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ADVISORY BOARD ON RADIATION AND WORKER HEALTH

NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH

A PRELIMINARY REVIEW OF NIOSH'S PROGRAM EVALUATION REPORT DCAS-PER-037, "AMES LABORATORY TBD REVISION"

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S. COHEN & ASSOCIATES: ***Technical Support for the Advisory Board on Radiation & Worker Health Review of NIOSH Dose Reconstruction Program***	Document No. SCA-TR-PR2013-0037 Effective Date: Draft – January 2, 2013
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Record of Revisions

Revision Number	Effective Date	Description of Revision
0 (Draft)	01/2/2013	Initial issue

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ABBREVIATIONS AND ACRONYMS

A&A	Attributions and Annotations
ABRWH or Advisory Board	Advisory Board on Radiation and Worker Health
AWE	Atomic Weapons Employer
DCAS	Division of Compensation Analysis and Support
DOE	Department of Energy (U.S.)
DR	Dose Reconstruction
EEOICPA	Energy Employees Occupational Illness Compensation Program Act
IREP	Interactive RadioEpidemiological Program
LAT	lateral
µg/d	micrograms per day
µg/L	micrograms per liter
NIOSH	National Institute for Occupational Safety and Health
OCAS	Office of Compensation Analysis and Support
ORAUT	Oak Ridge Associated Universities Team
PA	posterior to anterior
pCi/d	picocuries per day
PEP	Program Evaluation Plan
PER	Program Evaluation Report
POC	Probability of Causation
SC&A	S. Cohen and Associates (SC&A, Inc.)
SEC	Special Exposure Cohort
SRDB	Site Research Database
TBD	Technical Basis Document
TIB	Technical Information Bulletin

1.0 STATEMENT OF PURPOSE

To support dose reconstruction (DR), the National Institute for Occupational Safety and Health (NIOSH) and the Oak Ridge Associated Universities Team (ORAUT) have assembled a large body of guidance documents, workbooks, computer codes, and tools. In recognition of the fact that all of these supporting elements in DR may be subject to revisions, provisions exist for evaluating the effect of such programmatic revisions on the outcome of previously completed DRs. Such revisions may be prompted by document revisions due to new information, misinterpretation of guidance, changes in policy, and/or programmatic improvements.

The process for evaluating potential impacts of programmatic changes on previously completed DRs has been proceduralized in OCAS-PR-008, *Preparation of Program Evaluation Reports and Program Evaluation Plans* (OCAS 2006), Revision 2, dated December 6, 2006. This procedure describes the format and methodology to be employed in preparing a Program Evaluation Report (PER) and a Program Evaluation Plan (PEP).

A PER provides a critical evaluation of the effect(s) that a given issue/programmatic change may have on previously completed DRs. This includes a qualitative and quantitative assessment of potential impacts. Most important in this assessment is the potential impacts on the Probability of Causation (POC) of previously completed DRs with POCs of <50%.

As needed, a PEP may be issued that serves as a formal notification of an impending PER. The PEP provides a preliminary description of the issue(s) that will be addressed in the PER, and summarizes the likely scope of the effort required to complete the PER.

During an Advisory Board meeting on November 1, 2012, SC&A was tasked by the Board to conduct a review of DCAS-PER-037, *Ames Laboratory TBD Revision* (DCAS 2012). In conducting a PER review, SC&A is committed to perform the following five subtasks, each of which is discussed in this report:

Subtask 1: Assess NIOSH's evaluation/characterization of the "issue" and its potential impacts on DR. Our assessment intends to ensure that the "issue" was fully understood and characterized in the PER.

Subtask 2: Assess NIOSH's specific methods for corrective action. In instances where the PER involves a technical issue that is supported by document(s) (e.g., white papers, technical information bulletins, procedures) that have not yet been subjected to a formal SC&A review, Subtask 2 will include a review of the scientific basis and/or sources of information to ensure the credibility of the corrective action and its consistency with current/consensus science. Conversely, if such technical documentation has been formalized and previously subjected to a review by SC&A, Subtask 2 will simply provide a brief summary/conclusion of this review process.

Subtask 3: Evaluate the PER's stated **approach** for identifying the universe of potentially affected DRs, and assess the **criteria** by which a subset of potentially affected DRs was selected for re-evaluation. The second step may have important implications in instances

where the universe of previously denied DRs is very large and, for reasons of practicality, NIOSH's re-evaluation is confined to a subset of DRs that, based on their scientific judgment, have the potential to be significantly affected by the PER. In behalf of Subtask 3, SC&A will also evaluate the timeliness for the completion of the PER.

Subtask 4: Conduct audits of DRs affected by the PER under review. Based on information contained in Table 1 (and discussed in Section 3.1 below), the number of DRs selected for audit for a given PER will vary. (It is assumed that the selection of the DRs and the total number of DR audits per PER will be made by the Advisory Board.)

Subtask 5: Prepare a comprehensive written report that contains the results of the above-stated subtasks, along with our review conclusions.

2.0 SUBTASK 1: IDENTIFY THE CIRCUMSTANCES THAT NECESSITATED THE NEED FOR DCAS-PER-037

DCAS-PER-037 was issued on July 17, 2012, in response to a series of technical revisions to the Ames Laboratory Technical Basis Document (TBD) (ORAUT-TKBS-0055) and the sequential designation of four classes of employees at Ames for addition to the Special Exposure Cohort (SEC) authorized under EEOICPA.

While some changes incorporated in these revisions increased the assigned doses, others resulted in a decrease. As stated in DCAS-PER-037, all changes introduced in Revision 01, Revision 02, and Revision 03 of ORAUT-TKBS-0055 (ORAUT 2009, ORAUT 2011a, and ORAUT 2012, respectively) reflect formal internal reviews by ORAUT, as well as NIOSH review comments.

2.1 CHANGES INCORPORATED IN REVISION 01 OF ORAUT-TKBS-0055

On December 18, 2009, **Revision 01** of the Ames TBD (ORAUT 2009) was issued, which contained the following changes that impacted dose estimates:

- Incorporated SEC-00075. This class includes all employees and subcontractors at Ames Laboratory from January 1, 1942, through December 31, 1954.

- Occupational Medical Doses. In Revision 00, it had only been **assumed** that pre-employment medical chest x-rays used a posterior to anterior (PA) exposure geometry. In the absence of empirical documentation, dose estimates to skin and other organs were also derived for a lateral (LAT) exposure geometry. As a result, Tables 3-1 through 3-6 were modified and Tables 3-7 and 3-8 were added for each of the four time periods.

- Default Intake Values (for workers without bioassay data). Select default intake values that were cited in Table 5-7 of Revision 00 were corrected in Table 5-8 of Revision 01.

- Revision to Unmonitored Doses before 1953. Sections 6.2.1 and 6.3.1 of Revision 01 of the Ames TBD were revised to address changes for deriving external doses. Prior to 1953, reference to ORAUT-OTIB-0004 was replaced with methods described in Battelle-TBD-6000 (Battelle 2006a) and Battelle-TBD-6001 (Battelle 2006b). Section 6.3.1.2 of Revision 01 was modified to include coworker doses between 1952 to the present. For Ames Laboratory, the label of an unmonitored worker includes workers who were not monitored, as well as monitored workers without dosimeter records or whose records were incomplete.

2.2 CHANGES INCORPORATED IN REVISION 02 OF ORAUT-TKBS-0055

On January 14, 2011, Revision 02 of the Ames TBD (ORAUT 2011a) was issued, which contained the following changes salient to dose reconstruction:

- Revision 02 included SEC-00075. This SEC class **includes** sheet metal workers, plant maintenance and associated support staff, and supervisory staff who worked at least 250 days from January 1, 1955, through December 31, 1970.

- Revision 02 **initiated** the inclusion of SEC-00166. This class includes **all** employees and contractors with at least 250 days employment between January 1, 1955, and December 31, 1960.

- Section 5.1.1.3 (Resuspension During Periods with No Uranium Operations) was updated with internal intake data from SEC-00166. Changes involved daily inhalation and ingestion values in the Chemistry Building, which increased from 1.8 and 0.16 pCi/d to 4.1 and 0.68 pCi/d as given in Table 5-4.

- In 1951, a **hot laboratory** that had operated in the Chemistry Building since 1943 was replaced by a **hot** cell. Revision 01 had stated that "… Intakes from the hot cell would have been negligible." This statement was deleted in Revision 02 with the acceptance of SEC-00166, which stated that "… intakes from the hot cell cannot be determined for radionuclides other than **uranium**.

- Occupational Medical Exposure. In Revision 00 of the Ames TBD, Occupational Medical Exposure was defined for the PA exposures geometry of chest x-rays as a requirement for employment.

  In Revision 01, occupational medical exposures were amended to include the LAT exposure geometry for chest x-rays.

  In **Revision 02**, medical occupational exposures were no longer included, based on the following explanation:

  > *Occupational medical exposures are only included for medical examinations obtained at the Ames Laboratory facility (ORAUT 2011*[c]*). There were no X-ray examinations performed **onsite**, therefore **no** occupational medical exposures were incurred.* [Emphasis added.]

2.3 CHANGES INCORPORATED IN REVISION 03 OF THE ORAUT-TKBS-0055

On January 3, 2012, Revision 03 of the Ames TBD was issued, which incorporated the following changes salient to dose reconstruction:

- Expanded the three previous SEC classes by defining a fourth; SEC-00185 class. SEC-00185 encompasses **all** previous Ames SEC periods and includes **all Ames employees and contractors** with 250 or more workdays for the period August 13, 1942 (the official start of the Manhattan Project), through December 31, 1970.

- Section 5.4.1 was amended for those Research Building workers who after 1951 did **not** work with the hot cell or associated laboratories. Exposures for these workers are to be limited to **environmental** internal and external doses.

- Changes to unmonitored external doses were made due to the fact that Battelle 2006a was updated to Battelle 2011, and Battelle 2006b was cancelled and replaced with other references. Changes in surrogate dose models altered select internal exposure estimates cited in Section 5.1, as well as external dose estimates, as given in Tables 6-4, 6-5, and 6-6.

Summary of Revisions and Their Impacts

While some of the aforementioned revisions resulted in an increase in assigned dose, others decreased the dose, and still others decreased in an earlier revision and increased in a subsequent revision, as summarized below:

- Revision 01 increased uranium intakes for researchers in the Ames Chemistry Building from August 1942 through December 1953. This change remained unchanged in Revisions 02 and 03. Revision 01 also added LAT exposure dose estimates to occupational medical exposure.

- External dose for unmonitored workers for some job categories before 1946 increased in Revision 01, remained the same in Revision 02, but increased again in Revision 03.

- External dose for unmonitored workers between 1946 and 1953 decreased for **all** job categories and locations in Revision 01, remained the same in Revision 02, but increased in Revision 03.

- Revision 02 increased uranium intakes for **all** employees in the Chemistry Building for the period January 1954 through May 1976. These higher intakes remained unchanged in Revision 03. All occupational medical exposures were eliminated in Revision 02 and Revision 03.

2.4 SEC CLASSES ADDED

NIOSH added classes to the SEC in 2006 and 2007 to include worker groups based on work locations and job descriptions. On November 5, 2010, the final SEC class was added.

The 2010 class determined that the information available about worker job descriptions, work locations, and/or movement about the site was insufficient to determine if an employee worked in any of the affected areas identified in prior SEC classes. Thus, in 2011, NIOSH designated a fourth class (SEC-00185) that included all Ames employees/contractors for all previous Ames SEC periods with one exception: the covered period's start date was switched from January 1, 1942, to August 13, 1942, to coincide with the start of the Manhattan Project. Thus, the covered period for SEC-00185 extended from August 13, 1942, through December 31, 1970.

3.0 SUBTASK 2: ASSESS NIOSH'S SPECIFIC METHODS FOR CORRECTIVE ACTION

As previously stated in Section 1.0 above:

> *. . . In instances where the PER involves a technical issue that is supported by document(s) (e.g.,* ***white papers, technical information bulletins, procedures) that have not yet been subjected to a formal SC&A review, Subtask 2 will include a review of the scientific basis and/or sources of information to ensure the credibility of the corrective action and its consistency with current/consensus science.*** *Conversely, if such technical documentation has been formalized and previously subjected to a review by SC&A, Subtask 2 will simply provide a brief summary/conclusion of this review process.* [Emphasis added.]

It must be noted that there have been several instances among completed reviews of PERs by SC&A in which technical issues were supported by documents that had not been previously evaluated by SC&A. Their inclusion in the PER review, however, was considered manageable and appropriate. For example, in behalf of OCAS-PER-014, *Construction Trades Workers* (OCAS 2007b), SC&A critically evaluated the technical support provided by Technical Information Bulletin (TIB) ORAUT-OTIB-0052, *Parameters to Consider When Processing Claims for Construction Trade Workers* (ORAUT 2011b). However, as discussed below, the magnitude of the changes to the Ames site profile encompassed by this PER far exceed those that we have experienced in the past, and the scope of work required to evaluate these revisions is more akin to site profile as opposed to PER reviews. This issue is discussed in greater detail below, along with SC&A's suggestions on how the Board might best deal with this unique circumstance.

3.1 DOCUMENTS SALIENT TO DCAS-PER-037 THAT HAVE NOT BEEN EVALUATED

Our evaluation of DCAS-PER-037 with regard to documents considered relevant to this review has identified the following documents, **none of which SC&A has been requested to evaluate**:

Site Profiles

- ORAUT-TKBS-0055, Rev. 00, (06/22/2007) Site Profile for Ames Laboratory (ORAUT 2007c)
- ORAUT-TKBS-0055, Rev. 00 PC-1, (08/20/2008) Site Profile for Ames Laboratory (ORAUT 2008)
- ORAUT-TKBS-0055, Rev. 01, (12/18/2009) Site Profile for Ames Laboratory (ORAUT 2009)
- ORAUT-TKBS-0055, Rev. 02, (01/04/2011) Site Profile for Ames Laboratory (ORAUT 2011a)

- ORAUT-TKBS-0055, Rev. 03, (01/03/2012) Site Profile for Ames Laboratory (ORAUT 2012)

SEC Petitions

- Petition SEC-00075: January 1, 1955 through December 31, 1970
- Petition SEC-00166: January 1, 1955 through December 31, 1960
- Petition SEC-00185: August 13, 1942 through December 31, 1970

SEC Petition Evaluation Reports

- SEC Petition Evaluation Report: Petition SEC-00075 (January 1, 1955, through December 31, 1970), Approved May 14, 2007 (OCAS 2007a).
- SEC Petition Evaluation Report: Petition SEC-00166 (January 1, 1955, through December 31, 1960), Approved July 30, 2010 (DCAS 2010b).
- SEC Petition Evaluation Report: Petition SEC-00185 (August 13, 1942, through December 31, 1970)—REVISED, Revised July 14, 2011; corrects the start date to match the Manhattan Engineering District start date (DCAS 2011).

Technical Guidance Documents

- ORAUT-OTIB-0079, 2011, *Guidance on Assigning Occupational X-Ray Dose under EEOICPA for X-Rays Administered Offsite, Rev. 00* (ORAUT 2011c)
- DCAS-IG-003, 2010, *Radiation Exposures Covered for Dose Reconstructions Under Part B of the Energy Employee Occupational Illness Compensation Program Act, Rev. 01* (DCAS 2010a)

3.2 PRELIMINARY FINDINGS AND THE NEED FOR A FORMAL REVIEW OF SALIENT DOCUMENTS

The need to thoroughly evaluate the above-cited documents prior to our review of DCAS-PER-037 is supported by SC&A's **very preliminary** review of the Ames Laboratory's TBDs (ORAUT-TKBS-0055, Rev. 00 through Rev. 03). Presented below is but a sample of potential issues that the Subcommittee on Procedures Review/Board may have to address.

3.2.1 Use of Potentially Inappropriate Dose Models/Surrogate Data

Uranium Inhalation. From the very beginning of the Manhattan Project in 1942 through 1953, monitoring of worker exposures to uranium at Ames Laboratory was either absent or insufficient for DR. Surrogate data in Revision 00 of ORAUT-TKBS-0055 (ORAUT 2007) was based on ORAUT-OTIB-0004 (ORAUT 2005), which was replaced by Battelle-TBD-6000, Revision F0 (Battelle 2006a), and Battelle-TBD-6001, Revision F0 (Battelle 2006b), in Revision 01 (ORAUT 2009) and Revision 02 (ORAUT 2011a) of the Ames TBD.

In Revision 03 (ORAUT 2012), internal doses from uranium metal were based on Battelle-TBD-6000, Revision 01 (Battelle 2011) and Christofano and Harris 1960. The questionable use of these data/dose models is largely based on unsupported **assumptions**, as discussed in Section 3.2.4 below.

Exposure to Thorium Contamination after 1954. Air concentrations and daily intakes as given in Table 5-5 of the Ames TBD were **derived** by extrapolation from (1) the 1995 wipe survey data of the East Pipe Tunnel located in the sub-basement of Wilhelm Hall, and (2) the 95th percentile air concentration for "General Air Samples" as reported in Table III by Paul B. Klevin in a 1952 survey (Klevin 1952).

SC&A has reviewed these sources and questions their applicability for use in DR.

3.2.2 Use of NUREG-1400 for Modeling Intakes of Fission Products

Between 1943 and 1951, workers at the **Ames hot laboratory** separated plutonium from uranium and their associated fission products. In the absence of empirical survey/bioassay data, Table 5-7 of the Ames TBD provides modeled estimates based on a generic formula defined in NUREG-1400: *Air Sampling in the Workplace* (Hickey et al. 1993):

$$I_p = Q \times 10^{-6} \times R \times C \times D \qquad \text{(Eq. 1)}$$

where,

Q = total quantity of unencapsulated material
R = release fraction
C = confinement factor
D = dispersibility

The intent of NUREG-1400 is to assist licensees in establishing air sampling programs that conform with recommendations in the 1992 Regulatory Guide 8.25, Revision 1, *Air Sampling in the Workplace* (NRC 1992), and the regulatory requirements stated in 10 CFR Part 20 (NRC 1991). Thus, modifying factors for the intake I_p are based on **licensed facilities** that reflect current-day timeframes of operation. For example, the **10^{-6}** factor cited in Equation 1 represents a rule of thumb that applies ". . . when **normal** precautions are taken [and] a worker is not likely to have an intake I_p exceeding 10^{-6} of the material being handled . . ." [Emphasis added.]

In brief, very little is known about the operation of the Ames hot laboratory that operated between 1943 and 1951, and generic values and guidance provided in Section 1.2 of NUREG-1400 focused on air sampling needs and was never intended for use in DR.

3.2.3 Unsupported "Attributions and Annotations"

Revision 01 of ORAUT-TBKS-0055 (ORAUT 2009) contains a total of 44 Attributions and Annotations (A&As), many of which are based on little or no recorded information or records. For example, the above-cited concerns regarding the "hot laboratory's environmental releases as

well as worker intake estimates of fission products" must be viewed in context with A&As, which state:

A&A #10

> *. . . The exact nature of the **hot laboratory** used in the 1940s was **not** discovered in the records. **Presumably**, it would have involved some methods for recognizing and controlling the spread of contamination with some filtration on the exhausts, but it was **unlikely** that the controls of the hot laboratory were as good as those for the hot cell.* [Emphasis added.]

A&A #26

> *Strontium is type F with the exception of the titanate form, which is rare. There is no reason to **suspect** strontium titanate was in use at Ames Laboratory.*
> [Emphasis added.]

A word search for the words **assume, assumed, assumption,** and **presume** in Revision 3 of ORAUT-TKBS-0055 (ORAUT 2012) identified a total of **114** instances (85 in the text of TBD and 29 in A&As). In most instances, these words were prefaced with ". . . because no information/ . . . no data/ . . . no records were found an assumption was made . . ." For illustration, Section 5.1.1.1 of ORAUT-TKBS-0055 is reproduced here as Exhibit 1 with key words/phrases highlighted and underlined.

EXHIBIT 1: Section 5.1.1.1 of ORAUT-TKBS-0055

5.1.1.1 Uranium Inhalation

From 1942 through August 1945, individuals working in Physical Chemistry Annex 1 (also known as Little Ankeny) can be assigned doses from inhalation of uranium [12]. Similarly, individuals who worked in the Chemistry Building during this period or in Physical Chemistry Annex 2 from 1944 through December 1945 should be assigned doses from inhalation of uranium [13]. Job titles of researchers acknowledged for their work in uranium production (Fulmer 1947) include (1) chemist, (2) associate chemist, (3) junior chemist, (4) research assistant, (5) junior research assistant, (6) physicist, (7) analyst, (8) assistant physicist, (9) associate director, and (10) director. However, it is not entirely clear how much time these researchers spent in the area where production was performed.

Because it is not clear if there were clerical, janitorial, or nontechnical personnel and other types of researchers working in these buildings, and it is not known what precautions might have been taken for contamination control, it can be assumed that all individuals who worked in the buildings had some potential for exposure to uranium.

The data in Tables 5-1 and 5-2 were derived from data in Christofano and Harris (1960). In Christofano and Harris (1960), there is a description of the process for metal reduction that is similar to the process used at Ames Laboratory for production of uranium metal (Fulmer 1947). The primary difference appears to be that at Ames Laboratory the process used granulated calcium metal and at AWE sites the process used magnesium. Fulmer (1947) describes the process using magnesium, and it appears to be similar enough to be representative of the intakes at Ames Laboratory.

Table 5-1. Chemistry Building uranium intakes (pCi/d)

Period	Inhalation	Ingestion
Aug 1942–December 1953	8.5[a,b]	0.09[b]

a. No data were available for determination of intakes in the Chemistry Building; therefore, it was assumed that research activities would have one-hundredth the intake of production activities since uranium metal production was moved to the Physical Chemistry Annex 1.

b. Values are for workers assumed to work in research or production full time. For supervisors, assume one-quarter of the intake; for all other employees (clerical, janitorial, security, etc), assume one-tenth of the supervisor's intake.

Table 5-2. Physical Chemistry Annex 1 uranium intakes (pCi/d)

Period	Inhalation	Ingestion
Aug 1942–December 1945	853[a]	8.7[a]

a. Values are for workers assumed to work in research or production full time. For supervisors, assume one-quarter of the intake; for all other employees (clerical, janitorial, security, etc), assume one-tenth of the supervisor's intake.

Exhibit 1 (Continued)

Table 5-2. Physical Chemistry Annex 1 uranium intakes (pCi/d)

Period	Inhalation	Ingestion
January 1942–December 1950	6,061[a]	124[a]
January 1951–December 1953	5,556[a]	114[a]

a. Values are for workers assumed to work in research or production full time. For supervisors, assume one-quarter of the intake; for all other employees (clerical, janitorial, security, etc), assume one-tenth of the supervisor's intake.

Christofano and Harris (1960) provide data for multiple stages of the production operation for operators. Using the techniques outlined in *Default Assumptions and Methods for Atomic Weapons Employer Dose Reconstructions* (Battelle 2007), the values in the above tables were calculated from Table 8 of Christofano and Harris (1960). However, review of Ames Laboratory documentation did not reveal any information specific enough for determination of who would be responsible for what aspects of the process and for how long. Therefore, the value used for determining inhalation intakes, which was from Christofano and Harris (1960, Table 8), is for the Bomb Preparation operator, who is assumed to work a 2400-hour year. This value was the highest intake rate for the metal reduction process. This number is then scaled for the potential for intake (see Tables 5-1 and 5-2).

Battelle (2011) provides data for a process of scrap recovery that is similar to the scrap recovery process described in Fulmer (1947). Data from Battelle (2011, Table 7.8) are used in Table 5-3 for Ames Laboratory workers who worked in the Physical Chemistry Annex 2 building. The value used in Battelle (2011, Table 7.8) represents the most conservative intake for the scrap recovery operations, similar to those performed in Physical Chemistry Annex 2.

Research in the Chemistry Building began in January 1942. For workers involved only in research from January through July 1942 in the Chemistry Building, an exposure of one-tenth of that of the workers involved in the production operations is assumed, which corresponds to smaller quantities of uranium [14]. This period is prior to the beginning of the covered period for the EEOICPA statute, which is August 1942, the start of the Manhattan Engineer District, known later as the Manhattan Project. The process developed by this research was moved to the Physical Chemistry 1 building in July/August of 1942. There are very few details on the research activities in the Chemistry Building after July 1942; therefore, it was assumed that another one-tenth fraction should be applied (for a 1/100 reduction overall from operations). These intakes should be applied to researchers in the Chemistry Building through 1953, when production ended.

Individuals supervising the production processes were assumed to be exposed for one-fourth of the time of the production staff [15].

For workers not directly associated with uranium metal research or production, an exposure of one-tenth of that of the supervisors was assumed (see Tables 5-1, 5-2, and 5-3) [16].

Exhibit 1 (Continued)

The intakes in Tables 5-1, 5-2, and 5-3 were compared to the few actual bioassay results found for workers in approximately the same period. Chapter 7 in Stone (1951), "Uranium Excretion Studies," provided data from a series of uranium bioassays obtained from Ames Laboratory workers in 1944 and 1945. Of special interest was a series of samples from the supposedly highest exposed worker at Ames Laboratory and samples from the most highly exposed group of workers at the Laboratory (21 samples from 11 workers). An intake evaluation was performed on the results for the highest exposed worker assuming chronic intake from the start of that person's employment and absorption type M uranium (the document indicated the person was exposed to UF_4). The estimated intake was 1,200 μg/d or 820 pCi/d assuming natural uranium. This is consistent with the intake estimate in Table 5-2 for Physical Chemistry Annex 1 and quite a bit lower than that in Table 5-3 for Annex 2. The average bioassay result for the group of highest exposed workers was 75 μg/L. Assuming chronic intake for 1 year before the bioassay, the estimated intakes were:

- Absorption type F: 390 μg/d, 260 pCi/d
- Absorption type M: 1,670 μg/d, 1,100 pCi/d
- Absorption type S: 45,400 μg/d, 31,000 pCi/d.

If the geometric mean of the data is used, the estimated intakes are smaller; if the highest bioassay result of the set is used, the estimated intakes are 2.7 times greater. For type M, this range is still consistent with the intakes in Tables 5-1, 5-2, and 5-3. . . .

3.2.4 Failure to Address U and Th Blowouts as Significant Environmental Events

ORAUT-TKBS-0055, Revision 3 (ORAUT 2012), Section 4.5, *Significant Environmental Event*, states the following:

> *The **only significant environmental event in the history** of the Ames Laboratory was the release to the environment from operations that occurred from July 1951 through August 1952. Metallic thorium was being produced from thorium nitrate tetrahydrate. During an early stage of the process, a filtrate with traces of thorium in the form of thorium nitrate and oxalate was released to the sewer that connected to the City of Ames sewer system.* [Emphasis added.]

These statements are in conflict with earlier statements contained in Section 2.3 of the TBD that include the following:

> *There were **frequent small explosions and fires** associated with the uranium and thorium production operations (Payne 1992). Payne (1992) cited as many as six small fires in a single day; these fires contributed to work-area contamination and potential airborne radioactive material exposures. **No records were found to indicate that air sampling or contamination control was associated with these fires**.* [Emphasis added.]

Moreover, these statements not only understate the magnitude of these events, but totally ignore environmental releases, as well as potentially high internal doses to workers, as reported by SC&A in three previous draft reports.

In the first and second draft reports [*Review of the Ames Laboratory Special Exposure Cohort (SEC) Petition SEC-00038* (SC&A 2006) and *An Assessment of Worker Eligibility Criteria* (SC&A 2007b)], SC&A identified to the Advisory Board the relatively common radiological incidents of chemical explosions or "blowouts" at the Ames facility in context with the 250-workday requirement. In response to SC&A's concern, the Advisory Board appointed an ad hoc working group chaired by Dr. James Melius to further evaluate this issue. The work group requested SC&A to (1) review all available records/sources that would establish the **frequency of such events**, and (2) **provide scoping calculations that would assess reasonable estimates of potential internal exposures associated with a single event**.

This request was fulfilled in a third SC&A draft report, *The Relevance of the 250-Workday Requirement to Potential Exposures Associated with a Single Blowout* (SC&A 2007a), which was submitted on March 22, 2007. Included in the report were several personal recollections of blowouts by Dr. Frank H. Spedding, Director of the Ames Laboratory, who provided the following accounts:

> *. . . Although I remember one night we had an explosion that **blew the whole south end of the building** out and being an old wooden building, when things quieted down we all went outside and shoved the wall back in again and went to work.*

> . . . *Mr.* [name deleted] *was adding a booster to the reactor in a room a few doors down the hall from my office. Suddenly there was a* ***terrific explosion*** *which blew out several of the windows in the front of the Chemistry Building. When I came out of my office to see what happened, the corridor was filled with dust about six feet above the floor to the ceiling . . .* [Emphasis added.]

The third SC&A report (2007a) was the central topic of discussion for the Work Group Meeting of the Advisory Board on November 29, 2007. Much of the discussion focused on the feasibility of bounding doses associated with blowouts, identifying those individuals (with less than 250 workdays and/or a cancer not included under SEC rules) who may have been exposed to one or more blowouts, and **the promise by NIOSH to reconsider the inclusion of blowouts in dose reconstruction** [see pp. 133 through 158 of the November 29, 2007, meeting transcript (ABRWH 2007)].

4.0 SUBTASK 3: EVALUATE THE PER'S STATED APPROACH FOR IDENTIFYING THE NUMBER OF DRS REQUIRING RE-EVALUATION OF DOSE

Based on time periods of facility operations at the Ames Laboratory and changes introduced in Revisions 01, 02, and 03 to the Ames Laboratory TBD (ORAUT-TKBS-0055), NIOSH identified two discrete groups of claimants in DCAS-PER-037 whose previous dose reconstruction may have been affected by changes in the final revision of (i.e., Rev. 03) of ORAUT-TKBS-0055.

4.1 IDENTIFICATION OF TWO EMPLOYMENT PERIODS

The **first group** of potentially affected claimants involves workers with employment before 1954 and whose DRs were processed before January 3, 2012, with POC values of less than 50%. NIOSH identified 19 claims with the following breakdown:

- Two claims met the criteria for inclusion in the SEC-00185 class
- Seven claims had **previously** assigned organ doses that were ≥ what would currently be assigned under Revision 03 of ORAUT-TKBS-0055
- The remaining 10 claims were subject to a new DR using the criteria defined in Revision 03 of ORAUT-TKBS-0055

The **second group** of claims was based on the same criteria as the first group, except the required employment changed to January 1954 through June 1976. NIOSH identified a total of 61 claims that met these criteria with the following results:

- Sixteen claims qualified for the inclusion in the SEC-00185 class.
- The remaining 45 claims were reviewed to determine whether Chemistry Building intakes had been assigned using a previous revision of the ORAUT-TKBS-0055. The review identified that six claims had been assigned Chemistry Building intakes based on previous version of the TBD.
- These 6 claims (along with the 10 claims from the first group) were subject to a DR under the criteria defined in Revision 03 of ORAUT-TKBS-0055.

Of the total 16 claims (10 from the first group and 6 from the second group) that were re-evaluated using Revision 03 of the Ames TBD, 13 claims yielded POC values below 45%. The remaining three claims with POCs >45% were evaluated by expanded IREP iterations. This yielded only one claim with a POC that exceeded 50%.

4.2 SC&A's COMMENTS REGARDING CORRECTIVE ACTIONS TAKEN BY NIOSH FOR IDENTIFYING CLAIMS/DRs THAT MAY REQUIRE FURTHER EVALUATION

NIOSH's criteria for the selection of claims potentially affected by DCAS-PER-037, as well as the protocol for their new DR, are based on several revisions to the Ames TBD, several additions to the SEC class, and recently issued guidance documents that impact DR.

Due to the fact that SC&A has not been requested to review these documents, our comments pertaining to corrective actions [that include the selection of affected claims and revised method(s) for dose reconstruction] must be viewed as premature and of limited value.

SC&A concludes that a credible evaluation of DCAS-PER-037 will have to await a decision by the Subcommittee on Procedures Review on the need to include a full review of all documents relevant to the genesis of PER-037.

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