National Institute for Occupational Safety and Health
Division of Compensation Analysis and Support

DEPARTMENT OF HEALTH & HUMAN SERVICES

Memorandum

To: Kansas City Plant (KCP) SEC Working Group

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Subject: KCP dosimetry database validation and verification (V&V)

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BACKGROUND

In 2001, KCP created an electronic database to facilitate their access to dosimetry information. In response to a data request from NIOSH, a KCP site health physicist extracted information from the database, placed the data into a spreadsheet, and provided it to NIOSH on March 3, 2004[1]. That spreadsheet contains internal and external dosimetry data for the years 1950 through 2003. Within the spreadsheet, there are 14,759 lines, with each line containing between one and five individual records. Each individual record is the sum of the individual monitoring results collected throughout a given year. The spreadsheet does not contain names or social security numbers; however, KCP transferred the complete database with this information to NIOSH on February 9, 2012, via Iron Key[2].

On January 6, 2006, NIOSH used the spreadsheet data to develop a coworker model in the Site Profile for KCP[3]. The NIOSH Evaluation Report for Special Exposure Cohort (SEC) 210, typically referred to as SEC-00210, uses the coworker model to bound some doses.

As an action item relating to the KCP SEC Working Group (WG) Issues one and nine, NIOSH committed to perform a V&V of the database that was previously used for the coworker model.

[1] Site Research Database (SRDB) Reference Identification Number (Ref ID) 14707
[2] SRDB Ref ID 111136
[3] SRDB Ref ID 20217, PDF pp. 23

At the July 2015 WG meeting, NIOSH described the plan for V&V of the database and showed a copy of the template used to compile the data. NIOSH stated that we would extract the raw data from DOE-supplied dose records in NOCTS and compare them to the data previously used for the coworker model. The NOCTS files contain 223 claims with external dosimetry records, and 95 claims with internal dosimetry records. NIOSH also stated its intention to compare 100% of the NOCTS dosimetry records contained within the 318 claims to the database records. At that July 2015 meeting, the WG agreed that comparison sampling would be an appropriate method for validating the electronic database.

DATA ENTRY ACTIONS

Beginning their work on August 24, 2015, and completing it by September 30, 2015, five data-entry staff compiled the external dosimetry data from claimant files located in NOCTS. The staff entered data in a single pass with periodic stops to peer review the data. The data entered by one person was peer reviewed by another staff member so that the same person was not reviewing his or her own work. This amounted to a 100% peer review of the data entered.

After completing the external data entry, staff compiled "Uranium in urine" (U in U) results for the identified claimants. Two data-entry staff inserted this in vitro analysis data into the spreadsheet and the staff performed another peer review to identify and correct any discrepancies or errors.

There were several different formats for staff to decipher while entering data. Attached to this memo are examples of the various record formats KCP used over the years. In the end, the data entry staff compiled 5,878 lines of data on the spreadsheet, with each line containing between one and seven individual records.

Compilation method for NOCTS data

NIOSH developed a template for data entry staff to use while entering the separate claim data into the spreadsheet. There were nineteen columns set up for possible data entry.

A	B	C	D	E	F
NIOSH #	Source of data	Page	Last Name	First Name	SSN

The first six columns, as shown above, contain required information identifying the claim and the person for whom the data belong.

NIOSH # (column A of the spreadsheet) refers to the NOCTS claim number.

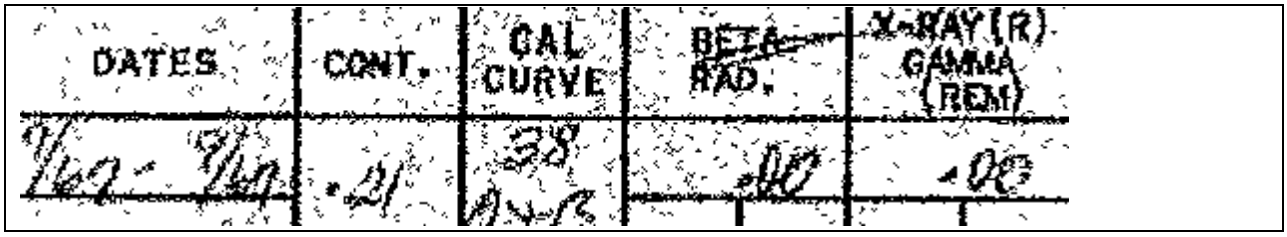
Source of data (column B) refers to the DOE Response or Personnel Exposure file(s) where the data were located. For example, an entry in this column might appear as *DOE Response_000000_D143* or *Personnel Exposure_000000_D143_vX*.

Page (column C) refers to the page where the data are located in the DOE Response or Personnel Exposure file.

Last Name (column D), **First Name** (column E), and **SSN** (column F) information are taken from one of the first pages of the DOE Response file for each claim.

G	H
Start	Stop

The **Start** and **Stop** (G & H above) list the **start** date (i.e., beginning) and **stop** date (i.e., end) of the particular date range for a set of readings. Referring to the example shown below, the data entry staff entered the start data (column G) as *7/1/1967* and the stop data (column H) as *9/30/1967*. The typical record format is that KCP lists the month and year without listing the actual date. Unless given in the specific date, the staff assumed the first day of the month was the start date and the last day of the month was the stop date.



I	J	K	L	M	N	O	P	Q	R	S
RAD	Roent	REM	Neutron	unit	Deep or Whole Body	unit	Shallow or Skin	unit	U in U (µg/L)	COMMENTS

Staff labeled the remaining columns, as shown above, after reviewing a sample of the NOCTS records and determining the available types of data.

RAD, **Roent** and **REM** (columns I, J, and K) are necessary because much of the data from earlier years was provided with only these descriptors. Staff recorded the data, as found, in the column with a matching label. The staff did not attempt to interpret data, and recorded it in only one column.

The three **unit** columns (columns M, O and Q) are for **units** and have drop down menus. When data entry staff encountered nonstandard units or information, they notified their supervisor and added comments to column S.

The **COMMENTS** column (column S) is included to list any explanations that may have been included on the data report or information that the data entry staff felt were important to understand the data entered.

Assumptions

Due in part to the different formats encountered, the data entry staff made some assumptions under the guidance of their supervisor and the lead health physicist for the KCP V&V study. These assumptions are below and are in no particular order:

- The staff entered "M" in the Deep (column N) and Shallow (column P) columns of the Excel spreadsheet when the results were reported that way in the dosimeter (TLD or Film) vendor's report (usually Landauer or Eberline).
- When the staff found an "M" on logbook records without any other designation, the result of "M" (indicating 0 exposure) was entered in the Neutron column (column L).
- The staff entered REIRS data only when there were no other data in the claim response for the applicable period.
- For the U in U data, staff entered the date of the sample in the Start column (column G) for the cycle or range start date.
- Regarding duplicates, if dates were within 5 days, staff considered the results duplicate as long as the dates fell within the cycle or range.
- Film Badge Register Reports list the run or print dates, and not the actual exposure period; therefore, the staff left the date columns blank when recording these data.

COMPILATION RESULTS

On October 1, 2015, three health physicists began compiling the database data used in the KCP Site Profile's coworker model (i.e. Deep, Neutron, Shallow, and U in U) onto the spreadsheet. The HPs inserted two rows into the spreadsheet after each set of annual exposures for an employee. In the first row, the HPs summed the NOCTS data, and in the second row, they inserted the annual total from the database. The HPs completed this preliminary work on October 19, 2015.

NIOSH noted that the hand-entered film-badge dosimetry data (typically seen on exposure records prior to 1965 in NOCTS) had columns labeled "RADS" and "ROENT." When KCP transferred this information into the database, they used the ROENT value for Deep dose, and ROENT + RADS for Shallow dose.

External exposure record comparison

There were 1,502 external-exposure annual totals compared between the sum of the NOCTS raw records and the database annual totals. Of those, 1,462 or 97% were determined to agree. Of the 40 entries with some level of disagreement, 27 are associated with the database or NOCTS

listing an actual zero value and the other having no recorded value (i.e. blank). NIOSH noted that many of these blanks are concentrated to certain individuals. In other words, there were not 27 separate employees affected, but instead when NIOSH did not locate corroborating evidence for a record, often that employee had several records unsubstantiated, and one employee accounted for five discrepancies.

KCP used Landauer dosimetry services for both gamma and neutron monitoring[4]; however, the Landauer forms do not distinguish between neutron or gamma doses[5], and NIOSH data entry staff assumed it was gamma. However, in some cases KCP assigned these exposures to the neutron category in the database. An explanation could be KCP's process knowledge or other documentation that directed them to enter the Landauer data as neutron exposures; however, without KCP's process knowledge, NIOSH determines there to be a discrepancy.

An assumption NIOSH made during NOCTS data entry for this V&V was that an "M" on logbook records, without any other designation, indicated a neutron exposure of zero. This assumption may account for many of the 15 disagreements where NOCTS records show an "M" and the database is blank for neutron exposure for that year.

For several of the database blanks, NIOSH noted that NOCTS records included comments that may explain why KCP did not include the record with the database annual totals. These comments include, "Badge read early" and "Employment terminated."

NIOSH found 13 discrepancies associated with a greater than zero exposure. Of these 13, 12 were for exposures that were less than 70 millirem, and of these, four employees had two errors each. One discrepancy is associated with a NOCTS record with the comment "light leak on film."

NIOSH classified eight additional entries as *unverified* because of legibility issues with the NOCTS records. Requesting a cleaner copy from KCP would most likely resolve this discrepancy. One reason for the legibility issues is that KCP recorded exposure data on the individual's 3-inch × 5.5-inch Exposure-record cards that were prone to fading. In addition, KCP's and NIOSH's image-capturing ability during earlier years was a lower quality than today's capabilities. See Attachment Example 1.

Internal exposure record comparison

When analyzing internal data, NIOSH found 173 annual totals compared between the sum of the NOCTS raw records and the database annual totals. Of these, 162 or 94% were determined to agree. Similar to the external dose comparison, nine discrepancies are associated with the database or NOCTS listing an actual zero value and the other having no recorded value (i.e., blank). For the two remaining discrepancies, one appears to be a data entry error by KCP

[4] SRDB Ref ID 20217, PDF pp. 26
[5] NOCTS DOE Response_007960_D143, PDF pp. 3-7

because the database shows 4.55 µg/l and NOCTS records indicate it was 4.5 µg/l. For the other discrepancy, the database indicates a 9.5 µg/l annual exposure and NOCTS is blank.

NIOSH classified 10 additional U in U entries as *unverified*, because of legibility issues with the NOCTS records. Requesting a cleaner copy from KCP would most likely resolve this discrepancy. One reason for the legibility issues is that KCP recorded bioassay data on either the individual's film badge envelope or the annual 3-inch × 5.5-inch radiation exposure-record cards[6] that were prone to fading. In addition, KCP's and NIOSH's image-capturing ability during earlier years was a lower quality than today's capabilities. See Attachment Example 1.

KCP monitored workers for DU intake from 1959 to 1971 using a fluorophotometric method to measure the level of uranium in urine. As a note, while doing the comparison of the internal records, NIOSH observed that the U in U values reported in the database are the sum of the individual urinalysis results collected throughout a given year. Of the 175 annual person records that were compiled from the NOCTS data, 112 of them only had one urine same for that year. The maximum number of samples in a given calendar year was six, with an average of 1.7 samples per calendar year. In general, the 95th percentile of the annual maximum urine result from the NOCTS data was within a factor of 50% for all years but one (the one year that was not within 50% was within a factor of two), as compared to the 95th percentile of the annual summed data from KCP database. Though this is a limited sample size, NIOSH expects that using the KCP database to estimate coworker exposures is a claimant-favorable estimate of the true coworker value without being a gross overestimate. The KCP Site Profile currently notes that bioassay data maybe reported as annual sums and if an individual's records do not yield the details of sample collection, then the dose reconstructors should make the claimant-favorable assumption that the recorded bioassay quantities represent a single bioassay measurement taken at the end of the calendar year[7].

CONCLUSION

On November 6, 2015, NIOSH provided the WG with the spreadsheet used to compare NOCTS data to the KCP database. On November 12, 2015, NIOSH conducted a technical call to help explain and discuss the spreadsheet.

Based on a review of available data, NIOSH has determined that KCP faithfully transferred dosimetry information from raw exposure records into an electronic format, and that information, used by NIOSH to develop a coworker model, is sufficiently accurate.

[6] SRDB Ref ID 15928 PDF pp. 5-15
[7] SRDB Ref ID 20217 PDF pp. 20

Reviewed and Concurred by:

[redacted]

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