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DENTON, H. R. Office of Nuclear Reactor Regulation, Director (post 851125

SUBJECT: Forwards response to 860108 Question 10 re XN-NF-85-28, "DC Cook Unit 2 SAR." Info provided re calculated coolant pressure rise & DNBR during rod ejection accident.

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April 14, 1986
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Donald C. Cook Nuclear Plant No. 2
Docket No. 50-316
License No. DPR-74
TRANSMITTAL OF
PLANT TRANSIENT ANALYSES RESULTS
IN SUPPORT OF UNIT 2 OPERATION

Mr. Harold R. Denton, Director
Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Dear Mr. Denton:

SUBJECT: Responses to NRC Questions on XN-NF-85-28(P)

Ref.: XN-NF-85-28, "D.C. Cook Unit 2 Safety Analysis Report," Exxon Nuclear Company, July 1985

Enclosed are five copies of the response to Question 10 which the NRC transmitted to American Electric Power Service Corporation (AEPSC) on January 8, 1986. This question concerned the Reference report. At the request of AEPSC, this response is being transmitted directly to the NRC by Exxon Nuclear.

If you have any questions regarding this transmittal, please contact Mr. James B. Feinstein of AEPSC at (614) 233-2040.

Sincerely,

G. N. Ward, Manager
Reload Licensing

gf

Enclosure

cc: Mr. D. L. Wigginton (NRC)(w/enc.)
Mr. W. Jensen (NRC)(w/enc.)
Mr. M. P. Alexich (AEPSC)

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Attachment

RESPONSE TO NRC QUESTION ON THE CONTROL ROD EJECTION

ANALYSES REPORTED IN XN-NF-85-28

Question 10

Analyses of a postulated control rod ejection accident is described in Section 7.3 of XN-NF-85-28. Using the approved model, the maximum energy deposition in the UO_2 fuel was concluded to be acceptable. The Staff SER on Exxon rod ejection model, Regulatory Guide 1.77 and the Standard Review Plan require additional evaluations.

a. Using the Staff approved methodology in XN-NF-78-44, provide the calculated coolant pressure rise during a rod ejection accident.

b. Provide an analysis of DNBR during the accident. Calculate the offsite dose consequences. Compare the methodology used in the above calculations with that discussed in Regulatory Guide 1.77 and justify any deviation.

Response

The control rod ejection transient is defined as the mechanical failure of a control rod pressure housing such that the coolant system pressure would eject a rodded control assembly (RCA) and drive shaft to a fully withdrawn position. A control rod housing failure is a low probability event and, consequently, the rod ejection is classified as a Postulated Accident (PA) Condition IV event. The rod ejection accident is the most rapid reactivity insertion that can be reasonably postulated. The resultant rapid core thermal power excursion is limited primarily by the Doppler reactivity feedback and is ultimately terminated by a reactor trip of all remaining control rods. The consequences of this rapid power excursion, coupled with an adverse core power distribution, may result in localized fuel rod damage.

The acceptance criteria for the rod ejection accident is given in the Standard Review Plan (SRP) Section 15.4.8, and the acceptable analytical methods and assumptions are described in Regulatory Guide 1.77. The acceptance criteria given in the SRP are:

a. Reactivity excursions should not result in a radially averaged enthalpy greater than 280 cal/gm at any axial location in any fuel rod.

b. The maximum reactor pressure during any portion of the assumed excursion should be less than the value that will cause stresses to exceed the "Service Limit C" as defined in the ASME Code.

c. The number of fuel rods calculated to experience DNB shall not result in exceeding 25 percent of the 10 CFR Part 100 exposure guideline values, i.e., 75 rem for the thyroid and 6 rem for whole-body doses.

The criterion on average enthalpy has been addressed in Section 7.3 of XN-NF-85-28. The methodology and application to D.C. Cook Unit 2 Cycle 6 for items (b) and (c) are discussed below.

From the results of the rod ejection analysis presented in XN-NF-85-28, the BOC and EOC HFP conditions will be limiting compared to the HZP conditions since the calculated energy deposition for the HFP conditions is larger by at least a factor of three. Comparison of the two HFP conditions indicates that both have to be evaluated at least to the point where one becomes obviously limiting. The static no feedback rod worths and power distributions were used in the analysis because they are limiting over the static rod worths and power distributions obtained by including the feedback effects. The static no feedback and Doppler feedback rod worths are compared in Table 1.

Table 1 Comparison of Feedback and No Feedback Rod Worths

HFP	Doppler Feedback	No Feedbacks
BOC	172 pcm	212 pcm
EOC	195 pcm	261 pcm

The calculated energy generated during the transient from PTSPWR2 was compared with that calculated by the XTRAN code used in developing the Exxon Nuclear generic rod ejection methodology for deposited energy, XN-NF-78-44(A). The results of this comparison showed that for the same neutronic and thermal hydraulic conditions, the PTSPWR2 code overpredicted the energy generation to the time of MDNBR calculated by XTRAN.

The BOC and EOC HFP rod ejection transients were performed for D.C. Cook Unit 2. The results of these two calculations indicated that the EOC case would bound the results of the BOC case in the calculation of MDNBR. Thus, the EOC calculation of MDNBR, fuel failure, and radiological consequences was continued. The biasing for these calculations was taken from both the Exxon Nuclear generic rod ejection report, XN-NF-78-44(A), and the Exxon Nuclear PWR methodology report, XN-NF-84-73(P), Revision 2. The parameters for which sensitivity studies were performed in the generic rod ejection report were biased according to that report, with all other parameters being biased according to the PWR methodology report for the uncontrolled control rod withdrawal from at power conditions.

An XCOBRA-IIIC (XN-NF-75-21) calculation was then performed using the conditions from the PTSPWR2 EOC HFP calculation to determine the flow penalty for the hot octant of the core. This flow penalty accounted for the non-symmetric effects of the rod ejection by using a bounding no feedback radial power distribution at the time the rod is fully ejected from the core. The flow penalty was then used in the approved XCOBRA-IIIC core octant and assembly octant model to determine the power level which gives a MDNBR of 1.17. This calculation was also performed using the bounding no feedback radial power distribution at the time the rod is fully ejected from the core. Once the assembly power level that produced a MDNBR of 1.17 had been determined, all assemblies with a higher power than this were conservatively assumed to fail. This resulted in 10.4% of the assemblies in the core being predicted to penetrate the DNBR limit.

The radiological consequences corresponding to 10.4% fuel failure were calculated using the Exxon Nuclear methods described in XN-NF-719(P), Revision 1. This method uses the ORIGIN code to calculate the total fission product inventories for the appropriate operating conditions and exposures. The release fractions to the fuel clad gap for the varioius isotopes are computed from these inventories using the approved RODEX2 code with the fission gas release4 models from the ANS Standard 5.4. Dose ratios are then calculated which relate the doses for the current fuel and exposures to the doses for the design base fuel in the FSAR. These dose ratios were used to calculate a dose rate corresponding to the current degree of predicted fuel failure. In this analysis, both the release pathway through containment and from the primary to secondary must be considered and a composite of the calculated dose rates reported. The conservative composite site boundary dose rates calculated using this method are 7.6 rem for the thyroid dose and 1.0 rem for the whole body dose. This is within the criteria of 25% of 10 CFR Part 100, i.e., 75 rem for the thyroid and 6 rem for the whole body dose.

Having completed the limiting calculation for fuel failure and radiological consequences, the calculation of the peak pressure was performed. Both BOC and EOC HFP cases were calculated using the biasing described in the Exxon Nuclear methodology report XN-NF-84-73(P), Revision 2, for the loss of load overpressure calculation. The results of these PTSPWR2 calculations indicated that the BOC cse is bounding. The calculated peak pressure for the BOC case adjusted to the maximum pressure point at the pump discharge was 2747.6 psia. This pressure satisfies the criteria for peak pressure of 2750 psia and is quite conservative since the PTSPWR2 code has been shown to overpredict the energy generated during the rod ejection transient.