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DOCKET NUMBER 50-269/270/287

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TO: Mr Rusche

FROM: Duke Power Company
Raleigh, NC
W O Parker Jr

DATE OF DOCUMENT 12-18-75

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DESCRIPTION

Ltr re our 10-14-75 ltr....w/attch info & drawings.....furnishing info concerning post long term cooling capability.....

NOTE: ONEY ONE CY DRAWINGS REC"D & SENT TO J. MAZETIS ALL OTHERS WITH LETTER & ADDL INFO ONLY.

ENCLOSURE

LOCA

DOCKET MATERIAL

PLANT NAME: Oconee 1-3

SAFETY — FOR ACTION/INFORMATION — ENVIRO 2-16-76 ehf

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14199

NRC FORM 195 (2-76)

DUKE POWER COMPANY
POWER BUILDING
422 SOUTH CHURCH STREET, CHARLOTTE, N. C. 28242

WILLIAM O. PARKER, JR.
VICE PRESIDENT
STEAM PRODUCTION

TELEPHONE: AREA 704
373-4083

December 18, 1975

Mr. Benard C. Rusche
Director of Nuclear Reactor Regulation
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

Attention: Mr. R. A. Purple, Chief
Operating Reactors Branch #1

Re: Oconee Nuclear Station
Docket Nos. 50-269, -270, -287

Dear Sir:

In response to your letter dated October 14, 1975, our letter of October 31, 1975 was submitted which provided information concerning post-LOCA long-term cooling capability. The response described a method of boron dilution consisting of a gravity flowpath for the reactor coolant from the hot leg nozzle to the Reactor Building sump through the decay heat drop line. The method will prevent unacceptable boron concentrations from developing following a postulated loss-of-coolant accident and will satisfy the requirements of the single failure criteria. Since our October 31, 1975 submittal, certain changes have been made to the proposed design. Consequently, a revised complete description of the proposed method of assuring boron dilution following a loss-of-coolant accident is attached.

Necessary station modifications and changes to station operating procedures will be implemented on each Oconee unit prior to restart following each unit's next refueling. This will assure compliance with the Commission's Order for Modification of License issued on December 27, 1974 and assure Oconee compliance with 10 CFR 50 §50.46.

Additionally, information is provided in Attachment 2 which pertains to the Oconee Unit 1 ECCS evaluation requested in question 3(h) of your letter dated October 30, 1975 to Mr. K. E. Suhrke of Babcock and Wilcox Company. Information relative to the partial-loop LOCA analysis is also included in Attachment 2.

Very truly yours,

William O. Parker Jr.

William O. Parker, Jr. by WAH

MST:mmb
Attachment

ATTACHMENT 1

METHODS TO PREVENT BORON PRECIPITATION IN THE LONG-TERM FOLLOWING A POSTULATED LOSS OF COOLANT ACCIDENT

December 18, 1975

METHODS TO PREVENT BORON PRECIPITATION IN THE LONG-TERM FOLLOWING A POSTULATED LOSS OF COOLANT ACCIDENT

In Duke Power Company's April 16, 1975 submittal, it was demonstrated that if a core circulation in excess of 40 gpm following a postulated loss-of-coolant accident was maintained, the resulting boron concentration buildup would be limited to a C/Co of less than 11. This concentration buildup assures that boron precipitation does not adversely affect long term cooling capability.

In order to assure that this minimum 40 gpm core circulation can be maintained, a station modification will be made to each Oconee unit to provide a gravity flowpath from the hot leg nozzle to the Reactor Building sump through the decay heat drop line. A 2" ID, or larger, drain line with two electric motor operated isolation valves (LP-X and LP-Y) will be installed on the decay heat drop line above valve LP-1 (See attached figures.). This line will allow drainage of highly concentrated water from the top of the core for all postulated loss-of-coolant accidents, allowing dilute water to enter the core and thus promote significant core circulation. The gravity head in these lines will assure that a flow in excess of 40 gpm will exist following the postulated LOCA.

The above described drain line is not single failure proof in itself; therefore, an additional flowpath is necessary. For Unit 1, another 2" ID, or larger, drain line and electric motor operated valve (LP-Z) will be installed below valves LP-1 and LP-2. This will establish a second flowpath from the hot leg to the Reactor Building sump through the decay heat drop line and will enable the single failure criteria to be met.

For Units 2 and 3, the existing flowpath through valves LP-1, LP-2, LP-3, LP-4 (Unit 2 only) to the A LPI pump suction or to the Reactor Building sump through valve LP-19 provides an alternate gravity flowpath.

The following additional information concerning the design and required changes in procedures is provided:

(a) The gravity flowpaths for the proposed mode of boron dilution are identified in the attached PO drawings.

(b) The elevation of the 36" ID outlet nozzle is 809' 6". For Unit 1, the decay heat line begins at the bottom of the hot leg nozzle, elevation 808', and continues downward to valves LP-1 and LP-2 at elevation 798' 6", the line then turns upward and penetrates the Reactor Building at elevation 812'. The tap for valves LP-X and LP-Y will be above LP-1, and the tap for LP-Z will be below LP-2 before the decay heat line turns upward. The sizing and location of the drain lines will be such that a minimum flow of 40 gpm, following a postulated LOCA, will be assured.

For Units 2 and 3, the decay heat line begins at the bottom of the hot leg nozzle, elevation 808', and continues downward to valves LP-1 and

LP-2 at elevation 795' 3" and then continues downward to elevation 772' 10" where it is imbedded in the Reactor Building base slab and exits the Reactor Building. The line continues in a downward path until it intersects the Reactor Building emergency sump line and LPI A pump suction at approximately 767'. The tap for valves LP-X and LP-Y will be above LP-1 and will be designed to assure a minimum flow of 40 gpm following a postulated LOCA.

(c) The electrical power supplies for valves LP-1, 2, X, Y, Z, 3, 19 have not been determined at present. They will be arranged such that LP-X and LP-Y have one source which is independent of the sources for valves LP-1, LP-2, LP-3 (Units 2 and 3), LP-Z (Unit 1), LP-19 (Units 2 and 3) such that a single electrical failure cannot affect both dilution paths. All valve operators will be above the post-LOCA water level and all motor operators will be qualified for the post-LOCA environment. The capacity of the emergency power source is more than adequate to carry these additional loads.

(d) The only operator action required for initiation of the boron dilution loop is to open the valves LP-1, LP-2, LP-X, LP-Y, LP-Z (Unit 1), LP-3 (Units 2 and 3), LP-19 (Units 2 and 3) from the control room. For large breaks, these valves may be opened following initiation of recirculation and within 24 hours following a LOCA. For small breaks, the valves are to be opened only after the Reactor Coolant System is depressurized and recirculation has been initiated. Valve LP-4 on Oconee Unit 2 will be changed to a normally open valve.

(e) Remote readouts of dilution flow is not required for this method of boron dilution since flow is assured due to the gravity feed nature of the lineup, and no action is dependent upon the actual dilution flow.

(f) The size and the minimum driving head of these drain lines will be such that a minimum 40 gpm will exist in each of these flowpaths.

(g) Remote valve operability and flow through these lines will be verified at the time the necessary modifications are implemented.

(h) The design, engineering evaluation and procurement effort for materials and equipment needed for the necessary station modifications is currently being initiated. The modifications and necessary changes to procedures will be implemented prior to restart following each unit's respective refueling.

ATTACHMENT 2

December 18, 1975

Additional Information in response to Question 3h

Table 1 provides additional information on the parameters used in the Oconee I ECCS evaluation. Utilizing Table 5-3 of BAW-10103, it is demonstrated that the oxide thicknesses used in the Oconee I analysis is consistant with the time-in-life analyzed.

As demonstrated in the time-in-life study (Section 5.4 of BAW-10103), the worst pin pressure (which is directly related to time-in-life) is the lowest that causes rupture at approximately mid-blowdown. In the study in BAW-10103, a pin pressure of 1190 psia caused rupture during blowdown (Rupture occured at 23.76, and the end of blowdown was 24.4 seconds). However, when the pin pressure was changed to 1250 psi, rupture occured at approximately mid-blowdown (14.73 seconds) and a marked increase in peak cladding temperature occured. The reason for this increase was explained in Section 5.4 of BAW-10103. Therefore, when LOCA limit calculations are performed, the pin pressure used must be the lowest that causes rupture during mid-blowdown in order to ensure a conservative calculation.

Figure 5-6 of BAW-10103 shows a typical cladding temperature transient during blowdown. The worst pin pressure causes rupture at the peak in the cladding temperature during mid-blowdown. The magnitude of this peak temperature and the time it occurs is dependent on the peak linear heat rate and elevation within the core that is analyzed. Therefore, the worst pin pressure will be different for each LOCA limits case analyzed.

In order to ensure that the worst pin pressure has been analyzed, the following procedure is used for the Category 1 plants. A CRAFT run is made using some initial pin pressure. Typically, rupture does not occur during blowdown. From this run, the time and maginitude of

the peak temperature that occurs at approximatley mid-blowdown can be determined. An initial pin pressure that will cause rupture at this time is estimated. The estimated pin pressure is, in general, low because the extent of plastic deformation has been underestimated in the original CRAFT calculation. As documented in B&W's Evaluation Model, BAW-10104, the clad is assumed to deform plastically when its temperature is within 200F of the value required for rupture. Plastic deformation results in a larger fuel to clad gap, degraded gap conductance, a reduction in internal pin pressure, and slightly lower cladding temperatures. In order to acccount for these phenomena, the estimated pin pressure is increased by approximately 100 psi since more plastic deformation will occur when the pin pressure is increased. The CRAFT analysis is then repeated with the revised initial pin pressure. This procedure is utilized until cladding rupture is calculated at mid-blowdown. Although not exact, this iterative procedure results in the use of initial pin pressure that are at most 100 psi higher than the most conservative value. In BAW-10103 a 150 psi increase over the worst pin pressure lowers peak cladding temperatures only 8F and 16F for the unruptured and ruptured nodes respectively. Thus, the procedure outlined above would result in little or no loss in conservatism. In actuality, an $\approx$ 100 psi error is not likely because of the plastic deformation effects.

In order to demonstrate that this approach was used in the Oconee I evaluation, the results of the preliminary CRAFT runs are presented. For the 2-foot case, two additional pin pressures were analyzed, 1575 and 1800 psia. Neither case caused rupture at mid-blowdown. From the 1800 psi case, it was found that a pin pressure in excess of 1825 psi was needed. A pin pressure of 1910 psi was used to develop the

2-foot limit and it caused rupture at 10.9 seconds. For the 4-foot case, one additional pin pressure was analyzed, 1475 psia. This did not cause rupture during blowdown. From this case it was found that a pin pressure in excess of 1600 psi was needed to cause rupture during mid-blowdown. When 1725 psi was used, rupture occured at 12.4 seconds. This is the case that the 4-foot LOCA limit is based on.

As demonstrated, the LOCA limits calculated in the Oconee I evaluation were performed at the worst time-in-life and thus represent conservative limits for all cycles of operation.

TABLE 1

Elevation, ft	2	4
Peak Linear Heat Rate, kw/ft	16.0	17.5
Burnup, MWD/MTU	38,200	28,200
Initial Pin Pressure, psia	1910	1725
Inside Oxide Thickness, inches	3.78×10^{-4}	2.8×10^{-4}
Outside Oxide Thickness, inches	3.5×10^{-4}	2.2×10^{-4}
Peak Unruptured Node Temperature/ Time, F/s	1930/43.5	1978/43.0
Peak Ruptured Node Temperature/ Time, F/s	1882/43.0	1975/43.0
Rupture Time, s	10.9	12.4

ADDITIONAL INFORMATION ON PARTIAL-LOOP LOCA ANALYSIS

The partial-loop LOCA analysis was performed using an initial pin pressure of 1600 psi in order to compare to the Spectrum analysis reported in Section 6 of BAW-10103. Since rupture occurs after blowdown, the worst pin pressure is the beginning-of-life pin pressure (760 psi) as was demonstrated in the time-in-life study in Section 5.4 of BAW-10103. The three pumps case with the break in the cold leg with the active pump in the loop with the idle pump was reanalyzed using an initial pin pressure of 760 psi. The peak cladding temperatures for the unruptured and ruptured nodes were 1784F and 1688 F respectively. This is an increase of 18 F and 14F for these nodes relative to the 1600 psi case. The sensitivity is not as large as that demonstrated in Section 5.4 of BAW-10103 due to the relatively low cladding temperatures for the partial-loop LOCA analysis.

As shown, the peak cladding temperature for partial-loop LOCA analysis is 416 F lower than the 2200 F criteria at the worst time in life. Therefore, an extremely large safety margin is demonstrated for partial-loop operation.