INTERNATIONAL
TECHNOLOGY
CORPORATION

1992 WORKPLACE AIR MONITORING RESULTS FOR THE NEWFIELD, NEW JERSEY FACILITY

Submitted to:

Shieldalloy Metallurgical Corporation
West Boulevard
Post Office Box 768
Newfield, New Jersey 08344

By:

C. D. Berger
IT Corporation/Nuclear Sciences
1133 21st Street, N.W., Suite 710
Washington, D. C. 20036
(202) 331-8510

Report No. IT/NS-93-106
February 16, 1993

TABLE OF CONTENTS

INTRODUCTION 1

1992 AIR SAMPLING DATA 2
- Area Sampling 2
- Personnel Breathing Zone Sampling 2

INTERPRETATION OF RESULTS 2
- Area Sampling 2
- Personnel Breathing Zone Sampling 3

SUMMARY AND CONCLUSIONS 5

REFERENCES 6

TABLES AND FIGURES 7
- Table 1: Area Air Monitoring Results 8
- Table 2: Personal Breathing Zone Sampling Results 14
- Table 3: Isotopic Ratios in Area Monitoring Filters 18
- Table 4: Isotopic Ratios in Personal Breathing Zone Sampling Filters 19
- Figure 1: Area Air Monitoring Results, CY 1992 20
- Figure 2: Personnel Monitoring Results, CY 1992 21

INTRODUCTION

Shieldalloy Metallurgical Corporation (Shieldalloy) operates a manufacturing facility located in Newfield, New Jersey. This facility manufactures or has manufactured specialty steel and super alloy additives, primary aluminum master alloys, metal carbides, powdered metals, and optical surfacing products. Raw materials currently used at the facility include ores which contain oxides of columbium (niobium), vanadium, aluminum metal, titanium metal, strontium metal, zirconium metal, and fluoride (titanium and boron) salts. During the manufacturing process, the facility generates slag, dross, bag house dust, and waste waters, among other waste streams.

One of the materials received, used and stored by Shieldalloy contains radioactive material which his classified as "source material" pursuant to Title 10, Code of Federal Regulations, Part 40. It is pyrochlore, a concentrated ore containing columbium (niobium). The pyrochlore contains greater than 0.05% of natural uranium and natural thorium.

Shieldalloy currently holds a U. S. Nuclear Regulatory Commission (USNRC) License (No. SMB-743) allowing possession, use, and storage of source material. The most recent renewal of SMB-743 was granted in July, 1980. Prior to its expiration in July, 1985, Shieldalloy submitted an application for renewal, thus extending SMB-743 until the USNRC acts upon the renewal application. A revised renewal application was submitted on July 18, 1988, and again on June 2, 1992.

As part of the application review process, on January 14, 1993, the USNRC requested that Shieldalloy provide the results of all air sampling performed during 1992, with specific interest in isotopic air concentrations in the work place derived through the use of lapel air samplers (Hickey, 1993). This report, which contains a summary and evaluation of 1992 air sampling results, is intended to provide that information. It contains a description of the type and quantity of data acquired, a listing of results obtained, and an interpretation of those results with respect to the radiological character of the workplace and personnel exposure potential.

1992 AIR SAMPLING DATA

Area Sampling

Eberline Model Number RAS-1 area air samplers were positioned in various locations within the ferrocolumbium production building (D-111). These included a location on an elevated platform near the furnace, and a location on the ground level in the vicinity of the scale, where feed materials are weighed prior to transfer to the furnace. In general, samples were acquired throughout a work shift. At that time, the filters were removed from the pumps, stored for a minimum of four days to permit radon daughter decay, and counted with an Eberline Model SAC-4 zinc sulfide detector and scaler. Gross alpha results were then converted into μCi/ml, based upon the counter's efficiency for ^{230}Th alpha particles. Table 1 is a listing of these results.

Personnel Breathing Zone Sampling

To investigate the magnitude of intakes of radioactive materials by workers, Shieldalloy employees who work directly with radioactive materials in the ferrocolumbium production operations were equipped with personal breathing zone (lapel) samplers for certain work periods when ferrocolumbium production was on-going. At the end of the sampling period, the filters were collected from the samplers and stored for a minimum of four days. They were then counted with the zinc sulfide counter/scaler, and the results were converted to μCi/ml based upon the counter's detection efficiency for ^{230}Th. Table 2 is a listing of these results.

INTERPRETATION OF RESULTS

Area Sampling

The results shown in Table 1 are based upon gross alpha activities, and no correction is made for mass loading or self-attenuation. To establish the relationship between gross alpha activity and ^{232}Th activity, a representative number of filters were sent to a commercial analytical laboratory for analysis by alpha spectroscopy. The results of these analyses are shown in Table 3. The ratio of ^{232}Th and ^{238}U activity to gross alpha activity is 0.08 ± 0.10 and 0.23 ± 0.15, respectively.

If the results based on gross alpha counting shown in Table 1 are corrected to reflect the concentration of ^{232}Th and ^{238}U, it is then possible to estimate personnel exposures to thorium and uranium in these sampling locations of building D-111 for 1992.[1] The following are the assumptions that were made for this assessment:

- The data shown in Table 1 were normalized to reflect conditions throughout a 2000-hour annual work period.
- The measured airborne radioactivity concentrations in D-111 at the time of sampling are representative of the concentrations throughout the entire 2000-hour annual work period.
- The measured air concentrations, based on gross alpha results, were multiplied by 0.08 in order to obtain the airborne ^{232}Th concentrations, and by 0.23 in order to obtain the airborne ^{238}U concentrations.
- The regulatory dose limit for D-111 employees is 2000 DAC-hours.
- The regulatory dose limit for which internal radiation monitoring is required for D-111 employees is 200 DAC-hours.

Figure 1 is a graphical representation of the results of this assessment. It is important to note that no D-111 employees work routinely in the vicinity of these area monitors. Therefore, in order to evaluate individual exposure potentials, the results shown in Figure 1 must be adjusted to include occupancy factors, or personnel breathing zone sampling can be performed.

Personnel Breathing Zone Sampling

The personnel monitoring results shown in Table 2 are based upon gross alpha activities. Therefore, a representative number of filters were sent to a commercial analytical laboratory for isotopic uranium and thorium analysis. The results of these analyses are shown in Table

---

[1] For this assessment, exposures are reported in units of Derived Air Concentration-Hours, or DAC-Hours.

4. For these filters, the ratio of ^{232}Th and ^{238}U activity to gross alpha activity is 0.01 ± 0.01 and 0.01 ± 0.01, respectively.[2]

If the data in Table 2 are corrected to reflect the actual airborne concentrations of thorium and uranium during sampler use, it is possible to estimate the maximum annual personnel internal exposures for Shieldalloy employees from the 1992 monitoring data. The following are the assumptions that were made for this assessment:

- The maximum number of hours worked in D-111 by any individual at Shieldalloy was 2000.
- The D-111 workers who wore the personal breathing zone samplers are considered to be the maximally-exposed employees at Shieldalloy.
- The airborne radioactivity concentrations in all Shieldalloy work areas did not exceed those measured in D-111 in 1992.
- The measured air concentrations, based on gross alpha results, were multiplied by 0.01 in order to obtain the airborne ^{232}Th concentrations, and by 0.01 in order to obtain the airborne ^{238}U concentrations.
- The regulatory dose limit for Shieldalloy employees is 2000 DAC-hours.
- The regulatory dose limit for which internal radiation monitoring is required for Shieldalloy employees is 200 DAC-hours.

Figure 2 is a graphical representation of the results of this assessment.[3] From this figure, it is clear that, even after applying generous assumptions, no internal radiation dose limits were exceeded at Shieldalloy, and that routine internal radiation monitoring for thorium and uranium isotopes is not required.

---

2 The analytical results for the presence of ^{232}Th and ^{238}U were below the minimum detectable activity of the detection system. However, for this assessment, the isotopic concentrations were assumed to be equal to the detection limits specified for the individual radionuclides.

3 The maximum number of hours that a D-111 employee worked during 1992 was 2,500. If the results shown in Figure 2 are corrected to reflect a 2,500-hour work year, the monitoring limit of 200 DAC-hours is still not exceeded.

SUMMARY AND CONCLUSIONS

Personal breathing zone sampling results for 1992 indicate that intakes of thorium and uranium by workers in D-111 are not significant, and that no routine monitoring of these employees is required. In addition, the results of the quarterly area surveillance, as described in the 1992 application for license renewal (SMC, 1993), can be used as an indicator of maximum personnel exposures. These conclusions remain valid for the Newfield plant if the results of on-going area surveillance do not deviate significantly from those shown in Table 1.

REFERENCES

Hickey, 1993 — Hickey, John W. N., U. S. Nuclear Regulatory Commission, letter to Mr. David R. Smith, Shieldalloy Metallurgical Corporation, January 14, 1993.

SMC, 1993 — Shieldalloy Metallurgical Corporation, "USNRC Source Material License No. SMB-743, Supplement to Application Dated June 2, 1992", February, 1993.

TABLES AND FIGURES

Table 1: Area Air Monitoring Results

Collection Location	Collection Date	Collection Time (m)	Flow Rate (LPM)	Sample Volume (ml)	Sample Counts (cpm)	Counting Efficiency (gross alpha)	Sample Activity (dpm)	Sample Concentration (μCi/ml)
AA-0001	02/10/92	397	39	15483000	2.48	0.358	6.927374	2.02E-13
AA-0002	02/10/92	393	39.1	15366300	1.54	0.358	4.301676	1.26E-13
AA-0003	02/11/92	408	39	15912000	2.06	0.358	5.75419	1.68E-13
AA-0004	02/11/92	402	39.1	15718200	2.02	0.358	5.642458	1.62E-13
AA-0008	02/13/92	525	39.1	20527500	2.8	0.358	7.821229	1.72E-13
AA-0022	02/20/92	505	39.1	19745500	35.68	0.358	99.6648	2.27E-12
AA-0021	02/20/92	450	34.5	15525000	27.96	0.358	78.10056	2.27E-12
AA-0023	02/21/92	543	39	21177000	23.14	0.358	64.63687	1.37E-12
AA-0024	02/21/92	540	39.1	21114000	12.8	0.358	35.75419	7.63E-13
AA-0025	02/24/92	627	38.1	23888700	12.9	0.358	36.03352	6.79E-13
AA-0026	02/24/92	629	32	20128000	11.96	0.358	33.40782	7.48E-13
AA-0028	02/25/92	469	39.1	18337900	28.66	0.358	80.05587	1.97E-12
AA-0027	02/25/92	473	39	18447000	7.96	0.358	22.23464	5.43E-13
AA-0029	02/25/92	470	39.5	18565000	23.5	0.358	65.64246	1.59E-12
AA-0030	02/26/92	470	39	18330000	35.78	0.358	99.94413	2.46E-12
AA-0031	02/26/92	460	39.1	17986000	8.4	0.358	23.46369	5.88E-13
Furnace	04/13/91	471	39	18369000	21.64	0.358	60.44693	1.48E-12
Furnace	01/06/92	307	39	11973000	5.68	0.358	15.86592	5.97E-13
Furnace	01/07/92	336	39	13104000	10.38	0.358	28.99441	9.97E-13
Furnace	01/08/92	311	39	12129000	25.96	0.358	72.51397	2.69E-12
Furnace	01/09/92	301	39	11739000	29.96	0.358	83.68715	3.21E-12
Furnace	01/10/92	173	39	6747000	9.62	0.358	26.87151	1.79E-12
Furnace	02/03/92	384	39	14976000	57.86	0.358	161.6201	4.86E-12
Furnace	02/04/92	356	39	13884000	23	0.358	64.24581	2.08E-12

Collection Location	Collection Date	Collection Time (m)	Flow Rate (LPM)	Sample Volume (ml)	Sample Counts (cpm)	Counting Efficiency (Gross alpha)	Sample Activity (dpm)	Sample Concentration (μCi/ml)
Furnace	02/07/92	361	39	14079000	1.4	0.358	3.910615	1.25E-13
Furnace	02/12/92	371	39	14469000	4.4	0.358	12.2905	3.83E-13
Furnace	02/13/92	526	39	20514000	4.4	0.358	12.2905	2.70E-13
Furnace	02/14/92	525	39	20475000	4.56	0.358	12.73743	2.80E-13
Furnace	02/17/92	918	39	35802000	9.72	0.358	27.15084	3.42E-13
Furnace	02/17/92	513	34.5	17698500	13.78	0.358	38.49162	9.80E-13
Furnace	02/18/92	407	36.7	14936900	18.36	0.358	51.28492	1.55E-12
Furnace	02/28/92	518	36.7	19010600	149.12	0.358	416.5363	9.87E-12
Furnace	03/02/92	464	34.5	16008000	20.28	0.358	56.64804	1.59E-12
Furnace	03/03/92	433	39	16887000	17.46	0.358	48.77095	1.30E-12
Furnace	03/04/92	463	39	18057000	8.8	0.358	24.58101	6.13E-13
Furnace	03/05/92	530	39	20670000	5.8	0.358	16.20112	3.53E-13
Furnace	03/06/92	445	39	17355000	56.56	0.358	157.9888	4.10E-12
Furnace	03/09/92	469	39	18291000	8.4	0.358	23.46369	5.78E-13
Furnace	03/10/92	355	39.1	13880500	14.12	0.358	39.44134	1.28E-12
Furnace	03/11/92	445	39	17355000	15.5	0.358	43.29609	1.12E-12
Furnace	03/12/92	518	39	20202000	10.4	0.358	29.05028	6.48E-13
Furnace	03/12/92	505	39.1	19745500	10.84	0.358	30.27933	6.91E-13
Furnace	03/16/92	393	29.7	11672100	31.7	0.358	88.54749	3.42E-12
Furnace	04/03/92	503	39	19617000	23.54	0.358	65.75419	1.51E-12
Furnace	04/06/92	561	39	21879000	11.42	0.358	31.89944	6.57E-13
Furnace	04/07/92	460	39	17940000	47.62	0.358	133.0168	3.34E-12
Furnace	04/08/92	385	39	15015000	53.32	0.358	148.9385	4.47E-12
Furnace	04/09/92	1440	39	56160000	28.78	0.358	80.39106	6.45E-13
Furnace	04/10/92	360	39	14040000	13.3	0.358	37.15084	1.19E-12

Collection Location	Collection Date	Collection Time (m)	Flow Rate (LPM)	Sample Volume (ml)	Sample Counts (cpm)	Counting Efficiency (Gross Alpha)	Sample Activity (dpm)	Sample Concentration (μCi/ml)
Furnace	04/13/92	503	39	19617000	23.54	0.358	65.75419	1.51E-12
Furnace	04/14/92	596	39	23244000	149.66	0.358	418.0447	8.10E-12
Furnace	04/14/92	325	39	12675000	68.04	0.358	190.0559	6.75E-12
Furnace	05/04/92	400	36.95	14780000	7.82	0.358	21.84358	6.66E-13
Furnace	05/05/92	440	39	17160000	52.64	0.358	147.0391	3.86E-12
Furnace	05/06/92	310	39	12090000	74.18	0.358	207.2067	7.72E-12
Furnace	05/07/92	588	43.25	25431000	150.04	0.358	419.1061	7.42E-12
Furnace	06/02/92	398	39.4	15681200	7.16	0.358	20	5.75E-13
Furnace	12/03/92	485	38.4	18624000	22.26	0.358	62.17877	1.50E-12
Furnace	12/04/92	531	38.4	20390400	5.46	0.358	15.2514	3.37E-13
Furnace	12/07/92	452	38.4	17356800	18.58	0.358	51.89944	1.35E-12
Furnace	12/08/92	496	38.4	19046400	20.04	0.358	55.97765	1.32E-12
Furnace	12/09/92	314	38.4	12057600	15.6	0.358	43.57542	1.63E-12
Furnace	12/09/92	144	38.4	5529600	21.06	0.358	58.82682	4.79E-12
Furnace	12/10/92	494	38.4	18969600	21.02	0.358	58.71508	1.39E-12
Furnace	12/11/92	181	34	6154000	13.58	0.358	37.93296	2.78E-12
Furnace	12/11/92	367	38.4	14092800	17.28	0.358	48.26816	1.54E-12
Furnace	12/28/92	517	38.4	19852800	9.2	0.358	25.69832	5.83E-13
Furnace	12/29/92	570	38.4	21888000	5.5	0.358	15.36313	3.16E-13
Furnace	12/30/92	419	38.4	16089600	1.44	0.358	4.022346	1.13E-13
Furnace	01/04/93	480	38.4	18432000	14.7	0.358	41.06145	1.00E-12
Furnace	01/05/93	482	38.4	18508800	20.18	0.358	56.36872	1.37E-12
Furnace	01/06/93	530	38.4	20352000	15.18	0.358	42.40223	9.38E-13
Furnace	01/07/93	496	38.4	19046400	25.54	0.358	71.34078	1.69E-12
Furnace	01/08/93	500	9.5	4750000	63.28	0.358	176.7598	1.68E-11

Collection Location	Collection Date	Collection Time (m)	Flow Rate (LPM)	Sample Volume (ml)	Sample Counts (cpm)	Counting Efficiency (Gross Alpha)	Sample Activity (dpm)	Sample Concentration (μCi/ml)
Lunch Room	04/07/92	456	39.5	18012000	1.62	0.358	4.52514	1.13E-13
Mixer	01/06/92	332	39.1	12981200	4.52	0.358	12.6257	4.38E-13
Mixer	01/07/92	340	39.1	13294000	7.6	0.358	21.22905	7.19E-13
Mixer	01/08/92	310	39.1	12121000	12.72	0.358	35.53073	1.32E-12
Mixer	01/09/92	299	39.1	11690900	14.7	0.358	41.06145	1.58E-12
Mixer	01/10/92	190	39.1	7429000	9.8	0.358	27.3743	1.66E-12
Mixer	02/03/92	380	39.1	14858000	22.38	0.358	62.51397	1.90E-12
Mixer	02/04/92	357	39.1	13958700	13.4	0.358	37.43017	1.21E-12
Mixer	02/05/92	364	39.1	14232400	4.66	0.358	13.01676	4.12E-13
Mixer	02/07/92	362	39.1	14154200	0.86	0.358	2.402235	7.64E-14
Mixer	02/12/92	365	39.1	14271500	2.26	0.358	6.312849	1.99E-13
Mixer	02/16/92	462	39.5	18249000	19.18	0.358	53.57542	1.32E-12
Mixer	02/28/92	516	39.5	20382000	110.44	0.358	308.4916	6.82E-12
Mixer	03/02/92	458	39.5	18091000	22.64	0.358	63.24022	1.57E-12
Scale	02/14/92	513	39.1	20058300	2.28	0.358	6.368715	1.43E-13
Scale	02/17/92	513	39.1	20058300	3.28	0.358	9.162011	2.06E-13
Scale	02/17/92	916	39.1	35815600	13.94	0.358	38.93855	4.90E-13
Scale	02/18/92	406	31.9	12951400	20	0.358	55.86592	1.94E-12
Scale	02/28/92	520	31.9	16588000	23.2	0.358	64.80447	1.76E-12
Scale	03/02/92	465	39.1	18181500	10.42	0.358	29.10615	7.21E-13
Scale	03/03/92	428	39.1	16734800	15.44	0.358	43.12849	1.16E-12
Scale	03/04/92	580	39.1	22678000	6.92	0.358	19.32961	3.84E-13
Scale	03/05/92	530	39.1	20723000	8.36	0.358	23.35196	5.08E-13
Scale	03/06/92	445	39.1	17399500	17	0.358	47.48603	1.23E-12
Scale	03/09/92	468	39.1	18298800	32.58	0.358	91.00559	2.24E-12

Collection Location	Collection Date	Collection Time (m)	Flow Rate (LPM)	Sample Volume (ml)	Sample Counts (cpm)	Counting Efficiency (Gross Alpha)	Sample Activity (dpm)	Sample Concentration (μCi/ml)
Scale	03/10/92	358	39	13962000	11.32	0.358	31.62011	1.02E-12
Scale	03/11/92	443	37	16391000	15.5	0.358	43.29609	1.19E-12
Scale	03/16/92	388	37	14356000	48.1	0.358	134.3575	4.22E-12
Scale	03/31/92	280	39.1	10948000	16.38	0.358	45.75419	1.88E-12
Scale	03/31/92	280	39.1	10948000	16.38	0.358	45.75419	1.88E-12
Scale	04/03/92	505	39.1	19745500	14.9	0.358	41.62011	9.49E-13
Scale	04/06/92	569	39.1	22247900	22.94	0.358	64.07821	1.30E-12
Scale	04/07/92	460	39.1	17986000	17.12	0.358	47.82123	1.20E-12
Scale	04/08/92	385	39.1	15053500	20.84	0.358	58.21229	1.74E-12
Scale	04/09/92	1440	39.1	56304000	18.12	0.358	50.61453	4.05E-13
Scale	04/10/92	315	39.1	12316500	7.54	0.358	21.06145	7.70E-13
Scale	04/13/92	468	39.5	18486000	9.99	0.358	27.90503	6.80E-13
Scale	04/14/92	329	39.1	12863900	7.12	0.358	19.88827	6.96E-13
Scale	04/15/92	590	39.1	23069000	13.66	0.358	38.15642	7.45E-13
Scale	05/04/92	365	34.9	12738500	7.38	0.358	20.61453	7.29E-13
Scale	05/05/92	442	34.9	15425800	12.66	0.358	35.36313	1.03E-12
Scale	05/06/92	310	39.1	12121000	10.72	0.358	29.94413	1.11E-12
Scale	05/07/92	587	39.1	22951700	29.78	0.358	83.18436	1.63E-12
Scale	06/02/92	425	39.1	16617500	6.22	0.358	17.3743	4.71E-13
Scale	12/03/92	482	35.8	17255600	9.06	0.358	25.30726	6.61E-13
Scale	12/04/92	533	38.1	20307300	15.3	0.358	42.73743	9.48E-13
Scale	12/07/92	454	38.1	17297400	5.38	0.358	15.02793	3.91E-13
Scale	12/08/92	493	38.1	18783300	7.64	0.358	21.34078	5.12E-13
Scale	12/09/92	147	38.1	5600700	3.44	0.358	9.608939	7.73E-13
Scale	12/09/92	312	38.1	11887200	2.88	0.358	8.044693	3.05E-13

Collection Location	Collection Date	Collection Time (m)	Flow Rate (LPM)	Sample Volume (ml)	Sample Counts (cpm)	Counting Efficiency (Gross Alpha)	Sample Activity (dpm)	Sample Concentration (μCi/ml)
Scale	12/10/92	492	38.1	18745200	4.88	0.358	13.63128	3.28E-13
Scale	12/11/92	367	38.1	13982700	3.14	0.358	8.77095	2.83E-13
Scale	12/11/92	185	38.1	7048500	5.74	0.358	16.03352	1.02E-12
Scale	12/28/92	508	38.1	19354800	3.72	0.358	10.39106	2.42E-13
Scale	12/29/92	571	38.1	21755100	1.04	0.358	2.905028	6.02E-14
Scale	12/30/92	416	38.1	15849600	1.02	0.358	2.849162	8.10E-14
Scale	01/04/93	478	38.1	18211800	6.18	0.358	17.26257	4.27E-13
Scale	01/05/93	480	38.1	18288000	9.08	0.358	25.36313	6.25E-13
Scale	01/06/93	535	38.1	20383500	6.68	0.358	18.65922	4.12E-13
Scale	01/07/93	485	38.1	18478500	9.3	0.358	25.97765	6.33E-13
Scale	01/08/93	495	38.1	18859500	10.04	0.358	28.04469	6.70E-13
Westwall	03/09/92	1420	39.5	56090000	4.26	0.358	11.89944	9.56E-14
Westwall	04/10/92	326	39.5	12877000	7.58	0.358	21.17318	7.41E-13
Westwall	04/13/92	468	39.5	18486000	8.84	0.358	24.69274	6.02E-13
Westwall	04/14/92	335	39.5	13232500	9.32	0.358	26.03352	8.86E-13
Westwall	04/15/92	587	39.5	23186500	4.58	0.358	12.7933	2.49E-13

Table 2: Personal Breathing Zone Sampling Results

Employee Number	Collection Date	Collection Time (m)	Flow Rate (LPM)	Sample Volume (ml)	Sample Counts (cpm)	Background Counts (cpm)	Net Counts (cpm)	Detector Efficiency (Gross Alpha)	Sample Activity (dpm)	Concentration (μCi/ml)
Employee 1	12/08/82	401	1.996	800396	1.22	0.22	1	0.3384	2.955083	1.66E-12
Employee 1	12/03/92	394	2.002	788788	0.8	0.28	0.52	0.3384	1.536643	8.78E-13
Employee 1	12/04/92	212	2.011	426332	0.8	0.28	0.52	0.3384	1.536643	1.62E-12
Employee 1	12/07/92	498	1.994	993012	0.82	0.24	0.58	0.3384	1.713948	7.77E-13
Employee 1	12/08/92	401	1.996	800000	1.22	0.22	1	0.3384	2.955083	1.66E-12
Employee 1	12/10/92	454	1.963	891202	1.38	0.22	1.16	0.3384	3.427896	1.73E-12
Employee 1	12/11/92	508	1.994	1012952	1.45	0.26	1.19	0.3384	3.516548	1.56E-12
Employee 1	12/29/92	429	1.987	852000	1.32	0.26	1.06	0.3384	3.132388	1.66E-12
Employee 1	12/30/92	432	1.972	852000	0.84	0.12	0.72	0.3384	2.12766	1.12E-12
Employee 1	01/04/93	307	1.993	612000	0.5	0.28	0.22	0.3384	0.650118	4.79E-13
Employee 1	01/05/93	499	1.946	971000	1.34	0.24	1.1	0.3384	3.250591	1.51E-12
Employee 1	01/06/93	405	1.984	803000	0.38	0.24	0.14	0.3384	0.413712	2.32E-13
Employee 1	01/07/93	490	1.993	976000	1.94	0.24	1.7	0.3384	5.023641	2.32E-12
Employee 1	01/08/93	507	1.973	1000000	3.52	0.18	3.34	0.3384	9.869976	4.45E-12
Employee 2	12/04/92	556	1.994	1108664	2.2	0.28	1.92	0.3384	5.673759	2.31E-12

Employee Number	Collection Date	Collection Time (m)	Flow Rate (LPM)	Sample Volume (ml)	Sample Counts (cpm)	Background Counts (cpm)	Net Counts (cpm)	Detector Efficiency (Gross Alpha)	Sample Activity (dpm)	Concentra-tion (μCi/ml)
Employee 2	12/28/92	523	1.967	1028000	6.38	0.26	6.12	0.3384	18.08511	7.92E-12
Employee 2	12/29/92	463	1.95	903000	1.68	0.26	1.42	0.3384	4.196217	2.09E-12
Employee 2	12/30/92	435	1.975	859000	0.48	0.12	0.36	0.3384	1.06383	5.58E-13
Employee 2	01/04/93	393	1.975	776000	0.68	0.28	0.4	0.3384	1.182033	6.86E-13
Employee 2	01/05/93	468	1.986	929000	1.38	0.24	1.14	0.3384	3.368794	1.63E-12
Employee 2	01/06/93	544	1.952	1062000	6.14	0.24	5.9	0.3384	17.43499	7.40E-12
Employee 3	12/08/82	522	2.028	1058616	1.42	0.22	1.2	0.3384	3.546099	1.51E-12
Employee 3	12/03/92	349	1.981	691369	2.2	0.28	1.92	0.3384	5.673759	3.70E-12
Employee 3	12/04/92	561	2.008	1126488	1.58	0.18	1.4	0.3384	4.137116	1.65E-12
Employee 3	12/07/92	202	1.985	400970	0.64	0.24	0.4	0.3384	1.182033	1.33E-12
Employee 3	12/08/92	522	2.028	1059000	1.42		1.42	0.3384	4.196217	1.78E-12
Employee 3	12/09/92	471	1.957	921747	1.06	0.22	0.84	0.3384	2.48227	1.21E-12
Employee 3	12/10/92	501	1.99	996990	1.6	0.18	1.42	0.3384	4.196217	1.90E-12
Employee 3	12/11/92	503	1.964	987892	3.36	0.26	3.1	0.3384	9.160757	4.18E-12
Employee 3	01/06/93	546	1.972	1077000	1.72	0.24	1.48	0.3384	4.373522	1.83E-12
Employee 3	01/07/93	493	1.961	967000	1.78	0.24	1.54	0.3384	4.550827	2.12E-12

Employee Number	Collection Date	Collection Time (m)	Flow Rate (LPM)	Sample Volume (ml)	Sample Counts (cpm)	Background Counts (cpm)	Net Counts (cpm)	Detector Efficiency (Gross Alpha)	Sample Activity (dpm)	Concentra-tion (μCi/ml)
Employee 3	01/08/93	506	1.966	995000	2.68	0.18	2.5	0.3384	7.387707	3.34E-12
Employee 6	12/28/92	203	1.993	404000	0.6	0.26	0.34	0.3384	1.004728	1.12E-12
Employee 4	12/08/82	514	1.998	1026972	0.86	0.22	0.64	0.3384	1.891253	8.30E-13
Employee 4	12/03/92	344	1.978	680432	0.74	0.28	0.46	0.3384	1.359338	9.00E-13
Employee 4	12/04/92	551	1.984	1093184	0.7	0.28	0.42	0.3384	1.241135	5.11E-13
Employee 4	12/07/92	495	1.963	971685	1.26	0.24	1.02	0.3384	3.014184	1.40E-12
Employee 4	12/08/92	514	1.998	1027000	0.86	0.22	0.64	0.3384	1.891253	8.30E-13
Employee 4	12/09/92	463	1.977	915351	1	0.22	0.78	0.3384	2.304965	1.13E-12
Employee 4	12/10/92	503	1.942	976826	0.76	0.26	0.5	0.3384	1.477541	6.81E-13
Employee 4	12/11/92	406	1.993	809000	1.38	0.26	1.12	0.3384	3.309693	1.84E-12
Employee 4	12/28/92	517	1.968	1017000	8.96	0.26	8.7	0.3384	25.70922	1.14E-11
Employee 4	12/29/92	459	1.976	907000	1.26	0.12	1.14	0.3384	3.368794	1.67E-12
Employee 4	12/30/92	9	2.001	18000	0.64	0.12	0.52	0.3384	1.536643	3.85E-11
Employee 4	01/04/93	386	1.975	762000	1.16	0.28	0.88	0.3384	2.600473	1.54E-12
Employee 4	01/05/93	495	1.965	972000	0.58	0.24	0.34	0.3384	1.004728	4.66E-13
Employee 4	01/07/93	490	1.987	973000	1.14	0.24	0.9	0.3384	2.659574	1.23E-12

Employee Number	Collection Date	Collection Time (m)	Flow Rate (LPM)	Sample Volume (ml)	Sample Counts (cpm)	Background Counts (cpm)	Net Counts (cpm)	Detector Efficiency (Gross Alpha)	Sample Activity (dpm)	Concentra-tion (μCi/ml)
Employee 4	01/08/93	507	1.974	1001	1.18	0.18	1	0.3384	2.955083	1.33E-09
Employee 5	12/08/82	473	2.027	958771	2.92	0.18	2.74	0.3384	8.096927	3.80E-12
Employee 5	12/03/92	350	1.986	695100	3.34	0.28	3.06	0.3384	9.042553	5.86E-12
Employee 5	12/07/92	470	1.971	926370	7.54	0.24	7.3	0.3384	21.5721	1.05E-11
Employee 5	12/09/92	451	1.945	877195	2.22	0.18	2.04	0.3384	6.028369	3.10E-12
Employee 5	12/10/92	308	1.991	613228	0.9	0.26	0.64	0.3384	1.891253	1.39E-12
Employee 5	12/11/92	503	1.944	978000	1.52	0.26	1.26	0.3384	3.723404	1.71E-12
Employee 5	12/28/92	524	2.004	1050000	15.34	0.26	15.08	0.3384	44.56265	1.91E-11
Employee 5	12/29/92	343	1.95	669000	0.88	0.26	0.62	0.3384	1.832151	1.23E-12
Employee 5	12/30/92	412	1.954	805000	1.22	0.12	1.1	0.3384	3.250591	1.82E-12
Employee 5	01/04/93	486	2.002	973000	2.58	0.28	2.3	0.3384	6.79669	3.15E-12
Employee 5	01/06/93	544	1.942	1056000	1.4	0.24	1.16	0.3384	3.427896	1.46E-12
Employee 5	01/07/93	491	1.976	970000	2.84	0.24	2.6	0.3384	7.683215	3.57E-12
Employee 5	01/08/93	504	1.956	986000	1.96	0.18	1.78	0.3384	5.260047	2.40E-12

Table 3: Isotopic Ratios in Area Monitoring Filters

Sample Collection Date	*Shieldalloy Results (µCi/ml gross alpha)*	*Laboratory Results (µCi/ml ^{232}Th)*	*Ratio of Laboratory to Shieldalloy Results for ^{232}Th*[a]	*Laboratory Results (µCi/ml ^{238}U)*	*Ratio of Laboratory to Shieldalloy Results for ^{238}U*[a]
February 28, 1992	9.87×10^{-12}	Less than 6×10^{-13}	6.08×10^{-2}	Less than 1×10^{-12}	1.01×10^{-1}
February 28, 1992	6.82 c 10^{-12}	Less than 5×10^{-13}	7.33×10^{-2}	Less than 1×10^{-12}	1.47×10^{-1}
March 6, 1992	4.10×10^{-12}	Less than 5×10^{-13}	1.22×10^{-1}	Less than 1×10^{-12}	2.44×10^{-1}
March 9, 1992	2.24×10^{-12}	6.51×10^{-13}	2.91×10^{-1}	Less than 1×10^{-12}	4.46×10^{-1}
December 10, 1992	1.39×10^{-12}	$6.4 \pm 3.0 \times 10^{-15}$	4.60×10^{-3}	--	--
January 4, 1993	1.00×10^{-12}	Less than 3×10^{-15}	3.00×10^{-3}	--	--
January 8, 1993	1.68×10^{-11}	$1.3 \pm 0.4 \times 10^{-14}$	7.74×10^{-4}	--	--
Average			7.94×10^{-2}		2.35×10^{-1}

[a] Assuming that the MDA for the laboratory results is an actual value.

Table 4: Isotopic Ratios in Personal Breathing Zone Sampling Filters

Sample Collection Date	*Shieldalloy Results (µCi/ml gross alpha)*	*Laboratory Results (µCi/ml ^{232}Th)*	*Ratio of Laboratory to Shieldalloy Results for ^{232}Th*[a]	*Laboratory Results (µCi/ml ^{238}U)*	*Ratio of Laboratory to Shieldalloy Results for ^{238}U*[a]
December 3, 1992	5.86×10^{-12}	Less than 4×10^{-14}	6.83×10^{-3}	2.76×10^{-14}	4.71×10^{-3}
December 4, 1992	2.30×10^{-12}	Less than 4×10^{-14}	1.74×10^{-2}	2.76×10^{-14}	1.20×10^{-2}
December 7, 1992	1.05×10^{-11}	Less than 3×10^{-14}	2.86×10^{-3}	2.07×10^{-14}	1.97×10^{-3}
December 8, 1992	1.80×10^{-12}	Less than 5×10^{-14}	2.78×10^{-2}	--	--
December 10, 1992	1.73×10^{-12}	Less than 3×10^{-14}	1.73×10^{-2}	2.07×10^{-14}	1.20×10^{-2}
December 11, 1992	4.18×10^{-12}	Less than 2×10^{-14}	4.78×10^{-3}	1.38×10^{-14}	3.30×10^{-3}
January 6, 1993	7.40×10^{-12}	Less than 3×10^{-14}	4.05×10^{-3}	--	--
January 8, 1993	4.45×10^{-12}	7.4×10^{-14}	1.66×10^{-2}	--	--
Average			1.22×10^{-2}		7.00×10^{-3}

[a] Assuming that the MDA for the laboratory results is an actual value.

Figure 1: Area Air Monitoring Results, CY 1992

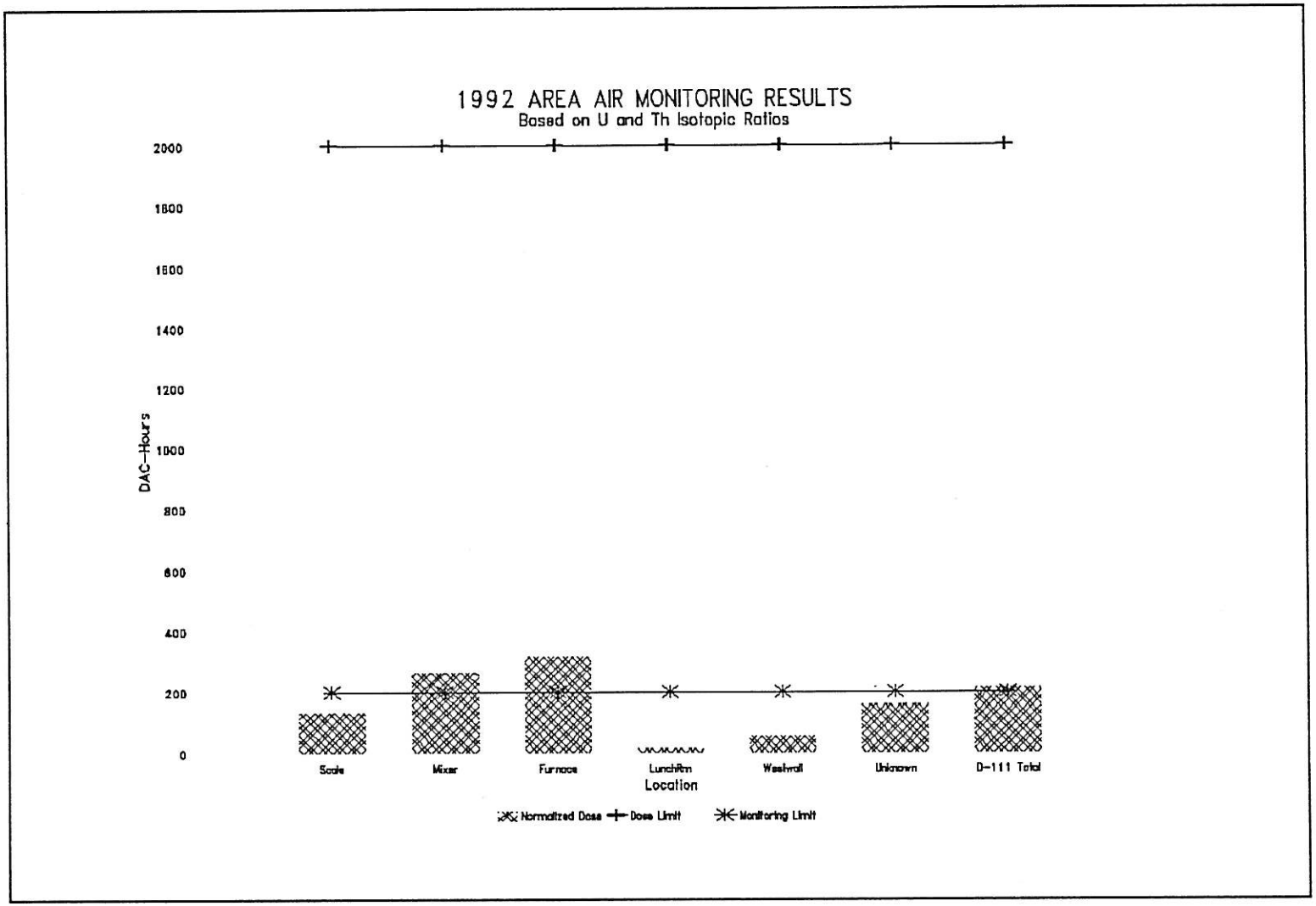
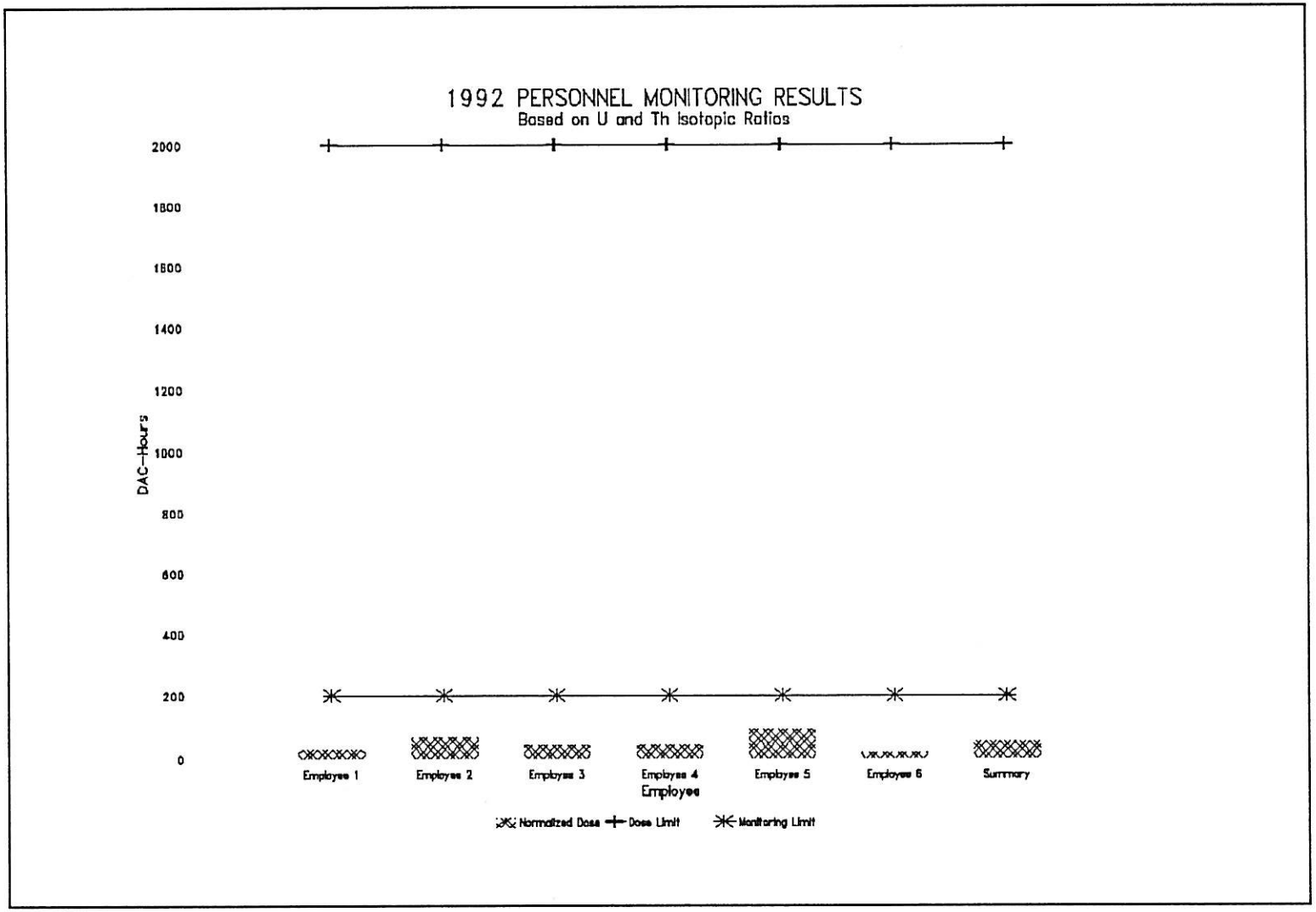
Figure 2: Personnel Monitoring Results, CY 1992