

DRAFT MEMO

TO: Savannah River Site Work Group (Chair – Mark Griffon)
FROM: Arjun Makhijani
DATE: January 20, 2011
SUBJECT: Matrix Issues 22 and 23 Regarding Petitioner External Dose Issues

During the November 10, 2010, Work Group meeting on the Savannah River Site (SRS) Special Exposure Cohort (SEC-00103), SC&A was asked to prepare a memorandum on external dose issues raised by the petitioners (SC&A 2010a). The concerns raised by the petitioners and during worker interviews were grouped under two separate entries in the SRS Issues Matrix on SEC issues (SC&A 2009a).

Matrix Issue 22 is as follows:

SC&A worker interviews suggest that workers kept their badges out of higher radiation areas in order not to exceed dose limits, or sometimes CW would be in radiological situations without knowing it (one incident is described when workers were working with radioactive tools thought initially to be clean). [SC&A 2009a]

Matrix Issue 23 states:

Petitioners raise the issue of working conditions with high dose rates when badge dose may have been under-recorded or not recorded (such as weekend work) and/or pencil dosimeters were off-scale, or when there are zero doses in the record. An issue connected to this would be whether the HPAREH database reflects actual work experience. Petitioners also state that in some cases, workers thought they were working in clean areas that were then determined to be contaminated. [SC&A 2009a]

SC&A has previously examined some external dose issues relating to SRS. Specifically, SC&A evaluated the SRS external dose database Health Physics Annual Radiation Exposure History (HPAREH) as part of its evaluation of the NIOSH procedure for reconstructing doses for construction workers across the DOE complex (SC&A 2007). The adequacy of HPAREH was raised by the SRS petitioners (SRS Petition 2007, p. 7 of the pdf file). However, the findings relating to the proposed use of the HPAREH database to construct a coworker model for external dose reconstruction in SC&A's review were discussed and resolved in the course of the issue resolution process led by the Subcommittee on Procedures Review.

The issue of the incompleteness of HPAREH, in the sense that it does not contain all the records of workers who worked at SRS prior to 1979, was addressed in the NIOSH Evaluation Report (NIOSH 2008, Section 6.2, pp. 31–36). It was also addressed, in part, in SC&A's review of

construction worker dose reconstruction procedures, since SC&A examined the Fayerweather database that contained a considerable amount of data for the early years that was not in the HPAREH database. SC&A found that the use of the HPAREH database for coworker models did not compromise claimant favorability of the proposed NIOSH approach (SC&A 2007, pp. 25-35).

For the above reasons, Matrix Issue 21, which explicitly relates to data adequacy for SRS construction worker external dose coworker models, was judged to be closed as an SEC issue by the Work Group.

In view of the above, this memorandum does not revisit the issue of external dose coworker models for SRS construction workers, or the adequacy of HPAREH in that regard. This memorandum addresses the remaining external dose issues, as expressed in Matrix Issues 22 and 23. Specifically, we catalog the concerns regarding external dose that have been raised in the petition and in interviews that have not yet been addressed in the SEC comment resolution process.¹ Therefore, while we do not raise the issue of the doses recorded in HPAREH compared to raw worker data in individual files, this memorandum does address petitioner issues as they relate to the issue of whether the recorded external dose reflects the actual exposure experience of construction workers in many specific situations. A master summary of SC&A worker interviews was posted on the O-Drive in June and was also attached to a report on incidents prepared by SC&A in December 2010 (SC&A 2010b).²

1. Unmonitored Work in Hot Areas Thought to be Clean

The SRS Petition, as well worker interviews, provides examples of workers' work with equipment or in areas thought to be clean, but later turned out to be contaminated. The following example is from the SC&A master interview summary:

[Between 1984 and 1986, a building addition was constructed above the FB-line.] There was an extra floor added to the top of the building. The original building is concrete, but the additions were made out of blue metals. There were hundreds of construction workers, all crafts, working on that addition. It was considered new construction and the area was considered a clean area. There were no radiological postings and the workers were not monitored. Although it was considered a clean area, there was hot air coming out of the stacks of the FB-line. The chutes coming out of the FB-line (a tremendously hot area) were opened periodically to the vents. All the air in the hot canyon area came out on the ladders right next to the vents. There were all kinds of construction workers that worked out there that received doses that were not monitored.

[SC&A 2010, pp. 16–17 – the phrase in square brackets at the start of the paragraph was an explanation added by SC&A to the master interview.]

¹ It should also be noted that this memorandum does not include neutron doses, which are covered separately as Matrix Issues 15 and 16.

² The page numbers provided in this memorandum when referring to the master interview summary are those in SC&A 2010b, where the master interview summary is Attachment A.

A similar example occurs in the SRS Petition. In this case, electrical tools were brought to a central repair facility in a truck. The tools were contaminated and not supposed to be removed from the radiation area, something the workers who transported them and were handling them did not realize until they brought the tools to the central repair facility. A check by Health Physics revealed that the tools were indeed contaminated; they were “covered with plastic bags and later sent to burial grounds” (SRS Petition 2007, pdf file pp. 8–9).

For external dose, such examples should be viewed in the context of worker statements that construction workers often worked without film badges when they thought they were in clean areas:

Workers who were not expected to encounter radiation hazards did not have routine dosimetry. If an area was considered a clean area, workers may not be badged. In the 1950s, a worker with new construction was not assigned a dosimeter. Workers who worked outages in the 100 Areas (reactors and reactor controls) had a badge and a pencil [dosimeter]. On the B-line, workers had to wear a regular TLD, a pencil [dosimeter], and a neutron button. Those required to dress-out in the Central Shops recalled having TLDs. In the mid-1970s, workers had TLDs. [SC&A 2010b, p. 19]

SC&A notes that worker statements regarding wearing badges were variable. In addition to the above, it was also stated that, “People generally wore badges when required, but there were lots of exceptions” (SC&A 2010b, p. 20). While this statement is compatible with the one quoted prior to it (“...workers may not be badged” in areas thought to be clean), it is not quite as broad. The varying statements may reflect different worker experiences at SRS.

It should also be noted in this context that construction workers noted that they often worked without Health Physics coverage (SC&A 2010b, pp. 15–17).

NIOSH addressed the issue of unrecorded construction worker external doses briefly in its evaluation report for the SRS SEC as follows:

Another type of monitoring exception noted in the SRS Radiation Survey Log Sheets (RSLs) is that for some construction work, access controls were put in place to limit the exposure received by construction workers during large modifications. The access controls effectively cordoned off the work zone within a larger radiation control area. Within this area, radioactive materials were removed from the work zone so that the only external exposure would originate from outside the work zone. The perimeter of the work zone was then monitored through the use of survey instruments and/or dosimeters hung on the perimeter towards the radioactive materials to ensure that radiation levels within the zone were below regulatory requirements. As noted, these exceptions are documented in the Radiation Survey Log Sheets (RSLs).

Thus, while the normal practice was to monitor all individuals within a radiation control area, there were occasions, as indicated by workers during the outreach meetings, in which it would appear as if the workers were not monitored within a radiation area. However, based on NIOSH's review, area monitoring was being conducted to ensure that exposures were less than regulatory requirements. Since this control was in effect, the use of a co-worker model for workers within these controlled zones supports NIOSH's ability to bound the photon dose for the class under evaluation. [NIOSH 2008, pp. 60–61]

NIOSH's position in the ER is that documented area monitoring would suffice for NIOSH to be able to bound dose for unmonitored workers in areas that were cordoned off and declared clean enough for work.

The NIOSH statement does not fully address the issue raised by petitioners. First, it is unclear whether such documentation exists in workers' individual dose records. If it only exists in Radiation Survey Log Sheets, it is unclear what procedure a dose reconstructor would follow to determine that recourse to such log sheets was necessary.

Second, the workers made no reference to area monitoring and radiation controls in the examples cited above. On the contrary, those handling and transporting contaminated tools were unaware that the tools were contaminated. In the other example, the new construction was thought to be in a completely clean area, precisely because it was new construction. However, it was in an area where there were process vents from the FB-line. The construction work lasted from 1984 to 1986 in this example. The explanation in the NIOSH ER does not address such circumstances, since there would be no recorded dose. It would be useful to examine the dose records of some of the construction workers who worked on the addition above the FB-line to follow-up the information provided by workers regarding unmonitored dose.

The issue of unrecorded doses when workers were exposed to areas with the potential for external exposure has not been investigated by SC&A. Specifically, SC&A has not investigated the records of workers who said they were unknowingly in hot areas and did not wear badges. Designing a protocol to effectively investigate this problem retrospectively may be difficult or impossible.

2. Compromised Badge Readings

SRS workers have also stated that several common practices would result in an under-recording or non-recording of external dose:

- Wearing badges away from the source, so it would record a lower amount of dose.
- “Workers could keep their badges out of the shine when they were working at a tank and in the canyons, also. The lead door of the sample box would shield part of the body, and a worker would put the badge there if they were trying to keep their radiation down to shield the TLD.” (SRS 2010b, p. 20)

- Workers going from the F-Area to the H-Area “picked up a temporary badge.” However, the badges were not signed out by specific workers. They just used a badge from “a row of leftover badges.” (SC&A 2010b, p. 20)
- Workers who worked on weekends and during shifts other than the day shifts when there were only a few workers often “did not have any badges to wear. We were used to not having badges, so the work continued as usual.” (SRS Petition 2007, pdf file p. 20)

In addition to these practices, the petition also describes situations in which worker badges in the H-Area would be “wiped out” by passing radioactive waste tanker trucks that “leaked radioactive materials on to the road...” In such instances, all TLDs would be removed from the badge rack and workers would be issued new TLD badges, sometimes not until a day after the incident (SRS Petition 2007, pdf file p. 18). It is unclear from the petition what, if anything, was recorded in the workers’ records. This problem seems to have been particular to the H-Area, where the badge house had no sides, in contrast to the one in the F-Area (SC&A 2010b, p. 20).

NIOSH has not provided a dose reconstruction approach for such issues that put into question the accuracy of the recorded dose, either because the full extent of the exposure was not recorded or because of practices where badges were not worn or were damaged with possibly unrecorded doses.

3. Exposure Geometry and Organ Dose Issues

Interviews indicate that ring badges were not always worn, even when they were needed. In other cases, the badge would be on the opposite side of the radiation source (SC&A 2010b, p. 21). SC&A has raised the issue of geometry of exposure as part of tank farm issues (SC&A 2009, Matrix Issue 20). We note here that it has also been raised by petitioners in a more general way.

4. Pencil Dosimeter-Related Issues

Interviews indicate that pencil dosimeters sometimes went off-scale, but that such instances were explained by Health Physics as being due to dropped dosimeters or were not recorded in some cases when construction workers were doing work during reactor outages prior to 1965:

Pencil dosimeters were used in some areas, in addition to the regular film or TLD badge. A single Personal Ionization Chamber (PIC) was worn at the pocket level. These dosimeters were the kind that you zeroed before you go on the job. If the pencil [dosimeter] read more than a certain amount, a worker would have to come out of the area. Workers filled in a daily form that had a place to record a date and a dose. These forms were used as far back as 1975 at F Canyon. Other areas, such as when CTWs worked reactor outages in the 100 Areas (prior to 1965), did not use forms. Some comparison studies between pencil dosimeters and TLDs may have been done during the French Fuel job.

Pencil dosimeters would go off-scale. For example, when an interviewee worked on hot crane maintenance, the pencil dosimeter would peg out. When workers were changing anything out in the tank farms, they would run up the pencil [dosimeter] very quick. Workers were told, "If you get radiation, you're going to get your foreman in trouble." An interviewee received a pencil dosimeter that was off-scale. The HP asked: "Did you drop it?" The individual said, "No, you just gave it to me." The HP told the individual to go to work and he would bring another one. He did not return. [SC&A 2010b, pp. 20–21]

NIOSH did not address this issue in its Evaluation Report, even though it is raised in the petition (SRS Petition 2007, pdf p. 18).³

SC&A had addressed this briefly in our "paper study" of the SEC Petition (SC&A 2009b, p. 21). In the paper, SC&A also stated that a review of dose records of petitioners who had raised this issue would be helpful and, in one case, that it would review those records (SC&A 2009b, pp. 18, 21, and 22). SC&A did pursue the pencil dosimeter issue further. This investigation is described below.

Due to their tendency to give false readings, pencil dosimeters are not relied upon for recording the dose of record. However, because they give an immediate readout, pencil dosimeters are used to alert workers of a possible high radiation condition. A high reading from a pencil dosimeter should cause the Health Physics personnel monitoring the worker to stop the work and collect the film badges or TLDs to determine whether the high pencil dosimeter reading was valid or a false alarm. In the cases provided by the four petitioners, the Health Physics personnel did not stop the work or collect the film badges/TLDs, but instead told the workers to continue with their work.

SC&A reviewed the available Special Hazards Incident (SHI) Investigations for instances of high pencil dosimeter readings. SC&A identified more than a dozen SHIs⁴ when a high pencil dosimeter reading was reported, and Health Physics pulled and processed the worker's film badge or TLD. Most interesting with respect to this issue is SHI 382, in which the worker attempted to explain his pegged pencil dosimeter by saying that he remembered bumping it. The Health Physics inspector required the worker to turn in his badge for processing anyway. Below is the relevant portion from SHI 382:

12. Upon exiting the windbreak the [redacted] was checked by HP. No contamination was detected. When the [redacted] checked his self-reading dosimeter he found it to be off-scale (greater than 500 mR).

³ The issue raised on p. 18 in the petition is the same as in the second paragraph of the above quote from pp. 20–21 of the master interview summary.

⁴ SHIs No. 39 (May 1955), 98 (April 1959), 127 (April 1960), 142 (October 1960), 147 (November 1960), 192 (March 1962), 213 (October 1963), 244 (September 1966), 248 (December 1966), 351 (May 1981), 382 (June 1983), 417 (February 1985), and 477 (February 1986). SHI compilations are in the following references: SHI 001-099, SHI 100-199, SHI 200-299, SHI 300-399, and SHI 400-499.

13. The WM [redacted] remembered he had bumped his dosimeter on the catheter piping and attributed the off-scale reading to that occurrence. He informed the HP inspector. The HP inspector informed the WM [redacted] that his badge would have to be turned in for reading. [SHI No. 382, June 1983, in SHI 300-399]

Consistent with the petitioners' concern, SHI 146 documents that there was one instance when the worker's film badge was not processed following high pencil dosimeter readings. The relevant portion from SHI 146 is shown below:

10. [Redacted]'s two pencils at the end of the shift, read 200 mr each. **Requirements are to make a special check of the employee's film badge when this occurs. Due to an oversight this was not done.** Later in the badge period [redacted] was assigned to another potentially high exposure job, which assignment would not have been made if a high film badge reading had been determined. [SHI No. 146, October 1960, emphasis added, in SHI 100-199.]

However, instead of showing that dose was missing from the official record, SHI 146 shows that even if the film badge is not checked immediately following a high pencil dosimeter reading, the routine film badge/TLD reading will result in the high exposure being in the official record.

This SC&A investigation does not indicate any evidence of a site-wide systematic effort to ignore high pencil dosimeter readings. Also, even if some high pencil dosimeter readings were missed by Health Physics personnel (e.g., SHI 146), this would have little, if any, impact on an individual's reconstructed dose, since dose is reconstructed from film badge readings, and not from pencil dosimeter readings. Hence, the issue of whether the worker's exposure is reflected in the dose records, discussed above, is more germane to the ability of NIOSH to reconstruct dose than the pencil dosimeter issue.

5. Records of DuPont Operations Workers compared to Construction Trades Workers

One worker who worked as a DuPont construction worker and then was employed by DuPont as part of the operations work has stated that he was not routinely monitored in the former role, but was in the latter:

While working for DuPont – Construction, a worker was not on a routine program for external dosimetry, although the individual conducted work at 100R after it was up and running and in 400 Area. The same worker was routinely monitored after transferring to DuPont – Operations. [SC&A 2010b, p. 20]

SC&A stresses that it has not investigated whether this was a unique or rare situation or whether it was a more common occurrence. A comparison of records of some workers who were in construction trades for some time and also in operations at another separate, discrete time period may throw further light on this issue. To yield meaningful results, such an investigation would

have to determine external exposure potentials in the jobs done in the two different capacities besides examining the dose records.

6. Overall Petition Challenge to NIOSH

As noted at the start of this memorandum, NIOSH has addressed some of the issues raised by petitioners regarding external dose, notably in regard to the use of the HPAREH database for coworker models. However, a number of other external dose issues remain to be addressed in regard to construction workers, as described in this memorandum. In this context, it may be worthwhile to cite an overall challenge to NIOSH in the petition.

Specifically, the petition contains a November 2003 statement to NIOSH from [Redacted], [redacted] of the Augusta Building and Construction Trades Council, the construction workers union covering the Savannah River Site. He recalled that SRS personnel had initially claimed that SRS construction workers had no potential for beryllium exposure. Yet, the union had insisted on screening, and 2 of the first 20 workers tested positive. In this context, he made the following statement and asked the following questions:

...[I]f the facility [SRS] staff has not understood our [construction trades workers] work, how could they determine whether or not we had significant exposures? And now, if they could not, how can you? This is what I want to be assured of at the end of this meeting: that we don't see a repeat of the beryllium experience. That is what I will be looking for in what you tell us. I want to come from this meeting and look our members in the eyes and say, NIOSH is being fair to us. [SRS Petition 2007, pdf file, p. 38]

References

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SC&A 2009b. "Paper Study" Evaluation of Special Exposure Cohort (SEC) Petitions, SEC-00103 and SEC-00104, Related to Construction Workers' Exposures at the Savannah River Site, SC&A, Inc., Vienna, Virginia. March 2009.

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SHI 300-399, *Dosimetry Special Hazards Incident Investigations 300-399*, compilation by Savannah River Site, SRDB 45096.

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SRS Petition 2007. Petition for “Construction Workers and All Other Workers,” filed in November 2007. On the DCAS website at <http://www.cdc.gov/niosh/ocas/pdfs/sec/srs/srspet.pdf>.