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9/19/05

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- Placed cover materials passed all testing equipment.
- To date, the soil covers are performing as designed. There are no signs of erosion on top of the leach tanks.

Results of all design, calculations, test results and reports can be found at the Colorado Department of Health and Environment – Hazardous Materials and Waste Management Division's Record Center.

3.1.6 Evaporation Pond and Raffinate Pond Stabilization-Closure Cell

Six evaporation ponds contained residual soils and liquids that were byproducts of the leachate-extraction process. They occupied an area of approximately 13.4 acres. The salts, gels and liquids were mixed and solidified and consolidated into a single 4-acre repository or closure cell adjacent to the "Mancos Hill". The closure cell was designed to contain these wastes for not less than 200 years.

The evaporation pond materials were mixed with Mancos Shale in order to solidify and neutralize the contaminants present. Laboratory tests performed in 1992 showed that mixing of the calcareous shale with the pond material would help to neutralize the pond material. The materials were mixed at an approximate ratio of 1 part shale to 2 parts pond material by volume until it was dry enough to be placed as a soil. This mixed material was called solidified pond material (SPM). Any SPM containing moisture contents higher than those that would allow the required compaction were reworked, disked, scarified, or otherwise manipulated so as to dry those materials to the necessary moisture content for compaction prior to their relocation and placement within the closure cell.

SPM materials that had sufficiently reacted, solidified, and allowed to dry were excavated and hauled to locations within the closure cell and placed in lifts not to exceed 8.0 inch uncompacted lift thickness. Each lift of SPM was compacted to not less than 90% of maximum Standard Procter density before placement of subsequent lifts.

Four small (80 ft. wide by 80 ft. long and 10 ft. deep) lined raffinate ponds were located near the north side of leach tank 201. The raffinate was mixed in place with Mancos shale so that it could be solidified sufficiently to be hauled to the evaporation ponds and mixed with the SPM and eventually taken to the closure cell.

The closure cell was constructed with a one-foot compacted clay liner on top of scarified Mancos Shale. The liner was constructed to meet a permeability of $1x10^{-7}$ cm/sec. The sideslopes of the cell have a 5H: 1V slope and the top of the cell is sloped at 2 percent. A three-foot thick soil cover was constructed on the sideslopes of the waste cell. **The top cover was initially to be 3 feet thick, but because additional low-level radioactive material was encountered, the cap was increased to 8.7 feet. Most of the materials placed in 1996 and 1997 placed in the cap contained significant quantities of clay that was moisture conditioned and compacted to the radon barrier or cover specifications when placed. These materials were removed from along haul roads,**

the wind blown areas, and within the evaporation ponds. The final soils removed from the evaporation pond were placed in the upper 0.5-feet of the closure cell as the final cover. A rock cover for erosion protection was also placed on the top and on the sideslopes. The rock cover prevents the soil from becoming airborne and being dispersed from the closure cell. This eliminated the need to consider the air pathway for off-site exposure.

The radium-226 activity throughout the closure cell, including the SPM, is low. Results from clean-up verification samples collected in 1995 and 1996 revealed that several contaminated areas remained within the old Evaporation ponds. Results showed that soils contained minor quantities of radioactive materials. Contaminated soils were removed, and placed and compacted on top of the Closure Cell. Only minor amounts of contaminated soils were encountered. Laboratory results from samples collected within the Closure Cell revealed that after excavation and transfer to the Closure Cell, radium-226 activity levels decreased to near background (1.0 pCi/gm) due to the significant quantity of "clean" soil removed with the contaminated soil. The radium –226 activity of the SPM averaged 6.4 pCi/g. This is only slightly elevated over the approved site cleanup level for radium-226 of 6 pCi/g. The measured average radium-226 activity of each layer of the upper 12.7 feet of the closure cell ranges from 1.8-2.3 pCi/g. The top 0.5 feet of the closure cover has an average radium-226 activity of 1.8 pCi/g. When the thorium-230 and radium-226 activities are decayed for 1,000 years, the radium activity in the upper 0.5 feet of the cell calculates to 6 pCi/g, which is equivalent to the radium activity used as the cutoff for site cleanup. Therefore the cover radium-226 activity is essentially the same as in the surrounding surface soils both currently and in 1,000 years. Further, a 0.5 –feet layer of rock, which will help to maintain high moisture content in the cover, overlies the cover. The cell cover meets the condition of criterion 6 for longevity and control of radon release.

3.1.7 Slope Protection Measures for the Waste Repositories

Slope protection measures were constructed to protect the waste repositories. These measures included construction of a new closure cell for the evaporation pond residues and the placement of rock cover on the sideslopes of the leach tanks and new closure cell. Rock cover was also placed on top of the closure cell. The leach tanks were constructed with a relatively flat top surface slope of 0.5 %, which is a drop of 1 foot for 200 feet of run, and revegetated to minimize erosion. The outslopes were protected by a minimum 6-inch thick rock cover consisting of rock with composite durability scores of 80% or more (AK Geoconsult, Inc.). Field measurements were taken of rock depth on April 19 and April 26, 1996 of rock depth. Measurements indicated an average rock cover of 6.7 inches and no single depth less than 6 inches on LT-201, an average depth of 6.7 inches and no single depth less than 6 inches on LT-202, and an average depth of 6.5 inches on LT-203. A small area with a depth of 4 inches was found on the west slope. The contractor later placed additional rock at this location. The size and gradation of the rock used was calculated according to guidelines provided by the U.S. Nuclear Regulatory Commission NUREG/CR 4620. All design analyses indicate that the covers will withstand wind and water erosion for more than one thousand years.