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Office of Nuclear Reactor Regulation
Attn: J. F. Stolz, Director
PWR Projects Directorate No. 6
U.S. Nuclear Regulatory Commission
Washington, DC 20555

Dear Mr. Stolz:

Three Mile Island Nuclear Station Unit 1 (TMI-1)
Operating License No. DPR-50
Docket No. 50-289
Control Room Habitability

This letter responds to your December 23, 1985 letter and questions raised during the April 23, 1986 meeting. Additional description of our Control Room Habitability analysis submitted October 18, 1985 and the results of smoke tests performed in 1986 are included.

Primarily, there are two issues raised in your December 23, 1985 letter which are addressed as follows:

First, a positive pressure of 0.1" H_2O is not maintained at all locations in the Control Building Envelope (CBE) with or without the worst case Control Room (CR) HVAC single active damper failure. This is postulated to result in infiltration to the CR from in plant areas.

Second, the degree of conservatism in the existing GPUN analysis for the source term developed for internal release pathways was questioned. This analysis assumes that the source term is fully mixed in the Auxiliary and Fuel Handling Building (A & FHB) upon release from the Reactor Building (RB) prior to entry into the Control Building Hallway or Patio. The concern was that unique flow patterns or "sneak paths" might exist which would limit mixing in the A & FHB and thus result in a concentrated source term entering the Patio.

The first concern has been addressed in GPUN's submittal of October 18, 1985 which considered the dose contribution to the control room operator from infiltration. A conservative calculation of inleakage to the CBE is used for locations where a positive pressure of 0.1" H_2O is not achieved. This inleakage is included in the dose analysis and a source term associated with leakage from the RB to the A & FHB is applied to determine control room operator exposure. Section II of Technical Data Report (TDR) 728 details the technique employed in calculating inleakage. The conservatism associated with this method assures the calculated operator dose will be conservative.

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In order to address the second NRC concern, the assumptions utilized in developing the source term applied to inleakage have been reviewed in detail both analytically and empirically to insure that they are bounding.

This review is summarized as follows:

A. Releases

The release is assumed to occur in the Auxiliary Building (AB). All radionuclides in the RB from the LOCA are assumed to be released to the AB even though only about 4% of the RB surface area is adjacent to the AB/FHB. Approximately 40% of all RB penetrations are located in the AB/FHB. The Murphy-Campe method for calculating releases is based upon surface area and not the concentration of penetrations. Therefore, it is valid to compare the assumption of releasing 100% of the radionuclides into the AB to the amount of adjacent RB surface area to assess a degree of conservatism.

B. RB Leakage

RB Leakage rate was calculated consistent with the requirements of Reg. Guide 1.4. This assumes a leak rate of 0.1% for the first 24 hours after an accident, followed by a leak rate of 0.05% for the remaining 29 days. 0.1% leakage rate is based upon RB design pressure during a LOCA. This method is conservative as the TMI-1 FSAR analysis determines that the peak RB pressure lasts for only the initial 100 seconds following a LOCA. Within the first 2 hours, building pressure would be less than 5 psig.

C. Source Term Transport

The dose model assumes that the A & FHB H&V System provides complete mixing of the RB release. In addition, a driving force is assumed which draws air from the A & FHB to the patio. These assumptions are conservative. Mixing uniformly and instantaneously distributes the source term at all locations and disregards time for decay and transporting the source term from the RB wall to the point where it enters the patio. In fact, mixing will not be perfect but will function to preferentially reduce the concentration. The A & FHB H&V design promotes direct removal of RB leakage via its exhaust system through the A & FHB exhaust stack. In addition, A & FHB Supply Fans will be automatically shutdown upon detecting high radiation in the exhaust, as described in TMI-1 FSAR Sections 9.8.2 and 9.8.3. This mode of operation will increase the direct leakage removal capability of the system and preclude source term transport to the Patio. Without supply fans, air supply to the A & FHB is via infiltration induced by the exhaust fans. This will draw air away from rather than into the Patio.

The dose model assumes a continuous flow through the patio, equivalent to that if the Patio H&V exhaust system were not shutdown. This assumption provides a driving force for introduction of air from the A & FHB to the patio. This is conservative since, by design, the patio H&V System will shutdown automatically as a result of either high radiation in the Control Room HVAC Supply or an Engineered Safeguard Signal. This will substantially reduce the rate at which contamination can enter the patio and CBE.

Therefore, the TMI-1 H&V system designs preclude sneak paths of concentrated source terms to the Patio and the existing assumptions used for generating an internal pathway source term are bounding.

D. Empirical determination of TMI-1 Internal Pathways

In order to demonstrate that the assumptions used in the source term transport model are conservative, GPUN performed the following:

1. An evaluation of previous internal release occurrences; namely, a make-up pump seal failure and a leak in the Spent Fuel Pool Cooler Room. The occurrences were independent, but in both cases, the A & FHB H&V system and all CB HVAC systems were operating normally.

   In both events activity was discharged from the A & FHB Exhaust Stack. There was some migration of activity to the operating floor of the Fuel Handling Building where it was subsequently discharged out the TMI-1 and TMI-2 exhaust stacks. In both cases there was no activity detected in the control room. The pathway for transport to the FHB operating floor was determined and does not present a potential for "sneak" paths to the patio or CBE. Note that the releases were minor and were not sufficient to trip the A & FHB supply fans.

2. A smoke test to determine air flow patterns in the Patio and A & FHB HVAC System.

   The smoke test was performed with the CB HVAC System in the Radiation Emergency Mode and with the A & FHB H&V System in normal operation. In addition variations in associated system operation were performed to determine if there was any impact on air flow patterns. These variations consisted of closing outside air intake (OAI) damper AH-D-39, opening AH-D-39 to a preselected position, operating and not operating the Control Access Area (CAA) Emergency Recirculation System and opening and closing doors on the CBE Boundary. Air mixing patterns were determined with AH-D-39 closed and supply fans serving the Turbine Building area adjacent to the Patio operating and not operating.

All forty-nine (49) sealed penetrations in the CBE adjacent to the CAA were found to have no detectable leakage. Of twenty-eight (28) penetrations in the Patio, four sealed penetrations showed no detectable leakage. The remaining twenty-four (24) exhibited varying degrees of minor infiltration and exfiltration. Most of the infiltration occurs from the Hot Machine Shop via the Turbine Building. Conditions in the patio were largely stagnant. An additional eighteen (18) penetrations outside the patio were tested to determine the potential sources of infiltration to the patio. Testing showed infiltration to the Hot Machine Shop from the Turbine Building, and infiltration to the CAA from the A & FHB. Observations of air flow patterns in the A & FHB in the area adjacent to the interface with the Patio indicate considerable air mixing. The aforementioned test variations did not vary the results and therefore did not change conclusions.

GPUN concludes from these tests that air flow to the patio from all adjacent areas is less than assumed in the dose model. Therefore, the assumed air flow is bounding. In addition, transport of the source term to the patio without mixing is not possible given the considerable mixing observed near the point of infiltration.

This supports the conclusion that the TMI HVAC design precludes sneak paths which preferentially direct a concentrated source term to the Control Building HVAC System.

E. Failure Modes Evaluation

Control room operator dose due to single active failures in the CB HVAC System have been considered. GPUN has concluded that no action is required to correct failures since the analyzed doses are well within the requirements of NUREG 0737 and GDC 19. However, GPUN has procedural requirements over and above those recommended in TDR 728. In addition to modifying procedures to set OAI damper AH-D-39 to a pre-selected position, visual inspection, and corrective action is possible, if required.

The more critical dampers (AH-D-39 and AH-D-28) are accessible, can be repositioned manually if necessary and have position indication available in the control room.

Internal pathways for radioactive material transport to the CBE were evaluated assuming operation of the A & FHB ventilation system. In the event of a loss of offsite power (LOOP) this system will not operate. Consequently mixing within the A & FHB generally will be

limited to diffusion and local thermal air movement with some local cubicle recirculating systems remaining in operation. Two factors will mitigate the introduction of radioactive material into the CBE in this event: First, the postulated entry point for contamination into the patio area is approximately 70 meters of transport distance from the containment penetration area. Diffusion along this path will be slow and will not be assisted by any preferential air movement. Thus, a substantial period will exist before contamination can reach the CBE. Second, the only significant HVAC system operating at this point will be the control room system. Since this system produces a positive pressure in all or most of the CBE the driving force for transport will be away from the CBE and patio, depending on failures assumed. This will further mitigate the potential for contamination entering the CBE. These mitigating factors will provide time to permit restoration of offsite power prior to reaching operator dose limits.

GPUN plans to insure that future modifications will not alter plant or systems configuration which would invalidate the Control Room Habitability Control Room Operator Dose analysis. Procedures will be revised to verify that modifications will not alter previous key assumptions which could affect analyses. This will maintain the validity of the Control Room Habitability analysis.

Sincerely,

H. D. Hukill
Vice President & Director, TMI-1

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cc: J. Thoma
R. Conte