

ER Site 36: HERMES Oil Spill (TA-V)

ADS: 1306

Operable Unit: Tech Area III & V

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Site History

The High-Energy Radiation Megavolt Electron Source-II (HERMES-II) Facility was built in 1968 and was located north of Building 6596 in Area V. This facility operated from 1968 until December 1989 and was used in radiation-effects testing operations in which large quantities of transformer oil were used as an electrical insulating medium. Shell Diala A oil, or similar mineral oil, was stored in five 35,000-gal (132,000-L) underground storage tanks (USTs) north of Building 6596 and was pumped in a closed-loop system between the buildings and tanks. Under normal operating conditions, the oil stayed in the enclosed system and did not come in contact with outside sources of contamination. There are no reported occurrences of the transformer oil becoming contaminated from outside sources.

The tanks, each 15-ft (4 m) in diameter, were buried approximately 3 to 5 ft (0.9 m to 1.5 m) below grade and were connected in parallel with 8-in. (20-cm) piping. Each tank was constructed with a vent. Facility personnel indicated that spills would commonly occur when the oil was pumped from inside the facility to the USTs. The high-volume, unregulated flow of oil through the discharge pipe into the USTs would discharge through the tank vents before the load could be distributed by the 8-in. (20-cm) piping throughout the series of tanks. These spills were generally not reported, and their frequency and volume are unknown.

The surface soil surrounding the tanks was covered with gravel and sloped to the northwest. Historically, spills drained toward the northwest, and would pond in low spots on the ground surface. This runoff area northwest of the tanks was paved in November 1986 to prevent infiltration of oil into the soil and to prevent precipitation from contributing to downward contaminant migration of the oil. The area potentially contaminated, including the former locations of the tanks and runoff, comprises approximately 39,750 ft² (3692 m²) (150 by 265 ft [45 by 88 m]).

In addition to the undocumented spills that took place during transfer of oil from the building to the former USTs, several spills were reported. One reported incident occurred in February 1985 and resulted in a spill of 1600 gal (6000 L) mineral oil onto the soil adjacent to the USTs and in low spots northwest of the USTs. A sample of the oil was reportedly analyzed for polychlorinated biphenyls (PCBs), and none were detected. Soil was then placed over the oil spill on the assumption that no environmental hazard was presented by the spill.

Another spill of approximately 100 to 200 gal (380 to 760 L) occurred on the paved area sometime in 1989 and was cleaned up by SNL. Oil samples were collected during the cleanup and analyzed for PCBs. One sample reportedly contained 3.6 ppm PCBs. This low level of PCBs in the transformer oil is believed to represent contamination of the oil by a previous process rather than a regular component of the oil.

Corrective Action

The HERMES-II Facility has not been in operation since December 1989 and has since been decommissioned and disassembled. In August 1991, the five USTs (6595-1 through 6595-5) and associated piping at the HERMES-II Facility were excavated and removed. During the HERMES-II UST removal activities, extensive petroleum hydrocarbon soil contamination was observed throughout the excavated pit. Contamination observed during UST excavation and removal activities is documented in a report submitted by SNL to the New Mexico Environment Department.

In November and December 1991, SNL/NM conducted an on-site investigation (OSI) for ER Site 36 in accordance with the New Mexico Underground Storage Tank Regulations (NMUSTRs) as amended in July 26, 1990, with oversight from NMED Underground Storage Tank (UST) Bureau (SNL 1992). Six "deep" soil borings and seven Geoprobe™ locations were advanced within the backfilled UST excavation pit and adjacent areas at the HERMES-II Facility. The investigation was performed to assess the presence or absence of total petroleum hydrocarbons (TPH) in the shallow subsurface soils underlying the former UST site. TPH concentrations were confirmed above the regulatory action level of 100 ppm at the bottom of one 271.2 ft (82.7 m) boring beneath this facility, but the total extent of contamination in the vertical direction was not determined. TPH concentrations above 100 ppm were not detected in four other borings at a depth of approximately 280 ft (85.3 m) bgs around the perimeter of the UST area.

The Hazardous and Radioactive Materials Bureau (HRMB) noted that the New Mexico Environment Department (NMED) Underground Storage Tank Bureau closed ER Site 36 based on their perception that the mineral oil plume did not pose an immediate public health or environmental threat. Although the specific degradation products for the mineral oil contamination at ER Site 36 are not definitively known, studies demonstrate that the bacterial fermentation by beta-oxidation of aliphatic hydrocarbons will produce ketones as intermediary degradation products. Ketones are volatile organic compounds (VOCs) that are regulated by the HRMB.

A RCRA Facility Investigation (RFI) was therefore conducted from July 1994 to March 1995 (SNL 1996) to completely define the vertical extent of mineral oil in the subsurface. Two boreholes were completed,

one to 340.50 ft (103.9 m) bgs and the other to 320.75 ft (97.8) bgs. TPH concentrations to a depth of 280 ft exceeded 100 ppm. In addition, investigation of potential surface mineral oil spills was conducted using a geoprobe and sampling seven boreholes to a depth of 15 ft below grade. The deep borehole soil samples were analyzed for TPH and VOCs, while the geoprobe soil samples were analyzed for TPH, VOCs, and PCBs.

As discussed in SNL's response to the NMED's Notice of Deficiency (NOD), the New Jersey Institute of Technology conducted a biofeasibility study for ER Site 36 in 1993 and found that the HERMES oil-contaminated soil is capable of supporting biological growth necessary for biodegradation of oil. Low levels of VOCs, primarily ketones, were discovered in the borehole soil samples. Small quantities of TPH, acetone, methylene chloride, and toluene were detected in the geoprobe soil samples. PCBs were not detected in the geoprobe soil samples. This indicates that bacterial fermentation is a likely degradation pathway for the mineral-oil plume.

SNL/NM constructed a three-dimensional model of the mineral-oil plume in response to NMED's NOD. The three-dimensional model used the TPH data obtained from both the OSI and RFI to characterize the mineral oil plume. Results of the modeling effort determined the highest TPH concentrations lie between 80 and 220 ft bgs. The deepest extent of the soil contamination (concentrations of TPH greater than 100 ppm) is at approximately 300 ft bgs, or more than 200 feet above the groundwater in this area. The estimated mineral oil volume within the 5,000-ppm contour of the plume is 130 cubic yard (26,300 gallons), not including the associated soil volume of the plume.

The risk assessment presented in the Supplemental Information for the 2nd NOD demonstrates that current levels of contaminants do not pose an unacceptable level of risk to human health or the environment. Remediation of ER Site 36 was not recommended for the following reasons: 1) excavation of soil at 300 ft is impractical; 2) the degradability of the VOC constituents of concern indicate a minimal potential for significant accumulation of the intermediary VOC degradation products; 3) active methods of vapor extraction of mineral oil would not significantly or economically reduce the contamination; 4) in-situ bioremediation techniques introduce water into the soil which could increase the mobility of the contaminants and drive the plume towards the groundwater; and 5) in-situ bioremediation techniques may accelerate the degradation process and increase the concentration of intermediary VOC degradation products.

Constituents Investigated

Mineral-based transformer oil
Volatile organic constituents (VOCs)
Semi-volatile organic constituents (SVOCs)
Polychlorinated biphenyls (PCBs)
Total petroleum hydrocarbons (TPH)

Institutional Controls

NMED has determined the site is complete and no controls are needed. However, as a best management practice, SNL has established Corporate Institutional controls (IC) to track this site in the IC database. Additional information regarding SNL Institutional Controls can be obtained from the SNL IC tracking database. For access to and/or more information, please contact the Environmental Message line at 505 284-9883.

Current Regulatory Status

Corrective action is complete at ER Site 36, and no further action is required. This site is acceptable for residential land use, and there are no restrictions on future activities. NMED approved completion of corrective action in November 2001.

Results of Risk Analysis

Because contaminants of interest were present in concentrations greater than background-screening levels or because constituents were present that did not have background-screening numbers, it was necessary to perform a risk assessment for the site. The risk assessment analysis evaluated the potential for adverse health effects for an industrial and residential land-use scenario. The results of the risk assessment were below the NMED risk guidelines for both the industrial and residential land-use scenarios. In conclusion, human health risk is within the acceptable range according to NMED guidance for the residential land use scenario. As summarized in the table below, acetone was the main contributors to the overall risks.

Results of Risk Screening
Human Health Risk Assessment Values for SWMU 36 Nonradiological COCs

COC Name	Maximum Concentration/ (Background Screening Level) (mg/kg)	Industrial Land-Use Scenario		Residential Land-Use Scenario	
		Hazard Index	Cancer Risk	Hazard Index	Cancer Risk
Acetone	12 (NA)	0.01	--	2.12	--
2-Butanone	2.9 (NA)	0.00	--	0.04	--
Chlorobenzene	0.11 J (NA)	0.00	--	0.00	--
Ethyl benzene	0.0065 J (NA)	0.00	--	0.00	--
2-Hexanone	1.6 (NA)	0.00	--	0.08	--
Methylene Chloride	0.27 BJ (NA)	0.00	2E-8	0.01	2E-6
4-Methyl-2-pentanone	0.22 J (NA)	0.00	--	0.01	--
Toluene	0.16 J (NA)	0.00	--	0.00	--
Xylene	0.3 J (NA)	0.00	--	0.00	--
Maximum Concentration Risk – Total/Incremental		0.01/0.01	2E-8/2.00E-8	2/2.26	2E-6/2.00E-6
Representative Risk – Total/Incremental		0.00/0.00	2E-8/2.00E-8	0.5/0.54	2E-6/2.00E-6
NMED Guidance		≤1	< 1E-5^a	≤1	< 1E-5^a

^a NMED March 2000

Waste Volume Estimated/Generated

Five cubic yards of hazardous and 4 cubic yards of nonregulated wastes were generated at this site.