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RRRP-004-0

Colorado Department of Health
Environmental Surveillance Report
on the
U.S. Department of Energy
Rocky Flats Plant

SEPTEMBER 1987

Monthly Information Exchange Meeting

This is a numerical summary of data accumulated during
SEPTEMBER 1987
pertaining to environmental surveillance activities of the Department. Also included are additional data not previously reported for earlier periods.

ADMIN RECORD
SW-A-003698
Best Available Copy

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Summary Rocky Flats Report, September 1987

This report is a summary of all current analytical data collected by the Radiation Control Division for the purpose of environmental surveillance and impact assessment of the Rocky Flats Plant. This information is collected as part of a continuing effort by the Colorado Department of Health to identify trends in radioactive hazards that may be associated with operations at Rocky Flats. The data included in this issue of the report is consistent with information collected from the same or similar sampling locations in the past.

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COLORADO DEPARTMENT OF HEALTH

U.S. DOE ROCKY FLATS PLANT SURVEILLANCE

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TABLE A

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

SURVEILLANCE SUMMARY
SEP 1987

	Sampler Type	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)	TSP/C	13	<0.004	0.001	<0.005	0.002	0.06	0.02	0.08	0.03	43937
RF D-2 ON-SITE (SECURITY)	TSP/C	11	<0.004	0.001	0.007	<0.002	0.08	0.02	0.12	0.05	39396
RF D-3 ON-SITE (SECURITY)	TSP/C	11	0.010	0.005	0.019	0.003	0.06	0.02	0.10	<0.04	43363
RF D-4 ON-SITE (SECURITY)	TSP/C	13	<0.006	0.002	0.010	<0.003	<0.06	0.02	0.10	<0.03	46834
SEP GROUP SUMMARY		48	<0.006	0.003	0.019	0.002	<0.06	0.02	0.12	<0.03	173530
ON-SITE (PERIMETER)											
RF D-5 ON-SITE (PERIMETER)	TSP/C	13	<0.004	<.001	<0.005	<0.002	0.06	0.02	0.09	0.03	49441
RF D-6 ON-SITE (PERIMETER)	TSP/C	12	<0.005	0.001	0.007	<0.003	0.07	0.02	0.11	0.06	44053
RF D-7 ON-SITE (PERIMETER)	TSP/C	13	<0.004	0.001	0.006	0.002	0.06	0.02	0.11	0.04	45351
RF D-8 ON-SITE (PERIMETER)	TSP/C	11	<0.004	0.001	0.006	<0.002	0.07	0.02	0.10	0.04	36785
SEP GROUP SUMMARY		49	<0.004	0.001	0.007	<0.002	0.06	0.02	0.11	0.03	175642
OFF-SITE (METRO)											
BROOMFIELD 18 Garden Ofc. Ctr	TSP/C	5	<0.005	0.003	0.011	<0.003	0.06	0.03	0.10	0.03	32714
ADAMS CITY 4301 E 72nd Ave	TSP/P	4	<0.008	0.002	<0.010	0.005	<0.09	0.02	0.12	<0.07	5911
AURORA 1633 Florence Street	TSP/P	5	<0.009	0.001	<0.011	<0.008	<0.08	0.02	0.10	<0.06	8587
BOULDER 13th & Spruce	TSP/P	3	<0.009	<.001	<0.010	<0.008	<0.10	0.03	0.12	<0.07	5027
DENVER 414 Fourteenth Street	TSP/P	5	<0.010	0.001	<0.011	<0.009	<0.10	0.02	0.12	<0.07	7949
ENGLEWOOD 4857 South Broadway	TSP/P	5	<0.010	0.001	<0.012	<0.009	0.11	0.03	0.14	0.08	7751
LAKEWOOD 260 South Kipling	TSP/P	2	<0.008	<.001	<0.009	<0.008	0.10	0.01	0.11	0.09	4027
WESTMINSTER 10100 Garland St.	TSP/C	5	<0.003	<.001	<0.003	<0.003	0.05	0.01	0.07	0.04	31004
SEP GROUP SUMMARY		34	<0.008	0.003	<0.012	<0.003	<0.08	0.03	0.14	0.03	104027
OFF-SITE (REMOTE)											
DURANGO Fire Station	TSP/P	4	<0.009	<.001	<0.010	<0.008	0.10	0.02	0.12	0.08	6523
LEADVILLE 510 Harrison Avenue	TSP/P	4	<0.010	0.001	0.011	<0.008	0.12	0.02	0.14	0.10	6300
STERLING 3rd & Ash Street	TSP/P	2	<0.010	<.001	<0.010	<0.009	0.10	<.01	0.11	0.10	3541
SEP GROUP SUMMARY		10	<0.010	0.001	0.011	<0.008	0.11	0.02	0.14	0.08	16364

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AUGUST 1987

TABLE A

REVISED

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

SURVEILLANCE SUMMARY
AUG 1987

	Sampler Type	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	T Vo
ON-SITE (SECURITY)											
RF D-1 ON-SITE (SECURITY)	TSP/C	13	<0.004	0.001	0.007	<0.003	<0.05	0.02	0.09	0.03	[illegible]
RF D-2 ON-SITE (SECURITY)	TSP/C	13	<0.005	<.001	0.006	<0.003	0.06	0.02	0.11	0.03	[illegible]
RF D-3 ON-SITE (SECURITY)	TSP/C	12	<0.007	0.005	0.019	<0.003	0.07	0.03	0.16	0.03	[illegible]
RF D-4 ON-SITE (SECURITY)	TSP/C	13	<0.008	0.005	0.017	<0.003	0.06	0.02	0.10	0.03	[illegible]
AUG GROUP SUMMARY		51	<0.006	0.004	0.019	<0.003	<0.06	0.02	0.16	0.03	[illegible]
ON-SITE (PERIMETER)											
RF D-5 ON-SITE (PERIMETER)	TSP/C	13	<0.004	0.002	0.009	<0.003	0.05	0.01	0.07	0.04	[illegible]
RF D-6 ON-SITE (PERIMETER)	TSP/C	13	<0.005	<.001	0.006	<0.003	0.06	0.02	0.09	0.04	[illegible]
RF D-7 ON-SITE (PERIMETER)	TSP/C	10	<0.004	<.001	<0.005	<0.003	<0.05	0.02	0.09	<0.03	[illegible]
RF D-8 ON-SITE (PERIMETER)	TSP/C	13	<0.004	<.001	0.005	<0.003	<0.05	0.02	0.09	<0.02	[illegible]
AUG GROUP SUMMARY		49	<0.004	0.001	0.009	<0.003	<0.05	0.02	0.09	<0.02	[illegible]
OFF-SITE (METRO)											
BROOMFIELD 18 Garden Ofc. Ctr	TSP/C	4	0.006	0.002	0.008	0.004	0.05	<.01	0.05	0.04	[illegible]
ADAMS CITY 4301 E 72nd Ave	TSP/P	6	<0.010	<.001	<0.011	<0.009	<0.07	<.01	<0.07	<0.07	[illegible]
AURORA 1633 Florence Street	TSP/P	6	<0.009	<.001	<0.010	<0.008	<0.07	<.01	0.08	<0.07	[illegible]
BOULDER 13th & Spruce	TSP/P	5	<0.009	<.001	<0.010	<0.008	<0.07	<.01	<0.08	<0.07	
DENVER 414 Fourteenth Street	TSP/P	6	<0.010	0.001	<0.012	<0.009	<0.08	<.01	0.10	<0.07	
ENGLEWOOD 4857 South Broadway	TSP/P	5	<0.010	<.001	<0.011	<0.009	<0.08	0.02	0.11	<0.07	
LAKEWOOD 260 South Kipling	TSP/P	2	<0.008	<.001	<0.008	<0.008	<0.08	0.02	0.09	<0.06	[illegible]
WESTMINSTER 10100 Garland St.	TSP/C	4	<0.003	<.001	0.003	<0.002	0.03	<.01	0.04	0.03	[illegible]
AUG GROUP SUMMARY		38	<0.008	0.002	<0.012	<0.002	<0.07	0.02	0.11	0.03	[illegible]
OFF-SITE (REMOTE)											
DURANGO Fire Station	TSP/P	5	<0.008	<.001	<0.009	<0.008	<0.08	<.01	0.08	<0.07	
LEADVILLE 510 Harrison Avenue	TSP/P	6	<0.009	<.001	<0.010	<0.008	<0.08	<.01	<0.08	<0.07	[illegible]
STERLING 3rd & Ash Street	TSP/P	6	<0.009	<.001	<0.010	<0.008	<0.08	<.01	0.10	<0.07	[illegible]
AUG GROUP SUMMARY		17	<0.009	<.001	<0.010	<0.008	<0.08	<.01	0.10	0.07	[illegible]

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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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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
D - 6	NE
D - 7	N
D - 8	NW

Rocky Flats Plant, Plant Boundary

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
LONGMONT	City Hall

Off-Site (Remote)	
DURANGO	Fire Station
LAMAR	Power Plant
LEADVILLE	510 Harrison Avenue
RANGELY	High School
STERLING	3rd & Ash Street

Colorado Department of Health - Radiation Control Division
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TABLE B, CONT.

Station	N	Total ALPHA (pCi/m^3) $\bar{x}$	Long-lived ALPHA (pCi/m^3) S.D.	ALPHA (pCi/m^3) max.	ALPHA (pCi/m^3) min.	Total BETA (pCi/m^3) $\bar{x}$	Long-lived BETA (pCi/m^3) S.D.	BETA (pCi/m^3) max.	BETA (pCi/m^3) min.	Volume (m^3)
OFF-SITE (Metro)										
1986										
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	63[illegible]
July	33	<0.007	0.002	<0.011	0.004	<0.08	0.02	0.11	0.03	789[illegible]
August	38	<0.008	0.002	<0.012	<0.002	<0.07	0.02	0.09	<0.02	111435
September	34	<0.008	0.003	<0.012	<0.003	<0.08	0.03	0.14	0.03	104038
OFF-SITE (Remote)										
1986										
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
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	1743[illegible]
July	13	<0.007	0.002	<0.009	<0.005	<0.10	0.02	0.14	<0.07	2052[illegible]
August	17	<0.009	<0.001	<0.010	<0.008	<0.08	<0.01	0.10	<0.07	26988
September	10	<0.010	0.001	0.011	<0.008	0.11	0.02	0.14	0.08	16366

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/T = 0.48 Bq/l

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										
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	207368
November	46	<0.006	0.001	0.010	<0.003	<0.03	<0.01	0.06	<0.02	167356
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	18831[illegible]
February	47	<0.003	0.001	0.008	<0.000	<0.03	<0.01	<0.05	<0.00	19975[illegible]
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
July	54	<0.009	0.006	0.036	<0.003	<0.05	0.01	0.08	0.02	190553
August	51	<0.006	0.004	0.019	<0.003	<0.06	0.02	0.16	0.03	189725
September	48	<0.006	0.003	0.019	<0.002	<0.06	0.02	0.12	<0.03	173550
ON-SITE (Perimeter)										
1986										
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	215241
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	1844[illegible]
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
July	55	<0.006	0.002	0.012	0.003	<0.05	0.01	0.09	0.02	197874
August	49	<0.004	0.001	0.009	<0.003	<0.05	0.02	0.09	<0.02	184755
September	49	<0.004	0.001	0.007	<0.002	<0.06	0.02	0.11	0.03	176842

TABLE D
WATER SURVEILLANCE SUMMARY
(INDIVIDUAL SAMPLES)
September 1987

Station	Date	Activity (pCi/l) ALPHA	BETA	TRITIUM
R. F. Pond A-3	09/09/87	7 ± 4	<5	<350
R. F. Pond B-3	09/02/87	7 ± 3	11 ± 4	<350
	09/09/87	<4	10 ● 4	<350
	09/16/87	<4	9 ± 4	<350
	09/23/87	<4	11 ± 4	<350
	09/30/87	<4	10 ● 4	<350
Monthly Average		<6	10	<350
Walnut Creek at Indiana	*09/02/87			
	*09/05/87			
	*09/07/87			
	*09/09/87			
	09/11/87	5 ± 4	8 ± 4	<350
	*09/14/87			
	*09/18/87			
	*09/21/87			
	*09/23/87			
	*09/28/87			
	*09/30/87			
Monthly Average		5	8	<350
Broomfield	09/02/87	<3	5 ± 3	<350
	09/09/87	7 ± 3	6 ± 3	<350
	09/16/87	<4	<5	<350
	09/23/87	<4	<5	<350
	09/30/87	4 ± 3	7 ± 4	<350
Monthly Average		<4	<6	<350
Woman Creek at Indiana	*09/09/87			
	*09/23/87			
Westminster	09/02/87	3 ± 3	<5	<350
	09/16/87	<3	<5	<350
	09/30/87	5 ± 3	9 ± 4	<350
Monthly Average		<4	<6	<350

* Dry or Not Running

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

Station	DATE Month/Quarter	$Pu^{239+240}$ (pCi/m^3)	Total Long-lived ALPHA (pCi/m^3)

No plutonium in air data this month

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.

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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				
	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
	July	<8	<8	<350
	August*			
	September	7 ± 4	<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 D
WATER SURVEILLANCE SUMMARY
(INDIVIDUAL SAMPLES)
August 1987

Station	Date	Activity (pCi/l) ALPHA	BETA	TRITIUM
Arvada	09/25/87	<2	<5	<350
Boulder				
Golden				
North Table Mountain	09/25/87	<2	<5	<350
CDH (ppt)	09/15/87			<350
D-4 (ppt)	09/11/87			<350
	09/21/87			<350
Planned Releases				
A-4				
B-5	09/09/87	7 ± 4	10 • 4	<350
C-2	09/09/98	7 ± 4	14 • 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.
* = dry not running
SI unit equivalent: 1 pCi/l = 0.037 Bq/l
20 pCi/l = 0.74 Bq/l
**** No Trituim results this month

13/30

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										
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
July	4	10	13	9	12	20	7	<350	<350	<350
August	1	<4	<4	<4	12	12	12	<350	<350	<350
September	1	5	5	5	8	8	8	<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-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										
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
July	5	<4	6	<4	<10	12	7	<350	364	<350
August	4	<4	<4	<4	< 9	12	7	<409	469	<350
September	5	<6	7	<4	10	11	9	<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

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			
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
July	6 ± 4	5 ± 4	<350
August*			
September*			

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-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										
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
July	5	<5	10	<4	<6	8	<5	<350	<350	<350
August	3	<4	<4	<4	<5	<5	<5	<350	<350	<350
September	5	<4	7	<3	<6	7	<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-7
WATER SURVEILLANCE SUMMARY
MONTHLY COMPARISON DATA
ARVADA
1986 and 1987

Date	ALPHA (pCi/l)	BETA (pCi/l)	TRITIUM (pCi/l)
1986			
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
July	<2	<5	<350
August	2 ± 2	<5	<350
September	<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-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										
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
July	2	<3	<3	<3	5	<5	<5	<350	<350	<350
August	2	<3	<3	<3	<5	<5	<5	<350	<350	<350
September	3	<4	5	<3	<6	9	<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-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			
3rd Q - 07/30/86	<2	<5	<350
4th Q - 11/28/86	<2	<5	<350
Annual Data	<2	<5	<350
1987			
1st Q - 02/18/87	<2	<5	<350
2nd Q - 05/19/87	<3	<5	
3rd Q - 08/28/87	<2	<5	<350
Golden			
1986			
3rd Q - 07/30/86	4 ± 2	7 ± 4	<350
4th Q - 11/19/86	<3	<5	<350
Annual Data	<3	<6	<367
1987			
1st Q - 01/21/87	<3	<5	<350
2nd Q - 05/13/87	<3	<5	
3rd Q - 07/21/87	<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

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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			
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
July	<3	<5	<350
August	<2	<5	<350
September	<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 G
NATURAL URANIUM AND TOTAL ALPHA
CONCENTRATIONS IN WATER
September 1987

Station	Date	URANIUM (ug/l)	URANIUM (pCi/l)	ALPHA (pCi/l)
R.F. Pond B-3	08/19/87	<3	<2	<4
	09/02/87	<3	<2	7 ± 3
Walnut Creek at Indiana	08/19/87	<3	<2	<4
Broomfield	08/19/87	<3	<2	<4
Westminster	08/19/87	<3	<2	<3
Boulder	08/28/87	<3	<2	<2

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.

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TABLE F
PLUTONIUM AND TOTAL ALPHA
CONCENTRATIONS IN WATER
September 1987

Station	DATE Month/Day/QTR	$Pu^{239+240}$ (pCi/l)	Total Alpha (pCi/l)
Walnut Creek	08/19/87	.10 ± .02	<4
Broomfield	November 1985 Composite	<.01	<4
	08/19/87	<.01	<4
Westminster	08/19/87	<.01	<3
North Table Mountain	12/20/84	<.01	3 ± 2
DP-1-66	08/23/83	.02 ± .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.

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TABLE F
PLUTONIUM AND TOTAL ALPHA
CONCENTRATIONS IN WATER
September 1987

Station	DATE Month/Day/QTR	$Pu^{239+240}$ (pCi/l)	Total Alpha (pCi/l)
Walnut Creek	08/19/87	.10 ± .02	<4
Broomfield	November 1985 Composite	<.01	<4
	08/19/87	<.01	<4
Westminster	08/19/87	<.01	<3
North Table Mountain	12/20/84	<.01	3 ± 2
DP-1-66	08/23/83	.02 ● .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.

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

Station	Date	URANIUM (ug/l)	(
R.F. Pond B-3	08/19/87	<3	
	09/02/87	<3	
Walnut Creek at Indiana	08/19/87	<3	
Broomfield	08/19/87	<3	
Westminster	08/19/87	<3	
Boulder	08/28/87	<3	

NOTE: Total Alpha error terms a
2 sigma counting error fo
Nominal values for the mi
activity are listed in Ap

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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
D - 6	NE Rocky Flats Plant,
D - 7	N Plant Boundary
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
LONGMONT	City Hall

Off-Site (Remote)	
DURANGO	Fire Station
LAMAR	Power Plant
LEADVILLE	510 Harrison Avenue
RANGELY	High School
STERLING	3rd & Ash Street

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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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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.

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

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	350.0	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 ?g/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
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