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August 6, 1982

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

Subject: Byron Station Units 1 and 2
Braidwood Station Units 1 and 2
Containment Pressure Analyses
NRC Docket Nos. 50-454, 50-455,
50-456 and 50-457

Dear Mr. Denton:

This is to provide advance copies of answers to questions on the Byron/Braidwood FSAR. NRC review of this information should close Confirmatory Issue 19 of the Byron SER.

Enclosed are the responses to FSAR questions 22.23 and 22.24. They document the results of reanalyses of ECCS performance with reduced temperature of the essential service water to the reactor containment fan cooler units. These responses will be incorporated into the next amendment.

Please address questions regarding these matters to this office.

One signed original and fifteen copies of the enclosures are provided for your review.

Very truly yours,

T. R. Tramm

T. R. Tramm
Nuclear Licensing Administrator

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QUESTION 22.23

Provide an analysis of the effect of the miniflow purge system, i.e., an open purge line, on the minimum containment pressure analysis for performance capability studies on the ECCS (Reference Branch Technical Position CSB 6-4 B.5.c).

RESPONSE

An analysis was performed for the Byron/Braidwood Stations to determine the reduction in the minimum containment backpressure for ECCS performance evaluation resulting from purging during a LOCA (i.e., open miniflow purge lines when the break is initiated). This analysis is based upon the containment conditions defined in the limiting large break analysis case (DECLG break, C_D = 0.6) obtained using the February 1978 Westinghouse Evaluation Model. In the analysis, a containment isolation signal is received at 1.12 seconds after inception of the LOCA. Adding 1.5 seconds for signal delay, and 5 seconds for isolation valve closure time gives a 7.62 second period for containment isolation. The analysis was performed for a mini-purge system consisting of two (inlet and outlet) 8-inch diameter lines and the following conservative assumptions:

1. During the 7.62 second period immediately following the LOCA, no credit is taken for the reduction in effective flow area which occurs while the isolation valves are in the process of closing.

2. The frictional resistance associated with duct entrance and exit losses, filter, ductwork bends, and skin friction has not been considered.

3. No fan coastdown effects are considered.

4. No inertia is considered. Steady state flow out the purge system ducts is established immediately at the time of the LOCA.

A mixture of steam and air will be exhausted from the containment through the purge lines during 7.62 seconds that the isolation valves are assumed to remain open. The effect of the composition of the gas being exhausted on containment pressure has been bounded by investigating the two extreme cases, air alone and steam alone. Within several seconds of the inception of the LOCA, containment pressure will have increased to the point that critical flow will occur in the purge lines. To bound the calculated containment gas mixture exhaused through the purge lines, the critical flow rates of steam and air were calculated during the first 7.62 seconds of the C_D = 0.6 DECLG break transient. Using these flow-rates, critical flow was then conservatively assumed to be in effect from time zero. Equation (4.18) in Reference (1), was employed to calculate the critical flow rate of air through the purge lines. Figure 14 of Reference (2) was applied to compute the critical flow rate of steam through the purge lines. The total mass released during the 7.62 seconds that the valves are presumed open is calculated as 448 lbs. of air or 324 lbs. of steam. The impact on containment pressure at 7.62 seconds resulting from this loss of air or of steam is less than 0.05 psi in either case. The effect of a containment pressure reduction of this magnitude on the calculated peak clad temperature is negligible (perhaps 1°F). Therefore, the results of this evaluation indicate that the Byron/Braidwood Plants meet 10 CFR 50.46 requirements even if the containment is being purged at the time of a LOCA event.

REFERENCES

1. Shapiro, H. A., The Dynamics and Thermodynamics of Compressible Fluid Flow, Volume 1, p. 85.

2. 1967 ASME Steam Tables, p. 301.

QUESTION 022.24

Provide the assumed essential cooling water temperature used in FSAR Table 6.2-25 to verify that the minimum essential service water temperature has been used to maximize the heat removal capcity of the reactor containment fan coolers used in the minimum containment pressure analysis for ECCS performance evaluation (Reference Branch Technical Position CBS 6-1).

RESPONSE:

A reanalysis has been performed for the Byron/Braidwood Stations, reflecting revised fan cooler performance based on a reduction in the minimum essential service cooling water temperature to 45°F. The large break LOCA analysis performed is identical to the previously docketed (Amendment 32) analysis for the worst break except for the use of revised fan cooler data and for the use of more accurate fuel temperature data. Westinghouse has obtained NRC approval (Reference 1) for use of the more accurate fuel temperature data on a generic basis. Figure 6.2-25 has been revised to reflect performance of the containment fan cooler with an inlet cooling water temperature of 45°F.

Figures 6.2-24 and 15.6-12 have been revised to show the minimum ECCS containment backpressure results for the revised analysis. The revised containment pressure results are essentially identical to the previous results for the first 100 seconds, then begin a gradual decline and are approximately 0.5 psig lower than the previous results at 400 seconds.

Table 15.6-3 has been revised to incorporate the revised large break LOCA results. Since the peak clad temperature occurs at 133 seconds, and there is very little change in the pressure transient up to this time, the effect on the large break LOCA results is minimal. The 7°F benefit in peak clad temperature is due to the more accurate fuel temperature data.

(1) Letter John F. Stolz to Thomas M. Anderson, March 27, 1980.

d. Mass released to Containment during blowdown. (Figure 15.6-16)

e. Energy released to Containment during blowdown. (Figure 15.6-17)

f. Fluid quality in the hot assembly during blowdown. (Figure 15.6-18)

g. Mass velocity during blowdown. (Figure 15.6-20)

h. Accumulator water flow rate during blowdown. (Figures 15.6-19)

i. Pumped safety injection water flow rate during reflood. (Figures 15.6-21)

The maximum clad temperature calculated for a large break is 2102°F which is less than the Acceptance Criteria limit of 2200°F of 10CFR50.46. The maximum local metal-water reaction is 5.53% which is well below the embrittlement limit of 17% as required by 10CFR50.46. The total core metal-water reaction is less than 0.3% for all breaks, as compared with the 1% criterion of 10CFR50.46, and the clad temperature transient is terminated at a time when the core geometry is still amenable to cooling. As a result, the core temperature will continue to drop and the ability to remove decay heat generated in the fuel for an extended period of time will be provided.

Small Break Results

As noted previously, the calculated peak clad temperature resulting from a small break LOCA is less than that calculated for a large break. Based on the results of the LOCA sensitivity studies (Reference 21) the limiting small break was found to be less than a 10 inch diameter rupture of the RCS cold leg. Therefore, a range of small break analyses are presented which establishes the limiting break size. The results of these analyses are summarized in Tables 15.6-1 and 15.6-4.

Figures 15.6-34 through 15.6-47 present the principal parameters of interest for the small break ECCS analyses. For all cases analyzed the following transient parameters are presented:

a. RCS pressure. (Figure 15.6-34, 15.6-41, 15.6-42)

b. Core mixture height. (Figure 15.6-35, 15.6-43, 15.6-44)

TABLE 15.6-3

LARGE BREAK LOCA RESULTS FUEL CLADDING DATA

	C_D = 0.8 DECLG	C_D = 0.6 DECLG	C_D = 0.4 DECLG
Results for N Loop			
Peak clad temperature (°F)	2016	~~2102~~ 2095	1657
Peak clad temperature location (ft)	7.5	7.5	7.25
Local Zr/H_2O reaction, maximum (%)	4.29	~~5.53~~ 5.43	0.40
Local Zr/H_2O location (ft)	7.5	7.5	7.25
Total Zr/H_2O reaction (%)	<0.3	<0.3	<0.3
Hot rod burst time (sec)	56.4	~~44.0~~ 40.6	152.86
Hot rod burst location (ft)	6.25	6.25	7.25

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