Philippine Atmospheric, Geophysical
and Astronomical Services Administration

NO.

BASIC DESIGN STUDY REPORT
ON
THE PROJECT
FOR
IMPROVEMENT OF THE METEOROLOGICAL RADAR SYSTEM
IN
THE PHILIPPINES

January 2009

JAPAN INTERNATIONAL COOPERATION AGENCY

JAPAN WEATHER ASSOCIATION

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PREFACE

In response to a request from the Government of the Republic of the Philippines, the Government of Japan decided to conduct a basic design study on the Project for Improvement of the Meteorological Radar System in the Philippines and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent to the Philippines a study team from June 26 to August 3, 2008.

The team held discussions with the officials concerned of the Government of the Philippines, 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 Philippines in order to discuss a draft basic design, and as this result, the present report was finalized.

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

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

January, 2009

Ariyuki MATSUMOTO
Vice-President
Japan International Cooperation Agency

January, 2009

Letter of Transmittal

We are pleased to submit to you the basic design study report on the Project for Improvement of the Meteorological Radar System in the Philippines.

This study was conducted by Japan Weather Association, under a contract to JICA, during the period from June, 2008 to January, 2009. In conducting the study, we have examined the feasibility and rationale of the project with due consideration to the present situation of the Philippines and formulated the most appropriate basic design for the project under Japan's Grant Aid scheme.

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

Very truly yours,

Yoshihisa UCHIDA
Project Manager
Basic design study team on
the Project for Improvement of the Meteorological
Radar System in the Philippines

Japan Weather Association

Summary

Summary

The Philippine archipelago, located near the western edge of the Pacific Ocean, is in the direct path of seasonal typhoons and monsoon rains which bring floods, storm surges, and their attendant landslides and other forms of devastation. For the past 60 years, an average of 19 to 20 tropical cyclones per year occurred in the Philippine Area of Responsibility (PAR). An annual average of 8 to 9 tropical cyclones made landfall/crossed the country. The Philippines has long been associated with extreme vulnerability to natural disasters, and has particularly been affected by tropical cyclones. The National Disaster Coordinating Council (NDCC) record says that approximately the number of dead, injured and missing people is in the vicinity of 12 thousand, the number of disaster victims is approximately 49 million, and the total cost of damage is estimated to be around 77 billion Pesos for the last 10 years between 1998 and 2007. The devastation from tropical cyclones and sever weather disturbances has accounted for 92.5% of the total damage from natural disasters. Every year, the Philippines seriously experience huge economic losses coupled with human anguish and sufferings generated by destructive tropical cyclones that cross the country. They have caused significant damage to agriculture which is a vital industry in the Philippines, thereby inflicting widespread poverty on its people. The extensive damage from tropical cyclones is a determining factor for the significant set-back of the national economy. They adversely affect the people's standard of living. To alleviate and proactively deal with the situations indicated above, establishment of effective countermeasures against natural disasters resulting from tropical cyclones is of pressing urgency.

The 4-Point Action Plan of the National Government was conceptualized after the series of tragedies in 2004 that hit Aurora and Quezon Provinces, and some neighboring areas. President Gloria Macapagal-Arroyo gave the go-signal for the immediate adoption and execution of a National Action Plan in disaster preparedness. The components of the 4-point action plan are to upgrade 1) PAGASA forecasting capability, 2) public information campaign on disaster preparedness, 3) capability building for local government units in identified vulnerable areas, and 4) mechanisms for government private sector partnership in relief and rehabilitation.

The Medium-Term Philippine Development Plan for 2004 to 2010 (MTPDP) embodies the 10-point agenda of the Arroyo administration. Its number five thrust is to mitigate the occurrence of natural disasters to prevent the loss of lives and properties. It is also focused on fighting against poverty of the greatest number of the Filipino people and employ strategic measures that will sustain economic growth. In addition, the National Science and Technology Plan for 2002-2020 (NSTP 2020) is a long-term plan that defines the direction of science and technology (S&T) development in the Philippines until year 2020. Among the priority sectors identified for S&T development includes natural disaster mitigation, which point toward the urgent implementation of the Project to minimize damage caused by natural disasters.

The Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA) is the sole national meteorological service provider in the Philippines and is under the administrative supervision

of the Department of Science and Technology. Its main responsibility as a National Meteorological Service is to record meteorological observations round the clock and to provide weather information, forecasts, advisories and warnings necessary for the mitigation and prevention of natural disasters and improvement of socio-economic conditions.

In view of the current situation of the meteorological observation capability of PAGASA through its existing meteorological radar systems and facilities, the Philippines is beset by the following issues and major concerns:

[1] Due to the age of the existing Virac, Aparri and Guiuan radar systems, it is difficult to conduct radar monitoring for a number of reasons such as the transmitted power is down, each circuit in the system is obsolete, and radar pictures in the display are unreadable. Therefore, currently PAGASA is not able to appropriately monitor the tropical cyclones in the Pacific Ocean, and cannot accurately detect the centers or intensities. Consequently, the Meteorological Radar Stations cannot provide the required information to the Weather and Flood Forecasting Center (WFFC) as an input for the preparation of the public storm signal warning and tropical cyclone information.

[2] Since the existing radar systems have no Doppler function, PAGASA is unable to monitor in real time basis stormy wind generated by tropical cyclone, including direction of rainfall motion, and detection of local severe storm associated with tornados in the Pacific Ocean and the coastal areas and cannot accurately locate cyclone centers or intensities of the numerous tropical cyclones and detect heavy rainfall area since no wind convergence area data is contained in the radar observed data.

[3] The existing radar tower buildings at Virac, Aparri and Guiuan Meteorological Radar Observation Stations have seriously structurally deteriorated, and continued use of those buildings is now quite dangerous.

[4] There is no data communication system to transmit the meteorological radar data such as rainfall intensity, wind speed/direction, etc. from the proposed Meteorological Radar Systems to the Weather & Flood Forecasting Center (WFFC) of PAGASA.

In order to effectively protect life and property from tropical cyclone damage, it is urgent to remedy the current situation as soon as possible. It is therefore imperative to establish a reliable and timely dissemination of public storm signal warning and tropical cyclone information to the public and disaster management agencies. Because of lack of financial and technical capabilities, the Government of the Philippines has requested the Government of Japan to procure and install the required equipment,

construct appropriate radar tower buildings, as well as provision of relevant systems and facilities, etc. under Japan's Grant Aid Assistance scheme.
In response to the request from the Government of the Philippines, the Government of Japan decided to conduct a Preparatory Study for the Project under the Japan International Cooperation Agency (JICA) that commission a Preparatory Study Team to the Philippines from November 11 to December 12, 2007 in order to confirm feasibility and appropriateness of Project implementation.

In accordance with the result of the Preparatory Study, the Government of Japan decided to conduct a Basic Design Study for the Project, and consequently the Japan International Cooperation Agency (JICA) sent the Basic Design Study Team to the Philippines from June 26 to August 3, 2008. The team had a series of discussions with the Philippine Government officials, conducted surveys and collected necessary information and data for the Project.

Upon return to Japan, the team conducted further studies including feasibility, justification and scope of the Project, paying particular attention to the present situation in the Philippines, especially on the operation and maintenance capabilities of PAGASA. From those studies, the team formulated the draft basic design for the Project. JICA then sent the team again to the Philippines from October 20 to November 5, 2008 in order to discuss the draft basic design study report. Accordingly, the basic design for the Project was finalized.

The concluded items in the basic design for the Project are as follows.

Table 1: Concluded Items for the Project

Items	Head Office (WFFC)	Virac Meteorological Radar Observation Station	Aparri Meteorological Radar Observation Station	Guiuan Meteorological Radar Observation Station
Procurement and Installation of Equipment				
S-Band Doppler Radar System including Power Back-up System, Lightning System, Measuring Equipment and Spare Parts	-	1	1	1
Data Display Systems including Software	1	1	1	1
Meteorological Data Satellite Communication System (VSAT)	1 (Hub)	1	1	1
Construction of Radar Tower Building				
Radar Tower Building with Furniture	-	1	1	1

The required implementation period of the Project, including the detailed design study and the tendering procedures, is approximately 50 months. The project cost to be borne by the Philippines, as estimated in the basic design study, is approx. 213,690,000 Peso (approx.555 Million JP Yen).

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

[1] Enable PAGASA to conduct more extensive monitoring of sever phenomena and tropical

cyclone since the meteorological radar detection range of precipitation intensity 1mm/h or more will be increased from 300km radius to 450km radius.

[2] Enable PAGASA to monitor tropical cyclonic wind velocity maximum 75m/s and detect the direction of rainfall motion within 200km radius from the time when the meteorological Doppler radar systems will be installed in Virac, Aparri and Guiuan.

[3] Enable PAGASA to issue an hourly public storm signal warning and tropical cyclone information (intensity, location and track) to agencies concerned with disaster management, the mass media, etc. during tropical cyclone in the radar detection range given that 24 hours continuous operation can be made and the rainfall intensity and wind speed/direction, etc. of tropical cyclone observed by Virac, Aparri and Guiuan Doppler radar systems can be received at the WFFC in real time.

[4] Enable PAGASA to monitor stormy wind generated by tropical cyclone, detect local severe storm associated with tornados that briefly occur in the Pacific Ocean and the coastal areas and detect heavy rainfall area with wind convergence area data contained in the radar observed data for prompt issuance of weather, flood and landslide warnings as the meteorological Doppler radar systems will be installed in Virac, Aparri and Guiuan.

[5] Enable PAGASA to improve accuracy of flood forecasts and warnings because precipitation data of 2.5 km mesh in the detection range of Virac, Aparri and Guiuan meteorological radar observation network can be manually inputted to the existing flood forecasting model of the WFFC.

PAGASA, the agency which will implement the Project, has quite a good organizational capability. Its engineers have sufficient experience and knowledge in the daily operation, repair and maintenance of its existing meteorological radar systems. Moreover, PAGASA's budget is expected to be able to cover the Philippine portion of the capital cost and recurrent cost of the Project indicated in this report.

As adequately pointed out in the above careful and comprehensive evaluation of the Project effects, considerable and enhanced benefits can be expected to be achieved vis-à-vis PAGASA's capabilities in reducing human loss and the recurrent economic set-back brought about by tropical cyclone disasters. The Project would substantially contribute to the mitigation of the adverse effects of natural disasters and effectively safeguard the basic human needs of the Filipino people. The foregoing indicates and amply confirms the appropriateness and necessity of carrying out the Project under grant-aid scheme. The implementation of the Project is therefore wholly considered to be appropriately suitable and worthwhile.

Contents

Appendices

■ Philippines

Virac Meteorological Radar Tower Building

Aparri Meteorological Radar Tower Building

Guiuan Meteorological Radar Tower Building

Damage Records caused by Major Tropical Cyclones (1998 - 2007)

Date	TC Classification	Highest Maximum Winds/Gusts (m/s)	Maximum 24 hr RR(mm)	Damage to Infrastructure and Agriculture (M Php)	Damage				
					Killed	Missing	Injured	House Destroyed	House Damaged
July 8 - 11, 1998	TD	8.0	84.0						
August 1 - 5, 1998	TS	25.0	93.2						
August 7 - 9, 1998	TD	15.0	235.6						
August 24 - 25, 1998	TS	(15.2)	81.1						
September 16 - 17, 1998	T	(22.2)	173.6						
September 17 - 21, 1998	T	30.0	173.6	547,478.5	107	10	22		
September 26 - 28, 1998	TS	(17.5)	203.0						
October 11 - 16, 1998	T	35.0	221.6						
October 15 - 25, 1998	T	25.0	307.0						
November 23 - 24, 1998	T	5.0	86.4						
December 9 - 12, 1998	T	26.1	256.6						
January 6 - 7, 1999	TD	5.0	30.2						
February15 - 18, 1999	TD	8.0	10.4						
April 8 - 9, 1999	TD	8.3	290.8						
April 22 - 26, 1999	TS	5.5	236.1						
June 1 - 6, 1999	T	23.0	242.2						
June 4 - 6, 1999	TD	(20.8)	108.7						
July 21 - 26, 1999	TS	9.7	160.6						
July 28 - August 1, 1999	T	(18.0)	142.6						
August 18 - 21, 1999	TS	23.0	433.4	146.25	7	2	23		
August 31 - September 3, 1999	TS	11.9	200.8						
September 10 - 15, 1999	TS	16.1	204.8	0.616	19		3		
September 19 - 22, 1999	T	15.2	83.4						
October 2 - 6, 1999	T	30.0	423.0	139.69	15	1	10		
October 15 - 18, 1999	TS	18.0	323.4						
November 7 - 9, 1999	TS	26.9	189.5						
November 14 - 15, 1999	TS	8.3	37.9						
May 6 - 9, 2000	T	8.3	118.0						
May 18 - 19, 2000	TS	5.5	221.7	50.08					
May 21 - 22, 2000	TD	9.7	64.0						
July 2 - 6, 2000	TD	23.6	322.0						
July 3 - 9, 2000	T	15.2	322.0	1,101.0					
July 12 - 14, 2000	TD	5.0	121.8						
July 21 - 25, 2000	TD	8.3	62.8						
August 19 - 23, 2000	T	20.8	215.8	7.15					
August 25 - 30, 2000	TS	9.7	101.5						
September 2 - 7, 2000	TS	8.3	267.0						
September 2 - 6, 2000	TS	25.0	235.0						
September 10 - 12, 2000	T	23.6	182.1						
October 23 - 25, 2000	T	20.8	46.7						
October 25 - November 1, 2000	T	27.7	312.3	3,752.4					
October 31 - November 5, 2000	T	25.0	238.5	699.2					
November 27 - December 3, 2000	TS	18	168.4	488.7					
December 6 - 8, 2000	TD	12.5	507.5	888.0					
December 29, 2000 - January 1, 2001	TS	5.5	80.0						
February 18 - 20, 2001	TD	16.1	151.4		20				
April 18 - 19, 2001	TD	3.8	81.8						
May 10 - 14, 2001	TS	31.9	242.2						
June 17 - 20, 2001	TD	11.1	174.6						
June 20 - 23, 2001	T	30.0	273.4						
July 2 - 5, 2001	T	43.0	1085.8	1,500	163	180	60		
July 9 - 12, 2001	TS	15.0	224.6						
July 23 - 24, 2001	TS	30.0	224.6						

July 26 - 30, 2001	T	33.0	127.8						
August 16 - 19, 2001	TD	(9.7)	145.5						
September 17 - 19, 2001	TS	(22.2)	54.5						
September 22 - 28, 2001	T	50.0	355.2						
October 11 - 16, 2001	T	(20.8)	125.2						
November 6 - 10, 2001	T	21.9	213.6		184	106	147	119	2,811
November 20 - 25, 2001	TS	(20.8)	167.4						
November 22 - 24, 2001	TD	-	143.2						
December 4 - 7, 2001	TS	21.1	161.5						
January 10 - 14, 2002	TS	12.5	63.8						
March 3 - 7, 2002	T	(18.0)	49.2						
March 20 - 23, 2002	TD	(15.2)	61.1						
March 28 - 30, 2002	TD	18.0	59.2						
June 7 - 9, 2002	T	18.0	194.0						
June 28 - July 3, 2002	T	30.5	96.0						
July 7 - 9, 2002	T	18.0	346.8						
July 9, 2002	TS	18.0	346.8						
July 12 - 14, 2002	T	22.2	287.6						
July 17 - 23, 2002	TD	15.2	231.4						
July 22 - 25, 2002	T	18.0	250.9						
August 1 - 3, 2002	TD	18.0	110.9						
August 11 - 14, 2002	TD	18.0	254.2						
April 16 - 24, 2003	T	31.1	80.4						
May 19 - 20, 2003	TD	8.0	48.2						
May 25 - 30, 2003	TS	23.8	722.6	538	44	8	19	178	2,040
May 31 - June 3, 2003	TS	28.0	237.0						
June 13 - 18, 2003	T	25.0	315.6	131	12	2	2	176	
July 9, 2003	TD	11.9	62.8						
July 15 - 20, 2003	TS	18.8	95.0	67.25	4	4	1		
July 19 - 23, 2003	ST	48.0	467.4	3,233	64	2	154		
July 30 - 31, 2003	TD	11.9	76.8	7.98					
August 1 - 4, 2003	TS	23.8	182.6						
August 4 - 6, 2003	T	18.8	174.6	36.9					
August 18 - 20, 2003	TS	20.0	128.1						
August 19 - 20, 2003	TS	20.0	117.2						
August 20 - 24, 2003	T	23.8	342.0	4,330		1			
August 29 - September 2, 2003	T	46.1	296.7		1		1		
September 7 - 10, 2003	T	16.1	79.0						
September 15 - 19, 2003	TD	15.0	166.1						
September 18 - 19, 2003	TS	18.0	148.8						
September 25 - 26, 2003	TD	6.3	65.7						
October 17 - 24, 2003	T	18.8	120.5						
October 23 - 24, 2003	TD	21.9	107.4	0.094	1				
October 30 - November 4, 2003	TS	33.8	173.4						
November 12 - 15, 2003	TS	26.1	166.2	0.045	13	11	5		
November 27 - 30, 2003	T	13.0	9.7						
December 25 - 28, 2003	TD	16.9	-						
February 13 - 14, 2004	TD	(15.2)	22.2						
March 17 - 23, 2004	TS	(25.0)	78.7						
April 10 - 14, 2004	T	(33.3)	14.0						
May 13 - 20, 2004	T	25.0	244.0		35	6	23		
May 19 - 21, 2004	TS	-	104.2						
June 5 - 9, 2004	T	(22.2)	230.0		2	3			
June 7 - 11, 2004	TS	(13.8)	152.0		7	3	7		
June 16 - 19, 2004	T	(15.2)	138.4						
June 25 - July 2, 2004	T	27.7	444.2		55	20	47		
July 13 - 15, 2004	TS	13.8	55.2						
August 6 - 11, 2004	T	25.0	84.3						
August 15 - 17, 2004	TS	15.2	100.3						
August 20 - 24, 2004	T	15.2	207.2						

September 3 - 5, 2004	T	27.7	191.4						
September 11 - 12, 2004	TS	15.2	152.4						
September 15 - 17, 2004	TD	(10.2)	135.9						
September 24 - 26, 2004	T	22.2	34.8						
October 4 - 8, 2004	T	(15.2)	227.4						
October 15 - 19, 2004	T	(38.8)	82.3						
October 22 - 25, 2004	T	(25.0)	46.2						
November 14 - 21, 2004	T	15.2	216.4	434.2	71	69	160		
November 22 - 23, 2004	TD	(15.2)	185.2		31	17	167		
November 28 - 30, 2004	TD	(15.2)	156.4	701.6	1,060	559	1,023	38,000	134,000
December 1 - 4, 2004	T	22.2	228.1	560.8	73	24	168		
December 15 - 19, 2004	TS	(15.2)	53.0						
March 15 - 18, 2005	TS	(15.2)	139.8	21.1	13	63			
April 22 - 26, 2005	T	(15.2)	26.5						
May 16 - 17, 2005	TD	-	36.8						
June 3 - 8, 2005	T	(15.2)	20.8						
July 4 - 6, 2005	TD	(15.2)	96.6						
July 15 - 19, 2005	T	27.7	111.0	19					
July 31 - August 5, 2005	T	37.5	145.6						
August 10 - 13, 2005	TS	(27.7)	302.5						
August 29 - September 1, 2005	T	38.8	73.1						
September 2 - 4, 2005	T	33.3	54.4						
September 7 - 10, 2005	T	33.3	88.0						
September 19 - 23, 2005	TS	26.9	402.0	496	9	5	5		
September 29 - October 2, 2005	T	22.2	60.2						
October 10 - 16, 2005	T	(27.7)	79.8						
November 8 - 11, 2005	TS	(13.8)	154.4						
November 14 - 20, 2005	T	(36.1)	211.2						
December 16 - 18, 2005	TD	(33.3)	242.2	5	26	16	6		
January 21 - 24, 2006	TD	10.2	184.0						
March 6 - 7, 2006	TD	11.1	46.0						
May 9 - 15, 2006	T	12.5	247.0	4,400	82	36	59	600	3,500
June 24 - 27, 2006	TS	10.2	118.0						
July 2 - 9, 2006	T	18.0	157.0						
July 10 - 14, 2006	T	20.8	355.4	1,200	45	6	33		
July 21 - 25, 2006	T	15.2	303.4	77.8					
July 28 - August 2, 2006	TS	16.6	206.6	223.7	12	6	1		
August 5 - 9, 2006	TS	16.6	72.6						
August 8 - 9, 2006	T	16.6	72.6						
August 13 - 15, 2006	TS	(25.0)	207.0						
September 10 - 16, 2006	T	41.6	176.2						
September 25 - 29, 2006	T	30.5	221.6	6,000	213	48	660	118,081	
October 1 - 5, 2006	TS	19.4	159.0						
October 12 - 13, 2006	TD	(279.9)	70.1						
October 27 - 31, 2006	T	16.6	227.0	1,200	32	23	62	1,395	
November 8 - 12, 2006	T	11.1	176.2		1		10		
November 28 - December 3, 2006	T	78.0	446.0	5,400	709	753	2,190	181,676	
December 7 - 12, 2006	T	26.3	200.0	500	27	8	42	211,032	
December 18 - 19, 2006	TS	(18.0)	81.9						
May 18 - 20, 2007	T	(10.2)	112.0						
July 11 - 13, 2007	T	26.3	179.6						
August 5 - 8, 2007	TS	15.2	205.2						
August 8 - 9, 2007	TS	9.72	302.7	307.1	15	1	10		
August 13 - 18, 2007	T	15.2	228.0	69.7	5	1	1		
September 13 - 14, 2007	T	10.2	106.0						
September 15 - 18, 2007	T	38.8	80.2			2			
September 27 - 30, 2007	TS	13.0	129.8						
October 1 - 7, 2007	T	33.3	171.4	0.4	1	14	1		
October 26, 2007	TS	13.0	52.0						
November 3 - 7, 2007	T	10.2	119.0	120.3	6	2			

November 19 - 22, 2007 November 26 - 28, 2007	T	20.8	228.9		9		5	11	7
November 21 - 28, 2007	T	20.8	134.8	735	31	21	8		

* TC Classification
ST : Super Typhoon T : Typhoon TS : Tropical Storm TD : Tropical Depression
* Highest Maximum Winds/Gusts
( ) : Over Water

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Chapter 3 Project Evaluation and Recommendations

ABBREVIATIONS

ASEAN : Association of Southeast Asian Nations
AVR : Automatic Voltage Regulator
BIR : Bureau of Internal Revenue
CAAP : Civil Aviation Authority of the Philippines
CNC : Certificate of Non-Coverage
DCC : Disaster Coordinating Council
DOA : Department of Agriculture
DOH : Department of Health
DBM : Department of Budget and Management
DOST : Department of Science and Technology
ECC : Environment Compliance Certificate
EMB : Environmental Management Bureau
GDP : Gross Domestic Products
GNP : Gross National Product
ICAO : International Civil Aviation Organization
ICC : Investment Coordinating Council
IEEE : Institute of Electrical and Electronic Engineers
JIS : Japan Industrial Standard
JICA : Japan International Cooperation Agency
KOICA : Korea International Cooperation Agency
MEASAT : Malaysia East Asia Satellite
MTSAT : Multi-Functional Transport Satellite
NDCC : National Disaster Coordinating Council
NEDA : National Economic and Development Authority
NGO : Non-Governmental Organization
NTC : National Telecommunications Commission
ODA : Official Development Assistance
PAGASA : Philippine Atmospheric, Geophysical and Astronomical Services Administration
PAR : Philippine Area of Responsibility
PHIVOLCS : Philippine Institute of Volcanology and Seismology
SSB : Single Side Band Radio
USTDA : United States Trade and development Agency
UNDP : United Nations Development Program
VAT : Value-Added Tax
VSAT : Very Small Aperture Terminal
WFFC : Weather and Flood Forecasting Center
WMO : World Meteorological Organization

Chapter 1
Background of the Project

Chapter 1 Background of the Project

For the past 60 years, an average of 19 to 20 tropical cyclones per year occurred in the Philippine Area of Responsibility (PAR). An annual average of 8 to 9 tropical cyclones made landfall/crossed the country.

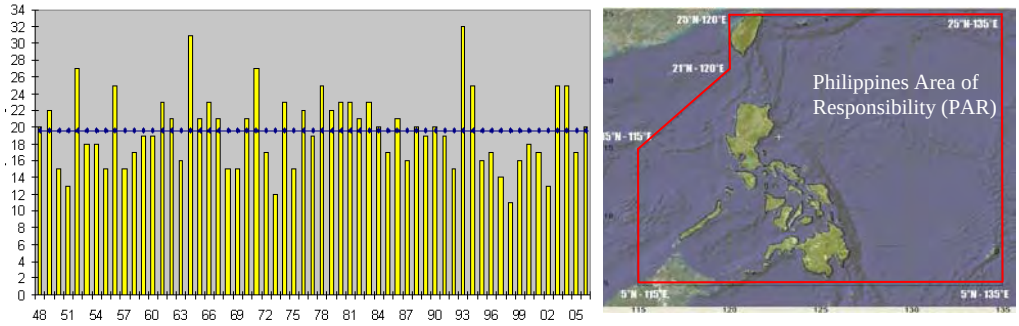


Figure 1: Annual Frequency of Tropical Cyclone in the PAR (1948 - 2006)

Prepared by PAGASA

The Philippines has long been associated with extreme vulnerability to natural disasters, and has particularly been affected by tropical cyclones. Tropical cyclones are the extreme manifestations of nature that lead to immense distress and deprivation for quite a number of people. It is responsible for huge amount of property losses with major consequences for the poor. Areas which are prone to tropical cyclones are found to have higher incidence of poverty. The main reason is that tropical cyclones have a direct bearing on the rural economy, which has a strong linkage with agricultural production. Among all the natural disasters that occurred in the Philippines, tropical cyclones have caused the largest economic losses and more than 90% of the total damage from natural disasters in the country has been produced by tropical cyclones. Regrettably, the extensive damage from tropical cyclones is a determining factor for the significant set-back of the national economy. During the last 10 years before 2007, the number of victims and the economic losses resulting from tropical cyclones are indicated in the following table.

Table 2: Destructive Typhoons 1998 - 2007

Year	Casualties			Affected Persons	Damaged Properties (Billion Pesos)			Total Cost of Damage (Billion Pesos)
	Dead	Injured	Missing		Agriculture	Infrastructure	Private Sector	
1998	490	866	104	7,322,133	10.714	4.903	1.400	17.017
1999	103	63	16	1,789,013	1.292	1.060	0.226	2.578
2000	345	386	106	7,284,946	4.980	2.120	0.370	7.470
2001	441	463	137	3,769,262	2.987	3.584	0.397	6.968
2002	169	71	33	3,546,469	0.480	0.340	0.009	0.829
2003	139	182	28	3,362,991	2.743	1.315	0.113	4.171
2004	1,232	1,250	586	6,966,136	8.683	4.124	0.122	12.929
2005	54	22	88	1,019,646	2.099	0.360	0.094	2.553
2006	1,155	3,232	890	11,253,211	10.535	9.098	0.049	19.682
2007	124	50	39	2,998,885	1.667	1.060	0.061	2.788
Total	4,252	6,585	2,027	49,312,692	46.180	27.964	2.841	76.985

Prepared by National Disaster Coordinating Council: NDCC

The existing Virac, Aparri and Guiuan radar systems located at the most strategic places for monitoring tropical cyclones making landfall/crossing the country were completed in 1994, financed by Japanese soft loan, and are now more than 15 years old. Due to the age of the existing radar systems, it is difficult to conduct radar monitoring for a number of reasons such as the transmitted power is down, each circuit in the system is obsolete, and radar pictures in the display are unreadable. Therefore, currently the Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA) is not able to properly monitor the weather and cannot accurately locate cyclone centers or intensities of the numerous tropical cyclones. In addition, since the existing radar systems have no Doppler function, PAGASA is unable to monitor in real time basis stormy wind generated by tropical cyclone, including direction of rainfall motion, and detection of local severe storm associated with tornados in the Pacific Ocean and the coastal areas and cannot accurately locate cyclone centers or intensities of the numerous tropical cyclones and detect heavy rainfall area due to no wind convergence area data in the radar observed data. To adequately protect life and property from tropical cyclone, it is imperative to improve the current situation as soon as possible in order to provide continuous and timely dissemination of the public storm signal warning and tropical cyclone information to the public.

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

In response to the request from the Government of the Philippines, the Government of Japan decided to conduct a Preparatory Study for the Project and the Japan International Cooperation Agency (JICA) sent the Preparatory Study Team to the Philippines in 2007. During the team's stay in the Philippines, the following items were requested by PAGASA.

Table 3: Items Requested by the Government of the Philippines

Items	Virac Meteorological Radar Observation Station	Aparri Meteorological Radar Observation Station	Guiuan Meteorological Radar Observation Station
Procurement and Installation of Equipment			
S-Band Doppler Radar System (Klystron Doppler Radar or Pulse Compression Solid State Doppler Radar) including Power Back-up System, Lightning System, Measuring Equipment and Spare Parts	1	1	1
Data Processing and Display Systems including Software	1	1	1
4 wheel Drive Pick-up Truck	1	1	1
Engine Generator System	2	2	2
Construction of Radar Tower Building			
Construction of a new radar tower building and/or Renovation/Extension on the existing building including Air-conditioning systems	1	1	1

In accordance with the result of the Preparatory Study Team, the Government of Japan decided to conduct

a Basic Design Study for the Project, and consequently the Japan International Cooperation Agency (JICA) sent the Basic Design Study Team to the Philippines.

The team had a series of discussions with the Philippine side, conducted surveys and collected necessary and pertinent information and data for the Project. As a result of the several discussions with PAGASA during the Basic Design Study in the Philippines, the following components were finally requested by PAGASA to be included in the Project with the end view of generating wider project effects and enhanced benefits from the project. However, it was also agreed not to include in the Project the requested 4 wheel Drive Pick-up Trucks listed in the above table.

Table 4: Final Items Requested by the Government of the Philippines

Items	Head Office (WFFC)	Virac Meteorological Radar Observation Station	Aparri Meteorological Radar Observation Station	Guiuan Meteorological Radar Observation Station
Procurement and Installation of Equipment				
S-Band Doppler Radar System including Power Back-up System, Lightning System, Measuring Equipment and Spare Parts	-	1	1	1
Data Display Systems including Software	1	1	1	1
Meteorological Data Satellite Communication System (VSAT)	1 (Hub)	1	1	1
Construction of Radar Tower Building				
Construction of a new radar tower building and/or Renovation/Extension on the existing building	-	1	1	1
Engine Generator System		2	2	2
On-the-job training at each project site for the radar system (hardware and software) operation and maintenance				

- Meteorological Data Satellite Communication System (VSAT)

In order to fully utilize and achieve maximum benefit from the installation of the new radar systems, it is indispensable that the observed data from Virac, Aparri and Guiuan Meteorological Radar Stations be able to be transmitted and analyzed at the Weather and Flood Forecasting Center (WFFC). However, PAGASA explained that the existing VSAT system to be transferred from the Department of Agriculture may have problems in future usage. Therefore, in order to ensure the effective establishment of the national radar observation network, PAGASA requested the Basic Design Study Team the inclusion of a new VSAT system in the Project, and the Team accepted to assess the appropriateness of the request.

- Meteorological Radar Transmission Type

As a consequence of comparison between Klystron and Solid State Power Amplifier (SSPA) raised by PAGASA-DOST during the Preparatory Study, the Team recommended SSPA due to the following advantages; cost effectiveness, easy replacement of amplifier unit, low power consumption, longer estimated life-span, narrow transmitting spectrum (band width), stable transmitting output power, no preheating time, etc. PAGASA agreed with the recommendation of the Team.

Table 5: Comparison between Klystron Radar and SSPA Radar Systems

Comparison Item	Klystron Radar		Solid State Power Amplifier (SSPA) Radar	
Doppler observation accuracy	High accuracy	○	High accuracy	○
Transmitting power	500kW	△	10kW	◎
Transmitting power stability	Depends upon circuit element accuracy, such as high-voltage power supply stability and modulator device accuracy	△	Easy to acquire excellent stability due to DC low voltage power supply	◎
Output pulse width	A maximum of 5microsec	○	80microsec	◎
Duty	About 0.2%	○	10% max.	◎
Transmitting spectrum (occupancy bandwidth)	It is narrow (based on a seed signal).	○	It is narrow (based on a seed signal).	○
Expected life time	About 30,000 hours	○	About 128,000 hours	◎
Transmitting tube (unit) failure	Transmitting stop	△	Continuous operation is possible	◎
Replacement of transmitting tube (unit)	3 hours by two persons	△	1 minute by 1 person	◎
Periodical aging	Required	△	Not required	◎
Pre-heating time	15 minutes	△	0 minute	◎
Power consumption	Approx. 10kVA	△	Approx. 8kVA	○
Noise	Large	△	Small	◎

Study of the need for replacement of the Existing Meteorological Radar Systems and construction of Meteorological Radar Tower Buildings

At Virac, Aparri and Guiuan Meteorological Radar Observation Stations, the following assessment of the need for replacement of the Existing Meteorological Radar Systems and construction of Meteorological Radar Tower Buildings were conducted. As a result of the study indicated in the following tables found hereunder, the replacement of the Existing Meteorological Radar Systems and the construction of Meteorological Radar Tower Buildings at Virac, Aparri and Guiuan Meteorological Radar Observation Stations were confirmed.

Table 6: Detailed Status of the Existing Meteorological Radar Systems as of July 2008

	Name of Equipment	Criteria	Evaluation		
			Virac	Aparri	Guiuan
1	Radome	Availability of panel cracks, panel surface coating deteriorated, water leakage, base ring rust	×	×	×
2	Antenna Assembly	Parabolic reflector surface is damaged	○	○	○
		Availability of abnormal rotation noise	○	○	×
		Parabolic reflector cannot stop at azimuth/elevation angle not more than ±0.3degee indicated by the antenna controller.	× (hunting)	× (hunting)	× (hunting)
		PPI or RHI automatic scanning is not working	× (RHI)	○	× (RHI)
3	Waveguide	Availability of dent	×	○	○
		Waveguide inside portion is rusting	○	○	○
4	Dehydrator	Dry air of 200g/m^2 pressure is not supplied.	×	○	○
5	Antenna Servo Assembly	Parabolic reflector does not rotate by the control switches on the control Panel	× (RHI)	○	× (RHI)
6	Transmitter/Receiver	Output power is less than 500kW	×	×	○
7	Digital Video Integrator and Processor	Gray coded echo signals are not displayed on the scope of the Operation Console Assembly.	×	×	×
8	Control Console Assembly	Remotely cannot control the radar system.	×	×	×
		Echo signals are not displayed.	○	○	○
9	Color Monitor Display	Radar echo (rainfall intensity) classified 7 levels are not indicated.	×	×	×
10	Automatic Voltage Regulator (AVR)	Input and output power is not 220V 3-phase shown at the input and output indicators	×	○	×
11	Diesel Generator	The required power for AVR such as 220V 3-phase, 3-wire and 60Hz are not generated.	× (fluctuated)	× (fluctuated)	× (fluctuated)
12	Uninterrupted Power Supply (UPS)	AC115V output does not come out due to simulated power stoppage.	×	×	×
13	Power Distribution Board	Input voltage and current indicated on the indicator are not nominal value. The non-fuse circuit breakers cannot supply AC power to the equipment.	× (lightning circuit failure)	○	○
Result			×	×	×

×: True ○: False

Table 7: Structure Study and Analysis for the Existing Meteorological Radar Tower Buildings

Current Situation on the Main Structures of the Existing Meteorological Radar Tower Buildings			
Main Structure	Virac Meteorological Radar Observation Station	Aparri Meteorological Radar Observation Station	Guiuan Meteorological Radar Observation Station
Column	Many concrete cracks are found. Covering concrete of reinforcing bars chop down at many places.	Serious concrete cracks which affect structural strength are observed.	Many repaired areas for concrete cracks are found.
Beam	Many concrete cracks are found.	Many concrete cracks are found.	Many repaired areas of concrete cracks are found.
Floor slab	Many concrete cracks around the columns and walls are found.	Due to the existing finishing material, no crack is found.	Many concrete cracks are found.
Wall	Many concrete cracks are found and some finishing chops down.	Many concrete cracks are found and some finishing chops down.	Many concrete cracks are found and some finishing chops down.
Eves	Due to significant deterioration, covering concrete for reinforcing bars chop down at many areas.	Due to progressive rust damage of reinforcing bars, covering concrete chops down at many areas.	Due to significant deterioration, covering concrete for reinforcing bars chop down at many areas .
Reinforcing Bars	Many exposed rusty reinforcing bars are found due to chipping off of covering concrete.	Many exposed rusty reinforcing bars are found due to chipping off of covering concrete.	No exposed rusty reinforcing bars are found.
Roof	Leaking rain and deflected slabs are found.	Deflected slabs are found and some parts of concrete handrails are collapsed.	Two rain leak points and deflected ceiling boards are found.
Structure of the Existing Meteorological Radar Tower Buildings			
Main Structure	Virac Meteorological Radar Observation Station	Aparri Meteorological Radar Observation Station	Guiuan Meteorological Radar Observation Station
Column (mm)	Main column: 450ϕ x 8ps. Center column: 1,250ϕ x 1p. Main & Center columns: supporting the vertical and horizontal load. Each column of the upper part is out of the column's center line of the bottom part. Outer column: 350 x 600 x 8ps Support for partial vertical loads from 2nd and 3rd Floor.	Main column: 500 x 500 x 8 ps. Supporting the vertical and horizontal load. Sub-column: 350 x 350 x 1p Supporting only partial vertical load of stairs.	Main column: 350 × 600 × 6ps Center column: supporting the vertical and horizontal load.
Beam (mm)	2nd Floor: 300x450 3rd Floor: 300 x 600/200 x 450 4th - Top Floors: 300 x 600	2nd - Top Floors: 300 x 550	2nd Floor and Top Floor: 300 x 600
Floor Slab (mm)	Thickness: 150	Thickness: 150	Thickness: 150
Schmidt Hammer Test Results of Concrete Compression Strength for the Existing Meteorological Radar Tower Buildings			
Main Structural	Virac Meteorological Radar Observation Station	Aparri Meteorological Radar Observation Station	Guiuan Meteorological Radar Observation Station
Column	×	×	○
Beam	○	○	○
Floor Slab	○	N/A: Finish material	○
○: Test Result ≧ Design Strength of 21N/mm² ×: Test Result < Design Strength of 21N/mm^2			
Study on Horizontal Distortion Angle of the Existing Meteorological Radar Tower Buildings by Wind Pressure			
	Virac Meteorological Radar Observation Station	Aparri Meteorological Radar Observation Station	Guiuan Meteorological Radar Observation Station
Horizontal Distortion Angle	0.298 degree	The existing building leans 90mm to North-West side due to the subsidence by several earthquakes: hazardous condition	0.022 degree
Horizontal Displacement	81.40 mm		2.33 mm
Result	× (negative)	× (negative)	If extended by even just one story : × (negative)
(Allowable Horizontal Distortion Angle ≦ 0.075 degree)			

Possibility of Extensions on the Existing Meteorological Radar Tower Buildings							
Expansion by	Virac Meteorological Radar Observation Station		Aparri Meteorological Radar Observation Station		Guiuan Meteorological Radar Observation Station		
Steel Structure	Horizontal distortion angle: negative	×	The existing building leans 90mm to North-West side: hazardous condition	×	Horizontal distortion angle: negative	×	
Reinforced Concrete	Horizontal distortion angle: negative	×			Horizontal distortion angle: negative	×	
Appropriate Structure for the proposed Meteorological Radar Tower Buildings							
Structure	Virac Meteorological Radar Observation Station		Aparri Meteorological Radar Observation Station		Guiuan Meteorological Radar Observation Station		
Steel Structure	Does not satisfy the allowable horizontal distortion angle by wind pressure. Salt corrosion: foremost concern.	×	Does not satisfy the allowable horizontal distortion angle by wind pressure. Salt corrosion: foremost concern.	×	Does not satisfy the allowable horizontal distortion angle by wind pressure. Salt corrosion: foremost concern.	×	
Reinforced Concrete	Appropriate	○	Appropriate	○	Appropriate	○	

Negative Impact to the Development of the Philippine Economy

The Gross Domestic Product of the Philippines consists chiefly of the Service Sector: approx. 50%, Industry Sector: approx. 30% and Agriculture, Fishery & Forestry: approx. 20%. Tropical cyclone disasters create significant economic losses with major consequences for the poor. They have direct bearing on the rural economy which has a close linkage with agricultural production. It is to be noted that 37% of the total population earns a living from agriculture in rural areas. With an increase in population and the growth of physical infrastructure, vulnerability of the society to tropical cyclones has also increased. Since 2000, the Gross Domestic Product of agriculture has constantly and fortunately increased approximately 4%/year due to improvement of irrigation facility, introduction of improved cultivar, etc. implemented by the Government of the Philippines. However, agricultural damage created by frequent natural disasters especially tropical cyclones and drought prevent further development of the Gross Domestic Product.

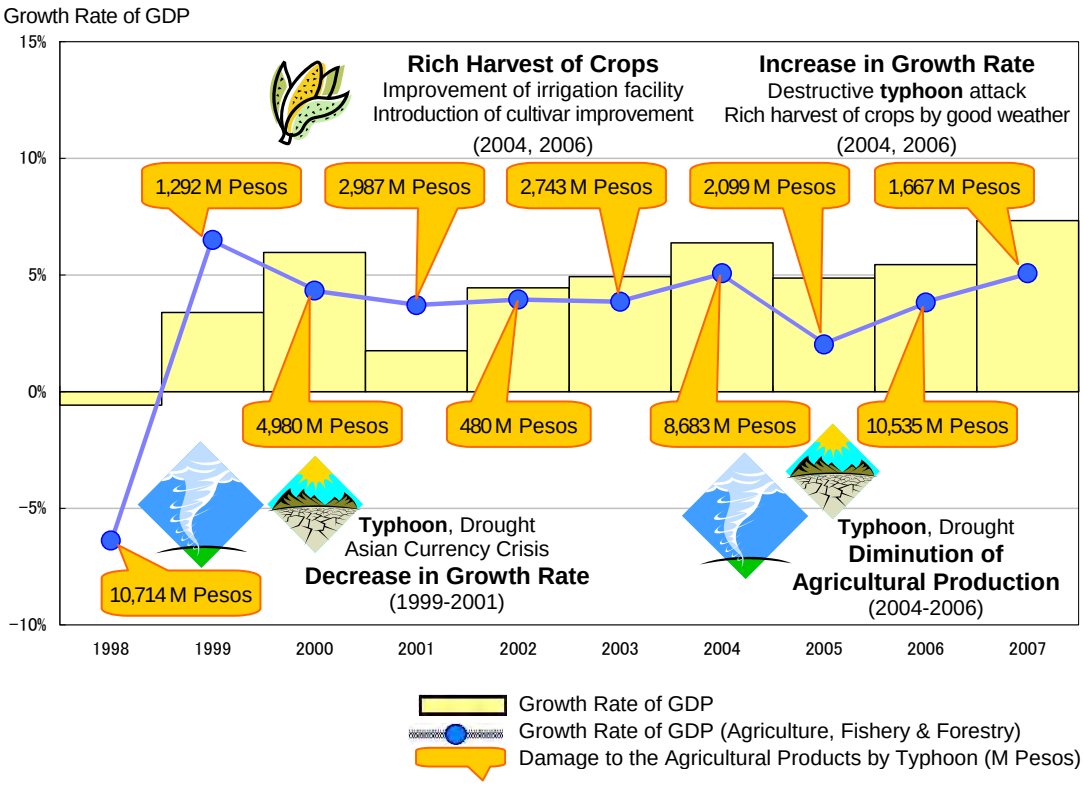


Figure 2: Growth Rate of GDP and Damage generated by Typhoons

<Natural Conditions of the Project Sites>

- Climate

The Philippines is located southeast of the big Asian continent, with an almost north to south orientation extending over thirteen degrees (4.7°N to 21.5°N latitude and from 117°E to 127°E longitude) and consists of 4 types of climate as indicated in the following map. Virac, Aparri and Guiuan are located in Type II.

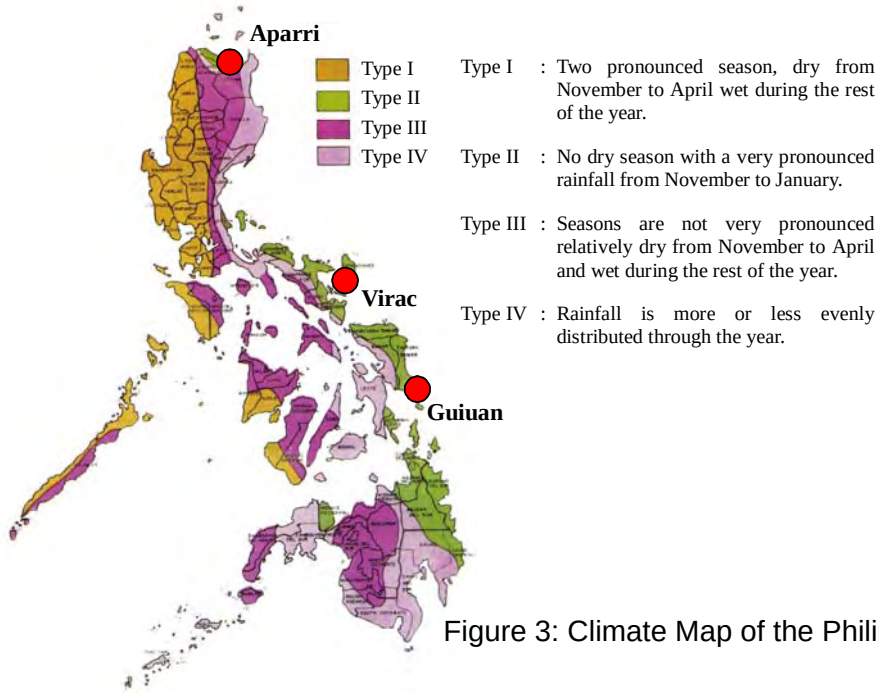


Figure 3: Climate Map of the Philippines

- Temperature

Table 8: Temperature Normal Values (1971– 2000)

	Virac			Aparri			Guiuan		
Month	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean
January	26.4	21.1	23.7	27.2	20.6	23.9	28.5	23.5	26.0
February	26.8	21.2	24.0	28.3	20.9	24.6	28.9	23.6	26.2
March	27.6	21.8	24.7	30.2	22.1	26.1	29.7	24.0	26.8
April	28.7	22.7	25.7	32.1	23.6	27.8	31.1	24.7	27.9
May	29.6	23.4	26.5	32.9	24.4	28.7	32.2	25.3	28.8
June	29.6	23.5	26.5	33.4	24.8	29.1	31.8	25.0	28.4
July	29.3	23.1	26.2	32.8	24.7	28.8	31.2	24.8	28.0
August	29.5	23.2	26.4	32.5	24.5	28.5	31.5	25.0	28.3
September	29.5	23.0	26.2	32.0	24.2	28.1	31.5	24.8	28.2
October	29.0	23.0	26.0	30.7	23.7	27.2	30.8	24.7	27.7
November	28.0	22.4	25.2	29.2	22.9	26.0	29.9	24.3	27.1
December	26.9	21.6	24.2	27.5	21.2	24.4	29.0	23.9	26.4
Annual	28.4	22.5	25.4	30.7	23.1	26.9	30.5	24.5	27.5

- Rainfall

About 47% of the average annual rainfall in the Philippines is attributed to occurrence of tropical cyclones in its vicinity. Virac, Aparri and Guiuan have no dry season with a very pronounced maximum rain period from November to January.

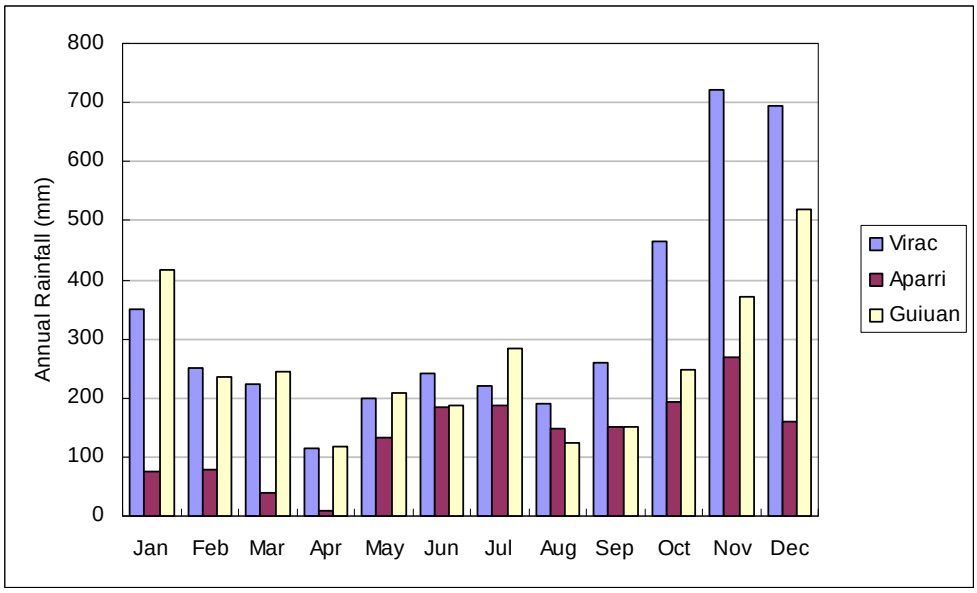


Figure 4: Virac, Aparri and Guiuan Monthly Mean Rainfall of 2001-2007

- Lightning

Southeast Asia including the Philippines, Central Africa and Central American-Northern South America located in the southern and northern latitude of 30 degrees has the greatest concentration of occurrence of lightning in the world.

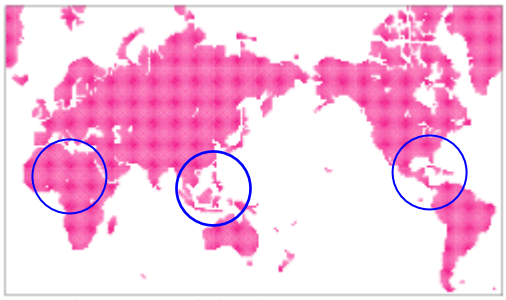


Figure 5: Lightning-prone Area

Table 9: Thunderstorm and Lightning Normal Values (1971 - 2000)

	Virac		Aparri		Guiuan	
Month	Thunderstorm	Lightning	Thunderstorm	Lightning	Thunderstorm	Lightning
January	0	0	0	0	0	1
February	0	0	0	0	0	1
March	0	0	0	0	1	2
April	2	2	3	2	2	5
May	7	10	8	9	3	13
June	8	13	10	14	5	18
July	10	13	8	13	8	20
August	7	11	7	9	7	18
September	10	14	5	9	9	20
October	8	10	2	5	6	18
November	3	4	1	1	4	11
December	1	1	0	0	2	5
Annual	56	78	44	62	47	132

- Tropical Cyclone

For the past 60 years, an average of 19 to 20 tropical cyclones per year occurred in the Philippine Area of Responsibility (PAR). An annual average of 8 to 9 tropical cyclones made landfall/crossed the country. Tropical cyclones generate extensive damage in the Philippines.

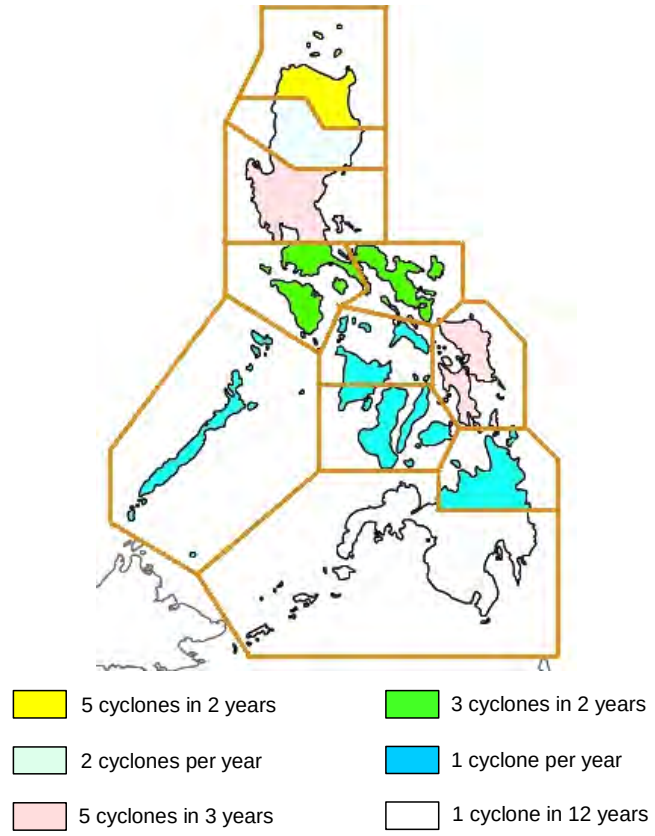


Figure 6: Frequency of Tropical Cyclone passage over each Geographical Zone in the Philippines

- Earthquake

The Philippines consists of 7,107 islands. The archipelago, like that of Japan, is characterized by subduction-related volcanic belts with many active volcanoes and experiences frequent seismic activity. The Philippines, being situated in a zone where at least three lithospheric plates coalesce, hosts more than 200 volcanoes distributed in five volcanic belts intimately related to subduction/convergent processes and at least 5 imperceptible to perceptible earthquakes occur everyday.

- Topographic and Geotechnical Surveys

At Virac, Aparri and Guiuan Meteorological Radar Observation Stations, the topographic and geotechnical surveys indicated in the following tables were implemented by a local contractor consigned by the Basic Design Study Team.

Table 10: Topographic Survey

Required Works	• Plane surveying (0.5m contour line) - Position of the existing building, observation facility, observation field - Position of the existing facilities (electrical lines, water lines, telephone lines, sewage, public roads, fences, vegetation, trees: more than 4m height, streetlights, manholes and other features) - Bearing survey of the magnetic north - Calculation of the area planned
	• Longitudinal profile and cross section - Indication of ground level at intervals of 10m - Public roads, ponds, river and each water level - Setting bench marks
Required Products	• Plane surveying map • Longitudinal profile and cross section • AutoCAD data file in CD-ROM

Table 11: Geotechnical Survey

Boring (All core boring)	Required number of borings: 3 Required depth of borings: 30m (Borings shall be continued to extend to suitable bearing layer for a building construction, even if borings have reached more than a depth of 30m. After reaching the bearing layer, borings shall be continued to a depth of at least 3m.)
Collecting soil samples	• Undisturbed soil sampling: 3 samples (at different level) x 3 holes • Disturbed soil sampling: 3 samples (at different level) x 3 holes • Adoption of standard: ASTM or JGS-Japanese geotechnical society
Standard Penetration Test	At intervals of every 1m till the bottom of each borehole
Laboratory Testing	Density Test of Soil Particle, Particle Size Distribution, Specific Gravity, Water Content , Liquid Limits, Plastic Limits, Unconfined Compression Test and Consolidation Test
Required Products	Geotechnical Survey Report: expected soil bearing capacity and calculation of consolidation coefficient

<Geotechnical Survey Results>

Table 12: Geotechnical Survey Result of Virac Meteorological Radar Observation Station

Boring	Depth (m)	Soil Type USCS	N-value	Unit Weight (g/cc)	Friction Angle (dgree)	Cohesion (kPa)
BH-1	0-8	Clayey silt	10	1.70	-	60
	8-18	Sandy silt/Silty clay	26	1.86	-	150
	18-19	Clayey gravel	70	1.90	40	-
	19-21	Rock	Coring	-	45	-
BH-2	0-8	Clay	9	1.70	-	50
	8-15	Clay/Clayey silt/Sandy silt	34	1.90	-	200
	15-22	Weathered rock	coring	-	40	-
	23	Rock			45	-
BH-3	0-15	Clayey silt/Clay	12	1.72	-	75
	15-19	Clay	39	1.90	-	200
	19-21.5	Weathered rock	Coring	-	40	-
	22	Rock	Coring	-	45	-

Table 13: Geotechnical Survey Result of Aparri Meteorological Radar Observation Station

Boring	Depth (m)	Soil Type USCS	N-value	Unit Weight (g/cc)	Friction Angle (dgree)	Cohesion (kPa)
BH-1	0-6	Silty sand	9	1.70	26	-
	6-14	Silty sand to poorly graded sand	23	1.76	32	-
	14-19	Silty clay/Clayey silt	7	1.70	-	40
	19-24	Highly plastic clay	21	1.80	-	250
	24-32	Poorly graded sand	60	2.00	40	-
BH-2	0-6	Silty sand	11	1.70	26	-
	6-9	Silty sand	31	1.82	34	-
	9-18	Silty clay/Clayey silt	9	1.76	-	50
	18-22	Silty clay	14	1.76	-	90
	22-24	Silty sand to poorly graded sand	27	1.80	33	-
	24-30	Clayey sand/Silty sand	60	2.00	40	-
BH-3	0-10	Silty sand to poorly graded sand	12	1.70	26	-
	10-23	Silty clay/Highly plastic clay	9	1.76	-	50
	23-32	Silty sand	60	2.00	40	-

Table 14: Geotechnical Survey Result of Guiuan Meteorological Radar Observation Station

Boring	Depth (m)	N-value	Unit Weight (g/cc)	Absorption (%)	UCT (kg/cm^2)
BH-1	1.5	2.09	4.05	36.9	1.5
	3.5	2.22	5.26	85.0	3.5
	6.0	2.17	10.70	154.0	6.0
	9.0	2.25	5.40	100.0	9.0
	11.0	2.24	2.63	138.0	11.0
	12.0	2.31	3.90	69.0	12.0
	16.5	2.27	4.11	49.0	16.5
	21.0	2.19	5.40	120.0	21.0
BH-2	3.0	2.36	4.76	49.0	3.0
	4.5	2.27	6.80	63.0	4.5
	5.0	2.28	6.80	139.0	5.0
	9.0	2.20	9.60	153.0	9.0
	17.0	2.34	5.00	110.0	17.0
	20.0	2.30	3.17	176.0	20.0
BH-3	2.0	2.16	8.80	62.0	2.0
	3.0	2.19	3.90	131.0	3.0
	6.0	2.21	5.70	63.0	6.0
	9.0	2.17	5.56	119.0	9.0
	12.5	2.18	5.40	99.0	12.5
	16.0	2.21	6.94	72.0	16.0

<Consideration for Environmental Conservation>

Virac, Aparri and Guiuan Meteorological Radar Observation Stations are existing observatories of PAGASA, and are not covered by the Environmental Impact Statement (EIS) System which consequently is not required to secure an Environmental Compliance Certificate (ECC). Instead, a Certificate of Non-Coverage (CNC) to be issued by the Environmental Management Bureau (EMB) is required. PAGASA completed all the procedures in early May 2008, and has already obtained CNC on May 26, 2008.

Chapter 2
Contents of the Project

Chapter 2 Contents of the Project

2-1 Basic Concept of the Project

The Philippine archipelago is one of the worst-hit countries by catastrophic tropical cyclones in the world. It is in the direct path of seasonal typhoons which bring floods, storm surges, and their attendant landslides and other forms of devastation. The National Disaster Coordinating Council (NDCC) record says that approximately the number of dead, injured and missing people is in the vicinity of twelve thousand, and the number of disaster victims is estimated to be around 49 million for the last 10 years between 1998 and 2007. The devastation from tropical cyclones and sever weather disturbances has accounted for 92.5% of the total damage from natural disasters. Every year, the Philippines seriously experience huge economic losses coupled with human anguish and sufferings generated by destructive tropical cyclones that cross the country. They have caused significant damage to agriculture which is a vital industry in the Philippines, thereby inflicting widespread poverty on its people. The extensive damage from tropical cyclones is a determining factor for the significant set-back of the national economy. They adversely affect the people's standard of living. To alleviate and proactively deal with the situations indicated above, establishment of effective countermeasures against natural disasters resulting from tropical cyclones is of pressing urgency.

The existing Virac, Aparri and Guiuan meteorological radar systems were completed in 1994 financed by the Japanese soft loan. Those three radar systems are located at the most strategic places for monitoring tropical cyclones generated in the Pacific Ocean, and are now more than 15 years old. Because of the age of the existing radar systems, frequent repairs are required. However, it has become very difficult to procure the required spare parts making it an extremely difficult job even for the experienced PAGASA engineers to operate, maintain and repair the radar systems. Therefore, currently PAGASA is not able to appropriately detect tropical cyclones and locate cyclone centers or intensities.

The activities of the government agencies concerned with disaster management in close coordination and partnership with the local government units and the mass media mainly with their role in disaster management in the Philippines (especially in relation to the quick and timely evacuation of residents and disaster prevention countermeasures) depend almost entirely on the public storm signal warning and tropical cyclone information from PAGASA. Therefore, deterioration in the quality and accuracy of PAGASA's warnings and advisories create significant obstacle for the effective disaster management system of the Philippines. Under these circumstances, rehabilitation and strengthening of the cyclone monitoring capability of PAGASA by replacing the existing Virac, Aparri and Guiuan meteorological radar systems has become an urgent task.

Therefore, the key objective of the Project is the effective mitigation of the devastation caused by tropical cyclones and other severe weather phenomena, thereby protecting lives and properties via enhancement of

the capability of PAGASA in tropical cyclone monitoring, especially those that cross the country from the Pacific Ocean. In order to achieve such objective, the planned project components are;

i) replacement of the existing Virac, Aparri and Guiuan meteorological radar systems,
ii) construction of radar tower buildings at Virac, Aparri and Guiuan Meteorological Radar Observation Stations,
iii) installation of meteorological data display systems at each Meteorological Radar Observation Station and the WFFC, and
iv) establishment of meteorological data satellite communication systems (VSAT) connecting between the Meteorological Radar Observation Stations and the WFFC.

2-2 Basic Design of the Requested Japanese Assistance

2-2-1 Design Policy

(1) Basic Design Policy of the Project

a) To design a meteorological observation system to contribute to disaster prevention.
b) To enable PAGASA to provide weather information, forecasts, advisories and warnings necessary for the mitigation and prevention of natural disasters and improvement of socio-economic conditions.
c) To enable PAGASA to monitor weather conditions round-the-clock on a real time basis.
d) To enable PAGASA to promptly issue the public storm signal warning and tropical cyclone information to the public.
e) To ensure improvement of PAGASA's overall function and capacity in reducing human loss and economic setback brought about by tropical cyclone disasters through the upgrading of PAGASA's tropical cyclone monitoring capabilities.
f) To determine and set up the size and components of the Project to match with the technical, operational and maintenance capabilities of PAGASA.

(2) Design Policy

[1] Design Policy of the Equipment

a) To cover the areas of tropical cyclones coming into the Philippines by three (3) new meteorological radar systems to be installed at the existing PAGASA meteorological radar observation stations.

b) To ensure the equipment is compatible with and meets the technical requirements of the World Meteorological Organization (WMO) since the Philippines is a member of WMO.
c) To ensure the equipment is suitable for the routine observation and forecasting work of PAGASA.
d) To design the radar systems with functions of having quantitative rainfall observation and air-turbulence observation capabilities that enhances and upgrades accuracy of weather forecasts by PAGASA.
e) To design the radar systems to get constant altitude information from 3-dimensional raw data obtained by scans of the radar systems at multiple elevations for ensuring wider covering range and detecting rainfall distribution at each altitude.
f) To design that all of the meteorological radar data produced are delivered to the WFFC every 15 minutes by high-speed satellite communications for enabling the timely dissemination of the tropical cyclone forecasts.
g) To design that a composite radar picture of precipitation intensity in the observation range of the three (3) meteorological radar systems is prepared by a computer system to be installed in the WFFC.
h) To design the system so that it is within PAGASA's capability to operate, maintain and repair.
i) To select equipment for which spare parts and consumables can be easily procured and replaced.
j) To select reliable and durable equipment suitable for the local environment.
k) To minimize the recurrent costs to PAGASA for the operation, maintenance and repair of the equipment.
l) To design the equipment by adjusting the accuracy of radar data through calibration.
m) To design the equipment to minimize lightning damage.
n) To design the equipment to operate using 240V±20%, 3-Phase 3-Wire, 60Hz power.

[2] Design Policy of Radar Tower Building

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

a. To design the height of the radar tower buildings for construction to be free of the influence of the surrounding mountains and existing facilities creating the blind areas for radar observations.
b. To select the most suitable foundation structures to ensure that the permissible horizontal deflection of the building is not more than 0.075 degree.
c. To adopt the basic wind speed and the seismic zone factor indicated in the "National Structural Code of the Philippines" based on 50-year mean recurrence interval to the structural design.

d. To provide the necessary environment for PAGASA's 24hours/day work schedule of observations to be performed effectively and efficiently.
e. To have the necessary power supply back-up equipment (diesel generator, radar power backup unit, auto voltage regulator, etc.) for performing round-the-clock meteorological services 24 hours a day, 365 days a year.
f. To be sufficiently robust to withstand extreme weather and allow the performance of uninterrupted radar observation and the supply of weather forecast & warnings, even during a natural disaster.
g. To make use of local building materials for easy maintenance of the radar tower buildings by PAGASA.
h. To design the equipment to minimize lightning damage.

(3) Design Policy on Environmental Conditions

1) Temperature

Air-conditioning systems are required for rooms where the equipment is to be installed since Virac, Aparri and Guiuan have a high temperature and high humid climate.

2) Rainfall

The maintenance stair-case has been located at the center of the building, covered by the upper concrete slab, to enable PAGASA personnel to easily reach each room for regular maintenance of the radar equipment without getting wet during raining.

3) Lightning

The frequent lightning occurs especially during the rainy season. A lightning protector is, therefore planned, to prevent damage to the building and to the equipment.

4) Tropical Cyclone (Stormy Wind)

To ensure highly accurate radar observations, in accordance with the "National Structural Code of the Philippines", the maximum horizontal movement angle of the buildings must be not more than 0.075 degree at the survival wind velocity of 250km/h (approx. 69m/s) in Virac, Aparri and Guiuan.

5) Earthquake

According to the "National Structural Code of the Philippines", Virac, Aparri and Guiuan are located in "Zone 4". The "Seismic Zone Factor" of Zone 4 is defined z = 0.4 indicated in the Code will be incorporated into the structural design and calculation for the radar tower buildings.

6) Load Bearing Layer

The structural design of the radar tower buildings is implemented according to the result of the geotechnical survey conducted at Virac, Aparri and Guiuan Meteorological Radar Observation Stations by the local contractor consigned by the Basic Design Study Team. Foundation type of each radar tower building is as follows.

Table 15: Foundation Type of the Proposed Radar Tower Buildings

	Virac Meteorological Radar Observation Station	Aparri Meteorological Radar Observation Station	Guiuan Meteorological Radar Observation Station
Foundation type	Pile foundation (cast in site concrete)	Pile foundation (cast in site concrete)	Spread foundation

(4) Design Policy for Construction Work

1) Environmental Regulation

Waste water discharged from the radar tower buildings must undergo initial treatment before filtering treatment into the soil at each site.

2) Use of Locally Procurable Materials

Gravel, sand, cement, blocks, floor materials, reinforced bars, etc. are produced in the Philippines while other construction materials are imported from ASEAN (Association of Southeast Asian Nations) countries. Most of the construction materials can be procured in the local market. For the Project, durable maintenance materials not containing asbestos will be selected from the locally available materials.

3) Use of Local Construction Methods and Local Workers

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

(5) Policy for Use of Local Construction Companies

1) Construction Work of the Radar Tower Buildings

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

2) Equipment Installation Work

Under supervision of a Japanese engineer, a local electrical work contractor will effectively be used in the equipment installation work.

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

1) Easy to operate the equipment

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

2) Easy maintenance and affordable recurrent costs of the equipment

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

3) Consideration of minimizing operation & maintenance costs

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

- The ability to restrict the operation of air-conditioning systems and the electricity supply to the operational rooms in the radar tower buildings
- The utilization of natural light to reduce energy requirements by minimizing the hours of artificial lighting required.
- The incorporation of solid-state parts into the radar system as much as possible to reduce the cost and frequency of parts replacement.

(7) Design Policy for Equipment & Building Grade

To allow the supply of uninterrupted forecasts and warnings to the public, even during tropical cyclone crossing the country, the equipment and buildings must be sufficiently robust to withstand floods, local severe storms and lightning strikes and enable the provision of meteorological services 24 hours per day.

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

Locally procurable materials and the local construction methods must be used in the building design. The equipment to be installed in the radar tower buildings such as specialized power backup systems and meteorological equipment is not available in the local market. The pulse compression solid state

Doppler radar system which has already been put into practical use for meteorological observation and has confirmed its reliability, durability, accuracy and performance is only available and made in Japan. The equipment for the Project must be durable, reliable, of a high technical level, and cost effective.

In accordance with the priority of the project sites (1: Virac, 2: Aparri and 3: Guiuan) indicated by PAGASA and as a result of the study on the climate conditions, the Project will be implemented one site at a time and operation of 2 existing/new radar systems must be kept during the Project implementation for monitoring tropical cyclones.

2-2-2 Basic Plan

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

Table 16: Finalized Components for the Project

Component	WFFC	Virac Meteorological Radar Observation Station	Aparri Meteorological Radar Observation Station	Guiuan Meteorological Radar Observation Station
Equipment Procurement and Installation				
Meteorological Radar System	-	1	1	1
Meteorological Radar Data Display System	1	1	1	1
Meteorological Data Satellite Communication System (VSAT)	1 (Hub)	1	1	1
Facility Construction				
Radar Tower Building (including furniture for Equipment)	-	1	1	1

According to the design policies aforesaid, the basic design plan of the Equipment and the Radar Tower Buildings are clarified below.

(1) Basic Plan of the Equipment

1) Meteorological Radar System

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

The requested meteorological radar systems for Virac, Aparri and Guiuan are S band. S band radar system is the most suitable type of radar system for the observation of precipitation over a very wide area. S band radar system has several important characteristics, including lower attenuation by rain and the atmosphere than other types of radar, and the ability to transmit at high power, providing a “long range”, “real time” system. For these reasons, S band radar has been selected as the most suitable to monitor large-scale and distant phenomena such as tropical cyclones. In addition, the S band radar

system must be a Doppler system with a changeable function having quantitative rainfall observation and air-turbulence observation capability in real time.

The existing 2,850MHz ±5MHz frequency band will be used for the proposed Doppler radar systems supplied under the Project. Technical features of the S band meteorological Doppler radar system are as follows.

Table 17: Major Features of Meteorological Radar System

Major Features	Existing Radar System	Proposed Radar System
Main Purpose	Tropical Cyclone Monitoring	Tropical Cyclone Monitoring
Band	S band	S band
Frequency	2,850MHz	2,850MHz
Rainfall Resolution	16 gradation level indication	256 gradation level indication
Detectable Range of Precipitation Intensity 1mm/h or more	300km	450km
Doppler Function	None	Available
Accumulated Rainfall	None	Available

As indicated in the table attached hereunder, the existing meteorological radar systems can detect a precipitation rate of 1mm/h or more only within a 300km radius. However, the proposed meteorological Doppler radar system is designed to be able to detect a precipitation rate of 1mm/h or more within a 450km radius.

Table 18: Comparison of Precipitation Detection Range
between the existing radar systems and the proposed radar systems
by Reception Power (dbm) Precipitation Intensity

Detection Range of the Existing Radar System (Antenna Diameter: 4m) Reception Power: -110dBm							
Distance (km)	Precipitation Intensity (mm/h)						
	0.50	**1.00**	**5.00**	**10.00**	**20.00**	**40.00**	**100.00**
10	-80.5	-75.7	-64.5	-59.7	-54.9	-50.1	-43.7
50	-94.9	-90.1	-78.9	-74.1	-69.3	-64.5	-58.1
100	-101.4	-96.6	-85.4	-80.6	-75.8	-71.0	-64.6
150	-105.5	-100.7	-89.5	-84.7	-79.8	-75.0	-68.7
200	-108.5	-103.7	-92.5	-87.7	-82.8	-78.0	-71.7
250	-110.9	-106.1	-94.9	-90.1	-85.3	-80.5	-74.1
300	-113.0	-108.2	-97.0	-92.2	-87.4	-82.5	-76.2
350	-114.8	-110.0	-98.8	-94.0	-89.2	-84.4	-78.0
400	-116.5	-111.7	-100.5	-95.7	-90.9	-86.0	-79.7
450	-118.0	-113.2	-102.0	-97.2	-92.4	-87.6	-81.2

Detection Range of the proposed Radar System (Antenna Diameter: 5m) Reception Power: -110dBm							
Distance (km)	Precipitation Intensity (mm/h)						
	0.50	**1.00**	**5.00**	**10.00**	**20.00**	**40.00**	**100.00**
10	-75.4	-70.5	-59.4	-54.5	-97.4	-44.9	-38.5
50	-89.7	-84.9	-73.7	-68.9	-64.1	-59.3	-52.9
100	-96.3	-91.4	-80.3	-75.4	-70.6	-65.8	-59.4
150	-100.3	-95.5	-84.3	-79.5	-74.6	-69.8	-63.5
200	-103.3	-98.5	-87.3	-82.5	-77.6	-72.8	-66.5
250	-105.7	-100.9	-89.7	-84.9	-80.1	-75.3	-68.9
300	-107.8	-103.0	-91.8	-87.0	-82.2	-77.4	-71.0
350	-109.6	-104.8	-93.6	-88.8	-84.0	-79.2	-72.8
400	-111.3	-106.5	-95.3	-90.5	-85.7	-80.9	-74.5
450	-112.8	-108.0	-96.8	-92.0	-87.2	-82.4	-76.0

Out of Range New Area of Detection Reliable Detection Range

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

[1] Doppler Mode

The meteorological radar system is designed to work in Doppler mode, which detects the wind motion and wind patterns of severe weather phenomena such as tropical cyclones, local sever storms and tornadoes within a 200km radius. This will help PAGASA to monitor the movement and the development of severe weather system for the preparation of more accurate and timely weather forecasting and warning. The Doppler mode is essential to allow for more accurate forecasting and longer forecast prediction times.

[2] CAPPI (Constant Altitude PPI (Plan Position Indicator)) Mode

CAPPI is a horizontal cross-section display at an altitude which can be specified by the user. It is

derived from the interpolation of volumetric data. Data from all azimuth and elevation points are used in the calculation of precipitation intensity in order to generate the display for a specified altitude. The product displays constant altitude information from 3-dimensional raw data obtained by scans at multiple elevations. To get 3 dimensional data, the radar antenna can operate in "volumetric scan" mode, changing the antenna elevation at regular time intervals. For the estimation of rainfall from a convective system and the preparation of composite pictures using multiple radar systems, accurate observed data, especially CAPPI data at an altitude of 2km or 3km, is required. An automatic multi-level CAPPI function will be provided with the proposed radar systems.

[3] Required Radar Display and Output Information Functions

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

Table 19: Required Radar Display and Output Information Functions

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

“Present Detection Range of the Existing Meteorological Radar Observation Network in the Philippines” and “Composite Picture of the Proposed Meteorological Radar Observation Network in the Philippine” are attached hereunder.

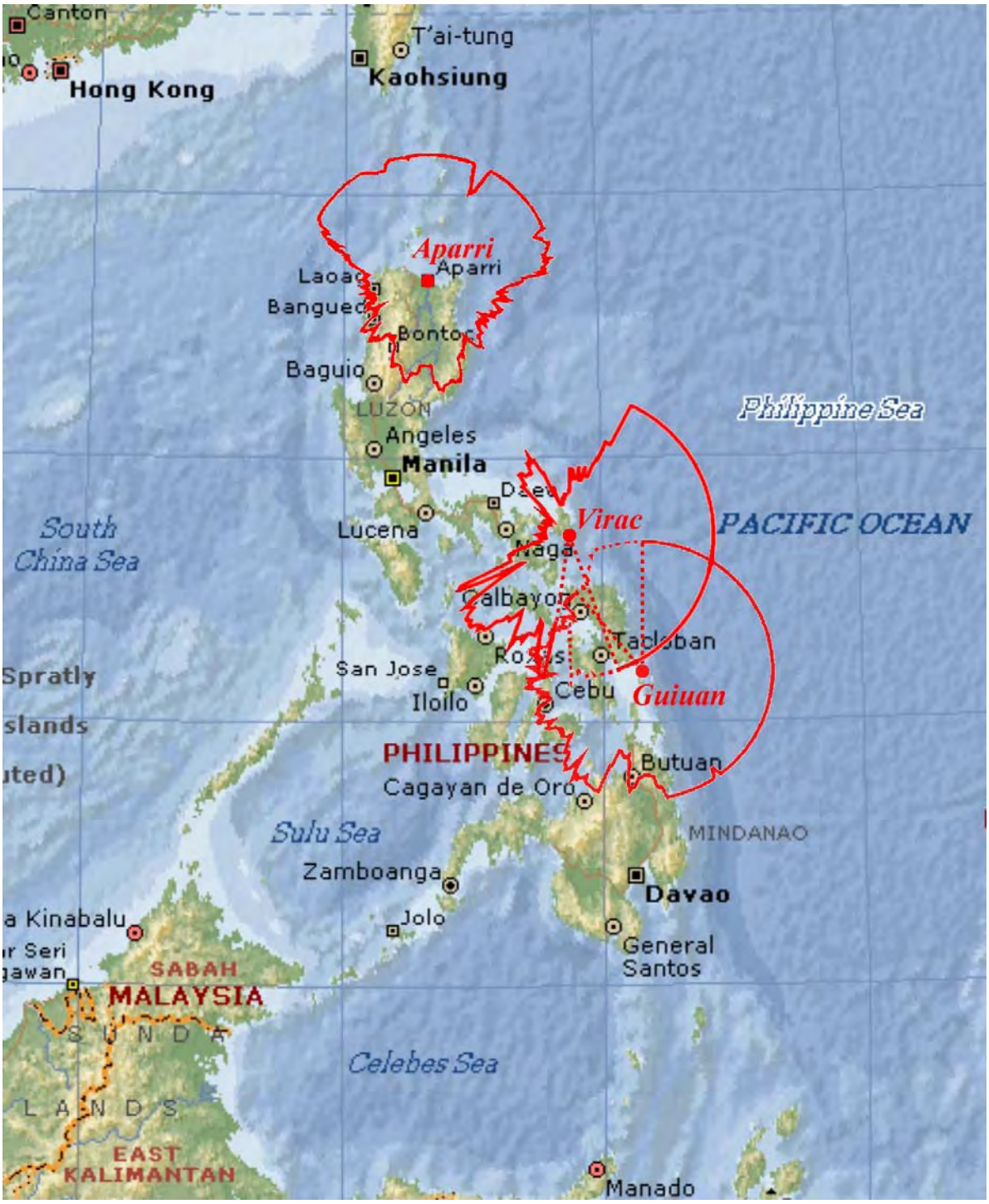
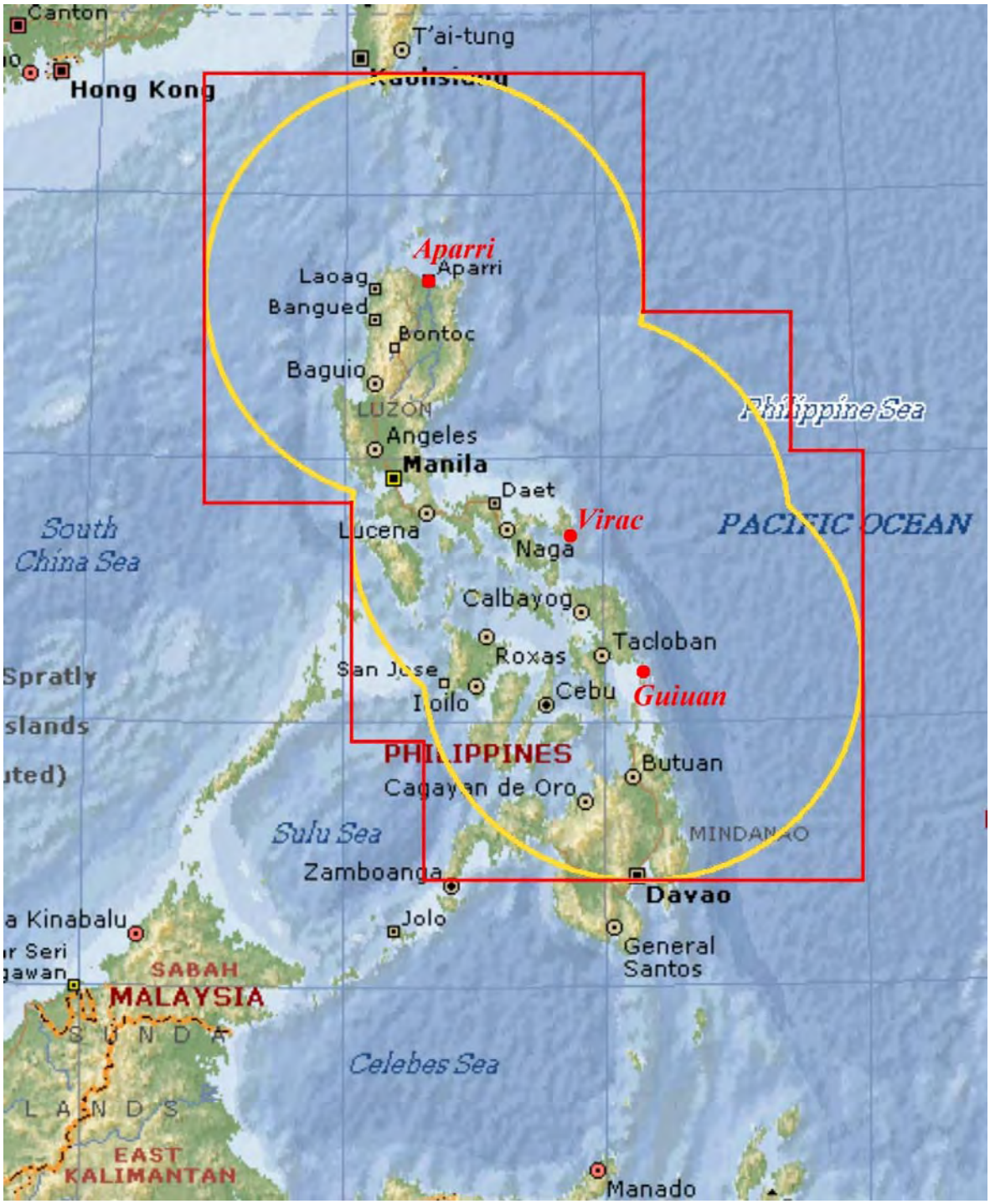


Figure 7: Present Detection Range
of the Existing Meteorological Radar Observation Network
in the Philippines
(The range indicates beam height of 3000m above sea level)



: Observed Data Processing Area
: Maximum Detection Area

Figure 8: Composite Picture of the Proposed Meteorological Radar Observation Network in the Philippines

2) Meteorological Radar Data Display System

PAGASA's forecasters are required to do a substantial amount of work, at a number of locations, very rapidly, in order to produce the required outputs. Therefore, meteorological radar data display systems are to be installed at Virac, Aparri and Guiuan Meteorological Radar Tower Buildings to be constructed in the Project and the WFFC. In addition, the system must have the ability to receive and display all the meteorological products in real time for routine weather forecasting & warning.
Displays of the system must be minimized heat production for effective room cooling, power-saving type and less screen reflections for smooth and long time operation.

A composite radar picture of precipitation intensity in the observation range of three (3) meteorological radar systems will be prepared by a computer system to be installed in the WFFC. Data file of the composite radar picture will be stored as binary data of hourly accumulated precipitation data of 2.5 km mesh in the detection range shown in the last page. The meteorological radar data display system will be designed to enable the WFFC to manually input the hourly accumulated precipitation data of 2.5 km mesh to the existing flood forecasting model of PAGASA.

3) Meteorological Data Satellite Communication System (VSAT)

In order to improve the tropical cyclone monitoring and forecasting work, enabling the timely dissemination of products, all of the meteorological radar data produced by the proposed Virac, Aparri and Guiuan Meteorological Radar Systems must be delivered to the WFFC, every 15 minutes in view of CAPPI mode observation. The required data transmission speed is 32kbps or more between Virac, Aparri and Guiuan Meteorological Radar Systems and the WFFC. To do this, a data acquisition system is required, employing the most suitable band for high-speed satellite communication links using C-band, because of its low attenuation by rain.

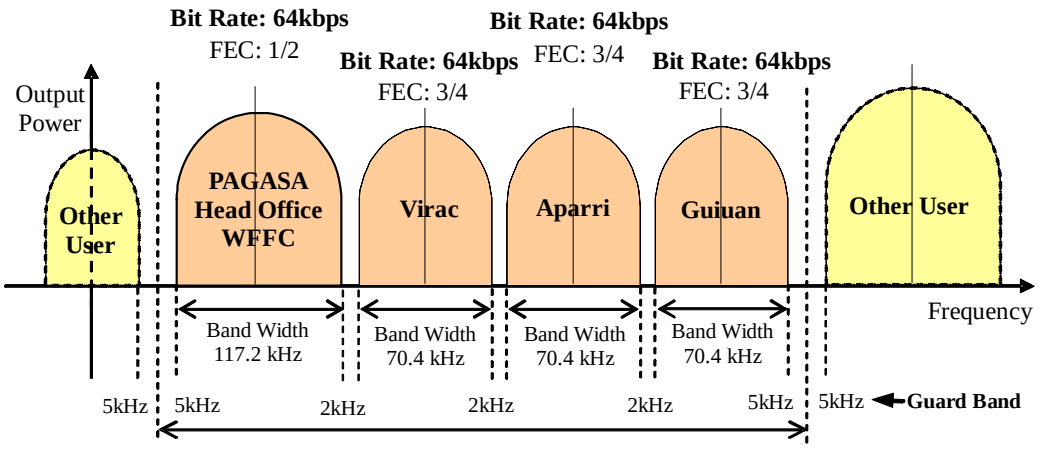


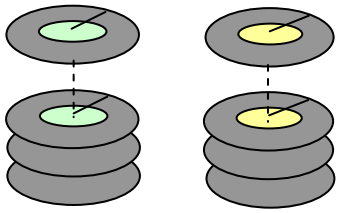
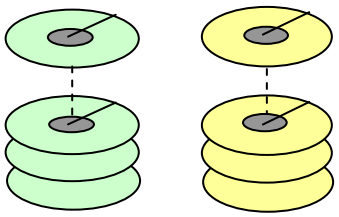
Figure 9: Estimation of Minimum Required Space Segment

The required transmission time for the radar products to be transmitted by the Meteorological Data Satellite Communication System (VSAT) from Virac, Aparri and Guiuan Meteorological Radar Systems to the WFFC is indicated in the following tables.

Table 20: Required Transmission Time at Transmission Speed 64kbps

Meteorological Radar Data	Data Transmission Time to WFFC	Total	Required Time
Intensity RAW Data and Doppler RAW Data for a Fixed Elevation Angle (481kBytes)	1.3min	⇒ 13.8min	⇒ **15min**
Intensity RAW Data and Doppler RAW Data for 10 elevation Angle (4.81MBytes)	12.5min		

Table 21: Data Volume and Products of the Proposed Meteorological Radar System

Descriptions of Data	Data Volume of Single Observation	Radar Display
Intensity RAW Data and Doppler RAW Data for a Fixed Elevation Angle [8bit Intensity] [Doppler] Short pulse  Long pulse 	Short Pulse Observation Data ・R-θ data ・320range x 360 angle ・8bit data（Intensity /Doppler） Sub-total: 230.4kbytes Long Pulse Observation Data ・R-θ data ・320range x 360 angle ・8bit data（Intensity /Doppler） Sub-total：230.4kbytes Header:5.12kbyte x 4 =20.48kbytes **Total: 481kbytes**	<Radar Products> ・PPI/RHI Display ・Cyclone Tracking Indication and Forecast ・Wad Velocity and Direction ・Wind Shear Alert
Intensity RAW Data and Doppler RAW Data for Multi-elevation (10 elevation) Angle [8bit Intensity] [Doppler] Short pulse  Long Pulse 	Short Pulse Observation Data ・R-θ data ・320range x 360 angle ・8bit data（Intensity /Doppler） ・10 elevation angle Subtotal: 2.304Mbytes Short Pulse Observation Data ・R-θ data ・320range x 360 angle ・8bit data（Intensity /Doppler） ・10 elevation angle Subtotal: 2.304Mbytes Header: 5.12kbyte x 40 =204.8kbytes **Total: 4.81Mbytes**	<Radar Products> ・PPI/RHI Display ・Cyclone Tracking Indication and Forecast ・Wad Velocity and Direction ・Wind Shear Alert ・CAPPI Display ・Heavy Rainfall Warning Output ・N-hour Accumulated Rainfall ・Vertical Integrated Liquidation ・Surface Rain Indication ・Composite Display ・3-Dimensional Data Display ・Vertical Cross Section ・Echo Top Display ・Wind Profile of the Upper Layer ・Catchment Area Rainfall Amount Display

For transmitting all the meteorological radar data from Virac, Aparri and Guiuan Meteorological Radar Systems to the WFFC, the transponder to be selected for the Project must satisfy the following requirements.

✧ Geographic Coverage : Southeast Asia area including Philippines

- ✧ Satellite Beam : C band beam
- ✧ Frequency : Up Link 5850MHz - 6425MHz
- ✧ Down Link : 3625MHz - 4200MHz
- ✧ Polarizations : Orthogonal Linear
- ✧ Satellite EIRP (Max) : more than 41 [dBW]
- ✧ Satellite G/T : more than 2.0 [dB/K]
- ✧ Satellite SFD : less than -86.5 [dBW/m2]
- ✧ Satellite Orbital Slot : 87°E - 156°E

<EIPR>

Effective Isotropic Radiated Power – This term describes the strength of the signal leaving the satellite antenna or the transmitting earth station antenna, i.e., final amplifier output power + antenna gain in dB. The unit dBW is the logarithmic expression of Power in Watt.

<G/T>

G/T is called “Figure of merit” and represents the receive system performance. G/T is the ratio of the receive antenna gain and the system thermal noise including the antenna noise.

<SFD – Saturation Flux Density>

This means the flux density at the satellite receive antenna required to saturate a satellite transponder.

The “Schematic Diagram for the Project for Establishment of the Meteorological Radar System in the Philippines” is attached hereto.

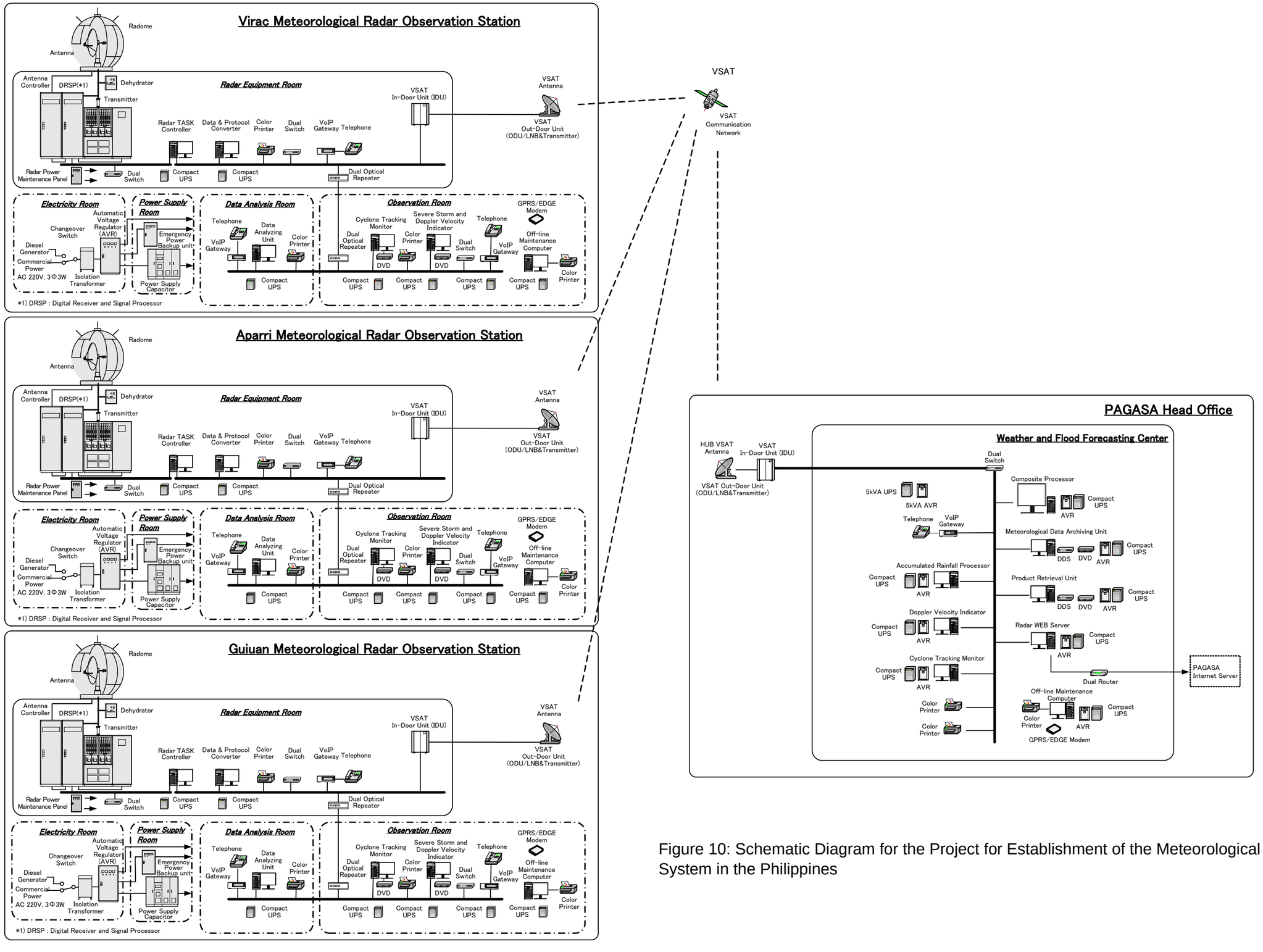


Figure 10: Schematic Diagram for the Project for Establishment of the Meteorological Radar System in the Philippines

(2) Major Equipment List

As a consequence of the basic design study, the major components of the Project are described below.

Table 22: Major Components

Name of System	WFFC	Virac Meteorological Radar Observation Station	Aparri Meteorological Radar Observation Station	Guiuan Meteorological Radar Observation Station
Meteorological Radar System	-	○	○	○
Meteorological Radar Data Display System	○	○	○	○
Meteorological Data Satellite Communication System (VSAT)	○	○	○	○

Major Equipment List

Meteorological Radar System
(Virac Meteorological Radar Observation Station)

Name of Site: Virac Meteorological Radar Tower Building (Radome Floor)			
Equipment	Specification	Quantity	Purpose
Radome	Type: Sandwich Type (Spherical surface) Dimension: Approx. 8m diameter Color: White Suitable non-observant and non-water stickling finish for making smooth surface Design Wind Pressure: 370kg/m^2 Suitable Frequency: 2,850MHz (±5MHz) Transmission loss: 0.5dB or less on one way path in dry Relative humidity: 0 to 100% Lightning Rod: Protecting angles of 60degree Obstruction light: Waterproof lightning system Base ring including necessary installation materials	1	For protecting the radar antenna assembly (a parabolic dish reflector) and maintenance personnel from severe weather conditions and lightning attacks.
Antenna	Type: Horn feed parabolic antenna Reflector: approx. 5m diameter Suitable Frequency: 2,850MHz (±5MHz) Beam width: not wider than 1.7 degree at -3dB point Antenna gain: 39dB or more without Radome Polarization: Linear, horizontal Side lobe level: not more than -25dB without Radome Pedestal including the motor and rotary joint for azimuth and elevation Driving range: Azimuth 360 degree, elevation -2 to +90 degree Safety switch: to inhibit from radiating during maintenance works in Radome VSWR: not more than 1.4 without Radome Optical connection box: For converting electric control signal to optical one Directional coupler: Coupling coefficiency: forward –50dB ±2dB backward –35dB ±1dB Calibration accuracy: ±0.5dB VSWR: less than 1.10 Rating power: not less than 20kW	1	For radiating radar beam into the atmosphere and receiving scatter waves while rotating the parabola antenna as azimuth and elevation direction.

Name of Site: Virac Meteorological Radar Tower Building (Radar Equipment Room)			
Equipment	Specification	Quantity	Purpose
Antenna Controller	Control processor: PC-based computer Control mode: Programming mode and manual control mode Driving method: Servo motor control method Scanning method: Independently scanning both of azimuth and elevation Driving range: Azimuth 360 degree, elevation –2 to +90 degree Rotation speed Azimuth: 0.5 to 6 rpm (6 rpm in operation) , selectable Elevation: not more than 17 second for each way scan between -2 and 60 degree Automatically and manually capable for clockwise and counterclockwise rotation in AZ and up & down in EL Accuracy of specified angle for both antenna calibration and digital readout: Azimuth: not more than ±0.1 degree Elevation: not more than ±0.1 degree Interlock: Protecting overload and overrun of the Antenna Reset switch for EL limit and antenna overrun Monitor: Real-time indication of the angle of azimuth and elevation Fitting: Control Card for Antenna Controller (x1)	1	For rotating the parabolic dish reflector and for controlling the antenna in azimuth and elevation by both horizontal and vertical drive motor units.
Transmitter	Transmitting frequency: 2,850MHz (±5MHz) Center frequency: Short range observation by short pulse width: 2,847.5MHz Long range observation by long pulse width: 2,852.5MHz Transmitting power: 10kW peak (at Tx output) Power amplifier: Solid state type Power amplifier protection: to inhibit operation individually in case of abnormal high temperature in chassis Radiation blanking feature: It shall be able to set both azimuth and elevation Pulse width: from 1μs to 100μs, selectable -Short range observation by short pulse width: from 1μs to 2μs -Long range observation by long pulse width: from 50μs to 100μs -Short pulse and long pulse are combined for the observation period. Pulse repetition frequency (PRF): [Doppler mode: Dual PRF] From 500Hz to 1,800Hz (Pulse width: 1μs or 50μs) selectable [Intensity mode: Single PRF] From 250 Hz to 900Hz (Pulse width: 2μs or 100μs) selectable Duty: less than 7% Status display: Transmission hour, status of Local/Remote control Alert display: Transmitting power alarm, Temperature alarm in cabinet Fitting: Power amplifier unit for transmitter (x2) Control card for transmitter (x1)	1	For amplifying the pulse-modulated power with stable frequency and transmitting the power to the antenna.

Digital Receiver and Signal Processor (DRSP)	Noise figure of the high frequency circuit: 3dB or better at the input terminal of low noise amplifier (LNA) Pulse compression type: Chirp modulation Pulse Compression ratio: 80 or less Receiver type: Coherent IF digitizer Sensitivity: -110dBm or better (at 10μs plus) Dynamic range: 80dB or better from noise level to the saturated level (depending on matched filter bandwidth) Doppler signal processor (including DSP card and Rx card): Software based controller Quantization: 14 bits Range bin: 1024 Processing area: (Intensity mode) throughout 0 km to 440 km or more in range and 0 to 360 degree in azimuth (Doppler mode) throughout 0 km to 200 km or more in range and 0 to 360 degree in azimuth Intensity signal process -Ground clutter suppression: Frequency analysis by filter-bank and low frequency suppression with minimum influence to precipitation intensity -Logarithmic linearity: within ±1dB throughout 80dB -Range correction: depending on radar equation -Air-attenuation correction: 0.005dB/km in Observation Range Velocity signal process -Processing type: Pulse Pair, FFT and Random Phase -Velocity De-arising: Real-time processing by Dual-PRF -Trigger control: PRF ratio selectable (2:3, 3:4, 4:5) Averaging: Block averaging and/or sliding averaging Output data: Reflectivity (Z), Doppler velocity (V), Spectrum width (W) Output data resolution: 8bit Output data indicating interval: within 1 minute after automatic scan Time adjustment: Automatically adjustment by GPS NTP server (including GPS antenna) Fitting: Control Card for DRSP (x1)	1	For receiving, pulse compression and processing echo signal from the Antenna. For suppressing unnecessary echo such as clutter signals reflected from the ground. For sending ingest data to radar TASK controller.
Dehydrator	Capability of ventilation pressure: 3±1 liter/min, Upper limit: 300 ±30 hPa Lower limit: 70±30 hPa	1	For supplying dried and pressurized air into the wave-guide to reduce wave propagation loss.
Wave-guide Configuration	Wave-guide Type: S-band wave-guide (conformity with WR-284 or equivalent) Circulator Allowable maximum power: at least 20 kW TR limitter (x6) Type: Dual backup type	1	For feeder line propagation wave traveling between the antenna and TX/RX.

Radar TASK Controller	CPU: Intel Core™2 Duo 2GHz or equivalent Main memory (RAM): 1024Mbytes or more Hard disk unit: 250GBytes or more x two (2) drives CD-RW Drive: one (1) Monitor display: Color LCD type, 19 inches or more LAN interface: IEEE802.3/u/ab, 10BASE-T/100BASE-TX/1000BASE-T, TCP/IP, two (2)ports or more LAN Arrester: for surge protection, RJ45 interface Input power: AC 220V, 60Hz, single phase Software Operating system: UNIX or LINUX-based Application software: -Radar local control and monitoring -Observation scheduling -Radar echo display -Radar data generation and dissemination	1	For operating the radar system, monitoring condition of the radar system and generating raw product data. Control and monitoring items: Radiate control/status Azimuth/elevation position control/status TX standby status Pulse width control/status Antenna local/maintenance mode status.
Data & Protocol Converter	CPU: Intel Core™2 Duo 2GHz or equivalent Main memory (RAM): 1024Mbytes or more Hard disk unit: 250GBytes or more x two (2) drives CD-RW Drive: one (1) Monitor display: Color LCD type, 19 inches or more LAN interface: IEEE802.3/u/ab, 10BASE-T/100BASE-TX/1000BASE-T, TCP/IP, two (2)ports or more LAN Arrester: for surge protection, RJ45 interface Input power: AC 220V, 60Hz, single phase Software Operating system: UNIX or LINUX-based Application software: -Data receiving, converting and transfer -Parameter setting -Display processing	1	For sending Raw data to central system according to specified interval.
Peripherals	Compact UPS -Capacity: 500VA or more -Input power: AC 220V ±15%, single phase, 60Hz -Output power: AC 220V ±5%, single phase, 60Hz -Back-up time: 5 minutes or longer at full load	2	For supplying back-up AC power to computer equipment in order to enable proper shutdown procedure of the system in case of power failure.
	Dual Switch -LAN interface: IEEE 802.3 Ethernet -Connection port: 100BASE-TX or more, eight (8)ports or more -Input power: AC 220V, single phase, 60Hz -Each ports and power supply shall be duplicated	2	For connecting all the computing equipment on LAN.
	Color Printer -Color inkjet type, A3 size -At least 1200 dpi resolution, 7ppm of faster printing speed -Interface USB or LAN -Input power: AC 220V, single phase, 60Hz	1	For printing radar image.
	Dual Optical Repeater -LAN interface: IEEE 802.3 Ethernet -Connection port: 100BASE-TX, one (1) port or more, Optical fiber interface one (1) set, Multi-mode (100Mbps) -Input power: AC 220V, single phase, 60Hz -Each ports and power supply shall be duplicated	1	For converting electrical signal and optical signal on LAN for surge protection.
	Radar Power Maintenance Panel -Circuit breaker: no-fuse-breaker type -Main breaker: no-fuse-breaker type or magnetic-breaker -Power distribution: 5 outputs include 1 spare -Input power: AC 220V, three phase, 60Hz -Output power: AC 220V, single phase, 60Hz	1	For distributing and supplying AC power to radar system.

Name of Site: Virac Meteorological Radar Tower Building (Electricity Room)			
Equipment	Specification	Quantity	Purpose
Isolation Transformer	Capacity: 35kVA or more Input Power: AC 220V, 240V selectable, three phase three wire, 60Hz Output Power: AC 220V, three phase three wire, 60Hz Insulation: Class B Surge voltage: 30kV or more	1	For protecting each equipment from surge voltage in main power.
Automatic Voltage Regulator (AVR)	Capacity: 30kVA or more Input Power: AC 220V ±20%, three phase three wire, 60Hz Output Power: AC 220V ±5%, three phase three wire, 60Hz	1	For supplying the constant or regulated voltage to the radar system.
Name of Site: Virac Meteorological Radar Tower Building (Power Supply Room)			
Equipment	Specification	Quantity	Purpose
Power Supply Capacitor	Capability: 15kVA or more Input voltage: AC 220V±10% (three phase three wire, 60Hz) Normal output: Direct output of input voltage CVCF output: AC 220V ±5% (three phase three wire, 60Hz) Back up time: 4 minutes or longer for radar equipment Energy storage: Electric double layer capacitor Others: Bypass function	1	For supplying the uninterrupted power by Electric Dual Layer Capacitor energy to the radar system when power failure occurres.
Name of Site: Virac Meteorological Radar Tower Building (Maintenance Room)			
Equipment	Specification	Quantity	Purpose
Test Instruments and Materials	Test signal Generator	1 set	For maintenance of radar system.
	Power Meter	1 set	
	Power Sensor	1 set	
	Frequency Counter	1 set	
	Detector	1 set	
	Attenuator Set	1 set	
	Terminator for Detector	1 set	
	Oscilloscope	1 set	
	Digital Multimeter	1 set	
	CW Converter	1 set	
	Network Camera	1 set	
	Tool Kit	1 set	
	Extension Cable	1 set	
	Leveler	1 set	
	Step Ladder	1 set	
	Clump Current Meter	1 set	
	Vacuum Cleaner	1 set	
	Radar Antenna Maintenance Deck	1 set	

Spare Parts	Timing Belt for Antenna (For Azimuth Angle Signal)	1 set	For maintenance of radar system.
	Timing Belt for Antenna (For Elevation Angle Signal)	1 set	
	Encoder for Antenna (For Azimuth Angle Signal)	1 set	
	Encoder for Antenna (For Elevation Angle Signal)	1 set	
	Motor for Antenna (For Azimuth Angle Signal)	1 set	
	Motor for Antenna (For Elevation Angle Signal)	1 set	
	Servo Unit for Antenna Controller (For Azimuth Angle Signal)	1 set	
	Servo Unit for Antenna Controller (For Elevation Angle Signal)	1 set	
	Power Supply Unit for Antenna Controller	1 set	
	Power Supply Unit for Transmitter	1 set	
	Power Supply Unit for Digital Receiver and Signal Processor	1 set	
	Fan Unit for Radar Equipment	2 set	
	Hard Disk Unit for Computer (not less than 250GB)	1 set	
	LAN Arrester	1 set	
	Obstruction Light	2 pcs	
Consumables	Grease with Pump and Oil with Jug for Antenna	1 set	For maintenance of radar system.
	Antenna Carbon Brush for Power	1 set	
	Antenna Carbon Brush for Signal	1 set	
Service Manuals	Operation & Maintenance Hand Book	2 sets	For maintenance of radar system.

Meteorological Radar System
(Aparri Meteorological Radar Observation Station)

Name of Site: Aparri Meteorological Radar Tower Building (Radome Floor)			
Equipment	Specification	Quantity	Purpose
Radome	Type: Sandwich Type (Spherical surface) Dimension: Approx. 8m diameter Color: White Suitable non-observant and non-water stickling finish for making smooth surface Design Wind Pressure: 380kg/m^2 Suitable Frequency: 2,850MHz (±5MHz) Transmission loss: 0.5dB or less on one way path in dry Relative humidity: 0 to 100% Lightning Rod: Protecting angles of 60degree Obstruction light: Waterproof lightning system Base ring including necessary installation materials	1	For protecting the radar antenna assembly (a parabolic dish reflector) and maintenance personnel from severe weather conditions and lightning attacks.
Antenna	Type: Horn feed parabolic antenna Reflector: approx. 5m diameter Suitable Frequency: 2,850MHz (±5MHz) Beam width: not wider than 1.7 degree at -3dB point Antenna gain: 39dB or more without Radome Polarization: Linear, horizontal Side lobe level: not more than -25dB without Radome Pedestal including the motor and rotary joint for azimuth and elevation Driving range: Azimuth 360 degree, elevation -2 to +90 degree Safety switch: to inhibit from radiating during maintenance works in Radome VSWR: not more than 1.4 without Radome Optical connection box: For converting electric control signal to optical one Directional coupler: Coupling coefficiency: forward –50dB ±2dB backward –35dB ±1dB Calibration accuracy: ±0.5dB VSWR: less than 1.10 Rating power: not less than 20kW	1	For radiating radar beam into the atmosphere and receiving scatter waves while rotating the parabola antenna as azimuth and elevation direction.

Name of Site: Aparri Meteorological Radar Tower Building (Radar Equipment Room)			
Equipment	Specification	Quantity	Purpose
Antenna Controller	Control processor: PC-based computer Control mode: Programming mode and manual control mode Driving method: Servo motor control method Scanning method: Independently scanning both of azimuth and elevation Driving range: Azimuth 360 degree, elevation –2 to +90 degree Rotation speed Azimuth: 0.5 to 6 rpm (6 rpm in operation) , selectable Elevation: not more than 17 second for each way scan between -2 and 60 degree Automatically and manually capable for clockwise and counterclockwise rotation in AZ and up & down in EL Accuracy of specified angle for both antenna calibration and digital readout: Azimuth: not more than ±0.1 degree Elevation: not more than ±0.1 degree Interlock: Protecting overload and overrun of the Antenna Reset switch for EL limit and antenna overrun Monitor: Real-time indication of the angle of azimuth and elevation Fitting: Control Card for Antenna Controller (x1)	1	For rotating the parabolic dish reflector and for controlling the antenna in azimuth and elevation by both horizontal and vertical drive motor units.
Transmitter	Transmitting frequency: 2,850MHz (±5MHz) Center frequency: Short range observation by short pulse width: 2,847.5MHz Long range observation by long pulse width: 2,852.5MHz Transmitting power: 10kW peak (at Tx output) Power amplifier: Solid state type Power amplifier protection: to inhibit operation individually in case of abnormal high temperature in chassis Radiation blanking feature: It shall be able to set both azimuth and elevation Pulse width: from 1μs to 100μs, selectable -Short range observation by short pulse width: from 1μs to 2μs -Long range observation by long pulse width: from 50μs to 100μs -Short pulse and long pulse are combined for the observation period. Pulse repetition frequency (PRF): [Doppler mode: Dual PRF] From 500Hz to 1,800Hz (Pulse width: 1μs or 50μs) selectable [Intensity mode: Single PRF] From 250 Hz to 900Hz (Pulse width: 2μs or 100μs) selectable Duty: less than 7% Status display: Transmission hour, status of Local/Remote control Alert display: Transmitting power alarm, Temperature alarm in cabinet Fitting: Power amplifier unit for transmitter (x2) Control card for transmitter (x1)	1	For amplifying the pulse-modulated power with stable frequency and transmitting the power to the antenna.

Digital Receiver and Signal Processor (DRSP)	Noise figure of the high frequency circuit: 3dB or better at the input terminal of low noise amplifier (LNA) Pulse compression type: Chirp modulation Pulse Compression ratio: 80 or less Receiver type: Coherent IF digitizer Sensitivity: -110dBm or better (at 10μs plus) Dynamic range: 80dB or better from noise level to the saturated level (depending on matched filter bandwidth) Doppler signal processor (including DSP card and Rx card): Software based controller Quantization: 14 bits Range bin: 1024 Processing area: (Intensity mode) throughout 0 km to 440 km or more in range and 0 to 360 degree in azimuth (Doppler mode) throughout 0 km to 200 km or more in range and 0 to 360 degree in azimuth Intensity signal process -Ground clutter suppression: Frequency analysis by filter-bank and low frequency suppression with minimum influence to precipitation intensity -Logarithmic linearity: within ±1dB throughout 80dB -Range correction: depending on radar equation -Air-attenuation correction: 0.005dB/km in Observation Range Velocity signal process -Processing type: Pulse Pair, FFT and Random Phase -Velocity De-arising: Real-time processing by Dual-PRF -Trigger control: PRF ratio selectable (2:3, 3:4, 4:5) Averaging: Block averaging and/or sliding averaging Output data: Reflectivity (Z), Doppler velocity (V), Spectrum width (W) Output data resolution: 8bit Output data indicating interval: within 1 minute after automatic scan Time adjustment: Automatically adjustment by GPS NTP server (including GPS antenna) Fitting: Control Card for DRSP (x1)	1	For receiving, pulse compression and processing echo signal from the Antenna. For suppressing unnecessary echo such as clutter signals reflected from the ground. For sending ingest data to radar TASK controller.
Dehydrator	Capability of ventilation pressure: 3±1 liter/min, Upper limit: 300 ±30 hPa Lower limit: 70±30 hPa	1	For supplying dried and pressurized air into the wave-guide to reduce wave propagation loss.
Wave-guide Configuration	Wave-guide Type: S-band wave-guide (conformity with WR-284 or equivalent) Circulator Allowable maximum power: at least 20 kW TR limitter (x6) Type: Dual backup type	1	For feeder line propagation wave traveling between the antenna and TX/RX.

Radar TASK Controller	CPU: Intel Core™2 Duo 2GHz or equivalent Main memory (RAM): 1024Mbytes or more Hard disk unit: 250GBytes or more x two (2) drives CD-RW Drive: one (1) Monitor display: Color LCD type, 19 inches or more LAN interface: IEEE802.3/u/ab, 10BASE-T/100BASE-TX/1000BASE-T, TCP/IP, two (2)ports or more LAN Arrester: for surge protection, RJ45 interface Input power: AC 220V, 60Hz, single phase Software Operating system: UNIX or LINUX-based Application software: -Radar local control and monitoring -Observation scheduling -Radar echo display -Radar data generation and dissemination	1	For operating the radar system, monitoring condition of the radar system and generating raw product data. Control and monitoring items: Radiate control/status Azimuth/elevation position control/status TX standby status Pulse width control/status Antenna local/maintenance mode status.
Data & Protocol Converter	CPU: Intel Core™2 Duo 2GHz or equivalent Main memory (RAM): 1024Mbytes or more Hard disk unit: 250GBytes or more x two (2) drives CD-RW Drive: one (1) Monitor display: Color LCD type, 19 inches or more LAN interface: IEEE802.3/u/ab, 10BASE-T/100BASE-TX/1000BASE-T, TCP/IP, two (2)ports or more LAN Arrester: for surge protection, RJ45 interface Input power: AC 220V, 60Hz, single phase Software Operating system: UNIX or LINUX-based Application software: -Data receiving, converting and transfer -Parameter setting -Display processing	1	For sending Raw data to central system according to specified interval.
Peripherals	Compact UPS -Capacity: 500VA or more -Input power: AC 220V ±15%, single phase, 60Hz -Output power: AC 220V ±5%, single phase, 60Hz -Back-up time: 5 minutes or longer at full load	2	For supplying back-up AC power to computer equipment in order to enable proper shutdown procedure of the system in case of power failure.
	Dual Switch -LAN interface: IEEE 802.3 Ethernet -Connection port: 100BASE-TX or more, eight (8)ports or more -Input power: AC 220V, single phase, 60Hz -Each ports and power supply shall be duplicated	2	For connecting all the computing equipment on LAN.
	Color Printer -Color inkjet type, A3 size -At least 1200 dpi resolution, 7ppm of faster printing speed -Interface USB or LAN -Input power: AC 220V, single phase, 60Hz	1	For printing radar image.
	Dual Optical Repeater -LAN interface: IEEE 802.3 Ethernet -Connection port: 100BASE-TX, one (1) port or more, Optical fiber interface one (1) set, Multi-mode (100Mbps) -Input power: AC 220V, single phase, 60Hz -Each ports and power supply shall be duplicated	1	For converting electrical signal and optical signal on LAN for surge protection.
	Radar Power Maintenance Panel -Circuit breaker: no-fuse-breaker type -Main breaker: no-fuse-breaker type or magnetic-breaker -Power distribution: 5 outputs include 1 spare -Input power: AC 220V, three phase, 60Hz -Output power: AC 220V, single phase, 60Hz	1	For distributing and supplying AC power to radar system.

Name of Site: Aparri Meteorological Radar Tower Building (Electricity Room)			
Equipment	Specification	Quantity	Purpose
Isolation Transformer	Capacity: 35kVA or more Input Power: AC 220V, 240V selectable, three phase three wire, 60Hz Output Power: AC 220V, three phase three wire, 60Hz Insulation: Class B Surge voltage: 30kV or more	1	For protecting each equipment from surge voltage in main power.
Automatic Voltage Regulator (AVR)	Capacity: 30kVA or more Input Power: AC 220V ±20%, three phase three wire, 60Hz Output Power: AC 220V ±5%, three phase three wire, 60Hz	1	For supplying the constant or regulated voltage to the radar system.
Name of Site: Aparri Meteorological Radar Tower Building (Power Supply Room)			
Equipment	Specification	Quantity	Purpose
Power Supply Capacitor	Capability: 15kVA or more Input voltage: AC 220V±10% (three phase three wire, 60Hz) Normal output: Direct output of input voltage CVCF output: AC 220V ±5% (three phase three wire, 60Hz) Back up time: 4 minutes or longer for radar equipment Energy storage: Electric double layer capacitor Others: Bypass function	1	For supplying the uninterrupted power by Electric Dual Layer Capacitor energy to the radar system when power failure occurres.
Name of Site: Aparri Meteorological Radar Tower Building (Maintenance Room)			
Equipment	Specification	Quantity	Purpose
Test Instruments and Materials	Test signal Generator	1 set	For maintenance of radar system.
	Power Meter	1 set	
	Power Sensor	1 set	
	Frequency Counter	1 set	
	Detector	1 set	
	Attenuator Set	1 set	
	Terminator for Detector	1 set	
	Oscilloscope	1 set	
	Digital Multimeter	1 set	
	CW Converter	1 set	
	Network Camera	1 set	
	Tool Kit	1 set	
	Extension Cable	1 set	
	Leveler	1 set	
	Step Ladder	1 set	
	Clump Current Meter	1 set	
	Vacuum Cleaner	1 set	
	Radar Antenna Maintenance Deck	1 set	

Spare Parts	Timing Belt for Antenna (For Azimuth Angle Signal)	1 set	For maintenance of radar system.
	Timing Belt for Antenna (For Elevation Angle Signal)	1 set	
	Encoder for Antenna (For Azimuth Angle Signal)	1 set	
	Encoder for Antenna (For Elevation Angle Signal)	1 set	
	Motor for Antenna (For Azimuth Angle Signal)	1 set	
	Motor for Antenna (For Elevation Angle Signal)	1 set	
	Servo Unit for Antenna Controller (For Azimuth Angle Signal)	1 set	
	Servo Unit for Antenna Controller (For Elevation Angle Signal)	1 set	
	Power Supply Unit for Antenna Controller	1 set	
	Power Supply Unit for Transmitter	1 set	
	Power Supply Unit for Digital Receiver and Signal Processor	1 set	
	Fan Unit for Radar Equipment	2 set	
	Hard Disk Unit for Computer (not less than 250GB)	1 set	
	LAN Arrester	1 set	
	Obstruction Light	2 pcs	
Consumables	Grease with Pump and Oil with Jug for Antenna	1 set	For maintenance of radar system.
	Antenna Carbon Brush for Power	1 set	
	Antenna Carbon Brush for Signal	1 set	
Service Manuals	Operation & Maintenance Hand Book	2 sets	For maintenance of radar system.

Meteorological Radar System
(Guiuan Meteorological Radar Observation Station)

Name of Site: Guiuan Meteorological Radar Tower Building (Radome Floor)			
Equipment	Specification	Quantity	Purpose
Radome	Type: Sandwich Type (Spherical surface) Dimension: Approx. 8m diameter Color: White Suitable non-observant and non-water stickling finish for making smooth surface Design Wind Pressure: 380kg/m^2 Suitable Frequency: 2,850MHz (±5MHz) Transmission loss: 0.5dB or less on one way path in dry Relative humidity: 0 to 100% Lightning Rod: Protecting angles of 60degree Obstruction light: Waterproof lightning system Base ring including necessary installation materials	1	For protecting the radar antenna assembly (a parabolic dish reflector) and maintenance personnel from severe weather conditions and lightning attacks.
Antenna	Type: Horn feed parabolic antenna Reflector: approx. 5m diameter Suitable Frequency: 2,850MHz (±5MHz) Beam width: not wider than 1.7 degree at -3dB point Antenna gain: 39dB or more without Radome Polarization: Linear, horizontal Side lobe level: not more than -25dB without Radome Pedestal including the motor and rotary joint for azimuth and elevation Driving range: Azimuth 360 degree, elevation -2 to +90 degree Safety switch: to inhibit from radiating during maintenance works in Radome VSWR: not more than 1.4 without Radome Optical connection box: For converting electric control signal to optical one Directional coupler: Coupling coefficiency: forward –50dB ±2dB backward –35dB ±1dB Calibration accuracy: ±0.5dB VSWR: less than 1.10 Rating power: not less than 20kW	1	For radiating radar beam into the atmosphere and receiving scatter waves while rotating the parabola antenna as azimuth and elevation direction.

Name of Site: Guiuan Meteorological Radar Tower Building (Radar Equipment Room)			
Equipment	Specification	Quantity	Purpose
Antenna Controller	Control processor: PC-based computer Control mode: Programming mode and manual control mode Driving method: Servo motor control method Scanning method: Independently scanning both of azimuth and elevation Driving range: Azimuth 360 degree, elevation –2 to +90 degree Rotation speed Azimuth: 0.5 to 6 rpm (6 rpm in operation) , selectable Elevation: not more than 17 second for each way scan between -2 and 60 degree Automatically and manually capable for clockwise and counterclockwise rotation in AZ and up & down in EL Accuracy of specified angle for both antenna calibration and digital readout: Azimuth: not more than ±0.1 degree Elevation: not more than ±0.1 degree Interlock: Protecting overload and overrun of the Antenna Reset switch for EL limit and antenna overrun Monitor: Real-time indication of the angle of azimuth and elevation Fitting: Control Card for Antenna Controller (x1)	1	For rotating the parabolic dish reflector and for controlling the antenna in azimuth and elevation by both horizontal and vertical drive motor units.
Transmitter	Transmitting frequency: 2,850MHz (±5MHz) Center frequency: Short range observation by short pulse width: 2,847.5MHz Long range observation by long pulse width: 2,852.5MHz Transmitting power: 10kW peak (at Tx output) Power amplifier: Solid state type Power amplifier protection: to inhibit operation individually in case of abnormal high temperature in chassis Radiation blanking feature: It shall be able to set both azimuth and elevation Pulse width: from 1μs to 100μs, selectable -Short range observation by short pulse width: from 1μs to 2μs -Long range observation by long pulse width: from 50μs to 100μs -Short pulse and long pulse are combined for the observation period. Pulse repetition frequency (PRF): [Doppler mode: Dual PRF] From 500Hz to 1,800Hz (Pulse width: 1μs or 50μs) selectable [Intensity mode: Single PRF] From 250 Hz to 900Hz (Pulse width: 2μs or 100μs) selectable Duty: less than 7% Status display: Transmission hour, status of Local/Remote control Alert display: Transmitting power alarm, Temperature alarm in cabinet Fitting: Power amplifier unit for transmitter (x2) Control card for transmitter (x1)	1	For amplifying the pulse-modulated power with stable frequency and transmitting the power to the antenna.

Digital Receiver and Signal Processor (DRSP)	Noise figure of the high frequency circuit: 3dB or better at the input terminal of low noise amplifier (LNA) Pulse compression type: Chirp modulation Pulse Compression ratio: 80 or less Receiver type: Coherent IF digitizer Sensitivity: -110dBm or better (at 10μs plus) Dynamic range: 80dB or better from noise level to the saturated level (depending on matched filter bandwidth) Doppler signal processor (including DSP card and Rx card): Software based controller Quantization: 14 bits Range bin: 1024 Processing area: (Intensity mode) throughout 0 km to 440 km or more in range and 0 to 360 degree in azimuth (Doppler mode) throughout 0 km to 200 km or more in range and 0 to 360 degree in azimuth Intensity signal process -Ground clutter suppression: Frequency analysis by filter-bank and low frequency suppression with minimum influence to precipitation intensity -Logarithmic linearity: within ±1dB throughout 80dB -Range correction: depending on radar equation -Air-attenuation correction: 0.005dB/km in Observation Range Velocity signal process -Processing type: Pulse Pair, FFT and Random Phase -Velocity De-arising: Real-time processing by Dual-PRF -Trigger control: PRF ratio selectable (2:3, 3:4, 4:5) Averaging: Block averaging and/or sliding averaging Output data: Reflectivity (Z), Doppler velocity (V), Spectrum width (W) Output data resolution: 8bit Output data indicating interval: within 1 minute after automatic scan Time adjustment: Automatically adjustment by GPS NTP server (including GPS antenna) Fitting: Control Card for DRSP (x1)	1	For receiving, pulse compression and processing echo signal from the Antenna. For suppressing unnecessary echo such as clutter signals reflected from the ground. For sending ingest data to radar TASK controller.
Dehydrator	Capability of ventilation pressure: 3±1 liter/min, Upper limit: 300 ±30 hPa Lower limit: 70±30 hPa	1	For supplying dried and pressurized air into the wave-guide to reduce wave propagation loss.
Wave-guide Configuration	Wave-guide Type: S-band wave-guide (conformity with WR-284 or equivalent) Circulator Allowable maximum power: at least 20 kW TR limitter (x6) Type: Dual backup type	1	For feeder line propagation wave traveling between the antenna and TX/RX.

Radar TASK Controller	CPU: Intel Core™2 Duo 2GHz or equivalent Main memory (RAM): 1024Mbytes or more Hard disk unit: 250GBytes or more x two (2) drives CD-RW Drive: one (1) Monitor display: Color LCD type, 19 inches or more LAN interface: IEEE802.3/u/ab, 10BASE-T/100BASE-TX/1000BASE-T, TCP/IP, two (2)ports or more LAN Arrester: for surge protection, RJ45 interface Input power: AC 220V, 60Hz, single phase Software Operating system: UNIX or LINUX-based Application software: -Radar local control and monitoring -Observation scheduling -Radar echo display -Radar data generation and dissemination	1	For operating the radar system, monitoring condition of the radar system and generating raw product data. Control and monitoring items: Radiate control/status Azimuth/elevation position control/status TX standby status Pulse width control/status Antenna local/maintenance mode status
Data & Protocol Converter	CPU: Intel Core™2 Duo 2GHz or equivalent Main memory (RAM): 1024Mbytes or more Hard disk unit: 250GBytes or more x two (2) drives CD-RW Drive: one (1) Monitor display: Color LCD type, 19 inches or more LAN interface: IEEE802.3/u/ab, 10BASE-T/100BASE-TX/1000BASE-T, TCP/IP, two (2)ports or more LAN Arrester: for surge protection, RJ45 interface Input power: AC 220V, 60Hz, single phase Software Operating system: UNIX or LINUX-based Application software: -Data receiving, converting and transfer -Parameter setting -Display processing	1	For sending Raw data to central system according to specified interval.
Peripherals	Compact UPS -Capacity: 500VA or more -Input power: AC 220V ±15%, single phase, 60Hz -Output power: AC 220V ±5%, single phase, 60Hz -Back-up time: 5 minutes or longer at full load	2	For supplying back-up AC power to computer equipment in order to enable proper shutdown procedure of the system in case of power failure.
	Dual Switch -LAN interface: IEEE 802.3 Ethernet -Connection port: 100BASE-TX or more, eight (8)ports or more -Input power: AC 220V, single phase, 60Hz -Each ports and power supply shall be duplicated	2	For connecting all the computing equipment on LAN.
	Color Printer -Color inkjet type, A3 size -At least 1200 dpi resolution, 7ppm of faster printing speed -Interface USB or LAN -Input power: AC 220V, single phase, 60Hz	1	For printing radar image.
	Dual Optical Repeater -LAN interface: IEEE 802.3 Ethernet -Connection port: 100BASE-TX, one (1) port or more, Optical fiber interface one (1) set, Multi-mode (100Mbps) -Input power: AC 220V, single phase, 60Hz -Each ports and power supply shall be duplicated	1	For converting electrical signal and optical signal on LAN for surge protection.
	Radar Power Maintenance Panel -Circuit breaker: no-fuse-breaker type -Main breaker: no-fuse-breaker type or magnetic-breaker -Power distribution: 5 outputs include 1 spare -Input power: AC 220V, three phase, 60Hz -Output power: AC 220V, single phase, 60Hz	1	For distributing and supplying AC power to radar system.

Name of Site: Guiuan Meteorological Radar Tower Building (Electricity Room)			
Equipment	Specification	Quantity	Purpose
Isolation Transformer	Capacity: 35kVA or more Input Power: AC 220V, 240V selectable, three phase three wire, 60Hz Output Power: AC 220V, three phase three wire, 60Hz Insulation: Class B Surge voltage: 30kV or more	1	For protecting each equipment from surge voltage in main power.
Automatic Voltage Regulator (AVR)	Capacity: 30kVA or more Input Power: AC 220V ±20%, three phase three wire, 60Hz Output Power: AC 220V ±5%, three phase three wire, 60Hz	1	For supplying the constant or regulated voltage to the radar system.
Name of Site: Guiuan Meteorological Radar Tower Building (Power Supply Room)			
Equipment	Specification	Quantity	Purpose
Power Supply Capacitor	Capability: 15kVA or more Input voltage: AC 220V±10% (three phase three wire, 60Hz) Normal output: Direct output of input voltage CVCF output: AC 220V ±5% (three phase three wire, 60Hz) Back up time: 4 minutes or longer for radar equipment Energy storage: Electric double layer capacitor Others: Bypass function	1	For supplying the uninterrupted power by Electric Dual Layer Capacitor energy to the radar system when power failure occurred.
Name of Site: Guiuan Meteorological Radar Tower Building (Maintenance Room)			
Equipment	Specification	Quantity	Purpose
Test Instruments and Materials	Test signal Generator	1 set	For maintenance of radar system.
	Power Meter	1 set	
	Power Sensor	1 set	
	Frequency Counter	1 set	
	Detector	1 set	
	Attenuator Set	1 set	
	Terminator for Detector	1 set	
	Oscilloscope	1 set	
	Digital Multimeter	1 set	
	CW Converter	1 set	
	Network Camera	1 set	
	Tool Kit	1 set	
	Extension Cable	1 set	
	Leveler	1 set	
	Step Ladder	1 set	
	Clump Current Meter	1 set	
	Vacuum Cleaner	1 set	
	Radar Antenna Maintenance Deck	1 set	

Spare Parts	Timing Belt for Antenna (For Azimuth Angle Signal)	1 set	For maintenance of radar system.
	Timing Belt for Antenna (For Elevation Angle Signal)	1 set	
	Encoder for Antenna (For Azimuth Angle Signal)	1 set	
	Encoder for Antenna (For Elevation Angle Signal)	1 set	
	Motor for Antenna (For Azimuth Angle Signal)	1 set	
	Motor for Antenna (For Elevation Angle Signal)	1 set	
	Servo Unit for Antenna Controller (For Azimuth Angle Signal)	1 set	
	Servo Unit for Antenna Controller (For Elevation Angle Signal)	1 set	
	Power Supply Unit for Antenna Controller	1 set	
	Power Supply Unit for Transmitter	1 set	
	Power Supply Unit for Digital Receiver and Signal Processor	1 set	
	Fan Unit for Radar Equipment	2 set	
	Hard Disk Unit for Computer (not less than 250GB)	1 set	
	LAN Arrester	1 set	
	Obstruction Light	2 pcs	
Consumables	Grease with Pump and Oil with Jug for Antenna	1 set	For maintenance of radar system.
	Antenna Carbon Brush for Power	1 set	
	Antenna Carbon Brush for Signal	1 set	
Service Manuals	Operation & Maintenance Hand Book	2 sets	For maintenance of radar system.

Meteorological Radar Data Display System
(Virac Meteorological Radar Observation Station)

Name of Site: Virac Meteorological Radar Tower Building (Radar Equipment Room)			
Equipment	Specification	Quantity	Purpose
Peripherals	VoIP Gateway -Type: H323 or SIP -Decoding method: G.723, G.729 or G.711 -VoIP Interface: phone-line (Telephone, Fax, etc.) -VoIP port: 4ports -LAN interface: IEEE802.3/u, 10 BASE-T/100BASE-TX, TCP/IP, one (1) port -Security: by the password -IP address: fixed type -Input power: AC 220V, single phase, 60Hz	1	For converting voice packet signal, and exchange dial signal for telephone.
	Telephone -Type: Analog 2wire, DTMF	1	For voice communication.
Name of Site: Virac Meteorological Radar Tower Building (Observation Room)			
Equipment	Specification	Quantity	Purpose
Severe Storm and Doppler Velocity Indicator	CPU: Intel Core™2 Duo 2GHz or equivalent Main memory (RAM): 1024Mbytes or more Hard disk unit: 250GBytes or more x two (2) drives CD-RW Drive: one (1) Monitor display: Color LCD type, 19 inches or more LAN interface: IEEE802.3/u/ab, 10BASE-T/100BASE-TX/1000BASE-T, TCP/IP, one (1) port or more LAN Arrester: for surge protection, RJ45 interface Input power: AC 220V, 60Hz, single phase Software Operation system: UNIX or LINUX-based Application software: -Basic data monitoring feature -Weather product processing -Map projection -Product display & retrieval	1	For monitoring and alerting severe storm condition by various Doppler radar products.
Cyclone Tracking Monitor	CPU: Intel Core™2 Duo 2GHz or equivalent Main memory (RAM): 1024Mbytes or more Hard disk unit: 250GBytes or more x two (2) drives CD-RW Drive: one (1) Monitor display: Color LCD type, 19 inches or more LAN interface: IEEE802.3/u/ab, 10BASE-T/100BASE-TX/1000BASE-T, TCP/IP, one (1) port or more LAN Arrester: for surge protection, RJ45 interface Input power: AC 220V, 60Hz, single phase Software Operation system: UNIX or LINUX-based Application software: -Radar local control and monitoring -Observation scheduling -Basic data monitoring feature -Weather product monitoring and display -Map projection -Product display & retrieval	1	For tracking cyclone course and predicting cyclone course and time.

Peripherals	Color Printer -Color inkjet type, A3 size -At least 1200 dpi resolution, 7ppm or faster printing speed -Interface USB or LAN -Input power: AC 220V, single phase, 60Hz	1	For printing radar image.
	Dual Switch -LAN interface: IEEE 802.3 Ethernet -Connection port: 100BASE-TX or more, eight (8)ports or more -Input power: AC 220V, single phase, 60Hz -Each ports and power supply shall be duplicated	1	For connecting all the computer equipment with LAN.
	Dual Optical Repeater -LAN interface: IEEE 802.3 Ethernet -Connection port: 100BASE-TX or more, one (1) port or more Optical fiber interface one (1) set, Multi-mode (100Mbps) -Input power: AC 220V, single phase, 60Hz -Each ports and power supply shall be duplicated	1	For converting electrical signal and optical signal on LAN for surge protection.
	DVD Drive -Type: External Type -Interface: USB -Media: -R/+R/-RW/+RW -Input power: AC 220V, single phase, 60Hz	2	For storing of radar and weather information in DVD media.
	Compact UPS -Capacity: 500VA or more -Input power: AC 220V ±15%, single phase, 60Hz -Output power: AC 220V ±5%, single phase, 60Hz -Back-up time: 5 minutes or longer at full load	4	For supplying back-up AC power to computer equipment in order to enable proper shutdown procedure of the system in case of power failure.
	VoIP Gateway -Type: H323 or SIP -Decoding method: G.723, G.729 or G.711 -VoIP Interface: phone-line (Telephone, Fax, etc.) -VoIP port: 4ports -LAN interface: IEEE802.3/u, 10 BASE-T/100BASE-TX, TCP/IP, one (1) port -Security: by the password -IP address: fixed type -Input power: AC 220V, single phase, 60Hz	1	For converting voice packet signal. Exchange dial signal for telephone.
	Telephone -Type: Analog 2wire, DTMF	1	For voice communication.
	Off-line Maintenance Computer -CPU: Intel Core™2 Duo 2GHz or equivalent -Main memory (RAM): 1024Mbytes or more -Hard disk unit: 250GBytes or more x two (2) drives -CD-RW Drive: one (1) -Monitor display: Color LCD type, 19 inches or more -LAN interface: IEEE802.3/u/ab, 10BASE-T/100BASE-TX/1000BASE-T, TCP/IP, one (1) port or more -LAN Arrester: for surge protection, RJ45 interface -Input power: AC 220V, 60Hz, single phase -Software Operation System: Microsoft Windows XP or VISTA Application software: Microsoft Office 2007 or latest version	1	For weather service, record of daily operation and maintenance. In case of emergency, data communication to PAGASA Head Office by connecting GPRS/EDGE modem.
	Color Printer (for Off-line Maintenance) -Color inkjet type, A4 size -At least 1200 dpi resolution, 7ppm or faster printing speed -Interface USB -Input power: AC 220V, single phase, 60Hz	1	For Printing the record of daily operation and maintenance.

	GPRS/EDGE Modem -GPRS class 10 or higher -EDGE class 6 or higher -Dual Band (900MHz, 1800MHz) -USB Interface -Input power: USB power supply -Driver software: For Windows	1	For Data Communication to PAGASA Head Office by connecting Off-line Maintenance Computer in case of emergency
Name of Site: Virac Meteorological Radar Tower Building (Data Analysis Room)			
Equipment	Specification	Quantity	Purpose
Data Analyzing Unit	CPU: Intel Core™2 Duo 2GHz or equivalent Main memory (RAM): 1024Mbytes or more Hard disk unit: 250GBytes or more x two (2) drives CD-RW Drive: one (1) Monitor display: Color LCD type, 19 inches or more LAN interface: IEEE802.3/u/ab, 10BASE-T/100BASE-TX/1000BASE-T, TCP/IP, one (1) port or more LAN Arrester: for surge protection, RJ45 interface Input power: AC 220V, 60Hz, single phase Software Operation system: Unix or LINUX-based Application software: -Basic data monitoring feature -Weather product processing -Map projection -Product display & retrieval	1	For analyzing weather phenomena by observed radar data.
Peripherals	Color Printer -Color inkjet type, A3 size -At least 1200 dpi resolution, 7ppm or faster printing speed -Interface USB or LAN -Input power: AC 220V, single phase, 60Hz	1	For printing radar image.
	Compact UPS -Capacity: 500VA or more -Input power: AC 220V ±15%, single phase, 60Hz -Output power: AC 220V ±5%, single phase, 60Hz -Back-up time: 5 minutes or longer at full load	1	For supplying back-up AC power to computer equipment in order to enable proper shutdown procedure of the system in case of power failure.
	VoIP Gateway -Type: H323 or SIP -Decoding method: G.723, G.729 or G.711 -VoIP Interface: phone-line (Telephone, Fax, etc.) -VoIP port: 4ports -LAN interface: IEEE802.3/u, 10 BASE-T/100BASE-TX, TCP/IP, one (1) port -Security: by the password -IP address: fixed type -Input power: AC 220V, single phase, 60Hz	1	For converting voice packet signal. Exchange dial signal for telephone.
	Telephone -Type: Analog 2wire, DTMF	1	For voice communication.
Spare Parts	Hard Disk Unit for Computer (not less than 250GB)	1 set	For maintenance of the system.
	LAN Arrester	1 set	
Service Manuals	Operation & Maintenance Hand Book	1 set	For maintenance of the system.

Meteorological Radar Data Display System
(Aparri Meteorological Radar Observation Station)

Name of Site: Aparri Meteorological Radar Tower Building (Radar Equipment Room)			
Equipment	Specification	Quantity	Purpose
Peripherals	VoIP Gateway -Type: H323 or SIP -Decoding method: G.723, G.729 or G.711 -VoIP Interface: phone-line (Telephone, Fax, etc.) -VoIP port: 4ports -LAN interface: IEEE802.3/u, 10 BASE-T/100BASE-TX, TCP/IP, one (1) port -Security: by the password -IP address: fixed type -Input power: AC 220V, single phase, 60Hz	1	For converting voice packet signal, and exchange dial signal for telephone.
	Telephone -Type: Analog 2wire, DTMF	1	For voice communication.
Name of Site: Aparri Meteorological Radar Tower Building (Observation Room)			
Equipment	Specification	Quantity	Purpose
Severe Storm and Doppler Velocity Indicator	CPU: Intel Core™2 Duo 2GHz or equivalent Main memory (RAM): 1024Mbytes or more Hard disk unit: 250GBytes or more x two (2) drives CD-RW Drive: one (1) Monitor display: Color LCD type, 19 inches or more LAN interface: IEEE802.3/u/ab, 10BASE-T/100BASE-TX/1000BASE-T, TCP/IP, one (1) port or more LAN Arrester: for surge protection, RJ45 interface Input power: AC 220V, 60Hz, single phase Software Operation system: UNIX or LINUX-based Application software: -Basic data monitoring feature -Weather product processing -Map projection -Product display & retrieval	1	For monitoring and alerting severe storm condition by various Doppler radar products.
Cyclone Tracking Monitor	CPU: Intel Core™2 Duo 2GHz or equivalent Main memory (RAM): 1024Mbytes or more Hard disk unit: 250GBytes or more x two (2) drives CD-RW Drive: one (1) Monitor display: Color LCD type, 19 inches or more LAN interface: IEEE802.3/u/ab, 10BASE-T/100BASE-TX/1000BASE-T, TCP/IP, one (1) port or more LAN Arrester: for surge protection, RJ45 interface Input power: AC 220V, 60Hz, single phase Software Operation system: UNIX or LINUX-based Application software: -Radar local control and monitoring -Observation scheduling -Basic data monitoring feature -Weather product monitoring and display -Map projection -Product display & retrieval	1	For tracking cyclone course and predicting cyclone course and time.

Peripherals	Color Printer -Color inkjet type, A3 size -At least 1200 dpi resolution, 7ppm or faster printing speed -Interface USB or LAN -Input power: AC 220V, single phase, 60Hz	1	For printing radar image.
	Dual Switch -LAN interface: IEEE 802.3 Ethernet -Connection port: 100BASE-TX or more, eight (8)ports or more -Input power: AC 220V, single phase, 60Hz -Each ports and power supply shall be duplicated	1	For connecting all the computer equipment with LAN.
	Dual Optical Repeater -LAN interface: IEEE 802.3 Ethernet -Connection port: 100BASE-TX or more, one (1) port or more Optical fiber interface one (1) set, Multi-mode (100Mbps) -Input power: AC 220V, single phase, 60Hz -Each ports and power supply shall be duplicated	1	For converting electrical signal and optical signal on LAN for surge protection.
	DVD Drive -Type: External Type -Interface: USB -Media: -R/+R/-RW/+RW -Input power: AC 220V, single phase, 60Hz	2	For storing of radar and weather information in DVD media.
	Compact UPS -Capacity: 500VA or more -Input power: AC 220V ±15%, single phase, 60Hz -Output power: AC 220V ±5%, single phase, 60Hz -Back-up time: 5 minutes or longer at full load	4	For supplying back-up AC power to computer equipment in order to enable proper shutdown procedure of the system in case of power failure.
	VoIP Gateway -Type: H323 or SIP -Decoding method: G.723, G.729 or G.711 -VoIP Interface: phone-line (Telephone, Fax, etc.) -VoIP port: 4ports -LAN interface: IEEE802.3/u, 10 BASE-T/100BASE-TX, TCP/IP, one (1) port -Security: by the password -IP address: fixed type -Input power: AC 220V, single phase, 60Hz	1	For converting voice packet signal. Exchange dial signal for telephone.
	Telephone -Type: Analog 2wire, DTMF	1	For voice communication.
	Off-line Maintenance Computer -CPU: Intel Core™2 Duo 2GHz or equivalent -Main memory (RAM): 1024Mbytes or more -Hard disk unit: 250GBytes or more x two (2) drives -CD-RW Drive: one (1) -Monitor display: Color LCD type, 19 inches or more -LAN interface: IEEE802.3/u/ab, 10BASE-T/100BASE-TX/1000BASE-T, TCP/IP, one (1) port or more -LAN Arrester: for surge protection, RJ45 interface -Input power: AC 220V, 60Hz, single phase -Software Operation System: Microsoft Windows XP or VISTA Application software: Microsoft Office 2007 or latest version	1	For weather service, record of daily operation and maintenance. In case of emergency, data communication to PAGASA Head Office by connecting GPRS/EDGE modem
	Color Printer (for Off-line Maintenance) -Color inkjet type, A4 size -At least 1200 dpi resolution, 7ppm or faster printing speed -Interface USB -Input power: AC 220V, single phase, 60Hz	1	For Printing the record of daily operation and maintenance.

	GPRS/EDGE Modem -GPRS class 10 or higher -EDGE class 6 or higher -Dual Band (900MHz, 1800MHz) -USB Interface -Input power: USB power supply -Driver software: For Windows	1	For Data Communication to PAGASA Head Office by connecting Off-line Maintenance Computer in case of emergency.
Name of Site: Aparri Meteorological Radar Tower Building (Data Analysis Room)			
Equipment	Specification	Quantity	Purpose
Data Analyzing Unit	CPU: Intel Core™2 Duo 2GHz or equivalent Main memory (RAM): 1024Mbytes or more Hard disk unit: 250GBytes or more x two (2) drives CD-RW Drive: one (1) Monitor display: Color LCD type, 19 inches or more LAN interface: IEEE802.3/u/ab, 10BASE-T/100BASE-TX/1000BASE-T, TCP/IP, one (1) port or more LAN Arrester: for surge protection, RJ45 interface Input power: AC 220V, 60Hz, single phase Software Operation system: Unix or LINUX-based Application software: -Basic data monitoring feature -Weather product processing -Map projection -Product display & retrieval	1	For analyzing weather phenomena by observed radar data.
Peripherals	Color Printer -Color inkjet type, A3 size -At least 1200 dpi resolution, 7ppm or faster printing speed -Interface USB or LAN -Input power: AC 220V, single phase, 60Hz	1	For printing radar image.
	Compact UPS -Capacity: 500VA or more -Input power: AC 220V ±15%, single phase, 60Hz -Output power: AC 220V ±5%, single phase, 60Hz -Back-up time: 5 minutes or longer at full load	1	For supplying back-up AC power to computer equipment in order to enable proper shutdown procedure of the system in case of power failure.
	VoIP Gateway -Type: H323 or SIP -Decoding method: G.723, G.729 or G.711 -VoIP Interface: phone-line (Telephone, Fax, etc.) -VoIP port: 4ports -LAN interface: IEEE802.3/u, 10 BASE-T/100BASE-TX, TCP/IP, one (1) port -Security: by the password -IP address: fixed type -Input power: AC 220V, single phase, 60Hz	1	For converting voice packet signal. Exchange dial signal for telephone.
	Telephone -Type: Analog 2wire, DTMF	1	For voice communication.
Spare Parts	Hard Disk Unit for Computer (not less than 250GB)	1 set	For maintenance of the system.
	LAN Arrester	1 set	
Service Manuals	Operation & Maintenance Hand Book	1 set	For maintenance of the system.

Meteorological Radar Data Display System
(Guiuan Meteorological Radar Observation Station)

Name of Site: Guiuan Meteorological Radar Tower Building (Radar Equipment Room)			
Equipment	Specification	Quantity	Purpose
Peripherals	VoIP Gateway -Type: H323 or SIP -Decoding method: G.723, G.729 or G.711 -VoIP Interface: phone-line (Telephone, Fax, etc.) -VoIP port: 4ports -LAN interface: IEEE802.3/u, 10 BASE-T/100BASE-TX, TCP/IP, one (1) port -Security: by the password -IP address: fixed type -Input power: AC 220V, single phase, 60Hz	1	For converting voice packet signal, and exchange dial signal for telephone.
	Telephone -Type: Analog 2wire, DTMF	1	For voice communication.
Name of Site: Guiuan Meteorological Radar Tower Building (Observation Room)			
Equipment	Specification	Quantity	Purpose
Severe Storm and Doppler Velocity Indicator	CPU: Intel Core™2 Duo 2GHz or equivalent Main memory (RAM): 1024Mbytes or more Hard disk unit: 250GBytes or more x two (2) drives CD-RW Drive: one (1) Monitor display: Color LCD type, 19 inches or more LAN interface: IEEE802.3/u/ab, 10BASE-T/100BASE-TX/1000BASE-T, TCP/IP, one (1) port or more LAN Arrester: for surge protection, RJ45 interface Input power: AC 220V, 60Hz, single phase Software Operation system: UNIX or LINUX-based Application software: -Basic data monitoring feature -Weather product processing -Map projection -Product display & retrieval	1	For monitoring and alerting severe storm condition by various Doppler radar products.
Cyclone Tracking Monitor	CPU: Intel Core™2 Duo 2GHz or equivalent Main memory (RAM): 1024Mbytes or more Hard disk unit: 250GBytes or more x two (2) drives CD-RW Drive: one (1) Monitor display: Color LCD type, 19 inches or more LAN interface: IEEE802.3/u/ab, 10BASE-T/100BASE-TX/1000BASE-T, TCP/IP, one (1) port or more LAN Arrester: for surge protection, RJ45 interface Input power: AC 220V, 60Hz, single phase Software Operation system: UNIX or LINUX-based Application software: -Radar local control and monitoring -Observation scheduling -Basic data monitoring feature -Weather product monitoring and display -Map projection -Product display & retrieval	1	For tracking cyclone course and predicting cyclone course and time.

Peripherals	Color Printer -Color inkjet type, A3 size -At least 1200 dpi resolution, 7ppm or faster printing speed -Interface USB or LAN -Input power: AC 220V, single phase, 60Hz	1	For printing radar image.
	Dual Switch -LAN interface: IEEE 802.3 Ethernet -Connection port: 100BASE-TX or more, eight (8)ports or more -Input power: AC 220V, single phase, 60Hz -Each ports and power supply shall be duplicated	1	For connecting all the computing equipment with LAN.
	Dual Optical Repeater -LAN interface: IEEE 802.3 Ethernet -Connection port: 100BASE-TX or more, one (1) port or more Optical fiber interface one (1) set, Multi-mode (100Mbps) -Input power: AC 220V, single phase, 60Hz -Each ports and power supply shall be duplicated	1	For converting electrical signal and optical signal on LAN for surge protection.
	DVD Drive -Type: External Type -Interface: USB -Media: -R/+R/-RW/+RW -Input power: AC 220V, single phase, 60Hz	2	For storing of radar and weather information in DVD media.
	Compact UPS -Capacity: 500VA or more -Input power: AC 220V ±15%, single phase, 60Hz -Output power: AC 220V ±5%, single phase, 60Hz -Back-up time: 5 minutes or longer at full load	4	For supplying back-up AC power to computer equipment in order to enable proper shutdown procedure of the system in case of power failure.
	VoIP Gateway -Type: H323 or SIP -Decoding method: G.723, G.729 or G.711 -VoIP Interface: phone-line (Telephone, Fax, etc.) -VoIP port: 4ports -LAN interface: IEEE802.3/u, 10 BASE-T/100BASE-TX, TCP/IP, one (1) port -Security: by the password -IP address: fixed type -Input power: AC 220V, single phase, 60Hz	1	For converting voice packet signal. Exchange dial signal for telephone.
	Telephone -Type: Analog 2wire, DTMF	1	For voice communication.
	Off-line Maintenance Computer -CPU: Intel Core™2 Duo 2GHz or equivalent -Main memory (RAM): 1024Mbytes or more -Hard disk unit: 250GBytes or more x two (2) drives -CD-RW Drive: one (1) -Monitor display: Color LCD type, 19 inches or more -LAN interface: IEEE802.3/u/ab, 10BASE-T/100BASE-TX/1000BASE-T, TCP/IP, one (1) port or more -LAN Arrester: for surge protection, RJ45 interface -Input power: AC 220V, 60Hz, single phase -Software Operation System: Microsoft Windows XP or VISTA Application software: Microsoft Office 2007 or latest version	1	For weather service, record of daily operation and maintenance. In case of emergency, data communication to PAGASA Head Office by connecting GPRS/EDGE modem.
	Color Printer (for Off-line Maintenance) -Color inkjet type, A4 size -At least 1200 dpi resolution, 7ppm or faster printing speed -Interface USB -Input power: AC 220V, single phase, 60Hz	1	For Printing the record of daily operation and maintenance

	GPRS/EDGE Modem -GPRS class 10 or higher -EDGE class 6 or higher -Dual Band (900MHz, 1800MHz) -USB Interface -Input power: USB power supply -Driver software: For Windows	1	For Data Communication to PAGASA Head Office by connecting Off-line Maintenance Computer in case of emergency
Name of Site: Guiuan Meteorological Radar Tower Building (Data Analysis Room)			
Equipment	Specification	Quantity	Purpose
Data Analyzing Unit	CPU: Intel Core™2 Duo 2GHz or equivalent Main memory (RAM): 1024Mbytes or more Hard disk unit: 250GBytes or more x two (2) drives CD-RW Drive: one (1) Monitor display: Color LCD type, 19 inches or more LAN interface: IEEE802.3/u/ab, 10BASE-T/100BASE-TX/1000BASE-T, TCP/IP, one (1) port or more LAN Arrester: for surge protection, RJ45 interface Input power: AC 220V, 60Hz, single phase Software Operation system: Unix or LINUX-based Application software: -Basic data monitoring feature -Weather product processing -Map projection -Product display & retrieval	1	For analyzing weather phenomena by observed radar data.
Peripherals	Color Printer -Color inkjet type, A3 size -At least 1200 dpi resolution, 7ppm or faster printing speed -Interface USB or LAN -Input power: AC 220V, single phase, 60Hz	1	For printing radar image.
	Compact UPS -Capacity: 500VA or more -Input power: AC 220V ±15%, single phase, 60Hz -Output power: AC 220V ±5%, single phase, 60Hz -Back-up time: 5 minutes or longer at full load	1	For supplying back-up AC power to computer equipment in order to enable proper shutdown procedure of the system in case of power failure.
	VoIP Gateway -Type: H323 or SIP -Decoding method: G.723, G.729 or G.711 -VoIP Interface: phone-line (Telephone, Fax, etc.) -VoIP port: 4ports -LAN interface: IEEE802.3/u, 10 BASE-T/100BASE-TX, TCP/IP, one (1) port -Security: by the password -IP address: fixed type -Input power: AC 220V, single phase, 60Hz	1	For converting voice packet signal. Exchange dial signal for telephone.
	Telephone -Type: Analog 2wire, DTMF	1	For voice communication.
Spare Parts	Hard Disk Unit for Computer (not less than 250GB)	1 set	For maintenance of the system.
	LAN Arrester	1 set	
Service Manuals	Operation & Maintenance Hand Book	1 set	For maintenance of the system.

Meteorological Radar Data Display System
(PAGASA Head Office, Weather and Flood Forecasting Center)

Name of Site: PAGASA Head Office, Weather and Flood Forecasting Center			
Equipment	Specification	Quantity	Purpose
Composite Processor	CPU: Intel Core™2 Duo 2GHz or equivalent Main memory (RAM): 1024Mbytes or more Hard disk unit: 250GBytes or more x two (2) drives CD-RW Drive: one (1) Monitor display: Color LCD type, 42 inches or more, include support stand set LAN interface: IEEE802.3/u/ab, 10BASE-T/100BASE-TX/1000BASE-T, TCP/IP, one (1) port or more LAN Arrester: for surge protection, RJ45 interface Input power: AC 220V, 60Hz, single phase Software Operation system: UNIX or LINUX-based Application software -Data Receiving -Data Dissemination -Display of radar echo -Display of status -Parameter setting for composite -Output of radar image file	1	For generation composite picture from incoming data of all the radar stations.
Meteorological Data Archiving Unit	CPU: Intel Core™2 Duo 2GHz or equivalent Main memory (RAM): 1024Mbytes or more Hard disk unit: 250GBytes or more x two (2) drives CD-RW Drive: one (1) Monitor display: Color LCD type, 19 inches or more LAN interface: IEEE802.3/u/ab, 10BASE-T/100BASE-TX/1000BASE-T, TCP/IP, one (1) port or more LAN Arrester: for surge protection, RJ45 interface Input power: AC 220V, 60Hz, single phase Software Operation system: Unix or LINUX-based Application software: -Data Receiving -Display feature -Storing to external storages	1	For storing of radar and weather information to selected media.
Product Retrieval Unit	CPU: Intel Core™2 Duo 2GHz or equivalent Main memory (RAM): 1024Mbytes or more Hard disk unit: 250GBytes or more x two (2) drives CD-RW Drive: one (1) Monitor display: Color LCD type, 19 inches or more LAN interface: IEEE802.3/u/ab, 10BASE-T/100BASE-TX/1000BASE-T, TCP/IP, one (1) port or more LAN Arrester: for surge protection, RJ45 interface Input power: AC 220V, 60Hz, single phase Software Operation system: Unix or LINUX-based Application software: -Data Receiving -Basic data monitoring feature -Various weather products retrieving -Map projection -Product display & retrieval	1	For retrieving and displaying of radar data.

Accumulated Rainfall Processor	CPU: Intel Core™2 Duo 2GHz or equivalent Main memory (RAM): 1024Mbytes or more Hard disk unit: 250GBytes or more x two (2) drives CD-RW Drive: one (1) Monitor display: Color LCD type, 19 inches or more LAN interface: IEEE802.3/u/ab, 10BASE-T/100BASE-TX/1000BASE-T, TCP/IP, one (1) port or more LAN Arrester: for surge protection, RJ45 interface Input power: AC 220V, 60Hz, single phase Software Operation system: UNIX or LINUX-based Application software -Data Receiving -Data Dissemination -Display of radar echo -Display of status -Parameter setting and calculating	1	For generating and sending accumulated rainfall data.
Doppler Velocity Indicator	CPU: Intel Core™2 Duo 2GHz or equivalent Main memory (RAM): 1024Mbytes or more Hard disk unit: 250GBytes or more x two (2) drives CD-RW Drive: one (1) Monitor display: Color LCD type, 19 inches or more LAN interface: IEEE802.3/u/ab, 10BASE-T/100BASE-TX/1000BASE-T, TCP/IP, one (1) port or more LAN Arrester: for surge protection, RJ45 interface Input power: AC 220V, 60Hz, single phase Software Operation system: UNIX or LINUX-based Application software -Data Receiving -Doppler Product Processing -Map projection -Product display & retrieval	1	For generating various wind profile with each mesh by Doppler data.
Cyclone Tracking Monitor	CPU: Intel Core™2 Duo 2GHz or equivalent Main memory (RAM): 1024Mbytes or more Hard disk unit: 250GBytes or more x two (2) drives CD-RW Drive: one (1) Monitor display: Color LCD type, 19 inches or more LAN interface: IEEE802.3/u/ab, 10BASE-T/100BASE-TX/1000BASE-T, TCP/IP, one (1) port or more LAN Arrester: for surge protection, RJ45 interface Input power: AC 220V, 60Hz, single phase Software Operation system: UNIX or LINUX-based Application software -Basic data monitoring feature -Weather product monitoring and display -Map projection -Product display & retrieval	1	For tracking cyclone course and predicting cyclone course and time.

Radar Web Server	CPU: Intel Core™2 Duo 2GHz or equivalent Main memory (RAM): 1024Mbytes or more Hard disk unit: 250GBytes or more x two (2) drives CD-RW Drive: one (1) Monitor display: Color LCD type, 19 inches or more LAN interface: IEEE802.3/u/ab, 10BASE-T/100BASE-TX/1000BASE-T, TCP/IP, two (2) ports or more LAN Arrester: for surge protection, RJ45 interface Input power: AC 220V, 60Hz, single phase Software Operation system: UNIX or LINUX-based Application software -Data Receiving -Product output to Web -Radar image output	1	For output of various product with web based image.
Peripherals	Color Printer -Color inkjet type, A3 size -At least 1200 dpi resolution, 7ppm or faster printing speed -Interface USB or LAN -Input power: AC 220V, single phase, 60Hz	2	For printing radar image.
	Dual Router -LAN interface: IEEE 802.3 Ethernet -Connection port: 100BASE-TX, two (2)ports or more -Routing: IP routing -Input power: AC 220V, single phase, 60Hz -Each ports and power supply shall be duplicated	1	For connecting and routing the Radar Web Server to the PAGASA Internet Server.
	Dual Switch -LAN interface: IEEE 802.3 Ethernet -Connection port: 100BASE-TX, twenty four (24)ports or more -Input power: AC 220V, single phase, 60Hz -Each ports and power supply shall be duplicated	1	For connecting all the computer equipment on LAN.
	DVD Drive -Type: External Type -Interface: USB -Media: -R/+R/-RW/+RW -Input power: AC 220V, single phase, 60Hz	2	For storing of radar and weather information in DVD media.
	DDS Drive -Type: External Type -Interface: USB -Media: DDS4 -Input power: AC 220V, single phase, 60Hz	2	For storing of radar and weather information to DDS media.
	VoIP Gateway -Type: H323 or SIP -Decoding method: G.723, G.729 or G.711 -VoIP Interface: phone-line (Telephone, Fax, etc.) -VoIP port: 4ports -LAN interface: IEEE802.3/u, 10 BASE-T/100BASE-TX, TCP/IP, one (1) port -Security: by the password -IP address: fixed type -Input power: AC 220V, single phase, 60Hz	1	For converting voice packet signal, and exchange dial signal for telephone.
	Telephone -Type: Analog 2wire, DTMF	1	For voice communication.
	Compact UPS -Capacity: 500VA or more -Input power: AC 220V ±15%, single phase, 60Hz -Output power: AC 220V ±5%, single phase, 60Hz -Back-up time: 5 minutes or longer at full load	8	For supplying back-up AC power to computing equipment in order to enable proper shutdown procedure of the system in case of power failure.
	Automatic Voltage Regulator (AVR) -Capacity: 1kVA or more -Input power: AC 220V ±20%, single phase, 60Hz -Output power: AC 220V ±5%, single phase, 60Hz	8	For supplying the constant or regulated voltage to the computer system.

	Off-line Maintenance Computer -CPU: Intel Core™2 Duo 2GHz or equivalent -Main memory (RAM): 1024Mbytes or more -Hard disk unit: 250GBytes or more x two (2) drives -CD-RW Drive: one (1) -Monitor display: Color LCD type, 19 inches or more -LAN interface: IEEE802.3/u/ab, 10BASE-T/ 100BASE-TX/1000BASE-T, TCP/IP, one (1) ports or more -LAN Arrester: for surge protection, RJ45 interface -Input power: AC 220V, 60Hz, single phase -Software Operation System: Microsoft Windows XP or VISTA Application software: Microsoft Office Version 2007 (Latest Version)	1	For weather service, record of daily operation and maintenance In case of emergency, data communication to PAGASA Head Office by connecting GPRS/EDGE modem
	Color Printer (for Off-line Maintenance) -Color inkjet type, A4 size -At least 1200 dpi resolution, 7ppm of faster printing speed -Interface: USB -Input power: AC 220V, single phase, 60Hz	1	For Printing the record of daily operation and maintenance
	GPRS/EDGE Modem -GPRS class 10 or higher -EDGE class 6 or higher -Dual Band (900MHz, 1800MHz) -USB Interface -Input power: USB power supply -Driver software: For Windows	1	For Data Communication to PAGASA Head Office by connecting Off-line Maintenance Computer in case of emergency
Spare Parts	Hard Disk Unit for Computer (not less than 250GB)	4 sets	For maintenance of the system.
	LAN Arrester	4 sets	
Service Manuals	Operation & Maintenance Hand Book	1 set	For maintenance of the system.

Meteorological Data Satellite Communication System (VSAT)
(Virac Meteorological Radar Observation Station)

Name of Site: Virac Meteorological Radar Tower Building			
Equipment	Specification	Quantity	Purpose
VSAT Out-door Unit (ODU/Transmitter)	Frequency band: C band Output Frequency Range: 5.850GHz~6.425GHz Input Frequency Range: 950MHz~1525MHz Output Power Level: +40dBm min Linear Gain: 64dB nominal Gain Stability: 5dBp-p max IM3: -26dBc max External Reference Frequency: 10MHz(sin-wave) Input Power: -5 to +5 dBm Local Phase Noise : -60 dBc / Hz @100Hz : -70 dBc / Hz @1kHz : -80 dBc / Hz @10kHz : -90 dBc / Hz @100kHz Spurious In-band: -50dBc max Out-of-band: -50dBc max Receive band: -70dBm max Input Impedance: 50 ohms Input V.S.W.R.: 2:1 max Output V.S.W.R.: 2:1 max Input DC power: +48 V DC(+38 to +60 V DC) Input Interface IF/10MHz: N-female (50 ohms) DC Power: MS connector-female Output Interface: Waveguide,CPR137-G	1	Transmitter for communicating meteorological service and radar data transmission via satellite.

VSAT Out-door Unit (ODU/LNB)	Frequency band: C band Input Frequency Range: 3.625GHz~4.200GHz Output Frequency Range: 950MHz~1,525MHz Input Waveguide Flange: CPR-229G Input V.S.W.R.: 3:1 max Noise Temp (Ta: +25 C): 35K typ. 45K max Conversion Gain (Ta: +25 C): 60 dB min. 66 dB max Conversion Gain Ripple (Ta: +25 C): 2.0 dB max at 50MHz segments Conversion Gain Flatness (Ta: +25 C): 5.0 dB at 500MHz BW. Output Power Level for 1dB Compression: +3dBm min Intermodulation Products (3rd order): -45dB min Output Intercept Point: +13dBm Local Phase Noise : -65 dBc / Hz @100Hz : -75 dBc / Hz @1kHz : -85 dBc / Hz @10kHz : -90 dBc / Hz @100kHz : -105 dBc / Hz @1MHz External Reference Frequency: 10MHz(sin-wave) Input Power: -10 to 0 dBm Spurious At input unrelated to test CW signal: -140dBm max With test CW signal, -10dBm IF output: -55dBc max Output Connector: N-female 50ohm Output V.S.W.R.: 2.5:1 max Input Dc power : +13.5 to +24 V DC	1	Receiver for communicating meteorological service and radar data transmission via satellite.
VSAT Antenna	Diameter: Approx. 2.4m Frequency band: C band Tx Frequency Range: 5.850GHz~6.425GHz Rx Frequency Range: 3.625GHz~4.200GHz Antenna Drive Method: Manual Support Structure: AZ-EL mount with reinforcement bar	1	Antenna for communicating meteorological service and radar data transmission via satellite.
VSAT In-door Unit (IDU)	Satellite Access Scheme: SCPC Link Assignment Method: PAMA Channel Spacing: 10kHz Modulation Method: QPSK Tx Output Frequency Range: 950MHz~1,525MHz Rx Input Frequency Range: 950MHz~1,525MHz Down-link Data Speed: 9.6k, 19.2k, 32kbps or 64kbps Up-link data Speed: 9.6k, 19.2k, 32kbps or 64kbps Number of Tx Channel: 1ch (Data, VoIP) Number of Rx Channel: 1ch (Data, VoIP) Tx Output Interface: N-female (50 ohms) Rx Input Interface: N-female (50 ohms) Output Reference (Transmitter Port) Frequency: 10MHz(sin-wave) Output Power: -3 to +5 dBm (LNB Port) Frequency: 10MHz(sin-wave) Output Power: -8 to 0 dBm Output Dc power Transmitter Port: +48 V DC LNB Port: +24 V DC Demodulation Method : Coherent Detection System Error Correction Method: Turbo Product Code, Coding Rate 1/2, 3/4, 6/7 Data Interface: 10base-T or 100base-TX (Data, VoIP) Protocol: TCP/IP or UDP/IP Equipment Rack: 19 inch Rack (Floor Stand with Caster) Power Consumption: 200VA or less including ODU Input Power: 220VAC (single phase. 60Hz)	1	Modulator/Demodulator for communicating meteorological service and radar data transmission via satellite.

Arrester Box	For 48V DC Power: 1ch Striking Voltage: 88Vmin Response Time: 0.1 μs Max. Surge current capacity: 2000A (8/20μs) For Thermal sensor: 1ch Striking Voltage: ±6Vmin Response Time: 0.1 μs Max. Surge current capacity: 5000A (8/20μs) For high frequency signal: 2ch Striking Voltage: 90Vmin Frequency: DC-2.2GHz Max. Surge current capacity: 20KA (8/20μs)	1	For protection of VSAT equipment from lighting.
Emergency Power Backup Unit	Capacity: 1kVA or more Input power source: AC 220V, single phase, 60Hz and DC12V generated by Solar Panel Output power: AC 220V, single phase, 60Hz Back-up time: 15hours or longer (Covering rage: Circuit of VSAT IDU~Telephone installed in Radar Equipment room including LAN Circuit) Type of Battery: Deep Cycle Battery Solar Panel with fixing material: included	1	For supplying back-up AC power to VSAT equipment for keeping VoIP communication to Head Office in case of power failure.
Maintenance Terminal	OS: Windows XP or VISTA CPU: Intel Core™2 Duo T8300 or equivalent Memory: 1GB or more VSAT maintenance software Monitor IDU status, parameter, and health data: - Transmit/Receive Frequencies - Transmit/Receive Bit Rates - Transmit/Receive FEC Rates - Transmit Output Power - Voltage and current of Transmitter, LNB and Modem - Condition of Transmitting Control IDU data and parameter: - Transmit/Receive Frequencies - Transmit/Receive Bit Rates - Transmit/Receive FEC Rates - Transmit Output Power	1	For monitoring and controlling the system.
Directional Coupler	Frequency Band: 950~1525MHz Coupling Loss: 10dB±1.0dB Insertion Loss: 0.7dB or less Impedance: 50 ohms Connector: Type N, 3port Power: up to 100W	1	For maintenance of the system.
Spare Parts	Arrester Terminal Set	1 set	For maintenance of the system.
Service Manuals	Operation & Maintenance Hand Book	1 set	For maintenance of the system.

Meteorological Data Satellite Communication System (VSAT)
(Aparri Meteorological Radar Observation Station)

Name of Site: Aparri Meteorological Radar Tower Building			
Equipment	Specification	Quantity	Purpose
VSAT Out-door Unit (ODU/Transmitter)	Frequency band: C band Output Frequency Range: 5.850GHz~6.425GHz Input Frequency Range: 950MHz~1525MHz Output Power Level: +40dBm min Linear Gain: 64dB nominal Gain Stability: 5dBp-p max IM3: -26dBc max External Reference Frequency: 10MHz(sin-wave) Input Power: -5 to +5 dBm Local Phase Noise : -60 dBc / Hz @100Hz : -70 dBc / Hz @1kHz : -80 dBc / Hz @10kHz : -90 dBc / Hz @100kHz Spurious In-band: -50dBc max Out-of-band: -50dBc max Receive band: -70dBm max Input Impedance: 50 ohms Input V.S.W.R.: 2:1 max Output V.S.W.R.: 2:1 max Input DC power: +48 V DC(+38 to +60 V DC) Input Interface IF/10MHz: N-female (50 ohms) DC Power: MS connector-female Output Interface: Waveguide,CPR137-G	1	Transmitter for communicating meteorological service and radar data transmission via satellite.
VSAT Out-door Unit (ODU/LNB)	Frequency band: C band Input Frequency Range: 3.625GHz~4.200GHz Output Frequency Range: 950MHz~1,525MHz Input Waveguide Flange: CPR-229G Input V.S.W.R.: 3:1 max Noise Temp (Ta: +25 C): 35K typ. 45K max Conversion Gain (Ta: +25 C): 60 dB min. 66 dB max Conversion Gain Ripple (Ta: +25 C): 2.0 dB max at 50MHz segments Conversion Gain Flatness (Ta: +25 C): 5.0 dB at 500MHz BW. Output Power Level for 1dB Compression: +3dBm min Intermodulation Products (3rd order): -45dB min Output Intercept Point: +13dBm Local Phase Noise : -65 dBc / Hz @100Hz : -75 dBc / Hz @1kHz : -85 dBc / Hz @10kHz : -90 dBc / Hz @100kHz : -105 dBc / Hz @1MHz External Reference Frequency: 10MHz(sin-wave) Input Power: -10 to 0 dBm Spurious At input unrelated to test CW signal: -140dBm max With test CW signal, -10dBm IF output: -55dBc max Output Connector: N-female 50ohm Output V.S.W.R.: 2.5:1 max Input Dc power : +13.5 to +24 V DC	1	Receiver for communicating meteorological service and radar data transmission via satellite.
VSAT Antenna	Diameter: Approx. 2.4m Frequency band: C band Tx Frequency Range: 5.850GHz~6.425GHz Rx Frequency Range: 3.625GHz~4.200GHz Antenna Drive Method: Manual Support Structure: AZ-EL mount with reinforcement bar	1	Antenna for communicating meteorological service and radar data transmission via satellite.

VSAT In-door Unit (IDU)	Satellite Access Scheme: SCPC Link Assignment Method: PAMA Channel Spacing: 10kHz Modulation Method: QPSK Tx Output Frequency Range: 950MHz~1,525MHz Rx Input Frequency Range: 950MHz~1,525MHz Down-link Data Speed: 9.6k, 19.2k, 32kbps or 64kbps Up-link data Speed: 9.6k, 19.2k, 32kbps or 64kbps Number of Tx Channel: 1ch (Data, VoIP) Number of Rx Channel: 1ch (Data, VoIP) Tx Output Interface: N-female (50 ohms) Rx Input Interface: N-female (50 ohms) Output Reference (Transmitter Port) Frequency: 10MHz(sin-wave) Output Power: -3 to +5 dBm (LNB Port) Frequency: 10MHz(sin-wave) Output Power: -8 to 0 dBm Output Dc power Transmitter Port: +48 V DC LNB Port: +24 V DC Demodulation Method : Coherent Detection System Error Correction Method: Turbo Product Code, Coding Rate 1/2, 3/4, 6/7 Data Interface: 10base-T or 100base-TX (Data, VoIP) Protocol: TCP/IP or UDP/IP Equipment Rack: 19 inch Rack (Floor Stand with Caster) Power Consumption: 200VA or less including ODU Input Power: 220VAC (single phase. 60Hz)	1	Modulator/Demodulator for communicating meteorological service and radar data transmission via satellite.
Arrester Box	For 48V DC Power: 1ch Striking Voltage: 88Vmin Response Time: 0.1 μs Max. Surge current capacity: 2000A (8/20μs) For Thermal sensor: 1ch Striking Voltage: ±6Vmin Response Time: 0.1 μs Max. Surge current capacity: 5000A (8/20μs) For high frequency signal: 2ch Striking Voltage: 90Vmin Frequency: DC-2.2GHz Max. Surge current capacity: 20KA (8/20μs)	1	For protection of VSAT equipment from lighting.
Emergency Power Backup Unit	Capacity: 1kVA or more Input power source: AC 220V, single phase, 60Hz and DC12V generated by Solar Panel Output power: AC 220V, single phase, 60Hz Back-up time: 15hours or longer (Covering rage: Circuit of VSAT IDU~Telephone installed in Radar Equipment room including LAN Circuit) Type of Battery: Deep Cycle Battery Solar Panel with fixing material: included	1	For supplying back-up AC power to VSAT equipment for uninterrupted or continued VoIP communication to Head Office (WFFC) in case of power failure.

Maintenance Terminal	OS: Windows XP or VISTA CPU: Intel Core™2 Duo T8300 or equivalent Memory: 1GB or more VSAT maintenance software Monitor IDU status, parameter, and health data: - Transmit/Receive Frequencies - Transmit/Receive Bit Rates - Transmit/Receive FEC Rates - Transmit Output Power - Voltage and current of Transmitter, LNB and Modem - Condition of Transmitting Control IDU data and parameter: - Transmit/Receive Frequencies - Transmit/Receive Bit Rates - Transmit/Receive FEC Rates - Transmit Output Power	1	For monitoring and controlling the system.
Directional Coupler	Frequency Band: 950~1525MHz Coupling Loss: 10dB±1.0dB Insertion Loss: 0.7dB or less Impedance: 50 ohms Connector: Type N, 3port Power: up to 100W	1	For maintenance of the system.
Spare Parts	Arrester Terminal Set	1 set	For maintenance of the system.
Service Manuals	Operation & Maintenance Hand Book	1 set	For maintenance of the system.

Meteorological Data Satellite Communication System (VSAT)
(Guiuan Meteorological Radar Observation Station)

Name of Site: Guiuan Meteorological Radar Tower Building			
Equipment	Specification	Quantity	Purpose
VSAT Out-door Unit (ODU/Transmitter)	Frequency band: C band Output Frequency Range: 5.850GHz~6.425GHz Input Frequency Range: 950MHz~1525MHz Output Power Level: +40dBm min Linear Gain: 64dB nominal Gain Stability: 5dBp-p max IM3: -26dBc max External Reference Frequency: 10MHz(sin-wave) Input Power: -5 to +5 dBm Local Phase Noise : -60 dBc / Hz @100Hz : -70 dBc / Hz @1kHz : -80 dBc / Hz @10kHz : -90 dBc / Hz @100kHz Spurious In-band: -50dBc max Out-of-band: -50dBc max Receive band: -70dBm max Input Impedance: 50 ohms Input V.S.W.R.: 2:1 max Output V.S.W.R.: 2:1 max Input DC power: +48 V DC(+38 to +60 V DC) Input Interface IF/10MHz: N-female (50 ohms) DC Power: MS connector-female Output Interface: Waveguide,CPR137-G	1	Transmitter for communicating meteorological service and radar data transmission via satellite.

VSAT Out-door Unit (ODU/LNB)	Frequency band: C band Input Frequency Range: 3.625GHz~4.200GHz Output Frequency Range: 950MHz~1,525MHz Input Waveguide Flange: CPR-229G Input V.S.W.R.: 3:1 max Noise Temp (Ta: +25 C): 35K typ. 45K max Conversion Gain (Ta: +25 C): 60 dB min. 66 dB max Conversion Gain Ripple (Ta: +25 C): 2.0 dB max at 50MHz segments Conversion Gain Flatness (Ta: +25 C): 5.0 dB at 500MHz BW. Output Power Level for 1dB Compression: +3dBm min Intermodulation Products (3rd order): -45dB min Output Intercept Point: +13dBm Local Phase Noise : -65 dBc / Hz @100Hz : -75 dBc / Hz @1kHz : -85 dBc / Hz @10kHz : -90 dBc / Hz @100kHz : -105 dBc / Hz @1MHz External Reference Frequency: 10MHz(sin-wave) Input Power: -10 to 0 dBm Spurious At input unrelated to test CW signal: -140dBm max With test CW signal, -10dBm IF output: -55dBc max Output Connector: N-female 50ohm Output V.S.W.R.: 2.5:1 max Input Dc power : +13.5 to +24 V DC	1	Receiver for communicating meteorological service and radar data transmission via satellite.
VSAT Antenna	Diameter: Approx. 2.4m Frequency band: C band Tx Frequency Range: 5.850GHz~6.425GHz Rx Frequency Range: 3.625GHz~4.200GHz Antenna Drive Method: Manual Support Structure: AZ-EL mount with reinforcement bar	1	Antenna for communicating meteorological service and radar data transmission via satellite.
VSAT In-door Unit (IDU)	Satellite Access Scheme: SCPC Link Assignment Method: PAMA Channel Spacing: 10kHz Modulation Method: QPSK Tx Output Frequency Range: 950MHz~1,525MHz Rx Input Frequency Range: 950MHz~1,525MHz Down-link Data Speed: 9.6k, 19.2k, 32kbps or 64kbps Up-link data Speed: 9.6k, 19.2k, 32kbps or 64kbps Number of Tx Channel: 1ch (Data, VoIP) Number of Rx Channel: 1ch (Data, VoIP) Tx Output Interface: N-female (50 ohms) Rx Input Interface: N-female (50 ohms) Output Reference (Transmitter Port) Frequency: 10MHz(sin-wave) Output Power: -3 to +5 dBm (LNB Port) Frequency: 10MHz(sin-wave) Output Power: -8 to 0 dBm Output Dc power Transmitter Port: +48 V DC LNB Port: +24 V DC Demodulation Method : Coherent Detection System Error Correction Method: Turbo Product Code, Coding Rate 1/2, 3/4, 6/7 Data Interface: 10base-T or 100base-TX (Data, VoIP) Protocol: TCP/IP or UDP/IP Equipment Rack: 19 inch Rack (Floor Stand with Caster) Power Consumption: 200VA or less including ODU Input Power: 220VAC (single phase. 60Hz)	1	Modulator/Demodulator for communicating meteorological service and radar data transmission via satellite.

Arrester Box	For 48V DC Power: 1ch Striking Voltage: 88Vmin Response Time: 0.1 μs Max. Surge current capacity: 2000A (8/20μs) For Thermal sensor: 1ch Striking Voltage: ±6Vmin Response Time: 0.1 μs Max. Surge current capacity: 5000A (8/20μs) For high frequency signal: 2ch Striking Voltage: 90Vmin Frequency: DC-2.2GHz Max. Surge current capacity: 20KA (8/20μs)	1	For protection of VSAT equipment from lighting.
Emergency Power Backup Unit	Capacity: 1kVA or more Input power source: AC 220V, single phase, 60Hz and DC12V generated by Solar Panel Output power: AC 220V, single phase, 60Hz Back-up time: 15hours or longer (Covering rage: Circuit of VSAT IDU~Telephone installed in Radar Equipment room including LAN Circuit) Type of Battery: Deep Cycle Battery Solar Panel with fixing material: included	1	For supplying back-up AC power to VSAT equipment for uninterrupted or continued VoIP communication to Head Office (WFFC) in case of power failure.
Maintenance Terminal	OS: Windows XP or VISTA CPU: Intel Core™2 Duo T8300 or equivalent Memory: 1GB or more VSAT maintenance software Monitor IDU status, parameter, and health data: - Transmit/Receive Frequencies - Transmit/Receive Bit Rates - Transmit/Receive FEC Rates - Transmit Output Power - Voltage and current of Transmitter, LNB and Modem - Condition of Transmitting Control IDU data and parameter: - Transmit/Receive Frequencies - Transmit/Receive Bit Rates - Transmit/Receive FEC Rates - Transmit Output Power	1	For monitoring and controlling the system.
Directional Coupler	Frequency Band: 950~1525MHz Coupling Loss: 10dB±1.0dB Insertion Loss: 0.7dB or less Impedance: 50 ohms Connector: Type N, 3port Power: up to 100W	1	For maintenance of the system.
Spare Parts	Arrester Terminal Set	1 set	For maintenance of the system.
Service Manuals	Operation & Maintenance Hand Book	1 set	For maintenance of the system.

Meteorological Data Satellite Communication System (VSAT)
(PAGASA Head Office, Weather and Flood Forecasting Center)

Name of Site: PAGASA Head Office, Weather and Flood Forecasting Center			
Equipment	Specification	Quantity	Purpose
HUB Out-door Unit (ODU/Transmitter)	Frequency band: C band Output Frequency Range: 5.850GHz~6.425GHz Input Frequency Range: 950MHz~1525MHz Output Power Level: +40dBm min Linear Gain: 64dB nominal Gain Stability: 5dBp-p max IM3: -26dBc max External Reference Frequency: 10MHz(sin-wave) Input Power: -5 to +5 dBm Local Phase Noise : -60 dBc / Hz @100Hz : -70 dBc / Hz @1kHz : -80 dBc / Hz @10kHz : -90 dBc / Hz @100kHz Spurious In-band: -50dBc max Out-of-band: -50dBc max Receive band: -70dBm max Input Impedance: 50 ohms Input V.S.W.R.: 2:1 max Output V.S.W.R.: 2:1 max Input DC power: +48 V DC(+38 to +60 V DC) Input Interface IF/10MHz: N-female (50 ohms) DC Power: MS connector-female Output Interface: Waveguide,CPR137-G	1	Transmitter for communicating meteorological service and radar data transmission via satellite.
HUB Out-door Unit (ODU/LNB)	Frequency band: C band Input Frequency Range: 3.625GHz~4.200GHz Output Frequency Range: 950MHz~1,525MHz Input Waveguide Flange: CPR-229G Input V.S.W.R.: 3:1 max Noise Temp (Ta: +25 C): 35K typ. 45K max Conversion Gain (Ta: +25 C): 60 dB min. 66 dB max Conversion Gain Ripple (Ta: +25 C): 2.0 dB max at 50MHz segments Conversion Gain Flatness (Ta: +25 C): 5.0 dB at 500MHz BW. Output Power Level for 1dB Compression: +3dBm min Intermodulation Products (3rd order): -45dB min Output Intercept Point: +13dBm Local Phase Noise : -65 dBc / Hz @100Hz : -75 dBc / Hz @1kHz : -85 dBc / Hz @10kHz : -90 dBc / Hz @100kHz : -105 dBc / Hz @1MHz External Reference Frequency: 10MHz(sin-wave) Input Power: -10 to 0 dBm Spurious At input unrelated to test CW signal: -140dBm max With test CW signal, -10dBm IF output: -55dBc max Output Connector: N-female 50ohm Output V.S.W.R.: 2.5:1 max Input Dc power : +13.5 to +24 V DC	1	Receiver for communicating meteorological service and radar data transmission via satellite.
HUB Antenna	Diameter: Approx. 3.8m Frequency band: C band Tx Frequency Range: 5.850GHz~6.425GHz Rx Frequency Range: 3.625GHz~4.200GHz Antenna Drive Method: Manual Support Structure: Az - El mount	1	Antenna for communicating meteorological service and radar data transmission via satellite.

HUB In-door Unit (IDU)	Satellite Access Scheme: SCPC Link Assignment Method: PAMA Channel Spacing: 10kHz Modulation Method: QPSK Tx Output Frequency Range: 950MHz~1,525MHz Rx Input Frequency Range: 950MHz~1,525MHz Down-link Data Speed: 9.6k, 19.2k, 32k, 64k or 128kbps (Selectable) Up-link data Speed: 9.6k, 19.2k, 32k, 64k or 128kbps (Selectable) Number of Tx Channel: 1ch Multicast (Data, VoIP), max 128ksps or faster Number of Rx Channel: 4ch or more (Data, VoIP), total max 256ksps or faster Tx Output Interface: N-female (50 ohms) Rx Input Interface: N-female (50 ohms) Output Reference (Transmitter Port) Frequency: 10MHz(sin-wave) Output Power: -3 to +5 dBm (LNB Port) Frequency: 10MHz(sin-wave) Output Power: -8 to 0 dBm Output Dc power Transmitter Port: +48 V DC LNB Port: +24 V DC Demodulation Method : Coherent Detection System Error Correction Method : Turbo Product Code, Coding rate 1/2, 3/4, 6/7 Data Interface: 10base-T or 100base-TX (Data, VoIP) Protocol: TCP/IP or UDP/IP Equipment Rack: 19 inch Rack (Floor Stand with Caster) Power Consumption: 280VA or less including ODU Input Power: 220VAC (single phase. 60Hz)	1	Modulator/Demodulator for communicating meteorological service and radar data transmission via satellite.
Arrester Box	For 48V DC Power: 1ch Striking Voltage: 88Vmin Response Time: 0.1 μs Max. Surge current capacity: 2000A (8/20μs) For Thermal sensor: 1ch Striking Voltage: ±6Vmin Response Time: 0.1 μs Max. Surge current capacity: 5000A (8/20μs) For high frequency signal: 2ch Striking Voltage: 90Vmin Frequency: DC-2.2GHz Max. Surge current capacity: 20KA (8/20μs)	1	For protection of VSAT equipment from lighting.
5kVA Automatic Voltage Regulator (AVR)	Capacity: 5kVA or more Input power: AC 220V ±15%, single phase, 60Hz Output power: AC 220V ±5%, single phase, 60Hz	1	For supplying constant or regulated voltage to the VSAT equipment
5kVA UPS	Capacity: 5kVA or more Input power: AC 220V ±15%, single phase, 60Hz Output power: AC 220V ±5%, single phase, 60Hz Back-up time: 8 minutes or longer at full load	1	For supplying back-up AC power to VSAT equipment for uninterrupted or continued VoIP communication to the Radar Observation Stations in case of power failure.
Test Instrument and Materials	Spectrum Analyzer	1 set	For maintenance of the system
	Maintenance Terminal	1 set	
	Power Meter	1 set	
	Power Sensor	1 set	
	Frequency Counter	1 set	
	Directional Coupler	1 set	
Spare Parts	Transmitter (10W)	1 set	For maintenance of the system.
	LNB	1 set	
	Modem (for HUB IDU)	1 set	
	Modem (for VSAT IDU)	1 set	
	Arrester Terminal Set	1 set	
	Battery (for 5kVA UPS)	1 set	

Service Manuals	Operation & Maintenance Hand Book	1 set	For maintenance of the system.

(3) Basic Plan of the Facility

1) Site and Facility Layout Plan

Table 23: Outline and Current Situation of Infrastructures at the Existing Meteorological Radar Observation Stations (the Project Sites)

	Virac Meteorological Radar Observation Station	Aparri Meteorological Radar Observation Station	Guiuan Meteorological Radar Observation Station
Latitude(N) Longitude(E)	13º 37'52" 124º 19'58"	18º 21'34" 121º 37'49"	11º 02'46" 125º 45'16"
Altitude	223.27m	3m	60m
Area of Property (Inside of the existing fence/boundary wall)	Approximately 6,100m^2	Approximately 4,900m^2	Approximately 1,700m^2
Space availability for construction of the proposed radar tower building	Enough space is available. The existing unmanned mobile communication station should be considered in preparation of the building and layout plans.	Enough space is available. Height of 1st floor level should be determined vis-a-vis the high waves during tropical cyclones.	Minimum required space can be made available as a result of some strategic technical realignment as well as adjustments in building and layout plans.
Access Road	Poses no problem for construction of the proposed radar tower building.	Poses no problem for construction of the proposed radar tower building.	Expansion {required width: 3.8m (existing: 3.2 m)} and concrete pavement of the remaining unpaved portion of the existing access road from the main road to the site are indispensable.
Description/Outline of the Premises	The area is developed by cut and fill, with some leveling of the top portion of the hill.	The flat premises are located in an urban area facing the sea. Public facilities and private houses surround the area.	The area is developed by cut and fill, with some leveling of the top portion of the hill.
Commercial Power	3-phase 3-wire 240V 60Hz	3-phase 3-wire 240V 60Hz	Single-phase 2-wire 240V 60Hz
Water Supply	Deep well water	Deep well water	Deep well water
Waste water and Sewage	Septic tank and seepage pit in the site	Septic tank and seepage pit in the site	Septic tank and seepage pit in the site
Telephone	Not available	Available (Internet connection available)	Not available
Mobile phone in the property area	Usable/service is available	Usable/service is available	Usable/service is available
Internet	GPRS/EDGE is usable for Internet.	GPRS/EDGE is usable for Internet.	GPRS/EDGE is usable for Internet.

2) Architectural Design

[1] Floor Plan

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

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

Table 24: Calculation Base of Each Room In the Proposed Meteorological Radar Tower Buildings

Name of Room	Floor Area (m^2)			Room Function	Calculation Base
	Virac	Aparri	Guiuan		
Radome Room	30.2	30.2	30.2	Installation space for radar antenna apparatus.	Maintenance space for radar antenna apparatus. Room area depends upon radome base 6.2m in diameter.
Radar Equipment Room (including Spare Parts Room)	77.1	77.1	77.1	Installation space for antenna controller, transmitter, solid state power amplifier, digital receiver, signal processor, dehydrator, wave-guide configuration, radar task controller, power distribution box, optical repeater, VSAT terminal, maintenance box, maintenance cabinet, measuring instrument cabinet, air-conditioning units, etc.	Operation and maintenance space for all the apparatuses described in the left column. For installation of all the required equipment, at least 77m^2 required.
Observation Room	20.2	20.2	20.2	For weather observation terminals (2), VoIP exchange, optical repeater, dual switch, printer, IP telephone, UPS for PCs, filing cabinets, white board, etc.	For radar observation space and installation space for all the equipment described in the left column, 7m^2/person is required. In daytime always 3 persons in operation, approx. 20m^2 is required.
Maintenance Room	18.0	18.0	18.0	For maintenance instruments, measuring equipment, cabinets for operation & maintenance manuals and spare parts & consumables.	Maintenance space for various type of the equipment: 5m^2 (5m^2/person). Keeping space for maintenance instruments, measuring equipment: at least 12m^2. Cabinets for operation & maintenance manuals and spare parts & consumables: 6m^2.
Data Analysis Room	11.4	11.4	11.4	For data analysis terminal (1), desk for the terminal and data storage cabinets (high type: 3).	Approx. 12m^2 secured as a space for data analysis terminal (1), desk, data storage cabinets and also working space for day time staff.
Data Storage Room	8.4	8.4	8.4	For data storage cabinets (high type: 4) for keeping observation records and observed data of the radar system for analysis.	Necessary space for keeping all data secured.
Engine Generator Room	33.2	33.2	33.2	For 2 engine generators, oil pumps: 2, service tank, accessories, etc	Operation and maintenance space for 75kVA engine generators (2) with 1,000 liter service tank, automatic

					change-over switch, etc.
Electricity Room	14.0	14.0	14.0	For isolation transformers, power distribution boards, cable rack, test terminals, AVR, etc.	Installation, operation and maintenance space and cabling space for all the apparatuses described in the left column. Approx. 14m^2 required.
Power Supply Room	12.2	12.2	12.2	For radar power back-up unit and control rack.	Installation, operation and maintenance space for all the apparatuses described in the left column: approx. 12m^2 required.
Toilet	9.0	9.0	9.0	Closet bow: 2, Wash basin: 1, Slop Sink: 1	—
Tea Kitchen	6.6	6.6	6.6	Kitchen: 1	—
Changing Room	1.7	1.7	1.7	Changing space for taking shower	—
Shower Room	1.5	1.5	1.5	Space for taking shower.	—
Storage	3.1	3.1	3.1	Storage space for spare materials and miscellaneous goods.	Approx. 3m^2 secured as a storage space for spare materials and miscellaneous goods.
Pump Room	7.3	7.3	7.3	Well pump: 2 Pump for water reservoir tank: 2	For maintenance space and installation space for pumps: approx. 8 m^2 required.

[2] Sectional Plan

I. Height of the Radar Tower Building

As a result of the site surveys at Virac, Aparri and Guiuan Meteorological Radar Observation Stations, the required height of the radar antenna center from the ground level for the proposed radar systems are indicated in the table below.

Table 25: Required Height of Radar Antenna Center from G.L

	Virac Meteorological Radar Observation Station	Aparri Meteorological Radar Observation Station	Guiuan Meteorological Radar Observation Station
Required Height of Radar Antenna Center	38.6m	39.2m	39.0m
Recovery of Blind Area	100%	100%	100%

<Virac Meteorological Radar Observation Station>

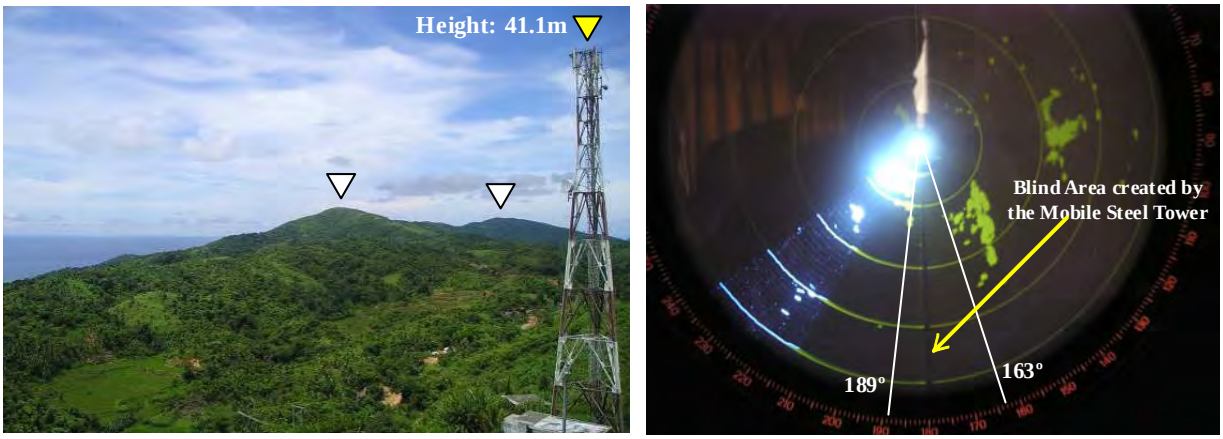
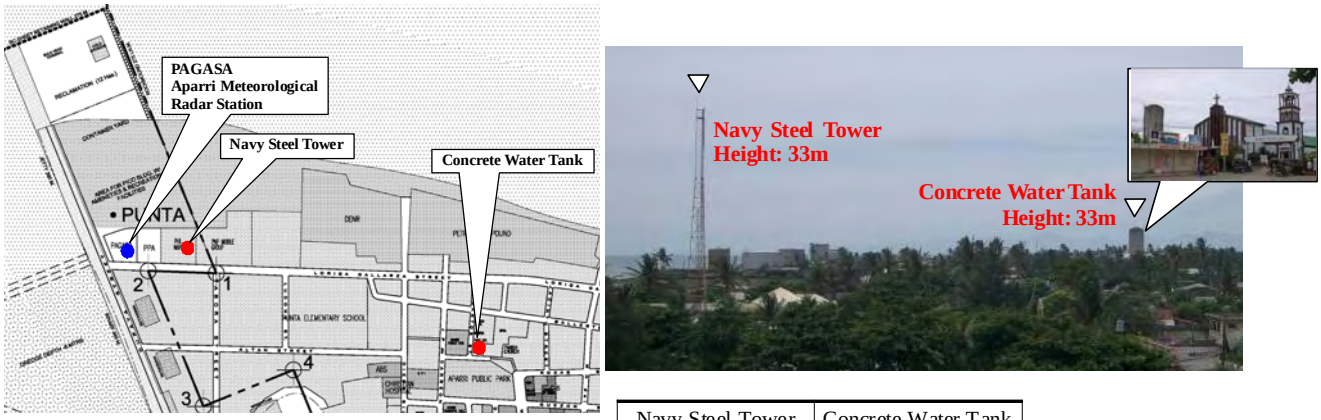


Figure 11: Blind Area created by the Mountains and the Mobile Tower

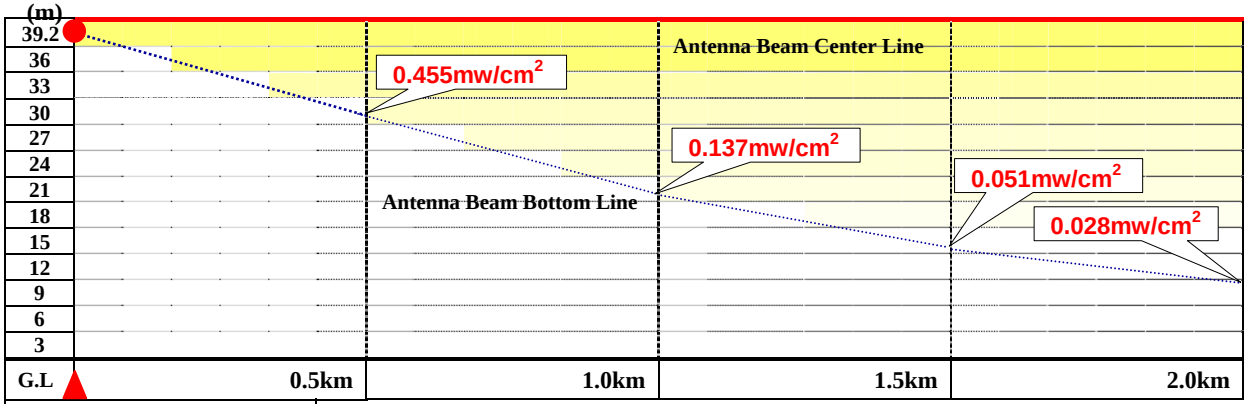
If the radar antenna center height is brought to about 39m, the upper part of the radar beam can clear the mountains creating the blind areas in the existing radar observation range shown in the picture of the previous page. It is to be noted as well that the ground level of the existing mobile telephone communication steel tower (41m), which is an obstruction to the existing radar system, is 3m lower than the location where the radar tower building is proposed to be constructed. If the steel tower top is even slightly lower than the radar antenna center, it is deemed that there is no problem for the radar observation. Hence, the required radar antenna center height for the proposed radar system is decided to be 38.6m.

<Aparri Meteorological Radar Observation Station>



	Navy Steel Tower	Concrete Water Tank
Distance from Appari Meteorological Radar Observation Station	Approx. 140m	Approx. 900m

Figure 12: Aparri Meteorological Radar Observation Station and Surroundings



G.L: 3m from the Sea Level

<Calculation Conditions>
Radar Antenna Size: 5m Diameter
Transmitted Peak Power: 10,000Watts
Pulse Width: 100 μ s
PRF: 1,800Hz

Figure 13: Power Density
and Height of Radar Antenna Beam Bottom Line at 0 Degree Antenna Elevation

Aparri Meteorological Radar Station located along the coast is approximately 1km away from the city

center (Municipality). In order to avoid the antenna beam bottom line from touching the Navy steel tower (33m high), the concrete water tank (diameter: appox. 11m), and the exiting hospital, schools and houses (3 stories) all located within the city central area, the required height of the antenna center from the ground level must be 39.2m. Such result of the calculation was derived at in view of the following critical consideration: the required height of the antenna beam bottom line shall be at least 10m from the ground level extending up to 2km from the Aparri Meteorological Radar Station.

<Guiuan Meteorological Radar Observation Station>

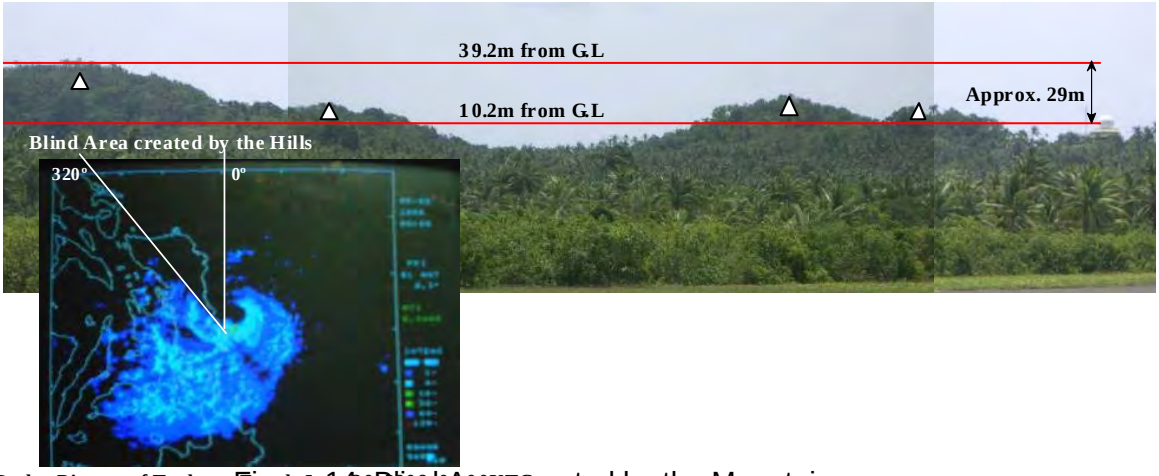


Figure 1-2. Blind Area created by the Mountains

If the radar antenna center height is brought to about 39m, the upper part of the radar beam can clear the highest mountain (which creates the blind area in the existing radar observation range shown in the above picture) on the north side of Guiuan Meteorological Radar Station. Upon its implementation, it is deemed that there will be no problem/blind spots for the radar observation. Thus, the required radar antenna center height for the proposed radar system is decided to be 39.0m.

II. Ground Level

At each project site, there can be found a bench mark which is the reference ground level made or determined in the course of the topographic survey work. Such reference will be used for construction of the radar tower building.

III. Equipment Installation

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

[3] Elevation Plan

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

[4] Internal and External Finishing Plan

I. Finishing of Major Rooms (Radar Equipment Room and Observation Room)

a) Floor

The radar equipment room and the observation room will have an access floor with a clearance of 15-18cm for easy wiring of power and signal cables, trouble-free maintenance and simple future expansion. An antistatic, heavy-duty access floor has been selected for the radar equipment room in which a high power radar transmitter weighting about 1 ton is to be installed.

b) External Walls

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

c) Ceiling

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

d) Window

Since the sustained wind pressure to be used for windows of the Radar Observation Room located at the height of 27m is expected to reach approximately 4,800 N/m^2, a laminated glass with a reinforced film will be used. In order to make a double protection for securely keeping wind and rain water from entering into the room, two aluminum windows at inside and outside will be individually installed.

II. Material Plan

Materials specified for both exterior and interior finishing, which are all available locally, have been

selected with a view to ease maintenance for PAGASA as follows.

Table 26: Finishing Materials of Proposed Meteorological Radar Tower Building

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

Table 27: Bases for Adoption of Materials
of Proposed Meteorological Radar Tower Buildings

		Bases for adoption of materials	Procurement
Exterior Finishing	**Roof Floor**	Due to external temperatures are high, reaching over 35 degrees, insulation board t=30mm will be required. Asphalt waterproofing is the most reliable waterproofing material to be protected by protection concrete, cement sand mortal and cement tiles.	To be procured locally
	Walls	Reinforced concrete blocks will be applied. Concrete blocks are generally used locally and are considered highly reliable in terms of both ease and accuracy of construction.	To be procured locally
Interior Finishing	**Floors**	Materials will be selected on the basis of superior durability and ease of maintenance. Vinyl tiles around offices, corridors and staircases will be applied. In rooms where dust must be avoided, a dust-proof paint finish will be specified.	To be procured locally
		In the offices where computer systems will be installed, access floors shall be applied for cabling under floor.	To be procured locally
	Walls	Cement sand mortal (trowel-coated) will be applied primarily for its durability, and vinyl paint will be applied to avoid dirt. Glazed ceramic tiles will be laid in the toilets and the slop sink booth.	To be procured locally
	Ceilings	In order to enhance the environment and efficiency of air-conditioning, none asbestos acoustic mineral boards will be used. Other rooms which will not require any ceiling board will be directly applied emulsion paint finish on cement and sand mortal.	To be procured locally
Windows and Door	**Exterior**	Aluminum and steel will be chosen throughout for reasons of durability, ease of handling and accuracy.	To be procured locally

	Interior	Wooden and steel with synthetic oil resin paint will be employed throughout for its handling ease during construction and from a maintenance standpoint.	To be procured locally

[5] Structural Plan

I. Structural Design Standard

In order to formulate and develop the structural design of the proposed radar tower buildings, the "National Structural Code of the Philippines" will be used.

II. Soil Condition and Foundation Plan

To ensure radar observation accuracy, building robustness is important and the permissible horizontal deflection of the building must be not more than 0.075 degree. Due to this, the foundation structures must prevent the building differential settlement. The bearing layer, pile and foundation of the Proposed Meteorological Radar Tower Buildings are indicated in the following table.

Table 28: Bearing Layer, Pile and Foundation of the Proposed Meteorological Radar Tower Buildings

	Virac Meteorological Radar Observation Station	Aparri Meteorological Radar Observation Station	Guiuan Meteorological Radar Observation Station
Depth of Bearing Layer	23.0m	29.0m	3.5m
Bearing Capacity	-	-	1,250kN/m^2
N value of Bearing Layer	50	50	-
Piling	Required	Required	Not Required
Designed Pile Length	24.0m	30.0m	-
Required Number of the Designed Pile	20 pcs	20 pcs	-
Diameter of the Designed Pile	1,200mm	1,200mm	-
Foundation type	Pile foundation (cast in site concrete)	Pile foundation (cast in site concrete)	Spread foundation

III. Structure Type

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

IV. Design Load

a) Dead load

The weight of all the structural and finishing materials has been included in the dead weight calculation for the radar tower buildings. The following combined weight as a special dead load will be considered.

<Roof Top>

Radom, Antenna and Pedestal: 4.5 tons

<Radar Equipment Room>

Transmitter/Receiver, Signal Amplifier, etc.: 3.0 tons

Signal Processor, Antenna Controller: 2.0 tons

<Electricity Room>

Isolation Transformer and Auto Voltage Regulator (for Equipment and Building): 4.0 tons

<Power Supply Room>

Capacitor: 2.0 tons

b) Live load

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

c) Wind load

The basic wind speed indicated in the "National Structural Code of the Philippines" is adopted based on 50-year mean recurrence interval. The basic wind speed of Virac, Aparri and Guiuan Meteorological Radar Observation Stations is 250km/h (approx. 69m/s). Since the radar tower building is classified in the Code as an essential facility, the Importance Factor (Iw) of the radar tower building is defined as Iw = 1.15.

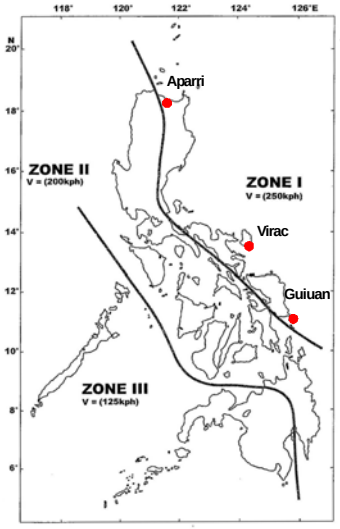


Figure 15: Wind Zone Map of the Philippines

d) Seismic load

According to the "National Structural Code of the Philippines", the country is classified into two (2) seismic zones with Seismic Zone Factor (Z). Virac, Aparri and Guiuan are located in Zone 4. The Seismic Zone Factor of Zone 4 is Z=0.4. Since the radar tower building is classified in the Code as an essential facility, the Importance Factor (I) of the radar tower building is defined as I = 1.25.

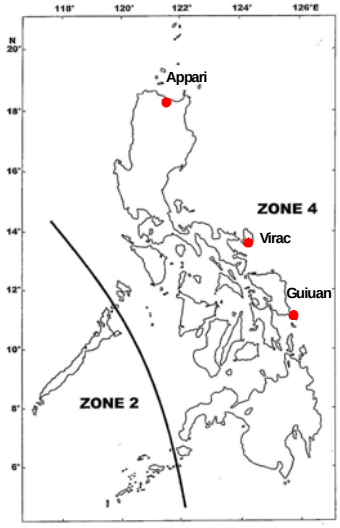


Figure 16: Seismic Zone Map of the Philippines

V. Structural Building Material

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

- Concrete : Conventional concrete specified concrete strength Fc= 21N/mm^2
- Cement : Japan Industrial Standard (JIS) or equivalent
- Deformed reinforcing bars : Grade 60 or equivalent

[6] Electrical Facility Design

I. Power intake facility

Table 29: Power intake facility

	Virac Meteorological Radar Observation Station	Aparri Meteorological Radar Observation Station	Guiuan Meteorological Radar Observation Station
Intake Power (Nominal Voltage of the Existing Wattmeter)	240V, 3-phase 3-wire, 60Hz	240V, 3-phase 3-wire, 60Hz	240V, 3-phase 3-wire, 60Hz

II. Power generating facility

Table 30: Power Generating Facility

	Virac Meteorological Radar Observation Station	Aparri Meteorological Radar Observation Station	Guiuan Meteorological Radar Observation Station
Number of Engine Generator	2	2	2
Capacity	75KVA	75KVA	75KVA
Output	240V, 3-phase 3-wire, 60Hz	240V, 3-phase 3-wire, 60Hz	240V, 3-phase 3-wire, 60Hz
Fuel Tank Capacity	1,000 liters	1,000 liters	1,000 liters

III. Trunk line and power facility

Power will be distributed to the switchboard for lighting and to the electricity control panel from the distribution panel in the electrical room. The trunk line for distribution and the power line will use suitable cabling through conduits. An alarm for the power equipment will be shown on an alarm panel in the observation room. The electrical systems for the trunk line and branch circuits are as follows.

Table 31: Trunk line and power facility

	Virac Meteorological Radar Observation Station	Aparri Meteorological Radar Observation Station	Guiuan Meteorological Radar Observation Station
Trunk line for lighting and power	240V, 3-phase 3-wire	240V, 3-phase 3-wire	240V, 3-phase 3-wire
Branch power circuits	240V, 3-phase 3-wire	240V, 3-phase 3-wire	240V, 3-phase 3-wire
Branch lighting circuits	240V, single-phase 2-wire	240V, single-phase 2-wire	240V, single-phase 2-wire
Branch equipment circuits	240V, 3-phase 3-wire	240V, 3-phase 3-wire	240V, 3-phase 3-wire

IV. Lighting and power outlet

The voltage required for lighting and power sockets is single-phase 240V and all the fixtures must be grounded. Steel pipes will be used for wiring conduits. Lighting fixtures will be mainly fluorescent, for their low power consumption, though incandescent fixtures will also be used to some extent, depending on the particular application. The lighting levels in the various rooms will be approximately as shown below.

Table 32: Approximate lighting levels in the various rooms

	Virac Meteorological Radar Observation Station	Aparri Meteorological Radar Observation Station	Guiuan Meteorological Radar Observation Station
Radome Room	200 Lx	200 Lx	200 Lx
Radar Equipment Room	300 Lx	300 Lx	300 Lx
Observation Room	300 Lx	300 Lx	300 Lx
Data Analysis Room	300 Lx	300 Lx	300 Lx
Data Storage Room	300 Lx	300 Lx	300 Lx
Maintenance Room	300 Lx	300 Lx	300 Lx
Engine Generator Room	200 Lx	200 Lx	200 Lx
Electricity Room	200 Lx	200 Lx	200 Lx
Power Supply Room	200 Lx	200 Lx	200 Lx
Pump Room	200 Lx	200 Lx	200 Lx
Entrance Hall	200 Lx	200 Lx	200 Lx
Other Rooms	200 Lx	200 Lx	200 Lx

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

V. Telephone system

A service terminal box and a relay terminal box will be installed inside the radar tower buildings and telephone lines will be installed to outlets in those rooms requiring a telephone.

VI. Intercom system

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

VII. Alarm system

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

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

VIII. Grounding system

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

IX. Lightning protection system

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

X. Aviation obstruction light

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

XI. Fire detection and alarm system

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

[7] Water Supply, Drainage and Sanitary Fixture Design

I. Water supply system

The public water supply is not available in Virac, Aparri and Guiuan so that a well construction is required for construction work of the radar tower building at each site. After the construction, this well will be used as the water supply facility for the radar tower building. For the well water intake for the radar tower building, a water supply gate valve will be installed.

II. Drainage system

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

III. Sanitary fixtures

- Closet bowl: European style

- Washbasin: wall-mounted type
- Slop sink: wall-mounted type

IV. Fire extinguisher

Fire extinguishers will be supplied in the following rooms.

Table 33: Fire extinguisher

	Virac Meteorological Radar Observation Station	Aparri Meteorological Radar Observation Station	Guiuan Meteorological Radar Observation Station
Radome Room	CO_2 type	CO_2 type	CO_2 type
Radar Equipment Room	CO_2 type	CO_2 type	CO_2 type
Observation Room	CO_2 type	CO_2 type	CO_2 type
Data Analysis Room	CO_2 type	CO_2 type	CO_2 type
Data Storage Room	CO_2 type	CO_2 type	CO_2 type
Maintenance Room	CO_2 type	CO_2 type	CO_2 type
Engine Generator Room	ABC type	ABC type	ABC type
Electricity Room	CO_2 type	CO_2 type	CO_2 type
Power Supply Room	CO_2 type	CO_2 type	CO_2 type
Pump Room	CO_2 type	CO_2 type	CO_2 type
Tea Kitchen	ABC type	ABC type	ABC type

[8] Air-conditioning and Ventilation System Design

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

Table 34: Air-conditioning and Ventilation System

	Virac Meteorological Radar Observation Station	Aparri Meteorological Radar Observation Station	Guiuan Meteorological Radar Observation Station
Radome Room	Fan forced ventilation	Fan forced ventilation	Fan forced ventilation
Radar Equipment Room	Air-conditioning system Heat exchange system	Air-conditioning system Heat exchange system	Air-conditioning system Heat exchange system
Observation Room	Air-conditioning system Fan forced ventilation	Air-conditioning system Fan forced ventilation	Air-conditioning system Fan forced ventilation
Data Analysis Room	Air-conditioning system Fan forced ventilation	Air-conditioning system Fan forced ventilation	Air-conditioning system Fan forced ventilation
Data Storage Room	Air-conditioning system Fan forced ventilation	Air-conditioning system Fan forced ventilation	Air-conditioning system Fan forced ventilation
Maintenance Room	Air-conditioning system Fan forced ventilation	Air-conditioning system Fan forced ventilation	Air-conditioning system Fan forced ventilation
Engine Generator Room	Fan forced ventilation	Fan forced ventilation	Fan forced ventilation
Electricity Room	Fan forced ventilation	Fan forced ventilation	Fan forced ventilation
Power Supply Room	Air-conditioning system Fan forced ventilation	Air-conditioning system Fan forced ventilation	Air-conditioning system Fan forced ventilation
Pump Room	Fan forced ventilation	Fan forced ventilation	Fan forced ventilation
Shower Room	Fan forced ventilation	Fan forced ventilation	Fan forced ventilation
Toilet (M & F)	Fan forced ventilation	Fan forced ventilation	Fan forced ventilation
Tea Kitchen	Fan forced ventilation	Fan forced ventilation	Fan forced ventilation

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

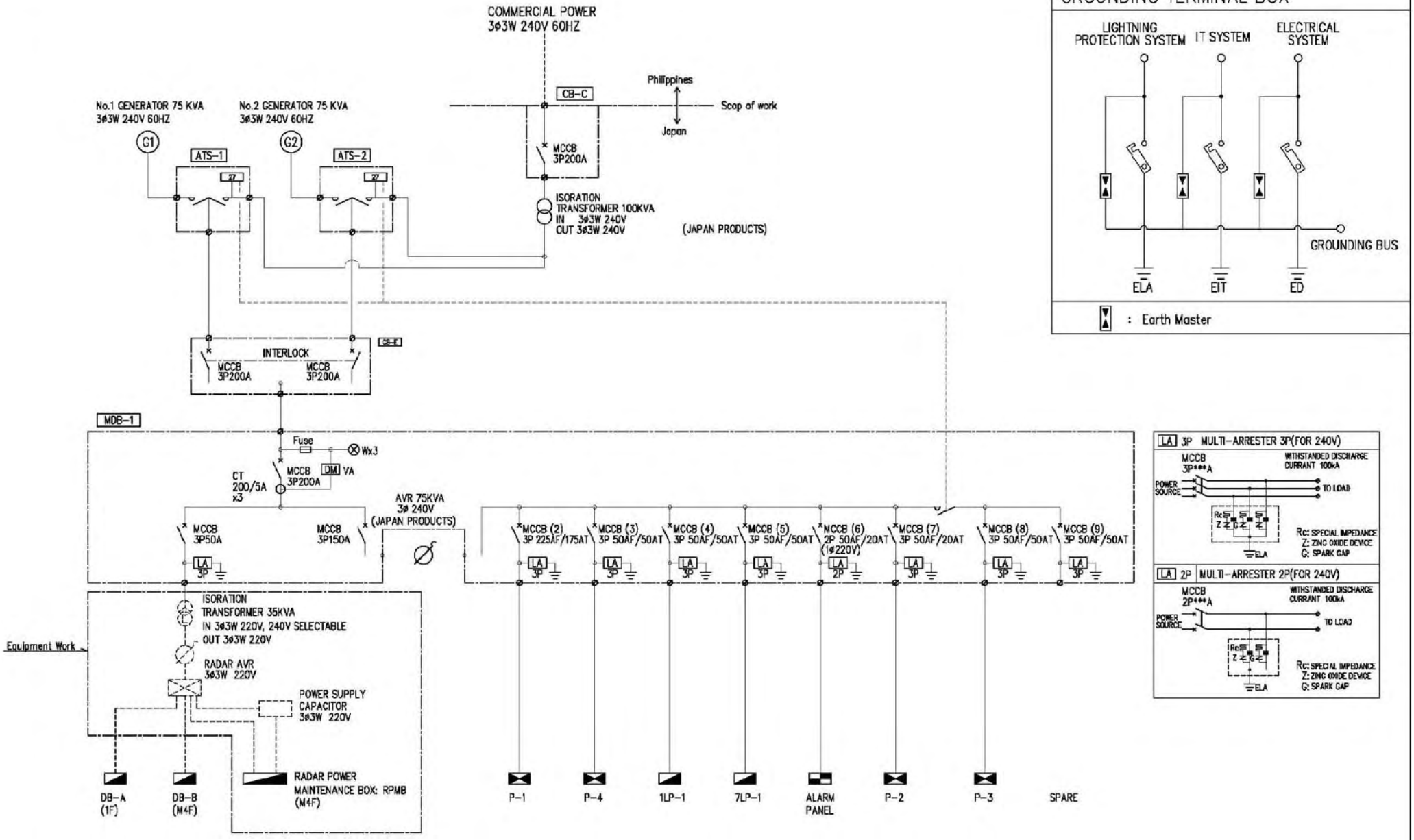
<Environmental conditions>

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

The following diagrams of the building equipment plan for the radar tower buildings can be found in the subsequent pages immediately hereafter.

<Virac, Aparri and Guiuan Meteorological Radar Tower Buildings>

- Power Feeder Diagram : System Diagram 1 (SD-01)
- Power Riser System : System Diagram 2 (SD-02)
- Interphone System & Tel Diagram : System Diagram 3 (SD-03)
- Riser Fire Alarm System : System Diagram 4 (SD-04)
- Alarm System Diagram : System Diagram 5 (SD-05)
- Riser Diagram Lighting Protection & Grounding System : System Diagram 6 (SD-06)
- Riser Diagram Obstruction Lighting : System Diagram 7 (SD-07)
- Water Supply & Drainage System : System Diagram 8 (SD-08)
- Air-Conditioning & Ventilation Diagram : System Diagram 9 (SD-09)



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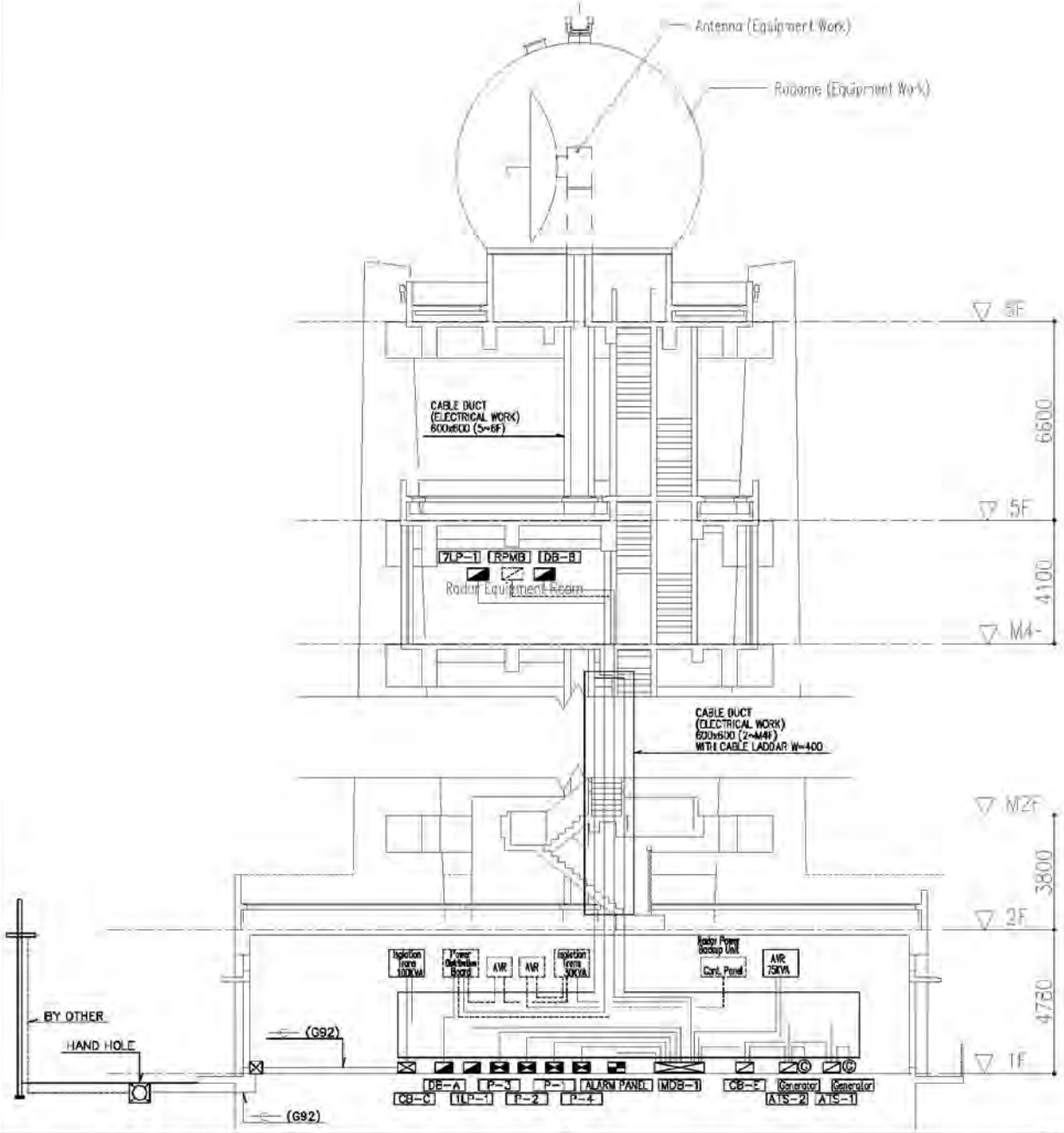
DRAWING TITLE: POWER FEEDER DIAGRAM

SCALE: NONE

DRAWING No.: SD - 01



POWER CABLE LIST

FROM	TO	CABLE SIZE	CONDUIT
CB-C	ISOLATION TRANS 100KVA	XLPE/PVC 1C-4x120sq +E70sq	G80 / CABLE LADDAR
ISOLATION TRANS	ATS-1	XLPE/PVC 1C-4x120sq +E70sq	G80 / CABLE LADDAR
ISOLATION TRANS	ATS-2	XLPE/PVC 1C-4x120sq +E70sq	G80 / CABLE LADDAR
GENERATOR	ATS-1	XLPE/PVC 1C-4x120sq +E70sq	G80 / CABLE LADDAR
GENERATOR	ATS-2	XLPE/PVC 1C-4x120sq +E70sq	G80 / CABLE LADDAR
ATS-1	CB-E	XLPE/PVC 1C-4x120sq +E70sq	G80 / CABLE LADDAR
ATS-2	CB-E	XLPE/PVC 1C-4x120sq +E70sq	G80 / CABLE LADDAR
CB-E	MDB-1	XLPE/PVC 1C-4x120sq +E70sq	G80 / CABLE LADDAR
MDB-1	ISOLATION TRANS 30KVA(EQUIP WORK)	XLPE/PVC 4C-16sq +E16sq	G40 / CABLE LADDAR
MDB-1	P-1	XLPE/PVC 1C-4x95sq +E50sq	G70 / CABLE LADDAR
MDB-1	P-2	XLPE/PVC 4C-16sq +E16sq	G40 / CABLE LADDAR
MDB-1	P-3	XLPE/PVC 4C-16sq +E16sq	G40 / CABLE LADDAR
MDB-1	P-4	XLPE/PVC 4C-16sq +E16sq	G40 / CABLE LADDAR
MDB-1	1LP-1	XLPE/PVC 4C-16sq +E16sq	G40 / CABLE LADDAR
MDB-1	7LP-1	XLPE/PVC 4C-16sq +E16sq	G40 / CABLE LADDAR
MDB-1	ALARM PANEL	XLPE/PVC 2C- 6sq +E 6sq	G32 / CABLE LADDAR
PowerDistributionBoard	DB-A	XLPE/PVC 2C-10sq +E10sq	G40 / CABLE LADDAR
PowerDistributionBoard	DB-B	XLPE/PVC 2C-10sq +E10sq	G40 / CABLE LADDAR
MDB-1	AVR 75kVA	XLPE/PVC 1C-4x95sq +E50sq	G70 / CABLE LADDAR
AVR 75kVA	MDB-1	XLPE/PVC 1C-4x95sq +E50sq	G70 / CABLE LADDAR

SPARE PARTS FOR LIGHTNING DAMAGE LIST

FROM	DESCRIPTION	UNIT
CB-C	MCCB 3P200A	1
ATS-1	UNDER VOLTAGE RELAY	1
	CHANGE OVER SWITCH	1
	RELAY	4
MDB-1	MCCB 3P200A	1
	FUSE	6
	INDICATING LAMP	3
	VOLTAGE AMPERE INDICATOR	1
	ARRESTER 2P	2
	ARRESTER 3P	7
CB-E	MCCB 3P200A	1
	RELAY	4
	FUSE	4
GENERATOR	CONTROL CIRCUIT BOARD	1
	RELAY	4
	FUSE	4
	VOLT METER	1

EQUIPMENT WORK

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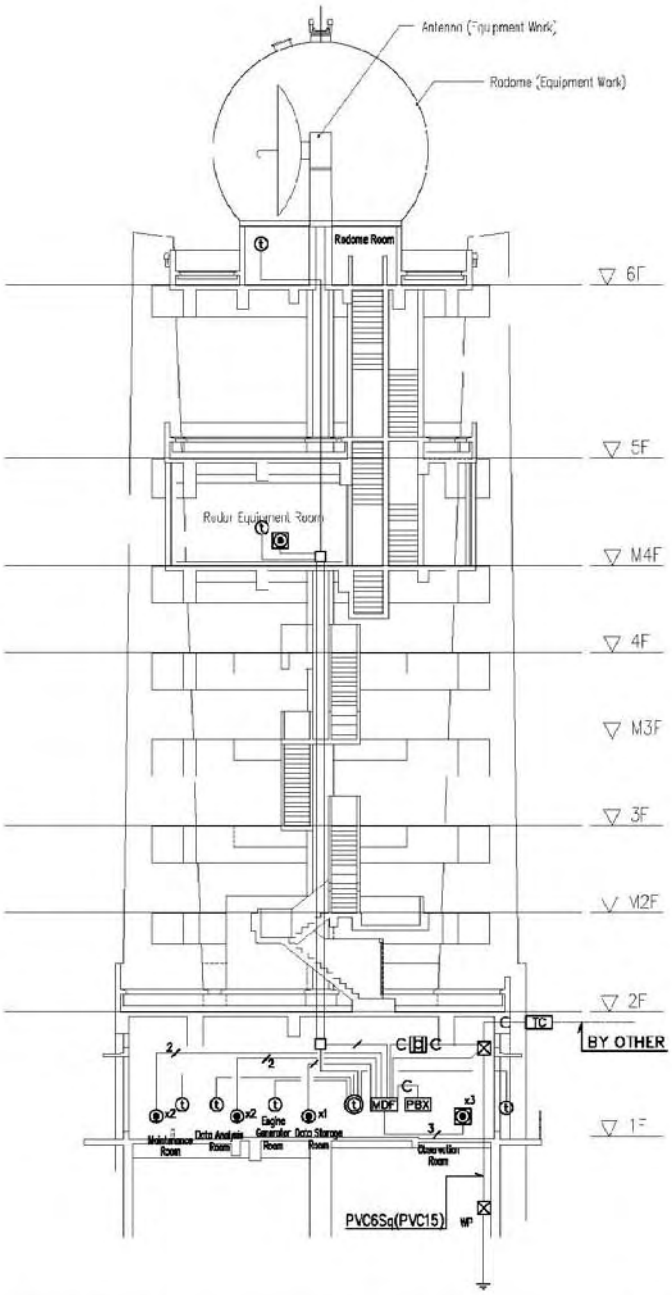
DRAWING TITLE: POWER RISER SYSTEM

SCALE: NONE

DRAWING No.: SD - 02



REMARK

- C — C — (G36)
- —/— : TIEV 0.65−4C (G20)
- —/2— : TIEV 0.65−4Cx2 (G20)
- —/3— : TIEV 0.65−4Cx3 (G25)
- —/— : TIEV 0.65−4C (UNDER THE ACCESS FLOOR)
- —/2— : TIEV 0.65−4Cx2 (UNDER THE ACCESS FLOOR)
- —/3— : TIEV 0.65−4Cx3 (UNDER THE ACCESS FLOOR)
- ——— : AE 0.9−2C (G20)
- ——— : AE 0.9−2C (UNDER THE ACCESS FLOOR)
- PBX : PBX COT. 5L , EXT. 15L
- MDF : MAIN DISTRIBUTION FRAME 30P
- : TELEPHONE OUTLET (MODULAR JACK)
- : TELEPHONE OUTLET SLAB MOUNT
- : ARRESTER
- : INTERCOM (POWER SUPPLY FOR INTERCOM)
- : INTERCOM
- : PULL BOX 200x200x200 (WATER PROOF TYPE)
- TC : INCOMING TERMINAL FRAME

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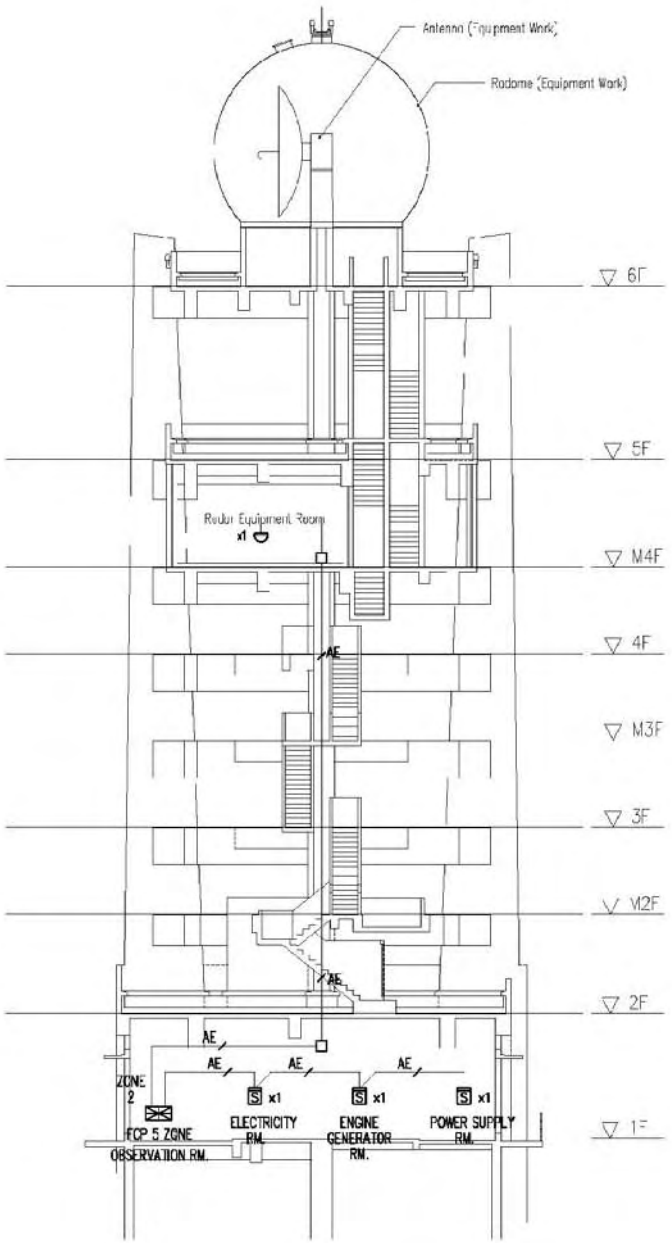
DRAWING TITLE	SCALE	DRAWING No.
INTERPHONE SYSTEM &TEL DIAGRAM	NONE	SD - 03



FIRE ALARM CONTROL PANEL 5 ZONE
SMOKE DETECTOR (PHOTO TYPE)
RATE OF RISE HEAT DETECTOR

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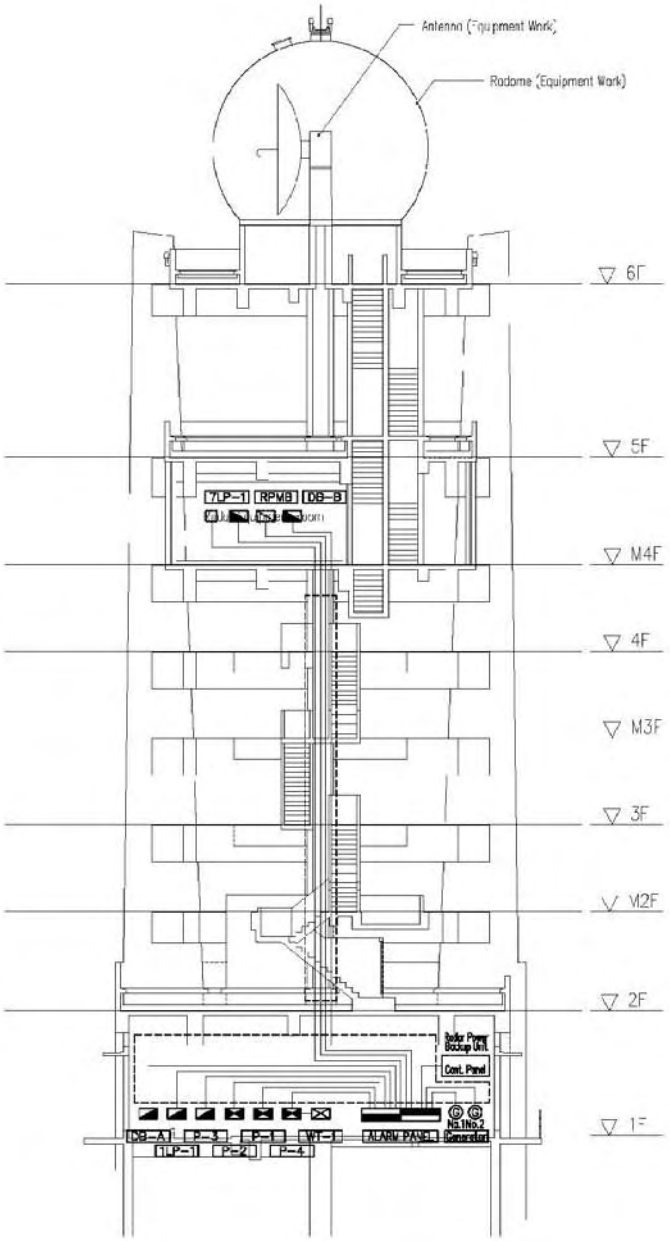
DRAWING TITLE: RISER FIRE ALARM SYSTEM

SCALE: NONE

DRAWING No.: SD - 04



☐ TEMPERATURE SWITCH
FOR ROOM TEMPERATURE ALARM

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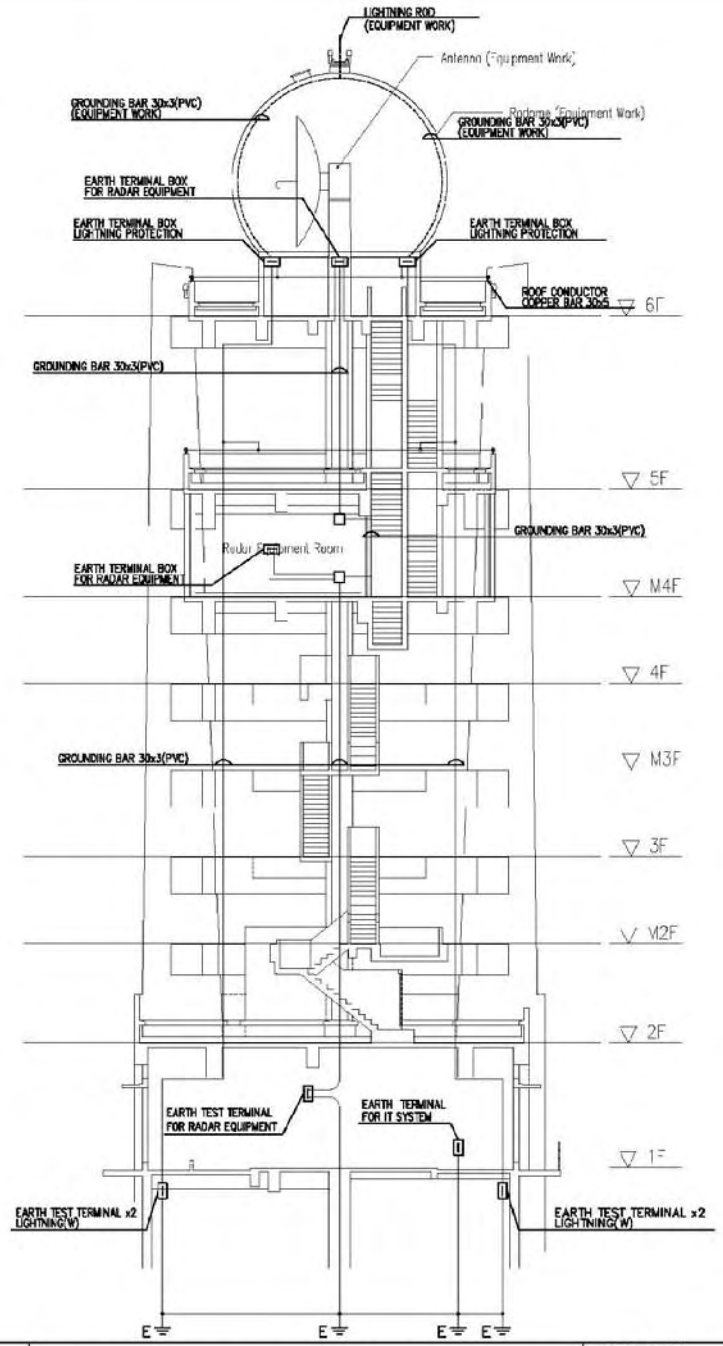
DRAWING TITLE: ALARM SYSTEM DIAGRAM

SCALE: NONE

DRAWING No.: SD - 05



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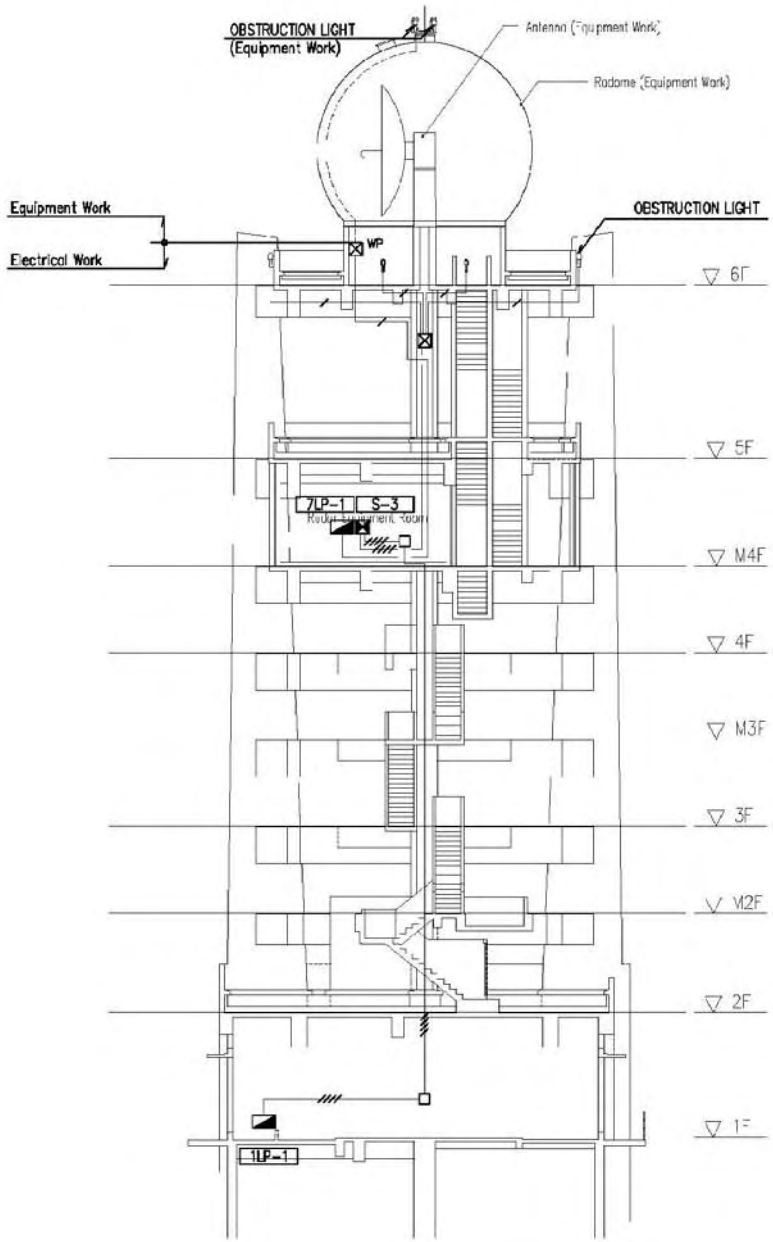
DRAWING TITLE
RISER DIAGRAM LIGHTNING PROTECTION AND GROUNDING SYSTEM

SCALE
NONE

DRAWING No.
SD - 06



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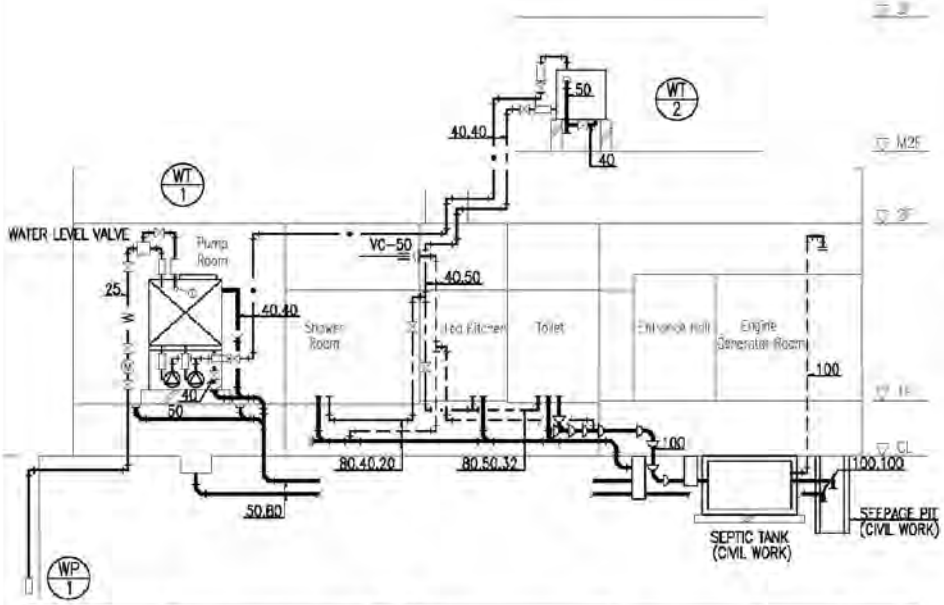

ITEM	DESCRIPTION	GFL	1 FL				TOTAL	REMARK
		PUMP ROOM	TOILET(M)	TOILET(F)	SHOWER ROOM	TEA KITCHEN		
WATER CLOSET	CW420J/SW420JP		1	1			2	
LAVATORY	LW240CJ/LW240HFJ		1	1			2	
SERVICE SINK	SK22A		1				1	
PAPER HOLDER	TS116R		1	1			2	
FAUCET	TL19A		1	1			2	
MIRROR	TS118ASR1		1	1			2	
SHOWER HEAD	TS364N,S208				1		1	
SINK						1	1	
FAUCET	T200ESNR13	1					1	
FAUCET	DK303					1	1	

NO.	NAME	SPECIFICATION	Q'TY	POWER SUPPLY					LOCATION	REMARKS
				PHASE	VOLT (V)	FREQUENCY (Hz)	MOTOR (KW)	EMERGENCY POWER SUPPLY		
WT-1	POTABLE WATER TANK / PUMP	FPR Tank	1					○	Pump Room	RC FOUNDATION (CIVIL WORK)
		Rated capacity 2.5 m^3								1.8x1.8x0.3mH
		Dimension 1,000 x 1,500 x 2,000H								
		Accessories Manhole 600ø Breather								
		Ball tap 25A , overflow and drain pipe 40A								
		Electrode 4P								
		Constant pressure type pump	2	3	240	60	1.5			
		40 ø x 100 l/min x 180 kpa x 2 pcs (1 spare)								
		Accessories Flexible connector for suction 40A								
WT-2	POTABLE WATER GRAVITY TANK	FRP tank	1						Roof	RC FOUNDATION (CIVIL WORK)
		Rated capacity 1.5 m^3								0.4x1.4x0.5mH
		Dimension 1,000 x 2,000 x 1,000H								
		Earth quake proof 2.00(Wind - Proof type)								
		Accessories Flat frame 150H,manhole 600 ø								
		Electrode 4P								
WP-1	DEEP WELL PUMP	Stainless Pump	1	3	240	60	2.2		Out door	EXCAVATING WORK (CIVIL WORK)
		40 ø x 80 l/min x 950 kPa								
		W/ Control Panel								
ABC	FIRE EXTINGUISHER	ABC Dry chemical, wall hang	2						Each room	
		10 Lbs Discharge time 14 sec								
CO2	FIRE EXTINGUISHER	Carbon dioxicide, wall hang	9						Each room	
		10 Lbs Discharge time 14 sec								
	SEPTIC TANK (CIVIL WORK)	Septic tank & Seepage pit (RC type, Civil work)	1						Out door	
		Blower pump (Civil work)								

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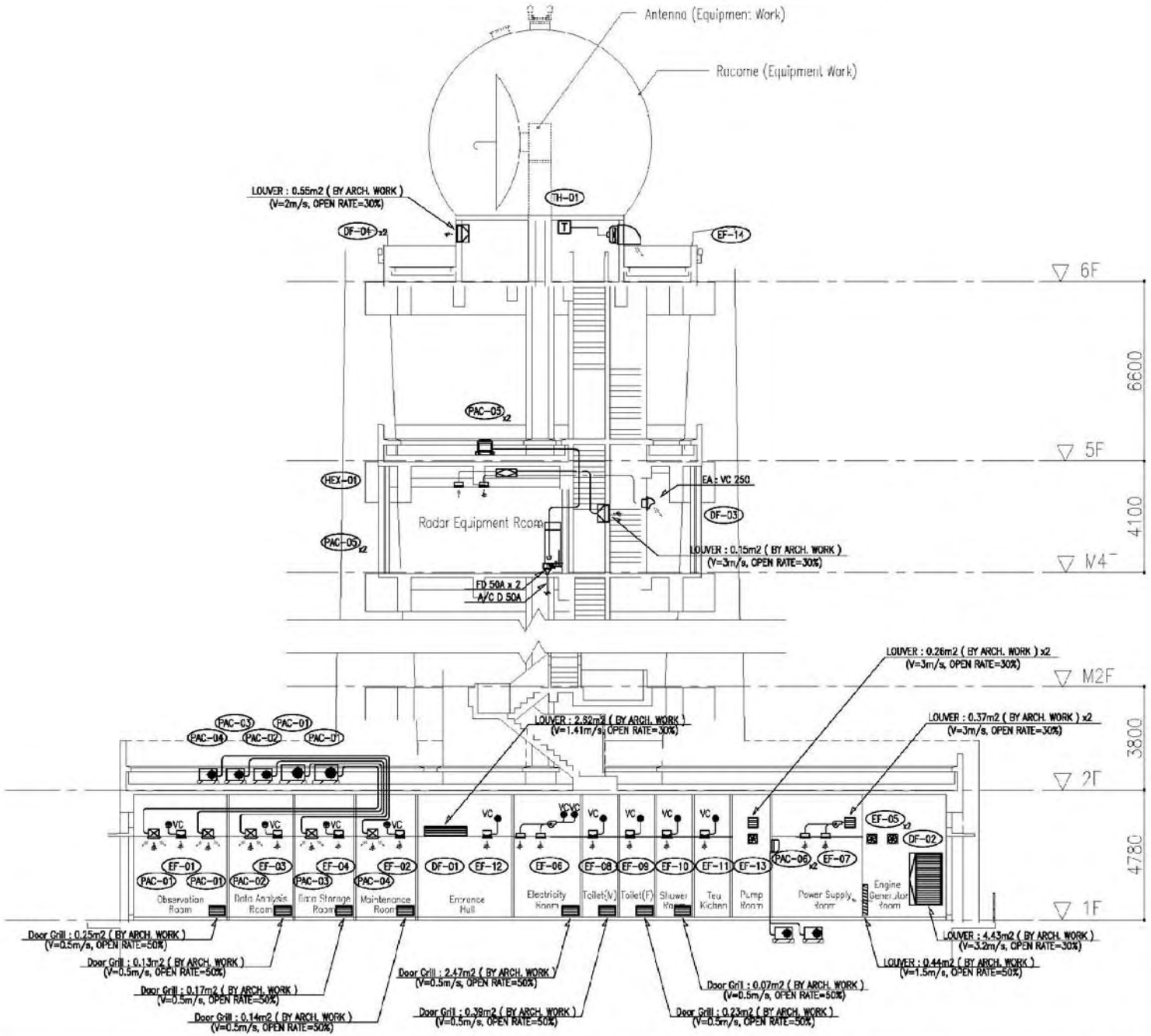
DRAWING TITLE: WATER SUPPLY AND DRAINAGE SYSTEM

SCALE: NONE

DRAWING No.: SD - 08



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DRAWING TITLE
A/C & VENTILATION
AIR-CONDITIONING & VENTILATION SYSTEM DIAGRAM

SCALE
NONE

DRAWING No.
SD - 09