Attachment to
Howe-269-79

SUBJECT: MCAR 30 (issued 7/11/79)

Service Water Supply Pressure for the Containment Recirculating Air Cooling Units

FINAL REPORT

DATE: September 26, 1979

PROJECT: Consumers Power Company
Midland Plant Units 1 and 2
Bechtel Job 7220

Introduction

This report is submitted to advise of the status of the project's action relating to the service water supply pressure for the containment recirculating air cooling units (CRACUs).

Description of Deficiency

During final system flow diagram review, project engineering discovered that the service water supply pressure to the CRACUs following a loss-of-coolant accident (LOCA) or main steam line break (MSLB) is less than the 40 psig (54.7 psia) stated in FSAR Subsection 6.2.2.2.3. The final calculations indicate that the service water pressure at the CRACU outlet could be as low as 13 to 14 psia under emergency operation, with the ultimate heat sink at its design elevation of 604 feet (see FSAR Subsection 9.2.5). The post-accident environment inside the containment reaches approximately 300F and causes service water inside the air coolers to boil, resulting in reduced performance of the CRACUs. Consequently, the CRACUs could not remove heat from the containment at the rate described in FSAR Subsections 6.2.2.2 and 9.2.1.3 following an MSLB or LOCA.

Summary of Investigation of the Causes of the Deficiency

While conducting the investigation, two principal circumstances contributing to the deficiency were identified.

A. A review of the preliminary calculations identified several errors and nonconservative assumptions, each of which contributed to the deficiency.

   1. It was assumed that the cooling pond was at the normal full-operating elevation of 627 feet rather than at the 604-foot initial design elevation of the ultimate heat sink. This assumption resulted in an overestimation of available service water pressure of 23 feet (10 psi).

2. It was assumed that service water would only be provided to the minimum equipment required for emergency core cooling system (ECCS) operation on the affected unit, totalling approximately 11,000 gpm. In fact, service water would also be provided to the diesel generator and the component cooling water heat exchanger of the unaffected unit, resulting in a total flow of approximately 18,400 gpm. This assumption underestimated the fluid friction loss to the auxiliary building loads and the CRACUs. It also resulted in an overestimation of the pump total developed head (tdh) by assuming that the pump would back up on its curve and deliver only 11,000 gpm rather than 18,400 gpm.

3. In determining the CRACUs' outlet temperature, the design fouling factor was used. This resulted in a CRACU outlet temperature of 241F, with corresponding saturation pressure of 25.4 psia. In FSAR Subsection 6.2.2.2.3, an analysis was done conservatively assuming no fouling factor. This results in a CRACU outlet temperature of 276F and a corresponding saturation pressure of 46.15 psia. This led to the determination that 40 psig was the minimum required pressure at the CRACU outlet. The preliminary analysis, based on design fouling factor, had determined that 25 psig at the CRACU outlet would provide an adequate margin to ensure that boiling would not occur.

B. It was determined that engineering department procedure (EDP) 4.37 Design Calculations had not been fully complied with. The calculation was performed and checked in accordance with the procedure. Contrary to the EDP requirements, the calculation was not reviewed and approved. The calculation was left in a preliminary status and the results of these calculations were used for implementation of the system design and procurement of the service water pumps.

Potential Safety Implications and Evaluation

If the deficiency had not been corrected, there would have been no effect on the normal safe operation of the plant. With the service water system as designed, the CRACUs are capable of removing heat from the containment for all power generation modes. However, under post-LOCA or MSLB conditions, the CRACUs would not have been able to fully meet their safety design bases to remove heat from the containment following a LOCA or MSLB.

Analysis of the effects on heat removal capability for representative LOCAs and a MSLB was done, conservatively assuming complete loss of CRACUs. Analysis of the following four cases assuming that one spray train and no CRACUs were operational was compared with analysis assuming that one spray train and one CRACU train were operational.

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A. 4.27 ft^2 pump discharge break with minimum ECCS
B. 4.27 ft^2 pump suction break with minimum ECCS
C. 14.1 ft^2 hot leg break with maximum ECCS
D. 12.22 ft^2 main steam line break at 102% power

The effect of CRACUs on peak pressure and peak containment are summarized below:

Case	$\Delta P^{(1)}$ (psi)	$\Delta T^{(2)}$ (f)
A	+ 0.455	+ 0.45
B	+ 0.217	+ 0.45
C	0.0	0.0
D	0.0	0.0

(1) Peak containment pressure without CRACUs minus peak pressure with CRACUs.
(2) Peak containment temperature without CRACUs minus peak temperature with CRACU.

The effects of CRACUs on peak containment pressures and peak temperatures following a LOCA or MSLB with no CRACUs operating and only one train of containment sprays operating are small and do not jeopardize containment integrity.

Various small steam line breaks and feedwater line breaks are also analyzed in FSAR Section 6.2. For some of these breaks (with one train of air coolers operational) peak pressures do not reach the containment spray setpoint of 30 psig. Although reanalysis of these breaks with no CRACUs operational has not been done, it is expected that containment pressures would rise to the 30 psig spray actuation setpoint, thereby actuating containment sprays and decreasing containment pressure.

While the effects of CRACUs on peak pressure and temperature are small, the CRACUs' role in the longer-term rate of reduction of containment pressure and temperature is significant. Following a MSLB or LOCA, the containment pressure and temperatures decrease more slowly when one spray train is used rather than one spray and one air cooler train. The temperature and pressure environmental qualification envelopes of various components inside the containment may be exceeded for LOCAs and large MSLBs. Therefore, the longer-term availability of various safety-related equipment and post-accident monitoring components cannot be ensured. It is concluded that this item is reportable in accordance with 10 CFR 50.55(e).

Corrective Action

Corrective action has been taken to ensure that boiling does not occur in the CRACUs and that the design conforms to the safety analysis report. Specifically, a pump is being provided in each service water supply line

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to the CRACUs to boost the service water pressure to a minimum of 40 psig at the outlet of the air coolers. A suitable flow control device is being provided to throttle the excess pressure before returning the service water to the main return header. Normally, the pump will not be running, but it will start automatically on a reactor building cooling actuation signal.

Design for this corrective action is essentially complete. IDCN 69, issued August 30, 1979, shows the the changes to be implemented on P&ID 7220-M-419(Q). Control and electrical design modifications to implement this corrective action are underway. Procurement and construction will be completed in a manner compatible with orderly project completion. The FSAR will be revised to include a description of the booster pump arrangement and operation by the November 1979 amendment. All modifications to place the system in compliance with the FSAR will be completed before fuel load for its respective unit.

Corrective action relating to calculation procedures deficiency has been taken. Those persons involved in the final calculations have been made aware of the errors in the preliminary calculations and instructed to ensure that these errors do not recur.

On a broader level, as a result of a USNRC Region IV QA program inspection/ audit conducted on May 22 and 25, 1979, all calculations were reviewed to determine conformance with MED 4.37 and EDP 4.37. MED 4.37 was revised (Revision 10) to clarify that calculations are to be checked and approved prior to the use of their results in finalizing a design basis.

Proper production and use of calculations will continue to be emphasized during project meetings and in surveys performed under the responsibility of the project quality engineer. We will stress that the user of any calculation must ensure, prior to finalizing a design basis, that the calculation has been checked and approved, and that it is current and pertinent to the use for which it was intended.

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