Evaluation of Remedial Actions for Contaminated Soil at Public Service Company of New Mexico's Person Generating Station

Introduction

A subsurface tank (i.e., 42 inches in diameter and approximately 10 feet long) was constructed at Public Service Company of New Mexico's (PNM) Person Generating Station to hold waste oils, greases, steam cleaner condensate, and solvents from routine equipment maintenance operations at the facility. Construction of the tank is believed to have occurred in summer of 1976. Use of the waste tank was discontinued on October 13, 1983, when it was discovered that some of the tank's contents had leaked into the ground. The solvents used at the facility that were collected in the tank included kerosene, stoddard solvent, water-trisodium phosphate mix from steam cleaning, and Dowclene EC (i.e., a commercial solvent manufactured by Dow Chemical Company that is composed of 25 percent tetrachloroethylene and 75 percent 1,1,1-trichloroethane). During 1980, repainting of equipment occurred at the facility. It is believed that waste paint, paint thinners, and turpentine were collected in the tank during this period. When it was visibly noticed that the tank was full, the tank would be pumped of its contents by various waste oil reclaimers for the purpose of recycling at another location.

When it was discovered that the tank was leaking on October 13, 1983, PNM immediately ceased its use, removed all fluids from the tank, and notified the New Mexico Environmental Improvement Division (NMEID) and the United States Environmental Protection Agency (EPA). Soil sampling in the tank area was initiated on October 24, 1983. The final phase of the soil sampling was completed on February 9, 1984. During this 15 week period, 22 boreholes within 50 feet of the tank were sampled and analyzed. Results of the soil boring investigation indicated that the unsaturated zone is composed of relatively uniform, medium to coarse grained sand containing silt and small amounts of clay and gravel. Tetrachloroethylene (PCE) was found to be the major soil contaminant with 1,1,1-trichloroethane (TCA) occurring at much lower concentrations. PCE concentrations of 10 ppm or greater were observed to depths up to about 65 feet below the ground and to lateral distances of about 15 feet from the tank.

Based on the soil sampling investigation, it was estimated that the total mass of PCE in the soil is about 225 pounds. About 99.7 percent of this total PCE is estimated to be contained in a volume described by an elliptically-shaped surface area of about 320 square feet that extends to a depth of 65 feet below ground. More details on findings of the soil investigations are presented in "Final Soil Contamination Assessment and Preliminary Groundwater Contamination Assessment, PNM Person Generating Station," prepared by Geoscience Consultants, Ltd., February 29, 1984.

After completing the soil investigation near the tank, three monitoring wells were installed in a triangular pattern around the tank at distances from about 30 to 50 feet. No PCE was detected in soil samples collected from these well boreholes, but water samples from the completed monitoring wells contained 1 to 3 ppm of PCE and 4 to 11 ppm of TCA. Subsequent groundwater sampling of these three monitoring wells in 1984 and 1985 indicate an overall decrease in PCE concentrations to about 0.3 ppm, and in TCA concentrations to about 0.5 to 1.0 ppm, by April 1985. Groundwater monitoring wells have also been installed near property boundaries at the facility, and concentrations of PCE (0.01 to 0.07 ppm) and TCA (0.005 to 0.03 ppm) have been measured 500 to 600 feet hydraulically down gradient from the tank. Additional details on groundwater investigations are presented in "Groundwater Investigations, PNM Person Generating Station", prepared by Geoscience Consultants, Ltd., June 1, 1984 and in "Phase V Program Progress Report - Person Generating Station Groundwater Investigations", prepared by Camp Dresser & McKee, Inc., March 8, 1985.

Potential for Future Contaminant Movement in the Unsaturated Zone

As discussed in the previous section, the contaminated soil (i.e., 10 ppm or greater PCE) has a surface area of about 320 square feet. About 90 percent of this 320 square foot area is covered with asphalt or concrete associated with the power plant building and driveways. The area is also sloped, and precipitation drains away from the waste tank area. Thus, infiltration of precipitation has been, and continues to be, restricted in the area of the waste tank. The observed distribution of contaminants (i.e., nearly all the contaminants are found in the upper part of the unsaturated zone) is consistent with a site with low natural precipitation and a cover of asphalt or concrete. That is, when soil moisture and infiltration rates are low, the downward transport of contaminants are expected to be very slow.

Results of soil sampling also indicate that the soil moisture distribution is relatively uniform with depth. No anomalously high moisture contents were observed. Thus, soil moisture data indicate that a wetting front is not advancing downward through the unsaturated zone. Soil samples were also analyzed in the laboratory to assess the unsaturated hydraulic conductivities. Results of these analyses (Geoscience Consultants, Ltd. 1984) indicate that contaminant movement under existing soil moisture conditions is extremely slow (i.e., hydraulic conductivities in the unsaturated zone calculated to be less than 6×10^{-6} cm/sec). Thus, observed conditions at the site are consistent with the conclusion that any future movement of the contaminants through the unsaturated zone will be extremely slow.

Remedial Options

Various remedial actions have been conceptually evaluated to formulate a cost-effective and environmentally acceptable plan for dealing with the soil contamination associated with the waste tank at Person Generating Station. The remedial actions considered are as follows:

1. Excavation of Contaminated Soil

   As discussed in the introduction, the soil sampling studies indicate that an elliptical area of about 320 square feet and about 65 feet deep encloses over 99 percent of the contaminants. Preliminary estimates indicate that the cost to excavate such a volume of soil (about 800 cubic yards) and to backfill with clean soil is about $260,000. Such excavation would require construction of a retaining wall system, and special care to minimize the risk of damage to the power plant building that is only 20 feet north of the waste tank. Various possibilities have been considered for handling the contaminated soil once it was excavated. Technically, it appears that land farming the soil would be a feasible treatment process. Land farming would involve spreading the soil on a liner and allowing the contaminants to volatilize. Estimated cost for land farming the soil at Person Generating Station is $100,000. Another option for treating the contaminated soil on-site would be placing the excavated soil in a "hot mix" plant (e.g., a large kiln such as is used to mix asphalt for highway construction) to enhance the volatilization of the organic contaminants. Such treatment could cost about $60,000. If decontaminated on-site, the soil would be backfilled into the excavation. The option for off-site disposal is shipping the contaminated soil to a licensed waste landfill at an estimated cost of about $260,000. For this option, clean fill would be hauled to the excavation to backfill the hole. Therefore, total estimated cost of excavation ranges from about $320,000 to over $500,000.

2. <u>In-situ Bacteriological Treatment</u>

Various microorganisms are commonly used in wastewater treatment. In recent years, specialized mutant microrganisms have been developed that will degrade toxic organic compounds. In reviewing the biodecontamination technology, it is apparent that the process has been used almost exclusively in controlled situations (e.g., treatment of hazardous waste contained in lagoons, impoundments, landfill leachate, or accidental surface spill sites). Such controlled conditions allow critical environmental conditions (i.e., nutrient requirements, oxygen level, temperature, pH, and moisture) to be optimized to enhance performance of the biodecontamination technology. In the ambient environment, such as exists in the soil contaminated to depths of 65 feet at Person Generating Station, the opportunity to control all the critical environmental factors is limited. Thus, the chance is poor that in-situ treatment using biodegradation technology would be successful.

PNM has explored the biodecontamination technology with various vendors, including Polybac Corporation. This company specializes in developing, manufacturing, and applying mutant microorganisms for bioreclamation services. Discussions with representatives of Polybac Corporation indicated that their technology had never been field tested under conditions similar to the situation at Person Generating Station. In particular, no microorganism had yet been bioengineered to degrade tetrachloroethylene, and the depth of the contamination presents considerable uncertainity in adequately controlling environmental factors. Based on PNM's assessment of the biodecontamination technology, it was concluded that it was not a proven technique for in-situ treatment of a soil contamination site as exists at Person Generating Station.

3. Vadoze Zone Flushing

In theory, contaminants that have even limited solubility in water can be leached out of unsaturated soils if adequate water is applied to the contaminated zone. The contaminated leachate from such a flushing process can then be collected and pumped to the surface for treatment. Vadoze zone flushing utilizes many of the principles common to leachate collection underneath leaking impoundments or landfills. However, leachate collection systems can be successfully employed at landfills because the contaminants occur in a comparatively thin layer, and the water table is often relatively shallow. In many cases, a natural confining layer (e.g., a significant bed of clay, shale, or crystalline rock) is present that limits contaminant migration in the aquifer. Such settings are optimal for successful collection of the contaminated leachate. At Person Generating Station, none of these favorable environmental conditions exist. That is, the contaminated soil occurs in a relatively thick layer (i.e., 65 feet deep) with narrow lateral dimensions (i.e., 15 feet, or less, radial distances). The depth to the water table is relatively great (i.e., 110 feet), and no natural confining layers of significance are known to exist in the aquifer material at the site. Additionally, the bottom 45 feet of the unsaturated zone below the waste tank is relatively free of contaminants, and vadoze zone flushing would thus force contaminants to enter a previously uncontaminated soil zone.

All of these negative factors imply that vadoze zone flushing is not a prime option for resolving the soil contamination situation at Person Generating Station. In fact, attempting vadoze zone flushing could complicate and worsen the present soil/groundwater situation occurring at the site. This concern was also identified by Polybac Corporation when PNM discussed vadoze zone treatment with this remedial clean-up firm.

Polybac's "POLYDETOX" process is used to leach contaminates from the soil matrix, and then to pump the aqueous leachate to the surface for treatment with microorganisms. However, Polybac was concerned that their leaching procedure would force contaminates into the aquifer making capture of leachate problematical at best, and in fact, worsening the groundwater contamination. Polybac thus concluded that their vadoze zone flushing method would be ineffective for soil remedial action at Person Generating Station.

4. <u>Improved Surface Covering</u>

As discussed, the immediate area around the waste tank is presently covered either with concrete or asphalt. This existing cover is already mitigating movement of contaminants through the unsaturated zone by restricting the infiltration of precipitation. The following could be undertaken for additional soil mitigation actions at the tank site:

a. The waste tank could be removed, cleaned, and either disposed of or recycled for other use.

b. The hole remaining after the tank was removed could be backfilled with clean fill.

c. The old grate area on the concrete pad near the tank could be permanently sealed.

d. The surface cover existing around the tank could be renovated and extended where needed to distances of about 30 feet from the tank using either concrete or asphalt.

e. The renovated surface cover could be adequately sloped to ensure the area remained well drained following precipitation events.

The estimated cost for performing the above mitigations is $20,000.

Preferred Remedial Option

Available technical information indicates that the existing contaminants are almost entirely located in the upper part of the unsaturated zone, and that any future movement of this material through the unsaturated zone would be extremely slow. Evaluation of various remedial options indicate that excavation and treatment or disposal of the contaminated soil are very costly, and would involve some risk of damaging the power plant building. In-situ treatment procedures are basically unproven for cases such as exist at Person Generating Station, and could adversely aggravate the current groundwater situation. After reveiwing the costs, likelihood of success, and environmental benefits of the various remedial options, the clearly preferred option is to improve the surface covering at the tank area. This preferred option would also include removal of the waste tank and permanently sealing the old grate area. Such a remedial action would be cost effective, mitigate future environmental effects, and avoid potential damage to the power plant.

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