

NO. 1

Department of Science and Technology
Philippine Institute of Volcanology and Seismology
The Republic of the Philippines

BASIC DESIGN STUDY REPORT ON THE PROJECT FOR EARTHQUAKE AND VOLCANO MONITORING IMPROVEMENT PROGRAM IN THE REPUBLIC OF THE PHILIPPINES

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ON
THE PROJECT
FOR
EARTHQUAKE AND VOLCANO MONITORING
IMPROVEMENT PROGRAM
IN
THE REPUBLIC OF THE PHILIPPINES

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JAPAN INTERNATIONAL COOPERATION AGENCY
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PREFACE

In response to a request from the Government of the Philippines the Government of Japan decided to conduct a basic design study on the Project for Earthquake and Volcano Monitoring Improvement Program in the Republic of the Philippines and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent to the Philippines a study team from 21st of October to 24 th of November, 1997.

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

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

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

March 1998



Kimio Fujita

President

Japan International Cooperation Agency

March, 1998

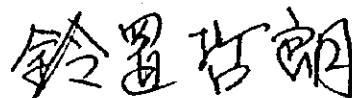
Letter of Transmittal

We are pleased to submit to you the basic design study report on the Project for Earthquake and Volcano Monitoring Improvement Program in the Republic of the Philippines.

This study was conducted by Japan Weather Association, under a contract to JICA, during the period from October 14, 1997 to March 31, 1998. In conducting the study, we have examined the feasibility and rationale of the project with due consideration to the present situation of the Philippines and formulated the most appropriate basic design for the project under Japan's grant aid scheme.

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

Very truly yours,

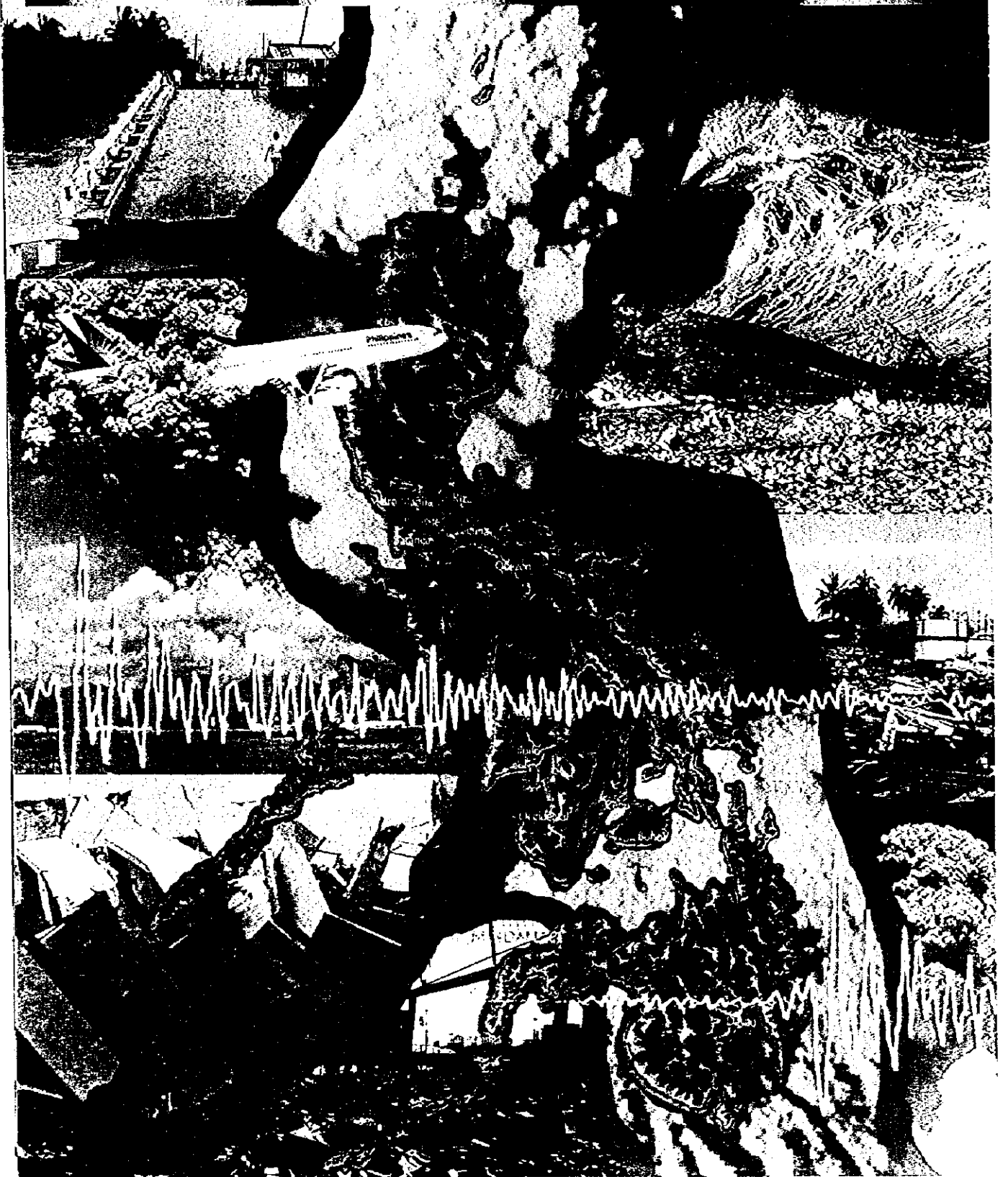


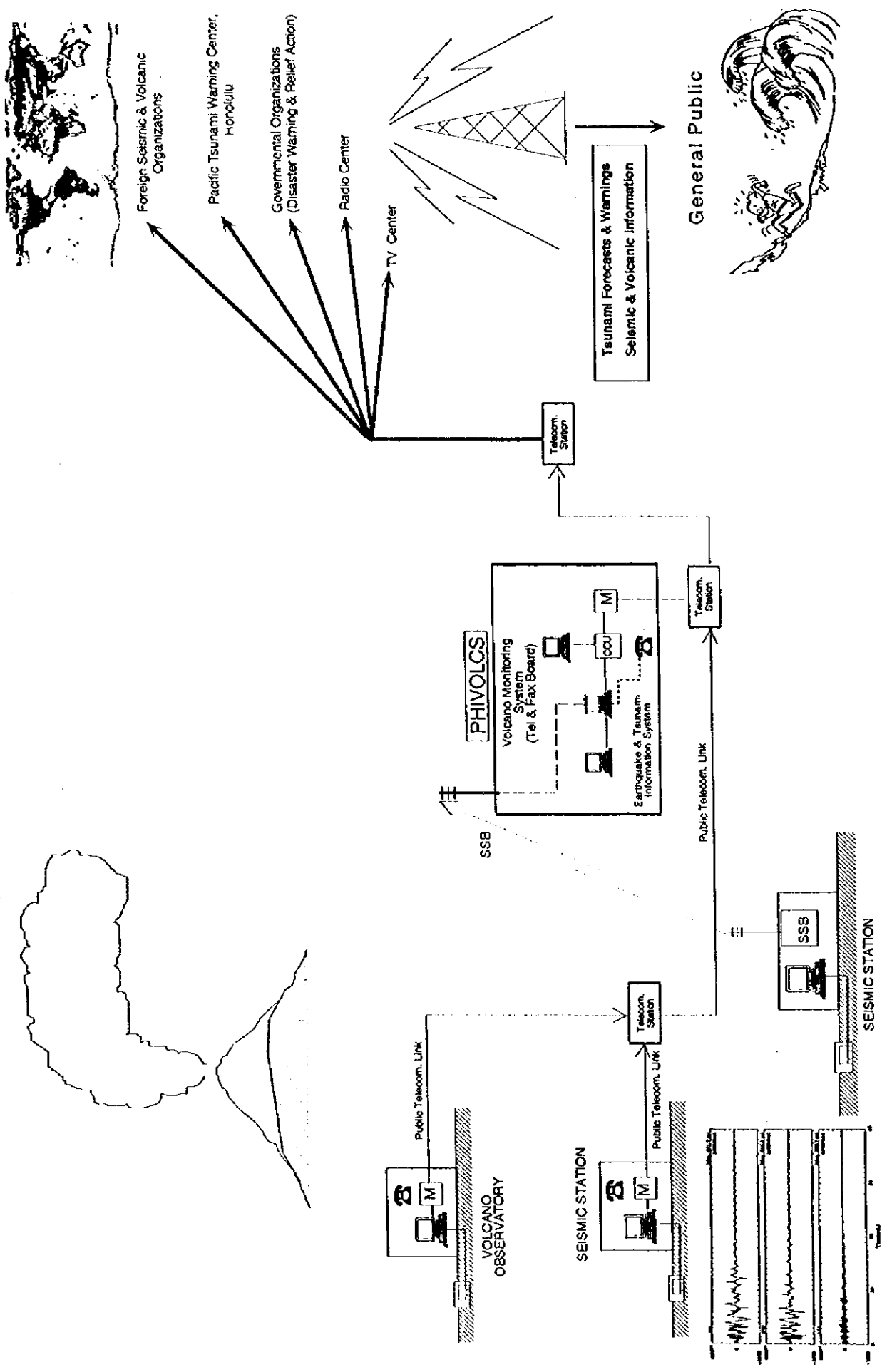
Tetsuro Suzuoki

Project Manager

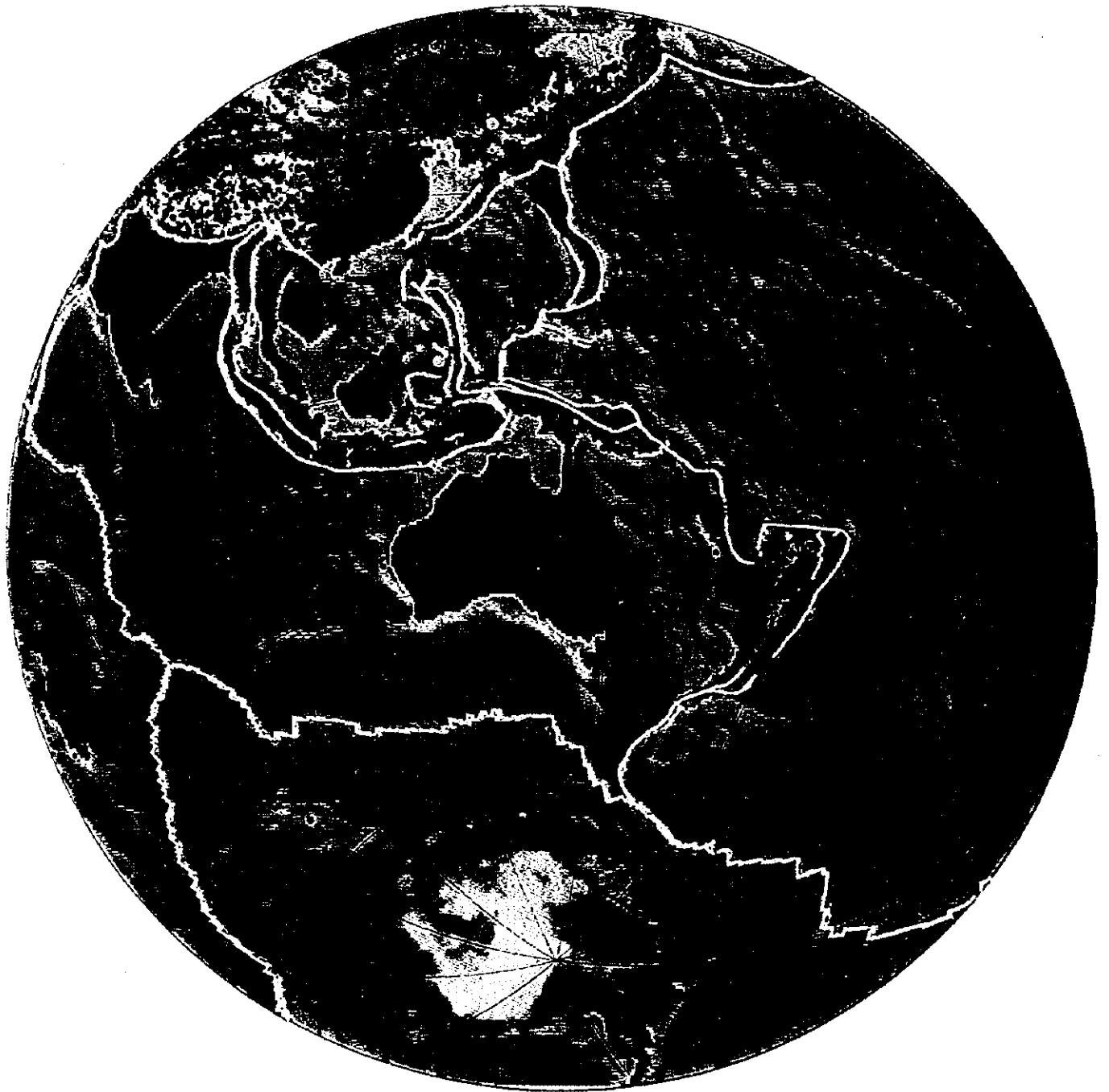
Basic Design Study Team on the Project for
Earthquake and Volcano Monitoring Improvement Program
in the Republic of the Philippines
Japan Weather Association

THE PROJECT FOR EARTHQUAKE AND VOLCANO
MONITORING IMPROVEMENT PROGRAM
IN THE REPUBLIC OF THE PHILIPPINES

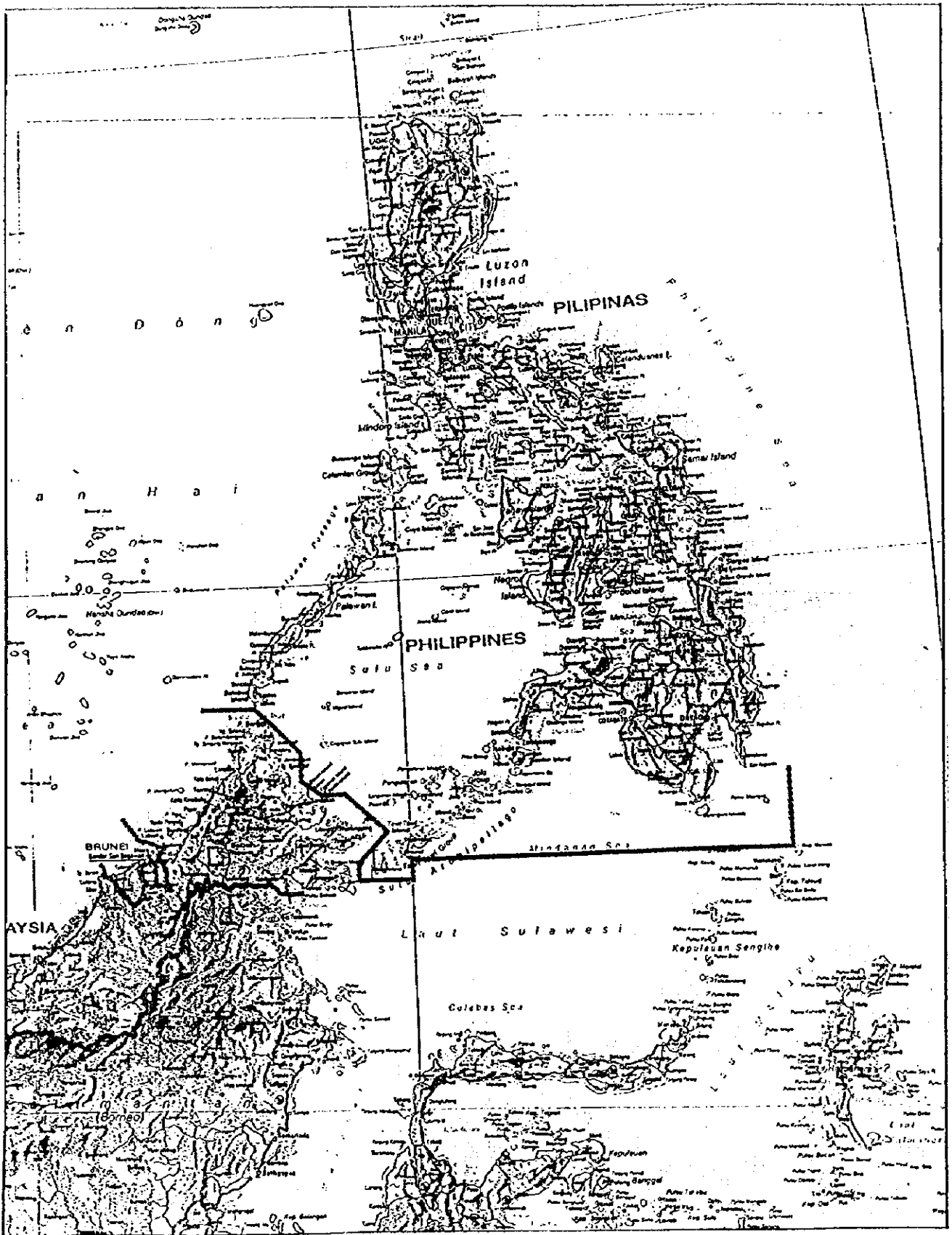




Project Configuration



Distribution of earthquake generators



Map of Philippines

Abbreviations

1. General

CPU	Central Processing Unit
GNP	Gross National Product
GPS	Global Positioning System
IOC	Intergovernmental Oceanographic Commission
OECD	Organization for Economic Cooperation and Development
PAGASA	Philippine Atmospheric, Geophysical and Astronomical Services Administration
PTWC	Pacific Tsunami Warning Center
PHIVOLCS	Philippine Institute of Volcanology and Seismology
SSB	Single Side Band
UHF	Ultra High Frequency

2. Unit

A	Ampere
AH	Ampere Hour
GB	Giga Byte
GHz	Giga Hertz
KVA	Kilo Volt Ampere
KW	Kilo Watt
M	Magnitude
MB	Mega Byte
MHz	Mega Hertz
V	Volt
W	Watt

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Chapter 1

Background of the Project

Chapter 1 Background of the Project

Natural hazards are unavoidable aspects of the country's life, therefore, reduction and prevention of the natural hazards such as earthquakes, volcano hazards, tsunami, etc. for keeping safety of people's lives and properties are the most significant task of the country.

The Philippine archipelago is one of the largest island-groups in the world, with its 7,100 islands. The Philippine Archipelago belongs to the Circum-Pacific Ring of Fire and as such is prone to hazards related to volcanic earthquake occurrences. The trace of the Philippines Fault Zone extends over 1,600km from Luzon to Mindanao.

The earth's crust is a mosaic of separate plates which are continuously moving relative to each other. Volcanoes and earthquakes occur in zones where these plates interact. The Philippines, being situated in a zone where at least three lithospheric plates coalesce, hosts more than 200 volcanoes distributed in five volcanic belts intimately related to subduction/convergent processes and at least 5 imperceptible to perceptible earthquakes a day and in the past, several large magnitude earthquakes and volcano eruptions have occurred and caused considerable loss of lives and damage to properties. In addition, large earthquakes have created sever tsunami disasters around the coastal areas, collapsing the buildings, etc. and also lava flows, pyroclastic flows and lahar by volcano eruptions have made the extensive damages. In recent years, Philippines is affected seriously by volcanic eruptions of Pinatubo, Mayon, Taal, Bulusan, Canlaon and Hibok-Hibok and also earthquakes in Luzon and Mindoro Islands which carry the highest potential for loss of life and property, and has suffered from serious damages to economic bases.

Records of the recent disasters by seismic and volcanic activities are as follows.

• The Moro Gulf (Mindanao) earthquake

August 17, 1996 was the worst natural calamity to hit Mindanao in terms of casualties and damage to property. Most of the losses were attributed to the 20-foot tsunami which inundated the coastal areas of Southern Mindanao. The tsunami reaching a peak velocity of 720 km/hr, rushed as far as 500 meters inland, drowning, injuring and washing away people and domesticated animals. The number of confirmed casualties reached a total of 3,564, missing were 1,502, injured were 8,256 people, and 12,183 families were rendered homeless. Some 650 structures were totally damaged, while the number of houses destroyed was placed at 1,076. The computed magnitude of this earthquake was 7.9 in the Richter Scale.

- The Cabanatuan Baguio earthquake

On July 16, 1990, an earthquake of magnitude 7.6, in which at least 1620 people died with severe damage, landslides, and liquefaction and subsidence of soils in the Baguio area. Surface faulting occurred on the Philippines and Digdig faults and there was some damage in Manila. Most of the death was caused by the collapse of structurally problematical reinforced concrete buildings in Baguio and the number of casualties was more than 2,600 people. In addition, liquefaction in Dagupan and land slide at mountainous area were occurred by this earthquake.

- Pinatubo Volcano Eruption

After a 500 year sleeping, Mt. Pinatubo started showing signs of restiveness on April 02, 1991. On the afternoon of June 15, 1991, the volcano exploded between 3.7 and 5.3 km³ of magma and it was in one of the world's most violent and destructive eruptions this century. Pinatubo's eruption threatened the lives of a million people. A gain ash cloud rose 35 kilometers into the sky and hot blasts seared the countryside. The eruption also injected so much sulfur dioxide into the stratosphere that the global climate was cooled for about 2 years. About 1,000,000 people were threatened, 250 died during the eruption and a hundred more have died in subsequent lahars.

- Mayon Volcano Eruption

Considered as the most active volcano in the Philippines, Mayon Volcano has had at least 43 eruptions since 1616. Its violent and devastating outburst occurred February 02, 1993. The number of casualties reached about 70 and at least 60,000 people evacuated in this eruption.

In the field of volcano eruption and earthquake prediction, Philippine Institute of Volcanology and Seismology (hereinafter referred to as "PHIVOLCS") has to raise its proficiency to a level which would facilitate the formulation of medium to long term strategies for disaster prevention/mitigation and of sound land use schemes for areas vulnerable to geologic hazards. Furthermore, PHIVOLCS has to participate in the overall national endeavor to develop the countryside and boost socio-economic growth by harnessing the beneficial potentials of volcanoes and volcanic terranes. Such participation requires PHIVOLCS to identify and characterize economic volcanic products, generate and/or adapt technologies for their utilization and deliver the tested technologies to end users.

The principal goal of PHIVOLCS is to formulate up-to-date and comprehensive disaster preparedness and loss reduction actions plans for volcanic eruption, earthquake occurrences

and related geotectonic processes/phenomena. A corollary goal is to exploit the positive aspects of these processes for the improvement of the living standard of the people of the Philippines. In line with its role in the promotion of science and technology in the country, PHIVOLCS will furthermore undertake activities geared towards making people aware of volcanoes and volcanology, earthquakes and seismology, and understand why, where and how natural disasters of volcanic and seismic origins occur in the Philippines.

The following present problems that is encountered by the Institute is the deterioration condition of equipment in its present seismic network. This results in a much lower detection capability such that precursory signs from big earthquakes are entirely missed.

- 1) At the present, PHIVOLCS operates only a total of 35 manned stations (6 volcano observatories and 29 seismic stations) equipped with fairly obsolete seismographs and are inadequate in terms of the desired number of monitoring stations for keeping useful quality data for disaster forecasting and preparedness planning. For accurate seismic observation and increasing detectable capability, establishment of observation points, installation of high sensitive seismographs and replacement of the antiquated equipment creating troubles are required.
- 2) At most of the existing observation stations, seismic observation of vertical motion is implemented by a short period seismograph. For accurate hypocenter determination and calculation of magnitude and also recording seismic occurrence time, the existing equipment is insufficient.
- 3) At the present, daily transmission of seismic data (2 times per day at 10:00 & 15:00) to the Head Office in Manila is done through single-side band radios (SSB), therefore, obtaining all necessary data at the Head Office, it takes about 35 minutes. In addition, the existing data processing and analysis systems is not satisfactory for accurate preparation of seismic and volcanic information and prompt dissemination.
- 4) For monitoring and detection of volcanic activities, two observation equipment are adopted for volcanic observation. One is permanent installed equipment and another is mobile equipment. As the permanent installed equipment points, there are six the existing volcano observatories in the Philippines. However, due to insufficient number of volcano observation points and the equipment, it is difficult for grasping volcanic activities and making accurate observation. For foreseeing a volcano erupting, observation of volcanic earthquake and slight movement, replacement of the antiquated equipment at the existing observatories, establishment of volcano observation points and supply of mobile observation systems are required.

- 5) In order to dissemination of the information on volcano eruptions, earthquakes and tsunami more speedily and accurately to the general public, the governmental agencies and other organizations concerned with natural disaster mitigation, dedicated links between PHIVOLCS Head Office and the existing seismic & volcano observation stations should be secured.

List of the Existing Observation stations of PHIVOLCS

	Name of the Stations	Number of the Stations
Head Office	Quezon	1
Seismic Stations	Basco, Pasuquin, Tuguegarao, Santa, Baguio, Palayan, Tagaytay, Lucban, Guinayangan, Puerto Galera, Masbate, Kalibo, Roxas, Palo, Antique, Cebu, Sibulan, Tagbilaran, Puerto Princesa, Surigao, Cagayan de Oro, Bislig, Dipolog, Davao, Cotabato, Kidapawan, General Santos and Zamboanga	28
Volcano Observatories	Pinatubo, Buco, Mayon, Sorsogon, Kanlaon and Hibok-Hibok	6
	Total	35

List of the Existing Equipment of PHIVOLCS (Major Equipment)

	Equipment
Seismic Stations	<ul style="list-style-type: none"> • Short period seismograph (vertical) • Drum recorder • SSB or Telephone
Volcano Observatories	<ul style="list-style-type: none"> • Short period seismograph (3 components) • Drum recorder • SSB or Telephone

For reaching the principal goal of PHIVOLCS, implementation of this Project is dispensable. The Project aims to upgrade the quality of geophysical monitoring and other geologic hazard studies which are being undertaken by PHIVOLCS and also aims to provide PHIVOLCS the capability to establish a reliable data base from which preparedness plans for disaster mitigation arising from volcano eruptions and earthquakes can be developed/formulated. The Project is in line with the objectives of the Medium-Term Philippine Development Plan (1993 ~ 1998) on disaster mitigation which provides for the enhancement of disaster preparedness and management. At present, PHIVOLCS has enough manpower for the continuous operation of all the stations. Most of the technical staff have the necessary technical capabilities to handle the project effectively and efficiently.

Taking these circumstances described above into consideration, if this Project is implemented, the facilities of PHIVOLCS will greatly be improved and thus PHIVOLCS will be capable of contributing effectively to the mitigation of natural disasters by volcanic eruption, earthquake and tsunami and also to advancement of relief action and civil defence activity of the Philippines. It is expected that with this PHIVOLCS can contribute to the reduction of volcanic and seismic disasters in the country. At the same time, overall standard of volcanic and seismic information will be in better position, and PHIVOLCS will thus be able to contribute in a greater perspective to reduction of the natural disasters generated by volcano eruptions and earthquakes. Further, the improvement of the volcano & seismic monitoring network as the result of this Project will highly enhance PHIVOLCS's activities and will put PHIVOLCS in a position to play its due role in the economic development of the Philippines.

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

- (1) PHASE-I (Strengthening of monitoring capability for seismic and volcanic activities)
Replacement of the existing seismographs and installation of data transmission equipment at the existing field stations (seismic stations and volcano observatories).

- (2) PHASE-II (Strengthening of data processing and analysis capability for information dissemination and observation capability in an emergency case)
Installation of seismic and volcanic data processing and analysis system at the Head Office of PHIVOLCS and sub-centers and supply of mobile observation seismographs.

(3) PHASE-III (Strengthening of detecting capability for seismic and volcanic activities and dissemination capability of information for reduction of natural disasters)

Establishment of unmanned seismic & volcano observation points, volcano satellite observation points and data relay points.

Main components of the equipment for requested project by the Government of the Philippines to be supplied under the Project is described in the table 1-1 hereunder.

List of the Proposed Equipment

Equipment	Purpose	Location	Quantity
Phase-I			
Short Period Seismic Observation System	For observation & recording of 3 components of short period motions (east/west, south/north, vertical)	Existing Seismic Stations & Volcano Observatories Bucos Existing Observatory)	34
Middle/Long Period Observation System	For observation & recording of 3 components of middle/long motions (east/west, south/north, vertical)	Existing Seismic Stations & Volcano Observatories Bucos Existing Observatory)	34
Acceleration System	For observation & recording of 3 components of acceleration motions (east/west, south/north, vertical)	Existing Seismic Stations & Volcano Observatories Bucos Observatory)	34
Power Supply System	For uninterrupted and stable power to the equipment and systems	Existing Seismic Stations & Volcano Observatories Bucos Existing Observatory)	34
Phase-II			
Data Processing, Analyzing and Archiving System at PHIVOLCS Head	For volcanic & seismic data processing, analyzing and archiving for technical development,	PHIVOLCS Head	1
Data Processing, Analyzing and Archiving System at Sub Centers	For volcanic & seismic data collection, processing and analyzing	Existing 4 Seismic Stations (Tuguegarao, Baguio, Cebu Davao)	4
Mobile Observation System	For mobile observation in an emergency case	PHIVOLCS Head	30
Phase-III			
Volcano Satellite Observation & Data Transmission System at Volcano Satellite Observation Points	For observation of short period motion (3 components) and data transmission at Volcano Satellite Observation Points to be established	Surrounding area of 6 existing Volcano Observatories	18
Observation & Data Transmission System at Observation Points	For observation of short period motion (vertical) and data transmission at Observation Points	Unmanned Sites (Volcano Observation Point & Seismic Observation Points to be established)	38
Observation & Data Transmission System at Observation Points with Data Relay	For observation of short period motion (vertical) and data transmission at Observation Points, and for data relay to other points	Unmanned Sites (Volcano Observation Point & Seismic Observation Points with Data Relay to be established)	20
Data Relay System	For data receiving from unmanned observation points and data transmission as a relay point	Unmanned Sites (relay point) to be established	7
Data Receiving System	For data receiving from an observation point/a relay point and data recording	Existing Seismic Stations and Volcano Observatories	23

Chapter 2

Contents of the Project

Chapter 2 Contents of the Project

2 - 1 Objectives of the Project

The Philippines has enormous potentialities of occurrence of geologic phenomena and is affected seriously by the frequent occurred earthquakes, tsunamis and volcano eruptions which carry the highest potential for loss of life and property. Regrettably, the extensive damage from earthquakes, tsunamis and volcano eruptions is the determining factor for significant set-back of national economy and development activities of the Philippines. Under these circumstances, the Government of Philippines has prepared this Project. The Project aims to upgrade the quality of geophysical monitoring and other geologic hazard studies which are being undertaken by PHIVOLCS to understand why, where and how natural disasters of volcanic and seismic origins occur in the Philippines and also aims to provide PHIVOLCS the capability to establish a reliable data base from which preparedness plans for disaster mitigation arising from volcano eruptions and earthquakes can be developed/formulated. The Project is in line with the objectives of the Medium-Term Philippine Development Plan (1993 ~ 1998) on disaster mitigation which provides for the enhancement of disaster preparedness and management.

The objectives of the Project are to improve the volcano and earthquake monitoring networks of PHIVOLCS through replacement of the existing seismograph and introduction of necessary equipment and systems and also in order to prevent and mitigate the natural disasters caused by volcanic eruption, earthquake and tsunami in the Philippines.

2 - 2 Basic Concept of the Project

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

- (1) PHASE-I (Strengthening of monitoring capability for seismic and volcanic activities)
Replacement of the existing seismographs and installation of data transmission equipment at the existing field stations (Seismic Stations and Volcano Observatories).

- (2) PHASE-II (Strengthening of data processing and analysis capability for information dissemination and observation capability in an emergency case)
Installation of seismic and volcanic data processing and analysis system at the Head Office of PHIVOLCS and sub-centers and supply of mobile observation seismographs.

(3) PHASE-III (Strengthening of detecting capability for seismic and volcanic activities and dissemination capability of information for reduction of natural disasters)

Establishment of unmanned Seismic & Volcano Observation Points, Volcano Satellite Observation Points and Data Relay Points.

In connection with all the equipment and systems as described above, the Basic Design Study and investigation have been held in the Philippines and Japan. In accordance with the result of the study, this Project has been designed to consist of two phases as follows. However, for implementation of the Phase-II, further basic design study is necessary for confirming necessity and importance of the Project and also exact locations of all the Project sites.

• **Operation & Maintenance**

In case of the Project implemented in accordance with the request of the Government of the Philippines, total number of the project sites would approximately be 3 times of the number of the existing stations and observatories. However, that might make the burden too heavy for the Philippines due to the present economical condition. Therefore, radical improvement of detecting capability for seismic and volcanic activities should be a further subject and the number of unmanned Seismic & Volcano Observation Points will be decided only to cover a blank space and gap of the seismic observation network.

• **Project Effects**

The Project must make immediate effects and benefit to the Philippines and prioritized project phases to be implemented are as follows.

- a) Phase-I (Strengthening of monitoring capability for seismic and volcanic activities)
- b) Phase-II (Strengthening of capabilities in detecting seismic and volcanic activities, data processing & analysis for preparation of information and dissemination of information for reduction of natural disasters)

After the completion of the Project Phase-I & II, the following the Project effects will be obtained.

- ① Supply of seismic observation system ⇒ Strengthening of monitoring capability for seismic activities

- ② Supply of data transmission system ⇒ Strengthening of prompt information dissemination for reduction of natural disasters
- ③ Supply of data processing & analysis system ⇒ Strengthening of data processing & analysis capability for preparation of accurate information and prompt dissemination
- ④ Volcanic observation system ⇒ Strengthening of monitoring capability for volcanic activities
- ⑤ Establishment of seismic observation points ⇒ Strengthening of detecting capability for seismic activities
- ⑥ Establishment of volcano observation points ⇒ Strengthening of detecting capability for volcanic activities
- ⑦ Mobile observation system ⇒ Strengthening of monitoring capability for seismic & volcanic activities in an emergency case

1. Basic Concept

The Philippine Fault Zone has been the site of many large (M_s (magnitude) > 5) historical earthquakes and more numerous moderate to small events ($2 < M_s <$). The evidence (geology, seismicity and historical accounts) gathered so far on the recency of its activity indicate that the fault zone shall continue to be the locus of future damaging earthquakes. Earthquakes could not be predicted yet and the nature of the Philippine Fault Zone is far from being fully understood. This is not to say, however, that nothing could be done to mitigate the effects of earthquakes originating along the fault zone.

In accordance with the local earthquake resistant regulations and the results of the Basic Design Study in the Philippines, it has been decided that this Project is aiming at establishment of seismic monitoring network which will be able to detect minimum of approximately 4.0 magnitude earthquakes in the whole regions of the Philippines and to obtain accurate hypocenter, focal depth etc., because 4.0 magnitude earthquakes has potentiality of generating a damage in the Philippines.

For selection of the Project sites of seismic, volcano and data relay points, necessary site survey has been held by PHIVOLCS and almost all the Project sites are belonging to the Government of the Philippines. If this Project is implemented, the facilities of PHIVOLCS will greatly be improved and thus PHIVOLCS will be capable of contributing effectively to the mitigation and prevention of natural disasters, damages and losses by volcanic eruption, earthquake and tsunami in the Philippines. Further, the improvement of observing, detecting, monitoring and warning

equipment and systems as a result of the Project will highly enhance the PHIVOLCS's activities and will put PHIVOLCS in a position to play its due role in the economic development of the Philippines.

Annotation for the Project sites

- * Seismic Station : the existing and manned station
- * Volcano Observatory : the existing and manned observatory
- * 3 Volcano Satellite Observation Points per 1 Volcano : to be established under the Project and unmanned points
- * Volcano Observation Point : to be established under the Project and an unmanned point
- * Seismic Observation Point : to be established under the Project and an unmanned point
- * Data Relay Point : to be established under the Project and an unmanned point

PHASE-I : for monitoring seismicity in the Philippines, detecting large earthquake generating a tsunami along the Philippine Fault Zone and archiving necessary data and information for upgrading of the local earthquake resistant regulations, replacement of the existing seismographs and installation of data processing & transmission systems at the existing seismic stations & volcano observatories and also establishment of data processing & analyzing system at PHIVOLCS Head Office will be implemented under the Project, Phase-I. Since installation of data processing & transmission systems at the existing Seismic Stations & Volcano Observatories, preparation time of seismic observation information for transmitting to the Head Office will be minimize roughly from 15 minutes to 5 minutes and also necessary time between observation and data transmission to the Head Office will be minimized about 35 minutes to 25 minutes. In addition, by establishment of data processing & analyzing system at PHIVOLCS Head Office, time of hypocenter determination and preparation of necessary information will be reduced approximately from 25 minutes to 20 minutes.

1) The existing Seismic Stations & Volcano Observatories

(34 project sites : Basco, Pasuquin, Tuguegarao, Santa, Baguio, Palayan, Pinatubo, Quezon, Tagaytay, Lucban, Guinayangan, Mayon, Sorsogon, Puerto Galera, Masbate, Kalibo, Roxas, Antique, Palo, Kanlaon, Sibulan, Cebu, Tagbilaran, Puerto Princesa, Hibok-Hibok, Surigao, Cagayan, Dipolog, Bislig, Davao, Cotabato, Kidapawan, Zamboanga and General Santos)

Replacement of the existing seismographs and installation of data processing & transmission systems at the existing Seismic Stations & Volcano Observatories will be implemented. In addition, long period seismographs will be installed at Baguio and Tagaytay existing

Seismic Stations. Other required middle and long period seismographs will be considered to be installed at the existing Seismic Stations and Volcano Observatories in the basic design study for the Phase-II as described hereunder. However, Buco existing Volcano Observatory is not included in the Phase-I, because as so far, there is no observation activity at existing Buco Volcano Observatory, thereby, a volcano monitoring system will be installed at the observatory in the Phase-II.

2) PHIVOLCS Head Office

For processing and analysis of data observed at the existing seismic stations & volcano observatories, data processing & analyzing system will be installed at PHIVOLCS Head Office. However, even after the completion of the Phase-I, daily transmission of seismic data to the Head Office in Manila will be done through single-side band radios (SSB) or through telephone lines as the same as the present.

PHASE-II : Establishment of necessary unmanned Volcano Observation Points for monitoring volcanic activities and unmanned Seismic Observation Points for detecting minimum of approximately 4.0 magnitude earthquakes in the Philippines and also installation of middle and long period observation systems for clarifying the mechanism of geologic phenomena will be implemented under the Project, Phase-II for strengthening of detecting and monitoring capabilities of PHIVOLCS, minimizing the damage from future earthquakes and volcano eruptions and also estimating the risk of their happening more accurately.

For making accurate and prompt information dissemination, upgrading of data processing, analyzing and transmission system at PHIVOLCS and establishment of data processing and archiving system at each sub center will also be implemented. In addition, for taking necessary measures to monitor hazardous circumstances of seismic and volcanic activities by PHIVOLCS, mobile observation systems and vehicles will be supplied.

1) The existing Seismic Stations & Volcano Observatories

(35 project sites : Basco, Pasuquin, Tuguegarao, Santa, Baguio, Palayan, Pinatubo, Quezon, Tagaytay, Buco, Luchan, Guinayangan, Mayon, Sorsogon, Puerto Galera, Masbate, Kalibo, Roxas, Antique, Palo, Kanlaon, Sibulan, Cebu, Tagbilaran, Puerto Princesa, Hibok-Hibok, Surigao, Cagayan, Dipolog, Bislig, Davao, Cotabato, Kidapawan, Zamboanga and General Santos)

The seismic observation systems including middle & long period seismographs, etc. will be

installed at the existing Seismic Stations and Volcano Observatories, which will not be supplied under the Phase-I project. An observation system for monitoring Taal volcano activities will be installed at existing Buco Volcano Observatory.

2) Establishment of Volcano Satellite Observation Points

(18 project sites : 6 volcanos×3 project sites)

At 6 major active volcanos, Taal, Mayon, Pinatubo, Bulusan, Kanlaon and Hibok-Hibok, where the existing Volcano Observatories are located, 3 Volcano Satellite Observation Points will be established to surround a volcano crater for obtaining hypocenter determination and observation of slight volcanic activities and earthquakes and also all volcanic data observed at Volcano Satellite Observation Points will be transmitted to each existing Volcano Observatory.

3) Establishment of data Relay Points for Volcano Satellite Observation Points

(9 project sites : 4 volcanos×2 project sites and 1 volcanos×1 project site)

In case that volcanic data observed at a Volcano Satellite Observation Point can not directly be transmitted to the existing Volcano Observatory, establishment of a data relay point will be required on the line of the site. One relay point for Mayon, 2 relay points for Pinatubo, Bulusan, Kanlaon and Hibok-Hibok will be necessary.

4) Establishment of Volcano Observation Points

(13 project sites: Iraya, Babuyan, Camiguin, Banahaw, Iriga, Biliran, Kalatungan, Calayo, Makaturing, Ragang, Matutun, Parker and Buddajjo)

At 13 number of active volcanos where no existing Volcano Observatory for ordinary observation is located, Volcano Observation Points will be established and volcanic data observed will be transmitted to the nearest location of the existing Volcano Observatory. In addition, a function as the Seismic Observation Point will be furnished to the Volcano Observation Points and those observed data will be utilized for seismic monitoring.

5) Establishment of Seismic Observation Points

(19 project sites : Cagayan, Apayao, Cauayan, Bolinao, Virac, Catarman, Guiuan, Busuanga, El Nido, Bataraza, Calayan, Rapu Rapu, Mayon Relay, San Jose, Northern Cebu, Kabalian, Tablas, Camotes and Davao Relay)

To cover a blank space and gap of the seismic observation network in the Philippines, Seismic Observation Points will be established. Seismic data observed at a Seismic

Observation Point will be transmitted to the nearest location of the existing Seismic Station. However, at 9 points of all the Seismic Observation points, data relay function will be added for data transmission from the Seismic & Volcano Observation Points to the existing Seismic stations & Volcano Observatories.

6) Establishment of Data Relay Points for Seismic and Volcano Observation Points

(9 project sites : Ilagan, Lingayen, Ayala, Ilian, Tinitian, Nara, Dougal, Sabtang and Tagaytay)

In case that data observed at a observation point can not directly be transmitted to the existing station or observatory, establishment of a Data Relay Point will be required on the line of the site. At Sorsogon existing Observatory, data relay function will be added for relaying and transmitting data observed at Catarman Seismic Observation Point to Masbate existing Seismic Station.

7) Improvement of Data Processing & Analyzing System at PHIVOLCS Head Office

Improvement of data processing & analyzing system at PHIVOLCS Head Office will be implemented according to the installation of Seismic and Volcano Observation Points.

All observed data will be transmitted to PHIVOLCS Head Office by the public telephone dialing and the Head Office will be able to accumulate received data and information from the existing Seismic Stations & Volcano Observatories and also be able to make on-line data processing.

8) Establishment of Data Processing & Analyzing System at Sub Centers

(4 project sites : Tuguegarao, Baguio, Cebu and Davao)

In order to prevent delay of data ingestion at PHIVOLCS Head Office by the public telephone dialing from the existing Seismic Stations & Volcano Observatories, Tuguegarao, Baguio, Cebu and Davao existing Seismic Stations will be designated as Sub Centers of the national seismic observation network and data processing & analyzing system for performing as the Sub Center will be installed. Received data from Seismic & Observation Points at the Sub Centers will be transmitted to PHIVOLCS Head Office. In addition, the Sub Center has a special function of a frontier base in case of serious disaster occurred in its responsible region, therefore, the Sub Centers should be located in regional center city with suitable infrastructures.

9) Supply of Mobile Observation Systems (30 sets)

There are two types of mobile observations, one is mobile seismic observation for monitoring aftershock of a large earthquake and earthquake swarm activities and another is mobile volcanic observation for monitoring abnormal volcanic activities. In case of earthquake swarm being occurred, mobile observation is very useful for distinguishing potentiality of a large earthquake occurrence and grasping movement of seismic active zone. In addition, in case of earthquake swarm being occurred, a large earthquake occurrence can be expected, thereby, for mobile observation, accelerometer and high sensitive short period seismograph are indispensable. Especially, in case of a large earthquake being occurred, its aftershock can reach to about 50 kilometers range. For making accurate focal depth determination, 10 sets of mobile systems are required to install in approximately 10 kilometer's mesh density.

For foreseeing a volcano erupting, observation of volcanic earthquake and slight movement by mobile observation systems are very useful and reliable. For making accurate focal depth determination of large scale of a volcanic earthquake, at least, 3 sets of mobile observation systems are required. However, due to complexity of volcano body structure and attenuation of seismic wave, 5 to 10 mobile observation points are necessary.

20 sets of mobile seismic observation systems for short period and 10 sets of mobile acceleration observation systems will be necessary.

10) Supply of Vehicles for maintenance (pick-up trucks & motorcycles)

Three pick-up trucks and nine motorcycles for maintenance for the equipment to be installed at unmanned seismic and volcano observation points will be supplied under the Project. Compression of basic concepts at each phase between the official request of the Government of the Philippines and this Basic Design are described hereunder.

Compression of basic concepts at each phase between the official request of the Government of the Philippines and this Basic Design are described hereunder.

	Official Request of the Government of the Philippines	Basic Design	
Phase-I	<p>Replacement of the equipment at the existing observatories for strengthening of monitoring capabilities for seismic and volcanic activities in the Philippines</p> <ul style="list-style-type: none"> •Replacement of seismographs of the existing Seismic Stations (Short period, Middle period, Acceleration) •Replacement of seismographs of the existing volcano observatories (Short period, Middle period, Acceleration) 	<p>Replacement of the equipment at the existing observatories and supply of data processing system for strengthening of monitoring and data processing capabilities for seismic activities with tsunami in the Philippines</p> <ul style="list-style-type: none"> •Replacement of seismographs of the existing Seismic Stations and Volcano Observatories (Short period, Acceleration) •Supply of long period seismographs to 2 existing Seismic Stations •Installation of data processing and analyzing system at PHIVOLCS Head Office 	Phase-I
Phase-II	<p>Upgrading of data processing and analyzing system for strengthening of PHIVOLCS's capability for preparation of accurate and prompt information on volcano eruption, etc. and supply of observation equipment for strengthening of observation capabilities in an emergency use.</p> <ul style="list-style-type: none"> •Upgrading of data processing and analyzing systems in PHIVOLCS Head Office •Establishment of data processing and analyzing system in the Sub Centers •Supply of mobile observation systems 	<p>Establishment of unmanned observation points for detecting volcanic and seismic activities in more than 4.0 magnitude</p> <p>Upgrading of data processing and analyzing system at PHIVOLCS Head Office for preparation of accurate and prompt information</p> <ul style="list-style-type: none"> •Installation of the equipment at the existing observation stations (Middle and Long period seismographs, etc.) •Establishment of Volcano Satellite Observation Points •Establishment of Relay Points for Volcano Satellite Observation Points •Establishment of Volcano Observation Points •Establishment of Seismic Observation Points •Establishment of Relay Points •Upgrading of data processing and analyzing system at PHIVOLCS Head Office •Establishment of data processing and analyzing system in the Sub Centers •Supply of Mobile Observation System •Supply of Vehicles 	Phase-II
Phase-III	<p>Supply of the equipment for strengthening of detecting capabilities for seismic and volcanic activities</p> <ul style="list-style-type: none"> •Establishment of Seismic Observation Points •Establishment of Volcano Observation Points •Establishment of Volcano Satellite Observation Points •Establishment of Relay Points 		

2. Basic Concept of the Equipment

1) Observation equipment for earthquake motion at the existing stations

In earthquake motion, signals of very wide frequency and dynamic range between short period in less than 1 second and long period in a few minutes are contained and also in seismic amplitude, motions between less than μm and more than 10s cm are contained. Therefore, in order to accurately observe seismic motions between short period and long period, generally, several types of seismographs are required at a seismic observation station. In the international seismic observation manuals issued by UNESCO (the United Nations Educational, Scientific and Cultural Organization), it is recommended and instructed to use short & long period seismographs and accelerometer for making accurate seismic observation. Through improvement of observation range and upgrading of operational function of middle period seismograph, nowadays, up to 1/100Hz peculiar frequency can be observed by a middle period seismograph, however, previously seismic motion in 1/100Hz peculiar frequency of was called as long period motion. In consequence of investigations on generating mechanism of tsunami by an earthquake, it is being clarified necessity of observing long period seismic motions in hundreds of peculiar frequency for distinguishing either high potential earthquake generating tsunami or not. Due to such needs of observing long period seismic motions, a long period seismograph for observing 1/300Hz peculiar frequency has been developed. However a long period seismograph is very sensitive to very small ground noise, therefore, selection of installation place, observation environment and operation and maintenance should be given special considerations. Due to a long wavelength of seismic wave can be observed by a long period seismograph, it is not required to install any number of a long period seismograph in a country.

In accordance with suitability of ground condition, installation space, facility structure, station condition, availability of reliable telecommunication infrastructure for seismic wave form data exchange and principal priority of the Seismic Stations, long period observation systems will be established at six existing Seismic Stations. Out of these existing Seismic Stations, Tagaytay Seismic Station has been designated as a monitoring observation point of a nuclear weapon test under the Comprehensive Test Ban Treaty (CTBT) and also Baguio Seismic Station has the most suitable observation environment and it was one of the world standard seismic observation point. Due to these reasons, long period observation systems will be installed at existing Tagaytay and Baguio Seismic Stations under the Phase-I, as the first priority. Remaining four stations to be installed the long period observation systems,

PHIVOLCS Head Office as the center of the national seismic network to be connected to Internet, Tuguegarao, Cebu and Davao existing Seismic Stations having satisfiable ground condition as the sub centers of the national seismic network have been selected as the long period observation points.

Due to the above reasons, short period, middle/long period and acceleration observation systems which can be observing 3 components (east/west, south/north, vertical) will be supplied under the Project at the existing seismic stations and volcano observatories to cover signal of wide frequency and dynamic range.

Function and features of each seismograph are as follows.

- Short Period Seismograph

Principally, this seismograph is used for small earthquakes observation in short range and it is the most sensitive seismograph to specially observe seismic motion in peculiar frequency, less than 1Hz. For obtaining necessary data to calculate hypocenter and magnitude of a small earthquake, 3 components (east/west, south/north, vertical) of short period motion can be observed by this seismograph.

- Middle/Long Period Seismograph

In order to clarify and increase the level of understanding/knowledge about volcanoes, volcanic eruptions, terranes, earthquake zones, occurrence mechanism, faulting, along with other related geologic phenomena, middle period seismograph (peculiar frequency : 1/100Hz) and long period seismograph (peculiar frequency : 1/300Hz) are utilized and 3 components (east/west, south/north, vertical) of middle/long period motion can be observed by middle/long period seismograph.

- Accelerometer

For observing strong motion up to 2G amplitude, only an accelerometer is useful and short, middle and long period seismographs are not useful. For calculating seismic intensity, wave form of accelerometer is necessary.

2) Data Processing & Transmission System at the existing Seismic Stations and Volcano Observatories

On-line & off-line processing of seismic wave form data at the existing station and unmanned

seismic & volcano observation points will be implemented by the data processing & transmission system.

The main items of on-line processing are as follows.

- Data trigger processing : processing for eliminating ground noise from observed data and extracting seismic wave data.
- Data interpretation processing : processing for extracting P wave (vertical wave) from seismic wave data and maximum amplitude and also for interpreting P wave arrival time and displacement.
- Observed data format preparation & data transmission processing : processing for preparation of data format (P-wave arrival time, initial direction of seismic wave, maximum amplitude, period, seismic intensity, etc.) from interpreted data.
- Data archives processing : processing for attaching time data to seismic wave data and recording serial seismic wave data.

The main items of off-line processing are as follows.

- Data format processing : processing for preparation of data format from manual interpreted data and for transmitting the data format.
- Data interpretation manual-processing : processing for manually interpreting phase and maximum amplitude from displayed seismic wave form.
- Wave form data compile processing : processing for eliminating noise from seismic wave data recorded into a magnetic optical disk (MO)

Regarding volcanic eruption, by using accumulated volcanic observation data of repeated volcanic activities, as well known, it is possible to foresee increase of volcanic earthquakes, appearance of volcanic noise, crustal activity and activation of volcanic activity.

For detecting volcanic activities, seismic observation is the most fundamental measure and the following data processing will be required for detecting volcanic activities and foreseeing volcano eruption.

- Seismic data analysis processing : processing for preparation of hourly, daily and monthly tables on number of earthquake occurrence and seismicity map.
- Analyzing processing of volcanic movement : processing for estimating number of volcanic movement occurrence, continual time, amplitude and energy of volcanic movement.

Due to installation of a facsimile machine under the Project, each volcano observatory will be able to promptly disseminate necessary information on volcano eruption detection and evacuation warning to the general public and the agencies concerning to reduction of natural disasters for making prompt relief action.

3) Seismic Observation Systems at Volcano Satellite Observation Points

Short period seismic observation system as unmanned system will be installed at each volcano satellite observation point for observing 3 components (east/west, south/north, vertical) of short period motion and detecting volcanic earthquake and movement. Then, operational power supply devices (battery, solar array, etc.) for uninterrupted operation will be furnished.

4) Seismic Observation Systems at Seismic Observation Points, Seismic Observation Points with Data Relay and Volcano Observation Points

Short period seismic observation system as unmanned system will be installed at each Observation Point for observing one component of short period vertical motion and detecting volcanic earthquake and movement. Then, operational power supply devices (battery, solar array, etc.) for uninterrupted operation will be furnished.

5) Data Relay Systems at Seismic Observation Points, Volcano Observation Points and Data Relay Points

For relaying and transmitting earthquake wave form data to the existing Seismic Station and Volcano Observatory, data relay systems will be installed with operational power supply devices (battery, solar array, etc.) for uninterrupted operation.

6) Volcanic & Seismic Data Processing and Analyzing System at PHIVOLCS Head Office

For improvement of data processing & analyzing capabilities, volcanic & seismic data processing and analyzing system will be installed at PHIVOLCS Head Office.

All observed data transmitted to PHIVOLCS Head Office by the public telephone dialing will be accumulated and processed by this system in on-line and off-line data processing.

The main items of on-line processing are as follows.

- Data format processing : processing for receiving data format transmitted from the Sub Centers, the existing Seismic Stations and Volcano Observatories.

The main items of off-line processing are as follows.

- Seismic data analysis processing : processing for preparation of hourly, daily and monthly tables of number of earthquake occurrence in the country and seismicity map and for analyzing earthquake occurrence mechanism.
- Data processing for hypocenter & magnitude : processing for calculating location of hypocenter and magnitude from observed data.
- Seismic bulletin & information processing : processing for preparation of seismic bulletin & information from the data obtained through the seismic data analysis processing for dissemination.

- Tsunami information processing : processing for preparation and dissemination of tsunami warning regarding size, expected arrival time and dangerous area for evacuation.
- Wave form data compile off-line processing : processing for archiving observed earthquake wave data of the whole country into CD-ROM.
- Data-base processing : processing for preparation of data base of observed earthquake wave form data and for digitalizing analog data for preparing data base.

By installation of these systems, analyzing and processing for hypocenter determination will be automatized and PHIVOLCS will be capable of contributing effectively to the mitigation and prevention of natural disasters, damages and losses by volcanic eruption, earthquake and tsunami in the Philippines and also will be able to accurately and speedily make detection and warning.

Using 2 facsimile machines and data transmission systems to be installed under the Project, PHIVOLCS will be able to promptly and widely distribute necessary information of volcano eruption detection and earthquake and also evacuation warning of volcano eruption & tsunami to the general public and the agencies concerning to reduction of natural disasters for making prompt relief action of the Government of Philippines and to other information users for taking measures against natural disaster. In addition, large seismic and volcanic observed data to be archived by the data processing and analyzing systems will be utilized for educational programs and research activities to increase the level of understanding/knowledge about volcanoes, volcanic eruptions, terranes, earthquake zones, occurrence mechanism, faulting, along with other related geologic phenomena.

7) Data Processing & Analyzing Systems at the Sub Centers

This system will be furnished data processing function required for the existing Seismic station and also functions of receiving observed data, information editing and seismic data processing & analyzing. The system will also be installed a special function to preform as a frontier base in case of serious disaster occurs in its responsible region.

For prevention of data ingestion delay at PHIVOLCS Head Office by the public telephone dialing, for performing as the sub center, this system will be utilized for strengthening of data relay and ingestion in the responsible region to support PHIVOLCS Head Office.

8) Mobile Observation Systems

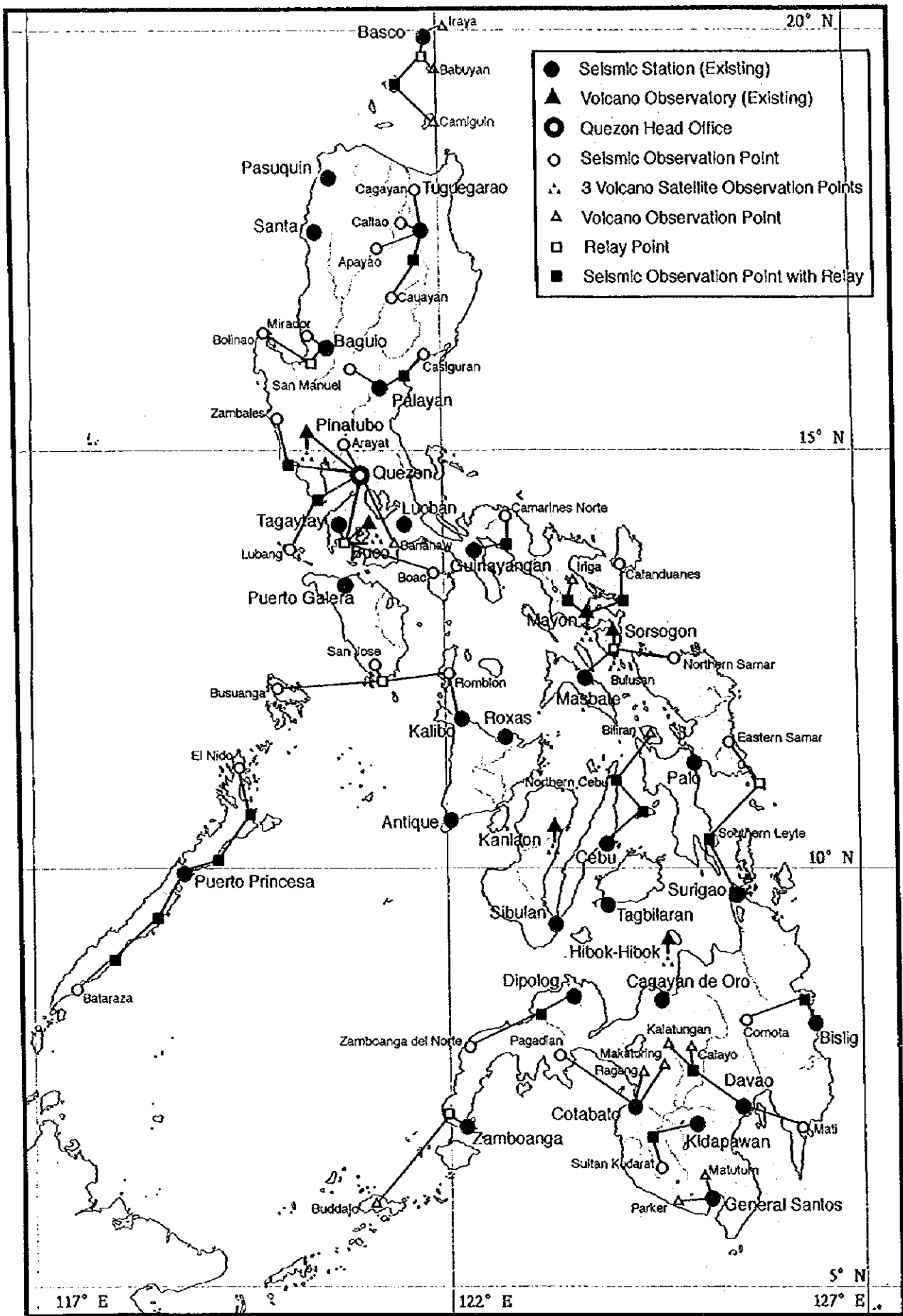
For seismic and volcano observation, Mobile Seismic Observation systems for short period

will be required and for seismic observation, mobile acceleration observation systems will be necessary for observing 3 components (east/west, south/north, vertical) of each motion. The mobile observation is very useful for monitoring aftershock activities after a large earthquake occurs and for strengthening of monitoring capabilities for volcanic activities in a rural area.

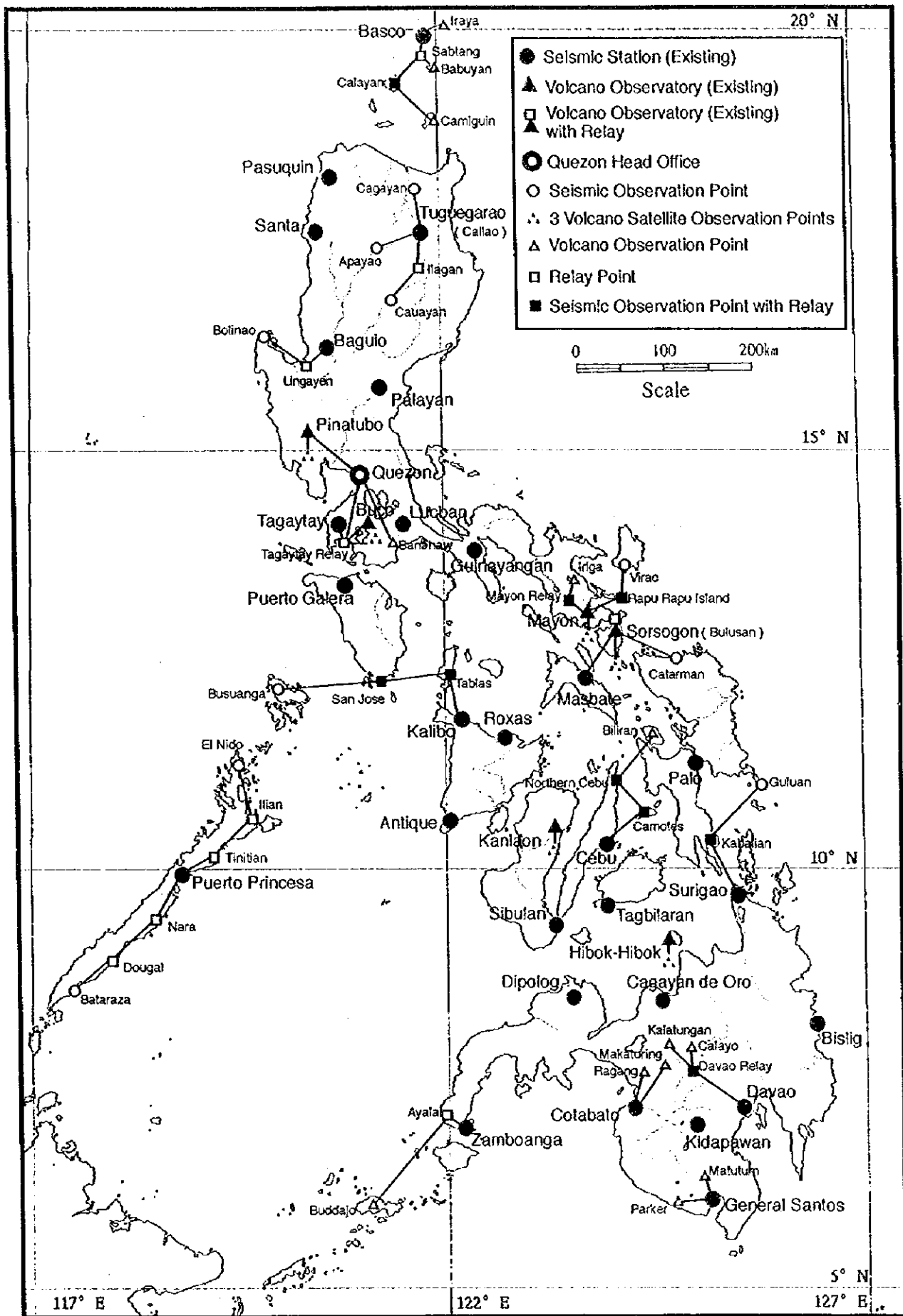
After completion of the Project, Phase-I, PHIVOLCS's activities and systems for volcano observation & detection and seismic monitoring will be strengthened and also eruption prediction, epicenter, focal depth, hypocenter and other factors will be determined more accurately and timely. Besides, the accuracy and reliability of volcano detection & warning and seismic monitoring related to natural disasters will be improved. And it is expected that PHIVOLCS will be able to contribute to the reduction of volcanic and seismic disasters in the country, expediting disaster prevention and safe operation of civil aviation.

After completion of the Project, Phase-II, all observed data will be transmitted to PHIVOLCS Head Office by the public telephone dialing and data ingestion time will be minimized very much. In addition, PHIVOLCS will be able to improve the seismic detection capability minimum of approximately 4.0 magnitude in the whole region of the Philippines for obtaining accurate hypocenter and focal depth determination and also will be able to accurately and speedily make detection and warning for reduction of natural disasters and making prompt disaster relief action. In case of emergency and an evacuation warning of volcano eruption and tsunami required to the general public, PHIVOLCS will be able to announce the warning immediately by the systems to be established under the Project.

"Location Map of the Project Sites & Data Transmission Routes (Phase-I, II & III)" proposed by the Philippine side and "Location Map of the Project Sites & Data Transmission Routes (Phase-I & II)" to be implemented under the Project are attached hereunder for comparison.



Location Map of the Project Sites & Data Transmission Routes (Phase-I, II & III) proposed by the Philippine side



Location Map of the Project Sites & Data Transmission Routes (Phase-I & II) to be implemented under the Project

2 - 3 Basic Design

2 -3 - 1 Design Concept

1. Design Concept of the Equipment

The basic design concept of all the equipment and systems to be installed under the Project are as follows.

- a. To design all the equipment and systems to conform operation and maintenance systems and technical capabilities of PHIVOLCS.
- b. To implement appropriate selection of the equipment and systems for easy procurement of spare parts and consumables.
- c. To procure durable and reliable equipment and systems to be suitable for the natural condition of the Philippines
- d. To make appropriate compatibility and suitability between the equipment to be supplied under this Project and the technical requirements of PHIVOLCS.
- e. To consider PHIVOLCS's technical method and organization structure of operation & maintenance for the equipment and systems.
- f. To minimize recurrent costs of operation and maintenance for the equipment and systems at PHIVOLCS.
- g. To ensure the system operation at least 90% reliability.

2. Design Conditions

1) Observation Equipment

- Installation of short period, middle/long period and acceleration seismographs which can be observing 3 components (east/west, south/north, vertical) at the existing seismic stations and volcano observatories.
- Installation of long period seismographs at only the existing seismic stations and volcano observatories where suitable existing facility and telecommunication link are available for data distribution to the international seismic organizations and institutes.
- Installation of a short period seismographs which can be observing 3 components (east/west,

south/north, vertical) at all 3 volcano satellite observation points for detection small volcanic earthquakes.

- Installation of a short period seismographs which can be observing only vertical motion at all volcano observation points, observation points and seismic observation points with data relay for upgrading detecting capabilities for seismicity.
- Recording of observed seismic wave form data identified as an earthquake wave by trigger processing in data recorder automatically.
- Automatic ingestion of arrival time of P wave, seismic wave first motion, maximum amplitude, period, seismic intensity, etc. from distinguished data.
- Manual and automatic preparation of seismic and volcanic bulletin.
- Data reading and archiving from analog data records.
- Data ingestion of arrival time of S wave and maximum amplitude from analog data records.
- Durable and reliable equipment against the installation environment and condition.
- Low power consumption.
- Provision of suitable power back-up devices (battery, solar array, etc.) for uninterrupted operation.

2) Data Transmission Equipment

- Construction of antenna and other equipment for data transmission should withstand strong winds due to typhoon.
- Durable and reliable equipment against the natural environment of the Philippines.
- Considering future expansion possibility of data transmission capacity due to increasing PHIVOLCS activities and the number of observation points.
- Provision of connecting interface for additional systems in the future.
- Suitable system for the existing computerized equipment.
- Operative systems by power supply of solar array & battery and low power consumption.
- Provision of suitable power back-up devices (battery, solar array, etc.) for uninterrupted operation.
- The systems conformable to 400 MHz frequency band and FM system

3) Data Processing, Analysis and Archiving Equipment

- Automatic data receiving from the existing seismic stations and volcano observatories.

- Enough capability for automatic data archiving and retrieving of received data and calculation results of hypocenter and magnitude.
- Durable and reliable computerized equipment suitable to the natural environment of the Philippines.
- Considering future expansion possibility of data processing, analysis and archiving function and capability due to increasing PHIVOLCS activities and the number of observation points.
- Selection of suitable and connectable equipment for the existing computerized equipment.
- Compatibility and suitability for the existing software.
- Enough capability of carrying out various performance as the data processing, analysis and archiving equipment.
- To be furnished with power back-up devices (Uninterrupted Power Supply equipment and Auto Voltage Regulator, etc.) for uninterrupted operation in round-the-clock.

4) Maintenance Measuring Devices

- Durable, reliable and portable measuring devices for appropriate operation and maintenance.
- Suitability for PHIVOLCS's maintenance technical method.
- Compatibility and suitability for the equipment and systems to be supplied.

2 - 3 - 2 Basic Design

The Project aims at improvement of volcano and earthquake monitoring network and strengthening of monitoring and dissemination capabilities of PHIVOLCS through replacement of the existing seismographs, introduction of necessary equipment and data processing & analyzing systems and also establishment of unmanned observation points (seismic observation points, volcano observation points, volcano satellite observation points) in order to prevent and mitigate the natural disasters caused by volcanic eruption, earthquake and tsunami in the Philippines.

After the completion of the Project, PHIVOLCS will be capable of contributing effectively to the mitigation of natural disasters by volcanic eruption, earthquake and tsunami and also to advancement of relief action and civil defence activity for the Philippines.

In accordance with the results of the Basic Design Study, the equipment and systems to be installed under the Project, Phase I & II have been designed as follows.

- Short Period Seismic Observation System

This system is for observation for 3 components of short period seismic motions (east/west, south/north, vertical) by moving coil velocity type sensor and for observed data recording by data recorder and drum recorder.

- Middle Period Seismic Observation System

This system is for observation for 3 components of middle period seismic motions (east/west, south/north, vertical) by feedback velocity type sensor with automatic pendulum adjustment and for observed data recording by data recorder and drum recorder.

- Long Period Seismic Observation System

This system is for observation for 3 components of long period seismic motions (east/west, south/north, vertical) by a feedback velocity type sensor with automatic pendulum adjustment and for observed data recording by data recorder and drum recorder.

- Acceleration Observation System

This system is for observation for 3 components of acceleration of motions (east/west, south/north, vertical) by a force balanced type sensor and for indicating seismic intensity.

- Acceleration Monitoring System

For monitoring 3 components of displacement of motions (east/west, south/north, vertical) by integration amplifier and for recording integrated data by drum recorder.

- Seismic Data Processing & Transmission System

This system will be installed at 34 existing seismic stations and volcano observatories (except Buco existing observatory) under the Project, Phase-I. The system will be composed of 2 sets of data processing system (CPU : Pentium 200MHz or more, memory : 128MB or more, hard disk : 6GB or more) with 14 inch display, MO disk unit (3.5 inch : 230/640MB), inkjet printer (A4 size), modem, software and facsimile for data transmission.

The seismic data processing system must have enough capability for real-time data processing and analyzing and also should be considered easy procurement.

- Volcanic Data Processing and Analyzing System

This system will be installed at 6 existing volcano observatories under the Project, Phase-II, and will be composed of 2 sets of data processing system (CPU : Pentium 200MHz or more,

memory : 128MB or more, hard disk : 6GB or more) with 14 inch display, MO disk unit (3.5 inch : 230/640MB), inkjet printer (A4 size), modem and software.

The system should be the same components of the seismic data processing system to be supplied under the Phase-I.

- **Data Processing and Archiving System for Sub Center**

This system will be installed at 4 Sub Centers under the Project, Phase-II and will be composed of 2 sets of data processing system (CPU : Pentium 200MHz or more, memory : 128MB or more, hard disk: 6GB or more) with 14 inch display, MO disk unit (3.5 inch: 230/640MB), inkjet printer (A4 size), modem and software.

This system should consists of the same components of the seismic data processing system to be supplied under the Phase-I.

- **Seismic Data Processing and Aanalyzing System**

This system will be installed at PHIVOLCS Head Office under the Project, Phase-I and will be composed of 12 sets of data processing & analyzing system (CPU : Pentium 200MHz or more, memory : 128MB or more, hard disk : 6GB or more) with 8 sets of 14 inch display, 4 sets of 17 inch display, 4 sets of MO disk unit (3.5 inch: 230/640MB : 2 sets, 5 inch : 640MB : 2 sets), 9 sets of A4 size laser printer, 2 sets of A3 size laser printer, 2 sets of A3 size color inkjet printer, 4 sets of A4 size scanner, software and other necessary network equipment. The specification of data processing & analyzing system should be the same as the seismic data processing system to be supplied under the Phase-I.

Using purposes of 12 sets of data processing & analyzing system are as follows.

- For the existing data editing & archiving at PHIVOLCS Head Office and also for the data processing & analyzing : 2 sets (with 5 inch MO disk unit and A4 size laser printer)
- For editing and archiving of observed data at the existing seismic stations and volcano observatories : 2 sets (with 3.5 inch MO disk unit, A4 size laser printer and A3 size laser printer)
- For seismic data processing & analyzing for hypocenter determination and for seismological research activities : 2 sets (with A4 size laser printer)
- For volcanic data processing & analyzing and for volcanological research activities : 2 sets (with A4 size laser printer)
- For preparation of earthquake and tsunami information : 2 sets (with 17 inch display and A4 size scanner)

- For preparation of statistical publications and other documents : 2 sets (with 17 inch display and A4 size scanner)

- **Volcanic & Seismic Data Processing and Analyzing System**

This system will be installed at PHIVOLCS Head Office under the Project, Phase-II and will be composed of 4 sets of data processing system (CPU : Pentium 200MHz or more, memory : 128MB or more, hard disk : 6GB or more) with 14 inch display, MO disk unit (3.5 inch : 230/640MB), inkjet printer (A4 size), modem and software. This system will process and analyze observed volcanic and seismic data at Satellite Observation Points of Taal volcano, Pinatubo Volcano Observatory, Banahaw Observation Point and Tagaytay Seismic Station. The specification of data processing & analyzing system should be the same as the seismic data processing system to be supplied under the Phase-I.

- **Volcanic & Seismic Data Processing, Analyzing and Transmission System**

This system will be installed at PHIVOLCS Head Office under the Project, Phase-II and will be composed of 16 sets of data processing and analyzing system (CPU : Pentium 200MHz or more, memory : 128MB or more, hard disk : 6GB or more) with 16 sets of 14 inch display, 4 sets of MO disk unit (3.5 inch : 230/640MB), 9 sets of A4 size laser printer, 2 sets of A3 size laser printer, 6 sets of A3 size color inkjet printer, 2 sets of CD-ROM drive, 4 sets of digitizer, 2 sets of facsimile board, 4 sets of data transmission/receiving unit, software and other necessary network equipment.

The specification of data processing & analyzing system should be the same as the seismic data processing system to be supplied under the Phase-I.

- For data receiving from the existing seismic stations and volcano observatories : 2 sets (with data transmission/receiving unit)
- For distribution of earthquake and tsunami information : 2 sets (with data transmission/receiving unit)
- For distribution of earthquake and tsunami information by using facsimile function : 2 sets (with facsimile board)
- For seismic data editing, processing & analyzing and for seismological research activities : 2 sets (with 3.5 inch MO disk unit, A3 size color inkjet printer, A4 size laser printer)
- For volcanic data editing, processing & analyzing and for volcanological research activities : 2 sets (with 3.5 inch MO disk unit, A3 size color inkjet printer and A4 size laser printer)
- For data archiving : 2 sets (with CD-ROM drive, A4 size laser printer)

- For digitalization of analog seismic data : 2 sets (with digitizer, A4 size laser printer, A3 size laser printer)
- For digitalization of analog volcanic data : 2 sets (with digitizer, A4 size laser printer, A3 size laser printer)

- **Mobile Observation System**

This system will be supplied at PHIVOLCS Head Office under the Project, Phase-II and will be composed of 20 sets of short period mobile observation system and 10 sets of acceleration mobile observation system for emergency use.

- **GPS Timing System**

One set of GPS timing system will be installed at each existing seismic station and two sets will be installed at each existing volcano observatory for time control of the equipment by GPS signals.

- **Observation and Data Transmission System at Volcano Satellite Observation Point**

For hypocenter determination and surrounding a volcano crater, three observation points will be required as a volcano satellite observation point. At each observation point, short period seismograph for observing 3 components of short period motions (east/west, south/north, vertical) and data transmission system will be installed.

- **Data Relay System for Volcano Satellite Observation Point**

In case of data observed at a observation point can not directly be transmitted to the existing observatory, establishment of a data relay point will be required on the line of the site.

- **Data Receiving and Recording System for Volcano Satellite Observation Point**

For data receiving from the satellite observation points and data recording by data recorder, this system will be installed at the existing volcano observatories.

- **Data Receiving and Recording system**

This system will be installed at the existing seismic stations and volcano observatories for receiving and recording observed data transmitted from the volcano and seismic observation points.

- **Data Transmission System**

For transmission of observed data to PHIVOLCS Head Office, this system will be installed at the existing Tagaytay seismic Station and Pinatubo volcano observatory.

- **Seismic Data Observation and Transmission System**

For observation of short period motion (vertical) and transmission of observed data to the existing seismic station or volcano observatory, this system will be installed at seismic observation points.

- **Seismic Data Observation, Transmission and Relay System**

For observation of short period motion (vertical) and transmission of observed data to the existing seismic station or volcano observatory, this system will be installed at seismic observation points. In addition, the system will have data relay function.

- **Volcanic Data Observation and Transmission System**

For observation of short period motion (vertical) and transmission of observed data to the existing volcano observatory, this system will be installed at volcano observation points.

- **Data Relay System**

In case of data observed at a observation point can not directly be transmitted to the existing station or observatory, establishment of a data relay point will be required on the line of the site.

- **Power Supply System**

The following equipment are included in the power supply system.

- Power distribution board with 12 circuit breakers (15A) to be installed at PHIVOLCS Head Office and 5 circuit breakers (15A) to be installed at the existing seismic stations and volcano observatories
- Uninterrupted power supply (UPS)
(one UPS to be attached to a processor terminal at PHIVOLCS Head Office)
(one UPS be attached to 2 processor terminals at the existing seismic stations and volcano observatories)
- Battery for an analog recorder
- Battery charger

- **Maintenance Measuring Devices**

These devices will be supplied at PHIVOLCS Head Office and the existing seismic stations and volcano observatories for maintenance of the equipment as follows.

- Function Generator (2 sets at PHIVOLCS Head Office)
- Oscilloscope (8 sets at PHIVOLCS Head Office)
- Stand wave ratio meter (4 sets at PHIVOLCS Head Office)
- Line level meter (6 sets at PHIVOLCS Head Office)
- Digital tester (34 sets at each existing seismic station and volcano observatory, 8 sets at PHIVOLCS Head Office)
- Tool set (34 sets at each existing seismic station and volcano observatory, 4 sets at PHIVOLCS Head Office)

The above described number of function generator, stand wave ratio meter and line level meter will be necessary for calibration of the recording equipment and will exclusively be used by the maintenance teams in PHIVOLCS Head Office.

In addition, 8 oscilloscope and digital testers will be supplied at PHIVOLCS Head Office, these devices are indispensable for maintenance of data receiving and transmission equipment and also will be used at Sub Centers as well as PHIVOLCS Head Office.

1. PHASE-I

(1) The equipment and systems to be supplied and installed at the Project sites under the Phase-I are as follows.

1) Existing Seismic Stations and Volcano Observatories

(31 project sites : Basco, Pasuquin, Tuguegarao, Santa, Palayan, Pinatubo, Lucban, Guinayangan, Mayon, Bulusan, Puerto Galera, Masbate, Kalibo, Roxas, Antique, Palo, Kanlaon, Sibulan, Cebu, Tagbilaran, Puerto Princesa, Hibok-Hibok, Surigao, Cagayan de Oro, Dipolog, Bislig, Davao, Cotabato, Kidapawan, Zamboanga and General Santos)

- Short Period Seismic Observation System
- Acceleration Observation System with seismic intensity indicating function
- Data Processing and Transmission System including software
- GPS Timing System
- Power Supply System

**2) Existing Seismic Stations
(Tagaytay and Baguio)**

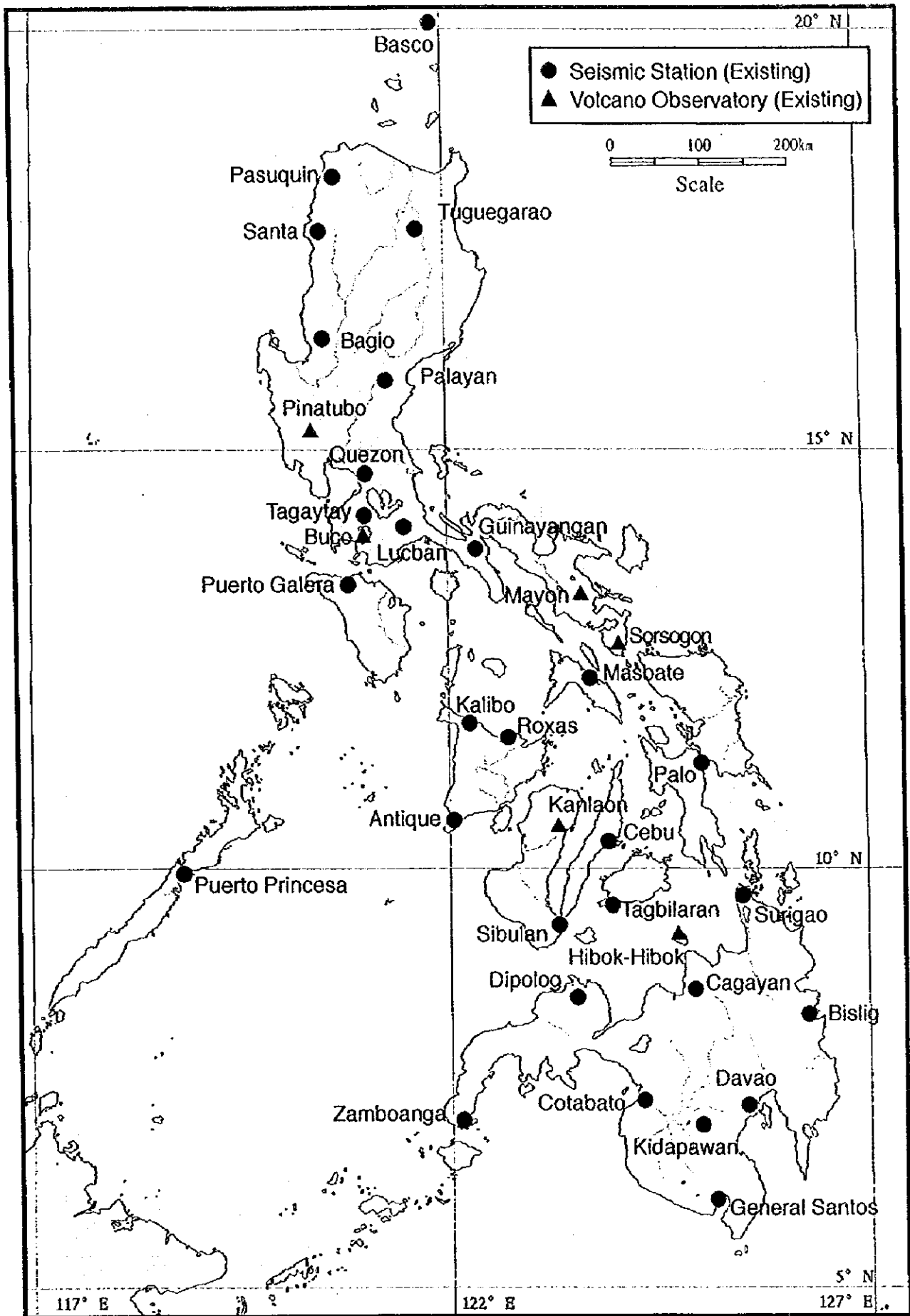
- **Short Period Seismic Observation System**
- **Acceleration Observation System with seismic intensity indicating function**
- **Long Period Seismic Observation System**
- **Data Processing and Transmission System including software**
- **GPS Timing System**
- **Power Supply System**

3) PHIVOLCS Head Office

- **Short Period Seismic Observation System**
- **Acceleration Observation System with seismic intensity indicating function**
- **Data Processing and Transmission System including software**
- **Data Processing and Analyzing System including software**
- **GPS Timing System**
- **Power Supply System**
- **Maintenance Measuring Devices**

(2) Location of the Project Sites.

"Location Map of the Project Sites (Phase-I)" is attached hereunder.



Location of the Project Sites (Phase-I)

2 PHASE-II

(1) The equipment and systems to be supplied and installed at the Project sites under the Phase-II are as follows.

1) Existing Volcano Observatory (Pinatubo)

- Middle Period Seismic Observation System
- Data Receiving and Recording System for Volcano Satellite Observation Points
- Acceleration Monitoring System
- Data Processing and Analyzing System including software
- Data Transmission System (data transmission to PHIVOLCS Head Office)
- GPS Timing System
- Power Supply System

2) Existing Volcano Observatory (Mayon)

- Middle Period Seismic Observation System
- Data Receiving and Recording System for Volcano Satellite Observation Points
- Acceleration Monitoring System
- Data Processing and Analyzing System including software (data receiving from 4 sites and data recording)
- Data Receiving and Recording System
- GPS Timing System
- Power Supply System

3) Existing Volcano Observatory (Sorsogon)

- Middle Period Seismic Observation System
- Data Receiving and Recording System for Volcano Satellite Observation Points
- Acceleration Monitoring System
- Data Processing and Analyzing System including software
- Data Relay System (data relay for 1 site)
- GPS Timing System
- Power Supply System

- 4) Existing Volcano Observatories (Kanlaon, Hibok-Hibok)
 - Middle Period Seismic Observation System
 - Data Receiving and Recording System for Volcano Satellite Observation Points
 - Acceleration Monitoring System
 - Data Processing and Analyzing System including software
 - GPS Timing System
 - Power Supply System

- 5) Existing Volcano Observatory (Buco)
 - Short Period Seismic Observation System
 - Data Receiving and Recording System for Volcano Satellite Observation Points
 - Data Processing and Analyzing System including software
 - GPS Timing System
 - Power Supply System

- 6) Volcano Satellite Observation Points
 - Observation and Data Transmission System
 - Data Relay System (data relay to the existing observatories)

- 7) Existing Seismic Stations (15 project sites : Pasuquin, Santa, Palayan, Lucban, Guinayangan, Puerto Galera, Roxas, Antique, Palo, Sibulan, Tagbilaran, Cagayan de Oro, Bislig, Dipolog and Kidapawan)
 - Middle Period Seismic Observation System
 - Acceleration Monitoring System

- 8) Existing Seismic Station (Basco)
 - Middle Period Seismic Observation System
 - Acceleration Monitoring System
 - Data Receiving and Recording System (data receiving from 4 sites and data recording)

- 9) Existing Seismic Station (Masbate)
 - Middle Period Seismic Observation System
 - Acceleration Monitoring System
 - Data Receiving and Recording System (data receiving from 1 site and data recording)

- 10) Existing Seismic Station (Zamboanga)
 - Middle Period Seismic Observation System
 - Acceleration Monitoring System
 - Data Receiving and Recording System (data receiving from 1 site and data recording)

- 11) Existing Seismic Station (Kalibo)
 - Middle Period Seismic Observation System
 - Acceleration Monitoring System
 - Data Receiving and Recording System (data receiving from 3 sites and data recording)

- 12) Existing Seismic Station (Puerto Princesa)
 - Middle Period Seismic Observation System
 - Acceleration Monitoring System
 - Data Receiving and Recording System (data receiving from 2 sites and data recording)

- 13) Existing Seismic Station (Cotabato)
 - Middle Period Seismic Observation System
 - Acceleration Monitoring System
 - Data Receiving and Recording System (data receiving from 2 sites and data recording)

- 14) Existing Seismic Station (General Santos)
 - Middle Period Seismic Observation System
 - Acceleration Monitoring System
 - Data Receiving and Recording System (data receiving from 2 sites and data recording)

- 15) Existing Seismic Station (Surigao)
 - Middle Period Seismic Observation System
 - Acceleration Monitoring System
 - Data Receiving and Recording System (data receiving from 2 sites and data recording)

- 16) Existing Seismic Station (Tagaytay)
 - Acceleration Monitoring System
 - Data Transmission System (data transmission to PHIVOLCS Head Office)

17) Existing Seismic Station (Baguio)

- Acceleration Monitoring System
- Data Processing and Archiving System for Sub Center
- Data Receiving and Recording System (data receiving from 1 site and data recording)
- Power Supply System

18) Existing Seismic Station (Tuguegarao)

- Long Period Seismic Observation System
- Acceleration Monitoring System
- Data Processing and Archiving System for Sub Center
- Data Receiving and Recording System (data receiving from 3 sites and data recording)
- Power Supply System

19) Existing Seismic Station (Cebu)

- Long Period Seismic Observation System
- Acceleration Monitoring System
- Data Processing and Archiving System for Sub Center
- Data Receiving and Recording System (data receiving from 3 sites and data recording)
- Power Supply System

20) Existing Seismic Station (Davao)

- Long Period Seismic Observation System
- Acceleration Monitoring System
- Data Processing and Archiving System for Sub Center
- Data Receiving and Recording System (data receiving from 3 sites and data recording)
- Power Supply System

21) PHIVOLCS Head Office

- Long Period Seismic Observation System
- Acceleration Monitoring System
- Volcanic and Seismic Data Receiving System
- Volcanic and Seismic Data Processing and Analyzing System
- Volcanic and Seismic Data Processing, Analyzing and Transmission System
- GPS Timing System
- Power Supply System

- 22) Mobile Observation System
- Mobile Seismic Observation System for short period
 - Mobile Acceleration Observation System
- 23) Volcano Observation Points (13 project sites : Iraya, Babuyan, Camiguin, Banahaw, Iriga, Biliran, Kalatungan, Calayo, Makaturing, Ragang, Matutun, Parker and Buddajjo)
- Volcanic Data Observation and Transmission System
- 24) Seismic Observation Points (10 project sites : Cagayan, Apayao, Cauayan, Bolinao, Virac, Catarman, Guiuan, Busuanga, El Nido and Bataraza)
- Seismic Data Observation and Transmission System
- 25) Seismic Observation Points with Data Relay (6 project sites : Calayan, Rapu-Rapu Island, Mayon Relay, San Jose, Northern Cebu and Kabalian)
- Seismic Data Observation, Transmission and Relay System (data receiving from 1 site and data transmission to 1 site)
- 26) Seismic Observation Points with Data Relay (Tablas and Camotes)
- Seismic Data Observation, Transmission and Relay System (data receiving from 2 sites and data transmission to 1 site)
- 27) Seismic Observation Point with Data Relay (Davao Relay)
- Seismic Data Observation, Transmission and Relay System (data receiving from 2 sites and data transmission to 1 site)
- 28) Relay Points (7 project sites : Ilagan, Lingayen, Ayala, Ilian, Tinitian, Nara and Dougal)
- Data Relay System (data receiving from 1 sites and data transmission to 1 site)
- 29) Relay Point (Sabtang)
- Data Relay System (data receiving from 3 sites and data transmission to 1 site)
- 30) Relay Point (Tagaytay)
- Data Relay System (data receiving from 1 site and data transmission to 2 sites)
 - Data Relay System (data receiving from 3 sites and data transmission to 1 site)

31) Vehicle

- Pick-up truck
- Autobicycle

(2) Location of the Project Sites

"Location Map of the Project Sites (Phase-II)" is attached hereunder.

"Major Equipment Lists" regarding designation, specifications, quantity and purpose of all the equipment and systems to be supplied under the Project are attached hereunder.

Phase-I. Major Equipment List

Equipment	Specifications	Purpose	Quantity
Existing Volcano Observatory and Seismic Station (31 project sites : Basco, Pasuquin, Tuguegarao, Santa, Palayan, Pinatubo, Luchan, Guinayangan, Mayon, Sorsogon, Puerto Galera, Masbate, Kalibo, Roxas, Antique, Palo, Kantaon, Sibulan, Cebu, Tagbilaran, Puerto Princesa, Iibok Iibok, Surigao, Cagayan de Oro, Dipolog, Bislig, Davao, Cotabato, Zamboanga, Kidapawan and General Santos)			
Short Period Seismic Observation System	<ul style="list-style-type: none"> • Short period sensor : movement pendulum type Peculiar frequency : 1Hz • Data recorder • Drum recorder (3ch) • Power amplifier 	For observation of 3 components of short period seismic motion (east/west, south/north, vertical)	31 sets
Acceleration Observation System	<ul style="list-style-type: none"> • Acceleration sensor : force balanced type Resolution : 18 bit or more Sampling : 100Hz • Seismic intensity indicating function • Software 	For observation of 3 components of acceleration of seismic motion (east/west, south/north, vertical)	31 sets
Data Processing and Transmission System	<ul style="list-style-type: none"> • Data processing & archiving device (2 sets) CPU : 200 MHz or more Memory : 128 MB or more Hard disk : 6 GB or more • 14 inch display (2 sets) • MO disk unit (2 sets) : 3.5 inch, 230MB/640MB • Inkjetprinter (2 sets): A4 size • Modem (2 sets): V.34 • Software • Facsimile : thermal paper type 	For seismic data processing and preparation & transmission of report telegraph	31 sets
GPS Timing System	Accuracy : within 5micro. sec. Mode : one satellite or more	For timing control of the equipment and systems by GPS signals	31 sets
Power Supply System	<ul style="list-style-type: none"> • Power distribution board : 15A×5 • Battery charger : Input : AC 220V, 50/60Hz Output : DC24V • Battery : 100AH • Uninterrupted power supply : 1.0kVA 	For uninterrupted and stable power supply to the equipment and systems	31 sets

Phase-I. Major Equipment List

Equipment	Specifications	Purpose	Quantity
Existing Seismic Station (Tagaytay and Baguio)			
Short Period Seismic Observation System	<ul style="list-style-type: none"> • Short period sensor : movement pendulum type Peculiar frequency : 1Hz • Data recorder • Drum recorder (3ch) • Power amplifier 	For observation of 3 components of short period seismic motion (east/west, south/north, vertical)	2 sets
Acceleration Observation System	<ul style="list-style-type: none"> • Acceleration sensor : force balanced type Resolution : 18 bit or more Sampling : 100Hz • Seismic intensity indicating function • Software 	For observation of 3 components of acceleration of seismic motion (east/west, south/north, vertical)	2 sets
Long Period Seismic Observation System	<ul style="list-style-type: none"> • Long period sensor : feedback velocity type with automatic pendulum adjustment Peculiar frequency : 1/300Hz • Control unit • Drum recorder (3ch) • Power amplifier • Data recorder with dial up interface : 6ch, 8MB memory, 340MB disc 	For observation of 3 components of long period seismic motion (east/west, south/north, vertical)	2 sets
Data Processing and Transmission System	<ul style="list-style-type: none"> • Data processing & archiving device (2 sets) CPU : 200 MHz or more Memory : 128 MB or more Hard disk : 6 GB or more • 14 inch display (2 sets) • MO disk unit (2 sets) : 3.5 inch, 230MB/640MB • Inkjetprinter (2 sets): A4 size • Modem (2 sets): V.34 • Software • Facsimile : thermal paper type 	For seismic data processing and preparation & transmission of report telegraph	2 sets
GPS Timing System	<ul style="list-style-type: none"> Accuracy : within 5micro. sec. Mode : one satellite or more 	For timing control of the equipment and systems by GPS signals	2 sets
Power Supply System	<ul style="list-style-type: none"> • Power distribution board : 15A×5 • Battery charger : Input : AC 220V, 50/60Hz Output : DC24V • Battery : 100AH • Uninterrupted power supply : 1.0kVA 	For uninterrupted and stable power supply to the equipment and systems	2 sets

Phase-I. Major Equipment List

Equipment	Specifications	Purpose	Quantity
PHIVOLCS Head Office			
Short Period Seismic Observation System	<ul style="list-style-type: none"> • Short period sensor : movement pendulum type Peculiar frequency : 1Hz • Data recorder • Drum recorder (3ch) • Power amplifier 	For observation of 3 components of short period seismic motion (east/west, south/north, vertical)	1 set
Acceleration Observation System	<ul style="list-style-type: none"> • Acceleration sensor : force balanced type Resolution : 18 bit or more Sampling : 100Hz • Seismic intensity indicator • Software 	For observation of 3 components of acceleration of seismic motion (east/west, south/north, vertical)	1 set
Data Processing and Transmission System	<ul style="list-style-type: none"> • Data processing & archiving device (2 sets) CPU : 200 MHz or more Memory : 128 MB or more Hard disk : 6 GB or more • 14 inch display (2 sets) • MO disk unit (2 sets) : 3.5 inch, 230MB/640MB • Laser printer (2 sets): A4 size • Software • Facsimile (2 sets) : normal paper type, A4 size 	For seismic data processing, preparation of report telegraph and dissemination of earthquake information and warning to the Government agencies	1 set
Data Processing and Analyzing System	<ul style="list-style-type: none"> • Data processing & archiving device (12 sets) CPU : 200 MHz or more Memory : 128 MB or more Hard disk : 6 GB or more • 14 inch display (8 sets) • 17 inch display (4 sets) • MO disk unit : 3.5 inch, 230MB/640MB (2 sets) 5 inch, 640MB (2 sets) • Laser printer : A4 size (9 sets), A3 size (2 sets) • Color inkjetprinter (2 sets) : A3 size • Scanner (4 sets): A4 size • Software • Networking equipment etc. 	<p>For hypocenter determination, calculation of magnitude and preparation of earthquake information by data processing and analyzing using data transmitted from the existing Seismic Stations and Volcano Observatories</p> <p>For seismological research, technical development and preparation of statistical publications</p>	1 set
GPS Timing System	<ul style="list-style-type: none"> Accuracy : within 5micro. sec. Mode : one satellite or more 	For timing control of the equipment and systems by GPS signals	1 set

Phase-I. Major Equipment List

Equipment	Specifications	Purpose	Quantity
PHIVOLCS Head Office			
Power Supply System	<ul style="list-style-type: none"> • Power distribution board: 15A × 12 • Battery charger (2 sets): Input : AC 220V, 50/60Hz Output : DC24V • Battery (2 sets) : 100AH • Uninterrupted power supply (13 sets) : 1.0kVA 	For uninterrupted and stable power supply to the equipment and systems	1 set
Maintenance Measuring Devices	<ul style="list-style-type: none"> • Function generator (2 sets) • Oscilloscope (8 sets) • Stand wave ratio meter (4 sets) • Digital tester (42 sets, for the existing Seismic Stations and Volcano Observatories: 34, PHIVOLCS Head Office: 8) • Line level meter (6 sets) • Tool set (38 sets, for the existing Seismic Stations and Volcano Observatories: 34, PHIVOLCS Head Office: 4) 	Measurement instruments and tools for maintenance of the equipment	1 set

Phase-II. Major Equipment List

Equipment	Specifications	Purpose	Quantity
Existing Volcano Observatory (Pinatubo)			
Middle Period Seismic Observation System	<ul style="list-style-type: none"> • Middle period sensor : feedback velocity type with automatic pendulum adjustment Peculiar frequency : 1/100Hz • Control unit • Drum recorder (3ch) • Power amplifier • Data recorder 	For observation 3 components of middle period seismic motion (east/west, south/north, vertical)	1 set
Data Receiving and Recording System for Volcano Satellite Observation Points	<ul style="list-style-type: none"> • Data receiving system (3 sets, 3 components from 1 site) • Drum recorder (3 sets, 3ch) • Power amplifier 	For receiving and recording 3 components of short period seismic motions (east/west, south/north, vertical) transmitted from 3 Volcano Satellite Observation Points	1 set
Acceleration Monitoring System	<ul style="list-style-type: none"> • Integration amplifier • Drum recorder (3ch) • Power amplifier 	For monitoring 3 components of displacement of seismic motion (east/west, south/north, vertical)	1 set
Data Processing and Analyzing System	<ul style="list-style-type: none"> • Data processing & archiving device (2 sets) CPU : 200 MHz or more Memory : 128 MB or more Hard disk : 6 GB or more • 14 inch display (2 sets) • MO disk unit (2 sets) : 3.5 inch, 230MB/640MB • Inkjetprinter (2 sets): A4 size • Software 	<p>For data processing and analyzing for detecting and foreseeing volcanic activities</p> <p>For volcanological research and technical development</p>	1 set
Data Transmission System	<ul style="list-style-type: none"> • Data transmission system (3 components to 1 site) 	For transmission of observed data to PHIVOLCS Head Office.	1 set
GPS Timing System	<ul style="list-style-type: none"> Accuracy : within 5micro. sec. Mode : one satellite or more 	For timing control of the equipment and systems by GPS signals	1 set
Power Supply System	<ul style="list-style-type: none"> • Battery charger (2 sets): Input : AC 220V, 50/60Hz Output : DC24V • Battery (2 sets): 100AH • Uninterrupted power supply : 1.0KVA 	For uninterrupted and stable power supply to the equipment and systems	1 set

Phase-II. Major Equipment List

Equipment	Specifications	Purpose	Quantity
Existing Volcano Observatory (Mayon)			
Middle Period Seismic Observation System	<ul style="list-style-type: none"> • Middle period sensor : feedback velocity type with automatic pendulum adjustment Peculiar frequency : 1/100Hz • Control unit • Drum recorder (3ch) • Power amplifier • Data recorder 	For observation 3 components of middle period seismic motion (east/west, south/north, vertical)	1 set
Data Receiving and Recording System for Volcano Satellite Observation Points	<ul style="list-style-type: none"> • Data receiving system (3sets, 3 components from 1 site) • Drum recorder (3sets, 3ch) • Power amplifier 	For receiving and recording 3 components of short period seismic motions (east/west, south/north, vertical) transmitted from 3 Volcano Satellite Observation Points	1 set
Acceleration Monitoring System	<ul style="list-style-type: none"> • Integration amplifier • Drum recorder (3ch) • Power amplifier 	For monitoring 3 components of displacement of seismic motion (east/west, south/north, vertical)	1 set
Data Processing and Analyzing System	<ul style="list-style-type: none"> • Data processing & archiving device (2 sets) • CPU : 200 MHz or more • Memory : 128 MB or more • Hard disk : 6 GB or more • 14 inch display (2 sets) • MO disk unit (2 sets) : 3.5 inch, 230MB/640MB • Inkjetprinter (2 sets): A4 size • Software 	<p>For data processing and analyzing for detecting and foreseeing volcanic activities</p> <p>For volcanological research and technical development</p>	1 set
Data Receiving and Recording System	<ul style="list-style-type: none"> • Data receiving system (2 sets, 2 components from 1 site) • Drum recorder (2 sets, 2ch) 	For receiving and recording 1 component of seismic motions transmitted from 2 Observation Points (Virac, Iriga) and 2 Observation Points with Relay (Mayon Relay, Rapu-Rapu Island)	1 set
GPS Timing System	<p>Accuracy : within 5micro. sec.</p> <p>Mode :one satellite or more</p>	For timing control of the equipment and systems by GPS signals	1 set
Power Supply System	<ul style="list-style-type: none"> • Battery charger (2 sets) : Input : AC 220V, 50/60Hz Output : DC24V • Battery (2 sets): 100AH • Uninterrupted power supply : 1.0kVA 	For uninterrupted and stable power supply to the equipment and systems	1 set

Phase-II. Major Equipment List

Equipment	Specifications	Purpose	Quantity
Existing Volcano Observatory (Sorsogon)			
Middle Period Seismic Observation System	<ul style="list-style-type: none"> • Middle period sensor : feedback velocity type with automatic pendulum adjustment Peculiar frequency : 1/100Hz • Control unit • Drum recorder (3ch) • Power amplifier • Data recorder 	For observation 3 components of middle period seismic motion (east/west, south/north, vertical)	1 set
Data Receiving and Recording System for Volcano Satellite Observation Points	<ul style="list-style-type: none"> • Data receiving system (3 sets, 3 components from 1 site) • Drum recorder (3 sets, 3ch) • Power amplifier 	For receiving and recording 3 components of short period seismic motions (east/west, south/north, vertical) transmitted from 3 Volcano Satellite Observation Points	1 set
Acceleration Monitoring System	<ul style="list-style-type: none"> • Integration amplifier • Drum recorder (3ch) • Power amplifier 	For monitoring 3 components of displacement of seismic motion (east/west, south/north, vertical)	1 set
Data Processing and Analyzing System	<ul style="list-style-type: none"> • Data processing & archiving device (2 sets) • CPU : 200 MHz or more • Memory : 128 MB or more • Hard disk : 6 GB or more • 14 inch display (2 sets) • MO disk unit (2 sets) : 3.5 inch, 230MB/640MB • Inkjetprinter (2 sets): A4 size • Software 	<p>For data processing and analyzing for detecting and foreseeing volcanic activities</p> <p>For volcanological research and technical development</p>	1 set
Data Relay System	<ul style="list-style-type: none"> • Data receiving system (1 component from 1 site) • Data transmission system (1 component to 1 site) 	For receiving 1 component of seismic motion transmitted from 1 Observation Point (Catarman) and for transmitting to Masbate existing Seismic Station	1 set
GPS Timing System	<p>Accuracy :within 5micro. sec.</p> <p>Mode : one satellite or more</p>	For timing control of the equipment and systems by GPS signals	1set
Power Supply System	<ul style="list-style-type: none"> • Battery charger : Input : AC 220V, 50/60Hz Output : DC24V • Battery (2 sets): 100AH • Uninterrupted power supply : 1.0kVA 	For uninterrupted and stable power supply to the equipment and systems	1 set

Phase-II. Major Equipment List

Equipment	Specifications	Purpose	Quantity
Existing Volcano Observatory (Kanlaon, Hibok-Hibok)			
Middle Period Seismic Observation System	<ul style="list-style-type: none"> • Middle period sensor : feedback velocity type with automatic pendulum adjustment Peculiar frequency : 1/100Hz • Control unit • Drum recorder (3ch) • Power amplifier • Data recorder 	For observation 3 components of middle period seismic motion (east/west, south/north, vertical)	2 sets
Data Receiving and Recording System for Volcano Satellite Observation Points	<ul style="list-style-type: none"> • Data receiving system (3 sets) (3 components from 1 site) • Drum recorder (3 sets, 3ch) • Power amplifier 	For receiving and recording 3 components of short period seismic motions (east/west, south/north, vertical) from 3 Volcano Satellite Observation Points	2 sets
Acceleration Monitoring System	<ul style="list-style-type: none"> • Integration amplifier • Drum recorder (3ch) • Power amplifier 	For monitoring 3 components of displacement of seismic motion (east/west, south/north, vertical)	2 sets
Data Processing and Analyzing System	<ul style="list-style-type: none"> • Data processing & archiving device (2 sets) • CPU : 200 MHz or more • Memory : 128 MB or more • Hard disk : 6 GB or more • 14 inch display (2 sets) • MO disk unit (2 sets) : 3.5 inch, 230MB/640MB • Inkjetprinter (2 sets): A4 size • Software 	<p>For data processing and analyzing for detecting and foreseeing volcanic activities</p> <p>For volcanological research and technical development</p>	2 sets
GPS Timing System	<p>Accuracy : within 5micro. sec.</p> <p>Mode : one satellite or more</p>	For timing control of the equipment and systems by GPS signals	2 sets
Power Supply System	<ul style="list-style-type: none"> • Battery charger : Input : AC 220V, 50/60Hz Output : DC24V • Battery : 100AH • Uninterrupted power supply : 1.0kVA 	For uninterrupted and stable power supply to the equipment and systems	2 sets

Phase-II. Major Equipment List

Equipment	Specifications	Purpose	Quantity
Existing Volcano Observatory (Buco)			
Short Period Seismic Observation System	<ul style="list-style-type: none"> • Short period sensor : movement pendulum type Peculiar frequency : 1Hz • Data recorder • Drum recorder (3ch) • Power amplifier 	For observation of 3 components of short period seismic motion (east/west, south/north, vertical)	1 set
Data Receiving and Recording System for Volcano Satellite Observation Points	<ul style="list-style-type: none"> • Data receiving system (3 sets, 3 components from 1 site) • Drum recorder (3 sets, 3ch) • Power amplifier 	For receiving and recording 3 components of short period seismic motions (east/west, south/north, vertical) transmitted from 3 Volcano Satellite Observation Points	1 set
Data Processing and Analyzing System	<ul style="list-style-type: none"> • Data Processing & archiving device (2 sets) • CPU : 200 MHz or more • Memory : 128 MB or more • Hard disk : 6 GB or more • 14 inch display (2 sets) • MO disk unit (2 sets) : 3.5 inch, 230MB/640MB • Inkjetprinter (2 sets): A4 size • Modem (2 sets): V.34 • Software 	<p>For data processing and analyzing for detecting and foreseeing volcanic activities</p> <p>For volcanological research and technical development</p>	1 set
GPS Timing System	<p>Accuracy : within 5micro. sec.</p> <p>Mode : one satellite or more</p>	For timing control of the equipment and systems by GPS signals	1 set
Power Supply System	<ul style="list-style-type: none"> • Power distribution board: 15A × 5 • Battery charger : Input : AC 220V, 50/60Hz Output : DC24V • Battery: 100AH • Uninterrupted power supply : 1.0kVA 	For uninterrupted and stable power supply to the equipment and systems	1 set
Volcano Satellite Observation Point			
Observation and Data Transmission System of Volcano Satellite Observation Points	<ul style="list-style-type: none"> • Short period sensor (3 sets, 3 components) • Data transmission system (3 sets, 3 components to 1 site) • Battery (3 sets):100AH • Solar panel (3 sets) 	For observation of 3 components of short period seismic motion (east/west, south/north, vertical) at 3 Volcano Satellite Observation points data and transmission to the existing Volcano Observatory	6 sets
Data Relay System for Volcano Satellite Observation Points	<ul style="list-style-type: none"> • Data receiving system (3 sets, 3 components from 1 site) • Data transmission system (3 sets, 3 components to 1 site) • Battery (2 sets):100AH • Solar panel (2 sets) 	<p>For receiving data from Volcano Satellite Observation Points and transmitting to the existing Volcano Observatory</p> <p>Number of Data Relay System : Mayon:1, Pinatubo:2, Sorsogon:2, Kanlaon:2, Hibok-Hibok:2</p>	9 sets

Phase-II. Major Equipment List

Equipment	Specifications	Purpose	Quantity
Existing Seismic Station (15 project sites : Pasuquin, Santa, Palayan, Luchan, Guinayangan, Puerto Galera, Roxas, Antique, Palo, Sibulan, Tagbilaran, Cagayan de Oro, Bislig, Dipolog and Kidapawan)			
Middle Period Seismic Observation System	<ul style="list-style-type: none"> • Middle period sensor : feedback velocity type with automatic pendulum adjustment Peculiar frequency : 1/100Hz • Control unit • Drum recorder (3ch) • Power amplifier • Data recorder 	For observation 3 components of middle period seismic motion (east/west, south/north, vertical)	15 sets
Acceleration Monitoring System	<ul style="list-style-type: none"> • Integration amplifier • Drum recorder (3ch) • Power amplifier 	For monitoring 3 components of displacement of seismic motion (east/west, south/north, vertical)	15 sets
Existing Seismic Station (Basco)			
Middle Period Seismic Observation System	<ul style="list-style-type: none"> • Middle period sensor : feedback velocity type with automatic pendulum adjustment Peculiar frequency : 1/100Hz • Control unit • Drum recorder (3ch) • Power amplifier • Data recorder 	For observation 3 components of middle period seismic motion (east/west, south/north, vertical)	1 set
Acceleration Monitoring System	<ul style="list-style-type: none"> • Integration amplifier • Drum recorder (3ch) • Power amplifier 	For monitoring 3 components of displacement of seismic motion (east/west, south/north, vertical)	1 set
Data Receiving and Recording System	<ul style="list-style-type: none"> • Data receiving system (3 components from 3 site, 1 component from 1 site) • Drum recorder (2 sets, 2ch) • Battery charger • Battery: 100AH 	For receiving and recording 1 component of seismic motions transmitted from 2 Observation Points (Iraya, Babuyan) and 2 Observation Points with Relay (Camiguin, Calayan)	1 set

Phase-II. Major Equipment List

Equipment	Specifications	Purpose	Quantity
Existing Seismic Station (Masbate)			
Middle Period Seismic Observation System	<ul style="list-style-type: none"> • Middle period sensor : feedback velocity type with automatic pendulum adjustment Peculiar frequency : 1/100Hz • Control unit • Drum recorder (3ch) • Power amplifier • Data recorder 	For observation 3 components of middle period seismic motion (east/west, south/north, vertical)	1 set
Acceleration Monitoring System	<ul style="list-style-type: none"> • Integration amplifier • Drum recorder (3ch) • Power amplifier 	For observation 3 components of acceleration seismic motion (east/west, south/north, vertical)	1 set
Data Receiving and Recording System	<ul style="list-style-type: none"> • Data receiving system (1 component from 1 site) • Drum recorder (1ch) • Battery charger • Battery: 100AH 	For receiving and recording 1 component of seismic motion transmitted from 1 Observation Point (Catarman)	1 set
Existing Seismic Station (Zamboanga)			
Middle Period Seismic Observation System	<ul style="list-style-type: none"> • Middle period sensor : feedback velocity type with automatic pendulum adjustment Peculiar frequency : 1/100Hz • Control unit • Drum recorder (3ch) • Power amplifier • Data recorder 	For observation 3 components of middle period seismic motion (east/west, south/north, vertical)	1 set
Acceleration Monitoring System	<ul style="list-style-type: none"> • Integration amplifier • Drum recorder (3ch) • Power amplifier 	For monitoring 3 components of displacement of seismic motion (east/west, south/north, vertical)	1 set
Data Receiving and Recording System	<ul style="list-style-type: none"> • Data receiving system (1 component from 1 site) • Drum recorder (1ch) • Battery charger • Battery: 100AH 	For data receiving and recording 1 component of seismic motion transmitted from 1 Observation Point (Buddajo)	1 set

Phase-II. Major Equipment List

Equipment	Specifications	Purpose	Quantity
Existing Seismic Station (Kalibo)			
Middle Period Seismic Observation System	<ul style="list-style-type: none"> • Middle period sensor : feedback velocity type with automatic pendulum adjustment Peculiar frequency : 1/100Hz • Control unit • Drum recorder (3ch) • Power amplifier • Data recorder 	For observation 3 components of middle period seismic motions (east/west, south/north, vertical)	1 set
Acceleration Monitoring System	<ul style="list-style-type: none"> • Integration amplifier • Drum recorder (3ch) • Power amplifier 	For monitoring 3 components of displacement of seismic motion (east/west, south/north, vertical)	1 set
Data Receiving and Recording System	<ul style="list-style-type: none"> • Data receiving system (3 components from 1 site) • Drum recorder (3ch) • Battery charger • Battery: 100AH 	For receiving and recording 1 component of seismic motion transmitted from 3 Observation Points (Busuanga, San Jose, Tablas)	1 set
Existing Seismic Station (Puerto Princesa)			
Middle Period Seismic Observation System	<ul style="list-style-type: none"> • Middle period sensor : feedback velocity type with automatic pendulum adjustment Peculiar frequency : 1/100Hz • Control unit • Drum recorder (3ch) • Power amplifier • Data recorder 	For observation 3 components of middle period seismic motion (east/west, south/north, vertical)	1 set
Acceleration Monitoring System	<ul style="list-style-type: none"> • Integration amplifier • Drum recorder (3ch) • Power amplifier 	For monitoring 3 components of displacement of seismic motion (east/west, south/north, vertical)	1 set
Data Receiving and Recording System	<ul style="list-style-type: none"> • Data receiving system (2 sets, 1 component from 1 site) • Drum recorder (2ch) • Battery charger • Battery: 100AH 	For receiving and recording 1 component of seismic motions transmitted from 2 Observation Points (El Nido, Bataraza)	1 set

Phase-II. Major Equipment List

Equipment	Specifications	Purpose	Quantity
Existing Seismic Station (Cotabato)			
Middle Period Seismic Observation System	<ul style="list-style-type: none"> • Middle period sensor : feedback velocity type with automatic pendulum adjustment Peculiar frequency : 1/100Hz • Control unit • Drum recorder (3ch) • Power amplifier • Data recorder 	For observation 3 components of middle period seismic motion (east/west, south/north, vertical)	1 set
Acceleration Monitoring System	<ul style="list-style-type: none"> • Integration amplifier • Drum recorder (3ch) • Power amplifier 	For monitoring 3 components of displacement of seismic motion (east/west, south/north, vertical)	1 set
Data Receiving and Recording System	<ul style="list-style-type: none"> • Data receiving system (2 sets, 1 component from 1 site) • Drum recorder (2ch) • Battery charger • Battery: 100AH 	For receiving and recording 1 component of seismic motions transmitted from 2 Observation Points (Makaturing, Ragang)	1 set
Existing Seismic Station (General Santos)			
Middle Period Seismic Observation System	<ul style="list-style-type: none"> • Middle period sensor : feedback velocity type with automatic pendulum adjustment Peculiar frequency : 1/100Hz • Control unit • Drum recorder (3ch) • Power amplifier • Data recorder 	For observation 3 components of middle period seismic motion (east/west, south/north, vertical)	1 set
Acceleration Monitoring System	<ul style="list-style-type: none"> • Integration amplifier • Drum recorder (3ch) • Power amplifier 	For monitoring 3 components of displacement of seismic motion (east/west, south/north, vertical)	1 set
Data Receiving and Recording System	<ul style="list-style-type: none"> • Data receiving system (2 sets, 1 component from 1 site) • Drum recorder (2ch) • Battery charger • Battery: 100AH 	For receiving and recording 1 component of seismic motions transmitted from 2 Observation Points (Matutun, Parker)	1 set

Phase-II. Major Equipment List

Equipment	Specifications	Purpose	Quantity
Existing Seismic Station (Surigao)			
Middle Period Seismic Observation System	<ul style="list-style-type: none"> • Middle period sensor : feedback velocity type with automatic pendulum adjustment Peculiar frequency : 1/100Hz. • Control unit • Drum recorder (3ch) • Power amplifier • Data recorder 	For observation 3 components of middle period seismic motion (east/west, south/north, vertical)	1 set
Acceleration Monitoring System	<ul style="list-style-type: none"> • Integration amplifier • Drum recorder (3ch) • Power amplifier 	For monitoring 3 components of displacement of seismic motion (east/west, south/north, vertical)	1 set
Data Receiving and Recording System	<ul style="list-style-type: none"> • Data receiving system (2 components from 1 site) • Drum recorder (2ch) • Battery charger • Battery: 100AH 	For receiving and recording 1 component of seismic motions transmitted from 1 Observation Point (Guiuan) and 1 Observation Point with Relay (Kabalian)	1 set
Existing Seismic Station (Tagaytay)			
Acceleration Monitoring System	<ul style="list-style-type: none"> • Integration amplifier • Drum recorder (3ch) • Power amplifier 	For monitoring 3 components of displacement of seismic motion (east/west, south/north, vertical)	1 set
Data Transmission System	<ul style="list-style-type: none"> • Data transmission system (3 components to 1 site) 	For transmitting 3 components of seismic motion to PHIVOLCS Head Office.	1 set
Existing Seismic Station (Baguio)			
Acceleration Monitoring System	<ul style="list-style-type: none"> • Integration amplifier • Drum recorder (3ch) • Power amplifier 	For monitoring 3 components of displacement of seismic motion (east/west, south/north, vertical)	1 set
Data Processing and Archiving System of Sub Center	<ul style="list-style-type: none"> • Data processing & archiving device (2 sets) • CPU : 200 MHz or more • Memory : 128 MB or more • Hard disk : 6 GB or more • 14 inch display (2 sets) • MO disk unit : 3.5 inch, 230MB/640MB (2 sets) • Inkjetprinter : A4 size (2 sets) • Modem : V.34 (2 sets) • Software 	<p>For appropriate regional data ingestion from the existing Seismic Stations & Volcano Observatories</p> <p>For processed data transmission to PHIVOLCS Head Office</p>	1 set
Data Receiving and Recording System	<ul style="list-style-type: none"> • Data receiving system (1 component from 1 site) • Drum recorder (1ch) • Battery charger • Battery: 100AH 	For data receiving and recording 1 component of seismic motion transmitted from 1 Observation Point (Bolinao)	1 set
Power Supply System	<ul style="list-style-type: none"> • Uninterrupted power supply : 1.0kVA 	For uninterrupted and stable power supply to the equipment and systems	1 set

Phase-II. Major Equipment List

Equipment	Specifications	Purpose	Quantity
Existing Seismic Station (Tuguegarao)			
Long Period Seismic Observation System	<ul style="list-style-type: none"> • Long period sensor : feedback velocity type with automatic pendulum adjustment Peculiar frequency : 1/300Hz • Control unit • Drum recorder (3ch) • Power amplifier • Data recorder with dial up interface : 6ch, 8MB memory, 340MB disc 	For observation of 3 components of long period seismic motion (east/west, south/north, vertical)	1 set
Acceleration Monitoring System	<ul style="list-style-type: none"> • Integration amplifier • Drum recorder (3ch) • Power amplifier 	For monitoring 3 components of displacement of seismic motion (east/west, south/north, vertical)	1 set
Data Processing and Archiving System at Sub Center	<ul style="list-style-type: none"> • Data processing & archiving device (2 sets) CPU : 200 MHz or more Memory : 128 MB or more Hard disk : 6 GB or more • 14 inch display (2 sets) • MO disk unit : 3.5 inch, 230MB/640MB (2 sets) • Inkjetprinter : A4 size (2 sets) • Modem : V.34 (2 sets) • Software 	<p>For appropriate regional data ingestion from the existing Seismic Stations & Volcano Observatories</p> <p>For processed data transmission to PHIVOLCS Head Office</p>	1 set
Data Receiving and Recording System	<ul style="list-style-type: none"> • Data receiving system (3 sets, 1 component from 1 site) • Drum recorder (3ch) • Battery charger • Battery: 100AH 	For data receiving and recording 1 component of seismic motions (transmitted from 3 Observation Points (Cagayan, Apayao, Cauayan))	1 set
Power Supply System	<ul style="list-style-type: none"> • Uninterrupted power supply : 1.0kVA 	For uninterrupted and stable power supply to the equipment and systems	1 set

Phase-II. Major Equipment List

Equipment	Specifications	Purpose	Quantity
Existing Seismic Station (Cebu)			
Long Period Seismic Observation System	<ul style="list-style-type: none"> • Long period sensor : feedback velocity type with automatic pendulum adjustment Peculiar frequency : 1/300Hz • Control unit • Drum recorder (3ch) • Power amplifier • Data recorder with dial up interface : 6ch, 8MB memory, 340MB disc 	For observation of 3 components of long period seismic motion (east/west, south/north, vertical)	1 set
Acceleration Monitoring System	<ul style="list-style-type: none"> • Integration amplifier • Drum recorder (3ch) • Power amplifier 	For monitoring 3 components of displacement of seismic motion (east/west, south/north, vertical)	1 set
Data Processing and Archiving System at Sub Center	<ul style="list-style-type: none"> • Data processing & archiving device (2 sets) • CPU : 200 MHz or more • Memory : 128 MB or more • Hard disk : 6 GB or more • 14 inch display (2 sets) • MO disk unit : 3.5 inch, 230MB/640MB (2 sets) • Inkjetprinter : A4 size (2 sets) • Modem : V.34 (2 sets) • Software 	<p>For appropriate regional data ingestion from the existing Seismic Stations & Volcano Observatories</p> <p>For processed data transmission to PHIVOLCS Head Office</p>	1 set
Data Receiving and Recording System	<ul style="list-style-type: none"> • Data receiving system (3 componentd from 1 site) • Drum recorder (3ch) • Battery charger • Battery: 100AH 	For receiving and recording 1 component of seismic motions transmitted from 1 Observation Point (Biliran) and 2 Observation Points with Relay (Northern Cebu, Camotes)	1 set
Power Supply System	<ul style="list-style-type: none"> • Uninterrupted power supply : 1.0kVA 	For uninterrupted and stable power supply to the equipment and systems	1 set

Phase-II. Major Equipment List

Equipment	Specifications	Purpose	Quantity
Existing Seismic Station (Davao)			
Long Period Seismic Observation System	<ul style="list-style-type: none"> • Long period sensor : feedback velocity type with automatic pendulum adjustment Peculiar frequency : 1/300Hz • Control unit • Drum recorder (3ch) • Power amplifier • Data recorder with dial up interface : 6ch, 8MB memory, 340MB disc 	For observation of 3 components of long period seismic motion (east/west, south/north, vertical)	1 set
Acceleration Monitoring System	<ul style="list-style-type: none"> • Integration amplifier • Drum recorder (3ch) • Power amplifier 	For monitoring 3 components of displacement of seismic motion (east/west, south/north, vertical)	1 set
Data Processing and Archiving System at Sub Center	<ul style="list-style-type: none"> • Data processing & archiving device (2 sets) • CPU : 200 MHz or more • Memory : 128 MB or more • Hard disk : 6 GB or more • 14 inch display (2 sets) • MO disk unit : 3.5 inch, 230MB/640MB (2 sets) • Inkjetprinter : A4 size (2 sets) • Modem : V.34 (2 sets) • Software 	<p>For appropriate regional data ingestion from the existing Seismic Stations & Volcano Observatories</p> <p>For processed data transmission to PHIVOLCS Head Office</p>	1 set
Data Receiving and Recording System	<ul style="list-style-type: none"> • Data receiving system (3 components from 1 site) • Drum recorder (3ch) • Battery charger • Battery: 100AH 	For receiving and recording 1 component of seismic motions transmitted from 2 Observation Points (Kalatungan, Calayo) and 1 Observation Point with Relay (Davao Relay)	1 set
Power Supply System	<ul style="list-style-type: none"> • Uninterrupted power supply : 1.0kVA 	For uninterrupted and stable power supply to the equipment and systems	1 set

Phase-II. Major Equipment List

Equipment	Specifications	Purpose	Quantity
PHIVOLCS Head Office			
Long Period Seismic Observation System	<ul style="list-style-type: none"> • Long period sensor : feedback velocity type with automatic pendulum adjustment Peculiar frequency : 1/300Hz • Control unit • Drum recorder (3ch) • Power amplifier • Data recorder with dial up interface : 6ch, 8MB memory, 340MB disc 	For observation of 3 components of long period seismic motion (east/west, south/north, vertical)	1 set
Acceleration Monitoring System	<ul style="list-style-type: none"> • Integration amplifier • Drum recorder (3ch) • Power amplifier 	For monitoring 3 components of displacement of seismic motion (east/west, south/north, vertical)	1 set
Volcanic and Seismic Data Receiving System	<ul style="list-style-type: none"> • Data receiving system (3 components from 3 sites) • Data receiving system (2 sets, 3 components from 1 site) • Data receiving system (1 component from 1 site) • Drum recorder (5 sets, 3ch) • Drum recorder (1ch) 	For receiving and recording seismic motions transmitted from 3 Satellite Observation Points of Taal Volcano, Pinatubo Volcano Observatory, Tagaytay Seismic Station, Banahaw Observation Point	1 set
Volcanic and Seismic Data Processing and Analyzing System	<ul style="list-style-type: none"> • Data processing & archiving device (4 sets) • CPU : 200 MHz or more • Memory : 128 MB or more • Hard disk : 6 GB or more • 14 inch display (4 sets) • Software • Networking equipment 	For processing and analyzing of data received from Volcanic and Seismic Data Receiving System	1 set
Volcanic and Seismic Data Processing, Analyzing and Transmission System	<ul style="list-style-type: none"> • Data processing & archiving device (16 sets) • CPU : 200 MHz or more • Memory : 128 MB or more • Hard disk : 6 GB or more • 14 inch display (16 sets) • MO disk unit : 3.5 inch, 230MB/640MB (4 sets) • Color inkjetprinter : A3 size (6 sets) • Lazer printer : A4 size (9 sets), A3 size (2 sets) • CDR drive (2 sets) • Digitizer (4 sets) • Facsimile board (2 sets) • Data transmission/receiving unit (4 sets) • Software • Networking equipment, etc. 	<p>For data receiving from the existing Volcano Observatories & Seismic Stations through the public telephone line</p> <p>For data processing, analyzing and archiving for preparation of tsunami & volcano eruption warnings and earthquake monitoring</p> <p>For distribution of information for disaster prevention to the Government agencies</p> <p>For seismological & volcanological research, technical development and preparation of statistical publications</p>	1 set

Phase-II. Major Equipment List

Equipment	Specifications	Purpose	Quantity
PHIVOLCS Head Office			
GPS Timing System	Accuracy : within 5micro. sec. Mode : one satellite or more	For timing control of the equipment and systems by GPS signals	1 set
Power Supply System	<ul style="list-style-type: none"> • Battery charger : Input : AC 220V, 50/60Hz Output : DC24V • Battery (2 sets) : 100AH • Uninterrupted power supply (20 sets): 1.0kVA 	For uninterrupted and stable power supply to the equipment and systems	1 set
Mobile Observation System			
Mobile Seismic Observation System for Short Period	<ul style="list-style-type: none"> • Short period sensor (20 sets) Peculiar frequency : 1Hz • Data recorder (20 sets) • GPS (20 sets) • PC&modem (6 sets) • Battery charger (10 sets) • Battery (20 sets) • Software 	For observation of short period seismic motion and data recording & storage	20 sets
Mobile Acceleration Observation System	<ul style="list-style-type: none"> • Acceleration sensor (10 sets) • Data recorder (10 sets) • GPS (10 sets) • PC&modem (4 sets) • Battery charger (6 sets) • Battery (10 sets) • Software 	For observation of acceleration of seismic motion and data recording & storage	10 sets
Volcano Observation Point (13 project sites : Iraya, Babuyan, Camiguin, Banahaw, Iriga, Biliran, Kalatungan, Calayo, Makaturing, Ragang, Matutun, Parker and Buddajjo)			
Volcanic Data Observation and Transmission System	<ul style="list-style-type: none"> • Data transmission system (1 component to 1 site) • Short period sensor (vertical) • Battery (100AH) • Solar panel 	For observation of short period seismic motion (vertical) and data transmission	13 sets
Seismic Observation Point (10 project sites : Cagayan, Apayao, Cauayan, Bolinao, Virac, Catarman, Guiuan, Busuanga, El Nido and Bataraza)			
Seismic Data Observation and Transmission System	<ul style="list-style-type: none"> • Data transmission system (1 component to 1 site) • Short period sensor (vertical) • Battery (100AH) • Solar panel 	For observation of short period seismic motion (vertical) and data transmission	10 sets

Phase-II. Major Equipment List

Equipment	Specifications	Purpose	Quantity
Seismic Observation Point with Data Relay (6 project sites : Calayan, Rapu-Rapu Island, Mayon Relay, San Jose, Northern Cebu and Kabalian)			
Seismic Data Observation, Transmission and Relay System	<ul style="list-style-type: none"> • Data receiving system (1 component from 1 site) • Data transmission system (2 components to 1 site) • Short period sensor (vertical) • Battery (2 sets, 100AH) • Solar panel (2 sets) 	For observation of short period seismic motion (vertical) and data transmission and for data receiving from Observation Points	6 sets
Seismic Observation Point with Data Relay (Tablas, Camotes)			
Seismic Data Observation, Transmission and Relay System	<ul style="list-style-type: none"> • Data receiving system (2 components from 1 site) • Data transmission system (3 components to 1 site) • Short period sensor (vertical) • Battery (2 sets, 100AH) • Solar panel (2 sets) 	For observation of short period seismic motion (vertical) and data transmission and for data receiving from Observation Points	2 sets
Seismic Observation Point with Data Relay (Davao Relay)			
Seismic Data Observation, Transmission and Relay System	<ul style="list-style-type: none"> • Data receiving system (2sets, 1 component from 1 site) • Transmission system (3 components to 1 site) • Short period sensor (vertical) • Battery (2 sets, 100AH) • Solar panel (2 sets) 	For observation of short period seismic motion (vertical) and data transmission and for data receiving from Observation Points	1 set
Relay Point (7 project sites : Ilagan, Lingayen, Ayala, Hian, Tinitian, Nara and Dougal)			
Data Relay System	<ul style="list-style-type: none"> • Data receiving system (1 component from 1 site) • Data transmission system (1 component to 1 site) • Battery (2 sets, 100AH) • Solar panel (2 sets) 	For data receiving from Observation Points / Relay Points and data transmission	7 sets
Relay Point (Sabtang)			
Data Relay System	<ul style="list-style-type: none"> • Data receiving system (2 components from 1 site) • Data receiving system (1 component from 1 site) • Data transmission system (3 component to 1 site) • Battery (2 sets, 100AH) • Solar panel (2 sets) 	For data receiving from Observation Points / Relay Points and data transmission	1 set

Phase-II. Major Equipment List

Equipment	Specifications	Purpose	Quantity
Relay Point (Tagaytay)			
Data Relay System	<ul style="list-style-type: none"> • Data receiving system (3 components from 1 site) • Data transmission system (3 components to 1 site) • Battery (2 sets, 100AH) • Solar panel (2 sets) 	For data receiving from Tagaytay existing Seismic Station and data transmission to PHIVOLCS Head Office	1 set
Data Relay System	<ul style="list-style-type: none"> • Data receiving system (3 sets, 3 components from 1 site) • Data transmission system (3 sets, 3 components to 2 sites) • Battery (2 sets, 100AH) • Solar panel (2 sets) 	For data receiving from Taal Volcano Satellite Observation Points and data transmission to Buco existing Volcano Observatory	1 set
Vehicle			
Pick-up truck	<ul style="list-style-type: none"> • 4WD, Double cabin 	For operation and maintenance of the equipment and systems, the equipment transport and relief action	3
Autobicycle	<ul style="list-style-type: none"> • 125cc Off-Road Type 	For operation and maintenance of the equipment and systems in rural area	9