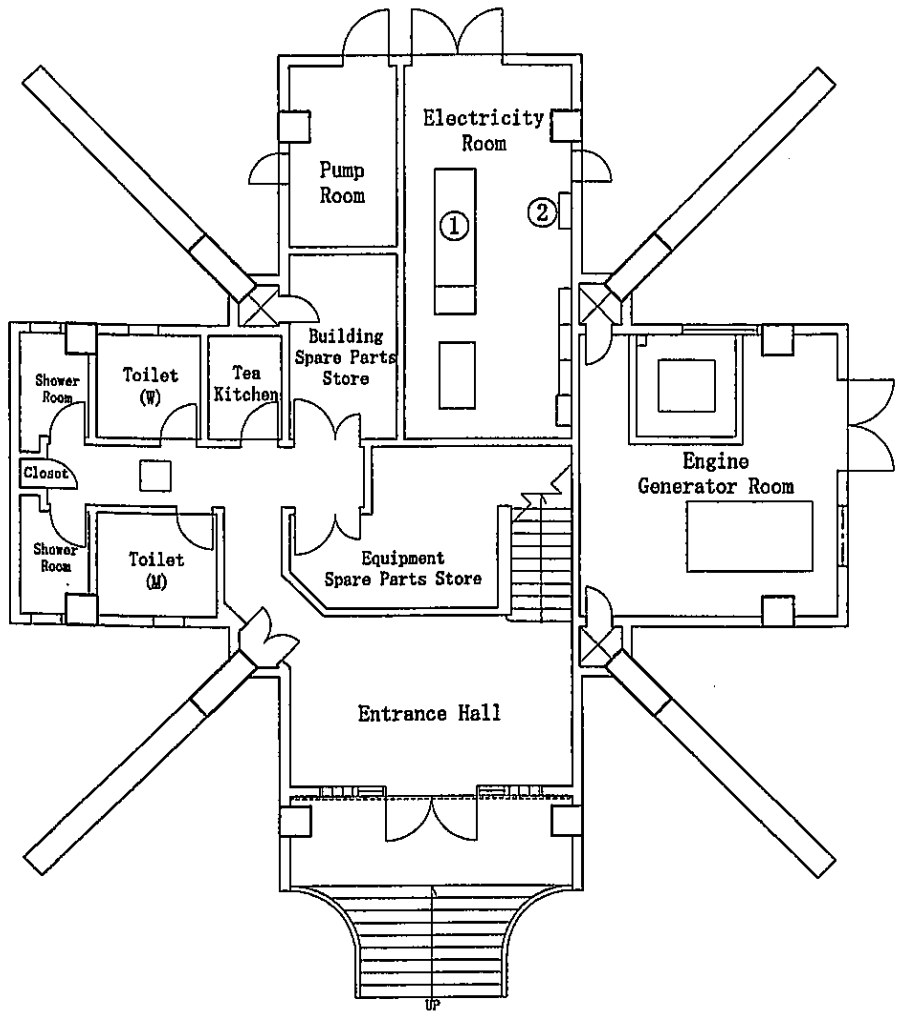


SOUTH ELEVATION

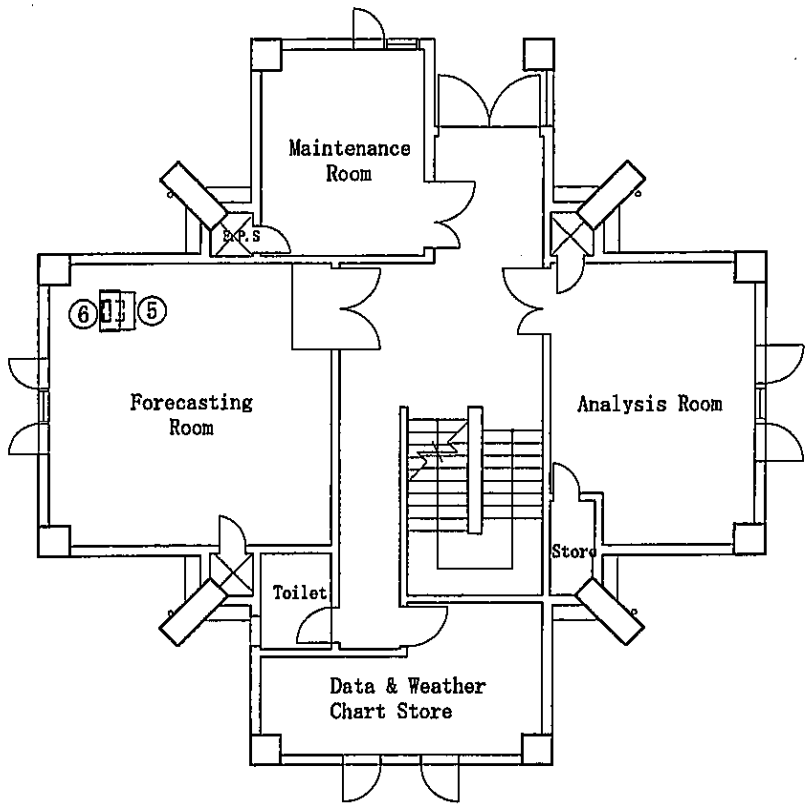


SECTION

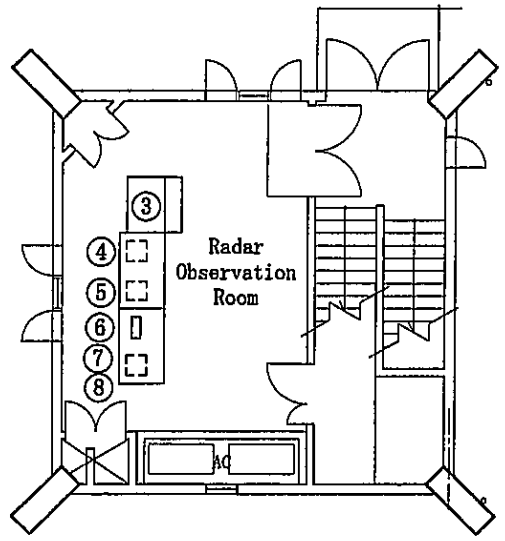
Japan Weather Association Sunshine 60 Bldg., 55F, 3-1-1, Higashi Ikebukuro, Toshima-ku, Tokyo, 170-6055 Japan Tel. +81-3-5958-8101 Fax. +81-3-5958-8102	PROJECT PLEIKU RADAR TOWER	DRAWING TITLE ELEVATION & SECTION	SCALE 1:300	DRAWING No. PA-03



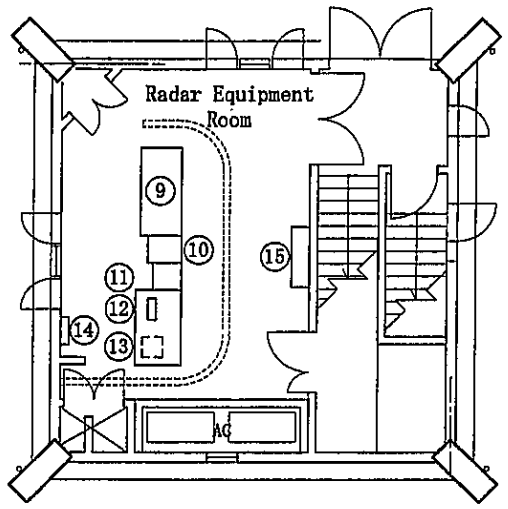
GROUND FLOOR PLAN



FIRST FLOOR PLAN



SECOND FLOOR PLAN



THIRD FLOOR PLAN

① CVCF
② Main Power Distribution Board

⑦ Remote Display Unit
⑧ Inkjet Printer

③ PPI/RHI Indicator
④ Radar Product Monitor Unit
⑤ Remote Display Unit
⑥ Inkjet Printer
⑦ Remote Access Controller
⑧ Router

⑨ Transmitter
⑩ Receiver & Signal Processor
⑪ Antenna Servo Controller
⑫ Inkjet Printer
⑬ Radar Master Control Station
⑭ Dehydrator
⑮ Power Distribution Unit

JWA 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

PROJECT	DRAWING TITLE	SCALE	DRAWING No.
PLEIKU RADAR TOWER	EQUIPMENT LAYOUT PLAN	1:150	PA-04

3. Basic Plan of Soft-Component Program

1) Background and Necessity of Soft-Component Program

Soft-Component Program aims at the following targets through technology transfer by experts to be dispatched to a recipient country.

- Appropriate and efficient utilization of a project donated by the Japan's Grant Aid Assistance for the nation of a recipient country
- Effective generation of the project benefit and effects
- Smooth operation and maintenance of a donated project

Through lectures and practical training to be implemented by the dispatched experts, the following 2 technology transfer programs are necessary to conduct as Soft-Component Program under the Project for satisfying the captioned targets of the Soft-Component Program.

(1) Soft-Component Program for fundamental knowledge & practical utilization technique of a radar system for forecasting works

After completion of the Project, 7 meteorological radar systems (5 existing and 2 new radar systems) will be exited in the Vietnam. For appropriate and efficient utilization of the radar systems for reduction of the natural disaster and effective generation of the project benefit and effects together with the existing radar systems, technology transfer on fundamental knowledge & practical utilization technique of a radar system for forecasting works will be required for HMS.

(2) Soft-Component Program for operation & maintenance technique of a radar system

Normally, operation & maintenance manuals of radar system prepared by a manufacturer consist of a large number of volumes. However, practically only some of paragraphs in the manuals are required for the routine work for radar system operation & maintenance. For smooth operation and maintenance of the Project and also easy & short time trouble-shootings by HMS, brief manuals including primary and significant descriptions translated to Vietnamese will be required for the HMS's routine work.

2) Objectives of Soft Component Program

For effective operation and maintenance of the radar network to be established under the Project, the followings are decided as objectives of the Soft-Component Program for the Project.

- Strengthening of HMS's capability for utilization of the radar data for the HMS's services
- Strengthening of HMS's capability for operation and maintenance of a radar system

3) Expected Outcomes (Direct Effects) of Soft Component Program

Expected outcomes as direct effects of the Soft-Component Program for the Project to be received by the HMS are as follows.

(1) Soft-Component Program for fundamental knowledge & practical utilization technique of a radar system for forecasting works

① Advancing fundamental knowledge of a radar system
② Advancing the radar-meteorology
③ Improving radar monitoring capability for meteorological phenomena
④ Obtaining preparation process technique of radar products and practical utilization technique of a radar system for forecasting works
⑤ Obtaining text books for radar fundamental knowledge, preparation process of radar products and practical utilization technique

(2) Soft-Component Program for operation & maintenance technique of a radar system

① Upgrading the radar system operation and maintenance technique and skill
② Obtaining significant check points for maintenance and measuring methodical skill
③ Improving operation skill of measuring instruments and tools for radar maintenance
④ Obtaining specialized technique for minimizing occurrence of the system failure using maintenance check sheets and for trouble-shooting
⑤ Obtaining the brief manuals on operation and maintenance of the radar system for the HMS's routine work

4) Scheduled Activities

(1) Implementation Schedule

① Soft-Component Program for fundamental knowledge & practical utilization technique of a radar system for forecasting works

- In Japan between April and May, 2003: 2 experts for 1 month
- In Vietnam between April and May, 2003: 1 expert for 1.5 months

② Soft-Component Program for operation & maintenance technique of a radar system

- In Japan in February, 2004: 1 expert for 1 month
- In Vietnam between April and May, 2004: 1 expert for 1.2 months

(2) Personnel Assignment

The following personnel assignments are required for the implementation of the Soft-Component Program.

i) Japan Side

① Soft-Component Program for fundamental knowledge & practical utilization technique of a radar system for forecasting works

- 2 Meteorological Experts (Meteorologists)

② Soft-Component Program for operation & maintenance technique of a radar system

- Radar Engineering Expert

ii) Vietnam Side

For each expert to be dispatched to the Vietnam, the following trainee assignments of the Vietnam side are required and at least, a counterpart of HMS are necessary for each expert for smooth management of technology transfer.

① Trainees for "Soft-Component Program for fundamental knowledge & practical utilization technique of a radar system for forecasting works"

- To be nominated from the HMS Head Office

② Trainees for "Soft-Component Program for operation & maintenance technique of a radar system"

- To be nominated from the Nha Be Radar Site, the Pleiku Radar Site and the Regional Hydrometeorological Center (RHMC) in Ho Chi Minh City

(3) Implementation Place for technology transfer

① Soft-Component Program for fundamental knowledge & practical utilization technique of a radar system for forecasting work

- The HMS Head Office
- The Regional Hydrometeorological Center (RHMC) in Ho Chi Minh City

② Soft-Component Program for operation & maintenance technique of a radar system

- The Nha Be Radar Site
- The Pleiku Radar

(4) Activities and Outcomes

i) Soft-Component Program for fundamental knowledge & practical utilization technique of a radar system for forecasting works

Taking the existing technical level of HMS into consideration, text books for radar fundamental knowledge, algorismic preparation process of radar products and practical utilization technique of a radar system for forecasting works will be prepared by the dispatched expert together with HMS.

Activities for the dispatched expert

① Lecture for radar observation technique & knowledge
② Lecture and practical training for radar monitoring of meteorological phenomena
③ Methodical lecture and practical training for preparation process of radar products
④ Preparation work for the text books

ii) Soft-Component Program for operation & maintenance technique of a radar system

Prior to commencement of Soft-Component Program to be implemented in the Vietnam, brief manuals required for the HMS's routine work for radar system operation & maintenance will be prepared by an expert to be dispatched to the Vietnam and the manuals will be translated to Vietnamese in Japan.

During the Soft-Component Program implementation in the Vietnam, the brief manuals will be revised and finalized by HMS through cooperation of the dispatched expert to be suitable for the HMS's routine work, if required.

Activities for the dispatched expert

① Technical and systematical lecture for primary technique & knowledge of a radar system
② Lecture and practical training for operation & maintenance routine work
③ Lecture and practical training for the system check with measuring instruments
④ Practical and operational training for the system measuring instruments and tools
⑤ Preparation work for operation and maintenance routine work flow charts
⑥ Preparation work for the radar system operation & maintenance manuals

Chapter 3 Implementation Plan

3 - 1 Implementation Plan

3 - 1 - 1 Implementation Concept

The coordination among related implementation works for completion of the Project will be required, because the Project concerns systematically many engineering fields such as meteorology, data communication, architecture, civil engineering, etc. In the Project, there is meteorological equipment work portion refers to manufacturing, shipment, inland transport, local installation, adjustment and commissioning.

For smooth implementing of the Project and avoiding delay and misunderstanding, communicating with the responsible organization (Hydrometeorological Service: HMS), Embassy of Japan, JICA Vietnam office and concerned government authorities will be necessary.

1. Executing agency of the Project

The responsible governmental agency of Vietnam for the implementation of the Project is HMS under supervision of the Prime Minister's Office, the Government of the Socialist Republic of Vietnam and it will be a signer of the Consultant Agreement and the Contract as the Client.

2. Consultant

After signing of the Exchange of Notes (E/N) for the Project between the Government of Vietnam and the Government of Japan, it is very significant to conclude an Agreement of the Consulting Services for the Project as early as possible. The Agreement of the Consulting Services will be signed by and between HMS and a consulting firm duly organized and existing under the laws of Japan, having its principal office in Japan and recommended by JICA.

After signing of the Agreement of the Consulting Services, a consulting firm will be the Consultant for the Project. The Consultant will conduct detailed design study in Vietnam with HMS and Japan, and prepare tender documents including technical specifications, drawings, diagrams, etc. In addition, the Consultant will conduct a tendering and supervise the Project implementation for successful completion of the Project as a project of Japan's Grant Aid Assistance.

3. Considerable points for the implementation

As for the implementation, it is necessary to discuss in detail and confirm the following points between HMS and the Consultant during the detailed design period.

1)Securing and clearing the Pleiku Radar Site.

2)Reclaiming and clearing the Nha Be Radar Site.

3)Distributing the required electricity and water supply, telephone line(s) and other incidental facilities to the Project sites.

4)Taking all necessary procedures and obtaining all required permissions regarding the project implementation by HMS prior to the commencement of the Project.

5)Obtaining necessary radio frequencies for radar systems to be supplied under the Project.

6)Taking necessary measures and making a special arrangement on security to Japanese nationals to perform our obligations against any force majeures during field survey, inland transport, civil work, installation work, etc.

7)Making appropriate and effective measures to ensure of the system and equipment to be supplied under the Project against any damage and disappearance during transportation, installation and operation.

8)Taking prompt necessary measures for tax exemption and customs clearance of the materials and equipment to be supplied for the Project at the port of disembarkation.

9)For procurement of the equipment and materials for this Project to be financed by Japan's Grant Aid Assistance, careful liaison and coordination must be maintained with the concerned governmental agencies of Vietnam.

10)All necessary procedures for importing limited items and obtaining import license for the materials and equipment to be supplied under the Project must promptly be completed in cooperation with the implementing organization, HMS.

11)Confirming the required budgetary allocation on capital cost and recurrent cost for appropriate operation & maintenance and also procurement of spare parts & consumables for the whole equipment and systems to be supplied under the Project.

12)Strengthening technical skill & capability of HMS and establishing a maintenance system.

4. Contractor

A contractor duly organized and existing under the laws of Japan, having its principal office in Japan, with necessary qualifications, will be selected by an open public tender in accordance with the tender documents prepared by the Consultant in accordance with the JICA guide line and approved by HMS.

The Project consists of many complicated implementing works such as procurement, manufacturing, installation, adjustment, testing and commissioning of the equipment and construction of the Radar Tower Buildings. Therefore, all bidders to participate in the open public tender shall constitute a consortium consisting of an equipment supplier (a trading company) and a building construction company duly organized and existing under the laws of Japan, having their principal offices in Japan, before participating the tender due to the following reasons. This condition is unchangeable for the successful completion of the Project.

a. For avoiding discrepancy between the equipment installation and the building construction,
b. For preventing unnecessary delay of the implementation work,
c. For implementing easy coordination within the contractor for smooth implementation works by the Consultant and HMS,
d. For clearing the responsibility on successful completion of both the building construction and the equipment installation,
e. For unifying the responsibility to deal with any problem and defect arise at the interfacial area between the buildings and the equipment, even in the duration of maintenance period to be set in the contract,
f. For economizing the implementation cost and saving time,
g. For conducting easy safety control for the works,
h. For simplifying storage management for the equipment and the construction materials.
i. For smooth and easy distribution of an instruction of the Consultant to all the contractor's personnel,
j. For keeping high quality of the equipment installation and the building construction works,
k. For making single channel to talk between the Client side (HMS and the Consultant) and the contractor regarding the Project implementation.

In addition, for confirming required qualifications of bidders to participate in the open public tender, it is necessary to make pre-qualification examination before the tender.

After selection of the contractor for the Project, it is necessary to conclude the contract for the Project implementation by and between HMS and the contractor. The contractor shall make a successful completion of the Project under supervision of the Consultant on behalf of HMS.

3 - 1 – 2 Implementation Conditions

1. Construction Conditions

1) Necessary Procedures in Vietnam for Construction of the Radar Tower Buildings

In accordance with "Circular Providing Guidelines for Management of Construction Works with Foreign Direct Investment Capital and Foreign Contractors Undertaking Construction Works in Vietnam" published by the Ministry of Construction, Vietnam, obtaining the following certificate, license and permit are required for the Project by HMS together with the Consultant.

- Planning Certificate

Planning certificates are necessary to obtain for planning construction of the Radar Tower Buildings at the Nha Be and the Pleiku Radar Sites prior to commencement of the detailed design of the Buildings for ensuring the Project implementation. A required application form must be prepared by HMS for submitting to either the construction department of a province or a city's chief architect office which issues the planning certificate to HMS after reviewing it.

- Technical Design and Design Assessment

<Consultant license>
For applying to issue a consultant license for making a design of a buildings in Vietnam, the Consultant for the Project have to associate with a Vietnamese design agency and have to prepare the following required documents.

1) Application form
2) An announcement of the investor's decision to nominate a consultant
3) A copy of investment license issued by the Ministry of Planning and Investment (MPI)
4) Notarized of legal status Certificate of the Consultant for the Project
5) List of similar projects undertaken during last 3 years
6) Scope of work undertaken in project
7) An association agreement with a Vietnamese Consultant

After the preparation, all the required documents must be submitted to the Ministry of Construction. The consultant license is issued by the Ministry of Construction normally after 20 days from the submission date of the required document.

Then the Consultant is able to submit the following 3 sets of design documents of the Radar Tower Buildings at the Nha Be and the Pleiku Radar Sites to the People's Committee of a Province for obtaining a design certificate.

1) Application form
2) Legal status certificate of the Consultant for the Project
3) General report of surveyed data and list of standards used in design
4) Project general layout plan, technological line plan
5) Project architectural drawings: plan, elevation and section drawings and Structural drawings of superstructure
6) Infrastructure facilities drawings of project, connection schema from project infrastructure facilities to the public infrastructure system
7) A copy of the investment license, fire fighting agreement (issued by police office) and environment agreement (issued by Environment Department) from the State
8) A copy of land lease decision or contract with cadastral map scale 1/200 – 1/500

Either before or after submission of all the required documents to the People's Committee of a Province, assessment of the design documents of the Radar Tower Buildings by either an assessed Vietnamese company or an assessed foreign company is necessary. The design certificate is issued by the People's Committee of a Province normally after 20 days from the submission date of the required documents.

- Construction Permit

For obtaining a construction permit, the following 4 required documents have to be submitted to the People's Committee of a Province by HMS.

1) Application form
2) Notarized copy of land use right certificates
3) Assessed design documents
4) Business registration certificate of HMS

The construction permit is issued normally after 30 days form the submission date of the required documents by the People's Committee of a Province.

2) Local Sub-contractors

Generally in Vietnam, the technical skills and levels of the major private local contractors are relatively sufficient and suitable for implementation of the equipment installation work and construction work together with engineers of a contractor to be selected through tendering. Local firms may participate in the Project as sub-contractors but must be not responsible for the whole or the main part of the work.

3) Labor Condition

The local laborers are generally classified by their skills. Common laborers are classified into special fields and are employed when necessary. Skills of the local laborers are much varied and truly the skilled laborers are a few. The laborers are quite suitable for construction works however not suitable for installation works of sophisticated equipment such as a radar system and a computing equipment.

4) Quality and process control

Concrete aggregate, cement, lumber and other construction materials as well as primary products and equipment are either produced or assembled on a knock-down basis within Vietnam. Thus, almost budding materials can be manufactured locally. Moreover, specialty machinery, big size of steel & aluminum materials, electric equipment and sophisticated & computing equipment can be imported from ASEAN countries such as Singapore, Malaysia and Thailand, so that a reasonable level of quality can be expected in this field.

2. Special Project Considerations

Weather surveillance radar systems, computing equipment and other sophisticated equipment will be installed in Nha Be and Pleiku radar tower buildings to be constructed under the Project. Thus, electrical power supply and power back-up equipment (engine generator system, AVR, UPS, etc.) for these systems are indispensable for the Radar Tower Building for uninterrupted operation. In accordance with the construction schedule, a dispatch of an electrical engineer is required at the time of the installation, adjustment and wiring for the electrical power supply and power supply back-up equipment and also a building equipment engineer is required for adjustment and confirmation of air-conditioning performance at the time of the installation of air-conditioning systems. During the construction period, procurement of the materials and securing of the skilled laborers will be necessary to be performed in accordance with the construction schedule. In addition to these dispatch mentioned above, specialized high skilled engineers for installation, adjustment and commissioning works of radar systems, computing equipment and sophisticated meteorological equipment are necessary for keeping high precision and quality of the installation work for all the systems. Such high precision and quality are necessary for accurate meteorological observation.

Furthermore, as technology transfer to the staff of HMS, specialized high skilled engineers are also required for on-the-job training at each site in view of appropriate and efficient operation and maintenance of all the equipment by HMS. After installation work, additional further discussion with HMS will be necessary for smooth and appropriate operation and maintenance of the systems and equipment in accordance with operation and maintenance manuals to be supplied under the Project.

3 - 1 – 3 Scope of Works

Scope of works to be undertaken by the Japan side and the Philippines side for the implementation of the Project are as follows.

(1) Construction of Weather Radar Tower Buildings

- Scope of works to be undertaken by the Japan side
  1) Architectural and civil works for the radar tower buildings
  2) Electrical works for the radar tower buildings
  3) Air-conditioning works for the radar tower buildings
  4) Plumbing works for the radar tower buildings

- Scope of works to be undertaken by the Vietnam side
  1) Securing necessary permission and certificate for the construction of radar tower buildings
  2) Securing the Project sites (Nha Be and Pleiku)
  3) External & planting work, if necessary
  4) Fencing work
  5) Access roads work
  6) Power supply intake work (including power transformer and meter)
  7) Water intake work
  8) Telephone line intake work
  9) Purchase of furniture
  10) Movement and relocation of the existing obstructive facilities on the Project sites, if required

(2) Installation Work for the Equipment

- Scope of works to be undertaken by the Japan side
  1) Required equipment procurement
  2) Transport of the equipment to the various project sites
  3) Installation work for the equipment
  4) Adjustment work for the equipment
  5) Commissioning for the total system

- Scope of works to be undertaken by the Vietnam side
  1) Provision of stable commercial power supply at the Project sites
  2) Provision of the public telephone lines at the Project sites for radar data transmission
  3) Securing necessary frequency for the radar systems
  4) Shifting and removing the existing obstructions in the Project sites
  5) Necessary measures against any damage and disappearance for the equipment & systems

3 - 1 - 4 Consultant Supervision

In accordance with the guidelines of Japan's Grant Aid Assistance and the basic design, the Consultant will be responsible for expeditious project implementation, forming project teams of detailed design and supervision for the implementation of the Project. The Consultant will dispatch at least one resident engineer to Vietnam at each implementation stage in the Project. The resident engineer of the Consultant together with HMS will provide appropriate advise and direction to personnel of the contractor and will maintain close liaison with HMS, Embassy of Japan, JICA local office, etc.

For the construction of the Radar Tower Buildings in the Nha Be and the Pleiku Radar Sites, a resident architectural engineer to Vietnam is required. With respect to installation and adjustment works of the equipment, meteorological hardware and software engineers of the Consultant are necessary to dispatch to Vietnam for timely installation guidance, inspection, etc. for each equipment. In connection with weather radar systems and computing equipment, performance test at a factory, adjustment, inspection, final test and commissioning of the systems and also data reception & transmission test in Vietnam by the Consultant together with HMS will especially be required.

1. Principal Guidelines for Supervisory Plan of the Consultant

   1) Communicate closely with responsible organizations and personnel of both countries, and complete the Project in time in accordance with the implementation schedule.

   2) In order to carry out the construction and equipment installation work in accordance with the technical specifications and drawings, direction and advice will be given to the contractor personnel without delay.

   3) Local construction methods will be adopted, and to the maximum possible extent, locally available materials will be procured.

   4) Instruction for construction and installation methods and technique will be provided to HMS's staff and local contractors as technology transfer so as to maximize the Project effect.

   5) Upon the Project completion, the contractors will be obliged to submit the installation, operation and maintenance manuals and also provide appropriate on-the-job training and guidance to the HMS to ensure smooth operation and maintenance of all the equipment.

2. Supervision Work of the Consultant

   1) Supervision
      The Consultant in coordination with HMS will prepare the form of the contract in accordance with JICA standard and select a Japanese prime contractor through tendering

with HMS, and also recommend the nominated contractor to the Government of Vietnam.

2) Confirmation of the drawings, materials and equipment
The Consultant will inspect and confirm shop-drawings, system drawings & diagrams and material samples submitted by a contractor as well as performance and function of all the equipment and systems.

3) Direction for Construction
Based on a review of the implementation schedule, the Consultant will provide instructions to a contractor and submit progress reports on the Project implementation to HMS, Embassy of Japan, JICA local office, etc.

4) Approval procedure for payment
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.

5) Attendance for inspection
As required during the implementation period, the Consultant will perform inspections at each stage of the work based on confirmation of completion and fulfillment of the contract conditions.

The Consultant will be present at the handing over of the equipment and systems, at which point its tasks will be completed, with the approval of HMS (the Client). Reports will also be made to concerned personnel in the Government of Japan on all required items, such as progress reports during the implementation period, payment procedures, completion and handing over.

3. Dispatch of Engineers

During the Project period, the Consultant's engineers will provide supporting services on drawings, methods as well as inspections of the equipment and systems. In addition, these engineers will be dispatched to the Philippines, as required, for supervision on installation and adjustment stages.

<Equipment Work>

Various kind of the equipment differs on function and performance. Thus, in order to combine each equipment organically into a single meteorological system, and integrate these separate systems into one total system, based on the specifications, it is vital that such overall integration be made the corner-stone of the implementation schedule.

To support the resident engineer, required meteorological hardware and software engineers will be dispatched to supervise the meteorological radar systems, computing equipment, etc. and a meteorological planning engineer to provide general supervision for all the system. Moreover, these supervisory services will be performed from the standpoint of the user, HMS. Supervision will be carried out in close coordination with a radar imagery engineer, a data processing engineer and other necessary engineers, based on the meteorological communication, data processing capabilities required for a total meteorological system.

In connection with the supervision of equipment installations, most suitable engineers will be dispatched timely to carefully supervise installations in their respective areas of expertise. During the implementation period, these engineers will also perform checks on system drawings and installation methods along with the equipment inspections in Japan and will be dispatched, as needed, to Vietnam for installation and adjustment works.

<Building Construction>

Accurate quality control and supervision of construction progress will be required throughout the construction period. With respect to the construction schedule, the delays of the construction can be expected in the piling and foundation work in rainy and flood season. Furthermore, as radar tower buildings are to be constructed at the Nha Be and the Pleiku Radar Sites, the supervisory service is likely to be quite complex. Based on the above considerations, in case of spot supervision, serious problems could be expected in both quality and progress control. Therefore, it is deemed that a resident architectural engineer will be dispatched for the construction of the radar tower buildings.

During the construction period, required engineers will provide supporting services on construction drawings, methods as well as inspections of the equipment in Japan. In addition, these engineers will be dispatched to Vietnam, as required, for supervision on installation and adjustment stages.

3 - 1 - 5 Procurement Plan

The procurement plan for materials and equipment is oriented to local maintenance level and structure for the weather radar network systems and equipment, and radar tower buildings and building equipment. The plan is deemed to be appropriate, in that recurrent costs have been estimated on the basis of HMS's probable financial capabilities after completion of the Project.

The procurement plan has been designed, with full awareness of the current situation at HMS, on the basis of the estimated useful life of each item, a regular maintenance cycle for the equipment and systems, a proper supply of spare parts for maintenance use, and procurement methods. Consideration has also been given to the preparation of installation, operating and maintenance manuals, related guidance, as well as training programs for HMS.

The most considerable factors in supplying the computing equipment are maintenance method of the equipment and also availability of the necessary parts and consumables for the computing equipment in the local market, Vietnam. The equipment procurement must take account of ongoing maintenance requirements after completion of the Project. Careful consideration should be given in making maximum use of local expertise (local computer suppliers) when problems occur with a particular item of the equipment and systems.

- Import License

Virtually all types of construction materials, including imports, are available in Vietnam, the procurement plan for materials for construction of the buildings and the equipment must be carefully prepared. Policy of procurement plan for the Project will be to utilize locally produced items wherever possible.

HMS is very conversant with procedures relating to the import of materials and equipment, and so a vital element in expediting this Project will be prior consideration of anticipated problems and the measures to be taken to deal with them.

In accordance with the Decree of the Government of Vietnam on the Issuance of the Regulation on Management and Utilization of Official Development Assistance, the Ministry of Trade has been assigned with approving list of equipment, supplies and goods to be imported by the Project and creating the most favorable conditions for their importation. The cooperation of HMS is essential to obtain the import license from the Ministry of Trade for importing the required equipment to be supplied under the Project. In order to ensure smooth Project implementation, careful consideration must be given to the following procedures, preparation of required documents and necessary time for obtaining the import license for the equipment.

(1) Procedures before shipment

1) Preparation of a Master List by the Contractor
2) Submission of the Master List to HMS for an approval
3) Stamps and signatures of the Representative of HMS on the Master List
4) Submission of the Master List to the belonging ministry level
5) Check on the Master List by the belonging ministry level
6) In case of no discrepancy in the Master List, submission of the Master List to the Ministry of Trade by the belonging ministry level with requirement of granting import license based on the Master List
7) Necessary time to get an approval from the belonging ministry: normally 10 days

(2) Necessary Document for obtaining Import License for each shipment from the Ministry of Trade after shipment being on board

1) 4 original applications for import license with the attachment of cargoes details from HMS
2) 1 copy set of shipping documents: B/L, Invoice, Packing List, Certificate of Origin (if any)
3) 1 set (copy) of other documents such as:
   a) Decision of the Prime Minister nominated HMS as the project owner
   b) Exchange Note between Vietnamese and Japanese Governments for the Project
   c) The Contract between the Contractor for the Project and HMS

(3) Necessary Time to get Import License from the Ministry of Trade: approximately 20 days (maximum 30 days)

(4) Necessary Arrival Time of Full Sets of Shipping Documents in Vietnam: at least 3 days before arrival of shipment in order to avoid demurrage charge

In order, therefore, to implement the Project without any delay, HMS, the Consultant and the Contractor must conduct a detailed examination and cooperate fully in adhering to the required procedures in executing the procurement plan.

1. Equipment and Systems

The most considerable factors in supplying equipment are maintenance method of the equipment and availability of the necessary parts and consumables in Vietnam. The equipment procurement must take account of ongoing maintenance requirements after completion of the Project. Careful consideration should be given to making maximum use of the local agent when problems occurred with a particular item of the equipment.

The most important areas concerned with supply of the systems involve operation & maintenance methods and also procurement of necessary spare parts long after completion of the Project. This will surely be a vital factor in determining the success of the Project. As might be expected, our major concerns form a maintenance standpoint are related with the weather radar systems, with the contemporary system being essentially computing systems.

As activities of the private sector related to computing systems, there are many agents of the computing equipment in Vietnam. The activities of the private sector in Vietnam will be useful for the computer systems and other sophisticated systems to be introduced under the Project. Based on the above considerations, the procurement plan for the equipment should be designed with a view to achieving the maximum possible degree of standardization as well as ease of obtaining spare parts and maintenance service in selecting computing equipment.

2. Construction Materials

Almost all of the required construction materials such as concrete aggregate, cement, lumber, and fittings are obtainable in Vietnam. On the other hand, building equipment is, at present, largely imported. The construction materials should basically be procured locally. Only the materials difficult to obtain in Vietnam and those specially required to achieve the quality and level of the facility of the Project will be procured from Japan.

1) Cement

Supply is relatively stable. However, careful quality checks will be required during construction.

2) Concrete aggregate

Concrete aggregate uses mainly crushed stone and rushed stone. Local supplies are stable and able to meet current demand in terms of both quantity and quality.

3) Concrete products

Concrete blocks and other secondary concrete products are also made locally. In Ho Chi Minh city, ready-mixed concrete plants are available and for construction work in the Nha Be Radar Site, ready-mixed concrete is quite usable. However in the absence of ready-mixed concrete in Pleiku city, all concrete must be made at the site, requiring careful quality and strength checks. Concrete should be test-mixed at the site, after which an optimum mixture can be determined.

4) Reinforced bars

Reinforced bars, as required for the production of reinforced concrete, can be locally manufactured, and a reliable intensity value can be confirmed from the mill sheet obtained of the reinforcing bars.

5) Timber and Plywood

Plywood for both interior and exterior use, as well as for use in concrete forms can be procured locally.

6) Door and window products

Various types of steel, aluminum and wooden windows and doors are produced in Vietnam. They are widely used in the country and generally pose no problems. For the Project, therefore, local steel, aluminum and wooden windows and doors are usable.

7) Paint

The paints both for indoor and exterior are available in a wide variety of colors and in terms of quantity, color, and base (oil, emulsion, epoxy).

As noted above, construction materials are generally available in Vietnam, with quality presenting no particular problem. In connection with the radar tower building construction period, since certain materials for special power-supply & back-up equipment, air conditioning equipment, ventilation equipment, etc., as needed to install for the weather radar system, cannot be locally procured, such items have to be brought in from Japan or third countries.

3. Transport Routing for Materials

Vietnam's transportation system consists of about 105,000 kilometeras of roads including 47,000 kilometers of rural roads, 2,600 kilometers of railway, 11,000 kilometers of navigable inland waterways (of which 3,500 kilometers are classified as main waterways), eight national seaports, about 20 provincial seaports and many inland riverports, three international airports and an additional number of smaller domestic airports.

Ho Chi Minh City is the principal in Vietnam and serves most of the south and now boats modern container loading facilities. The Project sites for the Project (excluding Hanoi) are located in the Southern Vietnam. Normally, imported goods, materials and equipment shipped by sea to Vietnam from Japan are unloaded at Ho Chi Minh City and passed through the customs. Thus, the equipment and systems shipped by sea to Vietnam from Japan will be unloaded at Ho Chi Minh City and shipped or trucked to all the Project sites.

1) Air service
Vietnam Airlines operates six round-trip flights per week between Osaka, Kansai International Airport and Ho Chi Minh City International Airport. This airline also has many domestic flights schedule a day among the major cities.

2) Shipping service
There are 2 ~ 3 scheduled shippings per week to the Ho Chi Minh City seaport from the major seaports in Japan (ex. Tokyo, Yokohama, Kobe, Nagoya, etc.). Direct service takes about 3 weeks from a Japanese port. Most of cargo are handled and cleared at the Ho Chi Minh City seaport. Due to the geographic condition of the Vietnam, the shipping service is quite popular and active.

3) Domestic transport
The main forms of domestic transport are road and air. Land transport is cheaper than air for long-haul and large-volume shipments and so more advantageous. Large vessels now call frequently at the Ho Chi Minh City seaport, whose port facilities are well developed, with one pier equipped to handle container cargo exclusively.

The most considerable factor in delivering the equipment to each Project site is domestic transport. Careful consideration should be given in making arrangements for the domestic transport and taking appropriate measures against any damage and disappearance during the delivery of the sophisticated equipment and systems and in

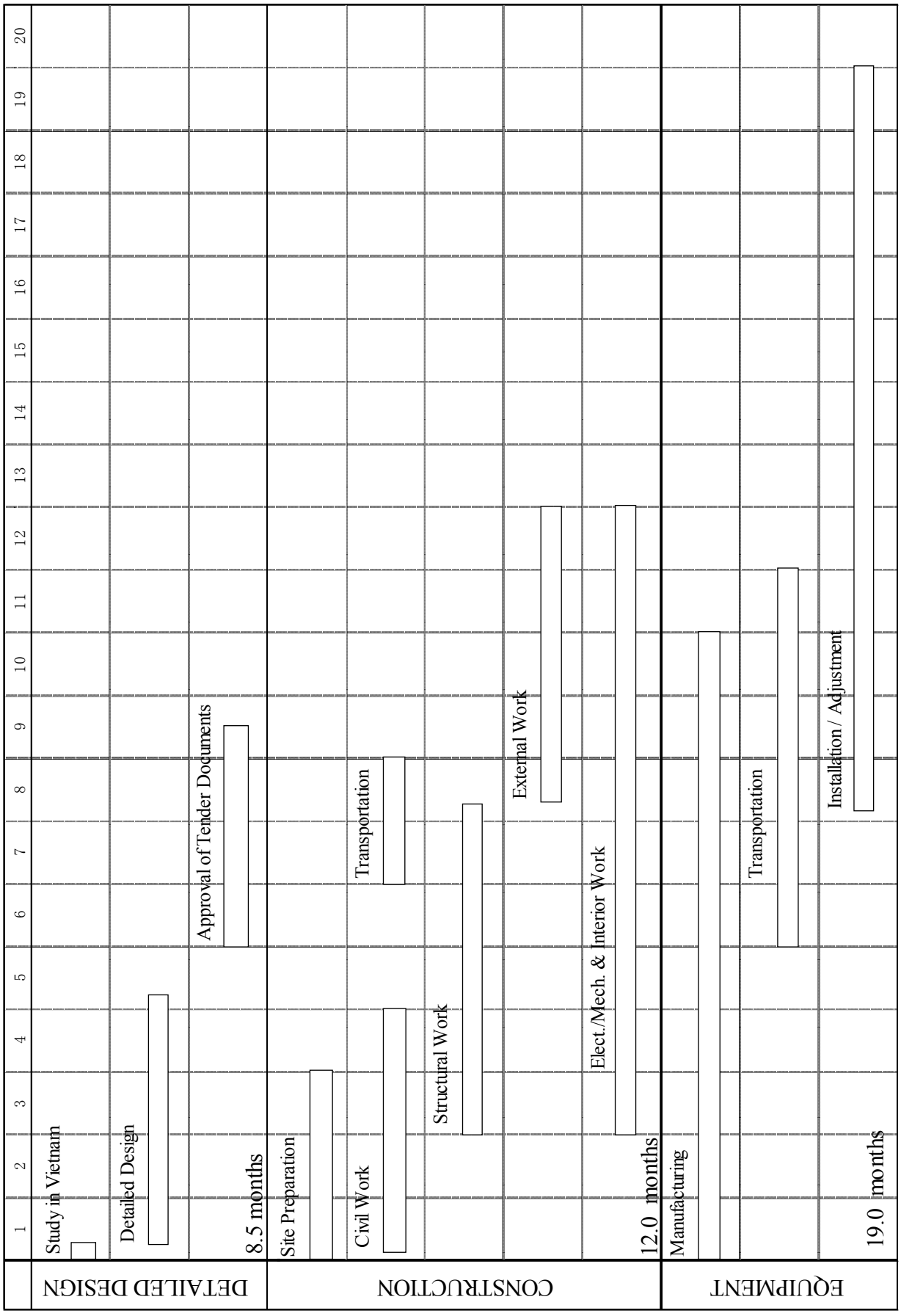
ensuring safety of the Project implementation. This will surely be a vital factor in determining the success of the Project.

4. Implementation Schedule

The Project involves the construction of weather radar tower buildings at 2 locations together with the manufacturing, installation, adjustment and commissioning of equipment for the weather surveillance radar systems. The entire implementation program is expected to require about 19 months in all from signing of the Contract between HMS and a Japanese contractor.

The building construction work will consume about 12 months from preparation work to completion, while about 10 months will be needed to manufacture all the equipment. The equipment introduced under the Project will be of a specialized and used exclusively for meteorological purposes, the production cycle will necessarily be longer than for conventional equipment.

3 - 1 - 6 Implementation Schedule



3 - 1 - 7 Obligation of Recipient Country

Undertakings required of the Government of Vietnam

In the implementation of the Project under Japan's Grant Aid Assistance, the government of Vietnam is required to undertake such necessary measures as the followings:

(1) General requirements

1) To take all necessary institutional and juridical procedures in Vietnam.
2) To open an account in the name of the Government of Vietnam in an authorized foreign exchange bank in Japan and to bear commissions to the Japanese foreign exchange bank for the banking services based upon Banking Arrangement.
3) To obtain necessary import licenses from the Ministry of Trade for importing the equipment for the Project prior to each shipment arrival.
4) To exempt taxes and to take necessary measures for customs clearance of the materials and equipment brought for the project at the port of disembarkation.
5) To accord Japanese nationals whose services may be required in connection with the supply of products and the services under the verified contracts such facilities as may be necessary for their entry into Vietnam and stay therein for the performance of their work.

(2) Requirements for the Equipment

1) To remove and relocate the existing facilities for installation work of the equipment, if required for the implementation of the Project, at the expense of Vietnam.
2) To bear all the expenses other than those to be borne by the Grant Aid, necessary for the transportation and the installation of the equipment.
3) To provide appropriate frequencies for the radar systems to be established.
4) To secure effective spaces at the existing facilities for installation of the equipment to be supplied.
5) To provide suitable existing telephone links and interfaces for establishing systems (for radar data transmission).
6) To secure availability of necessary converted data of the existing radar systems at NCHMF, Hanoi to be suitable for purpose of radar picture composite.
7) To maintain and use properly and effectively that the equipment purchased under the Grant Aid.

(3) Requirements for Construction of Radar Tower Building

1) To obtain necessary permissions for construction of the radar tower buildings and for import of the building equipment for the buildings.
2) To secure land necessary for the sites of the Project and to clear, level and reclaim the land prior to commencement of the construction.
3) To provide facilities for distribution of electricity, water supply, telephone trunk line, drainage, sewage and other incidental facilities to the Project sites.
4) To supply general furniture such as carpets, curtains, tables, chairs and others.

5) To undertake incidental outdoor works such as gardening, fencing, gates and exterior lighting in and around the sites.
6) To construct the access road to the sites prior to commencement of the construction work.
7) To provide temporary facilities for distribution of electricity, water supply, telephone, and other incidental facilities for construction work.
8) To secure effective spaces at the Project sites for temporary facilities such as a contractor's office, workshop, building materials storage, etc. for construction of the buildings
9) To bear all the expenses other than those to be borne by the Grant Aid, necessary for the transportation and construction of the buildings.
10) To maintain and use properly and effectively that the buildings constructed under the Grant Aid.

3 – 2 Project Cost Estimation

Cost estimation for major undertaking to be borne by Vietnam side (Capital Budget).

At the time of implementation of the Project under Japan's Grant Aid Assistance, the estimated cost for the major undertaking of the Government of Vietnam will be necessary as described in the following table.

Nha Be Radar Site	
Telephone line intake cost	US$300.-
Water intake cost	US$1,000.-
External work cost	US$2,500.-
Furniture cost	US$500.-
Miscellaneous	US$700.-
Sub-total (approximate)	US$5,000.-
Pkeiku Radar Site	
Clear of obstacle and level of the Site	US$9,000.-
Power line intake cost	
Transformer & circuit breaker for service entrance	US$10,800.-
Power cable (500m)	US$3,600.-
Telephone line intake cost	US$300.-
External work cost	US$2,500.-
Furniture cost	US$600.-
Miscellaneous	US$700.-
Sub-total (approximate)	US$27,500.-
Grand total (approximate)	US$32,500.-

Furthermore, due to the ODA regulation, commissions to the Japanese foreign exchange bank for the banking services based upon Banking Arrangement will be 0.1% of the total project cost and it shall additionally be borne by the Government of Vietnam.

3 - 3 Operation and Maintenance Plan

1. Personnel Requirement for Implementation of the Project

After completion of the Project, the following personnel assignments will be required at the Nha Be and Pleiku radar sites for appropriate and effective operation and maintenance of the radar systems to be supplied under the Project. However, in case of a major technical problem occurred, the head office of HMS should dispatch a high skilled engineer to repair and to solve the problem.

Nha Be Radar Site

		Number of Post
1.	Chief of Radar Station	1
2.	Radar Engineer	2
3.	Communication Engineer	1
4.	Meteorological Technician (Meteorologist)	4
5.	Engineering Technician	2
6.	Sweeper	1
	Total:	11

Pleiku Radar Site

		Number of Post
1.	Chief of Radar Station	1
2.	Radar Engineer	2
3.	Communication Engineer	1
4.	Meteorological Technician (Meteorologist)	5
5.	Engineering Technician	2
6.	Sweeper	1
	Total:	12

2. Estimation of Additional Expenditure for Regular Operation & Maintenance for the Project

2 Radar Sites (Nha Be and Pleiku)

1) Annual electricity charge for radar system operation: VND82,800,000/yaer
The electricity charge for radar system operation in 1999 of typical one (Phe Lien) of the existing operational radar stations is approximately VND36,000,000/year. Based on the expenditure of the existing situation, annual electricity charge can be roughly expected as follows.

Nha Be: VND36,000,000/year × 1.2 = VND43,200,000/year
Pleiku: VND36,000,000/year × 1.1 = VND39,600,000/year

2) Annual electricity charge for water pump for Pleiku: VND18,000,000/year
The electricity charge for water pump in 1999 of the existing Pleiku HMC is approximately VND60,000,000/year. Based on the expenditure of the existing situation, it can be roughly expected as 30 percents of the annual electricity charge for water pump in 1999.

Pleiku: VND60,000,000/year × 0.3 = VND18,000,000/year

3) Annual telephone charge for radar image transmission: VND60,000,000/yaer
The telephone charge for radar image transmission in 1999 of typical one (Phe Lien) of the existing operational radar stations is approximately VND30,000,000/year. Based on the expenditure of the existing situation, it can be roughly expected VND30,000,000/year as the same as the existing situation.

Nha Be: VND30,000,000/year
Pleiku: VND30,000,000/year

4) Annual water charge for Nha Be
In accordance with the water charge rate, annual water charge for a radar tower building in the Nha Be is roughly calculated as follows.

Average number of regular working staff: 7 staff
Per month: 7 staff × 100liters/ day × 1.2 × 30 days = 25,200liters/ month
1 m^3 = 1,000 liters
25,200 liters ÷ 1,000 liters = 25.2 m^3 = 26 m^3
VND3,000/ m^3
26 m^3/ month × 12 months × VND3,000/ m^3 = VND936,000/year

5) Annual periodical maintenance expense including periodical consumables
The annual periodical maintenance expense (painting, sweeping, lubricating oil, grease, engine oil, diesel oil, etc.) for the radar system in 1999 of typical one (Phe Lien) of the existing operational radar stations is approximately VND20,000,000/year. Based on the expenditure of the existing situation, it can be roughly expected as follows.

VND20,000,000/year × 1.3 (additional periodical consumables: 30%) × 1.05 (price increasing rate: 5%) = VND21,000,000/year

Nha Be: VND27,300,000/year
Pleiku: VND27,300,000/year

3. Operation and Maintenance Plan of Equipment

In connection with equipment operation and maintenance, consideration must be given to the following matters.

- Staff training
- Operation and maintenance structure of HMS
- System failure incidence
- Frequency of scheduled parts & consumables replacement and overhauls

Many electronic parts are used in the electronic equipment in these days. When they have developed a failure internally, only replacement of a part is useful to solve this failure. Therefore, the following methods will have to be applied to minimize the occurrence of failures and maintenance cost to be borne by HMS.

- Most reliable and durable equipment should be selected and procured.
- The power supply to the equipment should be provided through uninterrupted power supplies (UPS) and automatic voltage regulators (AVR) to avoid a system failure due to power stoppage and fluctuation.
- Consideration for selection and procurement of the equipment will be necessary for utilizing local activities as much as possible in the occurrence of a failure.
- During the installation works of the equipment, effective operation and maintenance method and technique should be provided through on-the-job training to HMS.

In order for each responsible person to be able to perform appropriately and effectively his duty to avoid any failure, provision of installation, operation and maintenance manuals are indispensable. In addition, on-the-job training through actual installation works together with the Contractor's engineers and actual use of the equipment should be conducted to as many staff as possible and as long as possible in accordance with these manuals. Furthermore, technique transfer from the Consultant and the Contractor to HMS during the implementation period of the Project will be necessary and quite useful for technical skill leveling up for operation and maintenance of the equipment.

After expiry of the warranty period of 1 year after completion of the Project, HMS will maintain all the equipment on its own. Thus HMS should recognize the necessity for some special expenditures every time problem occur. However, in order to minimize expenditures on the part of HMS for operation and maintenance of the equipment, standardization and selection of the most durable & reliable equipment should be undertaken as much as possible. Such a policy will contribute positively to reducing financial burden of future procurement of spare parts and consumables as well as reduce overall maintenance expenditures.

<Maintenance Cost for the Equipment>

Future maintenance costs for the equipment have been calculated on the basis of the following conditions. The equipment to be supplied under the Project will be supported by power backup systems such as engine generator system, uninterrupted power supply system, automatic voltage regulator, etc. Therefore, the whole equipment will be installed in a suitable and effective environmental condition. In case of normal operation of the equipment under the above said conditions, the annual maintenance cost for the equipment can be estimated.

1) Realistically expecting maintenance cost for the equipment

After completion of the Project, for the first year, all the equipment are still under warranty by the Contractor, no problems should be encountered. Spare parts for 2 years normal operation to be supplied under the Project should be adequate for the third and fourth year, and it is probably not expecting any major equipment failure because the whole system is still new. During these early years, therefore, maintenance expenses should be modest.

From the fifth year, practical maintenance cost will be required and the following expense may be anticipated.

Each Project site will be given a complete set of necessary testing tools, diagrams, appropriate and effective operation & maintenance manuals and spare parts. A logbook for each station will be maintained to indicate a history of repairs done to the instrument to serve as a guide for other technical personnel who might encounter the same problem in order to minimize downtime of the instrument. This would also serve as a basis to determine common spare parts used during repairs for future consideration in the quantity of spare parts to be procured.

- Major expensive items -
For operating a radar system, the following essential parts, in particular, will have to be procured by HMS on a continuing basis.

- Klystron
  Life time: approximately 25,000 ~ 30,000 hours (maximum)
- Batteries for uninterrupted power supply equipment
  Service life: approximately 5 ~ 6 years

The systems to be supplied under the Project can be expected to operate for approximately 6,000 ~ 7,000 hours per year (one year: 8,760 hours). On this basis, for appropriate operation of a radar systems to be installed at Nha Be and Pleiku radar sites,

For the Weather Surveillance Radar Systems to be installed at Nha Be and Pleiku radar sites, 3 klystron will be furnished to the radar system. Thus, for 10 years operation will be most provably possible. However, a klystron is a pulse radar transmission device, certain parts can wear out before the end of the klystron's life time, so HMS must obtain an annual maintenance

appropriation at an early stage to be absolutely sure of its ability to procure these essential parts for a radar system, as required.

The HMS's maintenance capabilities have been amply confirmed on the basis of the more than 10 years' experience it has had with the existing radar system made in former Soviet Union. The technical skill levels of the engineers and technicians in HMS are enough for maintenance of the radar equipment. In addition, HMS must obtain an annual maintenance appropriation at an early stage to be absolutely sure of its ability to procure these essential parts, as required.

Minimization of an annual operation and maintenance cost of HMS has been considered in the basic design study, nevertheless the operation and maintenance cost for the equipment and the radar tower buildings in Nha Be and Pleiku will be required. In order to minimize the operation and maintenance cost, it is necessary that HMS must have the special consideration on implementation of appropriate operation & maintenance procedures will lead to the minimization of consumption and cut down on operation cost.

Additional Expenditure for Regular Operation & Maintenance for the Project

As a consequence of the above conditions, the additional expenditure for regular operation & maintenance after completion of the Project will be needed in addition to the present expenditure of operation and maintenance cost.

Nha Be Radar Site

	1st year	2nd year	3rd year	from 4th year
Electricity charge	VND43,200,000.	VND43,200,000.	VND43,200,000.	VND43,200,000.
Telephone charge	VND30,000,000.	VND30,000,000.	VND30,000,000.	VND30,000,000.
Water charge	VND936,000.	VND936,000.	VND936,000.	VND936,000.
Periodical maintenance expense	VND0.	VND0.	VND0.	VND27,300,000.
Sub-total	VND74,136,000.	VND74,136,000.	VND74,136,000.	VND101,346,000.

Pleiku Radar Site

	1st year	2nd year	3rd year	from 4th year
Electricity charge	VND39,600,000.	VND39,600,000.	VND39,600,000.	VND39,600,000.
Electricity charge for water pump	VND18,000,000.	VND18,000,000.	VND18,000,000.	VND18,000,000.
Telephone charge	VND30,000,000.	VND30,000,000.	VND30,000,000.	VND30,000,000.
Periodical maintenance expense	VND0.	VND0.	VND0.	VND27,300,000.
Sub-total	VND87,600,000.	VND87,600,000.	VND87,600,000.	VND114,900,000.
Total for 2 Radar Sites	VND161,736,000.	VND161,736,000.	VND161,736,000.	VND216,246,000.

The Annual Budget of HMS in 2000 is VND166,382,000,000. It consists of 2 items such as Investment of Basic Construction and Operation Budget. The operation budget for annual expenses for routine maintenance and operation in 2000 is VND81,790,000,000. which is 49% of the actual annual budget of HMS in 2000. Furthermore, average increase percentage of the Annual Budget between 1996 and 2000 was 114%.

The above mentioned additional expenditure for regular operation & maintenance after completion of the Project (VND216,246,000.) is equivalent to approx. 0.26% of the operation budget in 2000.

Chapter 4 Project Evaluation and Recommendation

4 - 1 Project Effect

The Government of Vietnam prepared a *Strategy and Action Plan for Mitigation Water Disasters in Vietnam*. Three objectives were considered in the formulation of the strategy.

- Social: to reduce the loss of life, injury, trauma and social disturbance caused by water disasters.
- Economic: to increase the economic benefits from the use of areas prone to water disaster.
- Environment: to restore flood degraded land areas and to prevent the environmental degradation of key food production areas.

The Project will make the following objectives and Vietnam will benefit from the Project as the project effect.

1) Reduction of natural disasters (water disasters) in Vietnam by strengthening the capabilities for weather monitoring and forecasting of disastrous meteorological phenomena such as typhoons, heavy rain, flood, thunderstorm, tornadoes, wind shear etc., and improvement in saving people's life and property by providing more accurate forecasts and warnings.

2) Prompt and necessary action of civil defense and relief for minimizing extensive loss and damage which are the determining factor for significant set-back of the national economy and development activities of the Vietnam.

3) Improvement of the living standard of the people of Vietnam and to the development of socio-economic activities including activities of any sector not only in Vietnam but also in the region.

4) Improvement of safety of people's life & property and aviation operation by providing more accurate information and warnings for the general public around the clock.

5) Preparation and enforcement of standard, regulation and other necessary rules on structure, civil defense, relief action, operation of transports, etc. for appropriate and efficient development of the country.

After the implementation of the Project, the weather monitoring system of HMS will be strengthened, then the accuracy and reliability of meteorological forecasts and warnings related to natural disasters will greatly be improved. Consequently, the meteorological services of HMS will greatly be improved, and it is expected that with this HMS can contribute to the safety of people’s life and property by reducing natural disasters in the

country such as typhoons, heavy rain, flood, thunderstorm, tornadoes, wind shear, etc. Thus, the improvement of the weather monitoring system as the result of this Project will highly enhance HMS's activities and will put HMS in a position to play its due role in the socio-economic development of Vietnam.

A meteorological radar can detect occurrence, movement and intensity of rainfall (detecting range : 400km) and microburst, wind shear and atmospheric turbulence (detecting range : 200km). A meteorological radar is the only equipment to be able to observe rainfall & atmospheric turbulence distribution, intensity and movement and also to provide precipitation information for large geographic areas on real time basis.

Information to be given by the meteorological radar and its possible application are as follows:

1) A meteorological radar can observe the distribution of precipitation intensity and atmospheric turbulence & wind shear instantaneously, spatially and continuously over a broad area (qualitatively within a radius of 400 km). Whenever precipitation phenomena and microburst, wind shear and atmospheric turbulence appear in this area, their distribution and intensity can be monitored continuously.

2) The precipitation intensity, atmospheric turbulence and other characteristics of the hazardous weather condition can be obtained from echo intensity. The movement and modification of rainfall area also can be estimated by continuous monitoring of radar echo.

3) By integration of echo intensity data, the fine-meshed distribution of precipitation can be derived and also by doppler effect, information of atmospheric turbulence and wind shear can be provided to Civil Aviation Authority for safe operation of the air traffic.

In this way, a meteorological radar is very effective equipment for observing precipitation and atmospheric turbulence and wind shear since it enables to detect precipitation and closely associated meteorological phenomena in minute quantities, both spatially and temporally. A meteorological radar, therefore, is utilized throughout the world in areas that are frequently attacked by meteorological disaster caused by typhoons, heavy rain, atmospheric turbulence, wind shear, etc.

The expected project effects to be generated by the Project are as follows.

- Since the meteorological radar system with a changeable function of rain surveillance (detecting range: 400km) and atmospheric turbulence surveillance (detecting range: 200km) at Nha Be & Pleiku radar sites is installed, HMS will be able to monitor in Central Highland and Southern Region of Vietnam in addition to the covering area by the existing meteorological radar systems. Using radar image data on real time basis will enable HMS to more appropriate weather forecasts and warnings related to natural

disasters caused by hazardous weather phenomena is the determining factor for significant set-back of the socio-economy and development activities of Vietnam.

- Since HMS will monitor actual severe weather conditions such as rainfall, thunder and air turbulence using composite radar images at Hanoi, HMS will be able to issue primary weather forecasts and warnings more accurately, and then supply them to CCFSC, mass media and the other Regional Hydrometeorological Centers.

- Using the information on atmospheric turbulence, wind shear and other hazardous weather conditions to be detected by the meteorological radar systems, HMS will be able to provide appropriate aeronautical information to airports necessary for safety operation of civil aviation.

- Based more accurate and reliable on the weather forecasts and warnings which will be provided by HMS, agencies concerning to disaster management and other information users obtaining the information from many sources will take necessary actions earlier and more appropriately so as to reduce the loss of people's life and property caused by natural disasters. Those information will be utilized for taking measures against natural disaster and making prompt relief action of the central government and local government of Vietnam.

- Through establishing automatic weather observation stations throughout the Mekong River basin, HMS will be able to receive timely and accurate rainfall and other meteorological data and consequently to make flood forecasts & warnings for the safety of people's lives and properties. The accurate flood forecasting information will directly contribute to reduction of flood disasters through organizations related to flood action.

- Though the Mekong Delta is one of the most vulnerable areas affected by flood and typhoon, meteorological observation systems are not sufficient at the present. The meteorological radar system and automatic weather observation system to be provided in the Southern Region of Vietnam under the Project will enable HMS to issue more reliable weather forecasts and warnings on disastrous phenomena which may occur in the Southern Region of Vietnam.

- The Central Highland and the neighboring regions, almost the whole area of which is covered by hills and mountains, are annually affected by flash floods, landslides, strong wind or thunder which accompany typhoons and heavy rain. Up to now, it is very difficult for HMS to identify the location and the severity of weather conditions in case of their occurrence in remote areas of these regions because of the geographical situations of those areas. Using the meteorological radar to be provided under the Project, HMS will be able to detect such weather conditions in most of those areas both promptly and accurately.

- Meteorological data and information are exchanged on-line with neighboring countries through the Global Telecommunication System (GTS) of WMO. Thus, the benefits generated by this Project will extend also to the neighboring countries even Japan, which will be able to receive meteorological data of Vietnam.

- A project by international cooperation on improvement of meteorological services, it can make the project effect and provide global benefit to the whole of the world for improving accuracy of numerical weather prediction.

2. Verification of Appropriateness

In consequence of the Implementation of the Project, the HMS's observing systems on severe weather conditions especially caused by typhoons and heavy rain will be modernized. This will make it possible for HMS to promptly and continuously identify the hazardous weather condition, heavy rain, hail, flooding, atmospheric turbulence, wind shear, etc., which lead to meteorological damage, and so can be expected to improve forecasting accuracy. HMS will thereby be in a position to provide accurately timed forecasts and warnings to the general public, disaster relief organizations and aviation sectors. All of the organization concerning to disaster management have to take necessary measure to disaster preparedness and relief action in accordance with the weather warnings issued by HMS. Therefore, the improvement of weather forecasts and warnings is indispensable in order to reduce more loss of people's life and property.

HMS has operating and maintaining capabilities for the existing meteorological radar systems and automatic weather observation systems. Besides, HMS has a plan for personnel deployment in connection with ongoing operation and maintenance of all the meteorological systems to be established under the Project. Judging from operating performance, engineers of HMS have been satisfactorily nurtured, while an appropriate training system is also being planned. HMS is, accordingly, deemed fully capable of operation and maintenance of the new systems. It has, therefore, been determined that the operation and maintenance plans for this Project are quite realistic.

Based on all the above consequences, it has been concluded that it would be appropriate to implement the Project under Japan's Grant Aid Assistance.

4 - 2 Recommendation

The Project is expected to produce the considerable benefits as mentioned above. The Project would substantially contribute to the development of the basic human needs in the people of Vietnam, the appropriateness of carrying out this Project under a grant-aid has been amply confirmed. Therefore, the implementation of the Project is inferred to be truly significant.

In addition, by improving and expediting the following items, the smoothness and effectiveness of the Project could be increased further.

- In order to operate the meteorological radar system on an integrated basis, all information and data must be standardized and their monitoring must be conducted smoothly. It would be desirable, in this connection, that HMS should strengthen the engineering section and improve appropriate operation and maintenance structure within the organization and a proper maintenance system for the whole systems.

- For the meteorological radar systems and other equipment to be supplied under the Project, it is essential that competent maintenance engineers be secured for ongoing operations. To this end, an efficient and effective training plan should be established to ensure continuing development of a qualified technical personnel.

- In order to diffuse and improve the standards of forecasting techniques based on the use of radar data and images, it is desirable that forecasters be trained and that technical skills be constantly refined for short range forecasts especially on rainfall.

- Establishing a radar network consisting of the existing meteorological radar systems and the new meteorological radar systems will enable not only the HMS headquarter in Hanoi but the Regional Hydrometeorological Centers to monitor the weather conditions of the whole Vietnam.

- For appropriate operation & maintenance and also procurement of spare parts & consumables for the whole equipment and systems to be supplied under the Project, necessary financial measures should be taken and also against any damage and disappearance of the equipment, appropriate measures should be taken by HMS.

- In accordance with “the Regulation on Flood and Storm Warning”, HMS is designated by the Government of Vietnam as the sole organization for providing official information on severe weather. In order to utilize meteorological information for natural disaster mitigation, HMS should keep very close communication and association with the Central Committee for Flood and Storm Control and other necessary organizations as one of the governmental organizations obtained a special obligation of mitigation of the natural disaster.

- After completion of the Project, HMS will be able to exchange observed data and information from the meteorological radar systems and automatic weather observation systems by the public telephone dialing. However, in order to keep the reliability of data exchange, dedicated links among the systems and offices should be secured.