MARK III CONTAINMENT
HYDROGEN CONTROL OWNERS GROUP
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June 2, 1986*
HGN-094

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

Attention: Mr. Robert Bernero

Dear Mr. Bernero:

Reference: 1) Letter from Hobbs to Bernero, Vertical Flow Blockages and Containment Spray Carryover Fraction, HGN-054, dated August 28, 1985

2) Letter from Bernero to Hobbs, dated August 16, 1985

3) Letter from Bernero to Hobbs, dated April 2, 1985

Subject: Blockages to Horizontal Flow

In References 2 and 3, the NRC staff identified a concern related to the manner in which the Hydrogen Control Owners Group (HCOG) has addressed the issue of modeling blockages to gas flow in the 1/4 scale test facility. In subsequent meetings and conversations with the NRC, the concerns were clarified to HCOG as involving the following:

a) horizontal blockage to vertical gas flows and its effect on both the carryover of containment spray to the wetwell and the global gas flow patterns;

b) vertical blockages to horizontal flow fields and the potential for high local velocities near blockages that could affect the heat transfer mechanism to equipment required to survive hydrogen combustion;

c) vertical blockages in the River Bend Station in the vicinity of the unit cooler exhaust ducting and the effect of this blockage on the ability of the unit cooler to distribute cool air

*This letter was previously transmitted to the NRC via HGN-063, dated May 2, 1986 without page 4. This submittal supersedes HGN-063 in its entirety.

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Item (a) above has been addressed by HCOG in Reference 1. This letter indicated that the blockages which HCOG has committed to have in place during production tests are representative of horizontal blockages present in prototype plants. Sufficient horizontal blockage has been installed in the 1/4 scale test facility to eliminate spray carryover to the wetwell in all chimneys, except the relatively unobstructed equipment hatch chimney.

Items (b) and (c) above are addressed in the following discussions.

Vertical Blockage to Horizontal Flow

The question is related to the acceptability of using gas velocities measured in scoping and production tests to support equipment survivability analyses. The NRC has indicated that since the 1/4 scale test facility does not simulate all blockages attributable to equipment and structures that are present in prototype plants, horizontal gas velocities measured in the test facility may be lower than in the prototype plants. This is postulated to arise in regions of the containment where equipment and structures which represent blockages to horizontal gas flow significantly reduce the available flow area. The reduced flow area would then result in an acceleration of the gas flow and increase the magnitude of heat transfer to component(s) in the flow path.

In response to this concern, the HCOG has reviewed test data from the scoping test program. Based on the review of data, HCOG considers the level of blockage to horizontal flow in the 1/4 scale facility to be adequate. This conclusion is based on the low horizontal velocities measured in the 1/4 scale facility, the absence of significant deflagrations, and the level of blockage in prototype plants. Each of these factors is discussed below.

a) Horizontal Velocities

Horizontal gas velocities are measured at eight locations in the 1/4 Scale Test Facility. The eight velocity probes are located at the 8' (4 probes), 10' (1 probe) and 13.9' (3 probes) elevations. Though peak velocities measured in the scoping test program occurred at the probes on the 8' elevation, these probes will not be discussed in depth due to: a) the fact that the peak velocities persisted for short durations, and b) the proximity to the suppression pool precluded their providing relevant

information in regards to velocities in regions where equipment is installed in prototype plants. Therefore, the ensuing discussion will focus on horizontal velocity measurements at the 10' and 13.9' elevations. Horizontal velocities above the HCU floor have averaged about 3.5 fps full scale. Peak horizontal velocities in zones where equipment is located have ranged from 2 to 7 fps full scale but have persisted only for short time periods. In the wetwell just beneath the HCU floor, measured velocities have averaged about 2.5 fps full scale during the majority of combustion in several tests.

Considering that the small, horizontal velocities at elevations above the HCU floor, over the majority of the hydrogen release history for several tests, represent background velocities consistent with natural convection induced air currents, acceleration of the flow due to 10 to 24% area restrictions is of minimal consequence to equipment.

b) Level of Blockage

The NRC concern is premised, at least in part, on the absence of detailed modeling of blockages to horizontal flow in the 1/4 scale facility. HCOG has indicated that major blockages in prototype plants have been modeled in the test facility, but acknowledges that this does not entail the modeling of all equipment or structural elements. It should be noted that some additional level of blockage is provided by the River Bend unit cooler ductwork.

In order to assess the degree of blockage which exists in a prototype plant, and assess the reduction in the available flow area which results from this blockage, a review was conducted of plant drawings for a representative Mark III containment plant. This review involved selecting elevations and azimuths which were considered to be heavily congested, and calculating the available flow area along the resulting plane. This review was performed using a computerized set of plant drawings. The drawing data base included cable trays and small bore piping, but did not include instrument lines or conduit.

Five azimuthal planes were evaluated at the HCU floor. The HCU floor elevation was chosen because of the high level of congestion provided by the hydraulic control units (HCU), and because this elevation should experience the highest horizontal velocities for regions with equipment present. The azimuthal

locations resulted in cross-sectional areas involving HCUs and similar large components. The subject evaluations indicated that the resulting area available for gas flow ranges between 76 and 90 percent of the total cross-sectional area. This degree of vertical blockage to horizontal flow fields should not result in a significant acceleration of gas flows.

For the reasons discussed above, the current level of blockage included in the 1/4 scale test facility is deemed adequate, and the horizontal velocities measured in the test facility can be accurately scaled to represent the full scale velocity fields.

Vertical Blockage to Unit Cooler Exhaust

The NRC concern is related to the ability of the unit cooler system to properly perform its design function if the exhaust duct discharges are obstructed by vertical blockages (e.g., structures, components, panels, equipment). Unit coolers are used by the River Bend Station, in lieu of containment sprays, to reduce containment temperatures in post-accident conditions. The system employed by this utility has two safety grade unit coolers with a capacity of 50,000 CFM each. The unit coolers take suction locally and exhaust through the Reactor Plant Ventilation System. This results in chilled air being distributed throughout the containment and exhausted from the ventilation system at 70 separate locations. The various release points are distributed in the River Bend Station as follows: 12 discharge points at the 186'-3" elevation (refueling floor); 23 at the 162'-3" elevation (unit coolers installed at this level); 14 at the 141'-0" elevation; and 21 at the 114'-0" elevation (HCU level). The duct flowrates and discharge velocities similarly vary throughout the ventilation system.

The diversity of discharge locations and flow rates precludes the concern that a limited number of blockages can significantly reduce the effective distribution of chilled air.

Conclusion

The presence of equipment and structural blockage in either the 1/4 scale test facility or the prototype plants will have an insignificant effect on horizontal velocities. Therefore, the 1/4 scale facility is acceptable in its current configuration with regards to this concern.

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

Very truly yours,

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