Florida
Power
CORPORATION

July 11, 1980

File: 3-0-3-a-3

Mr. Robert W. Reid
Chief
Operating Reactors Branch #4
U.S. Nuclear Regulatory Commissic
Washington, DC 20555

Subject: Crystal River Unit No. 3
Docket No. 50-302
Operating License DPR-72
NRC Letter Dated February 29, 1980, Requesting Additional Information on Containment Purge and Vent System

Dear Mr. Reid:

By letter dated February 29, 1980, you requested additional information for Containment Purge and Vent System for Crystal River Unit 3. The enclosed response by B&W for Florida Power Corporation is for questions 1c and 1e of the subject letter. Our response to questions 1a, 1b, 1d, and 1f was submitted to you on June 20, 1980.

This transmittal completes our response to the subject letter.

Should you have any questions concerning this subject, please contact this office.

Very truly yours,

FLORIDA POWER CORPORATION

GCMoore

G. C. Moore
Vice President
Power Production

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STATE OF FLORIDA

COUNTY OF PINELLAS

G. C. Moore states that he is the Vice President, Power Production, of Florida Power Corporation; that he is authorized on the part of said company to sign and file with the Nuclear Regulatory Commission the information attached hereto; and that all such statements made and matters set forth therein are true and correct to the best of his knowledge, information and belief.

G. C. Moore

Subscribed and sworn to before me, a Notary Public in and for the State and County above named, this 11th day of July, 1980.

Notary Public

Notary Public, State of Florida at Large,
My Commission Expires: May 29, 1984

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FLORIDA POWER CORPORATION RESPONSE TO NUCLEAR REGULATORY COMMISSION QUESTIONS ON CONTAINMENT PURGE AND VENT SYSTEM

QUESTION 1c

Specify the amount of containment atmosphere released through the purge and vent isolation valves, for a spectrum of break sizes, during the maximum time specified for them to close in your technical specifications.

RESPONSE

An assessment of the mass released through the containment purge system has been performed for the spectrum of break sizes set forth in the Crystal River 3 FSAR. The following assumptions were used in this evaluation:

1. The containment pressures presented in the FSAR were assumed to be unaffected during the time period the purge valves were closing and the containment was not isolated. An assessment of the 0.5 ft^2 cold leg break was performed to evaluate the effect of the purging system on the 4 psig ESFAS actuation time. The 0.5 ft^2 break was chosen for this evaluation as its ESFAS actuation time, approximately 6.5 seconds, is the most delayed for the break spectrum considered. Results showed that the delay in actuation time would be approximately 0.5 seconds when accounting for the purging system. To offset this delay, there would be approximately a 20% decrease in pressure at the valve closure time (approximately 11 seconds). This decrease in pressure would have more impact than the ESFAS delay on the mass release. Therefore, the assumption of containment pressures being unaffected by the purging system is conservative for mass release calculations.

2. The time to reach containment isolation was accounted for in the following manner; the number of second(s) to reach ESFAS (4 psig), plus 0.5 seconds signal transmittal time, plus 5.0 seconds valve closure time. No allowance was made for flow reduction while the valves were closing.

3. The flow rates through the purge system is based on the orifice equation with a discharge coefficient of 1.0. This coefficient conservatively neglects flow resistance of the pipes, filters, fan drag, etc.

4. The density of the effluent passing through the purge system is based on the mass of saturated steam at the partial vapor pressure and the initial air mass based on the initial containment conditions listed in the FSAR. This partial vapor pressure, assuming a saturation condition, defines a density which is then used to calculate the vapor mass. This mass is

then combined with the initial air mass and containment volume to obtain the effluent density which is then used in the orifice equation to calculate mass release rates. The air mass was held constant throughout the transient.

5. Based on the Gilbert Associates, Inc. report, "Final System Description - Reactor Building Ventilation System," dated 10/7/75, the purge system exhaust rate has been calculated to be 62.5 lbm/sec. In the cases where the mass release rate calculated from the orifice equation was lower than this steady-state rate, the 62.5 lbm/sec was used as a lower limit.

The above assumptions were used in calculating mass release for the spectrum of break sizes. The method used was to integrate each pressure curve by using one second time intervals and an average pressure over that interval. This average pressure was then used along with the effluent density in the orifice equation to calculate the mass release for each curve.

The results of this analysis are shown in Table 1.

TABLE 1

Break size, ft^2	Break Location	ESFAS Time s, 4 psi	Leak Open Time, s	Maximum Mass Released, lbm
14.1	Hot leg	1.0	6.5	12810.
11.0	Hot leg	1.0	6.5	11900.
8.55	Hot leg	1.0	6.5	10960.
5.0	Hot leg	1.0	6.5	8690.
8.55	Cold leg P.S.	1.0	6.5	11900.
7.0	Cold leg P.S.	1.0	6.5	10330.
5.13	Cold leg P.S.	1.0	6.5	9090.
3.0	Cold leg P.S.	1.5	7.0	8090.
2.0	Cold leg P.S.	2.0	7.5	7470.
0.5	Cold leg P.S.	7.0	13.0	8650.

QUESTION 1e

Provide an analysis of the reduction in the containment pressure resulting from the partial loss of containment atmosphere during the accident for ECCS backpressure determination.

RESPONSE

An analysis of the minimum containment pressure, including the effect of the purge system, was performed for Crystal River 3. A CONTEMPT model was developed, using the basic approach listed in Section 4.4 of BAW-10103A, specific to the Crystal River 3 containment. Heat sink data is based on the Gilbert Associates Report GAI-1889, dated August 1975, and Branch Technical Position CSB6-1. All other data is based on the generic CONTEMPT model utilized for BAW-10103A, Revision 3. The following assumptions were used in performing the containment evaluation:

1. Mass and energy release was obtained from the worst case break, the 8.55 ft^2 double-ended break at the pump discharge with a C_D = 1.0, determined in BAW-10103A, Revision 3.

2. Leakage through the purge system was assumed for 6.5 seconds. This accounts for a one second time to reach the 4 psig ESFAS signal, a 0.5 second signal transmittal time, and 5 seconds for the purge valves to close. No allowance was made for flow reduction while the valves were closing.

3. The flow rates through the purge system is based on the orifice equation with a discharge coefficient of 1.0. This coefficient conservatively neglects flow resistance of the pipes, filter, fans, etc.

4. Initially, the reactor building is at 110F, 13.7 psia, and 100% relative humidity. These values are defined in BAW-10103A, Revision 3.

5. The outside air temperature is 40F.

6. The containment volume is 2050550 ft^3. This is the Crystal River 3 specific volume as reported in the Gilbert Associates Report GAI 1889.

7. All heat removal systems and their actuation times are used as reported in BAW-10103A, Revision 3. As reported by Gilbert Associates, Inc. in Report No. 1889, these heat removal systems are conservative relative to the specific systems in the CR-3 facility.

8. Complete mixing of the spilled ECCS water with the containment atmosphere is considered. The HPI injecting in the broken loop is considered part of the spilled ECCS water.

9. Rainout of suspended water is assumed, and a high heat transfer coefficient of 1000 Btu/h-ft^2-°F between the liquid and vapor regions is used.

10. The building is modeled with five heat sinks:

a. The reactor building walls including the concrete wall, steel liner, and anchors:

Exposed area, ft^2	63,304.0
Paint thickness, ft	0.0005
Steel thickness, ft	0.03125
Concrete thickness, ft	3.5

b. The reactor building dome including concrete, steel liner, and anchors:

Exposed area, ft^2	18,138
Paint thickness, ft	0.0005
Steel thickness, ft	0.03125
Concrete, ft	3.0

c. Painted internal steel:

Exposed area, ft^2	409,817.0
Paint thickness, ft	0.0005
Steel thickness, ft	0.017738

d. Unpainted stainless steel:

Exposed area, ft^2	46,059.0
Steel thickness, ft	0.0227

e. Internal concrete:

Exposed area, ft^2	105,941.0
Paint thickness, ft	0.00083
Concrete thickness, ft	1.4350

11. The following thermophysical properties are used:

Material	Thermal Conductivity Btu/h-ft-°F	Heat Capacity Btu/ft^3-°F
Concrete	0.92	22.62
Steel	27.0	58.8
Stainless Steel	9.1836	54.263
Paint	0.6215	40.42

12. The condensing heat transfer coefficients given in Section 4.3.6.1 of BAW-10104 are used:

   a. At the end of the blowdown, assume a maximum heat transfer coefficient four times higher than that calculated by Aerojets' Tagami correlation:

   $$h_{max} = 72.5\ (Q/Vt_p)^{0.62}$$

   where

   h_{max} = maximum heat transfer coefficient, Btu/h-ft^2-F,

   Q = primary coolant energy deposit to containment at end of blowdown, Btu,

   V = net free containment volume, ft^3,

   t_p = time interval to end of blowdown, s.

   Before the end of blowdown, assume a linear increase from

   $$h_{initial} = 8\ \text{Btu/h-ft}^2\text{-°F}$$

   to the peak value specified above.

   b. During the long-term stagnation phase of the accident, characterized by low turbulence in the containment atmosphere, assume condensing heat transfer coefficients equal to 1.2 times the one obtained from the Uchida data. The Uchida heat transfer coefficients are shown in Table A-1 of BAW-10095.

   c. During the transition in phase of the accident between the end of blowdown and the long-term, post-blowdown phase, a reasonably conservative exponential transition with a decay constant of 0.0255 is used.

The results of the CONTEMPT evaluation is depicted on Figure 1. As shown, the influence of the purge system is to reduce the containment pressure by 1.5 psig. However, even with the purge system assumed operational at the start of the event, the resultant containment pressure is still higher than the value obtained from the generic 177-FA lowered-loop containment pressure evaluation used for demonstrating ECCS conformance to 10 CFR 50.46.

FIGURE 1

MINIMUM CONTAINMENT BACK PRESSURE