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PLUTONIUM BIOASSAY RESULTS FOLLOWING DTPA TREATMENTS
ON TWO CASES 7 YEARS AFTER ACCIDENTAL EXPOSURE

by

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DOW

THE DOW CHEMICAL COMPANY
ROCKY FLATS DIVISION
U.S. ATOMIC ENERGY COMMISSION
CONTRACT AT (29-1) -1106

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ABSTRACT

Two employees were given a series of DTPA (diethylene-triaminepentaacetic acid) treatments 7 years after they were exposed to plutonium. Bioassay results show the amount of plutonium excreted during the course of treatment was 1.5% and 1.9% of the estimated body burdens of the two individuals.

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INTRODUCTION

Accidental plutonium exposures at this plant are treated with the chelating agent, DTPA (diethylenetriaminepentaacetic acid). (1) This treatment accelerates the excretion of plutonium in both the urine and the feces. (2) The degree of acceleration is dependent on the following:

The chemical form and solubility of the plutonium

The mode of entry into the body

The promptness of treatment

The method of administering the DTPA

The amount of DTPA given per treatment
and the frequency of treatments

This increased excretion is desirable in the treatment of the accident victim but it complicates the interpretation of the excretion data. At the present time, the plutonium excreted in the urine is used as an indication of the amount deposited in the body tissues and bones. A calculation of body burden is made using the Langham equation. (3) This equation relates urine excretion to body burden as a function of time. This equation, however, is based on the data obtained from an experiment which did not involve the use of chelating agents. Some data is available for plutonium excretion following DTPA treatments, (3-10) but more is needed before body burden calculations can be made on individuals receiving treatments.

It is the purpose of this paper to add to the available data on excretion rates of plutonium following DTPA treatments.

TREATMENT

In 1964, DTPA treatments were given to two employees who had been accidentally exposed to plutonium in 1957. They received general body contamination, lacerations, and inhalation exposures. Both were given EDTA (ethylenediaminetetraacetic acid) treatments shortly after the accident. Their EDTA treatment schedule and bioassay results have been previously reported. (11)

In the recent series of treatments, employee A was given one DTPA treatment per week for a period of 12 weeks. Each treatment consisted of one gram of CaNa_3 DTPA in 250 cc. of normal saline solution administered intravenously by slow drip.

Employee B was given three treatments per week on a 3-weeks-on then 3-weeks-off schedule. This continued for 15 weeks with a total of 24 treatments given.

BIOASSAY

Both employees have submitted 24-hour urine samples each month since the accident. Just prior to the recent DTPA treatments, employee A was excreting plutonium in the urine at the rate of 4 d/m/24 hours. Employee B was excreting 11 d/m/24 hours. These monthly assays have been used to estimate body burdens for each of the employees. These estimations indicate 3.5 and 8.6 times the MPBB (Maximum Permissible Body Burden) for Case A and Case B, respectively.

Nearly continuous urine sampling was conducted during the 1964 treatment on both individuals. Fecal samples were collected but not on a daily schedule. Blood samples were also assayed for plutonium. Prior to each DTPA treatment, a 30-ml sample of blood was taken for analysis.

For Case A, the urine, fecal, and blood assay results are shown in Tables I, II, and III, respectively. This information is also shown on semilogarithmic paper in Figure 1. The bioassay results for Case B are shown in Tables IV, V, VI, and Figure 2.

DISCUSSION

During the course of treatment, nearly 13,000 d/m of plutonium was excreted by Case B compared to 1300 d/m in a similar period without treatment. This 10-fold increase represents, however, only 1.5% of the estimated body burden of the individual. Case A excreted 5000 d/m during his course of treatment. This represented a 15-fold increase but only 1.9% of his estimated body burden.

APPENDIX A—CASE A

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TABLE I
AMOUNT OF PLUTONIUM EXCRETED IN URINE (CASE A)

<u>Date</u> <u>(1964)</u>	<u>d/m 24 hr.</u>	<u>Running</u> <u>Total</u> <u>(d/m)</u>	<u>Date</u> <u>(1964)</u>	<u>d/m 24 hr.</u>	<u>Running</u> <u>Total</u> <u>(d/m)</u>
8-12	88	88	9-27	71	2899
8-13	90	178	9-28	43	2942
8-14	49	227	9-29	273	3215
8-15	61	288	9-30	97	3312
8-16	50	338	10-1	101	3413
8-17	52	390	10-2	67	3480
8-18	57	447	10-3	63	3543
8-19	16	463	10-4	45	3588
8-20	7	470	10-5	16	3604
8-21	8	478	10-6	154	3758
8-22	5	483	10-7	100	3858
8-23	25	508	10-8	Lost	3858
8-24	39	547	10-9	25	3883
8-25	13	560	10-10	44	3927
8-26	1	561	10-11	29	3956
8-27	36	597	10-12	3	3959
8-28	67	664	10-13	Lost	3959
8-29	72	736	10-14	17	3976
8-30	52	788	10-15	113	4089
8-31	48	836	10-16	58	4147
9-1	232	1068	10-19	33	4180
9-2	100	1168	10-20	234	4414
9-4	108	1276	10-21	4	4418
9-8	86	1362	10-22	61	4479
9-9	65	1427	10-23	30	4509
9-10	37	1464	10-24	38	4547
9-11	51	1515	10-25	18	4565
9-12	38	1553	10-26	45	4610
9-14	34	1587	10-27	Lost	4610
9-15	126	1713	10-28	52	4662
9-16	70	1783	10-29	62	4724
9-17	90	1873	10-30	58	4782
9-18	99	1972	10-31	59	4841
9-21	59	2031	11-1	30	4871
9-22	376	2407	11-3	75	4946
9-23	138	2545	11-4	65	5011
9-24	96	2641	11-5	57	5068
9-25	99	2740	11-6	43	5111
9-26	88	2828			

TABLE II

AMOUNT OF PLUTONIUM EXCRETED IN FECES (CASE A)

<u>Date</u> <u>(1964)</u>	<u>d/m 24 hr.</u>
8-9	0.74
8-27	20.
9-22	2.3
10-28	17.5

TABLE III

AMOUNT OF PLUTONIUM IN BLOOD ASSUMING A 6-LITER VOLUME (CASE A)

<u>Date</u> <u>(1964)</u>	<u>d/m</u>
8-11	1600
8-18	72
8-25	87
9-1	50
9-8	336
9-15	162
9-22	1440
9-29	186
10-6	Lost
10-13	1420
10-20	532
10-27	1140

FIGURE 1
BIOASSAY RESULTS (CASE A)

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APPENDIX B—CASE B

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TABLE IV

AMOUNT OF PLUTONIUM EXCRETED IN URINE (CASE B)

Date (1964)	d/m 24 hr.	Running Total (d/m)	Date (1964)	d/m 24 hr.	Running Total (d/m)
7-7	568*	568	8-31	274*	9,256
7-8	578	1,146	9-1	169	9,425
7-9	508	1,654	9-2	357	9,782
7-10	675	2,329	9-3	226	10,008
7-11	333*	2,662	9-17	50	10,058
7-12	157	2,819	9-24	51*	10,109
7-13	305*	3,124	9-25	19*	10,128
7-14	509	3,633	9-28	286*	10,414
7-15	532	4,165	9-29	139	10,553
7-16	384	4,549	9-30	79	10,632
7-17	411	4,960	10-1	48	10,680
7-18	244	5,204	10-2	108	10,788
7-19	88	5,292	10-4	82*	10,870
7-20	450	5,742	10-5	495*	11,365
7-21	288	6,030	10-6	254*	11,619
7-22	420	6,450	10-7	254*	11,873
7-30	68*	6,518	10-8	215	12,088
8-6	50*	6,568	10-9	153	12,241
8-17	282*	6,850	10-12	150*	12,391
8-18	48*	6,898	10-13	87*	12,478
8-19	147	7,045	10-14	15	12,493
8-20	130	7,175	10-15	242*	12,735
8-21	246*	7,421	10-16	96	12,831
8-22	207*	7,628	10-17	130*	12,961
8-23	192*	7,820	10-18	95*	13,056
8-24	330*	8,150	10-19	65*	13,121
8-25	174	8,324	10-21	100*	13,221
8-26	285*	8,609	10-23	53*	13,274
8-27	179	8,788	10-27	38*	13,312
8-28	95	8,883	10-29	38*	13,350
8-29	99	8,982			

* extrapolated to 24 hr. from data obtained in more than 8 hr.

TABLE V

AMOUNT OF PLUTONIUM EXCRETED IN FECES (CASE B)

<u>Date</u> <u>(1964)</u>	<u>d/m 24 hr.</u>	<u>Date</u> <u>(1964)</u>	<u>d/m 24 hr.</u>
7-8	15	8-26	16
7-9	70	8-28	128
7-11	22	9-2	82
7-12	9	9-3	8
7-13	20	9-17	3
7-14	22	9-25	--
7-15	38	9-29	--
7-16	101	9-30	1
7-17	41	10-1	--
7-19	104	10-2	--
7-20	65	10-6	47
7-22	23	10-8	Lost
7-30	21	10-12	2
8-6	124	10-14	8
8-17	6	10-21	19
8-18	9	10-23	14
8-19	24	10-29	9
8-24	2		

TABLE VI

AMOUNT OF PLUTONIUM IN BLOOD ASSUMING A 6-LITER VOLUME (CASE B)

<u>Date</u> <u>(1964)</u>	<u>d/m</u>	<u>Date</u> <u>(1964)</u>	<u>d/m</u>
7-7	168	8-24	156
7-8	2740	8-26	116
7-9	168	8-28	224
7-10	306	8-31	252
7-13	138	9-2	204
7-15	2016	9-4	120
7-17	720 & 138	9-17	300
7-20	96	9-28	660
7-22	284	9-30	426
7-29	972	10-2	792
8-17	822	10-7	182
8-19	96	10-27	1440
8-21	356	11-13	348

FIGURE 2
BIOASSAY RESULTS (CASE B)

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