Dragon, Karen E. (CDC/NIOSH/EID)

From: DanMcKeel
Sent: Wednesday, October 23, 2013 9:35 PM
To: Katz, Ted (CDC/NIOSH/OD); NIOSH Docket Office (CDC)
Cc: danmckeel Hinnefeld, Stuart L. (CDC/NIOSH/DCAS); Allen, David (CDC/NIOSH/DCAS); Neton, Jim (CDC/NIOSH/DCAS);
Subject: New McKeel submission to ABRWH and Docket 140
Attachments: AnigSCA_MCNPvalidate_2005.pdf

Ted Katz, ABRWH DFO
All members of the ABRWH
Stuart Hinnefeld, Dr. James Neton, David Allen
NIOSH Docket 140 Office

October 23, 2013

Attachment: <AnigSCA_MCNPvalidate_2005.pdf> 414 KB PDF

Dear Mr. Katz and NIOSH Docket 140 Office,

Ted Katz: Please distribute this White Paper to all members of the ABRWH and to TBD-6000 WG NIOSH and SC&A staff who deal with GSI Appendix BB and SEC matters. The paper deals with an SC&A 2005 study of MCNPX and measured data validation study of sealed source terms. Two of these sources—Co-60 and Iridium-192—were similar to those used at GSI. The paper supports Dan McKeel's long held view that MCNPX and other computer-based radiation dosimetry models require accurate measured data for validation. The paper further describes significant differences in agreement between MCNPX and measured (instrumental) data for the Co-60 (good) and Ir-192 (poor) sources. Thank you.

Docket 140 Office: Please posting this as a new submission from Daniel McKeel, Jr., MD, to GSI Docket 140.

Thank you both in advance.

Sincerely,

-- *DanMcKeel* 10.23.13

Daniel W. McKeel, Jr., MD
GSI SEC-00105 co-petitioner

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"Evidence That SC&A Uses Measured Data to Validate Co-60 and Ir-192 MCNPX Computer Models"

-- October 22, 2013 --

- The key scientific paper (**REF 1**) that is the basis for this white paper is as follows:

"Review Draft. An Evaluation of Radiation Detectors for Use in Screening Potentially Contaminated Individuals"

Prepared by

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S. Cohen & Associates
6858 Dominion Drive
McLean, Virginia 22101

Under
Contract Number 200-2002-00367
Task Order Number 003

Prepared for

Phillip Green
Project Officer

November 2005

- This paper addresses the overarching EEOICPA scientific question: **"Is accurately, physically measured (real) data necessary to validate MCNP computer dosimetry models?"**
- With respect to the General Steel Industries ("GSI") AWE site and its multiple radioactive sources (2 Betatron accelerators, 2 industrial 250 Kvp x-ray machines, several Ir-192 sources, 3 Co-60 sources, 2 Ra-226 sealed sources) used in nondestructive testing ("NDT") of steel castings and AEC uranium metal, SEC co-petitioner Dan McKeel has repeatedly stated the correct answer from the peer reviewed world's literature is a strong "**Yes.**"

• The opposite view, that MCNP computer models are stand alone and do not necessarily need validating physically measured data, has long been held by the TBD-6000 work group "WG," especially by it's chairman, Dr. Paul Ziemer. This WG is considering GSI SEC-00105 and revising Appendix BB Rev 0 (June 2007) to TBD-6000 (Rev 1).

• The Board's contractor staff, especially Dr. Robert Anigstein and Dr. John Mauro of Sanford, Cohen & Associates ("SC&A") on the TBD-6000 WG have generally agreed with WG Board members (Ziemer (chair), Munn, Beach and Poston).

• NIOSH has implicitly agreed with the Board and with SC&A on the matter in several ways. *First*, NIOSH has not used measured data to validate it's Attila or MCNPX transport code models of the two GSI 24 and 25 Mev Betatrons. *Second*, NIOSH has never responded to McKeel's three (thus far) published proof papers (**REFS 2-4**) showing MCNPX radiation dosimetry models do have measured validating data. Furthermore, there is agreement at the ± 2 to 20% level between computer generated dosimetry values and measured dosimetry numbers among these three citations. *Third*, NIOSH is resisting using NYO-4699 Betatron surrogate data to validate its MCNPX Betatron computer models.

• The salient excerpts are from REF 1 section 2.3 found on page 2-6 and following text, and in Table 2.2 on page 2-7, as follows (from the Table of Contents):

Note: These text excerpts and Table 2-2 are reproduced on the following pages:

Section 2.3 Validation of Model Using Field Measurements:

[quote]

The computer model was validated by comparing the results with measurements on the Philips AXIS camera presented in Chapter 1. Three of the sources used in the measurements selected for the comparison had nominal activities of 1 :Ci (37 kBq), while ^{192}Ir had an activity 18.2 :Ci (673 kBq).

MCNP simulations were performed that replicated the geometries of the measurements of count rates from discrete sources of four radionuclides in air at selected distances from the detector. The configurations of the sources were modeled upon the dimensions and materials described in Section 1.2.2 and illustrated in Figures 1-5 to 1-7. Both heads of the gamma camera were included in the model. Although only the first head was used to accumulate counts in these simulations, the second head, placed in the same position as *during the measurement, potentially contributed to the backscattered photons reaching the first detector.*

The calculations utilized the MCNP pulse height tallies, which record the detector events that fall into specified energy bins, such as those corresponding to the energy windows displayed in Table 2-2. The results are recorded as count per photon, and represent the probability that a photon emitted by the source would produce a pulse within the specified energy range. A more detailed explanation is presented in LANL 2004b:

> *The pulse height tally provides the energy distribution of pulses created in a cell that models a physical detector. It also can provide the energy deposition in a cell. . . . The pulse height tally is analogous to a physical detector. The . . . energy bins correspond to the total energy deposited in a detector in the specified channels by each physical particle.*
>
> *In an experimental configuration, suppose a source emits 100 photons at 10 MeV, and ten of these get to the detector cell. Further, suppose that the first photon (and any of its progeny created in the cell) deposits 1 keV in the detector before escaping, the second deposits 2 keV, and so on up to the tenth photon which deposits 10 keV. Then the pulse height measurement at the detector would be one pulse in the 1 keV energy bin, 1 pulse in the 2 keV energy bin, and so on up to 1 pulse in the 10 keV bin.*

The results of the comparison are shown in Table 2-2. The fifth column of this table lists the normalized count rates (expressed in cpm/nCi) derived from the measurements. These count rates were converted to counts per photon by first converting the units to counts/s per Bq and then dividing by the number of photons per disintegration, listed in the last column of Table 2-1.

The results of the comparison in Table 2-2 show *good agreement in most cases. The agreement with the* ^{60}*Co measurements is particularly significant, since the count rates are based mostly on secondary radiation—primarily Compton scatter and, to a lesser extent, the annihilation quanta resulting from pair production—because the energy windows used in the measurements exclude the principal (rays. This result indicates that the components of the camera which contribute significantly to the scatter, primarily the lead alloy shields around the detector, were modeled realistically.*

2-6

[Table 2-2 here in paper: see top of page 5]

The ^{137}*Cs calculations agree very well with the measured values. This agreement is enhanced by the 20% (i.e., ± 10%) window centered on the photopeak, which excludes incoherently scattered radiation. The calculation is thus dependent on the detailed geometry of crystal and the entrance window, but not on the other components of the camera and the surrounding* *structures. The ^{241}Am comparison also shows excellent agreement; again, the energy window spanned the primary photopeak. Although the energy window is wider in this case, virtually all of the relatively low-energy primary photons would be absorbed by the crystal, minimizing the contribution of scattered radiation.*

The <u>poor agreement</u> for the ^{192}Ir source is due to the very high count rates experienced by the camera system. This source, which had an activity of 18.2 μCi, produced count rates in the range of $10^6 - 10^7$ cpm, which result in significant dead-time losses. The greatest discrepancy occurs when the source was closest to the crystal, producing the highest count rate. As the distance from the crystal increases, the count rate decreases and so does the discrepancy. (emphasis added)

[*The following nonindented text is also part of REF 1 being quoted on page 2-7*]

The lead alloy collimator used with the Philips AXIS camera could not be successfully modeled. Although MCNP can create a lattice of quadrilateral or hexagonal cells, this feature could not be used to replicate the actual structure of the AXIS collimator. Staelens et al. (2003) observed that the septa forming the hexagonal honeycomb are not uniform, being twice as thick in the horizontal direction as along the two diagonals, as shown in Figure 2-4. Since MCNP could not readily replicate this irregular geometry, we attempted to create an equivalent structure, constructing two collimator models using uniform hexagonal lattices. The first had septa with the thickness specified by Philips. In the second model, the additional thickness in the horizontal direction reported by Staelens et al. was distributed over all sides of the hexagonal cell, resulting in septa that were one third thicker than the manufacturer's specification. Neither model produced results that agreed with the

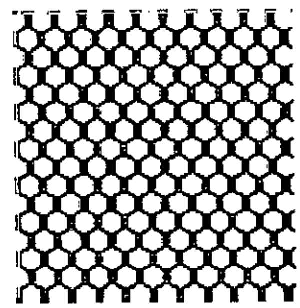

Figure 2-4. Details of Collimator (Staelens et al. 2003)

2-7

experimental measurements. Therefore, the remaining studies were limited to cameras without collimators.

A new section on page 2-7 of REF 1 then follows that is not reproduced here.

Table 2-2. Comparison of Measured vs. Calculated Count Rates

Nuclide	Energy Window[a] (keV)	Distance (cm)	Measurements		MCNP Model	Difference (%)
			cpm/nCi	count/photon	count/photon	
Co-60	1.0 - 3.0	16.8	181.7	0.04094	0.04133	-0.96%
		29.5	97.7	0.02202	0.02110	4.17%
Cs-137	1.8 - 2.2	10	149.1	0.07890	0.07897	-0.08%
		22.6	70.0	0.03703	0.03773	-1.90%
		41.5	29.8	0.01577	0.01589	-0.78%
Ir-192	255.5 - 766.5	4.1	559.4	0.10785	0.17951	-66.44%
		16.8	397.3	0.07659	0.09255	-20.83%
		29.5	242.3	0.04673	0.04894	-4.73%
Am-241	40.5 - 121.5	16.8	153.1	0.06720	0.06785	-0.97%
		29.5	86.9	0.03813	0.03853	-1.04%

[a] The same energy windows were used in the MCNP simulations as in the measurements.

• **McKeel comments on Table 2-2 (page 4)**: As noted by Dr. Anigstein and his colleagues, for the Co-60, Cs-137 and Am-241 sources, agreement between measured and MCNPX data was quite good: **range ± 0.08% and 4.17%.** In stark contrast, agreement between the measurements and MCNPX modeling for the Ir-192 source was "poor" to quote SC&A's characterization, **range 4.1% to 66.44%** depending on the distance.

At GSI, the isotope radiographers according to multiple sworn affidavits, used at least three known Iridium-192 sources: 1) an Ir-192 source used 25 to 50 times by his company at GSI according to Paul Sinn of St. Louis Testing Laboratories; (2) an Ir-192 used at GSI by GSI radiographers, six of whom provided affidavits this source was used to inspect welds, wires and railroad trucks in Building 6 and elsewhere, and (3) An Ir-192 source at American Steel Foundry in Granite City, IL, where GSI radiographers wearing their GSI-Landauer film badges, used the American Steel Foundry Ir-192 to perform overflow GSI NDT jobs,

Of utmost importance, despite many written urgings by Dan McKeel for NIOSH to calculate these Ir-192 source term external doses, NIOSH never did so in Appendix BB Rev 0, in the SEC-00105 evaluation report, or in any of the DCAS White Papers during 22 meetings about GSI in the Procedures Review WG (n=4) in 17 ensuing WG meetings and 1 technical call on 5/28/13. And SC&A, despite REF 1 having been published in 2005, to my knowledge never brought this paper, and the poor agreement of the Ir-192 source with measured data documented in it and in this paper, to the attention of the TBD-6000 WG. To me, *this constitutes gross scientific negligence and dishonesty*.

• In summary, this 2005 paper by Robert Anigstein *et al.* supports several long held, well documented on the written record views of Dan McKeel. The paper constitutes solid proof that:

(a) SC&A obviously does accept that validation of MCNPX radiation source term models requires measured data to validate its MCNPX code results at some sites other than GSI,

(b) SC&A did not divulge or reveal the existence of this paper to the TBD-6000 WG or to the full ABRWH or the SEC-00105 petitioners during GSI sessions held from 2006 through 2013 YTD,

(c) NIOSH and SC&A had a possible motive in not calculating Iridium-192 source term external photon dosimetry exposures at GSI because of known unacceptably large discrepancies between Ir-192 sources and measured data known to SC&A and possibly to DCAS/NIOSH as well. SC&A published REF 1 in 2005, at the inception of NIOSH/OCAS investigations, when GSI was first brought to the attention of the full Board during Public Comments attendant on MCW SEC-00012 St. Louis meetings by GSI site expert John W. Ramspott.

(d) SC&A and NIOSH had an obligation to make Reference 1 known to all concerned with adjudicating claims under EEOICPA for the EEOICPA GSI AWE site located at 1417 State Street in Granite City, IL. The failure to reveal the SC&A 2005 report that is the basis for this White Paper was especially regrettable and egregiously harmful to GSI claimants who have been denied compensation under Part B of EEOICPA.

(e) Not informing the ABRWH, the TBD-6000 WG and the petitioners about Reference 1 constitutes the 65th claimant adverse error that Dan McKeel has identified for the SEC-00105 Administrative Review underway since 5/17/13 (**REF 5**) and its October 2013 Addendum (**REF. 6**).

(f) Together, References 1 and 7 (NYO-4699[Suppl.1] 1957) constitute credible surrogate data that might be used at GSI to validate NIOSH and SC&A MCNPX models for, respectively, the GSI Co-60 and Ir-192 gamma sources (**REF 1**) and the two 24-25 Mev GSI Betatron electron accelerators (**REF 7a**) that produced x-rays and neutrons. NIOSH, at the 10/11/13 TBD-6000 WG, agreed to furnish in writing it's position on feasibility of using Ref 1 data as GSI Betatron surrogate data (Dan McKeel's position in his White Paper on the NYO-4699 1956 and 1957 reports (**REF 7b**).

References

[1] Anigstein R, Erdman MC, King SH, Mauro JJ, Miller KL, and Olsher RH. SC&A "Review Draft. An Evaluation of Radiation Detectors for Use in Screening Potentially Contaminated Individuals." November 2005. URL Internet link: www.bt.gov/radiation/pdf/hospitalinstruments.pdf

[2] Leone J, Furler M, Oakley M, Caracappa P, Wang B, Xu XG. "Dose mapping using MCNP5 mesh tallies." Health Phys 2005 Feb;88(2 Suppl):S31-3

[3] Juste B, Miro R, Morera D, Diez S, Campayo JM, Verdu G. "MCNP5 Monte Carlo simulation of amorphous silicon EPID dosimetry from MLC radiation therapy." Conf. Proc. IEEE Eng Med Biol. Soc. 2012: 2012:5786-9: doi:10. 11091EMBC.2012.6347309.

[4] Bednarz B, and Xu X George. "Monte Carlo modeling of a 6 and 18 MV Varian Clinac medical accelerator for in-field and out-of-field dose calculations: development and validation." Phys Med Biol. 2009 February 21; 54(4): N43–N57. [Difference between calculated (MCNPX) and measured neutron fluence was 20%].
URL link: www.ncbi.nlm.nih.gov/pmc/articles/PMC3376900/

[5] Submission from Daniel W. McKeel, Jr., M.D., SEC-00105 Co-petitioner: "GSI SEC-00105 Administrative Review application to HHS," dated 4/17/13 (with 10 Exhibits);
(September 19, 2013) URL Link DCAS website: http://www.cdc.gov/niosh/ocas/gsi.html
PDF 103 KB (184 pages)

[6] McKeel DW Jr. "GSI SEC-00105 Administrative Review: Listing Of 44 Original And 20 Post Board Final Vote Errors; With 19 Still Open Appendix BB and SEC-105 Matrix Issues." October 6, 2013, 12 pages.
• URL link DCAS website: http://www.cdc.gov/niosh/ocas/pubmtgs.html#oct11
(October 7, 2013)
PDF 499 KB (13 pages) under Ref. [5]. Filename: GSI SEC AR_ADD_matrix.pdf

[7a] McLaughlin JE Jr, O'Brien K, Solon, LR, Zua AV, Lowder WM, Blatz H, NYO-4699 (Supplement 1), "Stray radiation measurements at particle accelerator sites," Health and Safety laboratory AEC and Division of Research AEC, April 1, 1957. 20 references. (86 page PDF file).
URL Link DCAS website: http://www.cdc.gov/niosh/ocas/pdfs/d140/mckeel081913.pdf

[7b] McKeel, DW Jr., MD. White Paper: "HASL NYO-4699: The Missing Betatron Stray Radiation Monitoring Measurements and Film Badge Data Applicable to the General Steel Industries (GSI) AWE Site in Granite City, Illinois." August 19, 2013.
URL link DCAS website: http://www.cdc.gov/niosh/ocas/gsi.html
Filename: DWM_NYO-4699_WhitePaper.pdf (19 page PDF 431 KB)

Respectfully submitted,

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