Draft

ADVISORY BOARD ON RADIATION AND WORKER HEALTH

National Institute for Occupational Safety and Health

REVIEW OF THE NIOSH SITE PROFILE FOR BAKER-PERKINS, SAGINAW, MICHIGAN

DCAS-TKBS-0005

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S. COHEN & ASSOCIATES: ***Technical Support for the Advisory Board on Radiation & Worker Health Review of NIOSH Dose Reconstruction Program***	Document No. SCA-TR-SP2011-0036 Effective Date: Draft – November 2, 2011 Revision No. 1 (Draft)
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Document Reviewers: _____ Date:_____ John Mauro, PhD, CHP	Supersedes: Rev. 0
Project Manager: _____ Date:_____ John Mauro, PhD, CHP	Reviewer: Ron Buchanan

Record of Revisions

Revision Number	Effective Date	Description of Revision
0 (Draft)	09/15/2010	Initial issue
1 (Draft)	10/25/2011	Review of the DCAS revised site profile for Baker-Perkins. Note that the site profile for Baker-Perkins was revised because NIOSH eliminated TBD-6001 as the parent document for this and other uranium processing site profiles, and replaced the original site profile for Baker-Perkins with this standalone site profile.

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1.0 STATEMENT OF PURPOSE

The purpose of this report is to provide a critical review of technical basis document (TBD) DCAS-TKBS-0005, Baker-Perkins (B-P) Company of Saginaw, Michigan (DCAS 2011), issued on February 17, 2011. This report assesses the merit and technical basis of data and guidance proposed in the TBD for dose reconstructions.

2.0 INTRODUCTION

On February, 17, 2011, NIOSH issued TBD DCAS-TKBS-0005, which provides data and guidance for dose reconstruction of workers at Baker-Perkins (B-P) Company of Saginaw, Michigan. This document supersedes the *Site Profile for Atomic Employers that Refined Uranium and Thorium, Appendix P*, of Battelle-TBD-6001 (NIOSH 2007), issued on September 12, 2007. Appendix P to Battelle-TBD-6001 was first reviewed by SC&A in September 2010. The results of the SC&A review were documented in SCA-TR-SP2010-0036 (SC&A 2010). The intent of DCAS-TKBS-0005 is to change Battelle-TBD-6001, Appendix P, to a standalone document; to revise the external dose model to eliminate dependence on Battelle-TBD-6001; to provide more detailed descriptions of other dose models; and to incorporate review comments.

According to the TBD, the Saginaw factory, purchased by B-P around 1919, produced the first "Universal" mixer, which was identified as a key piece of machinery for processing chemical pharmaceutical products, colors, paints, varnishes, paper pulp, cellulose, foundry sands loams, rubber materials, etc. In the 1950s, B-P chemical machinery business offered products that included heavy duty mixers for use in industrial operations. One line of continuous duty mixers produced by B-P was called the "Ko-Kneader." This line of mixers was tested for use in mixing uranium compounds for NLO. These tests were performed on May 14–16, 1956, and the equipment used during the tests was decontaminated and cleaned on May 15–18 1956.

3.0 REVIEW OF DCAS-TKBS-0005: OBSERVATIONS/FINDINGS

DCAS-TKBS-0005 is a relatively brief document consisting of 12 pages. The following is SC&A's review of that document.

3.1 REVIEW OF SECTIONS 1.0 (INTRODUCTION), 2.0 (SITE DESCRIPTION AND OPERATIONAL HISTORY), AND 3.0 (PROCESS DESCRIPTION)

Observation 1: Baker-Perkins Site Description Is Insufficient: Many questions regarding the Atomic Weapons Employer (AWE) operations at B-P remain open. The reader is left to assume that the only radioactive material on site was from this test. No guidance is provided on ventilation characteristics, B-P personnel that may have been in the area, or housekeeping practices that could aid in assigning dose. Data capture failed to identify the location of "Laboratory, Building 15" and its relative location to other buildings in the complex.

3.2 REVIEW OF SECTION 4.0 (INTERNAL DOSE)

In estimating the potential internal dose, the radionuclide intake values were based on an air-sampling effort during the testing. Air-monitoring data were found in the Site Research Data Base (SRBD) relating to occupational internal dose during the 5 days of the testing period (Baker-Perkins 1991). Results of both breathing zone (BZ) and general area (GA) monitoring for alpha radiation (alpha scintillation) were reported. There are 26 GA samples and 14 BZ samples reported in the record and transcribed into a table in Attachment A. The original data sheets indicate that dust masks, "Dust-Foe," were worn by test participants during four "high" BZ sample measurements. SC&A had the following observation concerning the original data sheets and derivation of the concentrations in $d/m/m^3$.

Observation 2: Conversion/Adjustment Factor Unaccounted for in Original Data Sheets: SC&A analyzed the original data sheets (Baker-Perkins 1991, pages 17–25) and found that the data were orderly and legible. SC&A obtained similar $d/m/m^3$ values as listed in the right-hand column of the data sheets (see example in Exhibit 1 of this report), except that the original values were, on the average, approximately 1.43 times greater than those derived by SC&A. An example of the comparison for Sample #6907 is as follows:

$d/m/m^3$ = # ncpm/(Geo factor) × 1/(sample vol.)
$d/m/m^3$ = 54.51 ncpm/(0.44) × 1/(0.30 m^3) = 413 $d/m/m^3$

However, the value in the last column of the data sheet is listed as 590 $d/m/m^3$, a factor of 590/413 = 1.43 greater. SC&A could not locate the reason for this increased value, which was similar for all final concentration entries, indicating that some constant conversion or adjustment factor not listed on the original data sheets was used. The original data sheets did not include all the units in the headings (such as for "R," "T," "Q," "Time," (net) "c/min"), leaving these to be interpreted. Because this issue resulted in a greater concentration than that derived by SC&A, it was listed as an observation instead of a finding.

The TBD identifies four job categories against which the estimate should be made:

- The "operator" job category, consisting of personnel that were directly involved in the testing activities
- The "laborer" job category, consisting of personnel that supported the testing activities
- The "supervisor" job category, consisting of personnel that were in the operations area, but were not routinely involved in hands-on activities during the testing
- The "clerical" job category, consisting of all other personnel that did not routinely enter the testing area

To determine radionuclide intakes, the TBD considered a bounding estimate to assume that the "operators" were exposed 50% of the time to air concentrations represented by the BZ samples and 50% of the time to air concentrations represented by the GA samples; that the "laborers" were exposed 25% of the time to air concentrations represented by the BZ samples and 75% of the time to air concentrations represented by the GA samples; that the "supervisors" were exposed 100% of the time to air concentrations represented by the GA samples; and that the exposure of all other workers (clerical) was 10% of that of the "supervisors."

The document provides a Site Description and Operational History (Section 2.0) and a Process Description (Section 3.0). The document, however, fails to provide an account of worker activities (participant and non-participant) before and during the 5-day exposure period. For example, how many workers were employed at the time, how many workers participated in the testing, how the testing area was physically defined in relation to other areas of the building, what kind of routine activities were taking place outside the testing area, etc. This type of account, if it exists, could provide a rationale for the proposed job classification and the likelihood of the assigned exposure fractions for the job categories.

The document claims that, "since the highest BZ samples were associated with short duration operations and included respirator use," the 50% exposure for the "operator" job category to air concentrations represented by the BZ samples is a "bounding" estimate. SC&A finds that this reasoning is not sufficient to bound the "operator" job category exposure. For example, it has been NIOSH's practice to not take credit for respiratory protection. Therefore, SC&A has the following finding regarding the overall approach taken by the TBD in estimating internal doses.

Finding 1: Air Concentration Assignments Not Necessarily Claimant Favorable or Bounding

The division of potential exposures between the air concentrations represented by the BZ and GA samples for the four job categories is arbitrary and potentially not claimant favorable. The claim of a "bounding" estimate for the "operator" and consequently for the rest of the job categories is not demonstrated.

Table 1 provides the intakes of uranium from inhalation to be used in the dose reconstruction for each workday of operation (May 14, 1956, through May 18, 1956) and for each job category.

The air concentration estimates were also used to estimate ingestion intakes per the requirements of OCAS-TIB-009 (OCAS 2004).

Table 1. Daily Intakes of Uranium

Job Category	Year	Operation Phase	Nuclide	Inhalation dpm/day	Ingestion dpm/day	GSD
Operations	May 14–18, 1956	Operations	U-234	4,126.1	86.0	5.5
Laborers				2,456.9	51.2	
Supervisor				883.0	18.4	
Clerical				88.3	1.8	

Source: DCAS 2011, Table 1

For the "operator" and "laborer" job categories, the geometric mean (**50th percentile**) of each dataset was determined and used in combining the BZ and GA distributions. To obtain the geometric mean for each dataset, the TBD used equations provided in Battelle-TIB-5000 (Battelle 2007), using the average values of each set (3,325 dpm/m^3 for BZ and 351 dpm/m^3 for GA distributions), and the larger (5.5) of the two sets' geometric standard deviation (GSD). For the "supervisor" and "clerical" job categories, the lognormal distribution of the GA dataset alone was used, with a geometric mean of 91 dpm/m^3. SC&A verified the above numerical values from the datasets shown in Attachment A.

The implied calculations (from Battelle 2007, Section 2.1.2.4) are assumed to be as follows:

Geometric mean (50th percentile) = Arithmetic mean × exp[-ln^2(GSD)/2]

Geometric mean (BZ) = 3,325(dpm/m^3) × exp[-ln^2(5.5)/2] = 3325 × 0.2339 = 777 dpm/m^3

Geometric mean (GA) = 351(dpm/m^3) × exp[-ln^2(5.5)/2] = 351 × 0.2339 = 82 dpm/m^3

Radionuclide intake (operator) = [0.5 × 777 (dpm/m^3) + 0.5 × 82 (dpm/m^3)] × 1.2 (m^3/hr) × 8 (hr/day) = 4,128 dpm/day

Radionuclide intake (laborer) = [0.25 × 777 (dpm/m^3) + 0.75 × 82 (dpm/m^3)] × 1.2 (m^3/hr) × 8 (hr/day) = 2,458 dpm/day

Radionuclide intake (supervisor) = 1.0 × 91 dpm/m^3 × 1.2 (m^3/hr) × 8 (hr/day) = 883 dpm/day

Radionuclide intake (clerical) = 0.1 × 883 (dpm/day) = 88.3 dpm/day

SC&A was able to verify the Table 1 radionuclide intakes for all job categories using 1.2 m^3/hr (inhalation rate), and 8 work hours per day. However, SC&A has the following findings and observations regarding the TBD analysis.

Finding 2: 50th Percentile is Not Adequate

The use of the 50th percentile is not claimant favorable. NIOSH should consider using an alternative metric for the workers participating in the test, such as the 95th percentile.

Observation 3: Text Needs to be Corrected: In introducing Table 1 of the TBD, the text incorrectly states that it presents the internal dose estimates in pCi per calendar day to be used for each day of operation. However, Table 1 presents the radionuclide intakes (not doses) in disintegrations per minute per working day (not pCi per calendar day). A correction to the text is needed.

3.3 REVIEW OF SECTION 5.0 (EXTERNAL DOSE)

One of the reasons for NIOSH issuing this TBD was to revise the external dose model to eliminate dependence on the Battelle-TBD-6001. As in the original issue (NIOSH 2007), this TBD (DCAS 2011) maintains that there are no external dose readings reported in the SRDB related to occupational external dose during the 5 days of Atomic Energy Commission (AEC) work at B-P, and that "at least one, but no more than two drums of orange oxide are believed to have been used in the tests" (Baker-Perkins 1991).

In estimating the potential external exposure, the TBD makes the basic assumption that the highest external exposure potential existed when the uranium was contained in a drum, and that all personnel are assumed to spend their entire day 1 foot (30 cm) from a drum of uranium. The daily external dose recommended for use in dose reconstruction is provided in Table 2.

Table 2. Daily External Dose

Job Category	Year	Operation Phase	Daily Dose Rate[a] (mrem/day)	Total Dose[a] (mrem)
All workers – **Photon**	1956	Operations	8.0	40
All workers – **Other Skin**	1956	Operations	16	80
All workers – **Hands and Forearms**	1956	Operations	164	820

a – In this table, mrem, mR, and mrad are used interchangeably.
Source: DCAS 2011, Table 4, page 10

SC&A has the following findings and observations related to the basic assumptions made in the TBD.

Finding 3: No Submersion Dose Considered

The TBD provides no explanation as to why the new external dose model does not include "submersion" dose due to uranium dust cloud potentially surrounding the test area (and main source for the inhalation dose estimate), or consideration of "contaminated surface" dose.

Finding 4: Two Drums of Uranium Were Not Considered

The TBD provides no explanation as to why the analysis does not consider photon exposure from two drums of uranium.

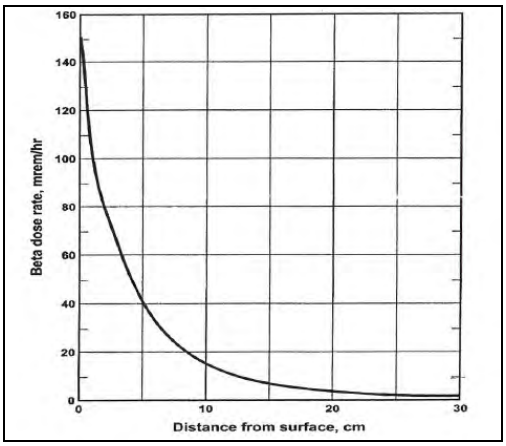
Observation 4: Inconsistency in Internal and External Dose Estimates: There appears to be an inconsistency, without appropriate explanation, in defining labor categories for the internal dose estimate, but ignoring these categories for the external dose estimate.

Based on the assumption that the only potential pathway for external photon dose is the direct dose received from the drum containing the uranium oxide, the TBD presents the methodology used in determining the photon dose rate to an individual standing 1 foot (30 cm) from the drum. This is shown to be approximately 1 mrem/hr and it is the value recommended for use in the dose reconstruction. SC&A has no findings or observations related to the particular methodology presented in determining the external photon dose.

The TBD also presents a methodology to determine a beta dose to the skin, recognizing the potential of a shallow dose from exposure to open drums during drum unloading and loading, as well as cleaning equipment; this is shown to be approximately between 1 and 2 mrem/hr. The TBD recommends the use of 2 mrem/hr for the shallow dose, and the assumption that "**production**" workers spent 100% of their time 1 foot from the open drum of uranium during an 8-hour day. SC&A has no findings related to the particular methodology presented in determining beta dose to the skin, but has the following observation.

Observation 5: Inconsistency In Terminology: There appears to be an inconsistency between the text and Table 4 of the TBD, page 10. The text refers to the recipients of the shallow dose as "production" workers. Table 4 refers to these workers as "all workers." A clarification is needed to avoid the inference that some non-identified group of workers is inadvertently introduced in the external dose estimate.

The TBD estimates an additional shallow dose rate to the skin of hands and forearms, since these could realistically be closer to the uranium source. It assigns a shallow dose to hands and forearms of all workers to be 150 mrem/hr for 1 hour and 2 mrem/hr for the remaining 7 hours of the 8-hour day, as shown in Figure 1.



Source: DCAS 2011, Figure 3, page 9

Figure 1. Beta Dose from Yellowcake Separated from Ore for More Than 100 Days as a Function of Distance from the Surface

The TBD states that the 1-hour-per-day assumption is considered claimant favorable, since "the purpose of the work was to test equipment;" hence, the hands-on work would occur only while unloading the drum and while cleaning the equipment. SC&A has the following observation regarding the estimate of the dose rate to the skin of hands and forearms.

Observation 6: Need Justification for Using 1 Hour Per Day: The explanations as to why the 1-hour-per-day assumption is "favorable" are not clear and, at best, qualitative. A clear explanation for this claim should be provided.

3.4 REVIEW OF SECTION 6.0 (OCCUPATIONAL MEDICAL DOSE)

According to the TBD, no documentation regarding occupational medical dose specific to B-P was found. The TBD recommends that the dose reconstruction is based on information provided in ORAUT-OTIB-0006, *Dose Reconstruction from Occupationally Related Diagnostic X-Ray Procedures* (ORAUT 2005). It also recommends that the assumed frequency for the testing period to be one PA chest x-ray for the year 1956. SC&A has no findings or observations related to the occupational medical dose.

3.5 RESIDUAL CONTAMINATION

The following is stated on page 5 of DCAS-TKBS-0005:

> *Because all equipment was decontaminated and cleaned after the completion of the tests, there is no defined residual radioactivity period for the Baker-Perkins Company site (Stout, 1991).*

The assumption that there is little potential for significant residual contamination appears to be valid. The documented cleanup of the equipment and post-job air sampling indicate a careful effort to restore the equipment and work area to pre-test conditions, thus eliminating potential residual contamination and resuspension. There are no findings regarding residual contamination.

4.0 CONCLUSION

This review has resulted in four Findings and six Observations. The main conclusion is that the document demonstrates that the present approach to dose reconstruction at B-P may be claimant favorable for some exposures, but it does not demonstrate bounding conditions and doses. For the internal dose analysis, contributing factors are the arbitrary and inconsistent division of labor and related exposure fractions, as well as a non-conservative use of the existing data. For the external dose analysis, there is the lack of completeness and insufficient technical bases for "bounding" claims.

5.0 REFERENCES

Baker-Perkins 1991. Memo from D. Stout to A. Williams, Baker-Perkins Company Consideration Recommendation. February 19, 1991. [Ref ID: 09505 pp. 17–25].

Battelle 2007. *Default Assumptions and Methods for Atomic Weapons Employer Dose Reconstructions*, Battelle-TIB-5000, Rev. 00. April 2, 2007.

DCAS 2011. *Technical Basis Document for the Baker-Perkins Company Saginaw, Michigan*, DCAS-TKBS-0005. National Institute for Occupational Safety and Health, Division of Compensation Analysis and Support, Cincinnati, Ohio. February 17, 2011.

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NRC 2002a, "Health Physics Surveys in Uranium Recovery Facilities," Regulatory Guide 8.30, Rev. 1. U.S. Nuclear Regulatory Commission. May 2002.

OCAS 2004. *Estimation of Ingestion Intakes*, OCAS-TIB-009, Rev. 0. National Institute for Occupational Safety and Health, Office of Compensation Analysis and Support, Cincinnati, Ohio. April 13, 2004.

ORAUT 2005. *Technical Information Bulletin: Dose Reconstruction from Occupationally Related Diagnostic X-Ray Procedures*, ORAUT-OTIB-0006, Rev. 03 PC-1. Oak Ridge Associated Universities Team, Cincinnati, Ohio. December 21, 2005.

SC&A 2010. *Review of the NIOSH Site Profile for Baker-Perkins, Saginaw, Michigan, Battelle-TBD-6001, Appendix P*, SCA-TR-SP2010-0036, Rev. 0. SC&A, Vienna, Virginia, and Saliant, Inc., Jefferson, Maryland. September 15, 2010.

Stout, D., 1991. *Baker-Perkins Company Consideration Recommendation with Site Summary*, February 19, 1991. SRDB Ref ID: 9505.

ATTACHMENT A: AIR SAMPLE DATA FROM ANALYTICAL DATA SHEETS

(Baker-Perkins 1991)

Page	Date	Bkgnd cpm	Geo	Sample No	Time	Type	R	T	Q	Gross Counts	Count Time	Net Cts/min	d/m/m^3
25	5/14/1956	0.27	0.40	6900	12:37	GA	0.02	10	0.20	7	15.3	0.19	3
25	5/14/1956	0.27	0.40	6901	13:28	GA	0.02	10	0.20	14	15	0.66	12
25	5/14/1956	0.27	0.40	6902	15:00	BZ	0.02	3.5	0.07	32	0.29	110.1	5,616
25	5/14/1956	0.27	0.40	6903		BZ	0.02	3.5	0.07	32	0.97	32.72	1,669
25	5/14/1956	0.27	0.40	6904		BZ	0.02	3.5	0.07	640	2.32	275.6	14,061
25	5/14/1956	0.27	0.40	6905		GA	0.02	10	0.20	32	0.21	152	2,714
24	5/14/1956	0.19	0.44	6906	15:32	GA	0.02	12	0.24	32	1.56	20.32	276
23	5/15/1956	0.19	0.44	6907	8:39	GA	0.02	15	0.30	32	0.585	54.61	590
23	5/15/1956	0.19	0.44	6908	8:39	GA	0.02	15	0.30	32	10.47	2.87	31
23	5/15/1956	0.19	0.44	6909	9:03	GA	0.02	10	0.20	32	4.82	6.45	106
23	5/15/1956	0.19	0.44	6910	9:03	GA	0.02	10	0.20	32	8.88	3.41	55
22	5/15/1956	0.19	0.44	6911	9:19	GA	0.02	10	0.20	32	1.81	17.49	284
22	5/15/1956	0.19	0.44	6912		BZ	0.02	5	0.10	32	0.22	145.3	4716
22	5/15/1956	0.19	0.44	6913		BZ	0.02	2.5	0.05	640	2.97	215.3	13981
22	5/15/1956	0.19	0.44	6914		Control	0.02			3	15	0.01	
21	5/15/1956	0.19	0.44	6915	11:19	GA	0.02	15	0.30	32	8.35	3.64	39
21	5/15/1956	0.19	0.44	6916	11:19	GA	0.02	15	0.30	13	15	0.68	7
21	5/15/1956	0.19	0.44	6917		GA	0.02	12	0.24	32	7.27	4.21	57
21	5/15/1956	0.19	0.44	6918		GA	0.02	12	0.24	32	8.45	3.6	49
20	5/15/1956	0.13	0.46	6919		BZ	0.02	2	0.04	17	14.44	1.06	82
20	5/15/1956	0.13	0.46	6920		BZ	0.02	2.5	0.05	20	11.59	1.6	99
20	5/15/1956	0.13	0.46	6921	13:31	GA	0.02	20	0.40	20	12.08	1.53	12
20	5/15/1956	0.13	0.46	6922		GA	0.02	20	0.40	20	8.16	2.32	18
20	5/15/1956	0.13	0.46	6923		BZ	0.02	3	0.06	20	2.73	7.2	373
20	5/15/1956	0.13	0.46	6924		BZ	0.02	5	0.10	20	1.11	17.89	556
19	5/16/1956	0.13	0.46	6925		GA	0.02	10	0.20	20	6.78	2.82	44
19	5/16/1956	0.13	0.46	6926	11:15	P	0.02	2	0.04	13	19.69	0.53	41
19	5/16/1956	0.13	0.46	6927	11:19	P	0.02	1	0.02	8	16.79	0.35	54
19	5/16/1956	0.13	0.46	6928	12:07	GA	0.02	15	0.30	20	9.8	1.91	20
19	5/16/1956	0.13	0.46	6929		GA	0.02	15	0.30	20	10.79	1.72	18
19	5/16/1956	0.13	0.46	6930		GA	0.02	20	0.40	20	20.88	0.83	6
19	5/16/1956	0.13	0.46	6931		GA	0.02	20	0.40	20	2.39	8.24	64
18	5/18/1956	0.19	0.44	6932	9:03	GA	0.02	15	0.30	32	0.88	36.17	391
18	5/18/1956	0.19	0.44	6933		BZ	0.02	3	0.06	32	1.25	26.41	1375
18	5/18/1956	0.19	0.44	6934		BZ	0.02	2	0.04	32	2.16	14.62	1187
18	5/18/1956	0.19	0.44	6935		GA	0.02	15	0.30	32	1.41	22.51	244
18	5/18/1956	0.19	0.44	6936		BZ	0.02	2.5	0.05	32	4.38	7.12	462
18	5/18/1956	0.19	0.44	6937		BZ	0.02	4	0.08	32	1.49	21.29	864
17	5/18/1956	0.19	0.44	6938		BZ	0.02	3	0.06	32	1.14	27.88	1509
17	5/18/1956	0.19	0.44	6939	9:44	GA	0.02	15	0.30	32	0.21	152.2	1647
17	5/18/1956	0.19	0.44	6940		GA	0.02	25	0.50	32	0.16	213.1	1384
17	5/18/1956	0.19	0.44	6941		p	0.02	1	0.02	32	15	1.01	164
17	5/18/1956	0.19	0.44	6942	12:35	GA	0.02	22	0.44	32	0.91	34.97	258
17	5/18/1956	0.19	0.44	6943	14:17	GA	0.02	20	0.40	32	2.45	12.87	104

The following definitions of parameters were assumed:

Parameter	Definition
Page	Data sheet page number
Sample No	Sample number
Geo	Geometry factor for detector
Time	Time of day sampling started
Type	GA and BZ for General Area and Breathing Zone
R	Air sampler flow rate in cubic meters per minute.
T	Sampling duration in minutes
Q	Sampled volume in m^3
Cts/min	Counts per minute
d/m/m^3	Disintegrations per minute per cubic meter of air sampled

EXHIBIT 1: ANALYTICAL DATA SHEET

Stout 1991, SRDB Ref ID: 9505, page 19

(3)

ANALYTICAL DATA SHEET
ANALYTICAL DEPT. – HEALTH AND SAFETY DIVISION

Nº 8539

1956 Industrial Hygiene or Medical Dept.

I. H.# 815 Sample Nos. 4 Date Collected 5/15 by CES Route to CES
Location BAKER-PERKINS CO. Type of Sample air dust Analyzed for F Alphaxx
Remarks SAGINAW, MICHIGAN U Beta
No_3 Ra
Oil pH
Be Th

Analytical Chemistry Section:
Date Received 5-22-56 by Lab
Date Reported 5-22-56 by MF
Method of Analysis Alpha scintillation counter 2 by CJM
Counting Data:
BKGD .19 c/min GEO 44%

Sample No.	Hour	Sample Description	R	T	Q	Count	Time	C/min	d/m/M³
6907	0839	GA East side of Ko-Kneader during first trial run.	.02	15	.3	32	5/86	54.51	580
6908	0839	GA West side of Ko-Kneader during same period as above. Water line plugged up after a few minutes of operating time and water supply cut off. Dry material dropped into product drum at discharge end causing considerable dust.	.02	15	.3	32	10.47	2.87	31
6909	0903	GA Same location as 6907; during 2nd test run.	.02	10	.2	32	4.82	6.45	106
6910	0903	GA Same as 6908; during 2nd test run. Some dusting as wet material falls into drum on top of dry material. Vacuum hose from Spencer inserted into drum to reduce amount of escaping dust. Water line plugged again toward end of sampling period (simultaneous with test period) and more dry material dropped from barrel resulting in more dust.	.02	10	.2	32	8.88	3.41	55

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