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DOW

Dow U.S.A.

The Dow Chemical Company
Midland, Michigan 48667

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John Austin, Chief
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Mail Stop 5-E4
U.S. Nuclear Regulatory Commission
Washington, DC 20555

20.302 LICENSE APPLICATION FOR SALZBURG LANDFILL

Dear Mr. Austin:

I appreciate your taking the time to meet with Dow on December 4, 1992. The meeting was beneficial and informational. At this meeting, you expressed an interest in an analysis of costs associated with potential extraction of thorium from the thoriated slag material presently stored at Dow's Bay City and Midland sites.

Upon researching this issue, it was discovered that the supply/demand relationship for thorium is not in balance. The supply of thorium oxide far exceeds the demand for this material. In addition to this, thorium contained in residues, monazite deposits, etc. is enough to supply the United States for at least 100 years at the current level of demand. According to the Bureau of Mines Bulletin 675 entitled, *Mineral Facts and Problems*, the availability of thorium as a byproduct of processing ore has exceeded demand for many years, and as a result, large U.S. and foreign surpluses have developed.

Another concern that arose when discussing potential extraction of thorium from any contaminated media was the high degree of selectivity essential to the separation process. If an almost quantitative separation is not achieved, then one can actually create additional volumes of materials that are radioactive. This will only aggravate the present disposal situation.

These concerns related to extraction of the thorium from Dow's slag have been raised by Raghaven et al. [*Technologies Applicable for the Remediation of Contaminated Soil at Superfund Sites*, USEPA Res. Dev., [Rep.] EPA/600/9-89/072, Int. Conf. New Front. Hazard. Waste Management, 3rd. ed., 59-66 (1989)]. In this work, they indicate that of the 25 contaminated Superfund sites discussed, no chemical extraction or physical separation techniques have actually been used in a remediation situation and their use must be approached with extreme caution.

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To address the question of costs associated with extraction of the thorium from the slag material, there are three basic technologies looked at. These include chemical extraction, physical separation, and soil washing. Each of these techniques are discussed in the USEPA report, and I will highlight key points from that work for your review.

Chemical Extraction

The various applicable chemical extraction techniques include extraction with inorganic salts, mineral acids, and complexing agents. Radioactive contaminants can be extracted by thoroughly mixing the slag with a series of different chemical solutions. The clean coarse solids are then physically separated from the extractant solution. The radioactive material is then removed from the extractant solution by ion exchange, coprecipitation, or membrane filtration.

The resulting chemically-leached material will create a potentially harmful waste stream. The reagents will be expensive and require corrosion resistant materials of construction for management of the streams. Assuming that a prolonged series of extractions are required to achieve an acceptable cleanup standard, along with corrosion resistant materials of construction, the cost estimate from the USEPA report would indicate roughly $200 per cubic meter of contaminated soil that is treated. This only includes the costs associated with the processing of the soils.

Another result of this technique is that the treated soils will undoutedly contain excessive salts and/or acidity from the extraction process. Due to this processing, it is likely that the soils would then be characterized hazardous waste, or mixed hazardous waste, and the residual soils would have to be placed in a hazardous waste landfill cell.

Assuming that there are 50,000 cubic meters of contaminated soils, the cost for processing via soil extraction would be on the order of $10,000,000. This would not include any equipment design, purchase, construction, and installation, nor transportation or landfill costs, which would be significantly greater than the processing cost specified.

Soil Washing

Soil washing uses a combination of physical separation and chemical extraction technologies. Contaminated soils are mixed with waste and/or extraction reagents. The clean coarse particle sizes are separated from the liquid containing the fines and radioactive material by a combination of physical separation methods. The radioactive material would then be extracted from the liquid by standard water treatment processes such as filtration, carbon adsorption, ion exchange, chemical treatment and membrane separation.

Again, the chemical extraction process would create a potentially harmful waste stream, that would very possibly be characterized hazardous or a mixed waste. This in turn has the possibility to create an even larger volume of radioactive (though less active) material. This process would appear to be very similar to the chemical extraction described above, except for the physical separations prior to extraction.

Using this technique, it is logical to assume that the residual soils will need to be managed as hazardous wastes, or else treated for salts, and the treated material properly managed. The processing cost for the thoriated slag using this method would be roughly $130 per cubic meter, as per the USEPA report. This again only includes the costs associated with the processing of the soils.

The cost, assuming 50,000 cubic meters of contaminated soils, to process the thoriated slag using this technique would be on the order of $6,500,000. This would not include any equipment design, purchase, construction, and installation, nor transportation or landfill costs, which would be significantly greater than the processing cost specified.

In the State of Michigan, this thoriated slag is a solid waste, and in the event that all radioactivity could quantitatively be extracted from the soil, this soil would not be allowed to be placed back on the site where it is now situated. This means that the cleaned soil would still be a solid waste, and have to be properly managed as such. The material would need to be transported to a solid waste landfill. If it became characteristically hazardous, then it would need to be managed in a hazardous waste landfill.

In light of the supply/demand situation for thorium and the unknown effectiveness of the extraction techniques on a large scale, along with the very distinct possibility of creating additional volumes of radioactive material if the extraction processing is not selective or complete enough, one needs to question the limitations of extraction as a means of remediating contaminated materials such as Dow's thoriated slag. The processing costs specified would represent only a fraction of the total remediation costs when one looks at what an acceptable closure and license termination would entail.

If you have any questions, please feel free to call me.

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