ENCLOSURE

SAFETY EVALUATION OF TORNADO WIND AND MISSILE LOADINGS PROBABILISTIC RISKS FOR THE SAN ONOFRE NUCLEAR GENERATING STATION, UNIT NO. 1 (TAC 63078)

1. Introduction

In the NRC Systematic Evaluation Program, topics III-2 and III-4.A entitled "Wind and Tornado Loadings" and "Tornado Missiles," respectively, require licensees to address potential damages which could result from a postulated tornado. In letter dated October 10, 1986, Southern California Edison Company, licensee of San Onofre Nuclear Generating Station, unit number 1 (SONGS-1), proposed modifications to upgrade the SONGS-1 plant systems to ensure safe shutdown following a tornado event. In letters dated October 2, 1989 and August 31, 1990, the licensee indicated that the proposed plant modifications were of low safety significance. The licensee submitted a probabilistic risk analysis in a report ("Tornado Hazard Review, San Onofre Unit 1, Final Report," June 1990), to demonstrate that upgrading the SONGS-1 plant systems for protection against tornado impacts would not be necessary.

An evaluation of the licensee's probabilistic risk analysis was performed by the Argonne National Laboratory, NRC contractor under the Technical Assistance Program Task Assignment No. 4, FIN A-2336. The contractor's evaluation was summarized in a report ("Evaluation of Tornado Wind and Missile Loadings Probabilistic Risk Study for the San Onofre Nuclear Generating Station - Unit 1 (SONGS-1)", June 1992), which was submitted to NRC on July 1, 1992.

2. Licensee's Analysis

The licensee's analysis consists of the evaluation of the following: the tornado hazard frequency, tornado wind impact, tornado missile impact, plant risks, and cost and benefit of the SONGS-1 plant upgrading.

The licensee used the tornado hazard frequency from an NRC staff study (letter from W. A. Paulson, NRC, to K. P. Baskin, Southern California Edison Company, "Tornado and Straight Wind Hazard Probability," January 17, 1985). In the analysis of tornado wind-related hazards, for each building structure considered to be vulnerable to tornado wind effects, the licensee calculated the impact in terms of fragility at each assumed tornado intensity. The components that are attached to or would be affected by failure of the structures were determined for inclusion in the respective system fault trees on the basis of the calculated fragilities.

In the tornado missile impact evaluation, the licensee computed the missile-related failure probability of each vulnerable structure or component, using the generic missile-strike probability per unit target area, the plant specific missile per population, and the exposed target area of the structure or component. The generic missile-strike probability was obtained from the report, EPRI-NP-768, "Tornado Missile Risk Analysis," May 1978 by L. A. Twisdale, et al.

In the evaluation of the plant risks, the licensee considered loss of offsite power and other plant trips as initiators in the event tree, given a tornado

occurrence. Loss of coolant accident was not considered since all components of the reactor coolant system are protected against tornado damage. Detailed system fault trees were developed for the charging system, auxiliary feedwater system, and main steam system. The licensee assumed that the charging system depends on the component cooling water system for lube oil cooling, and that credit is allowed for feed and bleed given failure of the auxiliary feedwater system.

Combining the results from the above evaluations, the licensee calculated the reactor core damage frequency due to a postulated tornado occurrence. A baseline core damage frequency was also calculated assuming that all the tornado-related vulnerabilities identified do not exist. The difference between these two core damage frequencies represents the maximum effect of upgrading the plant structures and components for tornado protection. The results of the licensee's analysis indicate that the most important contributor to the core damage frequency is the tornado wind-related failure of the 480-volt room wall in the fuel storage building.

The licensee then computed the benefit and cost of upgrading the SONGS-1 plant systems for protection against tornado impacts. Using the methodology described in NUREG/CR-3568, "Handbook for Value-impact Assessment," December 1983, the licensee calculated the benefit of upgrading to be about one million dollars over the remaining life of 12 years, assuming a power availability factor of 80 percent. By letter dated June 25, 1992, the licensee gave the estimated cost of upgrading the 480-volt room wall to be about $1.1 million (1.1 million dollars).

The licensee has not performed either an uncertainty analysis or a sensitivity study in the probabilistic risk assessment.

3. Contractor's Evaluation

In the contractor's report, the contractor summarized the methodology, assumptions, and data that are used in the licensee's analysis. The contractor has determined that the use of the NRC staff's tornado hazard frequency is conservative. The licensee's methodology used in the tornado wind impact on structures and components is the state-of-the-art. On the basis of a plant visit, the contractor verified the completeness of the components that are included in the licensee's risk analysis.

The contractor has also made the following findings. The tornado missile-induced failure probability is conservatively modelled and the data used are appropriate. The component failure data used in the fault tree analysis are consistent with those used in contemporary probabilistic risk assessments. The human error probability data are also appropriate. Finally, the radiation dose conversion factor used in the licensee's benefit computation is conservative, as the results in NUREG-1150, "Reactor Risk Reference Document," February 1987, show that the factor may be much lower.

The contractor performed a sensitivity study on the tornado-induced reactor core damage frequency by (1) using two different values of wind fragility; (2) assuming both dependence and independence of the charging system on the

component cooling water system for lube oil cooling; and (3) both allowing and not allowing credit for feed and bleed given failure of the auxiliary feedwater system or the secondary coolant pressure control.

From the results of the sensitivity study, the contractor obtained the bounding benefits of $1.2 million for the case in which the charging system depends on the component cooling water system, and $400,000 for the case in which the charging system is not dependent on the component cooling water system. In both of these cases, credit was allowed for feed and bleed given failure of the auxiliary feedwater system. The contractor has not performed an uncertainty analysis in the sensitivity study.

The contractor believes that the licensee's cost of $1.1 million for upgrading the 480-volt room wall in the fuel storage building is a reasonable estimate.

4. Staff Evaluation

On the basis of the contractor's evaluation, the staff finds that the methodology employed and assumptions made in the licensee's analysis are conservative, the data used are appropriate, and the cost estimate is reasonable.

The benefits computed by both the licensee and the contractor are in good agreement for the case in which the charging system depends on the component cooling water system. The cost/benefit ratio for upgrading the most important contributor to tornado-induced risks varies from 2.8 to 0.92. In view of the various built-in conservatisms in both the licensee's analysis and the contractor's evaluation, the staff finds that the cost/benefit ratio could realistically be much higher than unity. On the basis of the above evaluation, the staff views that upgrading the SONGS-1 plant systems for protection against tornado impacts is not cost beneficial and is, therefore, not required.

5. Conclusion

On the basis of the above evaluation, the staff concludes that it is not cost beneficial to upgrade the 480-volt room wall in the fuel storage building at the San Onofre Nuclear Generating Station, Unit Number 1, for protection against tornado impacts, and that the licensee's determination for not modifying the plant systems against tornado hazards is acceptable for the presently licensed period.