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memo

P. A. Morris, Director
Division of Reactor Licensing

INDIAN POINT NUCLEAR GENERATING UNIT 2 - DOCKET NO. 50-247

The enclosed FSAR evaluations of circumferential cracking in the reactor vessel, of a longitudinal reactor vessel split, and the structural capability for containment flooding were prepared by the DRS Structural Engineering Branch with assistance from the DRS consultant James F. Proctor of the Naval Ordnance Laboratory.

Original signed by
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Enclosure:
FSAR Evaluation for Indian Point Unit 2

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INDIAN POINT UNIT NO. 2

1. CIRCUMFERENTIAL CRACKING IN THE REACTOR VESSEL

Consolidated Edison in responding to Question 5.16.2 stated that the worst circumferential crack location from the standpoint of a downward generated missile was just below the recirculating coolant system nozzles. The applicant also stated that such a missile would not breach containment nor impair liner integrity.

We, with our consultant Mr. James F. Proctor of the Naval Ordnance Laboratory, reviewed the applicant's response in terms of his assumptions: missile weight, velocity, and "cratering" area; selection and use of penetration formula; parameter values used in the Petry formula; and the reported depth of penetration into the cavity floor of 1.4 feet. In addition, our consultant was requested to also consider the effect of the fifty 1-1/2 inch diameter nozzles projecting about 6-inches below the surface of the bottom head.

The Petry formula, although of limited applicability, was used by the applicant in determining the depth of penetration of the bottom head into the cavity floor. This formula, which serves to define only a representative behavior, yields a penetration depth within a reasonable degree of accuracy. However, our consultant contacted Oak Ridge and Union Carbide at Paducah and was unable to obtain experimental verification of calculated penetration depth behavior involving similar impacts. In our view, the applicant's assumptions are considered to be conservative--no deduction was made for the energy absorbed by the buckling of the bottom head; the 63 ft^2 cratering area was conservative; and no credit was taken for the energy absorbed by the 1-inch steel plate covering the floor of the reactor cavity. We also concluded that the 1-1/2 inch bottom head penetrations would punch out as the vessel impacted on the 1-inch thick cover plate causing further energy absorption. Notwithstanding these conservative assumptions and the use of reasonable values for the parameters used in the applicant's analysis, we believe the results of the analysis provide only a gross indication of penetration behavior of the reactor vessel missile.

2. LONGITUDINAL REACTOR VESSEL SPLIT

The applicant, in considering the consequences of a longitudinal reactor vessel split in Question 5.16.2, concluded that the reactor vessel cavity wall as designed would withstand without gross damage the resultant forces of a longitudinal vessel split, 24.4 feet long by an average width of 1.0 feet. The effects of the longitudinal vessel split on the vessel internal was not evaluated.

We and our consultant, Mr. Proctor, concur with the applicant's conclusion that such a reactor vessel split would not cause a breach of containment, although the cavity wall may be severely cracked as a result of forces developed by the blowdown.

3. STRUCTURAL CAPABILITY FOR CONTAINMENT FLOODING

Although the reactor cavity itself will not retain water due to numerous openings, penetrations, and postaccident cracks which may develop, the concrete containment structure can withstand the hydrostatic loads imposed by internal flooding to any desired level and act as a watertight container. Although a systems or thermodynamics evaluation of containment flooding has not been considered, a determination was made to evaluate the containment's structural capability to withstand the forces of internal flooding, to an elevation sufficient to immerse the reactor vessel (and its internals) to the top of the reactor core.

At the April 29, 1970, meeting with the staff, representatives of Consolidated Edison and their contractors orally stated that "they believed" the containment could be flooded to an elevation which would eventually partially cover the core.

We have concluded from our review of the design details that the containment structure, as related to its structural capability and leaktightness, can safely withstand the hydrostatic load imposed by internal flooding to an elevation which will partially cover the reactor core.