A. B. Bolt, Chief
Technical Assistance Branch, 53

October 12, 1964

R. J. Impara
Technical Assistance Branch, 53

THERMAL REVIEW PEACH BOTTOM EMERGENCY COOLING SYSTEM

50-171

I have reviewed the thermal analysis associated with a loss of coolant accident for the Peach Bottom reactor.

A complicated three dimensional transient numerical analysis has been performed by General Atomics which, of course, I could not duplicate with a hand calculation. I have, therefore, limited my review to an evaluation of the geometric model proposed and to an appraisal of the approach, in general, including input assumptions and physical constants.

The thermal analysis is not well defined in the hazards reports, although I infer from general statements and a description of a previous analogue solution that the designers have done a rather thorough job. Some basic points should be clarified for the completeness of the record. Figure C-5 of Vol. V indicates that at any cross section a single node point defines the 3½ inch diameter fuel element. No explanation is given in the text as to how the resistance and, therefore, radial temperature rise, within the fuel element is accounted for. In the prior calculation performed on the analogue computer, an effective conductivity, taking into account conduction and radiation, was employed, and it probably is a safe assumption that the same approach was used in this analysis. It should be so stated, however, because ignoring this effect could result in higher temperatures at the core center of the order of several hundred degrees.

The applicant in his analogue study uses an emissivity of 0.9 for graphite but gives no references to substantiate the selection of this value nor an indication of what value was used in the latest analysis. If the emissivity were lower, say 0.7, then the net value to be used between two parallel surfaces would be equal to 0.59 as compared with 0.82. This difference would have a significant effect on the temperature at the core center. Indications are that the designer has performed investigations of emissivity characteristics for graphite. This work should be referenced.

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Form AEC-318 (Rev. 9-53)

U. S. GOVERNMENT PRINTING OFFICE 16—62761-3

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Mr. Goller has requested I comment on a verbal statement made by the applicant to the effect that for the first few hours after a loss-of-coolant accident the influence of the emergency cooling system is not significant. This appears reasonable, considering the following argument. Although the emergency cooling system is described as having a capacity of 3.5×10^6 btu/hr for each of two loops, which amounts to almost 2% of full power capacity, this is a measure only of its capability to dissipate the heat which has been transferred to its cooling coils. However, the capability of the reactor to transfer this heat is, of course, strongly dependent upon the temperature of the pressure vessel wall, which at the start of the accident is relatively cool. Therefore, during the early period of this accident, before the full effect of the heat buildup has reached the outer periphery, the emergency cooling system would be operating well below its capacity, since it cannot remove heat which it has not yet received. Because of the massive structure of this core and the surrounding shields, it is reasonable to expect a delay of the order of several hours before significant therm.. changes would appear at the reactor boundaries. One relatively minor effect of the emergency system not immediately becoming operative would be that the dips in the curves of core plate and vessel temperature shown on Figure C-4 would be eliminated, but these temperatures would nevertheless peak at essentially the same values.

The report covering the earlier analogue study also states that in calculating temperatures at the core bottom, no credit was taken for the fin effect of the control rod nozzles. If this same conservative assumption was used in the later analysis, then we would expect actual core plate and vessel temperatures to be below those reported.

cc: J. J. DiNunno, SS
S. Levine, DRL
K. Goller, DRL

OFFICE ▶	TAB:SS					
SURNAME ▶	R. Impara:amp					
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