Commonwealth Edison
One First National Plaza, Chicago, Illinois
Address Reply to: Post Office Box 767
Chicago, Illinois 60690

January 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
Environmental Qualification of Equipment
NRC Docket Nos. 50-454 and 50-455

Reference (a): October 18, 1984 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 regard to the potential environmental effects of a high energy steamline break outside the containment. This information is provided to satisfy License Condition 2.C.(5)(a) of the Byron 1 Operating License, NPF-23.

As indicated in reference (a), we believe that the Owner's Group cooperative effort is the most appropriate manner in which to obtain final resolution of this generic safety question. After discussion with the NRC Staff, however, more detailed analyses of the Byron/Braidwood equipment have been undertaken to provide a better justification for interim operation. This letter provides the results of those analyses.

Subsequent to reference (a) and our last discussion with the NRC Staff, it was determined that the steamline break mass release estimates made by Westinghouse for another plant would be useable for a similar evaluation of equipment operability at Byron. Attachment A to this letter summarizes the results of Sargent and Lundy's temperature calculations for the main steam safety valve room and their evaluation of the possible adverse effects upon Category I equipment in those rooms. No Category I equipment is located in the steam tunnel.

Calculated temperature profiles are provided for the 0.2 ft^2 break at full power and 0.5 ft^2 break at 70% power. According to these calculations the room temperature could exceed the equipment qualification temperatures for a short period of time. Further evaluation indicates that this minor temperature transient would not threaten the operability of any of the Category I equipment in the safety valve room.

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This evaluation, in combination with the low probability of the catastrophic high energy line break event itself, provide assurance that the Byron units can be operated safely pending resolution of this issue on a generic basis.

Please address further questions regarding this matter to this office.

One signed original and fifteen copies of this letter and the Attachment 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

Attachment

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ATTACHMENT A

Evaluation of Environmental Effects of

HELB Outside Containment

Byron/Braidwood

9598N

1. INTRODUCTION

Commonwealth Edison was recently notified by Westinghouse of a potential main steam line failure scenario which could result in uncovering the steam generator tube bundle and production of superheated steam in the steam generator. Release of this steam could result in higher temperatures in the main steam tunnel and valve houses than have been used in the Byron/Braidwood Equipment Qualification program. The potential effects of this increased temperature on equipment required to safely shutdown the plant and maintain it in a safe shutdown condition have been evaluated and are described in this document. The evaluation demonstrates that the postulated superheated steam event is of low probability and, if the superheated steam condition did occur, necessary safe shutdown equipment would not be rendered inoperable.

2. DESCRIPTION OF POSTULATED EVENT

A spectrum of main steam line breaks (MSLB) ranging from small cracks to large double ended ruptures, have been postulated over a wide range of plant operating conditions. Very small breaks do not cause uncovering of the steam generator tubes because Auxiliary Feedwater Flow is adequate to maintain steam generator level. Very large breaks result in a rapid pressure drop and, consequently, reactor trip and steam line isolation prior to uncovering of the steam generator tubes. At an intermediate range of break sizes steamline isolation may not occur until sometime after the tubes have been exposed. If the tubes are exposed, the steam produced in the steam generator can be superheated as it rises. This results in increased temperatures in the area near the postulated break.

The range of break sizes which could result in a superheated condition is dependent upon plant parameters such as Auxiliary Feedwater system design, steam generator design, and piping arrangements. Westinghouse has reviewed the Byron/Braidwood design and confirmed that the information on transient superheat conditions generated for the Duke Power's Catawba and McGuire plants can be used to assess the potential effects at Byron/Braidwood. Differences between the plants were evaluated and found to have only minor influences on the predicted conditions.

Two limiting cases were identified to bound the superheat cases. A break of approximate area 0.5 ft^2 will result in tube uncovery and a rapid temperature rise followed quickly by isolation. A break of approximate area 0.2 ft^2 will result in a slowly decreasing level and a gradual increase in temperature with a significant delay before isolation.

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°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 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.

3. (Cont'd)

A. (Cont'd)

Environmental effects will not cause a spurious actuation of a valve in the Main Steam system. Failures in the electrical or hydraulic system of the MSIV's will result in the valve remaining "as-is". The PORV's will close upon loss of electrical or hydraulic power. The MSIV bypass valves are also fail closed valves. Section 4 demonstrates that environmental effects will not result in failure of the MSIV to actuate and, therefore, Main Steam isolation will be achieved.

B. Feedwater Valves

Feedwater Isolation Valves are normally open and fail as is. The Feedwater Isolation Bypass valves are normally closed and used during start-up, low flow conditions. They are not required to function during an MSLB. The Feedwater bypass valves are set to provide approximately 10% of the main feedwater flow to the upper feedwater nozzle. This flow path is automatically isolated by check valves upon loss of feedwater flow and, as a result, the feedwater bypass valves are not required to function following an MSLB.

C. Blowdown Valves

The steam generator blowdown isolation valves are normally open, fail close valves. The flow in this system is normally between 15 and 90 gpm per steam generator. Control valve SD007, located in the Auxiliary Building, can be used to isolate blowdown outside containment. The Steam Generator Sample Line Isolation valves are normally closed, fail close and are used only when taking samples of secondary coolant. Their function is not required during MSLB event.

D. Main Steam Instrumentation

Pressure switches on the MSIV hydraulic pump and accumulator tank provide alarms in the event of component failure or malfunction. Failure of the switches will not result in loss of MSIV operability. Therefore, these switches do not require qualification for the Main Steam Line Break transient.

The steam generator pressure transmitters must operate during the MSLB to transmit the low steam pressure signal which actuates the MSIV to close approximately seven seconds after the pressure set point is reached. The qualification of these transmitters was sufficiently conservative to envelope the predicted superheat conditions as discussed in Section 5.

E. Radiation Detection Instrumentation

Radiation detectors mounted near the Main Steam Penetrations and in each safety room are not required to function during an MSLB event. Their function is to monitor radiation levels from valve and penetration leakage and to detect radiation in the main steam line in the event of a tube rupture.

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 hydraulic cylinder which actuates the valve. A conservative heat transfer analysis has been completed to determine the actual temperature which the seals would experience. In both cases where EPR is used the seal temperature at the time of MSIV closure (1114 seconds) is conservatively estimated to be 240°F. Therefore, a temperature margin of approximately 60°F exists. Also, the time required for the seals to reach the rated temperature (300°F) is more than twice the time the seals are required to remain functional.

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.

These margins are sufficiently conservative to justify the transmitter's 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.

7. (Cont'd)

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.

FIGURE 1

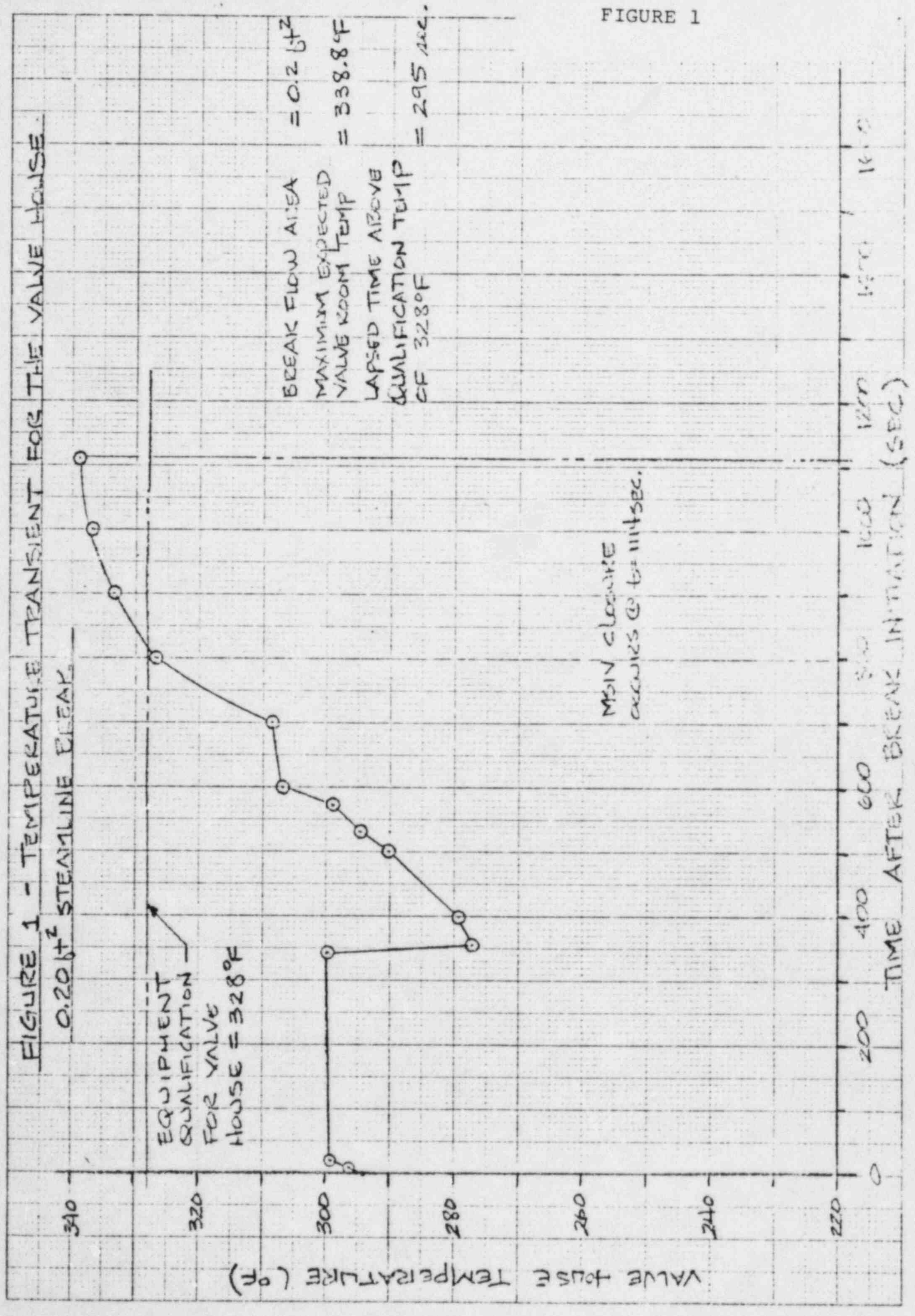

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FIGURE 1 - TEMPERATURE TRANSIENT FOR THE VALVE HOUSE
0.20 ft² STEAMLINE BREAK
EQUIPMENT QUALIFICATION FOR VALVE HOUSE = 328°F
BREAK FLOW AREA = 0.2 ft²
MAXIMUM EXPECTED VALVE ROOM TEMP = 338.8°F
LAPSED TIME ABOVE QUALIFICATION TEMP OF 328°F = 295 sec.
MSIV CLOSURE OCCURS @ t= 1114 sec.
VALVE HOUSE TEMPERATURE (°F)
340
320
300
280
260
240
220
0
200
400
600
1000
1200
TIME AFTER BREAK INITIATION (SEC)

FIGURE 2

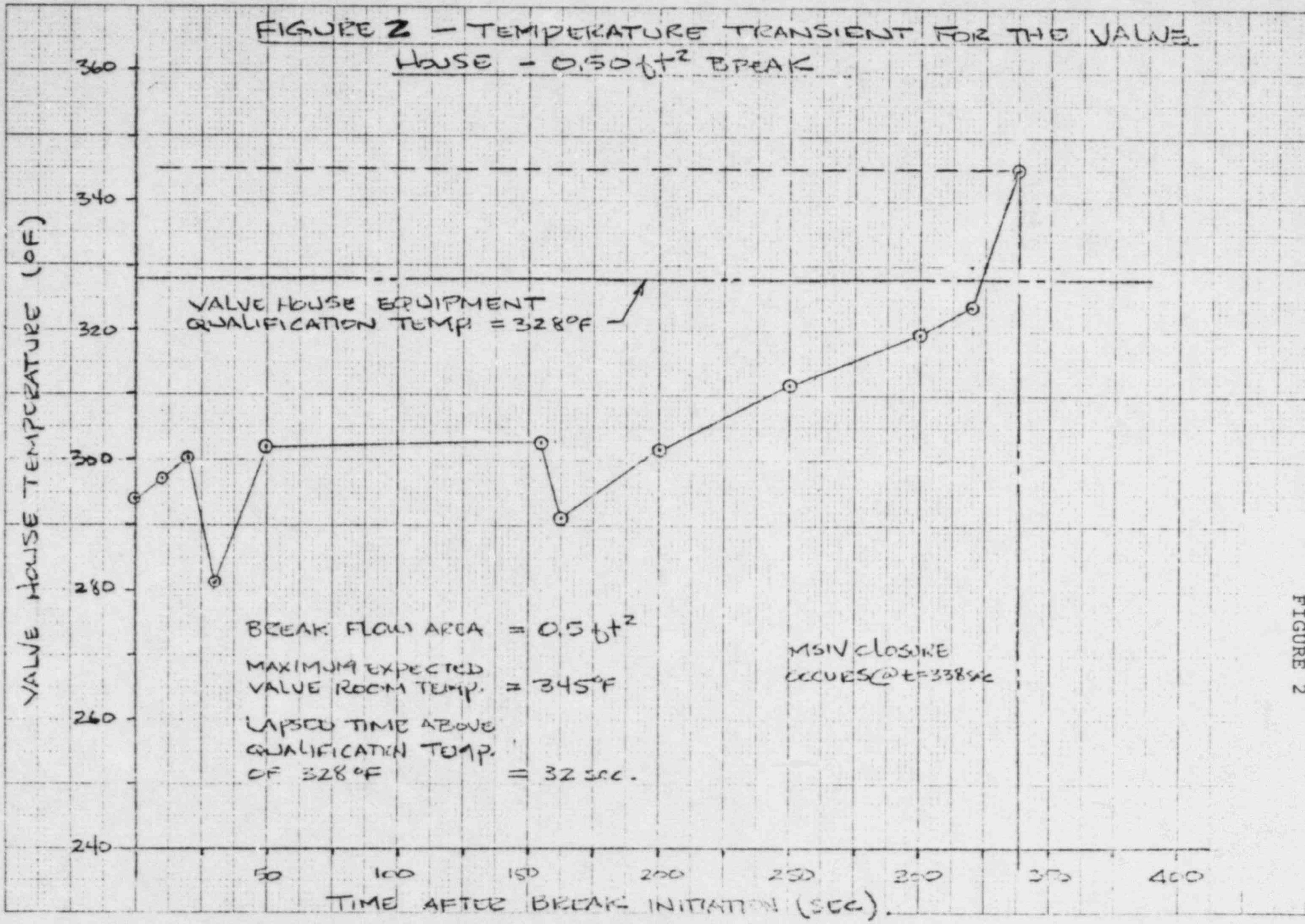
FIGURE 2 — TEMPERATURE TRANSIENT FOR THE VALVE HOUSE - 0.50 ft² BREAK
VALVE HOUSE EQUIPMENT QUALIFICATION TEMP = 328°F
BREAK FLOW AREA = 0.5 ft²
MAXIMUM EXPECTED VALVE ROOM TEMP. = 345°F
LAPSED TIME ABOVE QUALIFICATION TEMP. OF 328°F = 32 sec.
MSIV CLOSURE OCCURS @ t=338 sec
VALVE HOUSE TEMPERATURE (°F)
360
340
320
300
280
260
240
50
100
150
200
250
300
350
400
TIME AFTER BREAK INITIATION (SEC)