DEPARTMENT OF THE ARMY
ST. LOUIS DISTRICT, CORPS OF ENGINEERS
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ST. LOUIS, MISSOURI 63103-2833

887-EPA-EAM-0003
1309

REPLY TO
ATTENTION OF:

November 6, 1997

Daniel Wall
U. S. Environmental Protection Agency
Region VII, Superfund Branch
726 Minnesota Avenue
Kansas City, Kansas 66101

RE: CHEMICAL AND RADIOLOGICAL CONTAMINANTS FOR USE AS MED/AEC TRACERS AT THE ST. LOUIS, MISSOURI SITE

Dear Mr. Wall:

The purpose of this letter is to provide a list of potential radiological and chemical contaminants for use as MED/AEC tracers. The list is based on a review of a 1951 document by Vance and Warner titled *Uranium Technology General Summary* and the general knowledge developed by FUSRAP on the extraction of uranium from ore. Also provided are constituents that are not carcinogens or toxicants, but may be used as signature components of a particular source material or waste stream. There are additional constituents provided in the BRA that are not included here. Those constituents are not considered to be reliable MED/AEC tracers.

Chemical Constituents

Twelve potentially hazardous chemical constituents have been identified. They are:

arsenic	cadmium	lead	petroleum products
barium	chromium	molybdenum	vanadium
boron	copper	nickel	zinc

Other chemical constituents such as copper, gold, palladium, platinum, and rare earth elements are not considered hazardous, but may be used as tracers to identify MED/AEC material. Table 1 shows relevant chemical constituents, and provides a brief explanation of why these constituents were selected. Table 2 lists EPA's preliminary remediation goals (PRGs) for both industrial and residential exposure scenarios.

Contaminants such as HF, HNO_3, H_2SO_4, and diethyl ether could be added to Table 1 and 2 based on process knowledge but have likely degraded or volatilized over the years. TCE was used at Mallinckrodt, but was also used at many of the industries surrounding SLAPS and HISS

and if detected, may not be related to MED/AEC activities. Beryllium was detected above background concentrations in groundwater samples from SLAPS and SLDS. Beryllium, however, is probably not related to MED/AEC activities at St. Louis based on process knowledge and is only mentioned here because small amounts can drive risk under certain exposure scenarios.

Radiological Constituents

Elevated concentrations of radionuclides are also present at the St. Louis site as a result of the handling and processing of uranium ore and black oxide (U_3O_8) at Mallinckrodt, and the shipment and disposal of process waste material. These radionuclides include constituents from three decay series (uranium, thorium, and actinium), all known to be present in both Congo and domestic ores. The primary radiological contaminants include uranium-238 (U-238), U-234, thorium-230 (Th-230), radium-226 (Ra-226), Th-232, U-235, protactinium-231 (Pa-231), and actinium-227 (Ac-227). Relevant short-lived decay products are also considered to be contaminants but are assumed to be in secular equilibrium with respective long-lived parent radionuclides and are not specifically listed. Radiological contaminants are listed in Tables 1 and 2 with relevant tracking information and PRG values.

Sincerely,

Louis A. Dell'Orco
Deputy Project Manager

Enclosures
cc: Robert Geller, MDNR
Robert Boland, Mallinckrodt

Table 1. Radiological and Chemical Constituents for Use as MED Tracers at the St. Louis Site		
Radiological Constituent	**Site Detects[a]**	**Justification for Consideration**
Ac-227	S, GW	Waste product of ore processing operations. Present in original ores (Congo and domestic) and (probably) concentrated mostly in raffinate.
Pa-231	S, GW	Waste product of ore processing operations. Present in original ores (Congo and domestic) and (probably) concentrated mostly in raffinate.
Ra-226	S, GW	Waste product of ore processing operations. Present in original ores (Congo and domestic) and concentrated mostly in gangue cake (K-65) and barium sulfate cake.
Th-230	S, GW	Waste product of ore processing operations. Present in original ores (Congo and domestic) and concentrated mostly in raffinate.
Th-232	S, GW	Waste product of ore processing operations. Present in original ores (Congo and domestic) and concentrated mostly in raffinate.
U-234	S, GW	Mallinckrodt operations specifically designed to concentrate uranium.
U-235	S. GW	Mallinckrodt operations specifically designed to concentrate uranium.
U-238	S, GW	Mallinckrodt operations specifically designed to concentrate uranium.
Chemical Constituent	**Site Detects[a]**	**Justification for Consideration**
arsenic	S, GW	Present in original ores - not concentrated in any particular waste stream
barium	S, GW	Added during ore processing to precipitate out sulfate - concentrated in barium sulfate cake containing approximately 1% of the original radium
boron	S, GW	Present in original ores - found in all waste streams
cadmium	S, GW	Present in magnesium feed used for metal casting - concentrated in dolomite slag, magnesium fluoride slag, and oil dump residues
chromium	S, GW	Present in original ores - concentrated in gangue cake, barium sulfate, and raffinate
copper	S, GW	Present in original ores - concentrated in raffinate cake
gold	-	Present in original ores - extracted mostly in the gangue cake (80-95%) and the barium sulfate (5-20%)
lead	S, GW	Present in original ores - found in scrap metal, oil dump residues, gangue cake, barium sulfate, and raffinate
molybdenum	S, GW	Present in original ores - insoluble compounds concentrated in gangue cake and barium sulfate but around 99% of soluble compounds concentrated in raffinate. Also a waste residue in phosphate filter cake from black oxide batch feed process
nickel	S, GW	Present in original ores - found in UO_2 solid after batch treatment of black oxide (< 10 ppm) and in scrap metals
petroleum organics	S, GW	Oil dump residues especially at SLAPS
palladium	-	Present in original ores - extracted mostly in the gangue cake (≅100%)
platinum	-	Present in original ores - extracted in the gangue cake (10-80%), barium sulfate (0-20%), and the raffinate cake (20-80%)
rare earths	-	Present in original ores - concentrated in raffinate cake but also found in oil dump residues
vanadium	S, GW	Present in original ores - concentrated in gangue cake and barium sulfate. Also a waste residue in phosphate filter cake from black oxide batch feed process
zinc	S, GW	Found in original ore - concentrated in magnesium fluoride slag and spent dolomite from uranium metal casting operations. Also found in scrap metal
[a] S = detected in soil, GW = detected in groundwater		

Table 2. PRGs[a] for Industrial and Residential Exposure Scenarios

Radiological Constituent	Industrial Exposure Scenario PRGs				Residential Exposure Scenario PRGs			
	Soil (pCi/g)		Groundwater (pCi/L)		Soil (pCi/g)		Groundwater (pCi/L)	
Ac-227	89	R[b]	4.5	R	27	R	1.4	R
Pa-231	58	R	11	R	13	R	3.2	R
Ra-226	6.6	R	5.4	R	16	R	1.6	R
Th-230	810	R	43	R	240	R	13	R
Th-232	920	R	49	R	280	R	15	R
U-234	700	R	36	R	210	R	11	R
U-235	8.2	R	35	R	1.6	R	11	R
U-238	730	R	37	R	220	R	11	R
Chemical Constituent	**Soil (ppm)**		**Groundwater (mg/L)**		**Soil (ppm)**		**Groundwater (mg/L)**	
arsenic	33	R	1.9E-3	R	10	R	5.5E-4	R
barium	7,300	H	7.2	H	29,000	H	2.5	H
boron	170,000	H	9.2	H	62,000	H	3.3	H
cadmium	32	H	0.051	H	14	H	0.015	H
chromium	2,500	H	0.51	H	1,000	H	0.16	H
copper	82,000[c]	H	1.3	MCL[f]	3,100[c]	H	1.3	MCL
lead	2,000[g]	-	0.015	MCL	400[g]	-	0.015	MCL
molybdenum	8,800	H	0.51	H	3,200	H	0.18	H
nickel	33,000	H	2.0	H	12,000	H	0.72	H
benzene[c]	86	R	0.099	R	48	R	4.9E-3	R
ethylbenzene[c]	0.47	H	10	H	0.47	H	1.2	H
toluene[c]	250	H	20	H	250	H	0.74	H
xylene[c]	1,000,000	H	200	H	930,000	H	58	H
vanadium	2,000	H	0.72	H	810	H	0.21	H
zinc	470,000	H	31	H	170,000	H	11	H
gold	-[d]	-	-	-	-	-	-	-
palladium	-	-	-	-	-	-	-	-
platinum	-	-	-	-	-	-	-	-
rare earths	-	-	-	-	-	-	-	-

[a] Preliminary Remediation Goal (PRG) based on RAGS Part B methodologies (EPA 1991)
[b] R signifies that PRG results in target risk of 10^{-5}, H signifies PRG results in target hazard index of 1.0.
[c] Petroleum organics possibly found in SLAPS oil dump areas
[d] "-" = not listed as a hazard to human health
[e] Toxicity for copper based on MCL of 1.3 mg/L
[f] MCL = Safe Drinking Water Act maximum contaminant level (40 CFR 141)
[g] EPA soil lead guidance: 400 ppm for areas where children are present or 2,000 ppm for industrial exposure only

Formerly Utilized Sites Remedial Action Program (FUSRAP)

ADMINISTRATIVE RECORD

for the St. Louis Site, Missouri

U.S. Department of Energy