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

INFORMATION REPORT

SECY-80-107B

June 20, 1980

FOR: The Commissioners

FROM: H. Denton, Director, Office of Nuclear Reactor Regulation

THRU: W. Dircks, Acting Executive Director for Operations

SUBJECT: ADDITIONAL INFORMATION RE: PROPOSED INTERIM HYDROGEN CONTROL REQUIREMENTS

Purpose: To provide the balance of the additional information requested by the Commission regarding the Proposed Interim Hydrogen Control Requirements for Small Containments (SECY-80-107). Based on our consideration of the additional information contained in SECY-80-107A and in this paper, we continue to believe on balance that it is advisable to require the inerting of all Mark I and Mark II containments pending the rulemaking proceeding.

Discussion: In SECY-80-107, Proposed Interim Hydrogen Control Requirements for Small Containments, dated February 22, 1980, the staff reported its recommendation for certain interim hydrogen control requirements for small containments on the basis of a review of the TMI-2 experience. Specifically, the staff recommended inerting of all Mark I and Mark II containments for boiling water reactors as an interim measure pending a rulemaking proceeding on the subject of degraded cores and hydrogen management.

As a result of the March 19, 1980 meeting with the Commission to discuss SECY-80-107, a memorandum was sent from S. Chilk to W. Dircks requesting that certain additional supporting information be provided to the Commission. In SECY-80-107A, dated April 22, 1980, we provided responses to Items 1.a, 1.b, 1.c and 2 of the above cited Chilk memorandum. The balance of the information requested, i.e., Items 1.d and 1.e of the Chilk memorandum, is provided below along with a supplement for Item 2.

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SECY NOTE: This paper is scheduled to be discussed on June 26, 1980.

"1.d Further consideration be given to the views of the Probabilistic Assessment Staff (PAS) regarding the relationship of inerting to reduction of overall safety risks."

The views of the PAS are contained in an internal memorandum, "Value of Inerting To Overall Accident Risk Reduction," dated June 10, 1980, a copy of which is provided as Enclosure 1. In summary, the PAS view is that "... inerting has small value in terms of overall accident risk reduction and it is believed that means exist that could have equal or greater value. If an urgency presently exists for inerting the Mark I and II containments, the bases are not found in risk-based studies of which the PAS is aware. It should also be said that the PAS can presently offer no overwhelming argument against an inerting decision except for those views described above." Some preliminary analyses by the Risk and Reliability Branch of NRR with probabilistic risk assessment (PRA) methodology leads to the same conclusion (see Enclosure 2). However, this conclusion is subject to a fair measure of uncertainty because of the inability of the methodology to treat intermediate states for each event in the various scenarios. Operator intervention, including correct actions, incorrect actions, and delayed actions, similarly, cannot be adequately treated with the methodology.

For example, in the case involving a transient followed by the total loss of pool cooling (RHR failure), which is one of the dominant contributors to risk, current PRA methodology would find that the containment would fail due to overpressure before any metal-water reaction can occur in the core. For this case, having an inerted containment would not lead to any reduction in the off-site dose consequences.

However, the methodology used to arrive at the above conclusion did not give credit for the amount of energy transfer through the relatively thin shell of the steel drywell and torus. Our calculations indicate that at temperatures corresponding to near failure pressures for the containment, i.e., about 350°F, the heat transfer from the Mark I steel containment due to natural convection and radiation would serve to limit the pressure rise of the containment atmosphere. Additionally, if operator action with mechanically held fire hoses could lead to a dousing of the containment (torus) steel shell, then heat transfer rates would be increased by two orders of magnitude, at the peak conditions, promoting sufficient heat removal to prevent containment

failure from overpressurization. The rate of containment pressurization for this scenario is sufficiently slow that ample time will be available for decision and implementation of appropriate operator action. An inerted containment, in this scenario, would improve the plant's capability to tolerate subsequent and further degradation of the ECCS.

Accordingly, while we value the results of probabilistic analysis methods, we believe that licensing decisions should not be based entirely on the results of probabilistic analysis methods. There are a number of other factors that need to be considered in arriving at a balanced judgment for licensing decisions. Depending on the issue at hand, these factors can include: 1) the uncertainties associated with the probabilistic analysis models; 2) the extent to which operator intervention could ameliorate or exacerbate the accident sequences; 3) the impact-benefit ratios for the various mitigation measures; and 4) overall agency policy. It is our judgment, based on our consideration of these factors, that the PAS views on inerting should not modify our prior recommendation to require the inerting of all Mark I and Mark II containments. While we agree that there are no overriding safety arguments to support an inerting decision, we believe that a conservative approach to licensing supports a decision that inerting would be prudent. A decision analysis laying out this rationale is provided in Enclosure 3.

In the Office of Policy Evaluation memorandum dated March 26, 1980, some specific questions were raised regarding the issue of inerting for BWR containments (Mark I and Mark II). The questions and our responses are provided below.

a) "Do PWR/BWR system designs, response, operational practice, etc. differences invalidate equating the likelihood or impact of hydrogen post accident evolutions?"

We have not yet examined the PWR/BWR differences with the object of determining their effects on likelihood for accident sequences that lead to large amounts of metal-water reaction. While we recognize that there can be large swings in probabilities owing to differences in designs and in human factors, our judgment, pending the rulemaking proceeding, is that the probabilities are of the same order of magnitude. We have, however, examined the PWR/BWR differences in terms of their capability to accommodate metal-water reactions. Our results are reported in SECY-80-107.

b) "Should credit be taken for lessons learned at TMI (i.e., operators are not to interfere in automatic safety functions)?

Yes. In our view, implementation of the lessons learned at TMI makes the likelihood of severely degraded accidents sufficiently remote that, pending the rulemaking proceeding, interim modification of our licensing criteria for combustible gas control systems need not be made for most containments (except the Mark I and Mark II containments). For the Mark I and Mark II containments, we recommend that inerting be made a uniform requirement. With inerting of the Mark I and Mark II containments, a severely degraded core involving large amounts of metal-water reaction will lead to containment pressures that are well above the design pressure due to the formation of large volumes of non-condensible gas; but the estimated failure pressure will not be exceeded.

We find this condition acceptable, at least until the rulemaking proceeding, because we believe the likelihood of occurrence for these events has been made acceptably remote by implementation of the lessons learned from TMI.

c) "Are operational practices at currently inerted BWR's decreasing safety margins?"

The information we have reported in SECY-80-107A indicates that the operational practices at currently inerted BWR's involve no significant reduction in safety margins.

d) "Would hydrogen evolution be a dominant concern in accident scenarios severe enough to produce combustible gas mixtures in containment?"

The available probabilistic risk assessments (Enclosures 1 and 2) indicate that BWR Mark I and Mark II containments would fail from excessive pressure before any significant amount of hydrogen is produced during those accident sequences that dominate the risk.

However, the precise path taken during accidents involving severely degraded cores cannot be accurately predicted, especially when operator intervention in slow

moving accident sequences is considered. In our judgment, hydrogen evolution can be a concern and, pending the rulemaking proceeding, provisions for dealing with it are required.

1.e "Further consideration be given to an overall approach which would delay the proposed immediately effective interim actions on hydrogen management in containments while expediting the degraded core cooling rule so that hydrogen control can be evaluated in a broader context of accident and safety system design bases."

The overall approach described above was considered and adopted for all containment types except the Mark I and Mark II containments.

Because of the complexity of the problem with the many ramifications involved, it is difficult to further expedite the degraded core cooling rule beyond that presently envisioned. An advance notice of proposed rulemaking for the degraded core cooling rule is currently being circulated for staff review and comment. It is anticipated that the advance notice would be sent to the Commission for affirmation during July 1980. The notice of proposed rulemaking would be planned for publication by about July 1981 assuming no problems develop with the advance notice. The final rule could then be published by about July 1982 if no formal rulemaking hearing was required. If a rulemaking hearing were held, this could delay final issuance of the rule by as much as one year, or by about July 1983.

In view of the sensitivity of the small volume Mark I and Mark II containment to the effects of hydrogen generation from metal-water reaction, we believe it is not prudent to defer to the rulemaking proceeding our recommendation for inerting the Mark I and Mark II containments.

2. "The Commission also requested that the views of the General Electric Company (GE) on the utility of inerting, including any calculations which differ from those provided by the NRC staff, be provided in writing."

In SECY-80-107A, we provided the then available documents that characterize the views of the GE. We have subsequently

received two letters from GE on this subject. These are provided as Enclosures 4 and 5. In Enclosure 4, GE states that it "... believes that substantial hydrogen generation is effectively prevented in a BWR due to its unique inherent design features. Accordingly, inerting BWR Mark I and II containments is unnecessary and is not recommended due to its risks to plant personnel and reduction in operational safety. It is GE's recommendation that detailed evaluations to address the overall issue of hydrogen control requirements can be established through the rulemaking procedures on design features for core-damage and core-melt accidents recommended by the TMI-2 Lessons Learned Task Force." In Enclosure 5, GE states that its computational results do not differ significantly from those of the staff, but that there are some fundamental disagreements as to postulated conditions and interpretation of calculated results.

This completes the staff's response to the additional information requested by the Commission as detailed in the memorandum from S. Chilk, dated March 28, 1980. Based on our consideration of the additional information contained herein and in SECY-80-107A, we conclude on balance that it is advisable to require the inerting of all Mark I and Mark II containments pending the upcoming rulemaking proceeding.

Harold R. Denton

Harold R. Denton, Director
Office of Nuclear Reactor Regulation

Enclosures:
As stated

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