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DESCRIPTION:

Ltr re their 7-7-75 submittal...trans the following:

PLANT NAME: Oconee 1-2-3

ENCLOSURES:

Information concerning re-evaluation of ECCS cooling performance for partial loop operation...

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ACKNOWLEDGED

FOR ACTION/INFORMATION 8-5-75 ehf

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

WILLIAM O. PARKER, JR.
VICE PRESIDENT
STEAM PRODUCTION

TELEPHONE: AREA 704
373-4083

August 1, 1975

Mr. Angelo Giambusso, Director
Division of Reactor Licensing
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

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

Dear Mr. Giambusso:

Supplementing our submittal of July 9, 1975, Duke Power Company submits herewith information concerning re-evaluation of ECCS cooling performance for partial loop operation. This re-evaluation addresses two cases of three reactor coolant pump operation at the LOCA limited maximum allowable peak linear heat rate for four-pump operation, as established in BAW-10103, "ECCS Analysis of B&W's 177-FA Lowered-Loop NSS." The worst case break assumed is identical to that reported in BAW-10103.

The results of these analyses show that the peak cladding temperatures for partial loop operation are significantly below the four-pump, full power operation results reported in BAW-10103. These results, therefore, substantiate the proposed Technical Specifications for three- and two-pump operation submitted on July 9, 1975.

Forty copies of this letter and attachment are enclosed.

Very truly yours,

William O. Parker, Jr.

PMA:ge
Attachment

[redacted]

8330

PARTIAL LOOP ECCS ANALYSIS

Partial Loop ECCS Analysis

This study shows that in the event of a LOCA during partial loop operation, peak cladding temperatures and metal-water reactions are significantly lower than those during 4-pump operation. The partial loop analysis was performed assuming the worst case break ($8.55ft^2 DE, C_D=1$) reported in BAW-10103 and the maximum kW/ft limit shown in Figure 2.2 of BAW-10103. The maximum cladding temperature for the partial loop LOCA analysis is 1766F, which is 313°F less than the same break at full power and full flow conditions.

There are 5 possible break configurations at the pump discharge for partial loop operation:

1. 3-pump operation
   - a. break in inactive cold leg (cold leg with idle pump), partially idle-loop (loop with idle pump)
   - b. break in active cold leg, partially idle loop
   - c. break in active cold leg, fully active loop
2. 2-pump operation, one pump active in each loop
   - a. break in inactive cold leg
   - b. break in active cold leg

Analysis of the 3-pump operation instead of 2-pump operation was chosen for the following reasons. First, 3-pump operation is the more probable partial loop operational mode. Second, the rated power level for 3-pump operation is 77% of full power rating compared to 51% of full power rating for 2-pump operation. The reflooding rate will be lower for higher core power, thus a greater cladding temperature rise after the end-of-blowdown (EOB) is expected for 3-pump operation.

Due to the nature of core flow which results during a cold leg break, two break locations for 3-pump operation were examined. Typically, core flow remains highly positive during the initial phase of the blowdown transient. As the head of the RC pumps degrades, due to 2-phase effects, the magnitude of the positive core flow diminishes. Core flow then becomes negative for the remainder of the blowdown transient. The two phases of core flow, positive and negative, are effected by the choice of break location. Placement of the break at the pump discharge of the idle pump will induce a greater driving force from the intact cold legs. This will yield high positive flows and low negative flows.

A break at the pump discharge of the active cold leg in the partially idle loop will cause a loss in positive flow during the first half of the transient. Analyzing both break locations will ensure that the most conservative assumptions effecting core flow during the blowdown transient have been considered.

The parameters used in the partial loop CRAFT and THETA models are consistent with the spectrum analysis reported in section 6 of BAW-10103, except for the following:

1. The core power for both cases analyzed is reduced to 77% of rated power for 3-pump operation. The peak linear heat rate for the hot bundle is the maximum kW/ft LOCA limit shown in Figure 2.2 of BAW-10103 at the 6 ft. elevation for this mode of operation.
2. Since there is a power imbalance between the loop with 2 RC pumps running and the loop with 1 RC pump running, the load ratio between the steam generators is changed to 2.27:1 by control in the feedwater flow to each steam generator.
3. The flow and pressure distribution was modeled to reflectthe imbalance caused by the idle pump and the reduction in the RC flow to 75% of normal 4 pump operation. At steady state conditions the idle pump is locked in position because flow is reversed in that cold leg. The flow proceeds from the idle pump to the lower plenum of the steam generator where it mixes and proceeds back to the reactor vessel through the RC pump in the inactive cold leg. About 14% of the RC flow, from the downcomer plenum is directed back in the cold leg. If the flow reverses to the positive direction during the transient the idle pump would act as a free spinning rotor with no power.

Table 1 summaries the results of the partial loop analysis and compares those results to the worst break reported in BAW-10103. Figures 1 and 2 show respectively the hotspot and rupture node cladding temperature and the core flow for 3-pump operation with the break located at the active cold leg of partially idle loop. The maximum cladding temperature is 1766F at 98.5 seconds. Figures 3 and 4 show respectively the hot spot and ruptured node cladding temperature and the core flow for 3-pump operation with the break located in the inactive cold leg of the partially idle loop. The maximum cladding temperature is 1751°F at 91 seconds. Examination of the core flow for both cases reveals a distinct difference in the flow transient. With the break at the idle pump, core flow is similar to the 4-pump operation shown in Figure 6-2 of BAW-10103. When the break is placed at the pump discharge of the active cold leg of the partially idle loop, the positive phase of the core flow is sharply reduced and the transition from positive to negative flow occurs,earlier, approximately 11 seconds compared to approximately 14 seconds for the 4-pump case. The negative flow is increased due to the decrease from 3 to 2 active pumps trying to force the flow into the vessel. The flooding rates calculated using the REFLOOD code are slightly higher than those predicted for the 4 pump operation case because of the lower average core power. The hot pin cladding temperature response calculated with the THETA code are shown in Figures 1 and 3 for the two cases examined. Rupture for both cases occurs just after the EOB. The ruptured node cladding temperature decreases rapidly after rupture because of the reduced gap heat transfer from the fuel to the cladding and the increase in the surface area for cooling. The reflooding heat transfer coefficients are high enough to prevent a rise in the ruptured cladding temperature after rupture. The containment building pressure calculated by the CONTEMPT code is similar to the worst case shown in Figure 6-10 of BAW-10103.

The low temperatures experienced for the partial loop cases analyzed are considerably lower than those for 4-pump operation reported in BAW-10103. The maximum cladding temperature for the partial loop LOCA analysis is only 1766F compared to 2079F for the worst 4 pump operation break as reported in Section 6 of BAW-10103. The Technical Specifications for 3- and 2-pump operations previously submitted to the staff (7/9/75) for the operating Category 1 plants are calculated in a manner consistent with these results and remain applicable.

TABLE 1

Comparison of 8.55-ft^2 DE break at pump discharge, C_D = 1.0, with 4 and 3 pump operating.

	4-pump (BAW-10103)	3-pumps, break in active leg, partially idle loop	3-pumps, break in inactive leg, partially idle loop
Case Number	FC 112(IL)	PP102(Y1)	PP101(1B)
Percent Power (100% Power = 2772)	102	77	77
Peak Cladding Temp unrupt/time, F/s	2079/61.5	1766/98.5	1751/91.0
Peak Cladding Temp rupt/time, F/s	1916/43.5	1674.4/11.5	1569/42.0
Cont Pressure at Peak Cladding Temp, psia	36.4	35.37	35.48
Rupture Time/blockage S/%	13.8/63.14	25.39/65.04	25.9/64.78
CFT actuation time, s	16.7	16.6	17.2
End of bypass, s	24.4	24.8	25.2
End of Blowdown, s	24.4	24.8	25.2
End of adiabatic heatup, s s	35.4	35.8	36.4
Water mass in reactor at end of blowdown, lbm	1532.0	1824	1623.0
Local metal-water reaction, %	4.2923	2.86	2.738
Full-power seconds at end of blowdown	1.949	1.874	1.959