Met-Ed / GPU

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November 1, 1979
GQL 1377

Director of Nuclear Reactor Regulation
Attn: R. W. Reid, Chief
Operating Reactors Branch No. 4
U. S. Nuclear Regulatory Commission
Washington, D.C. 20555

Dear Sir:

Three Mile Island Nuclear Station, Unit 1
Operating License No. DPR-50
Docket No. 50-289
Moderate Dilution Accidents

Attached please find the results of our moderator dilution accident analysis. Based on the results of this analysis, should the entire contents of the sodium hydroxide tank enter the decay heat system, while it is operating to cool the core, it would be possible that the reactor would go critical under certain core conditions. Met-Ed has modified the procedures to allow testing of only the sodium hydroxide tank engineered safeguards actuated valve associated with the idle decay heat loop. This would prevent a moderator dilution accident occurring due to a single failure.

Sincerely,

J. G. Herbein
Vice President-Nuclear Operations

JGH:DGM:tas

Attachment

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MODERATOR DILUTION ACCIDENT

This analysis is in response to a request for a criticality study due to a moderator dilution accident.

This request was initiated by a concern that a single failure could release the contents, or portion thereof, of the NaOH tank into the decay heat removal system while that system is being used to cool the core thus causing criticality.

The analysis assumed the reactor in the cold shutdown condition, vessel temperature less than 100°F, beginning of core life characteristics, vessel drained to a level approximately equal to the height of the outlet nozzle, lowest initial boron concentration allowed by Technical Specifications, the maximum worth control rod stuck in the fully out position, and no credit assumed for operator action.

The first part of the analysis was to determine the lowest initial boron concentration as allowed by Technical Specifications. The Technical Specifications require a 1% shutdown margin with the maximum stuck rod worth removed from the core. Using the current in-house computer code combination of XPOSE and XTG a critical boron concentration for an ALL RODS IN (ARI) condition with the core at 70°F was calculated to be 650 ppm. B & W, in the Cycle 5 Reload Report, presents a maximum stuck rod worth of 2.24% $\Delta k/k$ or a boron equivalent of 166 ppm using a boron worth of 74 ppm/1% $\Delta k/k$ at 70°F. Applying this value plus the boron equivalent to a 1% shutdown margin yields a final boron concentration in the vessel of 890 ppm.

The second part of the analysis involved determining the volume of the NaOH tank. TMI-1 Technical Specifications require 16,000 to 17,000 pounds of sodium hydroxide stored at a nominal 20 weight percent solution: typical site values are 16,500 pounds. In order to obtain a 20 weight percent solution it is necessary to have 2.035 pounds of sodium hydroxide per gallon of water or a total of 8108 gallons of water. When this is added to the piping volume from the tank to the Decay Heat Removal System (DHRS) of 135 gallons, a total volume of 8243 gallons is obtained.

The next step of the analysis was to compare this volume to that of the reactor vessel. The fluid volume of the vessel to the outlet nozzle is 18950 gallons. In addition, the volume of the piping of the DHRS from the BWST is 3142 gallons or a total of 22092 gallons of borated water. Applying the assumption that no water is lost from the system and a homogeneous mixture is obtained, there is a net reduction of 27.2% of the boron in solution. This would result in a final boron concentration of 648 ppm which would result in criticality.