



International Coordination Group for the Tsunami Warning System in the Pacific

Eighteenth Session
Cartagena, Colombia

8 – 11 October 2001

Intergovernmental Oceanographic Commission
Reports of Governing and Major Subsidiary Bodies

International Coordination Group for the Tsunami Warning System in the Pacific

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1. OPENING

- 1 The Eighteenth Session of the International Co-ordination Group for the Tsunami Warning System in the Pacific was held in Cartagena, Colombia from 8-11 October 2001 under the Chairmanship of Mr. F. Schindele (France). He opened the meeting at 9:30 on 8 October 2001.
- 2 Capt. O. Malaver Calderon, Chairman of the Local Organizing Committee and the Executive Secretary of the National Committee for Oceanography welcomed the participants in Cartagena and informed them of the attention and support given by the Colombian Government to marine research and monitoring. Colombia has a long coastline in the Pacific and Caribbean Sea, both of which are prone to tsunamis. The coastal area of the country is very densely populated. It was the reason why the Government of Colombia invited the ICG/ITSU to have its Eighteenth Session in Cartagena – the city with a long tradition in marine research and a beautiful historical place, which is in the list of the World Heritage Cultural Centres of UNESCO. Capt. Malaver Calderon wished the participants a successful Session and a pleasant stay in Cartagena.
- 3 In his welcome address, Mr. F. Schindele, Chairman of the ICG/ITSU, gave a short historical excursion on the IOC Tsunami Programme and focused on the Session's objectives. He emphasized that to mitigate the tsunami hazard, several activities should be implemented:
 - accurately assess the nature of the threat posed by the hazard;
 - implement an appropriate warning system;
 - develop awareness/education programmes to reduce the impact of tsunamis.
- 4 Mr. Schindele identified the objectives of the Session as to review the progress achieved, identify gaps in the programme elements development, and recommend ways for making the programme more effective and responsive to the community's needs. He called on the participants to actively take part in the discussions and share their knowledge and experience for the benefit of the programme.
- 5 Finally, Mr. Schindele acknowledged with thanks, the kind invitation of the Government of Colombia to have ITSU-XVIII in Cartagena and thanked Capt. Malaver Calderon and all the members of the Local Organizing Committee for the time and energy they dedicated to the success of the Session.
- 6 Dr. I. Oliounine, IOC Consultant, passed on to the participants the best wishes for a productive Session from the IOC Executive Secretary, Dr. P. Bernal. He stressed that the IOC Tsunami Programme is the only programme of the Commission fully dedicated to the noble objectives of the International Decade of Natural Disaster Reduction (IDNDR) and the International Strategy for Disaster Reduction (ISDR), to devise strategies and policies for the reduction of natural disasters. The programme is performing a vitally important role in the international natural disaster reduction efforts. In the past years, it has assumed an increased importance. To effectively implement this role, there is a need, to not only develop scientific and technical knowledge, but also to develop contacts and exchanges, as well as further mutual understanding. He pointed out that this Session is a step in this direction.
- 7 Dr. Oliounine identified the two aims of the Session as: to make international and national instruments available for the advancement of the programme; and to place the programme at the service of the international and national communities.
- 8 The success of the programme and the surge of interest in the system clearly show that ITSU has a role to play in supporting the development of similar tsunami warning programmes in other regions. The experience in tsunami mitigation gained by IOC in the Pacific is needed in other regions.
- 9 Dr. Oliounine expressed his gratitude to the Government of Colombia for supporting numerous IOC activities and particularly the tsunami programme. Colombia has gained a wide reputation as a strong supporter and advocate of international co-operation in the world of ocean research and monitoring. Finally, he echoed the previous speakers in wishing the Session every success.

2. ORGANIZATION OF THE SESSION

10 The Agenda of the Session as adopted, is presented in Annex I of the Summary Report.

11 **The Group decided** that there was no need in designating a Rapporteur and agreed that input to the Summary Report under different Agenda items will be the responsibility of the Chairman, Vice-Chairman, Technical Secretary and those responsible for introducing a particular Agenda item.

12 **The Group established** two intrasessional working groups to work on the Programme and Budget 2002-2003 and on the Document IOC/ITSU-XVIII/17 containing a Project Proposal for the IAS TWS.

13 The Chairman of the Local Organizing Committee informed participants on local arrangements.

14 The List of Participants is presented in Annex III. The List of Documents is Annex IV.

3. PROGRESS IN THE PROGRAMME IMPLEMENTATION

3.1 REPORT OF THE CHAIRMAN

15 The Chairman presented Document IOC/ITSU-XVIII/6 on the intersessional activities of the ICG/ITSU focusing on his personal contributions to the programme.

16 Many of the activities recommended by ITSU-XVII have been successfully implemented: the procedures for issuing warnings, watches and cancellations have been improved; the HTDB development has been completed; three workshops have been implemented jointly with the IUGG Tsunami Commission and recommendations have been formulated and brought to the attention of the ICG/ITSU for future co-operative efforts; the format and regularity of the *ITIC Newsletter* has been improved and the *Tsunami Glossary* finalized.

17 The Chairman stressed that more detailed discussion of the programme implementation will be held under relevant Agenda items.

18 The Chairman emphasized the importance of the International Tsunami Information Centre (ITIC) in developing disaster prevention and preparedness activities. The Officers Meeting of the ICG/ITSU took place at ITIC during the first week of February 2001. The Officers examined the implementation of the decisions of the Group adopted at its Seventeenth Session and identified areas where further preparations were necessary for ITSU-XVIII.

19 The Chairman then reported on his input to the Thirty-third Session of the IOC Executive Council held in Paris in June 2000. The Executive Council approved the Summary Report of the ITSU-XVII and adopted the recommendations. The Executive Council noted the danger of potential tsunamis in the Intra-Americas Sea and along the Indian Ocean coastline of Indonesia and Australia, urged Member States concerned to take the necessary preventive and preparedness measures, and asked the IOC Executive Secretary to organize their co-ordination. The Executive Council adopted Resolution EC-XXXIII.5.

20 In July 2001, the Chairman reported to the Twenty-first Session of the IOC Assembly on the progress achieved in the tsunami programme implementation after IOC/EC-XXXIII. In his address, he identified ways for the future development of the Programme and the TWS in the Pacific. He pointed out that efforts should be made to adapt a network of sea-level measuring stations in the Pacific to the needs of the TWS, and to improve warnings for local tsunamis and those generated by submarine landslides and volcanoes, and to create sub-regional centres in order to facilitate the delivery of timely warning and watch messages.

21 The Assembly reiterated the importance of the tsunami programme as a programme fully dedicated to providing services in the area of natural disaster mitigation to the coastal communities.

22 The Chairman concluded by drawing the attention of the Session to problems the programme faces in its implementation: the low level of funding from the IOC Regular Programme, limited contributions to the Trust Fund and poor participation of some members of the ICG/ITSU in the Tsunami Programme activities. He said that the progress achieved by the programme was due to the dedication and hard work of a small group of collaborators and expressed the desire to see input to the programme coming from all Member States. He called on participants to give the best of themselves to the programme.

23 Finally, he thanked the delegates of Australia, Chile, France, New Zealand, Republic of Korea and the USA for their contribution to the Trust Fund in support of the Tsunami Programme and expressed the wish that other Member States would follow this most important example.

24 **The Group congratulated** its Chairman for the continuous attention to the programme's needs and accepted his report on intersessional activities.

25 **The Group called on** Member States to be more responsive to the efforts of the ICG/ITSU Officers and more supportive to the programme implementation.

26 **The Group requested** the Technical Secretary to include the updated version of the Action Sheet, presented as Annex V to the ICG/ITSU Officers Meeting Summary Report (IOC/INF-1152) as Annex V to the Summary Report of the Eighteenth Session of the ICG/ITSU, taking into account information provided under different Agenda items of the Session.

3.2 NATIONAL REPORTS

27 By the IOC Circular Letter N^o. 1680 of 15 February 2001, Member States of the ICG/ITSU were invited to submit national reports on intersessional activities, paying special attention to the timeliness of the submission (2-3 months prior to the Session in order to give participants time to get acquainted with national achievements) and the need to give a short summary for easy publication in the Tsunami Newsletter. It was recommended that Member States would include in the report, information on the developments of national tsunami warning systems, centres specification, progress in training and education of tsunami hazards, and information on awareness efforts of tsunami dangers. It was further recommended that while writing national reports, Member States would consider the usefulness of the format proposed by the ITIC Director as it was presented in Document IOC/ITSU-XVIII/8.

28 Fifteen National Reports have been received and compiled in Document IOC/ITSU-XVIII/7. Many of the reports were received with delays and in different formats. Additional comments to the National Reports were produced by several Member States.

29 The Delegate of Canada highlighted from his national report, the participation of the Geological Survey of Canada, with partners in the US, in Consolidated Reporting of Earthquakes and Tsunamis (CREST). One objective of CREST is to reduce the time necessary to issue the tsunami warning for large earthquakes occurring along the west coast of North America by rapid exchange of seismic data. He further noted that the national tsunami and tide-gauging networks, are working reliably and that excellent records were obtained following the 23 June 2001 earthquake.

30 A national (Pacific coast) tsunami response and communication exercise was conducted in late September. During that exercise, one of the tsunami gauges could not be contacted by telephone. The backup system worked exactly as designed and within ten minutes a satellite link with the gauge was established and maintained. The Delegate of Canada mentioned a recent modelling effort related to search and rescue. It is important to note that this is one of several recent research efforts and will hopefully lead to further on-going tsunami research and modelling in Canada. In a related initiative, approximately US\$130K has been provided to convert detailed bathymetric information from analogue to digital format. The highest priority will be given to the areas adjacent to coastal communities susceptible to tsunami inundation.

- 31 The Delegation of Chile informed the Group of the Chile-USA (PMEL) agreement to deploy a DART buoy in the northern part of Chile. It will strengthen the effectiveness of the Pacific-wide system. A meeting on the International Bathymetric Chart of the Southeast Pacific took place in Viña del Mar, Chile in the first days of October 2001. The result of the meeting was an agreement among South American countries bordering the Pacific to co-operate in the chart development.
- 32 The Delegate of Indonesia stressed that there is an increased interest in the tsunami Programme in Indonesia and he emphasized the need for assistance in tackling the local tsunami problems.
- 33 The Delegate of Colombia highlighted the tsunami mitigation activities carried out by different national institutions. The review of the national Tsunami Warning and Response Plan is in its final stage. He mentioned, *inter alia*, several projects aimed at diminishing tsunami threat to coastal communities: one with the usage of the TIME methodology for the production of inundation maps, and another, of the production of liquefaction charts for soil type identification. The Delegate also described efforts targeted to the creation of education material for the communities at risk. Colombia has acquired a new broadband seismic station and the TREMORS for updating the SNDAT (OSSO).
- 34 The Delegate of France reported that in French Polynesia, the LDG has developed a tsunami emergency plan. Thresholds for warnings were defined for French Polynesia as a whole and for the Marquesas Islands in particular. A project on the Rapid Determination of Focal Mechanisms was developed by the CPPT in Tahiti. After computation, information on the focal mechanisms is determined and sent to the European Mediterranean Seismological Centre (EMSC) website.
- 35 The Delegate of Ecuador reported on the plans of publishing a national *Tsunami Newsletter* in Spanish before the end of the year. The Newsletter will contain information about tsunami events, tsunami-related activities and description of tsunami mitigation exercises.
- 36 The Delegate of Japan reported that the Japanese Government had conducted the Grant Aid project and short-term dispatch of a JMA expert to the Philippine Institute of Volcanology and Seismology (PHIVOLCS). This would contribute to the improvement of TWS in the Pacific through the upgrading of the Philippine's national TWS.
- 37 The Delegate of Peru reported on the results of implementing the methodologies learned in the TIME Training Course. The knowledge gained from the TIME Course has resulted in the development of the improved tsunami inundation maps.
- 38 The Delegate of the Russian Federation presented an Album containing detailed information on the tsunami waves near the coasts of Russia. The Album contains 13 large-sized multi-coloured pages with information on the waves characteristics, results of research, modelling and national warning system operations. The Album covers the areas of the Far East, Black Sea and Caspian Sea. He also highlighted the role of the Russian Foundation for Basic Research in supporting national activities and partnerships in tsunami research and mitigation. Out of the RFBR budget of US\$40 million, 4% is for oceanography.
- 39 The Delegate of the USA highlighted the progress made over the first five years of the US National Tsunami Hazard Mitigation Programme, particularly the improvements in seismic and sea-level data that enhance the capabilities of PTWC as the operational centre of ITSU. He noted that these improvements would be discussed in detail under another Agenda item. He expressed the regret of the United States that the National Contact to ITSU, Mr. Richard Hagemeyer, was unable to attend the Session.
- 40 **The Group expressed its gratitude** to the Member States, which submitted national reports and **thanked** the IOC Secretariat for the timely delivery of the reports to all users concerned by sending the documents through regular mail, e-mail and also making them available on the IOC website.
- 41 **The Group accepted** the format for national reports preparation developed by the ITIC Director as presented in Annex VI. **The Group recommended** that all Member States, while making contributions to the

next Session of the ICG/ITSU, use this format. **The Group requested** all Member States to submit summaries of their reports preferably in electronic form to the ITIC Director by 1 December 2001, in order to include them in the 2001 Tsunami Annual planned for publication at the end of January 2002.

3.3 ITIC DIRECTOR'S REPORT

42 The ITIC Director, Mr. M. Blackford, presented a summary of key activities during the intersessional period and noted that details of his report be found in Document IOC/ITSU-XVIII/9.

43 In keeping with a viewpoint expressed at ICG/ITSU-XVII that the Visiting Experts Programme (VEP) should place greater emphasis on giving the experts detailed training in the functions and operations of regional or local tsunami warning systems, the participants of the training sessions in 2000 and 2001 were purposely selected from Member States of the northwest South American and southwest Pacific areas respectively, namely, from Colombia, Peru, Indonesia and the Philippines. In both sessions the participants received information through briefings and field visits on the overall operations of ITSU and on the operations of the PTWC, and the State and Country Emergency Operations Centers of Hawaii. The participants also visited the Pacific Tsunami Museum in Hilo, Hawaii, considered to be an excellent example of a tool for increasing public tsunami awareness and education. All the participants were introduced to the ITIC Library and they all made use of its resources during the training sessions.

44 Initial library cataloguing has been completed and efforts are now focusing on indexing articles in certain serial publications in the ITIC Library that are not indexed elsewhere. The ITIC will be placing its catalogues and indexes on its website so that it will be easier for researchers seeking information on tsunamis and tsunami warning systems, to determine what holdings are available in the ITIC Library. The ITIC continues to add to its collection through subscriptions to various serial publications on natural hazards in general, and tsunamis in particular, and purchases of selected newly published texts on tsunamis.

45 The Director reported that the transition of the publication of the Tsunami Newsletter from a semi-annual to a bi-monthly schedule has been completed and efforts were focused at present on the 2000 and 2001 Tsunami Annuals publication. The Director then turned the ITIC presentation over to the Associate Director to provide details on other activities including the information that is available on the ITIC website that is maintained by SHOA.

46 The ITIC Associate Director gave a detailed description of publications available on the ITIC website. The *Tsunami Newsletter* is on-line, starting with the July 2000 issue. English, French and Spanish versions of the *Great Waves* brochure are also on-line, as well as other publications such as the *Tsunami Glossary* (English version), *Post Tsunami Survey Guide* (English and Spanish versions) and the *Tsunami Master Plan* (English, French and Spanish).

47 **The Group recommended** that all publications should be available on the website in all IOC working languages.

48 The ITIC website has been expanded to include links to other tsunami websites, information on recent tsunami events (such as the 23 June 2001, Peruvian Tsunami), information for ITSU Member States and the proposed Intra-Americas Seas Tsunami Warning System.

49 Much attention has been given to the educational material available on the website. Since October 2001, the Spanish and English versions of the textbooks developed by Chile, with the support of IOC, are available for downloading in PDF format. The Russian version of the textbooks will be ready for posting in the first semester of 2002, when the modified figures are received from the Russian National Contact.

50 As requested by the ITSU Officers during the meeting in Honolulu in February 2001, the ITIC Associate Director transferred most of the publications available on-line to a CD-ROM that was distributed during ITSU-XVIII. The CD-ROM contains all Tsunami Newsletters (starting in July 2000), the *Tsunami Glossary*, the *Great Wave Brochure*, the Tsunami textbooks, The Tsunami Master Plan and a Spanish brochure called '*Once lecciones de cómo sobrevivir a un maremoto*' (based on similar publication by USGS – Circular 1187).

51 **The Group expressed its satisfaction** with the new CD-ROM produced by ITIC.

52 The ITIC Associate Director quoted part of the ITIC responsibilities as "... *a day-to-day monitoring of the performance of the system and as a source of information on the operation of the Tsunami Warning System...*" He expressed concern that due to the lack of response from Member States it was difficult to meet this responsibility, to facilitate the ITIC work or to improve the content of the Tsunami Newsletters.

53 The Group discussed the comments made by the ITIC Associate Director on the problems encountered to fulfil his mandate. Regarding the *Tsunami Newsletter*, it was decided to keep the format of the publication adopted two years ago and a bi-monthly periodicity. The ITIC will also publish an annual issue with a detailed description of events that occurred during the year. Every other year it will include the summaries of the National Reports presented at the corresponding ICG/ITSU meeting.

54 **The Group commended** the work done by the ITIC Director and Associate Director whose devotion to the programme helped to implement almost all responsibilities assigned to them by ITSU-XVII. Special recognition and appreciation was made by the Group to the work of Cmdr. R. Nuñez whose services are provided and supported by Chile. **The Group thanked** Cmdr. Nuñez for the productive work and expressed the desire to see Cmdr. Nuñez continue working as an ITIC Associate Director, especially taking into account that the current ITIC Director may retire shortly to be replaced by a new person.

55 The Delegate of Chile then expressed the readiness of his country to continue providing the services of Cmdr. R. Nuñez. **The Group acknowledged** this offer and **requested** the Chairman and Technical Secretary to provide the necessary funding for Cmdr. Nuñez to visit ITIC as soon as possible, after a new ITIC Director is appointed, in order to develop a joint plan of action based on the existing ITIC Associate Director's responsibilities and taking into account the decisions of ITSU-XVIII.

56 **The Group expressed** great concern with the poor response of the Member States to the request for information on warning and watches follow-up, for contributions to the *Tsunami Newsletter* and to the correspondence coming from the ICG/ITSU Officers and the IOC Secretariat. **The Group** once again **reiterated** the need to be more active in the programme and **urged** Member States to become more involved in the ITIC activities and to co-operate with PTWC by sending feedback on tsunami warning and watches.

57 **The Group requested** the ITIC Associate Director to take the necessary actions for updating the list of National Contacts and mailing lists, and make them available to the Member States and the IOC Secretariat by February 2002.

4. PROGRAMME MATTERS IN LIGHT OF THE INTERSESSIONAL ACTIVITIES

4.1 COMMUNICATION PLAN AND OVERVIEW OF THE WARNING SYSTEM

58 The Director PTWC gave a summary of progress on various outstanding communication issues, related to the Tsunami Warning System in the Pacific (TWSP). He noted that the communication plan for the ITSU has not been updated for the last two years, and a new version is needed soon to properly accommodate recent changes in the system, and to facilitate an electronic version of the plan. He advised the Group that an update would be sent to all participants before the end of 2001, and a new version prepared in the next intersessional period.

59 Regarding the monthly communications tests conducted by PTWC, three issues were discussed: performance results; dissemination of results; and wider participation in the tests. The PTWC Director reported that tests were conducted most months during the intersessional period and that no significant problems with communication circuits were encountered. He also reported with regret that the rapid dissemination of test results, as requested by the Group at ITSU-XVII to encourage more active participation by participants, had not been satisfactorily accomplished. He assured the Group that this would be done in the next intersessional period. The Director PTWC also reported that in spite of the encouragement of the Group at ITSU-XVII for

more of the Member States to participate in the tests, no other Member States joined in the tests during the intersessional period.

60 The Director PTWC reminded the Group that at its Seventeenth Session, it was recommended to investigate the possibility of PTWC producing and disseminating a Spanish version of the bulletins. With the assistance of the ITIC Associate Director from Chile, PTWC modified its message generation software to produce all pre-scripted bulletins in Spanish. However, at the ITSU Officers Meeting this topic was discussed and it was decided not to recommend the use of this bulletin for the reason that PTWC often modifies its pre-scripted bulletin to suit particular situations, and there is no possibility to similarly modify the Spanish versions. **The Group agreed** with this recommendation and **reaffirmed** the official language of the bulletin as English.

61 The final communication issue discussed was in regard to PTWC getting feedback from the Members States regarding their experiences with warning/watch bulletins. The PTWC Director reported that PTWC gets very little feedback and that such input is essential to improve the performance and effectiveness of the system. There was considerable discussion on this topic, and at the request of the Chairman, several of the Member States including France, Colombia, Nicaragua and Chile provided accounts of some of their recent warning/watch experiences as a result of this discussion. The Chairman requested the Group, that following each tsunami warning/watch, Member States send information to PTWC within a few days indicating which bulletins were received, what time they were received, and that additional feedback would also be useful.

62 **The Group recommended** that Member States having problems with receiving bulletins explore with PTWC the possibility of using alternate/backup methods such as EMWIN or e-mail.

63 A few delegates noted that they had good results in using EMWIN Tsunami bulletins. In Chile, e.g., the bulletin can reach users 2-3 minutes faster than by using faxes. It was also proposed to consider the usage of the Internet for sending tsunami messages as an alternative method.

4.2 RECENT TECHNOLOGICAL DEVELOPMENTS

64 The PTWC Director presented an overview of some significant technological developments that have occurred at PTWC during the intersessional period. These include improvements to seismic data acquisition, seismic data processing, and sea-level data acquisition. The PTWC is now receiving continuous real-time digital broadband seismic data from approximately 80 stations across the Pacific. These data have become available as a result of the US National Tsunami Hazard Mitigation Programme (NTHMP). This is two orders of magnitude more data than PTWC received only a few years ago. The PTWC has also implemented new software for more modern seismic data processing using these high quality data including calculations of magnitudes Mwp, and Mm, and the E/Mo 'tsunami earthquake' discriminant. Lastly, PTWC is now receiving sea-level data from six deep ocean tsunami detectors, the last of which was deployed in August 2001. These gauges, also a result at the NTHMP, are situated off dangerous tsunamigenic seismic zones and can provide an accurate measure of tsunami waves in the deep ocean for improved tsunami forecasting.

65 **The Group adopted Recommendation ITSU-XVIII.1.**

66 The Delegate of France reported the progress achieved in the implementation of the Rapid Determination of Focal Mechanism (RDFM) by CPPT during the last intersessional period. He demonstrated that in the case of a very large earthquake, the RDFM aids in the determination of which part of the fault zone moved and in consequence which part of the Pacific would be threatened by the tsunami. During the last two years, the software and system have been improved. The RDFM is working now with TREMORS results and also with data received through the AutoDRM. Quality is checked using automatic plots of the radiation pattern at several periods. The stability of the inversion has also been improved. Focal mechanisms are sent to the EMSC web page (www.emsc.csem.gov). The RDFM has the capability to provide other accurate source parameters in addition to the focal mechanism, centroid and focal depth of the earthquake.

67 At this stage, the RDFM is not automated due to the small amount of data available. To improve the situation, the Delegate of France requested the Director of PTWC to send data of the amplitude spectra of the

surface waves they used to compute Mm and Mw by e-mail for all events of magnitude greater than 7.0, as soon as the data from 20 stations are available.

- 68 **The Group thanked** the Delegate of France and the PTWC Director for this interesting information and **recommended** continuing the practice of including in the ICG/ITSU Sessions' Agenda, an item on technological development.

5. IMPLEMENTATION OF ITSU-XVII RECOMMENDATIONS

5.1 WARNING CENTRE BULLETINS

- 69 The ITIC Director presented Document IOC/ITSU-XVIII/11 containing recommendations for the ITSU Regional Tsunami Warning/Watch Messages. He pointed out that the Regional Watch/Warning (RWW) messages were in reality advisory messages for the participants in ITSU because nearly all of the participants who receive a message make some independent decisions whether or not to actually warn their coastal populations. It is the local authorities that actually warn their citizens.

- 70 **The Group felt** that the participants of ITSU have developed a good understanding of the terms 'warning' and 'watch', which are currently used, and that it was not necessary to change the language to 'urgent advisory' and 'advisory'.

- 71 The Director then recommended to define the ITSU Area of Responsibility (AOR) as a line 200 kilometres inland from the Pacific coast. He described the AOR boundary in detail and recommended that the marginal basins in the Western Pacific, as well as the Gulf of California in the Eastern Pacific be excluded from the dissemination of RWW messages but be included in the dissemination of Tsunami Information Bulletins. Thus, the outer boundary of the AOR would be 200 kilometres inland from the coasts of the Americas, Asia, including all of Indonesia, Australia, and Antarctica. An inner boundary would be 200 kilometres away from the main basin of the Pacific following the island chains that lie between the main basin and the marginal basins.

- 72 **The Group accepted** the recommendation for this ITSU AOR.

- 73 Under this Agenda item, the PTWC Director also gave here a report on the recommendations of the Working Group on procedures and criteria used for issuing warnings, watches and cancellations (ITSU-XVIII/12). Eight recommendations were made:

- (i) Change magnitude from Ms to Mw,
- (ii) Upgrade threshold for regional warning/watch to $M_w > 7.8$,
- (iii) Issue local/regional warning for $7.5 < M_w \leq 7.8$,
- (iv) Issue information bulletin for $6.5 \leq M_w \leq 7.5$ in Pacific Basin,
- (v) Issue information bulletin for $6.5 \leq M_w$ in western Pacific marginal seas,
- (vi) Compute discriminants for "slow" or "tsunami" earthquakes,
- (vii) Do not issue warnings for areas blocked by landmasses,
- (viii) Continue to review procedures and criteria to achieve improvements.

- 74 In general, the recommendations are intended to make PTWC's tsunami warnings timelier, accurate and effective. An overview of the reasoning and justification for these recommendations was presented. Following the report, a discussion of the recommendations was made by the Group. Canada asked if this would be co-ordinated with the West Coast/Alaska Tsunami Warning Center (WC/ATWC). The PTWC Director explained that implementation of the recommendations would take place during the next intersessional period, but only after co-ordination with WC/ATWC and an advance announcement of these changes to all Tsunami Warning System participants. The Delegate of France expressed that in regard to the Recommendation (vii), PTWC must exercise caution, especially for very large earthquakes, because the epicentre might be on one side of a landmass but the rupture area could extend to the other side. The PTWC Director agreed, and added that the accuracy of the epicentre location must also be taken into consideration.

75 **The Group accepted** all the recommendations of the ad hoc Group and **requested** the PTWC to put them in practice, taking into account the comments made.

5.2 CD-ROM AND WEB VERSION OF THE BASIC PACIFIC TSUNAMI CATALOGUE AND DATABASE

76 The compilation of the Historical Tsunami Database (HTDB) for the Pacific and its conversion into a computerized version has been the ICG/ITSU concern for a number of years. By Recommendation ITSU-XVII.2 it was decided to develop a CD-ROM '*Tsunamis in the Pacific, 47 BC – 2000 AD*', create a Web-version of the database and create a mirror site for easier access. Progress in the implementation of this Recommendation was reported to the Group by Dr. V. Gusiakov, HTDB/PAC Project Co-ordinator (Doc. IOC/ITSU-XVIII/13).

77 The current version of the database, written on a CD-ROM, represents the most complete parametric tsunami data set available in a digital domain. It covers the whole Pacific region from 65°S to 65°N and from 80°E to 90°W and the period of historical observations from 47 BC to 2000 AD. The database consists of two main parts – tsunami event catalogue containing a list of Pacific tsunamigenic events with their basic source parameters (about 1450 events) and tsunami run-up catalogue containing a list of observed or measured run-up or maximum heights measured on water level gauges (more than 6,000 observations). The data are provided with specially developed graphic shell (GIS-type mapping software) for easy data retrieval, mapping, processing and analysis. Copies of the CD-ROM '*Tsunamis in the Pacific, 47 BC – 2000 AD*' were presented to the participants together with an HTDB/PAC Manual. The Web-version of the HTDB/PAC containing the basic set of historical data that are presented in the CD-ROM is maintained on the Novosibirsk Tsunami Laboratory web-server (<http://tsun.sccc.ru/htdbpac>). A mirror site was established in August 2001 on the NOAA/PMEL web-server (<http://toast.pmel.noaa.gov/htdbpac>). Through the mirror site, the access to this information resource for the users from the North and South America and from Western Europe has been greatly improved.

78 Speaking about the future development of the HTDB/PAC Project, Dr. Gusiakov stressed the need for further improvement in terms of data quality and completeness. The present version of the database covers most of the information contained in published tsunami catalogues, proceedings of tsunami conferences and workshops, as well as articles from leading international and national scientific journals. However, a wealth of additional data and information exists in original reports, institutional archives and primary publications, which are inaccessible outside the region of origin. Further HTDB/PAC development is seen as search and collection of such data, its parameterisation and its inclusion in the database. This work can be done in close co-operation with regional HTDB/PAC co-ordinators, local agencies, institutions and individual researches from the region. As a mechanism for implementation of this activity, Dr. Gusiakov proposed the organization of a Training Workshop on the HTDB application and on the improvement of its content. Such a workshop could be arranged in conjunction with one of the international tsunami-related meetings where regional HTDB co-ordinators and representatives of the ITSU Member States would be invited to bring new and corrected data from their regions for inclusion in the database.

79 **The Group acknowledged** the IOC support for the project and **noted** with satisfaction that Recommendation ITSU-XVII.2 has been fully implemented. **The Group agreed** that the HTDB/PAC package is a valuable source of data on tsunami observations. It will be widely used by research and operational communities in many countries.

80 **The Group recommended** that further action be taken for improving the quality and completeness of the historical data set collected within the HTDB/PAC. **The Group considered** the HTDB Training Workshop as a useful instrument for extending the scope of database application and for improvement of the database content. **The Group supported** having a workshop in the intersessional period.

6. TRAINING AND EDUCATION

81 The ITIC Director introduced Document IOC/ITSU-XVIII/14 containing some ideas on how to improve a training and education component of the tsunami programme. He based the document on ITIC's long experience in implementing the Visiting Experts Programme (VEP) and on the experience of the ICG/ITSU Member States.

82 The ITIC Director described the VEP in some detail and pointed out that in recent years ITIC has attempted to place more emphasis on the importance of bolstering the capabilities of the expert's countries to deal more effectively with the occurrence of local tsunamis. The varied briefings, field trips, study periods and ample opportunity to scan the shelves of the library, helped the trainees to gain a wide picture of TWS's operations, ICG/ITSU and ITIC activities and gain knowledge with which they would be able to use in creating or strengthening their national tsunami warning facilities and mitigation capabilities.

83 The ITIC Director invited the Group to consider some improvements to the VEP. He suggested focusing the training sessions on the most significant tsunamis that have occurred in the expert's areas and what measures have and have not been instituted since these events took place to reduce the effects when the next tsunami occurs. The experts would be expected to come up with ideas or a plan as to how an on-going programme of public education may be implemented in their countries, based on information they receive in their training sessions.

84 The ITIC Director went on to describe some possible strategies that may be considered to help heighten public awareness of the tsunami threat. One strategy might be to have the visiting experts not only receive training at ITIC but report back to ITIC and the ICG/ITSU for some time on how they have applied what they learned through the VEP. Another strategy might be to have an appropriate Government Representative of a Member State annually declare some significant period of time as a period of national tsunami awareness. During this period of time, scientists or emergency managers would make presentations in schools or at public meetings, describing tsunamis in general and the local tsunami threat.

85 The Delegate of Colombia shared his experience in training and education activities in tsunami mitigation implemented by the Maritime Authority (DIMAR).

86 The Pacific Coast was chosen as a target region due to being a tsunami-prone area. Main efforts were focused on educating children, because of their high vulnerability to natural disasters.

87 After some experience, it was decided to modify the methodology taking the following basic principles into account:

- Limited resources available for education in the Colombian Pacific coastal zone did not allow the authorities to widely use CD technology or on-line material. It forced the authorities to step back to paper-format material.
- It was decided to use teachers for disseminating tsunami awareness knowledge and material, as with the available resources it would allow the authorities to cover a greater percentage of the population of the coastal communities.

88 In 2002, a new subject will be introduced in the Tumaco schools curricular for the Eight Grade. It will be called 'Risk Management'. Material is being developed by the Civil Defence and Centro Control Contaminación del Pacífico. At the national level, work has been done to include in the high school curricular, the development of a Plan on Risk Management. This initiative has been led by the Civil Defence and National Office for Natural Disasters.

89 So far efforts have been focused on basic aspects of the phenomena, explaining to people what a tsunami is, why certain areas are tsunami-prone and what consequences a tsunami would have for Tumaco's population. Evacuation plans and emergency actions are still poorly covered, because the Colombian

experience in these areas is limited and careful evaluation is needed by an external expert who can provide the necessary guidelines to help Colombia in the mitigation process.

90 **The Group recommended** that tsunami education should be institutionalised by incorporating the knowledge on the phenomena and hazard in general national education programmes and maintain education and awareness of the tsunami phenomena on a continuous basis.

91 **The Group supported** the ITIC Director's proposals on the improvement of the VEP. **The Group agreed** that the proposed measures will increase the effectiveness of the programme and will help to make VEP attendees to become 'lobbyists' for the Course of tsunami awareness in their countries.

92 **The Group recommended** the ITIC Director and Associate Director to keep track of the experts who received training within the VEP and use them actively for assisting serving national and regional problems.

93 **The Group recommended further** to direct the VEP even more towards addressing the local or regional tsunami threat. The candidates for the VEP training should be selected from those who have demonstrated interest in the tsunami programme. **The Group advised** the IOC Executive Secretary and the ITIC Director to have trainees for the 2002 VEP Course from Central America. The Group noted the interest of Chile to have Chilean experts in the 2003 Course but decided to take a final decision on the list of trainees for 2003 at a later stage.

94 The ITIC Director then referred to the educational materials developed by the ICG/ITSU, which have been very useful to teachers as source materials for developing study plans regarding natural hazards. He pointed out that it was quite difficult to have this material as part of the school curricula. The ITIC and the IOC Secretariat very often receive requests for educational material and tsunami/earthquake textbooks. The content of these publications is highly appreciated by users. Recently the textbooks have been made available on the ITIC website and requesters are referred to the website where they can download the material if they so wish.

95 **The Group noted** that the educational material developed by the ICG/ITSU Member States have contributed to an overall awareness of the hazard. **The Group expressed concern** that the ITSU National Contacts are very slow in providing ITIC and the IOC Secretariat with information on national training activities and with copies of their educational and awareness material. **The Group requested** that necessary steps be taken to improve the situation.

96 **The Group noted** that there are many areas in the Pacific without access to the Internet and facilities for the use of CD-ROMs. The need for printed material exists and issuing of hard copy publications should be continued.

97 The ITIC Director invited the Group to consider establishing a small Group of Experts on tsunamis and tsunami mitigation that could travel to countries in the ITSU area of responsibility most vulnerable to tsunami attacks. The Group could brief emergency managers on the hazard and methods that may be employed to mitigate their effects. Finally, the Director described the tsunami memorial mound that was built at Aonae, Japan. He pointed out that such a structure acts not only as an on-going reminder of the tsunami hazard but it can also act as a mitigation measure providing a site of refuge in areas of low relief. He said that such structures could be constructed and outfitted with plaques describing the tsunami hazard and possible mitigation measures in areas that are quite vulnerable and have yet to be affected by the tsunami threat.

98 **The Group agreed** with the Director in principle **and recommended** the ICG/ITSU Officers to study these proposals in more detail.

99 Noting the importance of local tsunami warning problems, **the Group recommended** to include in the ICG/ITSU programme for 2002-2003, the organization of the Workshop on '*Local Tsunami Warning and Mitigation*' **and accepted** the kind offer of the Delegate of the Russian Federation to have it in Petropavlovsk-

Kamchatski in the Fall of 2002. **The Group invited** the Chairman and the Delegate of Japan to explore the interest of European and Japanese funding agencies in supporting the Workshop.

100 The Delegate of Colombia and Ecuador called on the Group to assist their countries in developing national mitigation plans. **The Group appreciated** the need **and accepted** the kind offer of Chile to provide the necessary expertise. It was decided that a consultant from Chile would visit Colombia and Ecuador in the first quarter of 2002. The Action Plan of his visit will be jointly developed by the countries concerned. Funding will be shared between the countries (local expenses – Colombia and Ecuador) and IOC (international travel).

7. PREPAREDNESS FOR AWARENESS OF THE TSUNAMI DANGER

7.1 TSUNAMI NEWSLETTER

101 Based on the information provided in Document IOC/ITSU-XVIII/8 on the ITIC activities, the Group discussed the need for the Tsunami Newsletter publication and ways for improvements.

102 The Group noted that in the past years the format has changed from bi-annually to bi-monthly and to electronic, as well as hardcopy format. The content includes information on tsunamigenic events. It also contains information on tsunami-related meetings, ITIC and ICG/ITSU activities and updates of National Contacts. The Tsunami Newsletter is supplemented by the Tsunami Annual. **The Group agreed** that the Newsletter and the Annual have a role to play as they provide information of importance to natural hazard emergency organizations, tsunami researchers and the general public.

103 The delays with the publication were noted with concern. Some delegates suggested that a number of publications within a year should be reduced to give more time for Member States to participate actively in the preparation of publications. Experience of the Group dealing with volcano information, which is distributed through e-mail, was noted with interest. **The Group recommended** to continue efforts with the publication of the Newsletter and the Annual with the periodicity and format of today **and urged** Member States to be more responsive to the need for new articles and other publishing material. The publication should be continued in hardcopy and electronic form. **The Group decided** to come back to this issue at its next session and evaluate the experience gained during the intersessional period.

7.2 TSUNAMI PRESS KIT

104 The Technical Secretary IOC presented Document IOC/ITSU-XVIII/15 with the textual part of the Tsunami Press Kit. He reminded the Group that the decision to develop the Press Kit was taken at ITSU-XVII and the list of content was approved by the ITSU Officers.

105 **The Group acknowledged** the work made by IOC and supported the content. Member States were requested to send editorial changes that they would like to make in the text to the Technical Secretary by the end of 2001. **The Group urged** the ICG/ITSU Officers and Technical Secretary to complete the work for a multi-coloured publication of the Kit within 2002. The Kit should contain graphics and pictures, text should be artistically presented and new software for graphic and text presentation should be used.

106 **The Group recommended** shortening the Kit's list of available websites, keeping only those, which play the role of portals. The ITIC Associate Director was requested to provide the Technical Secretary with a revised list by the end of 2001. **The Group discussed** the content of the List of Publications and **agreed** that it should contain only relevant IOC publications and a few others of those recommended by the ICG/ITSU Officers. The Chairman will provide a recommended list to the Technical Secretary by the end of 2001.

107 **The Group advised** the Technical Secretary to have the Press Kit published in hardcopy form but also make it available in electronic form. The Delegate of Chile expressed readiness to help IOC in designing and publishing the Kit folders, provided some support is available from IOC.

108 Taking into account that the Press Kit will be published in a loose-leaf form, **the Group noted** that Member States would have an opportunity to enrich the Kit's content by including page(s) on national activities. It will be the full responsibility of a Member State. National contributions should have a footnote explaining that it is a national addition to the basic text, which was approved by the Group.

7.3 TSUNAMI GLOSSARY

109 During the ITSU-XVII Session, the draft of the Tsunami Glossary proposed by Mr. F. Schindele was reviewed. As recommended, the text has been revised by the Director of PTWC. Graphical material and photographs were incorporated by the ITIC Associate Director. The final draft of the Glossary was presented during the Officers Meeting in February 2001. The modifications and improvements recommended by the Officers were included in the final text.

110 The English version of the Tsunami Glossary was published in 2001 on the ITIC website. It was also included in the CD-ROM prepared by the ITIC Associate Director. This version was sent to Nicaragua for translation into Spanish. The Spanish version will be reviewed by the end of October 2001 by the Spanish speaking countries and published on the ITIC website. A multi-coloured document in English and Spanish will be published by Nicaragua before the end of 2001 with financial assistance from IOC.

111 The Delegate of the Russian Federation expressed readiness to translate the Glossary into Russian and to publish it free of charge to IOC. **The Group appreciated** the offer of Russia and requested the ITIC Associate Director to provide the Russian Federation with all the necessary documentation.

112 The Delegates of Canada and France informed the Group that their countries would consider translation of the Glossary into French. The Delegate of Canada will inform the Chairman of the ICG/ITSU on the costs of translation in Canada, and after comparing costs with those in France, a final decision will be taken on where the translation in French will be done. France will publish the French version of the Glossary in multi-colour.

113 **The Group thanked** its Chairman, the ITIC Associate Director and the Delegate of Nicaragua for the work done and expressed a wish to have the project completed in 2002. The Group noted that the distribution of the Glossary by mail to the Member States will be a very costly exercise and invited IOC to consider supporting this effort.

7.4 TSUNAMI WEBSITES

114 The ITIC Associate Director presented a short description of some of the available websites listed in Document IOC/ITSU-XVIII/16.

115 The websites were presented by categories as follows:

- West Coast Alaska and Pacific Tsunami Warning Centers. (WC/ATWC and PTWC).
- Tide (sea-level) Networks with real-time telemetry. (WC/ATWC, Australia, PMEL/NOAA, Chile, Peru).
- University and Government (research) links. (PMEL/NOAA, USA-Universities, Japan, Russia, others).
- Historical Data and on-line museums.
- On-line catalogues (HTDBpac, HTDBatl, HTDBmed, Hilo Tsunami museum, others).
- Seismic Information. (USA, France, regional/local networks).
- Others, i.e., tsunami from asteroid impacts and underwater slides.
- National websites related to tsunamis. (Operational centres and any other on-line information provided by National Contacts).
- Scientific Publications and Journals.

116 The Delegate of Canada requested to add a new category related to education and offered to send information on this subject. The proposal was accepted.

117 The ITIC Associate Director informed the Group that a link to the on-line Tsunami Press Kit available at the website of the Pacific Marine Environmental Laboratory of the National Oceanographic and Atmospheric Administration (PMEL/NOAA) will be added to the above list of links. He also requested the National Contacts to send information about links in their countries related to Tsunamis to be included on the ITIC website.

118 **The Group decided** that a web page will be added to the ITIC website with the links to the sites

119 The Technical Secretary informed the Group of the Ocean Portal produced by IOC and maintained by its Ocean Services Section. The Ocean Portal is a high-level directory of Ocean Data and Information-related websites. It's objective is to help scientists and other ocean experts in locating such data and information. The Technical Secretary presented the Directory of the IOC Ocean Portal and invited the Group to consider developing a link between the ITIC website and the IOC Portal. **The Group welcomed** the information and **invited** the ITIC Associate Director to contact the Head of the IOC Ocean Services Section and include the ITIC site in the list of the Ocean Portal URLs.

8. SUB-REGIONAL TSUNAMI WARNING SYSTEMS

8.1 FAR EAST TSUNAMI WARNING CENTRE

120 The Delegate of Japan reported that on 15 January 2001, the Japan Meteorological Agency (JMA) partially began operations of the Regional Tsunami Warning Centre (Doc. IOC/ITSU-XVIII/7 Japan) to provide the tsunami forecasts in the sea between the Asian continent, Korean Peninsula and Japan to overseas authorities concerned. The JMA prepared and distributed a '*Handbook for Tsunami Forecast in the Japan Sea*' with the explanation of the procedure for the effective utilization of forecasts.

121 The next stage will be the expansion of the target area to the Northwestern Pacific. Its boundaries will be determined later. The Delegate of Japan explained that real-time seismic waveform data in the target area are indispensable for determining the hypocenters accurately and quickly (Doc. IOC/ITSU-XVIII/21). The JMA is proceeding with a study on optimal distribution of seismographic stations, considering the tsunami travel time to each coast.

122 The Delegate of Japan explained that JMA was planning to include tsunami heights and arrival times in the content of the forecast like those for the sea between the Asian continent, Korean Peninsula and Japan. By executing numerical simulation for various cases, the characteristics of tsunamis on each coast will be obtained and used to set up the forecast areas. For that purpose, the JMA is going to carry out many simulations and analyse the results.

123 **The Group expressed** deep appreciation to Japan and **invited** the country to continue its efforts. Member States were encouraged to co-operate with Japan in the acquisition of real-time seismic waveform data in the target areas.

124 The Delegate of Japan explained that at this stage there is no need for a regional workshop to discuss actions to be taken for the smooth running of the system. **The Group decided** to come back to this issue when the target area of the Far East TWC is expanded and experience gained.

8.2 IAS TSUNAMI WARNING SYSTEM

125 The Technical Secretary drew the attention of the Group to the decision of the Thirty-third Session of the Executive Council by which it was recommended that "the Workshop on the IAS Project on the development of the Tsunami Warning System in the Caribbean be arranged with the participation of experts

from the Pacific and Caribbean region” in order to review the original project proposal of the IOCARIBE Tsunami Steering Group of Experts and provide comments based on the experience gained by the ICG/ITSU in tsunami warning and mitigation.

126 In compliance with this recommendation, the Workshop was organized in Mayaguez, Puerto Rico from 19-21 December 2000. Participants at the meeting identified the need for a revised version of the project proposal. This was prepared by Mr. R. Hagemeyer, Prof. G. Maul and the IOC Secretariat, taking into account comments received from the participants of the Mayaguez Workshop.

127 The Technical Secretary presented Document IOC/ITSU-XVIII/17 for comments and proposed modifications.

128 **The Group acknowledged** the work done by the experts for the revision of the project proposal, **noted** that there are some omissions related to the budget **and recommended** that an intrasessional group be established to look at and modify the text. **The ICG/ITSU invited** Prof. G. Maul, Chairman of the IOCARIBE Tsunami Steering Group of Experts to head the intrasessional group. The group had a few meetings and results of its deliberations were reported to the Plenary by Prof. G. Maul.

129 Prof. J. Shepherd from Trinidad and Tobago expressed the view that Central America is affected by tsunamis from both the Pacific and the Caribbean, and the main tsunami threat in the eastern Caribbean is from volcanoes not earthquakes.

130 He pointed out three serious concerns with the proposal:

- (i) Tsunamis, which are of socio-economic importance, are rare events in the Caribbean.
- (ii) No tsunami anywhere in the Caribbean has ever caused death or destruction at a distance of greater than 100-200 km from the point of origin.
- (iii) the proposal says nothing about the way in which any warnings will be communicated to national and regional disaster response agencies. In fact this will never matter. Tsunamis travel 100-200 km in 15-30 minutes so that Point (ii) above means that, to be effective, a Caribbean tsunami warning system must be capable of completing many tasks within 15-30 minutes of the origin of an earthquake-generated tsunami.

131 The warning system will be unable to issue warnings until long after the tsunami has caused whatever damage it is going to cause.

132 On the other hand, Prof. Shepherd emphasized that a tsunami mitigation programme is certainly justified. This would involve mapping of areas subject to tsunami inundation, improving public awareness of the tsunami hazard, and the development of evacuation plans and lines of communication with the civil authorities responsible for emergency preparedness. In the eastern Caribbean region volcanically generated tsunamis are at least five times as frequent as earthquake generated ones. These tsunamis can be predicted in sufficient time.

133 Prof. Shepherd concluded that the establishment of a completely new administrative structure to administer a tsunami mitigation programme is unnecessary. Existing regional scientific organizations can supply the necessary scientific data to the existing regional disaster agency (CDERA), which would organize the necessary programmes.

134 The Group noted that the views expressed by Prof. Shepherd, while valid for his area of interest in the Lesser Antilles, are not necessarily correct when the entire area of the Caribbean Sea, or more generally the Intra-Americas Sea, is taken into consideration. The Intra-Americas Sea Tsunami Warning System Project Proposal is meant to encompass the entire extent of the Intra-Americas Sea. Tsunami events in 1867, 1918 and 1946, all outside the Lesser Antilles area, caused a significant number of fatalities and damage. Tsunami run up for these events, at least in the case of the 1867 Virgin islands event, extended into the Lesser Antilles with the values exceeding one meter in Guadeloupe and Grenada. The Project should be able to complement rather than compete with projects of Prof. Shepherd and his Group in the Lesser Antilles.

135 The Delegate of Canada offered the opinion that the Project Proposal will be strengthened if it identifies other potential benefits of the proposed warning system. He mentioned storm surge warning, as well as the navigation and economic benefits possible from the distribution of real-time water level information, as possible linkages.

136 After a long discussion, the Group approved the IAS Project Proposal as presented in Document IOC/ITSU-XVIII/17 in principle and felt that a working group should be formed to address the outstanding issues remaining with the IAS Project Proposal, taking into account the comments that had been offered. The Group assigned the working group to make modifications and put the Proposal into a final form in a timely manner. Consequently, a working group was formed, Chaired by the USA National Contact and composed of Prof. G. Maul, the ITSU Chairman and Vice-Chairman, the ITIC Director and the National Contact of Nicaragua. A deadline of 31 January 2002 was set for completing the work and submitting the results to the Chairman of the IOCARIBE Regional Sub-Commission and the IOC Executive Secretary.

8.3 OTHER REGIONS

137 Under this Agenda item, Members of the Group considered the development of Tsunami Warning Systems or Regional Centres in Europe, Central America and Indian Ocean.

138 The Delegate of France gave the Group the history of tsunami programmes funded by the European Union named Genesis and Impact of Tsunamis on the European Coasts (GITEC and GITEC TWO) that ended in 1998. Improvements to tsunami modelling, tsunami catalogues and tsunami-warning systems were considered as the most important results of the projects. Although since 1998, new tsunami-related projects have been presented; none have been accepted by the European Commission. The European Commission decreased the interest in the tsunami Programme development in spite of the fact that tsunamis present a continuing threat to the European coastal community. The last large earthquake in Turkey in 1999 generated a tsunami. The Delegate of France mentioned that the tsunami warning centre, using the data from three TREMORS stations located in France, Portugal and Madeira, has been in operation continuously since 1998. Tsunami warning systems continue to be operational in some other European countries.

139 The experience gained in the Pacific region is very useful for the European national and regional institutions, involved in tsunami mitigation programmes.

140 The Group noted that the Portuguese authorities are organizing a Tsunami meeting in Lagos, Portugal in November 2001 with the support of the European Commission. The ICG/ITSU Chairman was invited to give a talk at the meeting on the IOC Tsunami Programme. **The Group advised** the Chairman to bring to the meeting the Group's concerns related to possible termination of Europe-wide Tsunami Programme within the EU activities. **It was emphasized** that a reduced tsunami research effort in any tsunamigenic region of the world ultimately affects all regions, as knowledge through this research usually benefits all regions.

141 The Group recalled that at its last session, Australia and Indonesia were invited to co-ordinate their activities in the development of an Indian Ocean Warning System.

142 The Delegate of Indonesia reported that in the last three-four years there have been several informal contacts between Indonesian and Australian scientists on the possibility of establishing international co-operation in the area of research and mitigation of tsunamis occurring in the Indian Ocean. The two sides are willing to bring the contacts to institutional and governmental levels. For this purpose he recommended to organize a meeting between the two sides, Indonesia and Australia, to have more detailed discussion on the implementation of the ideas. The meeting was proposed to be held in 2002 either in Australia or in Indonesia.

143 **The Group noted** that in 2003, the 120th anniversary of the 1883 Krakatau volcanic eruption and tsunami will be commemorated **and recommended** having an International Tsunami Workshop 2003 in Indonesia. Having the Workshop in Indonesia may help in raising awareness of the tsunami threat for the region and facilitate the establishment of the warning system in the Indian Ocean. It is expected that partial

support will be provided by IUGG and IASPEI. **The Group invited** the IUGG Tsunami Commission's Chairman to expose the interest of these organizations to sponsor the Workshop and inform the Chairman of the results of the contacts.

144 The Delegate of Nicaragua informed the Group that in 1999 the Centre for Disaster Prevention in Central America (CEPREDENAC) asked Nicaragua to develop a Regional Tsunami Warning Centre for Central America. The responsible institution for this task in Nicaragua, the Instituto Nicaraguense de Estudios Territoriales (INETER), decided to resolve this task in the following way:

- To develop the National Tsunami Warning System in Nicaragua, which would also emit tsunami warnings to all Central American countries, but will not have a formal responsibility for doing this.
- On the basis of experience gained by the National Tsunami Warning System of Nicaragua, to elaborate a project proposal for a Regional Tsunami Warning Centre (RTWC). It is expected that the National TWS will be developed at the end of 2002. At the same time a project proposal for the RTWC would be prepared.

145 The Group recognized efforts made by Nicaragua and the progress achieved in Nicaragua and Central America in the establishment of a National and Regional Tsunami Warning System (RTWC). **The Group expressed** readiness to support the CEPREDENAC through sharing experience and providing training.

9. EXISTING PARTNERSHIPS AND OPPORTUNITIES FOR NEW ONES

9.1 CO-OPERATION WITH THE IUGG TSUNAMI COMMISSION, CONCLUSIONS OF MOSCOW AND CARTAGENA WORKSHOPS AND FOLLOW-UP

146 The Chairman of the IUGG Tsunami Commission (IUGG/TC) informed the Group on the activity of the IUGG/TC with the focus on the joint IUGG-ICG/ITSU efforts.

147 The International Workshop '*Tsunami Risk Assessment Beyond 2000: Theory, Practice and Plans*' took place in Moscow, Russia from 14-16 June 2000. This was the second workshop in a series of three workshops organized jointly by the IUGG/TC and the ICG/ITSU in compliance with the recommendation of ITSU-XVI and of the Master Plan for the further development of the tsunami programme in the years after 2000. The Workshop was attended by 55 participants from 11 countries - Belarus, Bulgaria, Chile, France, Greece, Japan, New Zealand, Russian Federation, Turkey, Ukraine and the USA. The main purpose of the Workshop was to consider the present situation with the long-term tsunami risk and hazard assessment (tsunami zoning of the coast) in the Pacific and other regions (Caribbean, Mediterranean), and to analyse the existing tsunami hazard maps in order to identify the ways for the improvement of their quality and reliability. Specific topics discussed during the Moscow Workshop were: historical tsunami catalogues and databases; paleotsunami research; seismotectonics of tsunamis; tsunami generation and propagation effects; tsunami modelling techniques; methods of tsunami risk calculation; and tsunami risk mitigation and counter-measures.

148 In his presentation, the Chairman of the IUGG/TC highlighted several recommendations closely related to ICG/ITSU activity (databases development, web-access to historical data, risk assessment methodology) with the emphasis on those of them that have been already implemented (Doc. IOC/ITSU-XVIII/18). The selected papers presented at the Moscow Workshop were published by the Shirshov Institute of Oceanology as a volume of the Workshop Proceedings. It was distributed among the participants of the Session.

149 The Third Joint IUGG/TC-ICG/ITSU Workshop '*Tsunami Mitigation Beyond 2000*' was organized in Cartagena, Colombia from 5-6 October 2001 in conjunction with the Eighteenth Session of the ICG/ITSU. The Cartagena Workshop was mainly oriented on practical methods of tsunami mitigation and was of interest to a wide community of researchers, emergency managers, decision makers and other practitioners dealing with assessment and mitigation of the tsunami hazard. The Workshop was attended by 49

participants from 11 countries - Canada, Chile, Colombia, Ecuador, France, Indonesia, Japan, Korea (Republic of), Peru, Russian Federation and the USA. The objectives of the Cartagena Workshop were: to review state-of-the-art knowledge on tsunami mitigation and preparedness; to exchange national experiences on the development of counter-measures; and to formulate recommendations on the actions required for tsunami disaster reduction. Twenty-six papers were presented in three half-day sessions. One of these was in Spanish and dedicated to the presentations of experts from South and Central American countries.

- 150 A volume of the Workshop abstracts was printed by the local organizers and distributed among the Workshop participants. Five recommendations were discussed and adopted (Doc. IOC/ITSU-XVIII/19). It was decided that the full text of the papers presented at the Workshop would be posted on the ITIC website. The participants were requested to send their presentations in a computer readable form to Cmdr. R. Nunez, Associate Director of ITIC by the end of November. He will be in charge of their compilation and posting on the ITIC website. The recommendations adopted by the Moscow and Cartagena workshops are presented in Annex VII.
- 151 The Chairman of the IUGG Tsunami Commission also informed the Group on the results of the last IUGG/TC business meeting that took place in Seattle, USA, in 2001, in conjunction with Nineteenth International Tsunami Symposium. He brought to the attention of the Group to the Recommendation adopted at this meeting:
- 152 *“The IUGG Tsunami Commission is concerned about the lack of a system for the collection of data for the recent tsunamigenic events in the Pacific. The Commission recommends that ICG/ITSU direct ITIC to collect these data and put them on the Tsunami Bulletin Board within one month of the event. The Commission offers to assist ICG/ITSU in the formulation of guidance for collecting these data”.*
- 153 **The Group expressed satisfaction** with the results of co-operation with the IUGG Tsunami Commission **and stressed** that joint projects are beneficial both for the research tsunami community in different countries and for the operational community in the ITSU Member States. The Joint ICG/ITSU and IUGG/TC Projects TIME and HTDB/PAC proved to be very successful activities, the products and results of which are widely used by the Member States.
- 154 The Chairman of the ICG/ITSU in his capacity of a Co-Convener of the Moscow and of the Cartagena workshops revised the recommendations of both meetings. The Group noted that some of the recommendations have already been discussed under different ITSU-XVIII Agenda items and the way for their implementation has been identified. Some recommendations as, e.g., the access of the database, have already been implemented.
- 155 **The Group agreed** that the Recommendation on the development of an International Standard Set of Symbols and Signs is a very important issue and is pertinent to the ICG/ITSU mandate. The roundtable survey organized by the Chairman showed that the symbols and signs have already been developed in at least five countries present and their experience will be useful for working out international standards.
- 156 **The Group recommended** the establishment of an ad hoc intersessional study group consisting of experts from Canada, Chile, Colombia, ITIC and Peru under the Chairmanship of the ITSU Past Chairman, Mr. H. Gorziglia, to address the issues. The Chairman of the IOCARIBE Tsunami Steering Group of Experts, Prof. G. Maul, also expressed interest to contribute to the work of the *ad hoc* group.
- 157 **The Group adopted** Recommendation ITSU-XVIII.2 containing the Terms of Reference of the *Ad hoc* Working Group **and requested** the Chairman to report the progress to the ITSU Officers meeting, planned for the beginning of 2003 and present the results to ITSU-XIX. It was agreed that the *ad hoc* Working Group will work by correspondence.

9.2 POST-IDNDR DEVELOPMENTS

158 The IOC Technical Secretary reminded the Group that the International Decade for Natural Disaster Reduction (IDNDR) came to an end in December 1999. The Decade was successful in achieving substantial progress in natural disaster reduction at all levels and the ICG/ITSU contributed to this success. The IOC Tsunami Programme helped in advancing national disaster reduction efforts and assisted in developing preventive measures.

159 The IDNDR was succeeded by the International Strategy for Disaster Reduction (ISDR) as an international programme. The main objective of ISDR is to enable communities to become resilient to natural hazards and to proceed from an approach of protection against hazards to the management of risk. It is structured around four main themes for action: public awareness, community and public authority commitment, disaster resilient communities and the reduction of socio-economic loss. All these themes are part and parcel of the IOC Tsunami Programme.

160 The Technical Secretary then informed the Group of the decision of the Twenty-first Session of the IOC Assembly *“to establish a process for developing a strategy for the role of IOC in natural disaster reduction as a contribution to the ISDR. It was agreed that it would be desirable to clearly specify the needs and requirements of Member States in natural disaster preparedness and mitigation”*

161 **The Group expressed readiness** to contribute to this process **and recommended** to establish close links with the ISDR Secretariat. It was noted that many IOC Tsunami Programme activities fit well into the main principle of IDNDR – from disaster response to disaster preparedness. **The Group invited** its Chairman and the Technical Secretary to contribute to the development of a specific work plan for collaboration with ISDR. The Chairman was requested to provide ISDR through the IOC Executive Secretary with regular reports on the Group’s activities and system development. These reports should also be circulated to the ITSU National Contacts for information and contribution.

9.3 WORLD DATA CENTRE-A, SOLID EARTH GEOPHYSICS DEVELOPMENT RELATED TO TSUNAMIS

162 Dr. V. Gusiakov, in his capacity as the Co-ordinator of the HTDB/PAC Project, informed the Group on the relation of the HTDB/PAC database with the tsunami database supported by NGDC/NOAA. Both databases are based on a similar set of data sources (published tsunami catalogues, scientific articles, witness and mass media reports), have similar structure and data format, but differ in values of some parameters for particular events (such as tsunami intensity or validity of events), as well as in the level of detail and completeness for different geographical areas.

163 While ICG/ITSU and NGDC/NOAA may continue to hold two distinct tsunami databases, it looks reasonable to develop a joint product that could represent the standardized and unified set of historical data on Pacific tsunamis. The benefits of having such a single, unified product are straightforward. First, this product could help to reduce possible confusion for end-users looking for a reliable source of information on the historical tsunamis in the Pacific. Second, in the process of preparation of the joint product, many discrepancies and uncertainties in parameters of historical tsunamigenic events still existing in both databases could be resolved. In addition, the WDC-A has an effective and widely known distribution system through which the Pacific tsunami database will reach more users in a wider range of disciplines.

164 **The Group acknowledged** the importance of having a single unified source of historical tsunami data for the Pacific **and supported** the proposal put forward by the HTDB/PAC Project Co-ordinator to seek the possibility to make a joint NGDC/NOAA - ICG/ITSU – IUGG/TC product that could be published as a joint CD-ROM

165 **The Group requested** the Chairman to write a letter to the Director of NGDC/NOAA explaining the benefits of such a joint enterprise and requesting him to consider the possibility of making a joint NGDC/NOAA - ICG/ITSU – IUGG/TC CD-ROM on Pacific tsunamis.

9.4 CO-OPERATION WITH OTHER ORGANIZATIONS

166 The Delegate of France informed the Group that during the last Congress organized by the European Geophysical Society, a special session was conducted on tsunami research. The French, Russian and Italian experts participated in that event. The Chairman of the ICG/ITSU will be informed and certainly involved in the organization of the next meeting.

167 The Technical Secretary informed the Group on the creation of the World Agency of Planetary Monitoring and Earthquake Risk Reduction (WAPMERR) and on the participation of its experts in the last Session of the IOC Assembly in July 2001. The main goal of the Agency is to reduce the impact of natural and technogenic disasters on human life and health, as well as property. This goal is achieved by the Agency through:

- monitoring efforts to estimate the potential for earthquakes and other natural disasters;
- rapid detection of technogenic disasters;
- forecasting possible impacts of natural and technogenic disasters;
- assessment and mitigation of risks.

168 At the IOC Assembly, the Agency expressed interest to co-operate with IOC in the Tsunami Programme and provide its technologies, results of space monitoring and GIS (WAVELET) for the programme purposes.

169 **The Group noted** with interest the information provided by the Technical Secretary **and recommended** that exchange of information be organized between the Agency and the ICG/ITSU in order to identify areas of common interest.

170 The Delegate of Chile informed that a project '*Analysis of the Economic Benefits of the Provision of Hydrographic Services in the APEC Region*', endorsed by the APEC Transportation Working Group meeting (TPT-WG-17) in Singapore in March 2000, and by the APEC Ministerial Meeting of 12-13 November 2000 in Brunei, is being conducted under the guidance and oversight of the APEC Transportation Working Group and by Australia as the Project Overseer. The United States is co-sponsoring the project.

171 **The Group thanked** the Delegate of Chile for the information **and tasked** the Chairman of ICG/ITSU to contact APEC and explore its willingness to conduct a similar project oriented on '*Analysis of the Economic Benefits of the of Tsunami Warning Centers Operations in the Provision of Tsunami Warnings in the APEC Region*'. A study of an economic impact of tsunamis as a natural hazard, on coastal communities and their economies, could be a part of this project. The findings will be reported to ITSU-XIX.

10. PROPOSALS FOR FUTURE PROJECTS

172 Under this Agenda item, the Group considered Document IOC/ITSU-XVIII/20 containing proposals submitted by the USA (Tsunami: Reduction of Impacts through Three Key Actions (TROIKA)) and the Russian Federation (Spatial and Temporal Periodicity in the Pacific Tsunami Occurrence; and Development of a series of scientific popular books under general title 'Pulse of the Earth and Ocean').

173 The USA presented a proposal 'Tsunami Reduction of Impacts through Three Key Actions' (TROIKA) authored by Dr. E.N. Bernard. The proposal emphasizes three essential components required to effectively lessen the impact of tsunamis: hazard assessment, mitigation and warning guidance. It points to the example of the town of Aonae on Okushiri Island, Japan, where having these components in place saved 85% of potential victims in the 1993 tsunami. The proposal built on the idea recognized by the IDNDR that the scientific and technological capabilities to better mitigate hazards exist if only they were applied more widely.

174 Activities proposed within the project include: hazard assessment – production of inundation maps for local and distant tsunamis based on numerical simulations; mitigation – development of emergency response plans, posting of evacuation route signs, and development of educational programmes; and warning guidance –

development of global network of tsunami detection buoys. The proposal is global in scope and it builds on the experiences gained in the US National Tsunami Hazard Mitigation Plan (NTHMP).

175 The Group noted that the US Tsunami Warning and Mitigation Programme over the past five years has been well planned and executed. As a result, the United States is now much better prepared to respond to large earthquakes, which occur in the Northeast Pacific. The proposal to expand this programme to all tsunamigenic regions of the world is a bold initiative, which definitely deserves full support.

176 Noting that ICG/ITSU cannot be an effective funding source for this proposal, **the Group** nevertheless, **was of the general opinion** that the encouragement of the proposal may help in the solicitation of funds. **The Group also invited** the ICG/ITSU Member States to support the proposal through in-kind contributions to some components of the project (e.g., numerical modelling).

177 The Delegate of the Russian Federation presented a proposal on the Spatial and Temporal Periodicity in the Pacific Tsunami Occurrence. **The Group thanked** the Delegate for his interesting presentation **and encouraged** the scientists of the Russian Federation to continue their investigations and inform the Group of the results at the next Session.

178 Dr. E. Sassorova from the Russian Federation presented a proposal on a series of the scientific popular books. The Group noted that in the list of books proposed, there were many topics, which are not within the mandate of the ICG/ITSU and chapters of the first volume focused primarily on the results of research carried out by Russian scientists. **The Group decided** to come back to the proposal after the first volume related to tsunamis is published and demonstrated at the next session.

179 The Delegate of Chile shared his large experience in developing educational material. He expressed readiness to send Russia the artwork of the earthquake and tsunami textbooks, to include the captions in Russian, and offered to publish them on the website and on a CD-ROM at no cost to the IOC. He proposed that a training course on HTDB planned in Chile would be a good opportunity to verify the textbooks. The Group appreciated the offer from Chile and accepted the way of managing this issue.

11. FUTURE OF THE IOC TSUNAMI PROGRAMME

11.1 EVALUATION OF THE TSUNAMI PROGRAMME

180 The Technical Secretary referred the Group to the results of the External Evaluation of the IOC implemented by the Team of External Experts during 1999-2000. *Inter alia*, the External Evaluation Team noted that it is timely to examine the tsunami programme and to determine what should be the responsibility of benefiting Member States and what would be the most useful role for IOC. The Technical Secretary pointed out that the evaluation is understood as a set of activities that allows a systematic collection and analyses of information on the tsunami programme so as to bring a value judgment on the results and impact. The results of the evaluation will help to give a consolidated and comprehensive programme review, increase confidence of Member States in the programme and provide a solid and sound basis for the future of the programme.

181 **The Group acknowledged** the need for the programme evaluation **and agreed** that it should be carried out by a team of external experts knowledgeable in the tsunami programme and the work of international organizations. **The Group invited** Mr. M. Blackford, who will be retiring from the post of the ITIC Director in December this year, to lead the team. The names of the experts from Canada, USA and Chile were mentioned as potential team members. **The Group requested** its Chairman, jointly with the ICG/ITSU Officers, to finalize the list of candidates to the team and invite them to collaborate with the Team Leader in the evaluation process. **It was recommended** that the team should be of three-four persons and that some financial support be provided for its operation. **It was further recommended** to seek the interest of ISDR in joining the evaluation process. The Technical Secretary was requested to provide the Team Leader with available material related to the evaluation process. The evaluation should be completed in advance of and reported to ITSU-XIX.

11.2 EXPANSION OF THE RESPONSIBILITIES OUTSIDE THE PACIFIC

182 The Group decided to postpone the discussion of this item until the results of the evaluation process are known.

12. OTHER BUSINESS

183 The Group considered the increase of interest to the tsunami Programme among the IOC Member States not only in the Pacific but in other geographical areas as well. The number of users of the programme services and products is increasing to include the research community, emergency institutions, relief agencies, the public at large, insurance companies and different industries.

184 The Group thought that it would be beneficial to establish close links of co-operation with the private sector and start interacting with them without losing the Group's independence.

185 **The Group recommended** that this issue be considered by the Evaluation Team and proposals for collaboration be formulated.

13. PROGRAMME AND BUDGET FOR 2002-2003

186 The Technical Secretary informed the Group of the expenditures made during the years 2000-2001 to meet the decisions of ITSU-XVII on programme activities. The financial support for the programme from the Regular Fund of UNESCO, while still insufficient to support all projects, has continued to increase slightly, and was US\$ 58,000 for the 2000-2001 Budget period. In spite of the fact that the IOC Governing Bodies have declared the IOC Tsunami Programme one of the flagship programmes, it is still strongly under funded. As the IOC External Evaluation Team stated in its Evaluation Report "*The resources allocated to manage the ITSU Programme have never been generous*".

187 On the other hand, the Technical Secretary expressed his satisfaction with the ICG/ITSU Member State contributions to the Programme. In response to the IOC Circular Letter N^o. 1658 of 15 June 2000 from the IOC Executive Secretary, the Member States of the Pacific were invited to make a generous contribution to the IOC Trust Fund for the implementation of the IOC Tsunami Programme. Annex VIII contains the table of expenditures and resources available for the years 2000-2001.

188 **The Group expressed full endorsement** on the ways funds have been spent. **The Group expressed thanks** to the governments of those countries who supported the Tsunami Programme through the Trust Fund arrangements (Australia, Chile, France, Republic of Korea, New Zealand and the USA) **and expressed** hope that other countries of the Pacific will follow this example of support. **The Group requested** its Chairman **and invited** the Executive Secretary IOC to issue without delay, a joint Circular Letter informing the IOC Member States on the status of the Circular Letter N^o. 1658's implementation, and urging Member States to continue efforts in supporting the programme.

189 The Chairman of the Intersessional Working Group on the Programme and Budget for 2002-2003 introduced the findings of his group. **The Group adopted Recommendation ITSU-XVIII.3** containing the programme activities endorsed during the Session and estimate of funds needed to implement them successfully. **The Group noted** that based on previous funding, there may be a big deficit in what is planned for the implementation and potentially available funding.

190 **The Group invited** its Member States, Officers and the Secretariat to spare no efforts in looking for additional funds. **The Group re-emphasized** the fact that any expansion of the Tsunami Programme to other regions or increasing funding of other natural disaster reduction IOC activities will hamper the programme implementation if no additional funding is provided. **The Group expressed hope** that the IOC Executive Secretary will be able to find additional support to the programme from the Budget envisaged for TEMA and regional activities implementation.

14. DATES AND PLACE FOR ITSU-XIX

191 **The Group welcomed** the kind offer of New Zealand to host the next session of ICG/ITSU. The Representative of New Zealand, Mr. M. O'Leary, provided an extremely interesting and informative presentation in both Maori and English on the people and culture of New Zealand; its geographical location and the commitment of the Government to an effective natural hazard mitigation programme. At the conclusion of his presentation, Mr. O'Leary presented each Delegation with a calendar showing the many beautiful and varied landscapes of his country.

192 **The Group gratefully accepted** the offer of New Zealand to host the Nineteenth Session. The meeting will be held in Wellington and will be hosted by the Ministry of Civil Defense and Emergency Management. It is presently anticipated that this meeting will occur in October 2003.

193 **The Group requested** the Chairman to consider ways of involving the IOC/WESTPAC Regional Office in the invitation process for the Nineteenth Session. It was further requested that SOPAC also be involved.

194 **The Group recommended** that the next Officers meeting be held in Honolulu in the first months of 2003.

15. ADOPTION OF THE SUMMARY REPORT AND RECOMMENDATIONS

195 The Group reviewed the draft recommendations and the draft Summary Report and adopted them as herein presented. The Group requested the ICG/ITSU Chairman and the IOC Technical Secretary to prepare an Action Sheet based on the ITSU-XVIII decisions by the end of 2001 and make it available to all Member States and ITSU-XVIII participants.

16. CLOSURE

196 The Group noted that Mr. Blackford, the ITIC Director since 1996, would be retiring as of 31 December 2001. The Group thanked Mr. Blackford for his contributions to the Programme's success and in facilitating co-operation between scientists of the Pacific countries and presented him with tokens of their esteem.

197 The Chairman thanked all the delegates for their hard work in meeting the Session's objectives. He invited the ICG/ITSU Member States to participate more actively in the intersessional activities and in the Session's discussions. He expressed a strong belief that the success of the programme to a large extent depends on the efficiency of the ITSU National Contacts and their continuous involvement in the Tsunami Programme activities.

198 The Chairman declared the Meeting closed at 18:30 on 11 October 2001.

ANNEX I

AGENDA

1. **OPENING**
2. **ORGANIZATION OF THE SESSION**
3. **PROGRESS IN THE PROGRAMME IMPLEMENTATION**
 - 3.1 REPORT OF THE CHAIRMAN
 - 3.2 NATIONAL REPORTS
 - 3.3 ITIC DIRECTOR'S REPORT
4. **PROGRAMME MATTERS IN LIGHT OF THE INTERSESSIONAL ACTIVITIES**
 - 4.1 COMMUNICATION PLAN AND OVERVIEW OF THE WARNING SYSTEM
 - 4.2 RECENT TECHNOLOGICAL DEVELOPMENTS
5. **IMPLEMENTATION OF ITSU-XVII RECOMMENDATIONS**
 - 5.1 WARNING CENTRE BULLETINS
 - 5.2 CD-ROM AND WEB VERSION OF THE BASIC PACIFIC TSUNAMI CATALOGUE AND DATABASE
6. **TRAINING AND EDUCATION**
7. **PREPAREDNESS FOR AWARENESS OF THE TSUNAMI DANGER**
 - 7.1 TSUNAMI NEWSLETTER
 - 7.2 TSUNAMI PRESS KIT
 - 7.3 TSUNAMI GLOSSARY
 - 7.4 TSUNAMI WEBSITES
8. **SUB-REGIONAL TSUNAMI WARNING SYSTEMS**
 - 8.1 FAR EAST TSUNAMI WARNING CENTRE
 - 8.2 IAS TSUNAMI WARNING SYSTEM
 - 8.3 OTHER REGIONS
9. **EXISTING PARTNERSHIPS AND OPPORTUNITIES FOR NEW ONES**
 - 6.1 CO-OPERATION WITH THE IUGG TSUNAMI COMMISSION, CONCLUSIONS OF MOSCOW AND CARTAGENA WORKSHOPS AND FOLLOW-UP
 - 6.2 POST-IDNDR DEVELOPMENTS
 - 6.3 WORLD DATA CENTRE-A, SOLID EARTH GEOPHYSICS DEVELOPMENT RELATED TO TSUNAMIS
 - 6.4 CO-OPERATION WITH OTHER ORGANIZATIONS
7. **PROPOSALS FOR FUTURE PROJECTS**
8. **FUTURE OF THE IOC TSUNAMI PROGRAMME**
 - 11.1 EVALUATION OF THE TSUNAMI PROGRAMME
 - 11.2 EXPANSION OF THE RESPONSIBILITIES OUTSIDE THE PACIFIC
9. **OTHER BUSINESS**
10. **PROGRAMME AND BUDGET FOR 2002-2003**
11. **DATES AND PLACE FOR ITSU-XIX**

12. ADOPTION OF THE SUMMARY REPORT AND RECOMMENDATIONS

13. CLOSURE

ANNEX II

LIST OF RECOMMENDATIONS

Recommendation ITSU-XVIII.1

SEA LEVEL ENHANCEMENTS

The International Co-ordination Group for the Tsunami Warning System in the Pacific,

Recognizing the importance of the network of sea-level gauges used by the PTWC for detecting and evaluating tsunami waves in order to issue, continue, upgrade and cancel tsunami warnings and watches,

Also recognizing the importance of the data from this network for research to better understand the tsunami phenomenon and to verify tsunami simulations,

Being aware of certain gaps in this network that cause significant delays in PTWC's decision-making for warnings, as well as incomplete coverage of data for research,

Noting that to be useful to PTWC for tsunami warning and forecasting, the sea-level data should:

- Be unaliased with a sampling rate no less frequent than one sample every two minutes and ideally one or more samples per minute, and
- Transmit data no less frequently than once per hour and ideally in real-time continuously or triggered by the tsunami into continuous transmission.

Requests that Member States review their existing sea level gauges and the availability to PTWC of the data from those gauges,

Urges Member States to add or upgrade gauges as necessary to achieve a gauge spacing of at least one gauge every 500km along the coast or where possible,

Also urges Member States to consider installing either island gauges or deep ocean sensors such as DART buoys in areas seaward of known tsunamigenic seismic zones,

Encourages Member States to consider multi-use of existing gauges, such as for national tidal networks and for research on long-term sea-level change (e.g., GOOS, the IOC's Global Ocean Observing System) to help ensure the necessary long-term support and maintenance of the gauges.

Recommendation ITSU-XVIII.2

WORKING GROUP ON INTERNATIONAL TSUNAMI SIGNS AND SYMBOLS

The International Co-ordination Group for the Tsunami Warning System in the Pacific,

Noting the Conclusions and Recommendations of the Joint IOC/IUGG Workshop ‘Tsunami Mitigation Beyond 2000’ held in Cartagena, Colombia from 5-6 October 2001;

Recognizing that the recommendations of the Joint Workshop provide an ample opportunity for facilitating co-operation between the IOC/ITSU and the IUGG Tsunami Commission;

Acknowledging the achievements of some Member States in the development of the tsunami danger-related signs and symbols;

Recognizing further the need to establish appropriate internationally standardized and recognized signs and symbols for use in tsunami mitigation which will be an important instrument for contributing to tsunami preparedness and finally to saving human lives and property;

Agrees that a Working Group on International Tsunami Signs and Symbols should be formed with the following Terms of Reference:

- To develop an internationally standardized set of signs and symbols to be used in the field and on tsunami inundation maps, tsunami evacuation maps and educational material,
- To present a preliminary draft to the ICG/ITSU Officers Meeting planned for the beginning of 2003, and
- To present a final draft to the Nineteenth ICG/ITSU Meeting for ICG/ITSU consideration and further approval.

Recommends that the representatives from Canada, Chile, Colombia, Peru and Chairman of the IOCARIBE Tsunami Steering Group of Experts will form the Group, chaired by the Past Chairman of ICG/ITSU, Mr. H. Gorziglia.

Recommendation ITSU-XVIII.3**PROGRAMME OF WORK AND BUDGET FOR 2002-2003**

The International Co-ordination Group for the Tsunami Warning System in the Pacific,

Recalling that the IOC Tsunami Programme was identified by the IOC Governing Bodies as a high priority and flagship programme of the Commission, being an unique programme within the IOC fully dedicated to the co-ordination of an operational natural hazard warning system with the goal of reducing the tsunami danger and its impact on coastal communities;

Appreciating highly the support of Australia, Chile, France, New Zealand, the Republic of Korea and the USA provided to the IOC Tsunami Programme in 2000-2001 through Trust Fund contributions and **acknowledging** in-kind contributions of Member States;

Taking into account discussions, which took place during the Eighteenth Session of the ICG/ITSU regarding the programme activities and agreed upon priorities for 2002-2003;

Being informed of the IOC Programme and Budget for 2002-2003 adopted by the Twenty-first Session of the IOC Assembly held in Paris in July 2001;

Adopts the following ICG/ITSU Programme for 2002-2003 and identifies required resources;

- i. Assistance to the International Tsunami Information Centre (ITIC) for its continuing activities and fulfilling its obligations to the ICG/ITSU during 2002-2003.
 Budget: 2002 US\$ 20,000
 2003 US\$ 20,000
- ii. Support to the ITIC Associate Director, including one trip each year to ITIC for briefing and reporting on the accomplishments.
 Budget: 2002 US\$ 3,200
 2003 US\$ 3,400
- iii. Organization of the Nineteenth Session of the Group (ITSU-XIX) in the second half of 2003, in Wellington, New Zealand, and the ITSU Officers Meeting in January 2003 in Honolulu, Hawaii, USA.
 Budget: 2002 US\$ 5,000
 2003 US\$ 25,000
- iv. Participation of ITSU Officers/Experts/Secretariat at meetings of other organizations dealing with issues relevant to the Tsunami Programme and of the ICG/ITSU Chairman at meetings of other bodies,
 Budget: 2002 US\$ 5,000
 2003 US\$ 5,000
- v. Mission of a Chilean expert to Colombia and Ecuador to provide on-site advice to coastal community authorities regarding preparation of tsunami mitigation plans (international travel only).
 Budget: 2002 US\$ 1,800
- vi. Training session in Chile for HTDB regional co-ordinators, in conjunction with the Earth Science Congress in October 2002.
 Budget: 2002 US\$ 20,000

- vii. Tsunami Press Kit finalization.
Budget: 2002 US\$ 8,000
- viii. Preparation and translation of the Tsunami Glossary into French.
Budget: 2002 US\$ 3,000
- ix. Workshop on Local Tsunami Warning and Mitigation in Petropavlovsk-Kamchatsky, Russian Federation in the Fall of 2002.
Budget: 2002 US\$ 20,000
- x. Conference in Indonesia commemorating the 120th anniversary of the Krakatau eruption (place and dates to be identified later).
Budget: 2003 US\$ 20,000

Recognizing further that the IOC Tsunami Programme cannot meet successfully its obligation without an adequate provision of resources;

Invites all Member States to support the Tsunami Programme by following the example of a few Member States contributing directly to the IOC Trust Fund or in-kind by covering operational costs of maintaining the Tsunami Warning System;

Requests ITSU National Contacts to be pro-active in making national authorities aware of the programme and of the benefits of disaster reduction, through risk determination and resource allocation to diminish its impact,

Requests the Executive Secretary IOC to take all necessary measures for providing support to the Tsunami Programme, by allocating the necessary funds and staff, and

Expresses a strong hope that in the light of the importance and priority of the programme, all activities mentioned in the Work Programme for 2002-2003 above, will receive the necessary funding.

Budget Summary

Item	Year 2002 in US\$	Year 2003 in US\$
i.	20,000	20,000
ii.	3,200	3,400
iii.	5,000	25,000
iv.	5,000	5,000
v.	1,800	
vi.	20,000	
vii.	8,000	
viii.	3,000	
ix.	20,000	
x.		20,000
TOTAL	86,000	73,400

ANNEX III

LIST OF PARTICIPANTS

I. MEMBER STATES

CANADA

Mr. F. STEPHENSON
Manager, Geomatics Engineering
Canadian Hydrographic Service
Institute of Ocean Services
P.O. Box 6000
Sidney, B.C. V8L 4B2
Tel: <1> (250) 3 63-6350
Fax: <1> (250) 363-6323
E-mail: stephensonf@pac.dfo-mpo.gc.ca

CHILE

Cmdr. A. YOULTON
Deputy-Director
Servicio Hidrografico y Oceanografico de la
Armada de Chile
Errázuriz 232, Playa Ancha.
Valparaíso
Tel: <56> (32) 266 501
Fax: <56> (32) 266 542
E-mail: ayoulton@shoa.cl

Mr. H. GORZIGLIA (*Past Chairman*)
International Affairs Office
Servicio Hidrografico y Oceanografico de la
Armada de Chile
Errázuriz 232, Playa Ancha.
Valparaíso
Errazuriz 232, Playa Ancha
Tel: <56> (32) 266 506
Fax: <56> (32) 266 542
E-mail: hgorziglia@shoa.cl

Cmdr. R. H NUÑEZ (*Assistant Director ITIC*)
Head, Dept. of Oceanography
Servicio Hidrográfico y Oceanográfico de la
Armada de Chile
Errázuriz 232, Playa Ancha.
Valparaíso
Tel: <56> (32) 266 670
Fax: <56> (32) 266 542
E-mail: rnunez@shoa.cl
URL: <http://www.shoa.cl>

COLOMBIA

Capt. O. MALAVER CALDERON
CAN-Transv. 41 No. 27-50
P.O. Box 28466
Bogota
Tel: <57> (1) 222 0436/449
Fax: <57> (1) 222 0416
E-mail: ccoceano@colciencias.gov.co

Capt. E. CABRERA
Direccion General Maritima
Transv. 41# 27-50
CAN – Bogotá
Tel: 57-1 220 04 90
Fax: 57-1 222 26 36
E-mail: ecabrera@dimar.mil.co

Sr. G. LLANO
Calle 13 #32-69 Edificio Laboratorio Piso 4
Bogota
Tel : (57-1) 364 90 90, Ext. 9731
9813-9735/36
Fax: (57-1) 375 10 77
E-mail: progamas@dgpdp.gov.co

Capt. C. TEJADA
Centro Control Contaminacion del Pacifico
Apartado Aereo 187 - Tumaco
Tel: (57-92) 7272637
Fax: (57-92) 7271180
E-mail: carlos.tejada@hotmail.com

Mr. E. LARIOS REDONDO
Oficina de Prevención y Atención de Desastres
Gobernación de Bolívar
Cartagena
Tel: (57-5) 664 12 48
Fax: (57-5) 664 71 55
E-mail: silviajr@hotmail.com

ECUADOR

Mrs. P. ARREAGA VARGAS
Base Naval Sur
Av. 25 de Julio km 3 ½ via Pto Maritimo
Quayaquil
Tel: <593> (4) 248 11 05/286 14 00
Fax: <593> (4) 2485166
E-mail: tsunami@inocar.mil.ec
Inocar@inocar.mil.ec

FRANCE

Mr. F. SCHINDELE (*Chairman*)
Assistant Director
Departement Analyse, Surveillance,
Environnement
Laboratoire de Géophysique
B.P. 12
91680 Bruyeres-le-Chatel
Tel: <33> (1) 69 26 50 63
Fax: <33> (1) 69 26 70 23
E-mail: schindel@ldg.bruyeres.cea.fr

INDONESIA

Dr. N. T. PUSPITO
Dept. of Geophysics & Meteorology
Bandung Institute of Technology
Jalan Ganeca 10, Bandung 40132
Tel: <62> (22) 252 4142
Fax: (62) (21) 253 4239
E-mail: puspito@geoph.itb.ac.id

JAPAN

Mr. M. TAKAHASHI
1-3-4 Ote-Machi Chiyoda-ku
Tokyo.100-8122
Tel: (81-3) 3212 8341 Ext.4541
Fax: (81-3) 3215 2963
E-mail : mtakahashi@met.kishou.go.jp

KOREA, REPUBLIC OF

Mr. Young-Soon CHO
Director, Earthquake Division, Climate Bureau
Korea Meteorological Administration
460-18 Shindaebang- dong, Dongjak-gu
Seoul 156-720
Tel: <82> (2) 841 7663
Fax: <82> (2) 841 7664
E-mail: choys@kma.go.kr

Dr. Duk Kee LEE
Senior Researcher
Marine Meteorology & Earthquake Research
Laboratory
Meteorological Research Institute
Korea Meteorological Administration
460-18 Shindaebang-dong, Dongjak-gu
Seoul 156-720
Tel: <82> (2)847- 2495
Fax: <82> (2) 847-2496
E-mail: dukkee@metri.re.kr
dukkee@kma.go.kr

NEW ZEALAND

Mr. M. O'LEARY
Readiness Manager
Ministry of Civil Defense & Emergency
Management
33 Bowen st., P.O. Box 5010
Wellington
Tel: (64-4) 473 7663
Fax: (64-4) 473 7369
E-mail: mike.o'leary@dia.govt.nz

NICARAGUA

Mr. W. STRAUCH
INETER, Dirección de Geofísica
Frente a la Policlínica Oriental
Managua
Tel: (505) 2492761
Fax: (505) 2491082
E-mail: wil.gf@ineter.gob.ni

PERU

C de C. J. TEJEDA PEREIRA
Departamento del Medio Ambiente
Direccion de Hidrografia y Navegacion Marina
de Guerra del Peru
Av. Gamarra No. 500 Chucuito-Callao
Lima
Tel:<51>(1)4202 122/4296 019 Ext: 462/6461
Fax: <51> (1) 4202122/4652 995
E-mail: jtejeda@dhm.mil.pe

RUSSIAN FEDERATION

Prof. B.W. LEVIN
Head, Tsunami Laboratory
Shirshov Institute of Oceanology
Russian Academy of Sciences
Sumskoi Proezd 2-3-91 Moscow 113208
Tel: <7> (095) 938 1795
Fax: <7> (095) 938 1931
E-mail: levin@rfbr.ru

USA

Dr. C. McCREERY (Vice-Chairman)
Director, Pacific Tsunami Warning Center
(PTWC)
91-270 Fort Weaver Rd.
Ewa Beach, HI 96706-2928
Tel: <1> (808) 689 8207x301
Fax: <1> (808) 689 4543
E-mail: charles.mccreery@ptwc.noaa.gov

II. ORGANIZATIONS

International Tsunami Information Center (ITIC)

Mr. M. BLACKFORD
Director, International Tsunami Information
Center (ITIC)
737 Bishop St., Suite 2200
Honolulu, HI 96813-3213
USA
Tel: <1> (808) 532 6423
Fax: <1> (808) 532 5576
E-mail: michael.blackford@noaa.gov

Cmdr. R.H. NUÑEZ
Associate Director ITIC
Head, Dept. of Oceanography
Servicio Hidrográfico y Oceanográfico de la
Armada de Chile
Errázuriz 232, Playa Ancha
Valparaíso
CHILE
Tel: (56-32) 26 66 70
Fax: (56-32) 26 65 42
E-mail: rnunez@shoa.cl
URL: <http://www.shoa.cl>
(Also representing Chile)

IUGG Tsunami Commission

Dr. V. GUSIAKOV
Head, Tsunami Laboratory
Institute of Computation Math & Mathematical
Geophysics
Lavrentieva, 6
Novosibirsk 630090
RUSSIAN FEDERATION
Tel: <7> (3832) 34-20-70
Fax: <7> (3832) 34-37-83
E-mail: gvk@omzg.sccc.ru

III. OBSERVERS

Lt. Cmdr. J. REYNA
Jefe División de Hidrografía Centro de
Investigaciones Oceanográficas e
Hidrográficas(CIOH)
Escuela Naval de Cadetes Almirante Padilla
Cartagena
COLOMBIA
Tel : (57-5) 669 53 19
Fax : (57-5) 669 42 97
E-mail : sdihid@cioh.org.co

Ms. A. LORENA QUICENO
Transversal 13ª #116-65 Apto 305
Bogotá
COLOMBIA
Tel: (57-1) 22 00 490 Ext: 2701
E-mail: aquiceno@dimar.mil.co

Dr. E.V. SASSOROVA
Senior Researcher
Shirshov Institute of Oceanology
36 Nakhimov, Sky Prosp
Moscow 117851
RUSSIAN FEDERATION
Tel: <7> (095) 315-2709
Fax: <7> (095) 124-8713
E-mail: sasor@sio.rssi.ru

Dr. M. NOSOV
Physics Faculty, Moscow State University
Vozobyevy Gory
Moscow
RUSSIAN FEDERATION
Tel: (095) 939 3698
Fax: (095) 932 8820
E-mail: psiwc47@phys.msu.su

Prof. J.B. SHEPHERD
Head, Seismic Research
UWI, St. Augustine
TRINIDAD & TOBAGO
Tel: <1-868> 662 4659
Fax: <1-868> 663 9293
E-mail: johnbshepherd@hotmail.com
www.uwisekmic.com

Prof. G.A. MAUL
Professor & Department Head
Marine & Environmental Systems
Florida Institute of Technology
150, West University Blvd.
Melbourne, FL 32901-6988
USA
Tel: <1> (321) 674 8096
Fax: <1> (321) 674 7212
E-mail: gmaul@fit.edu

IV. IOC SECRETARIAT

Dr. I. OLIOUNINE
IOC Consultant
1, rue Miollis
75015 Paris
FRANCE
Tel: <33> (1) 45 68 39 63
Fax: <33> (1) 45 68 58 12
E-mail: i.oliounine@unesco.org

Dr. C. TORO
IOC Secretary for IOCARIBE
IOCARIBE Secretariat
Casa del Marquez de Valdehoyos
Calle de la Factoria, Centro
P.O. Box 1108, Cartagena
COLOMBIA
Tel: <57> (5) 664 6399
Fax: <57> (5) 660 0407
E-mail: iocaribe@col3.telecom.com.co
iocaribe@cartagena.cetcol.net.co

Mr. A. VANNIER
Administrative Assistant
Ocean Services Unit
1, rue Miollis
75015 Paris
FRANCE
Tel: <33> (1) 45 68 39 63
Fax: <33> (1) 45 68 58 12
E-mail: a.vannier@unesco.org

ANNEX IV

LIST OF DOCUMENTS²

Working Documents	Title
IOC/ITSU-XVIII/1 prov.	Provisional Agenda
IOC/ITSU-XVIII/1 add.	Provisional Timetable
IOC/ITSU-XVIII/2 prov.	Annotated Provisional Agenda
IOC/ITSU-XVIII/3	Summary Report (prepared during the Session)
IOC/ITSU-XVIII/4 prov.	Provisional List of Documents (this Document)
IOC/ITSU-XVIII/5 prov.	Provisional List of Participants
IOC/ITSU-XVIII/6	Report of the Chairman of ICG/ITSU on Intersessional Activities
IOC/ITSU-XVIII/7	National Reports on Tsunami-related Activities
IOC/ITSU-XVIII/8	Draft Format Recommendations for National Reports Presentation
IOC/ITSU-XVIII/9	Report of the ITIC Director
IOC/ITSU-XVIII/10	Report on Communication Issues
IOC/ITSU-XVIII/11	Report & Recommendations of the <i>Ad Hoc</i> Working Group on the Language of the ITSU Regional Warning/Watch Messages & the Area of Responsibility of the Tsunami Warning System in the Pacific
IOC/ITSU-XVIII/12	Improvements of Procedures & Criteria for Issuing Warnings, Watches & Cancellations
IOC/ITSU-XVIII/13	Summary of the HTDB Project Implementation
IOC/ITSU-XVIII/14	Training & Education Strategy in Tsunami Mitigation
IOC/ITSU-XVIII/15	Tsunami Press Kit (Draft)
IOC/ITSU-XVIII/16	List of Tsunami Websites
IOC/ITSU-XVIII/17	An Intra-Americas Seas Tsunami Warning System Project Proposal
IOC/ITSU-XVIII/18	Proceedings, Conclusions & Recommendations of the IOC/IUGG Workshop on Long-Term Tsunami Risk Assessment (June 2000, Moscow, Russia)
IOC/ITSU-XVIII/19	Conclusions & Recommendations of the IOC/IUGG Workshop on Tsunami Mitigation Beyond 2000 (5-6 October 2001, Cartagena, Colombia)
IOC/ITSU-XVIII/20	National Proposals for Future Projects
IOC/ITSU-XVIII/21	Expansion of Far East Tsunami Warning Centre functions to the North-western Pacific Area

² This List of Documents is for reference only. No stocks of these documents are maintained, except for the Summary Report.

ANNEX V

**ACTION SHEET - IMPLEMENTATION OF THE DECISIONS OF ITSU-XVII
(As of February 2001)**

Agenda Item	Major Subject	Actions	Responsible	Status of Implementation
2.1	Report of Chairman	Include ITSU-XVI Action Sheet as Annex to ITSU-XVII Summary Report (SR)	IOC	Done. Annex V of Summary Report
2.2	National Reports	Complete K/K Project by end '99	Russia, USA, Japan, IOC	Done. Project completed in 2000
		Provide abbreviated National Report summaries to ITIC in electronic form for publication by 1 Dec. '99	Member States (MS), ITIC, IOC	Done. Vol. XXXI for 01.98/12.99
2.3	ITIC Associate Director	Organize 2 visits of ITIC Assoc. Director to ITIC during 2000-2001. Develop plan of action of the Assoc. Dir. & submit to ITIC & IOC for approval	IOC, ITIC, Assoc. Dir.	Done. Visits implemented in Jul.'00 & Feb.'01
		Invite MS to make proposals for ITIC Assoc. Dir. based on ITIC Director's recommendations	ITIC, IOC	Done. Letter of 9 Jan. 01
3.1	TIME	Provide required funds for TIME Phase-II at level given in Annex VII to SR	MS, IOC	No funds available
3.2	Bathymetry Data	Continue organizing meetings on bathymetric data for tsunami research & operational activities	Chairman ICG/ITSU & IUGG/TC	No need for other meetings. Part. in & Contr. to the related activities
4.1	Communication Plan	Actively participate in monthly communication tests	MS, PTWC	Continuously
		Advertise results of tests through ITIC Newsletter & other means	PTWC	Letter of 5 Feb. 01, repeated on monthly basis (ITSU-XVIII/10)
		Investigate possibility of issuing Spanish version of bulletins	PTWC, ITIC Assoc. Dir.	Bulletins translated in Jul. 2000. PTWC produced Spanish version. ITSU-XVIII decided to have only English text.
		Solicit feedback from MS regarding actions taken in response to warnings	ITIC	Done. Letter of 21 Jul. 2000
4.2	Warning & Watches	Make recommendations regarding information bulletins & PTWC responsibilities	ITIC, <i>Ad hoc</i> WG	Done. Letters sent to each member of WG on 21 Jul. 2000 & Jan. 01.
		Establish WG & make recommendations regarding procedures & criteria for issuing warning & watches, & regarding more precise tsunami forecasting. Report progress to ITSU Officers Mtg. (Jan. 2001)	PTWCC, <i>Ad hoc</i> WG	Done. WG established. Results in ITSU-XVIII/12
4.3	Ocean-Bottom Tsunami Detectors	Develop project proposal with implementation plan & cost estimate	US Rep./E. Bernard	Done. Proposal included in ITSU-XVIII/20
	New Technology Development	Include this item in Agenda of ITSU-XVIII	Chairman IOC	Done. Title 'Recent Technological' changed to 'Developments'
5.	IAS Tsunami Project Proposal	Revise project taking into account latest scientific findings & technology development	Chairman, US Rep., ITIC, Chair IOCARIBE Tsunami Steering GE	Done. Consultant, Chairpersons
		Organize Joint Mtg. of Experts from the Pacific & IAS to review project	Chairman, Chairman IOCARIBE Tsunami St. GE, IOC	Done. Mayaguez, Puerto Rico, 19-21 Dec. 2000

Agenda Item	Major Subject	Actions	Responsible	Status of Implementation
		Invite CEPREDENAC to take part in Mtg.	IOC	Done
		Provide IAS with available educational & awareness material	ITIC	In progress, partly done.
	Far East TWC	Use of Internet for tsunami forecasts dissemination	Japan Rep., ITIC	Procedures being explored.
		Inform China & DPR of Korea of developments & invite them to join system	IOC	Done. 6 Jul. 2000 (IOC letter). Letter sent to China & DPR of Korea
		Try to expand the functions of Centre to other coastal areas in WESTPAC	Japan Rep., Rep. of WESTPAC countries	Progress reported in ITSU-XVIII/21
		Regional Workshop to be organized (provided funds are available)	IOC, ITIC, Japan Rep.	Postponed due to Japan's decision.
	Indian Ocean	Consider development of an Indian Ocean Warning System & report progress to ITSU-XVIII	Australia & Indonesia Rep., ITIC	Informal consultations took place.
		Nominate candidates for Visiting Experts Programme 2000	IOC	Done. IOC sent letter to MS. Indonesian & Philippine experts received training.
6.2	Tsunami Glossary	Publish Glossary in ITIC web site by end Nov.'99	Chairman, ITIC (Dir., Assoc. Dir)	Done in 2000. Continuing
		Provide Nicaragua with necessary graphics materials & photos by Apr.2000	Chairman ITIC	Done with delay.
		Make Spanish translation of Glossary	Nicaragua Rep. with assistance of Chile Rep.	In progress. Will be implemented with IOC support.
		Publish Glossary in multi-coloured booklet form before Jan.2001	Nicaragua Rep., IOC	Publication delayed till Jan.'02
		Make French & Russian translations	IOC	Canada, France & Russia will arrange translations.
6.3	Training & Education	ITIC Course in 2000-2001 for 4 experts	ITIC, IOC	Done. Nov/Dec '00-Sept.'01
		Include information on national training activities in national reports for ITSU-XVIII	All ICG/ITSU MS	ITSU-XVIII Invitation Letter, Feb-Mar. 01. Done. ITSU-XVIII/7
		Put earthquake & tsunami textbooks on ITIC web site	Chile Rep., ITIC (Dir. & Assoc. Dir)	Done partly. Russian text will be on the Web mid-2002.
		Provide Chile with textbooks in electronic form	IOC	Done. Russian version still missing.
		Download textbooks onto master CD-ROM & make copies for all MS. Include other educational materials in CD-ROM , if possible	USA Rep.	Done partly (see above item)
6.4	Tsunami Newsletter	Implement re-structuring of Newsletter & start in 2000 new arrangements as agreed upon by ITSU-XVII	ITIC	Done Vol. XXXII published in 2000. Vol. XXXIII in '01
		Provide necessary information to ITIC for inclusion in new information system regularly & without delay	All ICG/ITSU MS	Letter sent. Response is slow.
6.5	Mass Media	Develop draft of Tsunami Press Kit by Jan.2001	IOC	First draft by ITIC available for Officers Meeting. Textual part approved by ITSU-XVIII

Agenda Item	Major Subject	Actions	Responsible	Status of Implementation
7.1	ICG/ITSU & IUGG/TC Co-operation	Organize Tsunami Workshop in Moscow in first half of 2000	Chairmen ICG/ITSU & IUGG/TC, IOC	Done, June 2000
	Seoul Workshop Recommendations	Inform MS of products developed within HTDB Project & invite them to contact Pacific HQ of US NWS for available software	IOC, USA Rep.	Done.
7.2	ICG/ITSU & IDNDR	Inform IDNDR Secretariat or its successor of decision of ICG/ITSU regarding IOC Tsunami Programme contribution to implementation plan for <i>A Safer World in the 21st Century</i>	IOC	Done. IOC/ISDR consultation took place in Jul.'01
7.3	ICG/ITSU & WDC-A, SEG	Report to ITIC & international community on all sizes of tsunamis	ICG/ITSU MS	Letter of 21 July 2000. Response is slow.
7.4	ICG/ITSU & SOPAC	Invite SOPAC MS to become members of ICG/ITSU	IOC, ITIC, PTWC	Done. PTWC & ITIC Directors had contacts
8.	New Projects	Provide historical data & information to HTDB Project Leader	Regional HTDB Co-ordinators	In progress
		Provide necessary funding for implementation of CD-ROM " <i>Tsunamis in the Pacific, 47 BC-2000 AD</i> " & installation of web version of database	IOC, IUGG/TC Chairman	Done. CD-ROM & manuals are available. Installation of web version done. Installation of mirror site done.
10.	Programme & Budget for 2000-2001	Mobilize resources in support of Tsunami Programme	All ICG/ITSU MS	Request sent by IOC CL.1658, 15 June 2000; reminder sent on 16 Jan. 2001. Good response.
		Implement activities as presented in recommendation	ICG/ITSU Officers, MS, IOC	Done.
		Provide contributions to IOC Trust Fund & in-kind for ITSU Programme	ICG/ITSU MS	Resources received from Chile, France & USA, Australia, New Zealand, and Republic of Korea.
		Provide necessary funds for 2000-2001 programme implementation	IOC	Done partly.
11.	Date & Place for ITSU-XVIII	Send letter to Colombia informing country officials about accepting invitation to host ITSU-XVIII & Tsunami Workshop in Fall of 2001	IOC	Done
		Send letter to New Zealand explaining reasons for not accepting invitation to host ITSU-XVIII & invite them to consider hosting ITSU-XIX	IOC	Done
		Make necessary arrangements & implement ITSU Officers Mtg. in Jan. & ITSU-XVIII in fall of 2001.	IOC, ICG/ITSU Officers	ITSU Officers meeting implemented in Feb. 01. ITSU-XVIII meeting Oct. '01.
12.	ITSU-XVII Summary Report	Prepare final version & send for approval to ICG/ITSU Chairman	IOC	Done. Sent to Officers in Nov. 99

ANNEX VI

NATIONAL REPORT FORMAT

1. RECOMMENDATION

National reports, presented by the Member States of ITSU for the bi-annual ICG/ITSU meetings, should follow a standard format. This format should encompass basic information on the current status of any tsunami warning system that may exist in the Member State and any active tsunami mitigation programmes operating within the Member State. The National Report should contain three sections described in Sections 5, 6, and 7 of this document.

2. JUSTIFICATION FOR A STANDARDIZED FORMAT

Nearly all of the National Reports submitted to the ICG/ITSU do not necessarily provide such basic information as: the current National Contact, current procedures on dealing with local tsunami should such a hazard exist for the Member State, or current procedures on dealing with tsunami from a distant source. While such information may seem mundane and not necessary to repeat in each National Report, the mere fact that it is reported should represent an effort on the part of the preparer of the report to research the status of this information to ensure that it is indeed current. This information is very important when it comes to co-ordinating the warning process during events that have the potential to impact the entire Pacific Basin, as well as for events that affect only a limited area.

National Reports that contain basic information on the current status of the tsunami warning system of a Member State will be very useful for the Operations Centre of ITSU, the PTWC, in its effort to keep the ITSU Communications Plan up to date. The information will also be useful for the ITIC in its preparation of the ITIC/ITSU Annual.

3. DEFINITIONS GERMANE TO THIS DOCUMENT

National Contact: A person officially designated to represent a Member State of ITSU. This person may hold a specific position or office within the Member State with duties that require this person to be the National Contact. The person also may be an ordinary citizen of the Member State who has been designated by the Member State.

Primary Warning Recipient: The person, agency or organization within a Member State that has primary responsibility for receiving and acting upon Tsunami Warning/Watch or Information messages from the ITSU Operations Centre, the PTWC.

Tsunami Advisor(s): The person or persons responsible for advising Member State emergency managers on the appropriate action to be taken with regard to messages received from the PTWC.

Emergency Manager(s): The agency or agencies within the Member State that have primary responsibility for mitigating the effects of tsunami by evacuation or other means during a tsunami event.

Local tsunami: A tsunami with travel times from the source area to affected areas of less than two hours.

Distant tsunami: A tsunami with travel times from the source area to affected areas of two hours or more.

4. BASIC INFORMATION

National Contact: The name, postal address, e-mail address and all telephone numbers - voice, facsimile and cellular - should be listed as completely as possible. The National Contact's affiliation should be given.

Primary Warning Recipient: The name of the person, agency or organization that has primary responsibility for receiving and acting upon messages from the PTWC should be given. The postal address, e-mail address and all public telephone numbers - voice, facsimile and cellular - should be listed as completely as possible. Emergency telephone information should be restricted and be provided only to the PTWC for the Communications Plan.

Tsunami Advisor(s): The person, committee or agency that emergency management relies upon for advice on tsunami mitigation actions during events should be identified.

Emergency Management: The primary emergency management agency should be identified. It is not necessary to list all agencies within a Member State that may be involved in tsunami mitigation procedures during events in the Basic Information section of the National Report. Such information could be contained in the Narrative section of the Report.

Local Tsunami Procedures (if a local tsunami hazard exists): A concise statement that addresses the following questions: What organization, operating 24 hours per day, 7 days per week, identifies and characterizes events that have the potential to generate local tsunami that may be destructive in the immediate source area? What is the threshold for declaring a potential local tsunami emergency? What organization acts on the information provided by the agency responsible for characterizing the potential local tsunami threat? How is the emergency situation terminated?

Distant Tsunami Procedures: A concise statement that addresses the following questions: What organization, operating 24 hours per day, 7 days per week, becomes aware of the possibility of a tsunami threat from a distant source? (This could be the primary warning recipient or an organization capable of identifying and characterizing events in the far field that have the potential to generate a tsunami.) What action does this organization take with regard to the information on a potential tsunami from the distant source? What are the criteria for initiating tsunami mitigation procedures?

5. SUMMARY

A statement of no more than one page in length that addresses all items discussed in the Narrative section of the National Report is included in the Summary. The Summaries of all National Reports will be published in the Tsunami Newsletter of the ITIC and be posted on the ITIC website, if they conform to the page length criteria.

6. NARRATIVE

The Narrative section of the National Report is the place where more detailed descriptions of innovations or modifications to the Member States' tsunami warning procedures or operations since the previous National Report may be discussed. Tsunami research projects that have a bearing on tsunami mitigation may also be described in this section. Descriptions of public education programmes or other measures taken to heighten awareness of the tsunami hazard and risk are also appropriate for this section.

ANNEX VII

RECOMMENDATIONS OF THE MOSCOW (2000) AND CARTAGENA (2001) WORKSHOPS

RECOMMENDATIONS OF THE INTERNATIONAL WORKSHOP '*TSUNAMI RISK ASSESSMENT BEYOND 2000: THEORY, PRACTICE AND PLANS*' MOSCOW, RUSSIAN FEDERATION, JUNE 14-16, 2000

In response to the ITSU-XVII recommendations, the International Workshop '*Tsunami Risk Assessment Beyond 2000: Theory, Practice and Plans*' were organized in Moscow, Russia on 14-16 June 2000. This was the second workshop of a series of three workshops organized jointly by the IUGG Tsunami Commission (IUGG/TC) and the International Co-ordination Group of the Tsunami Warning System in the Pacific (ICG/ITSU), which complemented the recommendation of the Master Plan for the further development of the tsunami programme in the years after 2000 (Second Edition, April 1999, IOC/INF-1124). The Workshop was attended by 55 participants from 11 countries (Belarus, Bulgaria, Chile, France, Greece, Japan, New Zealand, Russia, Turkey, Ukraine and the USA). The main purpose of the Workshop was to consider the present situation with the long-term tsunami risk and hazard assessment (tsunami zoning of the coast) in the Pacific and other regions (Caribbean, Mediterranean), and to analyse the existing tsunami hazard maps in order to identify the ways for the improvement of their quality and reliability.

Specific topics discussed during the Workshop were:

- historical tsunami catalogues and databases,
- paleotsunami research,
- seismotectonics of tsunami,
- tsunami generation and propagation effects,
- tsunami modelling techniques,
- methods of tsunami risk calculation,
- tsunami risk mitigation and countermeasures.

Analysis of the state-of-the-art of the long-term risk assessment methodology made by the Workshop participants indicate that there is a potential for a significant improvement of its quality and reliability. Based on the presented papers and subsequent discussions, **the Workshop made the following recommendations:**

Databases

A historical tsunami database is one of the key elements of any tsunami risk assessment methodology. A standardized database format should be established and every effort should be made to complete the comprehensive parametric tsunami database for the Pacific and other regions. The existing databases supported by the NGDC/NOAA and the Novosibirsk Tsunami Laboratory (NTL) should be merged into a single database with the worldwide coverage. This worldwide database should contain regionally and nationally co-ordinated event and run-up catalogues, descriptions of tsunami manifestation and resulting damage, digitised and scanned tsunami records, paleotsunami data, tsunami photos and the related bibliography.

Web Access to Historical Data

The access to the historical data can be greatly improved by placing a dataset on a dedicated Website. The NTL is maintaining such a site on the laboratory server for the Pacific (<http://tsun.sccc.ru/htdbpac>) and for the Mediterranean regions (<http://tsun.sccc.ru/htdbmed>). It is

recommended that these sites be mirrored on one of the European and the North America servers to provide the better access to the data for the remote users.

Paleotsunami Research

High-resolution geologic records of pre-historical tsunamis can extend the historical and instrumental records to the recent past, to form longer intervals that are necessary to understand better the present day tsunami hazard. They are important also for filling gaps in historic records and for filling geographic gaps for known tsunamis. Paleotsunami observations are accumulating and need to be quantified, standardized and catalogued. This will require further development of the criteria for evaluating deposits, for identifying sources and for dating deposits. A guide to identify tsunami deposits is still needed, and more field workers need to be trained to study tsunami deposits.

Tsunami Generation Mechanism

The recent studies of the tsunami source mechanism provide the increasing evidence that the submarine slumping may be a leading factor in tsunami generation. The Workshop recommends the identification of coastal regions with high seismicity, strong potential for offshore mass failure, and vulnerable shorelines. Using the experience of the successful TIME (Tsunami Modelling Exchange) Project, it is also recommended that the software be developed that will generate initial conditions for tsunami generation by both co-seismic displacement and mass failure, separately or in combination. It is anticipated that this software will be implemented in the existing modelling software.

Community Model Development

The Workshop recommends that the tsunami scientific community forms a web-based community network in the Internet to exchange easily historical and observational data, results from model simulations, and new scientific discoveries. Such a network would enable tsunami scientists throughout the world to collaborate on the development and testing of numerical models that estimate tsunami risks. Such a network would also provide easy access to the new tsunami risk assessment tools by socially relevant users such as emergency managers, community planners, land use regulators, educators and other interested parties.

Risk Hazard Assessment and Vulnerability Assessment

A) **Hazard Assessment** consists of:

- Assessment of seismic and landslide hazard: prehistorical and historical studies by using the tools of marine geology, paleoseismology, paleotsunaminology, and searching of historical records. This database will be the basis of any attempt to relate the run-up height with return periods.
- Identification and characterization of the local faults and remote tsunamigenic areas with the purpose of estimating the parameters needed as input to the numerical simulations. We also need to identify the areas with a high potential for sub aerial and submarine landslides.
- A thorough search of all available bathymetry and topography for the study area. All this data should be examined and edited based on local knowledge. Special emphasis should be placed on the very near shore bathymetry and shore topography, as well as available information on roughness factors, bottom friction or anything that can lead to wave energy dissipation. This information is now available as 'layers' in GIS software.

- Numerical simulations in order to identify the hazardous areas by means of flood level and maximum current velocities maps. The output from the models should be made available in the GIS compatible format.
- B) **Vulnerability Analysis** should result in obtaining the GIS layers showing population zones, infrastructure information, etc., to estimate what is at risk in the previously identified hazardous areas. These 'layers' should be continually updated.

The resulted **Risk Analysis** should give the estimation of the tsunami risk based on the integration of the results of Part A, with the results of Part B making use of available GIS software.

Mitigation Requirements for Coastal Communities

The tsunami scientific community needs to understand the requirements of the coastal towns to provide reliable scientifically based information to manage tsunami risks. It is recommended that a workshop be held with the coastal town managers to learn their requirements for the mitigation of tsunami risks.

Tsunami Observations

Realizing that the small amplitude trans-oceanic tsunamis can generate damage in the regional and far-field areas, the Workshop recommends that for every large earthquake (with magnitude 7.5 or higher) or when a tsunami is observed or detected, a survey must be made to obtain reliable tsunami data for the historical database. For better understanding the tsunami generation mechanism, it is equally important to confirm that a particular large submarine earthquake was not followed by an observable tsunami.

* * *

CONCLUSIONS AND RECOMMENDATIONS OF THE IOC/IUGG WORKSHOP ON TSUNAMI MITIGATION BEYOND 2000, 5-6 OCTOBER 2001, CARTAGENA, COLOMBIA

In response to the ITSU-XVII recommendations, the International Workshop '*Tsunami Mitigation Beyond 2000*' was organized in Cartagena, Colombia from 5 to 6 October 2001 in conjunction with the Eighteenth Session of the ICG/ITSU. This was the third workshop of a series of three workshops organized jointly by the IUGG/TC and the ICG/ITSU. The focus of the first workshop held in Seoul, Korea in October of 1999 was on the operational aspects of tsunami warnings. The second workshop held in Moscow, Russia in June of 2000 was devoted to the methods of the long-term tsunami risk calculation and hazard assessment. The workshop in Cartagena was mainly oriented on practical methods of tsunami mitigation and was of interest to a wide community of researchers, emergency managers, decision-makers and other practitioners dealing with assessment and mitigation of tsunami hazard. The Workshop was attended by 35 participants from 11 countries (Canada, Chile, Colombia, Ecuador, France, Indonesia, Japan, Peru, Republic of Korea, Russia and the USA). These workshops complement the recommendations of the Tsunami Master Plan of the further development of the tsunami programme in the years after 2000 and assist in developing regional tsunami mitigation programmes, e.g., in the Intra-America Sea region.

The objectives of the Cartagena workshop were: to review state-of-the-art knowledge on tsunami mitigation and preparedness; to exchange national experiences on the development of countermeasures; to formulate recommendations on the actions required for tsunami disaster reduction.

Among the topics discussed during the Workshop were:

1. Tsunami mitigation and risk
 - national mitigation programmes,
 - determination of tsunami risk,
 - tsunami inundation maps as a tool for tsunami preparedness,
 - analysis of tsunami data accessibility and completeness,
 - tsunami in Colombia and South America,
 - role of the ICG/ITSU in co-ordinating of tsunami programme in the Pacific,
 - national system in Colombia,
 - community education for disaster prevention,
 - tsunami inundation maps in Colombia,
 - lessons and experience from the 2001 El Salvador in Chile,
 - 23 June 2001 earthquake and tsunami in Southern Peru.
2. Tsunami seismotectonics and related phenomena
 - research activities and national seismograph network in Korea,
 - historical tsunami catalogues and databases,
 - temporal regularities in the Pacific tsunami occurrence,
 - tsunami mitigation and source process validity,
 - rapid determination of focal mechanism,
 - hydro-acoustic signals from near-shore submarine earthquakes,
 - numerical modelling of landslide generated tsunamis,
 - tsunami hazard in the Marqueses Islands.

The following resolutions were discussed and adopted by the Workshop:

1. International Tsunami Standardized Symbols and Signals

Evacuation routes, dangerous areas, safe meeting areas, as well as other information must be indicated in the field, as well as on different types of maps prepared especially for tsunami preparedness, risk evaluation and other needs. This information should be presented by means of internationally standardized and recognized appropriate symbols and signage. Therefore, the Workshop participants recommend:

"The development of an international standardised set of symbols and signage to be used in the field and on tsunami inundation maps, tsunami evacuation maps and others."

2. Institutionalised Tsunami Education

Tsunami education is considered to be of the highest priority and importance for coastal communities living in tsunami-risk areas and for authorities responsible for those areas. This is also valid for visitors that might not be familiar with the phenomena, such as seaside tourists coming from inland areas and tourists on cruise ships. For local tsunamigenic events, proper education for inhabitants of the area, for visitors, and for authorities is critical and vital, as the success of the mitigation of the tsunami hazard will depend on sufficient planning and the correct actions of the public and emergency managers. Therefore, the Workshop participants recommend:

"That tsunami education should be institutionalised, by incorporating knowledge on the phenomena and hazard in general national education programmes and to maintain education and awareness of the tsunami phenomena on a continuous basis."

3. International Natural Hazards Reduction Day

All efforts are needed to keep the general public aware and educated regarding tsunami issues, especially with the risk that coastal communities might face in emergency situations. Acknowledging the existence of an International Natural Hazard Reduction Day, the Workshop participants recommends:

"Official National Tsunami Authorities should take advantage of the existence of the International Natural Hazard Reduction Day, highlighting on that particular occasion the importance of the Tsunami Hazard as a permanent coastal community threat. Mass media could be involved in this effort by disseminating official information provided, such as a Press Kit containing relevant information. By joining with the other hazards recognized on this day, there should be more widespread and regularly repeating opportunity for the dissemination of tsunami education information."

4. Improvements to the Sea-Level Network

Timely sea-level data is critical to PTWC in order to quickly evaluate a potential tsunami and subsequently continue, upgrade, or cancel a tsunami warning. Certain regions in the Pacific, notably the Pacific coasts of Central America and northern South America, and the South-west Pacific, have few or no transmitting sea-level gauges available to the PTWC. Consequently, it may be four hours or longer before the PTWC receives even a single sea-level reading following a potentially tsunamigenic earthquake in those areas. Therefore, the Workshop Participants recommends:

"To urge ITSU Member States, particularly those in the areas named above, to either add transmitting sea level gauges or upgrade existing gauges to be transmitting, and to work with PTWC to ensure that the data are of a quality, form, and availability appropriate for timely and accurate tsunami evaluation by PTWC. In addition, as a way of monitoring progress and to keep an up-to-day list of stations, it is requested that Member States report at each ICG/ITSU session on the status of their sea level instrumentation used for tsunami purposes, including a list of ID codes and the satellite used for the transmission. It is also requested that, as soon as the transmission parameters of a station are changed, the new set of parameters should be informed to PTWC."

In addition, for recent tsunamis there is quite often a long delay before the sea-level data becomes available to the international tsunami community. These data are transmitted to and stored by PTWC and/or WC/ATWC, but unless they are disseminated they are of little use to the research community. Therefore, the Workshop further recommends that:

"ITIC should be more proactive in collecting of the recorded tide gauge data for recent tsunamigenic events and in their further distribution for the needs of the international research community. Key parameters of these data (maximum double amplitude and time of arrival) should be distributed after an event as soon as possible."

5. Historical Tsunami Databases

Historical data are the basement of the study of tsunami risk for any particular area. The historical tsunami database for the Pacific that has been compiled by the Novosibirsk Tsunami Laboratory under the joint IUGG/TC – ICG/UTSU HTDB/PAC Project is the valuable and useful source of such data that covers the most of information containing in the published tsunami catalogues, proceedings of tsunami conferences and articles published in the main international and national scientific journals. However, a wealth of additional data and information exist in original reports, institutional archives and primary publications, some of them are inaccessible outside of the region of origin. Therefore, the Workshop Participants recommends:

“The further HTDB development should focus mainly on the search and collection of such data, their parameterisation and input in the database. This work can be done only in close co-operation of the database developers with the local agencies, institutions and individual researches from the regions.”

ANNEX VIII

TABLE OF EXPENDITURES

AVAILABLE FUNDS FOR 2000 – 2001
(FROM UNESCO REGULAR FUNDS [RF] ARRANGEMENTS)

<u>Programme</u>	<u>US\$</u>
ITSU-IDNDR	57,000
TEMA	15,000
IOCARIBE	5,000
POLICY	<u>24,000</u>
RF Total	101,000

FUNDS PROVIDED IN 2000 – 2001
TO THE IOC TRUST FUND [TF] IN SUPPORT OF THE TSUNAMI PROGRAMME

<u>Member States</u>	<u>US\$</u>
Australia	4,200
Chile	3,000
France	7,200
Republic of Korea	850
New Zealand	2,000
USA/NOAA	3,950
USA/Univ. of Puerto Rico	<u>5,250</u>
TF Total	26,450

ITSU-XVII total request for funding was US\$169,000 (Res. ITSU-XVII.3)

**IMPLEMENTATION OF RECOMMENDATION ITSU-XVII.3
(PROGRAMME AND BUDGET FOR 2000 – 2001)**

ACTIVITY	REQUESTED		SPENT	
	2000	2001	2000	2001
ITIC	25,000	25,000	18,000	19,000
Support to the ITIC Associate Director	2,000	2,000	2,000	2,500
Organization of Group Meetings (Officers meeting, ITSU-XVIII, Mayaguez Workshop)	8,000	22,000	11,800	35,000 (including Cartagena Workshop)
IOC/IUGG workshops	15,000	5,000	17,143	
Workshop in Chile	5,000		5,500	
TIME, Phase Two	20,000	20,000		
Support to ITSU experts, officers & Secretariat participation	3,000	3,000		1,500
HTDB (Web Server)	3,000			3,000
HTDB – Final Version	10,000		10,000	
Tsunami Glossary	1,000			2,000
Total	92,000	77,000	64,443	63,000

ANNEX IX

LIST OF ACRONYMS

AOR	Area Of Responsibility
APEC	Asia-Pacific Economic Cooperation
ATWC	Alaska Tsunami Warning Centre (USA)
CEPREDENC	Centre for Disaster Prevention in Central America
CPPT	Centre Polynésien de Prevention des Tsunamis (France)
DIMAR	General Directorate of Maritime & Port Affairs (Colombia)
EC	Executive Council (IOC)
EMSC	European Mediterranean Seismological Centre
EU	European Union
GIS	Geographic Information System
GITEC	Genesis and Impact of Tsunamis on the European Coasts
GOOS	Global Ocean Observing System (IOC)
HTDB	Historical Tsunami Data Base
IAS	Intra-Americas Sea
IASPEI	International Association of Seismology & Physics of the Earth's Interior
ICG/ITSU	International Co-ordination Group for the Tsunami Warning System in the Pacific
IDNDR	International Decade of Natural Disaster Reduction
INETER	Instituto Nicaraguense de Estudios Territoriales (Nicaragua)
INF	Information Document (IOC)
IOC	Intergovernmental Oceanographic Commission (of UNESCO)
IOCARIBE	IOC Sub-Commission for the Caribbean & Adjacent Regions
ISDR	International Strategy for Disaster Reduction
ITIC	International Tsunami Information Center (USA)
IUGG	International Union of Geodesy & Geophysics
JMA	Japan Meteorological Agency
LDG	Laboratoire de Géophysique (France)
NGDC	National Geophysical Data Centre (USA)
NOAA	National Oceanic & Atmospheric Administration (USA)
NTHMP	National Tsunami Hazard Mitigation Plan (USA)
OSSO	Observatorio Sismológico del Sur Occidente (Colombia)
PAC	Physics Action Council
PHIVOLCS	Philippine Institute of Volcanology and Seismology
PMEL	Pacific Marine Environmental Laboratory

PTWC	Pacific Tsunami Warning Centre (USA)
RDFM	Rapid Determination of Focal Mechanism (France)
RFBR	Russian Foundation for Basic Research
RTWC	Regional Tsunami Warning Centre
RWW	Regional Watch/Warning
SHOA	Servicio Hidrografico y Oceanografico de la Armada (Chile)
SOPAC	South Pacific Applied Geoscience Commission
TC	Tsunami Centre
TEMA	Training, Education & Mutual Assistance (IOC)
TIME	Tsunami Inundation Modelling Exchange Project
TWC	Tsunami Warning Centre
TWS	Tsunami Warning System
TWSP	Tsunami Warning System in the Pacific
UNESCO	United Nations Educational, Scientific & Cultural Organization
USGS	United States Geological Survey
VEP	Visiting Experts Programme (IOC)
WAPMERR	World Agency of Planetary Monitoring and Earthquake Risk Reduction
WC/ATWC	West Coast/Alaska Tsunami Warning Center
WDC	World data Centre
WESTPAC	IOC Sub-Commission for the Western Pacific
WG	Working Group