



**WMO**

**WORLD METEOROLOGICAL ORGANIZATION  
AND  
ECONOMIC AND SOCIAL COMMISSION  
FOR ASIA AND THE PACIFIC**



**ESCAP**

**WMO/ESCAP PANEL ON TROPICAL CYCLONES  
FOR  
THE BAY OF BENGAL AND THE ARABIAN SEA  
  
TWENTY-NINTH SESSION**

**Yangon, Myanmar**

**(12-18 March 2002)**

**FINAL REPORT**

## GENERAL SUMMARY OF THE WORK OF THE SESSION

### ORGANIZATION OF THE SESSION

The twenty-ninth session of the WMO/ESCAP Panel on Tropical Cyclones for the Bay of Bengal and the Arabian Sea was held at the Sofitel Plaza Hotel in Yangon, Myanmar from 12 to 18 March 2002.

#### Attendance

The session was attended by representatives of all the eight Member countries of the Panel namely: Bangladesh, India, Maldives, Myanmar, Oman, Pakistan, Sri Lanka and Thailand. The session was attended by observers from China, Asian Disaster Preparedness Center (ADPC), Asian Disaster Reduction Center (ADRC), International Civil Aviation Organization (ICAO), International Federation of Red Cross and Red Crescent Societies (IFRC), India Institute of Technology (IIT), International Strategy for Disaster Reduction (ISDR), Myanmar Red Cross (MRC), Office for the Coordination of Humanitarian Affairs (OCHA), United Nations Development Program (UNDP) and 3<sup>rd</sup> World Water Forum Secretariat (WWF). The session was also attended by representatives from WMO, ESCAP and TSU. The list of participants is attached as Appendix I.

#### 1. OPENING OF THE SESSION (Agenda item 1)

1.1 The opening ceremony commenced at 08.30 a.m. on Tuesday, 12 March 2002 at the Sofitel Plaza Hotel, Yangon.

1.2 In his inaugural address, His Excellency Major General Hla Myint Swe, Minister for the Ministry of Transport, extended a warm welcome to all the participants and declared the session open. The Minister highlighted the development plan of his government in all social and economic sectors in particular food security, shelter, education, energy and health. He mentioned that his government had continued to construct dams, roads, new ports and airports for domestic and international use with new facilities. He added that in the current third year short-term plan, priority was given to the development of rural areas where 70% of the Myanmar population resides. The plan was to ensure a better transportation, rural water supply, development of agriculture and live stocks breeding and promotion of education and health services. In this respect, Myanmar had to be more cautious about the natural disasters that may have negative consequences on sustainable development. He encouraged the participants to actively exchange views and ideas in a very constructive way and cooperative spirit. The Minister wished the participants a pleasant and memorable stay.

1.3 On behalf of Prof. G.O.P. Obasi, Secretary-General of WMO, Mr Eisa H. Al-Majed the representative of the WMO Secretariat, welcomed all participants to the session and expressed the appreciation of WMO to the Government of the Union of Myanmar for hosting the session and for the excellent arrangements made. He mentioned that tropical cyclones were among the most destructive of all natural hazards which are causing considerable human suffering and stressed that warning services and public awareness before disasters strike should be improved in order to reduce losses through improved observation networks, communication facilities, analyses, forecasts, warning and preparedness system. He highlighted some important issues that the session would address in view of the forthcoming World Summit on Sustainable Development scheduled to be held in Johannesburg in August/September 2002. Mr Al-Majed added that in-line with WMO and ESCAP's vision to promote, strengthen and implement projects in the Panel region, he noted the assistance extended by the organizations and institutions such as the International Civil Aviation Organization (ICAO) and the India Institute of Technology (IIT), and welcomed the participation of Asian Disaster Prevention Center (ADPC), Asian Disaster Reduction Center (ADRC), International Federation of Red Cross and Red Crescent Societies (IFRC), Office for the Coordination of Humanitarian Affairs (OCHA), United Nations Development Program

(UNDP) and the World Water Forum (WWF). He assured the session that WMO would continue making every effort to support the Panel's work to the extent possible.

1.4 The Executive Secretary of ESCAP, in his message transmitted by Mr Ti Le-Huu as representative of ESCAP, expressed his appreciation to the Government of the Union of Myanmar for hosting the session. He mentioned that the ESCAP Commission at its fifty-seventh session held in Bangkok in April 2001 praised the Panel for its past achievements and for the excellent cooperation among its Members to mitigate natural disasters. He commended the Panel for taking the initiative to arrange for technical discussions during the 29<sup>th</sup> session in order to enhance further interaction among the national and subregional institutions. In support of this initiative, he informed the session of ESCAP's willingness to assist in conducting a review, in collaboration with WMO, aiming at further strengthening cooperation among the Members in the hydrological component and disaster prevention and preparedness, if such assistance is required. He also assured the session that ESCAP would continue to undertake activities in support of the Panel within the framework of its own programme of work and available resources.

1.5 Dr Qamar-uz-Zaman Chaudhry, Coordinator of the Technical Support Unit (TSU), expressed on behalf of TSU its gratitude to the Government of the Union of Myanmar and the Department of Meteorology and Hydrology of Myanmar for hosting the 29<sup>th</sup> session of the Panel in Yangon. He expressed appreciation to the spirit of cooperation among the Members and WMO and ESCAP during the past years and looked forward to further strengthening this spirit of cooperation. In this connection, he expressed his sincere hope that the Members would inject new ideas, suggestions and proposals to further enhance the effectiveness of cooperation and continue their participation in the implementation of decisions and recommendations of this session. He pledged commitment of the Panel News Editor to give the Panel News an entirely new look and dimensions so as to truly reflect the spirit and activities of the Panel. He called on the Members to enhance their technical contribution and provide the Editor with latest news. He assured the Panel of his earnest efforts to contribute to the worthy objectives of the Panel.

## **2. ELECTION OF THE CHAIRMAN AND VICE-CHAIRMAN (Agenda item 2)**

### **Election of the Chairman and Vice-chairman of the Panel on Tropical Cyclones**

2.1 Dr San Hla Thaw (Myanmar) and Mr R.N. Goldar (India) were unanimously elected as Chairman and Vice-chairman of the Panel, respectively, to hold their posts until the next session.

### **Election of the chairman of the drafting committee**

2.2 Mr Sultan Al-Saifi (Oman) was elected as chairman of the drafting committee.

## **3. ADOPTION OF THE AGENDA (Agenda item 3)**

The Panel adopted the agenda as given in Appendix II.

## **4. REVIEW OF THE 2001 CYCLONE SEASON (Agenda item 4)**

4.1 India presented a review of the 2001 cyclone season on the basis of the comprehensive report of the Regional Specialized Meteorological Centre (RSMC)-tropical cyclones New Delhi on cyclonic disturbances over the North Indian Ocean during the year.

4.2 In 2001, six cyclonic disturbances formed over North Indian Ocean against an average frequency of 13 to 14 disturbances per year. Out of these, three disturbances formed over the Bay of Bengal and three over the Arabian Sea. Four out of the six disturbances attained the intensity of cyclonic storm (three over the Arabian Sea and one over

the Bay of Bengal). Out of the three cyclonic storms in the Arabian Sea, one which developed during the pre-monsoon month of May, further intensified to the stage of very severe cyclonic storm. The only cyclone which developed over the Bay of Bengal during the post monsoon month of October was a marginal cyclone.

4.3 There was a near absence of cyclogenesis in the Bay of Bengal during the southwest monsoon season. Only one depression developed over the Bay of Bengal as against 6-7 cyclonic disturbances during this season. This lone depression developed during the month of June and lasted for two days only. The system produced widespread rainfall with isolated heavy falls over the state of Orissa from 11 to 14 June 2001. It also produced record breaking two days rainfall of 70 cm (34 cm on 12 June and 36 cm on 13 June) at Puri (43053).

4.4 Development of a cyclonic storm over the Arabian Sea during the month of September is rare in the history of cyclonic storm in the Arabian Sea (since 1877). In each of the years 1929, 1974 and 1979, only one cyclone had developed over the Arabian Sea during the said month. They had also dissipated over the sea itself.

4.5 During the post monsoon season (October–December), cyclonic disturbances generally develop over the South-east/East-central Bay of Bengal. However, during the post-monsoon season 2001, there was a westward shift in the region of cyclogenesis in the Bay of Bengal. Systems developed over West Central Bay of Bengal. Thus they did not get enough time of sea travel to intensify beyond a depression or a marginal cyclone.

4.6 In 2001, all the three cyclonic storms that developed over the Arabian Sea, dissipated over the sea itself.

4.7 The loss to life and property due to cyclonic storms was minimum in the Panel region. Except for India, no other country was severely affected by cyclones in 2001.

4.8 As in previous years, the RSMC-tropical cyclones New Delhi mobilised all of its resources, both technical and human, to track the tropical disturbances evolving in the North Indian Ocean and issued advisories to Panel Members.

4.9 The Panel expressed its appreciation to the RSMC-tropical cyclones New Delhi for the valuable contribution it was making to its Members.

## **5. COORDINATION WITH OTHER ACTIVITIES OF THE WMO TROPICAL CYCLONE PROGRAMME (Agenda item 5)**

5.1 The Panel expressed its appreciation for the detailed information provided by the WMO Secretariat on the implementation of the WMO Tropical Cyclone Programme (TCP). It noted with satisfaction the developments and progress made in both the general component and the regional component of the TCP since the twenty-eighth session of the WMO/ESCAP Panel on Tropical Cyclones (Bangkok, Thailand, 14 to 20 March 2001).

5.2 The Panel noted with appreciation that the Second WMO Regional Technical Conference on Tropical Cyclones and Storm Surges will be held in late 2004. The said conference will not only provide a forum for the exchange of views and experience on improving tropical cyclone and storm surge forecasting but also strengthen cooperation between the Panel and the Typhoon Committee.

5.3 The Panel was informed that the TCP published the first issue of the "Annual Summary of the Global Tropical Cyclone Season 2000" (WMO/TD-No. 1082, TCP-46) with data provided by the five TC RSMCs and five TCWCs. The Panel requested that copies of the said publication as well as the 2001 summary, as soon as it is published, be provided to the Members.

5.4 The Panel was pleased to note that a storm surge expert from Sri Lanka undertook a two-week training (20 to 31 August 2001) at the India Institute of Technology (IIT) in New Delhi, India in the implementation and running of a specific high-resolution storm surge model for Sri Lanka. The Panel requested that WMO make similar arrangements with the IIT for the year 2002 for the attachment of two storm surge experts from Bangladesh and Myanmar.

5.5 The Panel, in its desire to further strengthen coordination and cooperation between Panel activities and those conducted under the programmes of other regional tropical cyclone bodies, requested WMO to explore the possibility for the Panel to be involved in the annual workshops, a pilot project being implemented by the Joint WMO/IOC Technical Commission for Oceanography and Marine Meteorology (JCOMM) for the South China Sea Region.

## **6. REVIEW OF THE COORDINATED TECHNICAL PLAN AND CONSIDERATION OF THE WORK PROGRAMME FOR THE NEXT TWO YEARS (Agenda item 6)**

6.0.1 In order to enhance visibility of the Panel's achievement in its Coordinated Technical Plan, the Panel decided to establish a working group and elected Dr Somsri Huntrakul (Thailand) as Chairperson. It also approved the Terms of Reference (T.O.R.) attached in Appendix III. The working group decided to carry out the T.O.R. in two phases.

6.0.2 In Phase I, the group carried out a detailed review of the Coordinated Technical Plan and decided on some substantial modifications and additions in the five components of the Panel's work programme as reflected in the modified text of the Plan (Appendix IV).

6.0.3 Phase II will involve an overall review of the Plan on the basis of the T.O.R. so as to ensure achievement of the visions adopted by the Panel. The Panel urged all Members to take active part in the work of the group and requested TSU, WMO, and ESCAP to assist in this effort. It requested the working group to submit its report to all the Members through TSU one month before the next session.

6.0.4 The Panel was given an update on the current status of the Panel's Storm Surge Project Proposal by WMO and TSU. Concerned Members, except for India and Pakistan, were again urged to take expeditious action in seeking approval of their respective Governments for the Project including national commitments.

6.0.5 The Panel agreed on the comments and recommendations mentioned in paragraphs 6.0.2, 6.0.3 and 6.0.4 above. It further adopted the updated Coordinated Technical Plan, as amended (see Appendix IV).

### **6.1 Meteorological Component (agenda item 6.1)**

6.1.1 Under this item, matters relating to the basic observational network, the telecommunication links and data-processing systems established in the region to fulfill the requirements of WMO's World Weather Watch Programme were given priority. The Panel Members were invited to present reports on the current progress in dealing with problems encountered and on programmes for the modernization of observing and telecommunication networks and forecasting systems, aiming at further improvements in tropical cyclone monitoring, forecasting and warning services. The Panel reviewed the activities under the meteorological component of the Members during the past year, details of which are presented in Appendix V.

### **Meteorological Observing and Telecommunications Systems**

#### ***Monitoring Results***

6.1.2 The annual global monitoring of the operation of the World Weather Watch provides information on the level of operation of the observing and telecommunications systems. The October 2001 monitoring results show that:

- (a) Less than 50 per cent of the required SYNOP reports were received from Myanmar, and less than 80 per cent were received from Maldives, Pakistan and Sri Lanka;
- (b) No or few TEMP reports were received from Myanmar and Pakistan, and less than 50 per cent of the required TEMP reports were received from other Members except from India.

6.1.3 The Panel felt that the deficiencies described in the monitoring results above, as before, arose largely due to lack of consumables, spare parts and trained staff in some Member countries. It urged Members to take necessary action to ameliorate the implementation of the observational programme and data exchange.

6.1.4 In recognizing the importance of the availability of data from the Panel Region in order to improve tropical cyclone forecasts and warning services, the Panel urged Members concerned to make every effort to maintain and upgrade the observation programmes.

6.1.5 The Panel was informed of the outcome of an Implementation Coordination Meeting on the GTS in Region II (Southern Part) (New Delhi-January 2002). It was pleased to note that the meeting recommended the upgradation of the Bangkok-New Delhi connection and its re-inclusion into the Regional Main Telecommunication Network (RMTN).

6.1.6 The Panel was informed that the percentage of SYNOP reports received during these periods with reference to the Regional Basic Synoptic Network (RBSN) of the region increased for India, Myanmar and Oman, constituting an average of 80-88%, 46% and 87% respectively. The percentage for Thailand remained unchanged constituting 98%, while availability of reports from Bangladesh, Maldives, Pakistan and Sri Lanka was decreased to 83%, 63%, 59% and 62% respectively.

6.1.7 It was further informed that availability of TEMP reports during the same Special MTN Monitoring (SMM) period in 2001 revealed some negative trends for India stations (south of latitude 20°) showing 81% in October as compared with a 90% level in April and July. Upper-air observations in Maldives, Myanmar, Pakistan and Sri Lanka continued to be silent during the whole period. The percentage of reports received from Oman and Thailand remained unchanged during SMM constituting an average of 38% and 49% respectively. Some positive tendency has been registered with the reports from Bangladesh with percentage increased from 17% to 25% by the end of SMM.

6.1.8 **Myanmar** reported to the meeting that the GTS telecommunication links between Yangon and Bangkok as well as Yangon and New Delhi are facing severe problems due to very old terminal equipment (teleprinter) and required spare parts are no longer available. There is therefore an immediate need to have the links upgraded. The Panel requested WMO to look into the matter and give it high priority.

### ***Cyclone Detection Radar***

6.1.9 **Bangladesh** informed the Panel that the Khepupara radar would be replaced by a new one and would be commissioned at Satkhira while the Cox's Bazar radar will be replaced under Japanese grant aid.

6.1.10 **India** informed the Panel that two S-band Doppler Weather Radars (DWRs) have been imported from Gematronik, Germany. Out of these two radars, one has already been installed and commissioned at Chennai. The installation of the second radar at Cyclone Detection Radar (CDR) Kolkata is likely to be completed by March 2002. One DWR

developed by the Indian Space Research Organization (ISRO) under IMD-ISRO collaboration is ready for installation at SHAR Centre, Sriharikota. This radar is expected to be installed and commissioned by May 2002. There are plans to replace five S-band conventional CDRs out of the remaining eight radars with state of the art S-band DWR during the period 2002-2007 in a phased manner.

6.1.11 **Sri Lanka** reported that due to technical problems, the cyclone detection radar at Trincomalee was not operational during the cyclone season 2001.

6.1.12 **Myanmar** reported that the Kyaukpyu radar was fairly operational due to lack of pre-amplifier and Digital Video Integrator Processor (DVIP) unit. It can detect storm position but not intensity and rainfall.

### ***Meteorological Satellites***

6.1.13 The Panel noted with appreciation the latest detailed information on the status reports on the operational meteorological satellite systems that are presently providing data or having the potential to provide the data to Members in the Bay of Bengal and the Arabian Sea.

6.1.14 Most of the Panel Members reported to the Panel in detail the present status and further developmental plans of their meteorological satellite ground receiving equipment and facilities.

6.1.15 **India** informed the Panel that a geostationary Meteorological Satellite (METSAT) is likely to be launched by September 2002 over the Indian Ocean. It will have payloads purely for meteorological purpose and will provide imagery in visible (VIS), infra-red (IR) and water vapour (WV) channels. In addition, it will also carry a Data Relay Transponder (DRT) for relaying the Automatic Weather Station (AWS) data. It will be followed by another geostationary satellite INSAT-3A shortly after that and the meteorological payload will be identical to those of INSAT-IIE.

6.1.6 The Panel expressed its appreciation to the Indian government in general and to the India Meteorological Department (IMD) in particular, on the planned launching of the Indian Meteorological Satellite (METSAT) geostationary satellite by September 2002 over the Indian Ocean.

6.1.17 In this connection, the Panel requested India to supply the specification for the satellite ground receiving station required to intercept the signal broadcasted from the METSAT satellite once it becomes fully operational.

6.1.18 The Panel noted with appreciation that METSAT 5 of the European Organization for the Exploitation of Meteorological Satellites (EUMETSAT) had continued to cover a large part of the Panel region.

### ***Report of the RSMC-tropical cyclones New Delhi activities in 2001***

6.1.19 India reported to the Panel that a new server Origin-200 system has been installed at the RSMC New Delhi. Operational limited area analysis and forecast system has been implemented on this system. Implementation of GTS data decoders in Origin-200 is on test mode. A limited area Quasi Lagrangian Model (QLM) for cyclone track prediction has been made operational. Current Limited Area Model (LAM) analysis and 24 hours forecast products, daily weather bulletins and forecasts (texts) for all regions including special weather warnings for tropical cyclones, heavy rainfall, etc., are now available on the IMD web site in real time. A storm surge model adapted from the Indian Institute of Technology (IIT), New Delhi for Indian coasts has been installed and is currently being validated.

6.1.20 The Panel expressed their appreciation to RSMC New Delhi for continuously providing the Members with tropical cyclone advisories and warnings.

### ***Tropical Cyclone Names***

6.1.21 The Panel expressed its appreciation on the excellent work done by Mr Ahmed Hamoud Mohamed Al-Harthy (Oman), Rapporteur on the Naming of Tropical Cyclones for the Bay of Bengal and the Arabian Sea. The report of the Rapporteur is reproduced as Appendix VI.

6.1.22 In as much as some Members of the Panel still has to submit a list of tropical cyclone names, the Panel decided to extend the process for another six months.

6.1.23 At the request of the Panel, Mr Al-Harthy agreed to continue his assignment as Rapporteur on the Naming of Tropical Cyclones for the Bay of Bengal and the Arabian Sea.

6.1.24 Panel Members were requested to designate contact persons for this endeavour and that their names be submitted to the Rapporteur by 15 April 2002.

## **6.2 Hydrological Component (agenda item 6.2)**

6.2.1 Under the hydrological component, the Panel reviewed the activities of its Members, ESCAP and WMO. The representatives of the Members reported the activities of their respective countries as reflected in Appendix VII.

6.2.2 **Bangladesh** informed the session that as 92 per cent of annual flow is generated in the upstream countries, cooperation with upstream countries in data exchange has improved flood forecasting in the country. **Pakistan** also informed the session that exchange of hydrological data between India and Pakistan has continued to enhance the effectiveness of flood forecasting. The Panel urged that these Members continue this kind of cooperation and inform the Panel of developments including specific details to enhance the visibility of achievements.

6.2.3 The Panel noted with interest that ESCAP and WMO had collaborated successfully in providing assistance to the Typhoon Committee through the participation in country missions to Members of the Typhoon Committee. The objective of the missions had been to assess the needs and capacities of Members of the Committee in flood forecasting and disaster preparedness and prevention activities. The results will be used in the design and implementation of specific projects relating *inter alia* to improve operational flood forecasting systems and to prepare inundation and flood hazard maps.

6.2.4 Based on the positive experience of activities in the Typhoon Committee, the Panel proposed the following activities to be undertaken by the TSU, WMO and ESCAP in close collaboration with Members:

- (a) Design and circulate a questionnaire amongst Member countries of the Panel with the aim to identify activities, capabilities and constraints in tracking and forecasting cyclones, associated winds and surges, precipitation, waves and floods and to assess national capacities to link forecasting activities to national efforts in disaster preparedness and prevention with immediate focus on flood mitigation;
- (b) Identify priority areas of activities and technical cooperation requirements on national levels;
- (c) Identify regional requirements for improved collaboration such as in capacity building, forecasting, preparedness and proper post-disaster survey;



- (d) Develop pilot projects on national and regional levels based on identified priorities of the countries represented in the Panel;
- (e) Convene a technical workshop in conjunction with the thirtieth session of the Panel to analyze regional and national requirements in the forecast of tropical cyclones and associated floods and storm surges and to exchange present knowledge and know-how related to tropical cyclones, forecasting and disaster preparedness.

6.2.5 The Panel was informed that an expert meeting on floodplain management was held in Kathmandu, Nepal in November 2001. This expert meeting was attended by representatives of ten countries of WMO Regional Association II (RA II) and representatives from donor agencies organizations and agencies such as ADPC dealing with disaster preparedness, prevention and disaster response. The meeting report will be published by WMO in March 2002. With relevance to the activity areas of the Panel, the expert meeting highlighted the necessity for an improved cooperation between meteorological and hydrological services to provide accurate and timely forecasting products needed for disaster preparedness and prevention. Recognizing that especially coastal floodplains are extremely vulnerable to the combined effects of river floods and storm surges as a result of tropical cyclone activities, the meeting had recommended that these areas deserve special attention in the establishment of management plans based on accurate forecasts, and response strategies shifting from mainly structural measures to a combination of structural and non-structural measures in flood management. The meeting further recommended the establishment of a network of experts as a first step to establish an informal source of regional knowledge and expertise in forecasting and floodplain management.

6.2.6 In discussing the Storm Surge Project, only Pakistan has responded to the request of the WMO Secretariat to develop national project proposals on storm surges. The Panel urged Members to submit the outstanding proposals, which will then be used to complete the regional framework for the storm surge project and find funding for its national components.

6.2.7 The Panel was also informed that the implementation of the "Associated Programme on Flood Management" was started in 2001 as a joint activity of WMO and the Global Water Partnership. One of the specific objectives of the programme is the documentation of good practices in flood management to be widely publicised. Presently, the programme activities are geared to collect good practices of a number of case studies for publication. At a later stage it is planned to develop pilot projects to demonstrate integrated flood management in the context of integrated water resources management on basin scale.

6.2.8 The Panel noted with interest progress made in the development of a regional flood information system in the Hindu Kush Himalaya in the framework of the WHYCOS project of WMO, a concept paper on the project has been developed and current activities aim to obtain concurrence with the project plans amongst participating countries and to develop a full project proposal.

6.2.9 ESCAP Commission expressed appreciation to the Panel for its contribution to disaster reduction and preparedness measures through monitoring, forecasting and disseminating information on tropical cyclones and hydrological hazards, and for the excellent cooperation among its Members in those activities. It also noted the continued efforts of the Panel to assign names to tropical cyclones in the Bay of Bengal and the Arabian Sea in order to enhance public awareness, and encouraged that initiative.

6.2.10 The Panel was informed that in the area of water resources management, ESCAP continued the implementation of the project on "Capacity-building in strategic planning and management of natural resources in Asia and the Pacific" which was approved by the General Assembly at the end of 1999. In this connection, an expert group meeting was held in June 2001 to discuss experiences in the region on strategic planning and management of water resources and a framework for the preparation of a set of guidelines on this subject for

possible application. Subsequently, the draft guidelines were prepared and discussed at the regional workshop held in Bangkok in December 2001. Following the adoption of the draft guidelines, with several recommended amendments, the guidelines are being finalized for dissemination in the first half of 2002. In connection with regional efforts in strategic planning and management, the joint FAO-ESCAP pilot project on the formulation of national water visions to action was completed and the synthesis report, including the four case studies, was posted on the Web-site of ESCAP and FAO in October 2001. ESCAP also conducted a regional study on enhancement of public awareness in water conservation in 2000 and in 2001 published a set of guidelines on promoting public awareness in this area of water resources management. The above findings and publications were distributed widely to the ESCAP members.

### **6.3 Disaster Prevention and Preparedness Component (agenda item 6.3)**

6.3.1 Under this agenda item, the Panel reviewed the activities of its Members, WMO and ESCAP. The representatives of the Members reported the activities of their respective countries as follows:

#### **Activities of Panel Members**

6.3.2 **Bangladesh** reported that it continued to improve its cyclone warning system, which had contributed importantly to reducing loss of lives and damage to properties. As a result of disaster prevention and preparedness, loss of lives due to major cyclones had reduced significantly from over 300,000 deaths in a 1970 cyclone, to 138,000 deaths for a 1991 cyclone and 194 deaths in two major cyclones in 1997.

6.3.3 **India** reported that the Government of India, Ministry of Agriculture constituted a high powered committee (HPC) to review the Disaster Management machinery in the country and to formulate a comprehensive model plan for disaster mitigation at the National, State and district levels. HPC formed five sub-groups to prepare the plan document. IMD was identified as the convenor of the sub-group 1 on "Water and Climate Related Hazards." Accordingly, a plan document was prepared in consultation with various Ministries, Departments and Non-Governmental Organizations (NGO). The final report was submitted to HPC in September 2001. Several suggestions for improvement in effective Disaster Management practices at the centre and state levels have been made. One of the recommendations is to constitute a Special Task Force equipped with latest state of the art technology and nationwide computerized data base and the emphasis has also been laid in the report for enhanced involvement of community at large in the process of disaster management and to create greater awareness.

6.3.4 **Maldives** reported that as in previous years, the Department of Meteorology continued to issue severe weather warnings to help minimize the risks to fishing vessels and passenger boats encountering stormy weather conditions in the open seas.

6.3.5 **Myanmar** reported cyclones which normally take place in July and August had affected reservoir operation. During the period from April 2001 to February 2002, the country was affected by 12 small scale floods and eight major strong wind events. It requested international assistance in providing experiences from other countries in the region and also class-room aids including references and video tapes for disaster preparedness training. It expressed its interest to obtain financial assistance to enable staff of the Relief and Resettlement Department to take part in international training courses such as those offered regularly by ADPC in Thailand, National Research Center for Disaster Prevention (NRCDP) of Japan and the United Nations.

6.3.6 **Oman** reported that disaster prevention and preparedness activities in their country are undertaken by the Directorate General of Civil Defense of the Royal Oman Police. Aside from disseminating warnings and advisories to the public, the Civil Defense also conducts

disaster awareness programs, roving workshops, rehabilitation programs, etc. There is a very good coordination and cooperation between the Directorate General of Civil Defense and the Meteorological Department.

6.3.7 **Pakistan** reported that the country is frequently hit by disasters such as tropical cyclones, hill torrents causing flash floods, floods, earthquakes, droughts, etc., causing heavy losses of life and property plus the untold direct and indirect long-term socio-economic consequences. This state of affairs calls for the formulation and implementation of well-coordinated and effectively managed disaster prevention and preparedness strategies to combat these disasters. So far as floods are concerned, a flood forecasting manual has already been prepared in which strategy has been formulated. Exact agencies with their responsibilities have been identified and designated with an extensive communication layout plan for quick dissemination of the signified forecasts and warnings in conjunction with the federal and provincial authorities including relief/mitigation agencies. After the May 1999 tropical cyclone and the accompanying storm surge phenomenon which caused havoc in the coastal areas of the Sindh Province, a comprehensive guideline regarding cyclone relief operations, to be undertaken by the local administration, and rescue and relief agencies, has been formulated to combat such disasters in future. Similarly, a National Oil Spill Contingency Plan along with a call up list of relevant government functionaries and private organizations/agencies involved in the rescue, relief and rehabilitation activities has been formulated for a quick and immediate response in the case of such an eventuality. Nevertheless, a lot more needs to be done towards proper education of the vulnerable masses for creating the desired sense of awareness among them. It is, therefore, need of the hour that a forward looking stance may be adopted at the grass-root level to address this weak point.

6.3.8 **Sri Lanka** reported that the National Disaster Management Plan had been finalized and to be submitted to the cabinet for approval. The National Disaster Counter Measure Act would be submitted to the Parliament for approval. It had conducted the following: Disaster Management Certificate Courses, Disaster Management National Training Courses, Disaster Management Awareness Programmes, and Disaster Management Workshops. It established a disaster management information data bank at the National Disaster Management Centre and conducted research projects on: Landslides in Kandy and Mixing of salt water with river water. Foreign training were organized for a few personnels, who are engaged in regional Disaster Management capacity. In the primary school curriculum Elementary Meteorology was introduced. School children and teachers visited the Department in large numbers and they were educated by conducting lectures and demonstrations. Awareness programs were organized for the Government officials, higher education institution, voluntary groups and the instructors of school teachers on various weather related disasters and Climate Change Issues. General public was educated by publishing weather related articles on newspapers and conducting awareness programs and holding discussions with electronic media at bad weather situations.

6.3.9 **Thailand** reported that activities on disaster prevention and preparedness continued to be implemented cooperatively at all levels under the National Civil Defense System. In response to the severe impacts of flash floods affecting the North, northeastern and upper central part of Thailand resulting in 191 deaths and hardship to over half million of families and damage of over US\$60 million, TMD has launched a network of voluntary rainfall monitoring stations. Initially some 50 stations had been established in the affected areas and some 7,000 stations are planned to cover other parts of the country. The representative of Bangkok Metropolitan Administration reported important achievements in flood disaster reduction as results of various measures initiated by H.M. the King of Thailand including flood retentions (monkey cheeks concept) and coordinated drainage system. Floods such as those lasting over two months in 1983 could now be effectively drained in few hours.

6.3.10 The Panel was informed that WMO is represented in the Inter-Agency Task Force (IATF) for Disaster Reduction, a committee formed of high-level members with an active

interest in disaster reduction matters who collectively are called upon to serve as the main forum within the UN system tasked to devise strategies and methodologies for the implementation of the ISDR. IATF convened two meetings in 2001, one in May and the second in November. In the November meeting the task force focused on the significance of disaster reduction as an element of sustainable development, in view of the World Summit on Sustainable Development (WSSD) scheduled for August/September 2002. Each representative of the Task Force is then to make sure that their respective organizations reflect this issue appropriately in their official position, reports and recommendations relating to WSSD and the preparations thereof.

6.3.11 As a member of working group 3 (Risk, Vulnerability and Assessment) of the IATF on Disaster Reduction, one of WMO initiatives was the establishment of the Emergency and Disaster Response Group (EDRG) within the WMO Secretariat. The EDRG is to assist, in particular, in the rehabilitation of meteorological and hydrological infrastructure in Member countries following a disaster. The established mechanism envisaged, as necessary, assembling an Emergency and Disaster Response Team (EDRT) and activating an Emergency Assistance Response Team (EART) which will provide assistance to NMHSs to ensure their continued ability to operate effectively during and after an emergency or disaster. The Panel Members were urged to provide relevant information on tropical cyclones to the WMO Secretariat through the TCP whenever conditions conducive to disaster or emergencies were likely to affect or were already affecting their respective countries and territories to enable the EART to take timely action. This would also help to ensure that the role and activities of the NMHSs during a particular disaster or emergency was appropriately acknowledged at the international level and especially within the UN system.

6.3.12 The Panel was pleased to note that the World Bank Group ProVention Consortium, a global coalition of governments, international organizations, academic institutions, the private sector, and civil society organizations, aimed at reducing disaster impacts in developing countries has two ongoing activities in the region namely:

- Economic and Financial Impacts of Natural Disasters: An assessment of their Effects and Options for Mitigation (Bangladesh);
- Improved Database for the Social and Economic Analysis of Disaster Impacts (India).

6.3.13 Inasmuch as disaster risk reduction is an essential part of sustainable development and would be a focus of interest for the World Summit on Sustainable Development (WSSD), Panel Members were invited to ensure that national delegations to the Summit were briefed on their role and that of WMO in disaster reduction activities.

6.3.14 The Panel was informed that the ESCAP Secretariat continued its work on disaster prevention and preparedness with emphasis on water-related disaster reduction, particularly for flood mitigation and preparedness. As part of the implementation of the recommendations of the programme on "Regional Cooperation in the Twenty-First Century on Flood Control and Management in Asia and the Pacific", ESCAP has started the implementation of a project on "Strengthening Capacity in Participatory Planning and Management for Flood Mitigation and Preparedness in Large River Basins." The project consists of three components:

- (a) Four country case studies, including India (Panel Member);
- (b) A regional workshop held in Bangkok in November 2001; and
- (c) Preparation of a set of guidelines on this subject.

The preparation of the guidelines was in progress and expected to be finalized in the first half of 2002 for subsequent dissemination in the region.

6.3.15 Also during the reporting period, ESCAP, in cooperation with the United Nations Department of Economic and Social Affairs (DESA), the United States National Weather Service, National Oceanic and Atmospheric Administration (NOAA), and the Secretariat for the International Strategy for Disaster Reduction (ISDR) organized an Interregional Symposium on Water-Related Disaster Reduction and Response, also held in Bangkok from 27 to 31 August 2001, to expand cooperation with other regions.

6.3.16 ESCAP organized a special event to commemorate the International Day for Natural Disaster Reduction on 10 October 2001 at the United Nations Conference Centre in Bangkok. The event included two major activities:

- (a) An exhibition of achievements and ongoing efforts of various international agencies and national agencies in the region on this subject; and
- (b) A panel of senior experts to discuss recent flood disasters in Thailand and future strategies to cope with new trends.

The panel consisted of the Director General of the Meteorological Department of Thailand, Director General of the Town and Country Planning Department of Thailand, Inspector General of the Ministry of Agriculture and Cooperatives of Thailand and the Programme Manager of the Asian Urban Flood Mitigation Programme of the Asian Disaster Preparedness Centre.

6.3.17 The Panel expressed its deep appreciation to the representatives of the Asian Disaster Preparedness Center (ADPC), Asian Disaster Reduction Center (ADRC), Office for the Coordination of Humanitarian Affairs (OCHA), and the Third World Water Forum (WWF) Secretariat for their presentations and welcomed future collaborative projects with these institutions.

#### **6.4 Training (agenda item 6.4)**

6.4.1 The Panel reviewed the involvement of its Members in the various education and training activities supported under UNDP, WMO Voluntary Cooperation Programme (VCP), WMO regular budget and TCDC arrangements. Members continued to take every opportunity to improve their human resources through the facilities available from both inside and outside the region. They also took advantage of the various training events, such as symposia, workshops and training courses.

6.4.2 **India** informed the Panel that they continued to provide training facilities at its WMO Regional Meteorological Training Centre (RMTC) for foreign candidates including those from the Panel Members under various programmes including the WMO VCP. Panel Members are encouraged to utilize training facilities in general meteorology, telecommunication, instrumentation, agricultural meteorology, etc.

6.4.3 Since its last session, the Panel had benefited from WMO's education and training activities, relating to the award of fellowships, relevant training courses, workshops, seminars, the preparation of training publications, and the provision of advice and assistance to Members.

6.4.4 The Panel noted that 26 fellows from the Panel Member countries have completed their training during 2001.

6.4.5 The Panel was satisfied with the number of training events and workshops, which were organized in 2001.

6.4.6 The Panel expressed appreciation to Panel Member countries and to other WMO Members such as China; Hong Kong, China; Japan; Republic of Korea and United States of America which offered their national training facilities under bilateral arrangements. These cooperative efforts have been found by the recipients of Panel Members to be very useful. The Panel strongly recommended that such endeavours should continue in the future and strengthened.

6.4.7 The Panel expressed its appreciation to the continuing development of the WMO Training Library (TLB) particularly its Web-site component, the Virtual Training Library (VTL), which provides an efficient operational service to Members using the latest technological advances. The Panel urged its Members to make use of this new development where possible.

6.4.8 **India** informed the Panel of its willingness to organize and host a two-week training workshop on "Interpretation of Satellite Data for Weather Analysis and Forecast" in late 2002 or early 2003 in New Delhi for Panel Members. The Panel expressed its appreciation to India for its initiative and invited IMD to study the cost involved in the organization of said workshop to be able to accommodate one participant from each Panel Member. India was further requested to coordinate with the NMHSs in the implementation of this important workshop. The Panel requested WMO to co-sponsor this event.

## **6.5 Research (agenda item 6.5)**

6.5.1 The Panel was informed that the Second Session of the CAS Working Group on Tropical Meteorology Research Programme (WGTMR-II) met in Cairns, Australia from 28 May to 1 June 2001. The CAS Working Group recommended that IWTC-V be held in Cairns, Australia from 3 to 12 December 2002. The Panel urged its Members to ensure full participation in the workshop. The Panel appealed to relevant scientific organizations and countries to provide logistical and financial support to Members to enable them to participate in the workshop.

6.5.2 The Panel noted that although the final report of the WGTMR-II was yet to be published some of the recommendations of the meeting are relevant to the activities of the Panel. These include:

- (a) Further assessment of the paper "Tropical Cyclones and global climate change" (a copy of which was distributed during the session) should continue to be prepared with quadrennial updates to coincide with future meetings of the WGTMR;
- (b) The continuation of the CAS demonstration project "Tropical Cyclone Disasters", which was adopted by CAS-XI as a Priority Mission. The project should, however, be renamed the "WMO/CAS Priority Mission on Tropical Cyclones".

6.5.3 The Panel was pleased with the recommendations and stressed the substantial contribution of their implementation to the other efforts being made to reduce the adverse effects of tropical cyclones.

## **6.6 Publications (agenda item 6.6)**

6.6.1 Publications issued under the Programmes of the Panel fall into two categories: (a) Panel News, and (b) Annual Review of Tropical Cyclones affecting the Bay of Bengal and the Arabian Sea. Information on the current status of each is presented below:

### **Panel News**

6.6.2 Panel News No. 15 was published by TSU in August 2001 while Issue No. 16 was published in February 2002. TSU informed the Panel of its plans to publish a special Jubilee issue of the Panel News in August 2002 to commemorate the silver jubilee of the TSU which

was founded in India in 1978. Panel Members and observers attending the session were requested to generously contribute to this endeavour.

6.6.3 The Panel invited TSU to continue publishing the Panel News and urged Members to ensure that their written contributions reach the TSU in time.

## **Annual Review**

6.6.4 **India** reported to the Panel that the Panel on Tropical Cyclones Annual Review for the year 1999 has been compiled and finalized by the Chief Editor, Dr R.R. Kelkar (India) in cooperation with national editors and that the manuscript has been forwarded to WMO for publication. India informed the Panel that the Annual Review for the year 2000 will be sent shortly to WMO.

## **7. REVIEW OF THE TROPICAL CYCLONE OPERATIONAL PLAN (Agenda item 7)**

7.1 The basic purpose of the operational plan is to facilitate the most effective tropical cyclone warning system for the region with existing facilities. In doing so the plan defines the sharing of responsibilities among Panel countries for the various segments of the system and records the coordination and cooperation achieved. The plan records the agreed arrangements for standardization of operational procedures, efficient exchange of various data related to tropical cyclone warnings, archival of data and issue of a tropical weather outlook for the benefit of the region, from a central location having the required facilities for this purpose, that is RSMC-tropical cyclones New Delhi, as agreed upon by the Panel.

7.2 The operational plan contains an explicit formulation of the procedures adopted in the Bay of Bengal and the Arabian Sea region for the preparation, distribution and exchange of information and warnings pertaining to tropical cyclones. Experience has shown that it is a great advantage to have an explicit statement of the regional procedures to be followed in the event of a cyclone and this document is designed to serve as a valuable source of information to be readily available for reference by the forecaster and other users, particularly under operational conditions.

7.3 The ICAO Observer presented to the Panel the new formats of the tropical cyclone advisory and SIGMET messages for aviation as a result of Amendment 72 to ICAO Annex 3, in view of its implementation in the area covered by the Panel. He proposed that changes be incorporated into the 2002 edition of the *Tropical Cyclone Operational Plan for the Bay of Bengal and the Arabian Sea* (WMO/TD-No. 84), aimed at harmonizing this document with the ICAO Annex 3/WMO Technical Regulations [C.3.1]. This will contribute to the improvement of the provision of TC advisories and SIGMET messages for international air navigation. The proposed changes are reflected in Appendix VIII.

7.4 The Panel submitted to WMO the changes necessary with a view to issuing an updated 2002 version of the Operational Plan to replace the 2001 edition. The Panel invited WMO to issue the year 2002 edition as soon as possible.

## **8. Technical Support Unit (Agenda item 8)**

8.1 The Panel expressed its gratitude to the Government of Pakistan for hosting the TSU and appreciated the services being rendered by Dr Qamar-uz-Zaman Chaudhry, Director General of Pakistan Meteorological Department (PMD) in his capacity as the Coordinator and Mr Umar Hayat Ghalib as the TSU Meteorologist.

8.2 The Panel was briefed by the TSU Meteorologist on the activities of TSU during the past year. The Panel expressed its satisfaction with the work of the TSU.

8.3 The Panel Members were requested to inform the WMO Secretariat whenever appropriate of the actions taken or plans made by them in relation to the matters addressed in the action sheet regarding decisions and recommendations of the Panel session.

8.4 During the intersessional period, TSU received a request from Pakistan for the development of an improved storm surge prediction model, access to such models and training in the use of these models. PMD in turn was requested to submit a more detailed proposal in this regard for onwards transmission to WMO and ESCAP for assistance.

8.5 In response to a request for contributions for inclusion in the documentation of the 29<sup>th</sup> session, the only reports received by the TSU were from Pakistan and Sri Lanka. These were subsequently forwarded to the WMO Secretariat.

8.6 As requested by the 28<sup>th</sup> session of the Panel, TSU prepared a report on Resource Mobilization (Appendix IX) which was circulated and presented during the session (see paragraph 9.6).

8.7 The TSU tried its best to communicate with Mr Smith Tumsaroch, Chairman, Board of Governors of the Smith Tumsaroch Award but to no avail. However, lately some progress was made on the status of the award (see paragraph 11.2).

8.8 The Panel will continue to maintain its present practice of reviewing the activities of the TSU at its subsequent annual session and requested the TSU Coordinator to provide annual report on the activities of the TSU.

8.9 The Panel agreed to establish its own web site within the TSU. It requested the Coordinator of TSU to collaborate with Panel Members, WMO and ESCAP in the design and development of the web site.

## **9. SUPPORT FOR THE PANEL'S PROGRAMME (Agenda item 9)**

9.1 The Panel was briefed on the activities of the WMO's Technical Cooperation Programme (TCO). The Panel expressed its appreciation to the WMO Secretariat for its continued support to its Members by providing support through VCP and implementing projects. It urged its Members to increase and give priority to the WMO/VCP and Technical Cooperation for Developing Countries (TCDC).

9.2 The Panel was informed that in 2001, a VCP project for the provision of a high-resolution satellite receiving station and computer equipment for climatological data rescue for Myanmar were completed.

9.3 The Panel was pleased to note with appreciation the continued activities implemented by the various Panel Members under the TCDC.

9.4 The Panel requested WMO to arrange for a meeting to be devoted to study the needs of NMHSs of the least developed countries of its Members.

9.5 The Panel Members were encouraged to use the Strategic Plan for the Enhancement of National Meteorological Services (NMSs) in Regional Association II (Asia) for the period 2001-2004 for the development of assistance programs and projects.

9.6 The Panel expressed its appreciation to the Coordinator of TSU for submitting the paper on resource mobilization (Appendix IX). The Panel encouraged its Members to approach the various social and economic sectors in their efforts to mobilize resources for the Panel's activities.



9.7 The Panel requested its Chairman to contact the international manufacturer's of meteorological instruments and equipment inviting them to provide financial assistance to the Panel's Trust Fund. It also requested WMO to provide the Panel's Chairman with the list of the manufacturers.

9.8 The Panel noted with appreciation that WMO and ESCAP would continue to undertake activities in support of the Panel on Tropical Cyclones.

9.9 The Panel was informed by WMO that voluntary cash contributions had been made to the Trust Fund by its Members.

9.10 The Panel noted that in order to initiate joint programmes and activities for its Members, in particular training workshops, experts' visits to Panel Members and attachments to Regional Meteorological Specialized Centers and elsewhere, it is necessary to increase the voluntary cash contributions. In this regard, the Panel agreed to increase the voluntary annual contribution to US\$2,000. Furthermore, the Panel welcomed any additional contributions by its Members.

9.11 The Panel approved the Statement of Account of the Panel on Tropical Cyclones as of 31 December 2001 as shown in Appendix X.

9.12 The Panel approved to meet from the Trust Fund the running cost of the TSU, the printing of the Panel News and the development of a website by October 2002 with an amount of US\$4,000.

9.13 The Panel also approved to meet from the Trust Fund a maximum amount of US\$4,000 for important activities of the Panel during the intersessional period. Such expenditures will be subject to the approval of the Chairman of the Panel and the Coordinator of TSU and should be in accordance with Trust Fund rules.

9.14 The Panel requested that a detailed breakdown of the expenses incurred by the TSU during the intersessional period be submitted by the WMO Secretariat during each session.

## **10. TECHNICAL DISCUSSIONS (Agenda item 10)**

10.1 The Panel expressed its deep appreciation to the following lecturers/presenters:

- Mr Gerhard Putman-Cramer (Deputy-Director and Chief, Emergency Services Branch OCHA, Geneva) "Complementarity existing between response activities and tropical cyclone prevention in improving disaster management capacities in the Panel region"
- Mr Kamal Kishore (Director, Information and Research, ADPC, Bangkok) and Ms Vivian Raksakulthai (Program Coordinator, Extreme Climate Events Program, ADPC, Bangkok) "Highlights of selected activities of ADPC and its partners in the area of hydro-meteorological disaster prevention and preparedness"
- Mr Satoru Nishikawa (Executive Director, ADRC, Kobe) " The Role of the Asian Disaster Reduction Center in the Panel Region"
- Mr Shishir K. Dube (Professor, Indian Institute of Technology, New Delhi) "Storm Surge Research Activities in the India Institute of Technology and Experimental Ocean State Forecasting (May 01-July 31, 2001)"

- Mr Hiroshi Yamaguchi (Vice-Secretary General for Regional Cooperation, Secretariat of the 3<sup>rd</sup> World Water Forum, Tokyo) “The World Water Forum and development of future collaboration with national partners in the Asia Pacific region”
- Ms Tian Cuiying (Meteorologist, China Meteorological Administration, Beijing) “The China Meteorological Administration and its partnership with the Panel on Tropical Cyclones”
- Mr Umar Hayat Ghalib (Meteorologist, TSU, Islamabad) “Storm Surge Project Proposal of Pakistan”
- Mr P.M. Jayatilaka Banda (Deputy Director, DM, Sri Lanka) “Drought in Sri Lanka”
- Mr R.N. Goldar (Deputy Director General, IMD, Kolkata) “Tropical Cyclone Analysis and Forecasting using Satellite Imagery at the IMD”
- U Tun Lwin (Director, DMH, Myanmar) “Climate Changes over Myanmar during the last five decades”
- Mr Le Huu Ti (Economic Officer, ESCAP, Bangkok) “Experiences in Strengthening Cooperation of the Typhoon Committee in the Hydrological and Disaster Prevention Preparedness Components”
- Ms Nanette Lomarda (Scientific Officer, TCP, WMO, Geneva) “Workshop on South China Sea Storm Surge, Wave and Circulation Forecasting”

10.3 The Panel recognized the importance of coordination of research activities, which could lead to more impacts of the Panel’s common efforts and increase the visibility of cooperation. The Panel agreed that a theme subject could be adopted for such common efforts and for the 30<sup>th</sup> session, the theme would be “Tropical cyclone-related disasters and poverty alleviation in the Panel Area”. In considering that coordination of research activities for this theme could be better integrated into the review of the Coordinated Technical Plan (CTP), the Panel requested that the Working Group on Coordinated Technical Plan appoint a Coordinator for the Theme Topic to assist the focal points in each country in carrying out related research activities.

## **11. OTHER MATTERS (Agenda item 11)**

11.1 The Panel discussed some issues raised at its last session as follows:

- (a) The Panel noted with appreciation the improvement on the presentation of country reports during the session wherein most of the delegates used an overhead projector or a Power Point Presentation. The Panel encouraged the participants to continue in this respect;
- (b) The Panel also encouraged its Members to further improve coordination by inviting and ensuring the participation of representatives at the Panel session from other institutions involved in hydrology, disaster prevention and preparedness.

11.2 The Panel agreed to formulate institutional arrangements for accepting the Smith Tumsaroch Fund Award. In this regard, the Panel expressed its appreciation to Mr Smith Tumsaroch and to the Administrator of the award for their proposal to re-start the Award for the Panel. The Panel requested its Chairman and the Coordinator of TSU to coordinate, as

necessary, with the Parties concerned. The Panel proposed that the proposal for the selection of the Awardee is to be coordinated with the host of the session in a period of time of not less than three months.

11.3 The Panel recognized the importance of exchanging information, technological know-how and research results in different fields covering the activities of the Panel and encouraged its Members to use the facilities available in particular, the new telecommunication technology.

11.4 The Panel discussed the issue of strengthening of the Panel. It requested ESCAP in consultation with WMO and TSU to undertake in 2002 a comprehensive survey with a priority focus on water-related disaster reduction as offered by the ESCAP Executive Secretary in his message to the session. The Panel also agreed to request WMO in consultation with ESCAP and other partners to mobilize resources and to undertake review missions to selected Members to discuss the survey findings with a view to recommending priority activities and programs to be implemented by the Panel and for subsequent resource mobilization.

11.5 The Panel expressed its sincere appreciation to the China Meteorological Administration for their participation in this year's session.

## **12. DATE AND PLACE OF THE THIRTIETH SESSION (Agenda item 12)**

The representatives of Pakistan and Sri Lanka informed the Panel that their countries would be willing to host the thirtieth session in March 2003, subject to the approval of their governments. The Panel requested its Chairman in consultation with WMO, ESCAP and TSU to arrange for convening the session.

## **13. ADOPTION OF THE REPORT (Agenda item 13)**

13.1 The Panel expressed its sincere appreciation to the Government of the Union of Myanmar, the host country, for providing excellent facilities, the venue, other arrangements and its warm hospitality for this year's session. The Panel also expressed its deep appreciation to Dr San Hla Thaw, the Chairman of the Panel and to Mr R.N. Goldar, Vice-chairman, for the successful conduct of the session. The Panel wished to express its gratitude to U Tun Lwin, Chairman of the Local Organizing Committee and his able staff for their hard work in producing a session report which is definitely of high quality.

13.2 The Panel expressed its gratitude to the Minister for the Ministry of Transport for organizing a one-day trip to the ancient city of Bagan to learn of the rich history and culture of the Bagan period and to the Department of Meteorology and Hydrology (DMH) for the visit to various industrial sectors in Yangon and to the Office of the DMH.

13.3 The report of the twenty-ninth session was adopted at the Panel's final meeting at 1240 hours on 18 March 2002.

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## APPENDIX I

### 29<sup>th</sup> Session of the WMO/ESCAP Panel on the Tropical Cyclones in the Bay of Bengal and the Arabian Sea

(12 to 18 March 2002, Yangon, Myanmar)

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## APPENDIX II

### AGENDA

1. OPENING OF THE SESSION
  2. ELECTION OF THE CHAIRMAN AND VICE-CHAIRMAN
  3. ADOPTION OF THE AGENDA
  4. REVIEW OF THE 2001 CYCLONE SEASON
  5. COORDINATION WITH OTHER ACTIVITIES OF THE WMO TROPICAL CYCLONE PROGRAMME
  6. REVIEW OF THE COORDINATED TECHNICAL PLAN AND CONSIDERATION OF THE WORK PROGRAMME FOR THE NEXT FIVE YEARS
    - 6.1 Meteorological component
    - 6.2 Hydrological component
    - 6.3 Disaster prevention and preparedness component
    - 6.4 Training
    - 6.5 Research
    - 6.6 Publications
  7. REVIEW OF THE TROPICAL CYCLONE OPERATIONAL PLAN
  8. TECHNICAL SUPPORT UNIT
  9. SUPPORT FOR THE PANEL'S PROGRAMME
  10. TECHNICAL DISCUSSIONS
  11. OTHER MATTERS
  12. DATE AND PLACE OF THE THIRTIETH SESSION
  13. ADOPTION OF THE REPORT
-

APPENDIX III

**TERMS OF REFERENCE OF THE WORKING GROUP TO  
REVIEW THE COORDINATED TECHNICAL PLAN**

(hard copy only)

APPENDIX IV

COORDINATED TECHNICAL PLAN

Activity	YEARS					Responsibility	Funding	Remarks
	2002	2003	2004	2005	2006			
<b>METEOROLOGICAL COMPONENT</b>								
1. Improvement of Observational set-up								
1.1 Special Coastal Stations (60)								
						Members	National	
						Myanmar	National	9 stations
* For observations when a cyclone is within 300 km								
1.2 Establishment of Upper Air Stations (11)								
1 in Bangladesh						Bangladesh	External	
1 in Sri Lanka						Sri Lanka	External	
1 in India						India	National	
3 in Myanmar						Myanmar	External	
2 in Thailand						Thailand	External	
2 in Maldives						Maldives	External	
1 in Oman						Oman	National	
1 in Pakistan						Pakistan	External	
1.3 Mobile Ships								
Installation of automatic stations and making arrangements with coastal earth stations (5)						Members	National	To be installed in consultation with shipping concerns
1.4 Automatic Weather Stations								
(i) establishment of simple AWS in Islands and reefs in the Bay of Bengal and Arabian Sea (4)						Pakistan	National	
						India	National	
						Members	National	
(ii) drifting buoy near Phuket (Thailand) in Andaman Sea						Thailand	National	
(iii) anchored buoy near Mumbai (India)						India	National	
1.5 Cyclone Detection Radar Stations								
(i) replacement of 3 out of 10 cyclone detection radars by 3 Doppler radars in India (Chennai, Srihatrikotha, Kolkata)						India	National	
(ii) two 10 cm radar at Khepupara, Bangladesh						Bangladesh	External	> Appropriate training required in maintenance, operation and interpretation of data
(iii) one 10 cm radar at Malè						Maldives	External	>
(iv) one 10 cm radar at Colombo						Sri Lanka	External	>



APPENDIX IV, p. 2

Activity	YEARS				Responsibility	Funding	Remarks
(v) one doppler radar at Yangon					Myanmar	External	>
1.6 Meteorological Satellites					Bangladesh	External	Operational
Modern facilities for reception of data from polar and geo-stationary satellites							
					Myanmar	External	
					Maldives	External	
					Pakistan	External	
					Sri Lanka	External	
1.7 Installation of High Gust Anemometer							
4 in India					India	National	Operational
5 in Bangladesh					Bangladesh	External	
2 in Myanmar					Myanmar	External	
1 in Oman					Oman	National	
1 in Pakistan					Pakistan	National	
5 in river mouths					Members	External	To be replaced by electrical anemometer
1.8 Deep Sea Meteorology Buoy Network							
(i) Procurement of 16 buoys					Regional Office	External	
(ii) Buoy Installation					Member	Member/ External	Expert assistance & fellowships will be required
(iii) Buoy operational					Member	Member/ IOC	>
(iv) Buoy maintenance					Member	Members	>
2. Communication Facilities							
2.1 Meteorological Telecommunication System							
2.1.1 Collection at NMCs of all observational data from basic networks as well as from special stations					Members	National	
					Bangladesh	National	
					Myanmar	National	
2.1.2 Upgrading of:							
Karachi-New Delhi to 9600 bps					India & Pakistan	External/ National	Under Implementation
Bangkok-Yangon to 2400 bps					Thailand & Myanmar	External	
New Delhi-Yangon to 2400 bps					Myanmar/India	External	
Colombo-New Delhi to 2400 bps					Sri Lanka & India	National/ External	

APPENDIX IV, p. 3

Activity	YEARS					Responsibility	Funding	Remarks
Dhaka-New Delhi from 2400 to 9600 bps						Bangladesh & India	External	In Progress
New Delhi-Malè 2400 bps						Maldives & India	National/ External	
2.2 Local communication for storm surge warning dissemination to DPP organization						Members	National/ External	To be strengthened jointly by NMHSs and DPP organizations (operational in India)
2.3 Regional Computer Network (RCN)								
Application of RCN in Tropical Cyclone and Flood Forecasting and Operation of Storm Surge Model and						Members/WMO	National/ External/ VCP/ IIT Delhi	Training activities, fellowships and consultant services will be required
Installation of software for NMCs						Maldives Myanmar Sri Lanka Thailand	External/ VCP/ IIT Delhi	
						Bangladesh	External	
						Oman	National	
						Pakistan	External	
3. Data Dossier and Archival								
Compilation of storm data files						Members	External	RO will report the progress to the Panel*
						Bangladesh	External	
						Pakistan	External	
Establishment of data archival centre at New Delhi						India	External	
<b>HYDROLOGICAL COMPONENT</b>								
1.0 Tide Gauge Network								
(i) Procurement of 50 tide gauges						Members	National/ External	
						Pakistan	External	
(ii) Selection of sites and installations						Member/RO	External	
						Myanmar	External	Installation by Govt of India
(iii) Tide Gauge Operations/Maintenance						Member/RO	External	Expert assistance & workshops will be necessary
1.10 Additional Hydrological Measurements						Members	National/ External	In consultation with national hydrological organizations
Bathymetric measurements						Members	National	

APPENDIX IV, p. 4

Activity	YEARS					Responsibility	Funding	Remarks
						Myanmar	National	
						Pakistan	External	
Topographic measurements						Members	National	
						Myanmar	National	
Rainfall measurements (real time)						Members	National	
						Myanmar	National	
River discharge measurements						Members	National	
						Myanmar	National	
Water level measurements (non-real time)						Members	National	
Water level measurements (real time)						Members	National	
						Myanmar	National	
1.11 Surge Height Measurements by								
Ribbons						Members	External	
Digital pressure loggers						Members	External	
Procurement of Ribbons						RO	External	Experts and training will be necessary
Procurement of digital pressure loggers (500)						RO	External	
Survey and identification of tree and land marks along surge prone areas						Members	Members	
						Bangladesh	National	
						Myanmar	National	
Episodic installation and recovery of ribbons and digital pressure loggers and measurement						Members	External	
1.12 Collection of Oceanographic data by DCP voluntary ships						Members/RO	National/ External	
Installation of automatic XBTs and CTD data						Members/RO	National/ External	
Installation of one hydrological radar						Bangladesh	External	Japan
Data Dossier and Archival								
Compilation of historical surge data sets						Members/WMO/ TSU	National	One workshop and expert assistance
						Bangladesh	National	
						Pakistan	National	
Establishment of Data Archival Centre at New Delhi						India	External	
<b>1.1 DISASTER PREVENTION AND PREPAREDNESS COMPONENT</b>								
*Development, maintenance and strengthening						Members	National	

APPENDIX IV, p. 5

Activity	YEARS					Responsibility	Funding	Remarks
organizational framework between NMHSs and DPP organizations for effective implementation of the Programme > Establish active link between NMHSs and DPP organizations						TSU		
						Bangladesh	National	
						Pakistan	National	
*Designing warning systems according to requirements of Govt DPP and other NGO organizations > Specialized seminar for DPP officials > Specialized seminar for DPP officials and decision makers on cyclone and surge warnings						Members/TSU	National	
						Bangladesh	National	
						Pakistan	National	
* Making warnings simple to be easily understood by common people > Workshop/Educational programme for community awareness						Members	National	
						Bangladesh	National	
*Establishment and maintenance of appropriate warning dissemination arrangement in conjunction with governments and other agencies for timely dissemination and reception of warnings and recommended response actions > Joint Workshop for forecasters and DPP officials						Members TSU	National	
						Bangladesh	National	
Promotion of community participation and involvement in all phases of counter disaster response > Conduct Public Awareness Programs						Members	National	
Seminar workshop to assess hazard risk and vulnerability of coastal areas						Members/TSU	National	
						India	National	
<b>TRAINING COMPONENT</b>								
Forecaster Training to Improve warning accuracy						India	National	
						Oman	National	
Formulation and implementation of educational programme for community awareness						Members/TSU	National	
Specialized seminar for counter-disaster officials and						Members/TSU	National	

APPENDIX IV, p. 6

Activity	YEARS					Responsibility	Funding	Remarks
decision makers								
On-the-job training in Doppler Radar						Members	India/ External	By request
Training for maintenance of RCN						Members/WMO	External	
						Oman	National	
Expert (2 months for each country) for application of RCN in operational forecasting						Members/WMO	External	By request
						Oman	National	
Workshop on Storm Surge Dossier and Archival						Members/WMO	External	
Expert (6 months) for organization and planning data files, historical data and archival						Members/WMO	External	
						Oman	National	
Two workshops (2 week duration) on cyclone prediction techniques and interpretation of satellite data						Panel TSU WMO	India/ External	
Expert (3 months) for choosing a storm surge model						Members	External	
Two experts (6 months for each country) for the development of a storm surge model						Bangladesh Myanmar WMO	External	
Expert (6 months) for model development for coastal inundation						Members TSU WMO	External	
Expert (6 months) for the development of a tide surge model and wave surge model						Panel TSU WMO	External	
Expert (3 months) for PC based real-time surge prediction						Members TSU WMO	External	
Workshop on Storm Surge problems and prediction techniques						Members TSU WMO	External	
3 month training of cyclone forecasters in all aspects of the storm surge project						Members WMO	External	
3 month training in river surge interaction						Members WMO	External	
Attachment of forecasters or support staff involved in storm surge forecasting						Members WMO	IIT Delhi/ External	
Exchange visits to advanced centres						Members	TCDC	

APPENDIX IV, p. 7

Activity	YEARS				Responsibility	Funding	Remarks
					WMO		
<b>RESEARCH COMPONENT</b>							
<b>Meteorology</b>							
Development of cyclone model for surface wind estimation					Panel/WMO	External	Consultant service and workshops required to execute programme
					Bangladesh	National	
Increasing accuracy in cyclone track and intensity					Panel/WMO	External	Consultant service and workshops required to execute programme
					Bangladesh	National	
Expert (6 months) for cyclone model development					Panel TSU WMO	External	
Expert (6 months) for cyclone intensity and track forecasting					Panel TSU WMO	External	
<b>Hydrology (Storm surge &amp; Inundation)</b>							
Review of existing storm surge models and adaptation and implementation of suitable model(s) for some countries on operational basis					Members/TSU/ WMO	External	
Development of new storm surge models, particularly for Bangladesh and Myanmar					Bangladesh	External	
					Myanmar	External	
PC based real time surge prediction					Members	National/ External	
					Bangladesh		
Improvement of empirical model by parameters Representing complex coastlines, river discharges, etc.					Members	National/ External	
Modification of existing models to study coastal inundation and storm surge envelope and to compute probable Maximum Storm Surge					Members/WMO	External	
					Bangladesh		
Development of Tide-Surge Models and wave surge models					Members/WMO	External	
Detailed bathymetry and on-shore topography for improved storm surge model					Members	National	
Expert (6 months) to study the Impact of possible sea					Maldives	External	Expert assistance required

APPENDIX IV, p. 8

Activity	YEARS			Responsibility	Funding	Remarks
level rise on storm surge				Sri Lanka WMO		
				Bangladesh	External	

- Data to be sent to WMO while awaiting for the establishment of the data archival center in New Delhi

## APPENDIX V

### ACTIVITIES OF THE MEMBERS - METEOROLOGICAL COMPONENT

#### BANGLADESH

- Bangladesh Meteorological Department is operating three RS-stations located at Dhaka, Chittagong and Bogra. Dhaka RS-station has been upgraded to GPS system. The RS-stations at Chittagong and Bogre need to be upgraded to GPS system. Bangladesh Meteorological Department also operates ten Pilot Balloon Observatories to record upper-air observations.
- Bangladesh Meteorological Department is operating four 10 cm S-band radars at Dhaka, Cox's Bazar, Kehpupara and Rangpur. All the radars are linked with the Storm Warning Centre by microwave and/or VSAT link for direct reception, view and animation.
- Radar Composite System has been installed. Composition of four radar images is being carried out with this system. It has become fully operational.
- Ship observations are scanty, however, they are received by the Bangladesh Meteorological Department through coastal radio stations at Chittagong via teleprinter.
- Bangladesh Meteorological Department is now receiving GMS-5 imageries (hourly) from GMS, NOAA imageries from NOAA (HRPT) and INSAT images from INSAT receivers regularly.
- Bangladesh Meteorological Department exchanges meteorological data, forecasts, warnings and other relevant information with RTH New Delhi on a routine basis through WMO's GTS system. All the observatories of BMD are connected with NMCC Dhaka by TP, telephone, SSB, etc. At present, the Bangladesh Meteorological Department is using the Centralized Message Switching System (CMSS) for HP-UNIX Workstations developed by the Bureau of Meteorology (BOM), Australia, with Japanese assistance for telecommunication purposes. Dhaka-New Delhi X.25 GTS link operating at 2400 bps may be upgraded to 64 kbps speed at the time of introduction of NWP in the BMD. RTH, New Delhi has offered upgrading of the link to TCP/IP at a speed of 64 kbps.

#### INDIA

- INSAT 3C was launched on 24 January 2002. A geo-stationary Meteorological Satellite (METSAT) is likely to be launched by September 2002 over the Indian Ocean. It will have payloads purely for the meteorological purpose and will provide imagery in VIS, IR and WV channels. In addition, it will also carry DRT transponder for relaying the AWS data. It will be followed by another geo-stationary satellite INSAT-3A shortly after that and the meteorological payload will be identical to those of INSAT-II E. The upgraded Meteorological Data Utilization Centre is being used for processing CCD payload data received from INSAT-II E.
- Two f S-band Doppler Weather Radars (DWRs) have been imported from M/S Gematronik, Germany. Out of these two radars, one has already been installed and commissioned at Chennai. The installation of the second radar at CDR Kolkata is likely to be completed by March 2002. One DWR developed by ISRO under IMD-ISRO collaboration is ready for installation at SHAR Centre, Sriharikota. The construction work of the building for this radar is likely to be completed by March-April



2002. This radar is expected to be installed and commissioned by May 2002. An expert committee for networking Doppler radars has been set up so that the meteorological products derived at radar stations can be made available at various offices.

There are plans to replace five more existing S-band conventional CDRs out of remaining eight radars by the state-of-the-art S-band Doppler Weather Radar during the tenth five-year (2002-2007) plan in a phased manner.

- The 1680 MHz WBRTs are being replaced by state-of-the-art solid state 1680 MHz radiotheodolites at New Delhi (RMO Ayanagar), Lucknow, Guwahati, Kolkata, Nagpur, Mumbai, and Jodhpur during 2002-2003 besides three more at Manali, Jammu and Bere-camp under Mountain Met. (Power) Project Network.
- Presently, RS/RW data at 35 RS/RW stations is being computed semi-automatically with PCs of second generation. A project has been initiated for developing computing system for automatic ingest of pressure, temperature, humidity, azimuth and elevation data at a faster rate during 2002-2003. One additional RS/RW stations at Jaipur is under progress after completion of the building.
- Twelve INSAT-AWS systems have been deployed in the field units at Dwarka, Karaikal, Pune, Nasik, Delhi, Thiruvananthapuram, Goa, Ahmedabad and Mumbai. There is a proposal to deploy 100 AWS with the state-of-the-art system in a phased manner and to install an AWS Data Reception, Processing and Dissemination Centre at Pune by 2004.
- Ten ultrasonic-type High Wind Speed Recorders (HWSR) had been successfully installed at Digha, Paradip, Gopalpur, Kakinada, Kavali, Kalingapatnam, Chennai, Mumbai, Veraval, and Okha. HWSR at Visakhapatnam, Machilipatnam and Karaikal maintained (Mechanical Type).

Procurement of ten more sets of HWSRs under World Bank Project (WBP) for installation of cyclone-prone areas along the east coast is in advanced stage of finalization.

- Action to upgrade Karachi-New Delhi circuit to 9.6 kbps is in progress. Response from Colombo to upgrade New Delhi-Colombo circuit to 2400 bps using internet is awaited. Action to upgrade Dhaka circuit to 6400 bps is in progress. 75 out of 77 RBSN stations have dedicated telecom link.
- A new message switching computer installed at NMTC, New Delhi.
- IMD website launched at New Delhi, Mumbai, Kolkata (RMC and PAC) and Chennai.
- Interactive Voice Response System (IVRS) installed at NHAC, New Delhi and RSMCs: Kolkata, Mumbai and Chennai for local forecasts of mega-cities and meteorological data of a large number of stations over telephone at local call rate.
- GMDSS bulletins are being broadcasted daily at 0900 GMT and 1800 UTC by INMARSAT safety-net system and additional bulletins during the cyclone period.

- Numerical Weather Prediction (NWP)

The major events during the year 2001 are as follows:

A new server Origin-200 system has been installed. Operational limited area analysis and forecast system has been implemented on Origin-200 computer system. Implementation of GTS data decoders in Origin-200 is on test mode. A limited area Quasi Lagrangian Model (QLM) for cyclone track prediction has been made operational. Current LAM analysis and 24 hours forecast products, daily weather bulletins and forecasts (texts) for all regions including special weather warnings such as tropical cyclones, heavy rainfall, etc., are available on the IMD website in real time. A storm surge model adapted from the Indian Institute of Technology, Delhi, for Indian coasts has been installed and is currently being validated.

A large volume of meteorological information, including the forecast tracks of tropical cyclones, is being provided on IMD's website.

## **MALDIVES**

- No observations were made last year. The WF100 radar provided by the USA under the VCP remained unserviceable throughout the year. The refurbished Plessey WF33 radar donated by the UK Meteorological Office under VCP, which is at Gan Island, was not functioning for the last several years and has to be replaced. The hydrogen generators at the National Meteorological Center and Gan Meteorological Office were out of service for the past three years. Upper-air observations from Gan and Malé are very important to monitor the onset of SW monsoons and study the upper atmosphere of data-sparse areas of the north and equatorial Indian Ocean. These observations are also vital for the study and prediction of the weather over the Maldives and the north Indian Ocean. Hence, Maldives' request to WMO and Panel members is to provide the necessary assistance to restore the upper-air observatories at Malé and Gan.
- The INSAT Meteorological Data Reception station functioned well until September last year. The Satellite Division of the India Meteorological Department is arranging an expert mission to assess the work to be done to regain the reception of the MDD system. The polar-orbiting satellite receiving system performed fairly well throughout the year. EUMETSAT imageries and upper winds available on the internet are used daily to locate the weather systems which affect the Maldives. Satellite winds which are available on a three-hourly basis and imageries updated every hour are very valuable aids for analyzing the weather systems.
- The local computer-based telecommunication system and the Radiotelephone system with telex modem which connects the local Meteorological Office and the National Meteorological Centre (NMC), performed efficiently in the last year. The 75-baud GTS link between Malé and New Delhi operated satisfactorily.
- The Analyzing, Forecasting, Data-processing and Operating System (AFDOS) functioned efficiently during the year 2001.

## MYANMAR

- There are two ground-receiving systems for meteorological satellite Skyceiver for WEFAX (Weather Fax) and APT (Automatic Picture Transmission) from GMS 5 and NOAA. The newly installed ground satellite receiver donated by the China Meteorological Administration is capable of receiving High-Resolution VISSR pictures from GMS 5. Now India has already allowed reception of INSAT Meteorological Images for countries within the INSAT footprint. Although INSAT sub-satellite location is much closer to Myanmar than GMS 5, the DMH is not yet equipped with an INSAT receiver and FY2 receiver as well. Therefore, Myanmar is keenly interested to receive those images and charts on a regular basis by using INSAT MDD (Meteorological Data Distribution) systems for forecasting and warning of tropical cyclones.
- A storm detection radar is located at Kyaukpyu and now is fairly operational due to the absence of preamplifier and DVIP (Digital Video Integrator Processor) function. Although lacking the above mentioned units, the radar can detect storm position except for true intensity and amount of rainfall. Since Kyaukpyu radar is the only radar in Myanmar, there is a gap of storm detection radar coverage in the region of Deltaic-Mon, Taninthayi coast and it is necessary to install a storm detection radar at Yangon (48097) to fill the gap of radar coverage for better tracking and warning of the tropical cyclones in the region.

## OMAN

- The Sultanate of Oman operates two upper-air observing stations, viz. Muscat (41256) and Salalah (41316). Both of these are equipped with Vaisala's Digicora GPS wind finding system. One flight is launched from each of these stations in a day.
- Weather reports from ships are received through GTS, as well as from Muscat Coastal Radio Station. In addition, ship reports are also received from the Royal Oman Navy.
- One wave measurement station was installed offshore Sohar and the collected data is inserted on the GTS every three hours. Two more stations will be repaired and/or replaced at Muscat and Salalah. One additional station is planned for Qalhat (Sur).
- The number of Synoptic Land Stations being inserted into the GTS still remained at 23 stations.
- All the meteorological stations operated by the Meteorological Department are connected to the MSS computer located at the Central Forecasting Office at Seeb International Airport by a reliable dial-up telephone link. The MSS is connected to the RTH Jeddah by a dedicated link at 9600 bps.

In addition, a 128 kbs internet leased line has been established, as well as an e-mail and FTP Server. All these are protected by a firewall.

- A Bilateral Internet Circuit was established between New Delhi and Muscat for the exchange of meteorological data. Another bilateral circuit link was also established between Abudhabi and Muscat for the exchange of meteorological data.

- The Department installed ground-receiving stations for intercepting high-resolution images from polar-orbiting satellites operated by NOAA, as well as from geostationary satellites operated by EUMETSAT.
- Numerical Weather Products are received via MDD, GTS and internet from Bracknell, Toulouse, Offenbach and Washington. A Local Oman Regional Model (ORM) was established with the kind cooperation of the National Weather Service of Germany (DWD). We run three model versions as follows:
  - (a) The ORM\_28 covers the region 30.0E, 07.0N (lower left corner) to 78.0E, 35.25N (upper right corner) with a mesh size of 0.25 degree (approx. 28 km). There are 193 x 114 grid points and 20 layers. The model gives a 78-h forecast in the 12 Processor E 4500 Sun Machine;
  - (b) The ORM\_07 covers the region 51.0E, 16.5N (lower left corner) to 61.0E, 26.5N (upper right corner) with a mesh size of 0.0625 degree (approx. 7 km). There are 161 x 161 grid points and 25 layers. The model gives a 78-h forecast in a 12 Processor E4500 Sun Machine;
  - (c) A WAM-based wave model was established with the kind cooperation of GKSS of Germany, which covers the Arabian Sea, the Gulf of Oman and the Arabian Gulf.
- In order to meet ICAO recommended practices and to fulfill the requirements for Aviation, the Department installed a SADIS workstation as early as 1996. Effective last year, the Department started to pay to the UK Met. Office the annual contributions for obtaining SADIS data and products.

## PAKISTAN

- Tender has been approved and awarded to service provider by the competent authority regarding data communication setup at 64 kbps using TCP/IP protocol as suggested by RTH New Delhi. The service provider has almost completed its work regarding communication software. Information like host/local IP addresses, TCP Routing Protocol, TCP Filtering (agreed TCP Port numbers for communication) is still awaited from RTH New Delhi. As soon as the same is received, PMD will test the data communication between NMCC Karachi and RTH New Delhi before regular commissioning of the circuit.
- Aeromet Observatory at Gwadar has been upgraded as Meteorological Observatory and started functioning round the clock with effect from 3 August 2001. Request has been made to WMO for the allotment of an Index No. for the said Observatory.
- A reference has been made to WMO for the allotment of an Index No. for the Class-I Surface Observatory which was established at Upper Atmospheric Research Station, Peshawar during April 2001.
- On account of financial constraints, some of the upper-air stations were not fully operational during the year 2001. For the same reason, all the six radiosonde/rawinsonde stations too were not operational. However, synoptic data of all the 13 GTS stations (portion I), eleven stations of RBSN (portion II) and 16 stations of RBSN (portion III), along with available pilot data, was collected by PMD's NMCC Karachi and transmitted to RTH New Delhi and other international links on 3 and 6-hourly intervals round the clock. All the transmitted data was

monitored immediately by internet facility at the NMCC. As the national economy is showing signs of revival, the Government is likely to allocate necessary funds for the procurement of Radiosondes for the RS Stations during the financial year 2002-2003.

## **SRI LANKA**

- Radiosonde observations at Colombo were made three times a week at 1200 UTC. India continued to supply Radiosonde transmitters, accessories and consumables for these observations. Radar wind observations were made at 0600 UTC and 1200 UTC using 100 g balloons and 350 g balloons at Colombo, throughout the year. Pilot balloon observations were made as usual at Colombo at 0001 UTC and at 0600 UTC.
- As usual, ship weather reports are received through the coastal radio station "Colombo Radio" and sent to the National Meteorological Centre (NMC) in the Meteorological Department via telephone or fax. During the non-real-time monitoring period of 1 to 5 October 2001, none of the report was received.
- Due to technical reasons, the cyclone detection radar at Trincomalee was not operational during the cyclone season 2001.
- The high gust anemometer at Trincomalee on the East Coast worked satisfactorily during the year 2001.
- Reception of HRPT Pictures from NOAA series of satellites were satisfactory. The Meteorological data receiving system including the INSAT cloud imagery provided by India under the Indo-Sri Lanka Joint Commission is operating well. Cloud imageries from various websites were also received for operational purposes.

## **THAILAND**

- Besides 19 stations where AWOS system had been installed previously, four more sets of this system were installed in 2001 in the following provinces: Nakhon Phanom, Mae Sot, Phetchabun and Phitsanulok. A fifth set will be installed in Phrae during 2002.
- The existing satellite receiving system (GSC-REALPAK) at the head office has been upgraded in order to obtain more NOAA series satellite data and to prepare to receive data from MTSAT (Japan) and FY-2A (China).
- The Frame Relay link using TCP/IP protocol was installed in July 2001 with Tokyo. Its port speed is 64 kbps. Committee Information Rate (CIR) equals to 16 kbps. The operation of the circuit is more satisfactory than the previous X.25 protocol (9.6 kbps). In early 2002, Thai Meteorological Department (TMD) plans to connect a new circuit with Vientiane, Laos using FTP protocol, 64 kbps. The installation is now under processing. The Bangkok-New Delhi link will be maintained and upgraded. Similarly, the inter-regional circuits between Bangkok and Kuala Lumpur and Singapore will be upgraded.

APPENDIX VI

**REPORT OF THE RAPPORTEUR ON THE NAMING OF TROPICAL CYCLONES  
FOR THE BAY OF BENGAL AND THE ARABIAN SEA**

(only hard copy)

**ACTIVITIES OF MEMBERS - HYDROLOGICAL COMPONENT**

**INDIA**

- IMD has established ten Flood Meteorological Offices (FMOs) located at Ahmedabad, Asansol, Agra, Bhubaneswar, Guwahati, Hyderabad, Jalpaiguri, Lucknow, New Delhi and Patna in the flood prone areas. These Offices cater their services to meet requirements of flood forecasting for the rivers like Yamuna, Ganga, Narmada, Tapti, Mahi, Mahanadi, Brahmaputra, Barak, Godavari, Krishna, Teesta etc. After crossing India, Ganga and Brahmaputra rivers enter Bangladesh. During the flood season 2001, 2,664 Quantitative Precipitation Forecasts (QPF) were issued. These QPFs have been used by the Flood Forecasting Division (FFD) of the Central Water Commission (CWC) for issuing flood forecasts. In addition to QPFs, FMOs also provide following information:
  - (1) Prevailing Synoptic Situation;
  - (2) Heavy rainfall warning;
  - (3) catchmentwise/sub-catchmentwise areal precipitation that occurred during the past 24 hours.
- Design storm studies are being conducted to study rainfall magnitude and its time duration for use as main input for the design engineers in estimation of flood for hydraulic structure, irrigation projects, dams, etc. on various rivers. The probable maximum precipitation values are also evaluated for optimum utilisation of water resources.
- Real-time monitoring of district wise daily rainfall is one of the important function of IMD. A network comprising a large number of rain gauge stations is utilised under the Districtwise Rainfall Monitoring Scheme (DRMS). Based on the real-time daily rainfall data, weekly districtwise, sub-divisionwise and statewide rainfall distribution, summaries are prepared as a routine activity of the Rainfall Monitoring Unit (RMU). Rainfall statistics are prepared in the form of rainfall tables and maps. The tables contain districtwise and sub-divisionwise actual, normal and percentage departures of rainfall. Maps showing weekly and cumulative rainfall figures in 35 meteorological divisions are also prepared to present a pictorial distribution of rainfall. Areas of excess, normal, deficient and scanty rainfall are depicted in different colours. Updated weekly, monthly and seasonal rainfall distribution summaries are also prepared regularly. District-wise and sub-division-wise rainfall statistics provide important information useful to the agriculture scientists, planners and decision makers. This information is supplied to various government agencies for official use.
- This unit provides design estimates of short duration rainfall in different sub-zones of the country for the purpose of railway and road bridge construction. Hydrometeorological data for a number of river catchments are analysed for probable maximum storms, return periods of very heavy rainfall and run-off relationship. The study in respect of 24 sub-zones (out of 26) have so far been completed and the flood estimate report for the six sub-zones have been revised. The flood estimation report for lower Narmada and Tapti basins has also been revised during 2001. In these studies, representative network of rain gauge stations and hydrometeorological observatories are being maintained for collection of data.

## MYANMAR

- The Department of Meteorology and Hydrology was able to start water quality activities since 1998 and initiative investigation of water quality measurement was carried out at Guaytanshay, Hlaing River on 10 January 1999. Now (24) monitoring stations are established and (12) parameters are used for water quality surveillance and monitoring system along four main rivers, six tributaries and a lake.

Regular measurements are taken at least two times a year at a station, once in wet season and once in dry season. From January 1999 to December 2001, (71) measurements had been collected and their physical and chemical analysis were tested.

- In order to provide runoff data, discharge and sediment discharge measurements are carried out yearly at suitable places. In 2001, discharge measurements are undertaken at Ngaung U (Ayeyarwady river), Myinmu (Ayeyarwady river), Hkamti (Chindwin river), and Ngathainggyaung (Ngawun river), under the supervision of the Hydrological Division.
- Hydrological data of full-time stations are checked, processed and published annually as Hydrologic Annual Volume I and II by the Hydrological Division. During the year 2001, Hydrological Annual for the years 1999 and 2000 were issued successfully. Volume I includes river stage data from 67 stations, discharge data from 37 stations and sediment discharge data from 21 stations. In Volume II, rainfall data from 111 stations, water temperature from 39 stations and evaporation data from 41 stations are given.

## OMAN

- One of the roles of the Ministry Regional Municipalities, Environment & Water Resources is to act as the flood information authority of Oman. As well as collecting storm and flood data in its nation-wide hydrological network, it provides a service of information on historic storms and floods, flood risk maps, flood frequencies, design storm rainfall intensities and frequencies, design floods and drainage rates. It is also involved in tidal flooding aspects.
- These services are used by various Ministries and the public in the course of planning any housing infrastructure and other developments that may involve wadis in any way, either as wadi crossings, or any structures within wadis or flood plains. They are also used for general drainage design.

## PAKISTAN

- In order to augment flood-forecasting capabilities in the Second Flood Protection Sector Project (FPSP-II), package C comprising following components has been made to further improve the flood forecasting techniques:
  - (a) Installation of S-Band i.e. 3 GHz, 10-cm wave length Doppler Weather Radar at Mangla;
  - (b) Upgrading of C-Band i.e. 5.5 GHz, 5.6-cm QPM radar at Sialkot;
  - (c) Allocation of sufficient amount for the maintenance of 10-cm Doppler radar at Lahore;



- (d) Allocation of funds for research studies on various operational topics relating to flash flood forecasting, hill torrents and radar calibration, etc.

PC-I, in this regard, has already been submitted to the Government. Provision of necessary funds and its release is under process.

## THAILAND

- TMD has launched the first phase of a Telemetry System Project in late September 1999. The project is undertaken by TMD so that collection activities related to flood monitoring, flood forecasting and warning are carried out in real time. The system consists of hydrometeorological forecast center workstations, PCs and other peripherals. During the year, 50 automatic rainfall stations in Bangkok, 18 automatic hydrometeorological stations in eight river basins, and water stage equipment at hydrometeorological stations were installed.
- The Management Overview of Flood Forecasting System (MOFFS) version 2C was replaced by MOFFS version 3.
- The flood forecasting and warning system in the three designated river basins, namely: Nan, Pasak and Prachin Buri River Basin are monitored on a routine basis. The three models currently used for flood forecasting and warning systems are as follows:
  - Discrete Linear Cascade Model (DLCM), software received from the World Meteorological Organization (WMO). It is one of HOMS Components;
  - Antecedent Precipitation Index (API);
  - MIKE 11 Modelling System was installed in November 1995.
- Serious flood events occurred in several places in the country. Continuous efforts have been made to alleviate flood problems. Flood forecasting and flood warnings were concentrated together with flood risk mapping. Many projects were started and carried out by the Royal Irrigation Department during this year as follows:
  - The establishment of a fully automatic telemetry system was started for Chumporn province of Tha Taphao river basin in the south. It will be used for real-time operation of flood forecasting, flood warning and flood management system. The project was planned for about two and a half years;
  - Same for the lower Chao Phraya river basin, the fully automatic telemetry system was started this year and will take about three years. Bangkok and vicinity are under the flood protection cooperational between Bangkok Metropolis, Public Works Department and Royal Irrigation Department;
  - The telemetry system of Hat Yai in the south was revised to be fully automatic for more efficiency. The project was with the cooperation of the Thai Meteorological Department;
  - Flood risk mapping was conducted for five river basins: Ping, Pasak, Mun, Bang Paking and Khlong Tha Paphao. The project was for policy matrix of water resources management through a loan from the Asian Development Bank.

APPENDIX VII, p. 4

The Royal Irrigation Department also took part in rehabilitation of damaged areas after flood disasters.

APPENDIX VIII

**CHANGES PROPOSED BY ICAO TO BE INCORPORATED INTO THE 2002 EDITION  
OF THE TROPICAL CYCLONE OPERATIONAL PLAN FOR THE BAY OF BENGAL AND  
THE ARABIAN SEA**

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APPENDIX IX

**REPORT ON RESOURCE MOBILIZATION**

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APPENDIX X

**STATEMENT OF ACCOUNT OF THE PANEL ON TROPICAL CYCONE TRUST FUND**

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