Samoa Meteorology Department
The Independent State of Samoa

PREPARATORY SURVEY II REPORT
ON
THE PROJECT
FOR
IMPROVING THE WEATHER FORECASTING SYSTEM AND METEOROLOGICAL WARNING FACILITIES
IN
THE INDEPENDENT STATE OF SAMOA

February 2010

JAPAN INTERNATIONAL COOPERATION AGENCY

INTERNATIONAL METEOROLOGICAL CONSULTANT INC.
JAPAN WEATHER ASSOCIATION

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PREFACE

Japan International Cooperation Agency (JICA) conducted the preparatory survey 2 on the Project for Improving the Weather Forecasting System and Meteorological Warning Facilities in the Independent State of Samoa.

JICA sent to Samoa a survey team from August 16 to September 15, 2009.

The team held discussions with the officials concerned of the Government of Samoa, 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 Samoa in order to discuss a draft outline 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 Independent State of Samoa for their close cooperation extended to the teams.

February, 2010

Kikuo NAKAGAWA
Director General, Global Environment Department
Japan International Cooperation Agency

February, 2010

Letter of Transmittal

We are pleased to submit to you the preparatory survey 2 report on the Project for Improving the Weather Forecasting System and Meteorological Warning Facilities in the Independent State of Samoa.

This survey was conducted by the Consortium of International Meteorological Consultant Inc. and Japan Weather Association, under a contract to JICA, during the period from July, 2009 to February, 2010. In conducting the survey, we have examined the feasibility and rationale of the project with due consideration to the present situation of Samoa and formulated the most appropriate outline 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,

Nobutaka NOGUCHI
Project Manager
Preparatory Survey 2 Team on
the Project for Improving the Weather Forecasting
System and Meteorological Warning Facilities
in the Independent State of Samoa

Consortium of
International Meteorological Consultant Inc. and
Japan Weather Association

Summary

Summary

The Independent State of Samoa (Samoa) is consisting of the two large islands of Savaii and Upolu, which are volcanic islands, and seven small islands. There are many precipitous mountains in Upolu and Savaii and the body of the population lives in the inshore areas which the social infrastructure established. In line with the increasing global concern on the intensification of disasters due to Climate Change, establishment of appropriate countermeasures for disasters such as destructive storm, storm surge and flooding caused by tropical cyclone, rising sea level due to Climate Change, tsunami, etc. has been the urgent task of Samoa. Islands in the South Pacific Ocean like Samoa are located in a very fragile environment vis-à-vis meteorological disasters aggravated by Climate Change due to its terrain condition which is generally susceptible to any damage generated by meteorological disasters, distance from the continents, underdeveloped meteorological observation and forecasting technique and effective disaster prevention countermeasures. In fact, there are concerns that wind speed and rainfall of tropical cyclones will be increased by global warming. Moreover, storm surge damage generated by tropical cyclone will be accelerated by sea-level rise due to global warming. Furthermore, islands located in the ocean which have scarce freshwater resources are very vulnerable to drought due to long spell of dry weather. It is said that if serious meteorological disaster occur in the islands, it would be difficult to see and assess the total picture of the damage, and deploying relief activities may probably be delayed due to underdeveloped communication infrastructure and long distance from each continent.

Based on the disaster records since 1950, 12 tropical cyclones attacked Samoa and in the recent years, it was reported that the island's entire population was affected, 8 deaths caused and US$ 120 million damage received in 1990, US$ 245 million damage in 1991, and US$ 35 million damage recorded in 2004 due to major agricultural products and facilities located in the shore and coastal lines seriously devastated. On the other hand, Samoa seriously experience huge agricultural and infrastructural losses coupled with human anguish and sufferings generated by destructive floods caused by torrential rains every year. They have caused significant damage to agriculture which is a vital industry in Samoa, thereby inflicting widespread poverty on its people. The extensive damage from these meteorological disasters is a determining factor for the significant set-back of the national economy. To alleviate and proactively deal with the situations indicated above, establishment of effective countermeasures against meteorological disasters are of pressing urgency. 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 Samoa, especially in relation to the quick and timely evacuation of residents and disaster prevention countermeasures, depend almost entirely on the information from the Samoa Meteorology Division (SMD). Under these circumstances, improvement and strengthening of the capability of the SMD by establishing the meteorological observation & forecasting and disaster early warning dissemination systems has become an urgent task.

Meanwhile, our blue planet consists of 30% land and 70% ocean. Since continuous meteorological observation in the ocean is extensively difficult, the observed data in the ocean is inadequate for perceiving trend of the Climate Change. The observed data at an island located in the Ocean like Samoa as the same as from an observation sea buoy is quite significant for the world. In order to more accurately understand Climate Change mainly caused by global warming, transmission of the observed data from Samoa through the Global Telecommunication System (GTS) to all over the world is strategically important and necessary. Effective and proper utilization of the observed data from Samoa by many meteorological organizations and research institutes all over the world will positively result towards obtaining accurate prediction of Climate Change caused by global warming. It is therefore extremely important to achieve this as our obligation and legacy for the next generation.

The Strategy for Development of Samoa (SDS) 2005 to 2007 and the SDS 2008-2012 clearly articulate the priority strategic areas and strongly emphasize the need for implementing the development of the Meteorological services by lifting its Aviation Weather Services to the Aviation Industry to the International Standards. The Ministry of Natural Resources, Environment and Meteorology Business Plan 2006-2008 also urges the importance of enhancing the capability of all Meteorology Division Sections. In addition, the SDS 2008-2012 prioritize the implementation of the National Adaptation Programme of Action (NAPA) for climate change adaptation for ensuring a sustainable economic and social progress. It also actively pushes for the effective implementation of the National Disaster Management Plan Act 2006-2009 and Climate Change Act 2006 for Environmental Sustainability and Disaster Risk Reduction for developing of resilience plans to adverse Climate Change impacts.

In view of the current situation of the meteorological observation, forecasting and information dissemination capability of the SMD, Samoa is beset by the following issues and major concerns:

[1] Due to no upper air observation specified by the World Meteorological Organization (WMO), the SMD is unable to;
- provide information of the movement of the tropical cyclone,
- monitor El Niño event, and
- provide upper air observation data required for upgrading the weather information & products of Fiji Regional Specialized Meteorological Center (RSMC) and the Numerical Weather Prediction (NWP) products of the meteorological organizations in the developed countries.

[2] Since there is no observatory in the 4 out of the existing 5 observation regions, the SMD is unable to;
- perceive weather phenomena in the existing 5 observation regions together,
- compare among weather phenomena of the existing 5 observation regions,
- receive all the observed data real-timely, and
- reflect the present weather phenomena to forecasting.

[3] Due to no sea level observation, the SMD is unable to;

- predict occurrence of storm surge caused by atmosphere pressure drop and strong wind during tropical cyclone approaching Samoa, and
- observe sea level rise due to the Climate Change and tsunami generated by earthquake.

[4] Since there is no Global Telecommunication System (GTS) message switch equipment, as a member of the WMO, the SMD is unable to transmit the observed data of Samoa to all over the world and receive the observed data globally. Consequently, it is an obstacle to forecasting work.

[5] Since the SMD is unable to provide weather information and tropical cyclone warning & information to TV center, it is likewise incapable to give wider and deeper understanding of natural disasters as well as vital knowledge and countermeasure techniques and strategies against these disasters, including but not limited to quick evacuation of directly affected population.

[6] Since meteorological satellite pictures obtained through the internet for preparation of forecasts and warnings are not processable and analyzable, SMD is unable to utilize the satellite pictures for monitoring tropical cyclone in the South Pacific and its forecasting & warning.

[7] Since the short message service of the existing mobile-phone network for providing warnings, which is verbally conveyed to the mobile telephone company by the SMD, to local community members of the Disaster Advisory Committee (DAC) is not feasibly and realistically utilized due to a longer transmission time is required and there is no other practical device in the SMD for provision of advisories and warnings to the public, it is an obstacle to the prompt dissemination of advisories and warnings especially during emergency and disaster occurrence.

[8] Since weather and sea level observations for more accurately perceiving trend of the Climate Change due to the global warming does not exist, the SMD is unable to provide the observed data to meteorological organizations and research institutes in the world.

[9] At the Faleolo International Airport, the existing aviation weather observation system does not satisfy the standard specified by the International Civil Aviation Organization (ICAO) and the WMO.

[10] The SMD is unable to provide weather information required for safety operation of civil aviation to the Samoa Airport Authority and airline companies.

Due to lack of financial and technical capabilities, the Government of Samoa requested the Government of Japan to procure and install the required equipment as well as to provide the relevant systems and facilities, etc. under Japan's Grant Aid Assistance scheme. In response to the request from the Government of Samoa in 2008, the Government of Japan decided to conduct a Preparatory Survey for the Project for Improving the Weather Forecasting System and Meteorological Warning Facilities (Programme). The Japan International Cooperation Agency (JICA) sent the Preparatory Survey Team to

Samoa on March 30-April 27, 2009 in order to confirm feasibility and appropriateness of Programme implementation.

In order to enable the SMD to contribute to the accumulation of observed data required for obtaining accurate prediction of Climate Change in the South Pacific, definite implementation of sea level, surface weather and upper air continuous observations are very much needed. Moreover, in order to achieve improvement of vulnerability to meteorological disasters or climate change adaptation, all the required warnings of cyclone, storm surge, high waves, heavy rain, strong & gusty wind, floods, droughts and volcano ash fall must be appropriately and timely sent to the Disaster Management Office (DMO), the Disaster Advisory Committee (DAC) and mass media by the SMD in accordance with the Disaster & Emergency Management Act.

Therefore, the key objective of the Programme is the accumulation of the observed data required for obtaining accurate prediction of the Climate Change in the South Pacific and improvement of vulnerability to meteorological disasters by establishment of the meteorological observation & forecasting and disaster early warning dissemination systems and development of the meteorological service capabilities through provision of the grant aid and technical cooperation under the Japan's Programme Grant Aid for Environment and Climate Change.

Since necessity and appropriateness of the requested items were confirmed, the Government of Japan decided to conduct the Preparatory Survey 2 on the Programme. Consequently, JICA sent the Preparatory Survey 2 Team to Samoa from August 16 to September 15, 2009. The Team had a series of discussions with the officials concerned of the Government of Samoa, conducted surveys and collected necessary and pertinent information and data for the Programme. Upon return to Japan, the team conducted further studies including feasibility, justification and scope of the Programme, paying particular attention to the present situation in Samoa, especially on the operation and maintenance capabilities of the SMD. From those studies, the team formulated the draft outline design for the Programme. JICA then sent the team again to Samoa from December 2 to 15, 2009 in order to discuss the draft preparatory survey report. Accordingly, the design of the preparatory survey for the Programme was finalized.

The concluded items in the design the Preparatory Survey for the Programme are as follows.

Table 1: Finalized Components of the Programme

Name of the Equipment	①	②	③	④	⑤	⑥	⑦	⑧	⑨	⑩	⑪	⑫	⑬	⑭	⑮	Total Quantity
Airport Weather Observation System (AWOS)							2									2
AWOS Display System							3									3
Automatic Weather System (AWS)				1	1	1		1	1				1		1	7
Calibration Instrument	1															1
Meteorological Data Communication System	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	15
Meteorological Data Management System	1															1
GTS Message Switch System	1															1
Meteorological Satellite Data Receiving System	1															1
Forecast Support System	1															1
Early Warning System	1															1
Power Back-up System	1															1
Wind Profiler System	1															1
Name of Ancillary Facility	①	②	③	④	⑤	⑥	⑦	⑧	⑨	⑩	⑪	⑫	⑬	⑭	⑮	Total Quantity
Power Back-up Shed	1															1
Equipment Shed	1															1
Concrete Shelter	1	1	1	1	1	1	3	1	1	1	1	1	1	1	1	17
Foundation of Wind Profiler System	1															1

Table 2: Site No. of the Programme

Name of Site	Site No.	Name of Site	Site No.
The SMD Head Office	①	Maota International Airport	⑨
Mt. Vaea	②	Mt. Valusia	⑩
Mt. Fiamoe	③	Tuasivi	⑪
Togitogiga	④	Mt. Tagotala	⑫
Le Mafa	⑤	Le Piu Tai	⑬
Saluafata	⑥	Vaisala	⑭
Faleolo International Airport	⑦	Mt. Talu	⑮
Manono	⑧		

The required implementation period of the Programme, including the detailed design study, the tendering procedures, soft component and technology transfer, is approximately 37 months. The programme cost to be borne by Samoa as estimated in the preparatory survey, is approx. 1.9 Million Tala (approx. 67 Million JP Yen).

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

[1] Enable the SMD to implement upper-air observation for monitoring wind direction and wind speed during; no raining: approx. 3-6 km high and raining: approx. 7-9 km high, and temperature up to approx. 1.4 km high in the sky, and also transmit the observed data from Samoa to all over the world.

[2] Enable the SMD to perceive weather phenomena in the existing 5 observation regions together, receive all the observed data real-timely and effectively reflect the present weather phenomena to forecasting through the technical cooperation.

[3] Enable the SMD to provide information of the movement of the tropical cyclone and El Niño event concerned with occurrence and intensity of tropical cyclone.

[4] Enable the SMD to transmit and receive the observed data and meteorological products globally through the GTS network and effectively utilize the meteorological data and products to the routine works through the technical cooperation.

[5] Enable the SMD to provide weather information and tropical cyclone warning & information improved through the technical cooperation to TV center thereby accelerating public education towards wider and deeper understanding of natural disasters as well as vital knowledge and countermeasure techniques and strategies against these disasters, including but not limited to quick evacuation of directly affected population.

[6] Enable the SMD to send all the required warnings of cyclone, storm surge, high waves, heavy rain, strong & gusty wind, floods, droughts and volcano ash fall through the existing mobile-phone network to Disaster Management Office (DMO), Disaster Advisory Committee (DAC) consisting of 47 public and private organizations, approx. 1,300 local community members and mass media in accordance with the Disaster & Emergency Management Act according to warning contents, standards and issuance methodology established through the technical cooperation.

[7] Enable the SMD to steadily improve weather information, advisories and warnings through the technical cooperation and provide them through the existing mobile-phone network by the mobile-phone users whenever required.

[8] Enable the SMD to have the climate database custody for analysis and annually issue climate change information prepared by analyzing knowledge transferred through the technical cooperation on changing trend, abnormal event, and differences from the normal climate to mass media, the government agencies and numerous countries of the world through the Internet.

[9] Enable the SMD to provide 6 hourly terminal aerodrome forecasts (TAF) and trend forecasts required for safety aircraft operation to the Samoa Airport Authority and airline companies according to the standard specified by the ICAO and progressively improve the forecast accuracy through the technical cooperation.

[10] Enable the SMD to prepare and provide weather condition briefing required for safety aircraft operation to airline pilots according to the briefing knowledge transferred through the technical cooperation.

The SMD, the agency which will implement the Programme, has quite a good organizational capability. Its engineers have enough experience and knowledge in the daily operation, repair and maintenance of its

existing meteorological equipment and instruments. Moreover, the SMD's budget is expected to be able to cover the Samoa portion of the capital cost and recurrent cost of the Programme indicated in this report.

As adequately pointed out in the above careful and comprehensive evaluation of the Programme effects, considerable and enhanced benefits can be expected to be achieved vis-à-vis the SMD's capabilities in reducing human loss and the recurrent economic set-back brought about by meteorological disasters including tropical cyclone. The Programme would substantially contribute to the mitigation of the adverse effects of meteorological disasters and effectively safeguard the basic human needs of the people of Samoa. The foregoing indicates and amply confirms the appropriateness and necessity of carrying out the Programme under the Japan's Programme Grant Aid for Environment and Climate Change Scheme. The implementation of the Programme is therefore wholly considered to be appropriately suitable and worthwhile.

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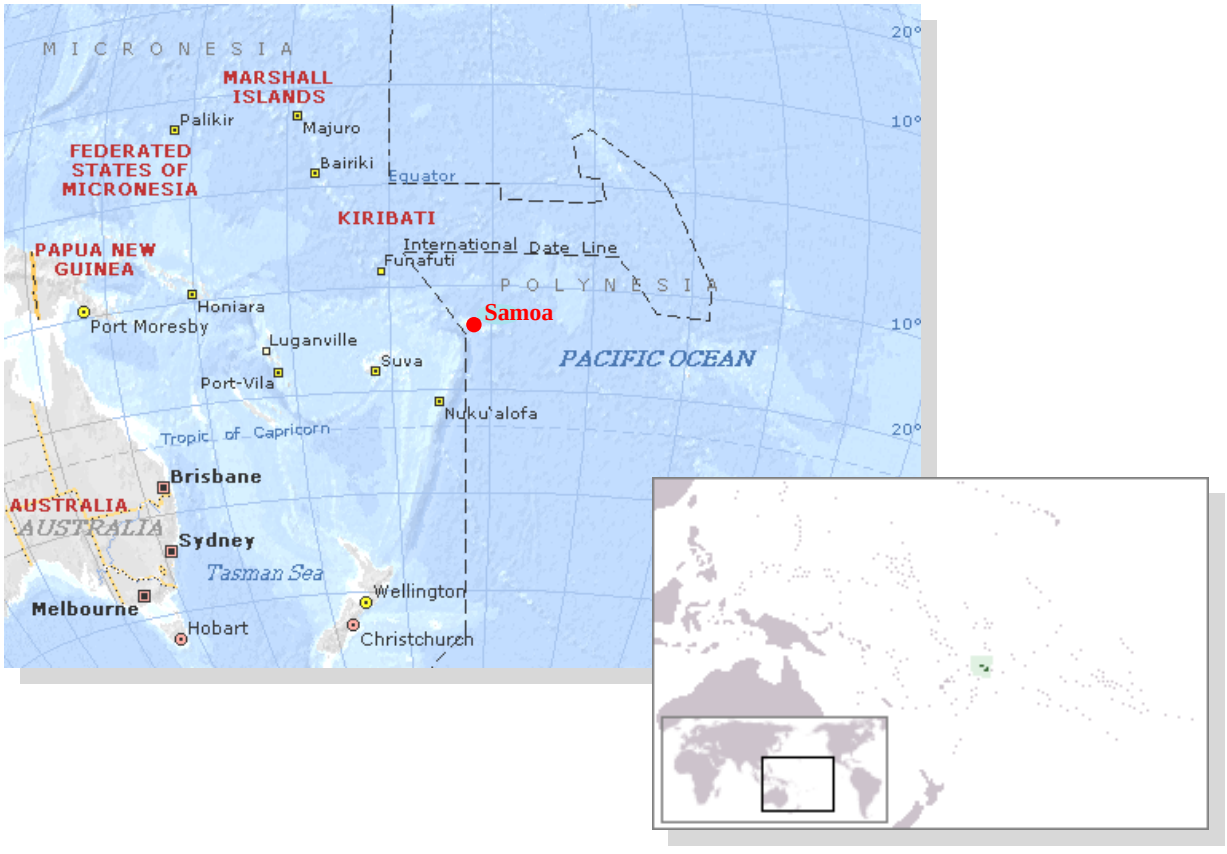
Appendices

■ Samoa


N
172°30' W
172° W
171°30' W
PACIFIC OCEAN
13°30' S
14° S
0 10 Miles
0 10 Kilometers
Cape Puava
Safotu
Sale'aula
Samalaeulu
Fatealupo
Cape Mulinu'u
Asau
A'opo
Falelima
Savai'i
Sagone
Mount Silisili
6,095 ft.
(1,858 m)
Lano
Sa'asa'ai
Cape Tuasivi
Sala'ilua
Salelologa
Gataivai
Satupa'itea
Apolima Strait
Taga
Cape Asuisui
Apolima
Manono
Manonouta
Nofoali'i
Fale'ula
Faleasi'u
Apia
Upolu
Solosolo
Faleta
Mount Fito
3,652 ft.
(1,113 m)
Cape Mulitapuili
Matautu
Si'umu
Ti'avea
Salata Bay
Poutasi
Lalomanu
Lotofaga
Nu'utele
Samoa


MICRONESIA
MARSHALL ISLANDS
Palikir
Majuro
FEDERATED STATES OF MICRONESIA
Bairiki
Equator
KIRIBATI
PAPUA NEW GUINEA
International Date Line
Funafuti
POLYNESIA
Honiara
Port Moresby
Samoa
Luganville
Suva
PACIFIC OCEAN
Port-Vila
Nuku'alofa
Tropic of Capricorn
Brisbane
AUSTRALIA
AUSTRALIA
Sydney
Tasman Sea
Wellington
Melbourne
Hobart
Christchurch
20°
10°
10°
20°

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Chapter 1 Background of the Programme

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ABBREVIATIONS

AVR : Automatic Voltage Regulator
CRED : Centre for Research on the Epidemiology of Disasters
EDF : European Development Fund
EIA : Environmental Impact Assessment
EMWIN : Emergency Management Weather International Network
E/N : Exchange of Notes
ENSO : El Nino South Oscillation Index
G/A : Grant Agreement
GDP : Gross Domestic Products
GTS : Global Telecommunication System
ICAO : International Civil Aviation Organization
ISCS : International Satellite Communications System
JICA : Japan International Cooperation Agency
MNRE : Ministry of Natural Resources and Environment
MTSAT : Multi-Functional Transport Satellite
NAPA : National Adaptation Programme of Action, Samoa
NOAA : National Oceanic and Atmospheric Administration
ODA : Official Development Assistance
OECD : Organization for Economic Cooperation and Development
OFDM : Orthogonal Frequency Division Multiplexing
PALM : Pacific Islands Leaders Meeting
RASS : Radio Acoustic Sounding System
RSMC : Regional Specialized Meteorological Center
SDS : Strategy for Development of Samoa
SMD : Samoa Meteorology Division
SOPAC : South Pacific Applied Geoscience Commission
SPCZ : South Pacific Convergence Zone
TAF : Terminal Aerodrome Forecast
TCWC : Tropical Cyclone Warning Center
UNDP : United Nations Development Program
VAT : Value-Added Tax
VPN : Virtual Private Network
VSAT : Very Small Aperture Terminal
WMO : World Meteorological Organization
WWB : Westerly Wind Burst

Chapter 1
Background of the Programme

Chapter 1 Background of the Programme

The Independent State of Samoa (Samoa) is located east of the international dateline and south of the equator. The total land area is 2840 km², consisting of the two large islands of Savaii (1,700 km²) and Upolu (1,115 km²), which are volcanic islands, and seven small islands. There are many precipitous mountains in Upolu and Savaii and the body of the population lives in the inshore areas which the social infrastructure established. In line with the increasing global concern on the intensification of disasters due to Climate Change, establishment of appropriate countermeasures for disasters such as destructive storm, storm surge and flooding caused by tropical cyclone, rising sea level due to Climate Change, tsunami, etc. has been the urgent task of Samoa.

Due to the terrain condition susceptible to any damage generated by meteorological disasters, distance from the continents, underdeveloped meteorological observation and forecasting technique and effective disaster prevention countermeasures, islands in the South Pacific Ocean are located in a very fragile environment to the Climate Change and will suffer immeasurable impact caused by extreme weather consistent with global warming. In fact, there are concerns that wind speed and rainfall of tropical cyclones will be increased by global warming. Moreover, storm surge damage generated by tropical cyclone will be accelerated by sea-level rise due to global warming. Furthermore, islands located in the ocean which have scarce freshwater resources are very vulnerable to drought resulting from long spell of dry weather. It is said that if serious meteorological disaster occur in the islands, it would be difficult to see and assess the total picture of the damage, and deploying relief activities may probably be delayed due to underdeveloped communication infrastructure and long distance from each continent.

Based on the disaster records since 1950, 12 tropical cyclones were attached to Samoa and in the recent years, it was reported that the island's entire population was affected, US$ 120 million damage received in 1990, US$ 245 million damage in 1991, and US$ 35 million damage recorded in 2004 due to major agricultural products and facilities located in the shore and coastal lines seriously devastated.

Given the situations indicated above, the Strategy for Development of Samoa (SDS) urges the importance of enhancing the capability of all Meteorology Division Sections as well as the prioritization of the implementation of the National Adaptation Programme of Action (NAPA) for climate change aimed at ensuring a sustainable economic and social progress. It also actively pushes for the effective implementation of the Disaster & Emergency Management Act and the Climate Change Act for Environmental Sustainability and Disaster Risk Reduction for developing of resilience plans to adverse climate change impacts.

Between 1980 and 2008, the number of victims and the economic losses resulting from natural disasters including tropical cyclones are indicated in the following table.

Table 3: Natural Disaster Record of Samoa (1980-2008)

Date	Location	Type	Disaster Name	Killed	Affected	Estimated Damage US$
September 09-16, 2008	North West of Savaii (Asau & Aopo)	Forest Fire	Asau & Aopo Forest Fire	0	40 families	$65,598
January 25, 2008	Apia urban area	Flash flood		0	About 1,500 families & businesses	$200,000
February 16, 2006	Apia urban area	Flash flood		0	About 1,200 families & businesses	$120,000
February 16, 2005	Savaii & Upolu Islands	Tropical Cyclone	OLAF	0	0	$30,000
January 05, 2004	Savaii & Upolu Islands	Tropical Cyclone	HETA	1	30,000	$35,000,000
April 15, 2001	Apia urban area, Lepea, Moataa, Falefa	Flash Flood		0	1,300 buildings	$4,400,000
December 07, 1991	Savaii Island	Tropical Cyclone	VAL	13	77,000	$240,000,000
			WASE			$5,200,000
February 01-04, 1990	Savaii & Upolu Islands	Tropical Cyclone	Ofa	8	195,000	$120,000,000
January 06, 1989	Country wide, especially Savaii Island	Tropical Cyclone	FILI & GINA			$15,500,000
July-September, 1983	Northwest Savaii Island	Forest Fire			1,000	$31,650,000

Prepared by the Centre for Research on the Epidemiology of Disasters (CRED) and Samoa Meteorology Division

<Tropical Cyclone>

3 typical tropical cyclone tracks in the South Pacific Ocean near Samoa are indicated below.

A Pattern: Tropical cyclone normally moves from Northwest to Southeast along the South Pacific Convergence Zone (SPCZ) as indicated in the A Pattern which is Standard.

B Pattern: The B Pattern (High Amplitude) shows Dominant Trough west of Samoa, so tropical cyclone moves from northwest to southeast along the current of Trough west of Samoa.

C Pattern: The C Pattern (Poleward) shows eastern subtropical anticyclone elongates northwestward forming ridge, so tropical cyclone moves from northwest to southeast along the current around the ridge east of Samoa.

The existence of the anticyclone region at the southwest and southeast of Samoa makes it vulnerable to erratic tropical cyclone tracking. The movement of the tropical cyclone depends on its steering environment and the steering will also depend on the strength of the tropical cyclones. Any cyclone caught up with the B pattern has possibility to move northwest or northeast towards the equator.

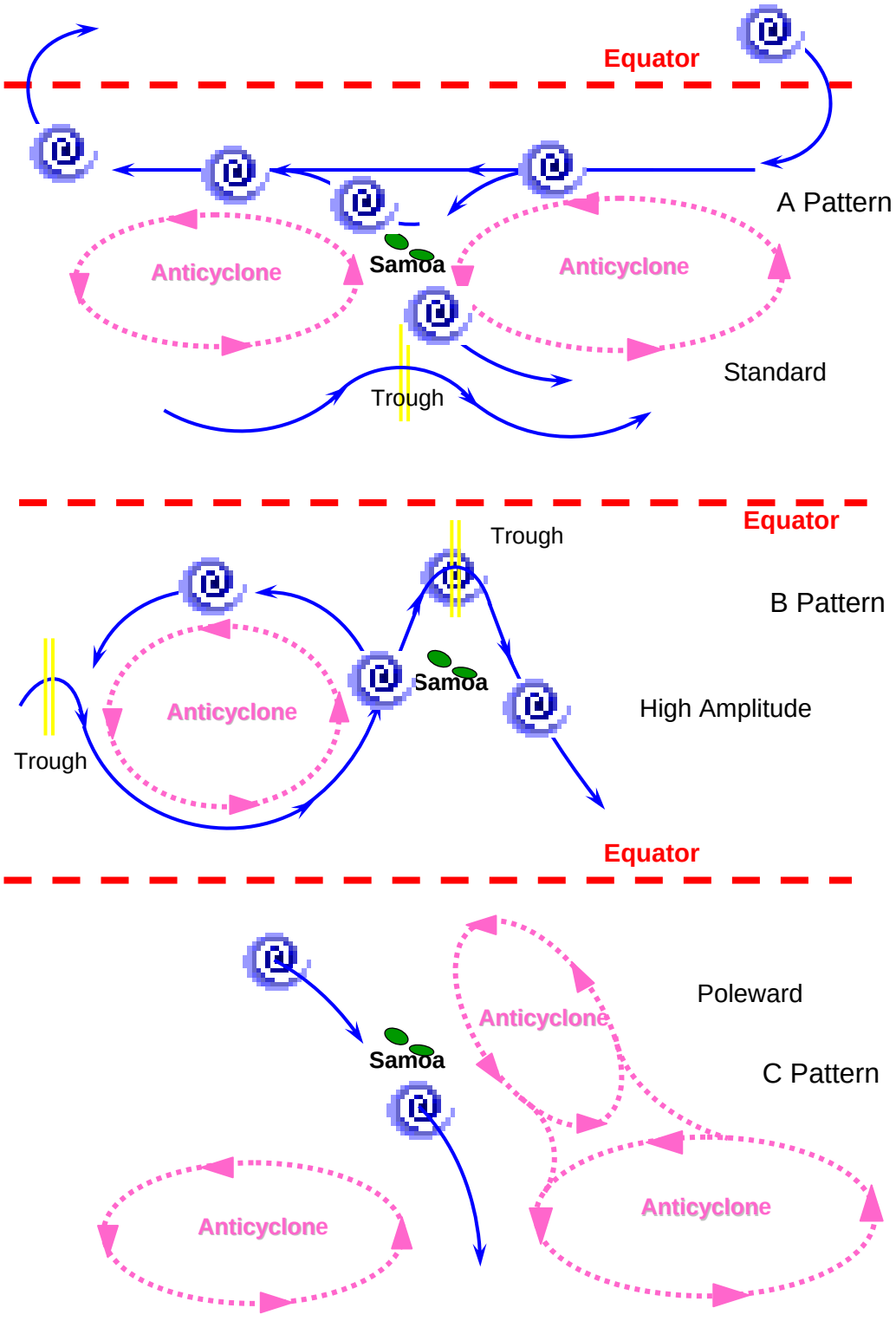
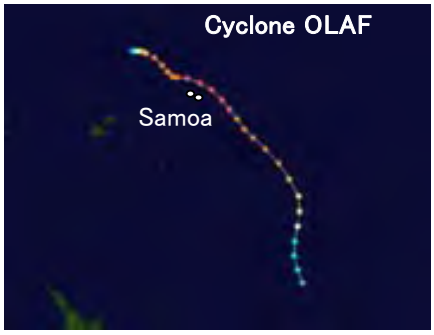
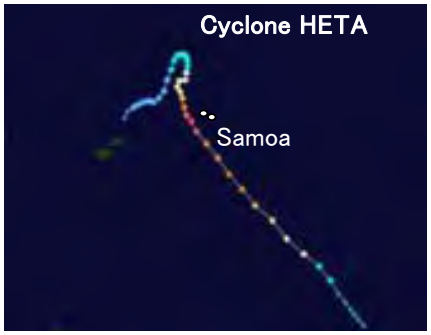


Figure 1: Movement of Tropical Cyclone in the Southern Hemisphere

When a tropical cyclone passes through the southern side of Samoa, in this case it creates enormous damage to Samoa as wind speed of the tropical cyclone depends on the movement direction whether Cyclone passing through the northern side or the southern side of Samoa.





A very strong tropical cyclone OLAF passed through the northern side of Samoa on 15 to 17 February 2005 but did not seriously affect Samoa. However, HETA passed through the southern side of Samoa on January 03-05, 2004 and created enormous damage to Samoa. It is to be noted that OLAF was even closer to Samoa. The estimated damage created by HETA is approximately 1,100 times larger than OLAF as indicated in the table attached on Page 1-2. Therefore, in Samoa, the information on movement of tropical cyclone is very much needed for prevention of the tropical cyclone disasters.

Table 4: Differences between OLAF and HETA

Cyclone Name	Pressure in Apia	Central Pressure	Passing Side	Date
OLAF	997.4 hPa	915hPa	Northern Side	Feb. 2005
HETA	991.5 hPa	945hPa(Niue)	Southern Side	Jan. 2004

As the wind velocity and the speed of tropical cyclone is put together in the left side of the moving direction (passing through the southern side of Samoa), the wind in Samoa is stronger than right side. On the other hand, as the speed of tropical cyclone is subtracted from the wind velocity of tropical cyclone in the right side of the moving direction (passing through the northern side of Samoa), the wind in Samoa is weaker than left side.

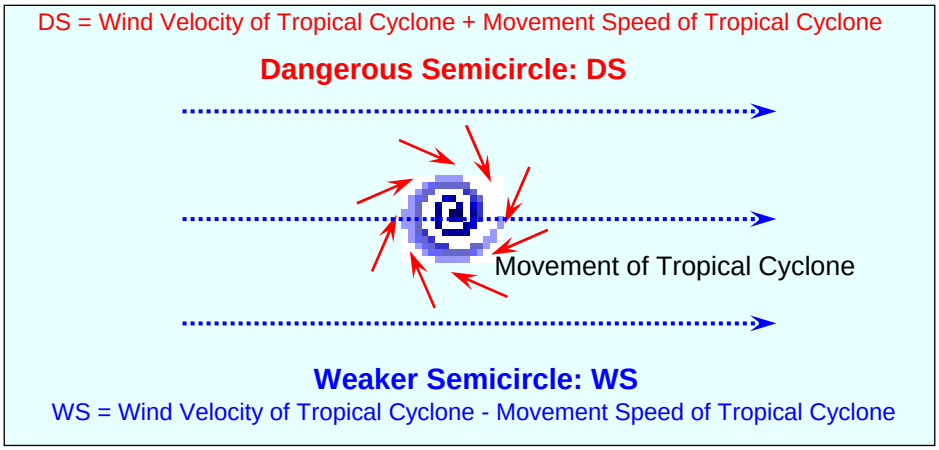


Figure 2: Cyclone Track and Dangerous Zone

<Improvement of Aviation Meteorological Services>

Take-off and landing for 11 minutes are the most critical times during a flight. For preparation of take-off and landing, weather condition at the airport is of prime concern to an aircraft pilot. Should a pilot and an airport controller know in advance the observed data of visibility and cloud height at the airport, which are the most significant observation elements for safe take-off and landing operation, it can directly contribute to safety operation of an aircraft. The Faleolo International Airport has been designated as Category 1. However, the meteorological observation standard of the international airport for Category 1 required by the International Civil Aviation Organization (ICAO) and the World Meteorological Organization (WMO) could not be satisfied. In order to satisfy the requirements, improvement of the meteorological observation system in the Faleolo International Airport for upgrading safety operation of aircrafts is indispensable. Since visual observation of visibility and cloud height, which is quite difficult to implement during evening hours, are presently conducted by SMD at the Faleolo International Airport, and there are in fact many international evening flights, prompt remedy to improve the existing situation is urgently needed.

<Climate Change>

The Pacific Island Countries including Samoa observed trends and variability in climate derived from long term climate data from the region. This data shows that mean island near-surface air temperature increased by between 0.3-0.8°C during the 20th century, with the largest increase in the zones south west of the South Pacific Convergence Zone (SPCZ). The following table shows findings of Samoa's study of its meteorological data that was collected over 101 years. It is projected that Samoa will continue to experience the increases in temperature as well as drought periods.

Table 5: Projected Climate Change in Samoa

Climate Element	Trend
Maximum Temperature	0.67 °C increase
Minimum Temperature	0.18 °C increase
Mean Temperature	0.59 °C increase
Precipitation	49.28 mm decrease

Prepared by Samoa Meteorology Division

Table 6: Observed data for Samoa comparing changes in return periods for extreme

Daily Rainfall of at least	1960 – 1979	1980 – 2006
200 mm	1 day/11.6 years	1 day/3 years
250 mm	1 day/60 years	1 day/5.5 years
300 mm	1 day/318 years	1 day/10 years
350 mm	1 day/1,700 years	1 day/21 years

Source: Samoa Meteorology Division

Due to acceleration of global warming, it is expected that the number of tropical cyclones will be decreased. However, damage and devastation to be created by a tropical cyclone will be more serious

since wind speed and rainfall will be increased. In sum, once a tropical cyclone attacks Samoa, damages caused by wind or flood will be more serious or might be increased more than ever Samoa has experienced.

Table 7: Community Vulnerabilities and its Associated Causes in Samoa

Major Vulnerabilities of Communities	Causes of Vulnerabilities					
	CVY: Climate variations	SLR: Sea level rise	DRT: Drought	FLD: Flooding	SSC: Storm surges and cyclones	TCS: Tropical cyclones
Loss of land due to erosion from the sea		○			○	○
Flooding, inundation of land and sedimentation		○		○	○	○
Lack of water supply (quantity) and poor water quality		○	○	○	○	○
Increased health hazards	○		○	○		
Destruction of crops	○		○	○	○	○
Loss of biodiversity, and loss of heritage and land values	○	○	○	○	○	○
Damage to community assets		○		○	○	○

Prepared by the Ministry of Natural Resources, Environment & Meteorology
(National Adaptation Programme of Action, Samoa)

< Monitoring of El Niño Event >

Westerly wind burst (WWB) events over the Western and Central Pacific (from 131.5°E and 150°W longitude) is considered to have a significant impact on El Niño South Oscillation Index (ENSO). This hypothesis is based on equatorial winds between 5.0°N and 5.0°S latitude and the changing of wind directions at this region may have an impact in the shifting of wind direction south of 5.0S of the Central Pacific region. The location of Samoa between Darwin Australia and Tahiti makes it the pivot point for the El Niño and La Niña seesaw. Samoa's short to long term weather and climate predictions is complex in many situations due to the unbalance of the ENSO phenomena. The climate season precipitation forecast has very low accuracy as it only depends on the Seas Surface Temperature index and the Southern Oscillation Index. It is assuming that improving weather observation including wind observations from low to upper level would improve climate season forecast.

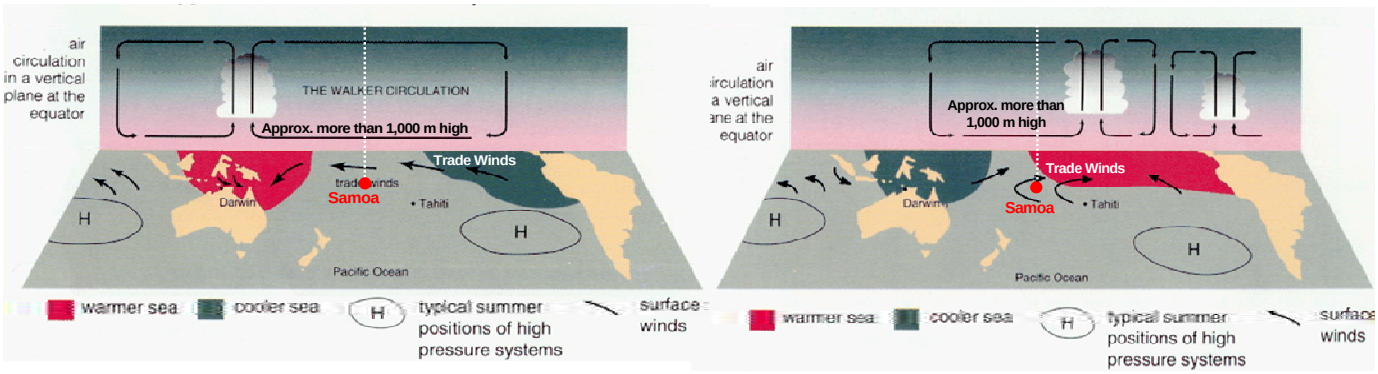
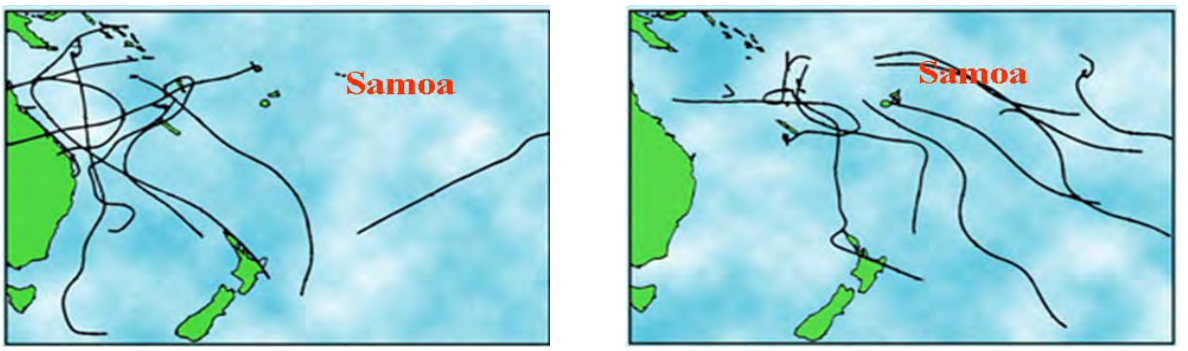


Figure 3: Typical Walker Circulation pattern during Normal or La Niña and Walker Circulation during an El Niño

Source: Bureau of Meteorology, Australia

The ENSO conditions have impacts on area of tropical cyclone genesis as shown by the following images. During La Niña, Samoa will be low risk of tropical cyclones and higher risks during El Niño period depending on the strength of El Niño phenomena. Samoa have experienced the worsening tropical cyclones in the last 20 years during neutral and weak ENSO conditions like HETA (2004), Val (1991) and OFA in 1990. Samoa has worst forest fires and agriculture greatly affected by the drought as water shortage accumulated.



1975/76 season, cold phase of ENSO (La Niña) 1976/77 season, warm phase of ENSO (El Niño)

Figure 4: Tracks of Tropical Cyclones in the South Pacific in 2 Contrasting Years

<Brief Summary on the Request for the Programme by Samoa >

In response to the request from the Government of Samoa in 2008, the Government of Japan decided to conduct a Preparatory Survey for the Project for Improving the Weather Forecasting System and Meteorological Warning Facilities (Programme). The Japan International Cooperation Agency (JICA) sent the Preparatory Survey Team to Samoa on March 30-April 27, 2009. During the team's stay in Samoa, the following items were requested by the Government of Samoa.

Table 8: Items Requested by the Government of Samoa in Preparatory Survey

No.	Component	Places	Quantity
1	Airport Weather Observation System (AWOS) (including the Display systems)	Faleolo International Airport	2
2	Automatic Weather System (AWS)	Afulilo	1
		Samatau / Lefaga	1
		Togitogiga	1
		Manono Tai	1
		Avao	1
		Maota International Airport	1
		Tufutafoe	1
3	Sea Level Monitoring System	Aleipata wharf	1
		Asau	1
4	Meteorological Data Communication System	Not yet fixed	Not yet fixed
5	Meteorological Data Management System	The SMD Head Office	1
6	GTS Message Switch System		1
7	Meteorological Satellite Data Receiving System		1
8	Forecast Support System		1
9	Early Warning System		1
10	Power Back-up System		1
11	Wind Profiler System		1

No. 11, Wind Profiler System indicated in the above table was newly requested to the Preparatory Survey Team by the Samoa Meteorology Department (SMD) and the written request on this matter was submitted to the JICA Samoa Office by the Ministry of Natural Resources and Environment after the Team's arrival in Japan.

Since necessity and appropriateness of the requested items indicated in the table above were confirmed, the Government of Japan decided to conduct the Preparatory Survey 2 on the Programme. Consequently, JICA sent the Preparatory Survey 2 Team to Samoa. The Team had a series of discussions with the officials concerned of the Government of Samoa, conducted surveys and collected necessary and pertinent information and data for the Programme. In the course of discussions and field survey, both parties confirmed the main requested items described in the table attached hereunder. The Team will proceed to further works and prepare the Preparatory Survey Report for outline design.

Table 9: Items Requested by the Government of Samoa in Preparatory Survey 2

No.	Component	Places	Quantity
1	Airport Weather Observation System (AWOS) (including the Display systems)	Faleolo International Airport	2
2	Automatic Weather System (AWS)	Le Mafa	1
		Saluafata	1
		Togitogiga	1
		Manono Tai	1
		Le Piu Tai	1
		Maota International Airport	1
		Mt. Talu	1
	Calibration Instrument ・ Mercury Barometer ・ Maximum Air Temperature Thermometer ・ Minimum Air Temperature Thermometer ・ Wet & Dry Bulbs Air Temperature Thermometer ・ Vernier Scale Measure ・ Tape Measure ・ Global Positioning System (GPS) ・ Spare Parts	The SMD Hed Office	1
3	Sea Level Monitoring System	Aleipata wharf	1
		Asau	1
4	Meteorological Data Communication System with Data Repeater System	Reference: Meteorological Observation Data Network	
5	Meteorological Data Management System	The SMD Hed Office	1
6	GTS Message Switch System		1
7	Meteorological Satellite Data Receiving System		1
8	Forecast Support System		1
9	Early Warning System		1
10	Power Back-up System		1
11	Wind Profiler System		1

Calibration Instrument for Meteorological Observation Equipment

No. 2, Calibration Instrument in AWS indicated in the above table was additionally requested by the SMD for maintenance, observation accuracy confirmation and adjustment of measuring precision of the Airport Weather Observation System (AWOS) and the Automatic Weather Station (AWS). Since the Calibration Instrument is essential for appropriate maintenance after completion of the Programme, it has been decided to include the Calibration Instrument in the Programme. As part of Calibration Instruments, spare units/parts and troubleshooting/testing equipment for the Airport Weather Observation System (AWOS) and the Automatic Weather Station (AWS) are required to ensure proper operation and minimize down time beyond warranty period.

Further Study on the Requested Items in Japan

As a consequence of the further study on the requested items in Japan, it has been decided that the following systems indicated in the table attached hereunder are object items of the Preparatory Survey for the Programme, and the Sea Level Monitoring System (2 sites) is not included in the Preparatory Survey due to the following reasons.

a. To unify all the observation elements of the meteorological observation network and simplify the network composition

b. To accelerate easier maintenance for the SMD and adjust the size of the meteorological observation network being suitable for dimension of the SMD structure due to reduction of the number of the observation sites

c. To reduce the maintenance cost of the SMD and the Programme cost

However, since sea level monitoring is very much required for disaster prevention, Automatic Weather Station (AWS) at Togitogiga Site will be furnished with a sea level monitoring sensor for preserving the requirement of the SMD.

Table 10: Object Items of the Preparatory Survey

No.	Component	Places	Quantity
Procurement and Installation of Equipment			
1	Airport Weather Observation System (AWOS)	Faleolo International Airport	2
	AWOS Display System		3
2	Automatic Weather System (AWS)	Le Mafa	1
		Saluafata	1
		Togitogiga	1
		Manono Tai	1
		Le Piu Tai	1
		Maota International Airport	1
		Mt. Talu	1
	Calibration Instrument ・ Mercury Barometer ・ Maximum Air Temperature Thermometer ・ Minimum Air Temperature Thermometer ・ Wet & Dry Bulbs Air Temperature Thermometer ・ Vernier Scale Measure ・ Tape Measure ・ Global Positioning System (GPS)	The SMD Head Office	1
3	Meteorological Data Communication System (including Data Repeater System)	Reference (Figure 11): Meteorological Data Communication Network	
4	Meteorological Data Management System	The SMD Head Office	1
5	GTS Message Switch System		1
6	Meteorological Satellite Data Receiving System		1
7	Forecast Support System		1
8	Early Warning System		1
9	Power Back-up System		1
10	Wind Profiler System		1
Construction of Ancillary Facilities			
11	Power Back-up Shed	The SMD Head Office	1
	Equipment Shed		1
	Concrete Shelter	Reference: Meteorological Observation Data Network	17
	Foundation of Wind Profiler System	The SMD Head Office	1

< Negative Impact to the Development of Samoa Economy>

The economy of Samoa has traditionally been dependent on development aid, family remittances from overseas, agriculture, and fishing. The country is vulnerable to devastating storms. Agriculture employs two-thirds of the labor force, and furnishes 90% of exports, featuring coconut cream, coconut oil, and copra. The manufacturing sector mainly processes agricultural products. The decline of fish stocks in the area is a continuing problem. Tourism is an expanding sector, accounting for 25% of the Gross Domestic Product (GDP); about 88,000 tourists visited the islands in 2001. They have direct bearing on the rural economy which has a close linkage with agriculture which is accounting for 14% and service sector including tourism which is counted on further development is accounting for 63% in the Gross Domestic Product. The growth rate (2002 constant) of the GDP and damages caused by the meteorological disasters since 1999 are indicated in the following graph in which decrease of the growth rate in the following year after serious damage received is found.

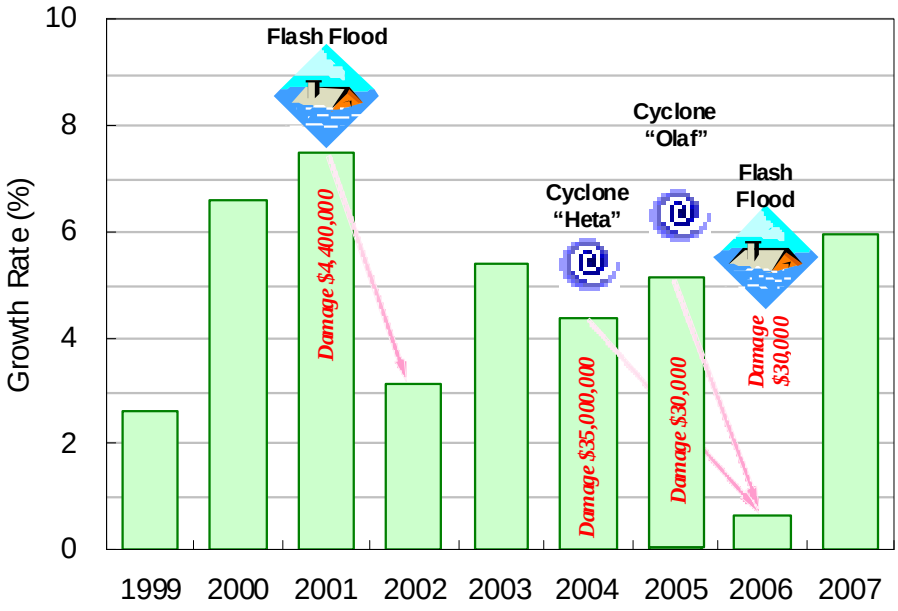


Figure 5: GDP Growth Rate (2002 constant) and Damage generated by Meteorological Disasters

<Natural Conditions of Samoa>

Samoa is located at 13.5-14.5°S latitude and has tropical maritime climate. Daily average temperature is 26-27°C which shows no major seasonal difference. Yearly precipitation is 2,500-3,000mm. The monthly precipitation is 100～150mm from May to September and the term is called Dry Season because of less humidity and slightly lower temperatures. On the other hand, the monthly precipitation is 300-400mm from November to March, which is called Rainy Season because of more humidity and slightly higher temperatures. Monthly precipitation in April and October are approx. 200mm, which are the border months between rainy season and dry season.

Some tropical cyclones occasionally attack Samoa in Rainy Season and they cause severe damages on Samoa. Tropical Convergence Zone like Baiu-front exists through the whole year in the South Pacific Area and occasionally causes flood in Samoa accompanied with active thunderstorm.

Samoa has no tropical cyclone in dry season, and is less humid and comparatively cool, but has sudden thunderstorm in many cases according to the activity of the South Pacific Convergence Zone.

- Rainfall and Temperature

Annual mean rainfall between 2005 and 2008 in Apia in the Upolu Island is 3,273.7 mm, in Maota in the Savall Island is 3,558.7 mm and some mountainous areas are more than 5,000 mm. Actually rainfall amount depends upon the sea level height.

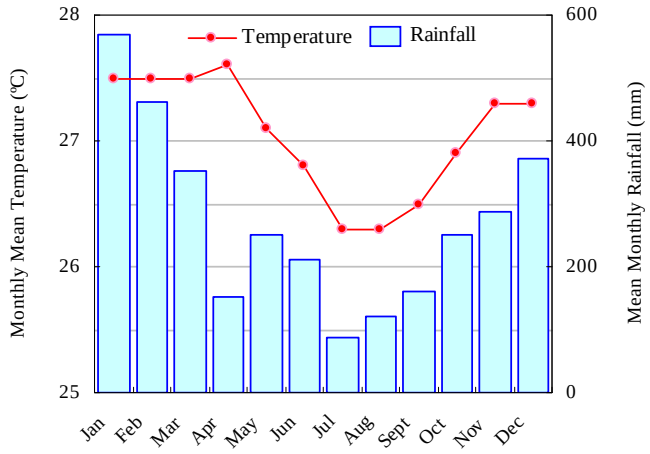


Figure 6: Monthly Mean Temperature and Mean Monthly Rainfall at Apia Station (from Jan. 2005 to Dec. 2008)

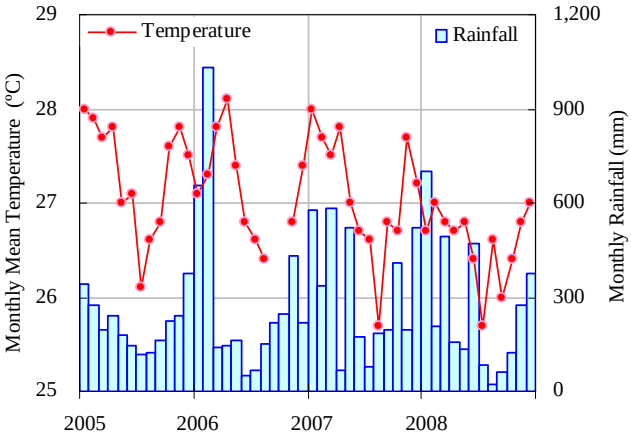


Figure 7: Monthly Mean Temperature and Monthly Rainfall at Apia Station (from Jan. 2005 to Dec. 2008)

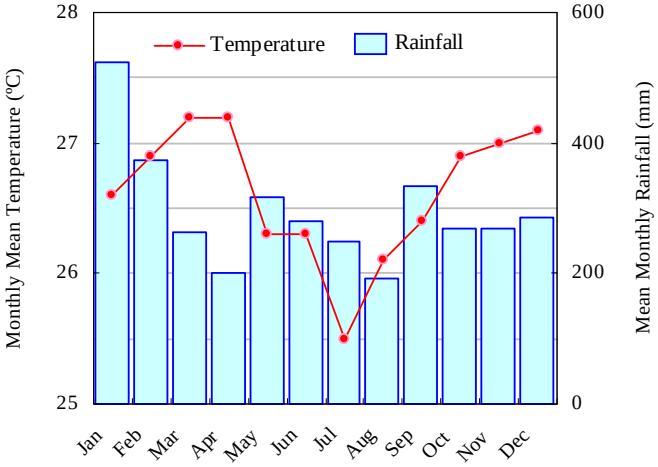


Figure 8: Monthly Mean Temperature and Mean Monthly Rainfall at Maota Station (from Jan. 2005 to Dec. 2008)

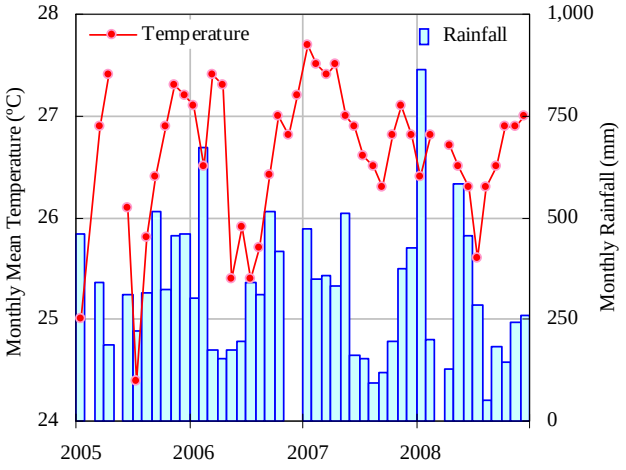


Figure 9: Monthly Mean Temperature and Monthly Rainfall at Maota Station (from Jan. 2005 to Dec. 2008)

- Tropical Cyclone

Tropical cyclone is among the most dangerous of natural disasters and most of them are generated between January and March. Statistically, a tropical cyclone is generated and developed in an ocean where the sea surface temperature is more than 27 dergee celsius. The sea surface temperature of the adjacent ocean area of Samoa is more than 28 degree celsius throughout the year and sometimes more than 30 degree celsius in the summer season in the South Pacific. Therefore, normally tropical cyclone approching Samoa is under development or in the highest prosperity, and the average wind speed is more than 136 knot/m (approx. 70m/s) which is categorized in the level 5 tropical cyclone. In fact, such very strong tropical cyclone attacking Samoa is not uncommon. Tropical cyclones generated in the South Pacific Ocean account for 9% of all the tropical cyclones generated in the world.

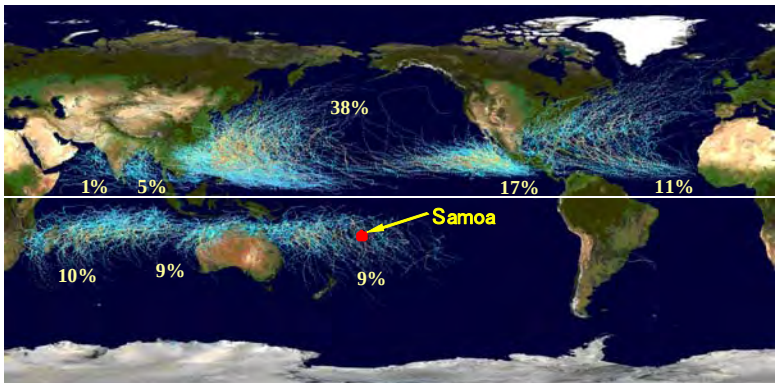


Figure 10: Tropical Cyclone Tracks occurred in the World

<Consideration for Environmental Conservation>

An Environmental Impact Assessment (EIA) is required by the Samoan Planning and Urban Management Act 2004 in order to obtain development consent for the Programme. The SMD obtained an elementary consent from Samoan Planning and Urban Management Agency.

For the Official Assessment, the following documents are required;

1) Development Consent Application Form
2) Plans and drawings (drawn to scale) showing, where relevant
   - Elevation plans
   - Floor plans
   - Photomontage
   - Design of earthworks
3) Site Plan (drawn to scale)
4) Certified Survey Plan
5) Written consent from property owners
6) Lease agreement
7) Deed of Conveyance

Chapter 2
Contents of the Programme

Chapter 2 Contents of the Programme

2-1 Basic Concept of the Programme

Samoa is located in the northern side of the subtropical ridge and the South Pacific Convergence Zone (SPCZ) mostly locates just south or over Samoa during tropical cyclone seasons. It is south of the SPCZ during the winter period. Samoa's geographical location puts it between the western and eastern subtropical anticyclones. This meteorological mechanism influences or dictates heavy rain occurrence, direction of movement of a tropical cyclone, etc. It is being said and observed that due to present acceleration of global warming, there is big concern that tropical cyclones will be more intense and drought will be experienced due to long spell of dry weather. Islands in the South Pacific Ocean like Samoa are located in a very fragile environment vis-à-vis meteorological disasters aggravated by Climate Change due to its terrain condition which is generally susceptible to any damage generated by meteorological disasters, distance from the continents, underdeveloped meteorological observation and forecasting technique and effective disaster prevention countermeasures. Therefore, vital improvement of meteorological services is one of the immediate priorities in Samoa. Samoa has seriously experienced through the years huge economic losses coupled with human anguish and sufferings generated by destructive meteorological disasters. It is unfortunately expected that these meteorological disasters will even be intensified due to Climate Change and its adverse effects will be immeasurable.

Since the location of Samoa between Darwin Australia and Tahiti makes it the pivot point for the El Niño and La Niña seesaw, upper air observation by wind profiler systems and surface observation by automatic weather observation systems are globally essential, which in turn will also prospectively contribute to upgrading weather forecasting accuracy and predicting climate change.

Our blue planet consists of 30% land and 70% ocean. Since continuous meteorological observation in the ocean is extensively difficult, the observed data in the ocean is inadequate for perceiving trend of the Climate Change. The observed data at an island located in the Ocean like Samoa as the same as from an observation sea buoy is quite significant for the world.

Meanwhile, in order to more accurately understand Climate Change mainly caused by global warming, transmission of the observed data from Samoa through the Global Telecommunication System to all over the world is strategically important and necessary. Effective and proper utilization of the observed data from Samoa by many meteorological organizations and research institutes all over the world will positively result towards obtaining accurate prediction of Climate Change caused by global warming. It is therefore extremely important to achieve this as our obligation and legacy for the next generation.

In order to enable the SMD to contribute to the accumulation of observed data required for obtaining accurate prediction of Climate Change in the South Pacific, definite implementation of sea level, surface weather and upper air continuous observations are very much needed. Moreover, in order to achieve improvement of vulnerability to meteorological disasters or climate change adaptation, all the required warnings of cyclone, storm surge, high waves, heavy rain, strong & gusty wind, floods, droughts and volcano ash fall must be appropriately and timely sent to the Disaster Management Office (DMO), the Disaster Advisory Committee (DAC) and mass media by the SMD in accordance with the Disaster & Emergency Management Act. 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 Samoa, especially in relation to the quick and timely evacuation of residents and disaster prevention countermeasures, depend almost entirely on the information from the SMD. Therefore, sluggish upgrading of the SMD's meteorological disaster monitoring capability creates significant obstacle for the effective disaster management system of Samoa. Under these circumstances, improvement and strengthening of the capability of the SMD by establishing the meteorological observation & forecasting and disaster early warning dissemination systems has become an urgent task.

Table 11: Required Data for Preparation of Warnings

Warning	Surface Weather Observation Data	Airport Weather Observation Data	Sea Level Monitoring Data	Upper Air Observation Data
Tropical Cyclone	○	○	○	○
Storm Surge	○	-	○	○
High Waves	○	-	○	○
Heavy Rain	○	○	-	○
Strong & Gusty Wind	○	○	-	○
Flooding	○	-	○	○
Drought	○	-	-	○
Volcano Ash Fall	○	○	-	○

Therefore, the key objective of the Programme is the accumulation of the observed data required for obtaining accurate prediction of the Climate Change in the South Pacific and improvement of vulnerability to meteorological disasters by establishment of the meteorological observation & forecasting and disaster early warning dissemination systems.

2-2 Outline Design of the Japanese Assistance

2-2-1 Design Policy

(1) Outline Design Policy of the Programme

a) To design a reliable meteorological observation network to implement the SMD's services over a long period of time.
b) To enable the SMD to provide higher quality weather information, forecasts, advisories and warnings necessary for the mitigation and prevention of meteorological disasters.
c) To determine and set up the size and components of the Programme to match with the technical, operational and maintenance capabilities of the SMD.
d) To design for reducing CO_2 emission as much as possible due to utilization of the natural power such as solar, wind, etc. for generating electric power for each system to be supplied.

(2) Design Policy

[1] Design Policy of the Equipment

a) To ensure the equipment is compatible with and meets the technical requirements of the World Meteorological Organization (WMO) since Samoa is a member of WMO.
b) To ensure the equipment is suitable for the routine observation and forecasting work of the SMD.
c) To enable quantitatively and periodically monitoring of the observed data utilization for the Climate Change.
d) To design the system so that it is within the SMD's capability to operate, maintain and repair.
e) To select equipment for which spare parts and consumables can be easily procured and replaced.
f) To select reliable and durable equipment suitable for the local environment.
g) To minimize the recurrent costs to the SMD for the operation, maintenance and repair of the equipment.
h) To minimize any effect from power stoppage as much as possible.
i) To design the equipment to operate using the commercial power (3-phase, 4-wire, 440V, 50Hz and single phase, 3-wire, 230V, 50Hz) fluctuated ±20%
j) To keep not more than 10Ω grounding resistance for protecting the equipment from lightning damage

[2] Design Policy of Ancillary Facilities for the Equipment

The plan is to construct ancillary facilities that will ensure appropriate and effective operations and will accommodate the required systems, equipment and personnel. It is a basic policy that the designed ancillary facilities satisfy the following requirements.

a. To have the necessary power supply back-up equipment (diesel generator, uninterruptible power supply system, auto voltage regulator, etc.) for performing round-the-clock meteorological services 24 hours a day, 365 days a year.
b. 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 meteorological disaster.
c. To make use of local building materials for easy maintenance of the ancillary facilities by the SMD.
d. To design the equipment to minimize power stoppage and 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 Samoa has a high temperature and high humid climate.

2) Rainfall

To design the equipment ensuring smooth transmission and receiving of the observed data even during heavy rain caused by tropical cyclone, etc.

3) Lightning

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

4) Tropical Cyclone (Stormy Wind)

In accordance with the "National Building Code of Samoa, a basic wind speed for ultimate strengths limit state of 70 m/s to all areas. The equivalent basic wind speed for permissible stress methods of design is 57 m/s. When the simplified procedure of AS 1170 part 2 is followed, the value of the factor B, to be applied is 2.3.

5) Earthquake

According to the "National Building Code of Samoa", the maps of New Zealand shows in the Standard are to be disregarded. All of Samoa is considered to be in Zone 7 and the corresponding zone factor of 1.05 for use with NZS 4203 which together with a structural performance factor of 0.67 provides a ZS_P factor of 0.7.

(4) Design Policy for Construction Work for Ancillary Facilities

1) Use of Locally Procurable Materials

Gravel, sand, cement and blocks are produced in Samoa while other construction materials are imported. Most of the construction materials for ancillary facilities for the Equipment can be procured in the local market. For the Programme, durable maintenance materials not containing asbestos will be selected from the locally available materials.

2) 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 Samoa. In order to utilize local laborers as much as possible, local construction method such as the concrete block structure 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 Samoa, the technical skills and competence of the major local construction companies are adequate, so they will effectively be used in construction of the ancillary facilities.

2) Equipment Installation Work

Under supervision of a consultant's or manufacturer's engineer, a local electrical work contractor will effectively be used in the equipment installation work.

(6) Design Considerations to Simplify Operation and Maintenance for the SMD

1) Easy to operate the equipment

The equipment to be supplied under the Programme is to be used to support the SMD'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 the SMD, 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 Programme 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 the SMD to meet the increased ongoing costs of the system, such as operation and maintenance costs, after the completion of the Programme, the following measures have been included in planning for the equipment.

Table 12: Concrete Methods of Minimizing Operation & Maintenance Costs

Key Points	Concrete Method
Fiber Cable	To use fiber cables as much as possible for protecting the systems from any troubles caused by lightening surge.
Solar Panel, wind power generator and Battery	To use higher efficient solar panels and wind power generators to supply electricity to the systems as much as technically possible. To use long life batteries guaranteed by the manufacturer and accommodate them into a battery case with higher heat insulation and install the battery case for accelerating natural heat releasing since the battery life time is shortening if its temperature is higher than 25ºC.
Remote Diagnosis, Adjustment and Operation	To design enabling remote diagnosis, adjustment and operation of the systems through the internet.
PC Monitor	To use liquid crystal display monitors (life time: approx. 30,000 hours) for long time operation, electric power saving, easy replacement
Data Logger for Weather Observation Systems	To use a data memory (internal RAM) instead of a hard disk which is an easily breakable driving device.

(7) Design Policy for Equipment Grade

To allow the supply of uninterrupted forecasts and warnings to the public, even during tropical cyclone crossing the country, the equipment 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 Procurement/ Construction Method and Schedule

The equipment to be installed in the ancillary facilities such as specialized power backup system and meteorological equipment is not available in the local market. The equipment for the Programme must be durable, reliable, of a high technical level, and cost effective. Locally procurable materials and the local construction methods must be used in the ancillary facility design.

2-2-2 Basic Plan

The finalized components in the Preparatory Survey for the Programme are as follows.

Table 13: Finalized Components of the Programme

Name of the Equipment	①	②	③	④	⑤	⑥	⑦	⑧	⑨	⑩	⑪	⑫	⑬	⑭	⑮	Total Quantity
Airport Weather Observation System (AWOS)							2									2
AWOS Display System							3									3
Automatic Weather System (AWS)				1	1	1		1	1				1		1	7
Calibration Instrument	1															1
Meteorological Data Communication System	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	15
Meteorological Data Management System	1															1
GTS Message Switch System	1															1
Meteorological Satellite Data Receiving System	1															1
Forecast Support System	1															1
Early Warning System	1															1
Power Back-up System	1															1
Wind Profiler System	1															1
Name of Ancillary Facility	①	②	③	④	⑤	⑥	⑦	⑧	⑨	⑩	⑪	⑫	⑬	⑭	⑮	Total Quantity
Power Back-up Shed	1															1
Equipment Shed	1															1
Concrete Shelter	1	1	1	1	1	1	3	1	1	1	1	1	1	1	1	17
Foundation of Wind Profiler System	1															1

Table 14: Site No. of the Programme

Name of Site	Site No.	Name of Site	Site No.
The SMD Head Office	①	Maota International Airport	⑨
Mt. Vaea	②	Mt. Valusia	⑩
Mt. Fiamoe	③	Tuasivi	⑪
Togitogiga	④	Mt. Tagotala	⑫
Le Mafa	⑤	Le Piu Tai	⑬
Saluafata	⑥	Vaisala	⑭
Faleolo International Airport	⑦	Mt. Talu	⑮
Manono	⑧		

According to the design policies aforesaid, the outline design plan of the Equipment and the Ancillary Facilities are clarified below.

(1) Basic Plan of the Equipment

1) Establishment of Meteorological Observation Network

a. Airport Weather Observation System (AWOS) and Automatic Weather Observation System (AWS)

As indicated in the following table, transmission method and operating electric power for the Airport Weather Observation Systems (AWOS) and the Automatic Weather Observation System (AWS) are as follows.

Table 15: Transmission Method and Operating Electric Power for AWOS and AWS

Name of System	Transmission Method	Operating Electric Power
Airport Weather Observation System Automatic Weather Observation System	Orthogonal Frequency Division Multiplexing (OFDM) Radio Communication	Solar Energy and Wind Generated Power

As indicated in the following table, the required observation elements of the Airport Weather Observation Systems (AWOS) and the Automatic Weather Observation System (AWS) are as follows.

Table 16: Required Observation Elements

Name of Island	Upolu Island					Manono Island	Savaii Island		
Name of Site	Faleolo International Airport		Le Mafa	Saluafata	Togitogiga	Manono	Maota International Airport	Le Piu Tai	Mt. Talu
	West	East							
Wind Speed/Direction	○	○	○	○	○	○	○	○	○
Temperature	○	○	○	○	○	○	○	○	○
Humidity	○	○	○	○	○	○	○	○	○
Pressure	○	○	○	○	○	○	○	○	○
Precipitation	○	○	○	○	○	○	○	○	○
Sunshine Duration	○	○	○	○	○	○	○	○	○
Solar Radiation	○	○	○	○	○	○	○	○	○
Soil Temperature (30cm, 100cm)	-	-	○	-	○	-	-	○	○
Visibility	○	○	-	-	-	-	-	-	-
Cloud Height	○	-	-	-	-	-	-	-	-
Seawater Level & Temperature	-	-	-	-	○	-	-	-	-

The required calibration instruments for operation and maintenance of Airport Weather Observation Systems (AWOS) and the Automatic Weather Observation System (AWS) are as follows.

- Mercury Barometer
- Maximum Air Temperature Thermometer
- Minimum Air Temperature Thermometer
- Wet & Dry Bulbs Air Temperature Thermometer
- Vernier Scale Measure
- Tape Measure
- Global Positioning System (GPS)

b. Meteorological Data Management System

All the observed data gathered and accumulated through the Meteorological Data Communication System at the SMD Head Office is designed to be collected by the Meteorological Data Management System and transmitted to each PC server where it is further processed and transformed into the WMO Climate Form 301 and saved thereat.

c. Meteorological Data Communication System

The results of the occupied channel scanning test conducted at each site are indicated in the following table.

Table 17: Results of the Occupied Channel Scanning Test

Programme Site Name	Programme Site Cord	Island	Occupied Channel in 2.4GHz Band													Unusable site of 5GHz Band due to long transmission
			1	2	3	4	5	6	7	8	9	10	11	12	13	
SMD Head Office	U-3	Upolu	■	■	■	■	■	■	■	■	■	■	■	■	■	
Mt. Vaea	UMR-2		■	■	■	■	■	■	■	■	■	■	■	■	■	
Mt. Fiamoe	UR-2		■	■	■	■	■	■	■	■	■	■	■			
Togitogiga	UTA-1															
Le Mafa	ULA-1															
Saluafata	UAR-3		■	■	■	■	■	■	■	■	■	■	■	■		
Faleolo International Airport	UAR-4, UAO-1+C, UAO-1, UFC-1, UFB-1, UFM-3		■	■								■				
Manono	MA-2	Manono	■			■	■	■	■	■	■					
Maota International Airport	SMA-1	Savaii							■						■	
Mt. Valusia	SVR-2															
Tuasivi	STR-4															
Mt. Tagotala	STR-2															
Le Piu Tai	SLR-2															
Vaisala	SSR-2															
Mt. Talu	STA-1															

As indicated in the above table, approximately 31% of the 2.4GHz Band channels have already been occupied. It is to be noted that there are many channels for the major trunk lines of the planned Meteorological Data Communication System. Therefore, the 2.4GHz Band is unusable or at least inadequate in this case. In addition, considering attenuation of transmission/receiving signal due to heavy rain, 5GHz Band is also unsuitable due to long distance communication required at 7 of 15 sites of the system. As a consequence of the technical study indicated above, it has been decided to use 4.9GHz Band, which is not yet used in Samoa, thereby avoiding frequency interference with any other communication equipment in the future. Furthermore, 4.9GHz Band Equivalent Isotropically Radiated Power (EIRP = Transmission Power + Antenna Gain) is able to be bigger than 5GHz Band will in turn

reduce signal attenuation. Thereby 4.9GHz Band is suitable for long distance communication. At present, the SMD has duly received the consent of the Office of the Regulator towards utilization of the 4.9GHz Band for the Programme.

All the equipment composing the Meteorological Data Communication System is designed to be fully operational utilizing the solar energy and wind generated power. A high-speed communication link (Orthogonal Frequency Division Multiplexing: OFDM) is required to transmit the continuous observed data from the Airport Weather Observation Systems (AWOS) and the Automatic Weather Observation System (AWS).

Table 18: Features of OFDM Transmission System

Items	OFDM Radio Communication Link
Frequency	4.9GHz Band (4,915-4,980MHz)
Data Transmission Rate	56Mbps
Transmission Power	+15dBm (20MHz System: 2mW/MHz, 10MHz System: 4mW/MHz)
Power Consumption	Not more than 5W
Communication Fee	Free
Reliability and Durability	High
Maintainability	Easy
Maintenance Cost	Low

The OFDM transmission system of the 4.9GHz Band has the following advantages.

- Very high data communication speed.
- The specifications and modulation standard of OFDM radio communication equipment is based on the International Standard IEEE802.11j (IEEE: the Institute of Electrical and Electronic Engineers under the International Telecommunication Union, ITU).
- The system has a 10Base-T/100Base-T Ethernet Interface (IEEE802.3/IEEE802.3u) and runs the TCP/IP protocol for easy networking and expandability. It also allows the unification of all digital equipment signal interfaces.
- The system has a two-way communication function for data collection and remote control & monitoring of the system.
- Deploying a microwave system allows the use of, a high gain antenna which is smaller and lighter than an ordinary yagi antenna.
- Attenuation of the radio signal by rain is 0.3dB per 1 km for rainfall rates of more than 100mm/h rain (that is, there is virtually no attenuation by rain).
- The system has security based on the IEEE802.11 standard; the Wi-Fi Protected Access (WPA), Wired Equivalent Privacy Algorithm (WEP), using Media Access Control ID (MAC) address and Set (ESS-ID).

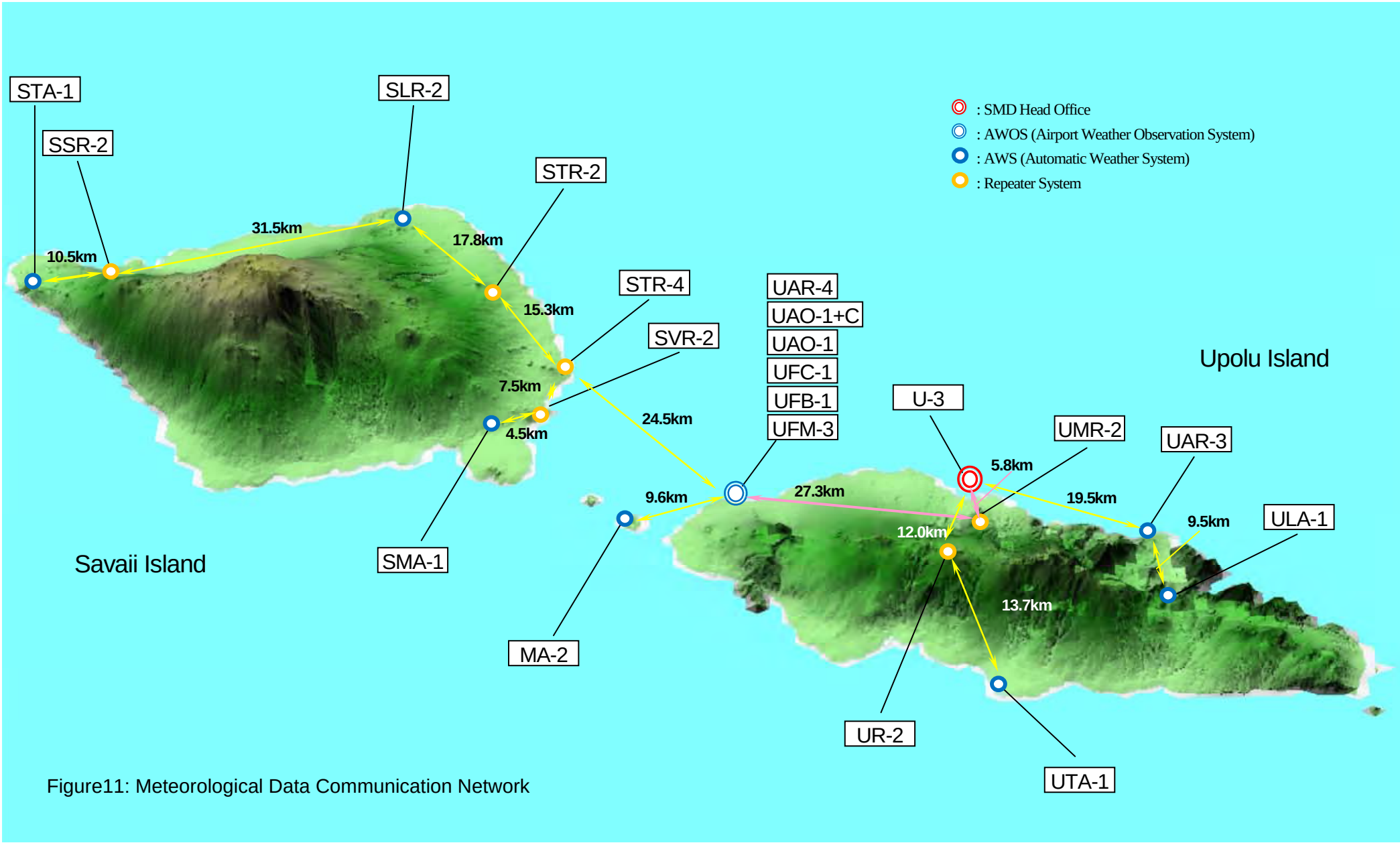


Figure11: Meteorological Data Communication Network

Table 19: Meteorological Data Communication Network Site List

Programme Site Name	Programme Site Cord	Island	Programme Site Location ・Latitude ・Longitude ・Altitude	Land Owner
SMD Head Office	U-3	Upolu	S 13°49'13.6" W 171°46'32.5" 3 m	SMD
Mt. Vaea	UMR-2		S 13°51'51.0" W 171°46'08.2" 412 m	SamoaTel
Mt. Fiamoe	UR-2		S 13°55'50.4" W 171°47'45.0" 967 m	Customary Land
Togitogiga	UTA-1		S 14°01'32.1" W 171°46'24.0" 5m	Customary Land
Le Mafa	ULA-1		S 13°57'41.3" W 171°35'44.5" 290m	Government Land (Ministry of Agriculture and Fishery)
Saluafata	UAR-3		S 13°52'41.6" W 171°36'05.2" 25m	Methodist Church
Faleolo International Airport	UAR-4		S 13º49'54.7" W 172º00'51.1" 12m	Samoa Airport Authority
	UAO-1+C		S 13º49'59.1" W 172º00'45.7" 18m	
	UAO-1		S 13º50'08.7" W 171º58'52.4" 8m	
	UFC-1		S 13º50'16.6" W 171º59'39.4" 21m	
	UFB-1			
	UFM-3			
Manono	MA-2	Manono	S: 13°51'09.6" W: 172°06'21.9" A: 44m	Customary Land
Maota International Airport	SMA-1	Savaii	S 13°44'54.7" W 172°15'07.9" 21m	Ministry of Natural Resources and Environment (Forestry Division)
Mt. Valusia	SVR-2		S 13°43'44.9" W 172°12'51.7" 126m	Customary Land
Tuasivi	STR-4		S 13°40'23.5" W 172°10'20.7" 30m	SamoaTel
Mt. Tagotala	STR-2		S 13°40'23.5" W 172°10'20.7" 375m	Customary Land
Le Piu Tai	SLR-2		S 13°27'40.9" W 172°23'20.0" A 119m	Customary Land
Vaisala	SSR-2		S 13°30'51.9" W 172°39'13.0" 14m	Customary Land (Vaai Papu Vaai Family)
Mt. Talu	STA-1		S 13°32'00.9" W 172°45'49.8" 234m	Customary Land

Table 20: Required Equipment & Ancillary Facility for Establishment of Meteorological Observation Network

Island	Upolu					
Name of Site	SMD Head Office	Mt. Vaea	Mt. Fiamoe	Togitogiga	Le Mafa	Saluafata
Site Cord	U-3	UMR-2	UR-2	UTA-1	ULA-1	UAR-3
Equipment to be supplied	Meteorological Data Management System	Data Repeater System	Data Repeater System	Automatic Weather System (AWS)	Automatic Weather System (AWS)	Automatic Weather System (AWS) and Data Repeater System
Steel Pole	25m×1	-	-	20m×1	20m×1	25m×1
Concrete Shelter	○	○	○	○	○	○
Number of Antenna	3	2	2	1	1	3
Solar Panel and Battery	○	○	○	○	○	○
Wind Power Generator	-	○	○	-	-	-
Existing Facility Usage	-	45m Steel Tower	30m Steel Tower	-	-	-

Island	Upolu	Manono	Savaii	
Name of Site	Faleolo International Airport (6 Sites)	Manono	Maota International Airport	Mt. Valusia
Site Cord	UAR-4, UAO-1+C, UAO-1, UFC-1, UFB-1, UFM-3	MA-2	SMA-1	SVR-2
Equipment to be supplied	Airport Weather Observation System (AWOS), AWOS Display System and Data Repeater System	Automatic Weather System (AWS)	Automatic Weather System (AWS)	Data Repeater System
Steel Pole	25m×2, 10m×2, 2m× 3	25m×1	25m×1	-
Concrete Shelter	○ (3)	○	○	○
Number of Antenna	11	2	1	2
Solar Panel and Battery	○	○	○	○
Wind Power Generator	-	-	-	-
Existing Facility Usage	-	-	-	45m Dooden Tower

Island	Savaii				
Name of Site	Tuasivi	Mt. Tagotala	Le Piu Tai	Vaisala	Mt. Talu
Site Cord	STR-4	STR-2	SLR-2	SSR-2	STA-1
Equipment to be supplied	Data Repeater System	Data Repeater System	Automatic Weather System (AWS) and Data Repeater System	Data Repeater System	Automatic Weather System (AWS)
Steel Pole	-	-	10m×1	-	20m×1
Concrete Shelter	○	○	○	○	○
Number of Antenna	4	2	2	2	1
Solar Panel and Battery	○	○	○	○	○
Wind Power Generator	-	-	-	-	-
Existing Facility Usage	40m Steel Tower	40m Dooden Tower	45m Steel Tower	45m Steel Tower	-

2) GTS Message Switch System

The existing interrupted GTS network of the SMD makes it unable to transmit and receive the observed data. Concrete improvement of this situation is essential for Samoa as a member of WMO. Upon definite recovery of the GTS network, the SMD can have important information received through other than the internet and timely transmit the observed data from Samoa to the world. Since recent weather forecasts in the world is prepared through the global data processing and analysis by the global model of numerical weather prediction (NWP), the observed data transmission from developing countries, most of which have undeveloped meteorological communication network, is very significant key point for further improvement of weather forecasts in the world.

- To connect by Virtual Private Network (VPN) of the internet to be established
- To connect with Melbourne, Australia, one of 3 Meteorological Centers of WMO (Washington, Moscow and Melbourne)
- To compose dual systems against any operation stoppage

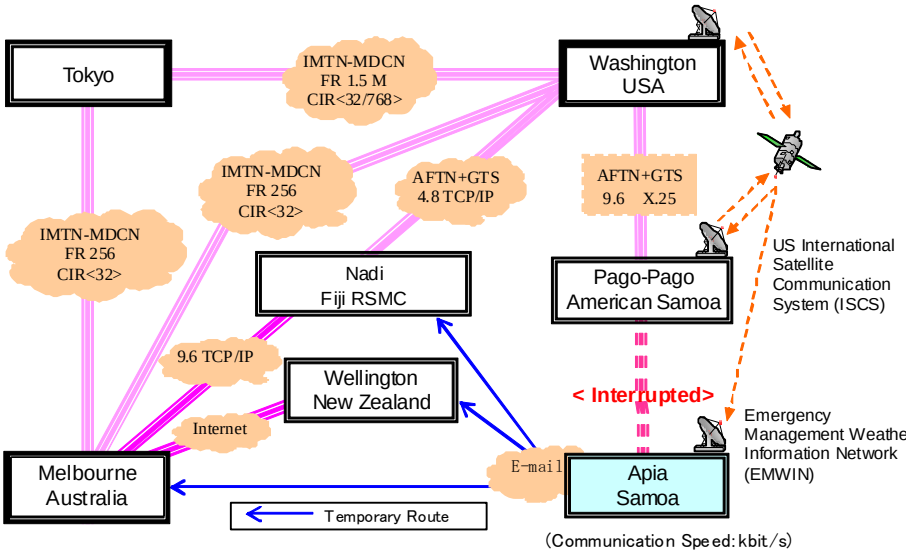


Figure 12: Existing GTS Network

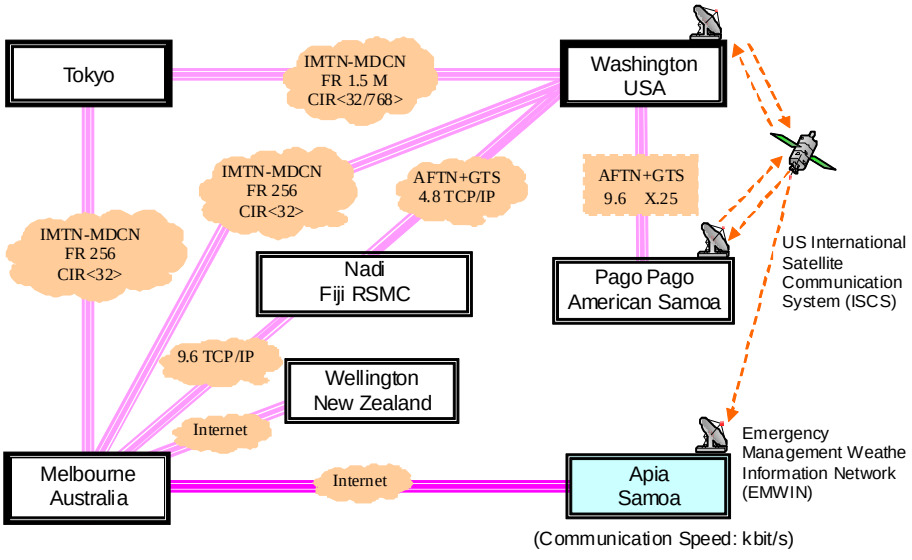


Figure 13: GTS Network after Completion of the Programme

3) Meteorological Satellite Data Receiving System (Multi-functional Transport Satellite: MTSAT)

The SMD Head Office is the center of weather forecasting. In order to prepare accurate weather forecasts with enough lead time for disaster preparedness and evacuation for the public by the SMD, it is necessary to grasp distribution and movement of rain cloud and tropical depression approaching to Samoa in advance using the system. In addition, perceiving disastrous rain occurring in short time and bad weather in these areas in real time, preparation of warnings and dissemination of information to all concerned with the civil aviation by the SMD are significant. MTSAT transmits only digital cloud images. New transmission methods for improvement of the data dissemination from the satellite are introduced in MTSAT series to transmit digital cloud images with high quality in a short time. As a result of analysis for the digital data from MTSAT every hour by the system, cloud distribution and its structure in the whole area of the country can be accurately grasped.

Since the existing broadcasting of digital cloud images through MTSAT has been scheduled to terminate by the Japan Meteorological Agency (JMA) from 2015, all the users must receive the images through the internet. Therefore, the data receiving method of the Meteorological Satellite Data Receiving System to be supplied under the Programme has also been designed as the internet.

4) Forecast Support System

The Forecast Support System has been designed to enable the SMD's forecasters to have the required products for effective preparation and prompt dissemination of weather forecasts and warnings through integration, analysis, etc. of the local observed data, data & meteorological products of the WMO member countries received via the GTS network, MTSAT data, regular meteorological information of Fiji RSMC, etc.

5) Early Warning System

Since the existing mobile telephone service in Samoa has over 97% of population coverage as indicated in the Figure attached right, it is deemed most appropriate as emergency information dissemination method. It is also to be noted that the mobile-phone company is quite cooperative to disaster prevention activities. Therefore, by usage of the existing mobile-phone service in Samoa, the Early Warning System which satisfies the following 6 conditions is designed.

Figure 14: Mobile Telephone Service Coverage

- To widely disseminate warnings to the public in a short time
- To deliver warnings to the public by self-directed operation and judgment

- To disseminate warnings of cyclone, storm surge, high waves, heavy rain, strong & gusty wind, floods, droughts and volcano ash fall as specified in the Disaster & Emergency Management Act
- To disseminate warnings to the Disaster Management Office (DMO), the Disaster Advisory Committee (DAC) and mass media
- To enable the mobile-phone users to acquire weather information of the SMD whenever the users require
- To minimized the recurrent cost of the SMD

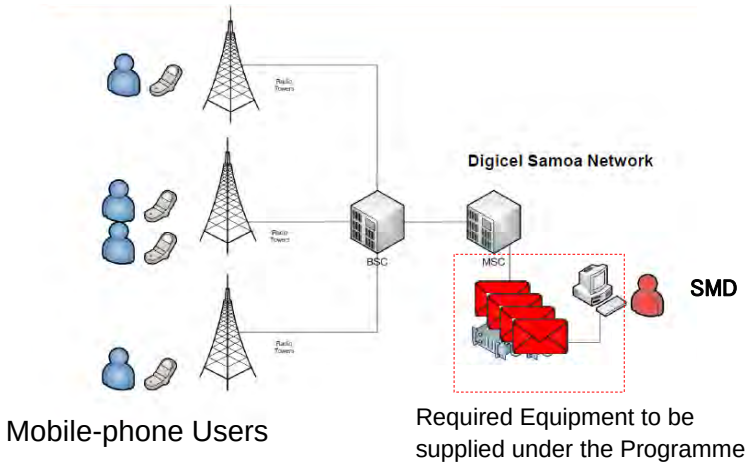


Figure 15: Early Warning System

Responsibilities on the Early Warning System between the mobile-phone company (Digicel) and the SMD are as follows.

- To disseminate warnings to the Disaster Management Office (DMO), the Disaster Advisory Committee (DAC), mass media, etc. by self-directed operation and judgment of the SMD
- To set contents of each warning and configure the Early Warning System with each warning which is not more than 160 characters by the SMD
- To be free of charge for warning dissemination by the Early Warning System of the SMD
- To provide the required numbers of the mobile-phone modems to the SMD by the Digicel
- To charge for the weather information acquisition through the mobile-phone network to each user by the Digicel

6) Power Back-up System

The Power Back-up System consists of the following equipment indicated below.

<Engine Generator>

In order for uninterruptable operation of each system to be supplied under the Programme, 2 engine generators as a power back-up equipment during power stoppage are required and these have been designed to be installed in the power back-up shed as an ancillary facility to be constructed in the premises of the SMD Head Office. In consideration of difficulty in refueling during tropical cyclone occurrence, it has been designed that the engine generators is furnished with 1,000 liters fuel tank for approximately 1 week continuous operation.

- Engine Generator Capacity: 20KVA
- Output Power: 3-Phase, 4-wire and 50Hz

<Solar Panel and Battery>

In order to minimize consumption of the commercial power so as to reduce CO_2 emission, which accelerates global warming, and the recurrent cost to be borne by the SMD as much as possible, it has been designed to install solar panels and batteries at the SMD Head Office and fix the solar panels on the rooftop of the ancillary facilities to be constructed against blowing them off by strong wind of tropical cyclone.

<Wind Power Generator>

Since 2 sites (Mt. Vaea and Mt. Fiamoe) located high above sea level has shorter sunshine duration because of cloud and fog, a compact wind power generator has been planned to be installed at these sites in order to fill in the gaps of electricity generated by solar panels,

7) Wind Profiler System

The Wind Profiler System is an apparatus which can make continuous unmanned observation of temporal vertical distribution of wind speed & direction and weather phenomena such as air turbulence, etc. by radio wave transmitted from the ground to the upper air 7km - 9km high (during raining), and has been known that there is a lower frequency of technical problem because it has no driving mechanism which is easily breakable. In addition, as the Wind Profiler System is furnished with the Radio Acoustic Sounding System (RASS), temperature into the atmospheric boundary layer can be observed.

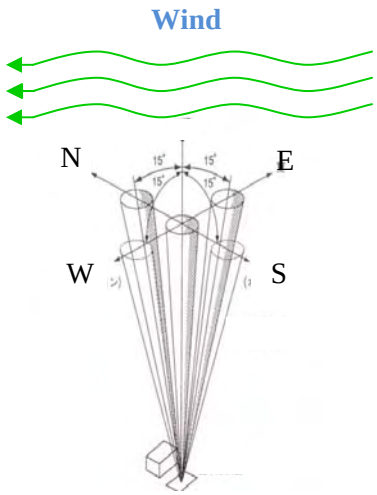


Figure 16: Wind Profiler System Conceptual Diagram

The Wind Profiler System enables the SMD to continuously observe wind and temperature in the atmosphere, watch weather phenomena and accumulate the observed data for prediction and countermeasure preparation of the Climate Change. Moreover, it enables the SMD not only to obtain the observed data significant for accurate and prompt preparation of weather forecasts, but also monitor the weather phenomena in the Southern Hemisphere such as vertical wind direction change, updraft from the change of wind direction and movement of tropical cyclone. The location of The Wind Profiler System has been designed in the premises of the SMD Head office.

The “Schematic Diagram for the Programme” is attached hereto.

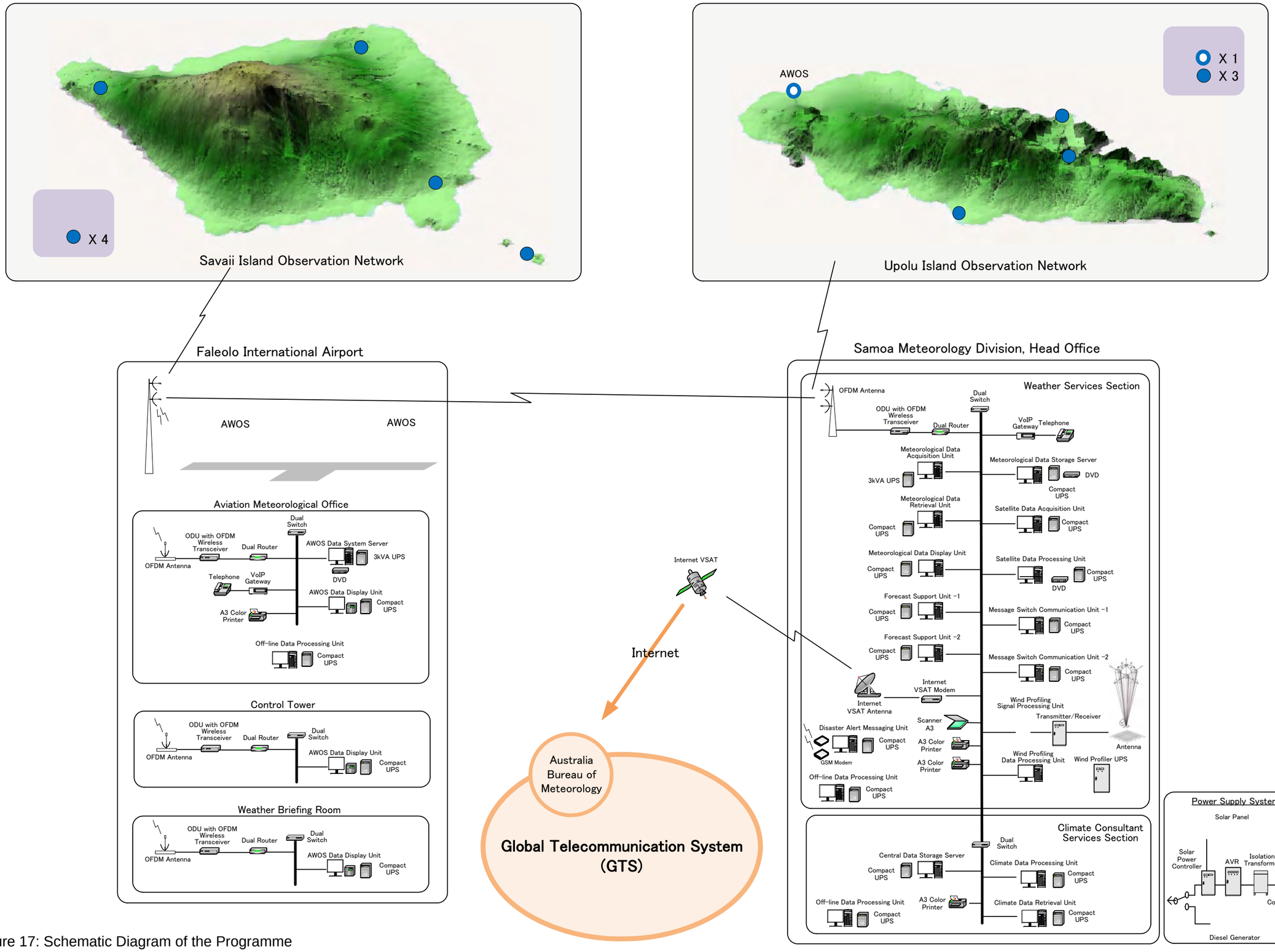


Figure 17: Schematic Diagram of the Programme

(2) Major Equipment List

As a consequence of the design of the Preparatory Survey, the major components of the Programme are described below.

Table 21: Major Components of the Programme

Name of the Equipment	①	②	③	④	⑤	⑥	⑦	⑧	⑨	⑩	⑪	⑫	⑬	⑭	⑮	Total Quantity
Airport Weather Observation System (AWOS)							2									2
AWOS Display System							3									3
Automatic Weather System (AWS)				1	1	1		1	1				1		1	7
Calibration Instrument	1															1
Meteorological Data Communication System	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	15
Meteorological Data Management System	1															1
GTS Message Switch System	1															1
Meteorological Satellite Data Receiving System	1															1
Forecast Support System	1															1
Early Warning System	1															1
Power Back-up System	1															1
Wind Profiler System	1															1

Table 22: Site No. of the Programme

Name of Site	Site No.	Name of Site	Site No.
The SMD Head Office	①	Maota International Airport	⑨
Mt. Vaea	②	Mt. Valusia	⑩
Mt. Fiamoe	③	Tuasivi	⑪
Togitogiga	④	Mt. Tagotala	⑫
Le Mafa	⑤	Le Piu Tai	⑬
Saluafata	⑥	Vaisala	⑭
Faleolo International Airport	⑦	Mt. Talu	⑮
Manono	⑧		

Major Equipment List

Airport Weather Observation System (AWOS)			
Name of Site: Faleolo International Airport (Runway West)			
Equipment	Specification	Quantity	Purpose
Wind Speed and Direction Sensor	Type Wind speed : Propeller Wind direction : Vane Range: Wind speed : 0.3 - 100m/s Wind direction : 0 - 360º Accuracy: Wind speed : ≤ ±0.3m/s (≤10m/s), ≤±1% (> 10m/s) Wind direction : ≤±3º Threshold Wind speed : 1.1m/s Wind direction : 1.1m/s	1	For observing wind speed and direction at 10m high from the ground level of the airport runway.
Temperature and Humidity Sensor	Temperature; Measuring Range : -10 - +50 ºC (Minimum Observation Range) Accuracy : ≤±0.2ºC (at 23 °C) Sensor Type : Platinum RTD Humidity; Measuring Range : 0 - 100%RH Accuracy : ≤±15% RH(at 23 °C) Radiation Shield : Naturally Aspirated	1	For observing temperature and humidity at the ground level of the airport runway.
Barometer	Internal pressure sensors : 3 Pressure range : 500 - 1,100hPa Accuracy : ≤ ±0.10hPa (at +20 °C) Temperature range : -10 - +60ºC Resolution : 0.01hPa	1	For observing atmospheric air pressure at the ground level of the airport runway
Rain Gauge	Type : Tipping Bucket Capacity : Unlimited Orifice : 8inch or 200mm Calibration : 0.1mm Accuracy : ≤±1% (≤ 250mm/hr), ≤±3% (≤ 500mm/hr) Materials : Copper or Stainless Steel (Funnel and Housing)	1	For observing precipitation at the ground level of the airport runway
Sunshine Duration Sensor	Spectral range : 400 – 1,100 nm Sunshine YES output : 1.0 ± 0.1V if direct irradiance >120 W/m^2 Sunshine NO output : 0.0 to ± 0.1V if direct irradiance <120 W/m^2 Accuracy : >90% in monthly total	1	For observing sunshine duration at the ground level of the airport runway.
Solar Radiation Sensor	Spectral range : 0.4 - 1.1µm Sensitivity : 100µV/W/m^2 Response time : less than 1s Max. irradiance : 2,000W/m^2 Directional error : ±5% (at 80º)	1	For observing solar radiation at the ground level of the airport runway.
Visibility Sensor	Type : Forward Scatter Ambient Light Sensor: Range : 0.5 to 10,000fL Field of View : 6.0º Range : 6m - 80km Accuracy : ≤±10% or 10ft (3m) Scatter angles : 42° (nominal) Source : Infrared LED	1	For observing visibility at airport runway.
Ceilometer	Range : 0 - 25,000ft Resolution : 30ft Configuration : Dual lens Accuracy : ≤30ft or 2%, whichever is greatest	1	For observing height of cloud top and bottom.

Data Collection Unit	Analog Inputs Number of channels : ≥ 10 voltage inputs, ≥5 current inputs with 250Ω internal shunt resistor, ≥3 inputs for RTD or thermistor transducers Input ranges : 100mV, 1.0V, 2.0V, 5.0V Digital Inputs/Outputs Frequency inputs : 3 counters, 16-bit Maximum count rate : 1.4KHz Serial Channels RS-232E ports : 6 or more, hardware and software handshaking, baud rates 110bps to 115Kbps, various protocols Processor Functions Configuration parameters : Stored in non-volatile EEPROM Data memory : 1MB internal RAM Calendar clock : Comply with leap year 2 times of day alarms Accuracy ≤±30 sec/month Synchronized with time source (AWOS Data System Server)	1	For collecting airport weather observation data from each sensors and transmitting the collected data to AWOS Data System Server.

Airport Weather Observation System (AWOS)			
Name of Site: Faleolo International Airport (Runway East)			
Equipment	Specification	Quantity	Purpose
Wind Speed and Direction Sensor	Type Wind speed : Propeller Wind direction : Vane Range: Wind speed : 0.3 - 100m/s Wind direction : 0 - 360º Accuracy: Wind speed : ≤ ±0.3m/s (≤10m/s), ≤±1% (> 10m/s) Wind direction : ≤±3º Threshold Wind speed : 1.1m/s Wind direction : 1.1m/s	1	For observing wind speed and direction at 10m high from the ground level of the airport runway.
Temperature and Humidity Sensor	Temperature; Measuring Range : -10 - +50 ºC (Minimum Observation Range) Accuracy : ≤±0.2ºC (at 23 °C) Sensor Type : Platinum RTD Humidity; Measuring Range : 0 - 100%RH Accuracy : ≤±15% RH(at 23 °C) Radiation Shield : Naturally Aspirated	1	For observing temperature and humidity at the ground level of the airport runway.
Barometer	Internal pressure sensors : 3 Pressure range : 500 - 1,100hPa Accuracy : ≤ ±0.10hPa (at +20 °C) Temperature range : -10 - +60ºC Resolution : 0.01hPa	1	For observing atmospheric air pressure at the ground level of the airport runway.
Rain Gauge	Type : Tipping Bucket Capacity : Unlimited Orifice : 8inch or 200mm Calibration : 0.1mm Accuracy : ≤±1% (≤ 250mm/hr), ≤±3% (≤ 500mm/hr) Materials : Copper or Stainless Steel (Funnel and Housing)	1	For observing precipitation at the ground level of the airport runway.

Sunshine Duration Sensor	Spectral range Sunshine YES output Sunshine NO output Accuracy	: 400 – 1,100 nm : 1.0 ± 0.1V if direct irradiance >120 W/m^2 : 0.0 to ± 0.1V if direct irradiance <120 W/m^2 : >90% in monthly total	1	For observing sunshine duration at the ground level of the airport runway.
Solar Radiation Sensor	Spectral range Sensitivity Response time Max. irradiance Directional error	: 0.4 - 1.1μm : 100μV/W/m^2 : less than 1s : 2,000W/m^2 : ±5% (at 80º)	1	For observing solar radiation at the ground level of the airport runway.
Visibility Sensor	Type Ambient Light Sensor: Range Field of View Range Accuracy Scatter angles Source	: Forward Scatter : 0.5 to 10,000fL : 6.0º : 6m - 80km : ≤±10% or 10ft (3m) : 42° (nominal) : Infrared LED	1	For observing visibility at airport runway.
Data Collection Unit	Analog Inputs Number of channels Input ranges Digital Inputs/Outputs Frequency inputs Maximum count rate Serial Channels RS-232E ports Processor Functions Configuration parameters Data memory Calendar clock	 : ≥ 10 voltage inputs, ≥5 current inputs with 250Ω internal shunt resistor, ≥3 inputs for RTD or thermistor transducers : 100mV, 1.0V, 2.0V, 5.0V : 3 counters, 16-bit : 1.4KHz : 6 or more, hardware and software handshaking, baud rates 110bps to 115Kbps, various protocols : Stored in non-volatile EEPROM : 1MB internal RAM : Comply with leap year 2 times of day alarms Accuracy ≤±30 sec/month Synchronized with time source (AWOS Data System Server)	1	For collecting airport weather observation data from each sensors and transmitting the collected data to AWOS Data System Server.
Test Instruments and Materials	Calibration kit for Visibility Sensor		1	For maintaining the system.
	Digital Multi Meter		1	
	Tool kit		1	
Spare parts	DCP I/F Board for Data Collection Unit		2	For maintaining the system.
	Quad Serial I/F Board for Data Collection Unit		2	
	Main board of Visibility Sensor		2	
	Receiver board of Visibility Sensor		2	
	Ambient Light Sensor		2	
	Main board of Ceilometer		1	
	Power Unit of Ceilometer		2	
	Power Sensor Board of Ceilometer		2	
	Blower Motor of Ceilometer		1	
Service Manuals	Operation & Maintenance Hand Book		3	For maintaining the system.

Airport Weather Observation Data Display System			
Name of Site: Faleolo International Airport (Aviation Meteorological Office)			
Equipment	Specification	Quantity	Purpose
AWOS Data System Server	Hardware: Tower Type CPU Main memory (RAM) Hard Disk Monitor display	 : Intel Xeon 2.4GHz or equivalent : 4GB or more : Dual 500GB (or more) Raid 1 configuration, hot swappable : 19” color TFT, 1280×1024 or more	1	For processing and storage of airport weather observation data according to the international standard.

	DVD-R/W drive : one (1) drive Software: O/S : Windows Server or LINUX Allow automatic and manual inputs from authorized users Data processing compliance : Certified compliant with ICAO, WMO, USA Federal Aviation Administration standards LAN : TCP/IP, Ethernet WAN : TCP/IP, Remote Access Service Alarms : User set visual and audible alarms		
AWOS Data Display Unit	Hardware Type : Thin Client type PC Memory (Storage) : Flash memory type – 4GB Memory (RAM) : 512MB or more Monitor Display :19" color TFT, 1280×1024 or more with low refection, high brightness, and wide viewing angle Software O/S : Windows CE Display Software : Graphical Display of all meteorological data on a single screen	1	For displaying airport weather observation data and information.
3kVA UPS	Capacity : 3kVA or more Input power : AC 230V ±15% (single phase, 50Hz) Output power : AC 230V ±5% (single phase, 50Hz) Back up time : at least 5 minutes at full load	1	For supplying stable power to each apparatus and peripheral.
Compact UPS	Capacity : 600VA or more Input power : AC 230V ±15% (single phase, 50Hz) Output power : AC 230V ±5% (single phase, 50Hz) Back up time : at least 5 minutes at full load	2	For supplying stable power to each apparatus and peripheral.
Double Switch	LAN Interface : IEEE802.3 Ethernet Connection Port : 100BASE-TX or more, 8 ports or more	1	For connecting all the computing equipment with LAN.
Off-line Data Processing Unit	Hardware: CPU : Intel Core2 Duo, 2GHz or equivalent Main memory (RAM) : 4GB or more Hard disk : 250GB or more x two (2) drives Monitor display : Color LCD type, 19 inches or more DVD-R/W drive : one (1) drive Software: O/S : Microsoft Windows XP or VISTA Application software : Microsoft Office Ver.2007 or better	1	For preparing and recording of documents, equipment maintenance records, etc.
A3 Color Printer	Color Ink-jet printer Maximum paper size : A3 Resolution :1200 Dots per inch (DPI) or more Printing speed : More than 7 ppm Interface : USB, LAN (Internet Printer Port) Input power : AC 230V (single phase, 50Hz)	1	For printing airport weather observation data and information.
Spare parts	Power Supply Unit for Server	1	For maintaining the system.
	Raid Type Hard Disk for Server	1	
	UPS Spare Battery (3kVA UPS)	1	
	UPS Spare Battery (600VA)	2	
	LAN Arrester	3	
Service Manuals -	Operation & Maintenance Hand Book	2	For maintaining the system.

Airport Weather Observation Data Display System			
Name of Site: Faleolo International Airport (Control Tower)			
Equipment	Specification	Quantity	Purpose
AWOS Data Display Unit	Hardware Type : Thin Client type PC Memory (Storage) : Flash memory type – 4GB Memory (RAM) : 512MB or more Monitor Display : 19" color TFT, 1280×1024 or more with low refection, high brightness, and wide viewing angle	1	For displaying airport weather observation data and information.

	Software O/S : Windows CE Display Software : Graphical Display of all meteorological data on a single screen		
Compact UPS	Capacity : 600VA or more Input power : AC 230V ±15% (single phase, 50Hz) Output power : AC 230V ±5% (single phase, 50Hz) Back up time : at least 5 minutes at full load	1	For supplying stable power to each apparatus and peripheral.
Double Switch	LAN Interface : IEEE802.3 Ethernet Connection Port : 100BASE-TX or more, 8 ports or more	1	For connecting all the computing equipment with LAN.
Service Manuals	Operation & Maintenance Hand Book	1	For maintaining the system.

Airport Weather Observation Data Display System

Name of Site: Faleolo International Airport (Control Tower)

Equipment	Specification	Quantity	Purpose
AWOS Data Display Unit	Hardware Type : Thin Client type PC Memory (Storage) : Flash memory type – 4GB Memory (RAM) : 512MB or more Monitor Display :19" color TFT, 1280×1024 or more with low refection, high brightness, and wide viewing angle Software O/S : Windows CE Display Software : Graphical Display of all meteorological data on a single screen	1	For displaying airport weather observation data and information.
Compact UPS	Capacity : 600VA or more Input power : AC 230V ±15% (single phase, 50Hz) Output power : AC 230V ±5% (single phase, 50Hz) Back up time : at least 5 minutes at full load	1	For supplying stable power to each apparatus and peripheral.
Double Switch	LAN Interface : IEEE802.3 Ethernet Connection Port : 100BASE-TX or more, 8 ports or more	1	For connecting all the computing equipment with LAN.
Service Manuals	Operation & Maintenance Hand Book	1	For maintaining the system.

Automatic Weather System (AWS)

Name of Site: Togitogiga

Equipment	Specification	Quantity	Purpose
Wind Speed and Direction Sensor	Type Wind speed : Propeller Wind direction : Vane Range: Wind speed : 0.3 - 100m/s Wind direction : 0 - 360º Accuracy: Wind speed : ≤ ±0.3m/s (≤10m/s), ≤±1% (> 10m/s) Wind direction : ≤±3º Threshold Wind speed : 1.1m/s Wind direction : 1.1m/s	1	For observing wind speed and direction at 10m high from the ground.
Temperature and Humidity Sensor	Temperature; Measuring Range : -10 - +50 ºC (Minimum Observation Range) Accuracy : ≤±0.2ºC (at 23 °C) Sensor Type : Platinum RTD Humidity; Measuring Range : 0 - 100%RH Accuracy : ≤±15% RH(at 23 °C) Radiation Shield : Naturally Aspirated	1	For observing temperature and humidity at the ground level.
Barometer	Internal pressure sensors : 3 Pressure range : 500 - 1,100hPa Accuracy : ≤ ±0.10hPa (at +20 °C)	1	For observing atmospheric air pressure at the ground level.

	Temperature range : -10 - +60ºC Resolution : 0.01hPa		
Rain Gauge	Type : Tipping Bucket Capacity : Unlimited Orifice : 8inch or 200mm Calibration : 0.1mm Accuracy : ≤±1% (≤ 250mm/hr), ≤±3% (≤ 500mm/hr) Materials : Copper or Stainless Steel (Funnel and Housing)	1	For observing precipitation at the ground level.
Sunshine Duration Sensor	Spectral range : 400 – 1,100 nm Sunshine YES output : 1.0 ± 0.1V if direct irradiance >120 W/m^2 Sunshine NO output : 0.0 to ± 0.1V if direct irradiance <120 W/m^2 Accuracy : >90% in monthly total	1	For observing sunshine duration at the ground level.
Solar Radiation Sensor	Spectral range : 0.4 - 1.1μm Sensitivity : 100μV/W/m^2 Response time : less than 1s Max. irradiance : 2,000W/m^2 Directional error : ±5% (at 80º)	1	For observing solar radiation at the ground level.
Soil Temperature Sensor (30cm, 100cm)	Type : Thermistor Tolerance : ±0.2 Range : -10ºC to +50ºC	1	For observing soil temperature at 30cm and 100cm depth from the ground level.
Sea Level Sensor	Type : Sequential Sonic/Pressure pulse Dynamic Range : Max. 15m Rate of Change : ±3m/sec Resolution : 1mm Accuracy : ±0.01%	1	For observing sea level.
Data Collection Unit	Analog Inputs Number of channels : ≥ 10 voltage inputs, ≥5 current inputs with 250Ω internal shunt resistor, ≥3 inputs for RTD or thermistor transducers Input ranges : 100mV, 1.0V, 2.0V, 5.0V Digital Inputs/Outputs Frequency inputs : 3 counters, 16-bit Maximum count rate : 1.4KHz Serial Channels RS-232E ports : 6 or more, hardware and software handshaking, baud rates 110bps to 115Kbps, various protocols Processor Functions Configuration parameters : Stored in non-volatile EEPROM Data memory : 1MB internal RAM Calendar clock : Comply with leap year 2 times of day alarms Accuracy ≤±30 sec/month Synchronized with time source (Meteorological Data Acquisition Unit)	1	For collecting weather observation data from each sensors and transmitting the collected data to Meteorological Data Acquisition Unit at the SMD Head Office.
Test Instruments and Materials	Stainless Wire (with a pully)	1	For maintaining the system.
	Aluminum Step Ladder	1	
Service Manuals	Operation & Maintenance Hand Book	1	For maintaining the system.

Automatic Weather System (AWS)			
Name of Site: Le Mafa			
Equipment	Specification	Quantity	Purpose
Wind Speed and Direction Sensor	Type Wind speed : Propeller Wind direction : Vane Range: Wind speed : 0.3 - 100m/s Wind direction : 0 - 360º Accuracy:	1	For observing wind speed and direction at 10m high from the ground.

	Wind speed : ≤ ±0.3m/s (≤10m/s), ≤±1% (> 10m/s) Wind direction : ≤±3º Threshold Wind speed : 1.1m/s Wind direction : 1.1m/s		
Temperature and Humidity Sensor	Temperature; Measuring Range : -10 - +50 ºC (Minimum Observation Range) Accuracy : ≤±0.2ºC (at 23 °C) Sensor Type : Platinum RTD Humidity; Measuring Range : 0 - 100%RH Accuracy : ≤±15% RH(at 23 °C) Radiation Shield : Naturally Aspirated	1	For observing temperature and humidity at the ground level.
Barometer	Internal pressure sensors : 3 Pressure range : 500 - 1,100hPa Accuracy : ≤ ±0.10hPa (at +20 °C) Temperature range : -10 - +60ºC Resolution : 0.01hPa	1	For observing atmospheric air pressure at the ground level.
Rain Gauge	Type : Tipping Bucket Capacity : Unlimited Orifice : 8inch or 200mm Calibration : 0.1mm Accuracy : ≤±1% (≤ 250mm/hr), ≤±3% (≤ 500mm/hr) Materials : Copper or Stainless Steel (Funnel and Housing)	1	For observing precipitation at the ground level.
Sunshine Duration Sensor	Spectral range : 400 – 1,100 nm Sunshine YES output : 1.0 ± 0.1V if direct irradiance >120 W/m^2 Sunshine NO output : 0.0 to ± 0.1V if direct irradiance <120 W/m^2 Accuracy : >90% in monthly total	1	For observing sunshine duration at the ground level.
Solar Radiation Sensor	Spectral range : 0.4 - 1.1μm Sensitivity : 100μV/W/m^2 Response time : less than 1s Max. irradiance : 2,000W/m^2 Directional error : ±5% (at 80º)	1	For observing solar radiation at the ground level.
Soil Temperature Sensor (30cm, 100cm)	Type : Thermistor Tolerance : ±0.2 Range : -10ºC to +50ºC	1	For observing soil temperature at 30cm and 100cm depth from the ground level.
Data Collection Unit	Analog Inputs Number of channels : ≥ 10 voltage inputs, ≥5 current inputs with 250Ω internal shunt resistor, ≥3 inputs for RTD or thermistor transducers Input ranges : 100mV, 1.0V, 2.0V, 5.0V Digital Inputs/Outputs Frequency inputs : 3 counters, 16-bit Maximum count rate : 1.4KHz Serial Channels RS-232E ports : 6 or more, hardware and software handshaking, baud rates 110bps to 115Kbps, various protocols Processor Functions Configuration parameters : Stored in non-volatile EEPROM Data memory : 1MB internal RAM Calendar clock : Comply with leap year 2 times of day alarms Accuracy ≤±30 sec/month Synchronized with time source (Meteorological Data Acquisition Unit)	1	For collecting weather observation data from each sensors and transmitting the collected data to Meteorological Data Acquisition Unit at the SMD Head Office.
Test Instruments and Materials	Stainless Wire (with a pully)	1	For maintaining of the system.
	Aluminum Step Ladder	1	
Service Manuals	Operation & Maintenance Hand Book	1	For maintaining of the system.

Automatic Weather System (AWS)			
Name of Site: Saluafata			
Equipment	Specification	Quantity	Purpose
Wind Speed and Direction Sensor	Type Wind speed : Propeller Wind direction : Vane Range: Wind speed : 0.3 - 100m/s Wind direction : 0 - 360º Accuracy: Wind speed : ≤ ±0.3m/s (≤10m/s), ≤±1% (> 10m/s) Wind direction : ≤±3º Threshold Wind speed : 1.1m/s Wind direction : 1.1m/s	1	For observing wind speed and direction at 10m high from the ground.
Temperature and Humidity Sensor	Temperature; Measuring Range : -10 - +50 ºC (Minimum Observation Range) Accuracy : ≤±0.2ºC (at 23 °C) Sensor Type : Platinum RTD Humidity; Measuring Range : 0 - 100%RH Accuracy : ≤±15% RH(at 23 °C) Radiation Shield : Naturally Aspirated	1	For observing temperature and humidity at the ground level.
Barometer	Internal pressure sensors : 3 Pressure range : 500 - 1,100hPa Accuracy : ≤ ±0.10hPa (at +20 °C) Temperature range : -10 - +60ºC Resolution : 0.01hPa	1	For observing atmospheric air pressure at the ground level.
Rain Gauge	Type : Tipping Bucket Capacity : Unlimited Orifice : 8inch or 200mm Calibration : 0.1mm Accuracy : ≤±1% (≤ 250mm/hr), ≤±3% (≤ 500mm/hr) Materials : Copper or Stainless Steel (Funnel and Housing)	1	For observing precipitation at the ground level.
Sunshine Duration Sensor	Spectral range : 400 – 1,100 nm Sunshine YES output : 1.0 ± 0.1V if direct irradiance >120 W/m^2 Sunshine NO output : 0.0 to ± 0.1V if direct irradiance <120 W/m^2 Accuracy : >90% in monthly total	1	For observing sunshine duration at the ground level.
Solar Radiation Sensor	Spectral range : 0.4 - 1.1µm Sensitivity : 100µV/W/m^2 Response time : less than 1s Max. irradiance : 2,000W/m^2 Directional error : ±5% (at 80º)	1	For observing solar radiation at the ground level.
Data Collection Unit	Analog Inputs Number of channels : ≥ 10 voltage inputs, ≥5 current inputs with 250Ω internal shunt resistor, ≥3 inputs for RTD or thermistor transducers Input ranges : 100mV, 1.0V, 2.0V, 5.0V Digital Inputs/Outputs Frequency inputs : 3 counters, 16-bit Maximum count rate : 1.4KHz Serial Channels RS-232E ports : 6 or more, hardware and software handshaking, baud rates 110bps to 115Kbps, various protocols Processor Functions Configuration parameters : Stored in non-volatile EEPROM Data memory : 1MB internal RAM	1	For collecting weather observation data from each sensors and transmitting the collected data to Meteorological Data Acquisition Unit at the SMD Head Office.

	Calendar clock : Comply with leap year 2 times of day alarms Accuracy ≤±30 sec/month Synchronized with time source (Meteorological Data Acquisition Unit)		
Test Instruments and Materials	Stainless Wire (with a pully)	1	For maintaining the system.
	Aluminum Step Ladder	1	
Service Manuals	Operation & Maintenance Hand Book	1	For maintaining the system.

Automatic Weather System (AWS)			
Name of Site: Manono			
Equipment	Specification	Quantity	Purpose
Wind Speed and Direction Sensor	Type Wind speed : Propeller Wind direction : Vane Range: Wind speed : 0.3 - 100m/s Wind direction : 0 - 360º Accuracy: Wind speed : ≤ ±0.3m/s (≤10m/s), ≤±1% (> 10m/s) Wind direction : ≤±3º Threshold Wind speed : 1.1m/s Wind direction : 1.1m/s	1	For observing wind speed and direction at 10m high from the ground.
Temperature and Humidity Sensor	Temperature; Measuring Range : -10 - +50 ºC (Minimum Observation Range) Accuracy : ≤±0.2ºC (at 23 °C) Sensor Type : Platinum RTD Humidity; Measuring Range : 0 - 100%RH Accuracy : ≤±15% RH(at 23 °C) Radiation Shield : Naturally Aspirated	1	For observing temperature and humidity at the ground level.
Barometer	Internal pressure sensors : 3 Pressure range : 500 - 1,100hPa Accuracy : ≤ ±0.10hPa (at +20 °C) Temperature range : -10 - +60ºC Resolution : 0.01hPa	1	For observing atmospheric air pressure at the ground level.
Rain Gauge	Type : Tipping Bucket Capacity : Unlimited Orifice : 8inch or 200mm Calibration : 0.1mm Accuracy : ≤±1% (≤ 250mm/hr), ≤±3% (≤ 500mm/hr) Materials : Copper or Stainless Steel (Funnel and Housing)	1	For observing precipitation at the ground level.
Sunshine Duration Sensor	Spectral range : 400 – 1,100 nm Sunshine YES output : 1.0 ± 0.1V if direct irradiance >120 W/m^2 Sunshine NO output : 0.0 to ± 0.1V if direct irradiance <120 W/m^2 Accuracy : >90% in monthly total	1	For observing sunshine duration at the ground level.
Solar Radiation Sensor	Spectral range : 0.4 - 1.1μm Sensitivity : 100μV/W/m^2 Response time : less than 1s Max. irradiance : 2,000W/m^2 Directional error : ±5% (at 80º)	1	For observing solar radiation at the ground level.

Data Collection Unit	Analog Inputs Number of channels : ≥ 10 voltage inputs, ≥5 current inputs with 250Ω internal shunt resistor, ≥3 inputs for RTD or thermistor transducers Input ranges : 100mV, 1.0V, 2.0V, 5.0V Digital Inputs/Outputs Frequency inputs : 3 counters, 16-bit Maximum count rate : 1.4KHz Serial Channels RS-232E ports : 6 or more, hardware and software handshaking, baud rates 110bps to 115Kbps, various protocols Processor Functions Configuration parameters : Stored in non-volatile EEPROM Data memory : 1MB internal RAM Calendar clock : Comply with leap year 2 times of day alarms Accuracy ≤±30 sec/month Synchronized with time source (Meteorological Data Acquisition Unit)	1	For collecting weather observation data from each sensors and transmitting the collected data to Meteorological Data Acquisition Unit at the SMD Head Office.
Test Instruments and Materials	Stainless Wire (with a pully)	1	For maintaining the system.
	Aluminum Step Ladder	1	
Service Manuals	Operation & Maintenance Hand Book	1	For maintaining the system.

Automatic Weather System (AWS)

Name of Site: Maota International Airport

Equipment	Specification	Quantity	Purpose
Wind Speed and Direction Sensor	Type Wind speed : Propeller Wind direction : Vane Range: Wind speed : 0.3 - 100m/s Wind direction : 0 - 360º Accuracy: Wind speed : ≤ ±0.3m/s (≤10m/s), ≤±1% (> 10m/s) Wind direction : ≤±3º Threshold Wind speed : 1.1m/s Wind direction : 1.1m/s	1	For observing wind speed and direction at 10m high from the ground.
Temperature and Humidity Sensor	Temperature; Measuring Range : -10 - +50 ºC (Minimum Observation Range) Accuracy : ≤±0.2ºC (at 23 °C) Sensor Type : Platinum RTD Humidity; Measuring Range : 0 - 100%RH Accuracy : ≤±15% RH(at 23 °C) Radiation Shield : Naturally Aspirated	1	For observing temperature and humidity at the ground level.
Barometer	Internal pressure sensors : 3 Pressure range : 500 - 1,100hPa Accuracy : ≤ ±0.10hPa (at +20 °C) Temperature range : -10 - +60ºC Resolution : 0.01hPa	1	For observing atmospheric air pressure at the ground level.
Rain Gauge	Type : Tipping Bucket Capacity : Unlimited Orifice : 8inch or 200mm Calibration : 0.1mm Accuracy : ≤±1% (≤ 250mm/hr), ≤±3% (≤ 500mm/hr) Materials : Copper or Stainless Steel (Funnel and Housing)	1	For observing precipitation at the ground level.

Sunshine Duration Sensor	Spectral range Sunshine YES output Sunshine NO output Accuracy	: 400 – 1,100 nm : 1.0 ± 0.1V if direct irradiance >120 W/m^2 : 0.0 to ± 0.1V if direct irradiance <120 W/m^2 : >90% in monthly total	1	For observing sunshine duration at the ground level.
Solar Radiation Sensor	Spectral range Sensitivity Response time Max. irradiance Directional error	: 0.4 - 1.1μm : 100μV/W/m^2 : less than 1s : 2,000W/m^2 : ±5% (at 80º)	1	For observing solar radiation at the ground level.
Data Collection Unit	Analog Inputs Number of channels Input ranges Digital Inputs/Outputs Frequency inputs Maximum count rate Serial Channels RS-232E ports Processor Functions Configuration parameters Data memory Calendar clock	: ≥ 10 voltage inputs, ≥5 current inputs with 250Ω internal shunt resistor, ≥3 inputs for RTD or thermistor transducers : 100mV, 1.0V, 2.0V, 5.0V : 3 counters, 16-bit : 1.4KHz : 6 or more, hardware and software handshaking, baud rates 110bps to 115Kbps, various protocols : Stored in non-volatile EEPROM : 1MB internal RAM : Comply with leap year 2 times of day alarms Accuracy ≤±30 sec/month Synchronized with time source (Meteorological Data Acquisition Unit)	1	For collecting weather observation data from each sensors and transmitting the collected data to Meteorological Data Acquisition Unit at the SMD Head Office.
Test Instruments and Materials	Stainless Wire (with a pully)		1	For maintaining the system.
	Aluminum Step Ladder		1	
Service Manuals	Operation & Maintenance Hand Book		1	For maintaining the system.

Automatic Weather System (AWS)

Name of Site: Le Piu Tai

Equipment	Specification		Quantity	Purpose
Wind Speed and Direction Sensor	Type Wind speed Wind direction Range: Wind speed Wind direction Accuracy: Wind speed Wind direction Threshold Wind speed Wind direction	: Propeller : Vane : 0.3 - 100m/s : 0 - 360º : ≤ ±0.3m/s (≤10m/s), ≤±1% (> 10m/s) : ≤±3º : 1.1m/s : 1.1m/s	1	For observing wind speed and direction at 10m high from the ground.
Temperature and Humidity Sensor	Temperature; Measuring Range Accuracy Sensor Type Humidity; Measuring Range Accuracy Radiation Shield	: -10 - +50 ºC (Minimum Observation Range) : ≤±0.2ºC (at 23 °C) : Platinum RTD : 0 - 100%RH : ≤±15% RH(at 23 °C) : Naturally Aspirated	1	For observing temperature and humidity at the ground level.
Barometer	Internal pressure sensors Pressure range Accuracy	: 3 : 500 - 1,100hPa : ≤ ±0.10hPa (at +20 °C)	1	For observing atmospheric air pressure at the ground level.

	Temperature range Resolution	: -10 - +60ºC : 0.01hPa		
Rain Gauge	Type Capacity Orifice Calibration Accuracy Materials	: Tipping Bucket : Unlimited : 8inch or 200mm : 0.1mm : ≤±1% (≤ 250mm/hr), ≤±3% (≤ 500mm/hr) : Copper or Stainless Steel (Funnel and Housing)	1	For observing precipitation at the ground level.
Sunshine Duration Sensor	Spectral range Sunshine YES output Sunshine NO output Accuracy	: 400 – 1,100 nm : 1.0 ± 0.1V if direct irradiance >120 W/m^2 : 0.0 to ± 0.1V if direct irradiance <120 W/m^2 : >90% in monthly total	1	For observing sunshine duration at the ground level.
Solar Radiation Sensor	Spectral range Sensitivity Response time Max. irradiance Directional error	: 0.4 - 1.1µm : 100µV/W/m^2 : less than 1s : 2,000W/m^2 : ±5% (at 80º)	1	For observing solar radiation at the ground level.
Soil Temperature Sensor (30cm, 100cm)	Type Tolerance Range	: Thermistor : ±0.2 : -10ºC to +50ºC	1	For observing soil temperature at 30cm and 100cm depth from the ground level.
Data Collection Unit	Analog Inputs Number of channels Input ranges Digital Inputs/Outputs Frequency inputs Maximum count rate Serial Channels RS-232E ports Processor Functions Configuration parameters Data memory Calendar clock	: ≥ 10 voltage inputs, ≥5 current inputs with 250Ω internal shunt resistor, ≥3 inputs for RTD or thermistor transducers : 100mV, 1.0V, 2.0V, 5.0V : 3 counters, 16-bit : 1.4KHz : 6 or more, hardware and software handshaking, baud rates 110bps to 115Kbps, various protocols : Stored in non-volatile EEPROM : 1MB internal RAM : Comply with leap year 2 times of day alarms Accuracy ≤±30 sec/month Synchronized with time source (Meteorological Data Acquisition Unit)	1	For collecting weather observation data from each sensors and transmitting the collected data to Meteorological Data Acquisition Unit at the SMD Head Office.
Test Instruments and Materials	Stainless Wire (with a pully)		1	For maintaining the system.
	Aluminum Step Ladder		1	
Service Manuals	Operation & Maintenance Hand Book		1	For maintaining the system.

Automatic Weather System (AWS)			
Name of Site: Mt. Talu			
Equipment	Specification	Quantity	Purpose
Wind Speed and Direction Sensor	Type Wind speed Wind direction Range: Wind speed Wind direction Accuracy: Wind speed Wind direction Threshold	: Propeller : Vane : 0.3 - 100m/s : 0 - 360º : ≤ ±0.3m/s (≤10m/s), ≤±1% (> 10m/s) : ≤±3º	1	For observing wind speed and direction at 10m high from the ground.

	Wind speed : 1.1m/s Wind direction : 1.1m/s		
Temperature and Humidity Sensor	Temperature; Measuring Range : -10 - +50 ºC (Minimum Observation Range) Accuracy : ≤±0.2ºC (at 23 °C) Sensor Type : Platinum RTD Humidity; Measuring Range : 0 - 100%RH Accuracy : ≤±15% RH(at 23 °C) Radiation Shield : Naturally Aspirated	1	For observing temperature and humidity at the ground level.
Barometer	Internal pressure sensors : 3 Pressure range : 500 - 1,100hPa Accuracy : ≤ ±0.10hPa (at +20 °C) Temperature range : -10 - +60ºC Resolution : 0.01hPa	1	For observing atmospheric air pressure at the ground level.
Rain Gauge	Type : Tipping Bucket Capacity : Unlimited Orifice : 8inch or 200mm Calibration : 0.1mm Accuracy : ≤±1% (≤ 250mm/hr), ≤±3% (≤ 500mm/hr) Materials : Copper or Stainless Steel (Funnel and Housing)	1	For observing precipitation at the ground level.
Sunshine Duration Sensor	Spectral range : 400 – 1,100 nm Sunshine YES output : 1.0 ± 0.1V if direct irradiance >120 W/m^2 Sunshine NO output : 0.0 to ± 0.1V if direct irradiance <120 W/m^2 Accuracy : >90% in monthly total	1	For observing sunshine duration at the ground level.
Solar Radiation Sensor	Spectral range : 0.4 - 1.1μm Sensitivity : 100μV/W/m^2 Response time : less than 1s Max. irradiance : 2,000W/m^2 Directional error : ±5% (at 80º)	1	For observing solar radiation at the ground level.
Soil Temperature Sensor (30cm, 100cm)	Type : Thermistor Tolerance : ±0.2 Range : -10ºC to +50ºC	1	For observing soil temperature at 30cm and 100cm depth from the ground level.
Data Collection Unit	Analog Inputs Number of channels : ≥ 10 voltage inputs, ≥5 current inputs with 250Ω internal shunt resistor, ≥3 inputs for RTD or thermistor transducers Input ranges : 100mV, 1.0V, 2.0V, 5.0V Digital Inputs/Outputs Frequency inputs : 3 counters, 16-bit Maximum count rate : 1.4KHz Serial Channels RS-232E ports : 6 or more, hardware and software handshaking, baud rates 110bps to 115Kbps, various protocols Processor Functions Configuration parameters : Stored in non-volatile EEPROM Data memory : 1MB internal RAM Calendar clock : Comply with leap year 2 times of day alarms Accuracy ≤±30 sec/month Synchronized with time source (Meteorological Data Acquisition Unit)	1	For collecting weather observation data from each sensors and transmitting the collected data to Meteorological Data Acquisition Unit at the SMD Head Office.
Test Instruments and Materials	Stainless Wire (with a pully)	1	For maintaining the system.
	Aluminum Step Ladder	1	
Service Manuals	Operation & Maintenance Hand Book	1	For maintaining the system.

Calibration Instrument for Automatic Weather System and Airport Weather Observation System			
Name of Site: Samoa Meteorology Division, Head Office			
Equipment	Specification	Quantity	Purpose
Mercury Barometer	Type : Mercury Barometer according to Hellman Measuring Range : 840hPa - 1,050hPa、-10ºC - +50ºC Accuracy : ≤±0.25hPa(20ºC±1ºC) Resolution : 0.1 hPa with venire (Air Pressure), 0.5ºC (Temperature) Division of Scale : 1hPa (Air Pressure), 1ºC (Temperature) Range of Application : 0m to 2,000m (Altitude), -10ºC to +50ºC (Temperature) Housing : Aluminum Application : Carrying Box	1	For calibrating for all meteorological sensors and instruments.
Maximum Thermometer	Type : Liquid-in-Glass (Mercury) thermometer, Wall mount type, thick wall with scale Measuring Range : -10ºC to +50ºC Accuracy : ≤±0.2ºC Division of Scale : 0.2ºC	1	For calibrating for all meteorological sensors and instruments.
Minimum Thermometer	Type : Liquid-in-Glass (Alcohol) thermometer, Wall mount type Measuring Range : -10ºC to +50ºC Accuracy : ≤±0.3ºC Division of Scale : 0.2ºC	1	For calibrating for all meteorological sensors and instruments.
Wet-and dry-bulb thermometer	Type : Unsheathed Liquid-in-Glass (Mercury) aspiration Psychrometer, Assmann type Measuring Range : -10ºC to +50ºC (Dry and Wet bulb) (Minimum Measuring Range) Accuracy : ≤±0.2ºC Division of Scale : 0.2ºC Aspiration fan : Spring-driven Wind Speed : 3 – 5 m/s	1	For calibrating for all meteorological sensors and instruments.
Vernier Scale Measure	Measuring Scale : 300mm Division of Scale : 0.05mm Material : Stainless	1	For calibrating for all meteorological sensors and instruments.
Tape Measure	Measuring Scale : 50m (Accuracy: ≤±20.6mm/50m)	1	For calibrating for all meteorological sensors and instruments.
Global Positioning System Instrument	Measuring Accuracy : 10m or less (Horizontal), 3m or less (Vertical) Altitude Measurement : Barometric Altimeter Altitude Resolution : 30cm Display : Liquid Crystal Display (LCD), 3cm x 4cm or more	1	For calibrating for all meteorological sensors and instruments.
Test Instrument	Digital Multi Meter	1	For maintaining the system.
	Tool Set	1	
Spare parts	Wind Speed and Direction Sensor	5	For maintaining the system.
	Solar Duration Sensor	5	
	Solar Radiation Sensor	5	
	Temperature and Humidity Sensor	2	
	Barometer	2	
	Rain Gauge	2	
	Thermometer for Soil Temperature	2	
	Sea Level Sensor	1	
	Data Collection Unit	2	
Service Manuals	Operation & Maintenance Hand book	2	For maintaining the system.

Meteorological Data Communication System			
Name of Site: Samoa Meteorology Division, Head Office			
Equipment	Specification	Quantity	Purpose
OFDM Wireless Transceiver (4.9GHz)	Frequency : 4.9GHz Band Tx Output : +15dBm (20MHz System: 2mW/MHz/10MHz System: 4mW/MHz) Channel : 20MHz System: 4ch/10MHz System: 6ch Modulation method : OFDM Transmission rate : 6, 9, 12, 18, 24, 36, 48, 54Mbps (20MHz System) 3, 4.5, 6, 9, 12, 18, 24, 27Mbps (10MHz System) Communication protocol : IEEE802.11j Security : ESSID,WEP, WPA-PSK,IEEE802.11i Antenna Input : 2 System (SMA), with function of SPD (Space Diversity) Cable interface : 10BASE-T/100BASE-TX	3	For receiving and transmitting the meteorological information and observed data among Faleolo International Airport, each observation point and the SMD Head Office.
Patch Antenna (21dBi)	Type of Antenna : Outdoor use Flat Panel Antenna Band : 4,900 - 5,000 (MHz) Polarisation : Linear (Vertical) Input impedance : 50Ω Gain : 21dBi VSWR : Max 1.7 Power rating : 1W Beamwidth : 10° (Az)12° (El) Wind speed for permissible stress method of design : 57m/s or over	2	For transmitting and receiving data from OFDM Wireless Transceiver.
Patch Antenna (18dBi)	Type of Antenna : Outdoor use Flat Panel Antenna Band : 4,900 - 5,000 (MHz) Polarisation : Linear (Vertical) Input impedance : 50Ω Gain : 18dBi VSWR : Max 2.0 Power rating : 5W Beamwidth : 18° (Az), 18° (El) Wind speed for permissible stress method of design : 57m/s or over	1	For transmitting and receiving data from OFDM Wireless Transceiver.
Double Router	Routing Protocol : BGP,EIGRP,OSPF,RIPv1,RIPv2 QoS Protocol : WFQ,CBWFQ,RSVP,NBAR VLAN Support : 802.1Q Interface : 10/100Base-T	1	For connecting and routing all computing equipment on LAN.
Double Switch	Port : 10/100Base-T or more, ≥5 ports Interface : IEEE 802.3 Ethernet	1	For connecting all the computing equipment with LAN.
Solar Panel (350W)	Voltage : 40V nominal Capacity : 350W or more Module Efficiency : 16.0% or higher	1	For utilizing the sunshine radiation for generating electric power.
Battery (470Ah)	Type : Sealed Maintenance Free Battery, designed for solar powered applications System Voltage : 12V Capacity : 470Ah or more Designed life time : More than 10years based upon 30% discharge cycles.	1	For supplying electric power to each system during no sunshine.
Regulator	Capacity : ≥45A (12V) System Voltage Output : 12V or 24V Solar Input Voltage : 40V Nominal Settings : Voltage at power charge commencement and completion Power and Network Monitoring : Fully integrated TCP/IP based power and network management	1	For regulating output power from solar panels and batteries.

	Display : LCD Display and control to adjust settings		
Outdoor Cabinet	Environmental standard : IP43 or better Material : Stainless steel Input power : DC12V or DC24V Others : Earth Terminal, Circuit breaker for power-supply line, Mounting part(s) and antitheft lock Power Arrester : For power cable surge protection at both cable ends	1	For accommodating transceiver, related devises.
Indoor Cabinet	Environmental standard : IP43 or better Material : Stainless or High-strength Plastic Input power : DC12Vor DC24V Others : Earth Terminal, Circuit breaker for power-supply line, Mounting part(s) and antitheft lock	1	For accommodating regulator, double switch, etc.
IP Telephone with Dust Proof Case	VoIP function Call control protocol : SIP (RFC3261) Voice codec : G.711 μ-law/a-law Digest attestation Network function : DHCP client, DNS client, FTP client, QoS (ToS), Setting by Web browser Others : Power supply switch	1	For voice communicating in the meteorological observation network.
Connecting Steel Pole (25m)	Height : 25m Lightning protection : Lightning Rod, Conducting Wire, Ground Plate (Earthing resistance: 10Ω or less) Wind speed for permissible stress methods of design : 57m/s Finish : Galvanized steel	1	For mounting communication equipment.
Service Manuals	Operation & Maintenance Hand Book	1	For maintaining the system.

Meteorological Data Communication System			
Name of Site: Mt.Vaea			
Equipment	Specification	Quantity	Purpose
OFDM Wireless Transceiver (4.9GHz)	Frequency : 4.9GHz Band Tx Output : +15dBm (20MHz System: 2mW/MHz/10MHz System: 4mW/MHz) Channel : 20MHz System: 4ch/10MHz System: 6ch Modulation method : OFDM Transmission rate : 6, 9, 12, 18, 24, 36, 48, 54Mbps (20MHz System) 3, 4.5, 6, 9, 12, 18, 24, 27Mbps (10MHz System) Communication protocol : IEEE802.11j Security : ESSID,WEP, WPA-PSK,IEEE802.11i Antenna Input : 2 System (SMA), with function of SPD (Space Diversity) Cable interface : 10BASE-T/100BASE-TX	2	For receiving and transmitting the meteorological information and observed data between each observation point and the SMD Head Office.
Patch Antenna (26dBi)	Type of Antenna : Outdoor use Flat Panel Antenna Band : 4,900 - 5,000 (MHz) Polarisation : Linear (Vertical) Input impedance : 50Ω Gain : 26dBi VSWR : Max 2 Power rating :10W Beamwidth : 6° (Az) 6° (El) Wind speed for permissible stress method of design : 57m/s or over	1	For transmitting and receiving data from OFDM Wireless Transceiver.
Patch Antenna (18dBi)	Type of Antenna : Outdoor use Flat Panel Antenna Band : 4,900 - 5,000 (MHz)	1	For transmitting and receiving data from OFDM Wireless

	Polarisation : Linear (Vertical) Input impedance : 50Ω Gain : 18dBi VSWR : Max 2.0 Power rating : 5W Beamwidth : 18° (Az), 18° (El) Wind speed for permissible stress method of design : 57m/s or over		Transceiver.
Double Switch	Port : 10/100Base-T or more, ≥5 ports Interface : IEEE 802.3 Ethernet	1	For connecting all the computing equipment with LAN.
Solar Panel (270W)	Voltage : 40V nominal Capacity : 270Wor more Module Efficiency : 16.0% or higher	1	For utilizing the sunshine radiation for generating electric power.
Wind Generator	Voltage : 12V, 24V and 48V Start-Up Wind Speed : 2.68 m/s or less Capacity : 160W (28m/s) or more 38kWh/month or more (at 5.4m/s) Mounting Guy Steel Pole : ≥8m high, approx. 50φ, Galvanized finish, Guy wire 5mm, Grounding rod and wire	1	For utilizing the wind velocity for generating electric power.
Battery (370Ah)	Type : Sealed Maintenance Free Battery, designed for solar powered applications System Voltage : 12V Capacity : 370Ah or more Designed life time : More than 10years based upon 30% discharge cycles	1	For supplying electric power to each system during no sunshine.
Regulator	Capacity : ≥45A (12V) System Voltage Output : 12V or 24V Solar Input Voltage : 40V Nominal Settings : Voltage at power charge commencement and completion Power and Network Monitoring : Fully integrated TCP/IP based power and network management Display : LCD Display and control to adjust settings	1	For regulating output power from solar panels, a window generator and batteries.
Outdoor Cabinet	Environmental standard : IP43 or better Material : Stainless steel Input power : DC12V or DC24V Others : Earth Terminal, Circuit breaker for power-supply line, Mounting part(s) and antitheft lock Power Arrester : For power cable surge protection at both cable ends	1	For accommodating transceiver, related devises.
Indoor Cabinet	Environmental standard : IP43 or better Material : Stainless or High-strength Plastic Input power : DC12Vor DC24V Others : Earth Terminal, Circuit breaker for power-supply line, Mounting part(s) and antitheft lock	1	For accommodating regulator, double switch, etc.
IP Telephone with Dust Proof Case	VoIP function Call control protocol : SIP (RFC3261) Voice codec : G.711 μ-law/a-law Digest attestation Network function : DHCP client, DNS client, FTP client, QoS (ToS), Setting by Web browser Others : Power supply switch	1	For voice communications in the meteorological observation network.
Service Manuals	Operation & Maintenance Hand Book	1	For maintaining the system.

Meteorological Data Communication System

Name of Site: Mt. Fiamoe

Equipment	Specification	Quantity	Purpose
OFDM Wireless Transceiver (4.9GHz)	Frequency : 4.9GHz Band Tx Output : +15dBm (20MHz System: 2mW/MHz/10MHz System: 4mW/MHz) Channel : 20MHz System: 4ch/10MHz System: 6ch Modulation method : OFDM Transmission rate : 6, 9, 12, 18, 24, 36, 48, 54Mbps (20MHz System) 3, 4.5, 6, 9, 12, 18, 24, 27Mbps (10MHz System) Communication protocol : IEEE802.11j Security : ESSID,WEP, WPA-PSK,IEEE802.11i Antenna Input : 2 System (SMA), with function of SPD (Space Diversity) Cable interface : 10BASE-T/100BASE-TX	2	For receiving and transmitting the meteorological information and observed data between each observation point and the SMD Head Office.
Patch Antenna (21dBi)	Type of Antenna : Outdoor use Flat Panel Antenna Band : 4,900 - 5,000 (MHz) Polarisation : Linear (Vertical) Input impedance : 50Ω Gain : 21dBi VSWR : Max 1.7 Power rating : 1W Beamwidth : 10° (Az)12° (El) Wind speed for permissible stress method of design : 57m/s or over	2	For transmitting and receiving data from OFDM Wireless Transceiver.
Double Switch	Port : 10/100Base-T or more, ≥5 ports Interface : IEEE 802.3 Ethernet	1	For connecting all the computing equipment with LAN.
Solar Panel (270W)	Voltage : 40V nominal Capacity : 270Wor more Module Efficiency : 16.0% or higher	1	For utilizing the sunshine radiation for generating electric power.
Wind Generator	Voltage : 12V, 24V and 48V Start-Up Wind Speed : 2.68 m/s or less Capacity : 160W (28m/s) or more 38kWh/month or more (at 5.4m/s) Mounting Guy Steel Pole : ≥8m high, approx. 50φ, Galvanized finish, Guy wire 5mm, Grounding rod and wire	1	For utilizing the wind velocity for generating electric power.
Battery (370 Ah)	Type : Sealed Maintenance Free Battery, designed for solar powered applications System Voltage : 12V Capacity : 370Ah or more Designed life time : More than 10years based upon 30% discharge cycles	1	For supplying electric power to each system during no sunshine.
Regulator	Capacity : ≥45A (12V) System Voltage Output : 12V or 24V Solar Input Voltage : 40V Nominal Settings : Voltage at power charge commencement and completion Power and Network Monitoring : Fully integrated TCP/IP based power and network management Display : LCD Display and control to adjust settings	1	For regulating output power from solar panels, a window generator and batteries.
Outdoor Cabinet	Environmental standard : IP43 or better Material : Stainless steel Input power : DC12V or DC24V Others : Earth Terminal, Circuit breaker for power-supply line, Mounting part(s)	1	For accommodating transceiver, related devises.

	and antitheft lock Power Arrester : For power cable surge protection at both cable ends		
Indoor Cabinet	Environmental standard : IP43 or better Material : Stainless or High-strength Plastic Input power : DC12Vor DC24V Others : Earth Terminal, Circuit breaker for power-supply line, Mounting part(s) and antitheft lock	1	For accommodating regulator, double switch, etc.
IP Telephone with Dust Proof Case	VoIP function Call control protocol : SIP (RFC3261) Voice codec : G.711 μ-law/a-law Digest attestation Network function : DHCP client, DNS client, FTP client, QoS (ToS), Setting by Web browser Others : Power supply switch	1	For voice communicating in the meteorological observation network.
Service Manuals	Operation & Maintenance Hand Book	1	For maintaining the system.

Meteorological Data Communication System

Name of Site: Togitogiga

Equipment	Specification	Quantity	Purpose
OFDM Wireless Transceiver (4.9GHz)	Frequency : 4.9GHz Band Tx Output : +15dBm (20MHz System: 2mW/MHz/10MHz System: 4mW/MHz) Channel : 20MHz System: 4ch/10MHz System: 6ch Modulation method : OFDM Transmission rate : 6, 9, 12, 18, 24, 36, 48, 54Mbps (20MHz System) 3, 4.5, 6, 9, 12, 18, 24, 27Mbps (10MHz System) Communication protocol : IEEE802.11j Security : ESSID,WEP, WPA-PSK,IEEE802.11i Antenna Input : 2 System (SMA), with function of SPD (Space Diversity) Cable interface : 10BASE-T/100BASE-TX	1	For receiving and transmitting the meteorological information and observed data between each observation point and the SMD Head Office.
Patch Antenna (21dBi)	Type of Antenna : Outdoor use Flat Panel Antenna Band : 4,900 - 5,000 (MHz) Polarisation : Linear (Vertical) Input impedance : 50Ω Gain : 21dBi VSWR : Max 1.7 Power rating : 1W Beamwidth : 10° (Az)12° (El) Wind speed for permissible stress method of design : 57m/s or over	1	For transmitting and receiving data from OFDM Wireless Transceiver.
Double Switch	Port : 10/100Base-T or more, ≥5 ports Interface : IEEE 802.3 Ethernet	1	For connecting all the computing equipment with LAN.
Solar Panel (220W)	Voltage : 40V nominal Capacity : 220Wor more Module Efficiency : 16.0% or higher	1	For utilizing the sunshine radiation for generating electric power.
Battery (290Ah)	Type : Sealed Maintenance Free Battery, designed for solar powered applications System Voltage : 12V Capacity : 290Ah or more Designed life time : More than 10years based upon 30% discharge cycles.	1	For supplying electric power to each system during no sunshine.
Regulator	Capacity : ≥45A (12V) System Voltage Output : 12V or 24V Solar Input Voltage : 40V Nominal	1	For regulating output power from solar panels and batteries.

	Settings : Voltage at power charge commencement and completion Power and Network Monitoring : Fully integrated TCP/IP based power and network management Display : LCD Display and control to adjust settings		
Outdoor Cabinet	Environmental standard : IP43 or better Material : Stainless steel Input power : DC12V or DC24V Others : Earth Terminal, Circuit breaker for power-supply line, Mounting part(s) and antitheft lock Power Arrester : For power cable surge protection at both cable ends	1	For accommodating transceiver, related devises.
Indoor Cabinet	Environmental standard : IP43 or better Material : Stainless or High-strength Plastic Input power : DC12Vor DC24V Others : Earth Terminal, Circuit breaker for power-supply line, Mounting part(s) and antitheft lock	1	For accommodating regulator, double switch, etc.
IP Telephone with Dust Proof Case	VoIP function Call control protocol : SIP (RFC3261) Voice codec : G.711 μ-law/a-law Digest attestation Network function : DHCP client, DNS client, FTP client, QoS (ToS), Setting by Web browser Others : Power supply switch	1	For voice communicating in the meteorological observation network.
Connecting Steel Pole (20m)	Height : 20m Lightning protection : Lightning Rod, Conducting Wire, Ground Plate (Earthing resistance: 10Ω or less) Wind speed for permissible stress methods of design : 57m/s Finish : Galvanized steel	1	For mounting communication and observation equipment.
Service Manuals	Operation & Maintenance Hand Book	1	For maintaining the system.

Meteorological Data Communication System

Name of Site: Le Ma Fa

Equipment	Specification	Quantity	Purpose
OFDM Wireless Transceiver (4.9GHz)	Frequency : 4.9GHz Band Tx Output : +15dBm (20MHz System: 2mW/MHz/10MHz System: 4mW/MHz) Channel : 20MHz System: 4ch/10MHz System: 6ch Modulation method : OFDM Transmission rate : 6, 9, 12, 18, 24, 36, 48, 54Mbps (20MHz System) 3, 4.5, 6, 9, 12, 18, 24, 27Mbps (10MHz System) Communication protocol : IEEE802.11j Security : ESSID,WEP, WPA-PSK,IEEE802.11i Antenna Input : 2 System (SMA), with function of SPD (Space Diversity) Cable interface : 10BASE-T/100BASE-TX	1	For receiving and transmitting the meteorological information and observed data between each observation point and the SMD Head Office.
Patch Antenna (21dBi)	Type of Antenna : Outdoor use Flat Panel Antenna Band : 4,900 - 5,000 (MHz) Polarisation : Linear (Vertical) Input impedance : 50Ω Gain : 21dBi VSWR : Max 1.7 Power rating : 1W	1	For transmitting and receiving data from OFDM Wireless Transceiver.

	Beamwidth : 10° (Az)12° (El) Wind speed for permissible stress method of design : 57m/s or over		
Double Switch	Port : 10/100Base-T or more, ≥5 ports Interface : IEEE 802.3 Ethernet	1	For connecting all the computing equipment with LAN.
Solar Panel (220W)	Voltage : 40V nominal Capacity : 220Wor more Module Efficiency : 16.0% or higher	1	For utilizing the sunshine radiation for generating electric power.
Battery (290Ah)	Type : Sealed Maintenance Free Battery, designed for solar powered applications System Voltage : 12V Capacity : 290Ah or more Designed life time : More than 10years based upon 30% discharge cycles	1	For supplying electric power to each system during no sunshine.
Regulator	Capacity : ≥45A (12V) System Voltage Output : 12V or 24V Solar Input Voltage : 40V Nominal Settings : Voltage at power charge commencement and completion Power and Network Monitoring : Fully integrated TCP/IP based power and network management Display : LCD Display and control to adjust settings	1	For regulating output power from solar panels and batteries.
Outdoor Cabinet	Environmental standard : IP43 or better Material : Stainless steel Input power : DC12V or DC24V Others : Earth Terminal, Circuit breaker for power-supply line, Mounting part(s) and antitheft lock Power Arrester : For power cable surge protection at both cable ends	1	For accommodating transceiver, related devises.
Indoor Cabinet	Environmental standard : IP43 or better Material : Stainless or High-strength Plastic Input power : DC12Vor DC24V Others : Earth Terminal, Circuit breaker for power-supply line, Mounting part(s) and antitheft lock	1	For accommodating regulator, double switch, etc.
IP Telephone with Dust Proof Case	VoIP function Call control protocol : SIP (RFC3261) Voice codec : G.711 μ-law/a-law Digest attestation Network function : DHCP client, DNS client, FTP client, QoS (ToS), Setting by Web browser Others : Power supply switch	1	For voice communicating in the meteorological observation network.
Connecting Steel Pole (20m)	Height : 20m Lightning protection : Lightning Rod, Conducting Wire, Ground Plate (Earthing resistance: 10Ω or less) Wind speed for permissible stress methods of design : 57m/s Finish : Galvanized steel	1	For mounting communication and observation equipment.
Service Manuals	Operation & Maintenance Hand Book	1	For maintaining the system.

Meteorological Data Communication System			
Name of Site: Saluafata			
Equipment	Specification	Quantity	Purpose
OFDM Wireless Transceiver (4.9GHz)	Frequency : 4.9GHz Band Tx Output : +15dBm (20MHz System: 2mW/MHz/10MHz System: 4mW/MHz) Channel : 20MHz System: 4ch/10MHz System: 6ch	2	For receiving and transmitting the meteorological information and observed data between each observation point and the SMD Head Office.

	Modulation method : OFDM Transmission rate : 6, 9, 12, 18, 24, 36, 48, 54Mbps (20MHz System) 3, 4.5, 6, 9, 12, 18, 24, 27Mbps (10MHz System) Communication protocol : IEEE802.11j Security : ESSID,WEP, WPA-PSK,IEEE802.11i Antenna Input : 2 System (SMA), with function of SPD (Space Diversity) Cable interface : 10BASE-T/100BASE-TX		
Patch Antenna (21dBi)	Type of Antenna : Outdoor use Flat Panel Antenna Band : 4,900 - 5,000 (MHz) Polarisation : Linear (Vertical) Input impedance : 50Ω Gain : 21dBi VSWR : Max 1.7 Power rating : 1W Beamwidth : 10° (Az)12° (El) Wind speed for permissible stress method of design : 57m/s or over	3	For transmitting and receiving data from OFDM Wireless Transceiver.
Double Switch	Port : 10/100Base-T or more, ≥5 ports Interface : IEEE 802.3 Ethernet	1	For connecting all the computing equipment with LAN.
Solar Panel (300W)	Voltage : 40V nominal Capacity : 300Wor more Module Efficiency : 16.0% or higher	1	For utilizing the sunshine radiation for generating electric power.
Battery (400Ah)	Type : Sealed Maintenance Free Battery, designed for solar powered applications System Voltage : 12V Capacity : 400Ah or more Designed life time : More than 10years based upon 30% discharge cycles.	1	For supplying electric power to each system during no sunshine.
Regulator	Capacity : ≥45A (12V) System Voltage Output : 12V or 24V Solar Input Voltage : 40V Nominal Settings : Voltage at power charge commencement and completion Power and Network Monitoring : Fully integrated TCP/IP based power and network management Display : LCD Display and control to adjust settings	1	For regulating output power from solar panels and batteries.
Outdoor Cabinet	Environmental standard : IP43 or better Material : Stainless steel Input power : DC12V or DC24V Others : Earth Terminal, Circuit breaker for power-supply line, Mounting part(s) and antitheft lock Power Arrester : For power cable surge protection at both cable ends	1	For accommodating transceiver, related devises.
Indoor Cabinet	Environmental standard : IP43 or better Material : Stainless or High-strength Plastic Input power : DC12Vor DC24V Others : Earth Terminal, Circuit breaker for power-supply line, Mounting part(s) and antitheft lock	1	For accommodating regulator, double switch, etc.
IP Telephone with Dust Proof Case	VoIP function Call control protocol : SIP (RFC3261) Voice codec : G.711 μ-law/a-law Digest attestation Network function : DHCP client, DNS client, FTP client, QoS (ToS), Setting by Web browser Others : Power supply switch	1	For voice communicating in the meteorological observation network.

Connecting Steel Pole (25m)	Height : 25m Lightning protection : Lightning Rod, Conducting Wire, Ground Plate (Earthing resistance: 10Ω or less) Wind speed for permissible stress methods of design : 57m/s Finish : Galvanized steel	1	For mounting communication and observation equipment.
Service Manuals	Operation & Maintenance Hand Book	1	For maintaining the system.

Meteorological Data Communication System			
Name of Site: Faleolo International Airport (Repeater)			
Equipment	Specification	Quantity	Purpose
OFDM Wireless Transceiver (4.9GHz)	Frequency : 4.9GHz Band Tx Output : +15dBm (20MHz System: 2mW/MHz/10MHz System: 4mW/MHz) Channel : 20MHz System: 4ch/10MHz System: 6ch Modulation method : OFDM Transmission rate : 6, 9, 12, 18, 24, 36, 48, 54Mbps (20MHz System) 3, 4.5, 6, 9, 12, 18, 24, 27Mbps (10MHz System) Communication protocol : IEEE802.11j Security : ESSID,WEP, WPA-PSK,IEEE802.11i Antenna Input : 2 System (SMA), with function of SPD (Space Diversity) Cable interface : 10BASE-T/100BASE-TX	4	For receiving and transmitting the meteorological information and observed data among Faleolo International Airport, each observation point and the SMD Head Office.
Patch Antenna (26dBi)	Type of Antenna : Outdoor use Flat Panel Antenna Band : 4,900 - 5,000 (MHz) Polarisation : Linear (Vertical) Input impedance : 50Ω Gain : 26dBi VSWR : Max 2 Power rating :10W Beamwidth : 6° (Az) 6° (El) Wind speed for permissible stress method of design : 57m/s or over	2	For transmitting and receiving data from OFDM Wireless Transceiver.
Patch Antenna (21dBi)	Type of Antenna : Outdoor use Flat Panel Antenna Band : 4,900 - 5,000 (MHz) Polarisation : Linear (Vertical) Input impedance : 50Ω Gain : 21dBi VSWR : Max 1.7 Power rating : 1W Beamwidth : 10° (Az)12° (El) Wind speed for permissible stress method of design : 57m/s or over	1	For transmitting and receiving data from OFDM Wireless Transceiver.
Patch Antenna (18dBi)	Type of Antenna : Outdoor use Flat Panel Antenna Band : 4,900 - 5,000 (MHz) Polarisation : Linear (Vertical) Input impedance : 50Ω Gain : 18dBi VSWR : Max 2.0 Power rating : 5W Beamwidth : 18° (Az), 18° (El) Wind speed for permissible stress method of design : 57m/s or over	1	For transmitting and receiving data from OFDM Wireless Transceiver.
Double Switch	Port : 10/100Base-T or more, ≥5 ports Interface : IEEE 802.3 Ethernet	1	For connecting all the computing equipment with LAN.
Solar Panel (430W)	Voltage : 40V nominal Capacity : 430Wor more	1	For utilizing the sunshine radiation for generating electric

	Module Efficiency : 16.0% or higher		power.
Battery (580Ah)	Type : Sealed Maintenance Free Battery, designed for solar powered applications System Voltage : 12V Capacity : 580Ah or more Designed life time : More than 10years based upon 30% discharge cycles.	1	For supplying electric power to each system during no sunshine.
Regulator	Capacity : ≥45A (12V) System Voltage Output : 12V or 24V Solar Input Voltage : 40V Nominal Settings : Voltage at power charge commencement and completion Power and Network Monitoring : Fully integrated TCP/IP based power and network management Display : LCD Display and control to adjust settings	1	For regulating output power from solar panels and batteries.
Outdoor Cabinet	Environmental standard : IP43 or better Material : Stainless steel Input power : DC12V or DC24V Others : Earth Terminal, Circuit breaker for power-supply line, Mounting part(s) and antitheft lock Power Arrester : For power cable surge protection at both cable ends	2	For accommodating transceiver, related devises.
Indoor Cabinet	Environmental standard : IP43 or better Material : Stainless or High-strength Plastic Input power : DC12Vor DC24V Others : Earth Terminal, Circuit breaker for power-supply line, Mounting part(s) and antitheft lock	1	For accommodating regulator, double switch, etc.
IP Telephone with Dust Proof Case	VoIP function Call control protocol : SIP (RFC3261) Voice codec : G.711 μ-law/a-law Digest attestation Network function : DHCP client, DNS client, FTP client, QoS (ToS), Setting by Web browser Others : Power supply switch	1	For voice communicating in the meteorological observation network.
Connecting Steel Pole (25m)	Height : 25m Lightning protection : Lightning Rod, Conducting Wire, Ground Plate (Earthing resistance: 10Ω or less) Wind speed for permissible stress methods of design : 57m/s Finish : Galvanized steel	2	For mounting communication equipment.
Service Manuals	Operation & Maintenance Hand Book	1	For maintaining the system.

Meteorological Data Communication System			
Name of Site: Faleolo International Airport (Runway West)			
Equipment	Specification	Quantity	Purpose
OFDM Wireless Transceiver (4.9GHz)	Frequency : 4.9GHz Band Tx Output : +15dBm (20MHz System: 2mW/MHz/10MHz System: 4mW/MHz) Channel : 20MHz System: 4ch/10MHz System: 6ch Modulation method : OFDM Transmission rate : 6, 9, 12, 18, 24, 36, 48, 54Mbps (20MHz System) 3, 4.5, 6, 9, 12, 18, 24, 27Mbps (10MHz System) Communication protocol : IEEE802.11j Security : ESSID,WEP, WPA-PSK,IEEE802.11i	1	For receiving and transmitting the meteorological information and observed data among Faleolo International Airport, each observation point and the SMD Head Office.

	Antenna Input : 2 System (SMA), with function of SPD (Space Diversity) Cable interface : 10BASE-T/100BASE-TX		
Patch Antenna (18dBi)	Type of Antenna : Outdoor use Flat Panel Antenna Band : 4,900 - 5,000 (MHz) Polarisation : Linear (Vertical) Input impedance : 50Ω Gain : 18dBi VSWR : Max 2.0 Power rating : 5W Beamwidth : 18° (Az), 18° (El) Wind speed for permissible stress method of design : 57m/s or over	1	For transmitting and receiving data from OFDM Wireless Transceiver.
Double Switch	Port : 10/100Base-T or more, ≥5 ports Interface : IEEE 802.3 Ethernet	1	For connecting all the computing equipment with LAN.
Solar Panel (800W)	Voltage : 40V nominal Capacity : 800Wor more Module Efficiency : 16.0% or higher	1	For utilizing the sunshine radiation for generating electric power.
Battery (960Ah)	Type : Sealed Maintenance Free Battery, designed for solar powered applications System Voltage : 24V Capacity : 960Ah or more Designed life time : More than 10years based upon 30% discharge cycles	1	For supplying electric power to each system during no sunshine.
Regulator	Capacity : ≥45A (12V) System Voltage Output : 12V or 24V Solar Input Voltage : 40V Nominal Settings : Voltage at power charge commencement and completion Power and Network Monitoring : Fully integrated TCP/IP based power and network management Display : LCD Display and control to adjust settings	1	For regulating output power from solar panels and batteries.
Outdoor Cabinet	Environmental standard : IP43 or better Material : Stainless steel Input power : DC12V or DC24V Others : Earth Terminal, Circuit breaker for power-supply line, Mounting part(s) and antitheft lock Power Arrester : For power cable surge protection at both cable ends	1	For accommodating transceiver, related devises.
Indoor Cabinet	Environmental standard : IP43 or better Material : Stainless or High-strength Plastic Input power : DC12Vor DC24V Others : Earth Terminal, Circuit breaker for power-supply line, Mounting part(s) and antitheft lock	1	For accommodating regulator, double switch, etc.
IP Telephone with Dust Proof Case	VoIP function Call control protocol : SIP (RFC3261) Voice codec : G.711 μ-law/a-law Digest attestation Network function : DHCP client, DNS client, FTP client, QoS (ToS), Setting by Web browser Others : Power supply switch	1	For voice communicating in the meteorological observation network.
Connecting Steel Pole (10m)	Height : 10m Lightning protection : Lightning Rod, Conducting Wire, Ground Plate (Earthing resistance: 10Ω or less) Wind speed for permissible stress methods of design : 57m/s Finish : Galvanized steel	1	For mounting communication and observation equipment.
Service Manuals	Operation & Maintenance Hand Book	1	For maintaining the system.

Meteorological Data Communication System

Name of Site: Faleolo International Airport (Runway East)

Equipment	Specification	Quantity	Purpose
OFDM Wireless Transceiver (4.9GHz)	Frequency : 4.9GHz Band Tx Output : +15dBm (20MHz System: 2mW/MHz/10MHz System: 4mW/MHz) Channel : 20MHz System: 4ch/10MHz System: 6ch Modulation method : OFDM Transmission rate : 6, 9, 12, 18, 24, 36, 48, 54Mbps (20MHz System) 3, 4.5, 6, 9, 12, 18, 24, 27Mbps (10MHz System) Communication protocol : IEEE802.11j Security : ESSID,WEP, WPA-PSK,IEEE802.11i Antenna Input : 2 System (SMA), with function of SPD (Space Diversity) Cable interface : 10BASE-T/100BASE-TX	1	For receiving and transmitting the meteorological information and observed data among Faleolo International Airport, each observation point and the SMD Head Office.
Patch Antenna (18dBi)	Type of Antenna : Outdoor use Flat Panel Antenna Band : 4,900 - 5,000 (MHz) Polarisation : Linear (Vertical) Input impedance : 50Ω Gain : 18dBi VSWR : Max 2.0 Power rating : 5W Beamwidth : 18° (Az), 18° (El) Wind speed for permissible stress method of design : 57m/s or over	1	For transmitting and receiving data from OFDM Wireless Transceiver.
Double Switch	Port : 10/100Base-T or more, ≥5 ports Interface : IEEE 802.3 Ethernet	1	For connecting all the computing equipment with LAN.
Solar Panel (800W)	Voltage : 40V nominal Capacity : 800Wor more Module Efficiency : 16.0% or higher	1	For utilizing the sunshine radiation for generating electric power.
Battery (960Ah)	Type : Sealed Maintenance Free Battery, designed for solar powered applications System Voltage : 24V Capacity : 960Ah or more Designed life time : More than 10years based upon 30% discharge cycles	1	For supplying electric power to each system during no sunshine.
Regulator	Capacity : ≥45A (12V) System Voltage Output : 12V or 24V Solar Input Voltage : 40V Nominal Settings : Voltage at power charge commencement and completion Power and Network Monitoring : Fully integrated TCP/IP based power and network management Display : LCD Display and control to adjust settings	1	For regulating output power from solar panels and batteries.
Outdoor Cabinet	Environmental standard : IP43 or better Material : Stainless steel Input power : DC12V or DC24V Others : Earth Terminal, Circuit breaker for power-supply line, Mounting part(s) and antitheft lock Power Arrester : For power cable surge protection at both cable ends	1	For accommodating transceiver, related devises.
Indoor Cabinet	Environmental standard : IP43 or better Material : Stainless or High-strength Plastic Input power : DC12Vor DC24V	1	For accommodating regulator, double switch, etc.

	Others : Earth Terminal, Circuit breaker for power-supply line, Mounting part(s) and antitheft lock		
IP Telephone with Dust Proof Case	VoIP function Call control protocol : SIP (RFC3261) Voice codec : G.711 μ-law/a-law Digest attestation Network function : DHCP client, DNS client, FTP client, QoS (ToS), Setting by Web browser Others : Power supply switch	1	For voice communicating in the meteorological observation network.
Connecting Steel Pole (10m)	Height : 10m Lightning protection : Lightning Rod, Conducting Wire, Ground Plate (Earthing resistance: 10Ω or less) Wind speed for permissible stress methods of design : 57m/s Finish : Galvanized steel	1	For mounting communication and observation equipment.
Service Manuals	Operation & Maintenance Hand Book	1	For maintaining the system.

Meteorological Data Communication System

Name of Site: Faleolo International Airport (Aviation Meteorological Office)

Equipment	Specification	Quantity	Purpose
OFDM Wireless Transceiver (4.9GHz)	Frequency : 4.9GHz Band Tx Output : +15dBm (20MHz System: 2mW/MHz/10MHz System: 4mW/MHz) Channel : 20MHz System: 4ch/10MHz System: 6ch Modulation method : OFDM Transmission rate : 6, 9, 12, 18, 24, 36, 48, 54Mbps (20MHz System) 3, 4.5, 6, 9, 12, 18, 24, 27Mbps (10MHz System) Communication protocol : IEEE802.11j Security : ESSID,WEP, WPA-PSK,IEEE802.11i Antenna Input : 2 System (SMA), with function of SPD (Space Diversity) Cable interface : 10BASE-T/100BASE-TX	3	For receiving and transmitting the meteorological information and observed data among Faleolo International Airport, each observation point and the SMD Head Office.
Patch Antenna (18dBi)	Type of Antenna : Outdoor use Flat Panel Antenna Band : 4,900 - 5,000 (MHz) Polarisation : Linear (Vertical) Input impedance : 50Ω Gain : 18dBi VSWR : Max 2.0 Power rating : 5W Beamwidth : 18° (Az), 18° (El) Wind speed for permissible stress method of design : 57m/s or over	2	For transmitting and receiving data from OFDM Wireless Transceiver.
Omni directional Antenna (6dBi)	Type of Antenna : Korinia Antenna Band : 4,900 - 5,000 (MHz) Input impedance : 50Ω Gain : 6dBi VSWR : Max 1.5 Beamwidth : Omni directional (Az) 22° (El) Wind speed for permissible stress method of design : 57m/s or over	1	For transmitting and receiving data from OFDM Wireless Transceiver.
Double Router	Routing Protocol : BGP,EIGRP,OSPF,RIPv1,RIPv2 QoS Protocol : WFQ,CBWFQ,RSVP,NBAR VLAN Support : 802.1Q Interface : 10/100Base-T	1	For connecting and routing all computing equipment on LAN.
Double Switch	Port : 10/100Base-T or more, ≥5 ports Interface : IEEE 802.3 Ethernet	1	For connecting all the computing equipment with LAN.

Outdoor Cabinet	Environmental standard : IP43 or better Material : Stainless steel Input power : DC12V or DC24V Others : Earth Terminal, Circuit breaker for power-supply line, Mounting part(s) and antitheft lock Power Arrester : For power cable surge protection at both cable ends	1	For accommodating transceiver, related devises.
Indoor Cabinet	Environmental standard : IP43 or better Material : Stainless or High-strength Plastic Input power : AC230V Others : Earth Terminal, Circuit breaker for power-supply line, Mounting part(s) and antitheft lock	1	For accommodating regulator, double switch, etc.
IP Telephone with Dust Proof Case	VoIP function Call control protocol : SIP (RFC3261) Voice codec : G.711 μ-law/a-law Digest attestation Network function : DHCP client, DNS client, FTP client, QoS (ToS), Setting by Web browser Others : Power supply switch	1	For voice communicating in the meteorological observation network.
Steel Pole (2m)	Height : 2m Lightning protection : Lightning Rod, Conducting Wire, Ground Plate (Earthing resistance : 10Ω or less) Permissible stress methods of design : 57m/s Finish : Galvanized steel	1	For mounting communication equipment.
Service Manuals	Operation & Maintenance Hand Book	1	For maintaining the system.

Meteorological Data Communication System

Name of Site: Faleolo International Airport (Control Tower)

Equipment	Specification	Quantity	Purpose
OFDM Wireless Transceiver (4.9GHz)	Frequency : 4.9GHz Band Tx Output : +15dBm (20MHz System: 2mW/MHz/10MHz System: 4mW/MHz) Channel : 20MHz System: 4ch/10MHz System: 6ch Modulation method : OFDM Transmission rate : 6, 9, 12, 18, 24, 36, 48, 54Mbps (20MHz System) 3, 4.5, 6, 9, 12, 18, 24, 27Mbps (10MHz System) Communication protocol : IEEE802.11j Security : ESSID,WEP, WPA-PSK,IEEE802.11i Antenna Input : 2 System (SMA), with function of SPD (Space Diversity) Cable interface : 10BASE-T/100BASE-TX	1	For receiving and transmitting the meteorological information and observed data among Faleolo International Airport, each observation point and the SMD Head Office.
Patch Antenna (18dBi)	Type of Antenna : Outdoor use Flat Panel Antenna Band : 4,900 - 5,000 (MHz) Polarisation : Linear (Vertical) Input impedance : 50Ω Gain : 18dBi VSWR : Max 2.0 Power rating : 5W Beamwidth : 18° (Az), 18° (El) Wind speed for permissible stress method of design : 57m/s or over	1	For transmitting and receiving data from OFDM Wireless Transceiver.
Double Router	Routing Protocol : BGP,EIGRP,OSPF,RIPv1,RIPv2 QoS Protocol : WFQ,CBWFQ,RSVP,NBAR VLAN Support : 802.1Q Interface : 10/100Base-T	1	For connecting and routing all computing equipment on LAN.

Double Switch	Port Interface	: 10/100Base-T or more, ≥5 ports : IEEE 802.3 Ethernet	1	For connecting all the computing equipment with LAN.
Outdoor Cabinet	Environmental standard Material Input power Others Power Arrester	: IP43 or better : Stainless steel : DC12V or DC24V : Earth Terminal, Circuit breaker for power-supply line, Mounting part(s) and antitheft lock : For power cable surge protection at both cable ends	1	For accommodating transceiver, related devises.
Indoor Cabinet	Environmental standard Material Input power Others	: IP43 or better : Stainless or High-strength Plastic : AC230V : Earth Terminal, Circuit breaker for power-supply line, Mounting part(s) and antitheft lock	1	For accommodating regulator, double switch, etc.
Steel Pole (2m)	Height Lightning protection Wind speed for permissible stress methods of design Finish	: 2m : Lightning Rod, Conducting Wire, Ground Plate (Earthing resistance: 10Ω or less) : 57m/s : Galvanized steel	1	For mounting communication equipment.
Service Manuals	Operation & Maintenance Hand Book		1	For maintaining the system.

Meteorological Data Communication System				
Name of Site: Faleolo International Airport (Weather Briefing Room)				
Equipment	Specification		Quantity	Purpose
OFDM Wireless Transceiver (4.9GHz)	Frequency Tx Output Channel Modulation method Transmission rate Communication protocol Security Antenna Input Cable interface	: 4.9GHz Band : +15dBm (20MHz System: 2mW/MHz/10MHz System: 4mW/MHz) : 20MHz System: 4ch/10MHz System: 6ch : OFDM : 6, 9, 12, 18, 24, 36, 48, 54Mbps (20MHz System) 3, 4.5, 6, 9, 12, 18, 24, 27Mbps (10MHz System) : IEEE802.11j : ESSID,WEP, WPA-PSK,IEEE802.11i : 2 System (SMA), with function of SPD (Space Diversity) : 10BASE-T/100BASE-TX	1	For receiving and transmitting the meteorological information and observed data among Faleolo International Airport, each observation point and the SMD Head Office.
Patch Antenna (18dBi)	Type of Antenna Band Polarisation Input impedance Gain VSWR Power rating Beamwidth Wind speed for permissible stress method of design	: Outdoor use Flat Panel Antenna : 4,900 - 5,000 (MHz) : Linear (Vertical) : 50Ω : 18dBi : Max 2.0 : 5W : 18° (Az), 18° (El) : 57m/s or over	1	For transmitting and receiving data from OFDM Wireless Transceiver.
Double Router	Routing Protocol QoS Protocol VLAN Support Interface	: BGP,EIGRP,OSPF,RIPv1,RIPv2 : WFQ,CBWFQ,RSVP,NBAR : 802.1Q : 10/100Base-T	1	For connecting and routing all computing equipment on LAN.
Double Switch	Port Interface	: 10/100Base-T or more, ≥5 ports : IEEE 802.3 Ethernet	1	For connecting all the computing equipment with LAN.
Outdoor Cabinet	Environmental standard	: IP43 or better	1	For accommodating transceiver,

	Material : Stainless steel Input power : DC12V or DC24V Others : Earth Terminal, Circuit breaker for power-supply line, Mounting part(s) and antitheft lock Power Arrester : For power cable surge protection at both cable ends		related devises.
Indoor Cabinet	Environmental standard : IP43 or better Material : Stainless or High-strength Plastic Input power : AC230V Others : Earth Terminal, Circuit breaker for power-supply line, Mounting part(s) and antitheft lock	1	For accommodating regulator, double switch, etc.
Steel Pole (2m)	Height : 2m Lightning protection : Lightning Rod, Conducting Wire, Ground Plate (Earthing resistance: 10Ω or less) Wind speed for permissible stress methods of design : 57m/s Finish : Galvanized steel	1	For mounting communication equipment.
Service Manuals	Operation & Maintenance Hand Book	1	For maintaining the system.

Meteorological Data Communication System

Name of Site: Manono

Equipment	Specification	Quantity	Purpose
OFDM Wireless Transceiver (4.9GHz)	Frequency : 4.9GHz Band Tx Output : +15dBm (20MHz System: 2mW/MHz/10MHz System: 4mW/MHz) Channel : 20MHz System: 4ch/10MHz System: 6ch Modulation method : OFDM Transmission rate : 6, 9, 12, 18, 24, 36, 48, 54Mbps (20MHz System) 3, 4.5, 6, 9, 12, 18, 24, 27Mbps (10MHz System) Communication protocol : IEEE802.11j Security : ESSID,WEP, WPA-PSK,IEEE802.11i Antenna Input : 2 System (SMA), with function of SPD (Space Diversity) Cable interface : 10BASE-T/100BASE-TX	1	For receiving and transmitting the meteorological information and observed data between each observation point and the SMD Head Office.
Patch Antenna (21dBi)	Type of Antenna : Outdoor use Flat Panel Antenna Band : 4,900 - 5,000 (MHz) Polarisation : Linear (Vertical) Input impedance : 50Ω Gain : 21dBi VSWR : Max 1.7 Power rating : 1W Beamwidth : 10° (Az)12° (El) Wind speed for permissible stress method of design : 57m/s or over	2	For transmitting and receiving data from OFDM Wireless Transceiver.
Double Switch	Port : 10/100Base-T or more, ≥5 ports Interface : IEEE 802.3 Ethernet	1	For connecting all the computing equipment with LAN.
Solar Panel (220W)	Voltage : 40V nominal Capacity : 220Wor more Module Efficiency : 16.0% or higher	1	For utilizing the sunshine radiation for generating electric power.
Battery (290Ah)	Type : Sealed Maintenance Free Battery, designed for solar powered applications System Voltage : 12V Capacity : 290Ah or more Designed life time : More than 10years based upon 30%	1	For supplying electric power to each system during no sunshine.

	discharge cycles.		
Regulator	Capacity : ≥45A (12V) System Voltage Output : 12V or 24V Solar Input Voltage : 40V Nominal Settings : Voltage at power charge commencement and completion Power and Network Monitoring : Fully integrated TCP/IP based power and network management Display : LCD Display and control to adjust settings	1	For regulating output power from solar panels and batteries.
Outdoor Cabinet	Environmental standard : IP43 or better Material : Stainless steel Input power : DC12V or DC24V Others : Earth Terminal, Circuit breaker for power-supply line, Mounting part(s) and antitheft lock Power Arrester : For power cable surge protection at both cable ends	1	For accommodating transceiver, related devises.
Indoor Cabinet	Environmental standard : IP43 or better Material : Stainless or High-strength Plastic Input power : DC12Vor DC24V Others : Earth Terminal, Circuit breaker for power-supply line, Mounting part(s) and antitheft lock	1	For accommodating regulator, double switch, etc.
IP Telephone with Dust Proof Case	VoIP function Call control protocol : SIP (RFC3261) Voice codec : G.711 μ-law/a-law Digest attestation Network function : DHCP client, DNS client, FTP client, QoS (ToS), Setting by Web browser Others : Power supply switch	1	For voice communicating in the meteorological observation network.
Connecting Steel Pole (25m)	Height : 25m Lightning protection : Lightning Rod, Conducting Wire, Ground Plate (Earthing resistance: 10Ω or less) Wind speed for permissible stress methods of design : 57m/s Finish : Galvanized steel	1	For mounting communication and observation equipment.
Service Manuals	Operation & Maintenance Hand Book	1	For maintaining the system.

Meteorological Data Communication System			
Name of Site: Maota International Airport			
Equipment	Specification	Quantity	Purpose
OFDM Wireless Transceiver (4.9GHz)	Frequency : 4.9GHz Band Tx Output : +15dBm (20MHz System: 2mW/MHz/10MHz System: 4mW/MHz) Channel : 20MHz System: 4ch/10MHz System: 6ch Modulation method : OFDM Transmission rate : 6, 9, 12, 18, 24, 36, 48, 54Mbps (20MHz System) 3, 4.5, 6, 9, 12, 18, 24, 27Mbps (10MHz System) Communication protocol : IEEE802.11j Security : ESSID,WEP, WPA-PSK,IEEE802.11i Antenna Input : 2 System (SMA), with function of SPD (Space Diversity) Cable interface : 10BASE-T/100BASE-TX	1	For receiving and transmitting the meteorological information and observed data between each observation point and the SMD Head Office.
Patch Antenna (18dBi)	Type of Antenna : Outdoor use Flat Panel Antenna Band : 4,900 - 5,000 (MHz) Polarisation : Linear (Vertical)	1	For transmitting and receiving data from OFDM Wireless Transceiver.

	Input impedance : 50Ω Gain : 18dBi VSWR : Max 2.0 Power rating : 5W Beamwidth : 18° (Az), 18° (El) Wind speed for permissible stress method of design : 57m/s or over		
Double Switch	Port : 10/100Base-T or more, ≥5 ports Interface : IEEE 802.3 Ethernet	1	For connecting all the computing equipment with LAN.
Solar Panel (220W)	Voltage : 40V nominal Capacity : 220Wor more Module Efficiency : 16.0% or higher	1	For utilizing the sunshine radiation for generating electric power.
Battery (290Ah)	Type : Sealed Maintenance Free Battery, designed for solar powered applications System Voltage : 12V Capacity : 290Ah or more Designed life time : More than 10years based upon 30% discharge cycles	1	For supplying electric power to each system during no sunshine.
Regulator	Capacity : ≥45A (12V) System Voltage Output : 12V or 24V Solar Input Voltage : 40V Nominal Settings : Voltage at power charge commencement and completion Power and Network Monitoring : Fully integrated TCP/IP based power and network management Display : LCD Display and control to adjust settings	1	For regulating output power from solar panels and batteries.
Outdoor Cabinet	Environmental standard : IP43 or better Material : Stainless steel Input power : DC12V or DC24V Others : Earth Terminal, Circuit breaker for power-supply line, Mounting part(s) and antitheft lock Power Arrester : For power cable surge protection at both cable ends	1	For accommodating transceiver, related devises.
Indoor Cabinet	Environmental standard : IP43 or better Material : Stainless or High-strength Plastic Input power : DC12Vor DC24V Others : Earth Terminal, Circuit breaker for power-supply line, Mounting part(s) and antitheft lock	1	For accommodating regulator, double switch, etc.
IP Telephone with Dust Proof Case	VoIP function Call control protocol : SIP (RFC3261) Voice codec : G.711 μ-law/a-law Digest attestation Network function : DHCP client, DNS client, FTP client, QoS (ToS), Setting by Web browser Others : Power supply switch	1	For voice communicating in the meteorological observation network.
Connecting Steel Pole (25m)	Height : 25m Lightning protection : Lightning Rod, Conducting Wire, Ground Plate (Earthing resistance: 10Ω or less) Wind speed for permissible stress methods of design : 57m/s Finish : Galvanized steel	1	For mounting communication and observation equipment.
Service Manuals	Operation & Maintenance Hand Book	1	For maintaining the system.

Meteorological Data Communication System			
Name of Site: Mt. Valusia			
Equipment	Specification	Quantity	Purpose
OFDM Wireless Transceiver	Frequency : 4.9GHz Band Tx Output : +15dBm (20MHz System:	2	For receiving and transmitting the meteorological information

(4.9GHz)	2mW/MHz/10MHz System: 4mW/MHz) Channel : 20MHz System: 4ch/10MHz System: 6ch Modulation method : OFDM Transmission rate : 6, 9, 12, 18, 24, 36, 48, 54Mbps (20MHz System) 3, 4.5, 6, 9, 12, 18, 24, 27Mbps (10MHz System) Communication protocol : IEEE802.11j Security : ESSID,WEP, WPA-PSK,IEEE802.11i Antenna Input : 2 System (SMA), with function of SPD (Space Diversity) Cable interface : 10BASE-T/100BASE-TX		and observed data between each observation point and the SMD Head Office.
Patch Antenna (18dBi)	Type of Antenna : Outdoor use Flat Panel Antenna Band : 4,900 - 5,000 (MHz) Polarisation : Linear (Vertical) Input impedance : 50Ω Gain : 18dBi VSWR : Max 2.0 Power rating : 5W Beamwidth : 18° (Az), 18° (El) Wind speed for permissible stress method of design : 57m/s or over	2	For transmitting and receiving data from OFDM Wireless Transceiver.
Double Switch	Port : 10/100Base-T or more, ≥5 ports Interface : IEEE 802.3 Ethernet	1	For connecting all the computing equipment with LAN.
Solar Panel (270W)	Voltage : 40V nominal Capacity : 270Wor more Module Efficiency : 16.0% or higher	1	For utilizing the sunshine radiation for generating electric power.
Battery (370Ah)	Type : Sealed Maintenance Free Battery, designed for solar powered applications System Voltage : 12V Capacity : 370Ah or more Designed life time : More than 10years based upon 30% discharge cycles	1	For supplying electric power to each system during no sunshine.
Regulator	Capacity : ≥45A (12V) System Voltage Output : 12V or 24V Solar Input Voltage : 40V Nominal Settings : Voltage at power charge commencement and completion Power and Network Monitoring : Fully integrated TCP/IP based power and network management Display : LCD Display and control to adjust settings	1	For regulating output power from solar panels and batteries.
Outdoor Cabinet	Environmental standard : IP43 or better Material : Stainless steel Input power : DC12V or DC24V Others : Earth Terminal, Circuit breaker for power-supply line, Mounting part(s) and antitheft lock Power Arrester : For power cable surge protection at both cable ends	1	For accommodating transceiver, related devises.
Indoor Cabinet	Environmental standard : IP43 or better Material : Stainless or High-strength Plastic Input power : DC12Vor DC24V Others : Earth Terminal, Circuit breaker for power-supply line, Mounting part(s) and antitheft lock	1	For accommodating regulator, double switch, etc.
IP Telephone with Dust Proof Case	VoIP function Call control protocol : SIP (RFC3261) Voice codec : G.711 μ-law/a-law Digest attestation	1	For voice communicating in the meteorological observation network.

	Network function : DHCP client, DNS client, FTP client, QoS (ToS), Setting by Web browser Others : Power supply switch		
Service Manuals	Operation & Maintenance Hand Book	1	For maintaining the system.

Meteorological Data Communication System			
Name of Site: Tuasivi			
Equipment	Specification	Quantity	Purpose
OFDM Wireless Transceiver (4.9GHz)	Frequency : 4.9GHz Band Tx Output : +15dBm (20MHz System: 2mW/MHz/10MHz System: 4mW/MHz) Channel : 20MHz System: 4ch/10MHz System: 6ch Modulation method : OFDM Transmission rate : 6, 9, 12, 18, 24, 36, 48, 54Mbps (20MHz System) 3, 4.5, 6, 9, 12, 18, 24, 27Mbps (10MHz System) Communication protocol : IEEE802.11j Security : ESSID,WEP, WPA-PSK,IEEE802.11i Antenna Input : 2 System (SMA), with function of SPD (Space Diversity) Cable interface : 10BASE-T/100BASE-TX	3	For receiving and transmitting the meteorological information and observed data between each observation point and the SMD Head Office.
Patch Antenna (26dBi)	Type of Antenna : Outdoor use Flat Panel Antenna Band : 4,900 - 5,000 (MHz) Polarisation : Linear (Vertical) Input impedance : 50Ω Gain : 26dBi VSWR : Max 2 Power rating :10W Beamwidth : 6° (Az) 6° (El) Wind speed for permissible stress method of design : 57m/s or over	3	For transmitting and receiving data from OFDM Wireless Transceiver.
Patch Antenna (18dBi)	Type of Antenna : Outdoor use Flat Panel Antenna Band : 4,900 - 5,000 (MHz) Polarisation : Linear (Vertical) Input impedance : 50Ω Gain : 18dBi VSWR : Max 2.0 Power rating : 5W Beamwidth : 18° (Az), 18° (El) Wind speed for permissible stress method of design : 57m/s or over	1	For transmitting and receiving data from OFDM Wireless Transceiver.
Double Switch	Port : 10/100Base-T or more, ≥5 ports Interface : IEEE 802.3 Ethernet	1	For connecting all the computing equipment with LAN.
Solar Panel (350W)	Voltage : 40V nominal Capacity : 350Wor more Module Efficiency : 16.0% or higher	1	For utilizing the sunshine radiation for generating electric power.
Battery (470Ah)	Type : Sealed Maintenance Free Battery, designed for solar powered applications System Voltage : 12V Capacity : 470Ah or more Designed life time : More than 10years based upon 30% discharge cycles.	1	For supplying electric power to each system during no sunshine.
Regulator	Capacity : ≥45A (12V) System Voltage Output : 12V or 24V Solar Input Voltage : 40V Nominal Settings : Voltage at power charge commencement and completion Power and Network Monitoring	1	For regulating output power from solar panels and batteries.

	: Fully integrated TCP/IP based power and network management Display : LCD Display and control to adjust settings		
Outdoor Cabinet	Environmental standard : IP43 or better Material : Stainless steel Input power : DC12V or DC24V Others : Earth Terminal, Circuit breaker for power-supply line, Mounting part(s) and antitheft lock Power Arrester : For power cable surge protection at both cable ends	1	For accommodating transceiver, related devises.
Indoor Cabinet	Environmental standard : IP43 or better Material : Stainless or High-strength Plastic Input power : DC12Vor DC24V Others : Earth Terminal, Circuit breaker for power-supply line, Mounting part(s) and antitheft lock	1	For accommodating regulator, double switch, etc.
IP Telephone with Dust Proof Case	VoIP function Call control protocol : SIP (RFC3261) Voice codec : G.711 μ-law/a-law Digest attestation Network function : DHCP client, DNS client, FTP client, QoS (ToS), Setting by Web browser Others : Power supply switch	1	For voice communicating in the meteorological observation network.
Service Manuals	Operation & Maintenance Hand Book	1	For maintaining the system.

Meteorological Data Communication System			
Name of Site: Mt. Tagotala			
Equipment	Specification	Quantity	Purpose
OFDM Wireless Transceiver (4.9GHz)	Frequency : 4.9GHz Band Tx Output : +15dBm (20MHz System: 2mW/MHz/10MHz System: 4mW/MHz) Channel : 20MHz System: 4ch/10MHz System: 6ch Modulation method : OFDM Transmission rate : 6, 9, 12, 18, 24, 36, 48, 54Mbps (20MHz System) 3, 4.5, 6, 9, 12, 18, 24, 27Mbps (10MHz System) Communication protocol : IEEE802.11j Security : ESSID,WEP, WPA-PSK,IEEE802.11i Antenna Input : 2 System (SMA), with function of SPD (Space Diversity) Cable interface : 10BASE-T/100BASE-TX	2	For receiving and transmitting the meteorological information and observed data between each observation point and the SMD Head Office.
Patch Antenna (26dBi)	Type of Antenna : Outdoor use Flat Panel Antenna Band : 4,900 - 5,000 (MHz) Polarisation : Linear (Vertical) Input impedance : 50Ω Gain : 26dBi VSWR : Max 2 Power rating :10W Beamwidth : 6° (Az) 6° (El) Wind speed for permissible stress method of design : 57m/s or over	2	For transmitting and receiving data from OFDM Wireless Transceiver.
Double Switch	Port : 10/100Base-T or more, ≥5 ports Interface : IEEE 802.3 Ethernet	1	For connecting all the computing equipment with LAN.
Solar Panel (270W)	Voltage : 40V nominal Capacity : 270Wor more Module Efficiency : 16.0% or higher	1	For utilizing the sunshine radiation for generating electric power.
Battery (370Ah)	Type : Sealed Maintenance Free Battery,	1	For supplying electric power to

	designed for solar powered applications System Voltage : 12V Capacity : 370Ah or more Designed life time : More than 10years based upon 30% discharge cycles		each system during no sunshine.
Regulator	Capacity : ≥45A (12V) System Voltage Output : 12V or 24V Solar Input Voltage : 40V Nominal Settings : Voltage at power charge commencement and completion Power and Network Monitoring : Fully integrated TCP/IP based power and network management Display : LCD Display and control to adjust settings	1	For regulating output power from solar panels and batteries.
Outdoor Cabinet	Environmental standard : IP43 or better Material : Stainless steel Input power : DC12V or DC24V Others : Earth Terminal, Circuit breaker for power-supply line, Mounting part(s) and antitheft lock Power Arrester : For power cable surge protection at both cable ends	1	For accommodating transceiver, related devises.
Indoor Cabinet	Environmental standard : IP43 or better Material : Stainless or High-strength Plastic Input power : DC12Vor DC24V Others : Earth Terminal, Circuit breaker for power-supply line, Mounting part(s) and antitheft lock	1	For accommodating regulator, double switch, etc.
IP Telephone with Dust Proof Case	VoIP function Call control protocol : SIP (RFC3261) Voice codec : G.711 μ-law/a-law Digest attestation Network function : DHCP client, DNS client, FTP client, QoS (ToS), Setting by Web browser Others : Power supply switch	1	For voice communicating in the meteorological observation network.
Service Manuals	Operation & Maintenance Hand Book	1	For maintaining the system.

Meteorological Data Communication System			
Name of Site: Le Piu Tai			
Equipment	Specification	Quantity	Purpose
OFDM Wireless Transceiver (4.9GHz)	Frequency : 4.9GHz Band Tx Output : +15dBm (20MHz System: 2mW/MHz/10MHz System: 4mW/MHz) Channel : 20MHz System: 4ch/10MHz System: 6ch Modulation method : OFDM Transmission rate : 6, 9, 12, 18, 24, 36, 48, 54Mbps (20MHz System) 3, 4.5, 6, 9, 12, 18, 24, 27Mbps (10MHz System) Communication protocol : IEEE802.11j Security : ESSID,WEP, WPA-PSK,IEEE802.11i Antenna Input : 2 System (SMA), with function of SPD (Space Diversity) Cable interface : 10BASE-T/100BASE-TX	2	For receiving and transmitting the meteorological information and observed data between each observation point and the SMD Head Office.
Patch Antenna (26dBi)	Type of Antenna : Outdoor use Flat Panel Antenna Band : 4,900 - 5,000 (MHz) Polarisation : Linear (Vertical) Input impedance : 50Ω Gain : 26dBi	2	For transmitting and receiving data from OFDM Wireless Transceiver.

	VSWR : Max 2 Power rating :10W Beamwidth : 6° (Az) 6° (El) Wind speed for permissible stress method of design : 57m/s or over		
Double Switch	Port : 10/100Base-T or more, ≥5 ports Interface : IEEE 802.3 Ethernet	1	For connecting all the computing equipment with LAN.
Solar Panel (300W)	Voltage : 40V nominal Capacity : 300Wor more Module Efficiency : 16.0% or higher	1	For utilizing the sunshine radiation for generating electric power.
Battery (400Ah)	Type : Sealed Maintenance Free Battery, designed for solar powered applications System Voltage : 12V Capacity : 400Ah or more Designed life time : More than 10years based upon 30% discharge cycles	1	For supplying electric power to each system during no sunshine.
Regulator	Capacity : ≥45A (12V) System Voltage Output : 12V or 24V Solar Input Voltage : 40V Nominal Settings : Voltage at power charge commencement and completion Power and Network Monitoring : Fully integrated TCP/IP based power and network management Display : LCD Display and control to adjust settings	1	For regulating output power from solar panels and batteries.
Outdoor Cabinet	Environmental standard : IP43 or better Material : Stainless steel Input power : DC12V or DC24V Others : Earth Terminal, Circuit breaker for power-supply line, Mounting part(s) and antitheft lock Power Arrester : For power cable surge protection at both cable ends	1	For accommodating transceiver, related devises.
Indoor Cabinet	Environmental standard : IP43 or better Material : Stainless or High-strength Plastic Input power : DC12Vor DC24V Others : Earth Terminal, Circuit breaker for power-supply line, Mounting part(s) and antitheft lock	1	For accommodating regulator, double switch, etc.
IP Telephone with Dust Proof Case	VoIP function Call control protocol : SIP (RFC3261) Voice codec : G.711 μ-law/a-law Digest attestation Network function : DHCP client, DNS client, FTP client, QoS (ToS), Setting by Web browser Others : Power supply switch	1	For voice communicating in the meteorological observation network.
Connecting Steel Pole (10m)	Height : 10m Lightning protection : Lightning Rod, Conducting Wire, Ground Plate (Earthing resistance: 10Ω or less) Wind speed for permissible stress methods of design : 57m/s Finish : Galvanized steel	1	For mounting communication and observation equipment.
Service Manuals	Operation & Maintenance Hand Book	1	For maintaining the system.

Meteorological Data Communication System			
Name of Site: Vaisala			
Equipment	Specification	Quantity	Purpose
OFDM Wireless Transceiver (4.9GHz)	Frequency : 4.9GHz Band Tx Output : +15dBm (20MHz System: 2mW/MHz/10MHz System: 4mW/MHz)	2	For receiving and transmitting the meteorological information and observed data between each observation point and the SMD

	Channel : 20MHz System: 4ch/10MHz System: 6ch Modulation method : OFDM Transmission rate : 6, 9, 12, 18, 24, 36, 48, 54Mbps (20MHz System) 3, 4.5, 6, 9, 12, 18, 24, 27Mbps (10MHz System) Communication protocol : IEEE802.11j Security : ESSID,WEP, WPA-PSK,IEEE802.11i Antenna Input : 2 System (SMA), with function of SPD (Space Diversity) Cable interface : 10BASE-T/100BASE-TX		Head Office.
Patch Antenna (26dBi)	Type of Antenna : Outdoor use Flat Panel Antenna Band : 4,900 - 5,000 (MHz) Polarisation : Linear (Vertical) Input impedance : 50Ω Gain : 26dBi VSWR : Max 2 Power rating :10W Beamwidth : 6° (Az) 6° (El) Wind speed for permissible stress method of design : 57m/s or over	2	For transmitting and receiving data from OFDM Wireless Transceiver.
Double Switch	Port : 10/100Base-T or more, ≥5 ports Interface : IEEE 802.3 Ethernet	1	For connecting all the computing equipment with LAN.
Solar Panel (270W)	Voltage : 40V nominal Capacity : 270Wor more Module Efficiency : 16.0% or higher	1	For utilizing the sunshine radiation for generating electric power.
Battery (370Ah)	Type : Sealed Maintenance Free Battery, designed for solar powered applications System Voltage : 12V Capacity : 370Ah or more Designed life time : More than 10years based upon 30% discharge cycles.	1	For supplying electric power to each system during no sunshine.
Regulator	Capacity : ≥45A (12V) System Voltage Output : 12V or 24V Solar Input Voltage : 40V Nominal Settings : Voltage at power charge commencement and completion Power and Network Monitoring : Fully integrated TCP/IP based power and network management Display : LCD Display and control to adjust settings	1	For regulating output power from solar panels and batteries.
Outdoor Cabinet	Environmental standard : IP43 or better Material : Stainless steel Input power : DC12V or DC24V Others : Earth Terminal, Circuit breaker for power-supply line, Mounting part(s) and antitheft lock Power Arrester : For power cable surge protection at both cable ends	1	For accommodating transceiver, related devises.
Indoor Cabinet	Environmental standard : IP43 or better Material : Stainless or High-strength Plastic Input power : DC12Vor DC24V Others : Earth Terminal, Circuit breaker for power-supply line, Mounting part(s) and antitheft lock	1	For accommodating regulator, double switch, etc.
IP Telephone with Dust Proof Case	VoIP function Call control protocol : SIP (RFC3261) Voice codec : G.711 μ-law/a-law Digest attestation Network function : DHCP client, DNS client, FTP client, QoS (ToS), Setting by Web browser	1	For voice communicating in the meteorological observation network.

	Others : Power supply switch		
Service Manuals	Operation & Maintenance Hand Book	1	For maintaining the system.

Meteorological Data Communication System			
Name of Site: Mt. Talu			
Equipment	Specification	Quantity	Purpose
OFDM Wireless Transceiver (4.9GHz)	Frequency : 4.9GHz Band Tx Output : +15dBm (20MHz System: 2mW/MHz/10MHz System: 4mW/MHz) Channel : 20MHz System: 4ch/10MHz System: 6ch Modulation method : OFDM Transmission rate : 6, 9, 12, 18, 24, 36, 48, 54Mbps (20MHz System) 3, 4.5, 6, 9, 12, 18, 24, 27Mbps (10MHz System) Communication protocol : IEEE802.11j Security : ESSID,WEP, WPA-PSK,IEEE802.11i Antenna Input : 2 System (SMA), with function of SPD (Space Diversity) Cable interface : 10BASE-T/100BASE-TX	1	For receiving and transmitting the meteorological information and observed data between each observation point and the SMD Head Office.
Patch Antenna (26dBi)	Type of Antenna : Outdoor use Flat Panel Antenna Band : 4,900 - 5,000 (MHz) Polarisation : Linear (Vertical) Input impedance : 50Ω Gain : 26dBi VSWR : Max 2 Power rating :10W Beamwidth : 6° (Az) 6° (El) Wind speed for permissible stress method of design : 57m/s or over	1	For transmitting and receiving data from OFDM Wireless Transceiver.
Double Switch	Port : 10/100Base-T or more, ≥5 ports Interface : IEEE 802.3 Ethernet	1	For connecting all the computing equipment with LAN.
Solar Panel (220W)	Voltage : 40V nominal Capacity : 220W or more Module Efficiency : 16.0% or higher	1	For utilizing the sunshine radiation for generating electric power.
Battery (290Ah)	Type : Sealed Maintenance Free Battery, designed for solar powered applications System Voltage : 12V Capacity : 290Ah or more Designed life time : More than 10years based upon 30% discharge cycles	1	For supplying electric power to each system during no sunshine.
Regulator	Capacity : ≥45A (12V) System Voltage Output : 12V or 24V Solar Input Voltage : 40V Nominal Settings : Voltage at power charge commencement and completion Power and Network Monitoring : Fully integrated TCP/IP based power and network management Display : LCD Display and control to adjust settings	1	For regulating output power from solar panels and batteries.
Outdoor Cabinet	Environmental standard : IP43 or better Material : Stainless steel Input power : DC12V or DC24V Others : Earth Terminal, Circuit breaker for power-supply line, Mounting part(s) and antitheft lock Power Arrester : For power cable surge protection at both cable ends	1	For accommodating transceiver, related devises.

Indoor Cabinet	Environmental standard : IP43 or better Material : Stainless or High-strength Plastic Input power : DC12Vor DC24V Others : Earth Terminal, Circuit breaker for power-supply line, Mounting part(s) and antitheft lock	1	For accommodating regulator, double switch, etc.
IP Telephone with Dust Proof Case	VoIP function Call control protocol : SIP (RFC3261) Voice codec : G.711 μ-law/a-law Digest attestation Network function : DHCP client, DNS client, FTP client, QoS (ToS), Setting by Web browser Others : Power supply switch	1	For voice communicating in the meteorological observation network.
Connecting Steel Pole (20m)	Height : 20m Lightning protection : Lightning Rod, Conducting Wire, Ground Plate (Earthing resistance: 10Ω or less) Wind speed for permissible stress methods of design : 57m/s Finish : Galvanized steel	1	For mounting communication and observation equipment.
Service Manuals	Operation & Maintenance Hand Book	1	For maintaining the system.

Maintenance Equipment for Meteorological Data Communication System			
Name of Site: Samoa Meteorology Division, Head Office			
Equipment	Specification	Quantity	Purpose
Maintenance Terminal	O/S : Windows XP or VISTA CPU : Intel Core2 Duo T8300 or better Memory : 2GB or more Software : Necessary Software for fault diagnosis and testing Accessory : Interface Cable	2	For maintaining the system.
Spare Parts	OFDM Wireless Transceiver (4.9GHz)	5	For maintaining the system.
	Patch Antenna (26dBi)	3	
	Patch Antenna (21dBi)	2	
	Patch Antenna (18dBi)	2	
	Omni direction Antenna (6dBi)	1	
	LAN Arrester	20	
	Power Cable Arrester	10	
	Power Supply Unit for Transceiver (DC/DC)	2	
	Power Supply Unit for Transceiver (AC/DC)	2	
	Regulator	2	
	Outdoor weather resistance shield LAN Cable	10	
	Solar Panel	4	

Meteorological Data Management System			
Name of Site: Samoa Meteorology Division, Head office (Equipment Shed)			
Equipment	Specification	Quantity	Purpose
Meteorological Data Acquisition Unit	Hardware: Tower type CPU : Intel Xeon, 2.4GHz or equivalent Main memory (RAM) : 4GB or more Hard Disk : 500GB x 2 Drive or more, Raid configuration, hot swappable Monitor display : Colour LCD type, 19 inches or more, 1280×1024 or more LAN Interface : 10/100 BASE-T LAN Arrester : for surge protection, RJ45 interface DVD-R/W drive : one (1) drive Timing : GPS based time synchronization Software: O/S : Windows Server or LINUX - Data Collection from all 7 AWS provided under the Programme - Data Collection from Faleolo International Airport AWOS site	1	For collecting and processing observed data from each observation point for recording.

	- Data Collection from existing stations (subject to appropriate data format information being obtained) - Display of data from sites in both graphical format, graph and table format - Storage and management of data - Output of data to GTS and other systems (to be determined) - Automatic and manual generation of standard WMO reports (SYNOP) - Editing of automatic and manual reports - Remote monitoring and diagnosis of the AWS and AWOS stations		
Meteorological Data Retrieval Unit	Hardware: Tower Type CPU : Intel Xeon 2.4 GHz or equivalent Main memory (RAM) : 4GB or more Hard disk unit : 500GB x 2 Drive or more Monitor display : Colour LCD type, 19 inches or more, 1280×1024 or more LAN Interface : 10/100 BASE-T LAN Arrester : for surge protection, RJ45 interface DVD-R/W drive : one (1) drive Software O/S : Windows Server or LINUX - Tide and Meteorological Data Retrievable System - Accesses data from Meteorological Data Acquisition Unit - Interchangeable with Meteorological Data Acquisition Unit – can function as a back-up - Includes remote site acquisition and display software - Fault and error diagnostics - Real time communications monitoring - OFDM Radio network data interface - Formats data for database - Provides graphs of meteorological and tidal data for user examination - Provide displays for selected sites of meteorological and tidal parameters including site location, local and UTC time, current meteorological data and tide and predicted tide - The user can move from site to site by clicking on the site name - Facility to set for “Manual or Auto” displays to allow the user to automatically cycle through the different sites	1	For retrieving and processing meteorological data.
Meteorological Data Storage Server	Hardware: Tower Type CPU : Intel Xeon 2.4 GHz or equivalent Main memory (RAM) : 4GB or more Hard disk unit : 500GB x 2 Drive or more, Raid configuration, hot swappable Monitor display : Colour LCD type, 19 inches or more, 1280×1024 or more LAN Interface : 10/100 BASE-T LAN Arrester : for surge protection, RJ45 interface DVD-R/W drive : one (1) drive Software O/S : Windows Server or LINUX - Primary function is the integration and quality control of meteorological and tidal data - SciView data display and graphing package or equivalent - Automatically receives data from Meteorological Data Acquisition Unit - Statistical processing of meteorological, tidal and climate data - Quality control function with outlier rejection - Fault and error diagnostics - Log data receptions - Generation of routine reports and summaries - Graphing and display of values and trends in meteorological and	1	For recording and archiving the observed data and meteorological products.

	tidal parameters both in real time and using historical data - SYNOP Data output to GTS Message Switch System - Sends meteorological and tidal data to Message Switch Communications Units and to Data Storage Server		
Meteorological Data Display Unit	Hardware: Tower Type CPU : Intel Core 2 Duo, 2GHz or better Main memory (RAM) : 2GB or better Hard disk unit : 500GB x 2 Drive or more Monitor display : Colour LCD type, 19 inches or more, 1280×1024 or more LAN Interface : 10/100 BASE-T LAN Arrester : for surge protection, RJ45 interface DVD-R/W drive : one (1) drive Software O/S : Windows Server or LINUX AWOS & AWS Display Software : Graphical Display of all meteorological data on a single screen per site and all sites simultaneously. - Graph and table display of Data - Tabular display of Data - Export function for selected data AWOS, AWS & Repeater Network Monitoring Software : Collection of Battery and Solar condition from all repeater, AWS and AWOS sites on a regular basis including voltages, power consumption and charging current (Ah) : Alarm and warning facilities in pre-determined conditions. : Graphical Display of collected data	1	For displaying weather observation data and information.
Scanner A3	Document Size : Min A3 (304.8 x 431.8 mm) Resolution : 1200 dpi Speed : Under 10 sec for one A3 document (300 dpi) Computer Interface : USB 2.0	1	For scanning materials of meteorological product
A3 Color Printer	Color Ink-jet printer Maximum paper size : A3 Resolution : 1,200 Dots per inch (DPI) or more Printing speed : More than 7 ppm Interface : USB, LAN (Ethernet Printer Port) Input power : AC230V (single pahse, 50Hz)	2	For printing weather observation data and information.
Double Switch	Port : 10/100Base-T or more, ≥24 ports Interface : IEEE 802.3 Ethernet	1	For connecting all the computing equipment with LAN.
DVD Drive	Type : External unit Interface : USB Acceptable media : -R/+R/-RW/+RW	2	For reading and recording data.
Off-line Data Processing Unit	Hardware: CPU : Intel Core2 Duo, 2GHz or equivalent Main memory (RAM) : 4GB or more Hard disk : 500GB x two (2) drives or more Monitor display : Colour LCD type, 19 inches or more, 1280×1024 or more DVD-R/W drive : one (1) drive Software: O/S : Microsoft Windows XP or VISTA Application software : Microsoft Office Ver.2007 or better	1	For preparing and recording of documents, equipment maintenance records, etc.
3kVA UPS	Capacity : 3kVA or more Input power : AC 230V ±15% (single phase, 50Hz) Output power : AC 230V ±5% (single phase, 50Hz) Back up time : at least 5 minutes at full load	1	For supplying stable power to each equipment and peripheral.
Compact UPS	Capacity : 600VA or more Input power : AC 230V ±15% (single phase, 50Hz) Output power : AC 230V ±5% (single phase, 50Hz) Back up time : at least 5 minutes at full load	5	For supplying stable power to each apparatus and peripheral.
Spare Parts	Power Unit for Server	2	For maintaining the system.
	Hard disk for the computer (500GBz) or Bigger	5	
	LAN Arrester	10	

	USP Battery (3kVA)	1	
	Battery for Compact UPS	4	
Service Manuals	Operation & Maintenance Hand Book	1	For maintaining the system.

Meteorological Data Management System			
Name of Site: Samoa Meteorology Division, Head office (Climate Consultant Service Section)			
Equipment	Specification	Quantity	Purpose
Data Storage Server	Hardware: Tower Type CPU : Intel Xeon 2.4 GHz or equivalent Main memory (RAM) : 4GB or more Hard disk unit : 500GB x 2 Drive or more, Raid configuration, hot swappable Monitor display : Colour LCD type, 19 inches or more, 1280×1024 or more DVD-R/W drive : one (1) drive Software O/S : Windows Server or LINUX - Functions as Central Database server - Maintains metadata database - Serves real time data - Serves historical data to network and internet - Creates reliable, backed-up database - Automatically receives data from Meteorological Data Acquisition Unit/Meteorological Data Storage Server - Statistical processing of meteorological, tidal and climate data - Quality control including outlier rejection - Report logging - Graphing of trends in meteorological, tidal and climate data	1	For recording and archiving the observed data and meteorological products.
Climate Data Processing Unit	Hardware: Tower Type CPU : Intel Xeon 2.4 GHz or equivalent Main memory (RAM) : 4GB or more Hard disk unit : 500GB x 2 Drive or more Monitor display : Colour LCD type, 19 inches or more, 1280×1024 or more LAN Interface : 10/100 BASE-T LAN Arrester : for surge protection, RJ45 interface DVD-R/W drive : one (1) drive Software O/S : Windows or LINUX Fully complies with WMO CDMS guidelines - Integrated user interface - Based on widely available database technology - Quality control - Storage and management of metadata about the observations and recording instruments - Ability to import climate data and observational data from standard applications software such as Excel spreadsheets - Ability to import GTS data - Data entry module for specified quality control mechanisms - Metadata management - Comprehensive data extraction tools - Full range of products available, such as daily, decadal, monthly and annual reports; and maps, diagrams and data subsets - Export into different formats - Installation and setup package - Capable of expansion for new data types, including new data entry forms - Capable of customization for additional products - Systems Management facilities for administering the database and for tailoring the functions of the system to local needs. - The system must include on-line documentation, forms and menus with context sensitive help, forms which prevent illegal	1	For processing and analysing climate data.

	user input in entry fields, error messages generated for illegal inputs.		
Climate Data Retrieval Unit	Hardware: Tower Type CPU : Intel Xeon 2.4 GHz or equivalent Main memory (RAM) : 4GB or more Hard disk unit : 500GB x 2 Drive or more Monitor display : Colour LCD type, 19 inches or more, 1280×1024 or more DVD-R/W drive : one (1) drive Software O/S : Windows Server or LINUX Fully complies with WMO CDMS guidelines. - Back up function for Climate Data Processing Unit - Integrated user interface - Based on widely available database technology - Quality control - Storage and management of metadata about the observations and recording instruments - Ability to import climate data and observational data from standard applications software such as Excel spreadsheets - Ability to import GTS data - Data entry module should have specified quality control mechanisms - Comprehensive data extraction tools - Full range of products available, such as daily, decadal, monthly and annual reports; and maps, diagrams and data subsets - Export into different formats - Capable of expansion for new data types, including new data entry forms - Capable of customization for additional products - Systems Management facilities for administering the database and for tailoring the functions of the system to local needs. - The system must include on-line documentation, forms and menus with context sensitive help, forms which prevent illegal user input in entry fields, error messages generated for illegal inputs.	1	For retrieving and processing meteorological data.
A3 Color Printer	Color Ink-jet printer Maximum paper size : A3 Resolution : 1,200 Dots per inch (DPI) or more Printing speed : More than 7 ppm Interface : USB, LAN (Ethernet Printer Port) Input power : AC 230V (single phase, 50Hz)	1	For printing of climate data and information.
Double Switch	Port : 10/100Base-T or more, ≥8 ports Interface : IEEE 802.3 Ethernet	1	For connecting all the computing equipment with LAN.
DVD Drive	Type : External unit Interface : USB Acceptable media : -R/+R/-RW/+RW	1	For reading and recording data.
Off-line Data Processing Unit	Hardware: CPU : Intel Core2 Duo, 2GHz or equivalent Main memory (RAM) : 4GB or more Hard disk : 500GB x two (2) drives or more Monitor display : Colour LCD type, 19 inches or more, 1280×1024 or more DVD-R/W drive : one (1) drive Software: O/S : Microsoft Windows XP or VISTA Application software : Microsoft Office Ver.2007 or better	1	For preparing and recording of documents, equipment maintenance records, etc.
Compact UPS	Capacity : 600VA or more Input power : AC 230V ±15% (single phase, 50Hz) Output power : AC 230V ±5% (single phase, 50Hz) Back up time : at least 5 minutes at full load	4	For supplying stable power to each equipment and peripheral.
Service Manuals	Operation & Maintenance Hand Book	1	For maintaining the system.

GTS Message Switch System			
Name of Site: Samoa Meteorology Division, Head office			
Equipment	Specification	Quantity	Purpose
GTS Message Switch Communications Unit	Hardware: Tower Type CPU : Intel Xeon, 2.4GHz or equivalent Main memory (RAM) : 4GB or more Hard disk unit : 500GB x two (2) drives or more Monitor display : Colour LCD type, 19 inches or more, 1280×1024 or more DVD-R/W : one (1) drive Software: O/S : LINUX or Windows Application software: [GTS Switching Functions] - The MSS must be able to handle reception, transmission and switching of alphanumeric messages as well as binary messages especially those in BUFR and GRID formats as specified in the ”WMO Manuals on CODES, WMO Report No. 306”. - Operational procedures must be based on the specification in "Part ll, Operational Procedures for the GTS" found in the "WMO Manual for the GTS, WMO Report No. 386". [Message Processing] Receive, store, and process all type of WMO messages, conforming to: - WMO procedures as defined in the Manual on Global Telecommunication System (WMO No. 386). - WMO Guide on the Use of TCP/IP on GTS, as well as WMO VPN Guide. - WMO Manual on codes (WMO No. 306). - Send and receive meteorological messages on Aeronautical Fixed Telecommunication Network (AFTN). The system should be able to interchange and convert between WMO and AFTN format messages, if required, to meet WMO as well as AFTN (ICAO) specifications. - Compile routinely selectable meteorological reports into GTS alphanumeric bulletins as well as BUFR bulletins and send them out to predefined destinations according to the procedures defined in the WMO Report No. 386. Bulletin preparation should be done automatically. Bulletin switching should also be done automatically, controlled by switching tables. - The software must be able to collect meteorological reports from received bulletins, compile them into new bulletins and send them out to predefined destinations according to the procedures defined in the WMO Manual on the GTS, WMO Report No. 386. It must be possible to extract reports from and compile into both formats - traditional alphanumeric codes (TAC) as well as Binary Universal Form for the Representation of meteorological data (BUFR). [Data Message Edit Menu] Edit WMO messages: - A GUI window menu for the creation of addressed messages for administrative, data, request for GTS data and service messages following the WMO addressed message format implemented in 1992. - The window must have a configurable auto return (set to 72 characters by default). - The message framing, header and contents must follow WMO GTS format. - The software must perform a check on formatting before transmission. - A GUI window menu for the creation of addressed messages for the request to AFTN OPMET databases is required.	2	For transmitting and receiving the observed data globally through the GTS network.

	- A GUI window menu for the creation of free format message is required. - A GUI window for editing of the rejected messages and reports. [Line Operation] Must be able to transmit and receive data via the GTS, the Internet and VPN Internet connections. - TCP/IP socket connections - For exchange of messages connected via TCP/IP network as well as future GTS - International line connections. The GTS connection must follow WMO report on the "Guidelines on the Use of the Transmission Control protocol/Internet Protocol (TCP/IP on the Global Telecommunication System (GTS)". FTP Input FTP Output E-mail TTY connections		
Double Switch	LAN Interface : IEEE802.3 Ethernet Connection Port : 1000BASE-TX or more, ≥8 ports	1	For connecting all the computing equipment with LAN.
Double Router	Gigabit 8 port or more, VPN end point, Firewall, Remote operation NAT (Telephone line, GSM, 3G network or internet).	1	For connecting and routing all computing equipment on LAN.
Compact UPS	Capacity : 600VA or more Input power : AC 230V ±15% (single phase, 50Hz) Output power : AC 230V ±5% (single phase, 50Hz) Back up time : at least 5 minutes at full load	2	For supplying stable power to each equipment and peripheral.
Service Manuals	Operation & Maintenance Hand Book	2	For maintaining the system.

Meteorological Satellite Data Receiving System

Name of Site: Samoa Meteorology Division, Head office

Equipment	Specification	Quantity	Purpose
Satellite Data Acquisition Unit	Hardware: Tower Type CPU : Intel Xeon, 2.4GHz or equivalent Main memory (RAM) : 4GB or more Hard disk unit : 500GB x 2 Drive or more Monitor display : Colour LCD type, 19 inches or more, 1280×1024 or more DVD-R/W : one (1) drive Software: O/S : LINUX Application software: - Log system operation. - Receive data from the receiver and store raw data to disk. - Conversion of the raw data to calibrated and navigated data files ("pre-processed data"). - Store at least 24 hours of pre-processed data on the hard drive. The operator shall be able to specify files to keep permanently on-line. - There shall be a "quick-look" display of the data as it is being received. - Ability to receive satellite data via the GTS and the Internet - Monitoring and control of the reception process.	1	For processing raw data for Satellite Data Processing Unit and monitoring the system operation.
Satellite Data Processing Unit	Hardware: Tower Type CPU : Intel Xeon, 2.4GHz or equivalent Main memory (RAM) : 4GB or more Hard disk unit : 500GB x 2 Drive or more Monitor display : Colour LCD type, 19 inches or more, 1280×1024 or more DVD-R/W : one (1) drive Software: O/S : LINUX Application software: For data processing	1	For analyzing the formatted data and processing high level meteorological output suitable for weather forecasting, event evaluation and research.

	- Receive data from the Acquisition Workstation - Store raw and processed data for rapid retrieval. - Archive data according to an archive schedule. - Act as database for satellite data, output products and textual information relating to processing of MTSAT data. - Monitor the reception process. For data display - Input: Geo-referenced, calibrated imageries (channels: VIS, IR, WV) - Projection: Mercator, equidistant cylindrical, stereographic, lambert, equal area, satellite view, polyconic and orthographic - Coast line: overlay feature - Overlay of other information: meteorological symbols, signs - Contour display - Zooming of imagery - Animation - indication of numerical value/information of a location pointed by pointing device: latitude & longitude, temperature, albedo - Calculation of range, direction and speed - Generation of Level 2 products, including; ・ Cloud-top pressure ・ Cloud-top height ・ Cloud-top temperature ・ Cloud type ・ Cloud amount ・ Sea-surface temperature ・ Land-surface temperature ・ Fire points product - Image format saving feature: JPEG, PNG, BMP, TIFF, GIF, HDF, netCDF		
DVD Drive	Type : External unit Interface : USB Acceptable media : -R/+R/-RW/+RW	1	For reading and recording data.
Compact UPS	Capacity : 600VA or more Input power : AC 230V ±15% (single phase, 50Hz) Output power : AC 230V ±5% (single phase, 50Hz) Back up time : at least 5 minutes at full load	2	For supplying stable power to each equipment and peripheral.
Service Manuals	Operation & Maintenance Hand Book	2	For maintaining the system

Forecast Support System			
Name of Site: Samoa Meteorology Division, Head office			
Equipment	Specification	Quantity	Purpose
Forecast Support Unit	Hardware: Tower Type CPU : Intel Xeon, 2.4GHz or equivalent Main memory (RAM) : 4GB or more Hard disk unit : 500GB x two (2) or more Monitor display : Color LCD type, 19 inches or more, 1280×1024 or more DVD-R/W : one (1) drive Software: O/S : LINUX or Windows Application software: [Main Functions] ・ Display, generating and printing of surface charts, upper-air charts, weather charts, model output, remote-sensing imagery ・ Overlaying of any kind of meteorological data and features ・ Display of NWP products ・ Preparing forecasts and forecast charts ・ Horizontal and vertical cross sections ・ Thermodynamic charts from observations and models ・ Report correction	2	For preparing weather forecasts and warnings through integration, analysis, etc. of the local observed data, data & meteorological products of the WMO member countries received via the GTS network, MTSAT data, regular meteorological information of Fiji RSMC, etc. for prompt dissemination.

	[Compliance] ・ WMO Manual No. 386 (Manual on GTS, incl. Attachment II) ・ WMO Manual No. 306 (Manual on Codes) ・ WMO Manual No. 485 (Manual on Global Data Processing System) ・ ICAO Annex 3 (incl. Amendment 73) ・ ISCS [Time Synchronization] ・ By GPS		
Compact UPS	Capacity : 600VA or more Input power : AC 230V ±15% (single phase, 50Hz) Output power : AC 230V ±5% (single phase, 50Hz) Back up time : at least 5 minutes at full load	2	For supply of stable power to each equipment and peripheral.
Service Manuals	Operation & Maintenance Hand Book	2	For maintaining the system.

Early Warning System

Name of Site: Samoa Meteorology Division, Head office

Equipment	Specification	Quantity	Purpose
Disaster Alert Messaging Unit	Hardware: Tower Type CPU : Intel Xeon 2.4GHz or equivalent RAM : 4GB Hard Disk : 500GB x 2 drivers or more Monitor Display : Color LCD type, 19 inches or more, 1280×1024 or more DVD-R/W : one (1) drive Software: OS : Windows - Manually compose messages - Select from pre-defined messages - Schedule messages - Select from destination database (names, mobile nos, email add, etc) - Create and edit destination database - Check status of transmitted messages	1	For disseminating early warning through the mobile telephone network.
GSM Modem	GPRS class : 10 or more EDGE class : 6 or more Frequency :Dual band (900, 1800MHz) Interface : USB	2	For connecting the existing mobile network.
Compact UPS	Capacity : 600VA or more Input power : AC 230V ±15% (single phase, 50Hz) Output power : AC 230V ±5% (single phase, 50Hz) Back up time : at least 5 minutes at full load	2	For supply of stable power to each apparatus and peripheral.
Spare Parts	GSM Modem	1	For maintaining the system.
Service Manuals	Operation & Maintenance Hand Book	2	For maintaining the system.

Power Back-up System

Name of Site: Samoa Meteorology Division, Head office

Equipment	Specification	Quantity	Purpose
Isolation Transfer	Capacity : 15kVA or more Input/Out power : AC 230V, 3-phase, 3-wire, 50Hz Surge Voltage : 30kVA or more	1	For protecting each equipment from serge voltage in main power.
AVR	Capacity : 15kVA or more Input power : AC 230V ±20%, 3-phase, 3-wire, 50Hz Output power : AC 230V ±5%, 3-phase, 3-wire, 50Hz	1	For supplying the constant or regulated voltage to the system.
Solar Panel	Capacity : 10kW or more Voltage : 40V nominal Module Efficiency : 16.0% or higher	1	For utilizing the sunshine radiation for generating electric power.
Solar Power Controller	General : AC Inverter with Grid Connection with MPPT Solar Voltage Range : 230-500VDC	1	For regulating output power from solar panels and commercial power.

	Input Current (Max) : 54.9A AC Output (Max) : 12kW (AC230V, 3phase, 50Hz) Efficiency (Max) : 96%		
Diesel Engine Generator	Excitation : Brushless type with AVR Rated speed : 1500 rpm Power : 20kVA Voltage : 415V 50Hz, 3 phase Fuel tank : Single shared Fuel Tank - 1000L Enclosure : Silenced, weatherproof, lockable Noise level : 63dB(A) @ 7m Control Unit: - Automatic transfer & manual switch	2	For generating stable electric power by diesel engine.
Consumables	Air Filter for Diesel Engine Generator	2	For maintaining the system.
	Oil Filter for Diesel Engine Generator	2	
Service Manuals	Operation & Maintenance Hand Book	2	For maintaining the system.

Wind Profiler System

Name of Site: Samoa Meteorology Division, Head office

Equipment	Specification	Quantity	Purpose
Antenna Unit	Type : Active Phased Array Antenna Aperture : 3m^2 or more Antenna Gain : 29dBi or more Beam Width : 6° or less at -3dB power point Polarization : Linear Zenith Angle : Fixed angle (10° - 15°) Installation Area : 6 m^2 or less	1	For electrical high speed beam scanning to Zenith, North, East, South, and West direction, and transmitting pencil beam towards the sky and receiving scattered echo from atmosphere.
Transmitter and Receiver Unit	Frequency : 1,290MHz Peak Power : 2,000W or more (It is prescribed with the actual radiated peak power from antenna elements) Average Power : 700W or more (It is prescribed with the actual radiated average power from antenna elements) Band Width : 10MHz or less Pulse Width : 2/3, 1, 4/3, 2, 8/3, 4μs (variable) Pulse Compression : 1, 2, 4, 8, 16 bits (variable) (Optimum Complementary Code)	1	For amplifying the signal by solid-state amplifiers and transmitting the signal to Antenna Unit and the echo transmitted by low noise amplifiers, and also transmitting the signal to Signal Processing Unit.
Power Supply Unit	Input power : AC 230V, single phase, 50Hz Module replacement : Individual replacement Monitoring function : Detection of abnormal output power and cooling fan failure	1	For making and supplying DC power to operate circuits of Antenna Unit and Transmitter/Receiver Unit.
Wind Profiler UPS	Capacity : 7,500VA or more Input power : AC 230V ±15%, single phase, 50Hz Output power : AC 230V ±5%, single phase, 50Hz Back up time : at least 5 minutes at full load Designed life time : Not less than 10 years	1	For supplying AC power by batteries when the interruption of AC power supply occurs.
Signal Processing Unit	A/D Converter : 14 bits or more Sampling Frequency : 1.5, 1, 0.75, 0.5, 0.375, 0.25MHz (variable) FFT Number : 64, 128, 256, 512 (variable) Coherent Integration : less than 200 (variable) Incoherent Integration : variable Observation Time Resolution : 1min. or less (variable) Output Data : Spectrum Raw Data (binary)	1	For digitizing the analog signal transmitted from Transmitter/Receiver Unit, and carrying out decode of pulse compression, integration, FFT, and averaging to the digitized data, and producing the spectrum data. For storing the spectrum data in HDD and transmitting to Data Processing Unit.
Data Processing Unit	<Hardware> CPU : Intel Core2 Duo 2GHz or equivalent RAM : 2GB or more Hard Disk : 500GB x two (2) drive or more Monitor : Color LCD type, 19 inches or more, 1280×1024 or more	1	For operating the system such as observation start, observation stop, and setting of observation parameters by using GUI. For carrying out removal of ground echo, fitting, and quality

	LAN Interface : 10/100BASE-T, two (2) ports or more LAN Arrester : for surge protection, RJ45 interface DVD-R/W : one (1) drive Input Power : AC 230V, 50Hz, single phase <Software> O/S : Windows XP Data Archiving Software shall be able to output following data; Spectrum Raw Data Element : spectrum Time Resolution : 1min. Moment Data (fitting data) Element : Peak Power, Doppler Frequency, Spectrum Width (half power width), Noise level Time Resolution : 1min. (after 10min. quality control) Average data (quality checked data) Element : Peak Power, Doppler Frequency, Spectrum Width (half power width), Noise level Time Resolution : 10 min. ASCII Data (quality checked data) Element : Wind speed, Wind direction, U, V, W, Temperature, etc. Time Resolution : 10min. Status Data (WPR status information data) Element : Monitoring Status Time Resolution : Recorded every 1min. (1 file/day)		control to the spectrum data transmitted from signal Processing Unit. For producing and storing the moment data and 10 minutes average data which is basic data of wind velocity calculation.
Sound Source Unit (RASS)	Sound Source : 4 sources Power Capacity of Speakers : 100W or more Output Power of Amplifiers : 100W or more Frequency Range : variable	1	For observing temperature up to approx. 1.4km high in the sky.
Clutter Fence	Material : Stainless steel mesh Mesh Size : 8mm × 8mm or less Oblique Angle : 20degree - 30degree (Zenith Angle) Installation Area : 50m^2 (7m × 7m) or less	1	For shielding the lateral leaky wave and suppressing the ground echo (clutter).
Spectrum Analyser	Frequency Frequency range : 100kHz to 3.0GHz Frequency reference : Aging ±1ppm/yr, Accuracy ±2ppm Frequency span : 10Hz to 2.99GHz in 1, 2, 5 step selections in auto mode, plus zero span Sweep time : ≤1.1 second full span	1	For maintaining the system.
Oscilloscope	Bandwidth : 300 MHz Channels : 2 Sample rate on Each Channel : 2.5 GS/s	1	For maintaining the system.
Frequency Conversion Unit	RF port : 1.29GHz LO port : 1.16GHz IF port : 130MHz	1	For maintaining the system.
Attenuator	Attenuation : 60dB (40dB+20dB) Maximum Input Power : 150W(average)	1	For maintaining the system.
High Frequency Semi-Flexible Cable	UT141 equivalent Length : 4.5m, 1.5m, 1m	1	For maintaining the system.
Test Instruments and Materials	Tool Kit	1	For maintaining the system.
	Extension Code	1	
	Water Level	1	
	Aluminium Step Ladder	2	
Spare Parts	Fan for Transmitter and Receiver Unit	7	For maintaining the system.
	Fan for Power Supply Unit	2	
	DC Power Device Type P for Power Supply Unit	4	
	DC Power Device Type S for Power Supply Unit	4	
	Filter for Power Supply Unit	4	
	DC Power Device Type P for Signal Processing Unit	1	
	DC Power Device Type S for Signal Processing Unit	1	

	Fan for Signal Processing Unit	2	
	Main PC for Signal Processing Unit	1	
	DSP/AD Board for Signal Processing Unit	1	
	Antenna Control Board for Signal Processing Unit	1	
	High Power Amplifier for Transmitter and Receiver Unit	2	
	Low Noise Amplifier for Antenna Unit	2	
Service Manuals	Operation & Maintenance Hand Book	2	For maintaining the system.

(3) Basic Plan of the Ancillary Facility

1) Site and Ancillary Facility Layout Plan

The premises of the SMD Head Office is located at the tip of the cape with commercial power supply and has ample space for the ancillary facilities (Power Back-up Shed, Equipment Shed and Foundation of Wind Profiler System) to be constructed under the Programme for the equipment.

SMD Head Office, Apia

In addition, each site for installation of the Meteorological Data Communication System including Data Repeater System, the Airport Weather Observation System (AWOS) and the Automatic Weather System (AWS) composing the meteorological observation network has enough space for construction of a concrete shelter.

2) Site and Ancillary Facility Layout Plan

[1] Floor Plan

Construction methods and materials follow local practice and the buildings are of standard grade in Samoa. The floor area of each room, the room's function and the method of calculation of the size of each room are shown in the following tables.

Table 23: Calculation Base of Each Ancillary Facility

Name of Room	Floor Area (m^2)	Room Function	Calculation Base
Power Back-up Shed	29.25	For installation of 2 engine generators, 1,000 litter service tank, battery, isolation transformer, automatic change-over switch , etc.	Operation and maintenance space for engine generators (2)
Equipment Shed	38.44	For installation of Meteorological Data Management System, GTS Message Switch System, Meteorological Satellite Data Receiving System, Forecast Support System, Early Warning System, Signal Processor of Wind Profiler System, UPS, Shelves of Maintenance Instruments and Air-conditioners.	Operation and maintenance space for the equipment
Concrete Shelter	3.24	For installation of battery, battery controller and ladder	Operation and maintenance space for the equipment
Foundation of Wind Profiler System	49	—	—

[2] Internal and External Finishing Plan

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

Table 24: Finishing Materials of Each Ancillary Facility

Finishing Materials of Power Back-up Shed		
Exterior Finishing	Roof Floor	Fare-faced Concrete
	Wall	Concrete blocks Fare-faced Concrete Cement sand mortar base spray tile finish
Interior Finishing	Floors	Cement sand mortal base, Epoxy resin paint finish
	Skirting	Cement sand mortar, Epoxy resin paint finish
	Wall	Cement Sand mortal base, Vinyl paint finish
	Ceiling	Fare-faced Concrete Cement sand mortar base Emulsion paint finish
Window and Door	Exterior	Glass block, Aluminum window, Aluminum grille, Aluminum door, Stainless steel door
	Interior	Aluminum door
Finishing Materials of Equipment Shed		
Exterior Finishing	Roof Floor	Fare-faced Concrete
	Wall	Concrete blocks Fare-faced Concrete Cement sand mortar base spray tile finish
Interior Finishing	Floors	Vinyl tile finish
	Skirting	Wooden Skirting, Vinyl paint finish
	Wall	Cement Sand mortal base, Vinyl paint finish
	Ceiling	Fare-faced Concrete, Acoustic panels
Window and Door	Exterior	Glass block, Aluminum window, Stainless steel door
Finishing Materials of Concrete Shelter		
Exterior Finishing	Roof Floor	Fare-faced Concrete
	Wall	Concrete blocks Fare-faced Concrete Cement sand mortar base vinyl paint finish
Interior Finishing	Floors	Cement sand mortal
	Skirting	Cement sand mortar
	Wall	Cement Sand mortal
	Ceiling	Fare-faced Concrete Cement sand mortar
Window and Door	Exterior	Stainless steel door
Finishing Materials of Foundation of Wind Profiler System		
Exterior Finishing		Fare-faced Concrete

[3] Structural Plan

I. Structural Design Standard

In order to formulate and develop the structural design of the proposed ancillary facilities, the “National Building Code” will be used.

II. Structure Type

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

[4] Electrical Facility Design

I. Power intake facility

Power Back-up Shed: 230V, 3-phase, 4-wire
Equipment Shed: 230V, 3-phase, 4-wire

II. Lighting and power outlet

Lighting fixtures will be mainly fluorescent, for their low power consumption. The lighting levels in the various rooms will be approximately as shown below.

Power Back-up Shed: 200 Lx
Equipment Shed: 300 Lx

General-purpose power outlets will be equipped with switches. Dedicated power outlets are required in the Equipment Shed for the computing equipment.

III. Grounding system

All the equipment to be installed in the Power Back-up Shed and the equipment Shed will be connected to terminal box grounded by erecting a grounding electrode and running a wire from there to the terminal box.

IV. Fire extinguisher

Fire extinguishers will be supplied in the following rooms.

Power Back-up Shed: ABC Type × 2
Equipment Shed: CO_2 Type × 2

[5] Air-conditioning and Ventilation System Design

Air-conditioning systems will be installed in the Equipment Shed. It is essential to have a good operating environment, especially for the equipment. Therefore, 2 air-conditioning systems are indispensable. Package type air-conditioning systems have been selected to minimize any impact to the operation if an air-conditioning system fails.

2-2-3 Outline Design Drawing

The following design drawings for the Programme are attached hereunder.

<Samoa Meteorology Division, Head Office>

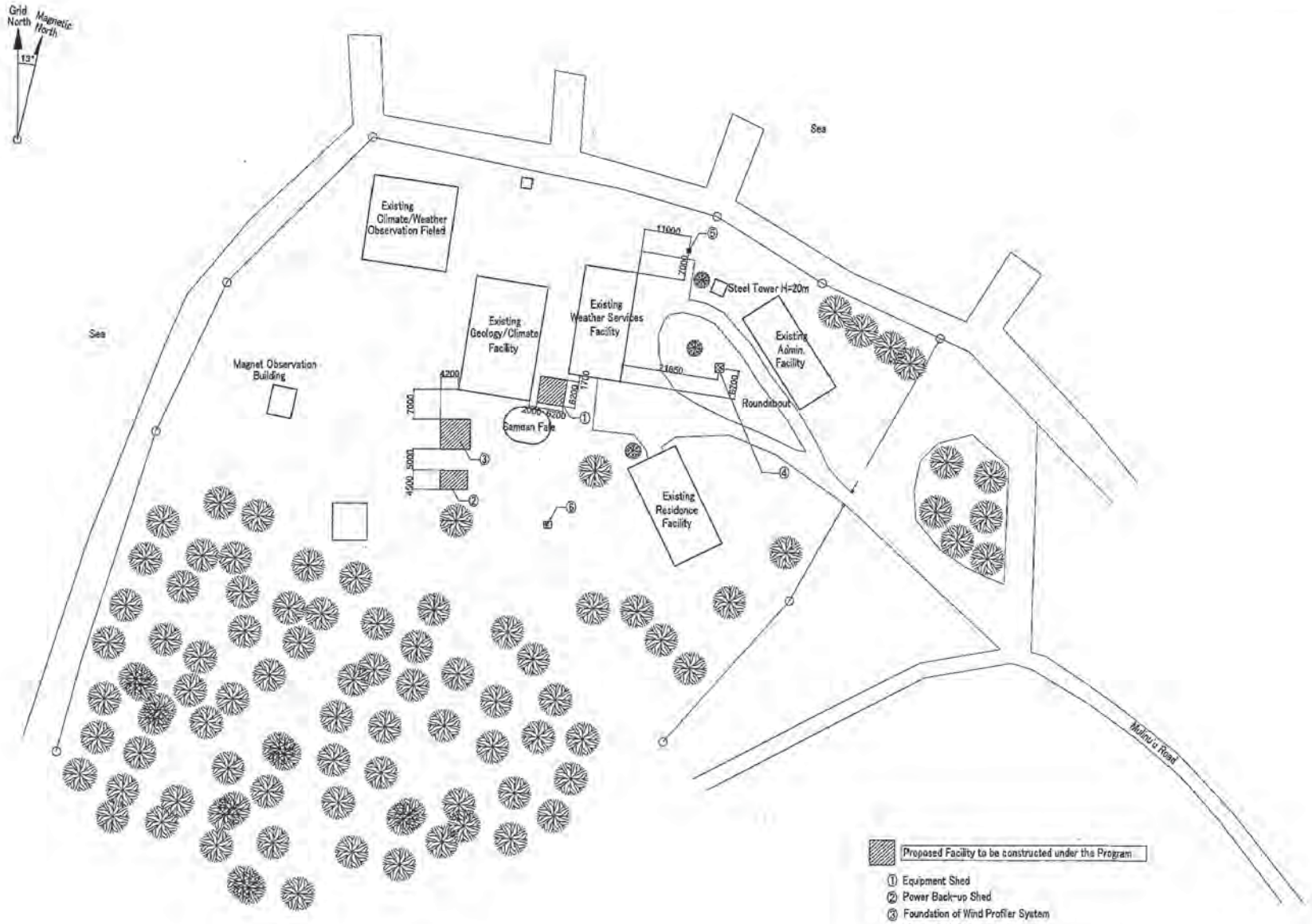
- Site Layout Plan : SMD-01
- Floor Plan, Elevation and Section for Equipment Shed : SMD-02
- Equipment Layout Plan for Equipment Shed : SMD-03
- Equipment Layout Plan for Climate Consultant Services : SMD-04
- Floor Plan, Elevation and Section for Power Back-up Shed : SMD-05
- Foundation of Wind Profiler System : SMD-06

<Faleoro International Airport>

- Site Layout Plan : FIA-01

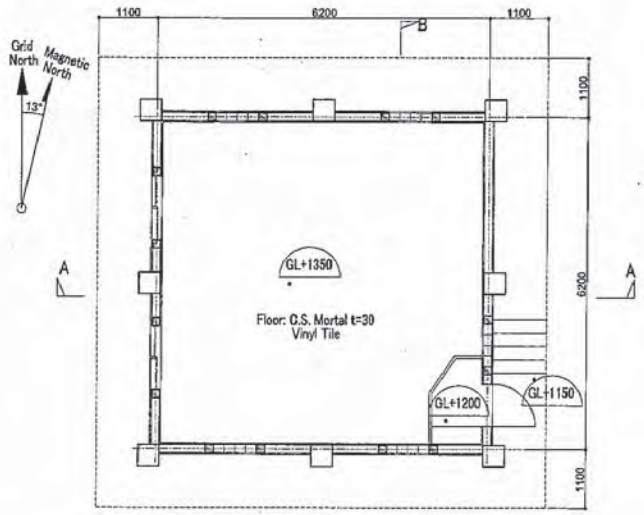
<Steel Pole and Concrete Shelter>

- Standard Layout Plan for Steel Pole and Concrete Shelter : SLT-01
- Floor Plan, Elevation and Section for Concrete Shelter : SLT-02
- Standard Details for AWS Steel Pole : AWS-01

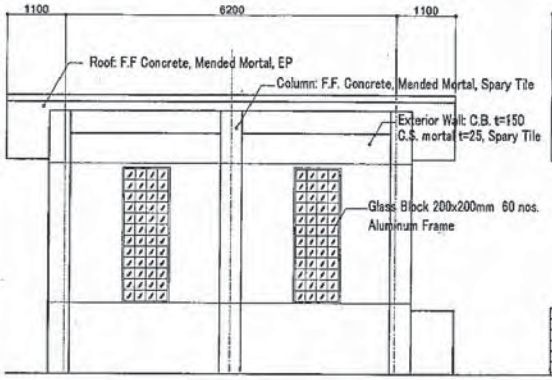


SITE LAYOUT PLAN SCALE 1:1000

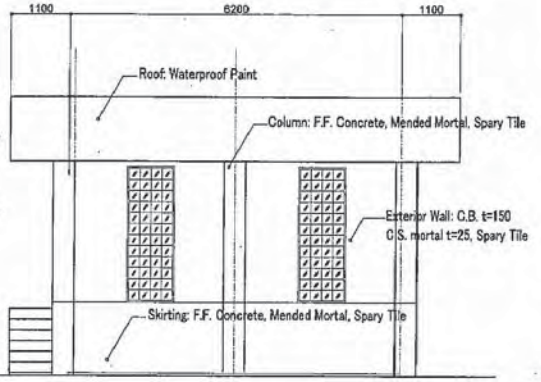
Consortium of International Meteorological Consultant Inc. and Japan Weather Association	The Programme for Improving the Weather Forecasting System and Meteorological Warning Facilities in the Independent State of Samoa	DRAWING TITLE: SITE LAYOUT PLAN SAMOA METEOROLOGY DIVISION, HEAD OFFICE	SCALE: 1:1000	DRAWING No.: SMD - 01



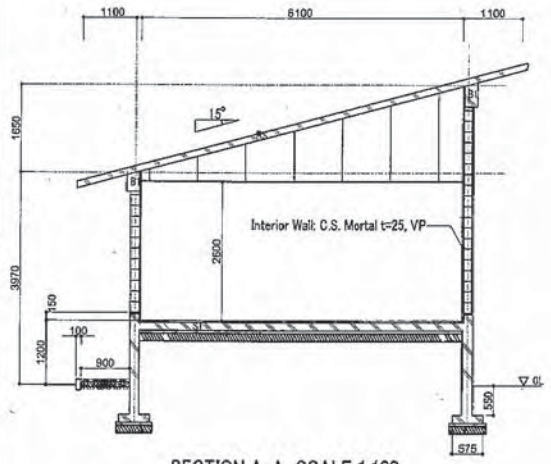
FLOOR PLAN SCALE 1:100



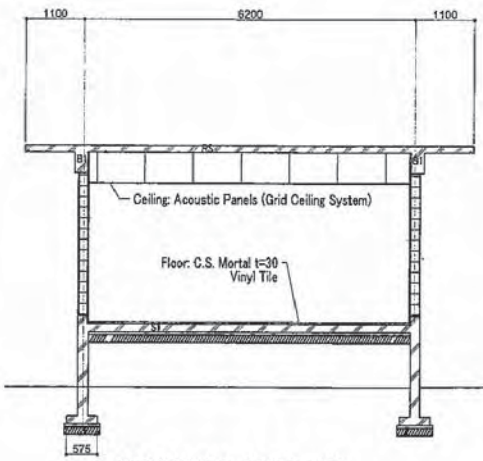
SOUTH ELEVATION SCALE 1:100



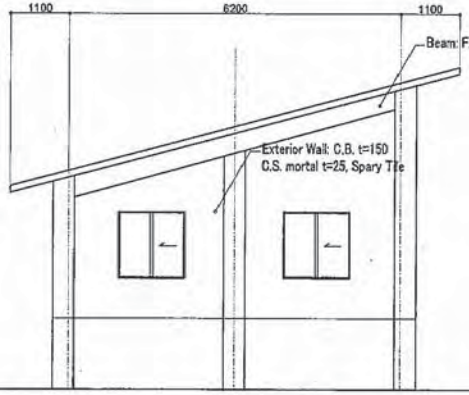
NORTH ELEVATION SCALE 1:100



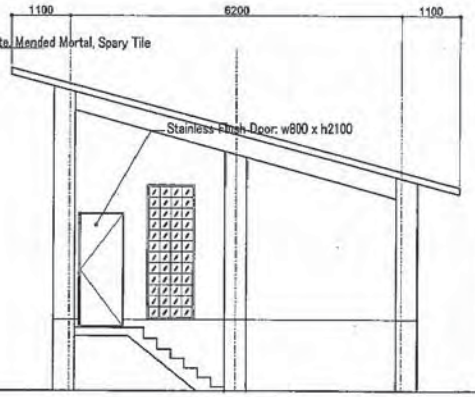
SECTION A-A SCALE 1:100



SECTION B-B SCALE 1:100

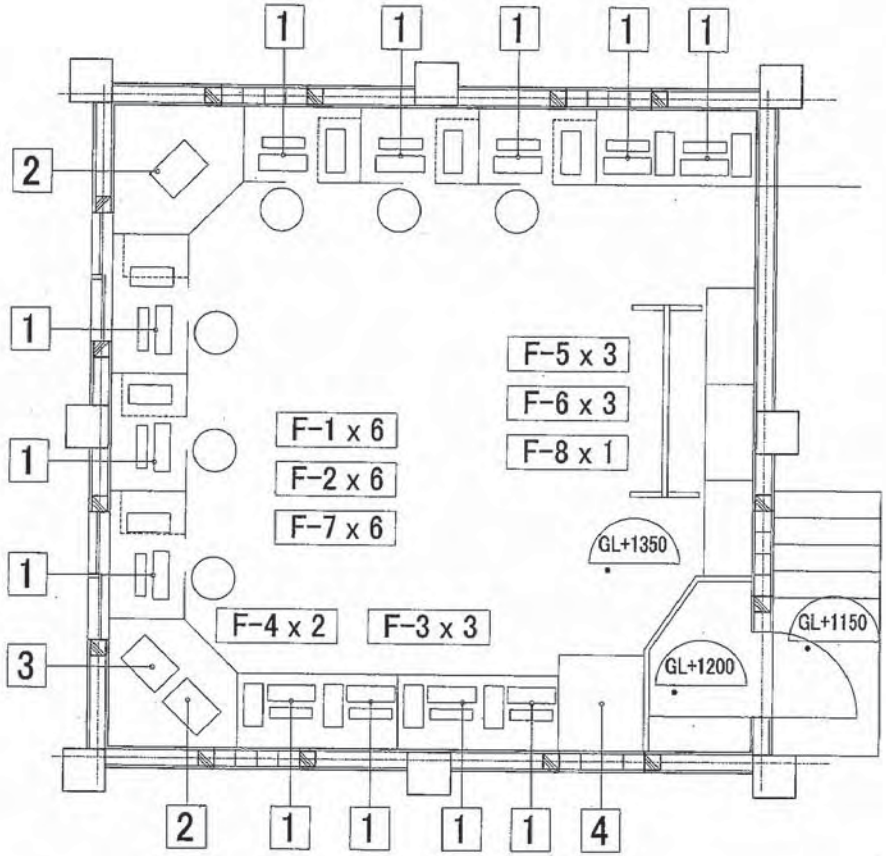


WEST ELEVATION SCALE 1:100



EAST ELEVATION SCALE 1:100

Consortium of International Meteorological Consultant Inc. and Japan Weather Association	The Programme for Improving the Weather Forecasting System and Meteorological Warning Facilities in the Independent State of Samoa	DRAWING TITLE: FLOOR PLAN, ELEVATION AND SECTION FOR EQUIPMENT SHED SAMOA METEOROLOGY DIVISION, HEAD OFFICE	SCALE: 1:100	DRAWING No.: SMD - 02



EQUIPMENT LAYOUT PLAN SCALE 1:50

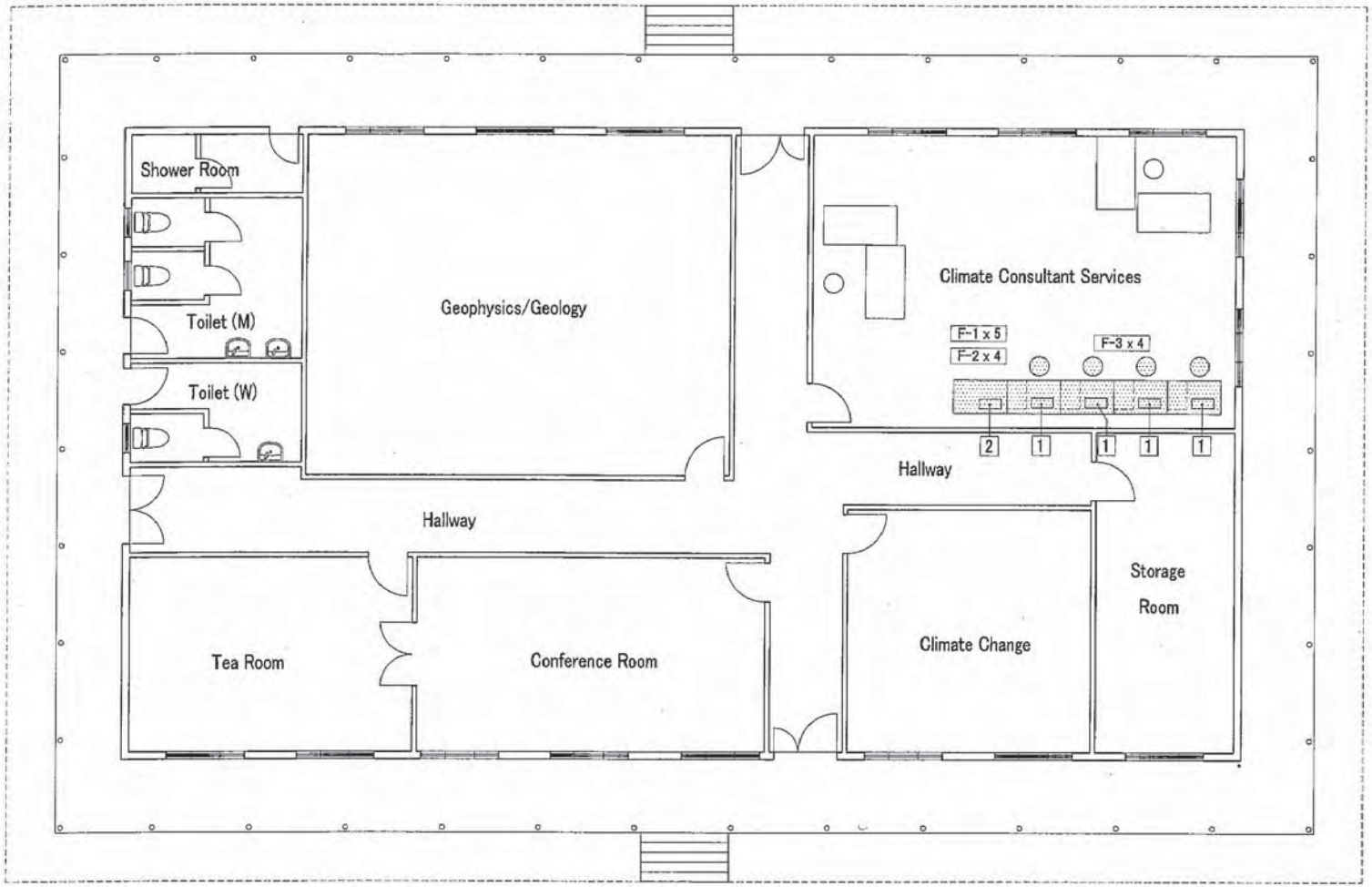
Equipment

1	Indicator
2	Color Printer
3	Scanner
4	Wind Profiler UPS

FURNITURE

F-1	Pedestal Desk w=1100
F-2	Drawer Unit with Casters
F-3	Pedestal Desk w=1500
F-4	Five-sided Corner Desk
F-5	Lateral Filling Cabinet
F-6	Cabinet with Double Hinged Door
F-7	Chair
F-8	White Board

Consortium of International Meteorological Consultant Inc. and Japan Weather Association	The Programme for Improving the Weather Forecasting System and Meteorological Warning Facilities in the Independent State of Samoa	DRAWING TITLE: EQUIPMENT LAYOUT PLAN FOR EQUIPMENT SHED SAMOA METEOROLOGY DIVISION, HEAD OFFICE	SCALE: 1:50	DRAWING No.: SMD - 03



Equipment

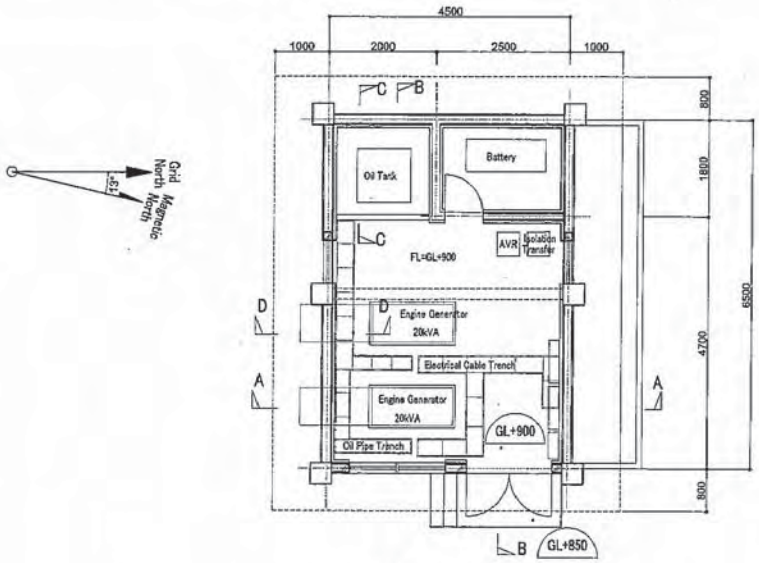
1	Indicator
2	Color Printer

FURNITURE

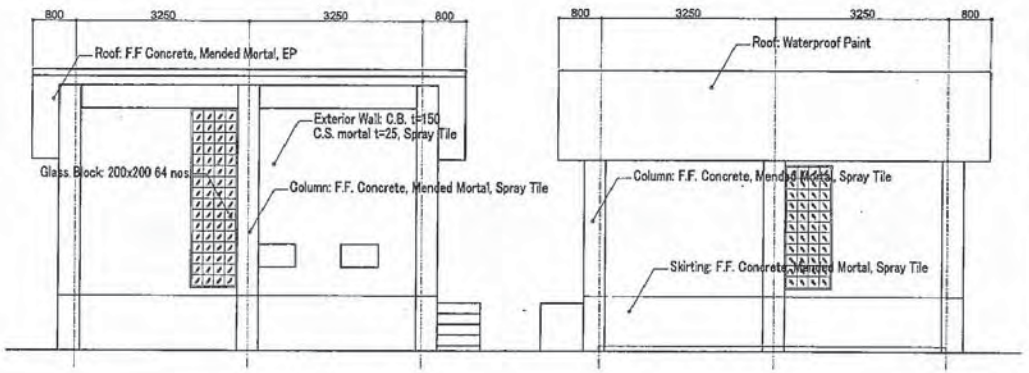
F-1	Pedestal Desk
F-2	Drawer Unit with Casters
F-3	Chair

EQUIPMENT LAYOUT PLAN FOR CLIMATE CONSULTANT SERVICES SCALE 1:50

Consortium of International Meteorological Consultant Inc. and Japan Weather Association	The Programme for Improving the Weather Forecasting System and Meteorological Warning Facilities In the Independent State of Samoa	DRAWING TITLE: EQUIPMENT LAYOUT PLAN FOR CLIMATE CONSULTANT SERVICES SAMOA METEOROLOGY DIVISION, HEAD OFFICE	SCALE: 1:50	DRAWING No.: SMD - 04

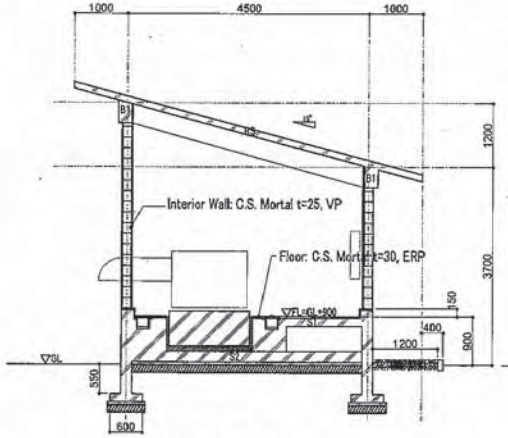


PLAN SCALE 1:100

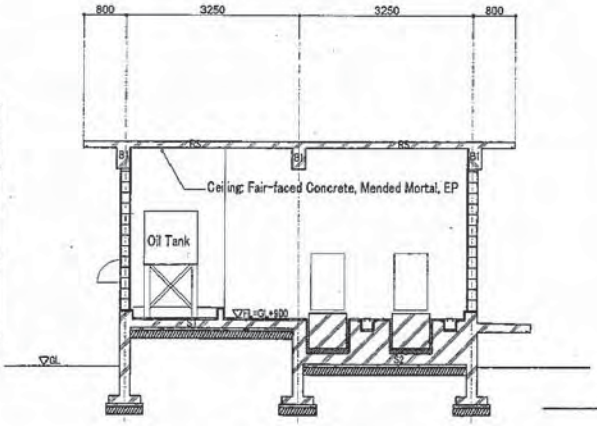


SOUTH ELEVATION 1:100

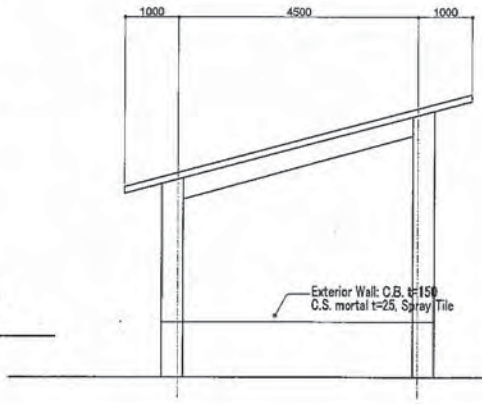
NORTH ELEVATION 1:100



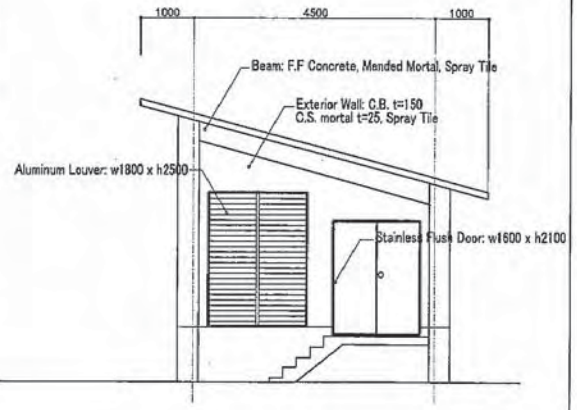
SECTION A-A SCALE 1:100



SECTION B-B SCALE 1:100

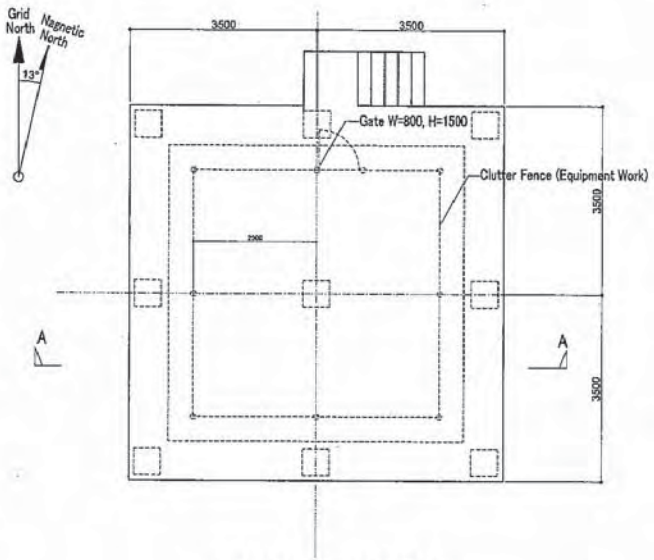


WEST ELEVATION SCALE 1:100

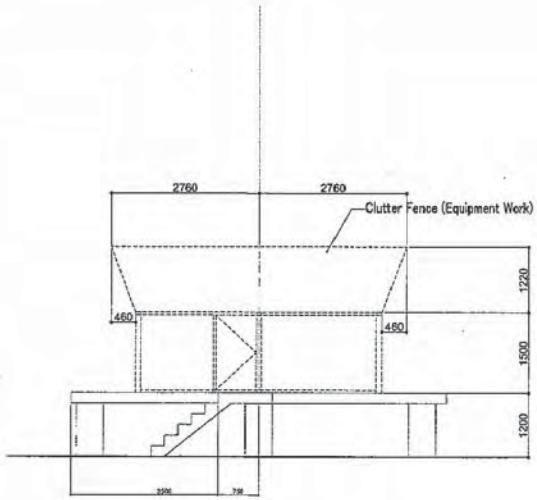


EAST ELEVATION SCALE 1:100

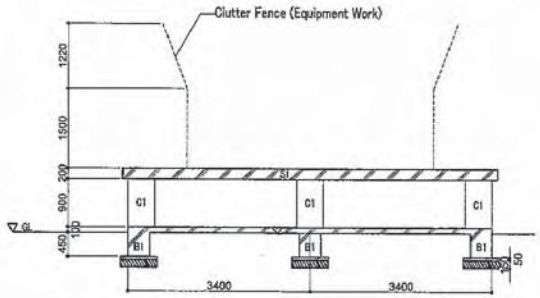
Consortium of International Meteorological Consultant Inc. and Japan Weather Association	The Programme for Improving the Weather Forecasting System and Meteorological Warning Facilities In the Independent State of Samoa	DRAWING TITLE: FLOOR PLAN, ELEVATION AND SECTION FOR POWER BACK-UP SHED SAMOA METEOROLOGY DIVISION, HEAD OFFICE	SCALE: 1:100	DRAWING No.: SMD - 05



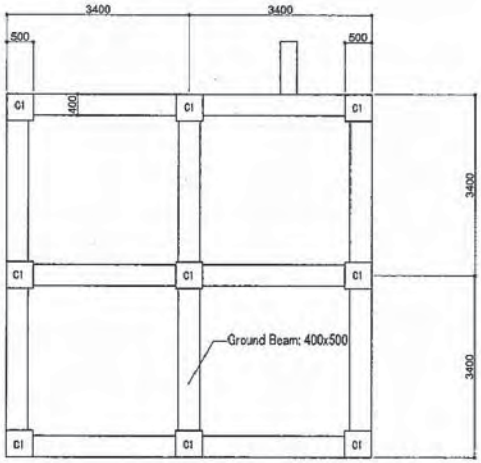
FLOOR PLAN SCALE 1:100



ELEVATION SCALE 1:100



SECTION A-A SCALE 1:100

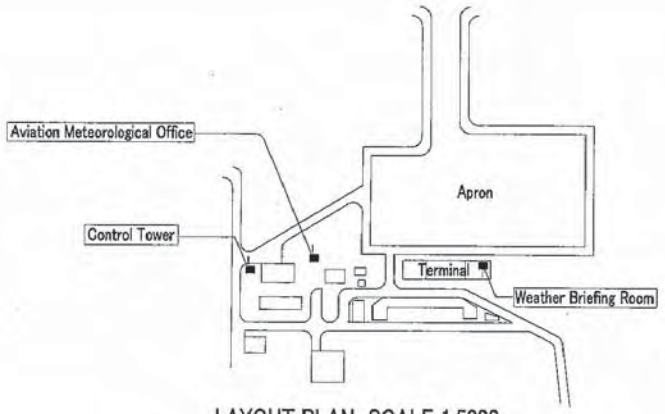


FOUNDATION PLAN SCALE 1:100

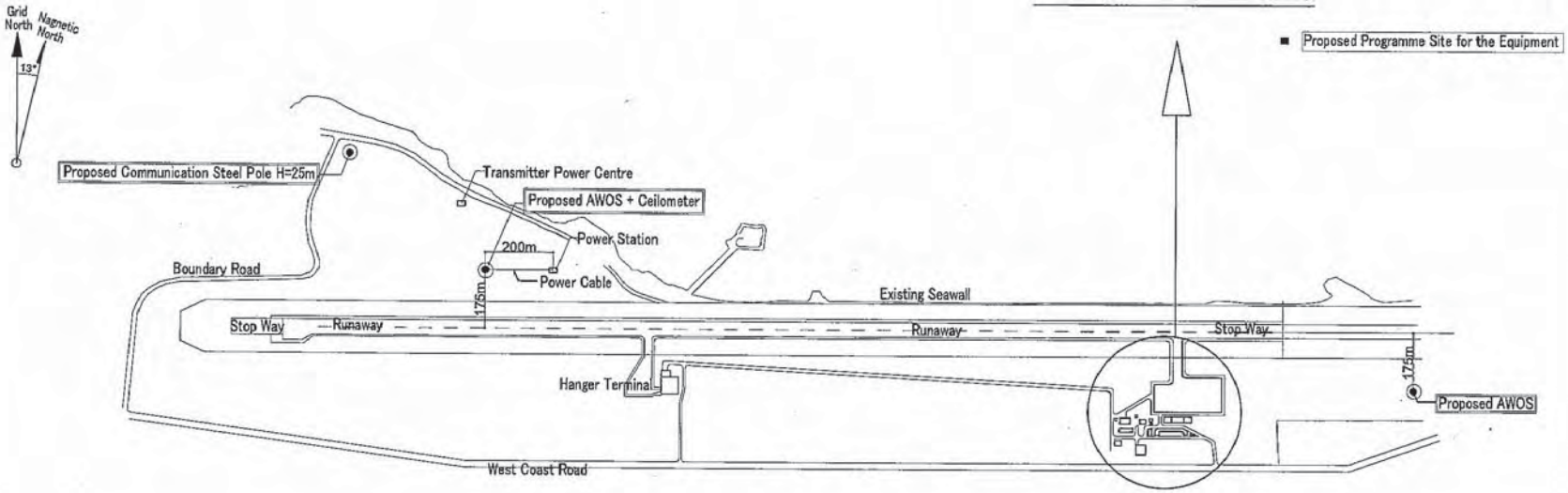
Consortium of International Meteorological Consultant Inc. and Japan Weather Association	The Programme for Improving the Weather Forecasting System and Meteorological Warning Facilities in the Independent State of Samoa	DRAWING TITLE FOUNDATION FOR WIND PROFILER SYSTEM SAMOA METEOROLOGY DIVISION, HEAD OFFICE	SCALE 1:100	DRAWING No. SMD - 06

FURNITURE LIST

	Pedestal Desk	Drawer	Chair	White Board
Aviation Meteorological Office	2	2	2	-
Control Tower	-	-	-	-
Weather Briefing Room	1	1	1	1



LAYOUT PLAN SCALE 1:5000



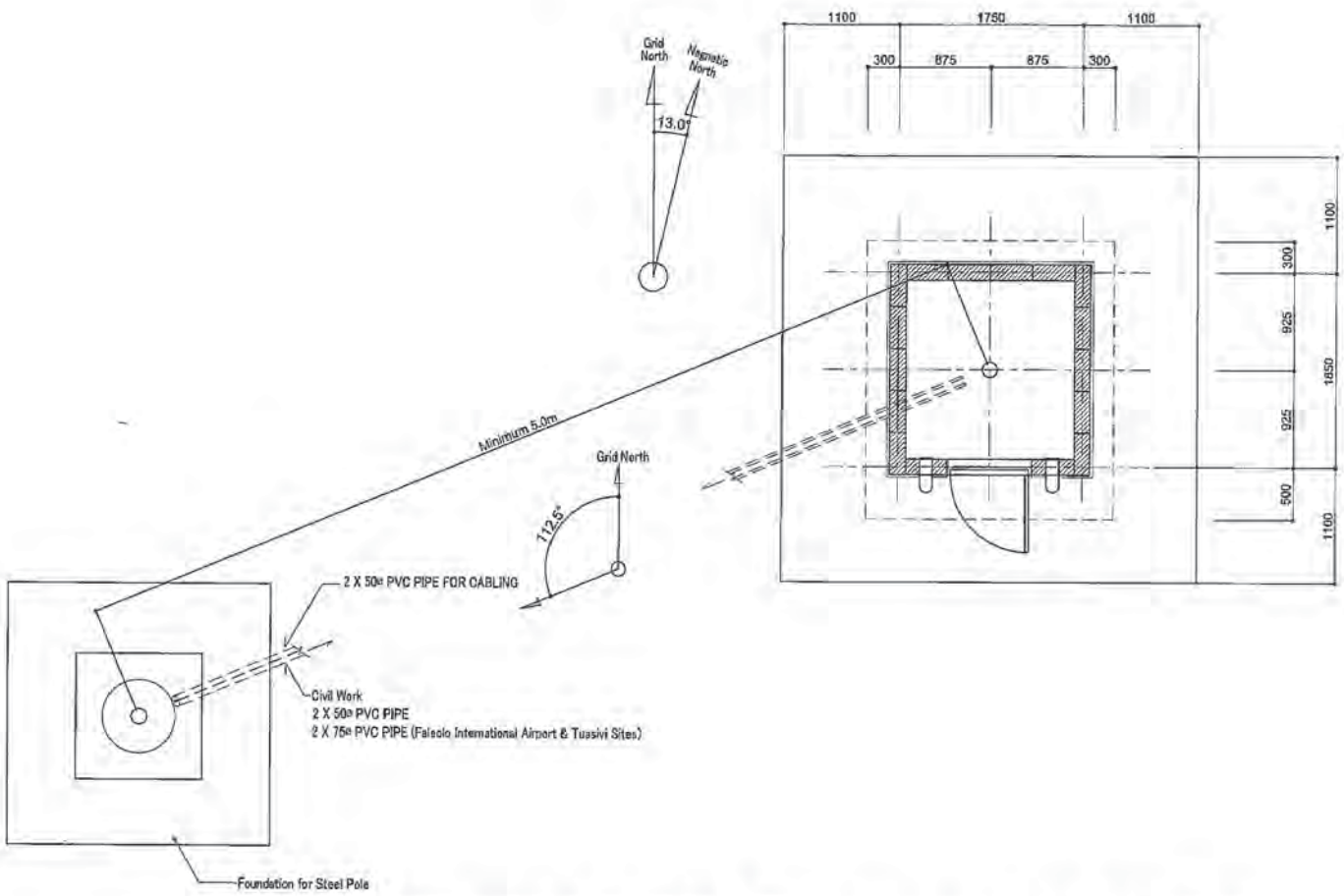
LAYOUT PLAN SCALE 1:15000

0 100M 200M 300M 400M

■ Proposed Programme Site for the Equipment

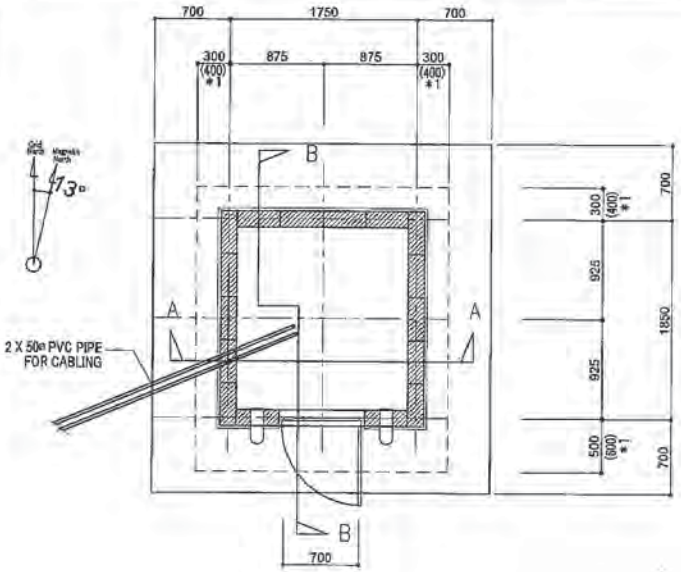
● Proposed Facility to be constructed under the Programme

IMC International Meteorological Consultant Inc. / JWA Consortium of International Meteorological Consultant Inc. and Japan Weather Association	The Programme for Improving the Weather Forecasting System and Meteorological Warning Facilities in the Independent State of Samoa	DRAWING TITLE SITE LAYOUT PLAN FALEOLO INTERNATIONAL AIRPORT	SCALE 1:15000 1:5000	DRAWING No. FIA - 01

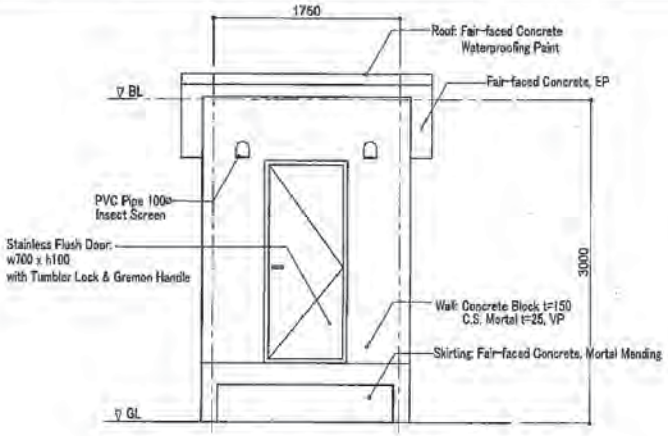


STANDARD LAYOUT PLAN FOR STEEL POLE AND CONCRETE SHELTER SCALE 1:50

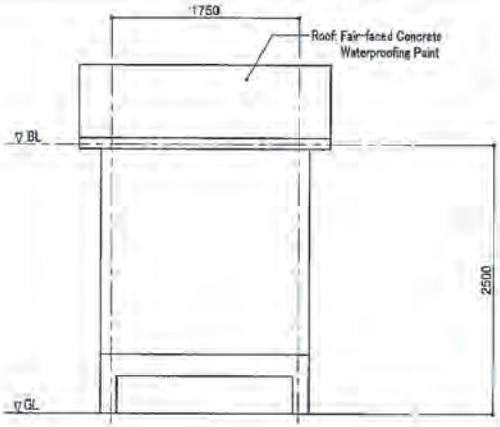
Consortium of International Meteorological Consultant Inc. and Japan Weather Association	The Programme for Improving the Weather Forecasting System and Meteorological Warning Facilities in the Independent State of Samoa	DRAWING TITLE: STANDARD LAYOUT PLAN FOR STEEL POLE AND CONCRETE SHELTER	SCALE: 1:50	DRAWING No.: SLT - 01



PLAN SCALE 1:50

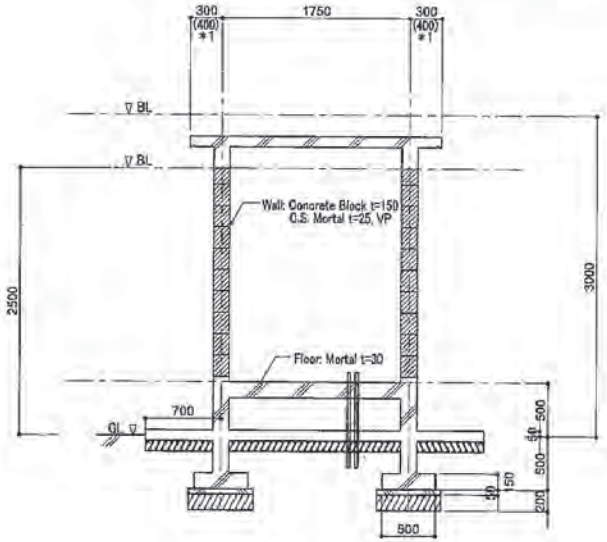


SOUTH ELEVATION SCALE 1:50

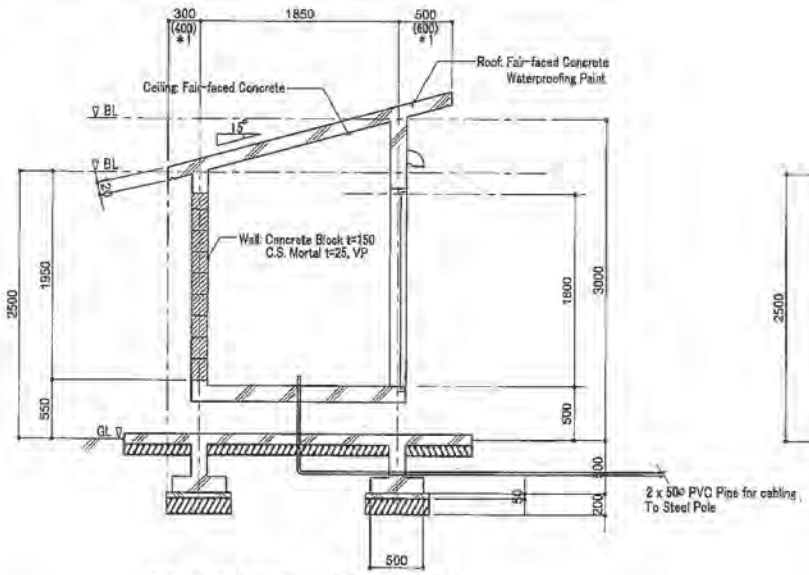


NORTH ELEVATION SCALE 1:50

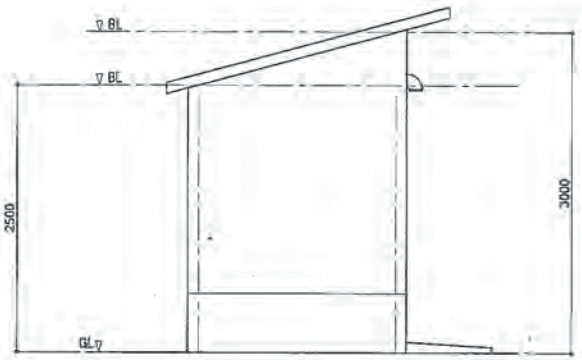
*1: Faleolo International Airport (Concrete Shelter for AWOS)



SECTION A-A SCALE 1:50

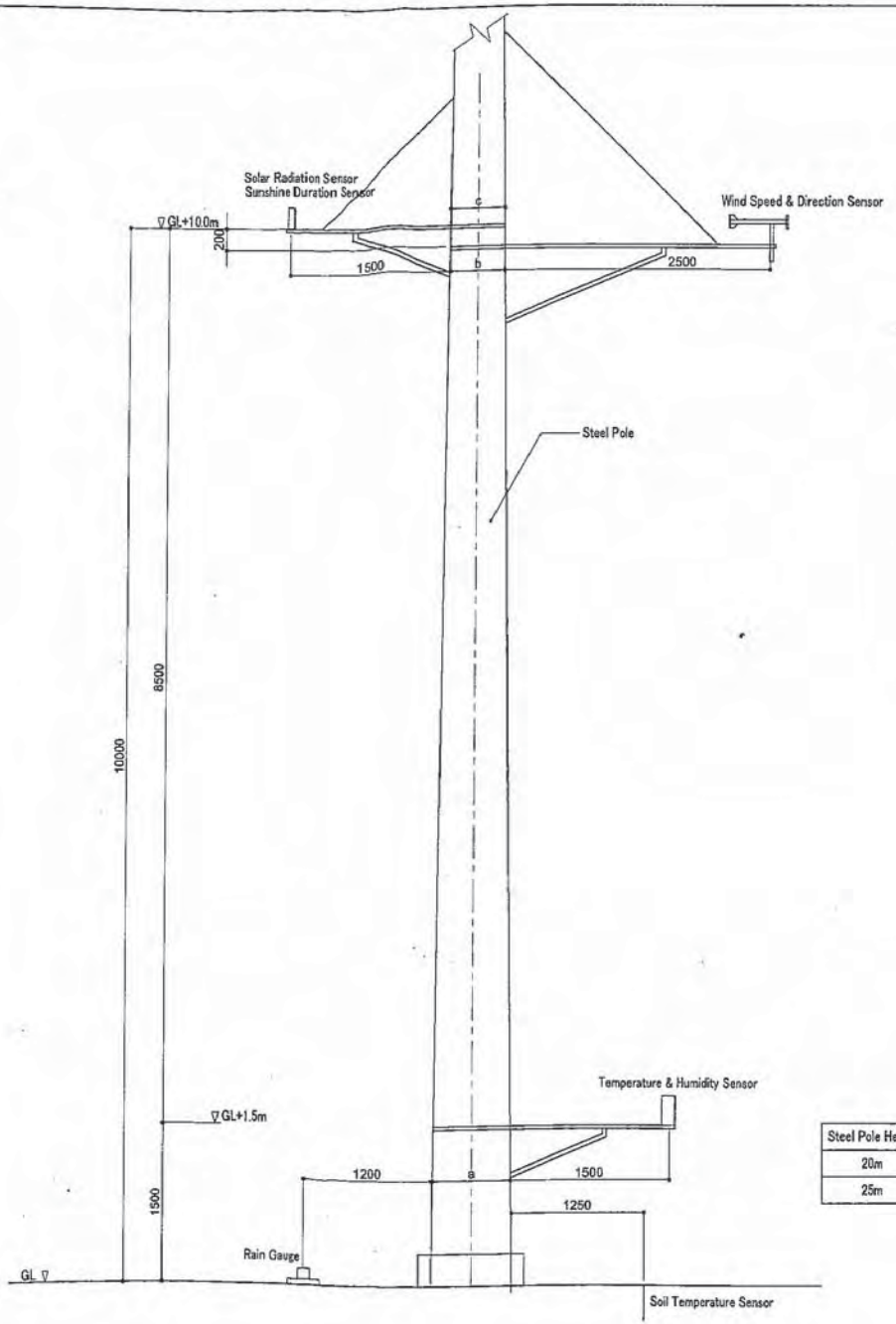


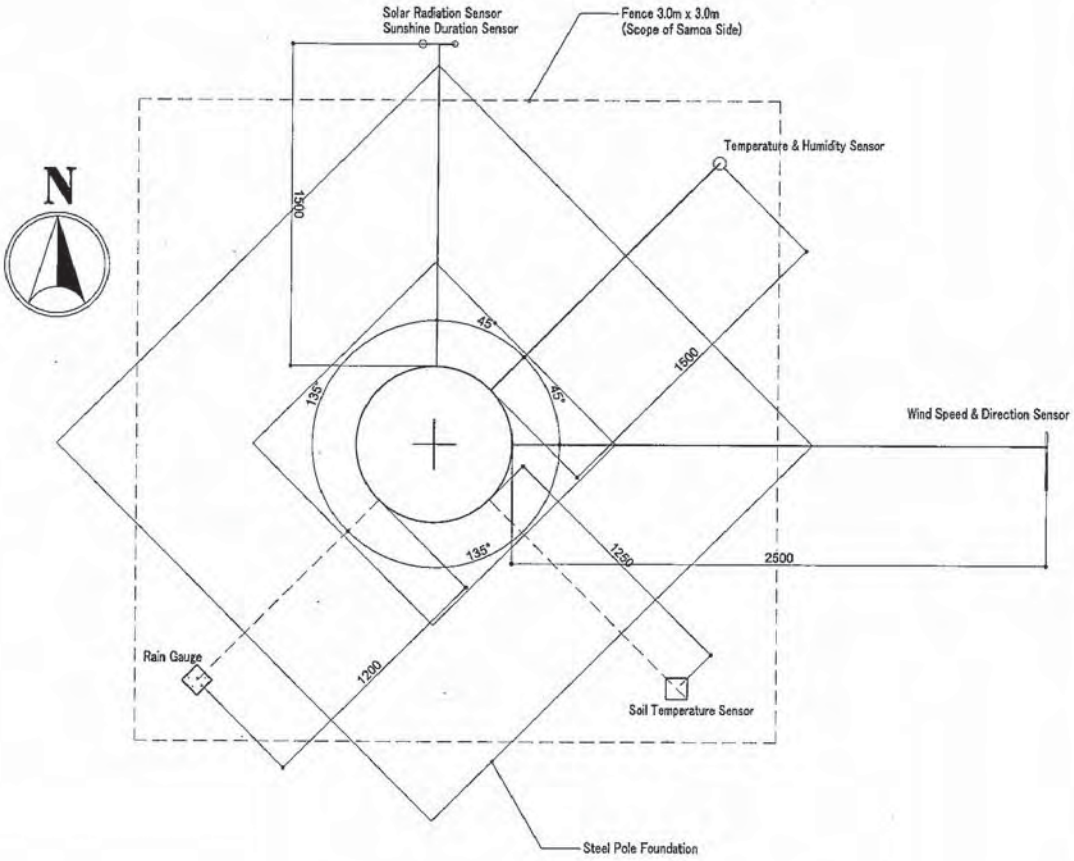
SECTION B-B SCALE 1:50



WEST ELEVATION SCALE 1:50

Consortium of International Meteorological Consultant Inc. and Japan Weather Association	The Programme for Improving the Weather Forecasting System and Meteorological Warning Facilities in the Independent State of Samoa	DRAWING TITLE: FLOOR PLAN, ELEVATION AND SECTION FOR CONCRETE SHELTER	SCALE: 1:50	DRAWING No.: SLT - 02





Steel Pole Height	a	b	c
20m	590	395	391
25m	704	504	501

Consortium of International Meteorological Consultant Inc. and Japan Weather Association	The Programme for Improving the Weather Forecasting System and Meteorological Warning Facilities in the Independent State of Samoa	DRAWING TITLE: STANDARD DETAILS FOR AWS STEEL POLE	SCALE: 1:50	DRAWING No.: AWS- 01

2-2-4 Implementation Plan

2-2-4-1 Implementation Policy

The Programme covers many fields, including procurement and installation of meteorological and communication equipment, ancillary facility construction work, etc. For the successful completion of the Programme, close coordination will be required among all parties.

1) Implementing agency for the Programme

The responsible government agency of Samoa for the implementation of the Programme is the SMD under the supervision of the Ministry of Natural Resources and Environment. The SMD has the responsibilities for recording meteorological observations round the clock and providing weather forecasts / warnings and other related services to meet the multifarious needs of the nation.

2) Consultant

After the signing of the Exchange of Notes (E/N) between the Government of Samoa and the Government of Japan and the Grant Agreement (G/A) between the Government of the Samoa and JICA for the Programme, it is important to finalize the Agent Agreement as early as possible. The Agent Agreement will be signed by the Ministry of Finance, Samoa and a Japanese Procurement Management Agent, having its principal office in Japan and appointed by the Government of Japan.

The consulting firm recommended by JICA will become the Consultant for the Programme by signing the Agreement with a Japanese Procurement Management Agent. The Consultant then will conduct a detailed design study in Samoa with the SMD and in Japan, prepare tender documents including technical specifications, drawings, diagrams, etc. and conduct tendering supports for a Japanese Procurement Management Agent. In addition, the Consultant instead of the SMD and a Japanese Procurement Management Agent will supervise the Programme implementation for successful completion of the Programme as a project of the Japan's Programme Grant Aid for Environment and Climate Change of the Government of Japan.

3) Contractor

A contractor with the required qualifications (an equipment supplier) will be selected by an open public tender, in accordance with the tender documents prepared by the Consultant, in accordance with JICA guidelines and the Grant Agreement (G/A).

2-2-4-2 Implementation Conditions

<Conditions for the Installation of Equipment>

In accordance with the implementation schedule, the dispatch of an electrical engineer is required at the time of the installation, adjustment and wiring of the electric power supply and power back-up system (AVR, Isolation Transformer, Engine Generator, etc.). In addition, specialized skilled engineers are needed for installation, adjustment and commissioning of the data communication and computing equipment and also the sophisticated meteorological equipment. They are essential to ensure the quality of the installation work necessary for accurate meteorological observations. Furthermore, as part of the technology transfer to the SMD staff, specialized highly skilled engineers are required as on-the-job trainees to ensure the SMD can operate and maintain the equipment efficiently.

2-2-4-3 Scope of Works

The scope of works to be undertaken by the Japan's Programme Grant Aid for Environment and Climate Change of the Government of Japan and the Samoa side for the implementation of the Programme are as follows.

1) Installation Work for the Equipment

<Scope of works to be undertaken by the Programme>

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

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

a) Flattening out access road furrows and cutting grass
b) Cutting grass at each site
c) Cutting branches of high trees which obstruct the Meteorological Data Communication System
d) Installation of fences for protection against any damage and theft of the equipment & systems

2) Construction of the Ancillary Facility

<Scope of works to be undertaken by the Programme>

a) Architectural and civil works

b) Electrical and Air-conditioning works

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

a) Securing the sites
b) Demolition/relocation of the existing facilities that may obstruct during the Programme implementation
c) Power supply intake work

2-2-4-4 Consultant Supervision

1) Principal Guidelines

a) To take the responsibility for expediting the Programme implementation as well as smooth supervision, in accordance with the guidelines of Japan's Grant Aid Assistance and the design made by this Preparatory Survey.
b) To communicate closely with responsible organizations and personnel of both countries, and complete the Programme in time in accordance with the implementation schedule.
c) To provide appropriate advice to personnel of the SMD and the contractor.
d) To ensure safety of the implementation as its top priority by earlier/advance detection of severe weather phenomena.

2) Consultant Supervision

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

3) Scope of Work for Supervision

a) The Consultant will conduct tendering supports for a Japanese Procurement Management Agent, in coordination with the SMD, and supervise the Programme implementation in accordance with the Agreement with a Japanese Procurement Management Agent.
b) The Consultant will inspect and approve shop-drawings, system drawings & diagrams and

material samples submitted by the contractor, and verify the performance and function of all the systems.

c) Based on a review of the implementation schedule, the Consultant will provide instructions to the contractor and submit progress reports on the implementation of the Programme to the SMD, a Japanese Procurement Management Agent and the JICA local office.

2-2-4-5 Quality Control Plan

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

Table 25: Quality Control Plan

Work	Work Type	Control Item	Method	Remarks
Structural Work	Concrete work	Fresh concrete Concrete strength	Slump, air volume, temperature Comprehensive strength test	Strength test at a public test institution
	Reinforcing work	Reinforcing bar Arrangement	Tensile test, mill sheet check Bar arrangement check	
Finishing Work	Roof work	Workmanship, leakage	Visual inspection, water spray test	
	Plastering work	Workmanship	Visual inspection	
	Door & window work	Products, Installation accuracy	Factory inspection sheet check Visual inspection, dimension check	
	Painting work	Workmanship	Visual inspection	
	Interior work	Products, workmanship	Visual inspection	
Electrical Work	Power Receiving & Transforming	Performance, operation installation check	Factory inspection sheet check; withstand voltage, megar, operation, visual inspection	
	Conduit work	Bending, support check	Visual inspection, dimension	
	Wiring and cable work	Sheath damage, loose connection check	Performance sheet check, cleaning before laying, marking after bolt fixing	
	Lighting work	Performance, operation, installation check	Performance sheet check, illumination measurement, visual inspection	

2-2-4-6 Procurement Plan

(1) Equipment Procurement

Maintenance requirements and the availability of the necessary parts and consumables in Samoa are two of the most important factors in selecting the equipment. The most important areas concerned with supply of the systems involve operation & maintenance methods and also procurement of necessary spare parts long after the completion of the Programme. This will surely be a vital factor in determining the success of the Programme. In view of the future maintenance aspect of highly specialized pieces of meteorological equipment by the SMD, it is advantageous to have suppliers that are available within the same region of Samoa and/or in friendly developed countries including Japan. Thus, in connection with quality and maintaining levels of sophisticated equipment, it will be essential to procure such

components from member countries of Organization for Economic Cooperation and Development (O.E.C.D.) including Japan. For quality control of each system, procurement of the equipment from member countries of O.E.C.D. will be easier than other countries. Procurement from member countries of O.E.C.D. would surely be advantageous to the SMD in consideration of durability & reliability of the systems and easy procurement of spare parts, operating procedures and maintenance techniques of the equipment.

The activities of the private sector in Samoa will be useful in the support of the computer systems and other sophisticated systems. There are some computing equipment local agents/suppliers. The procurement plan for the equipment is designed with a view to achieve the maximum possible degree of standardization as well as facilitating the acquisition of spare parts and maintenance services for the chosen computing equipment.

(2) Procurement of Ancillary Facility Construction Material

1) Procurement Policy of Construction Material

As the main construction materials can be procured locally, they will, in principle, be procured in Samoa. As the imported materials can be easily procured locally, they are considered as part of the procurement of local products. In order to ensure the easy maintenance of the ancillary facilities, locally available materials will be utilized for construction.

2) Procurement Plan of Construction Materials

[1] Structural Work

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

[2] Building Exterior and Interior Work

Timber, tiles, paint, glass, aluminum window frames, etc. used for the exterior and interior of a building are imported and, in principle, are readily available in the local market. For the proposed buildings, airtight aluminum and steel doors & windows, treated for salt-corrosion, are required.

[3] Air-Conditioning Work

Imported air-conditioning units are popular in Samoa. In principle, those products can be procured in the local market with a view to ease of repair and maintenance and large air-conditioning units are also available in the local market.

[4] Electrical Work

Imported Lighting fixtures, switches, lamps, electrical wires and cables, conduits and other items are available in the local market. They will, in principle, be procured in Samoa for the convenience of repair and maintenance. Custom-made building equipment such as control panels, power distribution boards and switch boards imported from New Zealand and Australia can be procured in the local market.

3) Transportation Plan

The scheduled trips between the major importing countries to the Apia seaport are indicated in the following table.

Table 26: Scheduled Vessels to Apia Port

Country	Name of Port	Schedule	Transit Time
Japan	Yokohama, Nagoya, Kobe	2 ships/month	Approx. 21days
Australia	Sydney, Melbourne	2 ships/month	Approx.21days
New Zealand	Auckland	2 ships/month	Approx. 7days
United States of America	Oakland (California)	4 ships/month	Approx.30days

The administration of the Ports is the responsibility of the Samoa Ports Authority. The port of Apia is the main Port of entry. Other ports and deep water anchorage are at Asau, Mulifanua and Salelologa. The port of Apia has the berthing facilities for both overseas and local vessels. The extended Apia Port provides a wide range of services which includes: pilotage, deep berths, general and cargo handling, freezer and cooler for loose cargo warehousing, weighbridge (up to 16T), stevedoring, cargo and container storage and fumigation. The summary of each sea port in Samoa is shown in the below table.

Table 27: Samoa Sea Port

Wharf	Length	Depth
Overseas: 🔴		
Apia	184.7m	9.3m
Asau (max.draft at channel is 5m)	120.0m	10.0m
Local: 🟢		
Mulifanua	70.0m	3.2m
Salelologa	70.0m	3.2m

Prepared by Samoa Ports Authority

Figure 18: Route Map of Transport

- Inland Transport

From Apia port to each site located in Savaii Island, it takes 1.5 days and to each site located in Upolu Island, it takes within 1 day. All of the major roads are paved nicely. In order to get to the site located in Manono Island where installation of the Automatic Weather Observation System has been scheduled, a small catamaran ship from Mulifanua in Upolu Island to Manono is required and after getting it off,

approximately 15 minutes walk is necessary.

- Duty Exemption Procedures

Regarding the duty exemption procedures, after arrival of all the shipment documents at the SMD, pre-procedures is required for approximately 2 weeks and customs procedures after ship arrival at the Apia port, approximately 10 days is necessary.

Table 28: Required Procedure on Duty Exemption

Name of Procedure	Apply to	Required Period	Required Documents	Applicant
Tax exemption for the import goods	Ministry of Inland Revenue	Ten (10) days	・Shipping Invoice ・Packing List ・Bill of Lading ・Certificate of Undertaking ・Request Letter to Customs	Ministry of Natural Resources and Environment (The SMD)
Import Permit			・Application ・Copy of Contract ・Shipping Invoice	

2-2-4-7 Operational Guidance Plan

The required operation guidance will be implemented through practical operation simulation of each system in the course of the completion of the equipment installation. During the equipment installation period, the operational guidance for cabling, piping, unit replacement/adjustment, etc. of the meteorological observation, forecasting and data communication systems will be imparted to the SMD, as such operational guidance for said items will no longer be able to be implemented after completion of the equipment installation. The operational guidance for each system will be implemented at the following places indicated in the table attached hereunder.

Table 29: Operation and Maintenance Training (OJT)

Name of System	SMD Head Office	Faleolo International Airport	Sites for Weather Observation System and Data Repeater System
Airport Weather Observation System (AWOS) AWOS Display System	—	○	—
Automatic Weather System (AWS)	○	—	○
Meteorological Data Communication System with Data Repeater System • Power Supply Equipment • Antenna • Meteorological Data Transmitting Equipment • Computer Network Equipment • Application Software	○	○	○
Meteorological Data Management System • Computer Network Equipment • Application Software	○	—	—
GTS Message Switch System • Computer Network Equipment • Application Software	○	—	—
Meteorological Satellite Data Receiving System (MTSAT) • Computer Network Equipment • Application Software	○	—	—
Forecast Support System • Computer Network Equipment • Application Software	○	—	—
Early Warning System • Computer Network Equipment • Application Software	○	—	—
Power Back-up System	○	—	○
Wind Profiler System • Power Supply Equipment • Antenna • Data Transmitting Equipment • Computer Network Equipment • Application Software	○	—	—

2-2-4-8 Implementation Schedule

Table 30: Implementation Schedule

Detailed Design and Tendering Procedures — **Total: 7 Months**

	1	2	3	4	5	6	7
Detailed Design	■	■	■	■	■		
Tendering Procedures					■	■	■

Equipment Procurement, Installation and Technical Cooperation — **Total: 30 Months**

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Preparation and Approval of Manufacturing and Shop Drawings		■																													
Equipment Procurement & Manufacturing	**Steel Pole for Meteorological Data Communication System**		■	■																											
	Meteorological Data Communication System, Airport Weather Observation System (AWOS) & Automatic Weather System (AWS)		■	■	■	■	■	■																							
	AWOS Display System, Meteorological Data Management System, GTS Message Switch System, Meteorological Satellite Data Receiving System, Forecast Support System, Early Warning System, Power Back-up System & Wind Profiler System		■	■	■	■	■	■	■	■	■																				
Pre-shipment Inspection				■				■			■																				
Transportation	**Marine (Equipment Procurement Country → Apia Port)**				■			■	■			■																			
	Inland (Apia Port → Each Site)					■			■				■																		
Ancillary Facility Construction Work	**Concrete Shelters**		■	■	■	■	■	■	■	■																					
	Equipment Shed, Power Back-up Shed & Foundation for Wind Profiler System		■	■	■	■	■	■	■	■																					
Steel Pole Foundation Work					■	■	■	■	■	■																					
Equipment Installation					■	■	■	■	■	■	■	■	■	■																	
Equipment Adjustment														■	■																
Inspection and Handing Over															■																
Technical Cooperation												■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■

2-3 Obligations of Recipient Country

In the implementation of the Programme under the Japan's Programme Grant Aid for Environment and Climate Change of the Government of Japan, the SMD is responsible for the following tasks.

1) General requirements

a) To undertake all necessary institutional and juridical procedures in Samoa.
b) To handle duty exemption procedures and to take necessary measures for customs clearance at the port of disembarkation for the materials and equipment imported for the Programme.
c) To accord nationals, whose services may be required in connection with the supply of products and services under contract(s), such facilities as may be necessary for their entry into Samoa and stay therein for the performance of their work.
d) To provide necessary space at the SMD Head Office for the Consultant and the Contractor for the implementation of the Programme, if required.
e) To allocate necessary personnel for meteorological observation and forecasting work.

2) Requirements for the Equipment

a) To secure the required sites
b) To clear the land including cutting grass necessary for the Programme prior to commencement of the implementation.
c) To cut braches of high trees which obstruct for the Meteorological Data Communication System.
d) To obtain the required permission for usage of the existing communication steel towers.
e) To obtain the required frequency(s) for the Meteorological Data Communication System.
f) To procure and install the equipment necessary for VSAT Internet.
g) To install fences for protection against any damage and theft of the equipment & systems
h) To secure effective space at the existing facilities for installation of the equipment to be supplied.
i) To maintain, and properly and effectively utilize, the equipment purchased under the Programme Grant Aid.

3) Requirements for Construction of Ancillary Facilities

a) To ensure the security and to secure and clear the land necessary for the Programme prior to commencement of the construction.
b) To obtain necessary permissions for construction of the ancillary facilities.
c) To move and relocate the existing obstructive facilities on the sites, if required.
d) To provide the commercial power supply and other incidental facilities for the ancillary facilities.
e) To install the required step-down transformer for the commercial power supply at the SMD Head Office.

f) To secure sufficient spaces at the SMD Head Office for temporary facilities such as a contractor's office, workshop, building materials storage, etc. for the construction work.

g) To provide adequate maintenance of the ancillary facilities constructed under the Programme Grant Aid, so as they can function effectively.

2-4 Programme Operation Plan

(1) Operation and Maintenance Plan for the Equipment

1) Operational Plan of Meteorological Observation Network components

Upon completion of the Programme, in order to appropriately operate and maintain each meteorological observation network components, establishment of the quick response team organized by the staff in the SMD and the Samoa Airport Authority indicated in the following figure is essential.

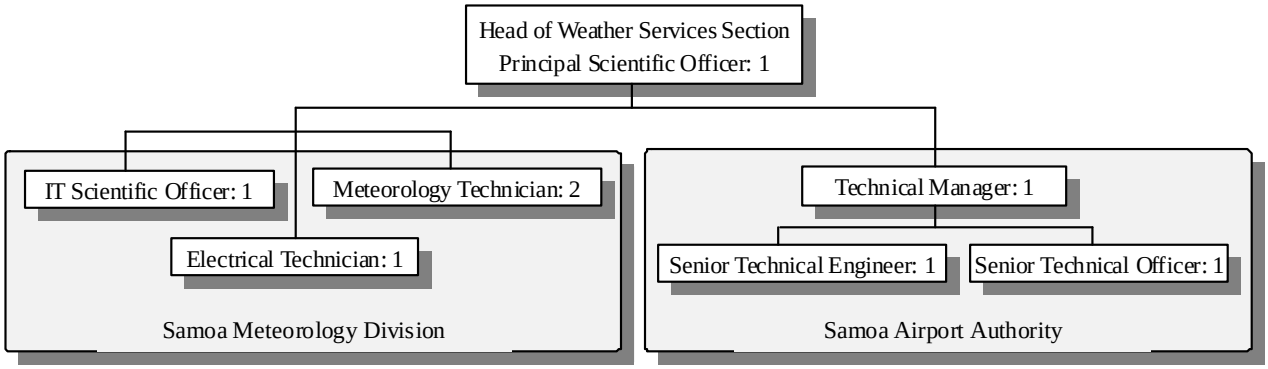


Figure 19: Quick Response Team

2) Operation and Maintenance Plan for the Equipment

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

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

<Recruitment of Engineer/Staff >

Operation and maintenance of the meteorological observation, forecasting and data communication systems is carried out mainly by the SMD engineers and technical staff, however, the number of engineers and technical staff to do this is not sufficient, so it is essential that the existing vacant

positions be filled. The SMD fully recognizes the need to fill the existing vacant positions and has made a firm commitment to recruit capable technical staff. In order for the SMD to become self-reliant in technical areas such as the operation and maintenance, it is essential that it make continuing efforts to fill vacancies and promote technology transfer for all staff levels, from entry level technicians to senior engineers.

Number of staff transition of the SMD is indicated in the table attached below. In the National Weather Services and Climate Consultant Services Section which mainly operate and maintain the systems to be supplied under the Programme, 1 personnel for each unit was augmented in 2009-2010 and 1 personnel for the National Weather Services has been scheduled to augment in 2010-2011.

Table 31: Staff Allocation of Samoa Meteorology Division

		2005-2006	2006-2007	2007-2008	2008-2009	2009-2010 (Plan)
Management and Administration	Recruited	0	0	1	1	0
	Retired	0	0	1	1	0
	Number of Staff at the end	3	3	3	3	3
National Weather Services	Recruited	2	4	4	3	1
	Retired	2	2	2	1	0
	Number of Staff at the end	10	12	14	15	16
Climate Consultant Services Section	Recruited	1	0	1	1	1
	Retired	0	1	0	0	0
	Number of Staff at the end	3	2	3	4	5
Geophysics	Recruited	0	1	0	0	1
	Retired	0	0	0	0	0
	Number of Staff at the end	3	4	4	4	5
Geology	Recruited	0	2	0	0	1
	Retired	0	0	0	1	0
	Number of Staff at the end	8	10	10	9	10
National Disaster Management Office	Recruited	0	0	1	1	Await Proposal to Public Service Commission
	Retired	0	0	0	1	
	Number of Staff at the end	2	2	3	3	
Climate Change Projects	Recruited	1	1	0	4	0
	Retired	1	1	1	0	0
	Number of Staff at the end	3	3	2	6	6

(2) Operation and Maintenance Plan for the Ancillary Facilities

There are three key issues for the maintenance of the ancillary facilities to be implemented by the SMD: (i) daily cleaning; (ii) maintenance to cover wear and tear; damage and aging; and (iii) security measures to ensure safety and to prevent crimes.

The implementation of daily cleaning of the ancillary facilities gives a good impression to visitors/users and encourages people to respect the ancillary facilities and the equipment. Cleaning is also important to ensure the equipment continues to operate correctly, it helps in the rapid detection and repair damaged equipment and prolongs the life of the equipment. The required inspections are outlined below.

Table 32: Outline of Regular Inspection for the Ancillary Facilities

	Items of Maintenance Work	Frequency
Exterior	Repair and repainting of external walls	Repair: every 5 years, Repaint: every 15 years
	Inspection and repair of roofs	Inspection: every year Repair: as required
Interior	Renewal of interior finishing	As required
	Repair and repainting of partition walls	As required
	Adjustment of window and door fitting	Every year

It is important that regular preventive maintenance of the building equipment is carried out before the equipment fails, or requires repair or replacement of part(s). The life of the air-conditioning equipment can be significantly extended by proper operation and regular inspection, lubrication, adjustment and cleaning. These regular inspections can prevent equipment failure and accidents. Regular inspection, replacement of consumables and cleaning/replacement of filters for air-conditioning units should be carried out in accordance with the maintenance manual.

It is essential to establish a proper maintenance structure in the SMD, involving the rigorous implementation of regular inspection and maintenance procedures. The general life expectancy of the major building equipment is shown below.

Table 33: Life Expectancy of Building Equipment

System	Building Equipment	Life Expectancy
Electrical System	• Distribution panels • Fluorescent lamps • Incandescent lamps	20 – 30 years 5,000 – 10,000 hours 1,000 – 1,500 hours
Air-Conditioning System	• Pipes • Air-conditioning units	15 years 15 years

2-5 Programme Cost Estimate

2-5-1 Estimate of Programme Cost and Capital Cost to be borne by the SMD

The estimated programme cost to be financed by the Japan's Programme Grant Aid for Environment and Climate Change is provisional and would be further examined by the Government of Japan for the approval of the Grant.

The estimated programme cost to be borne by the SMD has been estimated and is shown in the following tables.

Estimated Programme Cost to be borne by the Samoa Side

Table 34: Programme Cost Estimate

Estimated Capital Cost	125,390Tala (approx. 4.3 Million JP Yen)
Estimated VAT & Import Tax for Equipment	1,759,000Tala (approx. 61.7 Million JP Yen)
Estimated Bank Commissions	21,500 Tala (approx. 0.75 Million JP Yen)
Total (Estimated Programme Cost)	1,905,890 Tala (approx. 67 Million JP Yen)

Estimated Capital Cost to be borne by the Samoa Side

Table 35: Estimated Capital Cost for Implementation of the Programme (Tala)

Items		Capital Cost
Procurement of Internet VSAT Hardware		12,500
Upgrading the existing weather forecasting building in the SMD Head Office		20,000
Renovation of the existing building of the SMD in the Maota Airport		16,000
Renovation of the existing building of the SMD in the Faleolo International Airport		36,000
Frequency Application and Lisence Fee for the Meteorological Data Communication System		1,100
Obtaining Building Permits for Construction of Ancillary Facilities (Power Back-up Shed, Equipment Shed and Concrete Shelters) Application for Compliancy Confirmation: 80 Tala, Development Consent: 400 Tala and Building Permit: 6,770		7,250
Installation of a step-down transformer(s) for 200kVA and a power meter		18,300
Installation of Equipment Protection Fence, W:3m x W:3m x H:2.4m (Le Mafa, Saluafata, Togotogiga, Manono, Matao International Airport, Le Piu Tai and Mt. Talu)		9,800
1,400 x 7 Programme Sites =		
Cabling for 3 Phase Commercial Power Supply for the Equipment		1,200
Mowing and repairing very bumpy places of the existing access paths		2,160
	45 Tala/day x 2 laborers x 4 days for Mt. Vaea Site = 360	
	45 Tala/day x 2 laborers x 2 days for Mt. Fiamoe Site = 180	
	45 Tala/day x 2 laborers x 2 days for Le Mafa Site = 180	
	45 Tala/day x 2 laborers x 2 day for Manono Site = 180	
	45 Tala/day x 2 laborers x 2 days for Mt. Valusia Site = 180	
	45 Tala/day x 2 laborers x 4 days for Mt. Tagotala Site = 360	
	45 Tala/day x 2 laborers x 4 days for Le Piu Tai Site = 360	
	45 Tala/day x 2 laborers x 1 day for Vaisala Site = 90	
	45 Tala/day x 2 laborers x 3 days for Mt. Talu Site = 270	
	Total	
Clearing the sites		1,080
45 Tala/day x 2 laborers x 1 day x 12 sites =		
Total		125,390

Table 36: Estimated VAT & Import Tax for the Equipment to be supplied (Tala)

VAT & Import Tax	1,759,000

Table 37: Estimated Cost for Banking Arrangement (Tala)

Banking Arrangement	21,500 (JP Yen 754,000)

Applied Exchange Rate: US$ 1 = 97.55 JP Yen, 1 Samoa Tala = 35.10 JP Yen

The Programme Cost Disbursement Schedule of the SMD is attached hereunder.

Table 38: The Programme Cost Disbursement Schedule of the SMD

			2010									2011										
			4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11
Detailed Design and Tendering Procedures (Total: 6 Months)																						
Detailed Design																						
Tendering Procedures																						
Equipment Procurement and Installation (Total: 14 Months)																						
Preparation and Approval of Manufacturing and Shop Drawings																						
Equipment Procurement & Manufacturing	Steel Pole for Meteorological Data Communication System																					
	Meteorological Data Communication System, Airport Weather Observation System (AWOS) and Automatic Weather System (AWS)																					
	AWOS Display System, Meteorological Data Management System, GTS Message Switch System, Meteorological Satellite Data Receiving System, Forecast Support System, Early Warning System, Power Back-up System, Wind Profiler System																					
Pre-shipment Inspection																						
Transportation	Marine (Procurement Country - Apia Port)																					
	Inland (Apia Port - Sites)																					
Ancillary Facility Construction Work	Concrete Shelters																					
	Equipment Shed, Power Back-up Shed & Foundation for Wind Profiler System																					
Steel Pole Foundation Work																						
Equipment Installation																						
Equipment Adjustment																						
Inspection and Handing Over																						
Project Cost to be borne by SMD		(Tala)																				
Procurement of Internet VSAT Hardware		12,500																				
Upgrading the existing weather forecasting building in the SMD Head Office		20,000																				
Renovation of the existing building of the SMD in the Maota Airport		16,000																				
Renovation of the existing building of the SMD in the Faleolo International Airport		36,000																				
Frequency Application Fee for the Meteorological Data Communication System		1,100																				
Obtaining Building Permits for Construction of Ancillary Facilities		7,250																				
Installation of a step-down transformer(s) for 200kVA and a power meter		18,300																				
Installation of Equipment Protection Fence		9,800																				
Cabling for 3 Phase Commercial Power Supply for the Equipment		1,200																				
Mowing and repairing very bumpy places of the existing access paths		2,160																				
Clearing the sites		1,080																				
Total	(Tala)	125,390																				
VAT & Import Tax for the Equipment		(Tala)																				
1st Shipment		70,000																				
2nd Shipment		597,000																				
3rd Shipment		1,092,000																				
Total	(Tala)	1,759,000																				
Banking Arrangement		(Tala)																				
Bank Commission for Banking Arrangement	(Tala)	21,500																				

2-5-2 Estimate of Recurrent Cost for the Programme to be borne by the Samoa side

(1) Recurrent Cost to be borne by the SMD and the Samoa Airport Authority

The annual recurrent costs to be borne by the SMD for the first decade after the completion of the Programme are attached hereunder. The recurrent costs have been calculated in accordance with the following fundamental conditions.

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

The recurrent costs of all the sites, which mainly consist of operation and maintenance costs of the equipment and the ancillary facilities to be borne by the SMD and the Samoa Airport Authority have been calculated as shown in the following tables.

Table 39: Recurrent Cost to be borne by the SMD and the Samoa Airport Authority

Estimated Recurrent Cost to be borne by the Samoa Meteorology Division

Equipment	Item	Q'ty	1st Year	2nd Year	3rd Year	4th Year	5th Year	6th Year	7th Year	8th Year	9th Year	10th Year	Remarks
Wind Profiler	DC Power P Board for Power Supply Unit	1	0	0	49,200	0	0	0	0	0	0	0	
	DC Power S Board for Power Supply Unit	1	0	0	0	0	0	135,000	0	0	0	0	
	Fan for Power/Trans.Receiver Unit	1	0	0	0	0	15,000	0	0	0	0	15,000	
Compact UPS	Battery	6	0	0	132,000	132,000	0	132,000	132,000	0	132,000	132,000	Every 3 years
Computers (24hours operation)	Hard disk	6	0	0	0	90,000	90,000	0	0	90,000	90,000	0	Every 3 or 4 years
	CD for data storage (20sheets/1set)	1	2,500	2,500	2,500	90,000	2,500	2,500	2,500	2,500	2,500	2,500	
Computers (daytime operation)	Hard disk	6	0	0	0	0	90,000	90,000	0	0	0	90,000	Every 5 or 6 years
Printer	Printer ink cartridge	4	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	0	
	Paper(500sheets/1 set)	2	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	
Diesel Engine Generator	Oil seal and filter	2	0	4,000	4,000	22,500	4,000	4,000	4,000	22,500	4,000	4,000	Every 1 and 4 years
	Battery for Engine start	1	0	0	0	0	0	6,000	0	0	0	0	Every 6 years
Power Supply System	Long Life Battery	-	0	0	0	0	0	0	0	0	0	643,720	10% in 10th year
	Subtotal (JPY)		23,700	27,700	208,900	355,700	222,700	390,700	159,700	136,200	249,700	888,420	

Cost Item	Details	Q'ty	1st Year	2nd Year	3rd Year	4th Year	5th Year	6th Year	7th Year	8th Year	9th Year	10th Year	Remarks
Internet Connection	VSAT	1	11,520	11,520	11,520	11,520	11,520	11,520	11,520	11,520	11,520	11,520	
Observation Network Frequency Fee	Observation Network	1	100	100	100	100	100	100	100	100	100	100	
Antivirus Software	Software upgrading and annual extention	2	200	200	200	200	200	200	200	200	200	200	
Electricity Charge	Equipment	1	37,108	37,108	37,108	37,108	37,108	37,108	37,108	37,108	37,108	37,108	
Fuel cost	Fuel consumption of DEG	1	930	930	930	930	930	930	930	930	930	930	
Clearing at each project sites	8 sites x 1 day x 1 laborer/month x 40Tala/day	1	3,840	3,840	3,840	3,840	3,840	3,840	3,840	3,840	3,840	3,840	
Land Renting Cost	7 project sites (Customary Lands) x 500/year	1	3,500	3,500	3,500	3,500	3,500	3,500	3,500	3,500	3,500	3,500	
Existing Communication Tower Renting Cost	7 existing towers x 100 Tala/month x 12 months	1	8,400	8,400	8,400	8,400	8,400	8,400	8,400	8,400	8,400	8,400	
Travel Expenses of SMD's personnel	Accomodation Fee and Daily Allowance	1	7,000	7,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	
	Subtotal (Samoa Tala)		72,598	72,598	70,598	70,598	70,598	70,598	70,598	70,598	70,598	70,598	
	Total (Samoa Tala)		73,273	73,387	76,550	80,732	76,943	81,729	75,148	74,478	77,712	95,909	
	Total (JPY)		2,571,890	2,575,890	2,686,890	2,833,690	2,700,690	2,868,690	2,637,690	2,614,190	2,727,690	3,366,410	

Estimated Recurrent Cost to be borne by the Samoa Airport Authority

Cost Item	Details	Q'ty	1st Year	2nd Year	3rd Year	4th Year	5th Year	6th Year	7th Year	8th Year	9th Year	10th Year	Remarks
Electricity Charge	Equipment	1	3,905	3,905	3,905	3,905	3,905	3,905	3,905	3,905	3,905	3,905	
	Total (Samoa Tala)		3,905	3,905	3,905	3,905	3,905	3,905	3,905	3,905	3,905	3,905	
	Total (JPY)		137,066	137,066	137,066	137,066	137,066	137,066	137,066	137,066	137,066	137,066	

Recurrent Cost (Samoa Tala)											
Samoa Meteorology Division (SMD)	73,273	73,387	76,550	80,732	76,943	81,729	75,148	74,478	77,712	95,909	
Samoa Airport Authority (SAA)	3,905	3,905	3,905	3,905	3,905	3,905	3,905	3,905	3,905	3,905	
Recurrent Cost (JPY)											
Samoa Meteorology Division (SMD)	2,571,890	2,575,890	2,686,890	2,833,690	2,700,690	2,868,690	2,637,690	2,614,190	2,727,690	3,366,410	
Samoa Airport Authority (SAA)	137,066	137,066	137,066	137,066	137,066	137,066	137,066	137,066	137,066	137,066	

Conditions;
- Assuming all proposed equipment supplied
- Solar Power Supply System Supports 25% Electricity of the Head Office
- Operation time of Diesel Engine Generator : 105hrs./Year x 75% (25% covered by Solar power)
- Electricity charge for the Equipment to be installed in the Faleolo International Airport is borne equally by Samoa Meteorology Division and Samoa Airport Authority
- Exchange Rate : JPY35.1/Samoa Tala

(2) Annual Budget Trends

As indicated in the table attached hereunder, since the cost for extension of the SMD Head Office building was included in the Overheads of 2005-2006, the annual budget of 2005-2006 is bigger than 2006-2007. Except for this cost, the budget of the SMD has constantly increased for the last 5 years. In 2007-2008, the SMD was streamlined and as a consequence of the streamlining, the hydrology services was transferred to the Water Resources Department. Therefore, the annual budget of the present SMD is only 2008-2009 and 2009-2010 for 2 years. Though the hydrology services was transferred (1 section decreased from the SMD), the annual budget of the SMD in 2008-2009 has been increased 4.5%.

In order to secure the required budget which is the recurrent cost for the Programme, 6% increase of the total annual budget of the SMD in 2009-2010 is needed and it is assessed that there is no problem in its sustainability.

Table 40: Annual Budget of the Samoa Meteorology Division (Unit: Samoa Tala)

Items	2005-2006	2006-2007	2007-2008	2008-2009	2009-2010
Personal Expenses	764,497	830,452	830,452	907,983	895,717
Operation Expenses	146,974	144,632	157,800	112,449	132,848
Capital Cost	0	0	0	0	0
Overheads	216,486	100,121	100,121	130,411	122,415
Grand Total	1,127,957	1,075,205	1,101,022	1,150,843	1,150,980

Moreover, additional personnel expenses in case of the planned recruitments to be implemented have been included in each fiscal year of the SMD shown in the following table. 8-9% increase of the total annual budget of the SMD from 2010-2011 is required and it is assessed that there is no problem in its sustainability. In addition, as a consequence of discussions with the SMD, the SMD has committed to obtain the required budget prior to completion of the Programme.

Table 41: Annual Budget of the Samoa Meteorology Division (Unit: Samoa Tala)

Items	2008-2009	2009-2010	2010-2011	2011-2012	2012-2013	2013-2014
Personnel Expenses	907,983	895,717	895,717	895,717	895,717	895,717
* Additional Personnel Expenses from 2010			100,000	125,000	125,000	125,000
Operation Expenses	112,449	132,848	132,848	132,848	132,848	132,848
Programme Recurrent Cost	0	0	0	66,191	66,291	70,821
Capital Cost	0	0	0	0	0	0
Overheads	130,411	122,415	122,415	122,415	122,415	122,415
Grand Total	1,150,843	1,150,980	1,250,980	1,342,171	1,342,271	1,346,801
Year-to-year Basis		100.0%	108.7%	107.3%	100.0%	100.3%

*4 personnel expenses added from 2010-2011 and 1 personnel expenses added from 2011-2012 (All the new personnel are presumed as Scientific Officer)

2-6 Other Relevant Issues

(1) Required Procedures of the Programme Implementation

Table 42: Required Procedure of the Programme Implementation

Name of Procedure	Apply to	Required Period	Required Documents	Applicant
VAT Refund	1) Ministry of Finance 2) Ministry of Inland Revenue	6 Months	• Supplementary Agreement on VAT Payment between Implementation Agency and Contractor • Copy of the Contract	Contractor
Obtaining Capital Cost of the Programme	Ministry of Finance	2 Months	• Approval from Cabinet Development Committee • Project Document	Ministry of Natural Resources and Environment, the SMD
Obtaining Recurrent Cost of the Programme	1) Ministry of Finance 2) Ministry of Natural Resources and Environment	2–3 weeks	• Approval from Cabinet Development Committee	1) Ministry of Finance 2) Ministry of Natural Resources and Environment

(2) Building Permits for the Ancillary Facilities

For construction of the ancillary facilities, the required procedures, documents and fees for obtaining the building permits are as follows.

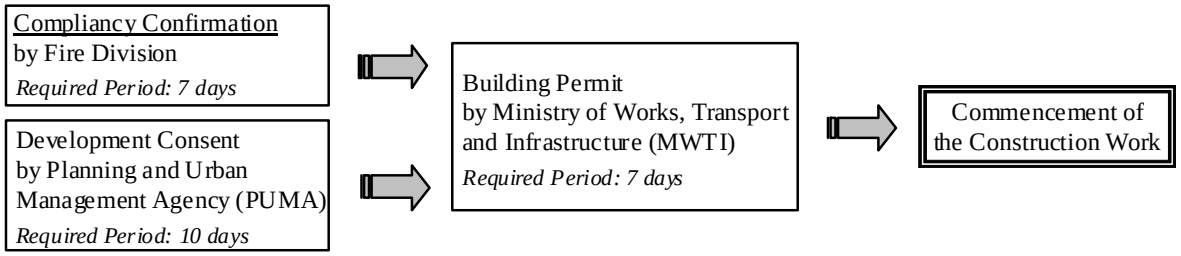


Figure 20: Required Procedures for Obtaining the Building Permit

Table 43: Required Documents for the Application

	Required Documents	Required Number
Compliancy Confirmation		
1	SMD Forward Letter	Original: 1
2	Compliancy Confirmation Application Form	Original: 1
3	Drawings (Site Plan, Floor Plan, Elevation, Layout Plan of Fire Extinguisher)	Copy: 2
Development Consent		
1	SMD Forward Letter	Original: 1
2	Development Consent Application Form	Original: 1
3	Drawings (Site Plan, Floor Plan, Elevation, Structure)	Copy: 2
4	Written Consent issued by Property Owners (in case of Customary Land)	Original: 1
Building Permit		
1	SMD Forward Letter	Original: 1
2	Building Permit Application Form	Original: 1
3	Drawings (Site Plan, Floor Plan, Elevation, Section, Structure, Electrical Installations)	Copy: 2
4	Written Consent issued by Property Owners (in case of Customary Land)	Original: 1
5	Compliancy Confirmation issued by Fire Division	Copy: 1
6	Development Consent issued by PUMA	Copy: 1

Table 44: Required Fee for the Application

Items	Power Backup Shed (1 no.)	Equipment Shed (1 no.)	Wind Profiler System Foundation (1 no.)	Concrete Shelter (17 nos.)	Total (Tala)
Compliancy Confirmation	40 Tala	40 Tala	Free of Fee	Free of Fee	80
Development Consent	20 Tala	20 Tala	20 Tala	17 nos. x 20 Tala = 340 Tala	400
Building Permit	400 Tala	400 Tala	360 Tala	17 nos. x 330 Tala = 5,610 Tala	6,770
				Total	7,250

(3) Recycle of Used Battery

To prevent deterioration of environment due to illegal waste dumping of used batteries, the following battery recycling system has been established in Samoa. In Samoa, there are 4 recycling manufacture. After use of the batteries to be supplied under the Programme, it will be exported as recyclable resources and reutilized. Therefore, there is no problem for environmental protection.

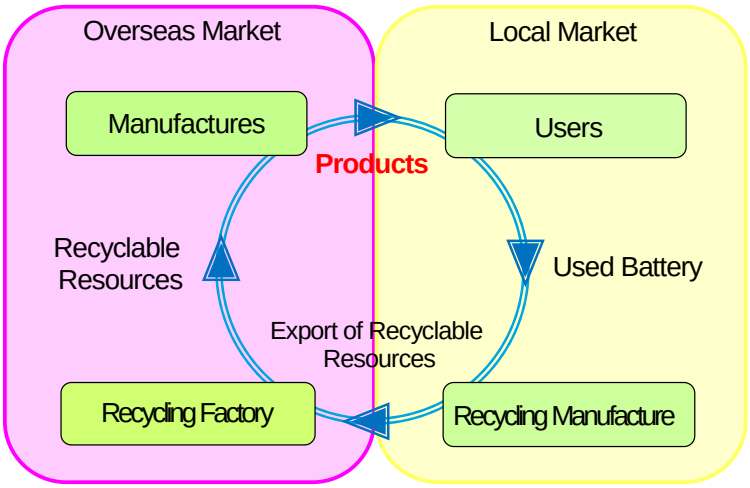


Figure 21: Flow Chart of Battery Recycling in Samoa

Chapter 3
Programme Evaluation and Recommendations

Chapter 3 Programme Evaluation and Recommendations

3 - 1 Programme Effect

(1) Programme Effect

Table 45: Programme Effect

Present Situation and Existing Issue	Remedial Measures under the Programme	Direct Effects and Degree of Improvement	Indirect Effects and Degree of Improvement
Due to no upper air observation specified by the WMO, the SMD is unable to; 1) provide information of the movement of the tropical cyclone, 2) monitor El Niño event, and 3) provide upper air observation data required for upgrading the weather information & products of Fiji RSMC and the NWP products of the meteorological organizations in the developed countries.	Installation of; • Airport Weather Observation System (AWOS) • AWOS Display System • Automatic Weather System (AWS) • Meteorological Data Communication System • Meteorological Data Management System • GTS Message Switch System • Meteorological Satellite Data Receiving System • Forecast Support System • Early Warning System • Power Back-up System • Wind Profiler System Construction of Ancillary Facilities	The SMD will be able to; 1) implement upper-air observation for monitoring wind direction and wind speed during; no raining: approx. 3-6 km high and raining: approx. 7-9 km high, and temperature up to approx. 1.4 km high in the sky, and also transmit the observed data from Samoa to all over the world; 2) perceive weather phenomena in the existing 5 observation regions together, receive all the observed data real-timely and effectively reflect the present weather phenomena to forecasting through the technical cooperation. 3) provide information of the movement of the tropical cyclone and El Niño event concerned with occurrence and intensity of tropical cyclone; 4) transmit and receive the observed data and meteorological products globally through the GTS network and effectively utilize the meteorological data and products to the routine works through the technical cooperation; 5) provide weather information and tropical cyclone warning & information improved through the technical cooperation to TV center thereby accelerating public education towards wider and deeper understanding of natural disasters as well as vital knowledge and countermeasure techniques and strategies against these disasters, including but not limited to quick evacuation of directly affected population; 6) send all the required warnings of cyclone, storm surge, high waves, heavy rain, strong & gusty wind, floods, droughts and volcano ash fall through the existing mobile-phone network to Disaster Management Office (DMO), Disaster Advisory Committee (DAC) consisting of 47 public and private organizations, approx. 1,300 local community members and mass media in accordance with the Disaster & Emergency Management Act according to warning contents, standards and issuance methodology established through the technical cooperation; 7) steadily improve weather information,	Acceleration of public education towards wider and deeper understanding of natural disasters as well as vital knowledge and countermeasure techniques and strategies against these disasters, including but not limited to quick evacuation of directly affected population Timely commencement of disaster preparedness and evacuation assistance will be made by agencies concerned with disaster management. Accuracy of weather forecasts will be higher. Accuracy of flood forecasts will be higher. Damage caused by tropical cyclones will be reduced. Concretization of the National Adaptation Programme of Action, Samoa: NAPA in each sector will be accelerated due to provision of the required weather information. Safety operation of civil aviation will be improved.
Since there is no observatory in the 4 out of the existing 5 observation regions, the SMD is unable to; 1) perceive weather phenomena in the existing 5 observation regions together; 2) compare among weather phenomena of the existing 5 observation regions; 3) receive all the observed data real-timely, and 4) reflect the present weather phenomena to forecasting.			
Due to no sea level observation, the SMD is unable to; 1) predict occurrence of storm surge caused by atmosphere pressure dropped and strong wind during tropical cyclone approaching Samoa; and 2) observe sea level rise due to the Climate Change and tsunami generated by earthquake.			
Since there is no GTS message switch equipment, as a member of the WMO, the SMD is unable to transmit the observed data of Samoa to all over the world and receive the observed data globally. Consequently, it is an obstacle to forecasting work.			
Since the SMD is unable to provide weather information and tropical cyclone warning & information to TV center, it is likewise incapable to give wider and deeper understanding of natural disasters as well as vital knowledge and countermeasure techniques and strategies against these disasters, including but not limited to quick evacuation of directly affected population.			
Since meteorological satellite pictures obtained through the internet for preparation of forecasts and warnings are not processable and analyzable, SMD is unable to utilize the satellite pictures for monitoring tropical cyclone in the South Pacific and its forecasting & warning.			

Since the short message service of the existing mobile-phone network for providing warnings, which is verbally conveyed to the mobile telephone company by the SMD, to local community members of the Disaster Advisory Committee (DAC) is not feasibly and realistically utilized due to a longer transmission time is required and there is no other practical device in the SMD for provision of advisories and warnings to the public, it is an obstacle to the prompt dissemination of advisories and warnings especially during emergency and disaster occurrence. Since weather and sea level observations for more accurately perceiving trend of the Climate Change due to the global warming does not exist, the SMD is unable to provide the observed data to meteorological organizations and research institutes in the world. At the Faleolo International Airport, the existing aviation weather observation system does not satisfy the standard specified by the ICAO and the WMO. The SMD is unable to provide weather information required for safety operation of civil aviation to the Samoa Airport Authority and airline companies.		advisories and warnings through the technical cooperation and provide them through the existing mobile-phone network by the mobile-phone users whenever required; 8) have the climate database custody for analysis and annually issue climate change information prepared by analyzing knowledge transferred through the technical cooperation on changing trend, abnormal event, and differences from the normal climate to mass media, the government agencies and numerous countries of the world through the Internet; 9) provide 6 hourly terminal aerodrome forecasts (TAF) and trend forecasts required for safety aircraft operation to the Samoa Airport Authority and airline companies according to the standard specified by the ICAO and progressively improve the forecast accuracy through the technical cooperation; and 10) prepare and provide weather condition briefing required for safety aircraft operation to airline pilots according to the briefing knowledge transferred through the technical cooperation.	

(2) Achievement Indicators for the Programme

As a result of extensive discussions with the SMD, the following Achievement Indicators for the Programme have been set as follows.

Table 46: Achievement Indicator

Indicator	Present (Base Line)	Target	Expected Achievement Time
Enhancement of weather monitoring capability	Lack of upper-air observations for better analysis	Upper-air observation capability to monitor wind direction and wind speed during; no raining: approx. 3-6 km high, raining: approx. 7-9 km high, and temperature up to approx. 1.4 km high in the sky.	At the Programme completion
	Observation system in 1 of the 5 existing observation territories in Samoa	Observations in the 5 existing observation territories in Samoa	
Enhancement of weather forecast provision capability	Weather forecast: 2/day (12 hourly) Coastal forecast: 2/day (12 hourly)	Weather forecast: 4/day (6 hourly) Coastal forecast: 4/day (6 hourly)	1 year after the Programme completion
Enhancement of cyclone information provision capability	Lack of capability to differentiate the provision of cyclone information from cyclone warning	Capability to additionally provide cyclone information on tracking to south side/north side of Samoa, extent of strong wind impact and current rainfall	At the Programme completion
Enhancement of aviation forecast provision capability	No service for provision of terminal aerodrome forecasts (TAF) and trend forecasts for Samoa Airport Authority and airline companies	Capability to provide 6 hourly TAF and trend forecasts for Samoa Airport Authority and airline companies	2 years after the Programme completion
	No weather condition briefing service to airline pilots	Capability to provide weather condition briefing to airline pilots	
Enhancement of the observed communication capability	Very low capability to transmit the data observed in Samoa and receive the data observed in numerous countries of the world due to no equipment	Capability to transmit the data observed in Samoa and receive the data observed in numerous countries of the world	At the Programme completion
Enhancement of the disaster warning provision capability	Inability to fully comply with all the requirements of the Disaster & Emergency Management Act	Capability to send all the required warnings of cyclone, storm surge, high waves, heavy rain, strong & gusty wind, floods, droughts and volcano ash fall to Disaster Management Office (DMO), Disaster Advisory Committee (DAC) and mass media in accordance with the Disaster & Emergency Management Act	At the Programme completion
	Lack of capability to present weather information and warnings on TV	Provide Weather Presentations for daily weather and tropical cyclone Warnings to TV	6 months after the Programme completion
Enhancement of capability for the climate database custody and delivery of the climate change information	Capability deficiency of the climate database custody for analysis and global issuance of the climate change information	Capability to have the climate database custody for analysis and annual issue of climate change information on changing trend, abnormal event, differences from the normal climate to mass media, the government agencies and numerous countries of the world through the Internet	1 year after the Programme completion
Enhancement of capability and tools for climate change research and to improve understanding of systems affecting Samoa's climate	Capability deficiency in monitoring impacts of El Niño Southern Oscillation and lack of timely reporting on micro-climate of Samoa and impacts to different sectors	Capability to provide monthly reports to forewarn the public of impeding climate impacts from El Niño Southern Oscillation and publish research papers on climate change findings in Samoa	1 year after t the Programme completion

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

The overall objective of the Programme is the accumulation of the observed data required for obtaining accurate prediction of the Climate Change in the South Pacific and improvement of vulnerability to meteorological disasters by establishment of the meteorological observation & forecasting and disaster early warning dissemination systems. Basically, the personnel of the SMD (approx. 50) and the Samoa Airport Authority (approx. 200) will directly benefit from the implementation of the Programme together with the whole nation of Samoa (the population of Samoa: approx. 180,000) as well as all the visitors who annually visit Samoa (approx. 160,000).

Tropical cyclones are the extreme manifestations of nature that lead to immense distress and deprivation for quite a number of people. Tropical cyclones have a direct bearing on the rural economy, which has a strong linkage with agriculture and coastal fishery. Regrettably, the extensive damage from tropical cyclones is a determining factor for the significant set-back of the national economy. It is unfortunately expected that these meteorological disasters will even be intensified due to Climate Change and its adverse effects will be immeasurable. Since 2004, the population of Samoa for the last 5 years has increased 6% (approx. 11,000) and Samoa has been pushed up from 175 to 166 in the world population rank. Therefore, there is real concern that the number of victims by tropical cyclone will proportionally increase due to the fact that the population of Samoa has been increasing.

Table 47: Administrative District and Population of Samoa

No on Figure	Administrative District	Capital	Area(km²)	Population (2006)
Upolu Island including small islands				
1	Tuamasaga	Afega	479	85,112
2	A'ana	Leulumoega	193	20,769
3	Aiga-i-le-Tai [A]	Mulifanua	27	4,857
4	Atua District [B]	Lufilufi	413	21,826
5	Va'a-o-Fonoti	Samamea	38	1,624
Savaii Island				
6	Fa'asaleleaga	Safotulafai	266	13,404
7	Gaga'emauga [C]	Saleaula	223	7,487
8	Gaga'ifomauga	Safotu	365	4,842
9	Itu Asau	Asau	178	6,478
10	Satupa'itea	Satupa'itea	127	5,260
11	Palauli	Vailoa i Palauli	523	9,082
Independent State of Samoa (Total)		Apia	2,831	180,741

[A]: Including Manono Island, Apolima, Nu'ulopa
[B]: Including Aleipata Islands, Nu'usafe'e Island
[C]: Salamumu (incl. Salamumu-Utu) and Leauvaa villages are in Upolu Island

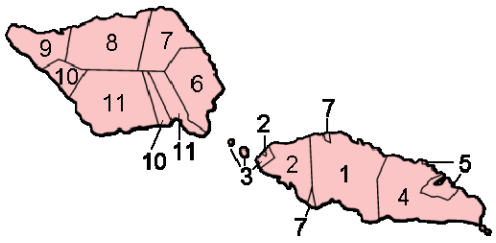


Figure 22: Administrative District of Samoa

3 - 2 Recommendations

In order to further enhance the benefits of the Programme, the following recommendations should be implemented, namely;

1) Manpower Development

   a) The development of more qualified technical personnel through continuous training and other related manpower development programs;
   b) The conduct of timely research to increase the level of understanding/knowledge about meteorological disasters, and its impact on socio-economic activities;

2) Meteorological Disaster Prevention and Management

   a) The creation of effective communication and collaboration with the various government agencies, NGOs, and international institutions for better coordination of meteorological disaster prevention and management;
   b) The formulation of effective and consistent disaster prevention schemes through different stages from Weather Forecasting, Warning Announcement, Disaster Occurrence, Information Dissemination, all the way to Evacuation Stage;
   c) Implement and ensure wider dissemination of knowledge and information on disaster-prevention activities to all sectors including government disaster management agencies, the private sector, and the population at risk;
   d) Setting up of redundancies in the announcement of warnings and other information dissemination to ensure reaching out to the general populace;
   e) Continuing education to the general public, especially the population at risk in coordination with various related disaster management agencies on effective meteorological disaster prevention and management;

3) Longer Life Span of Programme Equipment and Facilities

   a) Regularly secure the necessary budget for the efficient operation and maintenance of the systems, and the procurement of requisite spare parts and consumables for all the equipment to be supplied under the Programme;
   b) Ensure protection of the equipment and facilities against theft and vandalism;
   c) Require technical assistances (training, technology transfer, etc.) for accelerating long time effective utilization of all the systems to be supplied under the Programme;

4) Cost Recovery Schemes

a) Since it has been agreed between the SMD and the Samoa Airport Authority that the recurrent cost of all the systems to be installed in the Faleolo International Airport is shared, task and responsibility of both parties should be clarified for enhancing further collaboration.

The SMD is able to implement the fundamental routine works such as meteorological observation and forecasting using the meteorological systems and also the system operation and maintenance. For further improvement of the SMD's technical skill and effectively longer utilization of the meteorological systems to be supplied under the Programme, technical training and technology transfer are required for the staff of the SMD. The knowledge, technical skills and ability of the SMD personnel can be improved by training overseas in the operation and maintenance of the meteorological observation, forecasting and early warning systems, and this will be augmented by the SMD's own training.

3 - 3 Technical Cooperation under the Programme Grant

The following technical training and technology transfer as Technical Cooperation under the Japan's Programme Grant Aid for Environment and Climate Change are indispensable for the staff of the SMD, to enable the effective utilization of the meteorological systems to be supplied under the Programme for meteorological observation, forecasting and information dissemination works and the acceleration of the Programme effects efficiently.

Table 48: Required Technical Cooperation under the Programme

Component	Activity
Equipment Operation and Maintenance	Production of equipment manual summary
	Production of observation instruments and data communication equipment maintenance and management manual
	Production of observation and data communication equipment maintenance and management record book 1) Date and time of occurrence of system failure/trouble 2) Cause/s of system failure/trouble (abnormal noise, part degradation, etc.) 3) Repair procedures implemented 4) Name and quantity of replaced parts 5) Name of engineer/s who perform the repair/troubleshooting 6) Result of the solution undertaken
	Preparation of consumables & spare parts list including technical specification and detailed procurement plan
	Practice training of countermeasures, fault finding, remedy and recovery against abnormal conditions
	Adjustment and correction of the observation instruments
	PC networking and Linux operation

Data Quality Control	Standardized drawings of the AWS and AWOS observatory
	Formulation of observation rules (observation order, time and duration, reporting time, etc.) and standardized beau fort and cloud level
	Preparation of daily observation data input sheet (Excel file)
	Establishment of automated formula for calculating station pressure, sea level pressure, relative humidity, vapor pressure and dew-point temperature
	Handling of the observed data which deviates from normal level (data error check and data entry)
	Database development and management
	Implementation of statistical processing for the climate data by Excel 1) Target observation element: temperature, precipitation 2) Statistical processing item: average, maximum, minimum, moving average, standard deviation, anomaly from average and moving average
	Data protection, storage. retrieval protection
	Analysis of statistical processing results 1) Determining precipitation and temperature trend (clarification of ageing inclination with regression analysis) 2) Correlation analysis between rainfall amount & frequency and temperature 3) Monthly change of the correlation between Samoan data and another countries' data.(especially Tahiti and Darwin which are the internationally designated observation points of the southern oscillation index for monitoring El Niño event) 4) Setting the normal value range of the observed data with histogram
	Quality evaluation of the existing climate data
Weather Information Dissemination	Productions of newspapers, Journals and media release weather information
	Production of Television Weather and Internet products
	Renewal of Web site design
	Production of 2 types of booklets (leaflet holder type) such as "Tropical Cyclone" and "Climate Change" for promoting further understandings of pupils, students and the public
	Distribution of booklets and workshop for primary school students for year 1 to 8 to understand nature of weather & climate and the impact of climate change
	Distribution of booklets and workshop for college students for year 9 to 13 to understand nature of weather & climate and the impact of climate change
	Study for needs of weather information users
	Implementation of aviation weather services cost recovery formulation and policy
	Development and installation of product dissemination strategy
	Formulation and productions of weather and climate products
	Monitoring and assessing the quality of products
Weather Forecast	Short term forecast with the Wind Profiler and Observed data (grid data) 1) First row of Excel for Wind Profiler Data 2) Second row of Excel for Wind Profiler Data 3) 3rd row of Excel for Wind Profiler Data 4) Expression of Wind Direction 5) Calculation of Vertical Average of Wind Direction and Wind speed 6) Timely Difference of Wind Direction for 1 hour at 200m height and 2000m height 7) Difference of Wind Direction>0, Tropical Cyclone passing through the northern side of Samoa 8) Difference of Wind Direction<0, Tropical Cyclone passing through the southern side of Samoa
	Development of Point Forecast Guidance (VBA in Excel)
	Development of short term forecast with the observed data, guidance for daily forecast and weekly and extended forecast
	Development of Weekly Forecast and Extended Forecast(15days)
	Decision of the moving side with Pressure change
	Acquisition of the tropical disturbances with Satellite Picture and Wind Profiler
	Use of SATAID software for General Forecasting and Tropical cyclone forecasting.
	Watch of the relation of Easterly wave and SPCZ
	Producing of statistical analysis of low level and upper level system
	Production of forecast briefing flowchart and forecast briefing record book
	Practical training for forecast briefing

Table 49: Expert Activity Plan for Technical Cooperation

Expert	December 2011 - March 2012			April 2012 - March 2013			Total		
	Activity/month		Travel	Activity/month		Travel	Activity/month		Travel
	Japan	Samoa		Japan	Samoa		Japan	Samoa	
Meteorological Equipment Operation and Maintenance	0.15	1.00	1	0.10	0.70 0.70	2	0.25	2.40	3
PC Network/WEB Design	0.15	0.70	1	0.10	0.70 0.70	2	0.25	2.10	3
Weather Data Quality Management	0.10	0.60	1	0.10	0.70 0.70 0.60 0.60	4	0.20	3.20	5
Climate Data Statistical Analysis	0.05	-	-	0.10	0.60 0.70	2	0.15	1.30	2
Weather Product Planning	0.10	0.60 0.60 0.80	3	0.10	0.70	1	0.20	2.70	4
Weather Information Dissemination	0.20	0.60 0.60	2	0.10	0.80 0.80	2	0.30	2.80	4
Weather Forecasting Method/Guidance	0.20	0.60 0.60 0.60	3	0.10	0.60 0.60 0.60	3	0.30	3.60	6
Weather Briefing	0.15	0.70 0.60	2	0.10	0.60	1	0.25	1.90	3
Weather Information User Service	0.15	0.70	1	0.10	0.80 0.70	2	0.25	2.20	3
Total	1.25	9.30	14	0.90	12.90	19	2.15	22.20	33

Table 50: Technical Cooperation Schedule under the Programme Grant