

July 18, 2003

MEMORANDUM TO: Ledyard (Tad) Marsh, Director  
Division of Licensing Project Management  
Office of Nuclear Reactor Regulation

FROM: Michael E. Mayfield, Director */RA/*  
Division of Engineering Technology  
Office of Nuclear Regulatory Research

SUBJECT: TRANSMITTAL OF NUREG/CR-6810, "OVER -  
PRESSURIZATION TEST OF A 1:4 SCALE PRESTRESSED  
CONCRETE CONTAINMENT VESSEL MODEL "

The Division of Engineering Technology is forwarding the subject NUREG/CR report for information and use in support of resolution of containment issues. This report, prepared by Sandia National Laboratories, is an account of a testing program that was performed at SNL and jointly funded by NUPEC (of Japan) and the NRC .

This report was provided to aid the NRC staff in its evaluation of estimates of containment capacity provided by licensees or applicants of new plants. Containment buildings for the current generation of light water reactors were designed to withstand a variety of loading conditions including the effects of earthquakes and postulated accidents. Original designs were performed in accordance with the requirements of the ASME Boiler & Pressure Vessel Code leading to very high confidence that the vessels can sustain design basis conditions. After the TMI accident, the performance of containment systems under more severe accident conditions became a matter of continuing interest and concern and a research program to develop an understanding of dominant failure modes for the different types of containment began. Tests to failure of models of a free standing steel containment and a reinforced concrete containment were performed under NRC sponsorship in 1985 and 1987, respectively. Finally, tests to failure of models of a steel containment structure with a shield wall and a prestressed concrete containment vessel (PCCV) were performed jointly with NUPEC (of Japan) in 1995 and 2000, respectively. The last test is the subject of the attached report.

The PCCV model, uniformly scaled at 1:4, was based on a Pressurized Water Reactor (PWR) plant built in Japan. The objectives of the internal pressurization tests were to obtain data to validate predictions of structural response beyond design basis accident levels, to find the pressure capacity of the model and predict its failure modes. Previous containment model tests did not reach the point of structural failure. This report describes the design, construction, instrumentation and testing of the PCCV model. Detailed results of each test and the findings of post test inspections are presented and all model response data are provided in CD format.

The over-pressurization tests of the 1:4-scale PCCV model represent a significant advance in understanding the capacity of nuclear power plant containment structures for loads associated with severe accidents. The data collected during the tests, as well the response and failure modes exhibited, will be used to benchmark numerical simulation methods used to predict the response of concrete containment structures. These results may also be used as one of the bases to permit designers, owner/operators and regulators to make risk-informed judgments about nuclear plant safety.

This research work contributes to NRC's performance goals of maintaining safety and enhancing public confidence. This project demonstrated that the reported analytical method can predict behavior of a model similar to actual containments into the nonlinear range. This may encourage plant owners and designers to use these improved methods for actual plant applications. The fact that the test results provided a factual basis for calibrating risk related calculations can help to improve public confidence in the fidelity of the calculational methods used.

The RES point of contact for this report is Dr. James F. Costello. He can be reached at 415-6009.

Attachment: As stated

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