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TMI Program Office
Attn: Mr. Lake Barrett, Deputy Director
U. S. Nuclear Regulatory Commission
c/o Three Mile Island Nuclear Station
Middletown, Pennsylvania 17057

Dear Sir:

Three Mile Island Nuclear Station, Unit 2 (TMI-2)
Operating License No. DPR-73
Docket No. 50-320
Status of EPICOR II PF Liners

In response to our commitment to you at the June 8, 1981 meeting, this letter provides to you our current assessment of the status of the EPICOR II PF (prefilter) liners, and identifies potential actions related to these liners. This letter addresses our evaluation related to gas generation in the liners, hydrogen combustion, pressure buildups and long term storage of the liners, including the associated findings from the examination of PF-16 at Battelle, Columbus.

Briefly, the forty-nine (49) EPICOR-II prefilters currently stored on-site fall into two generic categories with regard to their ion exchange media configurations. Category 1 (PF-1 thru PF-11) contains primarily organic resins while category 2 (PF-12 thru PF-50) contains a mixture of both inorganic and organic ion exchange media. The analysis provided herein for gas generation is based on a total organic (category 1) mixture. This is considered to be the bounding case and the results are very conservative for the category 2 liners.

Gas generation rates in the EPICOR II PF liners have been studied, calculated, and compared with existing experimental data. The mechanisms of generation, recombination, oxidation, and adsorbtion are very complex and therefore exact generation rates and gas concentrations are difficult to calculate. Experimental data indicates that pressures in the liners are not expected to exceed 19 psig and actually liners begin gas leakage around 2 psig. At or below 19 psig the lids and seals will deform to the point that the seals will no longer hold the pressure and the pressure will decay to an equilibrium

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point. The 19 psig value was used in our calculations along with the following assumptions:

- o Resin water content = 70% which yields a $G(H_2)$ value of 1.6 molecules per 100 ev deposited energy
- o 80% of liner activity is deposited in the organic cation resins
- o Integrated dose of 9×10^7 Rads one year after removal of liner from service
- o Void volume of resin is 40%
- o Volume of liner is 44 ft^3; volume of resin is 32 ft^3
- o Resin density is 0.865 gm/cc
- o Gas G-values are: (molecules / 100ev)

H_2 = 1.6	CO = 0.009
CO_2 = 0.25	CH_4 = 0.016

Our calculations indicate that hydrogen concentrations are expected to be in the range of 40-65% by volume, and oxygen is expected to be below 0.2% by volume. Oxygen concentrations must be at least 5% to make a flammable mixture. The initial results from Battelle indicate hydrogen in the PF-16 was $\cong$ 12.5% and that oxygen was $\cong$ 0.2%. Note that PF-16 was open to the atmosphere for approximately one and one half hours two weeks prior to experimental sampling at Battelle and thus the composition observed at Battelle is different from that which is representative of an undisturbed intact liner in the storage modules. The levels of hydrogen in the liners have led to concerns for the potential combustion of hydrogen.

Basically, four things are needed for combustion. These are fuel (hydrogen), an oxidizer (oxygen), an ignition source, and chain carrier ions. As stated above, in the liners' present configuration hydrogen is available in sufficient quantities for combustion in the liners. Scenarios which have been examined for hydrogen leakage from a liner and mixing with air in the storage cell yield hydrogen levels below the flammable limit except in one case, discussed below, where the concentrations are slightly above the lower limit of flammability. To this point in time, no hydrogen has been detected during surveys around the storage module lids (detection limit is about 0.1%). It is felt that hydrogen buildup in the storage modules will not occur due to the combination of low H_2 generation rates, low H_2 leak rates out of the liners, and H_2 leakage from the modules due to diffusion and buoyancy. Leakage time from the storage modules is dependent on the size of the leak paths. In the liners, there are oxygen depletion mechanisms at work that will keep oxygen at well below the flammable mixture. These oxygen depletion mechanisms include corrosion, carbon dioxide production, carbon monoxide production and sulfur dioxide production. The presence of carbon monoxide is an indication that oxygen depletion is present. These depletion mechanisms are expected to continue for as long as hydrogen generation exists. Oxygen does occur in the modules in sufficient quantities for combustion but as stated above, hydrogen concentrations are low. The third item necessary is an ignition source. Sources of ignition include sparks from impact, friction, static electricity, and improper grounding as well as open flame sources such as matches and cigarettes. No ignition sources are known in the closed cells and efforts to reduce the potential for ignition sources are being made for open cells. Special handling procedures will be developed for handling PF liners. Requirements will include such things as the use of sparkless tools, proper grounding of equipment and the banning of open sources of flames. Also, training will be used to indoctrinate workers in the new procedures and the hazards involved in handling potential hydrogen sources. The fourth item is chain carrier ions. These ions are necessary to propagate combustion. The radiation from the liners will somewhat increase the presence of chain carrier ions but in amounts insufficient to effect the flash point or combustion rate of hydrogen.

Our conservative analysis has considered the combustion of all of the hydrogen corresponding to an internal liner pressure of 19 psig, which experimental data indicates would be the highest internal pressure we could expect to occur. In reality, pressures should be significantly less due to the expected gas leakage from the liners, as previously discussed. Our analysis shows that a combustible mixture does not occur in the liner. If the quantity of hydrogen equivalent to 19 psig liner pressure (36ft^3 at STP) is released to the module instantaneously, the equilibrium mixture is slightly above the lower limit of flammability but well below the detonable limit. Calculations based on these assumptions indicate that if combustion of the hydrogen did occur the result would be a slight lifting of the 16 ton concrete module lid. Upon movement of the lid, the seals on the module lid would blowout, allowing rapid release of the pressurizing gases. The lid would not raise more than a few inches due to the assymetrical nature of the pressure tilting and wedging the lid. This calculation assumes equilibrium throughout the evolution. Shock theory, acceleration and inertia of the lid are conservatively ignored. After ignition, temperatures in the modules would be below the air temperature for an equilibrium reaction, which is on the order of 500°C. The actual temperature would be substantially lower due to the venting of the hot gases through the module lid and heat transfer to the concrete. The resins would see only a small temperature increase, which would not be expected to exceed normal resin operating temperatures.

The probability of this event occuring is considered to be very low based on the expected gas leakage from the liner coupled with the low gas generation rates within the liner, the lack of known ignition sources, and rapid diffusion from the modules. Data has been gathered from experiments to determine the effects of internal explosions on sealed 17C shipping drums. If the total hydrogen inside a liner were deliberately placed into a mixture ideal for detonation, the yield approximates experimental charges which were unable to lift the drum lid or significantly damage the drum. As stated before, this ideal mixture is impossible under the conditions in either the liner or the module. The EPICOR-II liners are significantly thicker and stronger than a 17C drum. Compressive forces need to be much stronger than tensile forces to cause damage. For these reasons, it is considered highly unlikely that liner damage extensive enough to release resins will occur. For the short term, hydrogen generation and the storage of the liners does not present a threat to the health and safety of the public. The planned depressurization discussed below will minimize any long term concern with hydrogen generation.

As mentioned above, pressures of up to 19 psig can potentially exist in the liners. Currently we are developing plans for depressurizing the liners. This depressurization is for the purpose of ensuring the mechanical integrity of the liners. The depressurization would occur while preventing inleakage in order to maintain an oxygen deficient state. Presently it is intended that the liners remain in the modules for storage and that the depressurization process be done in the modules. Conceptual design work is being performed on a fixture for vent plug removal while the liners are in the storage modules. Additionally, it is presently planned to develop a method which will allow the liners to remain in a permanently depressurized mode. Depressurization will reduce the inventory of hydrogen in the liners and thus reduce the possibility of combustion as well as relieve pressure induced stress in the liners. As stated previously, this depressurization will alleviate any long term concerns with hydrogen generation in the liners.

An element of the long range concerns for the EPICOR II liners is the topic of eventual disposal. The final PEIS states in Section 8.1.2.3 that "these materials cannot be disposed of using routine methods at low-level disposal facilities". With the passage of time, the possibility of leakage from these liners will increase due to potential loss of liner integrity caused by the potential generation of corrosive liquids. The latest results from Battelle on PF-16 shows that the pH of the water in the liner is approximately pH 5 and that corrosion of the liner walls is minimal. Investigations will continue to try to determine the reasons for the difference in pH between the droplets on the liner lid (pH 2) and the moisture in the liner itself. The present data indicates that the corrosion problem is not as great as previously anticipated but concerns still exist. A more definitive understanding of this problem is expected to result as additional information becomes available from the PF-16 studies at Battelle.

GPU has initiated discussions with the DOE relative to performance of Research and Development on additional liners to determine an appropriate disposal approach. An activity which is underway which should provide an option for liner disposal is the High Integrity Container (HIC) development program being conducted by the DOE. A contractor has recently been selected for design and prototype fabrication. The container is expected to provide containment for a minimum of 300 years, by which time activity levels will be comparible to typical low level radwaste. It should be noted that shipments of HICs to the Richland, Wash. site will require a change to their burial license since the site license does not presently acknowledge the high integrity container concept. In addition, the sites approval of the container will need to be obtained. While the Barnwell burial site is accepting HICs for normal dewatered waste and thus they may more readily accept our HIC, the site will not accept TMI Unit-2 waste based upon action by the Governor of South Carolina. It is currently felt that HIC will not be available before 1982.

In summary we feel that hydrogen generation in the liners present no threat to the health and safety of the public but that some question exists relative to the long term storage and eventual disposal of the liners.

This represents our assessment of the current status of the EPICOR II PF liners. We will be happy to discuss any of these ideas with you if you desire.

Sincerely,

G. K. Hovey
Vice President & Director,
TMI-2

GKH: RBS: klk

cc: Dr. B. J. Snyder, Program Director, TMI Program Office