NOTES

AN ACTION PLAN FOR PREPAREDNESS AND MITIGATION OF DAMAGE AND DESTRUCTION DUE TO TSUNAMIS

(Recommendations emerging from the Group-Discussion on Tsunamis held at the University of Hyderabad on 16.1.05 under the joint auspices of the Geological Society of India and the University of Hyderabad)

In order to learn the lessons and focus attention on some of the vital issues relating to the devastating Tsunami that struck the Indian Coasts on 26th December 2004, a Group Discussion with wide participation was organized in Hyderabad, jointly by the University of Hyderabad and the Geological Society of India. The participants included senior scientists and officials from the Department of Ocean Development, Department of Space, National Geophysical Research Institute, Geological Survey of India, academicians from universities, legal and medical experts, specialists in social sciences, representatives of the student community and the general public.

The following recommendations summarise the outcome of the deliberations with special reference to Tsunamis.

Pre-Hazard Preparatory Work

1. Preparation of large scale vulnerability/hazard zonation and inundation maps for the Indian coastal regions prone to natural disasters (cyclones, storm surges and tsunamis) using bathymetry, digital elevation data ananlysis and evaluation of topographic, geomorphological, structural and drainage features along the coastal tract for a deeper understanding of wave ingress and run up during a tsunami. Building up of public awareness and understanding of such scientific data for compliance with regard to precautionary measures.

   Critical examination of offshore and submarine geomorpholgy for canyons, mounds and sediment cover/thickness to map out any possible large-scale submarine-slump hazard zones that may trigger tsunamis during a seismic event.
2. Preparation of hazard zonation maps at district, taluk/ mandal and village levels using multi-hazard risk analyses to evolve appropriate action plan to minimize damages.
3. Intensification of ongoing researches on various precursors of earthquakes, i.e, geomagnetic, geoelectric, geothermal, biological (including animal behaviour), radiological, chemical and other warning signals to provide some early warning for imminent earthquakes which in turn may trigger tsunamis (variations and disburbances in plasma density, EM and thermal field are reported to provide 1-2-day warning signals). Integrate also the atmospheric observations with solid earth observations for analyzing the precursors.
4. Updating the existing seismic stations, setting up new stations and networking of all stations for near-real time determination of earthquake parameters in potential tsunamigenic zones. It is advisable to entrust this responsibility to a single identified earth-science agency for proper coordination and deepening of research and analysis capabilities.

During a Hazard

5. Any seismic event of greater than 6.5M in the Indian Ocean region should automatically put the concerned scientific departments into a high alert mode for rapid analysis of any possible tsunami generation pending operationalisation of the early warning system contemplated.
6. The movement of tsunami to be monitored with Doppler radar and earth–orbiting radar satellites.
7. Evolve a system of constellation of satellites carrying optical and microwave payloads for monitoring, damage assessment, reconstruction and relief of natural disasters, including tsunamis.
8. Develop a "Satellite Web" by connecting Earth Observation Satellites and communication satellites for delivery of information to the affected regions which also provides emergency response capacity. Restoration of communication network is vital for post-disaster management.

Post-Hazard

9. Use of space technology (both communication and remote sensing) for disaster management by way of

connectivity and observations to assess the extent and type of damage, response for relief and priority areas for relief. Strengthen the ground (coastal and NE region) and ocean observation networks using automatic weather stations, ocean data buoys, radar etc.

Establishing a Tsunami Warning Centre for the Indian Ocean Littoral States

International efforts under the UN auspices for the establishment of an Indian Ocean Tsunami Warning Centre on similar lines as the Pacific one, are already underway with several agencies, governments and private companies coming forward. India should take a lead in this effort in view of its location as well as its scientific competence. Pending accomplishment of the above, following measures are to be taken by India to strengthen existing facilities.

10. Set up tide gauges to monitor sea level at important places on land , offshore and near islands; and radar–based monitoring stations for measurement of surface currents and waves.
11. Deploy atleast 10 highly sensitive "Deep Ocean Assessment and Reporting of Tsunamis" (DART) systems on a priority basis in the Indian Ocean, in addition to the existing seven gauges already deployed, to accurately record the tsunami waves and relay over satellite to the warning centre. Indigenous fabrication of DART systems substantially reduces the cost.
12. Modelling and simulation of wave propogation data is vital for tracking and issuing early warning on approaching tsunamis.

Education, Research and Development of Manpower

13. Initiate new training programmes at all levels and strengthen existing ocean related programmes in the Universities to build appropriate manpower to face the challenge through interdisciplinary ocean science and technology .
14. Setting up of Rural Science Centres to educate the masses in their regional languages about the need to be prepared to face such hazards. Training programmes should be organized on disaster management including sociological/psychological implications, security aspects and heirarchy of action-plan in case of a disaster and concurrently, strengthen and sensitise the administrative machinery to cope with such crisis situations. Introducing relevant concepts and imparting basic information at the school level is also extremely important in this context.
15. Strictly enforcing coastal zone regulations to avoid construction within the stipulated sensitive coastal zone is of highest priority.
16. A Central Disaster Management Act should be legislated to take care of all the legal aspects of claims and liabilities after any such natural disaster after a thorough public debate.

Centre for Earth and Space Sciences K.V. SUBBARAO
University of Hyderabad
Gachibowli,
Hyderabad - 500 046
Email: *kvsubbarao_iitb@yahoo.co.in*

TSUNAMI OF 26th DECEMBER 2004: OBSERVATIONS AT CHENNAI AND EAST COAST OF INDIA

The tsunamis generated were observed after about two hours of the earthquake occurring on board the Jason Satellite (NASA) in the Indian Ocean. The surface waves had a wavelength of about 800 km, same as its velocity of 800 km/hr in deep sea. The crest of the waves was higher by 50 cm than normal sea level while the trough was 40 cm than normal. The second wave following had a crest height of 40 cm. But in the northern direction (towards Myanmar it was much less (~40 and 20 cm).

The first tsunami waves hit the East Coast between 7.30 and 9 AM; the second around 11 AM. In Chennai, the tsunami hit the Marina beach around 8 AM. The waves rose to a height of about 2 m. The area around Marina beach accounted for a large number of deaths due to the fact that the day being a Sunday, several youngsters were playing on the beach and morning walkers were still present. In North Chennai, it was severely felt because of the presence of a large fishermen population, right on the beach, just like at Santhome, a few hundred metres south of Marina beach. In Besantnagar and further south, the loss of life was smaller since not many were living on the beach front. In the Marina area, the wide beach absorbed most of the energy, which prevented it effectively from crossing the road. However, in areas where monuments were constructed on the beach,