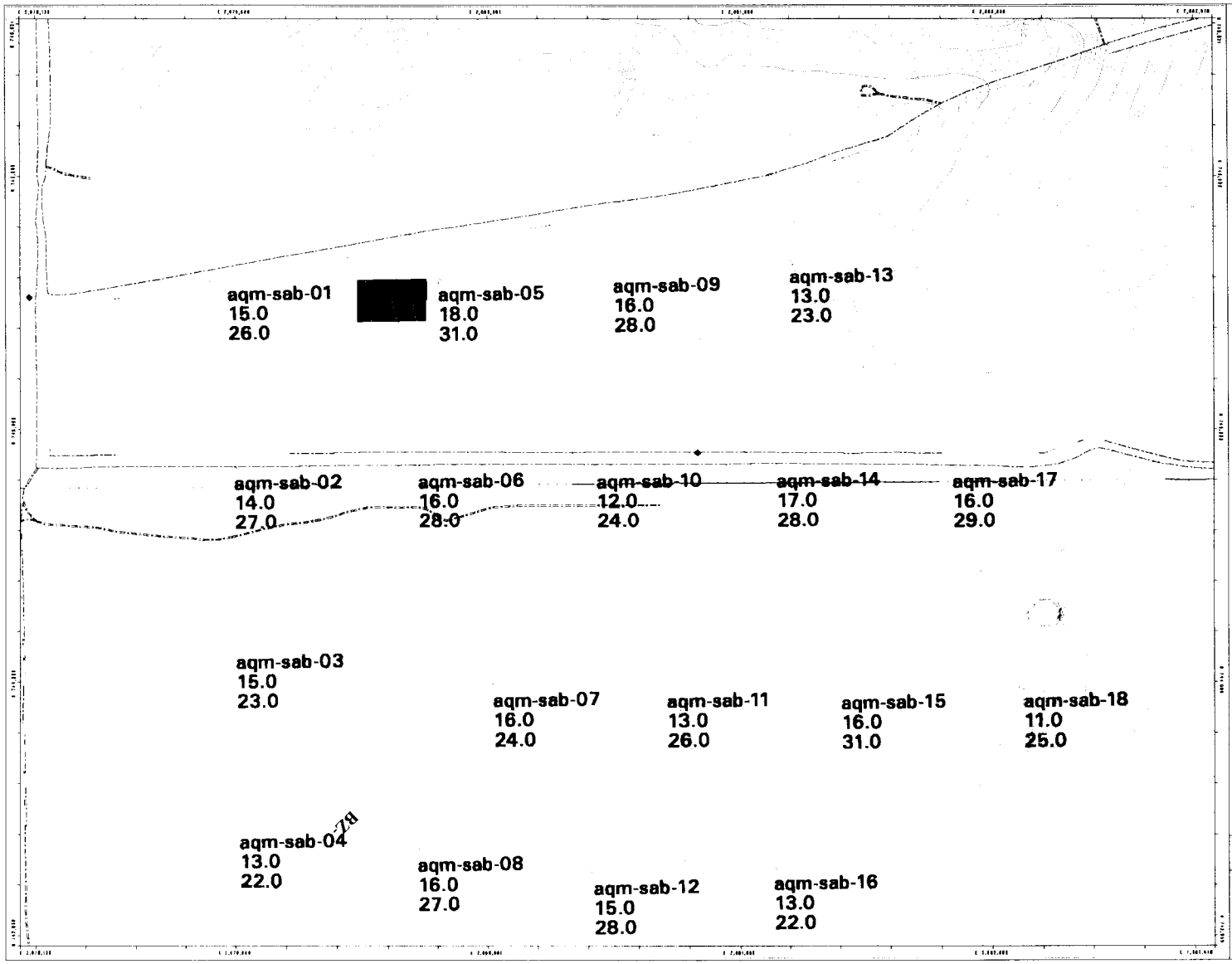
O/B SOIL MAP



Soil Alpha/Beta Activity in the Proposed 2000 Prescribed Burn Plot

EXPLANATION

- Proposed Location of HVOL Samplers During Test Burn
- Transect End Point
- Gross Alpha/Beta Activity in Shallow Soil Samples
- Proposed Prescribed Burn Plot
- 50 Meter Transect Line
- Wind Tunnel Study Plot

Standard Map Features

- Buildings and other structures
- Fences and other barriers
- Contour (2-Foot)
- Paved roads
- Dirt roads

Scale = 1 : 4720
1 inch represents approximately 396 feet

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD27

U.S. Department of Energy
Rocky Flats Environmental Technology Site

Rocky Mountain Remediation Services, L.L.C.
Geographic Information Systems Group
Rocky Flats Environmental Technology Site
P.O. Box 464
Golden, CO 80402-0464

MAP ID: 2b-0188 April 04, 2000

NT_Svr w:/projects/fy2k/2k-0188/burn.aml

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BZ-A-00292

1/10

α/β Soil Activity

FY00 Prescribed Burn Monitoring Plan -- Soil Sample Gross Alpha/Beta Results

		Gross Alpha, pCi/g					Gross Beta, pCi/g				
Sample Number	Location	Sample Activity	Sample Uncert.	Sample MDA	Background Mean	Background 2 Sigma	Sample Activity	Sample Uncert.	Sample MDA	Background Mean	Background 2 Sigma
1	north	15	3	5	22.32	16.36	31	2	1	24.1	13.5
2	north	15	3	5	22.32	16.36	35	2	1	24.1	13.5
3	north	18	3	5	22.32	16.36	34	2	1	24.1	13.5
4	north	17	3	5	22.32	16.36	31	2	1	24.1	13.5
5	north	14	3	5	22.32	16.36	31	2	1	24.1	13.5
6	south	15	2	4	22.32	16.36	28	2	1	24.1	13.5
7	south	16	3	4	22.32	16.36	31	2	1	24.1	13.5
8	south	16	3	5	22.32	16.36	31	2	1	24.1	13.5
9	south	18	3	4	22.32	16.36	34	2	1	24.1	13.5
10	south	17	3	4	22.32	16.36	28	2	1	24.1	13.5
mean		16.1			22.32		31.4			24.1	
SD		1.37			8.18		2.37			6.75	

All gross alpha sample results are within ±1 SD of the background mean.
All gross beta sample results are within ±2 SD of the background mean.

Pu 239 ACTIVITY

Statistical Analysis of Pu-239/240 Soil Sample Data To Determine Probability of Having Soil Concentrations of Pu-239 > 1.0 pCi/g in the Southern RFETS Buffer Zone Prescribed Burn Plot

SWD Data*

LOCATION	VALUE (pCi/g)
1-162	0.2500
1-180	0.0880
1-198	0.1994
1-216	0.1086
1-234	0.0483
PT12792	0.1463
SS133894	0.0644
SS512893	0.0079
SS512993	0.0218
SS513093	0.1700
SS513193	0.5510
SS513293	0.0714
SS513393	0.0431
SSSE06198	0.3480
SSSE06298	0.0348
SSSE06398	0.0282
SSSE06498	0.0682
SSSE06598	0.1320

SWD and Non-SWD Data

LOCATION	VALUE Pu (pCi/g)	Am			
1-162	0.2500				
1-180	0.0880				
1-198	0.1994				
1-216	0.1086				
1-234	0.0483				
B34	0.3300				
G30	0.1400				
G31	0.1700				
G34	0.1800				
G35	0.1800				
G37	0.0600				
G38	0.0100				
ILLS106	0.2800				
ILLS107	0.1000				
ILLS108	0.1000				
PT12792	0.1463	0.037070	1.188000	0.044370	1.437000
R3	0.0500				
SS133894	0.0644	0.044910			
SS512893	0.0079	0.015000	0.557000	0.029100	0.481000
SS512993	0.0218	0.011000	0.578000	0.054900	0.542000
SS513093	0.1700	0.024900	0.836000	0.029000	0.873000
SS513193	0.5510	0.011700	0.517000	0.022400	0.602000
SS513293	0.0714	0.012500	0.584000	0.037400	0.620000
SS513393	0.0431	0.011900	0.455000	0.018000	0.575000
SSSE06198	0.3480	0.175000			
SSSE06298	0.0348	0.043300			
SSSE06398	0.0282	0.008320			
SSSE06498	0.0682	0.022500			
SSSE06598	0.1320	0.030300			

Statistical Summary:

N	18
MEAN	0.132
SD	0.137
MAX	0.551
MIN	0.008
MEDIAN	0.080
GEOMEAN	0.083

Statistical Summary:

N	29
MEAN	0.137
SD	0.122
MAX	0.551
MIN	0.008
MEDIAN	0.100
GEOMEAN	0.091

* Soil sample data was selected from Site maps based on proximity to proposed prescribed burn plots. See attached map for sample locations.
Non-SWD data is included in the second column; the non-SWD data points have **not** been validated.

Statistical Analysis of Pu-239/240 Soil Sample Data To Determine Probability of Having Soil Concentrations of Pu-239 > 1.0 pCi/g in the Southern RFETS Buffer Zone Prescribed Burn Plot

SWD Data Only:

Ho = m >1.0	Student's one-tailed t-test:
H1 = m <1.0	
	t = (x-m)/(s/[SQRT(n)])
x = 0.13230	
s = 0.13715	t = (0.13230-1.0) / (0.13715/(SQRT(18))
m = 1.0	
n = 18	**t = -26.84**
df = 17	
a = 0.0005	t << tcrit, therefore reject Ho
tcrit = -3.965	

(source: "Statistical Techniques in Business and Economics", R. Mason & D. Lind, Irwin, Chicago, 1996)

SWD and non-SWD Data:

Ho = m >1.0	Student's one-tailed t-test:
H1 = m <1.0	
	t = (x-m)/(s/[SQRT(n)])
x = 0.137	
s = 0.122	t = (0.137-1.0) / (0.122/(SQRT(29))
m = 1.0	
n = 29	**t = -38.09**
df = 28	
a = 0.0005	t << tcrit, therefore reject Ho
tcrit = -3.674	

(source: "Statistical Techniques in Business and Economics", R. Mason & D. Lind, Irwin, Chicago, 1996)

Summary of Pre-Burn Analyses Supporting the FY00 Proposed Prescribed Burn at RFETS

Prepared for Kaiser-Hill ES&S
April 3, 2000

Media	Sample Number	Sample Location	Sample Date	Analyte	Result (pCi/g)	Background (pCi/g)	Statitical Test	Test Result
Soil	AQM5-RAD-3CM01	North	3/10/00	α/β	15/31	22/24	Comparison	< 2 SD difference
Soil	AQM5-RAD-3CM02	North	3/10/00	α/β	15/35	22/24	to	< 2 SD difference
Soil	AQM5-RAD-3CM03	North	3/10/00	α/β	18/34	22/24	Background	< 2 SD difference
Soil	AQM5-RAD-3CM04	North	3/10/00	α/β	17/31	22/24	using	< 2 SD difference
Soil	AQM5-RAD-3CM05	North	3/10/00	α/β	14/31	22/24	Standard	< 2 SD difference
Soil	AQM5-RAD-3CM06	South	3/10/00	α/β	15/28	22/24	Deviation	< 2 SD difference
Soil	AQM5-RAD-3CM07	South	3/10/00	α/β	16/31	22/24	as	< 2 SD difference
Soil	AQM5-RAD-3CM08	South	3/10/00	α/β	16/31	22/24	Error	< 2 SD difference
Soil	AQM5-RAD-3CM09	South	3/10/00	α/β	18/34	22/24	(both	< 2 SD difference
Soil	AQM5-RAD-3CM10	South	3/10/00	α/β	17/28	22/24	α and β)	< 2 SD difference
Soil	Mean, North	North	3/10/00	α/β	16/32	22/24	.	< 2 SD difference
Soil	Mean, South	South	3/10/00	α/β	16/30	22/24	.	< 2 SD difference
Soil	AQM-SAB-01	South	3/24/00	α/β	15/26	22/24	Comparison	< 2 SD difference
Soil	AQM-SAB-02	South	3/24/00	α/β	14/27	22/24	to	< 2 SD difference
Soil	AQM-SAB-03	South	3/24/00	α/β	15/23	22/24	Background	< 2 SD difference
Soil	AQM-SAB-04	South	3/24/00	α/β	13/22	22/24	using	< 2 SD difference
Soil	AQM-SAB-05	South	3/24/00	α/β	18/31	22/24	Standard	< 2 SD difference
Soil	AQM-SAB-06	South	3/24/00	α/β	16/28	22/24	Deviation	< 2 SD difference
Soil	AQM-SAB-07	South	3/24/00	α/β	16/24	22/24	as	< 2 SD difference
Soil	AQM-SAB-08	South	3/24/00	α/β	16/27	22/24	Error	< 2 SD difference
Soil	AQM-SAB-09	South	3/24/00	α/β	16/28	22/24	(both	< 2 SD difference
Soil	AQM-SAB-10	South	3/24/00	α/β	12/24	22/24	α and β)	< 2 SD difference
Soil	AQM-SAB-11	South	3/24/00	α/β	13/26	22/24	.	< 2 SD difference
Soil	AQM-SAB-12	South	3/24/00	α/β	15/28	22/24	.	< 2 SD difference
Soil	AQM-SAB-13	South	3/24/00	α/β	13/23	22/24	.	< 2 SD difference
Soil	AQM-SAB-14	South	3/24/00	α/β	17/28	22/24	.	< 2 SD difference
Soil	AQM-SAB-15	South	3/24/00	α/β	16/31	22/24	.	< 2 SD difference
Soil	AQM-SAB-16	South	3/24/00	α/β	13/22	22/24	.	< 2 SD difference
Soil	AQM-SAB-17	South	3/24/00	α/β	16/29	22/24	.	< 2 SD difference
Soil	AQM-SAB-18	South	3/24/00	α/β	11/25	22/24	.	< 2 SD difference
Soil	Mean	South	3/24/00	α/β	15/26	22/24	.	< 2 SD difference

Media	Source Data	Sample Location	Analysis Date	Analyte	Mean Result (pCi/g)	Confidence Interval	Statitical Test	Test Result
Soil	FY00 Pu239 Isopleth	South	3/23/00	Pu239	0.1323	99.95%	Student "t"	t = -26.84 (soil < 1.0 pCi/g)

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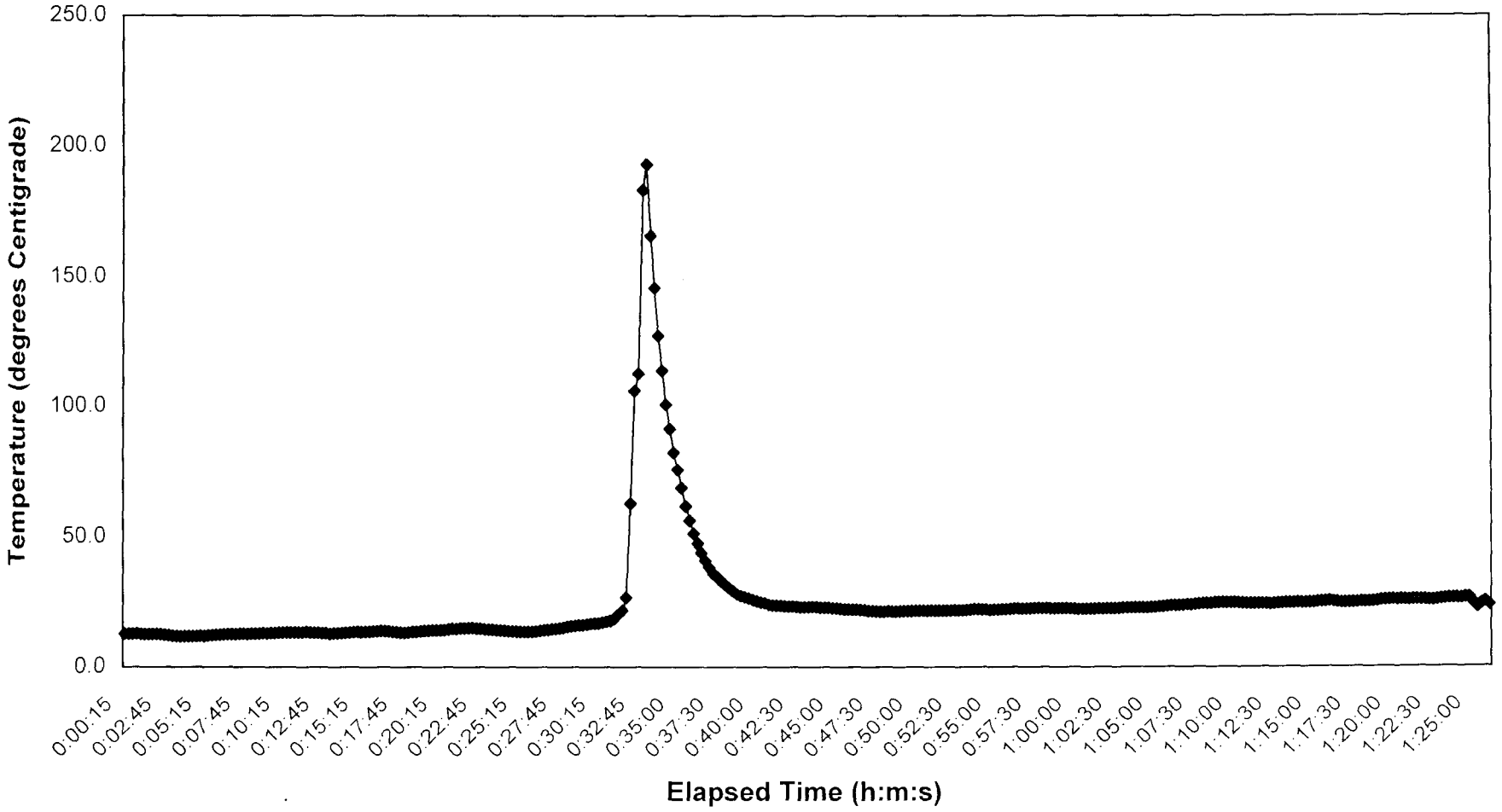
Summary of Pre-Burn Analyses Supporting the FY00 Proposed Prescribed Burn at RFETS

Media	Sample Number	Sample Location	Sample Date	Analyte	Result pCi/g	Blank pCi/g	Result - Blank	Result Within How Many SD's of Blank?
Veg	BB1-T1	North	3/6/00	U-234	0.1180	0.1260	-0.0080	-0.5
				U-235	0.0180	0.0000	0.0180	+1.5
				U-238	0.0560	0.0140	0.0420	+1
				Pu239	0.0610	0.0430	0.0180	+1
				Am-241	0.0000	0.0420	-0.0420	(result = 0)
Veg	BB1-T2	North	3/6/00	U-234	0.0590	0.1260	-0.0670	-2
				U-235	-0.0060	0.0000	-0.0060	-0.5
				U-238	0.0960	0.0140	0.0820	+1.5
				Pu239	0.0030	0.0430	-0.0400	-2
				Am-241	0.0220	0.0420	-0.0200	-1
Veg	BB2-T1	South	3/6/00	U-234	0.1000	0.1260	-0.0260	-1
				U-235	0.0000	0.0000	0.0000	(result = 0)
				U-238	0.0000	0.0140	-0.0140	(result = 0)
				Pu239	0.0240	0.0430	-0.0190	-1
				Am-241	0.0420	0.0420	0.0000	0
Veg	BB2-T2	South	3/6/00	U-234	0.0340	0.1260	-0.0920	-2.5
				U-235	0.0260	0.0000	0.0260	+2
				U-238	0.0950	0.0140	0.0810	+1.5
				Pu239	0.0150	0.0430	-0.0280	-1
				Am-241	0.0350	0.0420	-0.0070	-0.5
Veg	BB2-T3	South	3/6/00	U-234	0.1180	0.1260	-0.0080	-0.5
				U-235	0.0160	0.0000	0.0160	+1.5
				U-238	0.1520	0.0140	0.1380	+2.5
				Pu239	0.0140	0.0430	-0.0290	+1.5
				Am-241	0.0100	0.0420	-0.0320	-2
Veg	BLANK			U-234	0.1260			
				U-235	0.0000			
				U-238	0.0140			
				Pu239	0.0430			
				Am-241	0.0420			
Veg	Mean	All	3/6/00	U-234	0.0858	0.1260	-0.0402	-1.5
				U-235	0.0108	0.0000	0.0108	+1
				U-238	0.0798	0.0140	0.0658	+1.5
				Pu239	0.0234	0.0430	-0.0196	-1
				Am-241	0.0218	0.0420	-0.0202	-1.5

	Sample Std. Dev.
U-234	0.038
U-235	0.013
U-238	0.056
Pu-239	0.022
Am-241	0.017

Soil T burns FA

DRAFT
Surficial Soil Temperature at One Location in Burn Area
4/6/00 Buffer Zone Burn



5

Biomass Values for Prescribed Burn Sampling Converted to lbs/acre

Pre-Burn Data

Transect	Biomass Type	Mean Biomass (g/sq. meter)	Conversion Factor	Biomass in lbs/acre
BB1	Litter	203.768	8.924030831	1818.43
BB1	Vegetation	124.448	8.924030831	1110.58
Combined BB1 Litter and Veg	Both	328.216	8.924030831	2929.01
BB2	Litter	276.68	8.924030831	2469.10
BB2	Vegetation	188.552	8.924030831	1682.64
Combined BB2 Litter and Veg	Both	465.232	8.924030831	4151.74
Combined BB1 and BB2	Litter	240.224	8.924030831	2143.77
Combined BB1 and BB2	Vegetation	156.5	8.924030831	1396.61
Combined BB1 and BB2	Both	396.724	8.924030831	3540.38

Post-Burn Data

BB3	Litter	107.888	8.924030831	962.80
BB3	Vegetation	16.848	8.924030831	150.35
Combined BB3 Litter and Veg	Both	124.736	8.924030831	1113.15
Decrease in Biomass Resulting from Burn (BB2 - BB3 Data)		-357.3		-3188.9
Percent Change		-76.8		-76.8

Note: These differences are based on the differences between the pre-burn BB2 combined litter and vegetation values and the post-burn BB3 litter only values. The post-burn BB3 vegetation values are not included because it is assumed that this represents new growth that has occurred after the fire.

GRAV ANALYSIS

Gravimetric Analyses of Test Burn HVOL Filters

Prepared by Patrick Haines for KH ES&S

4/13/00

Filter ID	Sampler Location	Sampler Flowrate (m^3/min)	Time On	Time Off	Sample Volume (m^3)	Tare Weight (mg)	Post-burn Weight (mg)	TSP Weight (mg)	TSP Conc. (mg/m^3)	In-plume TSP conc. less Upwind sample (mg/m^3)
H1	In-plume	0.960	9:24	10:46	78.69	2792.8	2922.95	130.15	1.65	1.53
H2	Upwind	1.025	9:58	11:02	65.61	2801.1	2809.45	8.35	0.13	
H3*	Upwind	0.991	10:04	11:02	57.45	2813.4	2817.65	4.25	0.07	
HB	Blank					2766.4	2765.0	-1.4		

Volume-weighted In-plume weight gain minus higher upwind weight gain = 1.53 mg/m^3

No blank correction done -- blank showed negative weight gain

* H3 data is suspect because filter was torn during recovery

Ratio of activity to TSP concentration:

Filter ID	TSP Conc.	alpha activity (dpm/m^3)	beta activity (dpm/m^3)	alpha/TSP ratio	beta/TSP ratio
H1	1.65	0.60	1.45	0.36	0.88
H2	0.13	0.04	1.01	0.31	7.77
H3*	0.07	0.04	0.62	0.57	8.86

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α/β ANALYSIS

Estimate of Dose Equivalent from the Test Burn on April 6, 2000
Bob Nininger 4/11/00

Three filters were sampled, one downwind and two upwind of the burn area.
One of the three samples, the downwind, had alpha activity above the lab detection limit.

Sample ID	Description	Alpha Activity	Beta Activity	Alpha Activity	Activity Corrected for Area	Volume Sampled	Activity Concentration
		dpm	dpm	Ci	Ci	m3	Ci/m3
AQM-TB-H1	Downwind	2.034		9.245E-13	2.2E-11	78.69	2.8E-13
AQM-TB-H2	Upwind	0.114		5.18E-14	1.2E-12	65.61	1.9E-14
AQM-TB-H3	Upwind	0.101		4.59E-14	1.1E-12	57.45	1.9E-14
AQM-TB-HB	Field Blank	-0.297		-1.35E-13	-3.2E-12	0	NA

Filter Sample Area (L x W)	7	9 inches
Filter Punch Area (Diameter)	47 mm	
Area Correction	23.4	

With the conservative assumption that all of this activity is due to Plutonium-239 this activity concentration may be compared to that concentration that yields a EDE of 1 mrem. Extrapolating Appendix D, Table 2 of 40 CFR 61, Subpart H, which limits the average annual Pu-239 ambient air concentration to 2E-15 Ci (2E-3 pCi), the annual concentration for a one mrem EDE would be 2E-16 Ci. Converting from an annual inhalation to one lasting the period of the test burn yields the following:

Sample ID	Description	Isotope	Annual EDE	Equivalent Concentration	Sample Duration	Burn Period Equivalent Conc.	Extrapolated Burn Equivalent EDE (Worker Downwind)
			mrem	Ci/m3	min	Ci/m3	mrem
AQM-TB-H1	Downwind	Pu-239	1	2E-16	82	1.3E-12	0.21

These estimates indicate that the workers immediately downwind of the burn were exposed to concentrations less than those that would result in an EDE of 1 mrem.

α/β ANALYSIS

RADIATION DOSE FROM INHALATION
TEST BURN

EXPOSURE PARAMETERS

Exposure Factors Description	Units	Parameter Value
Total Sample Activity	Ci	2.20E-11
Total Sample Volume	m^3	7.87E+01
Exposure Duration	minutes	82
Inhalation Rate	m^3/hr	1.0 (1)

RADIATION DOSE AT PERIMETER OF BURN

Radionuclide	Air Concentration (2) (uCi/m^3)	Annual Intake (3) (uCi)	Inhalation Dose Conversion Factor (4) (mrem/uCi)	Radiation Dose (5) (mrem)
Gross Alpha (Pu-239 Assumed)	2.80E-07	3.82E-07	4.29E+05	1.64E-01

(1) - From EPA's 1997"Exposure Factors Handbook"
(2) - Air Concentration = ((Total Sample Activity)/(Total Sample Volume))*(1E+06 uCi/Ci)
(3) - Annual Intake = ((Air Concentration)*(Exposure Duration)*(Inhalation Rate))/(60 min/hr)
(4) - From EPA's Federal Guidance Report #11, "Limiting Values of Radionuclide Intake and Air Concentration and Dose Conversion Factors for Inhalation, Submersion, and Ingestion."
(5) - Radiation Dose = (Annual Intake)*(Inhalation Dose Conversion Factor)