MARK III CONTAINMENT
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HGN-106-NP

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

Attention: Document Control Desk

Reference: Letter from J. R. Langley, HCOG, to Robert Bernero, USNRC, "Supplemental Information on Secondary Burning," HGN-106, dated September 29, 1986.

Subject: Supplemental Information on Secondary Burning

In the June 19, 1986 meeting involving members of the Hydrogen Control Owners Group (HCOG) and the NRC staff, the HCOG presented data from a production test. At a point late in the test, burning occurred in a region above the HCU floor. This phenomenon is referred to as secondary burning, and was subsequently discussed with the NRC in an August 11 telephone conversation.

At the request of the NRC, the HCOG has documented information provided to the NRC in the August 11 telecon. This information, originally provided in the referenced letter, is summarized in the Attachment. As indicated in both the June 19 meeting and the Attachment, the HCOG does not consider additional evaluation of secondary burning to be warranted.

The attached document is the non-proprietary version of the referenced letter and is submitted in accordance with 10 CFR 2.790. Proprietary information contained in the referenced letter has been omitted from this document.

This submittal was compiled by HCOG from the best information available for submittal to the Nuclear Regulatory Commission. The submittal is believed to be complete and accurate, but it is not submitted on any specific plant docket. The information contained in this letter and its attachments should not be used for evaluation of any specific plant unless the information has been endorsed by the appropriate member utility. HCOG members may individually

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reference this letter in whole or in part as being applicable to their specific plants.

Very truly yours,

J. R. Langley
Project Manager

JRL/EEH/tm

Attachment

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Attachment to HGN-106-NP

Responses to Questions

INTRODUCTION

The Hydrogen Control Owners Group (HCOG) presented the results of Test * to the NRC in a June 19, 1986 meeting. The data from this test indicated that at an oxygen concentration of approximately * , burning on the pool extinguished and was subsequently measured in a region above the HCU floor * .

In an August 11, 1986 telephone call between HCOG and the NRC, HCOG provided responses to questions that had been identified by the NRC in an earlier meeting. The HCOG also committed to provide written responses to these questions. This documentation is provided below.

DISCUSSION

As a note of clarification, secondary burning will not occur in the Clinton Power Station facility due to the large air volume in the containment (i.e., the amount of oxygen consumed by hydrogen combustion arising from a 75% MWR will not result in a final oxygen concentration of less than *). Therefore, the discussions below will focus on River Bend, Grand Gulf and Perry.

Question 1:

How much hydrogen must be burned to create conditions conducive to secondary burning? How is this value affected when operation of the vacuum breakers and drywell mixing compressors is considered?

Response:

As indicated in Test * in which secondary burning was observed, this combustion phenomenon does not occur with oxygen concentrations above approximately * . Calculations indicate that the oxygen concentration in the full scale containment will drop below * at:

River Bend	69% MWR
Grand Gulf	65% MWR
Perry	55% MWR

The assumptions that were used in determining these values are summarized in Table 1. When it is assumed, that due to the operation of vacuum breakers and/or mixing systems, that the drywell air mass is introduced into the containment, then the point at which the oxygen concentration is calculated to decrease below * is:

River Bend	>75% MWR
Grand Gulf	>75% MWR
Perry	~67% MWR

*** Deleted due to proprietary information.**

These values were calculated assuming both the drywell and containment air masses are in the containment volume during the duration of the transient. A detailed mechanistic modeling of the air transfer process was not used in calculating these values.

Question 2:

Discuss how test facility initial conditions could be modified by pre-inerting (with nitrogen or other gas) such that the endpoint oxygen concentration for the prototype plant would be attained at the end of a test, even assuming continuous operation of the purge for the infrared cameras.

Response:

The HCOG had previously investigated the various methods by which the ¼ scale test facility could be pre-inerted. It was determined that while pre-inerting with nitrogen would support an accurate simulation of the initial oxygen concentration, it would not allow for the proper simulation of the oxygen depletion curve which would occur in prototype plants. This is illustrated in Figure 1, which provides a comparison of the oxygen depletion curves for a prototype plant and the ¼ scale facility, which has been pre-inerted to simulate the proper airmass. This figure shows that the slope of the oxygen concentration during the tail portion of the transient is steeper in the prototype plant than in the facility. This is due primarily to the addition of oxygen via the camera purges in the test facility. Therefore, the oxygen concentration in a pre-inerted test facility would nearly always be higher than that in prototype plants at the same times. This would result in the ¼ scale facility spending a longer time in the secondary burning regime than would the prototype plant.

As noted in the previous meeting with the NRC, an air purge is used to minimize condensation on the infrared camera enclosures. The camera purge system is operated continuously throughout a test at a constant flow rate of approximately * per camera. The cameras are an integral part of the test data and the air purge is necessary to optimize the quality of the videotapes. HCOG has evaluated options to the camera purge (e.g., intermittent purge flow vs. continuous, and nitrogen instead of air as the purge gas), and determined that the options represented potentially significant impacts to the schedule and cost of the test program. For example, the use of nitrogen, in lieu of air, as the purge gas would require the installation of a nitrogen system which is capable of supporting the pre-inerting of the facility prior to tests, of providing a regulated flow which could be used to maintain the proper nitrogen concentration during latter preconditioning of the test volume, and a constant flow to the camera purge system throughout a test.

In addition to the camera purges, the pre-inert option is adversely impacted by the inability to exactly simulate the free volume air space of different containment geometries in the 1/4 scale test facility.

*** Deleted due to proprietary information.**

Question 3:

What equipment is located in regions of the * that could experience secondary burning? Where is the redundant equipment?

Response:

As presented in the previous meeting with the NRC, secondary burning has only been observed * . This burning occurred when the stuck-open relief valve was located * , and was measured * in the 1/4 scale facility. Under the appropriate conditions, i.e., low oxygen concentration and a stuck-open relief valve in the * , secondary burning may also occur in the * , with burning expected to occur * as was the case in * .

In both the June 19 meeting, and HGN-099 which transmitted copies of slides for that meeting, the HCOG has identified the regions * that experienced secondary burning. These zones (i.e., those reflecting temperatures *) were used in identifying the equipment in Table 2 that could be affected by secondary burning occurring in either the * .

Question 4:

Discuss basis for the * secondary burning limit presented by HCOG in HCOG-NRC meetings.

Response:

The * secondary burning limit was defined after evaluation of * test data. As illustrated in Figures 2 and 3, secondary burning * initiated at the time when the oxygen concentration was * . Figure 4 provides the hydrogen concentration history for Test * .

Several tests have been conducted that had final oxygen concentrations at or below * . Figures 5 through 7 provide oxygen concentration profiles for * tests * . As indicated in these figures, the final endpoint concentration for oxygen * . Secondary burning was not observed in any of these tests.

CONCLUSIONS

The preceding documents information previously presented to the NRC in meetings and telephone calls. It indicates that conditions which would support the occurrence of secondary burning will not occur until very late in an accident

*** Deleted due to proprietary information.**

scenario which leads to a 75% MWR. HCOG has also indicated that both the assumption of a recoverable accident that results in a 75% MWR, and an accident scenario which includes a long, constant "tail" are very low probability events. If indeed secondary burning does occur, it would be a localized phenomenon, and this would preclude this burning from adversely affecting redundant components of the same system. It was also noted that for a drywell break scenario [illegible] LOCA), the drywell air is assumed to be introduced into the containment, such that an event involving a 75% MWR may not result in conditions which could support secondary burning.

Therefore, due to the low probability of secondary burning and the fact that it is a localized phenomenon that would not be expected to affect more than one train of safety-related equipment, the HCOG does not believe modifications to its current testing program to better quantify this combustion phenomenon are warranted.

TABLE 1. Assumptions for Oxygen Depletion Calculations

Initial Pressure	= 1 atm
Initial Temperature	= 80°F (Containment) = 130°F (Drywell)
Relative Humidity	= 50%
Test Facility Volume	= 21190 ft^3
Camera (Air) Purge Rate	= *
Endpoint Hydrogen Concentration	= *

	Free Volume (ft^3) Containment	Drywell	75% MWR Equivalent Hydrogen Injection (lbm)
Grand Gulf	1.39×10^6	270,130	2598
Perry	1.15×10^6	277,700	2429
River Bend	1.19×10^6	236,200	2027

* Deleted due to proprietary information.

Table [illegible] 'een excluded due to
the propr[illegible] ture of its contents.

Figures 1 through 7 have been excluded due to the proprietary nature of their contents.