Communications Plan for the Tsunami Warning System in the Pacific

2005 Draft Edition

Reviewed by F. Schindele and L. Kong, 2-March 05

SECTION 1

INTRODUCTION

1.1. COMMUNICATION PLAN - OBJECTIVE

The primary purpose of the Communication Plan for the Tsunami Warning System (TWS) is to serve as the communications operating manual for the Pacific Tsunami Warning Center (PTWC) and for participants of the Tsunami Warning System (TWS) of the Pacific. For each country participating in the TWS, Section VII lists that country's tidal and seismological stations with preferred methods of communications between those stations and the Pacific Tsunami Warning Center. Section VII also lists the dissemination agencies in each country, state, or dependency which receive Tsunami Warning/Watch and Information Bulletins and communication methods by which the bulletins are sent from PTWC to those entities agencies. For each country participating in the TWS, Section VII also lists selected Pacific tidal and seismological stations with preferred methods of communications between those stations and the Pacific Tsunami Warning Center.

A secondary purpose of the Communication Plan is to provide a general overview of the operational procedures of the TWS Tsunami Warning System and of the nature of Tsunamis. Accordingly, Sections II through VI discuss the general nature of tsunamis, the operation of the TWS Tsunami Warning System, the communication methods and procedures for data acquisition from seismological and tidal stations and the dissemination of information to participating agencies.

Appendix A of the Plan discusses the Alaska and West Coast Regional Warning System, giving criteria under which Warning/Watch and Information bulletins Warning Bulletins are issued and the recipients of those messages. A series of other appendices are attached to provide additional reference information.

1.2 ADMINISTRATIVE PROCEDURES

The United States Department of Commerce, National Oceanic and Atmospheric Administration's (NOAA) National Weather Service (NWS) operates and administers the tsunami warning program for the United States. The Pacific Tsunami Warning Center, Ewa Beach, Hawaii has mission responsibility as the operational center for the TWS in the Pacific, as the U.S. National Tsunami Warning Center for U.S. national interests throughout the Pacific basin, and also as the Hawaii Regional Tsunami Warning Center. The West Coast / Alaska Tsunami Warning Center, Palmer, Alaska, has responsibility as the Alaska and U.S. West Coast Regional Tsunami Warning Center within the United States and for the Canadian Province of British Columbia which is located between the U.S. States of Alaska and Washington. Program management for all U.S. TWS components is the responsibility of the Director, NWS Pacific Region, in Honolulu, Hawaii. The Director, NWS Pacific Region is also the U.S. National Contact to other participating countries of the TWS in the Pacific. The mailing address is:

Director, NWS Pacific Region

737 Bishop Street, Suite 2200

Honolulu, Hawaii 96813

U.S.A.

Internationally, participating countries are organized under the United Nations, Intergovernmental Oceanographic Commission (IOC) as the International Co-ordination Group for the TWS in the Pacific ICG/ITSU). The PTWC is the operational center for the TWS in the Pacific. The International Tsunami Information Centre (ITIC), Honolulu, Hawaii, was established upon the request of IOC and is maintained by the U.S. National Weather Service. ITIC serves many roles in assisting participating countries in planning for and mitigating the effects of tsunamis. The mailing address for ITIC is:

Director

International Tsunami Information Centre

737 Bishop Street, Suite 2200

Honolulu, Hawaii 96813

U.S.A.

The PTWC has been delegated the responsibility for the preparation and dissemination of the Communication Plan for the TWS and the issuance of changes thereto. All changes and comments concerning the Communication Plan should be submitted to PTWC for inclusion in future editions of the Communication Plan. The blank forms at the front of the Communication Plan may be used for this purpose.

Additional copies of the Communication Plan may be obtained from PTWC. The mailing address for PTWC is:

Geophysicist-in-Charge

Pacific Tsunami Warning Center

91-270 Fort Weaver Road

Ewa Beach, Hawaii 96706

U.S.A.

The following organizations will maintain up-to-date copies of the Communication Plan: NWS/Office of Meteorology; Tsunami Warning Centers; NWS Alaska, Pacific, and Western Region Headquarters; the ITIC; all participating seismological and tidal stations; all addressees of Tsunami Warning/Watch and Information bulletins ; communication centers serving the above: major communication relay stations handling TWS message traffic; and others who have a demonstrable need for the Plan.

SECTION 2

TSUNAMI

2.1 TERMINOLOGY

"Tsunami" is the Japanese term meaning wave in the harbor. As such it is most descriptive of the observed phenomenon frequently referred to as tidal wave or seismic sea wave, with both of these terms having misleading connotations with respect to the mechanism of generation. In South America, the term "maremoto", or moving sea, is frequently used. However the use of the word "tsunami" is most commonly accepted by scientists and by most of the lay public in Pacific basin countries.

For the TWS , tsunamis can be categorized as local, regional, or Pacific-wide, with those terms being used to describe the extent of potential destruction relative to the tsunami source area. Local tsunamis will often be associated with tsunami generation by submarine or subaerial landslides or volcanic explosions. An example would be the awesome local tsunami of July 9, 1958, at Lituya Bay, Alaska, where wave run-up exceeded 485 meters but the destruction was confined to a very limited area.

Regional tsunamis are by far the most common. Destruction may be limited in areal extent either because the energy released was not sufficient to generate a destructive Pacific-wide tsunami, or because the geomorphology of the source area limited the destructive potential of the tsunami. Examples of some recent tsunamis are shown in the table below:

Date	Magnitude	Max Ht	Killed	Location	Comments
9-2-92	7.2	10 m	170	Nicaragua	Measured Pacific-wide
12-12-92	7.5	26 m	1000	Flores Island	
7-12-93	7.6	30 m	200	Hokkaido	
6-2-94	7.2	14 m	220	Java	
10-4-94	8.1	11 m	11	Kuril Islands	Measured Pacific-wide
11-14-94	7.1	7 m	70	Mindoro	

Pacific-wide tsunamis are much less frequent, but of far greater destructive potential in that waves are not only larger initially, but in transit across the Pacific basin, many distant coastal areas are subject to destructive impact. For example, the tsunami of May 22, 1960, spread death and destruction across the Pacific from Chile to Hawaii, Japan, and the Philippines.

2.2 TSUNAMI GENERATION

A tsunami is a system of gravity waves formed in the sea as a result of a large-scale disturbance of sea level over a short duration of time. In the process of sea level returning to equilibrium through a series of oscillations, waves are generated which propagate outward from the source region. A tsunami can be generated by submarine volcanic eruptions, by displacement of submarine sediments, by coastal landslides into a bay or harbor, by meteor impact, or by vertical displacement of the earth's crust along a zone of fracture which underlies or borders the ocean floor. The latter is by far the most frequent cause of tsunamis and for all practical purposes the primary cause of tsunamis capable of propagation across an ocean basin. The rupture of the earth's crust will also generate a major earthquake which can be detected and measured by seismic instrumentation throughout the world. However, not all major coastal or near-coastal earthquakes produce tsunamis. At present, there is no operational method to determine if a tsunami has been generated except to note the occurrence and epicenter of the earthquake and then detect the arrival of the characteristic waves at a network of tidal stations.

2.3 EARTHQUAKE SEISMOLOGY

When a major earthquake occurs, the resultant energy released into the earth will propagate over a wide range of frequencies and velocities. Even though the earth movements discernible to the viewer may be confined to the general region of the earthquake origin, the various seismic wave phases propagating throughout the earth result in small, but measurable, ground motion which can be detected by a seismometer. A seismograph then provides a visual record of the ground motion at that station.

For the purposes of the Tsunami Warning System, consideration is given to three significant seismic wave phases. The first, the P-wave, is a compressional wave traveling through the earth’s interior at a velocity varying from approximately 8.0 km/second near the crust-mantle interface to about 13.5 km/second at the mantle-core interface. As such it is the first seismic phase to be recorded at any one seismic station and is the first indication that a distant earthquake has occurred. The location of the earthquake can be determined by assuming the "best fit" of the pattern of P-wave arrivals at several stations compared to a standard table of P-wave arrival times for various distances and depths of earthquake focus or, in the case of local earthquakes in or near the limits of a relatively small area seismic station network, compared to the calculated arrivals based on a local crustal seismic velocity model. The moment magnitude (MwP) can be estimated very early, with the long period P waves recorded by broad-band or long-period seismometer.

The second seismic phase of importance is the S-wave, or Secondary wave. This phase travels through the earth's interior as a shear wave, following approximately the same travel path as the P-wave but at a reduced velocity varying from approximately 6.7 km/second near the crust-mantle interface to about 8.0 km/second near the core. These seismic wave phases are classified as body waves due to their propagation through the earth's interior. In addition to providing a location, body waves are useful in determining the size of an earthquake, especially when the earthquake’s focus is deep within the earth.

The third set of seismic phases to be considered are the surface waves resulting from ground displacements propagating outward along the surface of the earth. These are observed at a seismic station as local or regional surface waves and are the basis for measuring mantle magnitude Mm computed from period of 50 s to 400 s. There is a direct simple relation between the mantle magnitude and the moment magnitude. For earthquake of magnitude greater than 8.0 and slow earthquake, the moment magnitude computed through mantle magnitude is much more relevant than MwP.

2.4 TSUNAMI PROPAGATION

Tsunamis travel outward in all directions from the generating area, with the direction of the main energy propagation generally being orthogonal to the direction of the earthquake fracture zone. Their speed depends on the depth of water, so that the waves undergo accelerations and decelerations in passing over an ocean bottom of varying depth. In the deep and open ocean, they travel at speeds of 500 to 1,000 kilometers per hour (300 to 600 miles per hour). The distance between successive crests can be as much as 500 to 650 kilometers (300 to 400 miles); however, in the open ocean, the height of the waves may be no more than 30 to 60 centimeters (1 or 2 feet), and the waves pass unnoticed. Variations in tsunami propagation result when the propagation impulse is stronger in one direction than in others because of the orientation or dimensions of the generating area and where regional topographic features modify both the wave form and rate of advance. Tsunamis are unique in that the waveform extends through the entire water column from sea surface to the ocean bottom. It is this characteristic that accounts for the great amount of energy transmitted by a tsunami.

The successive waves of a tsunami in the deep sea have such great length and so little height they are not visually recognizable from a surface vessel or from an airplane. The passing waves produce only a gentle rise and fall of the sea surface. During the April 1946 tsunami at Hawaii, ships standing off the coasts observed tremendous waves breaking on shore but did not detect any change in sea level at their offshore locations.

2.5 TSUNAMI IMPACT

Upon reaching shallower water, the speed of the advancing wave diminishes, its wave length decreases, and its height may increase greatly, owing to the piling up of water. Configuration of the coastline, shape of the ocean floor, and character of the advancing waves play an important role in the destruction wrought by tsunamis along any coast, whether near the generating area or thousands of kilometers from it. Consequently, detection of relatively small tsunamis at any locality warrants immediate reporting -- through the TWS -- to spread the alarm to all coastal localities of approaching potentially dangerous waves.

At present, detection of tsunamis is possible only near shore where the shoaling effect can be observed. The first visible indication of an approaching tsunami is often a recession of water caused by the trough preceding an advancing wave. Any withdrawal of the sea, therefore, should be considered a warning of an approaching wave. A rise in water level also may be the first event. Tide-gauge records of the

Chilean tsunami of May 22, 1960, generally showed a rise in water level as the first indication of this tsunami. This rise amounted to about one-half the amplitude of the following decrease in water level. Under certain conditions, the crest of an advancing wave can overtake the preceding trough while some distance offshore. This causes the wave to proceed shoreward as a bore -- a wave with a churning front.

The force and destructive effects of tsunamis should not be underestimated. At some places, the advancing turbulent front is the most destructive part of the wave. Where the rise is quiet, the outflow of water to the sea between crests may be rapid and destructive, sweeping all before it and undermining roads, buildings, and other works of man with its swift currents. Ships, unless moved away from shore, can be thrown against breakwaters, wharves, and other craft, or washed ashore and left grounded during withdrawals of the sea.

In the shallow waters of bays and harbors, a tsunami frequently will initiate seiching. If the tsunami period is related closely to that of the bay, the seiche is amplified by the succeeding waves. Under these circumstances, maximum wave activity often is observed much later than the arrival of the first wave.

A tsunami is not one wave, but a series of waves. The time that elapses between passage of successive wave crests at a given point usually is from 10 to 45 minutes. Oscillations of destructive proportions may continue for several hours, and several days may pass before the sea returns to its normal state.

During the 86-year period from 1900 to 1986, 253 tsunamis were observed or recorded in the Pacific Ocean. Fifty-four caused casualties and damage near the source only; nine caused widespread destruction throughout the Pacific. The greatest number of tsunamis during any 1 year was 11 in 1938, but all were minor and caused no damage. Only 9 years of the period were free of tsunamis, but this apparent freedom may be due to poor detection.

Twenty-nine percent of the total tsunamis were generated in or near Japan. The distribution of tsunami generation in other areas is as follows: South Pacific, 18 percent: South America, 9 percent; Taiwan , Philippines, Ryukyu Islands region, 11 percent: Kuril Islands and Kamchatka, 11 percent; Mexico and Central America, 7 percent: Alaska and Aleutian Islands, 6 percent; Indonesia 6 percent; West Coasts of Canada and the United States, 2 percent; and Hawaii, 2 percent.

2.6 REFERENCES

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Neumann, F., Principles Underlying the Interpretation of Seismograms, Department of Commerce Special Publication No. 254, U. S. Government printing Office, 1966.

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SECTION 3

THE TSUNAMI WARNING SYSTEM IN THE PACIFIC

3.1 OBJECTIVE

The operational objective of the TWS in the Pacific is to detect and locate major earthquakes in the Pacific region, to determine whether they have generated tsunamis, and to provide timely and effective tsunami information and warnings to the population of the Pacific to minimize the hazards of tsunamis, especially to human life and welfare. To achieve this objective, the TWS continuously monitors the seismic activity and ocean surface level of the Pacific Basin.

3.2 DESCRIPTION

The TWS is an international program requiring the participation of many seismic, tidal, communication, and dissemination facilities operated by most of the nations bordering the Pacific Ocean. Administratively, participating nations are organized under the IOC as the International Coordination Group (ICG) for the TWS in the Pacific (ICG/ITSU). The ITIC was established upon request of IOC and serves many roles in assisting ICG/ITSU member nations in mitigating the effects of tsunamis throughout the Pacific. The PTWC serves as the operational center for the TWS of the Pacific. PTWC collects and evaluates data provided by participating countries, and issues appropriate bulletins to both participants and other nations, states or dependencies within or bordering the Pacific Ocean basin regarding the occurrence of a major earthquake and possible or confirmed tsunami generation.

3.3 OPERATIONAL PROCEDURES

Functioning of the System begins with the detection, by any participating seismic observatory, of an earthquake of sufficient size to trigger an alarm attached to the seismograph at that station. Personnel at the station immediately interpret their seismograms and send their readings to PTWC. Upon receipt of a report from one of the participating seismic observatories or as a consequence of the triggering of their own seismic alarm, PTWC personnel will (1) check the Internet for email from the U.S. National Earthquake Information Center (NEIC) regarding the event. If the automatic picker at NEIC has not yet sent an email report, PTWC geophysicists will log onto the NEIC system and use data from their National Seismic Network (NSN) to locate the earthquake. The alarm thresholds at PTWC are set so that ground displacements of the amplitude and duration associated with an earthquake of approximate magnitude 6.5 or greater anywhere in the Pacific region will activate them. This magnitude is the threshold for issuing Warning/Watch and Information Bulletins .

After the earthquake has been located and magnitude determined, a decision is made concerning further action. If the earthquake is within or near the Pacific Ocean basin and its moment magnitude is greater than 6.5, but less than or equal to 7.8, then a

Tsunami Information Bulletin is issued to the Warning System participants. Tsunami Warning/Watch Bulletins are issued to the dissemination agencies for earthquakes of magnitude 7.8 or greater, alerting them to the possibility that a tsunami has been generated and providing data that can be relayed to the public so that necessary preliminary precautions can be taken.

If the earthquake appears to be strong enough to cause a tsunami and is located in an area where tsunami generation is possible, PTWC will check water level data from automatic tide stations located near the epicenter for evidence of a tsunami. If they show that a tsunami has been generated that poses a threat to the population in part or all of the Pacific, the Tsunami Warning/Watch Bulletin is extended until there is no longer the threat of a destructive tsunami or it is upgraded to a Warning for the whole Pacific. The dissemination agencies then implement predetermined plans to evacuate people from endangered areas. If the tide station data indicate that either a negligible tsunami or no tsunami has been generated, PTWC issues a cancellation of its previously disseminated Tsunami Warning/Watch.

3.4 NATIONAL AND REGIONAL TSUNAMI WARNING SYSTEMS

In some areas of the Pacific Basin national or regional tsunami warning systems function to provide timely and effective tsunami information and warnings to affected populations. For those coastal areas nearest the tsunami source region, the need for rapid data handling and communication becomes obvious. Because of the time spent in collecting seismic and tidal data, the warnings issued by PTWC cannot protect all areas in the Pacific against tsunamis generated in adjacent waters. To provide some measure of protection within the first hour after generation for tsunamis in the local area, national and regional warning systems have been established by some countries. Among the most sophisticated of the national systems are those of France (French Polynesia), Japan, Russia, Chile and the U.S.A. Regional systems provide the earliest possible alert to the population within the immediate vicinity of the earthquake epicenter by issuing immediate warnings based on earthquake information without waiting for tsunami wave confirmation.

A Regional (or Local) Tsunami Warning Center is responsible for the detection of tsunamis originating within the regional area of responsibility, the prediction of their arrival time within the region and, if possible, coastal impact, and the provision of the earliest possible information and warnings to those national interests responsible for the life and safety of the population of those coastal areas nearest the tsunami source. To function effectively, these regional systems generally have data from a number of seismic and tidal stations telemetered to a central headquarters. Nearby earthquakes are located, usually in 15 minutes or less, and a warning based on seismological evidence is released to the population of the area. Since the warning is issued on the basis of seismic data alone, one may anticipate that warnings occasionally will be issued when tsunamis have not been generated. Since the warnings are issued only to a restricted area and confirmation of the existence or nonexistence of a tsunami is obtained rapidly, disruptions are minimized while a higher level of protection is obtained.

PTWC acts as the Hawaii Regional Tsunami Warning Center for tsunami generated within the Hawaiian Islands. A description of the Japanese regional warning system may be found in publications cited in Section 3.5. A description of the U.S. regional system for Alaska, Canada and the U.S. west coast is documented in through the NWS Tsunami Directives reference in Section 3.5.

A National Tsunami Warning Center is responsible for the detection of tsunamis that pose a threat to the national interests located outside the boundaries of the nation. For the United States, PTWC has responsibility as the U.S. National Tsunami Warning Center to provide tsunami warning services for any tsunami impacting U.S. national interests. A National Tsunami Warning Center predicts the tsunami's arrival time, coastal impact if possible,. and provides timely and effective information and warnings to all national interests to minimize the hazards to human life and safety. Such information and warnings should be provided in the least possible time (generally within 10 minutes of when the threat has been determined) to allow national interests to implement the required safety procedures. If a threat has been determined to national interest and is located within the area of responsibility of a Regional Tsunami Warning Center, it should make provision to receive and heed these regional or local warnings as well.

3.5 REFERENCES

Japan Meteorological Agency, "Tsunami Warning Service in Japan", paper presented in Agenda 1 (Summary of the Present System) of the Intergovernmental Oceanographic Commission Working Group on International Aspects of the Tsunami Warning System in the Pacific meeting at Honolulu. Hawaii. April 27-30. 1965. Tokyo. 1965.

National Weather Service, NOM, Operations Manual, Part F, Chapter 60, "Tsunami Warning Service".

Wadati, K.; Hirono, T.: and Hisamoto, S., "On the Tsunami Warning Service in Japan", International Union of Geodesy and Geophysics Monograph 24, Proceedings of the Tsunami Meetings Associated With the Tenth Pacific Science Congress, University of Hawaii,August-September 1961, Imprime par L'institut Geographique National, Paris, France, July 1963.

SECTION 4

COMMUNICATION REQUIREMENTS AND METHODS

4.1 **OBJECTIVE** FACILITIES TO BE USED

To ensure the timely and effective operation of the TWS, communication facilities are essential which are capable of rapidly handling the data requests from PTWC, the seismic and tidal reports to PTWC, and Tsunami Warning/Watch and Information BulletinsWarning Bulletins. Since such traffic is relatively infrequent, existing communication channels are used with some supplementation where absolutely necessary, instead of establishing a separate communication system that would, to a large extent, duplicate existing channels. Hence, the communication channels under the management and control of the United States Defense Information Systems Communications Agency (DISA), Federal Aviation Administration (FAA), National Weather Service (NWS), Army, Navy, Air Force, Coast Guard, various international agencies, and private companies, as outlined herein, are be used to handle the message traffic involved between PTWC and the seismological and tidal stations and dissemination agencies participating in the warning system.

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4.2 Communications Services Available

PTWC maintains the following communications services:

Service	TWS User Audience
AUTODIN	U.S. Department of Defense and State Department facilities
AFTN	U.S. Federal Aviation Administration and International affiliates
NMC	National Weather Service forecast and data subscribers
NWW	National Weather Service forecast subscribers and U.S. emergency service agencies
HCD	State of Hawaii Civil Defense and NWS offices
TELEX	Emergency service agencies in some South America and Pacific island states
INTERNET	Most international and domestic government agencies and academic institutions
FAX	All the above
NAWAS	Emergency management agencies nationwide.
HAWAS	Emergency management agencies in State of Hawaii

4.2.1 Description of Services

- **AUTODIN**

To disseminate Tsunami messages to U.S. Department of Defense activities throughout the Pacific Basin, PTWC maintains an AUTODIN GateGuard teminal from which messages are uploaded directly to the Multilevel Messaging System (MMS) at NCTAMS EASTPAC in Wahiawa, Hawaii. USCINCPAC maintains a collective address header (RUCRTWP) that contains the AUTODIN addresses of some 192 separate commands and agencies requiring Tsunami message products. As an alternative method of delivery of messages into the AUTODIN system PTWC can request the NMC operator to relay tsunami products via its AUTODIN terminal to Fort Detrick Maryland. Once there, the products will be disseminated with exactly the same distribution as if transmitted directly from the PTWC.

- **AFTN**

The Aeronautical Fixed Telecommunications Network (AFTN) is a world-wide system of circuits for the exchange of messages and/or digital data beween stations primarily for the safety of air navigation and for the regular, efficient and economical operation of air services. Since most flight service facilities must be cognizant of current weather forecasts, many weather forecast offices are provided with AFTN terminals.

- **NMC**

The acronym "NMC" in the NWS can have two interpretations: the **N**ational **M**eteorological **C**enter, in Washington D.C. or the **N**OAA **M**essage **C**enter in Silver Spring Maryland. The circuit referred to as the NMC circuit at the PTWC is a 300 baud dedicated ASCII serial communication line between PTWC in Ewa Beach, Hawaii and the Honolulu Weather Service Forcast Office. From there the line is multiplexed onto a high speed dedicated service to the NMC NOAA Message Center in Silver Spring Maryland.

The NMC circuit is used as a PTWC's means of sending Tsunami Bulletins into the international Global Telecommunications System (GTS) and into the domestic NWS AFOS system. The primary audience for messages sent on NMC are meteorological agencies. Messages are transmitted with World Meteorological Organization (WMO) headers. All WMO headers describe a weather broadcast product category. The NMC in Silver Spring MD maintains a database (the Switching Directory) that directs these products to the appropriate subscribers' circuits automatically. This is also the means by which PTWC receives all the tide data from the automatic water level staions throughout the Pacific Basin. Some meteorological agencies that operate and maintain seismic networks within their country submit seismic phase pick information to PTWC by the GTS.

- **NWW**

The NOAA Weather Wire is a satellite broadcast service maintained by the NWS to disseminate weather products domestically. Both the Alaska Tsunami Warning Center and PTWC have uplink and downlink capability on the NWW system. Users of the the NWW system are comprised of Weather Service Offices and emergency management agencies. Receiver sites can program their selector box to receive any number of selected NWS products (or messages).

- **HCD**

The Hawaii State Civil Defense maintains a telecommunications network that connects all the Weather Service Offices, State and County Civil Defense offices in the State of Hawaii. Messages transmitted on this circuit are copied simultaneously at all the connected office terminals.

- **Telex**

A commercial Telex service (MCI) is maintained. The primary audience for Telex messages are remote stations or dissemination agencies that do not have access to the other services available at PTWC.

- **Internet**

PTWC is connected to the "Information Superhighway" by a high speed direct link. The Internet is used for (1) day-to-day business using e-mail services over the net, and (2) direct computer link with the National Earthquake Information Center and other seismic observatories.

- **NAWAS**

The NAational WArning System is a nationwide dedicated voice telephone system connecting selected national defense, emergency management, and Coast Guard agencies. The circuit is supported by the Federal Emergency Management Agency (FEMA). Control over transmissions on the circuit is maintained by the National Warning Center at the Cheyenne Mountain Complex in Colorado.

- **HAWAS**

The HAawaii WArning System is a statewide dedicated voice telephone system connecting selected State Civil Defense, National Guard, Law Enforcement and Weather Service Offices. The circuit is supported by the FEMA and Hawaii State Civil Defense. Control over transmissions on the circuit is maintained by the State Warning Point.

SECTION 5

REPORTING PROCEDURES FOR SEISMOLOGICAL AND TIDAL STATIONS

5.1 GENERAL

The rapid acquisition of seismic and tidal data by PTWC is critical for optimal operation of the TWS Tsunami Warning System. Although most some seismic and tidal data are telemetered directly to PTWC in real or near real-time, PTWC operations are still dependent on obtaining accurate information from many sources to properly evaluate tsunamigenic events and provide tsunami warning services to participants throughout the Pacific.

Before a seismological station or tidal station can be incorporated into the TWS, adequate communication facilities must be available on a 24 hour-a-day basis. This is required because tsunamis can strike at any time of the day or night, and reliable, fast communication facilities must be immediately available.

5.2 SEISMOLOGICAL STATIONS

5.2.1 FUNCTION

Seismological stations detect earthquakes and submit seismograph reports that are the basis for the determination of earthquake epicenters and magnitudes by PTWC. Seismological stations are encouraged to participate in the warning system by notifying PTWC by the most rapid communication means available of the occurrence of a major earthquake in the Pacific area as soon as detection occurs. The extent of the Seismic Network is shown in Figure below.

5.2.2 DUTIES AND RESPONSIBILITIES

Seismological stations report to PTWC as soon as possible after they have recorded P-phase arrival times for any large earthquakes in the Pacific. Individual observatories may be alerted that an earthquake has occurred either by an alarm attached to one of their instruments or by the arrival of a request for data.

5.3 TIDAL STATIONS

Tide gage Data Collection Platforms (DCP) report water level data to PTWC on a near realtime basis continuously. There are approximately 100 such DCP's operating in the Pacific Basin. The extent of the Water Level Network is shown in Figure below.

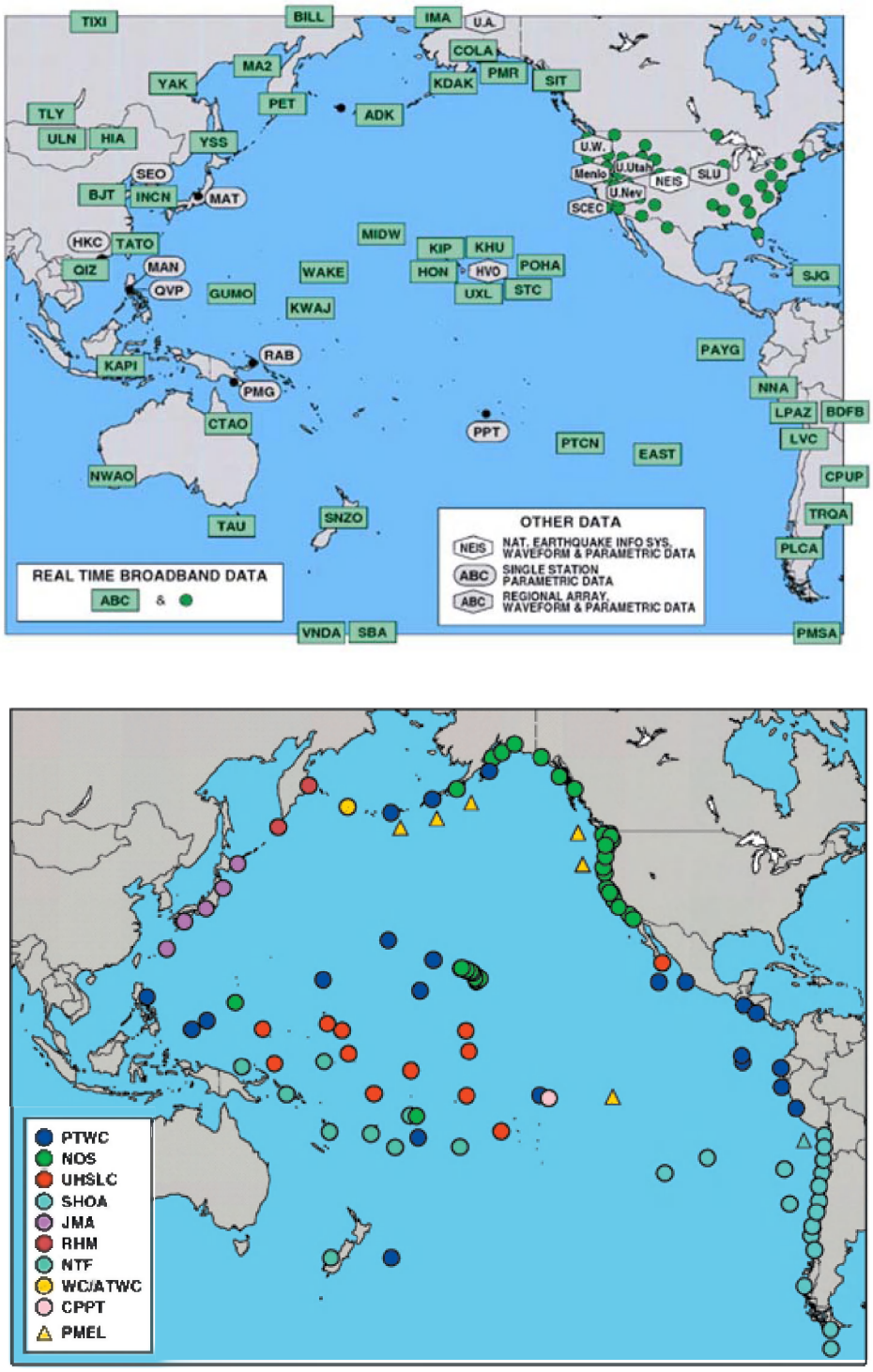

Fig : Seismic (top) and Water Level (bottom) Networks

SECTION 6

DISSEMINATION OF TSUNAMI WATCH AND WARNING INFORMATION

6.1 DISSEMINATION AGENCIES

6.1.1 SELECTION OF AGENCY

In order to limit the number of agencies to be contacted in the event of a tsunami, Tsunami Warning/Watch and Information bulletinsWarning Bulletins generally are issued to only one agency in a country, territory, or administrative area. This agency usually is appointed by the central government or administrative head of the area concerned and has fundamental responsibilities for public safety and disaster mitigation. To ensure the proper operation of the warning system. The agency designated to receive tsunami warnings must submit to PTWC the names and/or offices of the responsible administrators on both the central and local levels, and the communication procedures for reaching at any hour the head of the dissemination agency or a responsible assistant.

6.1.2 FUNCTION AND RESPONSIBILITIES OF DISSEMINATION AGENCY

The dissemination agency provides the last vital link between the TWS and the public, the ultimate user of the warning information. As such, the dissemination agency must motivate the public (by both education and, where possible, by law) to take necessary and desired actions to protect life and property. The dissemination agency and/or the governing body of an area subject to tsunami danger has the continuing responsibility for educating the public as to the dangers of tsunamis and for developing safety measures that must be taken to avoid loss of life and to reduce property damage.

It is the ultimate responsibility of the dissemination agency to evaluate the tsunami information received from PTWC and to decide on appropriate action after the receipt of a Tsunami Warning/Watch and Warning. Responsible agencies should have well-developed emergency plans for all threatened localities. These plans should clearly delineate areas of possible inundation. Evacuation routes should be designated and safe areas should be marked. The amount of advance warning necessary to ensure evacuation from danger areas also should be known. Emergency duties and responsibilities should be designated, and all affected officials should be thoroughly familiar with their duties. Tsunami Watch and Warning information may be passed (depending on the time and facilities available) to the coastal population by any or all of the following methods: radio, television, sirens, bells, whistles, warning flags, mobile loud speakers, and personal contact.

The U.S. National Weather Service, through PTWC and the International ITIC, will cooperate as far as possible in making available educational material for reproduction and distribution.

6.2 INFORMATION DISSEMINATION BY PTWC

6.2.1 DEFINITIONS

The PTWC Pacific Tsunami Warning Center issues four basic types of information. as summarized below:

A. Pacific-wide Tsunami Warning Bulletin - A message issued to all participants on a Pacific-wide basis after confirmation has been received that a tsunami capable of causing destruction beyond the local area has been generated and that poses a threat to the population in part or all of the Pacific. Approximately each hour updated information will be sent until the Pacific-wide Tsunami Warning is canceled. Sections 6.2.3 and 6.2.7 provide further explanation and sample text.

B. Regional Tsunami Warning/Watch Bulletin - A message issued initially using only seismic information to alert all participants of the probability of a tsunami and advise that a tsunami investigation is underway. The area placed in Tsunami Warning status will encompass a 3-hour tsunami travel-time relative to the time of message issuance from the earthquake epicenter. Those areas within a 3 to 6-hour tsunami travel-time of the epicenter will be placed in a Watch status. A Tsunami Warning/Watch will be followed by additional bulletins until it is either upgraded to a Pacific-wide Tsunami Warning or is canceled. Sections 6.2.4 and 6.2.7 provide further explanation and sample text.

C. Tsunami Information Bulletin - A message issued to advise participants of the occurrence of a major earthquake in the Pacific or near-Pacific area, with the evaluation that either (a) A Pacific-wide tsunami was not generated based on earthquake and historical tsunami data. This will be the only bulletin issued. No Pacific-wide tsunami warning is in effect; (b) An investigation is underway to determine if a Pacific-wide tsunami has been generated. Additional bulletins will be issued hourly or sooner as information becomes available. No Pacific-wide tsunami warning is in effect; or (c) No destructive Pacific-wide tsunami threat exists. However, some areas may experience small sea level changes. This will be the final bulletin issued unless additional information becomes available. No Pacific-wide tsunami warning is in effect.

If the event occurs in ATWC's area of responsibility and exceeds the ATWC Regional Warning threshold but is less than the PTWC Warning/Watch threshold. an investigation will be initiated by PTWC and additional Tsunami Information Bulletins will be issued until the investigation is concluded. Sections 6.2.5 and 6.2.7 provide further explanation and sample text.

D. Tsunami Communication Test Dummy Message - Test message issued by PTWC at unannounced times on a monthly basis to determine writer-to-reader delays in disseminating tsunami information, to test the operation of the warning system by the evaluation of two-way communications with interactive personnel response, and to keep communication operating personnel familiar with the procedures for handling message traffic pertaining to the TWS Tsunami Warning System. Sections 4.2, 6.2.6. and 6.2.7 provide further explanation and sample text.

6.2.2 SUMMARY OF OPERATIONAL PROCEDURES

A summary outline of the operational procedures used by PTWC for the issuance of the above bulletins as related to earthquake moment magnitude is as follows:

EARTHQUAKE MAGNITUDE	PTWC ACTION
A. Mw greater than Alarm threshold. but less than or equal to 6.5	Provide data and information to USGS/NEIC and/or other particpating observatories
B. Mw greater than 6.5. but less than or equal to 7.8	Issue **TSUNAMI INFORMATION BULLETIN**, with the evaluation that a Pacific wide tsunami was not generated.
C. For events in ATWC's area of responsibility exceeding ATWC Warning threshold, but less than PTWC Warning/Watch threshold.	(1) Query pertinent tidal stations. (2) Issue **TSUNAMI INFORMATION BULLETIN** with initiation of Investigation. (3) Based on tidal station reply: (a) Issue final **TSUNAMI INFORMATION BULLETIN** (b) Issue **TSUNAMI WARNING.** (c) Continue investigation by issuing additional **TSUNAMI INFORMATION BULLETIN.**
D. Mw greater than 7.8	(1) Issue **REGIONAL TSUNAMI WARNING/WATCH BULLETIN**. Issue E/Q ADVISORY or WATCH for State of Hawaii (see note below). (2) Monitor Query pertinent tidal stations. (3) Based on tidal station response: (a) Issue **CANCELLATION** of **REGIONAL TSUNAMI WARNING/WATCH BULLETIN.** (b) Issue **PACIFIC-WIDE TSUNAMI WARNING BULLETIN.** (c) Continue investigation by issuing additional **REGIONAL TSUNAMI**

	WARNING/WATCH BULLETINS until the tsunami warning/watch is canceled. (4) On issuance of a **PACIFIC-WIDE TSUNAMI WARNING**, continue investigation by issuing **TSUNAMI WARNING BULLETINS** until the tsunami warning/watch is canceled.

Note: For the Hawaii Civil Defense only, a separate message text consisting of an EARTHQUAKE ADVISORY is being issued for Mw greater than 7.8 and ETA for Hawaii greater than 6 hours. A WATCH is issued for Mw greater than 7.8 and ETA less than 6 hours. Hawaii also is included in WATCH status for earthquakes from Tokyo to Kamchatka. A WARNING is issued upon tsunami confirmation.

6.2.3 PACIFIC-WIDE TSUNAMI WARNING BULLETIN

When a major tsunami; is detected, a Tsunami Warning Bulletin will be sent out to all participants in the Pacific. A Pacific-wide Tsunami Warning is transmitted on AUTODIN circuits with FLASH precedence (using the CAD/CRI Tsunami Warning Pacific), on AFOS with priority 1, and on AFTN circuits with SS priority. Pacific-wide Tsunami Warnings are issued by PTWC upon receipt of positive evidence that a potentially destructive tsunami exists. Pacific-wide Tsunami Warnings will contain estimated times of tsunami arrival (ETA) at tide stations and specific warning points in the warning system. Pacific-wide Tsunami Warning Bulletins normally will carry information on wave heights and other information as deemed appropriate by PTWC.

Tsunami Warnings are issued by PTWC upon receipt of positive evidence that a potentially destructive tsunami exists. Tsunami Warnings will contain estimated times of tsunami arrival (ETA) at tidal stations in the warning system. Bulletins subsequent to the initial Tsunami Warning Bulletin normally will carry information on wave heights and other information as deemed appropriate by PTWC.

The Pacific-wide Tsunami Warning will be canceled when it is determined that the tsunami threat is over for the entire Pacific Basin. A cancellation will be issued if the Tsunami Warning was issued on the basis of erroneous data or if PTWC determines from subsequent information that only an insignificant wave has been generated. In addition, a Pacific-wide Tsunami Warning may be canceled on a selective basis when a significant wave that has been generated clearly poses no threat to one or more of the areas PTWC warns, either because of intervening continents or islands which screen them or because the orientation of the generating area causes the tsunami to be directed away from these areas.

At present, PTWC does not have enough data available to enable it to determine when danger has passed in many for any given areas. Local conditions can cause wide variations in tsunami wave action. Consequently, all-clear determinations must be made by the local action agencies and not PTWC. In general, after receipt of a Tsunami Warning, action agencies can assume all-clear status when their area is free from damaging waves for 2 hours unless additional ETA's have been announced by PTWC or local conditions, particularly strong currents in channels and harbors,

warrant the continuation of the Tsunami Warning status. If no wave or only insignificant waves occur, action agencies may assume all-clear status 2 hours after the latest ETA announced by PTWC, again taking caution as to the presence of strong currents in channels and harbors.

6.2.4 REGIONAL TSUNAMI WARNING/WATCH BULLETIN

A Regional Tsunami Warning/Watch Bulletin will be issued to all participants in the Pacific informing them of the occurrence of a major earthquake which could generate a potentially destructive tsunami for the Pacific community. (See Note below). A Regional Tsunami Warning/Watch Bulletin is transmitted to the same addressees and with the same precedence and priority as a Pacific-wide Tsunami Warning, i.e., FLASH precedence on AUTODIN circuits (using the CAD/CRI Tsunami Warning Pacific as listed in Section 4.3.4), on AFOS with priority 1, and on AFTN circuits with SS priority.

A Regional Tsunami Warning/Watch is issued based on earthquake location and moment magnitude, generally exceeding 7.8. The area within 3 hours tsunami travel-time of the epicenter will be placed in a Tsunami Warning status, with the area within a 3-6 hour travel-time zone placed in a Watch status. Tsunami ETA's will be disseminated for the tidal stations within the Tsunami Warning and Watch areas. Action agencies so designated should evaluate the probability of a tsunami having been generated and decide on appropriate action. It must be emphasized that a Tsunami Warning/Watch is issued by PTWC based on earthquake information only, without confirmation of wave activity. Meanwhile, PTWC will have initiated an investigation by sending queries to the nearest tidal stations.

Bulletins subsequent to the first Tsunami Warning/Watch Bulletin will be issued on an hourly basis. This policy will be adhered to even when no new data are available. Additional bulletins will be issued until the Tsunami Warning,/Watch is upgraded to a Tsunami Warning, or until PTWC determines that no tsunami was generated, at which time the Tsunami Warning/Watch will be canceled. If a small tsunami is detected, PTWC may extend the Tsunami Warning/Watch status until certain that no danger exists to further areas.

Note: For Alaska, British Columbia, Washington, Oregon and California. PTWC in its role as the international operational center for the TWS in the Pacific is the responsible warning center to all ICG/ITSU nations for tsunamis originating anywhere in the Pacific. PTWC in its role as the U.S. National Tsunami Warning Center is the responsible warning center to all U.S. national interests for tsunamis originating anywhere in the Pacific. The West Coast / Alaska Tsunami Warning Center (ATWC) functions as the Regional Tsunami Warning Center for Alaska and for the west coast of North America for tsunamis generated from Attu, Alaska to the southern California border. For tsunamis generated in the region from Attu to the southern California border PTWC Regional Tsunami Warning/Watch Bulletins will include a statement that the ATWC has issued a Regional Tsunami Warning. This is to minimize possible confusion for those dissemination agencies receiving both a Regional Tsunami WARNING/WATCH from PTWC and a Regional Tsunami WARNING from ATWC. Because ATWC's message is a Tsunami warning is the

Regional Tsunami Warning Center and as such should have the most specific and timely information, its message it should be acted upon first by agencies in those areas.

6.2.5 TSUNAMI INFORMATION BULLETIN

When a major earthquake occurs in a coastal or near-coastal location, or within the Pacific basin, generally with a moment magnitude from 6.5 to 7.8, PTWC will issue a Tsunami Information Bulletin, with the evaluation that a Pacific-wide tsunami was not generated. If PTWC's evaluation is such that tsunami generation is possible, queries will be sent to the nearest tideal stations will be monitored. A Tsunami Information Bulletin is transmitted on AUTODIN circuits with IMMEDIATE precedence (using the CAD/CRI Tsunami Warning Pacific), on AFOS with priority 1, and on AFTN circuits with SS priority. If ATWC issues a Regional Tsunami Warning for an event that is less than PTWC's Warning/Watch threshold, a Tsunami Information Bulletin will be issued by PTWC advising that an investigation is underway, and acknowledging that ATWC has issued a Regional Warning/Watch for (area).

On initiation of a tsunami investigation, additional bulletins will be issued hourly until the investigation is canceled, or positive information is received that a potentially destructive tsunami has been generated, at which

6.2.6 TSUNAMI COMMUNICATION TESTDUMMY MESSAGES

Two types of communication tests are conducted each month. One, the dissemination test, is primarily intended to evaluate the communication capability from PTWC to selected dissemination agencies. The other, the station test, is transmitted to selected seismological stations (Sections 5.2 and 7) and tidal stations (Sections 5.3 and 7) to evaluate the station response time and two-way transmission times. In many instances, particularly for international participants, the addressee for a dissemination agency, a tidal station, and/or a seismological station may be the same action agency.

Tsunami Communication test Dummy or test messages (as described in Sections 6.2.1, and 6.2.6) are sent at unannounced time on a monthly basis to various selected dissemination agencies to test the operation of the warning system, to keep communication operating personnel familiar with the procedures for handling message traffic pertaining to the system, and to determine transmission times.

Tsunami Communication test Dummy messages from PTWC to dissemination agencies are transmitted via SS priority for AFTN circuits, priority 1 for AFOS, and FLASH precedence (using the CAD/CRI Tsunami Warning Pacific) for AUTODIN circuits to evaluate the effectiveness of real event communication. Responses from dissemination agencies may utilize a routine priority or Precedence for test messages.

The text of test messages, and ONLY test messages, will begin with the words "TSUNAMI COMMUNICATION TEST DUMMY" to distinguish these messages from other action bulletins transmitted by PTWC.

Samples of message text for a Tsunami Communication TestDummy are included in Section 6.2.7 for a dissemination agency.

6.2.7 SAMPLE MESSAGE TEXTS

The following is a sample text for a Pacific-wide Tsunami Warning:

TSUNAMI BULLETIN NUMBER _____ *(number follows sequentially the last Regional Tsunami Warning/Watch number)*

PACIFIC TSUNAMI WARNING CENTER/NOAA/NWS

ISSUED *(time/date)* UTC

. . . A TSUNAMI WARNING IS IN EFFECT . . .

THE WARNING IS FOR ALL COASTAL AREAS AND ISLANDS IN THE PACIFIC.

AN EARTHQUAKE, PRELIMINARY MAGNITUDE _ , OCCURRED *(time/date)* UTC, LOCATED

EVALUATION: A TSUNAMI HAS BEEN GENERATED WHICH COULD CAUSE DAMAGE

TO COASTS AND ISLANDS IN THE PACIFIC. TSUNAMI WAVE HEIGHTS CANNOT BE PREDICTED AND MAY BE A SERIES OF WAVES WHICH COULD BE DANGEROUS FOR SEVERAL HOURS AFTER THE INITIAL WAVE ARRIVAL.

WAVE HEIGHTS HAVE BEEN REPORTED AT THE FOLLOWING TIDE GAUGES:

(List tide stations. tsunami height in cm and time)

ESTIMATED TIME OF INITIAL WAVE ARRIVAL AT TIDE GAUGES IS AS FOLLOWS:

(ETA's for North American stations will be in local time and UTC; stations will be listed chronologically so subsequent bulletins can be shortened by eliminating past ETA's)

ACAJUTLA, EL SALVADOR_____Z ACAPULCO, MEXICO _____Z

ADAK, AK _____Z ANTOFAGASTA,CHILE _____Z

APIA, WESTERN SAMOA _____Z ARICA, CHILE _____Z

ATTU, AK _____Z BALBOA HTS, PANAMA _____Z

BALTRA I, ECUADOR _____Z CHRISTMAS I,KIRIBATI_____Z

CRESCENT CITY, CA _____Z DUTCH HARBOR, AK _____Z

EASTER I. CHILE _____Z ENIWETOK, MARSHALL I_____Z

GUAM _____Z HACHINOHE, JAPAN _____Z

HILO, HI _____Z HONG KONG _____Z

HONOLULU, HI _____Z HUALIEN, TAIWAN _____Z

JOHNSTON I _____Z KODIAK, AK _____Z

KWAJALEIN,MARSHALL I_____Z LANGARA,CANADA _____Z

LEGASPI,PHILIPPINES _____Z MALAKAL,PALAU _____Z

MARCUS I _____Z NAURU _____Z

NEAH BAY,WA _____Z OKINAWA,JAPAN _____Z

PAPEETE,FR POLYNESIA_____Z PUERTO WILLIAMS _____Z

RIKITEA,FR POLYNESIA_____Z SAN DIEGO,CA _____Z

SAN FRANCISCO,CA _____Z SEWARD, AK _____Z

SHIMIZU, JAPAN _____Z SOCORRO, MEXICO _____Z

TALCAHUANO, CHILE _____Z CHUUK _____Z

WAKE _____Z YAKUTAT, AK _____Z

LA JOLLA, CA _____Z LA PUNTA, PERU _____Z

LYTTELTON, N.ZEALAND_____Z MANZANILLO, MEXICO _____Z

MIDWAY _____Z NAWILIWILI, HI _____Z

NOUMEA, N CALEDONIA _____Z PAGO PAGO, AM SAMOA _____Z

PUERTO MONTT, CHILE _____Z PUNTA ARENAS,CHILE _____Z

RAROTONGA, COOK I _____Z SANDPOINT, AK _____Z

SAN PEDRO, CA _____Z SHEMYA, AK _____Z

SITKA, AK _____Z SUVA, FIJI _____Z

TOFINO, CANADA _____Z VALPARAISO, CHILE _____Z

WELLINGTON, N ZEALAND_____Z YAP _____Z

BULLETINS WILL BE ISSUED HOURLY OR SOONER IF CONDITIONS WARRANT. THE TSUNAMI WARNING WILL REMAIN IN EFFECT UNTIL FURTHER NOTICE.

(The following will be included in all subsequent bulletins after the initial Pacific-WideWarning Bulletin.)

WHEN NO MAJOR WAVES HAVE BEEN RECORDED FOR TWO HOURS AFTER THE ESTIMATED TIME OF INITIAL WAVE ARRIVAL OR DAMAGING WAVES HAVE NOT OCCURRED FOR AT LEAST TWO HOURS, LOCAL AUTHORITIES SHOULD ASSUME THAT THE TSUNAMI THREAT IS OVER. DANGER TO BOATS AND COASTAL STRUCTURES MAY CONTINUE FOR SEVERAL HOURS DUE TO RAPID CURRENTS. AS LOCAL CONDITIONS CAN CAUSE A WIDE VARIATION IN TSUNAMI WAVE ACTION, THE ALL CLEAR DETERMINATIONS MUST BE MADE BY LOCAL AUTHORITIES STOP.

The following is sample text for a Pacific-Wide Tsunami Warning Cancellation:

TSUNAMI BULLETIN NUMBER

PACIFIC TSUNAMI WARNING CENTER/NOAA/NWS

ISSUED (time/date) UTC

. . . THE TSUNAMI WARNING IS CANCELED . . .

THE TSUNAMI WARNING IS CANCELED FOR ALL COASTAL AREAS AND ISLANDS

IN THE PACIFIC.

AN EARTHQUAKE, PRELIMINARY MAGNITUDE , OCCURRED (time/date) UTC,

LOCATED

EVALUATION: *(Text selected from options below)**

STOP

* *The text used for EVALUATION will be one of the following options:*

a.) SEA LEVEL REPORTS CONFIRM THAT NO PACIFIC-WIDE TSUNAMI WAS GENERATED. LOCAL AUTHORITIES CAN ASSUME ALL CLEAR UPON RECEIPT OF THIS BULLETIN. THIS WILL BE THE FINAL BULLETIN ISSUED. FOR ALL AREAS THE TSUNAMI WARNING IS CANCELED.

b.) A SMALL TSUNAMI WAS GENERATED AS CONFIRMED BY THE FOLLOWING

TIDE GAUGE REPORTS: *(List tide stations, tsunami height in cm and time)*

NO DESTRUCTIVE TSUNAMI THREAT EXISTS FOR COASTAL AREAS IN THE PACIFIC, ALTHOUGH SOME SMALL SEA LEVEL CHANGES MAY BE RECORDED. AS LOCAL CONDITIONS CAN CAUSE A WIDE VARIATION IN TSUNAMI WAVE ACTION, THE ALL CLEAR DETERMINATIONS MUST BE MADE BY LOCAL AUTHORITIES. THIS WILL BE THE FINAL BULLETIN ISSUED UNLESS ADDITIONAL INFORMATION BECOMES AVAILABLE. FOR ALL AREAS THE TSUNAMI WARNING IS CANCELED.

c.) A DESTRUCTIVE TSUNAMI HAS OCCURRED AND RESULTED IN DAMAGE AT SOME LOCATIONS. WAVE HEIGHTS HAVE BEEN REPORTED AT THE FOLLOWING TIDE GAUGES:

(List tide stations, tsunami height in cm and time.)

WHEN NO MAJOR WAVES HAVE BEEN RECORDED FOR TWO HOURS AFTER THE ESTIMATED TIME OF ARRIVAL OR DAMAGING WAVES HAVE NOT OCCURRED FOR AT LEAST TWO HOURS, LOCAL AUTHORITIES SHOULD ASSUME THAT THE TSUNAMI THREAT IS OVER. DANGER TO BOATS AND COASTAL STRUCTURES MAY CONTINUE

FOR SEVERAL HOURS DUE TO RAPID CURRENTS. AS LOCAL CONDITIONS CAN CAUSE A WIDE VARIATION IN TSUNAMI WAVE ACTION, THE ALL CLEAR DETERMINATIONS MUST BE MADE BY LOCAL AUTHORITIES. THIS WILL BE THE FINAL BULLETIN ISSUED UNLESS ADDITIONAL INFORMATION BECOMES AVAILABLE. FOR ALL AREAS THE TSUNAMI WARNING IS CANCELED.

LOCATIONS. WAVE HEIGHTS HAVE BEEN REPORTED AT THE FOLLOWING TIDE

GAUGES: *(List tide stations, tsunami height in cm and time.)*

WHEN NO MAJOR WAVES HAVE BEEN RECORDED FOR TWO HOURS AFTER THE ESTIMATED TIME OF ARRIVAL OR DAMAGING WAVES HAVE NOT OCCURRED FOR AT LEAST TWO HOURS, LOCAL AUTHORITIES SHOULD ASSUME THAT THE TSUNAMI THREAT IS OVER. DANGER TO BOATS AND COASTAL STRUCTURES MAY CONTINUE FOR SEVERAL HOURS DUE TO RAPID CURRENTS. AS LOCAL CONDITIONS CAN CAUSE A WIDE VARIATION IN TSUNAMI WAVE ACTION, THE ALL CLEAR DETERMINATIONS MUST BE MADE BY LOCAL AUTHORITIES. THIS WILL BE THE FINAL BULLETIN ISSUED UNLESS ADDITIONAL INFORMATION BECOMES AVAILABLE. FOR ALL AREAS THE TSUNAMI WARNING IS CANCELED.

The following is a sample text for a Regional Tsunami Warning/Watch:

TSUNAMI BULLETIN NUMBER _____

PACIFIC TSUNAMI WARNING CENTER/NOAA/NWS

ISSUED *(time/date)* UTC

. . . A TSUNAMI WARNING AND WATCH IS IN EFFECT. . .

A TSUNAMI WARNING IS IN EFFECT IN THE *(SW,NW,NE,SE)** PACIFIC

FOR_.

A TSUNAMI WATCH IS IN EFFECT FOR _____.

FOR OTHER AREAS IN THE PACIFIC, THIS MESSAGE IS FOR INFORMATION ONLY. (THE ALASKA TSUNAMI WARNING CENTER HAS ISSUED A REGIONAL WARNING FOR)**

AN EARTHQUAKE, PRELIMINARY MAGNITUDE ___, OCCURRED (time/date)UTC,

LOCATED_.

EVALUATION: IT IS NOT KNOWN THAT A TSUNAMI WAS GENERATED. THIS WARNING IS BASED ONLY ON EARTHQUAKE EVALUATION. ESTIMATED TIMES OF INITIAL WAVE ARRIVAL AT TIDE GAUGES WITHIN THE WARNING AND WATCH AREAS ARE: (Chronological list of tide stations and ETA's using UTC for all stations and also including local times for North American stations.)

BULLETINS WILL BE ISSUED HOURLY OR SOONER IF CONDITIONS WARRANT. THE TSUNAMI WARNING WILL REMAIN IN EFFECT UNTIL FURTHER NOTICE.

STOP

* (Region will be specified as SOUTHWEST, NORTHWEST, NORTHEAST, SOUTHEAST, NORTHERN, WESTERN, or EASTERN PACIFIC)

** (To be included only when the earthquake occurs from Attu, Alaska, to Southern California.)

The following is sample text for a Regional Tsunami Warning/Watch Cancellation:

TSUNAMI BULLETIN NUMBER _____

PACIFIC TSUNAMI WARNING CENTER/NOAA/NWS

ISSUED (time/date) UTC

. . . THE TSUNAMI WARNING AND WATCH ARE CANCELED . . . THE TSUNAMI WARNING AND WATCH ARE CANCELED FOR ALL COASTAL AREAS AND ISLANDS IN THE PACIFIC.

AN EARTHQUAKE, PRELIMINARY MAGNITUDE , OCCURRED AT (time/date) UTC,

LOCATED .

EVALUATION: *(Options to be selected from text below)**

STOP

* The text used for EVALUATION will be one of the following options:

a.) SEA LEVEL REPORTS CONFIRM THAT NO PACIFIC-WIDE TSUNAMI WAS GENERATED. THIS WILL BE THE FINAL BULLETIN ISSUED UNLESS ADDITIONAL INFORMATION BECOMES AVAILABLE. FOR ALL AREAS THE TSUNAMI WARNING AND TSUNAMI WATCH ARE CANCELED.

b.) NO DESTRUCTIVE PACIFIC-WIDE TSUNAMI THREAT EXISTS. HOWEVER, SOME AREAS MAY EXPERIENCE SMALL SEA LEVEL CHANGES. THIS WILL BE THE FINAL BULLETIN ISSUED UNLESS ADDITIONAL INFORMATION BECOMES AVAILABLE. FOR ALL AREAS THE TSUNAMI WARNING AND TSUNAMI WATCH ARE CANCELED.

Note: If sea level reports are available at the time of CANCELLATION, these data will be included with the CANCELLATION. If later reports are received after issuance of the CANCELLATION confirming generation of a small tsunami, a TSUNAMI INFORMATION BULLETIN will be issued reporting data received.

The following is Sample text for a Tsunami Information Bulletin:

TSUNAMI BULLETIN NUMBER _____

PACIFIC TSUNAMI WARNING CENTER/NOAA/NWS

ISSUED (time/date) UTC

. . . THIS IS A TSUNAMI INFORMATION MESSAGE. NO ACTION REQUIRED

*(See below for options if quake is in ATWC's area of responsibility)**

AN EARTHQUAKE, PRELIMINARY MAGNITUDE , OCCURRED AT (time/date) UTC.

LOCATED .

EVALUATION: (Optional text as listed below)**

STOP

* If the earthquake occurs from Attu, Alaska to Southern California, and ATWC has issued a Regional Warning, this statement will read:

. . . THIS IS A TSUNAMI INFORMATION MESSAGE . . .

THE ALASKA TSUNAMI WARNING CENTER HAS ISSUED A REGIONAL WARNING FOR (area) NO TSUNAMI WARNING IS IN EFFECT FOR OTHER REGIONS IN THE PACIFIC.

** The text used for EVALUATION will be one of the following options:

a.) A PACIFIC-WIDE TSUNAMI WAS NOT GENERATED BASED ON EARTHQUAKE AND HISTORICAL TSUNAMI DATA. THIS WILL BE THE ONLY BULLETIN ISSUED. NO PACIFIC-WIDE TSUNAMI WARNING IS IN EFFECT.

b.) AN INVESTIGATION IS UNDERWAY TO DETERMINE IF A PACIFIC-WIDE TSUNAMI HAS BEEN GENERATED. ADDITIONAL BULLETINS WILL BE ISSUED HOURLY OR SOONER AS INFORMATION BECOMES AVAILABLE. NO PACIFIC-WIDE TSUNAMI WARNING IS IN EFFECT.

c.) NO DESTRUCTIVE PACIFIC-WIDE TSUNAMI THREAT EXISTS. HOWEVER, SOME AREAS MAY EXPERIENCE SMALL SEA LEVEL CHANGES. THIS WILL BE THE FINAL BULLETIN ISSUED UNLESS ADDITIONAL INFORMATION BECOMES AVAILABLE. NO PACIFIC-WIDE TSUNAMI WARNING IS IN EFFECT.

Note: If later reports are received confirming generation of a small tsunami, a TSUNAMI INFORMATION BULLETIN will be issued reporting data received.

The following are a sample communication test and response for a Tsunami Communication testDummy:

ATTN KSFO, KLAX. KSEA, KPDX. ALL OTHERS DISREGARD.

FROM THE PACIFIC TSUNAMI WARNING CENTER

TSUNAMI COMMUNICATION TESTDUMMY.

THIS IS A TEST TO DETERMINE TRANSMISSION TIMES INVOLVED IN

DISSEMINATION OF TSUNAMI WATCH AND WARNING INFORMATION. ALL

ADDRESSEES ADVISE PACIFIC TSUNAMI WARNING CENTER OF TIME OF RECEIPT

OF THIS MESSAGE AND SIGN. REPLY ROUTINE PRECEDENCE THIS TEST ONLY.

STOP.

TO THE PACIFIC TSUNAMI WARNING CENTER TSUNAMI COMMUNICATION TESTDUMMY. YOUR 231901Z RECEIVED 231907Z.

[end]

SECTION 7

COMMUNICATION METHODS FOR SEISMOLOGICAL STATIONS, TIDAL STATIONS, AND DISSEMINATIONS AGENCIES

7.1 GENERAL

Appendix A details the communications information for the participating seismological observatories, tide stations, and dissemination agencies of the Tsunami Warning System. Each entry under the caption "Mail Address" is the official designation and mailing address of the agency indicated. The entry of telephone numbers is included to facilitate telephonic communication and should include those numbers whereby PTWC can contact responsible authorities on a 24 hour-a-day basis, either at their office or at their home residence. For each agency listed, the entry under the caption "Station Designator" is the term that may be used in each message to indicate the originator or addressee. This short descriptive title is intended to facilitate and expedite handling of messages by communication operating personnel.

The methods of communication listed in Section 4 and in Appendix A are those by which seismic and tide stations send reports to PTWC, or by which PTWC transmits tsunami watch and warning information to participating dissemination agencies, and are listed in order relative communication preference in the basis of presently available information. Changes in relative preference by any station as warranted by local conditions and previous experience should be communicated to PTWC. At a time of emergency, transmission of messages by telephone is encouraged in addition to teletype v

APPENDIX A.

COMMUNICATION POINTS

The PTWC maintains contact information for seismological and tide stations, and warning dissemination points for countries participating in the Tsunami Warning System in the Pacific. Presently, there are 123 communication points for the TWSP. For each communication point, the following information is available in a standardized format:

Locality Country-City (Physical Location)

Agency:
Agency Name

Postal address:
Postal contact
Postal address 1
Postal address 2
Postal address 3
Postal city
Postal State
Postal code
Postal Country

Phone numbers:
Phone 1
Phone 2
Phone 3
FAX

Email:
Email 1
Email 2
Email 3

Other contact codes:
NADIN2 NADIN2
NMC NMC (FAA country code)
PLA Plain Language Address
Telex Telex
NWW NWW
EMWIN EMWIN

lat Lat lon Lon id ID

Parent Agency:
Parent Agency
Parent Agency contact
Parent agency phone
Parent agency email
Parent agency City/Country

Comments: Parent agency comment

Each country is requested to update the current information on record at the PTWC using the following form:

COMMUNICATIONS METHODS – <insert country name>

For each Agency the receives information from, or sends data to the PTWC, please provide the following information:

Name of Country:

Postal Address: Name of Person, Agency and Address

Telephone numbers:
24 Hr Phone:
1st alternate:
2nd alternate:

Station Location:
Latitude: (minus=S)
Longitude: (minus=W)

FAX:
E-mail address:

Method – Primary:

Method – Alternate:

Warning Points Desired (Location name, Latitude, Longitude, Elevation)

Last Update: Date and Name of Person and Person`s Title reporting update

An example provided by the Republic of the Philippines is provided below:

PHILIPPINES, REPUBLIC of the

Postal Address: **Philippine Institute of Volcanology and Seismology**

PHIVOLCS (QVP)
Department of Science and Technology
PHIVOLCS BLDG.
Carlos P. Garcia Avenue
U.P. Diliman, Quezon City
Republic of the Philippines

Telephone numbers:

24 Hr. Phone: 011 632 426-1468 to 79
1st alternate 011 632 929-9253 to 54
FAX: 011 632 929-8366; 927-1087
E-mail address: MIS_team_PHIVOLCS@yahoogroups.com

Station Location:

Latitude: (minus=S)
14.62
121.00

Method – Primary: Sends seismic phase picks by voice telephone or FAX direct to PTWC.Receives Tsumani bulletins by FAX and by FAX relay from PAGASA (RPMMYMYX).

Method – Alternate: If internal routing instructions are included, AUTODIN messages to the American Embassy in Manila can be forwarded to PHIVOLCS.
FAX: 011-632-927-1342 or 926-3225

Last Update: January 24, 2004 by Annie Encarnacion, PHIVOLCS Secretary

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Postal Address: **National Mapping & Resource Information Authority**
Commodore Rodolfo Agaton
NAMRIA
Director, Coast & Geodetic Survey Department
P.O. Box 1620
421 Barraca Street, San Nicolas
Manila, Republic of the Philippines

Telephone numbers:

24 Hr. Phone: 011 632 241-3494
1st alternate: 011 632 242-2955
2nd alternate: 011 632 247-1280

Station Location:

Latitude: (minus=S) 14.58
Longitude: (minus=W) 120.97

FAX: 011 632 242-2090
E-mail address: cgsd@namria.gov.ph

Method – Primary: Receives Tsunami Warning/Watch and Information messages by FAX from PAGASA. Tide data from Legaspi DCP is received at PTWC by the GTS with the product **header** SWPA42 RJTD.

Method – Alternate:

Last Update: January 24, 2004 by Annie Encarnacion, PHIVOLCS Secretary

Communications Plan for the TWS

COMMUNICATIONS METHODS – PHILIPPINES, REPUBLIC OF THE

Postal Address: **Manila Observatory (QCP)**

Manila Observatory (QCP)
Head, Seismology Division
Ateneo de Manila University
P.O. Box 1231
Quezon City, Republic of the Philippines

Telephone numbers:

24 Hr. Phone 011 632 426-5921 up to 23 Station Location:
~~1st alternate: 011 632 426 5939~~
~~2nd alternate: 011 632 426 59_9~~ ? Latitude: (minus=S)
14.64

Longitude: (minus=W)
121.08

FAX: 011 632 426-6141
E-mail address: manila@observatory.ph; su@observatory.ph

Method – Primary: Sends seismic phase picks to PTWC by FAX.

Method – Alternate:

Last Update: January 24, 2004 by Annie, PHIVOLCS Secretary

Postal Address: **Philippine Atmospheric Geophy. & Astronomical SVC**

Dr. Florentino O. Tesoro, Undersecretary of DOST and OIC-PAGASA

PAGASA, Science Garden Complex
Agham Road
Diliman, Quezon City, Republic of the Philippines

Telephone numbers:

24 Hr Phone:	011 632 927-1541	Station Location:
1st alternate:	011 632 926-4258	
2nd alternate:	011 632 927-1325	Latitude: (minus=S) 14.60
		Longitude: (minus=W)

121.00

FAX:	011 632 926-3167
E-mail address:	Not available

Method – Primary:	Receives Tsunami Warning/Watch and Information messages by AFTN as a member of the AFTN Collective address NFZZCAXX. Also receives the same messages by GTS with WMO product header WEPA 40 PHEB.
Method – Alternate:	
Last Update:	January 23, 2004 by Annie Encarnacion, PHIVOLCS Secretary