

NIOSH Resolution of W. R. Grace Site Profile Finding 1

White Paper

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FINDING 1

SC&A's review of the W. R. Grace Technical Basis Document has the following summary for Finding 1 (SC&A 2013, p. 9):

The accuracy and completeness of the recorded bioassay data have not previously been addressed by either DOE or NIOSH as part of a routine "verification and validation" (V&V) database review. SC&A performed a preliminary scan of the WRG DOE files for a small sampling of claimants and did not identify any outstanding issues. However, a broader and more detailed survey should be conducted that would determine if workers who should have been monitored because of job title (i.e., chemical operator, production-line operator, etc.) and/or location (i.e., production buildings, waste facilities, burial grounds, etc.) have recorded bioassay data for the corresponding periods when working in these areas.

SC&A also added additional comments on this finding and concluded from a sampling of worker files for 1957 through 1970 "that a relatively small fraction of the workers were bioassayed, mostly for uranium by urinalysis." SC&A also stated that a scan of the files indicates plutonium bioassays are not evident until after the operational period ended (1970) and concluded coworker models are needed (SC&A 2013, pp. 22-29).

This finding was discussed by the Work Group on August 13, 2015. NIOSH reported that no uranium bioassay data are available until late 1964 and that the site profile provides uranium intakes for unmonitored workers. NIOSH also indicated that the site profile provides intakes from residual uranium contamination starting in 1971 (start of the residual contamination period). However, NIOSH also indicated a review was needed to determine: (1) whether or not the available uranium bioassay data is sufficient to assess intakes for the period of Burial Grounds remediation starting in 1991, and (2) whether or not the available plutonium bioassay is sufficient to reconstruction intakes of plutonium.

This paper provides an overview of available internal dose monitoring data, followed by an assessment of adequacy of those records for reconstructing intakes of uranium and plutonium.

BIOASSAY PROGRAM

This section is a summary of the bioassay data and other internal dose monitoring data that are available in claimant records.

NIOSH reviewed the monitoring records of all W.R. Grace claims in the NIOSH OCAS Claims Tracking System (NOCTS). There were 270 claims in NOCTS as of May 3, 2019. The "DOE Response" files were reviewed and lists made of the data that are available. Of the 270 worker files reviewed, 151 had employment in 1991 or later. The 151 files of workers employed 1991 or later were reviewed in detail as explained below.

Routine Uranium Urinalysis Program 1964 Through 1993

Claimant records indicate a robust uranium urinalysis program began in the fourth quarter of 1964; no bioassay monitoring records are found prior to late 1964. Most workers have multiple uranium bioassay results reported in all years through 1993. The uranium bioassay results are reported in units of uranium dpm per liter. Claimant records indicate the routine monitoring program ended in late 1993, which coincides with a number of workers being laid off and with the completion of the plutonium facility decommissioning project. A uranium bioassay program was reinstated in the latter part of 1997.

Although the data in NOCTS indicates most workers have many uranium urinalysis data for all years worked for 1964 through 1993, some workers with certain job titles (administrative and office type workers) have less frequent or only limited bioassay data, and there are several claims with employment during the AWE operational years (1958 through 1970) that do not have any bioassay data in NOCTS even though their job titles indicate they would have been monitored. Some of those workers with no data in NOCTS had very brief employment periods. For those workers with no or incomplete uranium monitoring data, the NIOSH technical basis document (TBD) provides default intakes. Therefore, no additional assessment of the adequacy of uranium bioassay was done for 1958 through 1990. However, the TBD specifies bioassay data should be used for workers remediating the Burial Grounds starting in 1991. All claims for workers with work in the post 1990 period were reviewed.

Of the 151 claims reviewed in NOCTS with employment after 1990, 136 of the claims have on-site work for all or part of 1991 through 1993. Of the 136 workers, 110 have routine uranium urinalyses during that period. The other 26 workers had no or only occasional uranium monitoring results in that period.

Routine Uranium Urinalysis Program 1997 to Present

There does not appear to have been a routine uranium urinalysis program from late 1993 until 1997. Starting in the latter half of 1997, a number of workers were routinely monitored for exposure to uranium by urinalyses, with the results reported in units of micrograms per liter. Of the 151 claims reviewed in NOCTS with employment after 1990, 97 of the workers had on site work in late 1997 or later. Of the 97 workers, 43% (42 of 97) have routine uranium urinalyses results in NOCTS from at least part of that period; the remaining 55 workers do not have in vitro data in the post 1997 period. The unmonitored workers includes some Operators and other job types who were included in the routine bioassay program that ended in 1993.

In Vivo Monitoring

Many workers have in vivo chest count results starting as early as 1970. The chest counts were performed by Helgeson Nuclear Services with a phoswich detector. The workers' U-235 chest count results are reported to NIOSH on forms that list the date of examinations and U-235 results in micrograms. There are also individual examination reports from Helgeson that provide the U-235 result in micrograms and the two sigma uncertainty. Detection limits are not provided in

the reports, but the NIOSH TBD reports a 120 microgram minimum detectable activity for U-235 (ORAUT 2011). In addition to the Helgeson lung counter, NFS had special monitoring of some workers performed at other DOE facilities (AEC 1974; Author unknown 1988).

NFS constructed a new in vivo counting system that became operational in September 1987. The system had four germanium detectors that were positioned over the subject's lungs while seated in a semi-reclining position in a shielded facility. NOCTS records indicate 30 minute counts were performed. The facility was owned by NFS, but operated by Canberra. After the system became operational NFS reported a study of a few workers who had lung burdens measured with the Helgeson counter, and noted that measurements with the new germanium counter, and measurements of those workers at another site, indicate the Helgeson lung counter underestimated the amount of uranium-235 in the lungs (Author unknown 1988).

After the NFS counter became operational in 1987, most workers in NOCTS have annual chest count reports up to the present. Reports include detection limits (minimum detectable activity) for radionuclides in the uranium, plutonium, and thorium series and cesium-137. Of the 151 claims from NOCTS (with post 1990 employment) reviewed for this white paper, 141 have chest count results available in NOCTS; the other 10 workers have no chest count results in NOCTS. Of the 141 workers monitored, 121 of the workers were routinely monitored, and another 20 were monitored during part of their employment.

Other Internal Dose Monitoring Data

As described above the site had a robust uranium urinalysis program from 1964 through 1993. Starting with 1994, the NFS monitoring reports sent to NIOSH have annual worker intakes reported on the NRC Form 5 annual dose report. These intakes are provided for individual radionuclides in units of microcuries. The intakes were determined by NFS based on air sampling data, stay time information, and respiratory protection, as applicable (ORAUT 2017). NIOSH has not determined whether or not the intakes listed on Form 5 also included intakes derived from bioassay data, although it is logical to presume those intakes are included as well as intakes determined from air sampling data.

NOCTS has claims for 109 workers who worked at the site in 1994 or later. Of the 109 workers, 90 of them have annual intakes reported in one or more years on NRC Form 5. The dose report includes annual intake by radionuclide in microcuries, intake mode, and inhalation solubility class. These data should be used to supplement dose reconstructions when bioassay data are not sufficient to quantify all intakes.

A number of employees have enhanced routine in vitro monitoring from 1990 through 1993 that included routine uranium, thorium, and plutonium urine and fecal analyses. This enhanced monitoring coincided with the period of remediation of the plutonium facility.

The site had an extensive air sampling program, as indicated by the large number of workers who had assigned intakes from air sampling data starting in 1994 on NRC annual dose reports

(other records available to NIOSH indicates an extensive air sampling program existed much earlier than that).

Additionally, some claims have DAC-hr exposure information that is useful to supplement the bioassay data. A number of the claims in NOCTS also have special monitoring data and assessments of intakes.

ADEQUACY OF URANIUM DATA

Finding 1 indicated NIOSH needs to assess adequacy of bioassay data for workers involved with remediation of the Burial Grounds starting in 1991. For this white paper, no effort was made to try to determine who was involved with Burial Ground remediation. This paper assessed all 151 workers in NOCTS with post 1990 employment.

Based on the data reported to NIOSH, the most comprehensive internal dose monitoring data available for the post 1990 era are the in vivo chest count data; these records include detection limits for U-235 that can be used to estimate total uranium. Of the 151 workers reviewed, 121 of them were routinely monitored on an annual frequency throughout their employment.

Of the 30 workers who do not have routine annual chest counts in the post 1990 era, 20 of them have some chest count data available, but not for all years. The remaining 10 workers have no in vivo chest count measurements in NOCTS.

Claims for all 30 workers with no, or only partial, annual chest counts were reviewed. Two of those claims appear to have incomplete responses in the DOE Response file because the files indicate the workers were likely monitored for intakes. NIOSH will review the two claims and follow-up with the site. Of the remaining 28 claims with limited in vivo data or no in vivo data, the descriptions of work for those individuals indicate they worked in jobs or in administrative areas where elevated workplace airborne radioactivity is not likely. The job categories include: Secretary, Manager, Clerk/Typist, PC Specialist, Director, Contracts Administrator, Guard, Security, Material Control & Accountability, Administrative Assistant, Supervisor of Delivery, and Analyst (recent years), (NOTE: a few of those workers changed jobs and were apparently removed from the routine monitoring program; the job titles used in this review are those associated with the 1990s period). On-site environmental intakes are appropriate for these unmonitored workers. Environmental intake rates were provided to the Work Group in a NIOSH white paper of July 22, 2019. It should be noted that only 10 claims have no in vivo data, while 20 workers were monitored once or more, but not every year. Some workers had jobs titles that appears to have had some periods with potential exposure. For example, several security personnel are included in the 30 workers who were not routinely monitored in all years, but all of them have some monitoring data.

Based on a review of all 151 claims in NOCTS with post 1991 site work, NIOSH concludes all the workers have either sufficient data to reconstruct intakes of uranium, or that environmental intakes are appropriate for the workers with unmonitored periods of employment. This conclusion is based solely on in vivo data. As described earlier in this paper, NIOSH has other

monitoring data for many workers that can be utilized, as appropriate, to estimate or bound intakes.

ADEQUACY OF PLUTONIUM DATA

NIOSH provided a white paper dated March 1, 2019, to the Work Group that contained coworker bioassay data for the period plutonium was produced at W. R. Grace, 1965 through 1973. That paper also contained intakes based on air concentrations for workers who may have entered the facility during the idle period and for general areas of the facility. Table 1 of the March 1, 2019, paper provides a timeline of plutonium activities. It shows the site began characterization of the plutonium facilities in 1988, began decontamination and decommission (D&D) work in 1990, and completed plutonium D&D work in 1993 (with the exception of an underground contaminated area inside a containment).

As discussed previously in this white paper, the site enhanced their internal dose monitoring program at a time that coincided with characterization of the plutonium facilities. A new in vivo facility became operational in late 1987. Additionally, starting in 1990 enhanced worker in vitro monitoring is found for a number of workers that include routine urine and fecal samples for uranium, thorium, and plutonium.

This paper previously discussed the in vivo monitoring program and concluded all workers with employment post 1990, and who have claims in NOCTS, have sufficient in vivo data to assess intakes for uranium, or that environmental intakes are appropriate (as noted earlier there are two claims for workers with post 1990 work in which the DOE Response files appear to be missing internal dose monitoring data). The in vivo reports also provide values and detection limits, including U-235, Pu-239 and Am-241. These data are sufficient to estimate or bound intakes of plutonium and uranium. The *Adequacy of Uranium Data* section discussed the 151 claims with employment post 1990, but did not evaluate sufficiency of data prior to 1991. There are an additional 12 claims in NOCTS for workers who worked some or all of 1988 through 1990. The data from those 12 claims were reviewed.

Of the 12 claims, 10 have routine in vivo examinations. One of the claims has an incomplete DOE Response file that NIOSH will review and follow-up with the site. The other claim with no routine in vivo examinations in that period was reviewed for information on exposure potential. During that period that worker performed duties in two specified facilities, neither of which are plutonium facilities (the worker was routinely monitored for uranium by urinalysis).

NIOSH concludes, that with the exception of three workers whose DOE Response files are incomplete, the in vivo data are sufficient to estimate or bound intakes of plutonium from 1988 on. Except where noted, this review made no attempt to actually determine who was potentially exposed to plutonium.

CONCLUSION

NIOSH has reviewed all claims in NOCTS to determine whether or not worker monitoring data are sufficient to reconstruct uranium intakes in the post 1990 period. NIOSH concludes that all workers who should have been monitored for intakes of uranium have either in vivo monitoring data, in vitro monitoring data, or both. Two claims were identified for workers whose NOCTS files indicate they were likely monitored for uranium, but the response file from the site appears to be missing the data. NIOSH will follow-up with the site for those two claims.

NIOSH has also reviewed all claims in NOCTS with employment post 1987 to determine if there are adequate monitoring data in the period of plutonium decontamination and decommissioning work. Two claims from the post 1990 era that are discussed in the above paragraph, and one claim in the 1988 through 1990 period, have apparent incomplete data responses from the site that NIOSH will review and follow-up with the site. NIOSH concludes that all workers who should have been monitored for plutonium were routinely monitored by annual chest counts. The review of available data in NOCTS also indicates the site had enhanced in vitro monitoring for multiple radionuclides for a number of workers during the plutonium D&D period.

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