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Colorado Department of Health

Environmental Surveillance Report

on the

U.S. Department of Energy

Rocky Flats Plant

JUNE 1987

Monthly Information Exchange Meeting

This is a numerical summary of data accumulated during

JUNE 1987

pertaining to environmental surveillance activities of the Department Also included are additional data not previously reported for earlier periods

ADMIN RECORD

SW-A-003696

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COLORADO DEPARTMENT OF HEALTH

U.S. DOE ROCKY FLATS PLANT SURVEILLANCE

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COLORADO DEPARTMENT OF HEALTH
Radiation Control Division
Gross Alpha and Beta Activity in Hi-Volume Air Filters

TABLE A

SURVEILLANCE SUMMARY
JUN 1987

	Number of Samples *******	Gross Alpha Mean Concen pCi/m 3 *******	Gross Alpha Standard Deviation pCi/M 3 *********	Gross Alpha Max pCi/M^3 *******	Gross Alpha Min pCi/M^3 *******	Gross Beta Mean Concen pCi/M^3 *******	Gross Beta Standard Deviation pCi/M^3 *********	Gross Beta Max pCi/M 3 *******	Gross Beta Min pCi/M 3 *******	Total Volume M 3 ******
ON-SITE (SECURITY)										
**********										
RF D-1 ON-SITE (SECURITY)	11	<0 004	< 001	0 005	<0 002	<0 03	< 01	0 05	0 02	39437
RF D-2 ON-SITE (SECURITY)	13	<0 004	< 001	0 006	<0 002	<0 03	< 01	0 04	0 02	46485
RF D-3 ON-SITE (SECURITY)	5	<0 006	0 002	0 009	<0 004	<0 03	< 01	0 04	<0 02	19282
RF D-4 ON-SITE (SECURITY)	11	<0 005	0 003	0 012	<0 002	0 03	< 01	0 05	0 02	40827
JUN GROUP SUMMARY	40	<0 004	0 002	0 012	<0 002	<0 03	< 01	0 05	0 02	146031
ON-SITE (PERIMETER)										
**********										
RF D-5 ON-SITE (PERIMETER)	12	<0 004	0 001	0 006	<0 002	<0 03	< 01	0 04	0 02	46591
RF D-6 ON-SITE (PERIMETER)	13	0 004	0 002	0 008	<0 002	<0 03	< 01	0 06	0 02	47613
RF D-7 ON-SITE (PERIMETER)	13	<0 003	< 001	0 006	0 003	<0 03	< 01	0 05	<0 02	48734
RF D-8 ON-SITE (PERIMETER)	12	<0 004	0 002	0 008	<0 003	<0 03	01	0 05	0 02	44367
JUN GROUP SUMMARY	50	<0 004	0 001	0 008	<0 002	<0 03	< 01	0 06	<0 02	188610
OFF-SITE (METRO)										
**********										
BROOMFIELD	3	0 002	< 001	0 003	0 002	0 03	0 01	0 04	0 02	21022
ADAMS CITY 4301 E 72nd Ave	4	<0 005	< 001	<0 006	<0 005	<0 05	< 01	0 06	<0 04	6743
AURORA 1633 Florence Street	4	<0 005	< 001	0 005	<0 005	<0 05	< 01	0 06	0 04	6862
BOULDER 13th & Spruce	5	<0 005	< 001	<0 006	<0 004	0 06	0 01	0 08	0 04	8287
DENVER 414 Fourteenth Street	4	<0 006	< 001	<0 006	<0 006	0 06	< 01	0 07	0 05	29
ENGLEWOOD 4857 South Broadway	5	<0 005	< 001	0 005	<0 005	0 08	0 02	0 10	0 06	7571
LAKEWOOD 250 South Kipling	4	<0 004	< 001	0 004	<0 004	<0 05	< 01	0 06	0 04	6943
JUN GROUP SUMMARY	29	<0 005	0 001	<0 006	0 002	<0 06	0 02	0 10	0 02	65557
OFF-SITE (REMOTE)										
**********										
DURANGO Fire Station	4	<0 005	< 001	0 005	<0 004	0 06	0 03	0 11	0 05	727
LEADVILLE 510 Harrison Avenue	4	<0 005	001	0 005	<0 005	<0 05	< 01	0 06	0 05	6094
STERLING 3rd & Ash Street	3	<0 005	< 001	0 005	0 005	0 07	0 02	0 09	0 06	5115
JUN GROUP SUMMARY	11	<0 005	< 001	<0 005	<0 004	0 07	0 02	0 11	<0 05	17436

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TABLE B
AIR SURVEILLANCE SUMMARY
MONTHLY COMPARISON DATA
1986 and 1987

Station	N	Total Long-lived ALPHA (pCi/m^3) $\bar{x}$	S.D.	max.	min	Total Long-lived BETA (pCi/m^3) $\bar{x}$	S.D.	max	min.	Volume (m^3)
ON-SITE (Security)										
1986										
June	50	<0.004	0.002	0.009	<0.002	<0.03	<0.01	0.04	0.01	186437
July	52	<0.004	0.002	0.012	<0.003	<0.03	<0.01	0.05	0.02	187257
August	52	<0.004	0.001	0.008	<0.002	<0.04	0.01	0.07	0.02	184851
September	51	<0.005	0.002	0.012	<0.002	<0.03	<0.01	0.06	0.02	178992
October	56	<0.004	0.002	0.011	<0.002	<0.03	<0.01	0.05	0.02	2073[illegible]
November	46	<0.006	0.001	0.010	<0.003	<0.03	<0.01	0.06	<0.02	1673[illegible]
December	54	<0.005	0.001	0.007	<0.003	<0.03	<0.01	0.06	<0.02	196299
1987										
January	52	<0.004	0.002	0.011	<0.002	<0.02	<0.01	0.04	0.01	188312
February	47	<0.003	0.001	0.008	<0.000	<0.03	<0.01	<0.05	<0.00	199755
March	48	<0.004	0.002	<0.013	<0.002	<0.03	0.01	<0.10	<0.02	166275
April	49	<0.004	0.002	0.012	<0.002	<0.03	<0.01	0.05	<0.02	178166
May	47	<0.005	0.004	0.025	<0.002	<0.03	0.01	0.07	<0.02	165496
June	40	<0.004	0.002	0.012	<0.002	<0.03	<0.01	0.05	0.02	146031
ON-SITE (Perimeter)										
1986										
June	47	<0.003	0.001	0.009	<0.002	<0.03	<0.01	0.04	0.01	162602
July	47	<0.004	0.001	0.006	<0.002	<0.03	<0.01	<0.05	0.02	173579
August	49	<0.003	0.001	0.011	<0.002	<0.04	<0.01	0.05	0.02	181472
September	52	<0.004	0.001	0.006	<0.002	<0.03	<0.01	0.05	0.02	192581
October	56	<0.003	<0.001	0.006	<0.002	<0.03	0.01	0.06	0.02	21524
November	46	<0.005	0.001	<0.008	<0.003	<0.03	<0.01	0.05	<0.02	176085
December	54	<0.005	0.001	<0.008	<0.003	<0.03	0.01	0.09	<0.02	206344
1987										
January	49	<0.003	<0.001	<0.005	<0.002	<0.02	<0.01	0.05	<0.01	184438
February	48	<0.003	<0.001	<0.004	<0.002	<0.03	<0.01	0.04	<0.02	185409
March	50	<0.003	<0.001	0.005	<0.002	<0.02	<0.01	0.03	<0.02	185301
April	51	<0.003	<0.001	0.005	<0.001	<0.03	<0.01	0.05	0.01	194260
May	45	<0.003	0.002	0.008	<0.001	<0.03	0.01	0.05	<0.02	173240
June	50	<0.004	0.001	0.008	<0.002	<0.03	<0.01	0.06	<0.02	188610

MAXIMUM CONTAMINANT LEVELS FOR RADIUM-226, RADIUM-228, AND GROSS ALPHA PARTICLE ACTIVITY IN COMMUNITY WATER SYSTEMS

The following are the maximum contaminant levels for radium-226, radium-228, and gross alpha particle activity in community water systems

a combined radium-226 and radium-228 -- 5 pCi/l

b gross alpha particle activity (including radium-226 but excluding radon and uranium) -- 15 pCi/l

MAXIMUM CONTAMINANT LEVELS FOR BETA PARTICLE AND PHOTON RADIOACTIVITY FROM MAN-MADE RADIONUCLIDES IN COMMUNITY WATER SYSTEMS

The average annual concentration of beta particle and photon radioactivity from man-made radionuclides in drinking water provided by community water systems shall not produce an annual dose equivalent to the total body of any internal organ greater than 4 mrem/year

Except for the radionuclides listed below, the concentration of man-made radionuclides causing 4 mrem total body or organ dose equivalents shall be calculated on the basis of a 2 liter per day drinking water intake using the 168 hour data listed in "Maximum Permissible Body Burden and Maximum Permissible Concentration of Radionuclides in Air or Water for Occupational Exposure", NBS Handbook 69 as amended August 1963, U S Department of Commerce If two or more radionuclides are present, the sum of their annual dose equivalent to the total body or to any organ shall not exceed 4 mrem/year

AVERAGE ANNUAL CONCENTRATIONS OF RADIONUCLIDES ASSUMED TO PRODUCE A TOTAL BODY OR ORGAN DOSE OF 4 mrem/YEAR

Radionuclide	Critical Organ	pCi per liter
tritium	total body	20,000
strontium-90	bone marrow	8

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APPENDIX III
LIMITS OF SENSITIVITY

Lower limits of detection (LLD's) are based on the U.S.A E C Health and Safety Laboratory Procedures Manual (HASL-300, 1972).

The calculated LLD will be reported based upon actual measurement when they are available Otherwise the following LLD will be reported, which are based upon nominal (average) measurements.

A WATER ANALYSIS

1	Gross alpha	7.0 pCi/L
2	Gross beta	6.0 pCi/L
3	Plutonium-239	0.02 pCi/L
4.	Tritium	360 0 pCi/L

B AIR ANALYSIS

1	Gross alpha (uncorrected to density thickness)	
	Individual samples	
	APC stations (1500 m^3)	.007 pCi/m^3
	D-x stations (3000 m^3)	.004 pCi/m^3
2.	Gross beta (uncorrected to density thickness)	
	Individual samples	
	APC stations (1500 m^3)	.05 pCi/m^3
	D-x stations (3000 m^3)	03 pCi/m^3
3	Plutonium-239	
	Individual samples (using 1/4 sample)	
	APC stations (1500 m^3)	.00019 pCi/m^3
	D-x stations (3000 m^3)	00009 pCi/m^3
	Monthly composites (using 1 inch^2 per sample)	
	APC stations (1500 m^3/sample x 8 samples)	00037 pCi/m^3
	D-x stations (3000 m^3/sample x 13 samples)	00011 pCi/m^3
	Quarterly composites (using 1 inch^2 per sample)	
	APC stations (1500 m^3/sample x 23 samples)	00013 pCi/m^3

C SOIL ANALYSIS

1	Plutonium - 239	0.08 pCi/gm	18 dpm/gm

A "lower detection limit" for fluorometric uranium analysis is reported by the Water Quality Laboratory as 3 µg/L, or 2 pCi/L at isotopic equilibrium, and is defined as "three times background"

COLORADO DEPARTMENT OF HEALTH
Radiation Control Division/Radiation Counting Facility
Rev 1/84

TABLE B, CONT

Station	N	Total Long-lived ALPHA (pCi/m^3) $\bar{x}$	S D	max	min	Total Long-lived BETA (pCi/m^3) $\bar{x}$	S D	max	min	Volume (m^3)
OFF-SITE (Metro)										
1986										
June	46	<0 005	0 001	0 007	<0 001	<0 04	<0 01	0 06	0 02	102168
July	54	<0 005	0 001	0 008	<0 001	<0 05	0 01	<0 06	<0 01	119083
August	36	<0 005	<0 001	<0 007	<0 002	<0 05	<0 01	0 08	0 03	85560
September	35	<0 004	0 001	0 011	0 002	<0 05	0 01	0 07	0 02	79628
October	37	<0 005	0 001	<0 008	0 002	<0 05	0 02	0 10	0 02	96020
November	34	<0 008	0 002	<0 012	<0 002	<0 04	<0 01	<0 05	<0 01	81158
December	39	<0 010	0 003	<0 015	<0 003	<0 04	<0 01	<0 06	0 02	10244
1987										
January	36	<0 006	0 002	<0 011	<0 002	<0 04	<0 01	<0 05	0 01	84046
February	34	<0 006	0 001	<0 007	<0 002	<0 05	<0 01	0 07	0 02	75269
March	35	<0 006	0 002	<0 010	<0 003	<0 04	<0 01	<0 05	0 02	81739
April	41	<0 006	0 001	<0 007	<0 002	<0 05	0 01	0 08	0 02	93465
May	32	<0 005	0 001	<0 007	<0 002	<0 05	<0 01	0 06	0 03	73401
June	29	<0 005	0 001	<0 006	<0 002	<0 06	0 02	0 10	0 02	63557
OFF-SITE (Remote)										
1986										
June	25	<0 006	<0 001	<0 007	<0 004	<0 05	<0 01	<0 06	<0 04	38866
July	27	<0 006	<0 001	<0 007	<0 005	<0 06	<0 01	0 07	<0 05	42545
August	22	<0 006	0 001	<0 007	<0 004	<0 05	<0 01	0 08	<0 05	36968
September	27	<0 005	<0 001	0 007	<0 004	<0 05	<0 01	0 06	<0 04	44653
October	21	<0 005	0 001	<0 008	<0 004	<0 06	0 02	0 10	<0 04	37576
November	20	<0 009	0 002	<0 015	<0 007	<0 05	<0 01	<0 07	<0 04	34766
December	23	<0 009	0 002	<0 013	<0 008	<0 06	0 02	0 11	<0 04	40314
1987										
January	26	<0 006	0 001	<0 009	<0 005	<0 05	0 01	0 09	<0 04	46920
February	21	<0 006	0 002	<0 011	<0 004	<0 05	<0 01	0 07	<0 04	37201
March	20	<0 006	0 001	<0 008	<0 004	<0 05	<0 01	0 06	<0 04	34650
April	15	<0 005	<0 001	<0 007	<0 004	<0 05	0 02	0 08	0 03	25685
May	17	<0 005	<0 001	<0 007	<0 005	<0 05	<0 01	0 06	<0 04	26453
June	11	<0 005	<0 001	<0 005	<0 004	<0 07	<0 02	0 11	<0 05	17436

NOTE N = number of observations (samples)
$\bar{x}$ = arithmetic mean
S D = standard deviation of the population of results observed (1 sigma)
max = maximum individual sample concentration observed
min = minimum individual sample concentration observed
Nominal values for the minimum detectable activity are listed in Appendix III
SI Unit Equivalent 1 pCi/l = 0 037 Bq/l
20 pCi/l = 0 48 Bq/l

TABLE C
PLUTONIUM AND TOTAL LONG-LIVED ALPHA
CONCENTRATIONS IN AIR
June 1987

Station	DATE Month/Quarter	$Pu^{239+240}$ (pCi/m^3)	Total Long-lived ALPHA (pCi/m^3)
RF-1	09/86	0.00004 ± 0.00001	<0.005
RF-2	09/86	0 00125 ± 0.00004	<0.004
RF-3	09/86	0.00006 ± 0.00001	<0.007
RF-4	09/86	0.00033 ± 0.00002	<0.005
RF-5	09/86	<0.00001	<0.003
RF-6	09/86	<0.00001	<0.004
RF-7	09/86	<0.00001	<0.004
RF-1	05/87	0.00003 ± 0.00001	<0.004
RF-2	05/87	0.00006 ± 0.00001	<0.004
RF-3	05/87	0.00171 ± 0.00005	<0.006
RF-4	05/87	0.00263 ± 0.00003	<0.005
RF-5	05/87	<0.00001	<0.004
RF-6	05/87	<0.00001	<0.004
RF-7	05/87	<0.00001	<0.003
RF-8	05/87	0 00001 ± 0.00001	<0 004

NOTE: Total Long-lived ALPHA and Plutonium error terms are based on the 2 sigma counting error for the single analysis.
Nominal values for the minimum detectable activity are listed in Appendix III.
The standard for general population exposure for soluble Pu is 0.02 pCi/m^3.

TABLE D
WATER SURVEILLANCE SUMMARY
(INDIVIDUAL SAMPLES)
June 1987

Station	Date	Activity (pCi/l) ALPHA	BETA	TRITIUM
R F Pond A-3	06/12/87	18 ± 6	7 ± 4	<350
R F Pond B-3	06/03/87	7 ± 4	7 ± 4	<350
	06/10/87	<6	5 ± 4	<350
	06/17/87	8 ± 5	7 ± 4	<350
	06/27/87	<4	12 ± 4	<350
Monthly Average		<6	<8	<350
Walnut Creek at Indiana	*06/01/87			
	06/03/87	<5	7 ± 4	<350
	06/05/87	<5	<5	<350
	06/08/87	<6	10 ± 4	<350
	06/10/87	12 ± 6	7 ± 4	<350
	06/12/87	<6	6 ± 4	<350
	06/15/87	6 ± 4	11 ± 4	<350
	06/17/87	<6	9 ± 4	<350
	06/19/87	22 ± 6	12 ± 4	<350
	*06/22/87			
	*06/24/87			
	*06/26/87			
	*06/29/87			
Monthly Average		<8	<8	<350
Broomfield	06/03/87	<4	<5	<350
	06/10/87	<4	<5	<350
	06/17/87	7 ± 3	6 ± 4	<350
	06/24/87	5 ± 3	10 ± 4	<350
Monthly Average		<5	<6	<350
Woman Creek at Indiana	06/01/87	5 ± 4	5 ± 4	<350
Westminster***	06/10/87	<3	<5	<350
	06/24/87	<3	<5	<350
Monthly Average		<3	<5	<350

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TABLE D
WATER SURVEILLANCE SUMMARY
(INDIVIDUAL SAMPLES)
June 1987

Station	Date	Activity (pCi/l) ALPHA	BETA	TRITIUM
Arvada	06/24/87	<3	<5	<350
Boulder				
Golden				
North Table Mountain	06/29/87	<3	<5	<350
CDH (ppt)	06/09/87			<350
	06/19/87			<350
	06/29/87			<350
D-4 (ppt)	06/08/87			<350
	06/19/87			<350
	06/29/87			<350
Planned Releases				
A-4	05/27/87	7 ± 4	11 ± 4	
B-5	05/27/87	8 ± 4	11 ± 4	
C-2	05/27/87	8 ± 4	8 ± 4	

NOTE Error terms are based on the 2 sigma counting error for the single analysis. Nominal values for the minimum detectable activity are listed in Appendix III.
* = No sample collected
** = weekly composite
*** = bi-weekly composite
SI unit equivalent: 1 pCi/l = 0.037 Bq/l
20 pCi/l = 0.74 Bq/l

**** No Trituim results this month

TABLE D
WATER SURVEILLANCE SUMMARY
(INDIVIDUAL SAMPLES)
May 1987

Station	Date	Activity (pCi/l) ALPHA	BETA	TRITIUM
R F Pond A-3	05/06/87			<350
R F Pond B-3	05/06/87			<350
	05/13/87			<350
	05/20/87			<350
	05/27/87			<350
Monthly Average				<350
Walnut Creek at Indiana	05/01/87			<350
	05/04/87			<350
	05/06/87			<350
	05/08/87			<350
	05/11/87			<350
	05/13/87			<350
	05/15/87			<350
	05/18/87			<350
	05/20/87			<350
	05/22/87			<350
	05/25/87			<350
	05/27/87			<350
	05/29/87			<350
Monthly Average				<350
Broomfield	05/06/87			<350
	05/13/87			<350
	05/20/87			<350
	05/27/87			<350
Monthly Average				<350
Woman Creek at Indiana	05/06/87			<350
Westminster***	05/13/87			<350
	05/27/87			<350
Monthly Average				<350

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TABLE D
WATER SURVEILLANCE SUMMARY
(INDIVIDUAL SAMPLES)
May 1987

Station	Date	Activity (pCi/l) ALPHA	BETA	TRITIUM
Arvada	05/19/87			<350
Boulder	05/13/87			<350
Golden	05/13/87			<350
North Table Mountain	05/19/87			<350
CDH (ppt)				
D-4 (ppt)	05/04/87			<350
	05/06/87			<350
	05/18/87			<350
	05/22/87			<350
	05/25/87			<350
Planned Releases				
A-4	05/27/87			<350
B-5	05/27/87			<350
C-2	05/27/87			<350

NOTE Error terms are based on the 2 sigma counting error for the single analysis. Nominal values for the minimum detectable activity are listed in Appendix III
* = No sample collected
** = weekly composite
*** = bi-weekly composite
SI unit equivalent: 1 pCi/l = 0.037 Bq/l
20 pCi/l = 0.74 Bq/l

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TABLE E-1
WATER SURVEILLANCE SUMMARY
MONTHLY COMPARISON DATA
POND A-3
1986 and 1987

Date	ALPHA (pCi/l)	BETA (pCi/l)	TRITIUM (pCi/l)
1986			
June	4 ± 3	7 ± 4	<350
July	<5	<5	<350
August	<5	6 ± 4	<350
September	4 ± 3	5 ± 4	433 ± 160
October	6 ± 4	5 ± 4	<350
November	30 ± 6	22 ± 4	<350
December*			
Annual Data	<7	<7	<358
1987			
January	<4	14 ± 5	<350
February	<3	<5	<350
March	5 ± 4	13 ± 4	<350
April	35 ± 8	20 ± 5	<350
May	5 ± 3	4 ± 3	<350
June	18 ± 6	7 ± 4	<350

NOTE Error terms are based on the 2 sigma counting error for the single analysis
Nominal values for the minimum detectable activity are listed in Appendix III
* = No sample collected
SI unit equivalent 1 pCi/l = 0 037 Bq/l
20 pCi/l = 0 74 Bq/l

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TABLE E-2
WATER SURVEILLANCE SUMMARY
MONTHLY COMPARISON DATA
POND B-3
1986 and 1987

Date	N	ALPHA (pCi/l) $\bar{x}$	max.	min.	BETA (pCi/l) $\bar{x}$	max.	min.	TRITIUM (pCi/l) $\bar{x}$	max.	min
1986										
June	4	<3	<4	<3	<10	13	<5	<350	<350	<350
July	5	<4	4	<3	9	11	6	<350	<350	<350
August	4	<3	<3	<3	10	11	9	<350	<350	<350
September	4	<5	7	<3	<10	14	<5	<350	<350	<350
October	5	<5	7	<4	<9	15	<5	<350	<350	<350
November	4	<5	8	<3	14	16	12	<350	<350	<350
December	5	<6	10	<3	12	17	9	<689	2046	<350
Annual Data	52	<4	10	2	<11	19	<5	<379	2046	<350
1987										
January	4	<4	5	<4	14	15	13	<350	<350	<350
February	3	<5	7	<4	11	14	7	<350	<350	<350
March	4	<5	9	<4	10	13	5	<361	394	<350
April	5	<5	5	4	10	11	9	<556	960	<350
May	4	<5	<5	<4	<10	14	5	<350	<350	<350
June	4	<6	8	<4	<8	12	5	<350	<350	<350

NOTE: N = number of observations (samples)
$\bar{x}$ = arithmetic mean
max. = maximum individual sample concentration observed
min. = minimum individual sample concentration observed
Nominal values for the minimum detectable activity are listed in Appendix III
SI Unit Equivalent: 1 pCi/l = 0.037 Bq/l
20 pCi/l = 0.48 Bq/l

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TABLE E-3
WATER SURVEILLANCE SUMMARY
MONTHLY COMPARISON DATA
WALNUT CREEK AT INDIANA
1986 and 1987

Date	N	ALPHA (pCi/l) $\bar{x}$	max	min	BETA (pCi/l) $\bar{x}$	max	min	TRITIUM (pCi/l) $\bar{x}$	max	min
1986										
June	10	<5	9	<3	<6	10	<5	<350	<350	<350
July	2	<5	6	<4	<5	<5	<5	<350	<350	<350
August	1	<4	<4	<4	7	7	7	<350	<350	<350
September*										
October	1	6	6	6	5	5	5	<350	<350	<350
November	3	<7	8	<5	8	9	7	<350	<350	<350
December*										
Annual Data	62	<7	15	<2	<7	18	<5	<356	655	<350
1987										
January*										
February	8	<6	7	<6	<5	6	<5	<350	<350	<350
March	13	<9	24	<4	<8	20	<5	<365	549	<350
April	13	<4	10	<3	<6	10	<5	<457	747	<350
May	13	<6	14	<3	<6	11	<5	<350	<350	<350
June	8	<8	22	<5	<8	12	<5	<350	<350	<350

NOTE N = number of observations (samples)
$\bar{x}$ = arithmetic mean
max = maximum individual sample concentration observed
min = minimum individual sample concentration observed
Nominal values for the minimum detectable activity are listed in Appendix III
* = No sample collected
SI Unit Equivalent 1 pCi/l = 0 037 Bq/l
20 pCi/l = 0 48 Bq/l

TABLE E-4
WATER SURVEILLANCE SUMMARY
MONTHLY COMPARISON DATA
BROOMFIELD*
1986 and 1987

Date	N	ALPHA (pCi/l) $\bar{x}$	max.	min.	BETA (pCi/l) $\bar{x}$	max.	min.	TRITIUM (pCi/l) $\bar{x}$	max.	min.
1986										
June	4	<3	3	<3	<5	<5	<5	<350	<350	<350
July	5	<4	7	<3	<5	<5	<5	<350	<350	<350
August	4	<3	3	<3	<5	<5	<5	<350	<350	<350
September	4	<3	<3	<3	<5	<5	<5	<385	488	<350
October	5	<4	5	<3	<5	<5	<5	<350	<350	<350
November	4	<6	11	<3	<5	<6	<5	<350	<350	<350
December	5	<4	6	<3	<6	8	<5	<350	<350	<350
Annual Data	50	<4	11	<3	<5	8	<5	<354	488	350
1987										
January	4	<3	3	<3	<5	<6	<5	<350	<350	<350
February	4	<3	<3	<3	<5	<5	<5	<350	<350	<350
March	4	<3	4	<3	<5	5	<5	<350	<350	<350
April	5	<4	<4	<3	<5	6	<5	<443	858	<350
May	4	<4	<4	<3	<5	5	<5	<350	<350	<350
June	4	<5	7	<4	<6	10	<5	<350	<350	<350

NOTE. N = number of observations (samples)
$\bar{x}$ = arithmetic mean
* = Weekly composite
max. = maximum individual sample concentration observed
min. = minimum individual sample concentration observed
Nominal values for the minimum detectable activity are listed in Appendix III
SI Unit Equivalent 1 pCi/l = 0.037 Bq/l
20 pCi/l = 0.48 Bq/l

TABLE E-5
WATER SURVEILLANCE SUMMARY
MONTHLY COMPARISON DATA
WOMAN CREEK AT INDIANA
1986 and 1987

Date	ALPHA (pCi/l)	BETA (pCi/l)	TRITIUM (pCi/l)
1986			
June	5 ± 4	<5	<350
July*			
August*			
September*			
October*			
November	<3	<5	<350
December	<3	<5	<350
Annual Data	<5	<5	<350
1987			
January	4 ± 3	<5	<350
February	<4	<5	<350
March	<4	<5	<350
April	<4	<5	<350
May	5 ± 3	6 ± 4	<350
June	5 ± 4	5 ± 4	<350

NOTE Error terms are based on the 2 sigma counting error for the single analysis
Nominal values for the minimum detectable activity are listed in Appendix III
* = *No sample collected*
SI unit equivalent 1 pCi/l = 0 037 Bq/l
20 pCi/l = 0 74 Bq/l

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TABLE E-6
WATER SURVEILLANCE SUMMARY
MONTHLY COMPARISON DATA
WESTMINSTER
1986 and 1987

Date	N	ALPHA (pCi/l) $\bar{x}$	max.	min	BETA (pCi/l) $\bar{x}$	max.	min.	TRITIUM (pCi/l) $\bar{x}$	max	min
1986										
June	2	<5	7	<3	<5	<5	4	<350	<350	<350
July	2	<3	<3	<3	<5	<5	<5	<350	<350	<350
August	2	<5	6	<3	<5	5	<5	<350	<350	<350
September	2	<3	3	<3	<5	<5	<5	<350	<350	<350
October	3	<3	<3	<3	<5	<5	<5	<350	<350	<350
November	2	<3	3	<3	<5	<5	<5	<350	<350	<350
December	1	<3	<3	<3	<5	<5	<5	<350	<350	<350
Annual Data	24	<3	7	<3	<5	5	4	<350	<350	<350
1987										
January	2	<4	5	<3	<5	<5	<5	<350	<350	<350
February	2	<3	<3	<3	<5	<5	<5	<350	<350	<350
March	2	<3	3	<3	<5	<5	<5	<350	<350	<350
April	3	<4	4	<3	<6	8	<5	<519	856	<350
May	2	<3	<3	<3	<5	<5	<5	<350	<350	<350
June	2	<3	<3	<3	<5	<5	<5	<350	<350	<350

NOTE: N = number of observations (samples)
$\bar{x}$ = arithmetic mean
max. = maximum individual sample concentration observed
min. = minimum individual sample concentration observed
Nominal values for the minimum detectable activity are listed in Appendix III.
SI unit equivalent 1 pCi/l = 0.037 Bq/l
20 pCi/l = 0.74 Bq/l

TABLE E-7
WATER SURVEILLANCE SUMMARY
MONTHLY COMPARISON DATA
ARVADA
1986 and 1987

Date	ALPHA (pCi/l)	BETA (pCi/l)	TRITIUM (pCi/l)
1986			
June	<2	<5	<350
July	<2	<5	<350
August	<2	<5	<350
September	<2	<5	<350
October	<2	<5	<350
November	<2	<5	<350
December	<2	<5	<350
Annual Data	<2	<5	<350
1987			
January	<2	<5	<350
February	<2	<5	<350
March	<2	<5	<350
April	2 ± 2	<5	907 ± 184
May	<3	<5	*
June	<2	<5	<350

NOTE Error terms are based on the 2 sigma counting error for the single analysis
Nominal values for the minimum detectable activity are listed in Appendix III
* = No sample collected
SI unit equivalent 1 pCi/l = 0 037 Bq/l
20 pCi/l = 0 74 Bq/l

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TABLE E-8
WATER SURVEILLANCE SUMMARY
MONTHLY COMPARISON DATA
NORTH TABLE MOUNTAIN
1986 and 1987

Date	ALPHA (pCi/l)	BETA (pCi/l)	TRITIUM (pCi/l)
1986			
June	<2	<5	<350
July	<2	<5	<350
August	<2	<5	<350
September	<2	<5	<350
October	3 ± 2	<5	<350
November	4 ± 2	5 ± 3	<350
December	<2	<5	<350
Annual Data	<2	<5	<350
1987			
January	<2	<5	<350
February	<2	<5	<350
March	<2	5 ± 3	<350
April	3 ± 2	<5	976 ± 184
May	<3	<5	*
June	<3	<5	<350

NOTE. Error terms are based on the 2 sigma counting error for the single analysis.
Nominal values for the minimum detectable activity are listed in Appendix III.
* = No sample collected
SI unit equivalent: 1 pCi/l = 0.037 Bq/l
20 pCi/l = 0.74 Bq/l

TABLE E-9
WATER SURVEILLANCE SUMMARY
QUARTERLY COMPARISON DATA
BOULDER AND GOLDEN
1986 and 1987

Date	ALPHA (pCi/l)	BETA (pCi/l)	TRITIUM (pCi/l)
Boulder			
1986			
2nd Q - 04/23/86	<2	<5	<350
3rd Q - 07/30/86	<2	<5	<350
4th Q - 11/28/86	<2	<5	<350
Annual Data	<2	<5	<350
1st Q - 02/18/87	<2	<5	<350
2nd Q - 05/19/87	<3	<5	
Golden			
1986			
2nd Q - 04/23/86	<3	<5	417 ± 170
3rd Q - 07/30/86	4 ± 2	7 ± 4	<350
4th Q - 11/19/86	<3	<5	<350
Annual Data	<3	<6	<367
1st Q - 01/21/87	<3	<5	<350
2nd Q - 05/13/87	<3	<5	

NOTE Error terms are based on the 2 sigma counting error for the single analysis
Nominal values for the minimum detectable activity are listed in Appendix III
* = No sample collected
SI unit equivalent 1 pCi/l = 0 037 Bq/l
20 pCi/l = 0 74 Bq/l

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TABLE F
PLUTONIUM AND TOTAL ALPHA
CONCENTRATIONS IN WATER
June 1987

Station	DATE Month/Day/QTR	$Pu^{239+240}$ (pCi/l)	Total Alpha (pCi/l)
R F Pond B-3	11/85	0.05 ± 0.01	<4
Broomfield	05/84	<0.01	<4
Woman Creek	2nd qtr 87	0.01 ± 0.01	<6
	2nd qtr 86	<0.01	<5
Westminster	11/85	<0.01	<3
	05/84	<0.01	<3
Boulder	11/86	<0.01	<2
	06/87	<0.01	
Golden	11/85	<0.01	<3
	07/84	<0.01	5
	01/84	<0.01	<3
NTM	07/84	<0.01	<3
	05/87	<0.01	<3

NOTE The 95%/% confidence interval for total alpha analysis is propagated from the sample count and background counts. The 95%/% confidence interval for plutonium analysis is propagated from the sample count, the background count, the tracer count, the tracer background count, and the contribution of tracer progeny to the sample count. Nominal values for the minimum detectable activity are listed in Appendix III.
The standard for general population exposure for soluble Pu is 1600 pCi/l

APPENDIX I
ROCKY FLATS PLANT AIR SURVEILLANCE
STATION IDENTIFICATION

On-Site (Security)	Location
D - 1	Rocky Flats Plant, Eastern perimeter at the security fence, North to south
D - 2	
D - 3	
D - 4	

On-Site (Perimeter	
D - 5	SE Rocky Flats Plant, Plant Boundary
D - 6	NE
D - 7	N
D - 8	NW

Off-Site (Metro)	
BROOMFIELD	Garden Office Center
ADAMS CITY	4301 East 72nd Avenue
ARVADA	8101 Ralston Road
AURORA	1633 Florence Street
BOULDER	13th & Spruce
DENVER	414 - 14th Street
ENGLEWOOD	4857 South Broadway
GOLDEN	911 - 10th Street
LAKEWOOD	260 South Kipling

Off-Site (Remote)	
COLORADO NATIONAL MONUMENT	
DURANGO	Fire Station
LAMAR	Municipal Complex
LEADVILLE	510 Harrison Avenue
STERLING	3rd & Ash Street

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TABLE G
NATURAL URANIUM AND TOTAL ALPHA
CONCENTRATIONS IN WATER
May 1987

Station	Date	URANIUM (ug/l)	URANIUM (pCi/l)	ALPHA (pCi/l)
R.F Pond A-3	03/14/84	5.2	3.5	5
	10/23/85	<3	<2	<4
	06/12/87	5.1	3.4	18
R F Pond A-4	04/08/87	91	61	33
	04/22/87	12	7.7	8
R F Pond B-3	04/87 composite	5.2	3.5	<5
R.F Pond B-4	05/06/87	3.8	2.5	5
R F Pond B-5	03/20/87	10	6.7	10
	04/08/87	11	7.4	6
	04/22/87	<3	<2	<5
Walnut Creek at Indiana	04/87 composite	5.6	3.7	<4
Broomfield	04 87 composite	3.0	2.0	<4
Woman Creek at Indiana	02/28/84	3.9	2.6	<4
	05/28/86	<3	<2	<5
	06/01/87	<3	<2	5
Westminster	04 87 composite	<3	<2	<4
Arvada	11/19/86	<3	<2	<2
Boulder	11/28/86	<3	<2	<2
Golden				
North Table Mountain	12/20/84	4.2	2.8	4

NOTE Total Alpha error terms are based on the 2 sigma counting error for the single analysis. Nominal values for the minimum detectable activity are listed in Appendix III.

Water	Insoluble (pCi/l)	Soluble (pCi/l)
Unidentified radionuclides[2]	10	10
Unidentified radionuclides[3]	1,000	1,000
Americium-241	10,000	1,300
Carbon-14	-	260,000
Cerium-141	30,000	30,000
Cerium-144	3,300	3,300
Cesium-137	13,000	6,600
Cobalt-60	10,000	16,000
Hydrogen-3 (Tritium)	1,000,000	1,000,000
Iodine-129	66,000	20
Iodine-131	20,000	100
Lead-210	66,000	33
Niobium-95	33,000	33,000
Plutonium-238	10,000	1,600
Plutonium-239	10,000	1,600
Polonium-210	10,000	230
Radium-226	10,000	10
Ruthenium-103	26,000	26,000
Ruthenium-106	3,300	3,300
Strontium-90	13,000	100
Uranium-Natural	10,000	10,000
Yttrium-91	10,000	10,000
Zinc-65	66,000	33,000
Zirconium-95	20,000	20,000

1 Concentrations may be averaged over a period not greater than a year
2 Any single radionuclide which decays by alpha emission or spontaneous fission
3 Any single radionuclide with a decay mode other than alpha emission or spontaneous fission and with a radioactive half-life greater than 2 hours

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APPENDIX II

MAXIMUM PERMISSIBLE CONCENTRADIONS OF RADIONUCLIDES IN EFFLUENT AIR AND WATER RELEASED TO UNCONTROLLED AREAS

The maximum permissible concentrations (MPCs) below are based on recommendations of the International Commission on Radiological Protection (ICRP), the National Council on Radiation Protection (NCRP) and the Federal Radiation Council (FRC). These recommendations are incorporated in the regulations of the Colorado Department of Health and those of the Nuclear Regulatory Commission The levels stated are those relating to general population exposures to radionuclides in effluent air and water [1]

	Chemical Form	
Air	Insoluble (pCi/m^3)	Soluble (pCi/m^3)
Unidentified radionuclides[2]	0 007	0.007
Unidentified radionuclides[3]	33	33
Americium-241	1 3	0 066
Carbon-14	330,000	100,000
Cerium-141	1,600	6,600
Cerium-144	66	100
Cesium-137	33,000	130,000
Cobalt-60	100	3,300
Hydrogen-3 (Tritium)	66,000	66,000
Iodine-129	660	6 6
Iodine-131	3,300	33
Krypton-85	100,000	100,000
Lead-210	2 6	1 3
Niobium-95	1,000	6,600
Plutonium-238	0 33	0 023
Plutonium-239	0 33	0 020
Polonium-210	2 3	6 6
Radium-226	0 66	1 0
Radon-220	-	3,300
Ruthenium-103	1,000	6,600
Ruthenium-106	66	1,000
Strontium-90	66	10
Uranium-Natural	1 6	1.6
Xenon-133	100,000	100,000
Yttrium-91	330	330
Zinc-65	660	1,300
Zirconium-95	330	1,300

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