Draft White Paper

FOCUSED REVIEW OF "WHITE PAPER: FOLLOW-UP EFFORTS ON SEC-00192 RFP TRITIUM ISSUES"

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FOCUSED REVIEW OF "WHITE PAPER: FOLLOW-UP EFFORTS ON SEC-00192 RFP TRITIUM ISSUES"	Page 2 of 15
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TABLE OF CONTENTS

FOCUSED REVIEW OF "WHITE PAPER: FOLLOW-UP EFFORTS ON SEC-00192 RFP TRITIUM ISSUES"

This report was prepared in support of the ongoing deliberations related to the ability to reconstruct tritium exposures to Rocky Flats Plant (RFP) personnel during the pre-1973, 1973, and post-1973 time periods, which are the three key issues described in the subject white paper.

1.0 BACKGROUND

According to, *Investigation of the Tritium Release Occurrence at the Rocky Flats Plant* (AEC 1973), the Department of Energy (DOE) became aware of a release of tritium to the offsite environment in 1973 as a result of environmental monitoring programs performed by the State of Colorado. Substantial follow-up investigations were performed at that time to understand the reasons for the release and to quantify the tritium exposures to workers associated with the receipt and handling of material that was contaminated with tritium. Apparently, the release was unexpected, because the shipments received by RFP from weapons complex facilities should not have contained substantial quantities of tritium. This incident is of concern to NIOSH under the Energy Employee Occupational Illness Compensation Program Act (EEOICPA), because it indicates that workers at RFP might have been exposed to unmonitored sources of tritium on an intermittent or possibly chronic basis prior to 1973. In light of this concern, NIOSH issued the subject white paper describing the protocol that it plans to use to reconstruct exposures before, during, and after the incident. This report presents a review of this document with respect to the three dose reconstruction approaches presented for pre-1973, 1973, and post-1973.

2.0 DESCRIPTION OF THE 1973 INCIDENT AND THE ASSOCIATED TRITIUM EXPOSURES

The subject white paper (Bogart et al. 2013) describes a number of different types of activities at RFP where workers might have been exposed to elemental tritium gas and tritiated water. However, there appears to be general consensus that, except for the receipt of contaminated shipments of plutonium from other weapons complex facilities, there was very little potential for exposure to tritium at RFP. In addition, until the events that took place in 1973, there appears to have been a general belief that there was little or no potential for exposure to tritium at RFP from these incoming shipments of plutonium, because any tritium associated with these shipments was to have been removed prior to being shipped to RFP.

According to an Atomic Energy Commission (AEC) report titled, *Investigation of the Occurrence of the Tritium Release Occurrence at Rocky Flats Plant* (AEC 1973), representatives of the State of Colorado Department of Health (CDH) informed the Dow Chemical Company, contractor for the AEC-owned RFP, that elevated levels of tritium were detected in water samples collected from Walnut Creek, a stream that receives waste waters from RFP, and also in Great Western Reservoir, which receives water from Walnut Creek. After considerable investigation, it became clear that a shipment of plutonium scrap delivered to RFP in April 1973 from Lawrence Livermore National Laboratory was the source of this tritium contamination, and that the total release was between 500 and 2,000 Ci of tritiated water.

In light of this experience, it is reasonable to inquire whether similar incidents occurred in the past and at what frequency. This is a difficult question to answer, since it appears that with the exception of bubblers located at exhaust plenums (in some, but not all areas), there was very limited onsite tritium monitoring prior to 1973 that would have detected such occurrences, and apparently the bubblers did not detect the 1973 release. However, page 13 of the white paper refers to a ChemRisk report (ChemRisk 1994, pdf p. 285), which identifies three other tritium releases prior to 1973, including 57 Ci in April 1969, 40 Ci in March 1971, and 29 Ci in November 1971. This is supportive of the contention that the 1973 release was by far the largest release of tritium from RFP.

Section IIA of the AEC report indicates that the CDH routinely collected and analyzed water samples for a number of analytes, including tritium, beginning in May 1969, and that "no significant increase in tritium concentration above background (CDH quotes background as 1,200 +/- 300 pCi/L) had been detected by CDH at the Walnut Creek and Indiana Sampling point until April 1973…" (AEC 1973). The implications are that the 1973 incident was a one-of-a-kind occurrence. Assuming there was nothing unique about the way in which plutonium materials were processed at RFP, the lack of elevated tritium levels in water samples from Walnut Creek prior to 1973[1] is indicative that any worker exposures to tritium associated with the 1973 incident likely bounds worker exposures to tritium prior to 1973. Hence, it is instructive to review the exposures experienced by workers due to the 1973 incident as a means to bound the tritium exposures that workers experienced due to the incident, and also possibly gain some understanding of the possible exposures workers might have experienced prior to 1973. Part II of the subject white paper ("Rocky Flats Tritium Dose Assignment for 1973 and Later") prepared by E.M. Brackett is helpful with respect to this matter.

Part II is divided into several parts. The first part describes the follow-up investigations at the time, where urine samples from 250 people were analyzed for tritium following the discovery of the incident by CDH. The report explains that, due to the large number of samples, the analytical techniques employed had limited efficiencies and many samples were re-analyzed. The outcome of this process was the identification of [**less than 9**] individuals with tritium concentrations in urine above the action level of 10,000 pCi/L. It appears that the dose reconstruction approach proposed for these [**less than 9**] workers was based on a determination of the dose commitment experienced by these workers due to the 1973 incident. The reconstructed doses ranged from 1.4 to 84 mrem. This analysis is useful in bounding the doses experienced by workers due to the 1973 incident, but its application for other time periods is questionable, given the uniqueness of the tritium source term involved, as explained below.

3.0 SUMMARY AND COMMENTARY ON APPENDIX 1 TO THE WHITE PAPER

Appendix 1 to the white paper, along with its supporting documentation, provides detailed information of interest to this review. Appendix 1 to the white paper is divided into three parts, as follows:

- PART I: *Analysis of Rocky Flats Tritium Exposures for 1959–1973* by J. S. Bogard

[1] At least back to 1969 when monitoring commenced.

- PART II: *Rocky Flats Tritium Dose Assignment for 1973 and Later* by E. M. Brackett
    - Attachment A: *Rocky Flats 1973 H-3 Dose Assignment* by E. M. Brackett
- PART III: *Example RFP Tritium Dose Reconstruction* by Mutty Sharfi

The organization of the information provided in the white paper is sometimes difficult to follow. Accordingly, the SC&A review begins with Part II of the white paper, which describes the 1973 incident, the data collected as a result of that incident, and also the bioassay data collected in 1974 and 1975. These data are not only essential for reconstructing doses for 1973, but also for developing a coworker model for post-1973. Likewise, these data are also important for judging whether it is possible to reconstruct tritium exposures pre-1973 with sufficient accuracy. That question is addressed in SC&A's analysis of Part I, which follows the review of Part II. Finally, a brief review is provided for the Part III sample dose reconstruction.

4.0 PART II: ROCKY FLATS TRITIUM DOSE ASSIGNMENT FOR 1973 AND LATER – ATTACHMENT A: ROCKY FLATS 1973 H-3 DOSE ASSIGNMENT

4.1 1973 Exposures

Attachment A to Part II is essential to understanding the tritium exposures to workers in 1973. It appears that Attachment A to the white paper is an accurate representation of the material provided in AEC 1973, which serves as an important source document for the 1973 incident. The follow-up investigation to the 1973 incident included the analysis of urine samples collected from the 250 workers at RFP that had the greatest potential for exposure to tritium due to the incident. Of these, only a few workers had tritium concentrations that exceed the action level of 10,000 pCi/L. A quick hand calculation reveals that a chronic concentration of tritium in urine of 10,000 pCi/L is associated with a uniform whole-body dose of about 1 mrem/yr.[2]

Attachment A to the white paper proceeds to reconstruct the doses to each of the [**less than 9**] workers with the highest tritium concentrations in urine. A series of plots are provided showing the concentration of tritium in urine for each worker. The following is an example of such a plot for one case using alternative plausible assumptions regarding the start of the exposures showing the data for pre-distilled and distilled urine samples.[3] Note that the commencement of urine sampling did not begin until several months after the incident, and the assumptions regarding the assumed initial pattern of intake has some effect on the predicted time integrated exposures.

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[2] 10,000 pCi/L × 0.037 dis/sec-pCi × 6 keV/dis × 0.01 rad-g/erg × 1.6E-6 erg/MeV × 0.001 Mev/keV × 0.001 L/g × 1000 mrad/rad × 3.15E7 sec/yr = 1.1 mrad/yr

[3] The analysis of the tritium samples apparently employed liquid scintillation detection (LSD). LSD involves mixing a liquid sample with a liquid organic phosphor (referred to as a cocktail) and inserting the vial containing the mixture into a detector that counts the light pulses generated when the beta emissions from tritium decay interacts with the organic phosphor. If the liquid sample being analyzed is urine, it is preferable to distill the urine and collect the "water" containing the tritium before mixing the water with the cocktail. This improves the counting efficiency substantially, because the presence of dissolved and suspended solids in undistilled urine absorbs the light pulses and reduces the counting efficiency. However, with appropriate correction factors for self-absorption, a reliable estimate of the tritium concentration in urine can be made using undistilled urine.

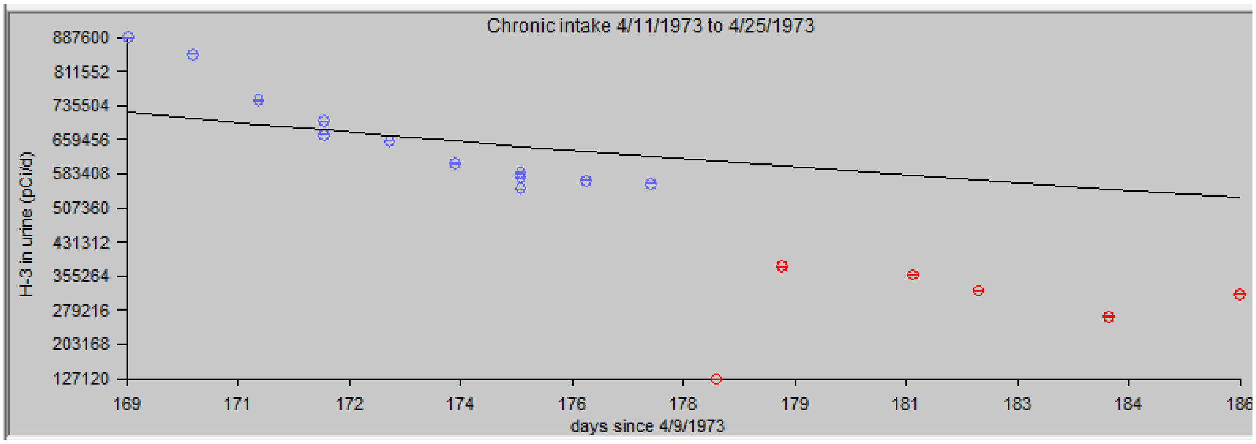
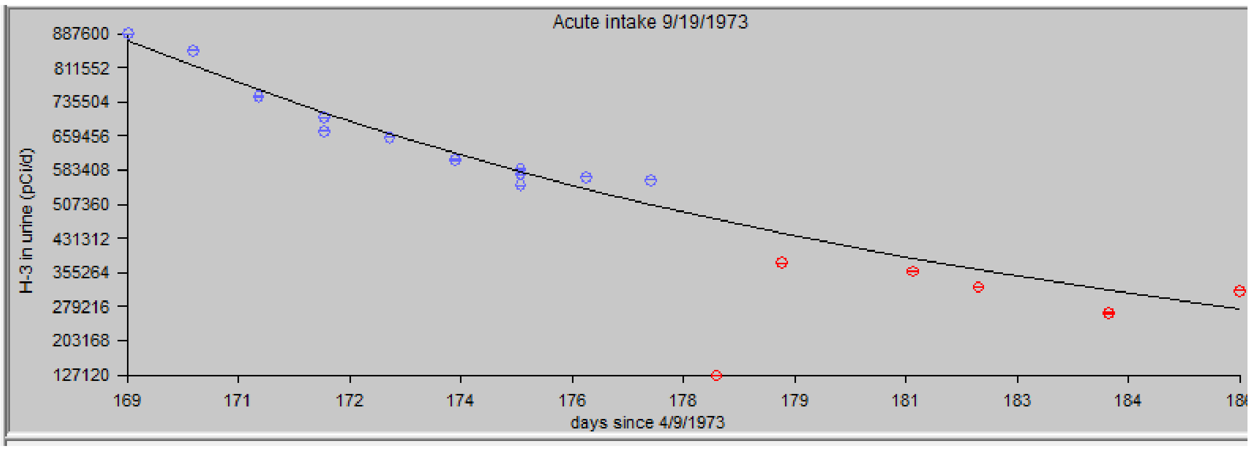


Figure A-1: Case A Chronic Intake of HTO from April 11 through April 25, 1973



[Note that the blue dots represent pre-distilled samples and the red dots represent distilled samples. Only the blue dots were used to develop the fit.]

Figure A-2: Case A Acute Intake of HTO on September 19, 1973

The plots indicate that the effective half-life of tritium in the body is about 10 days, which is consistent with the classic 10-day biological half-life of tritium. One of the limitations of this dataset is the need to back-extrapolate to the initial exposures, which likely began several months before the initial intakes might have begun in April 1973.[4]

[4] In two of the cases, the white paper assumes the initial exposures began in August and September 1973, and not in April when the release began.

Plots of this type, which are provided for each of the [less than 9] individuals, establish the basis for our understanding of the tritium exposures experienced by the most "exposed"[5] individuals following the 1973 incident. The white paper concludes with a table (Table A-5) of the tritium intakes and associated doses experienced by each worker due to the incident. However, for one of the [less than 9] workers ("Case D"), it is noted in an RFP follow-up review of the 1973 tritium exposures (Colston 1974) dated January 18, 1974, that a tritium dose of "700 mrems [sic] in the 2nd quarter of 1973" can be attributed to an "assumed chronic exposure while…in room 154, Building 779." This apparent "chronic" source of elevated tritium exposure is not clear and needs to be researched.

While we agree that NIOSH has proposed a reasonable approach to bound exposures to workers resulting from the 1973 incident, we believe that further review of the database limitations noted needs to be performed before closure can be achieved (this review is ongoing by SC&A).

4.2 1974 and 1975 Exposures

Given the 1973 incident, DOE recognized the potential for tritium exposures at RFP, and that there was a need to implement a more extensive tritium monitoring program. The next part of the Part II report addresses "Dose Assignment for 1974–1975," which describes the bioassay data collected in 1974 and 1975 and how that data was used to develop a coworker model for reconstructing tritium doses to workers in 1974 and 1975. However, before proceeding with this discussion, it is important to acknowledge that there was another tritium incident that occurred in one of the production buildings on August 30, 1974, which is described in "Investigation of Tritium Release Occurring in Building 777 on September 3-4, 1974" (AEC 1974(?)). Apparently, unusually high airborne tritium concentrations were observed in room 452 of Building 777. Normal air tritium concentrations had been <1E-8 µCi/ml, but in August and September 1974, airborne tritium concentrations were observed to be about 250 to 3,800 times the normal concentrations (on the order of 1E-6 to 2E-6 µCi/ml). It appears that these elevated concentrations were observed in an exhaust plenum of a glovebox in a room where plutonium was handled. Page 14 of the white paper states that (1) 1.5 Ci of tritium gas (not tritiated water vapor) was released to the working environment (not into a glovebox) during the August 1974 incident, (2) the release was from a shipping container, and (3) the release "can be taken as representative of shipping containers prior to 1973." These statements are important, because they go toward judging whether exposures of this type are typical of exposures that might have occurred routinely at RFP and perhaps can be used to build a coworker model, not only for 1974 and later, but also for use prior to the 1973 incident. Air samples of the tritium concentrations collected at the time indicated normal levels of <0.01 µCi/m^3 and a peak level of 37.7 µCi/m^3 in room 452 in Building 777 on August 29–30, 1974 (see Table A-2 of the white paper). It is worth noting that assuming a breathing rate of 1.4 m^3/hr, the dose commitment associated with breathing 37.7 µCi/m^3 is 3.4 mrem/hr.[6] Bioassay data collected on August 30, 1974, ranged

[5] It is unclear whether these workers with the "highest sample results" may have had exposures just a few days before they were sampled or whether other workers may have had larger acute exposures in April whose urine levels of tritium may have declined below the detection level at the time of bioassay.

[6] 37.7 µCi/m^3 × 1.4 m^3/hr × 1.73E-11 Sv/Bq × 3.7E10 Bq/Ci × 1E-6 Ci/µCi × 1E5 mrem/Sv = 3.4 mrem/hr

from 630 pCi/L to a maximum of 32,320 pCi/L. If the peak urine concentration remained constant for a year, the whole-body dose would be about 3 mrem/yr.

Given this as background, the Part II report explains that the coworker model makes use of bioassay data collected from the NIOSH/OCAS Claims Tracking System (NOCTS) claimant database for 38 workers in 1974 and 37 workers in 1975, along with guidance provided in ORAUT-OTIB-0075, *Use of Claimant Data Sets for Co-Worker Modeling* (ORAUT 2009). The challenge to developing a coworker model for tritium exposures is that tritium has a 10-day biological half-life, and if a person is intermittently exposed to tritium, it is easy to miss an intake unless the worker is on a routine bioassay program (e.g., weekly). Such a program is quite burdensome, especially if it is believed that exposure to tritium is not a frequent occurrence. Hence, the tritium bioassay program implemented in 1974 and 1975 was more of a cohort program, where 1 out of 10 of the urine samples collected for plutonium analysis was also analyzed for tritium. This sampling program resulted in an average of less than 1 sample per person per year. Hence, the challenge is how to develop a coworker model for tritium exposures given such limited data and the fact that the database is limited to claimants.

The coworker model is intended to be used to (1) reconstruct tritium doses to monitored workers in 1974 and 1975, (2) support a coworker model for possible tritium exposures for all workers in 1974 and 1975, and (3) support the conclusion that tritium exposures were of no dosimetric significance post-1975, and as a result, there is no need for routine tritium monitoring of workers.

The dataset collected in 1974 and 1975 indicates that none of the workers were observed to have tritium concentrations in urine that could have resulted in exposures in excess of 1 mrem/yr. On this basis, NIOSH concluded that the doses to all workers for 1974 and 1975 should be 0 mrem.

Our initial assessment is that it appears that the tritium bioassay program in 1974 and 1975 was very limited and cannot be used as the basis of a coworker model. Specifically, the protocol for developing coworker models, as described in ORAUT-OTIB-0075, is premised on the assumption that a representative dataset can be used to develop a coworker model. In the case of potential tritium exposures in 1974 and 1975 at RFP, the dataset consists of urine samples from 75 people, where most individuals were sampled only once over the 2-year period (see page 24 of 39 in the white paper). Is this sufficient data to build a coworker model, considering that tritium exposures, if any, were likely intermittent and tritium has about a 10-day biological half-life? Is a database confined to claimant results alone adequately representative to base a coworker model? These are concerns that have not been resolved by the white paper.

Notwithstanding the limitations in the data, it might still be reasonable to conclude that the doses to all workers in 1974 and 1975 were zero. There are 75 urine samples collected more or less randomly in 1974 and 1975 from workers who were monitored for plutonium. In principle, these would be the workers who had the greatest potential for tritium exposure, since it is the plutonium that would be contaminated with tritium. What is the likelihood that some workers experienced significant tritium exposures, but no tritium levels were observed that could have resulted in greater than 1 mrem/yr? Given these data, it seems self-evident that it is unlikely that that any worker experienced tritium exposures in 1974 and 1975 that could have resulted in exposures in excess of 1 mrem/yr. Without performing a detailed analysis of the work history of each worker involved in the sampling program, NIOSH's position that no worker experienced tritium exposures in excess of 1 mrem/yr in 1974 and 1975 seems reasonable. However, there seems to be some incongruity between the results of the air sampling and bioassay sampling program that was initiated following the August 1974 incident and the results of random bioassay sampling of the 75 workers. In the former set of measurements, it appears that some workers could have experienced doses in excess of 1 mrem due to the incident, while the latter set of measurements indicates that no individual experienced exposures in excess of 1 mrem/yr. This possible incongruity has applicability to building a coworker model for pre-1973 exposures, which is discussed in the next section.

5.0 PART I: ANALYSIS OF ROCKY FLATS TRITIUM EXPOSURES FOR 1959–1973

SC&A agrees with NIOSH that useable tritium measurement data is lacking before 1973 for RFP. However, the use of measurements from a 1974 tritium release to bound occupational tritium doses for the pre-1973 period is questionable.

Notwithstanding, the long held perception at RFP that tritium exposures were rare, a routine source of workplace tritium exposure was routine pit returns from Pantex. A former RFP worker noted that Pantex was supposed to "pump down" the pits, so that "clean" handling would be possible at RFP; however, this was not always accomplished completely ([Redact] 2012). It was noted that site returns from Pantex included containers for which a "positive" measurement for tritium offgassing would be experienced 1–2 times a year based on room bubbler results. However, use of area tritium bubblers was limited to "checking" for the presence of airborne tritium in the room during opening of the outer drum, but not during the later opening of the inner container with the pit, and not during its staging and introduction to the glovebox ([Redact] 2012). It was acknowledged by a former worker that these later hands-on steps would have presented a higher and more frequent exposure potential for tritium. It was also emphasized that room bubblers were positioned at the intake plenums of the room exhaust system ([Redact] 2012; [Redact] 2012). This would have located the bubblers away from the breathing zone of workers handling the pit containers. Before the 1973 incident, there were no Radiological Control Technicians (RCTs) trained to monitor actual airborne tritium exposure levels.

SC&A finds that unlike the one apparently unique tritium release event in 1973, there was clearly a source of intermittent tritium offgassing from site returns coming from Pantex, possibly as far back as the late 1950s. The frequency and size of such routine releases are unknown outside of the four known potential tritium releases identified (1968, plus the three identified in the RadChem report). Workers opened both outer and inner containers, and directly handled pits during this process, with only a building alarming bubbler for the initial step of opening the outer drum. It remains uncertain how much tritium was released during the many evolutions that took place since the late 1950s, because no routine tritium contamination smearing was done and no airborne measurements were made.

NIOSH advances six factors presented as essentially a "weight-of-evidence" basis for use of the 1974 release event as bounding of more typical releases from pre-1973 handling of Pantex pit returns. SC&A's review of these supporting factors is as follows.

1. *Background tritium levels immediately prior to the incident described in the RFAO report, although* ***undoubtedly*** *elevated since the more significant 1973 release, were well below dosimetrically-significant values and can be considered as* ***fairly representative*** *of* ***typical background levels*** *for this analysis.* [Emphasis added.]

The representativeness of 1974 background tritium levels as applied to pit return operations dating back to the late-1950s cannot be adequately modeled or corroborated given the lack of any useable source term or monitoring data representative of that operational time period. The 1968 release and the three potential releases reported in the ChemRisk report (ChemRisk 1994) all exceeded the 1974 release by a large margin, raising doubt about the existing background level in the pre-1973 period. Also, while the calculated tritium doses are very low, they are based on an event that transpired almost a year after the major 1973 release, which brings into question how representative of background levels these measurements would be given the probability of more rigorous contamination controls or handling procedures being implemented.[7]

2. *The quantity of tritium released (1.5 Ci) was significantly less than that released in 1973, and is* ***probably more typical*** *of potential undocumented releases in work areas – particularly those resulting from opening contaminating shipping containers.* [Emphasis added.]

SC&A finds this conclusion non-evaluative and not based on any relevant pre-1973 monitoring data. It is just as likely that previous undocumented releases in work areas from opening contaminated shipping containers would have been higher in the pre-1973 era when knowledge of operational tritium at RFP would have been considerably less and health physics practices would have been weaker. It is notable (again) that the 1968 release and the three potential releases reported in the ChemRisk report (ChemRisk 1994) were considerably higher than the 1.5 Ci release in 1974.

3. *Tritium was released to the workplace environment, and not in a glovebox.*

SC&A agrees that the standard practice pre-1973 was to open both the inner and outer containers prior to staging and placement of the pit (or other material as in the 1973 release) in a glovebox for cutting and processing. Based on available information, this remained the practice after 1973, albeit with more rigorous workplace monitoring. Any tritium released would have been to the workplace environment in either case.

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[7] It is clear from AEC communications and directives issued beginning in late-1973 (e.g., AEC/RFP 1973; Bowman 1974a) that RFP had implemented strict adherence to procedures in minimizing and monitoring for tritium contamination for any shipments of material at RFP, particularly "non-routine" shipments similar to the LLNL scrap material.

4. *The release involved elemental tritium (HT, T2), and not tritium oxide (HTO).*

SC&A agrees that elemental tritium was the likely source term in both 1974 and in earlier container contamination cases. However, the conversion of elemental tritium to HTO occurs in the presence of water vapor and it is likely that HTO contributed to worker exposure to an unknown degree.

5. *The tritium was released from a contaminated shipping container which was procured by Rocky Flats in 1970 and can be taken as representative of all shipping containers in use prior to 1973.*

SC&A finds that no basis is provided demonstrating that a shipping container procured in 1970 is representative of containers in use before that time. RFP was not aware of any tritium contamination on containers and was not monitoring them routinely for tritium. The "instruments for detection of tritium gas in particular work areas" that is referenced were tritium bubblers that were positioned at exhaust plenums for alarming purposes, and were located in some, but not all, pit handling areas, as indicated earlier.

6. *The incident occurred close enough in time to the 1973 tritium release that work practices and controls were likely more similar to those prior to 1973 than to those even a year or two later, as procedures and controls evolved with greater sensitivity to the potential for tritium contamination.*

SC&A questions this conclusion. Given the significance of the 1973 release and the wide public attention it garnered, it is just as likely that work practices and controls would have become tighter in the immediate aftermath of the event, such that those surrounding the later 1974 event would have been different in rigor than those before the 1973 event. To respond to this obvious concern, NIOSH identified an October 21, 1974, Dow Chemical Company, Rocky Flats Division, memorandum from B.A. Bowman to a wide distribution of AEC site managers, addressing "Shipments of Nonroutine SS or Non-SS Material to Dow Chemical Company U.S.A, Rocky Flats Divison" (Bowman 1974b). In that memorandum, he indicates that "a significant number of containers [checked] do have varying low levels of tritium contamination," and that since RFP "doesn't presently have a facility where these containers can be opened, the material can not (sic) be processed." He notes that an additional requirement – to verify the tritium level of the shipping container – will be enforced "until a new facility is built to permit contaminated containers to be opened and the material checked utilizing a smear sampling technique."

First, it appears that the use of "non-routine" in the subject of this memorandum defined the scope as applying to shipments of material, such as the LLNL scrap, that were not part of RFP's routine processing of pit returns, e.g., from Pantex. Therefore, this directive would not have been directed at the numerous routine shipments received from Pantex since the late-1950s, but rather to other AEC laboratories and production facilities that had shipped Pu scrap and similar material to RFP in the past. This is corroborated by the actual form that was required for such "non-routine" shipments; Pantex was not even listed as a potential shipper, while Savannah River, Los Alamos, Lawrence Livermore, and Batelle Northwest laboratories, were provided checkoff boxes (AEC/RFP 1973).

Second, the AEC was concerned enough regarding the implications of this offsite contamination event to take a number of interim control measures, e.g., a "three-point check" coupled with a complete written history, applicable to all shipments of material to RFP (AEC/RFP 1973). These interim actions were implemented in December 1973 and announced in a press release as responsive to one of the AEC investigation committee's recommendations (recommendation 2). These actions followed an earlier RFP directive on October 15, 1973, that written authorization would henceforth be required for all "non-routine" shipments, including detailed information regarding possible radiological contamination.

As a means to further clarify whether any additional direction or feedback regarding contaminated shipping containers had occurred following the 1973 (April–September) release, but before the October 1974 directive, SC&A requested an onsite document search at both Pantex and the Denver Federal Records Center for any correspondence between RFP and Pantex regarding tritium contamination during that timeframe. To date, no such correspondence has been identified. However, with the RFP actions taken in October 1973 and the AEC actions taken in December 1973, it is clear that AEC and RFP management's attention to and controls for minimizing tritium contamination as a backdrop for the circumstances surrounding the 1974 tritium release would not be representative of those surrounding Pantex pit container releases preceding the 1973 release.

SC&A does not dispute that the earlier 1973 event set the stage for a comprehensive health physics response to the October 1974 event, involving localized (downdraft tables) air sampling results, prompt urinalyses, and comprehensive workplace smear results, all of which resulted in the collection of adequate exposure data from which a well-founded maximum dose estimate can be made. SC&A also does not dispute that the doses involved were relatively small, primarily due to the presence of elemental tritium as the source of contamination. However, given that all of these monitoring capabilities were implemented in the months after the 1973 release the year before, it is difficult to accept, for the reasons stated, that no change had likewise taken place, from the preventative standpoint, in how tritium contamination was controlled or what practices were followed in pit return shipments and container handling at RFP.

5.1 Conclusions for Part I and II

Given all of the above considerations, and the fact that there was little or no tritium air sampling or bioassay data prior to the 1973 incident, the overarching question becomes: Can worker exposures to tritium be reconstructed with sufficient accuracy prior to 1973? With respect to the 1973 incident, we can be fairly confident that this was a one-of-a-kind event because, as noted above, it involved a unique source term; and from the late-1960s until the 1973 event, no elevated levels of tritium were observed in Walnut Creek, even though the water was routinely sampled and analyzed for tritium. Hence, that experience cannot serve as the basis for building a coworker model for pre-1973 exposures to tritium, except perhaps to conclude that no worker prior to 1973 experienced tritium exposures in excess of 84 mrem/yr.

In theory, the bioassay data collected in 1974 and 1975 could be used to build a coworker model for pre-1973 exposures if the operational activities that took place in 1974 and 1975 are representative of pre-1973 activities. (Albeit, it is not apparent that the 75 workers that were bioassayed in 1974 and 1975 captured the exposures associated with the 1974 incident, as discussed previously regarding the possible incongruity between the two datasets). In fact, the white paper uses that data as the basis for building a coworker model for pre-1973 tritium exposures. As indicated on page 38 of the white paper, NIOSH plans to assume that the 1974 incident, which resulted in exposures of about 0.15 mrem to the exposed workers, occurred every day prior to 1973. Based on this assumption, NIOSH plans to assign every worker 38 mrem/yr due to exposure to tritium.

Although it is NIOSH/ORAUT's claim that from a "weight-of-evidence" perspective, it can be concluded that these assumptions bound the potential pre-1973 exposures, SC&A finds that some of these controlling assumptions to be very subjective and without basis in available operational history or data. In addition, though it seems certain that 1973-type events did not occur in the pre-1973 period, there is a larger question of whether there could have been chronic exposures associated with the routine handling of plutonium that had smaller amounts of tritium contamination. In the end, a judgment needs to be made with regard to the degree to which the activities and associated tritium contamination levels experienced by workers in 1974 and 1975 are representative of pre-1973 conditions.[8] **As explained above, SC&A believes that the weight-of-evidence provided to date is not sufficient to provide a sound basis for bounding pre-1973 tritium exposures at RFP.**

6.0 PART III: EXAMPLE RFP TRITIUM DOSE RECONSTRUCTION

This example calculation is provided at the end of the white paper as a means to demonstrate how tritium doses will be reconstructed for workers at RFP pre-1973, 1973, and post-1973. As noted earlier, SC&A questions the assignment of 0 tritium doses for 1974 and 1975, given database limitations, and is conducting further validation of the dose bounding approach for 1973. And, as discussed above, we believe NIOSH's rationale for assigning 38 mrem/yr to pre-1973 exposures to be problematic.

[8] Or even representative of 1974–1975 given reliance on claimant bioassays alone, without knowledge of what specific operations are represented.

REFERENCES

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