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SEP 30 1982

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

Subject: US NRC Concerns Regarding Adequacy of Design Margins of Mark II Containment Systems

References: 1-Letter, J. S. Kemper, PECo. to R. L. Tedesco, NRC to E. G. Bauer, PECo. dated July 8, 1982

2-Letter, R. L. Tedesco, NRC to E. G. Bauer, PECo. dated July 8, 1982

Docket Numbers 50-352
50-353

Dear Mr. Schwencer:

Your letter of July 8, 1982, (reference 2) referred to a number of concerns that had been raised by Mr. John Humphrey regarding the adequacy of the General Electric Mark III Containment design. Further, your letter stated that these concerns were potentially generic and may be applicable to other Dockets with boiling water reactors which use the GE pressure suppression containment systems.

We have reviewed these concerns and prepared responses which are provided as an attachment to this letter.

Very truly yours,

John S. Kemper

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HWV/dmc 1/1
Attachment

cc: Judge Lawrence Brenner (w/o enclosures)
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Judge Peter A. Morris (w/o enclosures)
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Atomic Safety and Licensing Board Panel (w/o enclosures)
Docket and Service Section (w/o enclosures)

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

3.1 The design of the STRIDE plant did not consider vent clearing, condensing oscillation and chugging loads which might be produced by the actuation of these relief valves.

Response

Limerick has analyzed the effect of chugging suppression pool boundary loads due to RHR relief valve steam discharge and has determined that the resulting underpressures calculated at a point on the liner plate nearest the chug source are acceptable to liner plate design.

Issue 3.3 addresses vent clearing loads due to the actuation of RHR relief valves.

3.2 The STRIDE design provided only nine inches of submergence above the RHR relief valve discharge lines at low suppression pool levels.

<u>Response</u>

Interpreting this as a concern of direct steam discharge to wetwell environment, for LGS the RHR relief valve discharge line is submerged 4.0' below the low normal water level (LNWL). Therefore, this issue is not a concern to LGS.

3.3 Discharge from the RHR relief valves may produce air bubble discharge or other submerged structure loads on equipment in the suppression pool.

Response

In the LGS pool, there is no equipment directly below the RHR relief line discharge (which is an open pipe). Therefore, the water jet load on any equipment will be an induced load which is expected to be small.

The structures near the discharge are the downcomers and the downcomer bracing. The bracing is 3.5' above the discharge end, which is 18.0' above the basemat and 6.25' below the high normal water level. A downcomer is about 1' away from the RHR line. The suppression pool wall is about 2' from the RHR line. The design of all the structures was based on MSRV ADS air bubble loads with SBA/IBA load combination. It is expected that the RHR bubble load is small or in the worst case of the same order of magnitude as the MSRV bubble load due to the lower steam flow, lower pressure, and smaller submergence.

3.4 The RHR heat exchanger relief valve discharge lines are provided with vacuum breakers to prevent negative pressure in the lines when discharging steam is condensed in the pool. If the valves experience repeated actuation, the vacuum breaker sizing may not be adequate to prevent drawing slugs of water back through the discharge piping. These slugs of water may apply impact loads to the relief valve or be discharged back into the pool at the next relief valve actuation and apply impact loads to submerged structures.

Response

Reflood analyses for the LGS RHR relief valve discharge lines have been performed. Determined under conservative conditions, the reflood does not reach the relief valve or the vacuum breaker. For the stated concern the vacuum breaker sizing is adequate. The piping load during subsequent actuation has been included in the design.

Water jet loads on submerged structures are of no concern as discussed in Issue 3.3 response.

3.6 If the RHR heat exchanger relief valves discharge steam to the upper levels of the suppression pool following a design basis accident, they will significantly aggravate suppression pool temperature stratification.

Response

RHR heat exchanger relief valve discharge of steam to the suppression pool following a design basis accident will not aggravate pool temperature stratification. In a Mark II plant, there is considerable agitation and pool mixing due to steam condensation and chugging following a LOCA. Also, unlike the Mark III (STRIDE) 9" submergence of the RHR relief valve discharge line, Limerick's discharge line is submerged 4' with respect to the low normal water level.

3.7 The concerns related to the RHR heat exchanger relief valve discharge lines should also be addressed for all other ECCS relief lines that exhaust into pool (p. 132 of 5/27/82 transcript).

Response

There are no other ECCS relief lines that discharge to the suppression pool other than thermal reliefs of small capacity.

4. Suppression Pool Temperature Stratification

4.1 The present containment response analyses for drywell break accidents assume that the ECCS systems transfer a signifcant quantity of water from the suppression pool to the lower regions of the drywell through the break. This results in a pool in the drywell which is essentially isolated from the suppression pool at a temperature of approximately 135°F. The containment response analysis assumes that the drywell pool is thoroughly mixed with the suppression pool. If the inventory in the drywell is assumed to be isolated and the remainder of the heat is discharged to the suppression pool, an increase in bulk pool temperature of 10°F may occur.

Footnote 1: This concern is related to the trapping of water in the drywell.

Response

For a Mark II containment, this question refers only to the ability of the suppression pool to provide adequate cooling assuming part of the suppression pool water is held up in the drywell by the 18" downcomer riser. This water hold up capacity is much less than that of the drywell pool formed in a Mark III containment. The formation of water on the drywell floor at the expense of suppression pool inventory will depleat the suppression pool inventory by about 7%. However, a significant rise in suppression pool temperature is not anticipated because of the conservatism assumed in the RHR system (e.g., RHR heat exchanger heat transfer coefficient conservatively assumes a fully fouled condition).

4.2 The existence of the drywell pool is predicated upon continuous operation of the ECCS. The current emergency procedure guidelines require the operators to throttle ECCS operation to maintain vessel level below level 8. Consequently, the drywell pool may never be formed.

Footnote 2: This issue applies only to those facilities for which EPG's are in effect.

Response

As discussed in the response to Issue 4.1, a pool of 18" may form following an accident due to the depth of the downcomer riser. Formation of water on the drywell floor would have no affect on Mark II containment analyses.

..3 All Mark III analyses presently assume a perfectly mixed uniform suppression pool. These analyses assume that the temperature of the suction to the RHR heat exchangers is the same as the bulk pool temperature. In actuality, the temperature in the lower part of the pool where the suction is located will be as much as 7 1/2^{o}F cooler than the bulk pool temperature. Thus, the heat transfer through the RHR heat exchanger will be less than expected.

Response

The suppression pool temperature calculated in the FSAR assumes the entire pool to be in equilibrium and thus at the same temperature. In reality, the region of the pool in the vicinity of the downcomer exit (El. 193'11") will have a temperature in excess of the bulk suppression pool temperature due to steam condensation. For the LGS containment design, RHR suction is taken from the suppression pool at El. 192', near the vicinity of the downcomers exit. Therefore, Humphrey's concern is not applicable to LGS.

See the response to Issue 4.7 for details of the RHR suction locations.

4.4 The long term analysis of containment pressure/ temperature response assumes that the wetwell airspace is in thermal equilibrium with the suppression pool water at all times. The calculated bulk pool temperature is used to determine the airspace temperature. If pool thermal stratification were considered, the surface temperature, which is in direct contact with the airspace, would be higher. Therefore the airspace temperature (and pressure) would be higher.

Response

In a Mark II containment, the peak pressure in the wetwell airspace occurs during poolswell and will exceed any pressure increase due to heat transfer. Pool stratification is therefore of no significant concern in a Mark II containment peak pressure analysis. The maximum wetwell airspace temperature will be established by the greater temperature resulting from steam bypass leakage analysis (as described in Appendix I to Section 6.2.1.1c of the Standard Review Plan) or the current long-term suppression pool temperature analysis (as described in FSAR Section 6.2.1.1.3.3.1.6). The affect of potential pool stratification on airspace temperature will be insignificant.

4.5 A number of factors may aggravate suppression pool thermal stratification. The chugging produced through the first row of horizontal vents will not produce any mixing from the suppression pool layers below the vent row. An upper pool dump may contribute to additional suppression pool temperature stratification. The large volume of water from the upper pool further submerges RHR heat exchanger effluent discharge which will decrease mixing of the hotter, upper regions of the pool. Finally, operation of the containment spray eliminates the heat exchanger effluent discharge jet which contributes to mixing.

Footnote 3: For Mark I and II facilities, confine your response on this issue to those concerns which can lead to pool stratification (e.g., operation of the containment spray).

Response

None of these issues are significant for Mark II containments. In a Mark II containment, chugging occurs near the midplane of the pool and mixes the entire pool. Mark II containments do not have upper pool dumps. Operation of containment spray will not cause pool stratification. The wetwell spray diverts at most 5% of the RHR flow; the remaining 95% of the flow is still available for suppression pool mixing via the pool cooling mode or the drywell spray mode. If the drywell spray is employed, spray water would return to the pool midplane through the widely dispersed downcomers, providing adequate mixing.

4.6 The initial suppression pool temperature is assumed to be 95°F while the maximum expected service water temperature is 90°F for all GGNS accident analyses as noted in FSAR table 6.2-50. If the service water temperature is consistently higher than expected, as occurred at Kuosheng, the RHR system may be required to operate nearly continuously in order to maintain suppression pool temperature at or below the maximum permissible value.

Response

The initial suppression pool temperature is assumed to be at 95° for LGS accident analysis. The RHR service water system takes suction from the spray pond and is used to cool the suppression pool. The spray pond has an area of 9.9 acres and a depth of 10 ft. with a maximum design temperature of 88°F. This temperature is based on a very conservative analysis of site meteorology and assumes that all the water in the spray pond will reach the worst ambient temperature without considering the effects of temperature stratification in the pond. The spray pond analysis shows that even for the long term post accident condition, with one unit in the LOCA condition and the other unit at safe shutdown, the maximum pond temperature is only 95.2°F for the minimum heat transfer case.

We do not expect the bulk temp of spray pond to exceed 88°F. Technical specifications require that the plant be in a shutdown condition if the average pond temperature exceeds 88°F.

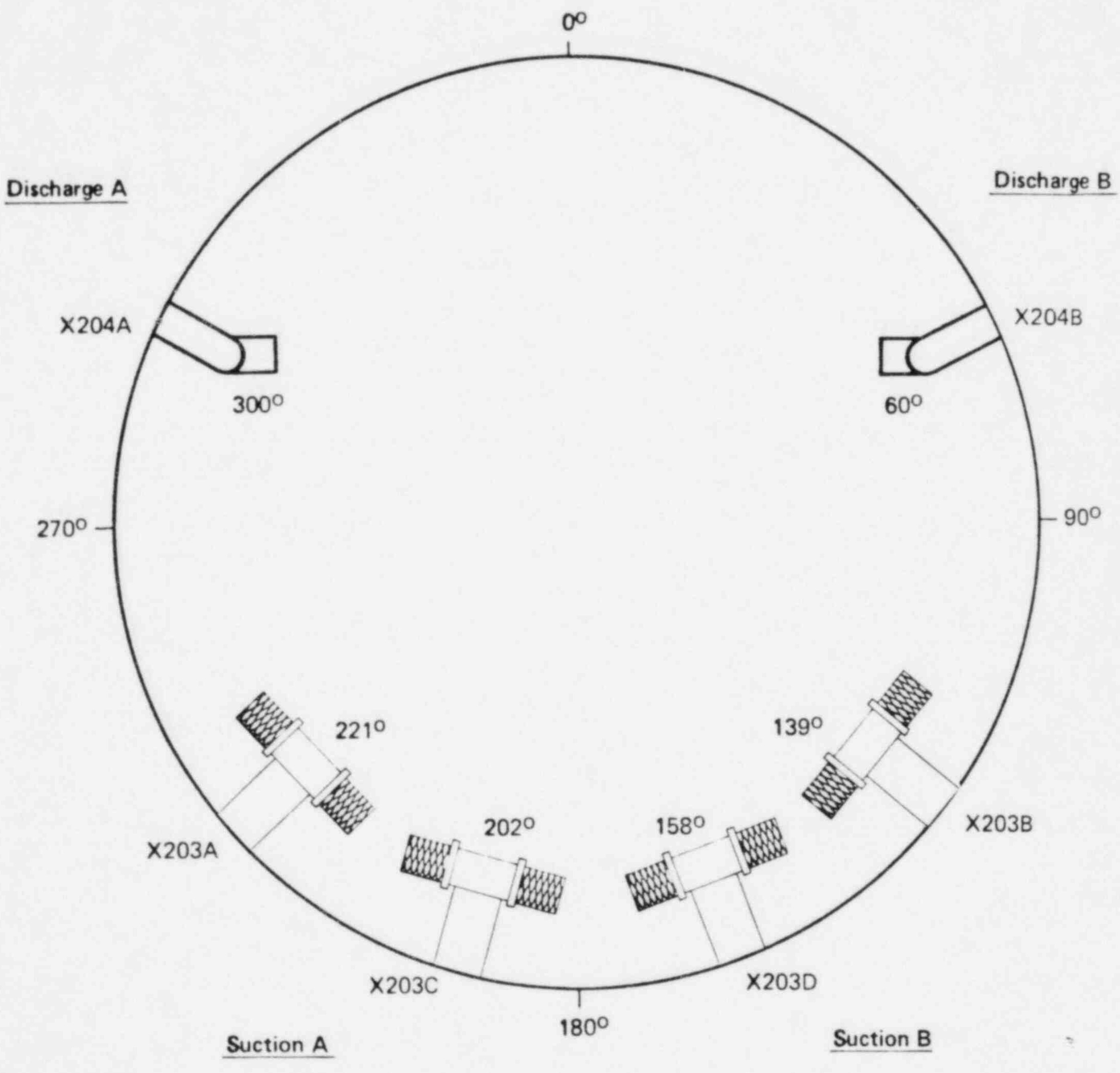
4.7 All analyses completed for the Mark III are generick in nature and do not consider plant specific interactions of the RHR suppression pool suction and discharge.

Response

There will be no adverse interaction of the Limerick pool cooling suction and discharge. The suction and discharge of both RHR loop "A" and loop "B" have an adequate radial separation of approximately 80°. All suctions are located about 10 feet above the basemat while the discharges are located about 18 feet above the basemat. Additionally, each discharge includes an elbow to direct flow away from the associated suctions.

The sketch on the following page shows the relative positions of Limerick's RHR suctions and discharges.

ISSUE 4.7: RELATIVE POSITIONS OF RHR SUCTION AND DISCHARGE



RHR DISCHARGE: PENETRATION AT ELEVATION 219'
DISCHARGE AT ELEVATION 199'-11"
RHR SUCTION STRAINERS: PENETRATION AND SUCTION AT ELEVATION 192'
BASEMAT ELEVATION: 181'-11"

4.8 Operation of the RHR system in the containment spray mode will decrease the heat transfer coefficient through the RHR heat exchangers due to decreased system flow. The FSAR analysis assumes a constant heat transfer rate from the suppression pool even with operation of the containment spray.

Response

Operation of the RHR system in the containment spray mode will not decrease the RHR heat exchanger effectiveness. In a Mark II, the containment pressure design is governed by the short-term peak pressure due to a LOCA. The LGS FSAR analysis shows that the drywell pressure peaks at 44 psig (due to a recirculation line breaks) in about 14 seconds after the break. The containment design pressure of 55 psig provides significant design margin. The containment spray mode in a Mark II is a manual mode and is not required post accident to maintain the containment pressure under the design limit. Additionally, the spray mode has a system flow rate equivalent to that of the pool cooling mode, and therefore the containment heat removal rate is independent of RHR system mode of operation.

4.9 The effect on the long term containment response and the operability of the spray system due to cycling the containment sprays on and off to maximize pool cooling needs to be addressed. Also provide and justify the criteria used by the operator for switching from the containment spray mode to pool cooling mode, and back again.
(pp. 147-148 of 5/27/82 transcript).

Response

For Limerick, cycling of the containment sprays to maximize pool cooling is not required. Once sprays are initiated, operator guidance for continued operation of sprays is provided by Emergency Procedures developed from the BWR Owners Group's EPG's.

4.10 Justify that the current arrangement of the discharge and suction points of the pool cooling system maximizes pool mixing.

Response

As described in the response to Issue 4.7, the current arrangement of the RHR discharge and suction points will provide adequate pool mixing.

5. Drywell to Containment Bypass Leakage

5.1 The worst case of drywell to containment bypass leakage has been established as a small break accident. An intermediate break accident will actually produce the most significant drywell to containment leakage pr to initiation of containment sprays.

Response

As directed by the NRC in Appendix I to Section 6.2.1.1c of the Standard Review Plan (SRP), Mark II containments should exhibit a steam bypass capability on the order of 0.05 ft^2 $(A/\sqrt{K})$ considering a small break accident. Limerick is currently addressing bypass leakage, as defined by the SRP, in response to NRC Question 480.6.

5.2 Under Technical Specification limits, bypass leakage corresponding to $A/\sqrt{K} = 0.1$ ft.^{2} constitute acceptable operating conditions. Smaller-than-IBA-sized breaks can maintain break flow into the drywell for long time periods, however, because the RPV would be depressurized over a 6 hour period. Given, for example, an SBA with $A/\sqrt{K} = 0.1$, projected time period for containment pressure to reach 15 psig is 2 hours. In the latter 4 hours of the depressurization the containment would presumably experience ever-increasing overpressurization.

Footnote 4: For Mark I and II facilities, refer to Appendix I to Section 6.2.1.1c of the Standard Review Plan (SRP).

Response

The consequences of bypass leakage on suppression chamber pressure response will be addressed in response to NRC Question 480.6.

5.3 Leakage from the drywell to containment will increase the temperature and pressure in the containment. The operators will have to use the containments spray in order to maintain containment temperature and pressure control. Given the decreased effectiveness of the RHR system in accomplishing this objective in the containment spray mode, the bypass leakage may increase the cyclical duty of the containment sprays.

Response

As discussed in the response to Issue 4.8, manual operation of the containment spray mode will not decrease the effectiveness of the RHR system. Therefore, this issue is not a concern.

5.4 Direct leakage from the drywell to the containment may dissipate hydrogen outside the region where the hydrogen recombiners take suction. The anticipated leakage exceeds the capacity of the drywell purge compressors. This could lead to pocketing of hydrogen which exceeds the concentration limit of 4% by volume.

Footnote 5: This concern applies to those facilities at which hydrogen recombiners can be used.

Response

This concern is not applicable to the Mark II containment because of its inherent differences from the Mark III containment. Leakage from the primary containment to the secondary containment may contain small amounts of hydrogen following a LOCA, but this occurrence would not be significant since the secondary containment air is exhausted to the outside atmosphere through the SGTS. This leakage would have no affect on the ability of the containment hydrogen recombiners to maintain the oxygen concentration below 5% in the primary containment.

As described in Section 6.2.5.2.1 of the FSAR, the hydrogen recombiners take suction from the drywell and discharge their flow to the suppression chamber. The opening of the primary containment vacuum relief valve assemblies allows gases to flow from the suppression chamber back into the drywell.

5.5 Equipment may be exposed to local conditions which exceed the environmental qualification envelope as a result of direct drywell to containment bypass leakage.

Response

The consequences of direct drywell to wetwell bypass leakage on suppression chamber pressure response will be addressed in response to NRC Question 480.6.

Safety-grade equipment located in the wetwell airspace will be qualified to the maximum temperature determined by bypass leakage analysis (as described in Appendix I to Section 6.2.1.1c of the SRP) or the current long-term suppression pool temperature analysis (as described in FSAR Section 6.2.1.1.3.3.1.6).

5.8 The possibility of high temperatures in the drywell without reaching the 2 psig high pressure scram level because of bypass leakage through the drywell wall should be addressed.
(pp. 168-174 of 5/27/78 transcript)

Response

For Limerick, the drywell design temperature is governed by a small reactor steam break. For drywell design purposes, it is assumed that there is a blowdown of reactor steam for the six-hour cooldown period. The corresponding design temperature is determined by finding the combination of primary system pressure and drywell pressure that produces the maximum superheat temperature. This temperature is then assumed to exist for the entire six-hour period. The maximum drywell steam temperature occurs when the primary system is at approximately 450 psia and the drywell pressure is maximum. Thus, for design purposes, it is assumed that the drywell is at 37 psig; this results in a temperature of 340°F.

Considering a postulated post-SBA short term transient without initiating automatic high drywell pressure scram because of bypass leakage, it is not possible to exceed 340°F in the drywell.

The possibility of excessively high drywell temperatures due to a drywell leak during normal operation has been considered in the design of the drywell air cooling system. As discussed in FSAR Section 9.4.5.2, the cooling units are designed to limit the temperature inside the drywell to an average of 135°F with the maximum not to exceed 150°F. This analysis assumes a 5 gpm constant steam leakage. Should excessively high discharge temperature exist in the drywell cooling system, the operator will be alerted to switch to standby cooling units.

6. RHR Permissive on Containment Spray

6.1 We understand that GE has recommended for Mark III containments that the combustible gas control systems be activated if the reactor vessel water level drops to within one foot of the top of the active fuel. Indicate what your facility is doing in regard to this recommendation.

Response

This issue is not applicable to Mark II plants because they are inerted and short-term hydrogen control is not an issue.

6.2 General Electric has recommended that an interlock be provided to require containment spray prior to starting the recombiners because of the large quantities of heat input to the containment. Incorrect implementation of this interlock could result in inability to operate the recombiners without containment spray.

Footnote 5: This concern applies to those facilities at which recombiners can be used.

Response

There is no interlcck in the LGS design. Therefore, this issue is not a concern.

6.3 The recombiners may produce "hot spots" near the recombiner exhausts which might exceed the environmental qualification envelope or the containment design temperature.

Footnote 5: This concern applies to those facilities at which recombiners can be used.

Response

The Limerick recombiners are located outside primary containment and exhaust to the wetwell airspace. Spray aftercoolers on the recombiner discharge preclude excessively high recombiner exhaust temperature. The maximum return gas temperature is 250°F. In the event the return gas temperature is higher than 250°F, there is an alarm and warning light in the control room and the recombiner is automatically shut down.

As noted before, the maximum wetwell airspace temperature used for qualification will be established by the greater temperature resulting from steam bypass leakage analysis or the current long-term suppression pool temperature analysis described in the FSAR. Even though there is no safety related equipment located directly adjacent to the exhaust penetration, the effect of a localized "hot spot" will be considered when establishing a maximum wetwell airspace temperature.

6.4 For the containment air monitoring system furnished by General Electric, the analyzers are not capable of measuring hydrogen concentration at volumetric steam concentrations above 60%. Effective measurement is precluded by condensation of steam in the equipment.

Response

The sample piping for the combustible gas analyzers is provided with heat tracing powered from safety-grade sources so that no condensation of steam will occur. Note that LGS has Comsip-Delphi monitors rather than GE equipment.

6.5 Discuss the possibility of local temperatures due to recombiner operation being higher than the temperature qualification profiles for equipment in the region around and above the recombiners. State what instructions, if any, are available to the operator to actuate containment sprays to keep this temperature below design values. (pp. 183-185 of 5/27/82 transcript)

Footnote 5: This concern applies to those facilities at which recombiners can be used.

Response

For LGS, the containment hydrogen recombiners are located in a general equipment area in the secondary containment, rather than inside primary containment. Adequate post accident ventilation is provided by the Reactor Enclosure Recirculation System (RERS) to maintain temperatures in the vicinity of the recombiner below safety-related equipment qualification limits considering the heat load of the recombiners.

7. Containment Pressure Response

7.1 The wetwell is assumed to be in thermal equilibrium with a perfectly mixed, uniform temperature suppresssion pool. As noted under topic 4, the surface temperature of the pool will be higher than the bulk pool temperature. This may produce higher than expected containment temperatures and pressures.

Response

As discussed in the response to Issue 4.4, the peak wetwell pressure due to pool stratification is bounded by the poolswell event and the maximum wetwell airspace temperature will be established by the greater temperature resulting from steam bypass leakage analysis or the current long-term suppression pool temperature analysis described in the FSAR.

7.2 The computer code used by General Electric to calculate environmental qualification parameters considers heat transfer from the suppression pool surface to the containment atmosphere. This is not in accordance with the existing licensing basis for Mark III environment qualification. Additionally, the bulk suppression pool temperature was used in the analysis instead of the suppression pool surface temperature.

Footnote 6: This issue as phrased applies only to a Mark III facility. However, the concern can be generalized and applied to the earlier containment types. For Mark I and II facilities, indicate what methodology was used to calculate the environmental qualification parameters including a discussion of heat transfer between the atmosphere in the wetwell and the suppression pool.

Response

The key design values and the maximum calculated accident values of these parameters for the pressure suppression containment are described in detail in FSAR Section 6.2. A summary evaluation is listed below:

Parameter	Design Value	Calc Accident Value
Drywell design pressure	55 psig	44.02 psig
Drywell design temperature	340°F	340°F
Suppression chamber design pressure	55 psig	30.57 psig
Suppression chamber design temperature	220°F	212.5°F

Containment analyses assume thermodynamic equilibrium in the drywell and wetwell. Equipment located in the drywell is qualified to 340°F and 44 psig. Equipment located in the wetwell airspace is qualified to at least 44 psig and the maximum temperature value resulting from the either the steam bypass leakage analysis or the calculated long-term pool temperature analysis.

7.2 (Cont'd)

As noted in the response to Issue 4.4, increase in wetwell pressure due to heat transfer considerations are not design controlling. Potential increases in wetwell temperature due to heat transfer between the wetwell atmosphere and the suppression pool are effected to be small and will be bounded by the peak wetwell airspace temperature determined by steam bypass leakage analysis.

7.3 The analysis assumes that the wetwell airspace is in thermal equilibrium with the suppression pool. In the short term this is non-conservative for Mark III due to adiabatic compression effects and finite time required for heat and mass to be transferred between the pool and containment volumes.

Fotnotes 6: This issue as phrased applies only to a Mark III facility. However, the concern can be generalized and applied to the earlier containment types. For Mark I and II facilities, indicate what methodology was used to calculate the environmental qualification parameters including a discussion of heat transfer between the atmosphere in the wetwell and the suppression pool.

Response

See the response to Issue 7.2.

8. Containment Air Mass Effects

8.1 This issue is based on consideration that some Tech Specs allow operation at parameter values that differ from the values used in assumptions for FSAR transient analyses. Normally analyses are done assuming a nominal containment pressure equal to ambient (0 psig) a temperature near maximum operating (90°F) and do not limit the drywell pressure equal to the containment pressure. The Tech Specs operation under conditions such as a positive containment pressure (1.5 psig), temperatures less than maximum (60 or 70°F) and drywell pressure can be negative with respect to the containment (-0.5 psig). All of these differences would result in transient response different than the FSAR descriptions.

Response

Conservatisms in analytical models used in transient analyses understate design margins. Although it is reasonable not to always use bounding values, the effect of bounding values would be minimized if a less conservative model were used that did not understate design margins.

The result of conservative calculations predict containment pressures and temperatures below the design values, so that any small increase in the predictions would not change the conclusion of design adequacy.

8.2 The draft GGNS technical specifications permit operation of the plant with containment pressure ranging between 0 and -2 psig. Initiation of containment spray at a pressure of -2 psig may reduce the containment pressure by an additional 2 psig which could lead to buckling and failures in the containment liner plate.

Response

During reactor operation, the primary containment atmosphere is maintained at a pressure in the range of 0.1 to 1.5 psig (FSAR Section 9.4.5.1.2). FSAR Section 6.2.1.1.4 discusses analysis for inadvertent spray actuation in which the following assumptions are made: 1) initial containment pressure is 0 psig, 2) one spray train is actuated, 3) all the air in the drywell was driven into the wetwell due to an SBA prior to the ISA, and 4) return flow of air to the drywell does not start until 3 psid is reached.

The results of this very conservative analysis show that the minimum containment pressure remains above the design pressure of -5.0 psig.

8.3 If the containment is maintained at -2 psig, the top row of vents could admit blowdown to the suppression pool during an SBA without a LOCA signal being developed.

Footnote 7: Not applicable to Mark II facilities.

Response

Not applicable as LGS is a Mark II facility.

8.4 Describe all of the possible methods both before and after an accident of creating a condition of low air mass inside the containment. Discuss the effects on the containment design external pressure of actuating the containment sprays.
(pp. 190-195 of 5/27/82 transcripts)

Response

Possible methods for creation of a decreased air mass before or after an accident include the following:

1) LOCA while purging - in this case some air (nitrogen) could be lost prior to the purge valves closing. An analysis has been performed for Limerick (based on a 5 second valve closure time) that demonstrated subsequent actuation of sprays does not exceed the -5 psig design value.

2) Containment post-accident leakage - The LGS containment design allows for a maximum 0.5% volume per day leakage to the secondary containment post-accident. In this case non-condensibles could be lost slowly over a period of time. However, equipment is available to replenish non-condensibles (nitrogen purge).

9. Final Drywell Air Mass

9.1 The current FSAR analysis is based upon continuous injection of relatively cool ECCS water into the drywell through a broken pipe following a design basis accident. Since the operator is directed to throttle ECCS operation to maintain the reactor vessel water level to about the level of the steam lines, the break will be releasing saturated steam instead of releasing relatively cool ECCS water. Therefore, the drywell air which would have been purged and then drawn back into the drywell, will remain in the wetwell and higher pressures than anticipated will result in both the wetwell and the drywell.

Response

This issue is not a concern for Limerick because the ECCS flow does not have to be throttled after a LOCA. Also, the containment peak pressure in Mark II plants is governed by short term response to a pipe break rather than the long term response.

9.2 The continuous steaming produced by throttling the ECCS flow will cause increased direct leakage from the drywell to the wetwell. This could result in increased wetwell pressures.

Response

This issue does not apply to Limerick. See response to Issue 9.1.

9.3 It appears that some confusion exists as to whether SBA's and stuck open SRV accidents are treated as transients or design basis accidents. Clarify how they are treated and indicate whether the initial conditions were set at nominal or licensing values. (pp. 202-205 of 5/27/82 transcript)

Response

The controlling containment design bases are as follows:

- short-term pressure condition - LOCA (FSAR Figure 6.2-4)
- long-term temperature condition - SBA (FSAR Figure 6.2-8)

Limerick pool temperature transient analysis has been conducted in accordance with NUREG 0783. Initial conditions for SORV and SBA events are set at licensing values as specified in the NUREG. Detailed results of this analysis will be provided in DAR Appendix I in the first quarter of 1983.

11. Operational Control of Drywell to Containment Differential Pressures

Mark III load definitions are based upon the levels in the suppression pool and the drywell weir annulus being the same. The GGNS technical specifications permit elevation differences between these pools. This may affect load definition for vent clearing.

Footnote 8: For Mark I and II facilities, consider the water in the downcomers.

Response

LGS vent clearing loads are based on the maximum suppression pool level. The small elevation difference that could exist in the downcomers due to a differential pressure between drywell and wetwell (corresponding to 0.5-1.0 psid vacuum breaker lift pressure) would yield an inconsequential difference in the loads.

14. RHR Backflow Through Containment Spray

A failure in the check valve in the LPCI line to the reactor vessel could result in direct leakage from the pressure vessel to the containment atmosphere. This leakage might occur as the LPCI motor operated isolation valve is closing and the motor operated isolation valve in the containment spray line is opening. This could produce unanticipated increases in the containment spray.

Response

Unlike the Mark III design, the Limerick containment sprays do not automatically initiate but are started manually. Operation of the drywell spray isolation valves is administratively controlled via a keylocked switch. In addition, if a LOCA signal is present, both the drywell and wetwell spray isolation valves are interlocked such that they cannot be opened unless the corresponding LPCI injection valve is fully closed. If a LOCA signal does not exist, the two isolation valves on each drywell spray line are interlocked such that they cannot both be open at the same time. The wetwell spray isolation valves are not interlocked with the LPCI injection valves if a LOCA signal is not present. However, these valves are only opened for testing purposes while the reactor is operating and the operator is instructed not to open both valves at once.

In addition the following should be noted:

1) The check valve in question is a testable check and is periodically exercised to assure its operability; therefore, likelihood of a check valve failure is remote.

2) The LPCI injection valve closes fairly rapidly (24 seconds from fully open to fully closed).

Based on the administrative control and the above considerations, this issue is not considered a concern for Limerick.

15. Secondary Containment Vacuum Breaker Plenum Response

The STRIDE plants had vacuum breakers between the containment and the secondary containment. With sufficiently high flows through the vacuum breakers to containment, vacuum could be created in the secondary containment.

Response

There are no vacuum breakers between the primary and secondary containment in the LCS design.

16. Effect of Suppression Pool Level on Temperature Measurement

Some suppression pool temperature sensors are located (by GE recommendation) 3" to 12" below pool surface to provide early warning of high pool temperature. However, if the suppression pool is drawn below the level of temperature sensors, the operator could be misled by erroneous readings and required safety action could be delayed.

Response

For Limerick there are 16 temperature sensors in the suppression pool located 20.0' above the basemat (2.0' below low normal water level). As the maximum decrease in pool level post-accident is 1.5' (due to water accumulation on the drywell floor up to the level of the downcomer openings), the temperature detectors will remain submerged and proper indication will be maintained.

17. Emergency Procedure Guidelines

The EPGs contain a curve which specifies limitations on suppression pool level and reactor pressure vessel pressure. The curve presently does not adequately account for upper pool dump. At present, the operator would be required to initiate automatic depressurization when the only action required is the opening of one additional SRV.

Footnote 9: This issue as phrased applies only to a Mark III facility. However, the concern can be generalized. Accordingly, discuss what actions the reactor operator would take in the event that the limitations on the suppression pool level and the pressure in the reactor vessel are violated.

Response

The suppression pool load limit curve presented in the Limerick EPGs specifies limitations on the suppression pool level and the reactor vessel pressure. Should the suppression pool water level rise above the suppression pool load limit, the operator is instructed to restore and maintain the water level below the suppression pool load limit; or if this cannot be accomplished, to maintain reactor pressure below the limit. This condition may necessitate emergency shutdown.

18. Effects of Insulation Debris

18.1 Failures of reflective insulation in the drywell may lead to blockage of the gratings above the weir annulus. This may increase the pressure required in the drywell to clear the first row of drywell vents and perturb the existing load definitions.

Footnote 10: This issue as phrased applies only to a Mark III facility. However, the concern can be generalized. Accordingly, discuss how the effects of insulation debris could perturb existing load definitions or could block suction strainers. In responding to this issue, you may refer to existing generic studies; e.g., the study done for the Cooper facility.

Response

In the Mark II design, the initial pressurization event, during which blockage of the downcomers could be of concern, is over in about 1 second. This is insufficient time for any insulation debris to transit to and block the downcomers. Subsequent to the initial pressurization, any minor blockage that might occur would have an insignificant effect (See response to Issue 18.2 for a discussion of the effects of insulation debris on suction strainers).

18.2 Insulation debris may be transported through the vents in the drywell into the suppression pool. This debris could then cause blockage of the suction strainers.

Footnote 10: This issue as phrased applies only to a Mark III facility. However, the concern can be generalized. Accordingly, discuss how the effects of insulation debris could perturb existing load definitions or could block suction strainers. In responding to this issue, you may refer to existing generic studies; e.g., the study done for the Cooper facility.

Response

Potential sources of debris that might clog the suction strainers are the permanently attached metallic insulation panels, aluminum-jacketed fiberglass anti-sweat insulation panels, and steel-jacketed low conductivity insulation panels installed on piping in the drywell. As discussed in FSAR Section 6.2.2.2, it is highly improbable that any dislodged insulation assemblies will be transported to the suppression pool through the downcomers and clog the suction strainers. The suction strainers of the ECCS pumps are designed to sustain 50% clogging without affecting system performance.

21. Containment Makeup Air For Backup Purge

Regulatory Guide 1.7 requires a backup purge H_2 removal capability. This backup purge for Mark III is via the drywell purge line which discharges to the shield annulus which in turn is exhausted through the standby gas treatment system (SGTS). The containment air is blown into the drywell via the drywell purge compressor to provide a positive purge. The compressors draw from the containment; however, without hydrogen lean air makeup to the containment, no reduction in containment hydrogen concentration occurs. It is necessary to assure that the shield annulus volume contains a hydrogen lean mixture of air to be admitted to the containment via containment vacuum breakers. For Mark I and II facilities, discuss the possibility of purge exhaust being mixed with the intake air which replenishes the containment air mass.

Response

As discussed is FSAR Sections 6.2.5.2.4 and 9.4.5.1.2, post-LOCA purging for oxygen control is performed using the liquid nitrogen facility as the source of purge gas. Since the nitrogen is stored in closed tanks, there is no possibilty of the nitrogen becoming contaminated with oxygen.

22. Miscellaneous Emergency Procedure Guideline Concerns

The EPGs currently in existence have been prepared with the intent of coping with degraded core accidents. They may contain requirements conflicting with design basis accident conditions. Someone needs to carefully review the EPG's to assure that they do not conflict with the expected course of the design basis accident.

Footnote 2: This issue applies only to those facilities for which EPG's are in effect.

Response

Philadelphia Electric Company has participated in the BWR Owners Group review of the Emergency Procedure Guidelines to assure that these procedures do not conflict with the expected course of the design basis accident. The committee's review has found the EPGs to be acceptable in this regard.