IOC/INF-1244
Honolulu, 1 May 2007
English only

INTERGOVERNMENTAL OCEANOGRAPHIC COMMISSION
(of UNESCO)

EXERCISE PACIFIC WAVE '06

SUMMARY REPORT

IOC/INF-1244
Honolulu, 1 May 2007
English only

ABSTRACT

The Intergovernmental Coordination Group for the Pacific Tsunami Warning and Mitigation System (ICG/PTWS) conducted its first end-to-end Pacific-wide tsunami exercise, entitled Exercise Pacific Wave (EPW) 2006, on 16-17 May 2006. Altogether, 44 countries participated, including 29 of the 30 ICG/PTWS Member States. Five countries also carried out public evacuations, thus exercising procedures down to the very "last mile." Opportunities for regional cross-learning and best-practice sharing were provided to enable several countries to participate as observers to the end-to-end communications exercise and community evacuation conducted in the Philippines.

Regional and national tsunami warning systems in the Pacific and globally must maintain a high level of readiness so as to be able to efficiently and effectively act to provide for the public's safety during fast-onset and rapidly-evolving natural disasters such as tsunamis. To maintain this high state of operational readiness, and especially for infrequent events such as tsunamis, tsunami warning centres and emergency agencies must regularly practice their response procedures to ensure that vital communication links work seamlessly, and that agencies and response personnel know the roles that they will need to play during an actual event.

The purpose of the Exercise was to evaluate the ability of Pacific countries to respond to an ocean-wide tsunami. The exercise provided an opportunity for Pacific countries to exercise their operational lines of communications, review their tsunami response procedures, and at the same time, promote emergency and tsunami preparedness. Each country participated in at least one of two tsunami scenarios initiated over the 16-17 May 2006 period. One scenario originated from the eastern Pacific off the central Chilean coast (16 May). A second scenario originated from the western Pacific, north of the Philippines (17 May).

The majority of responding countries and agencies that completed the evaluation forms for this Report expressed the positive view that EPW06 planning and conduct successfully met exercise objectives. It was recommended that ocean-wide exercises be conducted regularly, preferably annually and in real-time. National exercises that engage responsible stakeholders from the national to the local levels are encouraged in order to realize maximum preparedness and end-to-end tsunami warning. At the same time, awareness activities that build better public understanding of tsunamis and tsunami responses need to continue; these include the establishment of media as a valued partner for the broadcast of accurate information to the public.

***Note**: This report is published in electronic copy only and is available from the PTWS web site: http://ioc3.unesco.org/ptws/21/exercise_pacific_wave_06.htm*

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ANNEXES

1. Introduction

Exercise Pacific Wave '06 (EPW06) was proposed and agreed to at the Twentieth Session of the Intergovernmental Coordination Group for the Pacific Tsunami Warning and Mitigation System (ICG/PTWS, formerly ICG/ITSU) held in Chile in October 2005. Recommendation ITSU-XX.3 called for a Pacific-wide, end-to-end tsunami exercise that would simulate each country being put into a tsunami warning situation and require decision-making taken to the step just prior to public notification.

All countries of the Pacific were strongly encouraged to participate in the EPW06. Exercise Pacific Wave '06 is considered to be the inaugural drill of what will be a regular schedule of Pacific exercises in the future.

EPW06 was organized and coordinated by a Task Team chaired by Australia and comprised of the three warning centres providing international alerts and representatives from each quadrant of the Pacific. The Task Team was comprised of the Pacific Tsunami Warning Center (PTWC, international operational headquarters), West Coast/Alaska Tsunami Warning Center (WC/ATWC), Northwest Pacific Tsunami Advisory Center (NWPTAC), ITIC, Australia, Chile, France, Fiji, New Zealand, Nicaragua, Russian Federation, Samoa, and the USA. EPW06 Terms of Reference are provided in Annex I.

The Indian Ocean tsunami of December 2004 focused world attention to the very real threat posed by tsunamis to coastal communities. ICG/ITSU-XX noted that while localised Tsunami Exercises have been conducted, Pacific-wide exercise had never been held before. In discussion, the Group noted that the Exercise would provide an excellent opportunity for engage countries within the region to review their readiness. It was also noted that the holding of an exercise soon after the 2004 Indian Ocean tsunami could provide learning opportunities for the developing Indian Ocean Tsunami Warning and Mitigation System (IOTWS). In this regard, the UNDP Regional Programme, Bangkok, and the UNESCO IOC ITIC partnered to sponsor participants from several IOTWS countries to observe the exercise conducted in the Philippines.

Dr. Patricio Bernal, IOC Executive Secretary and UNESCO Assistant Director General, formally announced the planning of EPW06 through IOC Circular Letter No. 2186 dated 6 March 2006 (Annex II), and requested ICG/PTWS Member States to nominate national contacts for the Exercise.

A total of 44 countries participated in EPW06, which included 29 of 30 countries of the ICG/PTWS, and 15 non-PTWS nations (Belau, Brunei, Federated States of Micronesia, Kiribati, Marshall Islands, New Caledonia, Niue, Palau, Pitcairn, Solomon Islands, Taiwan, Tokelau, Tuvalu, Vanuatu, Wallis & Futuna). There were public evacuations conducted in five countries (France – French Polynesia, Malaysia, Philippines, Thailand, USA - American Samoa). The countries participating were:

- Australia
- Belau

- Brunei
- Canada
- Chile
- China (Hong Kong)
- Colombia
- Cook Islands
- Costa Rica
- Ecuador
- El Salvador
- Federated States of Micronesia
- Fiji
- France
- Guatemala
- Indonesia
- Japan
- Kiribati
- Malaysia
- Marshall Islands
- Mexico
- New Caledonia
- New Zealand
- Nicaragua
- Niue
- Palau
- Papua New Guinea
- Peru
- Philippines
- Pitcairn
- Republic of Korea
- Russian Federation
- Samoa
- Singapore
- Solomon Islands
- Taiwan
- Thailand
- Tokelau
- Tonga
- Tuvalu
- USA
- Vanuatu
- Vietnam
- Wallis & Futuna

A formal post-exercise evaluation using questionnaires developed by the Task Team was conducted to validate strengths and identify improvement opportunities for the participating organisations, and for the PTWS as a system. A Preliminary Report was written based on immediate responses and reported on to the XXXIXth Session of the IOC Executive Council in June 2006. Responses to the detailed questionnaires and surveys received afterward are compiled in this Summary Report for reporting to the XXIVth Session of the IOC General Assembly in June 2007.

2. Exercise Description

2.1 Core Exercise Objectives

The overall objectives of the EPW06 were to test, exercise, evaluate and review the operational lines of communication within the Pacific Tsunami Warning and Mitigation System's area of responsibility (AOR). The PTWS's AOR includes the Pacific Ocean, the southern ocean regions of the Pacific and all attached marginal seas, including the Philippine Sea, East China Sea, Yellow Sea, Sea of Okhotsk, Bering Sea, South China Sea, Java Sea, Arafura Sea, Sulawesi Sea, Mindanao Sea, Sulu Sea, Celebes Sea, Bismarck Sea, Solomon Sea, Coral Sea, and Tasman Sea.

Six Core Objectives were put in place in order to permit a detailed EPW06 evaluation of procedures, assessment of exercise success, and to receive input of

the interest and modalities for future exercises. The Core Objectives included to:

(1) Validate the Tsunami Warning Centres' dissemination process of issuing tsunami watch and warning bulletins to Pacific basin countries;

(2) Validate the process for countries to receive and confirm tsunami bulletins;

(3) Validate dissemination of warning messages to relevant agencies within a country, provinces and local jurisdictions;

(4) Validate the organisational decision making process about public warnings and evacuations;

(5) Identify the modes that would be employed to notify and instruct the public; and

(6) Assess the elapsed time until the public would be notified and instructed.

2.2 Exercise Description

The Exercise can be described as a functional style exercise that involves communication and decision-making at the government level. Within EPW06, individual countries could elect to extend the Exercise down to the level of actually warning the public.

The Exercise placed all Pacific countries into a Tsunami Warning situation that would require countries to practice their emergency response decision-making for the arrival of a destructive Pacific-wide tsunami upon their shores, and depending on the country, to take actions and test standard operating procedures to the step just prior to public notification. Two exercise scenario earthquake and tsunami events were developed to permit maximum engagement by all stakeholders (Annex III). One scenario originated from the eastern Pacific off the central Chilean coast (16 May). A second scenario originated from the western Pacific, north of the Philippines (17 May). An Exercise Manual (http://ioc3.unesco.org/ptws/21/exercise_pacific_wave_06.htm) was prepared containing background information, a description of the exercise arrangements, the post-exercise evaluation process and evaluation forms, and the actual messages to be issued by the three international warning centres. Custom Tsunami Tsunami Travel Time maps were prepared for the accelerated tsunami speeds (Annex III).

The exercise focused on two components of the warning system:

1. Evaluation and issuance of the warning message by tsunami warning centres, and
2. National and/or local response and warning dissemination mechanisms once a warning was received by emergency authorities.

During the first stage, the scenario of a destructive tsunami propagating across the Pacific was simulated through the issuance of communication messages by the Pacific Tsunami Warning Center and other international warning centres, including the sub-regional West Coast/Alaska Tsunami Warning Center and the Japan Meteorological Agency's Northwest Pacific Tsunami Advisory Center. Tsunami bulletins were transmitted from

the tsunami warning centres to 7x24 Tsunami Warning Focal Points and/or designated national emergency authorities responsible for tsunami emergency response. To avoid any possible misinterpretation, bulletins issued by the warning centres were in 'Dummy' exercise message format that instructed participants to refer to a specific scenario bulletin number in the exercise manual; in this manner, no actual message texts were issued. A compressed exercise time schedule using the two scenarios was executed in order to complete the drill in a timely manner during reasonable work hours across the 13 time zones of the Pacific and South China Sea.

In the second stage, national and local decision-making and notification down to the last stage before public notification was simulated. This stage was conducted the same day or within the following days and included notifications to the emergency management authorities of a single coastal community so as to sufficiently practice the end-to-end process. Countries were advised to take special care to ensure that the public was not inadvertently alarmed. UNESCO issued a Press Release announcing the EPW06 on 27 April 2006, and on 15 May 2006 (Annex IV). A sample Press Release template was provided to assist countries in preparing their countries for the Exercise (Annex IV).

The Exercise was coordinated from the Pacific Tsunami Warning Centre (PTWC) in Hawaii across 16 – 17 May 2006. Messages were sent by the PTWC, WC/ATWC, and NWPTAC. Messages were sent out via the normal operational mediums and countries were encouraged to make critical and timely decisions and disseminate information and warnings through their standardised channels to relevant jurisdictions, agencies and organisations.

During the exercise, the PTWC transmitted and conducted follow-up phone calls to ensure that PTWC messages were received by the Tsunami Warning Focal Points in countries. In total, PTWC operational warning contacts include more than 60 countries or island states, with some having more than one Tsunami Warning Focal Point for the receipt of official messages from the regional and sub-regional tsunami warning centres (TWCs). The PTWS Users Guide (formerly called its Communications Plan) describes the operational components, services, and products of the warning system, and includes 7x24 Tsunami Warning Focal Point information for every point of dissemination. The ITIC works with the PTWC and other sub-regional warning centres and national contacts to keep this Guide up-to-date.

As an added value learning component to encourage best practice sharing, the UNDP and UNESCO IOC partnered to enable representatives from Indonesia, Maldives, and Sri Lanka to observe the end-to-end communications exercise and community evacuation carried out in Albay province, Philippines. Observers learned about the national and community planning activities which went into preparing for the exercise, and on the day of EPW06, saw the testing of standard operating procedures for tsunami alert notification from the national to the local levels (e.g., from the Philippine Institute of Volcanology and Seismology (PHILVOLCS as TWFP) to the National Disaster Coordinating Council / Office of Civil Defence, to the Albay Provincial Disaster Coordinating Council, and finally concluding in the public response and evacuation action).

2.3 Post-Exercise Evaluation

The evaluation was conducted in two stages, first as a preliminary immediate assessment based on six questions, and second as a detailed assessment covering a broad range of issues. Countries were also asked if exercises are worthwhile and whether they should be conducted regularly.

The Preliminary Report (Annex V) providing a timely initial summary of the design and conduct of EPW was prepared under the coordination of Emergency Management Australia (EMA) immediately after the conclusion of EPW06 and available in June 2006. Questionnaire survey responses for this first report were received from 30 countries.

PTWS participants were then requested to submit responses to a detailed questionnaire survey focusing on the adequacy of plans, policies, procedures, assessment capabilities, communication, resources and inter-agency/inter-jurisdictional relationships to support effective tsunami warning and decision-making at all levels of government. The findings are presented in Annex VI based on responses from 17 countries. Member States requested that the Final Report be available for presentation to the IOC General Assembly in June 2007.

3. PRELIMINARY SURVEY FINDINGS

The six questions asked for the compilation of the Preliminary Report are as listed below;

Q1. Did you receive the relevant exercise bulletins?
Q2. Was the information clearly disseminated?
Q3. Did you find the exercise useful in confirming contact details and communication plans?
Q4. Did the bulletins provide sufficient realistic information for rapid decision-making?
Q5. Do you have any comments on the exercise?
Q6. What other initial points would you like to make?

The Preliminary Report is provided in Annex VI. The Report indicates that the Exercise confirmed the dissemination and receipt process of warning messages from the PTWC, WC/ATWC, and NWPTAC to the participating countries. Tsunami Warning Focal Points were confirmed as the 24-hour a day points of contact. Responses also identified the need to have sufficient staff on call to ensure bulletins can be actioned appropriately.

4. DETAILED QUESTIONNAIRE FINDINGS

A total of 17 countries representing over 20 agencies submitted detailed evaluation forms. Responses from the following countries and agencies are complied and discussed below.

- Australia (Bureau of Meteorology)
- Australia (Emergency Management Australia)
- Australia (Tasmanian State Emergency Service)
- Canada (British Columbia Provincial Emergency Program)
- Chile (SHOA)
- China PRC (China National Marine Environmental Forecasting Centre)
- China (Hong Kong Observatory of Hong Kong)
- Colombia (OSSO – SNDAT)
- Fiji (Ministry of Lands and Mineral Resources)
- France (CEA/DASE/Laboratoire de Geophysique)
- Japan (Japan Meteorological Agency)
- New Zealand (Ministry of Civil Defence and Emergency Management)
- Nicaragua (INETER)
- Philippines (Institute of Volcanology and Seismology)
- Samoa (Ministry of Natural Resources, Environment & Meteorology – DMO and Meteorology Division, plus 11 other agencies based in Samoa)
- Singapore (Meteorological Services Division, National Environment Agency)
- Thailand (Thailand National Disaster Warning Centre)
- USA (Guam Weather Service Office)
- Vanuatu (Vanuatu Meteorological Services – Seismology)
- Vietnam (Institute of Oceanography – Vietnam)

A summary of the Detailed Questionnaire Findings is provided in Annex VI. The Summary Report was compiled by the IOC International Tsunami Information Centre based on results provided by the EMA.

4.1 **Overall assessment**

The majority of responding countries and agencies that completed the evaluation forms expressed the positive view that Exercise Pacific Wave ‘06 planning and conduct successfully met the exercise objectives.

Core Objective Review: Outcomes arising from the evaluation about the effectiveness of the six core objectives for Exercise Pacific Wave 2006 were:

- That tsunami information dissemination was timely and methods used were effective - the majority of participating countries and agencies expressed that this objective was successfully met.
- Although response was limited, it appears that Objective 2 was met. Tsunami warning bulletins usually arrived by fax, email, or GTS. Confirmations were

usually made immediately or within ten minutes using the same communication systems.

- Most of the lead agencies were successful in disseminating the tsunami warnings in-country to their emergency services agencies, national government agencies and local, provincial and regional government agencies. A wide variety of communication methods were used including fax, telephone, email, SMS, dedicated landlines, satellite links, and radio communications. There was a positive response by participating countries and agencies stating that the communication methods used and the timeliness of information issued was sufficient to support national information requirements.
- The majority of evaluations for Objective 4 were positive stating that this objective was met (particularly in regards to the proven ability to assemble country management groups in a timely manner). The only comment made was that further attention is required when considering the quality of in-country information feedback and confirmation from response agencies and local level governments.
- The majority of responding countries and agencies stated that they intend to use public radio broadcasts, TV announcements, SMS cell phone systems, and a national website during a real tsunami event. In most of the participating countries, these media infrastructures already exist.
- The average elapsed time achieved from time of receipt of warning to activating the public notification systems was 56 minutes.

4.2 Communication Findings

With respect to the dissemination of messages, the following outcomes were compiled:

- Leading up to and during EPW06, the PTWC was able to confirm and update their 7x24 Tsunami Warning Focal Points for all Pacific countries except Wallis-Futuna, Tuvalu, Marshall Islands and North Korea.
- Many countries discovered they do not actually monitor communications channels (AFTN, EMWIN, GTS) which they thought they had monitored.
- E-mail is preferred the communication method everywhere, especially in less-developed countries (e.g., Kiribati, Pitcairn).
- HF digital e-mail via USAID's RANET Project was often the only reliable communication method. PTWC's FAX service (MCI), introduced substantial delays (up to 15 min).

4.3 Recommendations

Based on the information arising from Exercise Pacific Wave 06, the following recommendations are made to assist in the decision-making and the planning of future exercises or drills:

- It is suggested the Exercise Pacific Wave (EPW) be conducted regularly once per year to assist with a country's vigilance and operational preparedness testing in the event of a tsunami. It was expressed that tsunami warning exercises

conducted annually would assist countries and agencies by encouraging planning, facilitating operational testing and increasing preparedness for tsunamigenic events. Countries should consider to develop and conduct regular national tsunami exercises prior to a EPW for maximum benefit;

- To increase the realism of the exercise, it is suggested that Exercise Pacific Wave be conducted in real time instead of at an accelerated, compressed time schedule. This will enable realism, a proper review of the time reliability of communications, and critical decision-making processes to unfold;
- Countries should regularly review and confirm their 7 x 24 Tsunami Warning Focal Point contact data. Consideration should be given to the development of a mechanism for the regular review and update of the TWFP register;
- Future Exercise Pacific Wave exercises should have the lead national agencies continue to engage and coordinate the flow, content, and understanding of tsunami warning information with other national agencies and/or stakeholders. They should also engage local, provincial, and regional agencies to ensure vigilance and regular preparedness testing. The advantage in this would be an improved quality flow of information from local, regional and provincial agencies to national lead agencies and subsequently support national level decision making;
- Future Exercise Pacific Wave exercises should focus also on developing methods and mechanisms for improving the timeliness of tsunami warnings to the general public;
- With respect to the message contents, it was recommended to consider the inclusion of additional information in Tsunami Warning Centre messages, such as a simple English word-picture of tsunami threatened areas;
- With respect to improving public information dissemination, it was recommended as high priority to increase networking and public awareness activities between agencies and the media.
- Future exercises should provide opportunities for regional cross-learning as exercise observers, or by conducting adjacent-country cooperative exercises so that countries may learn and benefit from each other's experiences.

5. SUMMARY

The 2004 Indonesia earthquake and Indian Ocean tsunami brought to the attention of the world the urgent need to be better prepared. Accordingly, the intent of the Pacific-wide exercise was to motivate countries to review and test their tsunami response procedures, and for the PTWS to evaluate its operations to identify areas where overall preparedness can be improved.

The level of participation in EPW06 was excellent. A total of 44 Pacific countries participated; 29 of the 30 ICG/PTWS Member States participated, and additionally, 15 non-PTWS nations. Additionally, five countries conducted end-to-end exercises, with alerts disseminated down to the "last mile" local level, and in which the public was asked to respond by evacuating.

To measure the success of Exercise Pacific Wave 2006, criteria were established and each participating country was requested to respond to detailed post-exercise evaluation questionnaires. Preliminary Report questionnaires were received from 30 countries shortly after the conclusion of the exercise and this provided extremely useful information for quickly assessing the design and conduct of Exercise Pacific Wave 06. However, only 18 countries completed the detailed evaluation forms and a number of these responses were incomplete. The questionnaire requested important information to assess each country's ability to receive and assess the tsunami warning message, and to prepare and disseminate a public notification. The responses of both questionnaires were compiled and comprise the findings presented in this Summary Report.

The compilation of the responses showed that the EPW06 objectives were successfully met. The key outcomes include the following:

- The EPW06 core objectives were exercised, evaluated and reported upon, and enabling Pacific recommendations and lessons learned to be formulated.

- The intercommunication and dynamics between the various Tsunami Warning Centres, the national Tsunami Warning Focal Points, and the information dissemination points within countries and agencies were illustrated and understood, resulting in a learning process that is strengthening preparedness.

- Both tsunami warning centres and individual countries can improve their processes of how warnings are communicated for local and distant tsunamis in order to make them more effective.

- There is a need to establish of mechanisms that will ensure better planning and continuous review and improvement of tsunami response procedures at all levels (national, regional and local) within countries.

Future tsunami exercises should emphasize both the actual exercise activities (warning receipt, notification, and response) and the post-exercise evaluation components. Because exercises are testing the feasibility and applicability of established standard operating procedures, it is essential that post-exercise assessments be carried out to identify problems and where possible, to establish immediate corrective actions.

Inter- and Intra-regional best practice and knowledge sharing between countries is an important and beneficial way in which to develop practical capacity and increase information and understanding in tsunami warning and emergency in and between countries.

ANNEX I.

RECOMMENDATION ITSU-XX.3

PACIFIC-WIDE TSUNAMI EXERCISE

The International Coordination Group for the Tsunami Warning System in the Pacific,

Noting that the Indian Ocean tsunami of 26 December 2004 has brought to the attention of the world the urgent need to be more prepared for such events,

Understanding that simulating scenarios and learning lessons from such exercises is an effective way to improve preparedness,

Recognizing that the PTWS requires regular review and testing,

Recommends that an end-to-end tsunami exercise be carried out for the Pacific Ocean during the second week of May 2006, with a final report of results written before the next IOC Executive Council meeting in late June 2006.

Further recommends that a Task Team be formed to design and carry out the exercise and bearing in mind the following elements:

(i) Membership of the Task Team for organizing the exercise should include representatives from PTWC, WC/ATWC, NWPTAC, Australia, Chile, France, Fiji, New Zealand, Nicaragua, Russian Federation, Samoa and United States of America;

(ii) The exercise should simulate each country being put into a warning situation requiring decision-making and be taken to the step just prior to public-notification;

(iii) The exercise will take place in two stages:

- In the first stage, the scenario of a destructive tsunami crossing the Pacific will be simulated with notification by PTWC and other warning centres such as WC/ATWC and the NWPTAC to the designated contact points and national emergency authorities of the Member States responsible for tsunamis; this scenario may be compressed in time;
- In the second stage, it should be conducted the same day or sometime within the following days, decision-making and notification down to the last stage before public notification is simulated. In this stage, notification to the emergency management authorities of a single coastal community is sufficient for simulating the end-to-end process of the entire Member State;

(iv) Member States be strongly encouraged to participate;

(v) Due care be taken so as not to inadvertently alarm the public; a most conservative approach may be best, considering this will be the first such Pacific-wide exercise;

(vi) Member States should share information about past National or Sub-National tsunami exercises prior to this exercise;

(vii) Participating Member States be required to share information regarding the procedures applied and lessons learned during the exercise;

(viii) The details of the exercise, as well as its set of outcomes and performance measures be defined in advance, taking into consideration when possible, the results of the Member State assessments; outcomes and performance measures should be collected using a standard instrument and at a minimum include:

a. How each Member State received the warning (e.g., GTS, fax, e-mail)?

b. Elapsed time between when the bulletin is issued and when it is received and recognized;

- What assessment tools are applied for decision-making about evacuations?
- How the public would be notified and instructed?
- Elapsed time until the public would be notified and instructed;
- Summary of each Member State's National Emergency Plan for tsunamis, including any chapters on exercises;
- Feedback from stakeholders regarding their performance and the performance of the information providers;
- Media response;

(ix) ITSU National Contacts will be responsible for collecting results of their Member State and providing them to the Task Team by 1 June 2006;

(x) A formal letter announcing the exercise and providing its details should be composed by the Task Team and sent by the IOC as soon as possible to the highest possible contact within the emergency management structure of each Member State to help facilitate its participation.

The exercise should not be considered as a one-time event but as the first exercise in a pattern of recurring exercises;

Requests that resources be made available from the IOC and Member States to facilitate organizational and follow-up meetings, and a contractor to help facilitate the debriefing process and quickly assemble the report.

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Financial implications: US$ 5,000 in 2006

ANNEX II

INTERGOVERNMENTAL OCEANOGRAPHIC COMMISSION
COMMISSION OCÉANOGRAPHIQUE INTERGOUVERNEMENTALE
COMISIÓN OCEANOGRÁFICA INTERGUBERNAMENTAL
МЕЖПРАВИТЕЛЬСТВЕННАЯ ОКЕАНОГРАФИЧЕСКАЯ КОМИССИЯ
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E-mail: p.bernal@unesco.org

IOC Circular Letter N°. 2186 6 March 2006
(English only)

To : National Contacts PTWS;
Chairman, Vice-Chairman ICG/PTWS;

cc : Chairman, Vice-Chairmen IOC;
Chairman, Vice-Chairman IOC Regional Committee (WESTPAC, IOCARIBE);
IOC Member States (Action Addresses) of the ICG/PTWS
Permanent Delegations/Observer Missions to UNESCO of IOC PTWS Member States;
Directors of UNESCO and IOC Regional Officers in the Pacific, Indian Ocean, Caribbean, and Mediterranean areas;

Subject: **ICG/PTWS Pacific-wide Tsunami Exercise "Exercise Pacific Wave 06"**

Dear Sir/Madam,

At the XXth Session of the Intergovernmental Coordination Group for the Pacific Tsunami Warning and Mitigation System (ICG-PTWS, formerly ICG-ITSU) held in Vina del Mar, Chile, October 2005, Member States noted that a Pacific Ocean-Wide Tsunami exercise has never taken place, and agreed that an exercise of the Pacific Tsunami Warning and Mitigation System (PTWS) should be conducted in 2006. This letter seeks to advise you of the planned exercise.

The 26 December 2004 Indonesia Earthquake and Indian Ocean tsunami dramatically reinforced the need for an effective tsunami warning system. Indeed, activity is currently underway across the Indian Ocean to implement an Indian Ocean Tsunami Warning and Mitigation System (IOTWS). Already, opportunities for coordination between the developing IOTWS and the existing PTWS are

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being identified. As is being done for the IOTWS, there is a need to identify the current level of capability of the PTWS, and, more importantly, identify gaps to improve that capability. An Ocean-wide tsunami exercise is an effective tool in achieving this end. Moreover, the exercise will also commemorate the May 1960 Chilean Tsunami that crossed and impacted countries throughout the Pacific Basin.

The name of the exercise will be "Exercise Pacific Wave 06." The exercise will take place from 16-17 May 2006. The exercise will simulate Pacific countries being placed into a Tsunami Warning situation, and require Member State decision-making, and steps taken to just prior to public notification. These steps may be played during the exercise dates or the following days. The exercise scenario will use two originating earthquake source regions in the eastern and western Pacific Rim. A Tsunami Warning Cancellation will be issued as the wave nears the central Pacific. At least three Tsunami Warning Centres will issue exercise bulletins in a compressed time schedule, including the U.S. Pacific and West Coast/Alaska Tsunami Warning Centers, and the Japan Meteorological Agency Northwest Pacific Tsunami Advisory Center.

A sessional Task Team of the ICG-ITSU-XX has developed the guiding principles for the planning and conduct of Exercise Pacific Wave 06, and is continuing as an intercessional Task Team to oversee the conduct of the exercise. These are listed in Attachment 1 for your information. The key point to take from these principles is that the exercise is not required to be conducted through to community level. Rather, the aim is to exercise the operational lines of communication within the PTWS without disrupting or alarming individual citizens. Member countries will, however, be encouraged to exercise, evaluate and report back on communication and decision making within a warning situation down to the level just prior to public notification.

Despite this, you will note that there remains an option to exercise further levels of communication, such as public broadcasts and sirens, and provide relevant feedback during exercise evaluation. This activity will be regarded as optional. Each country will decide and design its own national exercise that commences after receiving the first message from the warning centers. Examples of sample operational tsunami response plans are placed in Attachment 2

Planning of the exercise will require significant work across many areas. Accordingly, in addition to the guiding principles at Attachment 1, a list of the ICG Task Team members is at Attachment 3. You will note that some of these members have been allocated specific responsibilities for developing certain parts of the exercise.

In order to ensure the commitment of participating countries is fully coordinated, we seek your nomination of National Contact for the Exercise Pacific Wave 06 with whom we will communicate to about *planning* for the conduct of the exercise. The designated National Contact will be expected to confirm the accuracy of existing tsunami warning arrangements within your country, including the identification of operational points of contact for the receipt and dissemination of tsunami warnings downstream from the national tsunami operational centre. The designated National Contact will also be responsible for coordinating input to the exercise evaluation instrument, which will be circulated post-exercise. **I would be grateful if you could provide the details of your nominated representative by 15 March 2006 to the ICG/PTWS Secretariat through email, facsimile, or post at the address below.** You are also encouraged to further disseminate copies of this letter to appropriate organizations and authorities within your country.

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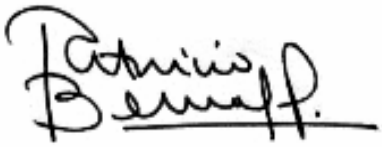
- 3 -

A copy of this letter will be provided to Southwest Pacific Island Countries through Australian diplomatic channels, as well as to SOPAC.

The 26 December 2004 Indian Ocean tsunami has put the whole tsunami warning community into a pro-active, action oriented mode that has stimulated this very important and time-critical work. We trust that you and your country Authorities will support this initiative, and we look forward to hearing from you further on this matter.

Yours sincerely,



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Attachments: 1. Recommendation ITSU-XX.3, Pacific-wide Tsunami Exercise
2. Tsunami Emergency Response, SHOA, Chile Tsunami Emergency Response, French Polynesia, France
Tsunami Emergency Response, Hawaii, USA
3. Exercise Pacific Wave 06 Task Team

cc: Dr Laura Kong, Director, ITIC, ICG/PTWS Secretariat
Mr Koichi Nagasaka, Director-General, JMA
Dr Charles McCreery, Director, PTWC

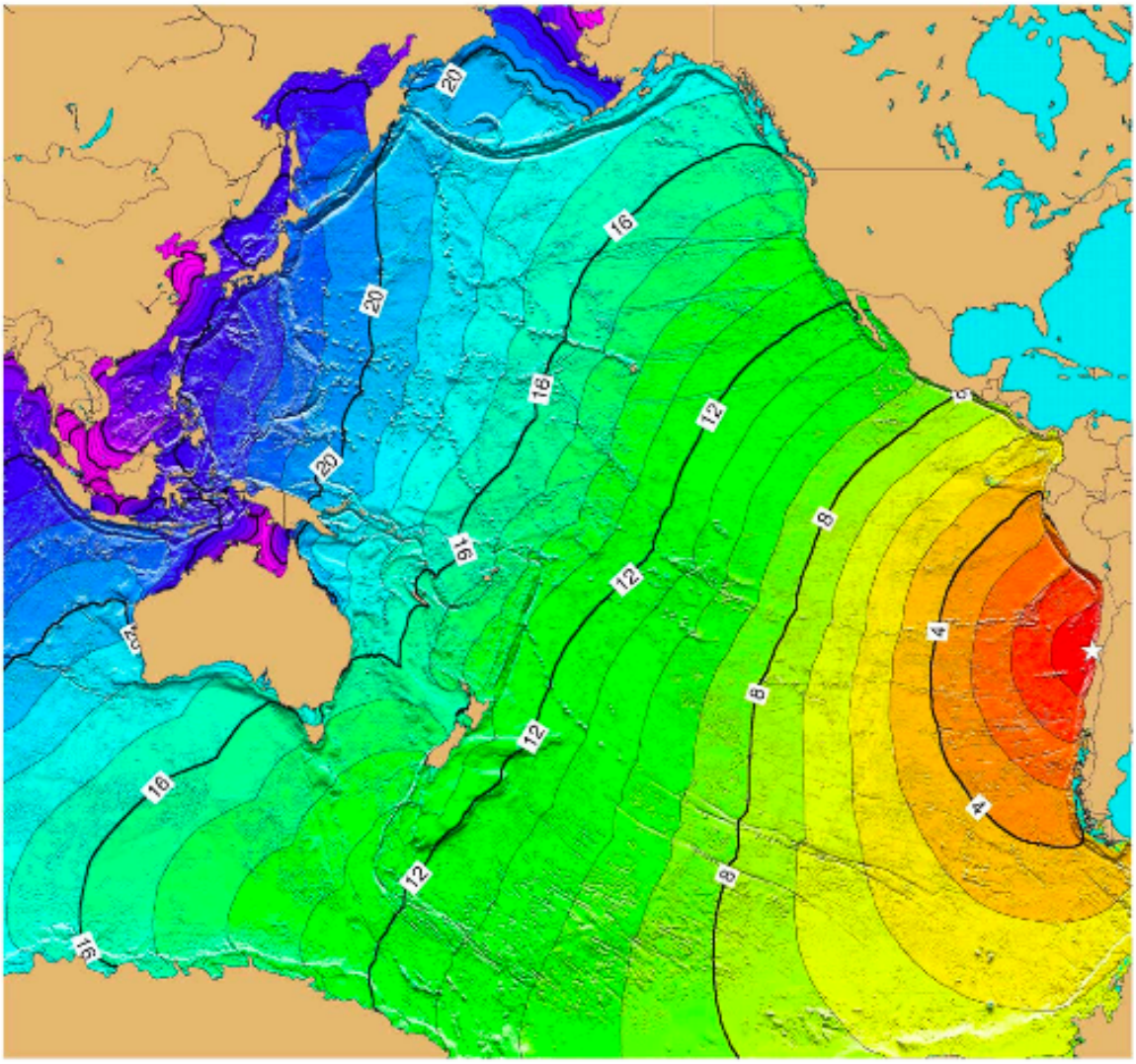
ANNEX III.

EXERCISE PACIFIC WAVE 06 SCENARIOS

Exercise Pacific Wave 06, Scenario 1

The first tsunami will be generated by a magnitude 9.2 earthquake off the coast of central Chile at 30ºS, 72ºW that occurs on May 16, 2006 at 1900 UTC. Suggested participants for this event simulation are: Chile, Peru, Ecuador, Colombia, Panama, Costa Rica, Nicaragua, El Salvador, Guatemala, Mexico, Honduras, Pitcairn, French Polynesia, Cook Islands, Kiribati, Niue, Tonga, American Samoa, New Zealand, Samoa, U.S.A., Canada, Wallis and Futuna, Tokelau, Fiji, Australia, Tuvalu, Vanuatu, New Caledonia, and the Marshall Islands. Bulletins will be issued for approximately 6 hours (24 hours of compressed exercise time) until the tsunami is simulated to have crossed the entire Pacific.

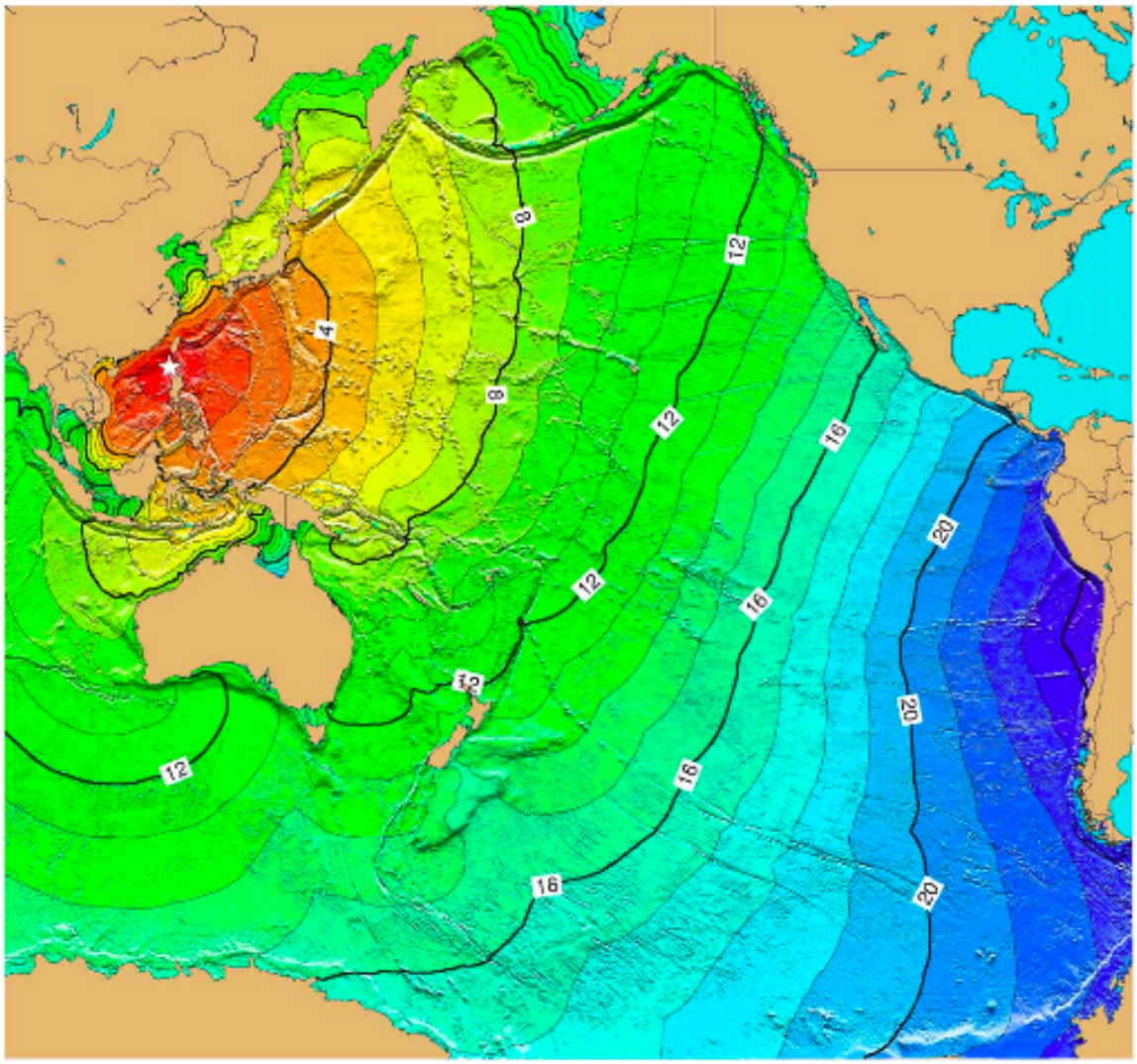
This plot shows Actual Tsunami Travel Time. For the purposes of the Exercise, time will be compressed 4 times so that, for the example below, the 4-hour actual time contour corresponds to 1 hr in Exercise time. Similarly, 8,12,16, and 20 hrs actual time correspond to 2, 3, 4, and 5 hrs in Exercise time



Exercise Pacific Wave 06, Scenario 2

The second tsunami will be generated by a magnitude 8.8 earthquake north of the Philippines at 20°N, 120°E on May 17, 2006 at 0200UTC. The tsunami will affect both the western Pacific and South China Sea. Suggested participants for this event simulation are: Philippines, Indonesia, Brunei, Vietnam, Cambodia, Thailand, Malaysia, Singapore, Belau, Yap, Taiwan, Korea, Japan, Guam, Northern Marianas, Papua New Guinea, Chuuk, Pohnpei, Marshall Islands, Kosrae, Solomon Islands, Russia, Nauru, China, and Majuro. This part of the exercise will last for approximately 2 hours (8 hours of compressed exercise time) until the tsunami is simulated to have crossed into the central Pacific and across most of the South China Sea and is observed to no longer pose a threat.

This plot shows Actual Tsunami Travel Time. For the purposes of the Exercise, time will be compressed 4 times so that, for the example below, the 4-hour actual time contour corresponds to 1 hr in Exercise time. Similarly, 8,12,16, and 20 hrs actual time correspond to 2, 3, 4, and 5 hrs in Exercise time



ANNEX IV.

MEDIA PRESS RELEASES

UNESCO Media Advisory Releases on 27 April and 15 May 2006
Sample Press Release

Pacific tsunami warning system put to the test

Source: UNESCOPRESS Media Advisory No.2006-25
Editorial Contact: Sue Williams, Press Relations Section, tel. +33 (0)1 45 68 17 06 - s.williams@unesco.org

27-04-2006 10:30 am The first-ever region-wide test of the Pacific Tsunami Warning System will be carried out over 16 and 17 May. Sponsored by UNESCO's Intergovernmental Oceanographic Commission (IOC) which established the system over 40 years ago, the exercise aims to increase preparedness, evaluate response capabilities in each country and improve coordination throughout the region. The simulation will be carried out in two stages, beginning with a mock tsunami warning bulletin from the Pacific Tsunami Warning Centre in Hawaii on May 16. The bulletin will be transmitted to designated contact points and national emergency authorities responsible for tsunami response in each country. It will clearly indicate that it is a test as opposed to an actual warning.

In the second stage, which should be conducted on the same day or the following day, government officials will disseminate the message within the country to local emergency management and response authorities, simulating what would happen in a real situation. Notifying authorities of at least one single coastal community is set as a sufficient measure for testing the end-to-end process of the entire country for the purposes of this first exercise.

"To be effective, warning systems must maintain a high level of readiness," said UNESCO/IOC Executive Secretary Patricio Bernal. "This means emergency agencies should regularly practice their response procedures to ensure that vital communications links work seamlessly and that agencies and response personnel know the roles that they will need to play during an actual event.

UNESCO Director-General Koïchiro Matsuura has urged all countries in the region to take part in the exercise, known as Exercise Pacific Wave '06.

"We should not lose sight of the fact that more tsunamis occur in the Pacific than in any other ocean. It is therefore imperative that all nations in this region participate," Mr Matsuura said. "UNESCO is committed to helping countries to improve their warning capability. We are confident the results of this exercise will not only help to protect the public from future tsunamis, but will also serve as a testing model for other areas that could be impacted by these destructive waves.

There are 28 member countries in the UNESCO/IOC International Coordinating Group of the Pacific Tsunami Warning and Mitigation System. Exercise Pacific Wave '06 is the first drill in a series of regular exercises. A task team chaired by Australia and including representatives from the Pacific Tsunami Warning Centre, West Coast/Alaska Tsunami Warning Centre,

Northwest Pacific Tsunami Advisory Centre, International Tsunami Information Centre, Australia, Chile, France, Fiji, New Zealand, Nicaragua, Russian Federation, Samoa and the USA, is coordinating the May 2006 exercise.

Media Advisory No.2006-28

Exercise Pacific Wave 06 seeks to consolidate tsunami warning system

Paris, 15 May – The first-ever region-wide drill for the Pacific Tsunami Warning and Mitigation System will be carried out over the next two days, 16 and 17 May. Sponsored by UNESCO's Intergovernmental Oceanographic Commission (IOC), the exercise, known as Pacific Wave 06, has taken on even greater importance following the major earthquake in the region earlier this month that highlighted the strengths and identified several weaknesses in the system.

"The earthquake on 4 May showed that we have greatly improved our capacity to get the initial information out quickly," said Patricio Bernal, Executive Secretary of the UNESCO-Intergovernmental Oceanographic Commission (IOC). "Information Bulletin 001 for this event was issued just 15 minutes after the earthquake. A few years ago this would have taken almost an hour.

"Likewise," he continued, "when data showed that the magnitude of the earthquake was not as high as first estimates indicated and as sea-level stations confirmed that it had not produced a destructive tsunami, the System was able to cancel the warning much faster, thus avoiding much wider warning and possibly unnecessary evacuations. This rapidity is due largely to the real time availability of seismic and sea-level data from stations in the Pacific Tsunami Warning and Mitigation System's Member States.

"However, the event also highlighted the need to improve the Information Bulletins. These internal bulletins are now available to people outside the System, and must be able to be understood by all – whether scientist, journalist or layperson. There is also clearly a need for better public education on the way the system works, how it operates. On 4 May, there was no official warning issued by any national authority, the only ones mandated to do so. The Pacific Wave 06 exercise, which will be the first of its kind, is a very important part of this awareness raising."

The simulation will be carried out in two stages, beginning with a mock tsunami warning bulletin from the Pacific Tsunami Warning Centre in Hawaii on 16 May (17 May in the South-West Pacific). The bulletin will be transmitted to designated contact points and national emergency authorities responsible for tsunami response in each country. It will clearly indicate that it is a test as opposed to an actual warning.

In the second stage, which should be conducted on the same day or even extended to the following day, government officials will disseminate the message within the

…/

UNESCOPRESS No.2006-28/2

country to local emergency management and response authorities, simulating the chain of events that would happen in a real situation. Notifying and coordinating actions with authorities of at least one single coastal community is set as a sufficient measure for testing the end-to-end process of the entire country for the purposes of this first exercise. Although communication drills are frequent in the System, this is the first time that the drill will extend to the "last mile", checking on the capability of national authorities to reach the people at risk.

"We should not lose sight of the fact that more tsunamis occur in the Pacific than in any other ocean. The recent earthquake in the region also served as a reminder of the vulnerability of small island states when natural disasters strike. It is therefore imperative that all nations in this region participate," said UNESCO Director-General Koïchiro Matsuura. "UNESCO is committed to helping countries to improve their warning capability. We are confident the results of this exercise will not only help to protect the public from future tsunamis, but will also serve as a testing model for other areas that could be impacted by these destructive waves.

There are 28 member countries in the UNESCO/IOC International Coordinating Group of the Pacific Tsunami Warning and Mitigation System (ICG/PTWS). Its secretariat is provided by the UNESCO-IOC International Tsunami Information Centre (ITIC), which also serves as the information and capacity building resource for the IOC's tsunami programme. A task team chaired by Australia and including representatives from the Pacific Tsunami Warning Centre, West Coast/Alaska Tsunami Warning Centre, Northwest Pacific Tsunami Advisory Centre, International Tsunami Information Centre, Australia, Chile, France, Fiji, New Zealand, Nicaragua, Russian Federation, Samoa and the USA, is coordinating the May 2006 exercise.

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More information from: http://ioc3.unesco.org/ptws, http://ioc3.unesco.org/itic/, http://www.tsunamiwave.info

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SAMPLE PRESS RELEASE

TEMPLATE FOR NEWS RELEASE

USE AGENCY MASTHEAD

Contact: (insert name)
(insert phone number and email address)

FOR IMMEDIATE RELEASE
(insert date)

FIRST EVER PACIFIC OCEAN TSUNAMI DRILL SET FOR MAY

(insert country name) will join over (insert number) other countries around the Pacific Rim as a participant in a mock tsunami scenario during 16 – 17 May 2006. The purpose of this unprecedented Pacific-wide exercise is to increase preparedness, evaluate response capabilities in each country and improve coordination throughout the region.

"The 2004 Indian Ocean tsunami brought to the attention of the world the urgent need to be more prepared for such events," said (insert name of appropriate official). "This important exercise will test the current procedures of the Pacific Tsunami Warning System and help identify operational strengths and weaknesses in each country."

The exercise will simulate Pacific countries being put into a Tsunami Warning situation requiring government decision-making. The role-playing will be taken to the step just prior to public notification. The exercise will occur in two stages.

In the first stage, a destructive tsunami crossing the Pacific will be simulated by notification from the U.S. Pacific Tsunami Warning Centre (PTWC) and other warning centres such as the U.S. West Coast and Alaska Tsunami Warning Centre (WC/ATWC) and the Japan Meteorological Agency/Northwest Pacific Tsunami Advisory Centre (NWPTAC). Tsunami bulletins will be transmitted from the tsunami warning centres to designated contact points and national emergency authorities in each country that are responsible for tsunami response. The scenario may be expedited in a compressed time schedule.

In the second stage, which should be conducted the same day or within the following day, government officials will simulate procedures down to the last step before public notification. Notifying emergency management and response authorities of a single coastal community is set as a sufficient measure for testing the end-to-end process of the entire country for purposes of this first Pacific exercise. Due care will be taken to ensure the public is not inadvertently alarmed.

Insert paragraph tailored for specific country. Could identify participating agencies and specific plans. Could describe current early warning program, past evacuation drills (if any), ongoing mitigation and public education programs, etc. Could describe tsunami threat, history of tsunami hazards, if any.

If there is excessive real world seismic activity on 16 – 17 May, the drill will be cancelled.

Following the exercise, a review and evaluation will be conducted by all participants. "We see this as the first of recurring exercises in the future," said (insert name of appropriate official). "Our goal is to provide early warning of tsunamis, educate communities at risk about safety preparedness, and improve our overall coordination. We will evaluate what works, make necessary changes, and continue to practice until we get it right."

The exercise is sponsored by UNESCO's Intergovernmental Oceanographic Commission through its Intergovernmental Coordination Group of the Pacific Tsunami Warning and Mitigation System (ICG/PTWS), which is comprised of 28 Member States/Countries.

###

On the Web:
Media Resources: insert new ITIC media page
Pacific Tsunami Warning and Mitigation System: http://www.tsunamiwave.info/
Pacific Tsunami Warning Centre: http://www.prh.noaa.gov/ptwc/
Insert country URLs

ANNEX V.

POST-EXERCISE EVALUATION OF EXERCISE PACIFIC WAVE 06: PRELIMINARY SURVEY FINDINGS
13 June 2006

A Preliminary Report coordinated by EMA immediately after Exercise Pacific Wave 2006 was based on the answers of participating countries and agencies to six initial questions. The six questions are as listed below;

Q1. Did you receive the relevant exercise bulletins?
Q2. Was the information clearly disseminated?
Q3. Did you find the exercise useful in confirming contact deals and communication plans?
Q4. Did the bulletins provide sufficient realistic information for rapid decision-making?
Q5. Do you have any comments on the exercise?
Q6. What other initial points would you like to make?

The preliminary report provided an interim summary on the design and conduct of Exercise Pacific Wave 2006. The responses for this first report were received from the following thirty (30) countries;

- **Australia**
- **Canada**
- **Chile**
- **China (Hong Kong)**
- **Colombia**
- **Coast Rica**
- **El Salvador**
- **Ecuador**
- **Fiji**
- **France**
- **Guatemala**
- **Japan**
- **Federated States of Micronesia**
- **New Zealand**
- **Nicaragua**
- **Malaysia**
- **Papua New Guinea**
- **Peru**
- **Philippines**
- **Republic of Palau**
- **Republic of Korea**
- **Russian Federation**
- **Samoa**
- **Singapore**
- **Solomon Islands**
- **Thailand**
- **Tonga**
- **USA**
- **Vanuatu**
- **Vietnam**

Question 1 Summary: Did you receive the relevant exercise bulletins?

Responses to this question indicated that most participating countries received the exercise bulletins. Some of the comments highlighted the need to regularly confirm points of contact and details. One responder stated that there was some disparity between bulletin timings with some agencies running ahead of the PTWC and this has the potential to cause confusion. Another relevant suggestion was that a final bulletin could be sent to clearly state the end of the Exercise.

Question 2 Summary: Was the information clearly disseminated?

The responses emphasise the importance of delivering messages by a variety of means including email, fax and phone as in some areas a single mode cannot be relied on 100% of the time. Some comments also highlighted the need to clarify internal communication channels within countries. Some participants noted that as it was an exercise they were able to refer to the manual, however concerns exist that in a real event countries will be totally reliant on information disseminated in bulletins. Some countries expressed a desire for the manual to be interpreted into other languages, however a greater lead-time may allow this to be completed within individual countries.

Question 3 Summary: Did you find the exercise useful in confirming contact details and communication plans?

Generally the responses indicated that the exercise was a useful tool to confirm and validate relevant contacts and communication arrangements. A number of responders stated that the Exercise identified the need to investigate a variety of modes of message delivery within countries. It also identified key players who needed to be contacted but were not on original contact lists. The Exercise also highlighted the time it takes to separately fax or phone individuals, and as such countries need sufficient staff on call to facilitate the dissemination of messages.

ICG/PTWS Secretariat (ITIC) Comment:
The PTWC, WC/ATWC and NWPTAC used this Exercise to confirm their Tsunami Warning Focal Point emergency contact information. Contact information from the Exercise, the ICG/PTWS-XXI National Reports, the 7x24 Tsunami Warning Focal Point forms submitted by countries, and other recent communications are being compiled to update the Users Guide for the Pacific Tsunami Warning and Mitigation System.

Question 4 Summary: Did the bulletins provide sufficient realistic information for rapid decision-making?

A number of responders stated the bulletins did not provide the detail that countries would require if they were to make critical decisions such as the need to evacuate areas of the population, however it was stated that most used the Exercise as a communications test and did not engage at the strategic decision-making level. It was suggested that the next Exercise be run in real time and provide more information on predicted wave heights. It was also suggested that bulletins could include more interpretive information on estimated wave heights at certain locations and that they be delivered using less technical and scientific terms i.e. a plain English version for non-scientists.

ICG/PTWS Secretariat (ITIC) Comment: Exercise participants should become familiar with the definitions of various tsunami bulletins (i.e. tsunami information; advisory; watch; warning bulletins). The different types of bulletins express degrees of earthquake and tsunami severity and threat, as well as wave arrival time estimations. It should be emphasised that Tsunami Warning Centres and tsunami bulletins do not order evacuations. According to the PTWS system, it is the responsibility of national and local authorities to interpret the threat evaluations issued by the TWCs for applicability to their country as a whole, or to specific localities along their coasts with potential for tsunami damage, and then, if necessary,

to issue public evacuation orders. Additionally, participants must be aware of the limitations of the TWC's capacity to detect earthquakes and tsunamis, and the possibility of "false warnings," or warnings being issued for non-destructive tsunamis.

PTWS Officers Comment:
Additionally, Exercise participants should be aware that currently TWC cannot predict tsunami wave heights for most events except for a few historical events that are well documented such as the 1960 Chile tsunami. To be able to provide accurate wave forecasts for the Pacific, all other sources must be studied, numerical modelling conducted and calibrated with actual tsunami data for all sources, operational wave forecasting software must be implemented in the warning centres, and inundation maps or estimates of run-up calculated. Any predictions of wave heights will need to also provide information of the accuracy of the estimates. Operational wave forecasting is being developed, but much work still needs to be done as techniques continue to be improved by researchers.

Question 5 Summary: Do you have any comments on the planning of the exercise?

Responders' commented that to plan an exercise of this size involving so many participating countries takes a significant amount of time and greater lead-time could also increase the amount of internal involvement within countries. This would allow a more comprehensive run through of the system from receipt of the bulletin, through the decision making process down to notifying agencies, warning the public and managing the evacuation. Exercising in real time was also expressed as preferred as it allows a more realistic response.

Question 6 Summary: What other initial points would you like to make?

Some very positive comments where received supporting the concept of running multi-national exercises on a regular basis. A number of participants used this as an opportunity to raise awareness of tsunami risk to a variety of agencies and organisations reinforcing the need to improve planning arrangements. Most participants noted that there were positive learnings from the exercise and it enabled them to identify areas requiring improvement. A number of participants stated that they look forward to future exercises allowing a full activation of their system.

Overall comment

Achievements and Learnings from the Exercise

The Exercise confirmed the dissemination and receipt process of warning messages from the PTWC, WC/ATWC, and NWPTAC to the involved countries and highlighted some opportunities for improvement.

Responses from participants confirmed that the exercise provided an excellent opportunity to clarify and confirm the 24-hour a day points of contact (7x24 Tsunami Warning Focal Points) for all involved countries. It also clarified the need to have sufficient staff on call in all countries to ensure bulletins can be actioned appropriately. Both the development and

conduct of the Exercise provided a valuable opportunity for countries, agencies and individuals to network and share information and initiatives. This dialog should be encouraged and fostered as a tsunami event has the potential to impact across a wide region and effective networks would greatly assist during a real event.

Future Exercises and Planning

Responses indicated that there is strong support for future exercises, but consideration should be given to increasing the lead-time and keeping countries updated on the development and aims and objectives of the exercise. Thought should also be given to value-adding to bulletins to assist countries to make informed decisions about actions and this should also be done in plain English avoiding the use of over technical jargon. Running an exercise in real time rather than compressed time would also assist in engaging the planning and decision-making process. It was suggested to consider conducting an Exercise on a yearly basis, and to alternate the location of the earthquake/tsunami from east to west to be able to have all areas to regularly experience a more real drill. Finally, it was suggested that it would be useful to enable some mechanism for media involvement since they are a key communicator for information.

Recommendations from this Report

A number of relevant suggestions were received from the feedback. Below is a consolidation of recommendations from the major themes:

- Future exercises be developed and conducted building on the achievements of Exercise Pacific Wave 2006. Development of these exercises will consider broadening the objectives to include allowing sufficient time for strategic and critical decision-making. Consideration should also be given to running the exercise in real time;

- Countries are encouraged to develop and conduct individual tsunami exercises to regularly exercise their national arrangements and these could be conducted prior to International exercises to maximize their benefit;

- Participants ensure that their points of contact are regularly reviewed and updates circulated. Consideration should be given to the development of a regularly updated contacts register;

- Consideration be given to the inclusion of additional information into the bulletins to provide a simple English word-picture of the threat faced by the tsunami; and

- Networking between the agencies and the media continue, to enhance the profile of the critical work being conducted.

Closing Comments

The Indian Ocean Tsunami of 24 December 2004 graphically demonstrated the potential threat faced by a tsunami. Exercise Pacific Wave 2006 provided the first opportunity for many participating countries to exercise their communication arrangements in such a regional activity. Many issues have been identified and some are being addressed. Hopefully we can seize the opportunity and continue to work together, network and share information to improve our capacity as a region to deal with tsunamis.

Compilation by:
Mark Sullivan (Australia), Task Team Chair
PTWS Officers (Rodrigo Núñez (Chair, Chile), Fred Stephenson (Vice-Chair, Canada), Francois Schindele (Past-Chair, France), Charles McCreery (PTWC), Laura Kong (ITIC Director), Emilio Lorca (ITIC Associate Director)
Brian Yanagi (ITIC)

ANNEX VI.

POST-EXERCISE EVALUATION OF EXERCISE PACIFIC WAVE 06: DETAILED QUESTIONNAIRE FINDINGS

The following information is taken and complied from the evaluation reports of participants who responded and considers the information against the objectives (including the six core objectives) put in place to measure the effectiveness of Exercise Pacific Wave 2006, using a four (4) point evaluation scale. This rating scale is outlined below;

RATING SCALE DEFINITION	
Rating	**Definition**
1	**Did not meet the objective**
2	**Met some of the objective**
3	**Met the objective**
4	**Exceeded the objective**

Assessment of Planning and Conduct

Participates made the following assessments about the overall planning and conduct of Exercise Pacific Wave 2006;

The exercise planning, conduct, format and style were satisfactory;

Score	**1**	**2**	**3**	**4**	**No response**	**Total**
	-	**4 responses**	**11 responses**	**-**	**3**	**18 Participants**

The majority of responding countries/agencies (ten out of sixteen) expressed a positive view that Exercise Pacific Wave 2006 planning and conduct successfully met this objective.

Three responders expressed a scale rating of 2, and felt this objective was only partly met. One of these responders (a Pacific Island country) did acknowledge that Exercise Pacific Wave 2006 was useful to help formalise points of contacts and planning, and to bring together key national decision makers. The warning from PWTC was also felt to be delivered in a timely manner through the GTS system. However, this responder felt that this objective was only partly met because public awareness and understanding of tsunamis, within their country, is poor and that technical capacity to issue tsunami warnings is limited. Nevertheless, this Pacific Island country was optimistic and felt that having regular annual tsunami warning exercises will help improve information flow and public understanding in their country.

The other two responders giving the lower score rating of 2 did so because they believed that running a tsunami warning exercises in compressed time is unrealistic for operational decision makers/making.

The ten responders who assessed Exercise Pacific Wave 2006 as meeting planning and conduct objectives did make some suggestions of how to help improve future tsunami warning exercises. These suggestions included:

(1) Exercise information should be delivered 3 or 4 months in advance and disseminated more widely so that as many relevant disaster management and response/mitigation organisations could be engaged for participation prior to the exercise.

(2) Based on historical data, the earthquake magnitude should be set at a realistic level to help avoid general public alarm, concern and confusion.

(3) That an exercise conducted in real time would help mitigate confusion of participating countries/agencies and would increase the authenticity of the exercise. The general comment was that compressed time resulted in loss of exercise reality and decision making.

Overview: The overall conclusion was that the majority of responding countries/agencies believed Exercise Pacific Wave 2006 planning and conduct met its objective here. However, many views were expressed that future tsunami exercises should be conducted in real time.

The preferred frequency for future conduct of Pacific-wide exercises was also asked of participants. The following outcomes emerged;

Pacific-wide exercise once per year	**9 responders**
Pacific-wide exercise once every two years	**3 responders**
Yearly exercises alternating between East and West Pacific	**2 responders**
Yearly exercises alternating between Indian and Pacific Ocean Warning and Mitigation Systems	**1 responder**
Yearly exercises of all warning and mitigation systems on a rotating basis (eg Pacific 2006, Caribbean 2007, Indian 2008, etc)	**1 responder**
No regular exercises	**-**
Other	**-**
Not stated	**2 responders**
Total	**18 participants**

Participants were also asked to indicate their preferences for compressed time versus real time. The following responses were collected;

Compressed time	**4 responses**
Real time	**12 responses**
Not stated	**2**
Total	**18 participants**

The tables above show that most participants (11 out of the 16 responding) expressed a preference for Exercise Pacific Wave to be conducted once every year, either for the entire Pacific, or alternating between the East and West Pacific. 15 pf 16 responders indicated that exercises should be done regularly, either annually or once every two years, while 1 responder suggested that once every three years may be sufficient. In explaining this preference, comments were made that although destructive

tsunamis do not occur regularly, the incidence of earthquakes in the Pacific region is high. Because of this factor responding countries/agencies felt that Exercise Pacific Wave should be conducted regularly.

The majority of responders (12 countries out of 16) also indicated they preferred real-time conduct of tsunami warning exercises, rather than compressed time as used for Exercise Pacific Wave 2006. As mentioned previously, real time allows emergency response procedures to be conducted within normal operating conditions. The reasoning for the minority preferring compressed time was because that this method allowed for effective outcomes with less workload effort.

Overview: The conclusions draw from this information was that most countries/agencies preferred to conduct a Pacific-wide exercise annually and preferring tsunami warning exercises run real as opposed to compressed time.

Objective 1: Validate the tsunami warning centres' dissemination process of issuing tsunami watch and warning bulletins to Pacific basin countries.

The participating countries and agencies provided the following assessment on a range of sub-objectives relating to Objective 1;

Validation of Tsunami Warning Centre's Dissemination Process;

Tsunami warning timeliness was the first category assessed, responses displayed in the table below;

.

Score	**1**	**2**	**3**	**4**	**No response**	**Total**
	-	**4 responses**	**11 responses**	**1 responses**	**2**	**18 Participants**

In respect to tsunami warning "timeliness", a majority of responders (twelve) felt that this sub-objective was met or exceeded. However, a fairly significant minority (four in thirteen responses) felt that tsunami warnings were not as timely as could be expected and rate this sub-objective as being only partly met. In relation to this, the following comments were made:

(1) That working in compressed time reduced the effectiveness of bulletins being received in a timely fashion.

(2) That information received via GTS was timely, but faxed information was too slow. On the other hand, while warnings delivered by telephone were timely it did not allow for vital detailed and specific information to be passed on.

(3) For some less developed countries, telecommunications systems suffered from delays (some up to 1-2 hours) for warnings delivered by email, fax, and telephone. It was noted by these countries that having a high priority emergency line would be useful in ensuring the timeliness of warning messages.

(4) For some countries, warnings emailed from the PTWC were significantly delayed (1-2 hours) and it was suggested that follow up telephone calls confirming that messages were received and understood would be useful. It was also suggested that faxes supporting information sent by email or delivered by phone would be a further advantage.

Participants were asked to rate the methods used of disseminating tsunami warning bulletins. As

indicated in the table below, the method(s) used by the Tsunami Warning Centre(s) to send bulletin to participating countries/agencies were deemed appropriate.

Score	1	2	3	4	No response	Total
	1 responses	1 responses	13 responses	-	3	18 Participants

These results show that the majority of responding countries/agencies expressed satisfaction in the methods used to send tsunami bulletins. The one response that suggested otherwise stated that they preferred the GTS method. This responder suggested that the GTS message could trigger an alarm on arrival which could be additionally backed up by fax, telephone, email.

The satisfied responders made comment that the PTWC method of using GTS, email and fax worked satisfactorily. However, less developed countries with weaker infrastructures expressed that they may have problems with reliance on technology networks.

Overview: The majority of responses asserted that the timeliness of tsunami warnings and the methods used to send tsunami bulletins during Exercise Pacific Wave 2006 met objectives. However, concerns were expressed about the quality of repair and maintenance of telecommunications networks, and the subsequent reliability of emergency messages to be sent and received.

Objective 2: Validate the process for countries to receive and confirm tsunami bulletins.

Participates made the following comments relating to the receipt and confirmation of tsunami warning bulletins during Exercise Pacific Wave 2006.

National focal point: Receipt of warning from Tsunami Warning Centres;

- Time of receipt (mm:ss) of warnings by our national focal point from;

PTWC: Country national focal points advised the following times of receipt of bulletin 1 from PTWC – Japan 02:06; Hong Kong SAR 02:06; China 02:15; Colombia 19:04; Nicaragua 19:47; Vanuatu 06:15; New Zealand 07:10; Vietnam 02:19; Singapore 10:06 (GTS), 10.35 (email); Samoa 06:43 (fax); Philippines 03:05; Chile 19:05; and Australia 19:06 (UTC).

Note: Three countries did not advise the timing of receipt of bulletin 1. Most of the participating countries did not advise of bulletins 2 to 12 receipt.

WC/ATWC: Country national focal points advised the following times of receipt of bulletin 1 from WC/ATWC – Singapore 10:32 (email).

Note: No other countries advised receipt of any WC/ATWC bulletin. Singapore did not advise receipt of any other WC/ATWC Bulletins.

NWPTAC: Country national focal points advised the following times of receipt of bulletin 1 from NWPTAC – Hong Kong SAR 02:04; China 02:11; Vietnam 09.08 (email), 10:48 (fax); Singapore 10:06 (fax), 10:08 (GTS).

Note: Nine countries did not advise timing of bulletin 1 receipt via NWPTAC. Vietnam advised receipt of additional bulletins up to 12 – 11:48 (fax), 12:14 (email).

Method of receipt by national focal point;

Fax – advised by 11 countries

Email – advised by 9 countries

SMS – advised by 1 country

GTS – advised by 7 countries

Telephone – advised by 1 country

The above information indicates that bulletin advice received from the PTWC were the most widely received, with fax, email or GTS methods being mostly used.

National Focal Point: Acknowledgement Confirmation of Warning;

Confirmation

(1) The national focus points confirmed timing of warning receipt back to Tsunami Warning Centre(s). The following times were advised;

a. Japan 02:06 (immediate confirmation)
b. Hong Kong SAR 02:11 (to PTWC) and 02:10 (to NWPTAC) which shows 5 minute confirmation delay to PTWC and 6 minute confirmation delay to NWPTAC
c. Colombia 19:04 (immediate confirmation)
d. Nicaragua 19:49 (2 minute confirmation delay to PTWC)
e. Vanuatu 06:18 (3 minute confirmation delay to PTWC)
f. New Zealand 07:11 (1 minute confirmation delay to PTWC)
g. Samoa 06:53 (10 minute confirmation delay to PTWC)
h. Philippines 03:12 (7 minute confirmation delay to PTWC)
i. Chile 19:13 (8 minute confirmation delay to PTWC)
j. Australia 19:07 (1 minute confirmation delay to PTWC)

Note: Six countries did not provide timings of their warning receipt.

(2) National focal points advised that the following methods were used to confirm receipt of warnings;

Fax – advised by 5 responders

Email – advised by 5 responders

SMS – advised by 2 responders

GTS – advised by responders

Telephone – advised by 2 responders

Overview: It is difficult to judge the success of Objective 2 for Exercise Pacific Wave 2006 because not all countries/agencies responded to this section of the evaluation questionnaire.

However, based on the limited responses received, it appears that the warning bulletins usually arrived by fax, email or GTS. Confirmations were generally made using the same systems, and usually occurred immediately or within 10 minutes of receipt.

Objective 3: Validate dissemination of the warning message to relevant agencies within a country, province and local jurisdiction.

Participants made the following assessments about the internal dissemination of the tsunami warning within their country.

National Focal Points: Dissemination of Warning within Country;

(1) The warning was disseminated to;

Emergency Services	**advised by 14 responders**
Other national government agencies	**advised by 12 responders**
Science agencies/universities for assessment	**advised by 3 responders**
Local government: provincial/regional level	**advised by 11 responders**
Local government: city/district level	**advised by 6 responders**

Note: Three countries/agencies did not supply answers

The above information suggests that most advice disseminated within countries were to;

- Emergency services agencies;
- Other national government agencies;
- Local, provincial and regional government agencies.

The timings and methods of delivering tsunami warnings within countries are noted below;

- Timing of in-country warning dissemination – Japan 02:06 (immediate); Hong Kong SAR 02:15 (9 minute delay); China 02:16 (1 minute delay); Nicaragua 19:49 (2 minute delay); Vanuatu 06:25 (10 minute delay); Philippines 03:12 (immediate); Chile 19:14 (1 minute delay); and Australia 19:08 (1 minute delay).

  Note: Eight responders either did not respond or gave real time dissemination times which were not comparable with the compressed time used during the exercise.

- Method(s) of delivery to local/provinces/regional government agencies were through the following methods;
  - dedicated landline – 1 response
  - satellite communication link – 2 responders
  - telephone – 6 responders
  - fax – 6 responders
  - radio – 2 responders
  - SMS – 2 responders
  - email – 4 responders

  Note: Six participants did not advise of method.

- Participants advised of the following number of failed deliveries (as shown by delivery systems);

- nil failures – 3 countries
- unknown – 1 country
- failure due to local electrical supply stoppage or restrictions – 1 country
- failure due to telecommunication system problem (including failures on encrypted fax systems) – 4 countries
- failure due to incorrect fax numbers – 2 countries

Note: Five participants did not advise of the failures.

- Participants advised of the following alternative delivery methods in the face of failed deliveries:
  - used alternative fax or telephone numbers – 3 countries
  - used email as alternative – 2 countries

Note: Ten participants did not advise answers.

This information indicates (despite most participants not providing a response) that once the tsunami warning was received by the country the national focal points distributed the warning to agencies within countries either immediately or within 10 minutes. The dissemination of in-country warnings were dispersed through a wide variety of methods including fax, telephone, email, and SMS – as well as dedicated landlines, satellite links, and radio communications. Although some in-country warnings failed it did not emerge as a significant issue because often alternative methods of disseminating warnings were available.

The confirmation of warning receipt within countries has been noted below;

- Method(s) of confirming receipt of messages by agencies/provinces/local jurisdictions;
  - fax – 6 responders
  - radio – 1 response
  - telephone – 3 responders
  - email – 2 responders
  - SMS – 1 response

  Note: Three participants did not provide this information.

- Process time of warning receipt confirmations was completed – participants advised the following times of in-country warnings received as follows; Hong Kong SAR 02:25 (received within 10 minutes of warning); China 02:20 (received within 4 minutes); Nicaragua 19:49 (immediate); Philippines 03:12 (immediate); Chile 19:16 (received within 2 minutes of warning); and Australia (immediate).

  Note: Ten participants did not answer or advise that specific details were/were not kept. One less developed country advised that internal communication systems were not well maintained due to difficulty to obtain funding, and this was a major reason for lack of confirmation.

The above information suggests that in-country warning methods are quite variable and not necessarily effective.

A range of sub-objectives for Objective 3 were also assessed. The following information emerged;

The information issued by national decision-makers and dissemination of warnings was timely;

Score	**1**	**2**	**3**	**4**	**No**	**Total**

					response	
	1 response	**-**	**12 responses**	**1 response**	**4**	**18 Participants**

Conclusions drawn from this information suggests that the majority of participants expressed that tsunami warning timeliness within countries met or exceeded expectations. The country giving a low rating advised that timeliness of information to local areas was affected by poor quality of telecommunications within their country.

The methods of communication from national decision-makers to dissemination points were sufficient to support local decision-making;

Score	**1**	**2**	**3**	**4**	**No response**	**Total**
	1 response	**-**	**14 responses**	**-**	**3**	**18 Participants**

The outcomes show that the majority of responding participants (fourteen) believed that the in-country warning received met the objective of supporting local decision makers. The country giving a low rating again advised that poor telecommunication systems within their country were to blame.

The method of communication between national decision-makers and dissemination points and individual response agencies and provinces/local jurisdictions was sufficient to support national information requirements;

Score	**1**	**2**	**3**	**4**	**No response**	**Total**
	2 responses	**1 response**	**12 responses**	**-**	**3**	**18 Participants**

Although a majority of participants (twelve) gave feedback that the methods of communication met objectives, comments were made that in less developed regions it is common to find poor telecommunication services to provincial and regional areas. There was also comment made that aid assistance strengthening communication infrastructure would be useful. In addition to this, some of the more developed countries suggested that increasing bandwidths of their own telecommunications network would be useful and was being considered.

Overview: Most of the participating countries/agencies sent warning messages from their national focal point to emergency agencies, other national government agencies and regional and provincial government agencies. Through these processes it was stated that the timeliness of warning messages to these stakeholders met the objectives in this part of the exercise. The methods used were also rated as successful in meeting local and national information requirements.

A wide range of methods (fax, email, telephone, and other telecommunication systems) were used within countries and largely worked, despite some difficulties with telecommunication systems in some developing countries.

Objective 4: Validate the organisational decision making process about public warnings and evacuations.

Objective 4 had a range of elements. On this objective the participating countries made the following assessments.

4 (a) Arrangements to assemble a management group relevant to decision-making on tsunami warnings and response were in place before the exercise;

Score	**1**	**2**	**3**	**4**	**No response**	**Total**
	2 response	**2 responses**	**13 responses**	**-**	**1**	**18 Participants**

The majority of participants (thirteen) rated the objective of arrangements to assemble their management group as being met. The countries rating this as not meeting this sub objective gave two reasons;

- Two countries (developed countries) advised that management processes for decision making are already planned and pre-determined and Exercise Pacific Wave 2006 did not assist in achieving this structure (Note: several of the countries rating Objective 4(a) as met, also made a similar comment that pre-determined management group assembly arrangements are already in place).
- Another country (developing country) advised that ad hoc systems are in place but capacity building exercise to strengthen policies and directives in assembling management would be helpful.

Note: It was also suggested that improvement of a multi-media warning messaging systems and fully established national crisis information systems for some countries was needed.

4(b) The management group relevant to decision-making on tsunami warning and response was assembled within minutes after receiving the first warning. Timely in this instance was to facilitate good decision-making;

Score	**1**	**2**	**3**	**4**	**No response**	**Total**
	2 response	**2 responses**	**10 responses**	**2 response**	**2**	**18 Participants**

Again, the majority of participants (twelve) also rated this element met or exceeded the ability to achieve management group assembly in a timely manner in order to achieve good decisionmaking. Several countries (particularly developed countries) advised that management group assembly procedures are already pre-determined and made it is possible to assemble the decision making management group within 5 minutes after the first warning. Again, one country (developing country) felt it was difficult to achieve timeliness due to poor telecommunications infrastructure in their country, and there were instances of internal confusion.

4 (c) The quality of the information issued by our national decision-making and dissemination point was sufficient to support local level decision-making;

Score	**1**	**2**	**3**	**4**	**No**	**Total**

					response	
	1 response	**2 responses**	**9 responses**	**1 response**	**5**	**18 Participants**

Most participants (ten) rated the quality of information issued nationally met the objective of supporting local level decision making. Some countries however, did not test this objective due to insufficient time for planning and requested a longer timeline for future exercise planning. Several countries also desired specific information which anticipated size of the tsunami wave and likely areas of impact and information on time intervals between waves.

4 (d) The quality of the information received back from response agencies and local level government were sufficient to support national level decision-making;

Score	**1**	**2**	**3**	**4**	**No response**	**Total**
	2 responses	**4 responses**	**8 responses**	**-**	**4**	**18 Participants**

With this sub-objective, many responding participants (six) felt that the quality of information feedback received from other national agencies and local government levels did not fully meet objectives. However, most of the participants also advised that such feedback was not actively sought nor encouraged during the exercise.

4 (e) Sufficient national information was available to support national level decision-making (PTWC, WC/ATWC, NWPTAC information, country-generated scientific assessments, national considerations etc);

Score	**1**	**2**	**3**	**4**	**No response**	**Total**
	-	**2 responses**	**10 responses**	**2 response**	**3**	**18 Participants**

From this information it can be seen that most responding participants (twelve) believed the objective was met in relation to sufficient national information being available.

4 (f) Sufficient local information was available to support assessment and decision-making (local hazard assessments, inundation areas identified, evacuation plans etc);

Score	**1**	**2**	**3**	**4**	**No response**	**Total**
	2 responses	**1 responses**	**5 responses**	**1 responses**	**9**	**18 Participants**

This question was not answered by most of the participants, but the responders that did comment expressed the view that the objective was met. Some responders did advise, however, that more risk modelling, inundation modelling, and bathymetric studies were needed in high risk areas. This was so that decision making could be more effective in creating community awareness and to design large scale evacuation plans and for allocation of post tsunami management resources.

4 (g) We were able to make decisions about appropriate warnings and response;

Score	1	2	3	4	No response	Total
	-	3 responses	13 responses	-	2	18 Participants

The majority of participants expressed the view that the objective was met in being able to make decisions about the appropriate warnings and response. Three countries, however, gave a lower rating because of poor telecommunication systems in their country or poor knowledge and confusion by some officials at local government level.

4 (h) Decision-making was based on pre-existing plans for an event of this nature;

Score	1	2	3	4	No response	Total
	1 response	2 responses	13 responses	-	2	18 Participants

Again, a majority of participants (thirteen) gave endorsement to the objective because decision making was based on pre-existing plans in a similar event. It was expressed that warning messages were disseminated in a timely manner to other agencies because of existing standard operating procedures. Again, the countries which gave lower ratings did so because of the difficulties caused by poor telecommunication systems within their country and/or because of poor knowledge and planning at local provincial levels.

4 (i) The exercise contributed to the improvement or the development of planning related to public warnings and other response activities required for an event of this nature;

Score	1	2	3	4	No response	Total
	1 response	1 response	12 responses	2 responses	2	18 Participants

The majority of participants (fourteen) supported that this sub objective met or exceeded expectations and that Exercise Pacific Wave 2006 contributed to the improvement and development of planning relating to public warnings and response activities. The one country giving a low rating on this issue did so because, although they thought Exercise Pacific Wave 2006 helped develop their emergency response systems, they required further assistance in building capacity in media communication, emergency agency system training and telecommunications.

Overview: The range of issues explored through this core objective identified that all of the sub objectives were believed to have been met except for the quality of feedback from local provincial agencies to the national lead agencies.

Objective 5: Identify the modes that would be employed to notify and instruct the public.

Participants made the following assessments regarding tsunami warning methods and the means of translating these messages to the public.

As part of decision-making processes during this exercise it has been determined that the following means of public notification and instruction will be used in a real event of this kind;

Method	Yes – Intend to Use	Arrangements Currently Exist
Public radio broadcasts	**14 countries**	**9 countries**
TV announcements/teletext	**12 countries**	**8 countries**
Public announcement systems	**5 countries**	**3 countries**
Cell broadcast	**4 countries**	**2 countries**
SMS (cell)	**10 countries**	**6 countries**
Public call centre	**5 countries**	**4 countries**
Website	**12 countries**	**9 countries**
Telephone	**9 countries**	**8 countries**
Sirens	**8 countries**	**5 countries**
Door to door announcements	**6 countries**	**4 countries**
Other - email	**2 country**	**2 country**
- Ranet (radio internet)	**1 country**	**1 country**
- VHF radio	**1 country**	**nil**
- UHF manned radio	**1 country**	**nil**
- Fax	**2 country**	**2 country**
- Helicopter sirens	**1 country**	**nil**
- Loudspeakers	**1 country**	**1 country**
- SEWS	**1 country**	**1 country**
- Bells and horns	**1 country**	**nil**
- Sirens (fixed or mobile)	**1 country**	**nil**

Comment about the table – does telephones includes fax messages?
Comment about the table – duplicate entries for "sirens".

Overview: It was felt by the majority that public radio broadcasts, TV announcements, SMS messages, and website information is intended to be use by most of the participating countries for future exercises and in real life events. Currently, many of these public communication warning arrangements exist in roughly half of the countries participating in the post exercise evaluation.

Objective 6: Assess the elapsed time until the public would be notified and instructed.

Participants made the following assessments about the timings of public warnings during Exercise Pacific Wave 2006;

Activity	Elapsed Time
Making a decision on public warning (From time of receipt of warning)	**Fourteen (14) countries advised elapsed times ranging from 4 minutes to 30 minutes, achieving 13 minutes elapsed time on average**
Formulation/compilation of public notification (From time of decision)	**Fourteen (14) countries advised elapsed times ranging from 2 minutes to 1 hour 13 minutes, achieving 19 minutes elapsed time on average**

Activation of public notification systems (From time of notification formulated)	**Fourteen (14) countries advised elapsed times ranging from 1 minute to 1 hour 13 minutes, achieving 24 minutes elapsed time on average**
Total Time	**Total average elapsed time achieved was 56 minutes**

Overview: The average elapsed time achieved from time of receipt of warning to activating the public notification systems was 56 minutes.

ANNEX VII.

REPORT PREPARATION

The Final Report was compiled by the International Tsunami Information Centre based on information and a summary draft provided by the EMA. through a contract with Market Attitude Research Services Pty Ltd (MARS) on analysis and reporting of evaluation questionnaires completed by countries participating in Exercise Pacific Wave 2006.

The Preliminary Report was compiled by Emergency Management Australia (EMA) with input from the PTWS Officers and ITIC.

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