

Intergovernmental Oceanographic Commission
Reports of Governing and Major Subsidiary Bodies



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

Sixteenth Session

Lima, Peru, 23-26 September 1997

UNESCO

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IOC/ITSU-XVI/3
Paris, 30 October 1997
Original: English ¹

¹ Report translated into French, Spanish and Russian. For reasons of budgetary constraints, the Annexes remain in English only.

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1. OPENING AND ARRANGEMENTS FOR THE SESSION

1. The Chairman, Mr. H. Gorziglia opened the Sixteenth Session of the International Co-ordination Group for the Tsunami Warning System in the Pacific at 10.00 on 23 September 1997.
2. He welcomed the participants and briefly described the objectives of the Session and presented his views on the future development of the system.
3. Dr. I. Oliounine, Deputy Executive Secretary IOC, speaking on behalf of the IOC Executive Secretary, joined the Chairman in welcoming the participants, extended his thanks to the local organizers for hosting the Meeting and providing the necessary facilities and wished the Session every success. He expressed the strong belief that the Session will supply guidance to the ITSU Officers and the IOC Secretariat on many matters related to the increase of the programme's effectiveness and to the capability of the Member States to manage the programme in the coming critical years, marked by the 1998 International Year of the Ocean, the final years of IDNDR and the last years of the Century. The Session should define the overall aim of the programme and identify the means to achieve it. Dr. Oliounine emphasized the responsibility of all the ITSU National Contacts in ensuring that governments and decision-makers give to the programme the highest level of priority, and financially support the programme's activities. The credibility of the programme will depend on the results and products which should be delivered to the users without delay and in a suitable fashion. Finally, he reiterated the strong support and commitment of the IOC Assembly to the programme and called on the Member States present to meet the Session's objectives in constructive, co-operative and friendly efforts.
4. Contralmirante L. Moreno Gonzales, Director, Hidrografia y Navegacion, welcomed the participants on behalf of the Peruvian Government, stressed the importance of the IOC Tsunami Programme to the sustainable development of Peru and described the role of the Hydrographic Service of the Peruvian Navy in organizing preventive measures against the tsunami disasters.
5. **The Group received** with interest and appreciation the statements given by the Chairman and the Director of the Peruvian Department of Hidrografia y Navegacion and decided to give the full texts in Annex V of the Summary Report.
6. **The Group adopted** the Agenda as presented in Annex I.
7. The Technical Secretary of the Session briefly reviewed the technical arrangements for the Session, presented the List of Documents, introduced new working and information documents and provided comments on the Provisional Timetable. The List of Documents is presented in Annex IV.
8. Cmdr. G. Hasembank Rotta, speaking on behalf of the local organizing committee described the local arrangements and informed the participants on the planned social activities. **The Group acknowledged** with thanks the decision of the Peruvian Government to provide interpretation into Spanish free of charge to the IOC and encouraged other Member States to follow this example when feasible.
9. The List of Participants and the List of Acronyms are given in Annex III and Annex IX respectively.

2. PROGRAMME MATTERS IN LIGHT OF INTERSESSIONAL ACTIVITIES

2.1 REPORT OF THE CHAIRMAN

10. The Chairman, ICG/ITSU, presented a summary of the intersessional activities of the Group (IOC/ITSU-XVI/6) and expressed the opinion that the period had been a successful one. He thanked all of his colleagues who had assisted in the implementation of the actions agreed upon during the last Session of the Group. He reviewed his participation at meetings of the IOC Governing Bodies and commented on activities related to the establishment of national and regional tsunami warning systems, training and education, and communications issues. He expressed the wish to see a greater support to the Chairman during the intersessional period and called on the Group to be more responsive to his efforts. The state of implementation of ITSU-XV decisions is presented in Annex VI to the Summary Report. **The Group accepted** the Report and **expressed** its appreciation to the Chairman for his activities. **The Group decided** to take into account the relevant parts of the reports when discussing other agenda items.

2.2 NATIONAL REPORTS ON THE TSUNAMI PROGRAMME ACTIVITIES

11. In response to IOC Circular Letter No. 1518 of 25 February 1997, national reports on tsunami-related activities were received from Australia, Canada, Colombia, Japan, Nicaragua, Peru, Chile, Hong Kong, France, Mexico, Republic of Korea, Russian Federation, Singapore, and the United States of America. **The Group noted** the good response of Member States. All reports were made available to the participants (Doc. IOC/ITSU-XVI/7, 7 add., 7 add.2 and 7 add.3), and additional comments on national activities were provided by several Member States.
12. The Delegate of Mexico announced the creation of a new Spanish-language brochure entitled "TSUNAMIS" containing general information about tsunamis, as well as specifics regarding the tsunami threat in Mexico. Fifteen thousand brochures have been printed and distributed in tsunami threatened coastal zones. The brochure was made available to the participants of the Session. The Delegate of Mexico also reported on the creation of a new web site at CICESE that contains most of the information from the brochure. He continued by giving a brief report, including a series of photographs, on the tsunami of 9 October 1995 that struck the Pacific coast of Mexico. The tsunami arrived at the coast only 7 minutes after the earthquake and it first produced a withdrawal of water that attracted curious local residents who dangerously ventured out onto the exposed sea floor. Fortunately, only one person was killed owing to the fact that a subsequent rise in the water level took place slowly over a 15 minute period. A survey team from CICESE and the University of Southern California later measured runups of more than 5 minutes and inundations of more than 400m. Extreme eventual tsunamis have now been numerically modeled by CICESE for four key coastal locations using the modeling method transferred to Mexico through the TIME Programme.
13. The Delegate of Canada noted the production of a poster-map of natural hazards of Canada in 1996 within the Canadian framework of IDNDR. This poster-map was widely distributed in Canada as an insert in the Canadian Geographic magazine. Copies of this poster-map were provided to each of the delegates.
14. He also mentioned the Canadian efforts to improve tsunami data collection using MSAT communication technology and the development of data visualization tools to support the decision-making process once water level data are received. He finally stressed the importance of bathymetric data for tsunami modeling and highlighted the work being implemented in Canada on a bathymetric dataset which will be for applications, such as coastal zone management and numerical modeling.
15. The Delegate of Peru noted that during the 1995-1997 period, Peru developed an ambitious programme of training about tsunamis in all the cities along its coastal areas. With regard to educational material, a video about tsunami was prepared in Spanish, as well as in English. Also, the national and regional warning systems have been strengthened with the acquisition of two TREMORS systems. Peru

has developed a tsunami information system and has also updated and automated its flooding, evacuation and shelter charts. Finally, Peru has achieved an important goal by implementing a tsunami numerical modeling programme with the support of the DASE Department of France, using as a model, the 21 February 1996 tsunami.

16. The Delegate from France reported on two tsunamis that struck Tahauku Bay, Hiva Hoa, Marquesas Islands, French Polynesia during the intersessional period. These were the first tsunami events to have been observed visually there since 1964, other than the ones observed only instrumentally. The first of these tsunamis was generated off the coast of Chile on 31 July 1995, only a day after the end of the ITSU-XV Meeting in Papeete. Photographs of Tahauku Bay that were presented showed a 2 m withdrawal followed by a surge that caused significant currents and eddies in the Bay resulting in the sinking of two small boats. The second event was the tsunami generated on 12 November 1996, off the coast of Peru. Photographs of this event were also presented showing similar effects at Tahauku Bay. No damage was reported. However, damage was reported in other places of the Marquesas Islands. Numerical modeling of the event carried out by the Laboratoire de Geophysique reproduced these effects using near-shore bathymetry with a horizontal resolution of 10 m. The Delegate from France noted also that it was important and necessary to consider both vertical and horizontal displacements of the sea floor at the source, in order to successfully model initiation of the tsunami.
17. The Delegate of the USA made a special note of their recent contributions to the efforts of the IOC/ARIBE to establish a tsunami mitigation programme for the Caribbean region. He also announced the recent creation by the Pacific Marine Environmental Laboratory of a web site for accessing real-time data coming from a deep sea tsunami pressure sensor recently deployed off the coast of Oregon. Real-time data from a second sensor located off the Alaska Peninsula should become available within about a month.
18. The Delegate of the USA informed the Group of recent personnel changes in the national Tsunami Programme that affect the international tsunami community. Mr. M. Blackford has left as the Geophysicist-in-Charge at PTWC and is now working on international tsunami issues as a Physical Scientist located at the Pacific Region Headquarters of the National Weather Service. Dr. C. McCreery, former Director ITIC, is now the Geophysicist-in-Charge at PTWC. The ITIC Director's position will be filled by the USA in the near future following their selection of a candidate and acceptance by the IOC Executive Secretary.
19. The Delegate from New Zealand noted with appreciation the Chairman's earlier plea not to set aside the issues of ITSU as soon as the Meeting is over, but to maintain efforts throughout the coming intersessional period. He also announced that New Zealand is currently undergoing a restructuring of their emergency management system that is not yet completely defined. He expressed his country's heightened concern for the near source tsunami event, and their reliance on and appreciation of PTWC and ITIC for providing tsunami warnings and information.
20. The Delegate from Colombia noted that destructive local tsunamis in 1905 and 1979 are a key basis for their concern about the tsunami hazard, and that it takes only 28 minutes for a tsunami generated near the offshore trench to reach their coast. He gave an overview of Colombia's on-going mitigation efforts organized through their Tsunami Committee, including the planned installation of a new broadband seismic station and 7 short-period stations. He also described a recent project to relocate 2,700 families living in high risk zones along Colombia's Pacific coast especially in the Tumaco area. He noted that tsunami education in Colombia is taking place on all levels.
21. The Delegate from Japan noted that his country has experienced no severe tsunamis since the ITSU-XV Meeting. He expressed that the tsunami that struck Okushiri Island in 1993, and the earthquake that struck the city of Kobe in 1995 provided the impetus to reconstruct Japan's national seismic network which now consists of 180 stations. He said that by using a magnitude calculation based on the P wave from earthquakes, the aim is to provide a tsunami warning within just 3 minutes of a potentially

tsunamigenic earthquake. As a result of these improvements, the JMA can now rapidly distribute these warnings through the mass media by an automatic electronic superimposition over regular programmes. New tsunami forecast procedures are also being developed based on pre-run modeling, with results obtained quickly via lookup tables and funding has been requested to permit implementation. Lastly, the Delegate from Japan announced the expanded exchange of data from key Pacific water level stations between the USA and Japan.

22. **The Group expressed** its gratitude to the Member States for their reports and comments and **requested** the Chairman to send letters of thanks to those Member States who submitted reports but were not able to participate at the Session. **The Group recommended** that the abbreviated texts of national reports be published in the coming issue of the ITIC Newsletter and **urged** Member States to provide the texts to ITIC by 1 December 1997.

2.3 REAL-TIME EXCHANGE OF TELEMETRY, SEISMIC AND TSUNAMI DATA

23. The Chairman of the *ad hoc* Task Team on Real-Time Telemetry, Seismic and Tsunami Data Exchange submitted his report on the activities of the Task Team during the intersessional period (Doc. IOC/ITSU-XVI/8). The Chairman indicated that a number of the activities were conducted by the Team members, either individually or in conjunction with one or more other Task Team members. The report addressed a few principle activities. The first was the implementation of TREMORS at the Pacific Tsunami Warning Center. The second activity was the implementation of the continuous exchange of near real-time data from additional stations in Japan and elsewhere in the Pacific between the United States and Japan. The third activity was the initiation of an effort involving Russia, the United States, and Japan to install improved water level stations in the northwest Pacific capable of telemetering their data to tsunami warning centers via the Japanese GMS satellite and WMO GTS communication network. Another reported activity was the initial efforts by the United States to deploy deep ocean tsunami gauges off of the States of Alaska and Washington. The Chairman also reported on his participation in meetings and discussions in the Caribbean area that are leading to the establishment of a regional tsunami warning centers for that area. The Chairman referred the Group to reports supporting other agenda items where many of these activities are described in greater detail.

24. **The Group determined** that many of the activities of the Task Team are now being carried out by Member States individually or in partnership with other Member States. **The Group further determined** that many new methods for real-time data exchange have come into existence since the establishment of the Task Team and that these methods are being used by Member States to enhance their rapid response capabilities. Given this information **the Group decided** that the Pacific Rapid Response Project was essentially complete and that a special Task Team to oversee the Project was no longer necessary.

2.4 TIME PROJECT - PRESENT AND FUTURE

25. In the absence of the TIME Project Leader, Prof. N. Shuto, the Delegate of Japan introduced Document IOC/ITSU-XVI/9 which contained the progress report of the TIME Project.
26. The computer programmes and manuals developed and prepared by the Disaster Control Research Centre (DCRC) of the Tohoku University have been widely distributed to more than 10 countries (Table 1). This process will be further facilitated after the publication of the TIME Manual by UNESCO/IOC and its wide distribution to interested Member States and organizations which is expected to be finalized before the end of 1997. The role of the ITSU National Contacts in the distribution of the Manual within the countries will become critical.
27. Special attention in the TIME implementation was given to training. In 1995-1997 eight trainees received training at DCRC: 2 trainees were financially supported by IOC, one by JICA, one received the Mubusho scholarship, one partially by DCRC and 3 by their own funding.

Table 1: List of Countries and Institutions Where and Persons to whom Codes were Transferred

No.	Country	Name	Institution	Remarks
1	USA	Prof. P.L-F Liu	School of Civil & Environmental Eng., Cornell University	Dr. S.B. Yoon stayed one month in DCRC by a fund of Cornell University. Jun-Jul'91
2	Korea, Rep. of	Prof. B.H. Choi	Dept. Civil Eng., Sung Kun Kwan University	Prof. Choi & Mr. Lee stayed one week in DCRC by a fund of Sung Kun Kwan University in Feb.'92
3	Turkey	Prof. A.C. Yalciner	Coastal & Harbour Eng., Res. Centre, Middle East Technical University	Codes & manuals sent by airmail in Jun.'92. Prof. Imamura spent 2 weeks to co-operate in Ankara in Jun.'93
4	Canada	Dr. T. Murty	Ocean Physics, Institute of Ocean Sciences	Codes sent by e-mail & manuals by airmail in Jan.'93
5	Mexico	Dr. S.F. Farreras	Centro de Investigacion Cientifica y de Educacion Superior de Ensenada	Mr. M. Ortiz stayed in DCRC from May to Nov.'93 supported by JICA. He joined the field survey of the '93 Okushiri tsunami in addition to visits to the Sanriku & Akita coasts to see the tsunami defense works
6	Greece	Dr. G. Papadoupoulos	National Observatory of Athens	Codes & manuals were transferred by Prof. Yalciner, Turkey in Dec.'93
7	Colombia	Prof. H. Meyer	Observatorio Sismologico del Suroccidente, Universidad del Valle	Codes sent by e-mail & manuals by airmail in May '94
8	USA	Prof. Z. Kowalik	Institute of Marine Science, University of Alaska	Codes sent by e-mail & manuals by airmail in Jan.'95
9	Korea, Rep. of	Mr. H.J. Lee	Dept. Civil Eng., Sung Kun Kwan University	Mr. Lee is studying in the Doctor Course in DCRC partially supported by DCRC since Apr.'95
10	Australia	Dr. B. Mitchell	National Tidal Facility, Flinders University of South Australia	Codes sent by e-mail & manuals by airmail in May '95

11	Indonesia	Mr. G.P. Prasetya	Tsunami Research Centre, Coastal Eng., Lab., LPTP-BPPT	Part of codes & manuals sent by airmail in Jun.'95. Mr. Prasetya stayed in DCRC from Oct to Nov.'95 supported by IOC. He carried out simulations of the 1883 Krakatau tsunami. He visited the Sanriku coast to see the tsunami defense works. He also visited Okushiri Island to see the tsunami traces & restoration works
12	Indonesia	Mr. N.A. Kristano	Marine geological Institute	Mr. Kristano stayed in DCRC from Oct.'96 to Mar.'97 supported by IOC. He carried out simulations of the 1994 East Java tsunami. He visited the Sanriku coast to see the tsunami defense works. He also visited the earthquake Research Institute, University of Tokyo for technical discussions
13	Indonesia	Mr. Latief Hamzeh	Dept. Geophysics & Meteorology, Bandung Institute of Technology	Mr. Hamzah is studying in the Doctor Course in DCRC supported by the Monbusho scholarship since Apr.'97
14	Malta	Mr. A. Drago	Malta Council for Science & Technology	Codes sent by e-mail & manuals sent by airmail in May '97
15	New Zealand	Dr. W.P. de Lange	University of Waikato	Manuals sent by airmail in Jul.'97 & codes will be sent soon

28. The knowledge gained by the trainees was effectively used in conducting a Workshop on Tsunami Modeling and Application for Coastal Zone Development (Jakarta, Indonesia, 1995) and a Training Course on Numerical Simulation of Tsunamis (Valparaiso, Chile, March 1996). As an initiative of Chile and Mexico, courses in Puerto Rico and Chile took place to continue the transfer of modeling technology to other Latin American countries including the Caribbean. Peru also showed interest to participate in this training process in the near future.
29. **The Group appreciated** the efforts made by DCRC and personally by Prof. Shuto in implementing TIME. It was the general opinion that the project has gained a worldwide reputation and is a valuable instrument in helping developed and developing countries in increasing preparedness against the tsunami disasters. **The Group considered** as very important to continue support to the training component of the TIME project and **recommended** that it should be taken into account in formulating the programme and budget for 1998-1999.
30. **The Group considered with interest** the proposal for the second phase of the TIME project, taking into account the need for more applicable and reliable model for estimating inundation. The second phase will include experiments on tsunami wave propagation in shallow water regions and runup, exchange of views through close collaboration among physical and numerical modelers and verification of different existing models using observational data. It is expected that the second stage will produce an

improved model including computer codes and visualization of the computed results for tsunami inundation/hazard maps.

31. **The Group strongly supported this proposal and approved Recommendation ITSU-XVI.1.**

32. **The ITSU Member States were urged** to provide national support to the TIME Project through the IOC Trust Fund arrangements.

33. **The Group emphasized** that the results of the second phase of TIME, if implemented, should be made available to and shared with developing countries of the Pacific and the necessary training be continued.

2.5 EXPERT TSUNAMI DATA BASE FOR THE PACIFIC

34. **The Group considered** the report on the implementation of the second phase of the Expert Tsunami Data Base (Doc. IOC/ITSU-XVI/11) presented by Dr. V. Gusiakov and noted the considerable progress made in developing version 2 of the ETDB datasets and supporting software. The project is implemented with the financial support from IOC and the USA.

35. Dr. Gusiakov highlighted the main achievements in the further development of the ETDB:

- (i) Extension of a detailed dataset of historical run-up measurements with geographical co-ordinates of sites on the north-eastern Pacific including Hawaii.
- (ii) Development of an additional software block for the estimation of a tsunami risk using the so-called historical probabilistic approach.
- (iii) Improvement of the ETDB geographical mapping subsystem which works with colour and grey raster images (3-D shaded relief maps).

36. Special efforts have been made for enriching the built-in digital bathymetry database with the Sandwell's 2-min. global array and several new 1-min. arrays on regional level.

37. **The Group welcomed** the plans for the further development of the ETDB project which include transfer from MS-DOS to Windows 95, development of a new version of the Mapping subsystem, accommodation of all basic functions of high-end GIS-like Arc Info and Map Info and extension of run-up dataset to the whole Pacific.

38. **The Group appreciated** the efforts made by the Tsunami Laboratory of the Novosibirsk Computing Center for the maintenance and upgrading of the ETDB datasets and software and **requested** the Member States to make every effort for providing the ETDB development team with the regional tsunami data which are now available in the form of published catalogues, maps, data files, etc.

39. **The Group considered** the further ETDB development and upgrading as a very important initiative and expressed belief that in future it will be very important to present the ETDB on CD-ROM "*Tsunamis in the Pacific 684-2000*". **The Group recommended** that test versions of the CD-ROM for the period 684-1999 be developed for demonstration at ITSU-XVII in 1999. More information is presented under Agenda item 9 of the Summary Report.

2.6 IMPLEMENTATION OF NEW TECHNOLOGIES

40. The Delegate of the USA introduced, and the Director ITIC presented, a preliminary proposal for an international tsunami mitigation plan as was requested at ITSU-XV. This plan is divided into three sections on Hazard Assessment, Warning Guidance and Response. It was noted that the overall

programme would be an expensive one and that contributions from the Member States would be required to implement the plan. Possible contributions identified were those of Chile in the development of educational materials, Japan, in the development of the TIME Project, France, in the development and implementation of TREMORS, and the USA in the development and deployment of ocean bottom pressure sensors (OBPS) for tsunami detection. After a lively discussion, mostly centered on the OBPS, **the Group thanked** the USA for its efforts, especially for the development and deployment of the OBPS, and **requested** that a formal Project Plan with a detailed budget be prepared for consideration by the Group at ITSU-XVII.

41. The Delegate of France gave a presentation on the recent developments of TREMORS. He mentioned the adaptation of the TREMORS to the IRIS broadband station format which was implemented jointly by PTWC and France. This included work on the development of a preliminary method of determining focal mechanisms from the seismic moment tensor within one hour which incorporated focal geometry, scalar moment, and focal depth. The data from a number of TREMORS stations, collected by INMARSAT-C, would be used in this determination. The 5-year experience demonstrated effectiveness of this communication system which helps to increase considerably the rate of the communication speed. Also presented was the work underway to improve the quality of data from nearby earthquakes provided by long period seismometers. **The Group took note** of, and expressed appreciation for the efforts of France and **encouraged** them to continue these efforts.
42. The Director, Pacific Tsunami Warning Center (PTWC), reported on the survey he conducted on the capabilities and response time of existing communications networks (Doc.IOC/ITSU-XVI/12). Of the eight Member States who responded to the survey the majority were using the Global Telecommunications Service of the WMO or the aeronautical circuits. Mexico, Chile and Guatemala were, however, using Internet or fax. **The Group accepted** his report, expressing disappointment at the low level of response to the survey and **recommended** that the routine communications tests continue.
43. The Delegate of the USA reported on his efforts to establish communications between the PTWC and the State Oceanic Administration of the Peoples Republic of China for the delivery of tsunami watches and warnings. He advised that he has been working on this problem for the last six years with no success. He informed the Group of his visit to Beijing last September and the discussions he had with the communications personnel of the China Meteorological Agency (CMA). An agreement was achieved on carrying out a communication test. Extensive arrangements were made to alert the CMA by facsimile in advance of the test and to establish communications in that manner. When the test was conducted no response was received from the CMA, either to the fax or WMO GTS messages. Until the initial problem of co-operation between two national agencies can be overcome there is no possibility of a relay from the CMA to the SOA. The Delegate of the USA asked to be relieved of any further responsibility in this matter. **The Group agreed** to this and **expressed** its great disappointment at the lack of results. It requested the IOC Secretariat to pursue this matter at a higher level.
44. The Director ITIC presented a summary of the paper (Doc. IOC/ITSU-XVI/14) prepared by the Working Group on Communications Technologies. In this summary he discussed upcoming, but not currently operational satellite communications systems based upon Low Earth Orbiting, Medium Earth Orbiting, and Geostationary Communications systems. Unfortunately, none of these, except INMARSAT-C are operational. The operational system of the US National Weather Service was discussed. This system, Emergency Manager's Weather Information Network (EMWIN) uses the USA geostationary weather satellites and is receivable everywhere within their range using a small antenna, receiver, and software costing about \$US 800. It has the capability to receive only selected products, to alarm upon receipt, activate pagers, etc. All warnings, including those from the two US tsunami warning centers are now available on the EMWIN.
45. **The Group accepted** the report and **congratulated** the Working Group for fully discharging their mandate. It was **considered** that while the task of the Working group was completed, a continuing review of developments in this area should be maintained and **requested** that each Member State report

on their experience in new communication technology development and utilization at each ITSU Session. **The Group expressed** great interest in the EMWIN system and **requested** the USA to provide any available technical data to the participants of ITSU-XVI.

46. The Director PTWC, presented his proposal to modify the criterion for issuing tsunami watch/warnings for earthquakes in the Aleutian Islands. This proposal would raise the warning threshold from a Richter magnitude of greater than 7.0 to greater than 7.5. With both warning centers now able to compute Mw in time to be useable for warning purposes the PTWC considers that this will enable them to detect the existence of "tsunami earthquakes" whose Richter magnitude is 7.5 or less.
47. After an extensive discussion **the Group accepted** the proposal and **agreed** that it was very desirable to closely follow the effect of this change. **The Group requested** the Director PTWC to inform all institutions concerned of this change and modify the Communication Plan accordingly.
48. During the discussion a side issue of considerable importance to the overall understanding of tsunamis for warning purposes arose. This issue addressed the need to be more thorough in the collection of mareographic and coastal flooding data for tsunamigenic events that are not generally destructive throughout the Pacific basin. It was felt that such events have value for tsunami research. It is important to know of all tsunami occurrences including small local events. Often such small events may yield critical data on the source mechanism. All the parametric data and other measurements are necessary for progress in the understanding of tsunami generation and propagation.
49. The October 1993 Guam, the July 1995 Chile, and the February 1996 Peru earthquakes were presented as examples of events that characterize this issue. The 1993 Guam earthquake produced tsunami waves of 2 meters in bays on the east coast of Guam, putting several people in life threatening situations. It was the second largest local tsunami in Guam's history but it was not internationally known to have local effects for over a year. It was known to have been recorded in Japan and Hawaii as only minor waves. This prevented a field survey by scientists. In some bays in the Marquesas Islands of French Polynesia, the July 1995 Chile and the February 1996 Peru earthquakes produced there runups of 3 to 4 meters, which was similar in height to the regions of origin. In the deep sea, the tsunami amplitude was only 10 to 15 centimeters high. There have been 21 reports of tsunamis occurring in the last 15 years that were not known to the International Tsunami Information Center, the US National Geophysical Data Center, and not included in the Expert Tsunami Data Base, the main sources of histories of tsunami occurrences, until well after these events took place. There undoubtedly were other tsunami occurrences that still have not been found.
50. Since the Tsunami Warning Centers are aware of the occurrence of earthquakes capable of causing tsunamis, it would be most useful if they would contact local tsunami authorities soon after the earthquake's occurrence. The local authorities should be requested to arrange checking their mareograms for minor recordings or for the reports of observations in harbors and on beaches. Such reports, either positive or negative, could be released to ITIC for inclusion in the tsunami history files and to other such repositories, as well as to tsunami researchers.
51. **The Group recommended** that all Member States request their respective oceanographic and hydrographic authorities to check mareograms for minor recordings after each earthquake equal to or greater than the magnitude 6.0.
52. Recent tsunamis caused by earthquakes of 1992 in Nicaragua, 1994 in Java and 1996 in Peru clearly showed the need for more than one criterium based only on magnitude for issuing watch and warnings. Four criteria were proposed: location of the earthquake epicenter, focal depth, source size and source duration.

53. However, the **Group recognized** that at present the seismologists send to PTWC only information about the P waves arrival times which does not give an opportunity to identify criteria other than location of the epicenter.
54. **The Group recommended** that either the arrival time of the pP or the focal depth determined by a regional network, or both, be transmitted by seismological stations to PTWC which will be in charge of the dissemination of the calculated focal depth to complement the epicenter location. **The Group requested** its Vice-Chairman jointly with the PTWC Director to inform regional and local observatories accordingly and **identify** procedures to implement this Recommendation.

3. ITIC ACTIVITIES

55. The ITIC Director presented a summary of key activities carried out by ITIC during the intersessional period, noting that a more detailed report is given in Document IOC/ITSU-XVI/15.
56. The occurrence of 19 tsunamis in the Pacific Region in the past 26 months was noted. Seven of these were destructive and four caused casualties. Reports on all but the most recent ones of these were published by ITIC in the Tsunami Newsletter.
57. Also noted was the publication by ITIC of three Tsunami Newsletters during the intersessional period, efforts were made to improve their contents including a more standardized format for tsunami reports with maps of historical data and travel time isochrons, and more comprehensive reporting of recent tsunami publications.
58. Special mention was made regarding the recent activities of the Pacific Tsunami Museum located in Hilo, Hawaii. The Museum, still in its fund-raising stage, is dedicated to increasing public awareness and education about the tsunami hazard, and will serve as an archive for historical tsunami materials such as photographs, videos, and oral histories, from across the entire Pacific. **The Group recommended** the ITIC Director to identify areas of common interest which may be beneficial for increasing awareness in the tsunami danger and tsunami programme. **The Group encouraged** Member States to contribute to the Museum, and to use it as a resource.
59. The ITIC Library was partially re-organized following a move by the Center to a new location. Appreciation was expressed to the USA for providing new and additional shelving to house the collection, and for providing a temporary student assistant for three months who electronically catalogued about a thousand of the library items.
60. Information requests from the general public, scientists, emergency managers, the media, and others were handled on a daily basis by ITIC. Some of the information provided to the media was used to produce "*Tsunami - Death Wave*" - a book for young readers by Margo Sorenson, "*Tsunami: Killer Wave*" - a National Geographic television documentary, and "*Three Minutes to Impact*" - a Discovery Channel special programme on asteroid impacts and their tsunamigenic potential.
61. In response to Recommendation ITSU-XV.3, ITIC took over operation of the Tsunami Bulletin Board, an electronic mail communication system for tsunami scientists, from the USA's Pacific Marine Environmental Laboratory in August 1996. Appreciation was expressed to the USA for providing ITIC with a UNIX-based workstation computer and dedicated Internet connection for this task. Also in response to this resolution, ITIC set up the infrastructure for creating, hosting, and maintaining an ITSU/ITIC tsunami web site that will be based initially on the University of Washington's "Tsunami!" web site. Work on the site is continuing, and it is expected to become operational in 1998. Appreciation was expressed to the IOC for providing ITIC with a personal computer, scanner, printer, and web creation software in support of this activity.

62. It was pointed out that there are still several countries in the Pacific, including six IOC Member States - El Salvador, Malaysia, Panama, Solomon Islands, Tonga, and Vietnam, which have a tsunami risk but are not members of ITSU. ITIC had contact with representatives from three of these countries during the intersessional period, provided them with information on the tsunami hazard and the activities of ITSU, and encouraged them to join. However, at this time there are no new Member States of ITSU to report. **The Group recommended** the Chairman to join the ITIC Director in these efforts.
63. Although ITIC unsuccessfully attempted to organize two post tsunami surveys under the IOC flag during the intersessional period, it was noted that surveys of all major tsunamis had been made by international teams, primarily from the academic community. **The Group expressed appreciation** to the Member States for their support of this important work.
64. Certain other activities in which ITIC was involved including the Visiting Experts Programme, the second edition of the Master Plan, translation into Spanish of the children's cartoon book "*Tsunami Warning*", and modification of the "*Tsunami - The Great Waves*" booklet are reported on under other agenda items of the Meeting.
65. Some general recommendations for ITIC activities during the next intersessional period were given by the ITIC Director and **supported by the Group**: (i) the content of the Tsunami Newsletter should continue to be standardized and improved to make it a more useful publication; (ii) the ITSU/ITIC web site should be established soon to provide a wider distribution for tsunami educational materials, and a place where tsunami reports, on-going activities, and meeting announcements and reports can be posted in a timely way; (iii) ITIC library acquisitions, re-organization, and cataloguing should continue with the goal of improving the collection and also improving the accessibility of those materials to the tsunami community; (iv) ITIC, working with the World Data Center-A for Solid Earth Geophysics, should establish and carry out strategies to better collect information and water level records of all tsunami events. ITIC, working with the IUGG Tsunami Commission, should assist in the development and support of virtual data centers for tsunami and tsunami-related data needed by the scientific community.
66. The ex-Associate Director of ITIC, Mr. S. Farreras presented the draft of a Field Guide for Post-Tsunami Surveys (Doc. IOC/ITSU-XVI/16) prepared by an *ad hoc* Working Group. This Guide contained guidelines to establish tsunami field survey teams, procedures to conduct the field investigations and identified required field survey equipment. The presentation included additions and corrections suggested by several tsunami experts as a result of a request made through the electronic Tsunami Bulletin Board. Mr. Farreras acknowledged the Delegate of Chile for providing the Spanish translation of the Guide.
67. **The Group expressed thanks** to the members of the *ad hoc* Working Group and especially acknowledged the input of Mr. Farreras to the project. **The Group recommended** that the deadline of 15 November 1997 be set for the National Contacts to ICG/ITSU to send further suggestions on additions and corrections to the Guide. **The Group agreed** that the additions and modifications to the document received earlier should be incorporated into the Guide and that a final version should be prepared with the editorial help of ITIC and the Delegate of Chile for both the English and Spanish versions. It was also agreed that these final versions should be submitted to the IOC Secretariat for publication in the series of IOC Manuals and Guides.
68. The ITIC Director expressed appreciation to Mexico for providing Mr. S. Farreras as the ITIC Associate Director during the period from April 1995 through April 1996, and also to the USA and the IOC for their support of his appointment. He expressed the importance of having an Associate Director to help carry out the many tasks of that office. Mr. Farreras acknowledged with thanks the help and support provided by IOC, ICG/ITSU and the NWS Pacific Region, as well as by the members of the tsunami community for the accomplishment of his duties of the ITIC Associate Director.
69. **The Group appreciated** the generous offer of Chile to provide the services of Dr. R. Nunez of SHOA to serve as the next ITIC Associate Director. This appointment would be made under the terms

discussed at ITSU-XV allowing the Associate Director to serve from his home country. **The Group** had a discussion of the benefits and potential shortcomings of this type of arrangement, and **agreed** that it should be tried as a strategy to help keep the position filled more than it has been in the past. **The Group also agreed** to evaluate the success of this arrangement at the next meeting of ITSU. The dates and terms of the appointment of Dr. Nunez will be finalized within the next few months by Chile, the USA, IOC and ITIC, as soon as a new ITIC Director is in place. **The Group recommended** that IOC arrange a short visit of Dr. Nunes to ITIC without delay after his appointment for briefing and formulation of a working plan.

70. The ITIC Director expressed appreciation to IOC, the USA and the other Member States, for their support of ITIC and its activities during the past two years, and **the Group expressed** its appreciation to ITIC for its accomplishments including the completion of most tasks assigned to it at ITSU-XV.

4. ESTABLISHMENT OF NEW REGIONAL TSUNAMI WARNING SYSTEMS IN THE PACIFIC AND IMPROVEMENT OF EXISTING ONES

71. The Deputy Executive Secretary IOC informed the Group that in spite of all the efforts being made during the intersessional period there was no progress on the implementation of the Project Plan for the Tsunami Warning System in the South Western Pacific. He explained that numerous approaches to the funding agencies did not give required resources, to a certain degree due to the lack of expressions of active support from the benefitting Member States.
72. **The Group expressed** its deep disappointment at this lack of progress. While continuing to consider the establishment of the System to be of great value to the area, **the Group recognized** that the Project Plan had become out of date and that some of the aspects of the Plan had been implemented. **The Group agreed** that it would not, at this time, pursue further the establishment of the System on the basis of the above-mentioned project Plan.
73. The Chairman ICG/ITSU reported on actions taken in relation to assisting the Cook Islands and Mexico in establishing national tsunami warning systems. He said that there was no further communication from the Cook Islands after the official correspondence sent by him offering assistance. However, Mexico was dealing with this issue at a national level and that for the time being there was no need for assistance. The Delegate of New Zealand offered his help in facilitating communications with the Cook Islands.
74. The Delegate of Mexico confirmed that a proposal to establish a national tsunami warning system in Mexico was under consideration by an Expert Committee of the National Center for Disaster Prevention. A feasibility study would be made with the participation of several national institutions. He also expressed that the Expert Committee was aware that the Caribbean coast of Mexico was also tsunami prone and should be included in the proposal.
75. **The Group expressed** satisfaction with the initiatives underway and **requested** Member States concerned to keep the Chairman and Secretariat informed of the progress.
76. In relation to the advances in the establishment of the Eastern-Indian Ocean Warning System, **the Group regretted** the absence of the Delegate of Australia but considered with satisfaction the complete information provided in his national report about this matter.
77. The Delegate of Japan reported on the progress made in relation to the establishment of the Far East Tsunami Centre in JMA. In the case of a regional centre he expressed concern on communication problems, especially on transmission of seismic signals to determine the hypocenters. Trying to solve this problem, JMA is considering to arrange a questionnaire survey within the countries of the region in order to identify problems, needs and requirements for a regional centre. The Delegate of USA expressed

appreciation for the Japanese initiative due to the fact that PTWC cannot be operationally effective for this region.

78. The Delegate of the Republic of Korea thanked Japan for the initiative underway, and expressed his willingness to participate and co-operate in it.
79. **The Group recognized** the effort made by Japan, expressed its appreciation for it and encouraged it to continue the progress of this activity.
80. There was no special report on the progress made in relation to the establishment of a Central American Warning System. The Delegate of Mexico kindly informed of contacts made with Costa Rica, Nicaragua and Guatemala, with the purpose of establishing or improving the communication methods, studying the eventual installation of sea-level gauges and exploring the interest to establish a RTWS. However, there was a very little progress on pursuing these activities.
81. The Deputy Executive Secretary informed of the progress in the implementation of a Kuril-Kamchatka Project which is jointly sponsored by IOC, Russia and the USA. The necessary equipment to re-build the Kuril Kamchatka network of the tsunami warning stations destroyed during the earthquake and tsunami of 1994 had been bought and is waiting to be installed. He noted some financial problems being faced which prevented accomplishing the originally agreed upon timetable of the project implementation. Due to these problems there is a delay in organizing training and equipment delivery to Russia. **It was noted** also that the location of the stations has not yet been approved and the permission to use the Japanese satellite to transmit data has not yet been received. The PTWC Director informed that the USA has a station at Chemya connected to the ATWC, and expressed interest to see the three Russian stations widely distributed and equally spaced. **The Group** was of the idea that the location of the stations should be identified through consultations with all the parties concerned and **expressed concern** that the delays may postpone the completion of the project until next year. **The Group requested** its Chairman and the Executive Secretary IOC, if necessary, to arrange a meeting of all interested parties to resolve the problems and implement the project quickly due to the need to rebuild the network rapidly because of its critical role for the effectiveness of the entire Pacific warning system.
82. **The Group encouraged** the involved parties to find solutions to the problems identified.

5. EXISTING PARTNERSHIPS AND OPPORTUNITIES FOR NEW ONES

5.1 CO-OPERATION WITH THE IUGG TSUNAMI COMMISSION

83. Dr. V. Gusiakov, Chairman of the IUGG Tsunami Commission introduced this agenda item and gave information about the activities of the Commission in 1996-1997. It consisted mainly in arranging and sponsoring several tsunami workshops and co-ordinating several international research projects such as TIME, ETDB and DBM. In particular, he presented recommendations of the Kamchatka International Workshop "Tsunami Mitigation and Risk Assignment" which was conducted in Petropavlovsk-Kamchatskii (Russian Federation) on 21-24 August 1996 with the contribution from IOC.
84. The main purpose of the Workshop was to consider the problem of the estimation of the long-term tsunami risk (tsunami-zoning) to establish a consensus on the tsunami hazard assessment based on seismo-tectonic probability and to create the framework for such a kind of project. Altogether nearly 55 participants from Japan, the Russia Federation, the republic of South Korea and the USA attended the Workshop. The contributions from the section conveners were collected by Dr. Gusiakov during the winter of 1996/1997 and will be published in the volume of proceedings of the Workshop by the Novosibirsk Computing Center by October 1997. Currently, all contributions and Workshop recommendations can be found on the NCC Tsunami Laboratory web site at the following address: <http://omzg.sscs.ru/tsulab/ktw96au.html>.

85. Another important part of the Commission's activity was to co-ordinate the efforts of scientific community for improving the digital bathymetry dataset available for tsunami research and operational communities and other numerous groups of users.
86. Dr. Gusiakov briefly described several existing gridded and contoured bathymetry datasets (global and regional) and pointed out the needs for compilation by tsunami modelers of numerous gridded bathymetry arrays that have been developed at different institutions and research centers. As the first step in this direction, the inventory of existing digital bathymetric arrays should be developed. The next step would be the collection of those data which are available within the public domain and presenting them on some dedicated web site. To facilitate this process and its completion in the near future, he proposed the idea of having a set of regional seminars, which could be conducted in 1998-1999 in the main tsunamigenic regions - Pacific, Caribbean and the Mediterranean.
87. In the following discussion, **the Group seconded** the idea of having a set of regional seminars on digital bathymetry and **approved Recommendation ITSU-XVI.2** The ITSU Member States were urged to stimulate national research and operational centers, having bathymetric data to actively participate in such seminars. The need to involve the IOC-IHO Ocean Mapping programme in these efforts was acknowledged and the IOC Secretariat requested to ensure co-ordination.

5.2 ICG/ITSU AND IDNDR

88. Dr. I. Oliounine introduced this item by noting that at present the Tsunami programme is the only IOC programme fully corresponding to the objectives of IDNDR providing warnings for the safety of people's lives and protection of property, and helping to increase awareness of the population in the danger of this natural disaster. He gave a brief overall description of the co-operation between the IOC Secretariat and Secretariat of IDNDR and described some of the joint activities. He particularly mentioned the nomination of the ICG/ITSU experts to the IDNDR Working Groups which will be working on the determination of early warning doctrine and the needs for the IDNDR Early Warning Programme.
89. The Delegate of Mexico provided information of his participation on behalf of IOC at the Third IDNDR Caribbean Roving Seminar (ICAROS) held in Puerto La Cruz, Venezuela, 25-29 November 1996 and of his contribution to the discussions. The participants of the Seminar were in favour of establishing close links with the ICG/ITSU as many of the issues discussed at the Seminar coincide with the activities of the ICG/ITSU. Extension of co-operation with IDNDR in the Caribbean could be beneficial to both partners. More information on this Seminar was provided and recommendations were formulated under Agenda item 5.4.
90. **The Group encouraged** its Chairman and Vice-Chairman to extend links of co-operation with IDNDR and identify concrete actions which will contribute to the final stage of IDNDR. **The Group noted** with regret that during the last year there was a slight decline of co-operation between the Secretariats of IOC and IDNDR, and **urged** the IOC Deputy Executive Secretary to take steps to improve the situation.
91. **The Group noted** with concern that **the decision of ITSU-XV** regarding the participation of ICG/ITSU Member States in the International Days for National Disaster Reduction has not been implemented, by the national authorities concerned, as neither the IOC nor IDNDR Secretariats have been informed of the actions taken by the Member States in meeting the Days objectives as it was recommended by ITSU-XV. **The Group re-emphasized** that this Recommendation of ITSU-XV is still valid and that the ICG/ITSU Member States should contribute to the 1997 theme "Water: Too Much - Too Little" through organizing lectures in schools, distribution of textbooks and other information and advertizing materials on tsunamis, circulating information through local mass media of the tsunami effects and measures to be taken to saving lives and property.

5.3 TSUNAMI PROGRAMME IN EUROPE

92. The Delegate of France, speaking on behalf of the Co-ordinator of the EC Project on Genesis and the Impact of Tsunami on European Coasts (GITEC and GITEC TWO), made a short presentation on the main objectives and topics of the project concerning research of tsunamis and related technological development which include: tsunami generation, tsunami propagation, tsunami warning, risk mitigation and elaboration of preliminary digital catalogue of European Tsunamis for events produced by earthquakes and submarine landslides. He informed the Group that GITEC TWO will finish at the end of 1998 and in May 1998, LDG will organize a joint IOC-EC Conference on tsunamis in Paris as a contribution to the IYO.
93. During the 1997 ICG/ITSU Officers Meeting, the Co-ordinator of GITEC, Prof. S. Tinti recommended that co-operation between European countries and ICG/ITSU be fostered especially in the areas of early tsunami warning systems, tsunami mitigation, tsunami numerical modeling, as well as education strategies.
94. **The Group recommended** its Vice-Chairman to identify jointly with Prof. S. Tinti concrete actions which may be implemented as co-operative activities of the ICG/ITSU and European Group and bring them to the attention of the ITSU Officers Meeting planned for January 1999, for review.

5.4 IOCARIBE

95. The Representative of the WDC-A for Solid Earth Geophysics, Mr. J. Lander, informed the Group about the IOCARIBE Meeting of tsunami experts held on St. John Island, Virgin Islands on 23 May 1996. The participants agreed that a tsunami warning system for the Caribbean was needed and named a Steering Committee, Chaired by Dr. G.L. Maul, for this task. The Conference on Natural Hazards and Disasters was held in Kingston, Jamaica in October 1996 where a paper "Caribbean Tsunamis: An Initial History" by James Lander was the only presentation on tsunamis. The paper mentioned data on 52 Caribbean tsunamis including the tele-tsunami from the 1755 Lisbon, Portugal earthquake which created 7 meter tsunami in the Caribbean 7-8 hours later, tectonic tsunamis such as the 1867 Virgin Islands which had 3 meter waves as far as Grenada, and landslide tsunamis such as the 1688 event which destroyed Port Royal, Jamaica, killing 2,000 people. Mr. Lander stressed that a repeat of any of these events would be disastrous given the great increases in population and tourism in the coastal areas and coastal development in general. There is concern of volcanic tsunamis due to the activity of the Soufriere Volcano on Montserrat and the submarine volcano *Kick-'em Jenny* near Grenada. Geologic data shows a great explosion from Dominica 28,000 years ago. Finally, Mr. Lander informed that the next Caribbean Natural Hazards and Disasters Conference is planned for 1998 in Dominica.
96. The Observer from Puerto-Rico, Dr. A. Mercado stated that following the IOCARIBE Meeting, and thanks to the Regional TIME Project, arranged through CICESE (Mexico) a numerical simulation of the 1918 Puerto Rico tsunami was undertaken, funded by the USA Federal Emergency Management Agency and the Puerto Rico Civil Defense. The USA National Oceanic and Atmospheric Administration (NOAA) Sea Grant College Programme, through the University of Puerto Rico, sponsored a Caribbean Tsunami Workshop, held at Mayaguez, Puerto Rico, during June 1997.
97. The Workshop had 130 participants including civil defense personnel around the Caribbean, showing a current high interest in the hazard. The Workshop's main objective was to bring the tsunami threat into focus as far as the Eastern Caribbean Emergency Response Co-ordinators are concerned. A Resolution was drafted with the ultimate goal of having heads of States endorse the extension of natural hazard protection to include tsunami risk detection with integrated system components of education, warning, management and research.
98. Prof. Mercado mentioned that the Emergency Response Co-ordinators who attended the Caribbean Tsunami Workshop including Mr. J. Collymore, Director of the Caribbean Disaster Emergency

Response Agency, agreed that the IOC should be the organization presenting the Resolution adopted at the Workshop to the Heads of States of the Eastern Caribbean island nations for their endorsement.

99. At this time, three tsunami research projects are on-going in the Caribbean region:
 - (i) Numerical simulation of the tsunami threat due to a potential catastrophic explosion of the Soufriere Volcano on Montserrat (See Doc. IOC/ITSU-XVI/7).
 - (ii) Mapping and characterization of the tectonic faults in the Mona Channel between Puerto Rico and the Dominican Republic, with the ultimate goal of preparing a tsunami flooding hazard map for Western Puerto Rico, including return periods.
 - (iii) Mapping and characterization of the tectonic faults offshore from Southeastern Puerto Rico, with the ultimate goal of preparing a tsunami flooding hazard map for Southeastern Puerto Rico, including return periods.
100. A summary of the decisions taken at different meetings held in the Caribbean region during the last few years related to the tsunami mitigation and warning system development is presented in Annex VII.
101. **The Group was of a general opinion** that there is known to be a significant tsunami risk in the Caribbean and little local expertise is available in tsunami mitigation and warning. Outside help is needed including scientific research, education of the population , authorities, and emergency planning. **The Group agreed** that the expertise of the IOC/ICG ITSU in promoting activities in these areas may be most helpful.
102. **The Group recommended** that a meeting of key people in the development of tsunami warning programmes from the Pacific, Mediterranean and Caribbean regions be organized in order to explore the possibility of bringing knowledge and expertise gained in different regions together and identify ways and means for effective co-operation.
103. The Observer from Puerto Rico expressed his feeling that there is an interest in the IOCARIBE community in co-operating with the ICG/ITSU and using its expertise. Prof. Mercado was asked to consult with Dr. G. Maul, the Chairman of the IOCARIBE Steering Committee on Tsunamis on the name of an expert who should be proposed to join the meeting, along with the Representative from the Pacific and the Mediterranean regions.
104. **The Group recommended** that as an initial action for the ICG/ITSU and the IUGG Tsunami Commission to assist with resolving the Caribbean Tsunami problem, a letter from the Executive Secretary IOC should be sent to the IOC contacts in the region with a request to inform each country or administrative area's heads of government of the high possibility of the regional tsunami hazard, and provide them with the information on the ICG/ITSU and its involvement with the co-ordination and improvements with the Pacific Tsunami Warning system for the last 32 years. The letter may ask the IOC contacts, jointly with national authorities, to name national contact to deal with the tsunami warning issue.

6. WAYS TO INCREASE PREPAREDNESS FOR, AND AWARENESS OF THE TSUNAMI DANGER

6.1 TSUNAMI GLOSSARY

105. As recommended during ITSU-XV, the revision of the Tsunami Glossary has been implemented. The Vice-Chairman presented the report on the progress (Doc. IOC/ITSU-XVI/19) and insisted that the

most important task is to establish an exhaustive book of the terms used specifically by the tsunami community. A revised version of the Glossary contains 5 different lists of definitions on: Tsunami Classification; Tsunami Measurements and Survey; ICG/ITSU organization; tide and sea wave measurements. Part of the definitions are accompanied by figures, photos and graphics.

106. **The Group was delighted** with the progress achieved, and **supported** the new concept of the glossary composition.
107. **The Group requested** its Vice-Chairman to send these lists to all Member States and selected IUGG experts who are working in the tsunami field in order to get comments and prepare a final draft for adoption during ITSU-XVII. The Delegate of Japan offered the participation of Japan in this task. The Chairman of the IUGG Tsunami Commission informed the Group that during the last IASPEI Assembly in 1997, two documents were recommended for publication: “*Guide to Earthquakes*” for general readers, and “*Handbook of Earthquake and Engineering Seismology*” as an authoritative reference for scientists and engineers. He invited the Group to consider the need and interest in developing the same type of publications for the tsunami community.
108. **The Group requested** the Vice-Chairman to follow the progress of IASPEI in developing the above-mentioned documents and report his views on the proposal to the next Session.

6.2 TRAINING AND EDUCATION

109. The Director of ITIC reported on the two Visiting Experts Programmes held during the intersessional period. He highlighted the collaboration with several Hawaiian institutions that provided the participants with briefings and use of their facilities in the training. The 1995 programme was attended by a Chilean and a Russian expert, and the 1996 programme was attended by two Colombian experts. He mentioned that in the near future ITIC plans to provide training to three experts from the Russian Federation who will be in charge of the re-built Kuril-Kamchatka network.
110. **The Group expressed satisfaction** for the training provided and **requested** the ITIC Director to conduct a survey of the former participants regarding their activities since their training to evaluate the effectiveness of the Visiting Experts Programme. **The Group was informed** of the same type of surveys which had been conducted by IOC for other programmes and **requested** the IOC Deputy Executive Secretary to provide the ITIC Director with the forms of available questionnaires.
111. The Delegate of Colombia informed the Group about a national workshop to be held on 30 September 1997, where the Director of ITIC will give a technical presentation and in which the Colombian experts, trained at ITIC, will have active participation.
112. The Delegate of Peru informed the Group that the National Training Workshop on tsunamis will be held right after ITSU-XVI in Lima with the participation of some of the experts present at the Session and thanked IOC for providing support to the foreign instructors.
113. The Delegate of Chile reported on the experience in organizing and conducting the TIME and TREMORS Course given in Chile in 1996. All students were able to work on an inundation model with their own bathymetric and topographic data. He highlighted the benefits of the close co-operation and collaboration observed between Chile, France, Mexico and IOC with an excellent final result - development of an inundation map for Arica.
114. The Chairman of ICG/ITSU informed the Group on the progress made in relation to the availability of earthquake and tsunami textbooks in languages other than Spanish. In this context he acknowledged the printing of an English version by IOC-UNESCO. Unfortunately, no further progress has been made on the publication of textbooks in other languages. The Delegate of Japan said that the Ministry of Education of his country is not considering the translation and publication of the books into

Japanese due to the availability of several other national publications. However, he emphasized the importance of the textbooks for educational efforts in all countries and considered them as a valuable contribution to the training component of the tsunami programme. The Delegate of the Russian Federation said that resources were needed to accomplish the translation of the books into Russian.

115. The Delegates of Colombia, Japan, Mexico and Peru reported on their efforts to create or improve tsunami brochures to be used as educational materials. Mexico requested Chile to provide a master copy of the Spanish version of the textbooks.

116. **The Group acknowledged** with satisfaction the implemented activities, recognized the importance of training and education issues and **recommended** to facilitate actions targeted to the capacity building. **The Group recommended further** to finalize arrangements for the publication of the earthquake and tsunami textbooks in Russian.

6.3 PUBLICATION OF ADVERTIZING MATERIALS

117. Under this agenda item three projects have been considered: "*Tsunami - The Great Waves*" (revised version), cartoon book on tsunamis (Spanish version) and an education poster "Oceans - Coastal Hazards".

118. The Delegate of France reminded participants that the first issue of the "*Tsunami - The Great Waves*" booklet was published by the USA before ITSU-XV and in response to the Recommendation of ITSU-XV the draft of a new version was prepared which takes into account new developments in technology and warning system organization. The new high quality booklet describes the activities of the IOC ICG/ITSU and ITIC, particularly their efforts in international tsunami hazard mitigation and research.

119. **The Group thanked** France and the ITIC Director for their efforts in revising the text and producing a new version for the consideration of the Session. **The Group decided** that Member States will be given an opportunity for more careful consideration of the text of the booklet and sending comments to the ICG/ITSU Vice-Chairman before 1 November 1997, in order to organize the booklet's publication in the first quarter of 1998 as a contribution to the IYO.

120. **The Group agreed** on the following timetable and arrangements for publication:

- Comments until 1 November 1997 (Member States);
- Incorporation of comments and preparation of the final version before 1 January 1998 (France);
- Transfer of the English text to ITIC for final editing before the end of January 1998 (France);
- Final editing and developing of a camera ready copy for publication before the end of February, 1998 (ITIC);
- Publication of the booklet in Spanish (by Chile), French (by France), and English (by USA) in March/April 1998.

121. **The Group appreciated** the kind offer of Chile and France to publish the booklet at no cost to IOC.

122. **The Group requested** that the possibility of producing a Russian version of this publication also be explored.

123. The ITIC Director described the progress that had been made in the translation of the children's cartoon book "Tsunami Warning" into the Spanish language, and to separate the graphics and text into a portable form so that any Member State might be able to translate and otherwise modify the document for publication and distribution within their own country or region. The Spanish translation of the text was made by the former ITIC Associate Director, with some modifications provided by Chile. Adjustments to the graphical content to make it more universal were identified at the ITSU Officers Meeting in January 1997. The USA has recently and generously volunteered to support work by a graphic artist to adjust the graphical content, make the portable graphics/text separation, and apply the Spanish text. This work will be completed within the next 6 months, and master copies of the artwork and text will be made available to the Member States upon request.
124. **The Group thanked** the ITIC Director, the USA and Mexico for the support to the project and **requested** its Chairman and the IOC Secretariat to consider ways of publishing a Spanish version of the cartoon book. The ITIC Director was requested to inform Member States of the availability of a portable form of the publication as soon as available.
125. The Deputy Executive Secretary presented the last iteration of the ocean and coastal hazards education poster presently being developed by the USA for the IYO and the information text on tsunamis which will appear on one of the poster back panels. He noted his communication with a number of countries regarding the production of the poster other than in English and acknowledged the readiness of some countries to provide Spanish, Arabic, Farsi and some other language versions. He invited the Group to give comments on the picture cutout and the text and emphasized the urgency of this work as comments should reach the poster developer by the end of September.
126. **The Group was delighted** with the US initiative in the production of the poster which will be a part of a series of water-resources education posters. The posters in the series are designed to be joined to create a large wall mural. The texts which accompany the posters provide a valuable educational material.
127. **The Group commented** on the tsunami text and **requested** the Deputy Executive Secretary to pass comments urgently to the USA.
128. **The Group was pleased** to know that the conditions of the copyright for the poster create no problems in getting the poster artwork to other sponsors to print. The only time a copyright comes into play is if the poster is sold commercially for more than the cost that would be incurred for the printing, shipping and handling of the poster.
129. **The Group invited** Member States to provide sponsorship for printing copies of the poster in English and various other languages.
130. **The Group appreciated** the commitment of Chile to produce 1,000 copies in Spanish provided the artwork and text of the poster are submitted in separate layers and the layout is available.
131. **The Group urged** the Deputy Executive Secretary to look for commitments of other countries in contributing to the translation of the poster into other than the English language and to ensure its wide distribution.

7. THE ICG/ITSU INPUT TO THE 1998 INTERNATIONAL YEAR OF THE OCEAN AND EXPO '98

132. Dr. I. Oliounine presented the report on the participation of IOC in the 1998 International Year of the Ocean (IYO) the objective of which is to reinforce the attention of the public, governments and decision makers at large to the importance of the oceans and the marine environment as resources for sustainable development. He called the attention of the Session to numerous activities dedicated by the

Member States to IYO, such as cruises, publications, conferences, educational efforts and development of promotional materials. **The Group noted with interest** the launching of the IYO Homepage hosted by the IOC WWW server (<http://www.unesco.org/ioc/iyo/iyohome.htm>) which was visited by thousands of users since the beginning of June 1997.

133. Dr. Oliounine emphasized that IYO gives a unique opportunity to present the tsunami programme to a very wide audience and obtain commitments from governments in support of the programme. He then drew the attention of the participants to the progress in the organization of EXPO '98 and, particularly, to the UN Pavilion composition. He concluded by emphasizing the need for the programme to contribute to IYO and EXPO '98 and invited the Member States to consider possible contributions.
134. Several delegates made comments on national plans to participate in IYO and EXPO '98 where the issue of tsunamis will also be emphasized.
135. **The Group agreed** that the work of extending the presence of the tsunami programme in national pavilions should be facilitated and **called on** the ICG/ITSU national contacts to discuss with national authorities responsible for the participation in IYO and EXPO '98 the most effective ways to implement this decision.
136. **The Group established** an *ad hoc* Task Team chaired by the ICG/ITSU Vice-Chairman to formulate final proposals for presenting the programme in the EXPO '98 pavilions by 1 December 1997, and **requested** the Deputy Executive Secretary to provide the Chairman of the *ad hoc* Task Team urgently with information on the space available in the UN Pavilion for the tsunami programme demonstration.

8. ITSU MASTER PLAN FOR THE YEARS BEYOND THE YEAR 2000

137. The ITIC Director reported on the development of the second edition of the Master Plan. The revised Plan is based on the first edition with an update to material that had grown out of date and a re-organization of material dividing mitigation activities into categories of hazard assessment, warnings and response, with an additional section for research. Each sub-section of the Plan contains the current status, shortcomings and directions for the future. Tasks are presented in a general form to prevent their becoming outdated quickly and to provide a wide umbrella for on-going and future projects.
138. **The Group was requested** to provide comments, corrections and additional input regarding the Plan to ITIC by 1 December 1997. This input could include additional figures, appropriate references to other documents and a description of the current state, limitations and future directions of their own National Warning Systems. The ITIC Director will incorporate these comments into a final form by 1 April 1998 and will utilize a graphic artist to create a more attractive black and white layout. The document will then be forwarded to the IOC for publication and distribution.
139. **The Group recommended** that it would be beneficial to have a loose-leaf publication so as to be able to update parts of the Plan easily if the need arises.

9. NATIONAL PROPOSALS FOR THE FUTURE PROJECTS AND OTHER BUSINESS

140. Under this agenda item, **the Group considered** proposals made by the IUGG Commission and France, namely the "Historical Tsunami Database on CD-ROM" and the "Tsunami Bulletin", respectively. The full texts of these proposals and of the proposal on the second phase of the TIME Project which was discussed and accepted under Agenda item 2.4, are presented in Annex VIII to the Summary report. Other proposals contained in Documents IOC/ITSU-XVI/10 and 10 add. have been discussed under Agenda items 2.2, 2.3 and 2.6 as information or national activities.
141. After a wide-ranging and constructive discussion, the Group concluded on the following:

- (i) to accept the Project “Historical Tsunami Database on CD-ROM” for the implementation during the next intersessional period and include it for funding in the Plan of the Programme activities. **The Group concurred** with the opinion of the IUGG Tsunami Commission of the high value of this project and agreed that the CD-ROM when developed will be an integral part of all training, monitoring and research activities. **The Group believed** that a joint implementation of this project by the IUGG and IOC will strengthen further bonds of co-operation between two organizations. **The Group recommended** Dr. V. Gusiakov as the Project Leader and requested him to develop a plan of action for the intersessional period so as to be able to organize demonstrations of the first version at ITSU-XVII. **The Group adopted Recommendation ITSU.XVI.3** in this regard.
- (ii) **The Group noted** the value of the Project “Tsunami Bulletin” and the good experience gained by the seismological community in using the same type of the bulletin for seismologists. The idea was supported. However, several delegates were concerned that the objectives of the proposal have not been well identified: it was not clear who will do what. It was noted that there could be a certain overlap with the existing ITIC Newsletter and Tsunami Bulletin Board and the whole initiative could be expensive for national and regional operational centres and the ITIC. **The Group welcomed** the kind offer of France to develop a preliminary tsunami bulletin version based on the format presented in the proposal and test it during the intersessional period in order to report findings to ITSU-XVII.

142. Under other business, concern was expressed that not all working documents arrive to national representatives well in advance of the ICG/ITSU sessions. As a result, the delegates do not have the necessary time to study the documents and have consultations with national and regional authorities on important issues. This finally hampers the quality of the sessional discussions and accepted decisions. **The Group recommended** that modern communication facilities like Internet should be used for the despatch of documents in addition to mailing. The IOC ICG/ITSU WWW Homepage can be used for this purpose with a reminder by fax to those national contacts who have Internet access to check the site continuously. **The Group also noted** with regret another reason for the delays, namely, a poor response by the document originators to the agreed-upon deadlines for document submission and **requested** all concerned to make their contributions without delay. The Deputy Executive Secretary IOC welcomed the idea but noted that under the present staffing it will be difficult to implement the proposed procedure, however, further efforts will be made for sending all documents on time.

10. ELECTIONS OF THE CHAIRMAN AND VICE-CHAIRMAN OF THE ICG/ITSU

143. The Deputy Executive Secretary IOC informed the Group of the procedures for the election of the Chairman and Vice-Chairman of the main subsidiary bodies of IOC as they are presented in the IOC Manual, 1989, UNESCO. **The Group noted** that there were no other candidates for the positions of the Officers, appraised the active leadership of the present Officers and re-elected Capt. H. Gorziglia and Dr. F. Schindele to the position of Chairman and Vice-Chairman by acclamation.

144. The re-elected Officers thanked the Group and expressed their sincere appreciation for the confidence in their contributions to the progress of the programme.

145. **The Group also appraised** the contributions made by Dr. C. McCreery, the former ITIC Director to the programme, wished him every success in his new position and noted with appreciation that though his term of service as the ITIC Director was only one intersessional period, his input will never be forgotten. **The Group requested** the Deputy Executive Secretary IOC to send an official IOC letter of acknowledgment to Dr. McCreery under the signature of the Executive Secretary IOC.

11. PROGRAMME AND BUDGET FOR 1998-1999

146. In introducing this item, Dr. Oliounine, Deputy Executive Secretary IOC and Technical Secretary of the Session, provided a brief overview of the implementation of Recommendation ITSU-XVI.4 on the Programme of Work and Priorities for 1996-1997. He noted that in spite of the very difficult financial situation which IOC was facing, the Recommendation was successfully implemented due to the contributions of a number of the ICG/ITSU Member States (Chile, France, Japan, Kuwait, New Zealand, Peru, Russian Federation, USA) to the IOC Trust Fund and in-kind, and the programme received a new thrust. He emphasized that the support of Member States to the programme signified the interest of the Member States in the programme and appreciation of its value. **The Group expressed** thanks to those who contributed to the programme and **called** on all Member States to continue and extend their efforts in support of the programme. It was stressed that there is no small or large contribution. All contributions brought together, give an opportunity to meet the needs of all in protecting the lives and property through the participation in the IOC Tsunami Programme. During the discussions, clarification was given on the organization of the IOC Trust Fund and procedures for sending contributions.

147. Dr. Oliounine then informed the Group of the decisions taken by the Nineteenth Session of the IOC Assembly (Paris, 2-18 July 1997) in regard to the IOC Programme and Budget for 1998-1999. **The Group appreciated** the continuous and extended support to the programme and **expressed** hope that the allocated funds to the programme implementation will be “incompressible”. **The Group invited** the IOC Executive Secretary to consider ways of providing additional funds to support the IDNDR-related activities, other than the tsunami programme. **The Group received** a report of the *ad hoc* open-ended sessional Working Group co-chaired by the ICG/ITSU Chairman and Past-Chairman which had been established to prepare the draft Recommendation on the Programme and Budget for 1998-1999. **The Group commented** on the draft and **adopted** Recommendation ITSU-XVI.4 which identified the intersessional work plan based on ITSU-XVI discussions and in the order of priority agreed upon by the Group.

12. DATE AND PLACE FOR ITSU-XVII

148. **The Group received with acknowledgment** the kind invitation of the Republic of Korea to have the next Session in his country. **The Group decided** that ITSU-XVII will be in the fall of 1999 and **requested** the Deputy Executive Secretary IOC to take the necessary actions for the organization of the Session and concluding the required formalities not later than the beginning of 1999.

149. The Delegate of the Republic of Korea was reminded of the need to despatch an official letter of invitation from the Republic of Korea addressed to the Executive Secretary IOC, not later than mid-1998, expressing the willingness to host the Session and offering the necessary facilities. This invitation will be used as the basis for an official agreement between the Republic of Korea and UNESCO(IOC).

150. **The Group noted** a comment made by the IUGG Tsunami Commission Chairman on the importance of having a joint ICG/IUGG Workshop on tsunami mitigation in conjunction with ITSU-XVII and **requested** its Chairman to explore the possibility before the end of 1998 in consultation with the IUGG Tsunami Commission's Chairman and the ITSU Contact Point of the Republic of Korea.

151. **The Group requested** the ITSU Officers to have discussions on the date and place of ITSU-XVIII at the next ITSU Officers Meeting, recommended to be held in Honolulu, Hawaii, USA in January 1999. **The Group advised** its Chairman to start seeking the agreement of the ICG/ITSU Member States to host ITSU-XVIII without delay in order to resolve the problem at the Officers Meeting.

13. ADOPTION OF THE SUMMARY REPORT

152. **The Group reviewed** the draft Recommendations and Summary Report and adopted them as herein presented. **The Group requested** its Chairman to bring the findings of ITSU-XVI to the attention of the Thirty-first Session of the IOC Executive Council, November 1998.

14. CLOSURE

153. The Chairman and the Deputy Executive Secretary IOC thanked the Member States and the staff of the Secretariat, the local organizers and those behind the scenes, translators, interpreters and other supporting staff for helping to implement the Session successfully and for creating a friendly and co-operating atmosphere.
154. The Chairman closed the Meeting at 16:00 on 26 September 1997.

ANNEX I**AGENDA**

- 1. OPENING AND ARRANGEMENTS FOR THE SESSION**
- 2. PROGRAMME MATTERS IN LIGHT OF INTERSESSIONAL ACTIVITIES**
 - 2.1 REPORT OF THE CHAIRMAN
 - 2.2 NATIONAL REPORTS ON THE TSUNAMI PROGRAMME ACTIVITIES
 - 2.3 REAL-TIME EXCHANGE OF TELEMETRY, SEISMIC AND TSUNAMI DATA
 - 2.4 TIME PROJECT - PRESENT AND FUTURE
 - 2.5 EXPERT TSUNAMI DATABASE FOR THE PACIFIC
 - 2.6 IMPLEMENTATION OF NEW TECHNOLOGIES
- 3. ITIC ACTIVITIES**
- 4. ESTABLISHMENT OF NEW REGIONAL TSUNAMI WARNING SYSTEMS IN THE PACIFIC AND IMPROVEMENT OF EXISTING ONES**
- 5. EXISTING PARTNERSHIPS AND OPPORTUNITIES FOR NEW ONES**
 - 5.1 CO-OPERATION WITH THE IUGG TSUNAMI COMMISSION
 - 5.2 ICG/ITSU AND IDNDR
 - 5.3 TSUNAMI PROGRAMME IN EUROPE
 - 5.4 IOCARIBE
- 6. WAYS TO INCREASE PREPAREDNESS FOR, AND AWARENESS OF THE TSUNAMI DANGER**
 - 6.1 TSUNAMI GLOSSARY
 - 6.2 TRAINING AND EDUCATION
 - 6.3 PUBLICATION OF ADVERTISING MATERIALS
- 7. THE ICG/ITSU INPUT TO THE 1998 INTERNATIONAL YEAR OF THE OCEAN AND EXPO '98**
- 8. ITSU MASTER PLAN FOR THE YEARS BEYOND THE YEAR 2000**
- 9. NATIONAL PROPOSALS FOR THE FUTURE PROJECTS AND OTHER BUSINESS**
- 10. ELECTIONS OF THE CHAIRMAN AND VICE-CHAIRMAN OF THE ICG/ITSU**
- 11. PROGRAMME AND BUDGET FOR 1998-1999**
- 12. DATE AND PLACE FOR ITSU-XVII**
- 13. ADOPTION OF THE SUMMARY REPORT**
- 14. CLOSURE**

ANNEX II

ADOPTED RECOMMENDATIONS

Recommendation ITSU-XVI. 1

TIME PROJECT- PHASE TWO

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

Acknowledging the successful completion of the first phase of the TIME project by the Disaster Control Research Center of the Tohoku University, Japan, which was implemented as a joint effort of the IUGG Tsunami Commission and IOC/ITSU;

Recognizing the significant benefits that the TIME project has achieved to date through transfer of numerical techniques of tsunami modeling and providing training to developing countries;

Recommends that a second phase of the TIME project be implemented to develop a more advanced numerical model(s) for tsunami propagation and inundation through integrated co-operation among tsunami modeling experts of the world;

Recommends that the results of this work be made readily available to all Member States with priority to the operational field, and particularly to developing countries through all available ICG/ITSU channels;

Further recommends that a second phase of the TIME project be placed under the direction of experts from the Tohoku University who have gained the necessary knowledge and expertise through implementing the first phase of the project;

Urges the Member States and the IOC to provide financial support for the second phase of the TIME project as noted in the Programme of Work and Priorities for 1998-1999.

Recommendation ITSU-XVI.2

REGIONAL SEMINARS ON DIGITAL BATHYMETRY DATABASE

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

Being informed by the Chairman of the IUGG Tsunami Commission about the current efforts undertaken for developing digital bathymetry datasets for the tsunami mitigation purposes and making them available to tsunami researchers and operators of the warning centers,

Being aware of the great importance of gridded bathymetry data for tsunami research ,as well as for operational warning (travel-time charts and predicted impacts) and hazard mitigation (long-term risk assessment),

Noting that considerable efforts are being undertaken by different international bodies and organizations such as the IOC and IHO through the IODE and GEBCO programmes, for presenting and exchanging bathymetric data in standard formats and converting them into the gridded form,

Recognizing that big volumes of gridded data have already been developed by tsunami modelers from different institutions and centers for some geographic regions of the Pacific,

Recommends that the project on the compilation of the gridded bathymetric data for the tsunami application be started jointly with the IUGG Tsunami Commission through the organization of a series of regional seminars in the North and South Pacific, the Mediterranean and Caribbean regions in 1998-1999,

Recommends further that the objectives of these seminars will include:

- (i) evaluation of the status and availability of the bathymetric data in the regions;
- (ii) establishment of formats and standards for data collection, maintenance and exchange;
- (iii) development of an inventory of gridded data already available;
- (iv) development of gridded databases based on the data available within the public domain.

Requests the Executive Secretary IOC to provide financial assistance for conducting such seminars bearing in mind that in order to minimize the required expenditures, seminars be arranged whenever possible, in conjunction with the tsunami-related meetings planned in relevant regions for 1998-1999.

Recommendation ITSU-XVI. 3

CD-ROM "TSUNAMIS IN THE PACIFIC, 684-2000" PROJECT

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

Being informed of the plans of the IUGG Tsunami Commission to issue by the end of this century a CD-ROM "Tsunamis in the Pacific 684-2000",

Recognizing the need to have a comprehensive source of historical data on tsunamis for the entire Pacific, which would be beneficial for a wide scope of application, and to different user groups,

Being aware of the considerable efforts taken in the field of compilation of tsunami data and their conversion into a computer readable form within the ETDB project,

Requests the Executive Secretary IOC to secure the necessary funds for the development of a beta-version of the CD-ROM "Tsunamis in the Pacific, 684-1999" by the end of 1999,

Recommends to nominate Dr. V. Gusiakov as the Project Leader and requests him to report on the implementation of the project to the ITSU-XVII Session,

Urges Member States to provide support to the project in fund and in kind.

Recommendation ITSU-XVI.4

PROGRAMME OF WORK AND PRIORITIES FOR 1998-1999

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

Recalling the view of the IOC Governing Bodies on the IOC Tsunami Programme as a programme of high priority which is targeted to saving human lives and reducing the impact of natural disasters,

Recalling further the discussion during the Session regarding the activities and priorities agreed upon by the Group,

Recognizing that the sustainable development of the programme cannot be achieved without adequate resources,

Noting with thanks the support by IOC to the programme through the regular programme budget and the contributions by Member States to the IOC Trust Fund,

Being informed of the IOC Programme and Budget for 1998-1999, adopted by the Nineteenth Session of the IOC Assembly,

Emphasizing the need for all Member States of the Pacific to share the operational costs of the tsunami warning system and of the resources required for implementation of agreed upon actions in 1998-1999,

Adopts the following ICG/ITSU Work Programme for 1998-1999, in the following order of priority:

- (i) Provision of increased assistance to the International Tsunami Information Center (ITIC) for the continuing activities in the following areas:
 - The Visiting Experts Programme (4-6 trainees) and other training activities which will help Member States of the region increase their capacity in preventing or diminishing effects of tsunamis, giving priority attention to developing States;
 - Preparation and publication of the ITIC Newsletter (4 issues), the Web page development;
 - Final graphics work and publication of the new version of the “Tsunamis - The Great Waves” booklet in English;
 - Finalization of graphic work for the revised version of the Master Plan and children cartoon book on tsunamis in Spanish;
- (ii) Provision of support to the activities of the Associate-Director, ITIC;
- (iii) Provision of funds for the organization of meetings of the Group (ITSU-XVII in the second half of 1999 in the Republic of Korea and the ITSU Officers Meeting in January 1999, in Honolulu), including regional meetings on the bathymetric database and co-ordinating meetings related to the co-operation with the Caribbean and Mediterranean regions;
- (iv) Provision of support to the development of the CD-ROM “Tsunamis in the Pacific 684-2000” and the TIME Project - Phase Two;
- (v) Provision of funds for translation and publication of tsunami and earthquake textbooks in Russian, and to assist in the distribution of copies to users;
- (vi) Provision of funds for the participation of ITSU Officers/Experts in the meetings of other organizations dealing with relevant problems, and of the ICG/ITSU Chairman at meetings of other bodies;
- (vii) Co-sponsoring scientific conferences and symposia of other international bodies related to the IOC Tsunami programme by providing support for participation of experts from developing countries.

Invites all Member States to continue their efforts in supporting the programme by contributions to the IOC Trust Fund and in-kind, through national and regional efforts; and ITSU National Contacts to make

national authorities aware of the programme and of the potential benefits of tsunami disaster reduction and preparedness by paying attention to the issue, making commitments and allocating resources;

Requests the Executive Secretary IOC to take all necessary measures for providing support to the programme by allocating the necessary funds and staff;

Expresses a strong hope that all activities mentioned in the programme for 1998-1999 above, will receive the necessary funding.

ANNEX III

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ANNEX IV

LIST OF DOCUMENTS²

WORKING DOCUMENTS

Document Code	Title
IOC/ITSU-XVI/1	Agenda
IOC/ITSU-XVI/1 add.	Timetable
IOC/ITSU-XVI/2	Annotated Agenda
IOC/ITSU-XVI/3	Summary Report
IOC/ITSU-XVI/4	List of Documents
IOC/ITSU-XVI/5	List of Participants
IOC/ITSU-XVI/6	Report of the Chairman of ICG/ITSU on Intersessional Activities
IOC/ITSU-XVI/7	National Reports on Tsunami-Related Activities
IOC/ITSU-XVI/7 add.	National Reports on Tsunami-Related Activities
IOC/ITSU-XVI/7 add.2	National Reports on Tsunami-Related Activities
IOC/ITSU-XVI/8	Report of the Chairman of an <i>Ad Hoc</i> Team on Real-Time Telemetry, Seismic and Tsunami Data Exchange
IOC/ITSU-XVI/9	Progress Report of the TIME Project
IOC/ITSU-XVI/10	National Proposals for Future Projects
IOC/ITSU-XVI/10 add.	National Proposals for Future Projects
IOC/ITSU-XVI/10 add.2	National Proposals for Future Projects
IOC/ITSU-XVI/11	Progress Report on the ETDB Project Implementation.
IOC/ITSU-XVI/12	Results of the Survey on the Capabilities and Response Time of Existing Communication Networks
IOC/ITSU-XVI/13	Proposal for Modification of the Magnitude Criterion used for the Determination of either Tsunami Information or Regional Tsunami Watch/Warning Messages
IOC/ITSU-XVI/14	Report of the Working Group on Communications Technology
IOC/ITSU-XVI/15	Report of the ITIC Director
IOC/ITSU-XVI/16	Field Guide for Post-Tsunami Surveys
IOC/ITSU-XVI/16 Annex	Proposed Additions and Corrections to the Post-Tsunami Survey Field Guide
IOC/ITSU-XVI/17	ITSU Master Plan (Revised Version, Draft)
IOC/ITSU-XVI/18	Work Plan for 1998-1999
IOC/ITSU-XVI/19	Tsunami Glossary, Revised Version (Draft)

ANNEX V**SPEECHES****A. WELCOME ADDRESS OF MR. H. GORZIGLIA, CHAIRMAN OF ICG/ITSU**

Contralmirante Luis Moreno Gonzales,
Mr. Deputy Executive Secretary,
Delegates,
National and International Officers dealing with tsunami matters,
Ladies and Gentlemen,

I have the honour to address you as the Chairman of the International Co-ordination Group for the Tsunami Warning System in the Pacific.

This Group was created in April 1965 and its principal objective was to recommend projects and co-ordinate activities of the Member Countries of the Intergovernmental Oceanographic Commission (IOC), whose coastal areas may be threatened by tsunamis. We acknowledge with thanks the kind invitation of the Government of Peru for the Sixteenth Session of the International Co-ordination Group which I am pleased to open in Lima.

We have come from different places of the “Blue” planet, with the majority from the coastal countries of the Pacific Ocean. The representatives than 11 Member States of the IOC, scientists, researchers and observers meet today with a common interest which is to contribute to the objectives of the tsunami programme.

This programme cannot be successful without the goodwill of co-operation and without the support given by the governments to the different aspects of the Tsunami Warning System.

During the coming 4 days, we will consider the implementation of the programme, exchange experiences gained and design the work programme for the next two years.

The programme is unique among other IOC programmes, as it is the only one fully dedicated to the reduction of natural disasters and corresponding entirely to the objectives of IDNDR. During the last few years there have no big changes among the national contacts for the IOC Tsunami Programme which helped to achieve stability and help

This has been possible, thanks to the personal efforts of many of you, as well as the organizations and governments you represent. However, there is a lot to be done at the international level.

Some aspects such as training, teaching and technological transfer and suitable advice for the design of national or regional systems; as well as the addition of new communication systems, deserve the continuous attention of the international community in order to optimize the systems and reduce the operational costs involved. Although these cannot be achieved if the concerned local authorities do not take into account these aspects in their own development programmes.

Unfortunately, the priority of the tsunami subject is only achieved when it is too late, i.e., when a locality was already been affected by the phenomenon, when we regret the human lives lost or when private and public buildings are destroyed and are not useful anymore.

The tsunami subject is only important when the tragedy is a reality. I think we must face it seriously and look for alternative solutions.

This Group, I have the honour to preside, in contributing to the improvement

For this purpose, leaflets, texts and guides have been prepared. They will permit the coastal communities to have a favorable attitude when they are threatened by tsunamis. We cannot expect an intelligent response from people who do not know this kind of threat at the moment it occurs. Warning is very important.

As you can appreciate, the work of the International Co-ordination Group of the Tsunami Warning System in the Pacific is quite wide and outstanding.

Its efforts are dedicated mainly to the prevention of the loss of human lives when a tsunami occurs, whose worst destructive effects, not necessarily happens near its source but it can go through the Pacific and cause unforeseen damages at the opposite and adjacent coasts.

Taking in account these special characteristics, international co-ordination is the keystone. That is why it is so important to carry out these sessions of the Group at least every two years.

I am confident that each one of you will do your best towards the success of this event.

Finally, I want to acknowledge in my name and on behalf of the Group, my sincere gratitude to our distinguished host country and especially to the organizing committee appointed by the Directorate of Hydrography and Navigation of the Navy, for the work done.

Thank you.

B. CONTRALMIRANTE L. MORENO GONZALES, DIRECTOR, HIDROGRAFIA Y NAVIGACION

Mr. Chairman,
Mr. Deputy Executive Secretary,
Distinguished Delegates,
Ladies and Gentlemen,

After two years of the closure of the Session of the International Co-ordination Group and after almost 24 months of continuous communication, today we meet here to turn out this hard work in effective actions, in order to find the appropriate link that permits us to review and design the most convenient operational proceedings for the early preparedness of the Member States of this organization.

Since our foundation, 32 years of hard work have elapsed. This work has been at the pace of the technological and scientific developments, so we have reached new trends and found better operational proceedings to give to the coastal people more security for a best living.

In this sense, the Co-ordination Group has been an excellent sponsor of techniques and proceedings for the warning, dissemination and preparedness of the population before the occurrence of natural phenomena difficult to forecast and impossible to avoid, but with an adequate dissemination we may be properly advised.

It is the second time we have the honour to welcome you in our country and be aware of the important work you carry out for benefit of society.

Taking account this important event, we have made the convenient arrangements to give to each one of you all the necessary help in order to obtain successful results.

I am confident that this Meeting which will last four days, will be useful for us to find the appropriate solutions that will diminish the risks and threat always present along our coasts. This Meeting will be also to strengthen the brotherhood and friendship links we have forged through the years. They will be renewed in this traditional city of Lima which welcomes you and offers you an enjoyable and comfortable stay, and wishes that when you finish your work you can go back home remembering our hospitality, and that together we took the task to design the efficient co-ordinations for the security of the people of our countries.

Thanking again each one of you, I wish you a productive Session, and I declare open the Sixteenth Session of the International Co-ordination Group for the Tsunami Warning System in the Pacific.

Thank you.

Intergovernmental Oceanographic Commission

Reports of Governing and Major Subsidiary Bodies

IOC/ITSU-XVI/3
Annex VI



ANNEX VI

ACTION SHEET- STATUS OF IMPLEMENTATION OF ITSU-XV DECISIONS

Agenda Item	Major Subject	Paras. Rec/Rec	Actions	Responsibility	State of Implementation
2	General review of intersessional	20	Include ITSU-XIV Action Sheet as Annex XV	IOC	Done. See ITSU-XV, Annex VI
		23-24	Provide Tsunami travel time software & water-level data to Australia	Nat. Contact of USA	Done
		25	Contact Russian experts to acquire Tsunami travel time software	Nat. Contacts of Australia & Russia	Done. See letters from H.G. of 14.10.96
		28-29	Provide necessary information on water-level data & advice on development of seismic & sea-level stations to Cook Islands	Chairman ICG/ITSU Nat. Contacts of France & Australia IOC	Nov.'95 letter was sent to Cook Islands offering information & advice. No reply.
		31	Provide details of GMS coverage & warning dissemination capabilities to Rep. of Korea	Nat. Contact for Japan	Japanese version available from '96. English version from Mar. '97

UNESCO

Agenda Item	Major Subject	Paras. Rec/Rec	Actions	Responsibility	State of Implementation
		32	Dissemination of Tsunami Warnings to neighbouring countries directly & urgently	All Nat. Contacts	Continuously
			Advice Mexico on establishment of national Tsunami Warning System	Chairman ICG/ITSU Directors PTWC, ITIC	Done. proposal been developed on national level
		45	Provide abstract texts of nat. reports & publish in Jan.'96 issue of ITIC Newsletter	ITSU Nat. Contacts Director ITIC	Done. See Tsunami Newsletter, Vol.28, N°1, '96
		48	Circulate SR to Regional Committees & Organizations in the Pacific	IOC	Done. Circulation done in Dec.'95
3.1	Real-time exchange of telemetry, seismic & tsunami data	49	Conduct survey of Tsunami/ Earthquake monitoring capabilities & procedures, & distribute results	Chairman & members of TT	Results presented in Doc. ITSU-XVI/12
		50	Conduct survey to ascertain status of plans to establish nat. & regional Tsunami Warning Systems	Chairman ICG/ITSU	Nov.'95 & Oct. '96 letters sent by H.G. requesting necessary information. results of survey included in Chairman's Report for ITSU-XVI (Doc.ITSU-XVI/6)

Agenda Item	Major Subject	Paras. Rec/Rec	Actions	Responsibility	State of Implementation
3.2	TIME	52	Seek funds to support project & '96 training courses	Chairman ICG/ITSU Exe. Sec. IOC, All Nat. Contacts of ICG/ITSU	Done. Training Course implemented for 2 experts
		53	Publication of TIME Manual	IOC	Done. Published in '97 by UNESCO
3.3	Expert Tsunami Database for Pacific (ETDB)	56	Provide additional funding for project & development of interface with WDC-A for Solid Earth Geophysics data bank	IOC	Done. Contract signed in Jan.'97
		57	Develop & update nat. Tsunami data catalogues	All Nat. Contacts of ICG/ITSU Director ITIC	Continuously.
3.4	Tsunami Communication Networks	61	Stay abreast of developing communication technologies & report to ITSU-XVI	Director ITIC Members of <i>ad hoc</i> WG	Done. Report was provided at ITSU-XVI (Doc. ITSU-XVI/14)
			Report to ITSU-XVI on usage of space vehicles for natural disaster mitigation	Nat. Contacts of USA & Russia	Portion is partly covered by Doc. ISTU-XVI/12 & 14
		63	Contact ITSU Members on capabilities & response times of existing PTWS communication networks & report to ITSU-XVI	Director ITIC Members of <i>ad hoc</i> WG	Done. Report on survey was at ITSU-XVI as Doc. ITSU-XVI/12

Agenda Item	Major Subject	Paras. Rec/Rec	Actions	Responsibility	State of Implementation
		65	Publication & distribution of CommPlan new edition	Director PTWC Nat. Contact of USA	Done. 12 th Edition published & distributed Jul.'96
		67	Ensure all ICG/ITSU members & non-members in Pacific receive Tsunami Warnings	Director PTWC	Continuously. Monthly tests being conducted by PTWC. Results were reported to ITSU-XVI
4	ITIC activities	71	Locate follow-up Ass. Director on basis of non-Honolulu residence option	IOC Chairman ICG/ITSU, All Nat. Contacts of ICG/ITSU Director ITIC	Done. IOC CL 1507, 18.12.96. Chile offered an expert to fill the post
		162	Send letter of appraisal to D. Sigrist for his accomplishments as Acting Director ITIC	ITIC	Done. Nov.'95
4.1	Standards for Tsunami Survey Measurements	75	Allocate funds to support survey teams in cases of emergency	IOC, All Nat. Contacts of ICG/ITSU	Intersessional period. Not implemented due to lack of funds
			Give names of candidates to survey team	All Nat. Contacts of ICG/ITSU	Done. International team been established
		77-78	Develop draft of field guide for post-Tsunami surveys report to ITSU-XVI	Director ITIC Members of <i>ad hoc</i> WG	Done. Draft was at ITSU-XVI for approval. Timetable was prepared for publication of guide

Agenda Item	Major Subject	Paras. Rec/Rec	Actions	Responsibility	State of Implementation
5	World Conference on Natural Disaster Reduction - Follow-up	87	Organize activities & distribute material for IDNDR Day (2 nd Wednesday of Oct). Inform IOC on actions taken	All Nat. Contacts of ICG/ITSU	No information received. On 14.10.96 reminder sent by H.G. Decision of ITSU-XV still in force
6	ITSU Master Plan Revision	Rec. XV.1	Write draft of revised Master Plan, circulate to ICG/ITSU ITIC, & present at ITSU officers meeting	Chairman ICG/ITSU, Members of Editorial Group	Draft was discussed at ITSU-XVI as presented in Doc.ITSU-XVI/17
			Secure funds to implement Master Plan revision	IOC, Director ITIC	Done under ITIC contract signed in May '96
7.1	Regional Tsunami Warning Systems - Pacific	92	Update South Pacific Project & present to ECHO	IOC Nat. Contact of France	Done. No result
		93	Continue efforts to solicit UNDP & other agencies support	Chairman ICG/ITSU	Cont. No progress was reported to ITSU-XVI.
		94-95	Continue efforts to establish Central America Warning System	Nat. Contacts of Mexico & Colombia	Continuously. Description of efforts was given in Nat. Rep. of Mexico for ITSU-XVI
		97	Consider possibility of Far East Tsunami Center	Nat. Contact of Japan	Continuously. Progress was reported by Japan at ITSU-XVI

Agenda Item	Major Subject	Paras. Rec/Rec	Actions	Responsibility	State of Implementation
7.2	Regional Tsunami Warning Systems - Europe	100	Establish close relations with European researchers in developing Tsunami Warning System	IOC, Vice-Chairman ICG/ITSU	Prof. Tinti participated at ITSU Officers Mtg. Vice-Chairman id following closely GITEC projects implementation
7.3	Regional Tsunami Warning Systems - Others	103	Keep contact with Australia & Indonesia on establishment of Eastern-Indian Ocean Warning System	Director ITIC	Intersessional period. No information available at present.
		104	Arrange participation of ICG/ITSU experts & acquire Caribbean Tsunami data at International Conference on Hazards	Nat. Contacts of Colombia & Mexico	9-12 Oct.'96. Done. J. Lander represented ICG/ITSU & reported results to ITSU-XVI
8	Co-operation with other International bodies	112	Ensure implementation of Recommendation s of Estes Park Workshop	Chair. ICG/ITSU, Chairman IUGG Tsunami Commission, Director ITIC	Intersessional period. In progress
		Rec. XV.2	Secure funds to support travel of some participants to Lake Baikal Tsunami Workshop	IOC	Workshop held in Kamchatka in Aug.'96. Support was provided
			Assist to formulate Lake Baikal Tsunami Workshop programme	Director ITIC	Done. ITIC Director provided assistance & participated at Workshop

Agenda Item	Major Subject	Paras. Rec/Rec	Actions	Responsibility	State of Implementation
9.1	E-mail & Electronic Bulletin Board	Rec. XV.3	Explore financial support to ITIC for TBB operation, WWW site development & purchase of computer	IOC, All Nat. Contacts of ICG/ITSU	Intersessional period. Done. Included in contract with ITIC for '96
9.2	Historical Tsunami Database	123	Review & recommend improvements to database standards & format, data collection & dissemination	Director ITIC Members of <i>ad hoc</i> WW	In progress. Recommendations are included in Doc.ITSU-XVI/15
9.3	Publications	125	Translate children's cartoon book into Spanish & present to ITSU-XVI	Assoc. Director ITIC	Done. Spanish version available
		126	Develop outline, distribute & explore publication of new ITSU-ITIC brochure " <i>Tsunami - The Great Waves</i> "	Nat. Contact of France, All other ICG/ITSU Nat. Contacts	A new version was developed & was discussed at ITSU-XVI as Inf.7
		128	Start revision of Tsunami Glossary & report to ITSU-XVI	Chairman IUGG Tsunami Commission, & Chairman ICG/ITSU	Outline of revised version was at ITSU-XVI for discussion as Doc.ITSU-XVI/19

Agenda Item	Major Subject	Paras. Rec/Rec	Actions	Responsibility	State of Implementation
10.1	Implementation of Rec.XIV.1	134-135	Continue efforts, explore possibilities & publish Tsunami textbooks in Japanese, English & Russian	Nat. Contacts of Canada, Russia & Japan, Chairman ICG/ITSU, IOC	Intersessional period. English version will be available at ITSU-XVI published by UNESCO. Russian & Farsi versions under consideration
10.2	Visiting Experts Programme & Other Training Activities	136	Submit names of candidates for ITIC Visiting Experts Programme	All Nat. Contacts to ICG/ITSU, Director ITIC & IOC	Aug.'95, Done Nov.'96. Done
		140	Provide financial support to Training Workshop in Chile & Seminar in Colombia	Nat. Contacts of Chile & Colombia	Chile Training Workshop Report N°42 in Chile available in Spanish. There was no request for support from Colombia
11	Future projects & other business	148	Prepare project proposal on Tsunami Hazard Reduction for Pacific Nations, & present to ITSU Officers Meeting	Dr. E. Bernard, Nat. Contacts of Australia & Russia	Project proposal was not prepared. Decision still in force
		155	Bring efforts & resources to rebuild Kuril Is. Warning System	All Nat. Contacts to ICG/ITSU IOC	Funds been raised. Project under implementation. Completion planned for '98

Agenda Item	Major Subject	Paras. Rec/Rec	Actions	Responsibility	State of Implementation
12	Election of Chairman & Vice-Chairman (see also 4)	162	Send letter of acknowledgment to Mr. Uchiike for his accomplishments as Vice-Chairman ICG/ITSU	IOC	Done. Nov.'95
13	Programme & Budget for '96-97	Rec. XV.4	Request IOC Exe. Sec. to provide support to Tsunami Programme by allocating funds & staff	Chairman ICG/ITSU, All Nat. Contacts to ICG/ITSU	Done. See SR of EC-XXIV & IOC-XIX
			Provide in-kind & in-fund support to programme through contributions to IOC Trust Fund & make national authorities aware of programme	All Nat. Contacts to ICG/ITSU, ICG/ITSU Officers	Continuously. Progress was reported at ITSU-XVI. Trust Fund allocation have been made by a number of countries
			Provide support for participation of developing countries experts & ITSU Officers/ Experts in & co-sponsoring scientific conferences & symposia related to programme	IOC, Chair. ICG/ITSU	Continuously. Support provided to few experts. Progress was reported at ITSU-XVI

Agenda Item	Major Subject	Paras. Rec/Rec	Actions	Responsibility	State of Implementation
14	ITSU-XVI, Date & Place	165	Send official letter of invitation to Exe. Sec. IOC, inviting to have ITSU-XVI in Lima, Peru on dates agreed upon at ITSU-XV	Nat. Contact of Peru	Done. Nov.'96
			Prepare letter of agreement between Peru & UNESCO	IOC	Done. Mar.'97
		167	Have meeting of ITSU Officers well in advance of ITSU-XVI	IOC, Chair. ICG/ITSU, Director ITIC	Done. 28-31 Jan.'97
		167	Send invitation letters for ITSU-XVI	IOC, Chair. ICG/ITSU	Done. Feb.'97
			ITSU-XVI	Nat. Contact of Peru, ITSU Officers, IOC	23-26 Sep.'97, Lima, Peru
15	Adoption of SR & Recs.	168	Report to IOC Governing Bodies on progress achieved by ICG/ITSU Submit SR & Recs for approval	Chair. ICG/ITSU, IOC	Done. Sep.'96. Jul.'97
		169	Give SR of ITSU-XV for publication & distribute to all participants, IOC Member States & International Organizations	IOC, ICG/ITSU Officers	Done. Dec.'95

Agenda Item	Major Subject	Paras. Rec/Rec	Actions	Responsibility	State of Implementation
		169	Prepare action sheet & submit it to responsible experts	IOC	Done. Feb.'96

ANNEX VII**SELECTED RECOMMENDATIONS OF DIFFERENT INTERNATIONAL AND REGIONAL MEETINGS RELEVANT TO THE TSUNAMI MITIGATION AND WARNING SYSTEM'S NEED FOR THE CARIBBEAN REGION****Fifth Session of the IOC Sub-Commission for the Caribbean and Adjacent Regions (IOCARIBE-V, Barbados, December 1995)****Summary Report, paras 91-95**

Prof. Maul the offered copies of a technical paper to be published in "Marine Geodesy Journal" entitled "State-of-the-Art Sea-Level and Meteorological Monitoring Systems in the Intra-Americas Sea" by D.M. Martin, J.L. Chapin and G.A. Maul. These new generation sea-level systems are capable of being part of a tsunami warning network which Prof. Maul proposed for the region as part of the IOC Global Tsunami Warning system. This consideration fully corresponds to the International Decade for Natural Disaster Reduction (1990-1999) IDNDR objectives. Although a severe tsunami (seismic sea wave) has not been observed in the region for a century, with the explosive population growth in the coastal zone and recent volcanic activity in Montserrat and the submarine volcano "Kick-em-Jenny", attention must be paid to the dangers of this phenomenon.

The discussion following Prof. Maul's presentation included a proposal to establish an *ad hoc* Committee to develop a regional response to the tsunami threat. To improve the observation necessary for tsunami warning includes modernizing numerous sea-level gauges to include digital sampling and GOES transmission of data in real-time. The need for 3 regional data banks, one in each of an English, Spanish and French speaking country was proposed with free Internet access for all nations and Member States.

Prof. Maul noted the sad history of tide gauge failures at the completion of the Inter-American Geodetic Survey in Central America, 1967, and urged the creation of an Endowment Trust Fund to ensure continuation of observation and training in sea-level/tsunami networking.

Finally, **the Sub-Commission asked** Prof. Maul to accept the responsibility to act as liaison person between IOCARIBE and the OAS/GEF/WB/CARICOM Programme. Prof. Maul accepted the responsibility.

An *ad hoc* drafting group drafted a recommendation, paying particular attention to the threat of tsunamis in the region.

Recommendation SC-IOCARIBE-V.5

Noting the region's history of coastal destruction and human suffering from seismic sea waves (tsunami) and recognizing the recent unexpected volcanic/seismic activity on Montserrat and the submarine volcano "Kick-em-Jenny", as well as other active fault systems,

Recognizing the great increase in population in our coastal areas, the geometric increase in capital invested in near coastal areas,

Appreciating the existence of IOC's Pacific Tsunami Warning Centre,

Recommends:

- (i) that IOCARIBE convene a small (ca. 12 person) Expert Consultation within the next 3 months hosted by the University of the Virgin Islands for the purpose of the Programme Development to include education, monitoring, forecasting, communications and mitigation of the tsunami hazard in the Caribbean and Adjacent Regions; and
- (ii) send invitations to the Director PTWC and to a regional expert in Volcanology/seismology, and an expert in tsunami wave propagation, and include representatives of funding agencies, CDERA, IGOs and NGOs, Regional GLOSS and the press.

ICAROS's IDNDR Roving Seminar (Puerto La Cruz, Venezuela, 25-29 November 1996)

Analysis and conclusion of the Seminar with regard to the IOC TSUNAMI PROGRAMME made by Mr. S. Farreras from Mexico who represented ICG/ITSU at the Seminar:

- Most of the participants became aware that the Caribbean basin is a region where tsunamis may happen and represent a real threat of devastating effects.
- Personal contacts were established with several participants to consider the development of future actions of co-operation.

The following needs which coincide with the IOC TSUNAMI PROGRAMME and its goals were explicitly identified in the Recommendations of ICAROS '96:

- Establish a regional register of persons qualified and willing to undertake POST-DISASTER SURVEYS and draw up procedures for carrying out these surveys and for dissemination of the results regionally. Prepare an inventory of experts ??? involved in the relevant tsunami mitigation activities, identify their interest and capability of implementing specific tasks related to the tsunami research and mitigation.
- Establish or reinforce close links with international organizations in the field of natural hazards;
- Implement education and training programmes as well as technical exchange programmes for the community, technicians and disaster management professional; and
- Develop hazard mapping for storm surges, flooding, landslides, earthquakes and TSUNAMIS.

Caribbean Tsunami Workshop (Mayaguez, Puerto Rico, 11-13 June 1997)

Resolution

The community of concerned citizens, emergency managers, educators and scientists gathered by the University of Puerto Rico, 11-13 June 1997 in Mayaguez, having:

Heightened awareness that per event, loss of life in the Caribbean due to tsunamis is at least equal to losses due to the major regional hazard, hurricanes;

Recognized that Caribbean tsunamis have been and will continue to be caused by local earthquakes, volcanic eruptions, landslides and by distant seismic events;

Appreciated that our region's population has grown ten-fold since the great Virgin Islands tsunami of 1867 with most of that growth concentrated near the coast;

Debated and considered the overwhelming potential for catastrophic loss and the current state of technology's ability to mitigate such a significant toll on life and property;

Do hereby collectively petition our governments to extend natural hazard protection to include tsunami risk reduction with integrated system components of education, warning, management and research.

Immediate Actions

- Seek advice from the Pacific Tsunami Meeting (September 1997/Lima)
 - Learn protocol
 - Education approach
 - Do not reinvent the wheel
- Integrate the Seismic Network at MIDAS Meeting (November 1997/Jamaica)
- Upgrade CPACC project now (Tide gauges/pressure sensors)
- Establish communication protocol (local, regional, intercontinental)
- Identify contacts in support/consulting organizations (regional and international)
 - MIDAS
 - USGS/NEIC
 - IOC/IOCARIBE
 - WMO
 - NOAA
- Identification of local and regional contacts
- Planning and response exercises (Hold first as soon as Possible)

I. EDUCATION

A. ISSUES

- Raise general awareness Caribbean wide and at national levels;
- Use Caribbean examples for multimedia public education productions taking into consideration cultural norms of each territory;
- Training:
 - Develop materials (e.g., audio visual, Internet, K-12 textbooks, etc),
 - Use different techniques,
- Provide access to modeling information for use in stimulating public education programmes;
- Target:
 - Schools/community groups/"shut ins (disabled)",
 - Coastal communities - vulnerable areas, boating community, community managers, tourist facilities, businesses, insurers,

- Emergency management officials,
- Churches,
- Transient population,
- Media

B. RECOMMENDATIONS

- Information sharing - regional workshop every 2 years;
- Regional working group to develop basic/generic information kit;
- Use of the Internet to establish a Regional Data Base;
- Funding:
 - “Piggyback” on existing educational programmes,
 - Development of regional proposals.

II. WARNING

- Two existing seismic warning systems for the Caribbean:
 - Puerto Rico (UPR Seismic Network),
 - Trinidad (UWI Seismic Research Unit),
- No existing sea-level warning component:
 - IOCARIBE to co-ordinate,
 - CPACC (with modifications) to stage initial programme,
- Regional GPS system to supplement seismic/sea-level network;
- Dissemination via STAR4 at Meteorological Services and National Emergency Broadcast System; involve Caribbean meteorological Institute and CPACC;
- Warning Systems should be automated and communicate across international boundaries;
- National mechanism must be a 24 hour-a-day system, 7 days a week network;
- Instrumentation - “near” real-time seismic/sea-level reporting:
 - What is there?
 - What is planned?
 - What is needed?
- Use/update existing seismic network (upgrade to state of the art);
- Establish earthquake/tsunami threshold criteria;
- Automatically send alarm (warning) to 24 hour-a-day establishments (determine who):
 - Weather service,
 - Police,
- Local event alarm system;
- Simultaneously transmit or disseminate information about impending danger;
- Regional centre for data analysis/Emergency Support Function:
 - UPR seismic network function as Caribbean Tsunami Warning Centre (24 hour on call),

- Communicate/confirmation:
 - magnitude,
 - travel time,
 - impact probability,
 - severity.
- Local decision to warn;
- Backup and redundancy.

III. MANAGEMENT

A. ISSUES

- Co-ordination of stakeholders (regional - local- municipal);
- Integration with other natural hazards warning;
- Exploration of funds;
- Warning and evacuation;
- Search and rescue;
- Fire suppression;
- Emergency medical services;
- Damage assessment;
- Intergovernmental Co-ordination:
 - IOCARIBE (lead agency), WMO, IMO, ICAO, WHO, UNDP, UNEP, PAHO,
 - National representatives; extra-regional expert advice,
- Intra governmental co-ordination:
 - National representative (;lead agency), Meteorological Service, Transportation,
 - Police,
- Damage reduction (mitigation):
 - Critical facilities (fire stations, hospitals, etc),
 - High occupancy facilities (schools, etc),
 - Lifelines (roads, bridges, water, electricity, telecommunications, etc),
 - Secondary hazards (fuel tanks, chemicals, etc),
- Hazard analysis (vegetation, debris, fire, ground failure, etc).

B. METHODS

- Response:
 - Co-ordination for training,
 - Response exercises at various scales based on scenarios,
 - * Warning and evacuation,
 - * Search and rescue,
 - * Fire suppression,
 - * Emergency medical,
 - * Damage assessment,
 - * Debris removal.
- Mitigation:
 - Vulnerability/risk assessment

- Land use and building standards,
- Identification,
 - * Critical facilities,
 - * High occupancy facilities,
 - * Lifelines,
 - * Secondary hazards.
- Risk reduction measures:
 - Local scale,
 - National scale.
- Co-ordination:
 - International agencies,
 - National,
 - Local,
 - Private sector,
 - * Building
 - * Insurance
 - * Tourism
 - * Financial
- Standards for training.

C. RECOMMENDATIONS

- General public awareness at regional and national levels;
- Use of Caribbean examples for multimedia public education productions
- Target:
 - Schools,
 - Coastal communities,
 - Emergency Management officials.

IV. RESEARCH

- Initial research supporting establishment warning system:
 - 1x1 km horizontal spatial resolution bottom relief,
 - travel time maps for population centres,
 - Earthquake magnitude/depth thresholds, geographic area and lead time for wave arrival,
 - tsunami amplitude estimation.
- Hazard assessment of long-term tsunami risk and mitigation;
- Evaluate potential for Kick-em-Jenny and Soufriere (Montserrat);
- Tsunami history improvement;
- Earthquake history improvement;
- Fault locations, activity, tsunamigenic mechanisms;
- Improved land topography data and nearshore bottom relief;
- Inundation maps;
- GPS stations for crustal motion monitoring;
- Loss estimation studies.

ANNEX VIII

PROPOSALS FOR FUTURE PROJECTS

SECOND PHASE OF THE TIME PROJECT

(submitted by Japan)

After the successful implementation of the first phase of the TIME project, the objective of which was to transfer technology of the tsunami modeling to developing countries, the second phase of the TIME project is proposed to develop the most advanced numerical model for tsunami propagation and inundation through an integrated co-operation among tsunami modeling experts of the world.

1. BACKGROUND

A demonstration project to develop a methodology for estimating tsunami inundation area and to transfer this technology to developing countries was proposed in 1991 and successfully completed in 1996. The Tsunami Inundation Modeling Center at Tohoku University under the Directorship of Prof. Nobuo Shuto prepared the manual of the numerical models and a general guide for conducting numerical simulation experiments. The publication of the manual was done by UNESCO in English. By sending the manual and source programme through e-mail, the center has continuously transferred the numerical model TUNAMI (Tohoku University Numerical Analysis Modeling for Inundation) to 10 research institutes/universities in 9 countries. One trainee from Mexico and two from Indonesia stayed at Tohoku University to learn how to use the numerical models and to run test cases until they can duplicate the standard experiment through applying the model to the case in their own country. Dr. Fumihiko Imamura, at the Center has assisted in the installation on a computer and applying to the practical problems. Numerous academic papers and project reports producing the inundating maps and tsunami hazard planning have been published as the result of the TIME project.

Although the project was completed with great success, further applicability and reliability of the model for estimating inundation for the demands of more detailed and accurate information of tsunami are needed. Improvement in modelling can be easier achieved through a co-operation among the tsunami modeling experts around the world.

2. PLAN

Step 1: Carry out physical experiments on tsunami waves propagation in a shallow region and runup at the center of Tohoku University which would provide experimental set-up, equipments for measurement and its analysis tools for the visiting experts. The obtained results would be shared among the tsunami modelers to improve tsunami modelling.

Step 2: Compare observational data with the results of computation received by using different models to find out or identify problem in the physical and numerical models. An extensive discussion among modellers would be organized to improve existing models or to develop a new one.

3. PRODUCT

The second stage of the project will produce the improved model including computer codes and pre- and post-processing to prepare the bathymetry data and visualization of the computed results for tsunami inundation/hazard maps.

4. SCHEDULE

- * Tsunami modelers and researchers visit the Center to discuss and carry out numerical /physical experiments to identify some problem in present modeling.
- * The staff of the Center visit the tsunami prone country to access a tsunami prevention work and carry out the feasibility study of the application of the developed numerical model.
- * Develop a new code for tsunami inundation model
- * Select a site to apply the advanced model

5. ONE-YEAR BUDGET (ALL US DOLLARS)

Numerical/physical experiment	US\$ 20,000
Exchange the researchers and staff	US\$ 25,000
Pre/post processing system	US\$ 20,000
Total:	US\$ 65,000

HISTORICAL TSUNAMI DATABASE ON CD-ROM "TSUNAMIS IN THE PACIFIC, 684-2000" Submitted by the IUGG Tsunami Commission

The compilation of historical data on tsunami occurrence and coastal manifestation is an important part of tsunami research and mitigation. Historically, observational data on tsunami have been compiled and published in the form of tsunami catalogues for the whole Pacific and for its particular regions (Cox, Pararas-Carayannis, 1976; Pararas-Carayannis, 1977; Soloviev, Go, 1974; Soloviev, Go, 1975; Iida, 1984; Lander, Lockridge, 1989, Lander, 1996). The collection and refinement of primary data scattered in numerous sources require a great deal of effort and the importance of published catalogues for tsunami research and mitigation cannot be overestimated. However, the data in the paper catalogues are not easy to be retrieved and handled. That is why the usage of catalogues is a rather complicated and time consuming process.

The modern information technology demands the organization of data in the form of databases, where data are in an active form and their handling can be interactively made in a fast and efficient manner. Recent technical achievements in the development of high-capacity recording media and declining prices of CD-ROM manufacturing provide an excellent opportunity to make all tsunami catalogues along with some reference geophysical and geographical data available to individual researchers and practitioners, and to provide them with a specialized PC-based software for manipulating this type of data.

The work on conversion of available tsunami catalogues into digital database has been started long ago but is still far from completion. However, a lot of historical data already exist in digital form and several GIS-types of software are available for their interactive processing and handling. To improve the situation with catalogization of historical tsunamis in the Pacific, an idea to develop the CD-ROM "Tsunamis in the Pacific, 684-2000" is proposed. This CD-ROM will summarize the long-term efforts of several research groups and individuals in developing digital tsunami catalogues and databases.

Possible content of the CD-ROM is seen as follows:

- Catalogue of historical tsunamis in the Pacific (source data, textual descriptions);

- Catalogue of the observed tsunami run-up heights (with geographical co-ordinates of sites);
- Digitized and/or scanned mareograph records of historical tsunamis;
- Digitized tsunami photos (historical and taken in recent field surveys);
- Pacific-wide and regional seismic catalogues;
- Gridded topography/bathymetry data on Pacific-wide (2-min) and regional (up to 3-sec) levels;
- Vectorized shoreline data (geographical contours), state and administrative boundaries;
- Some seismo-tectonic data (plate boundaries, main tectonic faults, axes of deep water trenches, data on sediments, etc.);

- List of existing mareograph stations with basic reference information related to each station (type of instruments, time coverage, etc.);

- List of geographical names mentioned in tsunami literature;

- Tsunami bibliography;

- Glossary of tsunami related terms.

The CD-ROM will be accompanied by a diskette with the GIS-type mapping software which will provide a possibility for manipulating the tsunami-related and digital geographical data. The basic functions of this software are:

- selection of the working area for the data retrieval;
- construction of raster and/or contour background map;
- data overlay;
- annotation overlay;
- saving resulted user-made map in one of standard graphic formats and its dumping to a printer.

The version 2.1 of the ETDB graphic shell, developed at the NCC Tsunami Laboratory under the IOC Contract CS-298.210.7 will have all these functions and can be used as a prototype for this kind of mapping software.

The proposal on having the comprehensive tsunami database on a CD-ROM was discussed on the Tsunami Commission Meeting in Melbourne on 2 July 1997. The idea was favoured by commission members, however, it was pointed out that the biggest problem foreseen will be to find the potential source of funding for this project (the estimated amount of funds for its full-scale implementation is about US\$50,000). Also, it was agreed that the Editorial Board should be established and local Project Co-ordinators should be designated for all major tsunamigenic regions in the Pacific (Japan, Kuril-Kamchatka, US and Canada Pacific coast, Central and South America, Australia, Indonesia, and Philippines).

As the first practical step, it was recommended that the Chair of the Commission would bring the project proposal to the attention of the next ITSU Session to be held on 23-26 September 1997 in Lima, Peru, with a request for some limited support (of about US\$10,000) to initiate the work on the beta-version of the CD-ROM. This beta-version could be developed by the ITSU-XVII in 1999 and could be distributed among the ITSU Member States for the review and data evaluation. After all remarks, additions and corrections are collected during the year of 2000, the final version of the CD-ROM "Tsunamis in the Pacific, 684-2000" will be developed for copying and distribution.

TSUNAMI BULLETIN
(submitted by France)

INTRODUCTION

Numerous regional and local tsunamis were generated during the last years (5 to 10 each year since 1992).

All these tsunamis with small amplitude are very important: recently, it is possible to simulate these small waves and compare the observed or recorded data, the run-up and inundations with the simulation and demonstrate the influence of all the seismic parameters (depth, seismic moment, focal mechanism ...) in the tsunami's generation.

Then, these results would be very useful to simulate the great tsunamis and to calculate inundation maps for numerous coastal zones and harbours.

For all tsunami observed and for all earthquake with $M_o > 1.0 \text{ E+19 Nm}$, each Warning center and Member State must:

1. Verify on their record if the tsunami is observed
2. Established a National Bulletin
3. Send their bulletin to PTWC

GOALS

1. List of all tsunami generated (with maximum of data) with amplitude greater than 5-10 cm.
2. Give to the Member States and the Tsunami Community an exhaustive Bulletin useful for Warning and Studies

DATA

1. Data of all PTWS tide gauge stations (numerical and analogic)
2. Run-up, Sea level, Run-up height distribution for all tsunami observed
3. Seismic data of the event (if known)

1. PRELIMINARY TSUNAMI BULLETIN (PTB)

TSUNAMI

- ALL TSUNAMI WARNING
- ALL TSUNAMI DETECTED
- ALL TSUNAMI OBSERVED

DATA

- TSUNAMI TIDE GAUGE (Arrival time, Period, Amplitude...)
 - Numerical
 - Analogic
- SEISMIC (Origin time, epicenter, depth, seismic moment....)
- Run-up, Run-up height, sea level, tsunami height at shore...

DELAY
1 month

2. TSUNAMI DATA REPORT (TDR)

Final bulletin established 6 month after with all data collected during the 6 months for all tsunamis.

ACTION SHEET AND RESPONSIBILITIES

1.	TSUNAMI BULLETIN BOARD	PTWC
2.	THEORETICAL ARRIVAL TIME of TSUNAMI (in each tide station) during a watch or a warning	PTWC
3.	PRELIMINARY NATIONAL TSUNAMI BULLETIN	MEMBER STATES
4.	PTB Preliminary Tsunami Bulletin	PTWC and ITIC
5.	LIST of ALL EARTHQUAKES with Mo > 1.0 E+19 Nm, and theoretical arrival time of tsunami	PTWC - ITIC
6.	SEND this LIST and the P T B to ALL MEMBER STATES (each month)	PTWC - ITIC
7.	NATIONAL TSUNAMI DATA REPORT	MEMBER STATES
8.	TDR Tsunami Data Report (6 month later)	PTWC and ITIC

ANNEX IX

LIST OF ACRONYMS

ATWC	Australian Tsunami Warning System
CARICOM	Caribbean Community
CICESE	Centro de Investigacion Cientifica y de Educacion Superior de Ensenada (Mexico)
CMA	China Meteorological Administration
DASE	Dept. d'Analyse et Surveillance de l'Environnement (France)
DBM	Data Bank Management
DCRC	Disaster Control Research Centre (Japan)
EC	Executive Council (IOC)
EMWIN	Emergency Manager's Weather Information Network (USA)
ETDB	Expert Tsunami Data Base
GEBCO	General Bathymetric Chart of the Oceans
GEF	Global Environment Facility
GIS	Geographic Information System
GITEC	Genesis & Impact of Tsunamis on European Coasts
GMS	Geostationary Meteorological Satellite (Japan)
GPS	Global Positioning System
GTS	Global Telecommunication System
IASPEI	International Association of Seismology & Physics of the Earth's Interior
ICAO	International Civil Aviation Organization
ICAROS	IDNDR Caribbean Roving Seminar
ICG/ITSU	International Co-ordination Group for the Tsunami Warning System in the Pacific
IDNDR	International Decade for Natural Disaster Reduction
IGO	Inter-Governmental Organizations
IHO	International Hydrographic Organization
IMO	International Maritime Organization
INMARSAT	International Maritime Satellite Organization
IOC	Intergovernmental Oceanographic Commission
IOCARIBE	IOC Sub-Commission for the Caribbean & Adjacent Regions
IODE	International Oceanographic Data & Information Exchange
ITIC	International Tsunami Information Centre
IUGG	International Union of Geodesy & Geophysics

IYO	International Year of the Ocean (1998)
JICA	Japan International Co-operation Agency
JMA	Japan Meteorological Agency
LDG	Laboratoire de Geophysique (France)
NGO	Non-Governmental Organizations
NOAA	National Oceanic & Atmospheric Administration (USA)
NWS	National Weather Service (USA)
OBPS	Ocean Bottom Pressure Sensors
PTB	Preliminary Tsunami Bulletin
PTWC	Pacific Tsunami Warning Centre
PTWS	Pacific Tsunami Warning System
RTWS	Regional Tsunami Warning System
SHOA	Servicio Hidrografico y Oceanografico de la Armada (Chile)
SOA	State Oceanic Administration (China)
TDR	Tsunami Data Report
TIME	Tsunami Inundation Modelling Exchange Project
TREMORS	Tsunami Risk Evaluating from Seismic Moment through a Real-time System (France)
TUNAMI	Tohoku University Numerical Analysis Modeling for Inundation (Japan)
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNESCO	United Nations Educational, Scientific & Cultural Organization
USGS	United States Geological Survey
WDC	World Data Centre
WMO	World Meteorological Organization
WWW	World Wide Web