Draft White Paper

SC&A RESPONSE TO NIOSH WHITE PAPER, "BAKER-PERKINS TBD REVIEW," DATED DECEMBER 12, 2011

Contract Number 200-2009-28555

Prepared by
John Mauro, PhD, CHP, and Aris Papadopoulos
S. Cohen & Associates
1608 Spring Hill Road, Suite 400
Vienna, Virginia 22182

Saliant, Inc.
5579 Catholic Church Road
Jefferson, Maryland 21755

January 2012

Disclaimer

This document is made available in accordance with the unanimous desire of the Advisory Board on Radiation and Worker Health (ABRWH) to maintain all possible openness in its deliberations. However, the ABRWH and its contractor, SC&A, caution the reader that at the time of its release, this report is pre-decisional and has not been reviewed by the Board for factual accuracy or applicability within the requirements of 42 CFR 82. This implies that once reviewed by the ABRWH, the Board's position may differ from the report's conclusions. Thus, the reader should be cautioned that this report is for information only and that premature interpretations regarding its conclusions are unwarranted.

S. COHEN & ASSOCIATES: ***Technical Support for the Advisory Board on Radiation & Worker Health Review of NIOSH Dose Reconstruction Program***	Document No. Response to NIOSH White Paper Effective Date: Draft – January 17, 2012 Revision No. 0 (Draft)
SC&A Response to NIOSH White Paper, "Baker-Perkins TBD Review," Dated December 12, 2011	Page 2 of 18
Task Manager: _____ Date:_____ William C. Thurber	Supersedes: N/A
Project Manager: _____ Date:_____ John Stiver, CHP	Peer Reviewer(s): William C. Thurber John Stiver

Record of Revisions

Revision Number	Effective Date	Description of Revision
0 (Draft)	01/17/2012	Initial issue

On December 21, 2011, SC&A received an e-mail report from NIOSH titled, "White Paper, Baker-Perkins TBD Review," dated December 12, 2011, and authored by David Allen of DCAS. This white paper was prepared by DCAS in response to SC&A's review of the Baker-Perkins site profile as provided in SC&A's report dated November 2, 2011. In this report, each of SC&A's findings and observations is repeated and a statement is provided regarding the degree to which we agree or disagree with the DCAS response, as well as SC&A's recommendations regarding the disposition of each finding and observation. For convenience, DCAS's white paper is provided as an attachment to this report. The bottom line is that SC&A accepts all of DCAS's commentaries and recommends closing all issues and observations, pending the inclusion of the proposed changes in a future revision of the TBD.

Observation 1: Baker-Perkins Site Description Is Insufficient: *Many questions regarding the 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 may 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.*

SC&A's Commentary Regarding Observation 1:

The sections of DCAS's white paper presenting the amount of material and the timeline of samples provide very detailed information of the activities that took place and the air samples that were collected. SC&A believes that this material negates the need to address ventilation characteristics, housekeeping issues, or general layout of the facility, because this information is not needed in order to reconstruct exposures, given the level of detail provided by DCAS regarding the operations and air sampling program. On this basis, SC&A recommends closing this observation.

Observation 2: Conversion/Adjustment Factor Unaccounted for in Original Datasheets: *SC&A analyzed the original datasheets (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 datasheets (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.*

SC&A's Commentary Regarding Observation 2:

The DCAS white paper provides the following explanation for the apparently "unaccounted conversion/adjustment factor:"

> *The unaccounted adjustment factor was a divisor of 0.7 to account for attenuation of alpha particles in the air sample filter media. Since a detailed description of the air sample calculations were not presented in the TBD nor deemed necessary, no mention of the factor was made.*

SC&A acknowledges the explanation and recommends closing the observation.

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.

SC&A's Commentary Regarding Finding 1:

As a result of Finding 1, the white paper redefined the job categories to avoid confusion. The more detailed analysis presented in the white paper eliminated the division between GA- and BZ-type air samples and provided a more physical basis for the distribution that was used. DCAS's response to Finding 1 is thorough and is completely responsive to this concern. SC&A recommends that this finding be closed.

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.

SC&A's Commentary Regarding Finding 2:

As indicated in the "Dose Estimate" section and Tables 4 and 5 of the white paper, the 95th percentile metric was used in the analysis, along with a redefinition of job categories, actual time lines for each activity, and corresponding BZ and AZ sample distributions. DCAS's white paper response to Finding 2 is thorough and is completely responsive to this concern. SC&A recommends that this finding be closed pending the inclusion of the white paper analysis in the next revision of the TBD.

Observation 3: Text Needs to be Corrected: *In introducing Table 1 of the TBD, the text incorrectly 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.*

SC&A's Commentary Regarding Observation 3:

The DCAS white paper agrees with the observation and will correct the text during the next revision to the TBD. SC&A finds the white paper response acceptable.

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.

SC&A's Commentary Regarding Finding 3:

In response to SC&A's finding, DCAS reiterated that the external dose was estimated by modeling the external dose from a full 55-gallon drum of UO_3, with the assumption that everyone was handling the full drum the entire time the uranium was present at Baker-Perkins. While this assumption neglects the low external dose from air or surface contamination, the estimate assumes the higher full drum dose in lieu of the lower external dose rates from contaminated surfaces or contaminated air.

SC&A finds DCAS's explanation acceptable and the approach in estimating the external dose claimant favorable. Therefore, it recommends closing the observation.

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.

SC&A's Commentary Regarding Finding 4:

In response to SC&A's finding, the white paper presents a robust analysis of the amount of uranium processed at Baker-Perkins during the test. The analysis indicates that the amount of uranium handled could easily fit into a single 55-gallon drum. Since, there is no documented evidence that "two" drums were handled, a single, full 55-gallon drum is assumed. SC&A finds the assumptions, subsequent analysis, and the conclusion acceptable and recommends closing this finding.

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.*

SC&A's Commentary Regarding Observation 4:

SC&A's commentary regarding Observation 4 is combined with SC&A's commentary on Observation 5 below.

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.*

SC&A's Commentary Regarding Observation 5:

In response to SC&A's Observations 4 and 5, DCAS maintains that the external dose estimate was developed using an individual working with the full drum of UO_3, and that the estimate was

low enough that it was applied to "all workers" without further refinement. The original TBD and the white paper do not clarify whether the term "all workers" refers to all Baker-Perkins employees (operator, laborer, supervisor, other), or just those involved in the test. SC&A recommends closing Observations 4 and 5 with the proviso that an unambiguous clarification of the term "all workers" be included in the next revision of the TBD.

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.*

SC&A's Commentary Regarding Observation 6:

The sections of the white paper presenting the detailed timeline of activities performed during the test provide an adequate justification of the 1-hour per day assumption. SC&A recommends closing this observation.

Attachment 1: DCAS's White Paper

White Paper

Baker-Perkins TBD Review

Prepared by David Allen, DCAS

December 2011

Introduction

In November 2011, SC&A issued a review of the NIOSH TBD for Baker-Perkins, which contained four findings and six observations. As a result of a discussion during a November 21, 2011 working group meeting, NIOSH agreed to prepare an analysis of the events at Baker-Perkins, based on documentation contained in a test report (SRDB # 63508) and reports of air sample data (SRDB #9505 pp. 17-25). This white paper presents a discussion of NIOSH's review of those documents. As a result of this analysis a revised intake model for Baker-Perkins is proposed.

Background

From May 14, 1956 through May 18, 1956 Baker-Perkins conducted a test for National Lead of Ohio (NLO) to determine if uranium trioxide (UO_3) could be satisfactorily blended with a water and ammonia mixture using a Baker-Perkins Ko-Kneader. Both "P" type and "K" type Ko-Kneaders were tested. NLO personal were present during the test and subsequent decontamination efforts. NLO also collected air samples at various stages of the process.

Amount of Material

The total amount of material handled at Baker-Perkins was not documented but the test report detailed the time and feed rate of the material used for each test. From that information it is possible to determine the total amount of uranium handled.

The test report indicates that there were three separate test runs. The first test using the P-100 Ko-Kneader was conducted on 5/14/1956. The batch processing parameters were scheduled to involve 189.5 gm/minute of water and ammonia solution and 1700 gm/min of solids (UO_3) for a final product moisture content of 10%. The rates were adjusted several times during the test and the output rate was checked twice during the test. The solids were started and stopped at several points during the run. Table 1 provides the times when this occurred.

Table 1 – Run Times for Test 1 from Test Log (5/14/56)

	Hours	Minutes	Accumulated minutes
Start solids	0	0	
Stop solids	0	26.5	26.5
Start solids	0	40.5	
Stop solids	1	0.5	46.5
Start solids	1	12.0	
Stop solids	1	24.0	58.5
Start solids	1	38.0	
Start solids [a]	1	54.0	
Last entry	2	5.0	85.5

[a] no entry for stopping solids prior to restarting them at 1 hour and 54 min.

The two times the rate was checked indicated 1890 gm/min and 2024 gm/min of material leaving the Ko-Kneader. The average of these two values is 1957 gm/min. Multiplying that by 85.5 minutes of run time indicates that 368 pounds of material were produced.

A second shorter test was also performed on P-100 Ko-Kneader on the following day (5/15/1956). The target processing rates were 1700 gm/min UO_3, 73 gm/min of liquid through port #1 and 106 gm/min of liquid through port #3 for a final target moisture content of 9.5%. The rate was checked once during the run resulting in a 1635 gm/min production rate. The run lasted 37 minutes with the flow of solids being interrupted once during the test.

Table 2 - Run Times for Test 2 from Test Log

	Hours	Minutes	Accumulated minutes
Start solids	0	0	
Stop solids	0	10	10
Start solids	0	12.5	
Stop solids	0	37	34.5

The 1635 gm/min production rate times 34.5 minutes indicating that 124 pounds of material were produced during the second test.

The third and final test was conducted on 5/16/1956 on the K-100 Ko-Kneader, which had the same target flow rates as test 2. This was a longer run which attempted to determine if the temperature of the material could be maintained on a continuous basis. The flow of solids was interrupted one time during this test.

Table 3 - Run Times for Test 3 from Test Log (5/16/56)

	Hours	Minutes	Accumulated minutes
Start solids	0	0.25	
Stop solids	0	23	22.75
Start solids	0	44.5	
Stop solids	5	5.75	284

The test run, which was checked 9 times during the test, had an average production rate of 1826 gm/min. This rate times the 284 minutes of run time indicates that 1141 pounds of material were produced during this run.

Based on the above analyses, the three tests combined produced 1633 pounds of mixed material, with a target moisture content of 9.5%. The only indication of the actual moisture content was the final material produced during test 3 which was measured at 12.4%. Assuming the 9.5% moisture content, the 1633 pounds of mixed material would equate to 1478 pounds of dry UO_3. The density of dry powders is variable but, assuming a tap density of 4 g/cc for UO_3, this material would occupy a volume of approximately 44.4 gallons. This indicates that the material would fit into a single 55 gallon drum.

Time Line

A comparison of the date, time, and description of the air samples with the test report allows for the development of a detailed time line. While not all the air samples had a collection time noted, the air samples were numbered sequentially, allowing the approximate time of each to be determined.

There was one inconsistency noted during the review of this information. The test log indicates that the first test lasted 2 hours and 5 minutes on 5/14/1956 and the second test lasted only 37 minutes on 5/15/1956. Both tests were conducted with the type P-100 Ko-Kneader. The air sample logs indicate that samples were taken during the trial run starting at 8:39 am on 5/15/1956. Samples were also taken during the trial runs on the same day at 9:03 am, 9:19 am, and 11:19 am. The 11:19 sample has a note that at that point it was determined that the “P” type Ko-Kneader would not work and that the “K” type would be tried next. So the indications are the second test ended at 11:19 am, lasted 37 minutes (including stopped period) but started by 8:39 am. To resolve this inconsistency, the air sample sheets from the previous day were reviewed.

The air sample sheets indicate that the Omega Feeder was being filled at 3:00 pm on 5/14/1956 followed by the calibration of the Feeder at 3:32 pm. No air sample descriptions on that day indicate the Ko-Kneeder was running. At 8:39 am the following day, the air sample sheets indicate that the sample was collected during the “first trial run”. To reconcile the inconsistency, it is assumed that the date on the first test sheet is in error and that the first test actually occurred on the morning of

5/15/1956. In this way, the first day consisted only of loading some material into the Omega Feeder to allow it to be calibrated and the Ko-Kneader testing did not actually start until the next morning. It is also possible the individual filling out the test sheet considered the Feeder calibration to be part of the test and started the test log during that calibration. In this case, the test log is not in error but merely incomplete, since it doesn't mention the test occurring over two separate days. Either way, with the assumption in place, the time line of the test is as follows:

5/14/1956

1:28 pm – Background air sample taken prior to opening or processing any material

3:00 pm – scooping UO_3 into Omega Feeder (Three breathing zone (BZ) samples and one general area (GA) sample were taken between 3:00 pm and 3:32 pm, indicating a desire for nearly constant coverage. Therefore, it is assumed that scooping began at 3:00 pm).

3:32pm – Calibration of the Omega Feeder

5/15/1956

8:39 am – Test in progress, "P" type Ko-Kneader

9:03 am – Test in progress, "P" type Ko-Kneader

9:19 am – Test in progress, "P" type Ko-Kneader

After 9:19 am – Scooping material into Feeder. (No collection time on air sample but after the 9:19 am sample two BZ samples were drawn while hand scooping material from the drum to the Feeder).

11:19 am – Test ended, "P" type machine determined not to work

1:04 pm – Decontamination of Ko-Kneader started (based on 11:19am air sample note)

1:31 pm – Decontamination in progress, the barrel of the machine had already been removed and placed on the floor, some material had been chipped and vacuumed out of machine.

5/16/1956

Morning – decontamination of "P" Ko-Kneader continued (1st air sample on 5/16/1956)
12:07 pm – Test #3 in progress on "K" Ko-Kneader (may have started by 11:19 am)
4:24 pm – Test #3 ended based on a start time of 11:19 am and a 5 hour and 5 minute test.

5/17/1956

9:03 am – Decontamination of "K" Ko-Kneader started

5/18/1956

Before 9:44 am – Decontamination of "K" Ko-Kneader continued
2:17 pm – Steam cleaning Omega Feeder

Summary of Time Frames

Scooping UO_3 into Feeder

The first scooping occurred at 3:00 pm on 5/14/1956 and continued until 3:32 pm. This was to add some material to calibrate the Omega Feeder. There does not appear to be any other work occurring on that day likely due to the lateness in the day. The next indication of scooping of material was at 9:19 am on 5/15/1956. The "P" Ko-Kneader was running prior to this but likely was using the material loaded into the Omega Feeder the previous day. One GA and two BZ samples were taken during this scooping. These samples were completed prior to 11:19 am. The last BZ indicated that the liner was pulled out of the drum and the UO_3 was dumped from the bag to the Feeder. The Test Report indicated that the material was fed into both Ko-Kneaders using the Omega Feeder so it was not necessary to empty one machine and load another. Also, as described previously in this white paper, it appears that only one drum of material was used and the description of air sample #6913 indicates that drum was emptied prior to 11:19 am.

Based on the above, it can be inferred that the scooping operation occurred for approximately 32 minutes on 5/14/1956 and up to an additional 2 hours on 5/15/1956 for a total of 2 hours and 32 minutes. Because multiple GA and BZ type air samples were collected during this evolution, a reasonable distribution of both types of air samples can be established. Since the BZ samples are intended to be in the breathing zone of the person scooping the material, this type of sample would be most representative of the individual scooping the material. Others in the area but not actually performing this work would be best represented by the GA samples.

Decontamination

From the air sample descriptions and notes, it can be determined that attempts to use the "P" type Ko-Kneader were abandoned on the morning of 5/15/1956 and decontamination started at 1:04 pm. This effort continued into the next day and appears to have ended in the morning with the steam cleaning of the "P" Ko-Kneader. There is no collection time recorded for the air sample taken while steam cleaning the Ko-Kneader. The next sample taken was at 11:15 am at the exhaust of a vacuum cleaner followed by one at 11:19 am over the feed hopper of a Ko-Kneader. That Ko-Kneader was presumably the "K" Ko-Kneader since the test on that machine started soon after. Therefore, we can assume the decontamination of the "P" Ko-Kneader occurred between 1:04 pm on 5/15/1956 and 11:19 am on 5/16/1956. The earliest sample taken on any day was at 8:39 am and the latest sample taken on any day was at 3:32 pm. Also, from the test logs, the "K" Ko-Kneader test lasted 5 hours and 5 min and if we assume it started at 11:19 am (from the air samples) it would have ended at 4:24 pm. Therefore, it can be estimated that work in the area normally started at 8:30 am and ended at 4:30 pm. These assumptions result in a decontamination time for the "P" Ko-Kneader of 6 hours and 15 minutes.

The decontamination of the "K" type Ko-Kneader and the Omega Feeder started at 9:03 am on 5/17/1956 and continued into the next day. The last step of the decontamination was steam cleaning which occurred for the barrel of the "K" Ko-Kneader at 12:35 pm on 5/18/1956 and at 2:17 pm for the Omega Feeder. Therefore, the estimated decontamination time associated with the "K" Ko-Kneader and Omega Feeder is 13 hours and 14 minutes. The combined decontamination time is then approximately 19.5 hours.

Other work

The first operation with UO_3 started on 5/14/1956 at 3:00 pm when the drum was opened and some of the material scooped into the Omega Feeder for the calibration of the Feeder. The last operation with contaminated materials was the steam cleaning of the Omega Feeder at 2:17 pm on 5/18/1956. With the start and stop time assumptions put into place earlier, this results in an estimated 31 hours and 14 minutes of work at Baker Perkins with radioactive material.

Dose Estimate

Material was hand scooped out of drum and into the Omega Feeder. This work may have been done by an operator or by a laborer. It is likely some type of supervision would have been in the area but not actually performing the work. Dust generated by the evolution would be highest in the immediate area of the scooping (near the persons breathing zone) but decreased as it dispersed into the immediate area. Therefore, the breathing zone (BZ) air samples associated with scooping appear to be the most representative of the operator or laborer while the general area (GA) air samples would be more

appropriate for a supervisor. This level of airborne concentration will be applied for the 2 hours and 32 minutes estimated time spent scooping material.

The decontamination could have been accomplished by an operator, a laborer or even maintenance personal. Again, a supervisor would likely be in the area but not directly involved with the physical work. Therefore, the BZ samples will again be used for estimating the airborne activity for personnel performing the decontamination and the GA samples will be used for Supervisors.

The highest airborne operation was the scooping followed by the decontamination. It is possible for a single person to have done all the scooping, as well as being involved with the decontamination and in the vicinity for the actual tests and ancillary operations the remainder of the time. Therefore, the estimate for operators and laborers would assume they spent 2 hours and 32 minutes scooping UO_3 plus 19.5 hours decontaminating the equipment and the remaining time (9.2 hours) in the vicinity of the tests. Only GA type air samples were collected during Ko-Kneader operation and ancillary work. Because most of the work would not result in a single specific source of airborne contamination, the airborne activity from this work will be estimated using the GA air samples.

Table 4 provides the geometric mean (GM) and the 95^{th} percentile of the air samples for the given operation. The duration of the operation combined with a breathing rate of 1.2 m^3/hr was used to determine the total intake for each operation. A geometric standard deviation (GSD) was determined from the GM and the 95^{th} percentile intakes assuming a lognormal distribution.

Table 4 – Airborne Concentrations and Intakes

Operation	GM (dpm/m^3)	95th (dpm/m^3)	Duration (hrs)	Intake (GM) (dpm)	Intake (95th) (dpm)
Operators					
Scooping	6135	26338	2.533	18650	80066
Decontamination	491	2888	19.5	11494	67585
Testing and other	43.7	447	9.2	482	4935
Total intake 30626 dpm (GM); 152587 dpm (95th); GSD = 2.65					
Supervisors					
Scooping	879	12098	2.533	2674	36778
Decontamination	128	1873	19.5	3002	43822
Testing and other	43.7	447	9.2	482	4935
Total intake 6158 dpm (GM); 85536 dpm (95th); GSD = 4.95					

The TBD currently uses four worker categories. However, since it is reasonable to believe the scooping and decontamination could have been done by laborers, the laborer category will be eliminated. The operator category will be defined as anyone who may have directly performed either scooping or decontamination based on job title or description of duties. Supervisors will be defined as anyone that would be routinely in the area but not have hands-on type duties. The remaining category (others) is intended to account for those not likely in the area but who could have entered the area infrequently during the tests. For these people, the estimate will be 10% of the Supervisors intake. Table 5 compares the current intakes from the TBD to the intakes proposed in this white paper.

Table 5 – Intake Comparison

	TBD (GM) (dpm/day)	This Paper (GM) (dpm/day)	TBD (95th) (dpm/day)	This Paper (95th) (dpm/day)
Operator	4126.1	6125	68145	30517
Laborer	2456.9	6125	40577	30517
Supervisor	883.0	1232	14583	17107
Other	88.3	123.2	1458.3	1710.7

Response to SC&A Review Findings and Observations

SC&A submitted a review the Baker-Perkins TBD in November 2011. The review detailed four findings and six observations. The NIOSH response to each of these findings and observations follow.

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

This finding indicated the division between GA and BZ air samples and between job categories was not sufficiently justified. The intent of categories is to estimate an intake consistent with the duties of an individual. For example, an accountant would not be expected to be routinely handling uranium during the test. The categories are intended to be applied with the benefit of the doubt going to the claimant. In reviewing the TBD, it was realized that the "laborer" category may be misinterpreted. It was intended for someone that would work hands on intermittently as opposed to operator working hands on routinely. However, the hands on work at Baker-Perkins would be scooping uranium and decontaminating the equipment. Both these jobs could be performed by a laborer resulting in an easy misinterpretation. It is also possible the individual operating the Ko-Kneader actually filled the Feeder himself by scooping the uranium from a drum to the Feeder. Therefore, it would not be appropriate to estimate lower intakes for the operators than the laborers. Because of this, the two jobs categories will be combined to avoid any confusion.

The more detailed analysis presented in this white paper eliminates the existing division between GA and BZ type air samples and provides a more physical basis for which distribution is used.

Finding 2 – 50th Percentile is not Adequate

The three key tasks resulting in different degrees of airborne uranium were scooping the uranium from the drum to the Feeder, decontaminating the equipment and all other tasks including operating the Ko-Kneader. There are several air samples available for each task and it is credible that each task was performed by the same workers for the duration of that task. Therefore, the air samples represent a variation in the air concentrations with time, not a variation of exposures to different people. It would therefore be appropriate to use the distribution of air sample results to estimate the intake for each individual rather than applying constant value.

The first two tasks result in localized high airborne activity that dissipates into lower general area concentrations. Operating the Ko-Kneader and other ancillary tasks do not have a single localized area of release but rather multiple points of release resulting in a dust level dispersed throughout the area. Therefore the first two tasks are estimated with BZ air samples and the remaining tasks with GA air samples. Those possibly in the vicinity of the first two tasks, but not actively involved in hands on work, are estimated using GA samples taken during those tasks.

Finding 3 – No Submersion Dose Considered

This finding indicated that external dose from submersion in a cloud and from surface contamination was not considered. External dose was estimated by modeling the external dose from a full 55-gallon drum of UO_3. Air and surface contamination would not occur until the uranium began to be fed into the Feeder. Once this begins, the uranium is less concentrated and the external dose rates would be reduced. Also, in the Ko-Kneader, the uranium is mixed with liquid which would reduce the beta dose rate. Once mixed with the liquid, the material was placed in an additional drum. Some of the material was left behind on the internals of the Ko-Kneader, which was later decontaminated.

Estimates of external dose due to handling the full drum of uranium were relatively low. Therefore as a bounding estimate, it was assumed everyone was handling the full drum the entire time the uranium was present at Baker Perkins. While this neglects external dose from air or surface contamination, the estimate actually assumes the higher full drum dose in lieu of the lower external dose rates from contaminated surfaces or contaminated air.

Finding 4 – Two Drums of Uranium Were Not Considered

The possibility of two drums of uranium was raised in the NIOSH Evaluation Report of Baker-Perkins. This possibility came from a 1991 letter which indicates that, based on the description in the air sample data sheets, “at least one but no more than two drums” were used (SRDB #9505 pg. 10). These data sheets do not specify if one or two drums of uranium was used. A more robust analysis of the amount of uranium processed at Baker-Perkins was presented earlier in this white paper. The analysis indicates the amount of uranium handled at Baker-Perkins could easily fit into a single 55 gallon drum.

Observation 1 – Site Description Insufficient

The first observation was that the site description is insufficient because it fails to identify:

- The location of the laboratory building relative to other buildings
- Baker Perkins personnel that may have been in the area
- Other sources of radioactive material
- Ventilation characteristics
- Housekeeping practices

The first two items pertain to placing claimants in the vicinity of the test. It is unlikely NIOSH will uncover reliable information as to the whereabouts of each individual during the one week in 1956. Therefore, the bounding estimate is to place everyone in the vicinity of the test at locations and time intervals consistent with their job titles. Because of that, the location of the lab is not needed.

For the third item NIOSH has uncovered no information related to the presence of other radioactive materials on site, which appears to be consistent with a company that manufactured food preparation equipment. However, if information were to come to light in the future, it is NIOSH's policy that the TBD would be revised to account for the additional source(s) of radiation.

The last two items pertain to activities that primarily effect levels of airborne activity. Because air samples were collected at each phase of the test, including decontamination, it is unnecessary to determine the effect of these activities on the airborne concentration. The measured values inherently account for any effect.

Observation 2 – Adjustment Factor Unaccounted for in Original Data Sheets
Observation 2 describes an unaccounted for adjustment factor in the original air sample data sheets. The unexplained adjustment factor was a devisor of 0.7 to account for attenuation of alpha particles in the air sample filter media. This factor was developed by HASL and used elsewhere depending on the filter type deployed. Since a detailed description of the air sample calculations were not presented in the TBD nor deemed necessary, no mention of the factor was made.

Observation 3 – Text Needs to be Corrected
Observation 3 indicates the description of Table 1 in the text of the TBD does not match the headers in Table 1. NIOSH agrees with this observation and will correct the error during the next revision to the TBD.

Observation 4 – Inconsistency in Internal and External Dose Estimates and
Observation 5 – Inconsistency in Terminology
These two observations are described as inconsistencies in the external dose estimate. The two inconsistencies are 1) the external dose rates are not broken out by job categories as are the intake assignments and 2) the description for the external dose rate describes a production worker while the table lists "all workers". As mentioned in the response to Finding 3, the external dose estimate was developed using an individual working with the full drum of UO_3. The estimate was low enough that it was applied to all workers without further refinement. Thus, the description of the development was for that of a production worker and the table assigns the dose to all workers.

Observation 6 – Need Justification for Using 1 Hour per Day
This observation indicates that the assumption operators were in direct contact with the uranium in a drum for one hour per day needs justification. A more detailed analysis of the time line presented in this white paper indicates the scooping of uranium occurred for approximately 2 hours and 32 minutes throughout the course of the week or approximately ½ hour per day. Packaging of the mixed product

appears to have occurred automatically as the Ko-Kneader emptied into a drum. However, if some hands on work were necessary, it should have taken no more time to package the material than it took to unload the material so the ½ hour per day could be doubled to account for packaging the mixed product making the total 1 hour per day.