# Logbook Analysis (DRAFT)

## January 18, 2007

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There have been questions regarding the implications of zero entries, and "no data available" entries in the actual dose records, as mentioned by multiple workers. Affidavits provided in support of the petition included discussions of situations where individuals received zero doses or "no data available" when the field and work circumstances would indicate that external exposure was expected. In addition, petitioners raised the issue of incomplete dose records for workers and had used the terms "falsified" dose entries and "manipulated dosimetry." Throughout the SC&A review, these issues were brought up repeatedly petitioners and former workers. During interviews with petitioners and former workers, personnel indicated that field RadCon logbooks (e.g., contamination control logs, radiation protection technician (RPT) logs, decontamination logbooks, and foreman's logbooks) might substantiate the claims made by workers. According to "field radiological control" (RadCon) personnel, logbooks were kept by radiation monitors and their supervisors to record daily events including unusual occurrences, contamination problems, special whole body dosimetry results, dose rates, and day-to-day activities. The logbooks contained some information related to individual dose.

SC&A noted the lack of corroborating evidence to back up assertions made by both the petitioners and NIOSH's site experts regarding the pervasiveness of dose record discrepancies and their historic origins. SC&A, under the broad guidance of the Board's working group, decided to directly interview petitioners and other site experts on these issues, and to conduct record reviews for such evidence at the Legacy Management, Mountain View Facility. Onsite interviews with the petitioners for the purpose of clarification and ascertainment of supporting documents were conducted March 27-29, 2006. Records were requested by SC&A prior to the RFP visit, and were partially retrieved by DOE's Legacy Management personnel from the Denver Federal Records Center. Those records made available during the onsite visit included Health Physics progress reports, limited dosimetry processing data, information on tritium, and technical reports. The records that were not available during the site visit included the field RadCon logbooks. These were not retrieved in time for the onsite visit; however, they were made available shortly following the visit. One of the outcomes of the site visit was the identification of documents that might be helpful in evaluating the data integrity issues raised in the petition. As a result, additional searches of the record databases were conducted while onsite and subsequent to the visit. The logbooks identified by SC&A and subsequently retrieved by Legacy Management for review included years ranging from 1957 – 1996. Both the uranium and plutonium areas were represented by the logbooks originally requested. Attachment 3 is a compilation of results potentially relevant to the data integrity from all record searches conducted to date. A request was made of Legacy Management that a copy of all records scanned for SC&A be also provided to NIOSH.

At the April 12, 2006 working group meeting, SC&A provided a summary of the types of records reviewed during the visit to RFP. The review of field RadCon logbooks and dosimetry information, including those records retrieve originally for SC&As review, was turned over to NIOSH for completion (ABRWH 2006a). SC&A was asked to identify records that were not reviewed during the site visit and provide information on how these records can potentially answer data integrity issues. The *Interim Evaluation of Data Reliability Issues: Needed Document Retrieval and Evaluation* (SC&A 2006a), outlining specific data integrity issues, was provided to NIOSH and the working group on April 19, 2006. Within this report were recommendations for logbook and document reviews. The list included contamination control logbooks, foreman's logs for the RadCon group, RCT logbooks, decontamination logbooks,

special TLD results, and dosimeter processing information. NIOSH was to review the original set of logbooks requested by SC&A during the site visit for information pertinent to the SEC petition. The logbooks containing pertinent information, particularly individual dose data, were to be scanned and made available to the working group. The original intention was to pull logbooks and dosimetry information corresponding to the work location and period of concern for workers providing affidavits or expressing similar comments during the petition interviews. The logbooks were to be reviewed for information on external exposures, overexposures, unusual exposure conditions, internal exposures, special dosimetry use, and involvement in incidents. NIOSH was also asked to retrieve urinalysis logbooks for comparison to the Health Physics Information System (HIS-20) database for the purposes of validating reliability of bioassay records.

The original intention was to track information provided by those submitting affidavits and comments in the logbooks and dosimetry receipt and processing logs, to validate the issues raised in the affidavit or comment. The various sources of dosimetry information were to be utilized to ascertain whether the individuals identified as having concerns (primarily from the affidavits) were mentioned in the logbooks, and if there was any dose information that differed from the dose of record. The RFP Health Physics dose data files were to be reviewed for documentation related to the years in question including dosimetry investigations and reported dosimeter results. The dosimetry processing logbooks for the same time period were to be pulled to determine whether there was indication of dosimeter damage or that the dosimeter had not been returned for the period in question. The secondary dosimetry results (e.g., chirpers, pocket ionization chambers), which were maintained in the field radiological control records, were also requested to permit evaluation between primary and secondary dosimetry results. During many of the high exposure jobs, secondary dosimetry was used to track real-time dose. The ultimate goal was to compare historical information from a variety of available sources and to determine if there was, in fact, corroboration. The specific individuals providing affidavits or comments where not always found in the field RadCon logbooks; therefore, the focus of the review was changed to verification of data for those individuals with internal or external monitoring information identified in the field RadCon logbooks.

At the July 26, 2006 working group meeting, NIOSH provided a comparison of extracted exposure data from the *Logbook 12-12-66 to 12-31-68* (Kittinger 1966) and the individual Health Physics dose data files. Information included dates of whole body counts, accidents/incidents, and exposures for a specified employee at a specified time. For each example, NIOSH checked the NIOSH-OCAS Computer Tracking System (NOCTS) for information matching the employees mentioned in the logbook. Only a portion of the individuals from logbook entries were claimants. For this population, NIOSH evaluated the logbook data against the available data in the Health Physics dose data file. Information in the logbook and Health Physics file were evaluated for exact matches where monitoring periods in both sources were identical and agreement where the logbook cycle covered only a portion of the cycle identified in the Health Physics file (e.g., The logbook information may cover one month while only a quarterly value is listed in the Health Physics file.) For the claimants identified with monitoring data in *Logbook 12-12-66 to 12-31-68* (Kittinger 1966), the data in the logbook was consistent with that in the Health Physics files.

There were an additional 36 individuals selected from *Logbook 12-12-66 to 12-31-68* (Kittinger 1966) who were not claimants. NIOSH requested the radiation files from DOE Legacy Management for employees matching the names cited in the logbook. For multiple hits (several radiation files of employees with the same last name), all possible matches were requested. The Health Physics files for the 36 individuals were received and are posted on the O-drive. Nineteen of the 36 non-claimant individuals named in NIOSH's review of *Logbook 12-12-66 to 12-31-68* were evaluated as a part of the second logbook review. The remainder have not been evaluated by NIOSH since the receipt of the dosimetry records.

A concern was raised by the working group that the evaluation of the *Logbook 12-12-66 to 12-31-68* only covered the years 1966-1968, and was for individuals assigned to the plutonium areas (Kittinger 1966). A commitment was made by NIOSH to sample logbooks (RadCon field and urinalysis) from 1969 through the 1990s (ABWRH 2006b, pp. 329-337). Randomized names with internal or external exposure information were to be selected from the logbooks for comparison to the Health Physics files and HIS-20. During the August 31, 2006 working group meeting, NIOSH acknowledged their matrix commitment for a sampling plan for the urinalysis and Field RadCon logbooks (ABWRH 2006c, pp. 202). Mark Griffon of the workgroup provided NIOSH /ORAU a preliminary comparison of logbook data which were thought to be beneficial in the comparison of logbook information with the database. One logbook 'flagged' by Mr. Griffon for NIOSH was Logbook 6-12-67 –12-29-68 which included data from 1957 thru 1960 (Griffon 2006). The logbook contained uranium urinalysis data from the late 1950s.

On October 27, 2006, however**,** NIOSH instead provided *Logbook Review for Rocky Flats* (NIOSH 2006a), a review of Rocky Flats logbooks, for purposes of ascertaining data reliability and provides its results on the "O" Drive for working group review. This review pulled individual monitoring or incident information from 36 logbooks, of which 20 were urinalysis processing logs. The logbooks represented both plutonium and non-plutonium areas for the between 1957 through 1971, but 1972-1999 data were not represented in the review.

SC&A conducted a review of the 59 logbooks and compiled logbook entries potentially relevant to the SEC petition as a part of the review of data integrity issues subsequent to the original records request. These requests concentrated on the 1969 Fire and specific supervisor logs. The logbooks entries of interest from these logbooks were extracted and are provided in three attachments. Attachment 1 contains logbook entries with individual specific internal or external monitoring, references to special badging, and referrals to medical or the *in vivo* counter. Attachment 2 represents logbook entries referencing radionuclides other and Pu-239, U-235, and U-238. Attachment 3 contains entries related to field measurements (e.g., surveys, air sampling, etc.), incidents, and destruction of badges. Entries were entered as they appeared in the logbook including retention of abbreviations and misspellings, unless otherwise indicated. Some logs were difficult to read due to the poor handwriting and image. The reference to logbook pages refers to the page designated in the logbook (not to be confused with the pdf pages in the scanned version of the logbook). Names of individuals have been removed from the entries to comply with the Privacy Act requirements.

### 1.1.1 Personnel Logbook Entries

Entries linkable to particular individuals including references to internal or external monitoring, special badging, and referrals to medical or the *in vivo* counter were of particular interest. This information was compared with the data in the Health Physics file and the HIS-20 database as a means of determining consistency between field logbook information and dosimetry data. This was particularly pertinent to the questions raised in the petition regarding blanks, zeros, or "no data available" entries in dosimetry records. NIOSH stated in *21 March 2006 SC&A Comments and NIOSH Responses* (NIOSH 2006b):

> *Pre-1964: A blank indicates a period when the worker was not monitored. This situation will be dealt with by applying unmonitored dose using coworker data (for radiation workers), or by applying ambient environmental dose (non-radiation workers). A zero indicates a monitored period when there was no positive recorded dose. This situation will be dealt with by applying missed dose.*

For the years 1964 and after, NIOSH states:

> *1964 and after: A blank or zero could indicate a period when a badge wasn't returned at the scheduled badge exchange, but was rather retained by the worker for an additional badge exchange cycle. In this situation, all dose recorded on the badge was recorded in one badge exchange cycle, and a blank appeared in the record for the other exchange cycle. A zero entry in the dosimetry records could also indicate that there was no positive dose recorded on the badge. In any case, whenever a blank or zero appears in the dosimetry record, missed dose is assigned.*

"No data available" entries indicate instances when either the badge was not turned in at the scheduled badge exchange, or the badge was turned in but there was a problem with the dosimetry badge. NIOSH proposes to use missed dose, coworker dose, or ambient environmental dose when a blank or a zero appeared in the dosimetry record. The comparison between the individual monitoring data in the field logbooks and the dosimetry files served as a method for validating whether blanks, zeros, and "no data available" were the result of explanations described above.

The logbooks clearly reference wound counts, *in vivo* counts (in some cases with only dates), urinalysis results, and in a few cases secondary dosimetry results. Other individual specific data included personnel contamination levels, nasal smear results, and identification of those involved in incidents such as explosions, fires, and breaches of containment. NIOSH was to provide a sampling plan on how this data would be evaluated; however, to date this plan has not been forthcoming. A preliminary screening was conducted by SC&A to ascertain the usefulness of the logbook data in evaluating data completeness and accuracy. The goal was to identify individuals in the logbooks who also had both hard copy and electronic dosimetry results readily available for review. Approximately 70 claimants were mentioned in some capacity in the logbook.

"Special badging" is routinely referred to in the field logbooks. It is typically referenced in the context of special dosimetry studies or job-specific usage. Special badging usually occurred with high exposure potential jobs such as the ZPPR project, work on the americium line, and special projects. In some cases, it was reported that routine dosimeters were worn in conjunction with the special dosimeters, while in other cases the special dosimeters replaced the routine dosimeters. For example, an entry from *Logbook 12/5/66-6/11/67* (RFP, 1966a, pg. 131) states "*Special film badges are to be worn by people involved with the PuBe Project. Regular film badges are not to be worn*." The exchange of these badges was as frequent as daily (Refer to Site Expert Interview) and can be observed on the computer printouts in some claimant files. With a higher frequency of exchange, the badge results are more likely to be below the minimum detectable dose. It is also unclear how the special dosimeter results were reflected in the dosimetry record.

Another general observation made were special bioassay samples were not collected in all cases immediately following an incident (especially minor incidents). Of the incidents reviewed, a majority of these were associated with wounds and skin contamination incidents. The medical record serves as an additional source of incident information that may or may not be reflected in the radiation exposure file. Although SC&A has identified individual's dose data in a few of the logbooks reviewed, we have been unable to find information on the particular individuals chosen for follow-up.

### 1.1.2 Other Radionuclides

One concern arising during the review was exposure of personnel to radionuclides other than U-235, U-238, and Pu-139. Thirteen of the 59 logbooks reviewed mention operations involving secondary radionuclides including U-233, U-237, Pu-236, Pu-238, Am-241, Am-243, Np-237, Co-60, Cf-252, Ir-192, curium, thorium, and tritium. The *1966-1969 Special Analysis Logbook* (RFP 1966b) contained individual specific bioassay data for 1/20/1966 thru 1/13/1969 for Sr-90, Po-210, Np-237, tritium, and thorium. Other radionuclides such as thorium, tritium, Po-210, Np-237, and curium were encountered at RFP as a part of the weapons part handling and manufacturing. Other radionuclides such as Co-60, Cs-137, and Ir-192 were used for quality assurance testing. Some notable entries included a spill of neptunium and an inadvertent exposure to Co-60 contamination. Inadvertent releases of tritium occurred with a significant release in 1973 that resulted in a release to the environment as well as to the work place. Thorium was mentioned in the context of thorium strikes and as ingots in Building 883. Clearly the logbook entries indicate that numerous radionuclides were handled in some capacity at RFP. The entries also provide some information on dates these radionuclides were handled. The logbooks demonstrate there was a potential for both internal and external exposure from radionuclides other than plutonium and uranium. Exposure to other radionuclides is evaluated in more depth in Section 7.0 of this review.

### 1.1.3 Field Logbooks, Incidents, and Badge Destruction

Attachment 2 includes log entries related to incidents, field measurements, and badge destruction entries obtained from the 59 logbooks. This information was pertinent to concerns over processing of lost, stolen, or otherwise compromised dosimeters. The logbooks also contain

periodic radiation and contamination measurements for high dose rate projects. Field survey information is useful in evaluating why badges may not have reflected the field exposure conditions and/or potential reasons for discrepancies between dosimeters and field exposure conditions.

One particular concern raised in eleven different entries was the destruction of contaminated badges. In *Kittinger's Personal Logbook 10/1/57 - 8/26/60* (Kittinger, 1957) and *RFP Logbook 5/10/66-12/3/66* (RFP 1966c) there were eleven references to the destruction of badges. Some of these were associated with specific individuals while others were more general comments. One example is provided on pg. 13),

> *Destroyed both exchange and permanent badges of [Name] [Badge Number], notified [Name] of security of intent. He asked for no formal notification of destroyer. I asked guard [Name] to witness, which he did at 9:10 a.m. Badges were cut into small pieces and placed in the hot waste can.* (Kittinger 1957, pg. 13)

There was some concern over the problem with contaminated badges as indicated in *Kittinger's Personal Logbook 10/1/57 - 8/26/60* (Kittinger, 1957).

> *[Name] informed of the large number of badges that were found contam. He agreed to try to work toward a different badging system that would not require personnel to wear them in the area. He asked that [Name] be notified and his assistance enlisted to get Security to adopt a new system. I contacted [Name] with [Name] approval. [Name] is somewhat interested in the possibility of a film badge type substitution.* (pg. 104)

Petitioners and former Rocky Flats workers have repeatedly mentioned in interviews that badges were disposed of. The entries in the logbook validate that this was the case, at least in earlier periods, when badges were contaminated. The frequency of badge destruction is unknown, yet contaminated badges appeared to be a significant enough problem that alternate badging systems were under consideration. The policy of destroying contaminated badges was confirmed by three RCTs interviewed by SC&A. The dosimetry staff may or may not have been cognizant of the destruction of badges since this occurred in the field. The purpose for not sending contaminated badges to the processing laboratory was to prevent the lab and its instruments from getting contaminated. SC&A found that further investigation into this practice is warranted, especially in the uranium areas where there was less containment of radioactive material.

There are also statements regarding gamma alarm evaluations. One particular entry of interest was included in the *Logbook W.D. Kittinger/R.M. Vogel 6-20-63 thru 10-27-67(*Kittinger and Vogel, 1963*)*, which stated:

> *Gamma alarm evac. At 2:00 PM. Good test. 72 people w/o film badges. (pg. 96).*

Were these individuals supposed to be wearing film badges? The exact meaning of this entry is unknown; however, this raises questions regarding the implementation of dosimetry requirements in the field.

SC&A, in its sampling of 59 logbooks found individual specific monitoring information which could be compared to Health Physics files and the HIS-20 database for validation of dosimeter results. The logbooks appear to indicate that special bioassay sampling did not always follow involvement in incidents. While reviewing the logbooks, SC&A noted mention of special projects involving secondary radionuclides. There were several entries related to destruction of badges, which provide additional examples of situations where external exposure investigations should have been conducted. The logbook entries also validated petition statements related to frequent fires and incidents, and existence of high radiation areas.

### 1.1.4 Field and Urinalysis Logbook Data Comparison

To investigate the alleged lack of corroboration between dosimetry records and individual doses reported in the field logbooks, SC&A requested dosimetry processing logbooks/logsheets, individual dosimetry files, secondary dosimetry results, and field logbooks corresponding to the work location and time of workers expressing concerns. Information from these logbooks was to be used to ascertain issues documented in the petition relating to dosimetry adequacy and occurrence of incidents.

Historical data, archived by the Federal Records Center (FRC) for the Rocky Flats Environmental Technology Site (RFETS), were reviewed by NIOSH and compared to radiological files and claimant files to determine the level of agreement between these data sources. The logbooks reviewed by NIOSH included:

- Urinalysis/bioassay logbooks: containing primarily or exclusively urinalysis or bioassay data.

- Health Physics logbooks: Radiation Monitor, Contamination Control, and Health Physics staff logbooks containing some notes regarding bioassay data, wound counting, *in vivo* counting, and external dosimetry data. Also contains field radiological control conditions.

- Foreman logs: containing foreman's notes for the day, shift notes, meeting notes, and occasionally individual specific information such as a reassignment of duty, follow-up monitoring, or clearance for work. These logbooks are less helpful since they contained minimal individual data.

- Building logbooks: containing sampling results of floors, walls, equipment, and other surfaces or documenting radiological clean-up of the same.

NIOSH was responsible for providing a sampling plan on which logbooks would be reviewed and how the data would be evaluated. They were also responsible for identifying and retrieving urinalysis/bioassay logbooks that included results from plutonium, americium, gross alpha, and uranium results. It was the working group's intention that SC&A turn the logbook review over to NIOSH and provide a list of outstanding records requested from RFP that could be used for comparison. The original logbook request included years ranging from 1957 – 1996, and encompassed both the uranium and plutonium areas. NIOSH was to retrieve and review the

logbooks on this list for information pertinent to the SEC petition. The logbooks were to be scanned and made available to the working group. NIOSH states in their logbook evaluation report (NIOSH 2006a):

> *Logbooks were requested from Mt. View RFETS Records staff starting in February 2006. Requests were made to Mt. View by the ORAU Team, and included search terms such as: urinalysis, bioassay, internal dosimetry, external dosimetry, and logbook. Occasionally, specific accession numbers of boxes containing logbook collections were identified and submitted to Mt. View. Dates were not necessarily specified at the start, to keep the search as broad as possible. Since April, Mt. View estimated that over 450 boxes were pulled from the FRC and that NIOSH and ORAU had reviewed over 1,000 documents. Requests were submitted through October, in attempts to find logbooks from all possible years. Logbooks of various types from 1957 through the mid-80s were located, including internal dosimetry logbooks from 1960 through 1971.*

There are 59 logbooks available on the O-drive which comprised primarily logbooks requested by SC&A in later records requests. This compilation of logbooks was not intended to be representative of all areas and time periods, but was specifically chosen to obtain information on particular events such as the 1969 fire. NIOSH was responsible for providing a broader review per the recommendations of the Board's working group. Based on the statements above from the logbook evaluation report NIOSH reviewed 450 boxes of records including logbooks extending into the mid-1980s. No information was provided on the specific contents of the 450 boxes; however, minutes from the May 30, 2006 working group meeting indicated there were 22 boxes of logbooks (ABRWH 2006d). NIOSH did not provide information on how the logbooks in these 450 boxes were evaluated; nor did they provide scanned copies of relevant logbooks or to the working group and SC&A other than the 59 logbooks on the O-drive. The original list of logbooks requested by SC&A represented a wide range of years and areas. As such, the logbook review conducted by NIOSH should have covered a wider range of years and areas. SC&A's evaluation was limited to the 59 logbooks on the O-drive since these were the only logbooks made available.

Two discrete comparisons were conducted by NIOSH. The first comparison involved only the *Logbook 12-12-66 to 12-31-68* (NIOSH 2006e). The *Logbook 12-12-66 to 12-31-68* (Kittinger 1966) was maintained by a supervisor in charge of field radiological control activities and was particularly useful in identifying individual exposures or monitoring within field logbooks. Information included dates of whole body counts, accidents/incidents, exposures for a specified employee at a specified time, etc. NIOSH extracted items of interest in the *Logbook 12-12-66 to 12-31-68* defined as any entry in the logbook that gave information of a specific nature that could be compared to information in an employee's radiation file. For example, entries included dates of whole body counts, accidents/incidents, and exposures for a specified employee at a specified time. For several entries, the information identifying the employee was incomplete (e.g., only last name was given, some of which are very common).

For each example, NIOSH checked the NOCTS database for information matching the employees mentioned in the logbook. If the employee was not a claimant, the radiation files for employees matching the names mentioned in the logbook were requested from DOE. For

multiple hits (several radiation files of employees with the same last name), all possible matches were requested. NIOSH then evaluated the logbook data against the data in the Health Physics file, where available. Information in the logbook and Health Physics file were evaluated for exact matches where monitoring periods in both sources were identical and agreement existed where the logbook cycle covered only a portion of the period identified in the Health Physics file (e.g., Logbook information may cover one month while only a quarterly value is listed in the Health Physics file.) Individual results evaluated (not inclusive of the 36 non-claimants) were found by NIOSH to be consistent between the logbook and the Health Physics files for those individuals reviewed (NIOSH 2006c).

A concern raised in the working group was that this comparison covered only the years 1966-1968, and individuals assigned to the plutonium areas. An expanded evaluation of logbooks for additional areas and years was requested. The expanded logbook review examined a total of 65 logbooks with 43 containing individual data adequate enough to attempt a comparison. Names were pulled from 36 logbooks.

In their analysis, values in Health Physics files were determined to either have exact matches (in agreement), to be consistent with logbook entries (either the dose record or logbook entry were not specific enough to determine exact match), or to be inconsistent. The NIOSH evaluation reported (NIOSH 2006m):

> *This evaluation found a 96% rate of agreement between data found in various logbooks, and the data found in the worker's radiation files. We found no evidence of a systematic lack of corroboration between logbooks and the individual worker radiation files which would cast doubt on the integrity of Rocky Flats dosimetry data, nor was there any evidence of inappropriate manipulation of workers' dosimetry results.*

They indicated the small numbers of confirmed mismatches were consistent with the types of clerical errors expected in a data set composed of hundreds of thousands of dosimetry results.

SC&A was asked to perform a validation and analysis of the logbook comparisons conducted by NIOSH. All the individuals (claimant and non-claimant) identified and evaluated by NIOSH in both the *Logbook 12-12-66 to 12-31-68* comparison and the expanded logbook comparison were reviewed, except those for which a Health Physics file was not available. Logbook entries relating to smaller incidents, personnel contamination, and exposure to other radionuclides were added to the SC&A evaluation since they were not well represented in the logbook entries selected by NIOSH. Entries from a total of 36 logbooks were reviewed for consistency with Health Physics files and HIS-20, where data was available. The logbook entries were divided into those related to external exposures and those related to internal exposure. Quantitative external dosimetry data was first compared to information in the Health Physics files. The smallest increment of time covering the period in question (e.g., quarterly, cycle) was used for comparison. Eleven of the thirty-one person-entries were compared to data from the hard copy NDRP data printouts in the Health Physics file.

This data was not available for twenty individuals so information from the *RFP Coworker Stats (NDRP Included, HIS_20)* file was used for comparison. In many cases this was not helpful

since the file contained primarily annual doses. Bioassay data from the urinalysis logbooks was compared to the results from the individual bioassay cards, the Health Sciences Data System (HSDS) printout, and the HIS_20 urinalysis logbook where available. The Health Physics files were reviewed to determine if reports and/or monitoring data were available for *in vivo* counts, wound counts, incidents, skin contaminations, dosimeter issues, and qualitative information. A summary of these data validations are provided in Tables 1 and 2. Individual entry comparisons are provided in Attachment 5.

The individuals selected by NIOSH for comparison were primarily from the 20 urinalysis logbooks and included approximately 65% of the sample set. The urinalysis logbooks covered January 1, 1960 through May 11, 1971, and included gross alpha, electroplating, plutonium, and americium results. The field logbooks covered June 4, 1957 through August 24, 1971. Nineteen of the individuals from the *Logbook 12-12-66 to 12-31-68* evaluation were also evaluated in the expanded logbook review.

There were thirty-one entries with qualitative and quantitative external dosimetry results. All but one entry was consistent with the value in the Health Physics file. Consistency was defined as an exact match or a logbook result that was less than the quarterly dose for the quarter encompassing the badge cycle. In some cases only the annual dose was available. Where possible, the cycle data was used for comparison. Three instances of overexposed, contaminated or destroyed dosimeters were identified. There was no indication of a dosimetry investigation in all three. Three instances of dose adjustments were noted in the field logbooks; however, no documentation regarding these particular adjustments was located in the Health Physics file. Eleven of the thirty-one individuals had hard copy NDRP data. The original gamma and neutron doses were compared to the logbook values. Only one instance of the eleven was found to be inconsistent. For the remaining twenty person-doses, the logbook was compared to the data in the *RFP Coworker Stats (NDRP Included, HIS_20)* file. There was a single instance where the dose values were inconsistent. Thirty percent of the individuals were not in the coworker dose file and therefore were considered inconclusive.

Overall, the comparison of urinalysis data between logbooks (field and urinalysis) and the Health Physics file was good. Approximately 94% of the results agreed. In eight cases, Health Physics files were not available. There were four individuals with numerical differences between the logbook and the Health Physics file. Bioassay results were also compared to the values in the HIS-20 database. 58% of the bioassay results from the urinalysis and field logbooks agreed with data in the HIS-20 database. The remaining 42% were absent from the HIS-20 database. These include both plutonium and uranium results, with some representing what SC&A believes are significant bioassay results. This further raises concerns regarding the appropriateness of using the electronic database urinalysis data for internal coworker dose determination.

The analysis for *in vivo* results was qualitative as specific results were generally not listed in the logbook. If there was an *in vivo* count documented within one week of the date mentioned in the logbook, the two sources were considered consistent. 86% of the logbook entries were consistent with the information found in Health Physics files. One individual did not have an *in vivo* count in his Health Physics files even though he was referred for an *in vivo* count. In four instances the Health Physics file was unavailable. Six out of six individuals had wound count

information in the Health Physics files. Seven out of seven individual had skin contamination reports in the Health Physics file for the dates mentioned in the field logbooks. In the case of incidents, those chosen by NIOSH all had incident reports in their Health Physics files. Only one of the four additional individuals selected by SC&A had a report related to the incident in their Health Physics file. Incidents such as spills and fires appear to be poorly documented in the Health Physics files. In the three cases were an incident report was not available, bioassay immediately following the event was also not available.

The *1966-1969 Special Analysis Logbook* (RFP 1966b), included bioassay results for Sr-90, Po-210, Np-237, tritium, and thorium. The NIOSH review indicated (NIOSH 2006a):

> *Eight cases from the 1966-1969 Special Analysis Logbook did not have matching information in the radiological files. Six of the eight had results of zero for the analyte of interest.*

The names corresponding to those evaluated from the *1966-1969 Special Analysis Logbooks* (RFP 1966b) were not provided to the working group or SC&A for review. The specific names of individuals used for comparison have been requested and will be integrated if time permits. NIOSH indicated in their analysis that only 16 out of 24 individuals had bioassay data for tritium, polonium, strontium, neptunium, and thorium. The agreement of only 67% of dosimetry data with urinalysis data in the *1966-1969 Special Analysis Logbooks* indicates a significant gap exists in the Health Physics files concerning monitoring other radionuclides (e.g., thorium, tritium, curium, and neptunium).

Data from the field logbooks referencing individuals working with or around radionuclides other than plutonium, americium, and uranium were identified; however, only two individuals had Health Physics files available. Both individuals were potentially exposed to thorium in 1960. No thorium or gross alpha bioassay data were available; however, electroplating data was available one week after the date of reference in the logbook. This method was primary used to determine enriched uranium in urine. Falk (2004) indicated in the internal TBD that site information about possible interferences with this method is not available. The absence of gross alpha and radionuclide specific data to determine internal exposure from thorium, polonium, neptunium, and other transuranics may prevent assessment of internal dose for these radionuclides. An alternative method would be to assume the bioassay value was equivalent to the plutonium values. The *Technical Basis for Rocky Flats Plant – Occupational Internal Dose* (Falk 2004) stated:

> *Interferences were likely in the period 1952 through 1962 because of a lack of specificity of the chemical procedure to isolate only the plutonium in the extract. Plutonium results would include some americium and thorium activity.*

Furthermore,

> *From 1963 to 1977, the ion exchange method significantly reduced interferences from americium, uranium, and thorium. As the PHA system was phased in starting in 1973, the possibility of interferences was further reduced. After 1977, these interferences were*

*not a significant issue for plutonium urine results because all samples were counted on the PHA system.*

The radiochemistry for plutonium allowed only some of the thorium and americium to come through, and was limited primarily to the pre-1963 time period. If thorium was the predominate radionuclide of concern, as was the case with the U-233 processing, use of plutonium bioassay results may underestimate thorium uptakes. Information on interferences by polonium, neptunium, and other transuranics were not specifically addressed. Any of the techniques used for determining internal exposure to alpha emitters would not be useful in determining uptakes of Sr-90. The absence of gross beta or radionuclide specific data creates a bioassay gap for those exposed to Sr-90. In general, tritium bioassay data is well documented on bioassay cards in Health Physics files starting in the early 1970s. Prior to this the tritium bioassay data is sparse. Although the bioassay cards in the late 1960s had thorium as an analysis type, no thorium bioassay results were observed in the approximately 150 individual files examined.

In summary, the following conclusions can be drawn from the comparison of logbook information with Health Physics file data and HIS-20 data.

1) NIOSH has indicated they reviewed 450 boxes of documents including some with logbooks; however, no input was provided by NIOSH to the working group on the outcome of this initial broader review. Scanned copies of pertinent logbooks identified in this broader review were not scanned and made available to the working group and SC&A.

2) The review was limited to the 59 logbooks available on the O-drive that consisted primarily of logbooks requested by SC&A for review of specific areas and time periods.

3) A logbook sampling plan was not submitted to the working group for review, as requested. As a result, the selection of logbook entries did not provide a representative sampling. The recommended coverage for the logbook review, discussed at the July 26, 2006 working group meeting (ABWRH 2006b), included both plutonium and non-plutonium areas. The period of interest was from 1969-1999. NIOSH covered non-plutonium areas for 1957-1960 and 1968, plutonium areas from 1964-1971, and urinalysis data from 1960, 1962, and 1964-1971.

4) Logbook entries relating to smaller incidents, badge contamination and/or destruction, and exposure to other radionuclides were not well represented in the NIOSH sampling. In many cases, gaps in the Health Physics file were noted for this group.

5) 96% of the external dosimetry data from thirty-one individuals had consistent data between the field logbooks and the corresponding Health Physics file. 30% of thirty-one individuals were not found in the HIS-20 database, and therefore were considered inconclusive.

6) 94% of the bioassay results from the urinalysis and field logbooks agreed with the individual bioassay cards in dosimetry records. Eight were considered inconclusive because the Health Physics file was not available for comparison.

7) 58% of the bioassay results from the urinalysis and field logbooks agreed with data in the HIS-20 database. The remaining 42% were absent from the HIS-20 database. These include both plutonium and uranium results, with some representing what SC&A believes are significant bioassay results.

8) 86% of the entries indicating *in vivo* counts in the field logbooks had corresponding *in vivo* counts in the individual Health Physics files. The Health Physics file was unavailable for four individuals.

9) The agreement of only 67% of dosimetry data with urinalysis data in the *1966-1969 Special Analysis Logbooks* determined by NIOSH indicates a significant gap exists in the Health Physics files concerning monitoring other radionuclides (e.g., thorium, tritium, curium, and neptunium). The names corresponding to those evaluated from this logbook were not provided to SC&A or the working group for validation.

10) Entries from logbooks validate the destruction of contaminated badges for at least some cases in the 1950s and 1960s. There was a limited sampling because the Health Physics file for most of those noted in the logbooks was not available. There were no records of a dosimetry investigation in the two examples where badges were destroyed. One individual had no dose while the other had a positive dose. Further investigation into destruction of badges and subsequent dose assignment is needed.

11) The medical record serves as an additional source of incident information that may or may not be reflected in the radiation exposure file.

There was no indication of systemic discrepancies between logbook entries and internal and external data within the Health Physics records where DOE records were available for comparison. However, as previously noted, the logbooks selected by NIOSH for evaluation were not necessarily representative of RFP operational time periods or facility-specific production activities. Significant gaps were identified in HIS-20 external dosimetry and urinalysis data, including positive results. The evaluation also found that the Health Physics files are incomplete as they relate to dosimetry investigations, bioassay for other radionuclides, and incident reports. The logbook review yielded minimal information pertaining to discrepancies between field exposure conditions and dosimetry readings raised in the petition.

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## Logbook Analysis (DRAFT)

Table 1: Summary Results for External Exposure Logbook Analysis.

| | | | Number | | |
|---|---|---|---|---|---|
| **Description of Entry** | **Number in Category** | **Comment** | **Consistent or Exact** | **Inconclusive** | **Not Consistent** |
| Overexposure Notation | 5 | Exposures for the monitoring period were in excess of DOE exposure limits. | 5 | 0 | 0 |
| Overexposed or Contaminated Film | 3 | There was no indication of investigations regarding how dose was eventually assigned. | 0 | 3 | 0 |
| Dose Adjustments | 3 | There was no indication of dose adjustments in the Health Physics file. | 0 | 3 | 0 |
| Exposure Values Recorded in Logbook vs. NDRP | 11 | Original neutron and/or gamma data was compared to the dose values reported in the logbook. Where available, the specific period of time referenced in the logbook was used. | 10 | 0 | 1 |
| Exposure Values Recorded in Logbook vs. Coworker Stats | 20 | Six individuals were not listed in the coworker stats file. | 13 | 6 | 1 |
| Exposure Values Recorded in Logbook vs. Health Physics File | 31 | There were six situations where exact matches were found. This corresponded to situations were the logbook provided either an annual or quarter dose. In the situation were the dose did not match, there may have been an issue with inadvertent exposure of the badge to neutrons. No investigations were identified in the individuals Health Physics file to confirm this. | 30 | 0 | 1 |
| Extremity Dose | 1 | Annual dose was greater than the dose through the date of logbook entry. | 1 | 0 | 0 |

1 There were two individuals without hard copy Health Physics records available.
2 The same individual may fall into more than one category.

Table 2: Summary Results for Internal Monitoring/Exposure Logbook Analysis.

| | | | Number | | |
|---|---|---|---|---|---|
| **Description of Entry** | **No. in Category** | **Comment** | **Consistent or Exact** | **Inconclusive** | **Not Consistent** |
| *In Vivo* Results Recorded in the Logbook vs. the Health Physics Record | 37 | The inconclusive entries were due to the unavailability of the Health Physics file with one exception. The incident file for one individual indicated that he was recommended for an *in vivo* count; however, there was no evidence that this occurred. | 32 | 4 | 1 |
| Wound Contamination/ Monitoring | 6 | All Health Physics Files evaluated had documentation on a wound count for the data in question. | 6 | 0 | 0 |
| Incident Involvement | 12 | Three additional incidents were selected beyond those selected by NIOSH. These incidents involved a fire and a spill. No follow-up bioassay was completed following these incidents. | 9 | 0 | 3 |
| Skin Contamination Events | 7 | All Health Physics Files evaluated had documentation on a skin contamination event. | 7 | 0 | 0 |
| Bioassay Results Recorded in the Logbook vs. the Health Physics Record | 233 | There were no Health Physics files available for eight person-entries; therefore, these were considered inconclusive. The four individuals with inconsistent results had numerical differences between what was listed in the logbook and the Health Physics file. | 220 | 8 | 4 |
| Bioassay Results Recorded in the Logbook vs. HIS_20 Results | 233 | The inconclusive entries were primarily the result of absence of data in the HIS_20 Urinalysis file. The two individuals with inconsistent results had numerical differences between what was listed in the logbook and HIS_20 Urinalysis results. | 133 | 98 | 2 |
| Other Radionuclide Monitoring | 2 | According to logbook entries, the two individuals were involved in operations where potential there was a potential for thorium exposure. Health Physics records were evaluated for availability of gross alpha and/or thorium analysis. There was an electroplating result one week after the logbook entry. | 0 | 2 | 0 |
| Urinalysis Requested | 2 | Where the field logbook indicated a urine sample was requested, a urine result was found in the general time period. | 2 | 0 | 0 |