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

DEPARTMENT OF HEALTH & HUMAN SERVICES

Memorandum

To: Mound Plant Working Group

From: Peter Darnell, DCAS Health Physicist

Subject: Validation and Verification of Mound Databases

Date: September 6, 2016

BACKGROUND

During development of the NIOSH responses to the Mound Plant Technical Basis Document (TBD) Issues Matrix, questions arose regarding the validation and verification (V&V) of several databases used in the reconstruction of doses at Mound. This memorandum describes the various databases and provides descriptions:

1. The quality assurance processes used to develop the list of names for the Mound Environmental Safety and Health (MESH) database;
2. The V&V of the internal dosimetry database; and,
3. The V&V of the external dosimetry database.

GENERAL DISCUSSION

The MESH Database

The Mound site created the MESH database between 1988 and 1990 as a single-source repository for personnel occupational safety, health, and radiation dose monitoring information.[1] In 1989 (Meyer, 1994d),[2] MESH became the record database for external dose monitoring information after merging the external dose records maintained in the earlier external dose databases, the "External Exposure Analysis System" (EXAS), from 1959, and the "Environmental Radiation" system (ERAD), from 1977 (Meyer 1994d, pg. 3) . Though Mound uploaded some internal dose information to MESH, MESH never became a single dose-of-record location for internal dose monitoring results. Rather, internal dose information was kept in hard-copy logbooks.

Dose Reconstruction Information

DOE provides records for dose reconstruction in response to EEOICPA Project (Project) requests. These records typically include MESH printouts for external dose monitoring and tritium bioassay results, database printouts for employees with monitoring for plutonium intakes,

[1] Mound employed the MESH database and quality assurance using formal procedures as described in the technical manual, M-10326, NONWEAPONS QUALITY ASSURANCE (NWQA) PLAN FOR THE MOUND ENVIRONMENTAL, SAFETY AND HEALTH (MESH) DATA SYSTEM. References relating to the development of MESH are listed in the table below.

Title	SRDB Ref ID
Mound Environmental, Safety and Health System (MESH) Implementation Plan	036414
Legacy Management Description of MESH	036415
MESH Subject Areas Display	036416
MESH system overview	036418
MESH Table Definitions	036425
Non-weapons Quality Assurance (NWQA) Plan for the Mound Environmental, Safety and Health System (MESH)	048315

[2] Mound's H.E. Meyer compiled an exhaustive history of Mound external dosimetry program in his *History of Personnel External Dosimetry Program at the Dayton Project and Mound Laboratory, 1946 – 1993*, (Meyer 1994 a-h), in eight volumes. It consists of several timeline overviews, a 57-page narrative document summarizing major activities by year, along with appendices with supporting memoranda and technical documents. Because the appendices are interspersed with the narrative in an unusual configuration, and due to the extremely large volume of information, for the convenience of the reviewer page numbers are provided for each reference.

and database printouts for polonium intake monitoring. DOE provides scans of original records for polonium, plutonium, and "other" radionuclides. NIOSH uses all of these records for the dose reconstruction process.

1. The list of names used to develop the MESH data

NIOSH does not maintain a list of names from the MESH database. Instead, DOE provides employee records that include MESH information. NIOSH has access to the MESH database. DOL does not use the MESH database to establish eligibility for the class established under SEC-0090. Instead, the primary tritium records in logbooks identify individuals monitored for tritium. NIOSH provided this information to the DOL.

2. V&V of the internal dosimetry database

No comprehensive internal dose-monitoring database exists for the Mound site. Mound implemented the MESH system as a full-service electronic repository for all Mound employee health information, including external and internal dose monitoring. The MESH system, however, did not reach full functionality before closure of the site in 2006.

Herbert Meyer, in his *History of Mound Bioassay Programs* (Meyer 1992), identifies no computerized records; listing logbooks and file cards instead. This is in contrast with the external dosimetry records practice, as described in the same author's external dosimetry program history document (Meyer 1994 a-h).

Contractors to the Mound site created the PURECON database in the early 1990s using plutonium hard-copy logbooks. Meyer and Reeder (1992) describes the industry-standard practices used for quality assurance and control of the data entry.

The Mound health physics group did not maintain a Polonium database before the Pre-1989 Dose Reconstruction project conducted by the MJW Corporation (described in more detail below). The Mound site completed the polonium program (and stopped performing polonium bioassay) in 1973 before efforts were initiated to collect all dose monitoring information in a single database such as ERAD or MESH.[3] Based on the fields available on the data cards used for EXAS, only external dose could be entered in this database (Meyer 1994c, 215—216). In addition, logbooks (MJW 2002a, 32) contained results for "Other radionuclides.[4]" Data for

[3] See section 3 of this document for a description of these databases.

[4] "Other" radionuclides (as referred to in the Working Group discussions) include uranium, thorium, and other radionuclides associated with short- or long-term research projects conducted at Mound.

tritium are available in MESH records and include individual bioassay results from September 1981 onward.

Creation and QA/QC for PURECON and PORECON

The University of Lowell (Meyer and Reeder 1992) created the (PURECON -short for Plutonium [PU] Reconstruction) database from primary records. The MJW Corporation's internal dose reconstruction project at Mound called the "Pre-1989 Dose Reconstruction" project and MJW's work as part of ORAUT on the EEOICPA project are not related. In addition to reconstruction of pre-1989 internal doses, the project

- Conducted a V&V of the PURECON database;
- Created a database for polonium data to complement the existing database for plutonium; PORECON, (short for POlonium RECONstruction); and,
- Created Excel Spreadsheets for "other radionuclides" when data contained neither polonium nor plutonium results.

The MJW V&V was a 5% review of the PURECON database against the hard-copy records. It found an error rate of approximately 8.2%. This prompted a 100% V&V check because of the unacceptable error rate. MJW identified approximately 2347 errors in 58,893 records; an error rate of ~ 4% (MJW 2001a, 44). MJW corrected errors in the data as they were identified.

The MJW reports on the project (MJW 2002a, MJW 2002b) provide details of the review of the PURECON database and creation of the PORECON database, including QA/QC methods for data entry. The PURECON and PORECON databases, at this time, exist as reference sources of information for dose reconstruction. DOE records from the employee files provide internal dose monitoring data for individual dose reconstructions.

NIOSH used PURECON, PORECON, and MESH data for the NIOSH/ORAUT internal coworker dose studies documented in the technical information bulletin, *Internal Dosimetry Coworker Data for the Mound Site, Rev 02* (ORAUT 2012). NIOSH did not conduct a V&V of these Mound databases for this technical information bulletin. The Mound TBD addresses use of the databases:

In Section 5.5.1.2, *Polonium*:

Primary and secondary records exist in most Mound claim files for polonium bioassay. The dose reconstructor should typically use the bioassay results listed in the PORECON database as most convenient. However, it is important to review all claim records to ensure the database reflects all listed bioassay results in the primary data.

In Section 5.5.2, *Plutonium*:

Primary and secondary records exist in many Mound claim files for plutonium bioassay. The dose reconstructor should typically use the listed bioassay results in the PURECON database as most convenient. However, it is important to ensure that the database reflects all bioassay results that are listed in the primary data. The dose reconstructor will also need to ensure that PURECON reflects earlier measurements using the gross alpha methodology and ensure that the gross alpha samples were taken as a plutonium intake monitoring program rather than another radionuclide that used the gross alpha bioassay method (ORAUT 2013).

And again in Section 5.8.2:

The dose reconstructor should keep in mind that both gross alpha and alpha spectrometric programs were used to detect ^{238}Pu, and that the PURECON database results should be verified against the primary data in claim files, even though PURECON results are typically listed as gross alpha results when this is the case (ORAUT 2013).

3. Validation and verification of the external dosimetry database

NIOSH did not create a database of external dosimetry information for Mound claims. Instead, the dose reconstruction process uses the MESH database printouts supplied in individual claim histories as references for external dose information.

The MESH database, though not comprehensive for internal dosimetry, is the dose-of-record for external doses. In September 1989, Mound transferred ERAD data into the MESH database (Meyer 1994g, 33). MESH represents the culmination of a series of Mound computer databases serving as primary records for external dosimetry. A brief chronology of Mound external dose computerized record-keeping methods follows.

- May 4, 1959: Mound converts from Form 1015-X to "IBM cards" for neutron results. Beginning January 2, 1960 (Meyer 1994a, 135), Mound enters all external dosimeter

(photon, neutron, and pocket dosimeter) results on IBM cards. Form 1015 cards document non-neutron doses in employee files for 1959. Dosimetry technicians record "all data" on IBM cards for the EXAS ADP program (Meyer 1994a, 126). [5]

- 1973: Recovery of individual dosimeter results using EXAS failed. Mound created a report documenting the results of all employee external dose monitoring from 1947 through 1973 (records before late 1949 apply to external dose monitoring for the Dayton Project). The report, dated October 28, 1974, contains "annual summaries of individual employee exposures" (Meyer 1994c, 208) and is updated annually through 1978 (Meyer 1994c, p. 198).
- 1977: The Mound information technology group (MISD) developed a new database called ERAD and implemented it in 1978 (Meyer 1994a, 16). ERAD contains complete Mound external dosimeter information (dosimeters issued and zero/non-zero results.
- 1989 (September): ERAD converted to MESH (Meyer 1994g, 33).

Only electronic data are available from about 1960 onward. Claims with employment before 1960 have the Mound external dosimetry result forms, Forms 1015 and 1015-X. Some hand-written records remain in employee files dating through the 1950's and 1960's (NIOSH/ABRWH 2009). Validation and verification of the external dosimetry reference, MESH, is possible for only those years with corresponding electronic and handwritten records.

SC&A (NIOSH/ABRWH 2009) conducted a V&V of 22 of 477 claims from the MESH database. The claims selected had starting dates of January 1950 (or later) for comparison of the latest MESH database with the handwritten records. The V&V evaluated about 4,000 pages covering about 530 occupational years. The review found 100% of the claims had MESH data sheets in their DOE records, 99.6% accuracy for photon doses, and 100% accuracy for neutron doses. The Mound WG (NIOSH/ABRWH 2009) closed the external dosimetry V&V issue on May 27, 2009.

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[5] At first, Mound issued separate IBM cards for pocket dosimeter results. In 1963 (March 17), Mound implemented a Kardex system to allow the recording of a year's data on a single card for each employee. This change apparently had no effect on the film dosimeter record-keeping practices.

4. REFERENCES

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