REFERENCE 5

Westinghouse Idaho Nuclear Company, Inc.

001902

FAH-20-85
From F. A. Hohorst
Phone 6-4542
Date October 21, 1985
Subject: Interim Report on Radiological Residues from the CFSGF

To G. J. McManus, Supervisor GJM
Monitoring Technology

cc: T. W. Chesnovar
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References: 1) D. M. White, et al., "Correlation of Coal Properties With Environmental Control Technology Needs for Sulfur and Trace Elements", PB84-200666, EPA-600/7-84-066 (June 1984)

At the Coal Fired Steam Generation Facility (CFSGF), CPP-687, coal is burned to generate steam for the ICPP. Limestone is added to the coal for two reasons. First, it reacts with sulfur oxides to keep their emissions at acceptable levels. Second, the addition of limestone is used to control bed depth in response to steam demands. The residue, a mixture of lime, limestone, fly ash, and bottom ash, is collectively called "ash". This ash is mixed with water to suppress the formation of dust, hauled to the ash pit by concrete truck, and dumped in the northwest corner of the pit behind a 3 foot dike. When dry, this solid mass is from time to time pushed into piles about 10 feet high in the southwest corner of the pit, as shown in Figure 1 (C). Also shown in Figure 1 are the current locations of the coal stockpiles (A), and the limestone silo (B).

In response to your request, estimates of the volume of ash and the natural, potentially environmentally significant radionuclide discharges to the ash pit from the CFSGF during FY85 were prepared. Used in the preparation of the estimates were: 1) an analysis of coal from the Hiawatha Mine (current ICPP supplier) and the average analytical values from 184 samples of Rocky Mountain coal (Reference 1); 2) analyses of limestone from the Treasure Canyon Mine in Preston, ID (current ICPP supplier) and from a report by the National Bureau of Standards; and 3) the amounts of coal and limestone used at the ICPP during FY85. Respectively, the typical compositions of the coal and limestone are listed in Tables 1 and 2 and the amounts of coal and limestone used at the ICPP in FY85 are shown in Table 3.

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Table 3 also reports the estimated mass and volume of ash (ash plus limestone) generated during FY85, assuming 7.05% ash in the coal. Respectively, the mass and volume of the ash are 3972 tons and 5100 cubic meters. Table 4 reports the estimated amounts of the various radionuclides generated in FY85 and are based on 7611 hours (87%) of CFSGF operation during during the fiscal year. As shown, the total estimated throughput of radioisotopes at the CFSGF is 0.132 curies per year, most of which are alpha emitters contributed by the uranium-238, thorium-232, and uranium-235 radionuclide decay series (Figures 2-4, respectively). Because I have relied on typical concentrations, I have made no estimate of associated errors. The average rate of discharge of these radioisotopes to the ash pit is therefore 10 uCi ton^{-1} of coal consumed.

Of note, radionuclide discharges to the ash pit are based only on the radioisotopes present in the coal and do not include any contribution from the limestone. In addition, this evaluation did not account for potential losses of radionuclides by vaporization or entrainment. Losses by entrainment in the form of ash are unknown but are expected to be minimal. Losses by vaporization are also unknown. As the majority of the precursor radioisotopes form refractory oxides in the CFSGF, however, most of the radionuclides are expected to be retained in the ash. The apparent exceptions to this are lead-210 in the uranium-238 decay chain and the radon radionuclides of all three decay chains. As a result, some losses of lead-210 and the total loss of the radon radionuclides are possible and the radionuclide estimates presented are probably somewhat conservative. As noted below, actual analysis in the future will help reduce the uncertainties associated with contributions from the limestone, entrainment, and vaporization.

Additional samples of the several specific materials, including limestone, coal and ash, used at the CFSGF are being submitted for analyses. Results of these analyses are expected within eight to twelve weeks and upon the receipt of the analysis a more comprehensive report will be issued. I expect to be able to include the following in the later report: 1) actual analyses of representative samples of coal and limestone used at the CFSGF, 2) actual analyses of a number of samples of ash generated at the CFSGF, 3) actual volume of ash generated since startup, 4) an estimate of the fraction of activity released to the atmosphere, 5) an inventory of radioisotopes currently present at the CFSGF ash pit, and 6) recommendations for future monitoring at the CFSGF.

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If you have any questions, please call me at 6-4542.

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Attachments

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TABLE 1

Typical Analyses of Coal

Constituent	Units	Report[a]	US Fuel Co.[b]
Ash	%	11.8 ±7.17	8.45
Sulfur (total)	%	0.46 ±0.31	0.60
Potassium	%	0.07 ±0.06	0.05
Vanadium	ppm	12.2 ±10.2	---
Thorium	ppm	3.06 ±2.22	---
Uranium	ppm	1.52 ±3.23	---
Cadmium	ppm	0.18 ±0.15	---

a. D.M. White, et al., "Correlation of Coal Properties With Environmental Control Technology Needs for Sulfur and Trace Elements", EPA-600/7-84-066 (June 1984).

b. Typical analysis of coal from the Hiawatha mine, Hiawatha, UT, in a report of Commercial Testing and Engineering Co., dated April 18, 1984.

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TABLE 2

Typical Analyses of Limestone

Constituent	Units	Limestone Argillaceous NBS SRM 1b	Treasure Canyon Mine Circa 1975
Calcium	%	35.93	38.68
Potassium	%	0.20	0.1
Sulfur	ppm	100	30
Vanadium	ppm	30.1	1
Thorium	ppm	---	<1
Uranium	ppm	---	<1
Cadmium	ppm	0.052	<1

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TABLE 3

Use of Coal and Limestone at CFSGF During FY85 and Associated Estimates of Mass and Volume of Generated Ash

Period	Coal (tons)	Theoretical Ash (tons)	Limestone (tons)	Limestone + Ash (tons)
Oct 84	1040	73	73	146
Nov 84	1272	90	495	585
Dec 84	1853	131	517	648
Jan 85	1879	132	408	540
Feb 85	1182	83	278	361
Mar 85	755	53	89	142
Apr 85	1161	82	271	353
May 85	907	64	247	311
Jun 85	865	61	235	296
Jul 85	702	49	190	239
Aug 85	710	50	98	148
Sep 85	788	56	147	203
Total (tons)	13114	924	3048	3972
Total (kg)	1.19 E+7	8.38 E+5	2.77 E+6	3.60 E+6
Total (m^3)	1.6 E+4	1.0 E+3	1.8 E+3	5.1 E+3

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TABLE 4

Radioactive Waste Discharged from the CFSGF[a] During FY85

Component (Concentration)	Radioisotopes Present	Quantity Mass (kg)	Activity (Ci)	
Potassium (.05%)	^{40}K	0.0702		4.91 E-4
Vanadium (12.2 ppm)	^{50}V	0.348		6.38 E-12[b]
Thorium-232	^{232}Th	36.4	3.99 E-3	
(3.06 ppm)	^{228}Ra		3.99 E-3	
	^{228}Ac		3.99 E-3	
	^{228}Th		3.99 E-3	
	^{224}Ra		3.99 E-3	
	^{220}Rn[c]		3.99 E-3	
	^{216}Po		3.99 E-3	
	^{212}Pb		3.99 E-3	
	^{212}Bi		3.99 E-3	
	^{212}Po		3.99 E-3	
	^{208}Tl		3.99 E-3	
	^{208}Pb		Stable	
	Total Thorium-232 Chain			4.39 E-2

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TABLE 4 (Continued)

Radioactive Waste Discharged from the CFSGF[a] During FY85

Component (Concentration)	Radioisotopes Present	Quantity Mass (kg)	Quantity Activity (Ci)
Uranium-235	^{235}U	0.128	2.77 E-4
(0.0108 ppm)	^{231}Th		2.77 E-4
	^{231}Pa		2.77 E-4
	^{227}Ac		2.77 E-4
	^{227}Th		2.73 E-4
	^{223}Fr		3.82 E-6
	^{223}Ra		2.77 E-4
	^{219}Rnc		2.77 E-4
	^{215}Po		2.77 E-4
	^{211}Pb		2.77 E-4
	^{211}Bi		2.77 E-4
	^{211}Po		2.77 E-4
	^{207}Tl		2.77 E-4
	^{207}Pb		Stable
	Total Uranium-235 Chain		3.32 E-3

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Table 4 (Continued)

Radioactive Waste Discharged from the CFSGF[a] During FY85

Component (Concentration)	Radioisotopes Present	Quantity Mass (kg)	Activity (Ci)
Uranium-238	^{238}U	18.0	6.05 E-3
(1.51 ppm)	^{234}Th		6.05 E-3
	^{234}Pa		6.05 E-3
	^{234}U		6.05 E-3
	^{230}Th		6.05 E-3
	^{226}Ra		6.05 E-3
	$^{222}Rn^{c}$		6.05 E-3
	^{218}Po		6.05 E-3
	^{214}Pb		6.05 E-3
	^{214}Bi		6.05 E-3
	^{214}Po		6.05 E-3
	$^{210}Pb^{c}$		6.05 E-3
	^{210}Bi		6.05 E-3
	^{210}Po		6.05 E-3
	^{206}Pb		Stable
	Total Uranium-238 Chain		8.47 E-2
		TOTAL	1.32 E-1
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Table 4 (Continued)

Radioactive Waste Discharged from the CFSGF[a] During FY85

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a. No contribution from limestone was considered in this analysis.

b. Vanadium is included here as an example of several naturally occurring radioisotopes with halflives greater than 10^{14} years. This includes ^{50}V, ^{113}Cd, ^{115}In, ^{123}Te, ^{142}Ce, ^{144}Nd, ^{145}Nd, ^{148}Sm, ^{149}Sm, ^{156}Dy, ^{174}Hf, ^{180}Ta, ^{186}Os, and ^{209}Bi. Although they are present in the ppm range, their contribution to the total release is negligible.

c. The secular equilibrium may have been disrupted by volatilization of lead-210 in the combustion process or by the losses of the gaseous radon radionuclides.

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Figure 1
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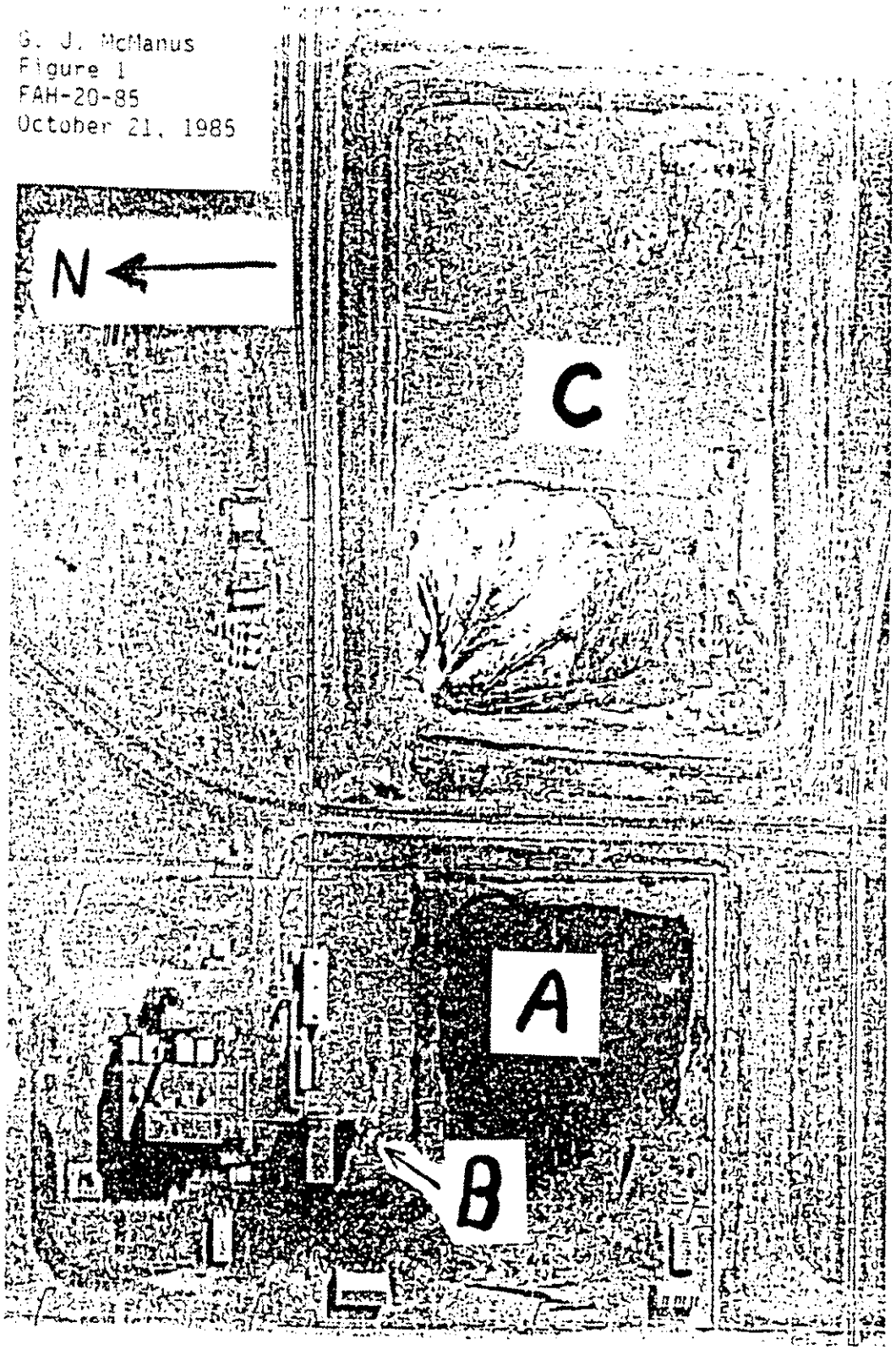

Figure 1.

The CFSGF Ash Pit and Vicinity

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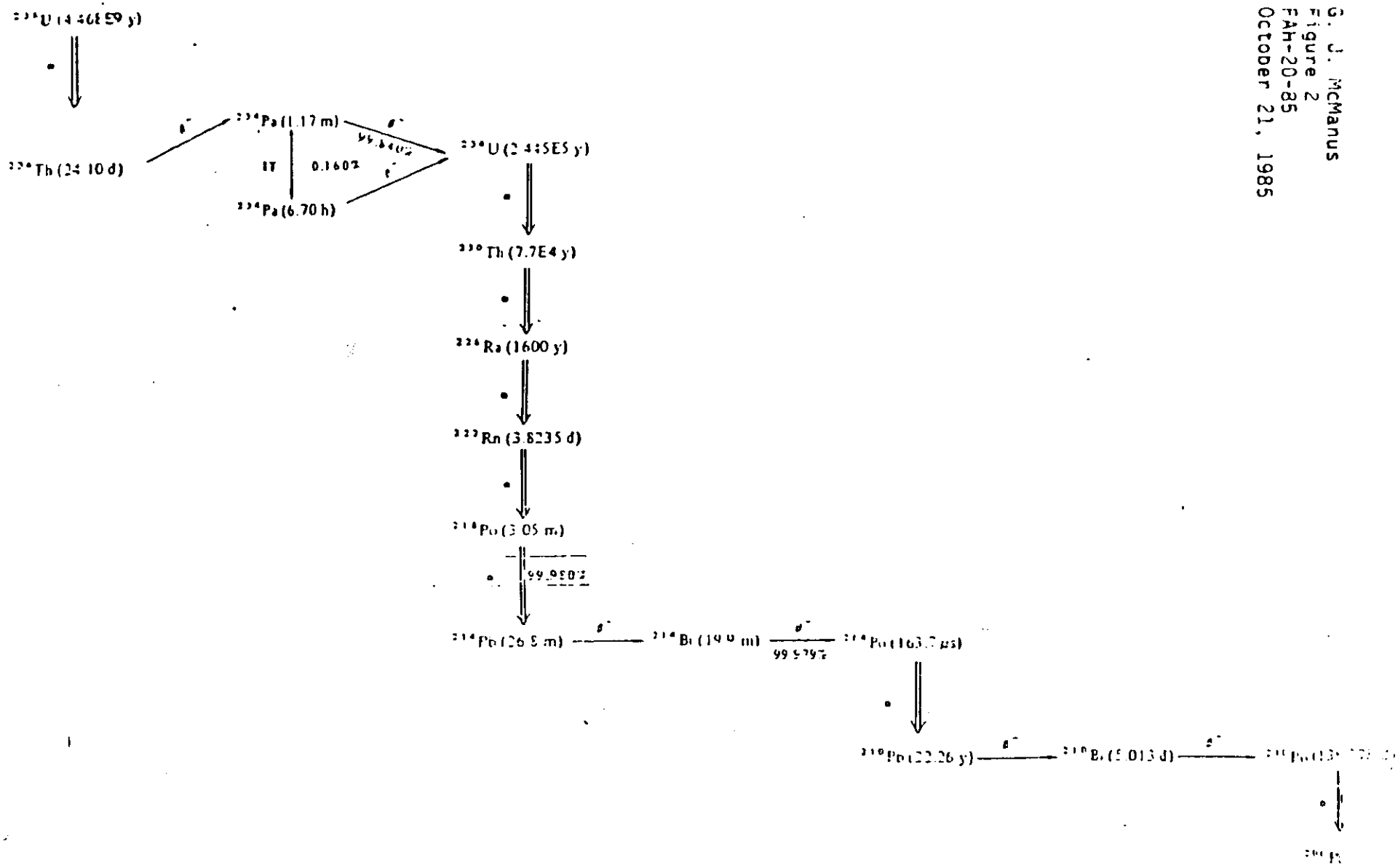

Figure 2

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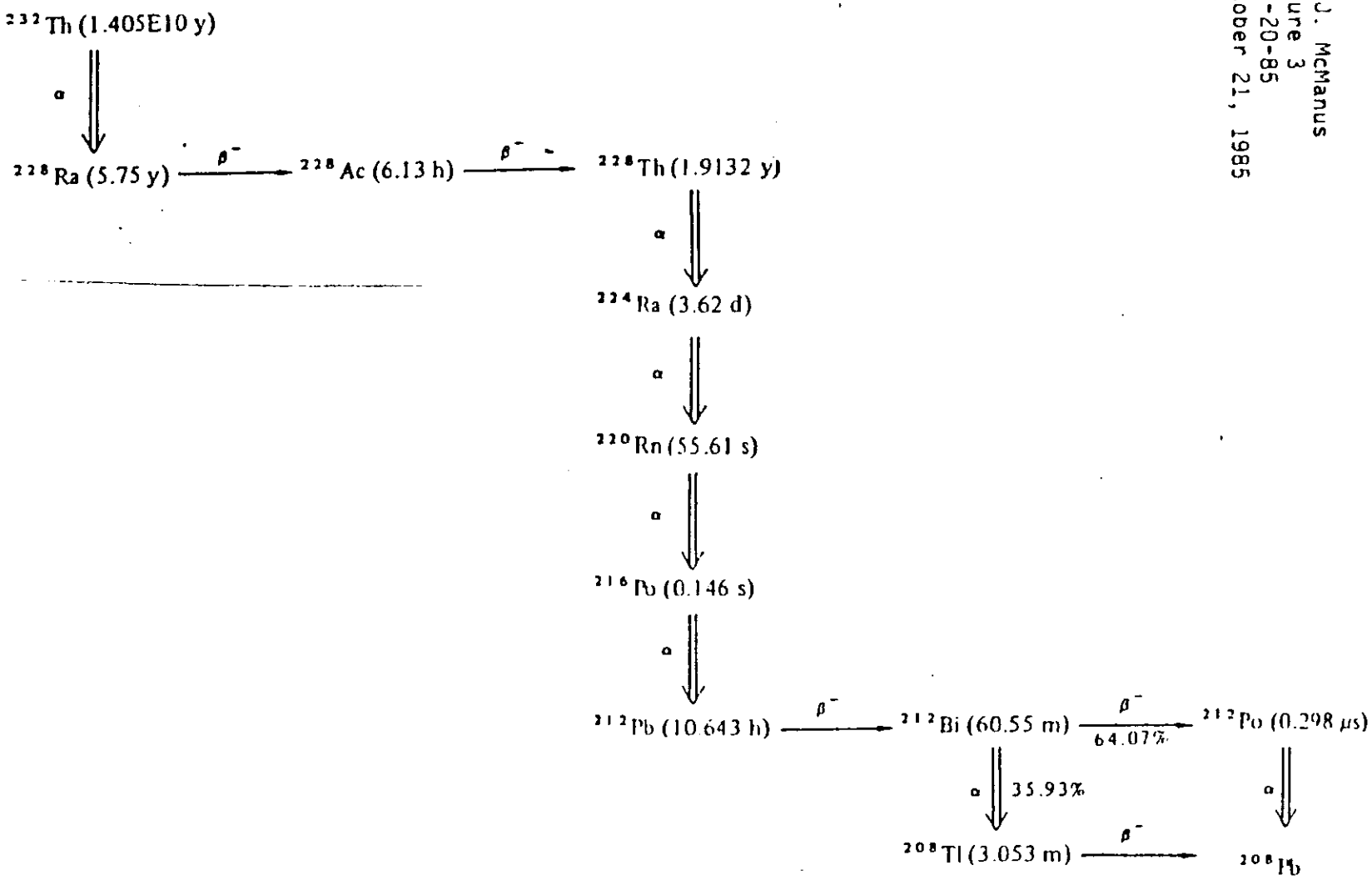

Figure 3

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Figure 4
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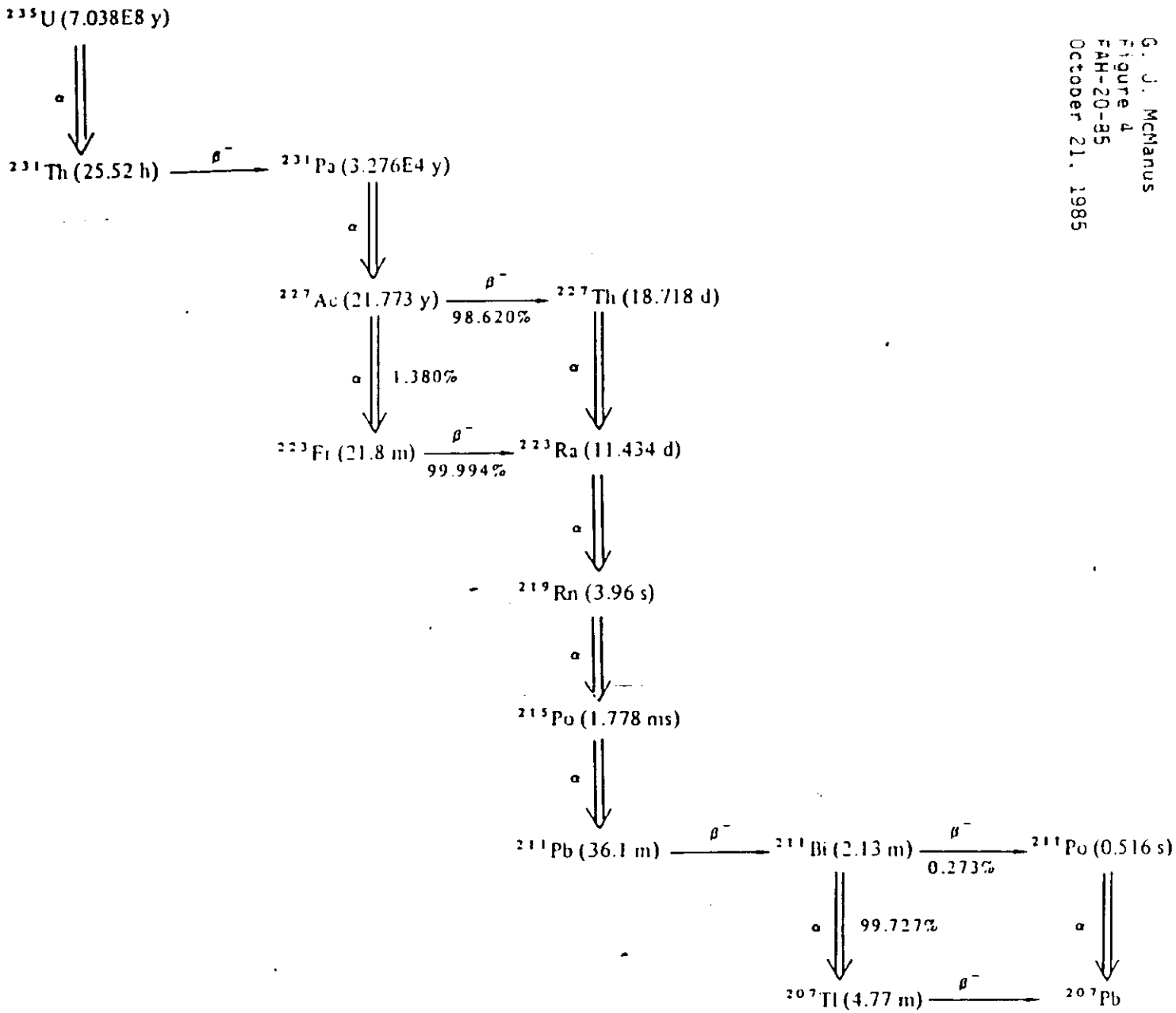

Figure 4

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