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SUBJECT: Forwards final response to 820708 concerns re adequacy of design margins of Mark II containment sys.Issues raised by GE do not represent significant safety concerns for facility.

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September 24, 1982
G02-82-804

Docket No. 50-397

Mr. A. Schwencer, Chief
Licensing Branch No. 2
Division of Licensing
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Dear Mr. Schwencer:

Subject: NUCLEAR PROJECT NO. 2
CONCERNS REGARDING THE ADEQUACY OF THE
DESIGN MARGINS OF MARK II CONTAINMENT SYSTEMS

Reference:
a) Letter, R.L. Tedesco (NRC) to R.L. Ferguson (SS), Same Subject, dated July 8, 1982

b) Letter, G.D. Bouchey (SS) to A. Schwencer (NRC), Same Subject, dated July 23, 1982

Reference (b) provided a preliminary response to reference (a). Attached to this letter is our final report on these issues. Our conclusion from the reviews performed since submittal of reference (b), as reflected in the attachment, is that the issues raised by Mr. Humphrey, formerly of General Electric, do not represent significant safety concerns for the WNP-2 plant.

Very truly yours,

SC Sorensen
for
G. D. Bouchey
Manager, Nuclear Safety and Licensing

B001

EAF/jca
Attachment

cc: R Auluck - NRC
WS Chin - BPA
R Feil - NRC Site

3. ECCS Relief Valve Discharge Lines Below the Suppression Pool Level

3.1 RHR steam condensing mode is used only during a controlled isolation, not during or following a postulated accident. Two RHR relief valves are provided with each RHR heat exchanger to comply with the ASME Code requirement for overpressure protection. The pressure control valve for the RHR heat exchanger in steam condensing mode is a fail-closed valve. In the extremely unlikely event that the pressure control valve failed open, allowing a high pressure to occur in one of the heat exchangers, the relief valves would be actuated. The maximum RHR relief valve discharge flow that occurs is comparable to that which occurs in each of the 102 downcomers during an intermediate break LOCA. Any condensation oscillation or chugging loads that may be produced by the RHR discharge flow will be bounded by that produced during an intermediate break LOCA for which the containment has been reviewed. In addition, Class 1E flow instrumentation in the RCIC steam supply line to the RHR heat exchanger will detect the open relief line and flow to the suppression pool will automatically be terminated before the pool heats up to the point where unstable steam condensation or pool temperature stratification becomes a concern. An effort has been initiated in the Mark II Owners group to quantify the magnitude of these postulated loads, based on previous test data. This effort is currently ongoing and is expected to verify that the RHR relief valve loads are bounded by downcomer vent and main steam relief valve loads. RHR relief valve failure and discharge of high energy fluid to the suppression pool during the shutdown cooling mode of RHR operation is not considered credible because such an event would also require a simultaneous check valve failure between the RHR heat exchanger and the relief line.

3.2 Not applicable for WNP-2. The suppression pool level in a Mark II containment cannot be drawn down as in a Mark III containment due to drywell holdup.

3.3 See 3.1. It is expected that MSRV discharge loads on submerged structures would bound RHR relief valve discharge loads. The RHR relief valve discharge lines terminate in the suppression pool with rams head discharge device which directs the discharges parallel

to the containment wall and away from any vital submerged structures, such as downcomers, MSRV discharge lines, or ECCS pump suction lines.

3.4 See 3.1. Because Class 1E high flow instrumentation would terminate flow through the relief valve, the potential for subsequent actuation of RHR relief valves is extremely unlikely and the consequences (back pressure on RHR heat exchangers, damage to relief valve, increased loads on submerged structures, potential damage to relief valve discharge line) need not be considered.

3.6 See 3.1.

3.7 Most of the other relief lines which discharge to the pool are installed to accommodate thermal expansion or leakage across closed valves and are much smaller in capacity than the RHR steam condensing relief valves. Therefore, for this general concern, the RHR relief valves are controlling. Detailed information concerning setpoint, capacity, and function for all the ECCS relief valves which discharge to the suppression pool is provided in the responses to FSAR Questions 211.40 and 211.76.

4. <u>Suppression Pool Temperature Stratification</u>

4.1 Not applicable for Mark II containments. No significant drywell pool can be formed in a Mark II containment.

4.2 Not applicable. See 4.1.

4.3 See 4.4. In addition, any hot water and/or steam released into the drywell will enter the suppression pool approximately 12 feet below the surface via the downcomers and it will be directed downward. The RHR pump suctions are located approximately 7 feet below the exit of the downcomers.

4.4 Mark II containment analyses conservatively account for pool stratification and effect on wetwell airspace temperature and pressure by (a) overestimating total energy input to the suppression pool, (b) ignoring structural heat sinks, and (c) assuming lower heat exchanger capability than actually exists. At peak pool temperature, the long term peak suppression chamber pressure is 18.3 psi, which is substantially less than the design pressure for containment (45 psig). A 7°-8°F increase in pool temperature due to pool stratification will not increase the wetwell pressure significantly beyond 18.3 psi.

4.5 Of the four causes of pool thermal stratification identified for Mark III containments, only one, containment spray operation, is applicable to a Mark II containment. Since containment spray in WNP-2 is a manual operation (rather than automatic as in a Mark III) and can be terminated easily following drywell depressurization, and also because of the conservatisms identified in 4.4, the effect of containment spray in causing pool stratification is not a significant concern for WNP-2. In addition, containment spray heated in the drywell is added to the suppression at a depth of 12 feet, via flow through the downcomers (not near the pool surface as in a Mark III containment).

4.6 The maximum service water temperature as allowed by the WNP-2 Technical Specifications, is 77°F, which provides sustantial margin below the maximum suppression pool temperature of 90°F. Therefore, we do not expect to continuously operate the RHR system to maintain the suppression pool temperature at or below the maximum permissible value.

4.7 The RHR suction and discharge locations in WNP-2 are separated approximately 96° in azimuth, and 13 feet in elevation. The RHR return lines terminate in rams head discharge devices directed circumferentially around the wetwell boundary. Thus, the RHR suction and discharge lines are considered to be sufficiently separated, and flow patterns are such that pool mixing is adequate.

4.8 Not applicable for WNP-2. Operation in containment spray mode will not decrease the heat transfer rate through the RHR heat exchangers. In WNP-2, the RHR system is designed so that flow rates through the RHR heat exchanger are the same in suppression pool cooling mode and containment spray mode.

4.9 Not applicable. Containment spray is not required to maintain containment pressure below the containment design pressure with the exception of drywell to wetwell steam bypass leakage (See 5.2). Unlike Mark III plants, the spray at WNP-2 is not automatic, so operability of the spray system due to cycling caused by high containment pressure is not an issue. As discussed in 4.8, use of containment spray mode does not affect the heat transfer rate of the RHR heat exchanger.

4.10 See 4.7

5. Drywell to Containment Bypass Leakage

5.1 For WNP-2, a break of less than 0.4 square feet has been determined to be the governing suppression pool bypass leakage case. Refer to Section 6.2.1.1.5 of the FSAR.

5.2 Refer to FSAR question 031.070 and FSAR section 6.2.1.1.5. The Technical Specification limit for $A/\sqrt{K}$ is 10% of the value assumed in the analysis. When wetwell pressure reaches 30 psig following an accident resulting in bypass leakage, containment spray will be manually actuated to prevent containment overpressurization. The operator has 41 minutes from the time wetwell pressure reaches 30 psig, to manually actuate containment spray, before containment pressure reaches 45 psig.

Bypass leakage has been omitted from post-LOCA containment pressurization analyses even though it is allowed per the plant Technical Specifications because its effect on peak containment pressure is negligible. Peak containment pressure is reached in less than a minute, whereas the effect of steam bypass at the Technical Specification limit does not become a factor until hours into the transient.

5.3 Not applicable for WNP-2. See 4.8.

5.4 Not applicable for WNP-2. WNP-2 has an inerted containment, and no drywell purge compressors. The Containment Atmosphere Control (CAC) system in WNP-2 can take suction from the wetwell airspace. In normal operation of the CAC system, hydrogen which accumulated to the wetwell airspace would return to the drywell through the drywell-to-wetwell vacuum breakers.

5.5 The only safety-related equipment located in the wetwell airspace which could be subjected to high local temperature conditions resulting from steam bypass leakage are the wetwell to drywell vacuum breakers, which are specified for 275°F ambient operating temperature. The internals were tested to 340°F and the stress report used 400°F as the design temperature. The maximum temperature of steam which could bypass into the wetwell is less than 300°F (Reference FSAR Figure 6.2-17b). The maximum ambient temperature in the wetwell is about 200°F for bypass leakage condition.

5.8 As explained by Mr. Humphrey on pages 168-171 of the 5/27/82 transcripts, there are two scenarios in which high temperatures in the drywell could be reached without reaching 2 psig in the drywell because of bypass leakage: 1) loss of drywell coolers, in which loss of

air mass due to bypass leakage equals the expansion of the air mass due to temperature buildup, and 2) a small break accident, in which bypass leakage equals the leakage from the small break. For WNP-2, the wetwell airspace is smaller than the drywell volume, so any loss of air mass from the drywell to the wetwell due to bypass leakage will pressurize the wetwell. The drywell pressure will always remain at or above the wetwell. Pressurization of the wetwell, will in turn, via the vacuum breakers, pressurize the drywell until 2 psig is reached. The drywell pressure will reach 2 psig before the drywell temperature reaches 340°F.

6. RHR Permissive on Containment Spray

6.1 At WNP-2, drywell mixers come on automatically following the DBA. With an inerted containment, the operator has more than six hours to start hydrogen recombiners before a combustible concentration is expected to occur.

6.2 Not applicable for WNP-2. Mark II containments do not have interlocks to require containment sprays prior to starting the recombiners.

6.3 Not applicable for WNP-2. WNP-2 uses catalytic recombiners with after-coolers to cool hot recombiner effluent gas to below 150°F before being returned to the containment. Safety-related components inside the drywell are designed for a maximum temperature of 340°F and components in the wetwell are designed for a maximum of 275°F

6.4 Not applicable for WNP-2. The air monitoring system used in WNP-2 are supplied by Beckman, and WNP-2 uses heat tracing to prevent condensation of steam in the equipment.

6.5 Not applicable for WNP-2. See 6.3.

7. Containment Pressure Response

7.1 See 4.4.

7.2 See 4.4.

7.3 See 4.4. Adiabatic compression effects are considered in the pool swell analysis for WNP-2, which is used to calculate conservative wetwell airspace compression for diaphragm floor uplift pressure. For long term suppression chamber pressure response, assuming equilibrium conditions between the suppression pool and

the wetwell airspace is justified since the peak long term wetwell airspace pressure (18.3 psi) is substantially less than design capacity (45 psig).

8. Containment Air Mass Effects

8.1 While it is true that the Technical Specifications allow operation at conditions that differ from the values assumed in the FSAR analyses, sufficient conservatisms exist to take into account the minor differences. The following is a listing of the assumptions used for the WNP-2 containment pressurization analysis and the Technical Specifications submitted for WNP-2:

I. Peak Positive Pressure Analysis (Ref. FSAR Table 6.2-4)

Parameter	Analysis Assumption	Tech. Spec. Limit
Containment Pressure	0.7 psig	+2.0/-2.0 psig
Wetwell Temperature	90°F	135°F
Drywell Temperature	135°F	135°F

II. Peak Negative Pressure Analysis (Ref. FSAR Table 6.2-19)

	Parameter	Analysis Assumptions: Drywell	Analysis Assumptions: Suppression Chamber	Tech. Spec. Limit
Case A:	Pressure	.75 psig	.75 psig	See Above
	Temperature	135°F	50°F	
Case B:	Pressure	0 psig	0 psig	
	Temperature	150°F	50°F	

The maximum calculated containment pressure is 34.7 psig, well below the 45.0 psig containment design pressure, which provides for adequate margin if the initial pressure is greater than 0.7 psig or if the initial temperature is less than 135°F.

The containment negative pressure analysis for WNP-2 is currently being reevaluated and addresses sensitivity to assumed initial conditions. This analysis will be documented in the FSAR when it is finalized.

8.2 The reactor building to wetwell vacuum breakers in WNP-2 limit initial negative differential pressure between reactor building and containment to 0.5 psi. The

effect of worst case initial conditions is considered in the negative pressure calculation described in 8.1. However, containment sprays cannot be initiated without a concurrent high drywell signal (2.0 psig nominal) via a pressure interlock in the opening circuit of the containment spray valves so that containment depressurization due to sprays cannot occur unless the drywell is at 2.0 psig (nominal).

8.3 Not applicable for WNP-2.

8.4 The causes and consequences of low initial air mass inside containment are addressed in the sensitivity analysis mentioned in 8.1. This will be documented in a future revision to the FSAR.

9. Final Drywell Air Mass

9.1 With cold water being injected into the RPV with full ECCS flow, condensation occurs which draws air back into the drywell from the wetwell airspace. If saturated steam is coming from the vessel due to reduced ECCS flow, the long term containment pressure would be higher than what has been analyzed (18.3 psig), but would be substantially less than design pressure (45.0 psig).

9.2 Use of containment spray is adequate to control any pressure increase associated with direct leakages from the drywell to wetwell (refer to FSAR Question 031.070 and FSAR Section 6.2.1.1.5). The concern raised by Mr. Humphrey (pages 207-209 of the 5/27/82 transcripts) is that with automatic drywell sprays it is difficult to get out of the spray mode and into pool cooling. In WNP-2, the drywell sprays are manually operated, so this is not a concern.

9.3 The containment pressurization analyses for design basis accidents (LOCA, main steam line break, intermediate break accidents, and small break accidents) are performed using initial conditions set at licensing values, rather than nominal values (refer to FSAR Section 6.2). In addition, suppression pool temperature transient response was evaluated for SBA's and stuck open relief valves, in conformance to NUREG-0783 and NUREG-0487, and showed acceptable results. The suppression pool temperature analyses were transmitted to the NRC on December 15, 1981 (Letter GO2-81-524, GD Bouchey, Supply System, to A. Schwencer, NRC).

11. Operational Control of Drywell to Containment Differential Pressures

This concern is translated into water level difference between suppression pool and water inside the downcomers, for a Mark II plant. The minor differentials in water level which could occur (limited by vacuum breaker pressure set points) was accommodated in the 4T and 4TCO tests, upon which the hydrodynamic load definitions for WNP-2 are based.

14. RHR Backflow Through Containment Spray

Not applicable for WNP-2. WNP-2 does not have automatic sprays and the valves are interlocked to prevent LPCI and containment spray valves from being open simultaneously.

15. Secondary Containment Vacuum Breaker Plenum Response

A vacuum breaker sensitivity has been performed, evaluating various conditions under which the wetwell-secondary containment vacuum breakers have to operate. The preliminary results show that in no case did the secondary containment pressure drop below 14.38 psia. The secondary containment walls have been designed for a pressure differential of -2 psi vacuum, therefore, this design condition is satisfactory.

16. Effect of Suppression Pool Level on Temperature Measurement

Not applicable for WNP-2. There is no suppression pool drawdown for a Mark II containment. Also, WNP-2 has pool temperature sensors at two elevations and the operator has sufficient water level information to make a correct judgement.

17. Emergency Procedure Guidelines

Not applicable for WNP-2. Mark II containments have no upper pool dump. There is no transient or plant operating condition for a Mark II containment that would result in a rapid increase in suppression pool water level, (which could conceivably increase hydrodynamic SRV discharge loads, or increase backpressure in the SRV discharge lines.) Conservatisms in the SRV load definition for WNP-2, and in design of the SRV discharge line piping and supports would account for any credible suppression pool water level fluctuation. No modification to EPG's are considered necessary.

18. Effect of Insulation Debris

18.1 The effect of pipe insulation debris in blocking entrance to downcomers has been considered, and is not credible. See FSAR section 6.2.1.1.2 d.

18.2 Stainless steel insulation is used exclusively inside containment. It is possible for some pieces of insulation from smaller piping (less than 4-inch) to work their way down through the grating and into a downcomer vent and into the suppression pool. However, suction strainers for WNP-2 are designed to permit 50% blockage, so ECCS performance would not be adversely affected.

21. Containment Makeup Air for Backup Purge

Not applicable for WNP-2 because containment is not purged for containment atmosphere control following a LOCA.

22. Miscellaneous Emergency Procedure Guideline Concerns

EPG's are reviewed to assure they are compatible with plant safety.