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# Characterization of Ventilation Ductwork in Building K-33 at the Oak Ridge K-25 Site

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MANAGED BY
MARTIN MARIETTA ENERGY SYSTEMS, INC.
FOR THE UNITED STATES
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# CHARACTERIZATION OF VENTILATION DUCTWORK IN BUILDING K-33 AT THE OAK RIDGE K-25 SITE

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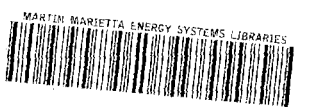

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## ABSTRACT

An extensive sampling and analysis program was initiated in September 1991 to characterize the ductwork of Building K-33, which is located at the Oak Ridge K-25 Site. This building, 32.4 acres under roof, contains nearly 3 miles of main plenums without considering the side laterals, which are extensive. A large number (i.e., 131) of hexane-moistened wipe samples were taken from within randomly selected locations in the 16 main plenums and the side lateral network. Samples were analyzed for polychlorinated biphenyls (PCBs), uranium, and technetium. These samples were augmented by 5 bulk material and 13 metal coupon samples that were subjected to TCLP (Toxicity Characteristic Leaching Procedure) analyses for arsenic, barium, cadmium, chromium, lead, nickel, selenium, silver, and mercury.

The analytical results indicated that the estimated range of PCB contamination exceeded 10 $\mu g/100\ cm^2$ for 50% (8 of 16) of the major plenums. The 6 main plenums and their attached side laterals from columns 39 through 59 seem to have the highest levels of uranium contamination; 5.1 $mg/100\ cm^2$ was the highest removable contamination found. Assuming it was present as natural uranium, this amounts to about 8000 disintegrations/min (dpm) alpha per 100 $cm^2$. Technetium contamination was highest in the main plenums, with about 50% of the side laterals having little or no contamination. The highest removable contamination of technetium found was 4617 $pCi/100\ cm^2$, or about 10,000 dpm beta per 100 $cm^2$.

# 1. INTRODUCTION

Complete characterization of the interior of the ventilation ductwork in Building K-33 at the Oak Ridge K-25 Site would be, of necessity, a rather massive and costly undertaking. The building itself is huge—with dimensions of 1455 by 970 ft, or a total of 32.4 acres, under roof. The ventilation ductwork consists of 16 main plenums, each 970 ft long (a total length of nearly 3 miles). Each main plenum expands from about a 330-ft length of 6-ft width in the center to approximately a 120-ft length of plenum that is originally 14 ft wide but gradually increases to a width of about 37.5 ft at the fans. One typical main plenum was intersected by 36 lateral ducts, each being approximately 2 x 2 ft in cross section, primarily covering half of the 80- by 970-ft area between paired main plenums. However, a sampling plan designed to determine the general-level and worst-case contamination of this ductwork is manageable and can be achieved with the resources at hand. Such a plan was developed for Buildings K-29, K-31, and K-33 by the Sampling and Environmental Support Department at the Oak Ridge K-25 Site, primarily under the authorship of M. R. Powell, Sampling Project Manager.*

## 1.1 SAMPLING AND ANALYSIS PLAN*

Briefly, the sampling plan divided the ductwork for the building into two distinct sampling areas, the main plenums and the lateral ducts. Approximately half the samples for Building K-33 were taken from each area. Sixty samples were taken from the main plenums and 60 were also taken from the side laterals, based on a statistical determination (assuming completely random selection of sample location) that, with a 95% confidence level, 95% of a large population of samples from each area would yield analytical results which would not exceed the maximum analysis found within the sample population of 60. These 60 samples were to be hexane-moistened wipes, 100 $cm^2$ in area, from the "arm-reachable area" (arm-reachable through a 12- by 12-in. hole cut into the side of the duct) on the bottom of the duct at the designated sampling point. Other samples to be taken were bulk portions of material if, in the sampler's judgment, they equaled or exceeded a

*For details, see Sampling and Environmental Support Department, Technical Services Division, *Sampling and Analysis Plans for Ventilation Ducts in the K-29, K-31, and K-33 Facilities*, QAP:04-91-0007.

total of 100 g and the actual metal coupons (12 by 12 in.) that were cut from the lower side of the duct at the designated sampling point to enable hand entry into the interior of the duct. The coupon openings were to be randomly alternated between the two sides of a duct whenever possible.

The interior of the duct was scanned visually through the 12- by 12-in. opening by the sampler, and appropriate comments were written into a log concerning the surface conditions observed. All samples were subjected to careful identification and logging, packaging, chain of custody, and archiving requirements immediately after sampling as detailed in the *Sampling and Analysis Plan*. The wipe sample, representing 100 $cm^2$ of interior duct surface area, was divided into thirds by the Sample Receiving Department and submitted to the Quality and Technical Services Division (K-25) for analyses of PCBs, uranium, and technetium. All bulk samples and a random selection of 100-$cm^2$ pieces of metal coupons were subjected to analyses by TCLP (Toxicity Characteristic Leaching Procedure; see 40 CFR Part 261, Appendix II) for toxic materials.

As shown in Table 17 of QAP:04-91-0007, 60 sample locations were specified for the main plenums. Table 18 contained a similar number of specified locations for the side lateral ductwork. These locations were indicated as specific column numbers within K-33 and were randomly generated. During the course of the actual sampling process, five of the randomly selected locations for the main plenums and seven locations for the side laterals were found to be inaccessible for sampling. Alternative locations were selected on the same major plenum; for the side laterals, a nearby lateral attached to the same major plenum was chosen. Tables 1 and 2 contain the column location data, with the alternative sampling locations shown for each inaccessible location. Drawing M3D41011, reproduced in reduced form as Fig. 1, illustrates the layout of the K-33 duct system and shows all column numbers of the building with respect to the main plenums and side laterals.

## 1.2 SAMPLING THE DUCTWORK OF BUILDING K-33

Sampling of the ductwork of Building K-33 began on September 5, 1991, and was completed on January 14, 1992. During this period, 131 wipe samples were taken, of which 12 were duplicates. The wipe samples were analyzed for PCBs, uranium, and

Table 1. Sampling locations[a] in main plenums of K-33

| Sample number | Column number | Sample number | Column number | |
|---|---|---|---|---|
| 1 | C-11 | 31 | M-15 | |
| 2 | Ca-43 | 32 | ~~Ma-7~~ | ~~P-7~~ |
| 3 | Ca-47 | 33 | ~~Ma-15~~ | ~~Mb-15~~ |
| 4 | Cb-3 | 34 | ~~Mb-7~~ | ~~Na-7~~ |
| 5 | Cb-7 | 35 | ~~Mb-39~~ | ~~Mc-39~~ |
| 6 | Cb-ii | 36 | N-19 | |
| 7 | E-11 | 37 | N-47 | |
| 8 | E-15 | 38 | ~~Na-11~~ | ~~Q-12~~ |
| 9 | E-27 | 39 | Na-23 | |
| 10 | Ea-39 | 40 | Na-47 | |
| 11 | F-31 | 41 | P-15 | |
| 12 | G-35 | 42 | Qa-63 | |
| 13 | Ga-55 | 43 | Qb-39 | |
| 14 | Gb-7 | 44 | R-55 | |
| 15 | Gb-19 | 45 | S-27 | |
| 16 | Gb-31 | 46 | Sa-19 | |
| 17 | H-35 | 47 | T-7 | |
| 18 | H-55 | 48 | U-59 | |
| 19 | Ja-3 | 49 | Ua-3 | |
| 20 | Ja-23 | 50 | Ua-23 | |
| 21 | Ja-47 | 51 | Ua-51 | |
| 22 | Jb-19 | 52 | Ua-55 | |
| 23 | Jb-23 | 53 | Ub-51 | |
| 24 | Jb-51 | 54 | V-3 | |
| 25 | K-7 | 55 | V-51 | |
| 26 | K-11 | 56 | W-19 | |
| 27 | K-23 | 57 | W-51 | |
| 28 | K-27 | 58 | Wa-15 | |
| 29 | La-7 | 59 | X-39 | |
| 30 | Lb-15 | 60 | X-43 | |

[a]Inaccessible locations are struck out; alternative locations are redlined.

Table 2. Sampling locations[a] in side lateral ducts of K-33

| Sample number | Column number | | Sample number | Column number | |
|---|---|---|---|---|---|
| 1 | C-6 | | 31 | M-44 | |
| 2 | C-24 | | 32 | N-31 | |
| 3 | Ca-55 | | 33 | Nb-16 | |
| 4 | Cb-61 | | 34 | Nb-59 | |
| 5 | D-18 | | 35 | Q-2 | |
| 6 | E-13 | | 36 | Q-7 | |
| 7 | Ea-52 | | 37 | Q-19 | |
| 8 | Eb-6 | | 38 | Q-54 | |
| 9 | Eb-35 | | 39 | Qa-56 | |
| 10 | ~~F-63~~ | Eb-60 | 40 | S-8 | |
| 11 | G-24 | | 41 | ~~S-61~~ | R-63 |
| 12 | ~~G-62~~ | Ga-60 | 42 | Sa-8 | |
| 13 | Ga-46 | | 43 | Sa-21 | |
| 14 | Gb-15 | | 44 | ~~Sa-43~~ | R-43 |
| 15 | Gb-36 | | 45 | Sa-58 | |
| 16 | H-4 | | 46 | Sa-63 | |
| 17 | ~~J-61~~ | J-59 | 47 | T-20 | |
| 18 | Ja-7 | | 48 | T-43 | |
| 19 | Jb-37 | | 49 | U-11 | |
| 20 | Jb-38 | | 50 | U-24 | |
| 21 | Jb-40 | | 51 | Ua-34 | |
| 22 | Jb-61 | | 52 | Ub-22 | |
| 23 | K-10 | | 53 | Ub-56 | |
| 24 | K-15 | | 54 | V-47 | |
| 25 | K-36 | | 55 | W-40 | |
| 26 | La-12 | | 56 | W-55 | |
| 27 | La-22 | | 57 | Wb-20 | |
| 28 | ~~Lb-5~~ | S-4 | 58 | ~~Wb-51~~ | W-52 |
| 29 | Lb-30 | | 59 | X-38 | |
| 30 | Lb-65 | | 60 | X-42 | |

[a]Inaccessible locations are struck out; alternative locations are redlined.

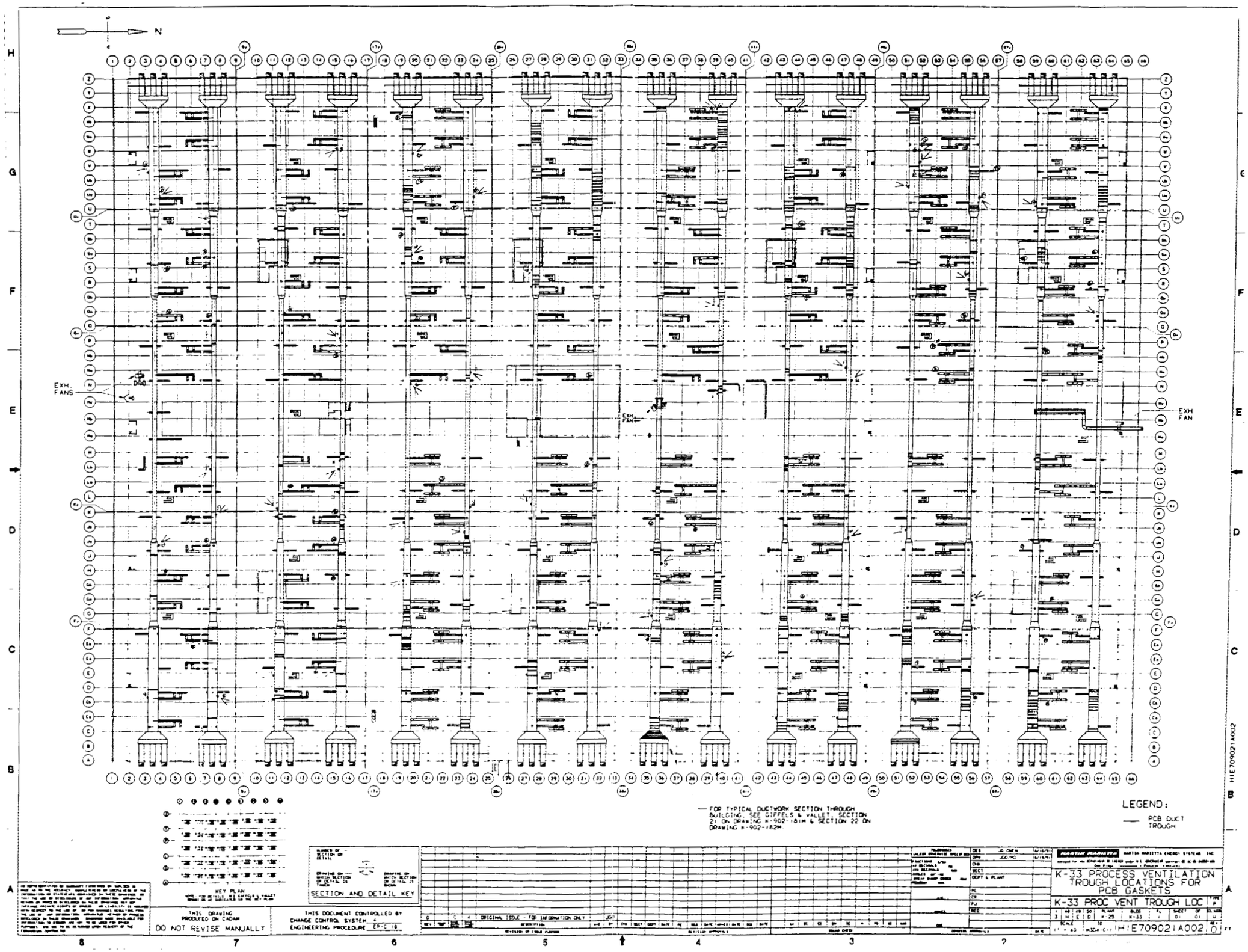


Fig. 1. Layout of main plenums and side laterals in Building K-33, showing column numbers.

technetium according to the methods listed in the *Sampling and Analysis Plan* (QAP:04-91-0007). Five bulk samples and 20 metal coupon samples were taken and submitted for TCLP analyses.

The procedure required to sample the ductwork involved four to five people and at least three departments, including Sampling and Environmental Support, Health Physics (HP), and Maintenance. A Verti-lift was utilized to position the individuals adjacent to the duct for the actual sampling. HP technicians surveyed the exterior where the opening was to be made prior to actually cutting into the duct. Following HP approval, a 12- by 12-in. template was used to mark the duct, and a transparent glove bag containing cutting tools and equipment to perform the actual sampling was duct-taped to the metal around the area to be cut. Holes were drilled around the periphery of the marked area, and nippers were employed to complete the opening. The glove bag and the size of the opening tended to restrict the view of the interior of the duct by the sampling technician. Their reports concerning the appearance of the duct interior generally indicated a layer of dust — in some instances, an oily-appearing dust with occasional surface crusts having a white color. In several instances, more interesting locations within the duct were beyond reach of the opening. In one case, a round object that was about the size of a baseball and covered with dust and a hairlike material was observed, again beyond reach. As is evidenced by the small number of bulk samples obtained in K-33 (a total of five for the entire sampling program), the interior of the ductwork was relatively clear of particulate matter, except for dust. After completion of the sampling event, tools and samples were bagged from the duct by twisting the glove bag around them. Following the HP survey, which indicated that the samples were safe to remove, they were bagged and tagged. The HP technician again surveyed the area around the opening, after which it was taped shut.

## 2. ANALYTICAL DATA FOR K-33 DUCT SAMPLES

A number of hexane-moistened wipe samples (i.e., 131), including 12 duplicates taken from the main plenum and side lateral ductwork of Building K-33, were analyzed. Each wipe sample was divided into thirds for the three analyses (PCBs, uranium, and technetium), and the reported analyses were converted to the total wipe area of 100 $cm^2$. Five bulk samples were taken, three from the main plenums and two from the side laterals, and were submitted for TCLP (arsenic, barium, cadmium, chromium, lead, nickel, selenium, silver, and mercury), technetium, uranium, PCB, and gross activity analyses.

One of the bulk samples from the side lateral ducts was later found to be insufficient in size and, thus, was not analyzed. Twenty metal (100-$cm^2$) coupons were taken, of which 13 were analyzed by TCLP; the remaining analyses were not completed due to time constraints and sample matrix problems. An appreciation for the variability, both in samples and the sampling process, can be gained by reviewing the results for duplicate samples in Table 3 (see also Table 6).

## 2.1 WIPE SAMPLES FROM MAIN PLENUMS

The analytical data (PCBs, uranium, and technetium) obtained for wipe samples from the main plenums of K-33 are listed in Table 3. The data are separated and listed for each of the 16 main plenums in K-33. Table 4 summarizes these data as mean analyses ± 3 standard deviations for each main plenum, together with the analytical range (low to high) for each of the three assays.

Table 5 lists the ranges (means ± 3 standard deviations) for 14 of the 16 main plenums in K-33, together with the highest measured concentrations of PCBs, uranium, and technetium in each main plenum. Only a single sample was obtained from the two remaining plenums in the building; therefore, ranges cannot be indicated for those plenums.

## 2.2 WIPE SAMPLES FROM SIDE LATERALS

Table 6 lists the individual assays of PCBs, uranium, and technetium for hexane-moistened wipes from the side lateral ductwork of Building K-33, again grouped by major duct to which the side lateral is attached. Table 7 lists the mean analyses, and Table 8 presents the range (mean ± 3$\sigma$) and highest single measured value for each of the three constituents, grouped as described above.

## 2.3 BULK SAMPLES FROM MAIN PLENUMS AND SIDE LATERALS

Prior to the beginning of this sampling and analysis project for Building K-33, it was estimated that perhaps 10% of the sampled locations would yield sufficient material (minimum of 100 g) for TCLP analysis. This was somewhat of an ambitious estimate since only 5 bulk material samples were obtained instead of the anticipated 12 to 13. One of these five samples was insufficient and, thus, could not be analyzed. The analytical results

Table 3. Analyses of wipe samples from main plenums in K-33

| Location[a] | Analyses | | |
|---|---|---|---|
| | PCB ($\mu g/100\ cm^2$) | Uranium ($\mu g/100\ cm^2$) | Technetium ($pCi/100\ cm^2$) |
| Cb3 | <3[b] | 105 | 308± 94 |
| Ja3 | <3[b] | 3 | 323±109 |
| Ua3 | 1.7 | 696 | 353± 99 |
| V3 | 2. | 351 | 1790±124 |
| | $\bar{x} = 2.4$ | $\bar{x} = 289$ | $\bar{x} = 694$ |
| | $\sigma = 0.7$ | $\sigma = 308$ | $\sigma = 731$ |
| Cb7 | 39 | 810 | 1690±115 |
| Gb7 | 0.8 | 111 | 251±104 |
| K7 | 9.6 | 42 | 122± 92 |
| La7 | 1.7 | 282 | 271±115 |
| Na7 | 4.2 | 210 | 378±184 |
| P7[c] | 7.5 | 108 | -181±151 |
| | 11.1 | 222 | 156±184 |
| T7 | 2. | 93 | 273±124 |
| | $\bar{x} = 9.5$ | $\bar{x} = 235$ | $\bar{x} = 370$ |
| | $\sigma = 12.5$ | $\sigma = 246$ | $\sigma = 559$ |
| C11 | <3[b] | 3 | -144± 10 |
| Cb11 | 1. | 18 | -97± 79 |
| E11 | 4.8 | 87 | 69± 85 |
| K11 | 1.6 | 297 | -80±102 |
| Q12[c] | 6 | 246 | 458±184 |
| | 3.6 | 267 | 1447±167 |
| | $\bar{x} = 3.3$ | $\bar{x} = 153$ | $\bar{x} = 276$ |
| | $\sigma = 1.9$ | $\sigma = 132$ | $\sigma = 615$ |
| E15 | 3.3 | 75 | 211±124 |
| Lb15[c] | 0.6 | 9 | -27± 90 |
| | 1. | 30 | -102± 80 |
| M15 | 2.4 | 123 | -151±124 |
| Mb15 | 3 | 123 | -189±167 |
| P15 | 0.7 | 39 | -72±100 |
| Wa15 | 1.7 | 282 | 1077±114 |
| | $\bar{x} = 1.8$ | $\bar{x} = 97$ | $\bar{x} = 107$ |
| | $\sigma = 1.1$ | $\sigma = 93$ | $\sigma = 447$ |

Table 3 (continued)

| Location[a] | Analyses | | |
|---|---|---|---|
| | PCB ($\mu g/100\ cm^2$) | Uranium ($\mu g/100\ cm^2$) | Technetium ($pCi/100\ cm^2$) |
| Gb19 | NA[d] | 450 | 716± 84 |
| Jb19 | 4.8 | 255 | -122±125 |
| N19 | 1.6 | 660 | -15± 77 |
| Sa19 | 1.4 | 330 | -47± 84 |
| W19 | 3 | 243 | 40± 90 |
| | $\bar{x} = 2.7$ | $\bar{x} = 388$ | $\bar{x} = 114$ |
| | $\sigma = 1.6$ | $\sigma = 173$ | $\sigma = 341$ |
| Ja23 | 0.8 | 492 | -13± 95 |
| Jb23 | 1.8 | 420 | -67±100 |
| K23 | 5.7 | 141 | 1238±268 |
| Na23 | 2.3 | 234 | -94± 79 |
| Ua23 | 0.7 | 291 | 177±112 |
| | $\bar{x} = 2.3$ | $\bar{x} = 316$ | $\bar{x} = 248$ |
| | $\sigma = 2.0$ | $\sigma = 141$ | $\sigma = 563$ |
| E27 | 3 | 534 | 216± 94 |
| K27[c] | 0.8 | 411 | -89±114 |
| | 0.7 | 573 | 28±112 |
| S27[c] | 96 | 1050 | 10±156 |
| | 99 | 432 | 335±234 |
| | $\bar{x} = 39.9$ | $\bar{x} = 600$ | $\bar{x} = 100$ |
| | $\sigma = 52.6$ | $\sigma = 260$ | $\sigma = 172$ |
| F31 | 1.8 | 138 | 43± 84 |
| Gb31 | 6.3 | 207 | 539±100 |
| | $\bar{x} = 4.0$ | $\bar{x} = 172$ | $\bar{x} = 291$ |
| | $\sigma = 3.2$ | $\sigma = 49$ | $\sigma = 351$ |

Table 3 (continued)

| Location[a] | Analyses | | |
|---|---|---|---|
| | PCB ($\mu g/100\ cm^2$) | Uranium ($\mu g/100\ cm^2$) | Technetium ($pCi/100\ cm^2$) |
| G35 | 5.1 | 201 | 928± 99 |
| H35 | 3.3 | 123 | -60± 84 |
| | $\bar{x} = 4.2$ | $\bar{x} = 162$ | $\bar{x} = 434$ |
| | $\sigma = 1.3$ | $\sigma = 155$ | $\sigma = 699$ |
| Ea39 | 24.9 | 900 | 325± 94 |
| Qb39 | 3.3 | 144 | 107±284 |
| X39 | 30 | 699 | 688±201 |
| | $\bar{x} = 19.4$ | $\bar{x} = 581$ | $\bar{x} = 373$ |
| | $\sigma = 14.2$ | $\sigma = 392$ | $\sigma = 294$ |
| Ca43 | 6.6 | 750 | 662±136 |
| X43 | 2.4 | 48 | 497±234 |
| | $\bar{x} = 4.5$ | $\bar{x} = 399$ | $\bar{x} = 580$ |
| | $\sigma = 3.0$ | $\sigma = 496$ | $\sigma = 117$ |
| Ca47 | 10.8 | 156 | 1164±318 |
| Ja47 | <3[b] | 5100 | 74± 67 |
| Na47 | 3.9 | 150 | 152±368 |
| N47 | 5.7 | 570 | 468±335 |
| | $\bar{x} = 5.8$ | $\bar{x} = 1494$ | $\bar{x} = 464$ |
| | $\sigma = 3.5$ | $\sigma = 2412$ | $\sigma = 496$ |
| Jb51[c] | <3[b] | 420 | 33± 75 |
| | <3[b] | 1770 | 201± 79 |
| Ua51 | 16.2 | 1050 | 3798±335 |
| Ub51 | 4.5 | 288 | 443±519 |
| V51 | 9.6 | 72 | 296±234 |
| W51 | 5.4 | 570 | 1365±468 |
| | $\bar{x} = 6.9$ | $\bar{x} = 695$ | $\bar{x} = 1023$ |
| | $\sigma = 5.1$ | $\sigma = 621$ | $\sigma = 1438$ |

Table 3 (continued)

| Location[a] | Analyses | | |
|---|---|---|---|
| | PCB ($\mu g/100\ cm^2$) | Uranium ($\mu g/100\ cm^2$) | Technetium ($pCi/100\ cm^2$) |
| Ga55 | 3 | 159 | 863±452 |
| H55 | 11.1 | 450 | 226±284 |
| R55 | <3[b] | 570 | 2560± 97 |
| Ua55 | 13.8 | 675 | 4617±318 |
| | $\bar{x} = 7.7$<br>$\sigma = 5.6$ | $\bar{x} = 464$<br>$\sigma = 223$ | $\bar{x} = 2066$<br>$\sigma = 1965$ |
| U59 | <3[b] | 540 | 907± 90 |
| Qa63 | <3[b] | 870 | 962± 77 |

[a]Data for individual main plenums assembled together.

[b]All Aroclors were reported as undetectable at 1-μg level; therefore, results were reported as <1 μg per approximately one-third wipe. This translates into <3 $\mu g/100\ cm^2$; for averaging and statistical analysis, the conservative approach of setting <3 to 3 is taken.

[c]Duplicates.

[d]Not analyzed.

Table 4. Mean analyses for PCB, uranium, and technetium in main plenums of K-33

| Major duct No.[b] | Mean analysis and range[a] | | | | | |
|---|---|---|---|---|---|---|
| | PCB ($\mu g/100\ cm^2$) | | Uranium ($\mu g/100\ cm^2$) | | Technetium ($pCi/100\ cm^2$) | |
| 3 | 2.4 ± 2.1[a] | (4)[c] | 289 ± 924[a] | (4)[c] | 694 ± 2193[a] | (4)[c] |
| 7 | 9.5 ± 32.5 | (8) | 235 ± 738 | (8) | 370 ± 1677 | (8) |
| 11 | 3.3 ± 5.7 | (6) | 153 ± 396 | (6) | 276 ± 1845 | (6) |
| 15 | 1.8 ± 3.3 | (7) | 97 ± 279 | (7) | 107 ± 1341 | (7) |
| 19 | 2.7 ± 4.8 | (4) | 388 ± 519 | (5) | 114 ± 1023 | (5) |
| 23 | 2.3 ± 6.0 | (5) | 316 ± 423 | (5) | 248 ± 1689 | (5) |
| 27 | 39.9 ± 158 | (5) | 600 ± 780 | (5) | 100 ± 516 | (5) |
| 31 | 4.0 ± 9.6 | (2) | 172 ± 147 | (2) | 291 ± 1053 | (2) |
| 35 | 4.2 ± 3.9 | (2) | 162 ± 465 | (2) | 434 ± 2097 | (2) |
| 39 | 19.4 ± 42.6 | (3) | 581 ± 1176 | (3) | 373 ± 882 | (3) |
| 43 | 4.5 ± 9.0 | (2) | 399 ± 1488 | (2) | 580 ± 351 | (2) |
| 47 | 5.8 ± 10.5 | (4) | 1494 ± 7236 | (4) | 464 ± 1488 | (4) |
| 51 | 6.9 ± 15.3 | (6) | 695 ± 1863 | (6) | 1023 ± 4314 | (6) |
| 55 | 7.7 ± 16.8 | (4) | 464 ± 669 | (4) | 2066 ± 5895 | (4) |
| 59 | <3[d] | (1) | 540 | (1) | 907 | (1) |
| 63 | <3[d] | (1) | 870 | (1) | 962 | (1) |

[a]Range indicated is ±3 standard deviations.
[b]Closest column to the south of each major plenum.
[c]Number of samples analyzed per major plenum.
[d]Single result only; all Aroclors were reported as undetectable at 1 µg per approximately one-third wipe. This translates into <3 $\mu g/100\ cm^2$.

Table 5. Ranges and highest analytical values for PCB, uranium, and technetium in main plenums of K-33

| Major duct No.[c] | Range[a] and highest level[b] | | | | | |
|---|---|---|---|---|---|---|
| | PCB[a] ($\mu g/100\ cm^2$) | Highest value[b] | Uranium[a] ($\mu g/100\ cm^2$) | Highest value[b] | Technetium[a] ($pCi/100\ cm^2$) | Highest value[b] |
| 3 | 0.3 — 4.5 | <3[d] | 0 — 1213 | 696 | 0 — 2887 | 1790 |
| 7 | 0 — 42 | 39 | 0 — 973 | 810 | 0 — 2047 | 1690 |
| 11 | 0 — 9.0 | 6 | 0 — 549 | 297 | 0 — 2121 | 1447 |
| 15 | 0 — 5.1 | 3.3 | 0 — 376 | 282 | 0 — 1448 | 1077 |
| 19 | 0 — 7.5 | 4.8 | 0 — 907 | 660 | 0 — 1137 | 716 |
| 23 | 0 — 8.3 | 5.7 | 0 — 739 | 492 | 0 — 1937 | 1238 |
| 27 | 0 — 198 | 99 | 0 — 1380 | 1050 | 0 — 616 | 335 |
| 31 | 0 — 13.6 | 6.3 | 25 — 319 | 207 | 0 — 1344 | 539 |
| 35 | 0.3 — 8.1 | 5.1 | 0 — 627 | 201 | 0 — 2531 | 928 |
| 39 | 0 — 62 | 30 | 0 — 1757 | 900 | 0 — 1255 | 688 |
| 43 | 0 — 13.5 | 6.6 | 0 — 1887 | 750 | 229 — 931 | 662 |
| 47 | 0 — 16.3 | 10.8 | 0 — 8730 | 5100 | 0 — 1952 | 1164 |
| 51 | 0 — 22.2 | 16.2 | 0 — 2558 | 1770 | 0 — 5337 | 3798 |
| 55 | 0 — 24.5 | 13.8 | 0 — 1133 | 675 | 0 — 7961 | 4617 |
| 59 | — | <3[d] | — | 540 | — | 907 |
| 63 | — | <3[d] | — | 870 | — | 962 |

[a]Range of values for a main plenum is mean value $\pm 3\sigma$; when the low-range value is negative, it is set at zero.
[b]Highest analysis, in units per 100 $cm^2$, for the indicated main plenum.
[c]Closest column to the south of each main plenum.
[d]All Aroclors in all samples from this plenum were undetectable at the level of 1 $\mu g$ per approximately one-third wipe; this translates into <3 $\mu g/100\ cm^2$.

Table 6. Analyses of wipe samples from side laterals (grouped by main duct) in K-33

| Location[a] | Analysis | | |
|---|---|---|---|
| | PCB ($\mu g/100\ cm^2$) | Uranium ($\mu g/100\ cm^2$) | Technetium ($pCi/100\ cm^2$) |
| H4 | 5.7 | 90 | 736± 217 |
| S4 | 1.2 | 30 | NA[c] |
| Q2[b] | 3.9 | 57 | NA[c] |
| | 0.9 | 6 | NA[c] |
| | $\bar{x} = 2.9$ | $\bar{x} = 46$ | |
| | $\sigma = 2.3$ | $\sigma = 36$ | |
| C6 | 9 | 180 | -273± 201 |
| Eb6 | 1.5 | 21 | 557± 251 |
| Ja7 | NA[c] | 108 | -1924± 435 |
| Sa8 | 1.6 | 6 | -159± 144 |
| S8 | 1.5 | 9 | -286± 157 |
| Q7 | <3[d] | 303 | 396± 217 |
| | $\bar{x} = 3.3$ | $\bar{x} = 104$ | $\bar{x} = -281$ |
| | $\sigma = 3.2$ | $\sigma = 119$ | $\sigma = 880$ |
| La12 | NA[c] | 231 | -895± 201 |
| U11 | <3[d] | 6 | -249± 201 |
| E13 | 1.4 | 816 | -842± 268 |
| K10 | NA[c] | 39 | -1824± 335 |
| | $\bar{x} = 2.2$ | $\bar{x} = 273$ | $\bar{x} = -952$ |
| | $\sigma = 1.1$ | $\sigma = 375$ | $\sigma = 650$ |
| K15 | 4.2 | 153 | -714± 184 |
| Gb15 | 0.8 | 93 | -1022± 217 |
| Nb16 | <3[c] | 96 | 9± 109 |
| | $\bar{x} = 2.7$ | $\bar{x} = 114$ | $\bar{x} = -576$ |
| | $\sigma = 1.7$ | $\sigma = 34$ | $\sigma = 529$ |

Table 6 (continued)

| Location[a] | Analysis | | |
|---|---|---|---|
| | PCB ($\mu g/100\ cm^2$) | Uranium ($\mu g/100\ cm^2$) | Technetium ($pCi/100\ cm^2$) |
| D18 | 1.8 | 12 | -1516± 301 |
| | <3[d] | 9 | -1169± 234 |
| Q19 | <3[d] | 21 | -239± 110 |
| | <3[d] | 306 | NA[c] |
| T20 | 6.6 | 153 | 361± 234 |
| Sa21 | 1.4 | 90 | -174± 184 |
| Wb20 | 12.9 | 255 | 465± 116 |
| | $\bar{x} = 4.5$ | $\bar{x} = 121$ | $\bar{x} = -379$ |
| | $\sigma = 4.0$ | $\sigma = 122$ | $\sigma = 805$ |
| C24 | 6.9 | 81 | -1178± 234 |
| G24 | NA[c] | NA[c] | NA[c] |
| La22 | 1.4 | 81 | 63± 184 |
| U24 | 2.2 | 126 | -37± 134 |
| Ub22 | 2.5 | 102 | 942± 146 |
| | $\bar{x} = 3.2$ | $\bar{x} = 98$ | $\bar{x} = -52$ |
| | $\sigma = 2.5$ | $\sigma = 21$ | $\sigma = 870$ |
| N31 | 5.4 | 291 | 169± 159 |
| Lb30 | 1.6 | 210 | 31± 234 |
| | $\bar{x} = 3.5$ | $\bar{x} = 250$ | $\bar{x} = 100$ |
| | $\sigma = 2.7$ | $\sigma = 57$ | $\sigma = 98$ |
| Eb35 | <3[d] | 261 | -1056± 903 |
| Gb36 | 2.4 | 21 | -818± 535 |
| K36 | 3.3 | 303 | -244± 535 |
| Jb37 | 0.8 | 9 | 57± 669 |
| Ua34 | 3.9 | 45 | -60± 184 |
| | $\bar{x} = 2.7$ | $\bar{x} = 128$ | $\bar{x} = -424$ |
| | $\sigma = 1.2$ | $\sigma = 142$ | $\sigma = 488$ |

Table 6 (continued)

| Location[a] | Analysis | | |
|---|---|---|---|
| | PCB ($\mu g/100\ cm^2$) | Uranium ($\mu g/100\ cm^2$) | Technetium ($pCi/100\ cm^2$) |
| Jb38 | 1.3 | 216 | -239± 335 |
| Jb40 | 0.2 | 15 | -286± 268 |
| W40[b] | 15 | 912 | 253± 217 |
| | 22.8 | 456 | 286± 217 |
| X38 | 252 | 12 | -32± 146 |
| | $\bar{x}$ = 58.3 | $\bar{x}$ = 322 | $\bar{x}$ = -4 |
| | $\sigma$ = 108.7 | $\sigma$ = 377 | $\sigma$ = 267 |
| M44 | 4.8 | 246 | 1089± 268 |
| Ga46[b] | 3.9 | 75 | NA[c] |
| | 1.5 | 66 | 333± 284 |
| T43 | <3[d] | 39 | -62± 162 |
| X42 | 1.5 | 405 | 100± 167 |
| R43 | <3[d] | <3[c] | NA[c] |
| | $\bar{x}$ = 3.0 | $\bar{x}$ = 139 | $\bar{x}$ = 365 |
| | $\sigma$ = 1.3 | $\sigma$ = 155 | $\sigma$ = 509 |
| V47 | 15.6 | 225 | 30± 184 |
| Ea52 | 1.8 | 1470 | 236± 217 |
| W52 | 8.4 | 336 | NA[c] |
| | $\bar{x}$ = 5.1 | $\bar{x}$ = 903 | |
| | $\sigma$ = 4.7 | $\sigma$ = 802 | |
| Ca55 | <3[d] | 198 | 102± 284 |
| Q54 | 2.1 | 180 | 291± 184 |
| Qa56 | <3[d] | 120 | -58± 164 |
| Ub56 | NA[c] | 2520 | NA[c] |
| W55 | 2.4 | 591 | 172± 159 |
| | $\bar{x}$ = 2.6 | $\bar{x}$ = 722 | $\bar{x}$ = 127 |
| | $\sigma$ = 0.4 | $\sigma$ = 1022 | $\sigma$ = 146 |

Table 6 (continued)

| Location[a] | Analysis | | |
|---|---|---|---|
| | PCB ($\mu g/100\ cm^2$) | Uranium ($\mu g/100\ cm^2$) | Technetium ($pCi/100\ cm^2$) |
| Cb61 | <3[d] | 132 | 5± 318 |
| Jb61 | 0.9 | 870 | 254± 217 |
| Nb59 | 8.1 | 705 | 532± 161 |
| Sa58 | <3[d] | 21 | -62± 201 |
| J59 | 15 | 825 | NA[c] |
| Eb60[b] | 13.2 | 327 | NA[c] |
| | 15 | 456 | NA[c] |
| Ga60 | 5.1 | 150 | NA[c] |
| | $\bar{x}$ = 7.9 | $\bar{x}$ = 436 | $\bar{x}$ = 182 |
| | $\sigma$ = 5.8 | $\sigma$ = 332 | $\sigma$ = 270 |
| Sa63 | 1.0 | 21 | -229± 318 |
| Lb65 | 0.6 | 27 | 83± 435 |
| R63 | 6.3 | 492 | NA[c] |
| | $\bar{x}$ = 2.6 | $\bar{x}$ = 180 | $\bar{x}$ = -73 |
| | $\sigma$ = 3.2 | $\sigma$ = 270 | $\sigma$ = 221 |

[a]Analyses for side laterals attached to a single main duct are grouped together.

[b]Duplicates.

[c]Not analyzed.

[d]All Aroclors were reported as undetectable at 1-μg level; therefore, results were reported as <1 μg per approximately one-third wipe. This translates into <3 $\mu g/100\ cm^2$; for averaging and statistical analysis, the conservative approach of setting <3 to 3 is taken.

Table 7. Mean analyses for PCB, uranium, and technetium in side laterals (grouped by main duct) of K-33

| Major duct No.[b] | Mean analysis and range[a] PCB ($\mu g/100\ cm^2$) | | Uranium ($\mu g/100\ cm^2$) | | Technetium ($pCi/100\ cm^2$) | |
|---|---|---|---|---|---|---|
| 3 | 2.9 ± 6.9[a] | (4)[c] | 46 ± 108[a] | (4)[c] | 736 | (1)[c] |
| 7 | 3.3 ± 9.6 | (5) | 104 ± 357 | (6) | -281 ± 2640 | (6) |
| 11 | 2.2 ± 3.3 | (2) | 273 ± 1125 | (4) | -952 ± 1950 | (4) |
| 15 | 2.7 ± 5.1 | (3) | 114 ± 102 | (3) | -576 ± 1587 | (3) |
| 19 | 4.5 ± 12 | (7) | 121 ± 366 | (7) | -379 ± 2415 | (6) |
| 23 | 3.2 ± 7.5 | (4) | 98 ± 63 | (4) | -52 ± 2610 | (4) |
| 27 | (No side laterals attached to this main plenum were sampled.) | | | | | |
| 31 | 3.5 ± 8.1 | (2) | 250 ± 171 | (2) | 100 ± 294 | (2) |
| 35 | 2.7 ± 3.6 | (5) | 128 ± 426 | (5) | -424 ± 1464 | (5) |
| 39 | 58.3 ± 326 | (5) | 322 ± 1131 | (5) | -4 ± 801 | (5) |
| 43 | 3.0 ± 3.9 | (6) | 139 ± 465 | (6) | 365 ± 1527 | (4) |
| 47 | 15.6 | (1) | 225 | (1) | 30 | (1) |
| 51 | 5.1 ± 14.1 | (2) | 903 ± 2406 | (2) | 236 | (1) |
| 55 | 2.6 ± 1.2 | (4) | 722 ± 3066 | (5) | 127 ± 438 | (4) |
| 59 | 7.9 ± 17.4 | (8) | 436 ± 996 | (8) | 182 ± 810 | (4) |
| 61 | 2.6 ± 9.6 | (3) | 180 ± 810 | (3) | -73 ± 663 | (2) |

[a]Range indicated is ±3 standard deviations.
[b]Closest column to the south of each main plenum.
[c]Number of samples analyzed per major duct.

Table 8. Ranges and highest analytical values for PCB, uranium, and technetium in side lateral ducts of K-33

| Major duct No.[c] | Range[a] and highest value[b] | | | | | |
|---|---|---|---|---|---|---|
| | PCB[a] ($\mu g/100\ cm^2$) | Highest value[b] | Uranium[a] ($\mu g/100\ cm^2$) | Highest value[b] | Technetium[a] ($pCi/100\ cm^2$) | Highest value[b] |
| 3 | 0 — 9.8 | 5.7 | 0 — 154 | 90 | | 736 |
| 7 | 0 — 12.9 | 9 | 0 — 461 | 303 | 0 — 2359 | 557 |
| 11 | 0 — 5.5 | <3[d] | 0 — 1398 | 816 | 0 — 998 | -249 |
| 15 | 0 — 7.8 | 4.2 | 12 — 216 | 153 | 0 — 1011 | 9 |
| 19 | 0 — 16.5 | 12.9 | 0 — 487 | 306 | 0 — 2036 | 465 |
| 23 | 0 — 10.7 | 6.9 | 35 — 161 | 126 | 0 — 2558 | 942 |
| 27 | (No side laterals attached to this main plenum were sampled.) | | | | | |
| 31 | 0 — 11.6 | 5.4 | 79 — 421 | 291 | 0 — 394 | 169 |
| 35 | 0 — 6.3 | 3.9 | 0 — 554 | 303 | 0 — 1040 | 57 |
| 39 | 0 — 384.3 | 252 | 0 — 1453 | 912 | 0 — 797 | 286 |
| 43 | 0 — 6.9 | 4.8 | 0 — 604 | 405 | 0 — 1892 | 1089 |
| 47 | | 15.6 | | 225 | | 30 |
| 51 | 0 — 19.2 | 8.4 | 0 — 3309 | 1470 | | 236 |
| 55 | 1.4 — 3.8 | 2.4 | 0 — 3788 | 2520 | 0 — 565 | 291 |
| 59 | 0 — 25.3 | 15 | 0 — 1432 | 870 | 0 — 992 | 532 |
| 63 | 0 — 12.2 | 6.3 | 0 — 990 | 492 | 0 — 590 | 83 |

[a]Range of values for side laterals grouped by major duct is mean value (from Table 6) $\pm 3\sigma$; when the low-range value is negative, it is set at zero.

[b]Highest analysis, in units per 100 $cm^2$, for side laterals attached to the indicated main duct.

[c]Closest column to the south of each main plenum.

[d]All Aroclors were reported as undetectable at the 1-$\mu g$ level; therefore, results were reported as <1 $\mu g$ per approximately one-third wipe. This translates into <3 $\mu g/100\ cm^2$.

obtained for the remaining four bulk material samples are given in Table 9. Included are the TCLP results for arsenic, barium, cadmium, chromium, lead, nickel, selenium, silver, and mercury, along with assays for technetium, uranium, PCB, and gross activity.

### 2.4 METAL COUPON SAMPLES FROM MAIN PLENUMS AND SIDE LATERALS

Twenty metal coupon samples (area, 100 $cm^2$) were obtained from the ductwork of Building K-33. Thirteen of these samples were analyzed by TCLP for arsenic, barium, cadmium, chromium, lead, nickel, selenium, silver, and mercury; the results are tabulated in Table 10. Five samples were from main plenums, while the remaining eight were from the side laterals.

## 3. DISCUSSION

As noted in Table 5, the estimated range of PCB surface contamination exceeds 10 μg/100 $cm^2$, the Martin Marietta Energy Systems, Inc.'s mandated cleanliness standard for either high- or low-contact PCB-contaminated surfaces (*Environmental Protection Manual*, EPM-3.6, p. 34), for 8 of the 16 major plenums. The highest contamination found in the main plenum was associated with column 27 (99 μg/100 $cm^2$). It should be noted that a single sample, a bulk sample obtained from the column 7 main plenum (location Cb7, Table 9), exceeded the Environmental Protection Agency's mandated 50-ppm limit for PCB contamination. Considering the fact that 100 $cm^2$ of duct surface weighs approximately 100 g, the highest PCB contamination indicated by wipe samples was less than 1 ppm (99 μg/100 $cm^2$ <1 mg/kg).

The highest estimated range of surface contamination and also the highest measured contamination of uranium (5100 μg/100 $cm^2$) were found in the main plenum associated with column 47. Since these samples are hexane-moistened wipe samples, it is removable contamination and, if the assumption is made that it is natural uranium, equivalent to about 8000 disintegrations/min (dpm) alpha per 100 $cm^2$. The estimated highest range of surface contamination for technetium was found in the duct associated with column 55, and the highest measured removable contamination, also in this duct, was 4617 pCi/100 $cm^2$. This level of contamination is equivalent to about 10,000 dpm beta per 100 $cm^2$. There did not appear to be any obvious relationship between the uranium and

Table 9. Analyses of bulk samples from main plenums and side laterals of K-33 ductwork

| Analysis | Location | | | | |
|---|---|---|---|---|---|
| | Main-Cb7 | Main-Gb19 | Main-Ua51 | Lateral-Ea52 | Lateral-Jb61 |
| Arsenic, mg/L (TCLP)[a] | 0.50 | 0.50 | 0.50 | NA[b] | 0.50 |
| Barium, mg/L (TCLP)[a] | 1.0 | 1.0 | 1.0 | NA | 1.0 |
| Cadmium, mg/L (TCLP)[a] | 2.0 | 1.6 | 1.7 | NA | 1.2 |
| Chromium, mg/L (TCLP)[a] | 0.37 | 0.52 | 0.25 | NA | 0.32 |
| Lead, mg/L (TCLP)[a] | 7.1 | 4.4 | 5.2 | NA | 2.5 |
| Nickel, mg/L (TCLP)[a] | 5.0 | 2.5 | 3.1 | NA | 1.0 |
| Selenium, mg/L (TCLP)[a] | 0.50 | 0.50 | 0.50 | NA | 0.5 |
| Silver, mg/L (TCLP)[a] | 0.10 | 0.10 | 0.10 | NA | 0.10 |
| Technetium, pCi/g | 29,700 ± 1,400 | 1,660 ± 260 | NA[b] | NA | 1,500 ± 86 |
| Uranium, mg/g | 1.90 | 1.30 | 2.70 | NA | 1.40 |
| Mercury, mg/L (TCLP)[a] | <0.02 | <0.02 | <0.002 | NA | NA[b] |
| Aroclor-1254, mg/kg | ND[c] | ND[c] | NA[b] | NA | 10.38 |
| Aroclor-1260, mg/kg | 52.00 | 34.00 | NA[b] | NA | ND[c] |
| Activity, dpm/g | 4747 | 6426 | 25000 | 8030 | 716[c] |

[a]TCLP limits (40 CFR Part 261, Subpart C); in mg/L, are:

| | | | |
|---|---|---|---|
| As | 5.0 | Ni | (not listed) |
| Ba | 100.0 | Se | 1.0 |
| Cd | 1.0 | Ag | 5.0 |
| Cr | 5.0 | Hg | 0.2 |
| Pb | 5.0 | | |

[b]Not analyzed.
[c]Not detected.

Table 10. Analyses of metal coupons from main plenums and side laterals of K-33 ductwork

| Analysis | Location | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Lateral-Q2 | Lateral-S4 | Main-P7 | Main-Q12 | Lateral-Q19 | Main-K27 | Lateral-W40 | Lateral-Ga46 | Lateral-Ea52 | Lateral-W52 | Lateral-Eb60 | Lateral-Ga60 | Lateral-Jb |
| Arsenic, mg/L (TCLP)[a] | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 |
| Barium, mg/L (TCLP)[a] | <1.0 | <1.0 | 1.3 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 |
| Cadmium, mg/L (TCLP)[a] | 0.054 | 0.039 | <0.030 | <0.030 | <0.030 | <0.030 | 0.040 | 0.032 | 0.038 | <0.030 | <0.030 | 0.042 | 0.032 |
| Chromium, mg/L (TCLP)[a] | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 |
| Lead, mg/L (TCLP)[a] | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | 0.55 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 |
| Nickel, mg/L (TCLP)[a] | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 |
| Selenium, mg/L (TCLP)[a] | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 |
| Silver, mg/L (TCLP)[a] | 0.31 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 |
| Technetium, pCi/g | NA[b] | NA[b] | NA[b] | NA[b] | NA[b] | NA[b] | NA[b] | NA[b] | NA[b] | NA[b] | NA[b] | NA[b] | NA[b] |
| Uranium, mg/g | NA[b] | NA[b] | NA[b] | NA[b] | NA[b] | NA[b] | NA[b] | NA[b] | NA[b] | NA[b] | NA[b] | NA[b] | NA[b] |
| Mercury, mg/L (TCLP)[a] | <0.002 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.002 | <0.02 | <0.02 | 0.02 | <0.002 | <0.002 |
| Aroclor-1254, mg/kg | NA[b] | NA[b] | NA[b] | NA[b] | NA[b] | NA[b] | NA[b] | NA[b] | NA[b] | NA[b] | NA[b] | NA[b] | NA[b] |
| Aroclor-1260, mg/kg | NA[b] | NA[b] | NA[b] | NA[b] | NA[b] | NA[b] | NA[b] | NA[b] | NA[b] | NA[b] | NA[b] | NA[b] | NA[b] |
| Activity, dpm/g | NA[b] | NA[b] | NA[b] | NA[b] | NA[b] | NA[b] | NA[b] | NA[b] | NA[b] | NA[b] | NA[b] | NA[b] | NA[b] |

[a]TCLP limits (40 CFR Part 261, Subpart C), in mg/L are:

| | | | |
|---|---|---|---|
| As | 5.0 | Ni | (not listed) |
| Ba | 100.0 | Se | 1.0 |
| Cd | 1.0 | Ag | 5.0 |
| Cr | 5.0 | Hg | 0.2 |
| Pb | 5.0 | | |

[b]Not analyzed.

technetium analyses. The levels of radiological contamination found would classify the main ducts as contamination areas according to the Energy Systems' *Health Physics Manual* (see RP-2.3, p. 2) and its interpretation of Attachment 2 of DOE Order 5480.11. As shown in Table 5, the highest surface contamination for each of the three constituents, PCB, uranium, and technetium, was within the estimated range for all main ducts.

Mean levels of surface contamination for PCB in side laterals, shown in Table 7, are very similar to the levels found in the main plenums. In fact, the mean of the means shown in Table 7 is 8.0 μg/100 $cm^2$ ($\sigma$ = 14.3) vs 7.5 ($\sigma$ = 9.6) for the main plenums in Table 5. Generally, uranium contamination of the side laterals was somewhat lower than that found in the main plenums. The mean of means in Table 7 was 271 μg/100 $cm^2$ ($\sigma$ = 244) as compared with 466 ($\sigma$ = 350) for main plenums in Table 5. Technetium levels in the side laterals seemed to be generally lower than those found in the main plenums. The mean of means for technetium in Table 7 is -64 pCi/100 $cm^2$ ($\sigma$ = 412), while that for the main plenums in Table 4 is 563 ($\sigma$ = 500). Eight of the mean analyses for technetium shown in Table 7 are negative, indicating little, if any, contamination, whereas all of the mean assays for the main plenums in Table 5 were positive, ranging from a low of 100 to a high of 2066 pCi/100 $cm^2$.

Levels of PCB contamination in the main plenums were highest in the duct located near column 27, followed by those in the duct located near column 39. The highest PCB levels for the lateral ductwork were also found in those attached to the main duct located near column 39; unfortunately, no side laterals attached to the main plenum near column 27 were sampled.

The six main plenums and their respective side laterals from columns 39 through 59 appear to have the highest uranium surface contamination, as indicated in Tables 5 and 7. Technetium contamination, on the other hand as mentioned previously, is relatively low in the side laterals as compared with the main plenums.

Leachate analyses of the bulk samples obtained from both main plenums and side laterals, shown in Table 9, indicate that cadmium TCLP concentrations exceeded the toxicity characteristic limit of 1 mg/L (see 40 CFR Part 261, Subpart C, Table 1) for all four of the samples tested. The toxicity characteristic limit for lead (5 mg/L) was exceeded for two of the samples; however, it seems likely that these elevated levels resulted from the sampling procedure. The samples were obtained by scraping material

from the bottom of the ducts, and this probably led to contamination of the sample with galvanizing material from the surface of the duct. This assumption is made more credible after consideration of TCLP analyses of metal coupons in Table 10. These results are well below the toxicity characteristic limits for all nine elements. Uranium and PCB levels in the bulk samples were relatively high, ranging from 1.3 to 2.7 mg/g and 10 to 52 mg/kg, respectively. The latter value is about 10 to 50 times the amount found in the wipe samples (100 $cm^2$ of metal ductwork weighs approximately 100 g).

NOTE: Analytical data listed in this report for wipe samples were calculated by multiplying original analytical results by three to account for the fact that approximately one-third of the original wipe sample was analyzed for total PCBs and for uranium. The original analytical data for technetium were reported as picocuries per gram of sample wipe weight. Ten sample wipes were weighed, yielding an average weight per clean wipe of 1.673 g ($\sigma$ = 0.0252). The original technetium data for wipe samples were then corrected by multiplying by 1.673 to place the values on a pCi/100 $cm^2$ basis.

It is recommended that future analyses of a portion of a wipe sample include weights of the total wipe and the individual pieces so that data need not be *approximately* corrected to a wiped-sample-area basis. If such weighings are not possible, then a separate 100-$cm^2$ wipe sample should be taken for each analysis to be performed so that *approximate* corrections would not be required.

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