ENCLOSURE

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

March 22, 1994

MEMORANDUM FOR: [redacted]
Division of Licensing

FROM: Richard H. Vollmer, Director
Division of Engineering

Roger J. Mattson, Director
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SUBJECT: AMENDMENT TO MARCH 16, 1984 BOARD NOTIFICATION MEMORANDUM REGARDING EQUIPMENT RESPONSE DURING HYDROGEN BURN EVENT

Reference: Memorandum from Robert T. Curtis, Chief, Containment Systems Research Branch, RES to Vincent S. Noonan, Chief, EQB et. al. dated February 16, 1984

Electric Power Research Institute (EPRI) has recently completed hydrogen burn equipment tests at the Nevada Test Site (NTS) as part of a jointly sponsored program with the NRC. The tests resulted in a number of failures and cable burning which had not been experienced in previous equipment tests conducted by NRC and Industry.

The referenced memorandum, which is attached, transmitted the visual observation performed by Sandia National Laboratory (SNL) on the equipment. Since then, EPRI has also transmitted a "Second Quick - Look Status Report on EPRI Hydrogen Burn Equipment Tests (RP-2168-3)" by memorandum dated February 17, 1984.

The purpose of the final two tests, conducted during the month of January, 1984 was to demonstrate equipment operability in a large, dry containment during and after the hydrogen burn event for a 75% metal water reaction (13% H_2 with 30% steam). A video cassette recording of these experiments shows that some cable burned extensively, both during and after the hydrogen gas burn. Post test visual observation of many of the cables revealed charring, cracking, bulging and/or wrinkling of the outer cable jacket surrounding the insulated conductors. In some instances, splits were seen in the outer jacket such that inner insulators were visible. Importantly, however, there was no evidence of exposed metal conductor; thus there is no basis at this time for concluding that the cable would not perform its function. Unfortunately, the cable was not energized during the test; thus it can not be concluded that the cable would have performed satisfactorily during the combustion event. Post-test evaluation of the cable will include testing to measure its current carrying and insulation capabilities.

In addition to the cable burning, two to three items of equipment did not perform their function during the experiment, and evidence of water condensation and construction material, e.g., metal filings, were found inside the examined pressure gages. However, no other evidence of damage was found on the examined pressure gages.

There are a number of reasons why the observed damage indicated above may conservatively exceed the damage which may occur to essential equipment during a hydrogen combustion event in a large dry containment. As we noted, the above preliminary information was obtained from tests involving the ignition of a mixture containing 13 percent hydrogen. This mixture was selected to represent a bounding case for large dry containments wherein the hydrogen produced from a 75 percent cladding-water reaction is allowed to accumulate in the containment. There is a probability albeit indeterminate that the hydrogen will not accumulate to a 13 percent concentration. This uncertainty is due to the presence of native random ignition sources inside containment, i.e., sparks from motors. Such random ignition may result in combustion at a lower hydrogen concentration with resultant less severe consequences. There was no burning of cable opened in the video tapes of NTS tests at hydrogen concentrations less than 13 percent. Another reason why the data may not be an appropriate representation of the probable damage in a large dry containment is that the equipment including cables was not necessarily installed or physically arranged in a manner representative of actual plant conditions. For example, the cables were simply looped over scaffolding in the test vessel; the cables were not laid in trays which would afford some protection. A last item to be noted is that the NTS facility had a relatively low spray capacity.

These results from the burn tests at 13% H_2 should not be applicable to the Mark I, Mark II, Mark III and ice condenser containments. Hydrogen combustion will not occur in the Mark I and Mark II containments as they are operated with inerted containments. Hydrogen combustion with rich mixtures, i.e., greater than 9 percent, in large volumes should not occur in ice condensers and Mark III containments because these containments are all furnished with specially designed hydrogen ignition systems to assure ignition in large volumes at lean mixtures, i.e., less than 9 percent hydrogen. In some other NTS tests of combustion of hydrogen at concentrations lower than 13 percent, there were no obvious failures of equipment due to combustion, but there were some failures by other causes that are still being studied in laboratory testing of the specimens.

The extent of applicability of these data to large dry containments and their safety significance are presently being evaluated. In April of 1984 NRR and RES will examine the applicability of the NTS data for validating the HECTR computer code. The need for any further tests at large scale and small scale will then be identified. The final analysis of the NTS data, to include such matters as the test water sprays, the physical arrangements for the test specimens, and the [illegible] examination of the damage to the specimens will require more time. We expect to report on the such longer term evaluation by the end of 1984. The implications of these evaluations on hydrogen rulemaking or individual reactor licensing cases will be addressed on a case-by-case basis for the interim.

Pursuant to NRR Office Letter No. 19, dated October 1, 1982, we recommend that this information be submitted for Board Notification for boards having jurisdiction over large dry containments.

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Enclosure: As stated

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