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TMI-2 Cleanup Project Directorate
Attn: Dr. W. D. Travers
Director
US Nuclear Regulatory Commission
c/o Three Mile Island Nuclear Station
Middletown, PA 17057

Dear Dr. Travers:

Three Mile Island Nuclear Station, Unit 2 (TMI-2)
Operating License No. DPR-73
Docket No. 50-320
Canister Dewatering

The purpose of this letter is to provide additional information in support of GPU Nuclear's request for NRC approval of an alternative dewatering acceptance criterion for defueling canisters. GPU Nuclear letter 4410-86-L-0193 dated November 10, 1986 requested NRC approval for a fuel canister dewatering acceptance criterion based on the quantity of exposed catalyst in the canister. The dewatering acceptance criterion in this letter was expressed in terms of the weight of water removed as a function of canister payload. Satisfying that expression would achieve at least a factor of safety of three on the required quantity of catalyst. The letter also requested NRC concurrence that a catalyst factor of safety of 1.5 is acceptable. GPU Nuclear has determined that a fuel canister dewatered to 25% void volume would expose, as a minimum, 25 grams of catalyst for the canister in any orientation. This minimum quantity of exposed catalyst considers the maximum allowable tolerance in the placement of the catalyst beds in the lower head; i.e., previously addressed in the November 10, 1986 letter. As noted in the referenced letter, 65 grams of exposed catalyst achieves a catalyst factor of safety of 4.2 for 1760 pounds (800 kg) of fuel debris. Since the factor is proportional to the quantity of catalyst, 25 grams of exposed catalyst would achieve a catalyst factor of safety of 1.6, i.e., = 4.2 x (25/65), for 1760 pounds of fuel debris. Thus, dewatering a fuel canister to obtain 25% void

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volume would achieve a minimum catalyst factor of safety greater than 1.5 for any canister payload less than or equal to 1760 pounds since the factor of safety is inversely proportional to the quantity of fuel debris. Therefore, GPU Nuclear proposes that a 25% void volume is an acceptable dewatering criterion for fuel canisters.

The November 10, 1986 letter also proposed that the maximum internal pressure be determined for each canister not dewatered to at least 50% void volume in order to assure that the maximum canister internal pressure in the Safety Analysis Report for the NuPac 125B Shipping Cask (Cask SAR) is not exceeded. This determination would be based on projecting the hydrogen appearance rate (obtained from the dewatered canister gas sample) for one year, the actual void volume of the dewatered fuel canister, and the remaining assumptions given in the Cask SAR. This determination would be made to show that the internal pressure calculated in the Cask SAR would be bounding. In lieu of determining the maximum internal pressure for each fuel canister dewatered to less than a 50% void volume, GPU Nuclear has determined the maximum pressure in a shippable canister based on a one year buildup of gases generated from the radiolysis of water entrained in the canister. This pressure is less than the pressure calculated in the Cask SAR.

The cask certificate of compliance (C of C) requires that the quantity of hydrogen be limited to 5 percent by volume of the canister gas (void) volume, or 5 percent by volume of the quantity of oxygen in those portions of the canister which could have hydrogen greater than 5%, for twice the expected shipping time. The shipping time is the summation of the canister storage time at TMI-2 (To), cask loading time (6 days), cask transit time (10 days), and cask unloading time (11 days) or To + 27 days. To meet this C of C requirement, GPU Nuclear determines the allowable canister storage time at TMI-2 (To) based on the limiting gas appearance rate (either hydrogen or oxygen) using the following expression:

$$0.05V = 2 \times (To + 27) \times R$$

Where: V = Canister Void Volume, liters
To = Allowable Storage Time, days
R = Limiting Gas Appearance Rate, liters/day

The worst case shippable canister would have no allowable storage time (To = 0) and the hydrogen and oxygen appearance rates would be equal (NOTE: This is not credible since based on the chemical formula for water, H_2O, the oxygen appearance rate could not be greater than one-half of the hydrogen appearance rate). Thus, the total gas appearance rate would be

$$R = (2)(0.05)(V)/((2)(27))$$

or (0.00185)(V) liters/day. For a one-year buildup, the total quantity of radiolytic gas in the canister is (0.00185)(v)(365) or less than (0.68)(V) liters. The quantity of argon (or other cover gas) in the canister is (2)(V) liters since 2 atm. of cover gas is injected into the canister.

Conservatively, considering that the radiolytic gas appearance rate and the injection of the cover gas are at a temperature of 32°F, the canister internal pressure at 200°F (the temperature assumed in the Cask SAR) from the radiolytic gases and the cover gas is

$$\left(\frac{0.68V + 2V}{V}\right) \times \left(\frac{200°F + 460°}{32°F + 460°}\right)$$

or 3.6 atm. Including water vapor at 200°F, the total internal pressure in the worst case shippable canister is 3.6 + 0.78 or approximately 4.4 atm. At an atmospheric pressure of 14.7 psi, the internal pressure is 50 psig, i.e. (4.4-1)(14.7). This pressure is for the worst case shippable canister following a one year buildup of radiolytic gas and is independent of canister void volume and canister type. Therefore, further pressure determinations of dewatered canisters are not necessary since the pressure in a shippable canister following a one year buildup of gas could not exceed the pressures calculated in the Cask SAR.

In conclusion, GPU Nuclear proposes that a 25% void volume is an acceptable dewatering criterion for fuel canisters and that this reduction from the previous dewatering acceptance criterion of 50% does not impact the bounding evaluations given in the Cask SAR. Additionally, GPU Nuclear is evaluating the void volume required to achieve a catalyst safety factor of 1.5 for filter and knockout canisters. This evaluation, when completed, will be submitted for your review and approval.

Sincerely,

Thomas T. Demmitt

for F. R. Standerfer
Vice President/Director, TMI-2

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