1213872

May 2, 2012

12-NWP-059

Matthew McCormick, Manager
Richland Operations Office
United States Department of Energy
P.O. Box 550 MSIN: A7-50
Richland, Washington 99352

Re: Summary Report on the Landfill barrier Technology Workshop Held in February 2012

Dear Mr. McCormick:

On February 1-2, 2012, the Department of Ecology (Ecology), Oregon State, and the three impacted Tribal Nations hosted a conference to gather information and learn of recent successes and failures of using landfill covers to contain waste. We felt that this was important since more than 1,900 waste sites have been identified at the Hanford site. These sites range from small areas of surface contamination to the 177 underground storage tanks holding more than 50 million gallons of highly radioactive waste. Sixty seven of the 177 underground waste storage tanks at Hanford are known, or suspected, to have leaked, releasing about one million gallons of highly radioactive and chemical waste to the soil. Some of this leaked tank waste, containing an estimated one million curies of radioactivity, has reached the groundwater.

Additionally, billions of gallons of liquid waste were dumped into hundreds of disposal trenches and waste sites, heavily contaminating the soil column and the groundwater. Solid waste, contaminated with various radioactive materials and chemicals, was buried in hundreds of different landfills. Finally, hundreds of contaminated buildings remain on site, including reactors, chemical processing facilities, and laboratories. Much of the waste will be hazardous for thousands to millions of years.

The United States Department of Energy (USDOE), which owns Hanford, is considering leaving waste in place, and permanently "disposing" of that waste by putting a cover, or "cap", on top. The cap is intended to keep water from percolating through the waste, which could spread contaminants further into the environment. Since these barriers are being proposed as a solution for isolating this waste, it was important to understand how the barriers work over the long-term and performance issues.

A brief summary of the workshop presentation is included in the attachment. We hope that USDOE finds this conference as useful as we have and that USDOE will consult with Ecology, Oregon, Environmental Protection Agency, and the three tribal nations before any future planning of barriers at the Hanford Site.

If you need any further information, please contact Dib Goswami at 509-372-7902.

Sincerely,

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Nuclear Waste Program

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Oregon Department of Energy

dbm
Enclosure

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Summary of the Landfill Barrier Technology Workshop
February 1-2, 2012

The following summary was generated from the speakers and sessions at the workshop:

- On the first day, information was presented on the importance of evaluating the entire landfill system relative to the dynamic response and the strength it may have during a seismic event. If a landfill contains waste such as boxes and drums, with the associated voids in and between this waste, then significant failures can occur through this waste material due to shaking. This was classified as a "huge problem".

- There was a very good presentation comparing an evapotranspiration (ET) cover to a barrier. An ET cover has to be very carefully designed for a particular location and could be compromised with climate variability, cracking, secondary permeability, vegetation performance, fire, etc. An ET cover has to be maintained until a vegetation system is established. If the vegetation system is compromised, such as from a fire, significant erosion can occur. ET covers are NOT zero flux. In municipal solid waste sites (MSW), the buried waste itself generates heat that helps the performance of at ET cover. Hanford has few MSW sites. Cracking during an earthquake can also occur with an ET cover. These cracks will fill with water could then penetrate the waste. Secondary permeability could also develop. A barrier could be more effective at limiting infiltration; especially a composite or hybrid barrier which may have at ET cover over it, a drainage layer, geosynthetic liners, and geomembranes. What was presented as the most important factor to prevent holes during construction of a barrier is good quality control. Various electrical methods can be applied to assure a barrier has not been breached during construction. The lifespan of a barrier may be limited to several hundred to 1,500 years. NO barrier will be effective for 10,000 years, and climate change could have a significant influence. One very important point that was brought up during the discussions was that if the waste is not placed in a contained landfill, i.e. one with a liner under as well as on top, then NO cover or barrier will be able to effectively prevent the migration of the waste. A generalized statement cannot be used to say that a cover will be effective in preventing migration of waste down to a designated depth.

- The workshop also discussed risk informed and performance based decisions, the importance of a good conceptual model, and the use of event trees to plot out what would happen to the buried or contained waste if an event would occur.

- Some of the performance from actual landfill covers and barriers included examples from Love Canal, Lake Charles, LA, New York Landfills, Ohio Landfills, and others. Information from these examples showed that construction methods and QA/QC was extremely important in assuring that barriers are not breached during the construction and cover process. One of the Ohio Landfills (Fernald) included a bio-intrusion barrier. However, regular maintenance was still required for parts of this barrier. This includes preventing trees, shrubs, and noxious weeds from growing; maintenance to prevent erosion; and regular trapping for burrowing animals. Settlement of waste can create voids and impact the effectiveness of a cap. Putting up signs to prevent intrusion appeared to work very poorly for long-term site preservation.

- During several of the question and answer periods, the topic was brought up of barriers or covers placed over pre-existing waste sites (not a constructed landfill). In these situations, the lateral migration of water into the waste must be addressed and controlled. This may require either more aggressive monitoring, or the waste should be removed and placed in a lined disposal facility. If

an ET barrier cracks, such as during an earthquake, the cracks could remain open for a lengthy period of time allowing direct percolation down to the buried waste. The impacts from large storm events are typically used in modeling or monitoring a landfill site. However, the water from these large storms may run off of the surface of the landfill cover. A more pervasive problem may arise due to climate change where there may be a little bit of precipitation every day. This is more likely to saturate and penetrate an ET cover and mobilize the waste.

- Natural analogs can help in the design of landfill covers, especially when expecting climate change and variability. Some waste site facilities have looked at past climate conditions to plan for future conditions, and some look at analogs at different elevations to gather information on how plant succession could change over time.

- The Hanford Prototype Barrier currently is not experiencing problems containing the waste beneath it. However, a compromised or reduced cover (compared to the Prototype) over a waste site could generate infiltration problems. After a fire, invasive species like cheat grass, or tumbleweeds may quickly move in to occupy a site. It can be expected that a fire may move across Hanford every 7-10 years. Long-term characterization of barrier performance is lacking since barriers at Hanford will be required to contain waste that will remain hazardous for tens of thousands or more years. If a barrier becomes compromised during this evaluation period, it may be repaired, but this would alter the results of the evaluation.

- Proposals to use sand as a capillary break with an ET barrier could create significant problems. Roots can easily grow through this type of barrier. The design life of the Hanford Prototype Barrier has been reduced from 10,000 years to only 1,000 years. A proposal was put forth that future barrier efforts may include artificially creating a hardpan layer by having water infiltrate a cover with the additional use of limespread on the surface of a capillary barrier. This was theorized to create a hardpan below grade.

- From the regulatory perspective, presentations were made on how some waste sites, such as in Puerto Rico, have become "lost". There was nobody to monitor or maintain these sites in this politically unstable government. These sites are now overgrown and difficult to find. One lesson that could be learned from that is that it is unlikely that a landfill can effectively protect the public without constant monitoring and regulation.

- The Rocky Mountain Arsenal was another example site that had chemical weapons and pesticides directly dumped in unlined pits. This area is now covered with four feet of soil over 18 inches of a bio-barrier. Some plants, such as tumbleweeds, could send roots down to 26 feet deep. Hanford does not have an adequate source for either borrow material nor for a bio-intrusion source material.

- Additional examples presented at the conference included the UMTRCA site in Oregon. The side slopes of this disposal site used rock that was susceptible to degradation, so annual inspections and long-term monitoring will be an important part of this site.

- The Nevada Test Site and Los Alamos both have ET covers that appear to be working at these relatively dry sites. However, subsidence is an issue. As the waste and the containers break down, there has been up to 49 feet of subsidence. These depressions or indentations in the cover can create high infiltration rates.

- Once again, it was emphasized during presentations that geomembranes are effective if they are not punctured. Good construction practices and quality control are very important.

- Nature will tend to alter the soil properties post-construction. At the ACAP site, cover soils were originally well compacted. Over time, vegetation roots and cracks developed more than two meters below ground level. The soil tended to redevelop a natural hydraulic conductivity.

- If a waste site is not completely entombed, then not only vertical, but lateral migration of water through the vadose zone must be controlled. Of the landfill covers failures, stability was the largest problem 21 percent of the time. This is generally because of a flaw in the design. Seepage and freeze/thaw cycles created the next biggest problems. Attempting to use only 24 inches of a protective soil cover has been shown to result in failure of the landfill cover. The best landfill barriers use multiple layers of protection, or a hybrid system that combines an ET with drainage and a barrier under it, and use regular monitoring and maintenance.

- Bentonite clay used in a cover, will degrade over time if it is exposed to calcite such as found in concrete.

- An ET cover is just a storage device and it will not work effectively if the soils do not have a chance to dry out from the previous winter and spring rains. A presentation was given using a landfill example in California that proved this. The vegetation is important in helping to remove this water. However, if the vegetation is removed from a fire, then the ET process is compromised.

- The conference concluded with future project directions such as the use of jet grouting and vertical barriers for controlling lateral migration of water flow through the vadose zone and isolating the bottom of a waste site. Information was also presented on synthetic aperture radar that is capable of showing as little as 1 mm variation in elevation changes. This is important if there could be subsidence in the buried waste. Fiber optics can also be incorporated into the geotextiles that can show if the barrier is broken over time.

Most landfills used as examples during the workshop are carefully engineered structures with not only a top barrier and liner, but there is a barrier or liner beneath the waste as well. This will help to limit any leachate from percolating through the vadose zone and reaching the ground water. Unfortunately, this is not an option for most of the waste sites being proposed to be covered at Hanford. There is not a bottom liner present for the tank farms, trenches, unplanned releases, etc. Thus the effectiveness of caps may be quite limited if used at Hanford.