APPENDIX F. RADIONUCLIDES OF CONCERN AT AREA IV

Radiological contaminants of concern at the Energy Technology Engineering Center (ETEC) and Area IV of the Santa Susana Field Laboratory (SSFL) are derived from two considerations: operating history and empirical observations from soil samples. The observed radionuclide concentrations are then compared against the approved soil release criteria, and the level of concern is determined by this comparison.

F.1 OPERATING HISTORY

Atomic Energy Commission-funded nuclear research started in Area IV in 1956. All the nuclear related research and development operations ceased in 1988, and the subsequent work has been directed toward decontamination and decommissioning. The operations at Area IV included ten nuclear research reactors, seven critical facilities, a large Hot Laboratory, a Nuclear Materials Development Facility, a Radioactive Materials Handling Facility (RMHF), and various test and nuclear material storage areas. As a result, a list of radionuclides involved in these operations is identified in Table F-1. These radionuclides, as they related to the past operations, are potential radionuclide contaminants. They are, however, not necessarily contaminants of concern at Area IV. Only those radionuclides that are released to the environment become radionuclides of concern. The list has served as a direction for selecting radionuclides to be analyzed in soil samples. Short-lived fission or activation products, such as iodine-131 (8-day half-life) and manganese-54 (300-day half-life), are not listed because they have decayed to stable isotopes during the period since shutdown of the last reactor at Area IV in 1980. Due to the atmospheric atomic bomb testing, all man-made radionuclides listed in the table could also come from the fallout.

F.2 OBSERVATIONS IN SOIL SAMPLES

During the past decades, several thousand soil samples in and around Area IV have been taken and analyzed for specific radionuclides. Table F-1 summarizes the results for the relevant radionuclides for the ETEC. The soil guidelines in the table were derived using RESRAD software and were approved by the California Department of Human Services and the U.S. Department of Energy (DOE) as the release criteria for soil. Because all the relevant radionuclides are also from either naturally occurring sources or global fallout, it is necessary to subtract background from these results before using them for risk assessment.

Americium-241, plutonium-241, and plutonium-242 are unlikely to be a major concern in soil because elevated plutonium-239 concentrations have not been found in soil samples.

To determine the potential radionuclides of concern for the decontamination and decommissioning work in Area IV, the following process was used. If the maximum observed concentration of a radionuclide is less than 10 percent of the release criteria, it is highly unlikely that this radionuclide will pose any risk to the environment and the public. If, however, the maximum observed concentration of a radionuclide exceeds 10 percent of the release criteria, further determination on background level is warranted. Uranium-238, thorium-232, cesium-137, strontium-90, and cobalt-60 fall into this category. Potassium-40 is a naturally occurring radionuclide, and DOE did not find significant differences between onsite and offsite observations from historical data.

In summary, the potential radionuclides of concern at Area IV are uranium-238, thorium-232, cesium-137, strontium-90, and cobalt-60.

Table F-1. Potential Radionuclides at Area IV

Source	Isotope	Half-Life	Principal Means of Production	Remarks
Fuel	Pu-239	2.4E4 y	Fuel material	Also fallout
	Th-232	1.4E10 y	Fuel material (in metal form)	Also naturally occurring, fallout
	U-234	2.3E5 y	Fuel material	Also naturally occurring, fallout
	U-235	7.1E8 y	Fuel material	Also naturally occurring, fallout
	U-238	4.5E9 y	Fuel material	Also naturally occurring, fallout
Transuranics	Am-241	458 y	Decay of Pu-241	Also from fallout
	Pu-238	86.4	Isotope in Pu fuel	Also from fallout
	Pu-240	6.6E3 y	Isotope in Pu fuel	Also from fallout
	Pu-241	13.2 y	Isotope in Pu fuel, multiple neutron capture from U-238 and Pu-239	Also from fallout
	Pu-242	3.8E5 y	Isotope in Pu fuel, multiple neutron capture from U-238 and Pu-239	Also from fallout
Fission Products	Cs-137	30.0 y	Fission	Also from fallout
	I-129	1.7E7 y	Fission	Also from fallout
	Sr-90	27.7 y	Fission	Also from fallout
Activation Products	Co-60	5.3 y	$Co^{59}(n, \gamma)$	Also from fallout
	Eu-152	12.7 y	$Eu^{151}(n, \gamma)$	Also from fallout
	Eu-154	16 y	$Eu^{153}(n, \gamma)$	Also from fallout
	Fe-55	2.6 y	$Fe^{54}(n, \gamma)$	Low hazard beta in rebar and steel
	H-3	12.3 y	$Li^{6}(n, \alpha)$	Also from fallout
	Ni-59	8.0E4 y	$Ni^{58}(n, \gamma)$	Low hazard beta in rebar and steel
	Ni-63	92 y	$Ni^{62}(n, \gamma)$	Low hazard beta in rebar and steel
Naturally Occurring and Its Progeny	U-238	4.5 E9 y	Primordial	
	U-234	2.5E5 y	progeny	
	Th-230	8.0E4 y	progeny	
	Ra-226	1.6E3 y	progeny	
	Pb-210	21 y	progeny	
	Th-232	1.4E10 y	Primordial	
	Ra-228	5.8 y	progeny	
	Th-228	1.9 y	progeny	
	K-40	1.3E9 y	Primordial	