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U.S. INDIAN OCEAN TSUNAMI WARNING SYSTEM (IOTWS)
PROGRAM

WORKSHOP PROCEEDINGS
REGIONAL SHARING OF BEST
PRACTICES ON TSUNAMI EARLY
WARNING SYSTEMS (TEWS)
AUGUST 2007

August 2007 Version 1.0

Prepared for the United States Agency for International Development
by the IRG-Tetra Tech Joint Venture



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REGIONAL SHARING OF BEST PRACTICES ON TSUNAMI EARLY WARNING SYSTEMS

August 13-14, 2007
Sanur Beach Hotel, Bali, Indonesia

Facilitating Institutions:

United States Department of Agriculture, Forest Service (USDA/FS)
and
National Oceanic and Atmospheric Administration (NOAA)
through the
U.S. Indian Ocean Tsunami Warning System (IOTWS) Program

Supported by:

United States Agency for International Development Regional Development Mission
for Asia (USAID RDM/A)





**Workshop Participants at the Regional TEWS Workshop, Bali, Indonesia
August 13-14, 2007**

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1. Background

The U.S. Indian Ocean Tsunami Warning System (IOTWS) Program is a two-year initiative of the U.S. Agency for International Development (USAID) through which scientists and experts are sharing technical expertise and helping to build early warning system capacity within the Indian Ocean region.

The Tsunami Alert Rapid Notification System (TARNS) for early warning is one component of the US IOTWS Program. The USDA Forest Service (USDA/FS) and National Oceanic and Atmospheric Administration (NOAA) are providing technical expertise for TARNS, which ensures that tsunami advisories or warnings are sent to all relevant national and local officials. Those officials are then able to send information to the public quickly and accurately. A series of workshops have been conducted with the governments of Thailand and Indonesia to enhance and refine their tsunami warning systems. To share best practices of tsunami warning systems and simulation exercises in the region, a regional workshop was conducted in Bali, Indonesia, on August 13-14, 2007. The workshop provided opportunities for experts from throughout the region to share their experiences regarding tsunami warning systems and simulation exercises for disaster management.

The event drew together participants from each of the five tsunami-affected countries (India, Indonesia, Maldives, Thailand, and Sri Lanka) and Australia. The list of participants is attached in Annex 4.

2. Workshop Objectives

The specific objectives of the workshop were to:

- Share best practices on tsunami early warning systems (TEWS) and lessons learned
- Share information about tsunami warning simulation exercises in the region
- Share experiences about developments in the Tsunami Alert Rapid Notification System process in Thailand

3. Inaugural Session

- **Mr. Winston Bowman**, Regional Environment Director, USAID Regional Development Mission for Asia welcomed participants to promote regional sharing on best practices regarding tsunami early warning systems and described the U.S. Government's contributions to develop TEWS in the region.
- **Mrs. Sri Woro B. Harijono**, Director General, Meteorological and Geophysical Agency (BMG), Indonesia, opened the workshop and requested the participants to explore solutions for some pressing regional problems, e.g. inadequate warning dissemination facilities and mechanisms, and lack of maintenance of technologies for tsunami early warning systems.
- **Mr. S.H.M. Fakhruddin**, Technical Specialist, US IOTWS/Asian Disaster Preparedness Center provided an overview of U.S. Government support for the Indian Ocean

Tsunami Warning System, the US IOTWS Program's major achievements to date, and transition and sustainability efforts.

- **Dr. Smith Dharmasaroja**, Chairman, Committee of National Disaster Warning Administration, and Advisor to the Minister of Information and Communications Technology (MoICT), Thailand, provided a keynote speech on the role of the national government in disaster recovery and the sustainable development of the tsunami early warning system in Thailand and the Indian Ocean Region.
- **Ms. Deanne Shulman**, Senior Emergency Management Specialist, US Forest Service presented on the Tsunami Alert Rapid Notification System (TARNS), i.e. the national early warning system, in Thailand and Indonesia and regional lessons learned.

Regional Lessons Learned:

- ✓ Tsunami warning is one of the most demanding of warning systems
- ✓ The “last mile” communication is critical and the most challenging
- ✓ Importance of media role
- ✓ Public education and adaptive learning
- ✓ Warning is the intersection point of science, technology, sociology, and human psychology

4. Progress and Lessons Learned on TEWS

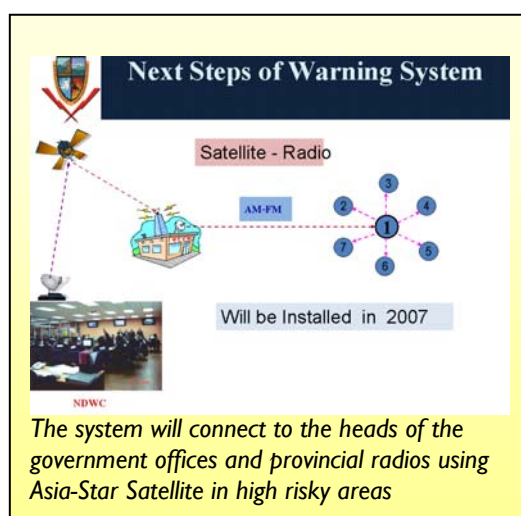
Representatives from the five US IOTWS Program countries presented on regional and country initiatives on tsunami early warning systems and lessons learned. Ms. Deanne Shulman chaired the session. Following the presentations, a panel of country experts brainstormed and discussed critical issues of tsunami early warning systems. The country presentations are summarized below.

4.1 Progress and Lessons Learned: Thailand

Mr. Waiyapot Worakanok, presented the progress and lessons learned in Thailand to develop the tsunami warning system, as summarized below:

Key Progress:

- 11 digital and 13 analog seismic stations are running properly and digital stations are available in GSN.
- Nine tide gauges installed and monitored by the Thai Meteorological Department (TMD) and another nine stations are monitored by the Royal Thai Navy.
- Two stations are connected with the global sharing system.
- One Dart II buoy has been installed at 9°N, 89°E under the US IOTWS Program and is running properly.
- 99 warning towers along the western coast of Thailand are connected directly with NDWC.



The system will connect to the heads of the government offices and provincial radios using Asia-Star Satellite in high risky areas

Warnings are also disseminated by telephone, fax, SMS, amateur radio, provincial radio, TV, etc.

- Tsunami warnings and advisories are generated at the NDWC using DSS developed under the US IOTWS Program, based on the available data and the guidance provided by the Pacific Tsunami Warning Center (PTWC), the Japan Meteorological Agency (JMA), and TMD.

Lessons Learned:

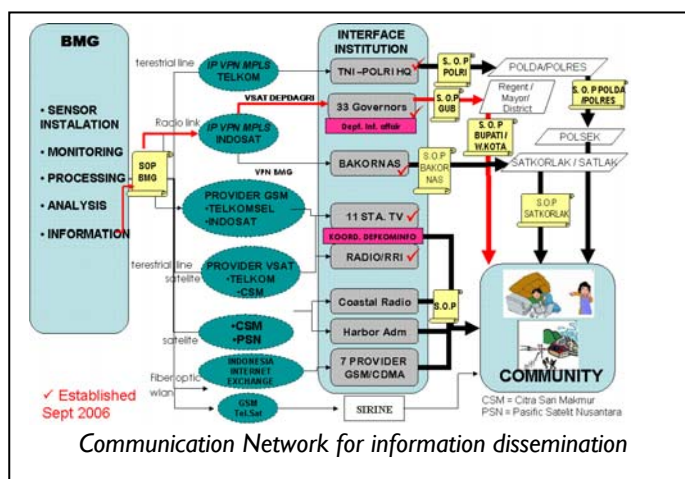
- There are significant challenges in setting up the organization and institutional framework, including development of regulations and policies, resources management, and cooperation with related agencies.
- Technology design should use optimal resources and provide regional benefits.
- Enhanced regional and international cooperation is required on data sharing to increase warning capabilities.
- Capacity building in mitigation and risk reduction was a major challenge.
- Gaining permission from the local government to test siren system capacities and procedures took a long time.

4.2 Progress and Lessons Learned: Indonesia

Dr Prih Harjadi, Director, Meteorological and Geophysical Agency (BMG) presented the overall Indonesian TEWS design, multi institution task arrangement, monitoring and dissemination system, and public awareness and preparedness.

Key Progress:

- 73 seismic sensors are in place and another 160 seismic sensors will be deployed in 2007-08.
- An SOP has been established from the national to local levels on warning formulation and dissemination.
- BMG introduced a five-in-one dissemination system to make the system more robust and build in redundancy.
- Enhancement of community awareness:
 - Disaster management workshop for local government officers
 - ToT for the community base
 - Community education packet
 - Preparation of evacuation maps and routes
 - Posting tsunami signboards along the evacuation routes
 - Simulations for TEWS and evacuations
 - Media toolkit
 - Exercises for school children



Lessons Learned:

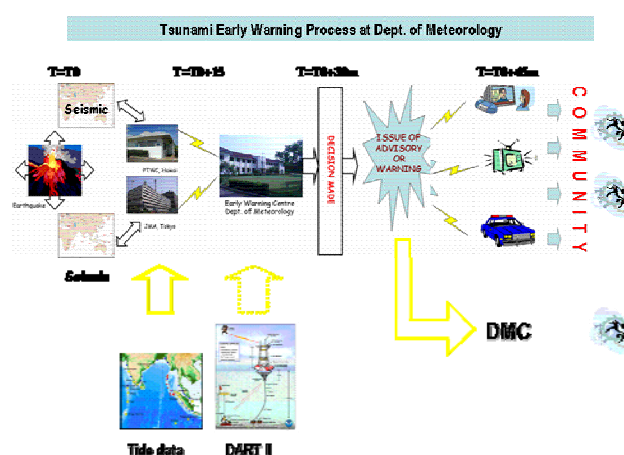
- Clarifying the roles and responsibilities of the institutions is a huge challenge.
- Limited budgets, a lack of resources, unstable network connections, and a lack of commitment impedes implementation.
- Disaster management agencies must ensure that warning messages reach all vulnerable areas

4.3 Progress and Lessons Learned: Sri Lanka

Mr. Lalith Chandrapala, Deputy Director, Department of Meteorology (DoM), and **Mr. Kelum Jayasoma**, Assistant Director, Disaster Management Centre (DMC), presented the progress and major challenges for TEWS in Sri Lanka.

Key Progress:

- Connection to the Global Telecommunication System (GTS) has been upgraded.
- Primary seismic information is available through advisories from PTWC and JMA by GTS, fax, email, and satellite phone. In addition, seismic data is received from the California Integrated Seismic Network (CISN), USGS, and RANET.
- Warning communication mechanisms include three siren towers established on a pilot basis, the disaster early warning network (DEWN), SMS, radio, and TV.
- Early warning committees and sub-committees at the district, divisional, and community levels, and awareness programs on early warning and dissemination have been established.
- Community-based hazard maps have been developed, and safe evacuation routes and shelter locations have been identified.
- Tsunami-prone communities and schools have conducted evacuation drills and adopted Incident Command Systems (ICS) for emergency response.



Lessons Learned:

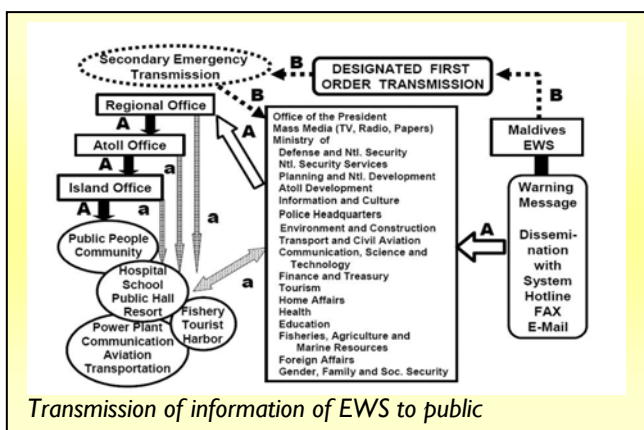
- There remain challenges in establishing national-level mandates for technical institutions on the formulation of early warning and the development of SOPs.
- An effective dissemination system and improved linkages with the media and critical agencies is needed.
- Hazard maps and risk profiles are needed.

4.4 Progress and Lessons Learned: Maldives

Mr. Ali Wafir, Deputy Director, National Meteorological Centre (NMC), presented on tsunami early warning system progress in the Maldives.

Key Progress:

- An SOP is in place.
- To speed up warning dissemination, on-duty forecasters have been given the authority to issue and disseminate advisories and warnings to the media and concerned authorities without consulting executives of the Department.
- Focal points are assigned in the concerned government ministries to disseminate all hazard advisories and warnings to the relevant sectors.
- The Global Telecommunication System (GTS) has been upgraded.
- Three tide gauges in the Maldives have been upgraded with pressure sensors and radar sensors to monitor tsunamis. The satellite data transmission interval has been changed from one hour to 15 minutes.
- The second and third phases of developing the Maldives early warning system will be funded by the government.



Lessons Learned:

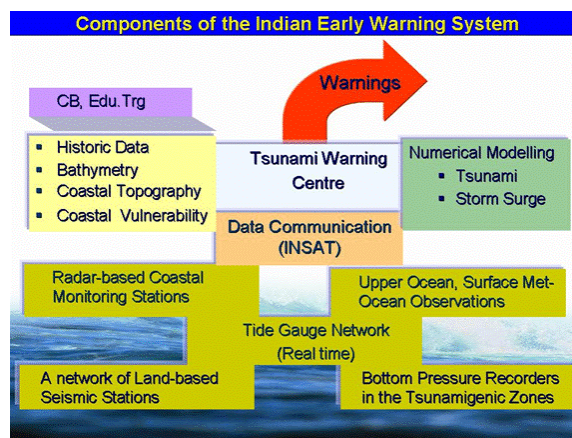
- A well-structured early warning system is vital for safeguarding lives and reducing property damage.
- Establishing a local earthquake monitoring network is important for providing information to the public about seismic hazards to keep them well informed and prepared.
- Upgrading the local tide gauge stations is needed for data on the height of tsunamis or large waves.
- Quick and reliable communication is extremely important for monitoring situations in real time and for disseminating forecasts and warnings.
- Enhancing the existing meteorological monitoring network is needed to better understand climate systems and improve the quality of forecasts and warnings.
- Dissemination of advisories and warnings to each and every individual in a timely and effective manner will help them take the necessary actions.
- Awareness raising on natural hazards is vital for communities to understand the hazard and respond quickly during emergencies.
- It is important to educate the public and schoolchildren to take necessary actions on their own when they are exposed to a threat even without a warning.
- There is a lack of human resources in various scientific fields in the Department of Meteorology.

4.5 Progress and Lessons Learned: India

Mr. C.B. Sankar, IAS, State Government of India presented the early warning system of India.

Key Progress:

- A tsunami early warning center has been functioning in Hyderabad since July 2005 on a 24/7 basis.
- The center receives earthquake information from the India Meteorological Department (IMD) and global networks.
- The seismic network is being strengthened with the addition of 17 interconnected broadband seismic stations with links to IMD, New Delhi, and the Parallel Central Receiving Station at the Indian National Center for Ocean Information Services.
- The installation of 12 bottom pressure recorders is planned, with 10 in the Bay of Bengal and two in the Arabian Sea. Six have already been deployed.
- 50 additional tide gauges will be installed. 12 are already in position.
- All of the critical locations to validate tsunami warnings have been covered. These have proved their effectiveness in the last two high-magnitude undersea earthquakes.
- Five coastal observing radars and two current meter moorings will be installed to monitor storm surges.



Lessons Learned:

- Vulnerable houses in the coastal areas need to be reconstructed.
- The government should provide robust early warning systems with a focus on operationalizing such early warning systems at the community level
- Hazard mapping is more effective with the involvement of the community. To support this, the government plans for continuous training of local communities in their programs.

Workshop participants took part in panel discussions on enhancing tsunami early warning systems and developing cooperation with other countries. A summary of discussions is as follows:

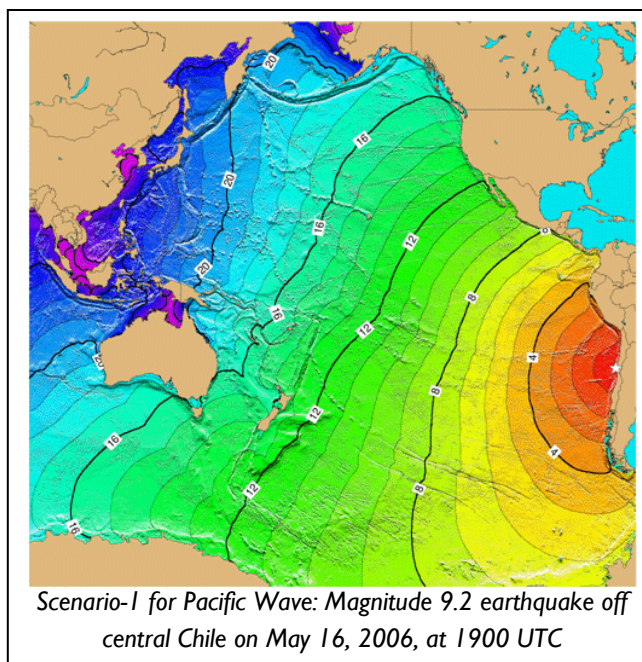
- Tidal gauges in Sri Lanka are located very close to land and will not be useful for Sri Lanka to detect tsunamis, but the data is very useful for African countries.
- Regional cooperation is very important and a center like PTWC is extremely necessary in the Indian Ocean region. Regional cooperation can help the countries to use existing resources optimally. Thailand is in a position to be a regional watch provider, but this requires greater capacity to provide this service to neighboring countries
- Countries should be informed about good practices as well as those practices that should be avoided.
- The tones of sirens should be similar in the Indian Ocean countries to avoid confusion with other sounds.
- Industries in high-risk zones are requesting information to reduce damage and save lives.
- Some participants commented that the region has enough seismic stations and does not need to spend money to install more seismometers.

5. Case Studies of Tsunami Warning Simulation Exercises

5.1 Pacific Wave Exercise, May 16-17, 2006

Dr. Mark Sullivan, Assistant Secretary, Emergency Management Australia (EMA), presented the Pacific Wave exercise, which was held on May 16-17, 2006. The purpose of that simulation was to evaluate the ability of countries around the Pacific Rim to respond to an ocean-wide tsunami. Other objectives included the following:

- Validate the regional tsunami centers' dissemination process.
- Validate the process for countries to receive and confirm tsunami bulletins.
- Validate dissemination of the warning message to relevant agencies within a country, its provinces, and local jurisdictions.
- Validate organizational decision-making processes about public warnings and evacuations.
- Identify the modes that would be employed to notify and instruct the public.
- Assess the elapsed time until the public would be notified and instructed.



Lessons Learned:

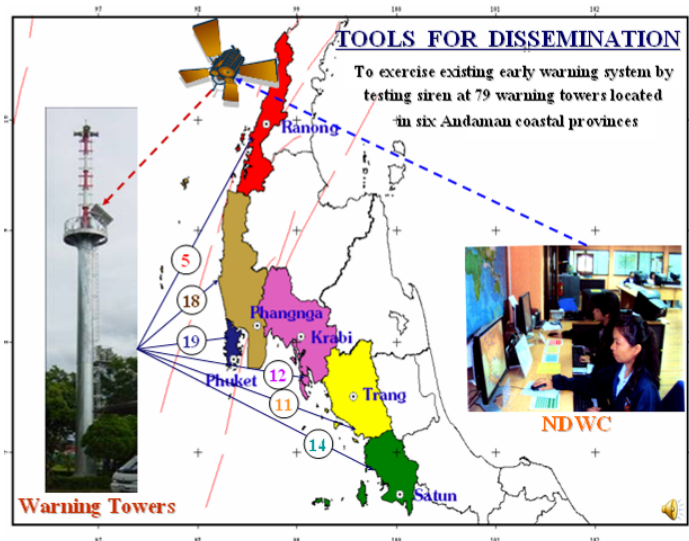
- The compressed time allotted for the simulation made it less realistic and affected quality.
- A longer planning horizon is required for better management.
- It did not satisfy regulatory requirements, policy change, etc.
- Roles and responsibilities should be clarified to improve individual performances.
- Warning messages should be simplified.
- The media should be engaged earlier in the planning process.
- The exercise should be held annually.

5.2 Thailand Tsunami Warning Simulation Exercise, July 25, 2007

Dr. Smith Dharmasaroja, Chairman, the Committee of National Disaster Warning Administration, and Advisor to the Minister, MoICT, Thailand, presented video footage from the Andaman Wave exercise on July 25, 2007, which was held in six coastal provinces.

Lessons Learned:

- With tsunami warning simulation exercises, every step needs to go perfectly so that people on the beach can be kept fully informed and feel safer. If agencies pin down the weak points now, there is a chance to fix them and make sure the system will work in case there is a real disaster.
- Establishing an evaluation process for the exercise, conducting and after action review, and following up with recommendations is the true measure of a successful simulation.
- Simulation exercises provide an opportunity to resolve conflicts and clarify roles between disaster management agencies.



5.3 Indonesia Tsunami Warning Simulation Exercise, December 26, 2005 and 2006

Mr Gde Sudiarta, Indonesian Red Cross, **Mr. Willy Wicaksono**, Director, Komunitas Siaga Tsunami (KOGAMI), and **Dr. Mohamad Rasyid**, Ministry of Research and Technology (RISTEK), provided a joint presentation on Indonesia's tsunami simulation exercise. In Padang, the government established a draft emergency response SOP prior to the exercise, trained 200 teachers on disaster procedures, and conducted a series of table-top simulations. In Bali, preparations for the exercise began with a planning workshop to determine roles and responsibilities. Then community members and key stakeholders were briefed, a ToT was held, and scenarios tested.

Lessons Learned:

- The government should focus on strengthening the management of SATKORLAK and SATLAK to conduct various trainings, develop SOPs, and develop emergency response plans.
- Agencies must increase community awareness related to risk reduction, mitigation, and response in coastal areas.
- The government should increase the response capacity of SATKORLAK and SATLAK (e.g. through emergency communication systems).
- Padang
 - Commitment is required from all stakeholders, including the government, private sector, and communities.
 - Prepare the system components well and test them before testing the whole system (e.g. EW, SOPs, and regulations).
 - Key actors and communities must have the necessary knowledge and capacities before running a simulation exercise.
- Bali

- The roles and responsibilities of all agencies improved, and all agencies learned from each other.
- Government attention to developing EWS and response should be increased.
- Communities must be aware of the appropriate actions needed when they receive an emergency warning.
- EWS equipment should be tested before a simulation.

5.4 Regional Panel Discussion on Tsunami Warning Simulation Exercises

Workshop participants took part in panel discussions on improving tsunami warning simulation exercises. Discussions are summarized below.

Planning timeframes for simulation exercises:

- Regional simulation exercises require a long planning timeframe due to the number of countries involved. The planning for Pacific Wave started one year in advance; however, in retrospect, 18 months to two years would have improved the process.
- Thailand started their planning process around six months in advance of the exercise; however, most of the activity occurred in the three months before the event. The exercise required approval from the Cabinet for funds obligation. Planning activities included interagency cooperation and extensive public awareness for communities and tourists, for which a private agency was hired. The ALDCAR program design, developed one year in advance of the July 25th exercise, focused on the evacuation of children from 24 schools in conjunction with the full-scale exercise.
- The Bali exercise committee was convened five months in advance of the 2006 date with 14 institutions represented. However, this committee was not very active until three months before the exercise. Most of the preparations were conducted during the last two months. This was inadequate time, and preparations for the Banten province simulation exercise scheduled for 2007 have initiated at an earlier date.
- Planning timeframes are dependent on the level of readiness of communities and government institutions. These entities must have ownership in the process. Government institutions that serve as part of the EWS must be engaged, although community evacuations may be facilitated by other organizations.

Australian emergency management structure:

- At the national level, EMA focuses on policy and training with a limited mandate for operational emergency management. This responsibility is held at the state level.
- Exercises are conducted autonomously in each state. Australia has never run a national level tsunami drill, although one is planned for 2009. If EMA wants to run a national-level exercise, they must cover the costs of states' participation.
- During Pacific Wave, Australia was engaged only at a “table-top” exercise level.

Structural mitigation in coastal areas for tsunamis:

- India has “built back better” in Tamil Nadu following the 2004 tsunami.
- Australia has not undertaken structural mitigation for tsunamis as it is not a high-level concern of citizens.

Indonesia's BMG has attempted to gain support for local tsunami drills by signing MOUs with local governors, which commit to such activities. This may be an important model for other countries.

Undersea alluvial fans may build over time to form "mud mountains" that can slump during relatively low magnitude earthquakes, causing a tsunami. Australia has experienced such an event and Thailand is poised for one due to the formation of a "mud mountain" off its coast.

6. Closing Session

Ms. Deanne Shulman, USFS, and Dr. Teddy W. Sudinda, RISTEK, closed the workshop. The organizers thanked all participants for attending the regional workshop and providing their valuable inputs and contributions to make the event successful. At the closing session, SHM Fakhruddin remarked:

"During the workshop opening, it was mentioned that many people have stories to tell about many disasters and their lessons learned. Many have proposed designs for future mitigation. But who is listening? We need to learn the past histories and good and bad experiences to improve early warning capacity in the region. Tsunami warning is the most demanding of warning systems. To reach the 'last mile', communication is critical and the most challenging, so cooperation with all is necessary."

Annex I: List of Participants

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Annex 2: Agenda

TRAVEL DAY

Sunday 12 August, 2007

- Afternoon Arrival and check-in
(Sanur Beach Hotel, Jalan Danau Tamblingan, Denpasar 80032 Bali Indonesia)
- 1900 Group Seafood Dinner in Jimbaran (optional, no host; meet in Lobby)

PROGRAM DAY I

Monday 13 August 2007

Session One: Opening

0800 – 0830 **Registration**

0830 – 1000 **Opening Session**

- **Welcome Remarks:** Mr. Winston Bowman, Regional Environment Director, USAID Regional Development Mission for Asia
- **Workshop Opening:** Ms. Sri Woro B. Harijono, Director General, Meteorological and Geophysical Agency (BMG), Indonesia
- **Presentation:** Overview of U.S. Government Support for the Indian Ocean Tsunami Warning System – Mr. S.H.M. Fakhruddin, Technical Specialist, US IOTWS/Asian Disaster Preparedness Center
- **Keynote Address:** Dr. Smith Dharmasaroja, Chairman, The Committee of National Disaster Warning Administration and Advisor to the Minister, Ministry of Information and Communications Technology (MoICT), Thailand
- **Presentation:** Overview of Tsunami Alert Rapid Notification System – Ms. Deanne Shulman, Senior Emergency Management Specialist, US Forest Service

1000 – 1030 **COFFEE BREAK and GROUP PHOTO**

Session Two: Introduction and Overview

1030 – 1045 **Workshop Introduction and Overview** (S.H.M. Fakhruddin)

- Meetings and business arrangements – US IOTWS Program Indonesia Team
- Overview of workshop process and outcomes
- Review of workshop agenda -

Session Three: Regional and Country Initiatives on Tsunami Early Warning Systems and Lessons Learned, Chair: Mr. S.H.M Fakhruddin (ADPC/US IOTWS)

1045 – 1115 **Presentation: Progress and Lessons Learned on the Early Warning System of Thailand** – Dr. Cherdasak Virapat/Mr. Waiyapot Worakanok, National Disaster Warning Center (NDWC)

1115 – 1145 **Presentation: Progress and Lessons Learned on the Early Warning System of Indonesia** – Dr. Prih Harjadi, Director, Meteorological and Geophysical Agency (BMG)

- 1145 - 1215** **Presentation: *Progress and Lessons Learned on the Early Warning System of Sri Lanka*** – Mr. Lalith Chandrapala, Deputy Director, Department of Meteorology (DoM) and Mr. Kelum Jayasoma, Assistant Director, Disaster Management Centre (DMC)
- 1215 – 1330** **LUNCH**
- 1330 – 1400** **Presentation: *Progress and Lessons Learned on the Early Warning System of Maldives*** – Mr. Ali Wafir, Deputy Director, National Meteorological Centre (NMC)
- 1400 – 1430** **Presentation: *Progress and Lessons Learned on the Early Warning System of India*** – Mr. C.B. Sankar, IAS, Government of India
- 1430 – 1500** **COFFEE BREAK**
- 1500 – 1700** **Panel Discussion**

PROGRAM DAY 2

Tuesday 14 August 2007

Session Four: Case Studies of Tsunami Warning Simulation Exercises, Chair: Dr. Teddy W Sudinda, Ministry of Research and Technology (RISTEK)

- 0800 – 0845** **Presentation: *Pacific Wave Exercise 17 May 2006*** – Dr. Mark Sullivan Assistant Secretary, Emergency Management Australia (EMA), Australia
- 0845 – 0930** **Presentation: *Thailand Tsunami Warning Simulation Exercise 25 July 2007*** - Dr. Smith Dharmasaroja, Chairman, the Committee of National Disaster Warning Administration and Advisor to the Minister, MoICT, Thailand
- 0930 – 1015** **Joint Presentation: *Bali Province and City of Padang, Indonesia Tsunami Warning Simulation Exercise 26 December, 2005 and 2006*** – Mr Gde Sudiarta, Indonesian Red Cross, Mr. Revanche Refrizal, Director of Komunitas Siaga Tsunami (KOGAMI) and Mr Mohamad Rasyid, RISTEK
- 1015 –1030** **COFFEE BREAK**
- 1030 – 1145** **Panel Discussion: Developing and Conducting Tsunami Warning Simulation Exercises – Lessons Learned**
- 1145 –1200** **CLOSING**