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P. O. BOX 1640, JACKSON, MISSISSIPPI 39205

May 11, 1983

NUCLEAR PRODUCTION DEPARTMENT

Division of Systems Integration
Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Attention: Mr. R. W. Houston, Assistant Director

Dear Mr. Houston:

SUBJECT: Hydrogen Control Owners Group (HCOG) Responses to NRC Request for Additional Information
File: 004,030
HGN-011

Reference: Letter from Mr. R. W. Houston to Mr. J. D. Richardson dated February 3, 1983

The reference letter included a list of questions from the NRC concerning the HCOG program. Attachment 1 to this letter includes responses to these questions. The HCOG believes that questions 8 and 9 in the reference letter must be addressed on a plant specific basis.

The HCOG remains committed to resolving the issue of hydrogen control in the Mark III containment. HCOG believes that the program which has been completed to date addresses many of the questions which were raised in the reference letter. Further effort in those areas deemed closed is not planned.

In response to your request for a meeting, we have made tentative arrangements for a meeting with the Containment Systems Branch on June 2, 1983.

If you have any questions regarding the responses contained in Attachment 1 to this letter, please contact me.

Yours truly,

J. D. Richardson

J. D. Richardson, Chairman
Hydrogen Control Owners Group

JRH/SHH:lm
Attachment

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PDR ADOCK 05000416
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M4M1

B001
Add: R.W. Houston
D. Houston LB#2

ATTACHMENT 1
RESPONSES TO REQUESTS FOR ADDITIONAL INFORMATION

1. Provide documentation of the CLASIX-3 code including a detailed discussion of code methodology, solution techniques, inputs and code verification.

RESPONSE:

The Hydrogen Control Owners Group (HCOG) believes that a large quantity of information has been submitted to describe the CLASIX-3 code in detail. Reference 1 provided a thorough discussion of the CLASIX program, from which the CLASIX-3 program evolved. Reference 2 provided an in-depth discussion of the equations solved by CLASIX-3, the program flow, and the solution techniques employed for various sets of equations. Reference 2 also contained detailed listings of the input data used for performing the analyses and a thorough discussion of the verification for CLASIX-3. Reference 3 provided a comprehensive discussion of the CLASIX code and the verification of the CLASIX code by comparison of CLASIX results with calculated results of other programs, comparison of CLASIX results to test measurements, comparison of CLASIX results to external calculations and performance of a large number of sensitivity studies. Reference 4 contained additional information regarding verification of the suppression pool model incorporated into CLASIX-3. The information contained in Reference 4 discussed comparisons of results from the CLASIX-3 suppression pool model against closed form analytical solutions, accepted licensing analysis predictions and external checks for consistency of results and mass conservation.

Reference 5 provided a comprehensive listing of all input parameters used in performing a series of sensitivity studies. Reference 5 also contained the results of 18 cases analyzed to evaluate the sensitivity of base case results to changes in selected key parameters. The report concluded that no unduly sensitive parameters were identified. Reference 6 submitted a document titled "Verification of the CLASIX-3 Computer Program." This document provided a sound basis for concluding that the results predicted by CLASIX-3 are conservative and reasonable.

The HCOG has also prepared a final topical report on the CLASIX-3 code. This report included all information which has been submitted to date and additional information as appropriate. This final report was submitted to the NRC on March 18, 1983, as HGN-009, Reference 7.

REFERENCES:

1. Tennessee Valley Authority Sequoyah Nuclear Plant Core Degradation Program, Volume 2, dated December 15, 1980.

2. Mississippi Power & Light Letter AECM-81/336, dated August 31, 1981, from L. F. Dale to H. R. Denton.

3. CLASIX Topical Report, dated December 1, 1981.

4. Mississippi Power & Light Letter AECM-81/505, dated December 21, 1981, from L. F. Dale to H. R. Denton.

5. CLASIX-3 Containment Response Sensitivity Analysis Submitted with Letter HGN-001, dated January 15, 1982, from the Hydrogen Control Owners Group to H. R. Denton.

6. Mississippi Power & Light Letter AECM-82/041, dated January 15, 1982, from L. F. Dale to H. R. Denton.

7. Hydrogen Control Owners Group (HCOG) submittal of CLASIX-3 Report with letter HGN-009, dated March 18, 1983, from HCOG to H. R. Denton.

2. Provide quantitative justification for the spray carryover fractions for water assumed to enter the wetwell as a spray and as sheet flow. Provide justification for the assumption that sheet flow is half as effective as droplet flow.

RESPONSE:

Reference 1 contained a response to a question from the Nuclear Regulatory Commission (NRC) regarding the fraction of containment spray which reaches the wetwell as sheet flow and the fraction which reaches the wetwell as spray. As noted in Reference 1, 26% of the carryover is in the form of spray, and 74% of the carryover is in liquid layers. These fractions were determined based upon the fraction the containment horizontal cross section which is unobstructed from the operating floor to the suppression pool surface.

The Hydrogen Control Owners Group (HCOG) believes that the assumption that sheet flow is half as effective in removing heat from the atmosphere as droplet flow is conservative. Since 74% of the wetwell volume is covered by floors and equipment at the HCU floor and above, the volume expansion caused by combustion in the wetwell will force the heated atmosphere to pass through curtains of water cascading into the wetwell from various runoff locations. The expansion of the heated atmosphere through these curtains of water should provide good heat transfer to the spray runoff. The assumption that this heat transfer will be approximtely 50% of the heat transfer to droplet flow is an engineering judgement of the decreases in heat transfer.

Regardless of the actual fraction of heat transfer for sheet flow versus droplet flow, the Owners Group believes that the possible effect of the assumption on analysis results is minimal. This can be demonstrated by evaluating two of the sensitivity analyses which were included in Reference 2. Case SA-10 evaluates the effect on the base case stuck open relief valve transient (SA-1) of assuming that no spray flow is carried over into the wetwell in any form. This case could also simulate the assumption that no heat is transferred to containment spray entering the wetwell either as sheet flow or as droplet flow. The net effect of having no spray carryover is that the peak pressures in all compartments are reduced. Because there is no spray in the wetwell, the ambient temperature in the wetwell is higher than it would be with spray carryover. Thus the number of pounds of hydrogen corresponding to the ignition criterion is reduced so that fewer pounds of hydrogen are available for combustion and the resulting peak pressure due to a wetwell burn is reduced. This is also reflected in the increased number of burns in the wetwell and, on the average, a reduction in the amount of hydrogen consumed per wetwell burn from 31 pounds to 23 pounds.

As can be seen in Table 20 of Reference 2, the increased number of wetwell burns in Transient SA-10 results in an increase in the total amount of hydrogen burned in the wetwell. As a result, more

oxygen is removed and the net pressure in the containment is reduced at the time of ignition in the containment volume. With the reduced pressure, fewer total pounds of hydrogen are required to reach the ignition criterion. Not only does the containment burn begin at a lower pressure, but fewer pounds of hydrogen are consumed with the net result being a lower peak pressure as a result of the containment burn.

Changing the assumption that sheet flow is half as effective as droplet flow to increase the assumed effectiveness of sheet flow would also not significantly affect the analytical results which have been submitted. Case SA-8 in Reference 2 evaluates the effect on the base results of assuming that two containment spray trains are operating. For this case, twice as much spray flow will be present in the wetwell as in the base case. This case could also simulate assuming that twice as much heat is transferred to the spray flow. There are small differences in the number of wetwell burns, quantity of hydrogen in the wetwell and peak wetwell temperature between this case and the base case.

The HCOG feels that on the basis of the results for cases SA-8 and SA-10 that the sensitivity of analytical results to assumptions regarding the effectiveness of sheet flow in removing heat has been adequately addressed. Consequently, no further action is intended.

REFERENCES:

1. Mississippi Power & Light Letter AECM-81/505, dated December 21, 1981, from L. F. Dale to H. R. Denton.

2. CLASIX-3 Containment Response Sensitivity Analysis for the Hydrogen Control Owners Group.

3. It is our understanding that the initial spray droplet assumed in the CLASIX analyses is based on an estimate of the number mean droplet size. Provide justification for using such an average size as opposed to a volume or mass mean droplet size, otherwise revise the base case analyses.

RESPONSE:

The diameter of the spray droplet affects the droplet fall time and the rate of heat and mass transfer to and from the droplet. To assess the accuracy required in determining the spray droplet diameter, sensitivity studies were performed as described in Reference 1. In these studies the diameter varied from 230 microns (number-mean) to 680 microns (mass-mean). The results of these studies showed that the largest change in the peak pressure was less than 1.0 psi and the temperature change was less than 1°F. Therefore, it was concluded that the difference in results when using the number-mean diameter versus the mass-mean diameter is insignificant.

REFERENCE:

1. Mississippi Power & Light Letter AECM-81/505, dated December 21, 1981, from L. F. Dale to H. R. Denton.

4. Provide justification for the assumed hydrogen burn parameters utilized in the base case analyses. Cite specific testing which demonstrates the validity of the assumed ignition and propagation limits and the requisite oxygen concentration.

RESPONSE:

Justification for lower limit on concentration of oxygen to support hydrogen combustion, lower limit on hydrogen concentration to permit ignition, hydrogen concentration required to permit propagation of combustion between compartments and justification for the assumed flame speeds are presented in this response.

The base cases in Reference 1 assume that hydrogen combustion cannot occur with an oxygen concentration below 5%. Reference 2 presents a table (Table III-1) which shows the best values for hydrogen flamability in air-saturated with water vapor at room temperature and pressure. This table shows the upper flamability limit for upward, horizontal and downward propagation of combustion is constant at 74% hydrogen. If the remaining atmosphere, neglecting pressure of any water vapor, is assumed to be air, the oxygen content would be 5.2%. Clearly, if the hydrogen concentration is greater than 74% or the oxygen concentration is less than 5.2%; combustion cannot occur.

There is a substantial body of test data from ignition testing which clearly demonstrates that concentrations as low as 5% hydrogen can be ignited reliably. Examples of this test data are References 3 and 4. The 8% hydrogen concentration assumed as the ignition limit consequently includes margin to account for possible non-uniform distribution of hydrogen throughout the given volume.

Reference 5 summarizes the results of various mixing tests which were performed in a compartmentalized vessel. Using helium as a hydrogen simulant, these tests showed that the maximum difference in concentration in the test compartment was 2.8% with the largest helium concentration equal to 10.7%. These tests were performed with a single simulant source. The Mark III wetwell volume will have a minimum of seven distributed sources which assures that the maximum concentration gradient throughout the compartment is lower. This means that even with a concentration gradient of 2.8%, the peak concentration at ignition would still be less that 8% since ignition is certain to occur when the minimum concentration reaches 5%.

The base case analyses assume that propagation of hydrogen combustion to a second volume will not occur until the hydrogen concentration in the new compartment reaches 8% by volume. There is very little data on hydrogen concentrations required for propagation. However, several tests were conducted at the Whiteshell Nuclear Research Establishment for the Ice Condenser Owners Group. In one test reported in Reference 6, a hydrogen-air mixture was ignited at the closed end of a pipe. The opposite end of the pipe was connected to a large sphere but the two were separated by a 15 psi rupture disc. When the disc ruptured, the

flame propagated into the sphere containing 6% hydrogen in the air. In other tests without a rupture disc and uniform concentrations throughout the system, a flame initiated at the closed end of the pipe propagated into the sphere at hydrogen concentrations as low as 5.5%. Although these tests were not designed to determine the lower limit of propagation, they do demonstrate that the 8% value used in the analysis is conservatively high.

The base case analysis included in Reference 1 assumes an average flame velocity of 6 feet/second. The burn time is input to the CLASIX-3 computer program at the time of ignition to calcuate the rate of combustion. The burn time is specified as being the result of dividing the flame path length by the flame speed. Because of the end use of the flame speed to determine the combustion rate, the flame speed relative to the gas rather than the rate of change of physical position (absolute velocity) is the parameter of interest. Thus it is most appropriate to determine the flame speed in a constant volume test vessel.

In approximately 50 tests conducted at Fenwal Laboratories for Westinghouse, quiescent mixtures of hydrogen, steam and air were burned in a closed vessel. The results presented in Reference 7 show that the flame speed was less than 3 fps for all tests of mixtures containing less than 10% hydrogen. These results are confirmed by the quiescent tests performed at WNRE.

Tests with turbulence resulted in higher flame speeds as well as higher fractions of hydrogen consumption. In some of the tests at WNRE, a fan was operated during the burn. No turbulence measurements were made in the test vessel but some pertinent information is available on the fan from Reference 8. At 1100 rpm, the fan flow was 15 cfm but during the tests the fan was operated at 1500 rpm. At 1100 rpm the fan flow corresponded to 7 test volumes per minute. At 1500 rpm, the flow rate can be expected to be considerably higher. The results of the tests with the fan operating resulted in flame speeds of 5.5 fps at 5.5% hydrogen and up to 7 fps at 7% and 8% hydrogen. The corresponding amounts of hydrogen burned were 83%, 100%, and 100%, respectively. However, the turbulence which increases flame speed and the degree of completion of reaction will also decrease any non-uniformity in the hydrogen distribution.

If similar turbulence were assumed in the Mark III containment, it would be more appropriate to use a criterion of 85% completion at 5.5% ignition. Assuming a conservatively high flame speed of perhaps 14 fps, the net effect of this would be to burn 85% of 5.5% or an equivalent of 4.7% hydrogen compared to 85% of 8% or an equivalent of 6.8% hydrogen in the base cases. With the higher flame speed, the turbulent values would result in a combustion rate 60% higher but 45% less hydrogen would be consumed in a given burn. The analytical results would show more burns with lower peak pressures and temperatures. Thus the values used in the base case provide higher temperatures and pressures and are therefore conservative.

REFERENCES:

1. CLASIX-3 Containment Response Sensitivity Analysis Prepared for Hydrogen Control Owners Group.

2. "The Behavior of Hydrogen During Accidents in Light Water Reactors," Sherman, et al, NUREG/CR-1561, August 1980.

3. "Igniter Development Conducted by AECL Whiteshell," Appendix A.2 of the 5th Quarterly Report Submitted to NRC by TVA, January 15, 1982.

4. "Igniter Tests - Endurance and Acceptance Tests," Appendix M, TVA Sequoyah Nuclear Plant Core Degradation Program, Volume II, December 1980.

5. "Hydrogen Mixing and Distribution Studies Conducted by Hanford Engineering and Development Laboratory," Appendix A.6 of the 5th Quarterly Report Submitted to NRC by TVA, January 15, 1982.

6. "A Review of Recent Experiments at WNRE on Hydrogen Combustion," Tamm, et al, Presented at the Second Internation Workshop on the Impact of Hydrogen on Water Reactor Safety, Albuquerque, New Mexico, October 1982.

7. "Flame Temperature Criteria Tests," Tsai, et al, Presented at the Second Internation Workshop on the Impact of Hydrogen on Water Reactor Safety, Albuquerque, New Mexico, October 1982.

8. "Hydrogen Combustion Conducted by AECC Whiteshell," Appendix A.3 of the 5th Quarterly Report Submitted to NRC by TVA, January 15, 1982.

5. Provide justification for the characteristic length used to determine the burn time.

RESPONSE:

Throughout the open volume of the Mark III containment, there is a fairly uniform matrix of igniters. However, there is no uniformity in the proximity of these igniters to the spargers. Also, the active spargers during a hydrogen generation transient, although distributed, will be randomly selected. Thus, the probability that a combustible concentration would reach an igniter and ignition would occur coincidentally at any two igniters is extremely small. The problem is further complicated by the influence of natural convection flow as well as flows induced by deflagration.

It can be expected that the hydrogen deflagration will be characterized as a large number of burns, randomly initiated and partially overlapping in duration. This type of deflagration would pose no threat to the containment integrity. As an upper bound on the temperature and pressure which might be generated by this type of burn, a conservative estimate would assume a single igniter in each volume and the characteristic length representing the entire volume.

The analysis was based on a very conservative characteristic length of 11 feet in the wetwell and a more representative characteristic length of 72 feet in the containment.

6. Expand the number of cases which consider no operation of containment sprays. The additional calculations should evaluate sensitivity to the following:

   a. ignition limits

   b. minimum requisite O_2 concentration

   c. burn time

   It appears that case SA-9 did not result in a containment burn due to the relatively high steam concentration suppressing the oxygen concentration to just barely below 5%. It is unreasonable to terminate the calculation if its extension would result in a containment burn due to gradual cooldown and steam condensation. Therefore when considering the above requests for additional analyses and when reevaluating case SA-9 do not terminate calculations when their continuation may result in significant hydrogen combustion. Furthermore the above arguments and the subject analysis (SA-9) performed to date was in reference to the postulated SORV accident. Provide similar analyses to that requested herein for the postulated small drywell break accident.

   RESPONSE:

   The Hydrogen Control Owners Group does not believe that any additional studies need to be performed for situations without containment spray available. The results from sensitivity case SA-9, as discussed in Reference 1, showed that unavilability of the containment spray does significantly affect the base case results.

   Two redundant containment spray trains powered from diverse offsite and onsite electrical supplies are included in the Mark III design. Given the large number of diverse systems capable of supplying the reactor presssure vessel with makeup flow, it is entirely probable that at least one of the containment spray systems will be available to operate and mitigate hydrogen burns. This conclusion is reinforced by the time interval available between the initiating event and the time when the first hydrogen burn occurs which is greater than 80 minutes.

   The Hydrogen Control Owners Group has extended the run for case SA-9 in order to resolve the stated concerns. The global burn in the upper containment was forced by arbitrarily reducing the oxygen concentration required to sustain combustion. The results from this are included in Figures 1 through 6.

   It is important to note that the Hydrogen Control Owners Group has not terminated analyses when additional hydrogen combustion may occur. For example all drywell break cases were extended well

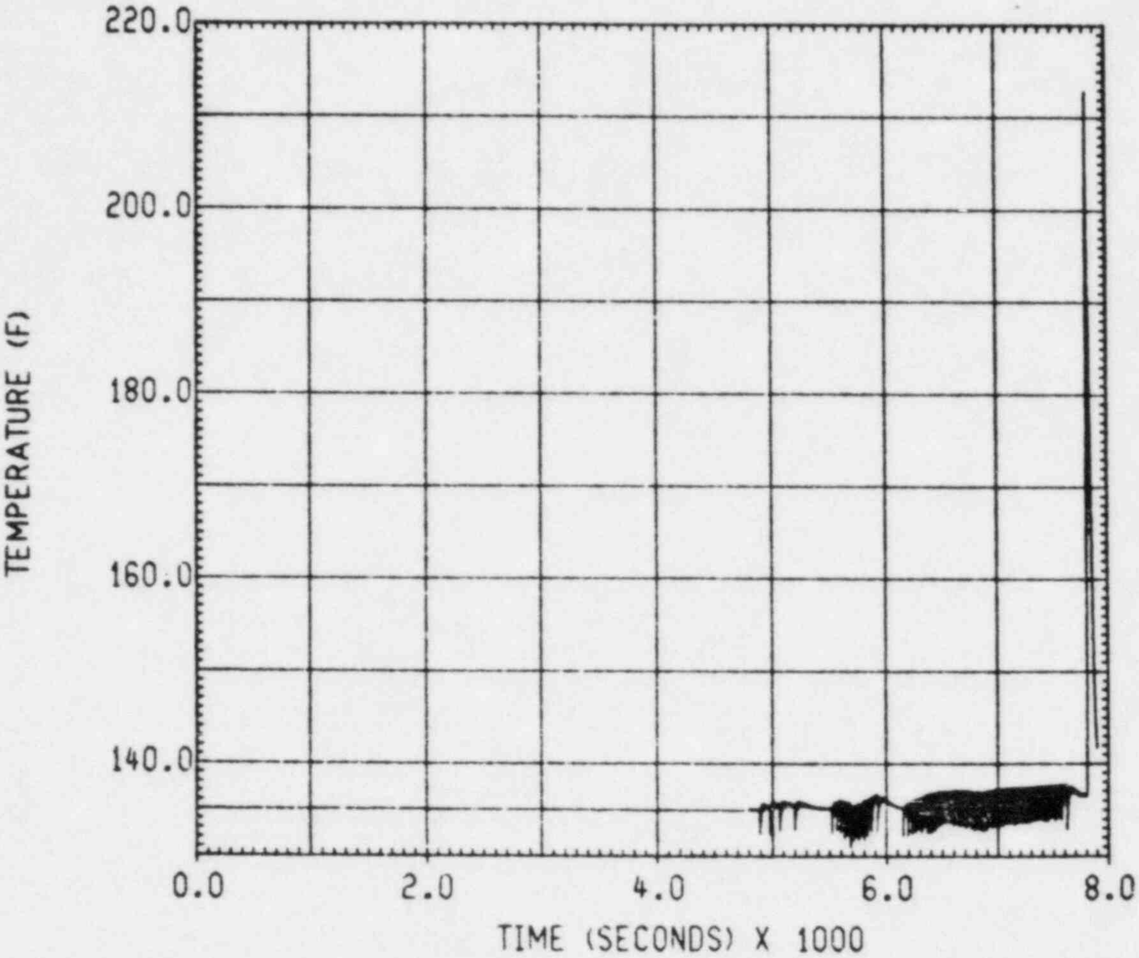
beyond the time at which hydrogen release was terminated which resulted in burns in the upper containment and in the drywell. In addition, the Hydrogen Control Owners Group forced a single global burn to occur in the stuck open relief valve (SORV) base case even though the code does not predict conditions capable of eliciting the global burn.

For the same rationale as provided above, the Hydrogen Control Owners Group does not believe that a need exists to perform any additional sensitivity studies on unavailability of containment sprays for the drywell break accident scenario.

REFERENCES:

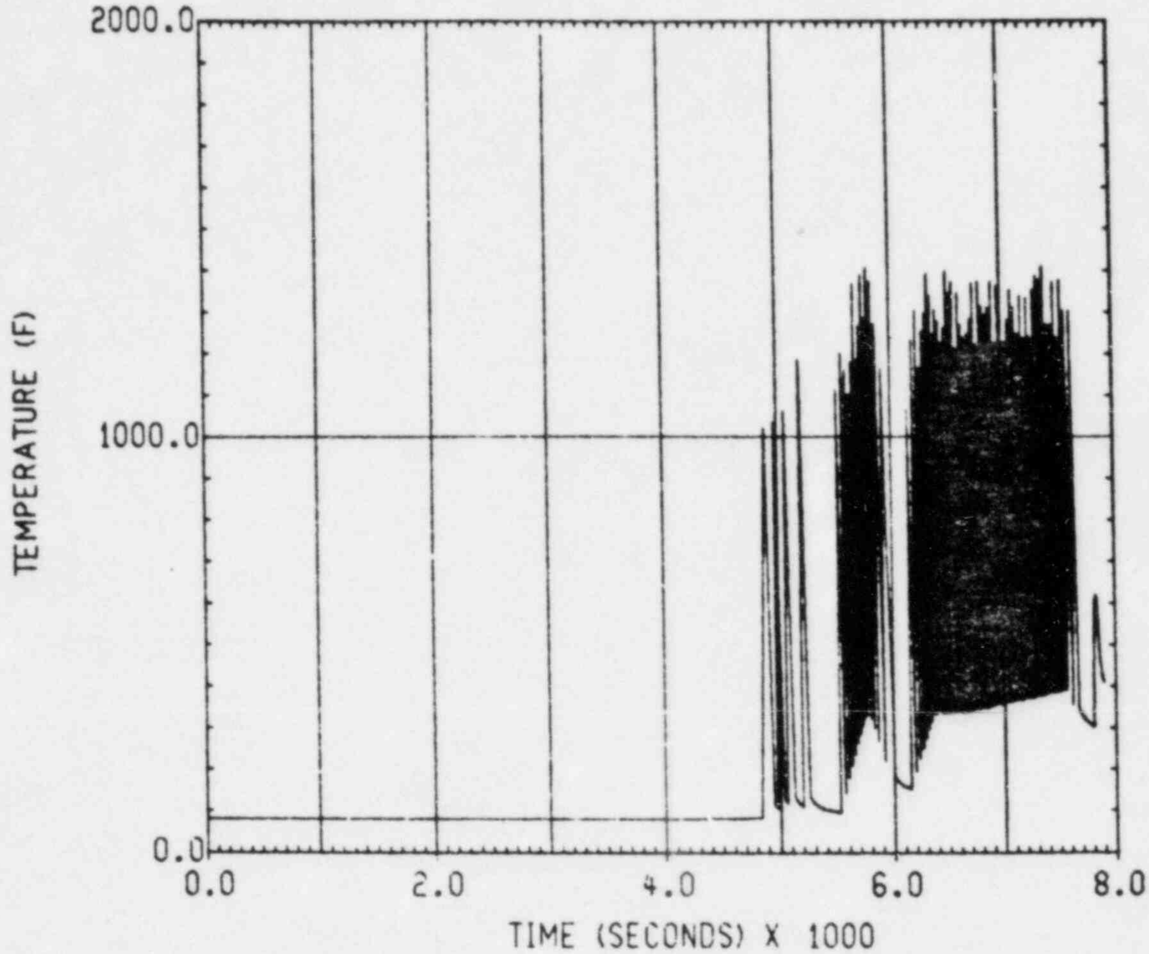
1. CLASIX-3 Containment Response Sensitivity Analysis, Prepared by Hydrogen Control Owners Group.

FIGURE 1



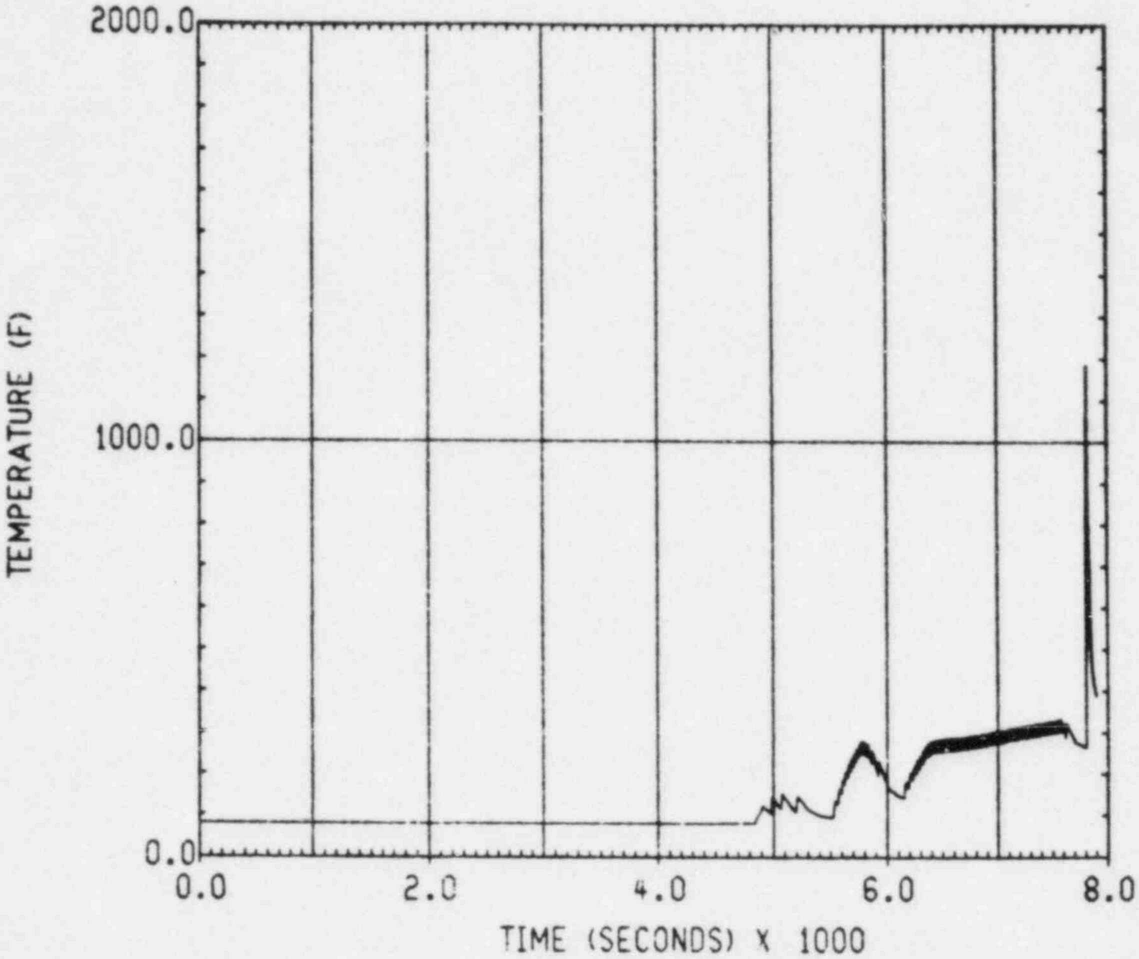
GGNS BASE CASE SORV
NO SPRAY
DRYWELL TEMPERATURE

FIGURE 2



GGNS BASE CASE SORV
NO SPRAY
WETWELL TEMPERATURE

FIGURE 3

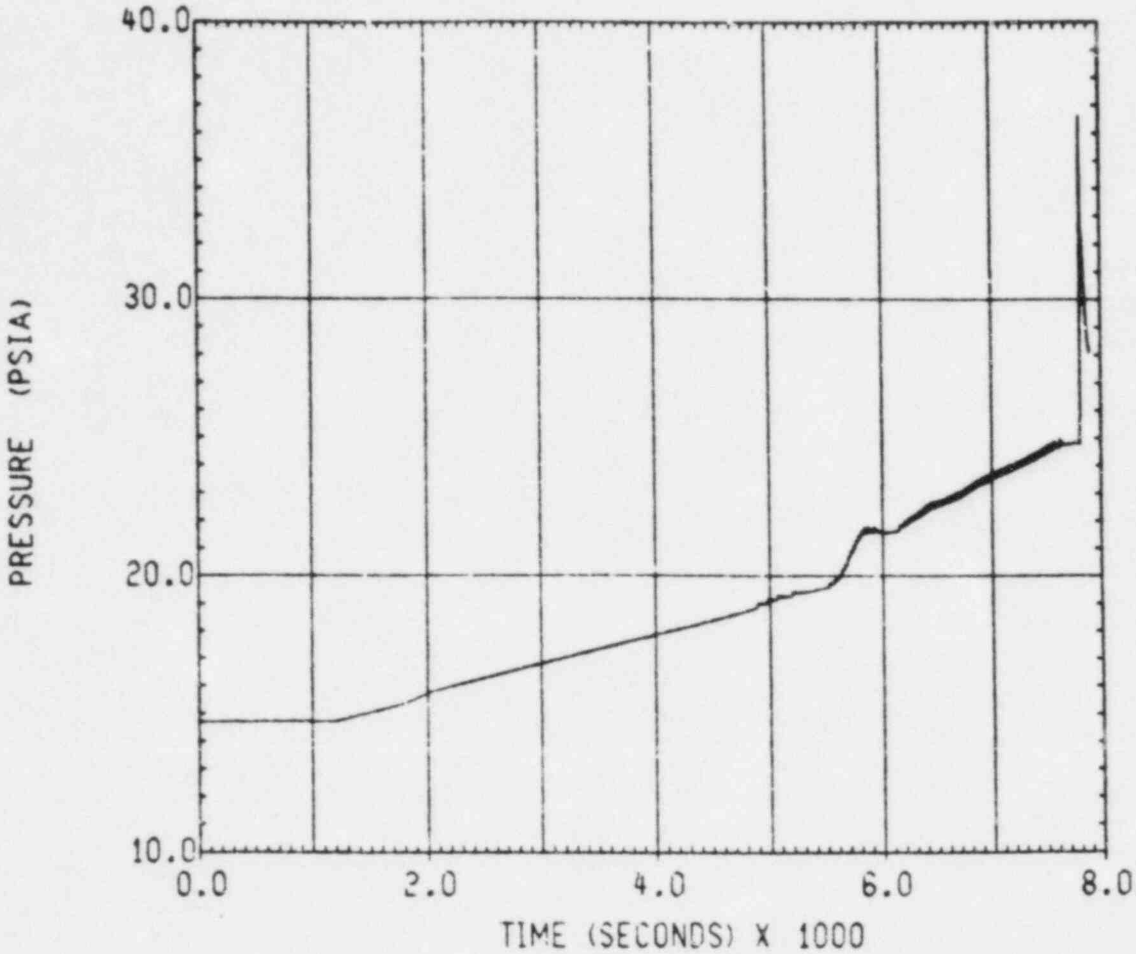


GGNS BASE CASE SORV

NO SPRAY

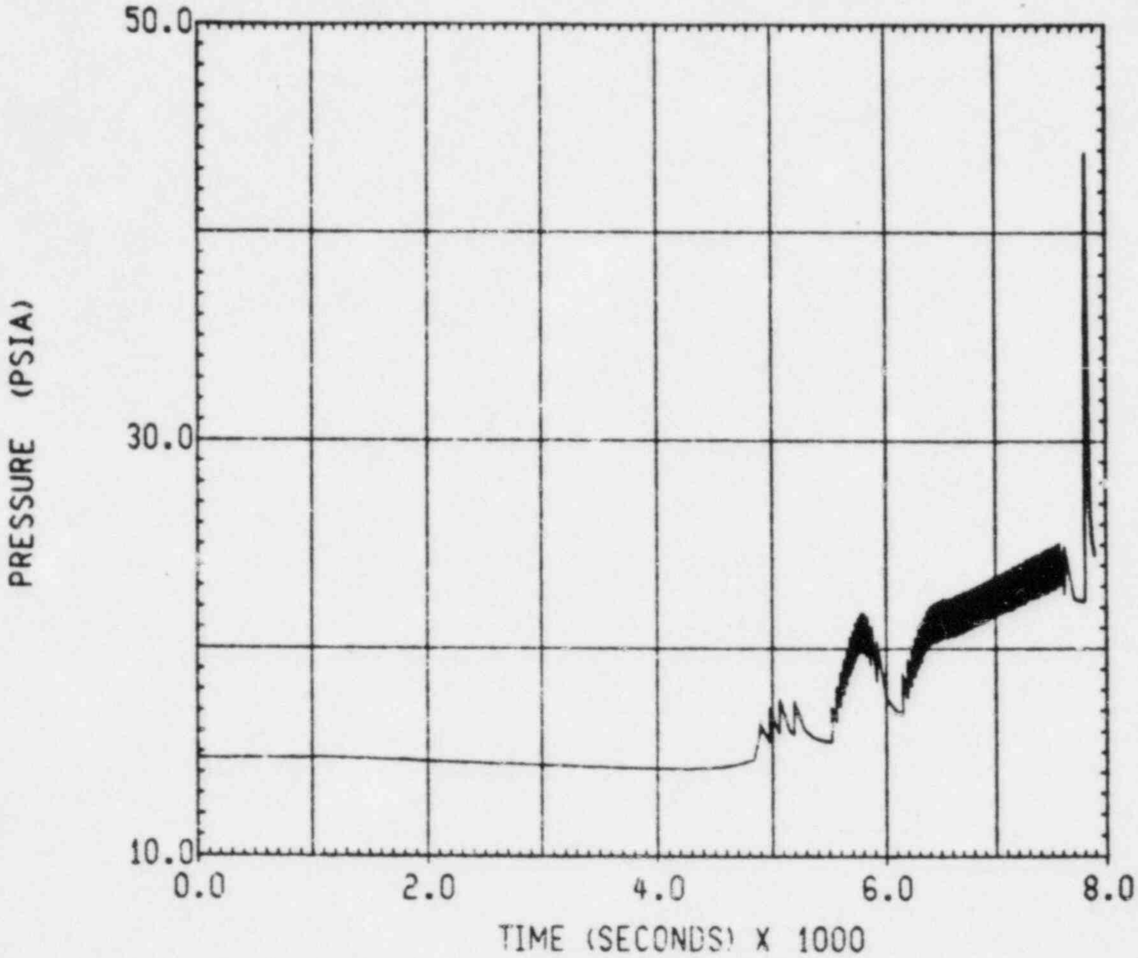
CONTAINMENT TEMPERATURE

FIGURE 4



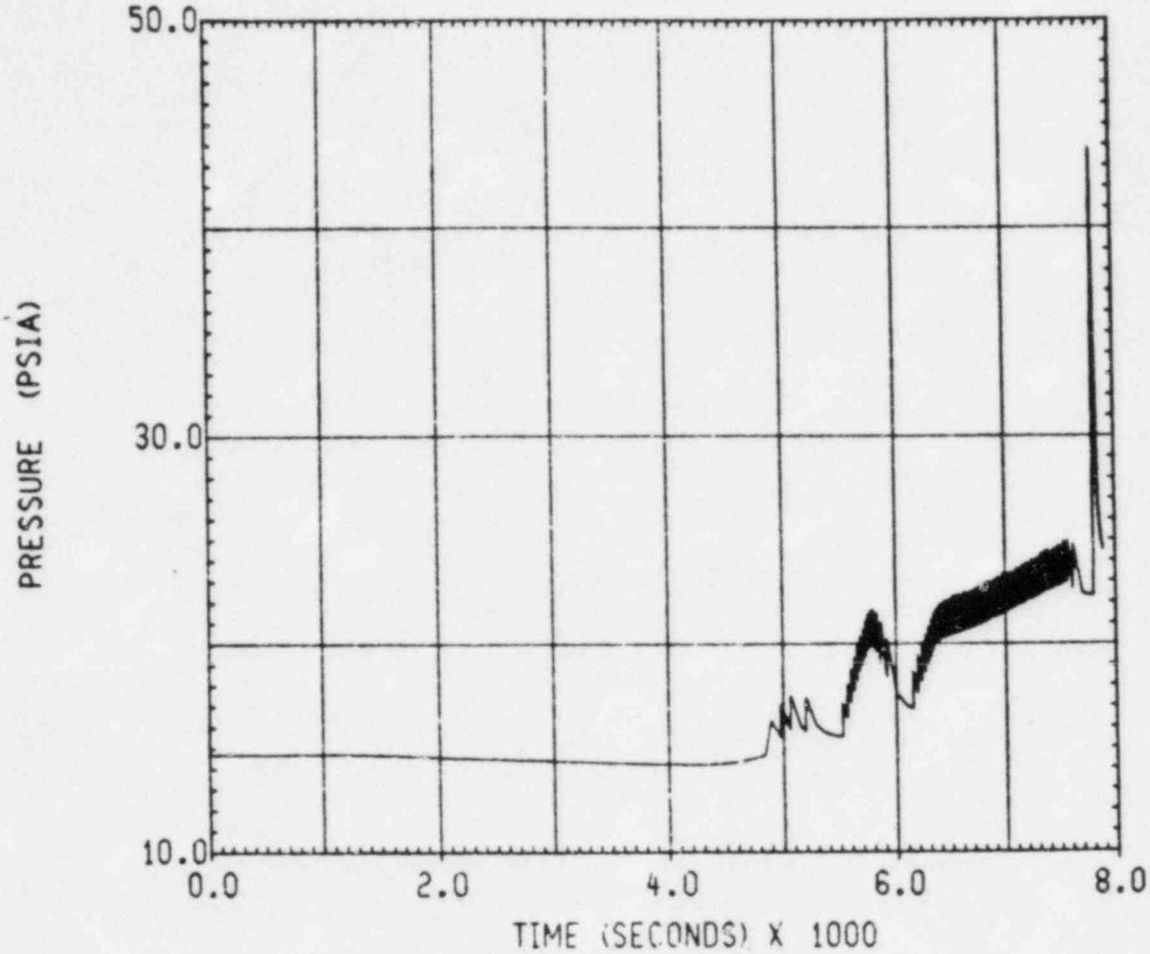
GGNS BASE CASE SORV
NO SPRAY
DRYWELL PRESSURE

FIGURE 5



GGNS BASE CASE SORV
NO SPRAY
WETWELL PRESSURE

FIGURE 6



GGNS BASE CASE SORV

NO SPRAY

CONTAINMENT PRESSURE

7. It is our position that the analyses of the consequences of a small break in the drywell have not sufficently considered the sensitivity to a number of parameters. Therefore provide additional sensitivity studies on the following parameters:

a. ignition criteria of 9-10% H_2 with 100% complete combustion

b. spray flow

c. minimum requisite O_2 concentration of 6% in the drywell

d. burn time

RESPONSE:

The Hydrogen Control Owners Group does not believe that additional sensitivity studies for the drywell break accident scenario as requested above are warranted. In addition, the HCOG feels that some of the requested runs are clearly unreasonable. In particular, the minimum requisite oxygen concentration run represents a 20% departure from the values used in the base case.

The Owners Group does not believe that discreet global burns will occur in the drywell. Reference 1 included a thorough evaluation of the most likely combustion mechanism in the drywell. Reference 1 concluded that as air is introduced into the steam and hydrogen rich drywell atmosphere via the purge compressors or vacuum breakers, combustion will take place in the form of an inverted diffusion flame at the purge compressor outlets. The inverted diffusion flames will produce slow pressurization of the drywell and will effectively prohibit global deflagrations at relatively high hydrogen concentrations. Additional work is not planned by Hydrogen Control Owners Group.

REFERENCES:

1. Mississippi Power & Light Letter AECM-82/25, dated March 2, 1982, from L. F. Dale to H. R. Denton.

8. Provide an evaluation of the consequences of pool dynamic loads created by the combustion of hydrogen. It is necessary to address the effects on both structures and equipment. Your evaluation should consider the effects of combustion in the drywell and combustion in the wetwell and containment. For events which produce combustion in the containment and which cause pool water to spray into the drywell, your analysis should consider the effect of the sprayed water cooling the drywell and contributing to the differential pressure transient.

RESPONSE:

The response to this question is plant specific and will be addressed by individual submittals from the HCOG members.

9. Provide an evaluation of the effects of differential pressures between the containment and drywell on essential equipment (e.g., vacuum breaker system, purge compressor system) and structures.

RESPONSE:

The response to this question is plant specific and will be addressed by individual submittals from the HCOG members.

1f. Provide a discussion of the emergency procedure guidelines to be followed for actuation of the igniter system. This discussion should address the evaluation of the following items:

a. Justification for manual or automatic actuation.

b. Interfaces with existing BWR EPG package (Rev. 2).

c. Justification for the time available for operation action.

d. Justification for the signals/setpoints intended to direct action and the impact of using such signals both on core recovery procedures and containment environment transients.

RESPONSES:

The emergency procedure guideline (EPG) for hydrogen control which has been drafted by the Hydrogen Control Owners Group (HCOG) requires activation of the igniter system when the reactor pressure vessel (RPV) level reaches or drops below [ ]* inches or when the RPV level cannot be determined. The EPG also requires activation of the igniter system if the hydrogen concentration in either the drywell or containment exceeds [3%]* by volume.

The Hydrogen Igniter System is manually activated. This is based upon the long time intervals available after the water level goes below top of active fuel, before conditions exist which could result in hydrogen combustion. Reference 1 transmitted the CLASIX-3 Containment Response Sensitivity Analysis prepared for the HCOG. Table 2 in this report lists the hydrogen release rate as a function of time. The table shows that hydrogen release does not begin until 2700 seconds into the accident and significant hydrogen release (i.e., greater than 1×10^{-3} lbm/sec does not begin until after 3300 seconds. The CLASIX-3 computer code which was used to predict the containment response to the hydrogen release predicts that the first hydrogen burn in the wetwell will not occur until approximately 4900 seconds into the accident for the scenario involving a stuck open relief valve. The code predicts that the first burn in the wetwell will not occur until approximately 5800 seconds into the accident for the scenario involving a small break accident in the wetwell.

The operator will therefore have a considerable period of time available before excessive quantities of hydrogen can begin to accumulate. This will allow the operator sufficient time to accurately conclude that an accident which requires activation of the igniter system has occurred.

The specific criteria which mandate activation of the igniter system assure that the system will be in operation well in advance of the time in the accident when the system must fulfill its safety function. The only source of hydrogen sufficient to necessitate use of the igniter system is large scale zirconium cladding -

*Number is specific to each plant.

reactor coolant interaction, which cannot occur unless the RPV level is below the top of active fuel. The draft EPG assures that the igniter system will be operable whenever the RPV level cannot be determined or is established to be below the top of active fuel.

Hydrogen combustion produced by the igniter system is not expected to occur at hydrogen concentrations below 4% hydrogen by volume. The draft EPG assures that the igniters will be operable before the hydrogen concentration increases to a value capable of supporting hydrogen combustion by requiring activation of the igniter system when the hydrogen concentration in either the containment or drywell exceeds [3%]* by volume.

The setpoints which are used as a basis for activating the igniter system will have no impact on core recovery procedures. Core recovery will involve restoring one or more of the emergency core cooling systems to operability. Activities relating to restoring the ECCS are not related in any way to activation of the igniter system. These setpoints assure that the igniter system will be operable well in advance of the time at which the first hydrogen burn could occur. Therefore these setpoints are conservative with respect to the containment environmental transients analytically predicted by the HCOG.

The proposed new EPG for hydrogen control interfaces with revision 2 of the BWR 1-6 Emergency Procedure Guidelines in numerous places. The following places in revision 2 of the EPGs refer to reactor pressure vessel (RPV) level dropping below the top of active fuel or inability to determine RPV level:

1. RPV Control Guideline, page RC-2, RC/L-1 line 9

2. RPV Control Guideline, page RC-3, RC/L-2 line 15

3. Contingency #1, page C1-1, second bullet in initial box

4. Contingency #1, page C1-4, last box on page

5. Contingency #3, Page C3-1, line 7

6. Contingency #6, page C6-2, item C6-3 first line

7. Contingency #6, page C6-3, item C6-5 first line

References will be made in each of these items to direct the operator to the new hydrogen control EPG.

REFERENCES:

1. CLASIX-3 Containment Response Sensitivity Analysis Submitted with Letter HGN-001, dated January 15, 1982, from the Hydrogen Control Owners Group to H. R. Denton.

*Number is specific to each plant.

11. Provide a discussion similar to that outlined in item 10 above for the actuation of the containment spray system and drywell purge compressors.

RESPONSE:

The Hydrogen Control Owners Group (HCOG) is developing an Emergency Procedure Guideline (EPG) which will integrate all operator actions required to respond to accidents involving significant generation of hydrogen. This guideline will include directions for activating containment spray, drywell purge compressors, and the hydrogen recombiners. At present the HCOG intends to submit the finalized guideline to the BWR Owners Group Emergency Procedures Committee for review and integration with the existing EPGs. When this new EPG has been reviewed and accepted by the BWR Owners Group Emergency Procedures Committee, the new EPG will be submitted to the NRC staff for review.

12. Provide an analysis of the concommitant effects of the largest credible containment detonation which could occur. Demonstrate that the effects of such an event could be safely accommodated by the structures and essential equipment. You may wish to consider a local detonation in the volume below the largest concrete/solid section of the HCU floor.

RESPONSE:

The Hydrogen Control Owners Group (HCOG) does not believe that either generic or plant specific analyses of postulated local detonations are needed. A substantial consensus exists among recognized authorities on hydrogen combustion that a transition to detonation cannot occur in the relatively open volumes which exist in the Mark III containment.

Reference 2 contained an evaluation of hydrogen control for Mississippi Power & Light's (MP&L) Grand Gulf Nuclear Station (GGNS). The evaluation was performed by Messers. Bela Karlovitz and Bernard Lewis who are two of the foremost experts on hydrogen combustion. Their conclusion, as expressed in the evaluation report, was that no danger of transition to detonation exists because the igniter system effectively precludes accumulation of large volumes of hydrogen-air mixtures with a composition in the detonable range in a geometry conducive to transition.

Reference 1 contained a detailed review of available literature related to hydrogen detonations. This literature review showed that most of the available information on hydrogen detonations has been obtained from rigid confinement conditions such as shock tubes. These results are not directly applicable to the large, open volume region in the Mark III containment.

The HCOG does not plan any futher work in this area.

REFERENCES:

1. Mississippi Power & Light letter AECM-82/25 from Mr. L. F. Dale to Mr. H. R. Denton dated March 2, 1982.

2. Mississippi Power & Light letter AECM-82/32 from Mr. L. F. Dale to Mr. H. R. Denton dated January 21, 1982.