

Research Needs for Tsunami Hazard Assessment

1.0 Introduction

This report outlines the proposed areas of research to assess the state-of-the-art of the tsunami hazard at the nuclear facilities, specifically the nuclear power plants (NPPs), located in the coastal areas of the United States. This assessment would allow the U. S. Nuclear Regulatory Commission (USNRC) staff to determine if the existing guidelines for the tsunami hazard need to be revised. The research is needed to review the tsunami hazard in view of the recent developments in probabilistic hazards analysis methods in the seismic area, and the occurrence of the 2004 Indian Ocean tsunami.

2.0 Background

A consultant (Dr. R. Sewell) for the Center for Nuclear Waste Regulatory Analyses conducted a study¹ that yielded the characteristics of potential tsunami generated by possible submarine landslides. The author reviewed bathymetric data and information on the material composition of potential submarine landslide sources and conducted analyses of this and other relevant information. The analyses calculated the characteristic of potential tsunami events and their effects, mainly the wave height at the coastline. The analyses conducted to bound the effects of a tsunami are comparable to the analyses of maximum credible earthquake (MCE) in seismic hazard analysis; but instead of MCEs, the analyzed events might be referred to as maximum deterministic/credible tsunami.

The staff evaluated Dr. Sewell's report² and concluded that even though the results/conclusions are not realistic and cannot be relied on to make conclusions, there is a need to review the state-of-the-art of the tsunami hazard at the nuclear facilities located in the coastal areas of the United States in view of the recent developments in the probabilistic hazard analysis methods, specifically, for the seismic hazard, and the occurrence of a large devastating tsunami in 2004 in the Indian Ocean. The staff must determine the likelihood of occurrence of such a large tsunami and their potential impact on nuclear facilities, specifically NPPs,.

3.0 Proposed Scope of Study

The recommended course of action includes:

Formation a Senior Tsunami Hazard Analysis Group (STHAG) to review the state-of-the-art for tsunami hazard assessment and provide individual recommendations on an appropriate course of action to address tsunami hazard assessment at currently licensed and

¹Sewell, R. T., *A Preliminary Numerical Study of the Hazard from Local Landslide Tsunami Scenarios at the Diablo Canyon Site in Central California*, Summary Report (Draft), R. T. Sewell Associates, Louisville, November 22, 2003.

²Seismic Issues Technical Advisory Group (SITAG), *Staff Evaluation of the Sewell's Report on Tsunami Hazard at the Diablo Canyon Site, August, 2005.*

future nuclear facilities. (The members of the group would be acting as individuals producing individual recommendations facilities, not as a federally constituted advisory group, which generally produces a single, consensus set of recommendations.)

The group would have a membership of three or five expert members with current knowledge of tsunami induced by submarine landslides or slumps and of tsunami induced directly or indirectly by seismic activity, similar to the December 26, 2004 "Great Sumatra/India Ocean Tsunami". The areas of expertise would include: (1) generation of the landslide source and initial water disturbance; (2) propagation of the wave from the source through open water; (3) interaction of the wave with the local shore including amplification due to shoaling for evaluating run-up and draw-down; and prediction of forces on off-shore structures affected by the tsunami wave. (It would be beneficial if the STHAG members had a working knowledge of NRC rules and guidance, but this would not be a requirement.). The work by the STHAG is proposed to be performed in two phases: Phase 1 would include collecting existing information on the tsunami hazard; and Phase 2 would include the research work to be performed by the group. The STHAG would have approximately 6 months to complete their Phase 1 work with a budget of approximately \$50K. While the members of STHAG would be acting as individuals, it would take on a committee-like structure with a chairman, charter, operating rules, etc.

Phase 1 Scope of Work:

1. Develop an assessment of the available methodologies for numerically simulating tsunami hazard assessment, both deterministic and probabilistic, using computer modeling, with primary emphasis to tsunami induced by submarine landslides, triggered by various events, including earthquakes, explosions, gas hydrate releases, static overload, or a combination of effects.
2. Review and compile a bibliography of the existing literature on the subject, including papers on the source of tsunami and propagation models.
3. Provide the NRC staff (Seismic Issues Technical Advisory Group) a briefing on the state of tsunami hazard assessment and the tsunami hazard in the United States. The briefing should include an assessment of the current status of the use of probabilistic methods, if available, in tsunami hazard assessment and the quality and reliability of these methods. The briefing should include an assessment of the status of including probability in tsunami hazard assessment.
4. Review the Sewell Report to define major area and extent of uncertainties which could be addressed by further research.
5. Evaluate existing methods for addressing Tsunami effects on structures (magnitudes and time-histories of pressures on structures due to tsunami waves)
6. Develop a response to the inquiry into existence of a probabilistic tsunami hazard assessment (PTHA) methodology, and if it exists, evaluate it and provide recommendations on the acceptability of the methodology.

Phase 1 Deliverable:

Prepare a report summarizing the work performed with recommendations on further research work and associated cost and schedule for the work in Phase 2. This may include, but not be limited to, the following:

- Development of
 - theory for PTHA
 - practical computer code
 - necessary source area data
 - Wave propagation model
 - interpretational model - predicted inundation model

- Potential research activity proposed for Phase 2 of the program, to address tsunami hazard to existing and future nuclear facilities; use of or the role for PTHA, etc.

References

TSUNAMI REGULATIONS, GUIDELINES AND REFERENCES

1. 10CFR100, APPENDIX A, IV(c), "Required Investigation for Seismically Induced Floods and Water Waves
2. USNRC, Standard Review Plan, "Floods," Section 2.4.2, Rev. 2, July 1981???
3. USNRC, Standard Review Plan, "Probable Maximum Tsunami Flooding," Section 2.4.6, Rev. 2
4. Regulatory Guide 1.59, "Design Basis Floods for Nuclear Power Plants," Rev. 2, 1977
5. Regulatory Guide 1.102, "Flood Protection for Nuclear Power Plants," Rev. 1, 1976
6. American National Standards Institute (ANSI) N170-1976, "Standards for Determining Design Basis Flooding at Power Reactor Sites"
7. Wiegel, R. L., "Earthquake Engineering," Prentice Hall Inc., Englewood Cliffs, New Jersey, 1970 (Chapter 11, Tsunamis)