PROBABILISTIC TSUNAMI RISK MANAGEMENT FRAMEWORK, SAFETY POLICY, AND APPLICATIONS

Robert T. Sewell
Louisville, CO USA
RTSewell@aol.com

ABSTRACT

High human casualties and economic losses from the 26 December 2004 Indian Ocean tsunami have resulted in heightened awareness, on global scale, of the potential extraordinary destructiveness of tsunamis, and of the vital need to better understand and manage the risks that they pose. However, thoughts and methods developed or proposed with the aim of making the most effective decisions concerning tsunami risk management vary dramatically, often on ad hoc basis, and this situation itself can present a problem, or risk, for effective tsunami risk reduction. There thus exists a need to have a common foundation and framework of scientific and systematic means for thinking about, and implementing, tsunami risk management. This framework should not be prepared in isolation considering tsunamis alone, since risks from many types of threats (both natural and man-caused) exist and must be balanced based on their relative severities and likelihoods – as available resources are limited for mitigating the composite of all such threats. Tsunami risk management should thus occur within a standard framework and associated methodology for risk management. Over the past few decades, probabilistic methods of risk assessment and associated decision science/analysis have been implemented effectively in safety policy and have established dominance in this area, in large part due to the fact that related phenomena are stochastic in nature, and so probability and supporting fields of statistics and decision theory thus comprise the most appropriate "language" to apply when characterizing, communicating, and otherwise addressing risk.

This paper discusses and explains a standard framework for probabilistic risk management, and introduces its relevance to safety policy and its applications to tsunami risk management.

Risk management is a complex process that consists of: risk identification, risk evaluation, risk quantification, risk screening and prioritization, risk communication, risk mitigation, and risk acceptance. An overview of these concepts is provided, and since risk quantification is central to scientific and systematic risk management, it is discussed in particular detail. Risk quantification involves a complex probabilistic development and synthesis of hazard and vulnerability scenarios. Methods for probabilistic tsunami hazard analysis (PTHA) have been previously presented and documented by the author and others. Hence, approaches for probabilistic tsunami vulnerability analysis (PTVA), and their combination with PTHA results to obtain applicable risk measures – probabilities of failure, probabilities versus damage, probabilities versus loss, and so on – are explain and illustrated

with examples. These methods are particularly useful for: (1) engineers, in allowing a formal, consistent and explicit basis for designing to achieve specified (and uniform) safety from structure to structure and facility to facility; and (2) scientists, in allowing them to conduct assessments and prepare hazard analyses that support effective engineering and risk management.

Probabilistic risk management is also important to the emergency services professions. Risk management encompasses disaster management, which includes relevant activities in: disaster identification, planning, mitigation, preparedness, response, and recovery – all of which involve uncertainties and are most adequately described through probabilistic methods. This paper thus also describes probabilistic risk-based aspects of implementing tsunami disaster management. Facilitation of these aspects through geographic information system (GIS) technology and associated tools (such as FEMA's HAZUS-MH software and extensive databases), as well as computing systems and mobile technologies, are also discussed.

Related issues and recommendations are presented to clarify key needs (in engineering, physical sciences, social sciences, policy making, etc.) for facilitating, and obtaining greatest benefit from, effective tsunami risk management.