DUKE POWER COMPANY
P.O. BOX 33189
CHARLOTTE, N.C. 28242

HAL B. TUCKER
VICE PRESIDENT
NUCLEAR PRODUCTION

TELEPHONE
(704) 373-4531

August 8, 1984

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

Attention: Ms. E. G. Adensam, Chief
Licensing Branch No. 4

Re: McGuire Nuclear Station
Docket Nos. 50-369, -370

Dear Mr. Denton:

On July 20, 1984, a meeting was held at the request of the NRC Staff to discuss the status of the main steamline break analysis for McGuire in light of recent activities relative to the Catawba licensing. As a result of this meeting, the NRC Staff requested that Duke submit a summary of the evaluation that had been conducted by Duke on McGuire on this issue.

Accordingly, please find attached a summary evaluation of the main steam line break analysis, both inside containment and in the doghouse, for McGuire. Also please note that an analysis is in progress with Westinghouse to confirm the preliminary information used in this evaluation for an outside containment main steam line break. This additional analysis will be completed on a schedule consistent with and in support of Catawba licensing.

Very truly yours,

Hal B. Tucker

Hal B. Tucker

RLG:slb

Attachment

cc: Mr. James P. O'Reilly, Regional Administrator
U. S. Nuclear Regulatory Commission
Region II
101 Marietta Street, NW, Suite 2900
Atlanta, Georgia 30323

W. T. Orders
NRC Resident Inspector
McGuire Nuclear Station

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cc: Ralph Birkel
Division of Project Management
Office of Nuclear Reactor Regulation
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

Duke Power Company
McGuire Nuclear Station
Summary Evaluation of Main Steam Line Break Analysis

I. HISTORY

Revised information has been received from Westinghouse giving mass/energy release rates for a Main Steam Line Break (MSLB) inside containment. The original Westinghouse information indicated a saturated steam condition from the steam generators; however, revised information identifies steam generator tube uncovery and the formation of superheated steam.

Duke Power had previously assumed the same saturated steam condition for a MSLB in the doghouses located outside containment. Consequently, environmental qualification parameters for the doghouses were based on original analysis results of 330°F. Utilizing the new data from Westinghouse, revised Duke Power environmental analysis with superheated steam conditions indicates a potential increase in doghouse temperature from the present 330°F parameter to approximately 440°F doghouse temperature. The potential existed that safety related components could be subjected to temperatures higher than the qualification basis of 330°F, and could possibly preclude components from performing their intended safety functions following a postulated MSLB in either doghouse. Detailed engineering evaluations were initiated to determine operability.

Duke Power Company received notification of the MSLB problem outside containment by letter from Westinghouse Electric Corporation on June 6, 1984. Duke Power and Westinghouse are currently performing analyses in order to resolve this issue.

II. CONTAINMENT ANALYSIS

Westinghouse has performed a study to determine the impact on the containment temperature transient of producing superheated steam in the steam generator once the steam generator tube bundle uncovers. A modified version of the LOTIC-3 code was used for this analysis. The modifications were made to the wall heat transfer model and the ice condenser drain model. These changes were made to better model the steamline break transient inside containment.

This model used is currently under review by the NRC Containment Systems Branch.

A small steamline split rupture transient, typical of the limiting temperature transient for Sequoyah and McGuire, was analyzed. The results are shown in Figure 1. These results show that the peak temperature is approximately 30°F below the FSAR transients. This shows that the FSAR MSLB containment model has more than adequate conservatisms to balance the additional superheat energy released.

III. PRELIMINARY EVALUATION OF MSLB IN THE DOGHOUSE

Westinghouse is performing a steamline break analysis for a spectrum of break sizes and power levels to determine a matrix of protection system actuation times and predicted superheat initiation times. The analysis is being performed using safety analysis assumptions of initial conditions and protection system time responses to provide a conservatively early prediction of steam generator tube bundle uncovery and, therefore, the earliest superheat initiation time. This will be used to verify that required safety system actuations (in the doghouse) occur prior to the initiation of superheat generation and determine if further doghouse analyses are required to assure functional operation of safety related equipment in the doghouse.

Anticipated results of the Westinghouse analysis are as described in the following paragraphs:

Large Break

Typical response to relatively large breaks, such as the .86 ft^2 break analyzed by Westinghouse for the Catawba Containment analysis, will be as follows:

- Reactor trip will occur on overpower ΔT.
- Main feedwater isolation valve (MFIV) closure will occur due to reactor trip and low Tavg.
- Safety injection will be initiated upon receipt of a low pressurizer pressure signal.
- The motor driven auxiliary feedwater pumps (MDAFP's) will start upon receipt of the safety injection signal.
- If a MDAFP fails to start, the turbine driven auxiliary feedwater pump (TDAFP) will start upon occurrence of a low-low level in an intact steam generator very shortly into the accident.
- Low steam pressure in the faulted steam generator causes main steam isolation valve (MSIV) closure.

All the above functions will occur before the temperature in the Doghouse exceeds qualification temperatures. Isolation of auxiliary feedwater to the faulted steam generator may be accomplished by the operator by closing the motor operated valves located in the doghouse, or by closing the control valves or manual isolation valves located in the auxiliary feedwater pump room.

Intermediate Break

Response to an intermediate break of, for example, 0.5 ft^2, will be similar to the response to the large break previously described. There is the possibility that MSIV closure will not occur until shortly after tube uncovery. However, the present evaluation is that the temperature effects on the equipment from the expected profile for the time period during which the equipment is required to function are no more severe than those of the original equipment qualification. Therefore, no consequential impairment of the MSIV will occur.

Faulted steam generator isolation will be accomplished as described for the large break.

Small Break

Small Break response will be as follows:

- Reactor trip will occur on low-low steam generator level. Note that all steam generators will approach low-low level at approximately the same time.

- MDAFP's will start upon receipt of first low-low level signal. TDAFP will start upon receipt of the second low-low level signal.

- MFIV closure will occur due to reactor trip and low Tavg.

- Safety injection and main steam isolation will occur due to low steam pressure. This may happen after tube uncovery. However, the present evaluation is that, due to the short duration of the transient, the temperature effects on the equipment from the expected profile are no more severe than those used for the original equipment qualification.

Faulted steam generator isolation is accomplished as described for the large break.

Duke has analyzed the potential consequences if the temperature in the doghouses exceeded the qualification temperature after the equipment has performed its intended safety function described above. The only potential failures that could compromise any safety functions (repositioning of valves) are valve operator heater circuits. These have been disconnected.

The only post-accident monitoring instrument located in the doghouse are the auxiliary feedwater flow transmitters. Although these may fail under this environment, steam generator level transmitters which will not be affected by a steamline break in the doghouse will be used to monitor auxiliary feedwater.

IV. LOW PROBABILITY OF A PIPE BREAK EVENT

The phenomona of high energy pipe break is known to be a low probability event. Branch Technical Position MEB 3-1 states that "It is recognized that pipe rupture is a rare event which may only occur under unanticipated conditions." Studies cited in attachments to the recent Generic Letter 84-04 from the NRC also support the preceding statement.

V. PRELIMINARY FRACTURE MECHANICS EVALUATION

Currently, the environmental analysis for the MSLB in the McGuire doghouses is performed by postulating non-mechanistic breaks in which catastrophic pipe failure is assumed. More realistic estimates of crack opening area and the resulting thermal and mechanical loads can be obtained through application of fracture mechanics techniques. A scoping study has been carried out by Westinghouse for in-containment MSLB's and preliminary results obtained indicate that a non-mechanistic pipe break will not occur in the main steam line.

The purpose of this scoping study was to show that a circumferential flaw larger than any that would be present in the McGuire main steam lines will remain stable when subjected to the worst combination of plant loadings. The flaw stability criteria for the analysis examined both the global and local stability. The global analysis was carried out using the plastic instability method, based on traditional plastic limit load concepts but accounting for strain hardening and taking into account the presence of a flaw. The local stability analysis was carried out for a postulated 10 inch long through-wall circumferential flaw. The objective of the local analysis was to show that unstable crack extension will not result for the postulated flaw. The crack opening area resulting from faulted load was calculated for the 10 inch flaw using simplified analysis techniques.

The following results were obtained from the above evaluation:

a. Limit moment calculations indicated that the critical flaw size (beyond which the flaw is unstable) would be greater than the pipe diameter.

b. A postulated 10 inch long through-wall circumferential flaw will remain stable when subjected to maximum faulted load of less than 20 ksi.

c. The crack opening area is estimated to be about 0.2 in^2. If a safety factor of 10 is used, the area would be about 2 square inches.

d. Available fatigue crack growth results for the main steam line of typical PWR plants indicate no significant crack growth due to the design transients.

From these results it is judged that it could be demonstrated by fracture mechanics analysis that catastrophic pipe breaks in the McGuire 1 and 2 main steam line would not occur.

VI. SUMMARY

This evaluation has shown that for a MSLB inside containment, the present FSAR containment model has more than adequate conservatisms to balance the additional superheat energy released.

Further, this evaluation has shown that for a MSLB outside containment all essential safety functions are expected to be completed before adverse temperature effects due to increased doghouse temperatures would occur. Spurious actuation of components following initial positioning has also been evaluated. Thus, Duke Power has concluded that plant safety would not be adversely affected in the event of a design basis main steam line break in the doghouse or inside containment.