SRI 86014
Attachment #1

SAFETY EVALUATON FOR THE MONTICELLO NUCLEAR GENERATING PLANT

IMPACT OF POSTULATED FEEDWATER LINE BREAK IN THE TURBINE BUILDING

Prepared for

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Thermal Hydraulics Evaluation

Thermal-hydraulics analyses were performed to determine the Monticello Nuclear Generating Plant Turbine Building environmental conditions resulting from a feedwater line break in the compartment adjoining the Plant Attendants Area. The analyses were performed based on the stable crack size and flowrate developed in Section 2.2 below, and on a double-ended guillotine break as required for equipment qualification purposes. The stable crack size analysis results will form the basis for the interim justification for continued operation, whereas the double-ended guillotine break will be the basis for a permanent fix which will be implemented later to ensure that the ability to safely shutdown the plant is not degraded.

A RELAP4/MOD5 computer model of the affected regions of the Turbine Building was developed using flow paths between compartments and floor. These flow paths were developed based on physical restrictions, equipment locations, appropriate assumptions and approximations. Heat conducting structures were modeled in the break compartment and in certain other compartments to remove unnecessary conservatism in the long term temperature results. The concrete walls, floors and ceilings were modeled as heat sinks to represent the heat absorption capacity of the Turbine Building. The overall modeling effort was to develop pressure and temperature response time histories consistent with a reasonable analysis approach.

Leak-Before-Break Evaluation

A leak-before-break evaluation was performed to estimate the leak rate from a circumferential crack that could potentially develop in the portions of the feedwater suction and discharge lines that are adjacent to the Plant Attendants Area. The approach demonstrates that the lines would develop stable, detectable cracks rather than suddenly breaking in a guillotine fashion. The leak-before-break evaluation provides a realistic determination of fluid leakage into the area which can be used to determine temperature and pressure conditions.

The evaluation consisted of three steps. First, linear elastic fracture analysis was performed to determine the opening area of a postulated through-wall circumferential crack. A 3-inch long through-wall crack was used for the analysis. For conservatism, only the normal operating pressure was assumed to open up the postulated crack. Second, two-phase fluid flow computations defined the leakage of high-energy fluid from the pipe into the room. The leak rate under normal operating conditions was shown to be detectable by walk-throughs of the area conducted every four hours. Third, the stability of the 3-inch long crack under seismic conditions (SSE) was evaluated.

Evaluation Results

Thermal-Hydraulics

The thermal-hydraulic analyses performed used computer modeling techniques to determine environmental conditions (pressure and temperature time-histories for the affected Turbine Building areas in which safety-related equipment are located. A postulated high energy line break in the feedwater line in the compartment adjoining the Plant Attendants Area was the only source of concern.

The results of the two analysis cases are discussed below.

Stable Crack Leakage: Based on the feedwater system piping normal operating pressure and temperature conditions within the compartment adjoining the Plant Attendants Area, a stable crack leak rate less than 10gpm from the discharge size of the piping was determined, as discussed in Section 3.2. For conservatism a leak rate slightly higher than 10 gpm was used in the calculations. The resulting environment analysis indicates that the existing flow paths between the break location and elevation 911 and the condenser area is sufficient to prevent any pressurization of the break compartment. The results further indicate that the temperature in the Plant Attendants Area would not exceed 150°F for a duration of eight (8) hours following the initiation of the leak. No safety-related equipment areas were adversely impacted by this break.

Double-Ended Break: Based on a double-ended guillotine break in the feedwater system in the compartment adjoining the Plant Attendant's Area, a total of 80,000 gallons of fluid would be discharged into the compartment prior to tripping of the condensate pumps. The resulting environmental analysis indicates that the existing flow paths would not be adequate to prevent pressurization of the break compartment. This pressurization would be sufficient to cause adverse impact on the safety-related MCC's located immediately outside the Plant Attendent's Area.

Additional analysis was performed which demonstrated that a permanent fix could be implemented that would eliminate any impact on the safety-related equipment in the Turbine Building resulting from a break in the compartment adjoining the Plant Attendants Area.

Fracture Mechanics Review

The leakage from a postulated through-wall circumferential crack 3 inches long was determined to be 0.28 gpm for the suction lines and 0.44 gpm for the discharge lines under normal conditions. This is substantially below the 10 gpm shown to be acceptable by the thermal-hydraulics evaluation.

To ensure detection of this leakage, a walk-through of the area will be performed every 4 hours.

The piping lines are not seismically designed and had not previously been analyzed under seismic loading. Simplified response spectrum analyses of the piping were performed as part of this evaluation. The stability of the postulated 3-inch throughwall circumferential was evaluated under SSE loading. The calculated value of the stress concentration factor under SSE loading is 38.2 ksi$\sqrt{in}$ for the 14" diameter discharge piping and 62.1 ksi$\sqrt{in}$ for the 16" diameter suction piping. Published data (EPRI Report NP-2715) shows, that for similar piping material and at the normal operating temperature, the fracture toughness of the piping material is 178.4 ksi$\sqrt{in}$. Thus, there is a substantial margin against unstable crack extension, even under SSE conditions.

CONCLUSIONS

In the event of a double-ended break of feedwater piping in the Turbine Building near the Plant Attendants room, the room will pressurize causing potential adverse impact on the Division II MCC's located immediately outside the room. However, the evaluation results shown above conclude the more likely scenario to be initiation of a small, stable crack that has negligible impact on the ability of the block wall to maintain it's integrity. This will have no adverse impact on the environmental equipment qualification program at Monticello.

While we recognize that fracture mechanics has not been previously accepted a permanent solution to environmental qualification concerns, we do believe it adequately justifies continued operation of the plant until a permanent resolution has been implemented. There is precedence for acceptance of fracture mechanics evaluations as interim justifications for continued operation.

On the basis of the evaluation performed and discussed above, it can be concluded that the ability of the plant operators to safely shutdown the plant will not be diminished. In addition, the safety of the general public will not be compromised until a permanent resolution of the potential block wall damage due to compartment pressurization is implemented.

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Op. Com. Rev. Req'd. Yes* x No ___

SRI # 86014
Attachment #2

☐ Order*
☐ Description
☒ Procedure*

VOLUME F TEMPORARY MEMO

REFERENCE(S): C.4 Abnormal Procedures

SUBJECT: Piping Leakage Detected in Room Behind the Plant Attendent's Office

The following procedure is to be added to Section III.H.4 of Operations Manual C.4, page 82.

d. Piping Leakage Detected in Room Behind Plant Attendents Office

The following actions are to be taken if leakage is detected in the Condensate and Feedwater lines located in the room behind the Plant Attendent's office. The lines involved are the RFP suction and discharge piping with in that space.

Upon notification that a leak exists:

1.) Reduce recirc flow to minimum.

2.) Expeditiously shutdown the plant in accordance with Operations Manual C.3.

3.) IF during the process of the shutdown, alarm 6-C-08, EARTHQUAKE is received
AND
evidence is seen or felt that an earthquake has in fact occurred,
THEN trip the condensate pumps, scram the reactor, and control reactor water level with RCIC or HPCI.

REVIEW AND APPROVAL*:

Prepared by: Richard Goranson Title: Sr. Prod. Engr

Authorized by: _____ Title: Asst. Plt. Supt.

Approved by: Richard Goranson Title: Sr. Prod Engr.
Licensed SRO

Approved by: _____ Date: 4/4/86
Plt. Supt., O&M or Plt. Supt. E&RP

Operations Committee Final Review: _____ Mtg.# _____ Date: _____

* For Safety Related Orders and Procedures: 1) At least two of the signatures shall be by Licensed Senior Operators, and 2) Operations Committee Review shall be conducted within 30 days.