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February 8, 1985

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

Subject: Byron Generating Station Units 1 and 2
Braidwood Generating Station Units 1 and 2
Environmental Qualification of Equipment
NRC Docket Nos. 50-454/455 and 50-456/457

Reference (a): January 8, 1985 letter from T. R. Tramm to H. R. Denton.

Dear Mr. Denton:

This letter provides additional information to justify interim operation of the Byron units with respect to the potential environmental effects of a high energy steamline break outside the containment. This supplements the information provided in referece (a) to satisfy License Condition 5.a of the Byron 1 Operating License, NPF-23.

Enclosed with this letter are revisions to pages four and five of Attachment A to reference (a). Two new graphs are also included. These pages have been revised to include more data on the temperature transient which could be experienced by components in the valve houses which are required for safe shutdown.

Please address further questions regarding this matter to this office.

One signed original and fifteen copies of this letter are provided for NRC review.

Very truly yours,

T. R. Tramm

T. R. Tramm
Nuclear Licensing Administrator

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cc: Byron Resident Inspector

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In evaluating the potential effects of these two breaks the smaller break was found to be limiting. Although the rate of temperature rise is less, the total time at a temperature higher than the original qualification temperature is greater and the potential for heating a component to unacceptable levels is higher.

The predicted temperature transient for the 0.2 ft^2 break is shown in Figure 1. Steam Generator tube uncovery occurs at 530 seconds after the break. Main Steam isolation occurs at 1114 seconds when the temperature in the valve room is approximately 339^{O}F. The temperature transient for the 0.5 ft^2 break is shown in Figure 2.

3. AFFECTED SAFE SHUTDOWN EQUIPMENT

The Category I electrical equipment located in the safety valve rooms has been identified and is listed in this section. No Category I equipment is located in the steam tunnel itself. The only components listed which are required for safe shut-down following a main steam line failure are the Main Steam Isolation Valves (MSIV's) and the Main Steam Pressure Trans-mitters. These are required to isolate the steam generators. Following the isolation valve closure, the components are not required to function during the remainder of the transient. The only cables in the valve rooms which must remain operable until MSIV closure are the cables associated with the MSIV's and the pressure transmitters. The function of all Class 1E equipment located in the Safety Valve Room is described below.

A. Main Steam

The Main Steam Isolation Valves (MSIV's), MSIV Bypass Valves and the Steam Generator Power Operated Relief Valves (SG PORV's) are required to isolate the SG pressure boundary and control cooldown. The MSIV bypass valve is used during start-up at low flow to temper the lines and is closed during normal operation and, therefore, not required to open during an MSLB event.

The PORV's are not required to maintain hot stand-by conditions. The Main Steam Safety Valves (which contain no non-metallic parts) will prevent overpressurization of the secondary system. Secondary depressurization can be accomplished with hydraulic hand pumps if the electrical controls on the PORV's are inoperable. PORV operation is not required during an MSLB. An analysis shows that the hand pump will be accessible within 30 minutes after Main Steam Isolation.

The MSIV Safety function (closure within 5 seconds at a maximum specified qualification temperature of 325°F) must be completed in order to isolate the steam generators to prevent blowdown of all steam generators. Qualification of the MSIV actuator during an MSLB is required and is described in Section 4.

4. MSIV QUALIFICATION

The Main Steam Isolation Valves (MSIV's) are required to close to prevent blowdown of all steam generators. When a valve is closed the differential pressure across the valve will maintain the closed position. Therefore, the valve actuator is required to remain functional only until the valve is closed.

The MSIV's have been qualified using an accident transient which peaks at 328°F. To evaluate the effects of higher temperatures, the individual components of the valve actuator have been reviewed for possible non-metallic material degradation or other high temperature effects which could adversely affect the performance. The non-metallic materials in the MSIV which are required to withstand the transient are listed below. The normal service limits have been compared with the predicted temperatures of the individual parts obtained by a conservative heat transfer analysis. A significant margin exists between the service limits and the predicted temperatures demonstrating the adequacy of the MSIV design.

MSIV Materials

Material	Use	Normal Allowable Temperature
Viton	Seals on 3-Way solenoid valves	425°F
Viton	Seals on 4-Way hudraulic valves	425°F
Viton	Seals on pilot check valves	425°F
Viton & telfon	Seals on hydraulic accumulators	425°F
EPR (Ethylene-propylene rubber)	End seal (internal) on pneumatic reservoir and seals on hydraulic actuation cylinder	300°F

By comparing the allowable temperature with the transient shown in Figure 1, it can be seen that the only material of concern is the EPR used to seal the pneumatic reservoir and the piston of the hydraulic cylinder which actuates the valve. A conservative heat transfer analysis has been completed to determine the expected temperature which the seals would experience. The limiting seal temperatures for the hydraulic cylinder and pneumatic reservoir at the time of MSIV closure (1114 seconds) are 240°F and 250°F, respectively. Therefore, temperature margins exist of approximately 60°F for the cylinder and 50°F for the reservoir.

Figures 3 and 4 show the temperature profile for the case where MSIV closure isolates only three of the four steam generators from the 0.2 ft^2 break at 1114 seconds. The room temperature rises more rapidly after 1114 seconds because all of the blowdown steam flow comes from only one steam generator. As shown in Figure 4, the time required for the seal on the hydraulic cylinder to reach the allowable temperature (300°F) exceeds the duration of the 1800 second transient. The cylinder seal temperature was estimated to be 288°F at 1800 seconds. As shown in Figure 3, the pneumatic reservoir seal temperature would not reach the allowable temperature until 9 minutes after closure. The calculation indicates they would reach 299°F at 1656 seconds. Based on the analysis of continued blowdown after MSIV closure extending to 1800 seconds, substantial margins on the hydraulic cylinder and pneumatic reservoir seal temperature exist.

Instrumentation cabling for the MSIV's has been environmentally qualified at 341°F for a duration of six hours followed by 320°F for three hours and 300°F for four hours. Power cables are qualified to a higher temperature. Since the valve house temperature reaches a peak of 339°F at the time of MSIV closure and the operability of the MSIV control circuitry is not required following closure, the cabling is qualified to operate an additional six hours at temperatures slightly above the peak 339°F. The terminal blocks are qualified for 6 hours at 385°F. These margins are sufficiently conservative to justify the MSIV and associated cabling performance during the MSLB.

5. STEAM LINE PRESSURE TRANSMITTERS QUALIFICATION

The pressure transmitters are required to function only long enough to provide the main steam isolation signal. Sufficient margin exists in the environmental qualification testing to assure the operability of the transmitters at the maximum calculated temperature of 339°F at the time of main steam line isolation (1114 seconds). The transmitters are qualified for a maximum of 420°F (duration three minutes) followed by 340°F for 15 minutes and 250°F for 16 days (Ref. EQDP Rev.4, March, 1983). The qualification transient is significantly more severe than the predicted transient shown in Figure 1. Additionally, the transmitters are mounted on the valve room concrete wall where temperatures will be lower due to steam condensation.

Instrumentation cabling from the pressure transmitters has been environmentally qualified at 341°F for a duration of six hours followed by 320°F for three hours and 300°F for four hours. Since the valve house temperature reaches a peak of 339°F at the time of MSIV closure and the operability of the pressure transmitters is not required following closure, the cabling is qualified to operate an additional six hours at temperatures slightly above the peak 339°F. These margins are sufficiently conservative to justify the transmitters and associated cabling performance during the MSLB.

6. CONSERVATISM AND MARGIN IN ANALYSIS

The re-evaluation of the MSIV and Pressure Transmitter environmental qualification is consistently conservative in assumptions and procedures. The postulated initiating event, a main steam line rupture with a break area of between 0.2 and 0.5 Ft^2, is a very low probability event. Prior to occurrence of superheat conditions in the pipe the plant operators will receive alarms for low level in a steam generator and large amounts of steam will be released to the turbine building and the environment. It would be expected that the operators would quickly isolate the main steam lines.

Assuming the event continued, temperatures in the valve room were calculated assuming no delay in flow from the break to the safe shutdown equipment. No credit was taken for the amount of heat transferred from the steam to the structure and equipment, resulting in a higher predicted environmental temperature.

When evaluating the potential heat transfer to the temperature sensitive components, there is some uncertainty involved with the heat transfer rate to a surface below the steam saturation temperature (approximately 212°F for this case) because of the variability of condensing heat transfer. To model this is a very conservative assumption was made that the surface of the component in question was initially at 212°F.

7. CONCLUSION

In the limiting steam superheat case, components could be exposed to temperatures slightly above the qualification temperature for about 10 minutes. The most critical components contain seals made of EPR which is rated for only about 300°F.

Conservative calculations show that the temperature at the seal location would rise only about 30°F prior to the completion of the safety function. This results in a temperature margin of about 60°F and a time margin estimated to be at least equivalent to the duration of the event.

Given the extremely low probability of the defined initiating event and the adequacy of the materials for the predicted temperatures, the components in the main steam tunnel have been shown to be qualified for the conditions caused by superheated steam due to low level in a steam generator.

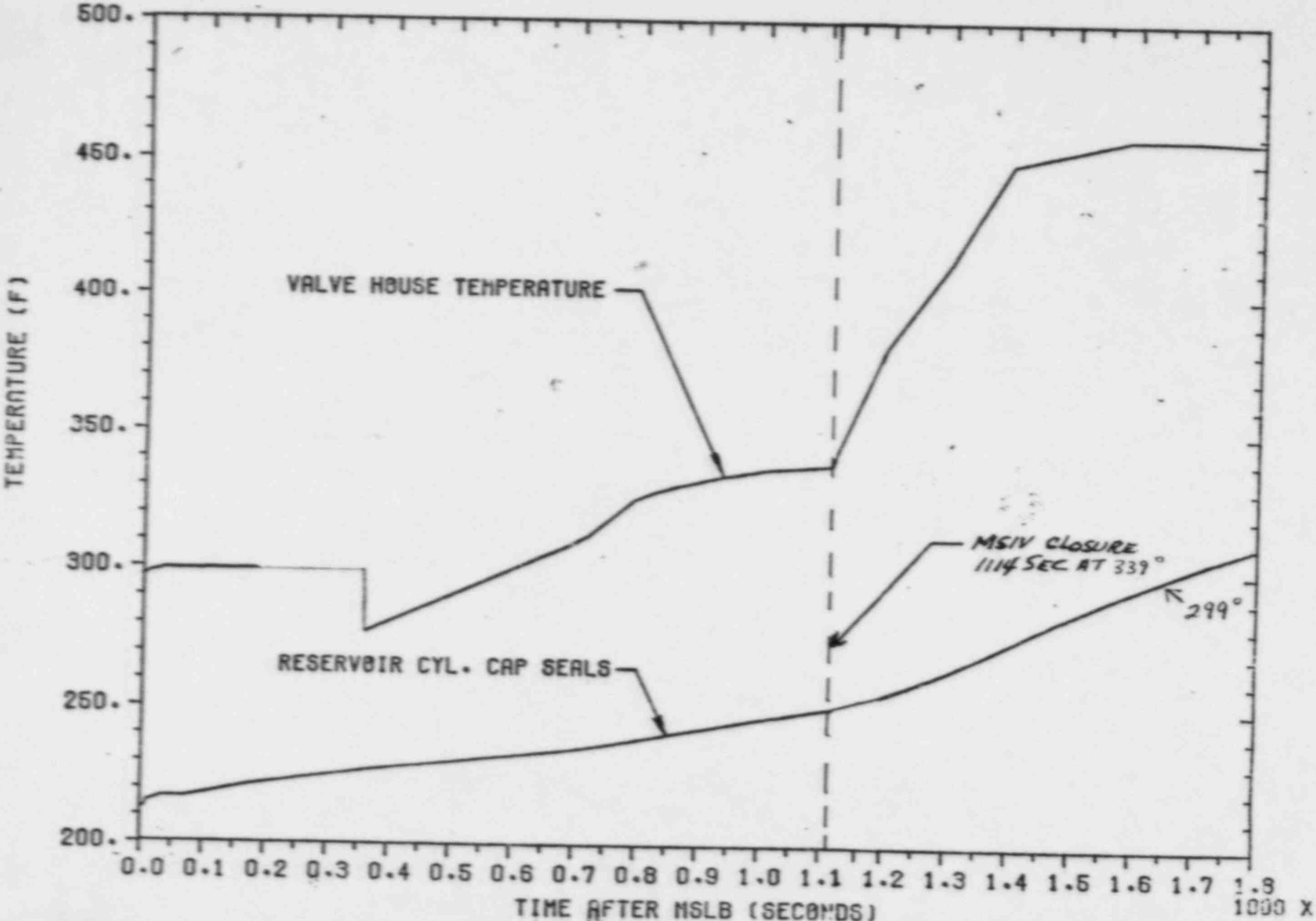

FIG 3. - TEMP. RESPONSE AT THE CRITICAL SEAL - PNEUMATIC RESERVOIR

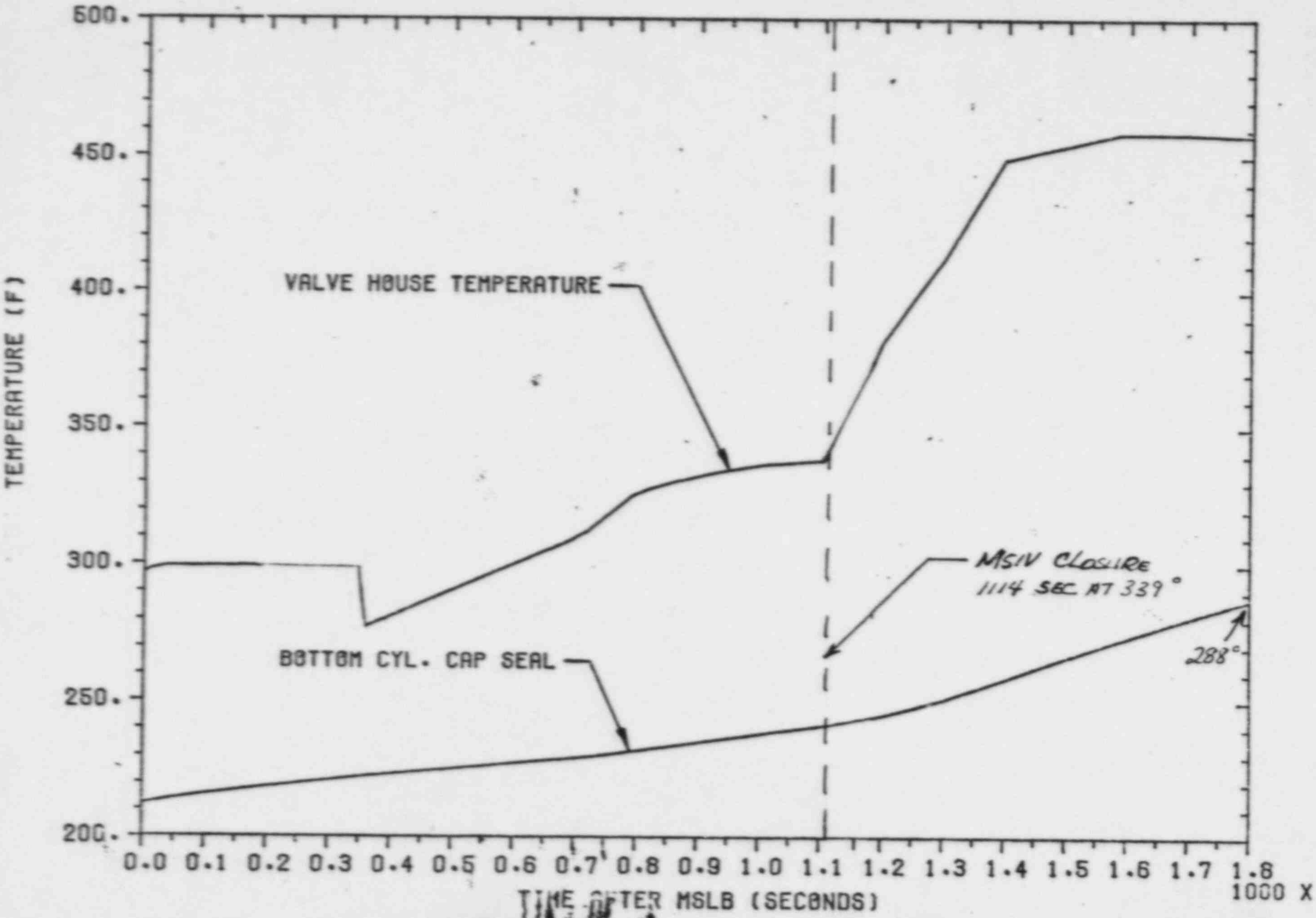

FIG. 4 - TEMP. RESPONSE AT THE CRITICAL SEAL - HYD. CYLINDER