SAFETY EVALUATION REPORT SUPPLEMENT

CRYSTAL RIVER
UNIT #3

On April 14, 1975, while placing cinch anchors in the dome concrete of the reactor building, the applicant's electrician found that the anchors would not hold. Subsequent soundings, core bearings and cutting investigations by the applicant indicated that the dome had delaminated into two layers. The approximate maximum thickness of the delaminated concrete was found to be 15 inches with a maximum gap of approximately 2 inches between the two layers. The plane area of delaminated concrete is approximately circular in shape with a 105 foot diameter. The delamination was not apparent via visual inspection of the dome surface. Additional cracks which scattered intermittently at various depths in the lower layer of the dome were found from the core borings.

On June 11, 1976 the applicant submitted an interim report entitled, "Reactor Building Dome Delamination." In the report, the applicant presented the original design criteria, the stresses and strains in concrete and steel liner of the original dome as well as the delaminated dome, and various investigations to determine the causes that led to the delamination. The applicant also proposed corrective action to be taken to assure that the containment structure, when so repaired will be capable of meeting the original design criteria as demonstrated by calculation and structural integrity tests.

The staff reviewed the report and had several meetings with the applicant. The staff expressed to the applicant concerns in areas ranging from the determination of the causes of delamination to the corrective action to be taken.

Even though the applicant did not identify positively any single or overriding mechanism as the cause of the delamination, it can be surmised from the facts presented by the applicant that:

(1) The characteristics of the dome concrete are such that it is crack-prone and localized cracks may have existed even before the prestressing force was applied.

(2) The coarse aggregates are fragile, and instead of acting as crack arrestors, they became the path of cracks.

(3) With the existence of precracks and the presence of fragile coarse aggregate, the radial tension accumulated from all sources and coupled with local stress concentration was so large that it overcame the much reduced tensile capacity of the concrete, resulting in the separation of the dome concrete.

After a series of discussions between the staff, the applicant's A/E and the consultants, the applicant concluded that the following procedure of repair would be the best from the standpoint of existing dome concrete integrity, cost, schedule and most importantly, of meeting staff's safety concerns:

1. Holes were core-drilled into the lower concrete.
2. The top delaminated concrete was removed.
3. Final inspection of the 24-inch lower concrete was made.
4. Lower level cracks were grouted with epoxy.

5. Radial anchors were set and grouted in holes core-drilled in the lower concrete.

6. New reinforcing steel was placed and concrete was cast to restore the dome to its original thickness.

7. Eighteen tendons which were detensioned to study the effects on the structure were retensioned.

The dome thus repaired is a hybrid structure. The lower portion is of prestressed concrete and the upper portion is basically of reinforced concrete. With the dome thus repaired, the lower portion concrete is under higher prestress than that originally designed for. For a specified concrete strength, this means that there will be greater loss of prestress. The dome design concrete strength was 5000 psi, but the dome actual concrete strength was determined by the applicant to be about 6000 psi. Therefore, higher concrete compressive stresses resulting from prestress would unlikely produce any higher creep than that in the original dome.

Since there has not been any experience with the behavior of such a hybrid structure, the staff required the applicant to make a detailed analysis of the repaired dome and to have it instrumented so that a correlation between the predicted and measured behavior can be established when the containment structure is subjected to structural integrity test. On November 3, 1976 the structural integrity test of the Crystal River Unit No. 3 was completed. The results as provided in the applicant's November 4, 1976 preliminary test report indicate that the repaired dome behaved as expected.

On the assumption that the results to be presented by the applicant in the final report would not be very different from those in the preliminary report, the staff has concluded that the repaired containment structure

meets the original structure design criteria and will withstand the specified design conditions without impairment of structural integrity or safety function.