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

**From:** DanMcKeel2@aol.com
**Sent:** Sunday, August 26, 2012 2:30 PM
**To:** NIOSH Docket Office (CDC); Katz, Ted (CDC/NIOSH/OD); Ziemer, Paul (CDC/NIOSH/OD); pl.ziemer@comcast.net; josiebeach@charter.net; j-poston@tamu.edu; wimunn@aol.com; danmckeel2@aol.com
**Cc:** Kinman, Josh (CDC/NIOSH/DCAS);
**Subject:** McKeel comment on 8.21.12 DCAS-Allen response to SC&A SD paper
**Attachments:** McKeel_reply_Allen_8.26.12.pdf

Dr. Paul Ziemer and members of the TBD-6000 work group
All members of the ABRWH
NIOSH Docket 140 (GSI) Office
Ted Katz (DFO, ABRWH)
Josh Kinman (NIOSH SEC Counselor)

August 26, 2012 Sunday

Dear Dr. Ziemer and TBD-6000 work group and Board members, NIOSH Docket Office,

Attachment: <McKeel_reply_Allen_8.26.12.pdf> 1.3 MB

Attached please find my comment on the DCAS and David Allen discussion paper dated 8/21/12. The DCAS-Allen paper is in response to SC&A's 7/16/12 paper on surrogate data use at GSI and the SC&A 7/25/12 alternate uranium intake model Discussion papers, all to be presented next Tuesday at the TBD-6000 work group meeting. I consider these issues to be SEC-00105 issues and not merely Appendix BB matrix issues.

Ted Katz: please distribute this e-mail and the attached PDF file to all Board members. Thank you.

NIOSH Docket Office: please consider this Discussion paper for posting on Docket 140 on the DCAS website. Thank you.

Sincerely,

-- Dan McKeel

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**Comment by Daniel W. McKeel, Jr., GSI SEC-00105 co-petitioner, to the TBD-6000 work group discussion paper "Use of Surrogate Data at GSI dated July 16, 2012 Response to SC&A Review," prepared by Dave Allen, DCAS, August 21, 2012**

On July 16, 2012, SC&A released a review of the use of surrogate data at GSI which evaluated the use of surrogate data at GSI against the Advisory Board's Surrogate Data Criteria. This paper provides NIOSH's response to that review.

MCKEEL GENERAL COMMENT: The majority of concerns about this paper is it repeatedly ignores well substantiated facts that have been put on the record by the GSI petitioner team, by site experts, and by previous GSI workers including multiple eye witness Betatron operators. This substantial body of factual evidence has been largely overlooked, or ignored, by DCAS.

## Overview

Unlike most Atomic Weapons Employer (AWE), the AEC contracted work at GSI did not involve active manipulation of uranium metal through processes such as rolling, machining, cutting, or straightening. The work at GSI consisted solely of taking x-rays of uranium metal that were used to evaluate the integrity of the casted billets manufactured at Mallinckrodt Chemical Works. Thus, the only potential for generation of airborne uranium at GSI would be from the movement of the metal into position for the examination.

MCKEEL: There are several major technical errors in the foregoing paragraph:

(1) The statement that: "***The work at GSI consisted solely of taking x-rays of uranium metal that were used to evaluate the integrity of the casted billets manufactured at Mallinckrodt Chemical Works.***" is not accurate for several reasons that are discussed here and in section (2) that follows.

(a) The petitioners believe they have proven through MCW records that the primary purposes of subjecting MCW uranium to Betatron NDT examination was not just to inspect the metal for structural defects. NDT radiographed was required to define the interface between the uneven thickness adherent outer "bomb" crust of dingots and ingots and the underlying pure uranium metal.

(b) **Uranium billets were not the primary or the sole type of uranium metal sent to GSI** from the MCW-Destrehan Street plant and the MCW Uranium Division Weldon Spring Uranium Feed Materials plant in St. Charles County. In fact, there were at least four different types of uranium metal examined by nondestructive testing (NDT) radiographic techniques at GSI:

- One step **dingots** with shaggy, irregular outer crust (magnesium fluoride) "bomb" remnants and weighing 3,000 pounds each;
- Two step **ingots** produced by a two step process in a "bomb" which were shipped before the crust was cropped and lathed off, weighing 3,000 pounds each;

• **Betatron slices** that were hand sawn at MCW into pieces perhaps 4 to 5 inches thick, and;

• A few cast **billets**.

Only the billets and the sawn surface of the Betatron slices had an exposed surface composed of pure uranium, free of crust, with an oxide later being exposed.

Exact numbers and composition of these four uranium metal types sent from the two MCW sites to GSI are unknown. Dingots and ingots were known to be alloyed and to contain trace impurities including thorium radionuclides. Recycled (previously irradiated in a nuclear reactor) uranium was known to be processed at the Weldon Spring MCW-DOE site for part of its operating period of 1957-66. Purchase orders from MCW to GSI are completely missing 1953-57. A 1992 DOE memo to its Oak Ridge office, which reproduced below, states that "dingots," not billets, were the main uranium metal product sent from MCW to GSI for NDT Betatron radiography.

United States Government — Department of Energy — 095801

**memorandum**

DATE: OCT 08 1992 — 92 OCT 13 AM 9:29

REPLY TO ATTN OF: EM-421 (W. A. Williams, )

SUBJECT: Authorization for Remedial Action at Granite City Steel Site, Granite City, Illinois

TO: Manager, DOE Oak Ridge Field Office

This is to notify you that the Granite City Steel site in Granite City, Illinois, is designated for remedial action under the Formerly Utilized Sites Remedial Action Program (FUSRAP). This notification does not constitute a FUSRAP baseline change control approval. Approval of the baseline change will be accomplished through the normal baseline change control procedures.

The site was used by the former Atomic Energy Commission for x-ray studies on uranium dingots during the 1950s and 1960s. A radiological survey found residual uranium inside one building and around an industrial vacuum cleaner. Because of the limited extent of the contamination, the site may be remediated using the expedited cleanup process now under development.

R. P. Whitfield
Deputy Assistant Secretary
for Environmental Restoration

It is difficult to understand, after all our previous interactions on this important point, why DCAS would mention uranium "billets" as the main product processed at General Steel Industries 1953 through June 30, 1966, the extent of the GSI AEC Mallinckrodt Chemical Works uranium contract period. The treatment of uranium dingots in TBD-6000 Rev 0 and Rev 1 is incomplete and not totally accurate.

A photograph of a typical Weldon Spring site uranium metal ingot/dingot was a rough coat is shown below. The photograph was provided to . through the courtesy of the DOE Weldon Spring Site Interpretive Center. This community resource feature a museum and visitor center in St. Charles County, MO, that is adjacent to the 45 acre engineered disposal cell.

**Symposium on nondestructive tests in the field of nuclear energy.**
**(See Page 7. *Fuel Tests)* It answers and confirms "why dingots went to GSI", and that Betatron X-rays were done "before any cropping" See Page 7.**
**This material had been provided to everyone and mentioned many times.**

**This is not a clean slug by any means: (Photo from Weldon Spring DOE Visitor Center).**

(2) **The complex uranium transport pathway at GSI was not acknowledged.**

GSI employed two 24-25 Mev Betatron electron accelerators operating in x-ray mode at two separate GSI building locations, the Old and New Betatron facilities. In order to get the uranium metal from the shipping and receiving dock, the products first needed to be lifted and scraped with sturdy metal grabber hooks and metal chain hoists and unloaded from trucks onto rail transfer cars that were not cleaned and themselves had uranium dust contamination that was never measured and quantified, nor was it accounted for and bounded as a portion of dose by DCAS/NIOSH. The rail tracks have been demonstrated by the petitioners to run though buildings 6, 7, 8, 9 and 10 and inside building 10 into a short above ground "tunnel" causeway and break area leading into the New Betatron Facility ("NBB"). The rail transfer tracks branched and led outside to the Old Betatron Building that stood alone 300 feet away from the NBB not connected to any other GSI building. It is to be expected, therefore, that some uranium contamination

would have accumulated along the entire transport pathway. In addition, uranium metal products were sometimes stored for several days before and after undergoing NDT radiography at GSI and being returned to the MCW Uranium Division. This interpretation of the facts has not been challenged or disputed.

(3) In light of the facts outlined in subsections (1) and (2), DCAS's statement that ***"Thus, the only potential for generation of airborne uranium at GSI would be from the movement of the metal into position for the examination."*** was simply not accurate. The reasons for making this statement include:

(a) The sentence ignores resuspension of surficial uranium (SC&A's term), that is, uranium particles and "dust" that was on surfaces that undoubtedly included the rail road tracks throughout the entire transport path; the rail transfer cars; the chain hoists; the overhead cranes; the storage area floors, walls and rafters; buildings 6, 7, 8, 9 and 10; and the tunnels leading into the OBB and NBB Betatron shooting rooms. NOTE: In a separate Discussion paper submitted to the Board by Dan McKeel on 8/25/12, the extensive cleanup and power washing and renovation of the NBB that occurred 1978-1993, and the power washing that occurred in OBB in 1984, led to a marked and unquantifiable attenuation of surficial uranium on the NBB and OBB facilities, further distorting and interfering with accurate quantification of both airborne and surficial uranium. In spite of all these cleanups and power "blasting" some residual uranium was demonstrated by ORNL on the floors, in the air vent ducts, and in a small industrial vacuum cleaner during the DOE/ORNL cleanup that marked the end of the residual contamination period at GSI in 1993.

Most active manipulation of uranium metal requires the metal to be heated. Typically uranium in these processes is heated to well over 1000 degrees Fahrenheit. At these high temperatures, the uranium metal oxidizes readily forming a loose oxide layer that can easily create airborne contamination. An exception to heating uranium metal during operations is machining. When uranium metal is machined or cut, it is not normally preheated. Rather, the area being cut is cooled with machine oil, water or some other coolant. This not only reduces the release of airborne activity, but also cools the metal to prevent fuming. In all cases, however, the metal is moved by various means to the furnace or equipment prior to working. The movement of cold uranium metal presents such a low potential for airborne uranium that



very few air samples were ever taken. Those that were, are often taken while other operations are also occurring causing the air in the vicinity to be contaminated by the nearby operations. Therefore, samples intended to be representative of the operation at GSI must consider not only the type of operation but the potential interferences in the vicinity.

MCKEEL COMMENT: There are major concerns about this presentation of the facts concerning the AEC MCW-GSI contract and MCW uranium NDT radiography. First, in

the case of ingots and dingots, the uranium was heated in stages to over 1400 degrees in a "bomb" by the MCW Uranium Division in Missouri before it was shipped to GSI 40 to 70 miles away across the Mississippi River to Granite City, IL, where GSI was located. The production process details for MCW uranium billets has not been described to my knowledge. At GSI, all the four MCW uranium products were subjected to high energy—24 to 25 Mev Betatron bombardment— known to cause both fission and generation of a range of fission products, and photon activation, causing added radionuclide daughter products. SC&A's Joe Fitzgerald acknowledged this potential danger to Weldon Spring workers in his 2009 revision of the Weldon Spring site profile, as shown in the following excerpt:

[Joe Fitzgerald SC&A WS site profile revision, page 15 of 91]

| Effective Date: | Revision No. | Document No. | Page No. |
|---|---|---|---|
| February 10, 2009 | 0 | SCA-TR-TASK1-0028 | 15 of 91 |

**1.3 OPPORTUNITIES FOR IMPROVEMENT**

SC&A has identified some areas where changes in the TBDs would be beneficial to the claimant by preventing possible mistakes during dose reconstruction or clarifying items to make them less ambiguous. These are listed as Observations in this section.

**1.3.1 Observations – General**

**Observation – Lack of Coverage of Offsite Activities**

Apparently, some work was performed by offsite contractors for the WS site, which consisted of inspection of uranium metal samples by cutting of the material and then irradiation using high-energy betatrons. This procedure could induce fission in uranium and create fission products that could emit radiation not normally encountered in a uranium facility, and expose nearby WS workers and transporters who may not have normally been badged; and it could have created inhalable radioactive material for which bioassays were not performed. This subject should be investigated and addressed in the appropriate TBDs.

GSI Appendix BB Rev 0 was one of the TBDs that Mr. Fitzgerald was referring to. Of course, we now know that bioassays were NOT performed. Note SC&A in this Weldon Spring document, states that the offsite x-rayed uranium ***"could have created inhalable radioactive material..."*** DCAS has ignored this possibility and so did SC&A in its new Alternate intake model that DCAS has dismissed as having too much uncertainty. The Betatron induced fission and photoactivation products were additional sources of intake radiation exposures not only to Weldon Spring handlers of the activated irradiation uranium, but also of the exposed GSI workforce after leaving the Betatron facilities on their way back along the transport pathway to the shipping dock.

## Responses to SC&A's Review Comments

### Criterion 1: Hierarchy of Data

SC&A points out that FUSRAP contamination data from 1993 exists at GSI and could be used to estimate intakes, thereby eliminating the need for surrogate data. However, the

hierarchy of data criterion adopted by the Board does not exclude the use of surrogate data when actual site data is available. The criterion states:

"*Surrogate data should only be used to replace data if the surrogate data have some distinct advantage over the available data and then only after the appropriate adjustments have been made to reflect the uncertainty inherent in this substitution*"

NIOSH agrees the use of the FUSRAP data would eliminate the need for the use of surrogate data, however, the uncertainty associated with back extrapolating the data 40 years would likely far exceed the uncertainty associated with the use of more contemporaneous sources of surrogate data.

MCKEEL: Here DCAS uses extremely tortured logic to ignore and circumvent SC&A's scientifically defensible finding that DCAS violated Board surrogate data criterion 1. In doing so, DCAS actually impugns its own current Appendix BB intake model for 1953 to 1993 for uranium by stating: ***"the uncertainty associated with back extrapolating the data 40 years would likely far exceed the uncertainty associated with the use of more contemporaneous sources of surrogate data."*** This misses the point entirely that the surrogate data from the slug facility that DCAS chose and back extrapolation of the scant GSI vacuum cleaner data uranium dust data from 1993 to the entire residual period in the new SC&A uranium intake model, are BOTH faulty in their inception. Also, the underlying slug facility surrogate data and the GSI ORNL 1993 vacuum cleaner real data are invalid for both reasons.

As outlined in my August 25, 2012, Discussion paper on the GSI residual period 1978-1993, the Old Betatron Building had been extensively power washed in 1984 and a new concrete berm that consumed 25% of the shooting room floor had been constructed. The berm was built in order to store PCB-contaminated oils and transformers, and the two Betatron machines, at some unknown time between 1974 and 1988 when ORNL/DOE first documented the condition of the GSI OBB as part of the FUSRAP cleanup.

Thus, NIOSH believes that the use of surrogate data at GSI is justified under criterion 1, given the complete lack of available contemporaneous monitoring data and the large degree of uncertainly inherent in backwards extrapolation of data collected in 1993.

MCKEEL: This argument is scientifically specious in a logical sense, based on the preposterous assumption that surrogate data ("SD") use is justified even if it fails to meet Board surrogate data criteria. DCAS again fails to mention whether the slug facility data meets it own surrogate data criteria in OCAS-IG-004. The DCAS-Allen argument is basically that *any type* of SD is OK if there is a total lack of real measured site data! This type of argument should not be acceptable to anyone. The GSI petitioners strongly object.

In TBD-6000, the daily average slug production airborne activity was estimated as 198 dpm/m3 by assuming an operator was exposed to the maximum airborne causing concentration 75% of the time. SC&A pointed out a mathematical error in TBD-6000 that caused the calculated geometric mean to be too high. SC&A also points out that while the

geometric mean of the airborne contamination may be appropriate for lognormal distribution, Appendix BB uses it as a constant.

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Appendix BB used the geometric mean as a constant instead of a lognormal distribution because the airborne concentration TBD-6000 is associated with slug production rather than simply moving cold uranium metal. The use of the geometric mean is an attempt to prevent the value from being unrealistically high (i.e., it represents a plausible upper bound) as SC&A appears to indicate in their review of criterion 5.

MCKEEL. All of these mathematical calculations are moot because the slug facility SD has been declared by SC&A as invalid, and the petitioners agree with this point of view and have advocated such a position, on the record, as far back as 2008.

**Criterion 2: Exclusivity Constraints**

This criterion requires the use of surrogate data to be stringently justified. SC&A points out that the basis for selecting the surrogate data used by NIOSH was that uranium handling alone results in less disturbance of the metal than the other scenarios listed in Battelle-TBD-6000. That is, the data used are higher than the exposure conditions that existed at GSI. SC&A does not believe this qualifies as stringently justified. NIOSH agrees the use of surrogate data at GSI has not been stringently justified in Appendix BB.

However, Appendix BB was written approximately three years prior to the Board formally adopting its surrogate data criteria.

MCKEEL: Again, this argument is specious. The slug facility data SD data is being evaluated for appropriateness in August 2012, years *after* both the Board and DCAS have approved separate sets of SD criteria. It is entirely appropriate to apply these criteria now. The petitioners position is the SD criteria should have been applied by the Board and SC&A at GSI years ago, earlier in the evaluation process, just as was done at Texas City Chemicals for SEC-00088, and for Dow Chemical (Madison, IL) under SEC-00079.

In response to SC&A's comment, NIOSH has reviewed the airborne exposure data available from a number of sites to determine if a more comprehensive dataset are available to satisfy the intent of this criterion. At the end of this paper NIOSH provides a more robust analysis of the use of surrogate data at GSI (see section titled Evaluation of Other Sources of Surrogate Data) with the intent to incorporate relevant parts in the next revision to Appendix BB.

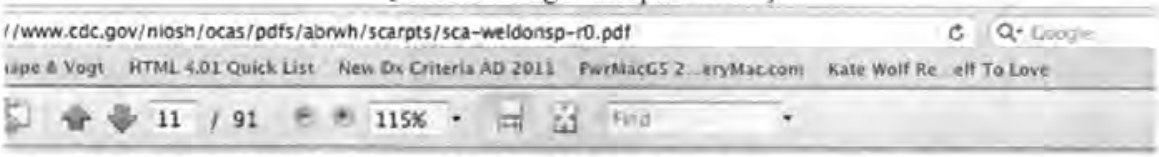
MCKEEL: Here DCAS misstates the scanty SD data from three sites, two producing uranium slugs, and one producing uranium billets, as being "more robust." The new SD is not robust, it is fragmentary as examination of the data sheets and text will clearly show. Furthermore, this is DCAS' third opportunity to construct a scientifically valid and

defensible intake model for uranium at GSI, and it admits it cannot so. DCAS states it has the ***"...intent to incorporate relevant parts in the next revision to Appendix BB."*** This is NOT sufficient to constitute evidence that the DCAS/NIOSH new model, its fourth attempt, will be superior to the first three attempts. In effect, this argument is "please trust me," whereas the Board should insist the argument should "you must show me now."

There is also a bothersome underlying assumption that somehow the DCAS uranium intake model for 1953-1993, which has now been stated to be invalid by SC&A, is purely an Appendix BB issue. It is not; it is also a key SEC issue. DCAS must persuade the full Advisory Board on Radiation and Worker Health it can bound with sufficient accuracy all intake doses 1953-1993 for all GSI in order to sustain its current recommendation to deny the GSI SEC-00105 for the entire covered and residual period for all workers in the class with all types of cancer.

Joe Fitzgerald, in the 2009 SC&A review of the Weldon Spring DOE site profile, has this to say about the use of scanty inhalation date to bound intake doses:

[SC&A Fitzgerald quote here]




**Insufficient Data for Unmonitored Workers' Internal Environmental Dose**

The TBD used one series of measurements (decontaminating 5-ton hoppers) and site parameter measurements to determine contributing intakes to non-bioassayed workers during 1957–1967. The hopper dust monitoring experiment consisted of measurements performed on one day under one particular condition, and the parameter measurements contributed very little (<1%) to the final results. This limited (in space, operations, and time) airborne/intake data is not sufficient to construct an adequate intake dose database for unmonitored workers at the WS complex, especially considering that a sizable fraction of the work force was not bioassayed on a routine basis during this period.

At GSI, none of the workforce was bioassayed for uranium at any time 1953-1993. The GSI airborne uranium intake data by inhalation is even more limited (i.e., is nonexistent).

## Criterion 3: Site or Process Similarities

SC&A points out that slug production by powder metallurgy is not similar to x-raying uranium metal. As discussed previously, each task in TBD-6000 inherently includes the movement of cold uranium metal at some step in the particular process. In the slug production process described in Harris and Kingsley1, the process starts with a uranium metal ingot loaded into a hydriding furnace. In the process, a uranium

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1 Harris, W.B., and I. Kingsley, 1959. "The Industrial Hygiene of Uranium Fabrication," A.M.A. Archives of Industrial Health, 19, 540–565.



hydride is formed and later dehydrided to form a metal powder that is shaped into slugs.

As with each process described in TBD-6000, the airborne contamination from this movement of cold uranium metal is not quantified so Appendix BB used one of the lowest airborne creating tasks as a bounding estimate of the movement of cold uranium metal. While the task as a whole is not representative of the movement of cold uranium metal, the movement of cold uranium metal is included in the task.

MCKEEL: This argument also is weak and scientifically indefensible. There really is no similarity between the slug facility operations and Betatron 24-25 Mev NDT radiography that produces fission and activation of crusted uranium ingots and dingots. The uranium is not "cold" following Betatron irradiation; it is "hot" by induced activation and fission products of uranium caused by the twin GSI 24-25 Mev Betatrons. Mr. Allen and DCAS cannot deny these salient facts. The last sentence is an argument *reductio ad adsurdum*.

**Criterion 4: Temporal Considerations**

SC&A notes that the data used was likely collected prior to 1958 which is therefore not contemporaneous with the end of the operational in 1966. However, the Board's criterion indicates the data should be from the same general period unless it can be demonstrated that the "working conditions, procedures, monitoring methods, and (perhaps) legal requirements were comparable to the period in question".
In addressing this, we note that there has never been any indication of any intentional controls over airborne contamination at GSI. The source of airborne uranium was simply movement of cold uranium metal in order to position it for x-ray examination. The source of airborne is then a physical characteristic of uranium metal which doesn't change over time.

MCKEEL: Mr. Allen restates the premise that ***"The source of airborne uranium was simply movement of cold uranium metal in order to position it for x-ray examination."*** This statement is ridiculous, specious, factually inaccurate, and scientifically indefensible for reasons already stated: (1) GSI uranium became airborne from handling uranium and from resuspension and dispersion all along the transport pathway and on many surfaces—rail transfer cars, chains, cranes surfaces, floors, rafters, ceiling, vents of air ducts, sweepers, floor traffic—to identify some of them. As is described in more detail in my 8/25/12 Discussion paper on the 1978-1993 residual period at GSI, several eye witness cleanup workers and electricians who observed the OBB power washing in 1984 and the renovation and power washing and rewiring of the NBB facility by Michigan Metals Processing, Water Blasting Company, Dow Chemical in 1984, and possibly later paneling by Affiliated Metals, the NBB facilities also were used as classrooms with lots of foot traffic by National Steel/Granite City Steel. Also, as noted previously, SC&A (first author Joe Fitzgerald), stated in his 2009 Weldon Spring site profile review that uranium photofission and activation production by 24-25 Mev Betatron x-irradiation posed another inhalation intake scenario for workers who handled this "hot uranium" after Betatron exposure. These effects begin to appear in the 6-10 Mev range. The petitioners have pointed out previously that both DCAS and SC&A have seriously underestimated the full range of half lives of these Betatron-induced daughter radionuclides. We have offered several key references from the literature to document

these daughter products (Kuttemperoor, Guo and Ziemer, Sugarman). Many of them had longer half-lives that lasted weeks rather than minutes or 24 hrs as is usually cited in the NIOSH technical reports that give data for only selected daughter products.

I offer a new abstract of another such study I just ran across by Harold G. Richter and Charles D. Coryell (Nobel laureate and the discoverer of the element promethium in 1945) to add to this evidence. Twenty fission products are identified in this abstract:

**Z11. Fission of Uranium with 16-Mev X-Rays.*** HAROLD G. RICHTER† AND CHARLES D. CORYELL, *M.I.T.*—The dependence of fission yield on mass number has been studied for the fission of natural uranium ($U^{238}$) with x-rays of 16-Mev maximum energy from the linear accelerator.[1] The following fission products were studied: $Br^{83,84}$, $Sr^{89,91,92}$, $Y^{93}$, $Zr^{97}$, $Mo^{99}$, $Ru^{105}$, $Pd^{109,112}$, $Ag^{112,115}$, $Cd^{117}$, $Te^{132}$, $I^{131,133}$, $Ba^{139,140}$, and $Ce^{143}$. Pre-existing chemical procedures[2] were tested and some modifications made for better suitability in quantitative isolation of the low activities available. Conditions of counting were controlled to permit the calculation of absolute disintegration rates. Fission yields were determined relative to 6.0 percent for 85m $Ba^{139}$. Precision of the values is about ±10 percent. The yield-mass curve exhibits the familiar double-humped shape, rising from about 0.3 percent at mass 83 to a maximum of about 6.2 percent at mass 97. The minimum is 0.05 percent at mass 117, and the heavy hump maximum is 6.2 percent at mass 138. Fission yields lying above a formal smooth curve were observed for 77*h* $Te^{132}$ (5.8 percent) and 22.4*h* $I^{133}$ (7.1 percent).

* This work was supported in part by the USAEC.
† Department of Chemistry, University of Oregon, Eugene, Oregon.
[1] P. Demos, M.I.T.-L.N.S.R. Technical Report No. 50, May, 1950.
[2] C. D. Coryell and N. Sugarman, *Radiochemical Studies: The Fission Products* (McGraw-Hill Book Company, Inc., New York, 1951), Book 3, Part VI.

The exact citation for this paper is not clear. Publication years is probably 1951-54. The same two authors published "Low energy photofission yields for U-238" Phys. Rev. 95: 1550-1553, 1954. Coryell and Sugarman production a 1951 monograph on "*Radiochemical Studies: The Fission Products.*" (see citation above)

**Criterion 5: Plausibility**

SC&A appears to be indicating the airborne contamination calculation in Appendix BB is not plausible because uranium work at GSI was intermittent and thus "large flakes" of

uranium oxides would not be quickly ground into dust under foot or forklift traffic. This results in the equilibrium value in Harris and Kingsley for a continuous operation being higher than that expected at GSI.

NIOSH agrees that work with uranium at GSI was intermittent and thus it is less likely that an equilibrium concentration would be reached. This implies the value in Appendix BB is too high. However, the argument used by SC&A appears to be based on the idea that the resuspension of surface contamination is the major source of airborne contamination during operational periods.

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In reality, airborne contamination while working with uranium metal would initially be caused entirely by disturbing uranium oxides on the surface of the uranium metal. This contamination would be relatively consistent from one piece of uranium to the next. As additional pieces of uranium metal are brought in, a fresh source of contamination is available. Since this source of airborne does not depend on the slow buildup of contamination, it occurs immediately and builds up quickly to a maximum.

The other source of airborne, resuspension from surface contamination, will build up to a maximum more slowly as the surface contamination builds up from continued operations. This source of airborne is much lower than the operational source. This effect can be seen in Figure 1 which depicts the relative levels of airborne contamination during operational and post-operational period at Simonds Saw and Steel. The time scale in this figure is days. Once the rolling operations end, the airborne contamination decreases quickly to a steady level caused by resuspension. It should be noted that, at Simonds Saw and Steel, the uranium metal was heated and rolled resulting in a much larger fraction of the metal being oxidized. This would result in higher levels of airborne and surface contamination than would be seen with the movement of cold uranium.

MCKEEL: There are several misstatements in this section because of incomplete data on key events that occurred during the GSI residual period 1978-1993 that are now on the record in the previously mentioned Dan McKeel 8/25/12 Discussion paper. The petitioners believe that DCAS has seriously underestimated uranium intakes at GSI. DCAS has no real data of significance related to GSI airborne uranium intake factors,

- The inference that surface uranium metal content would be similar from one specimen to another would be constant is a false premise. Different amounts of crust encoated both ingots and dingots. The Putzier effect contributes to dose and this was not mentioned.
- ***"Once the rolling operations end, the airborne contamination decreases quickly to a steady level caused by resuspension."*** However, this is true only while the surface levels of uranium remain undisturbed. We have now shown that the NBB and OBB and building 6 and 7 though 10 dust was cleanup up, power washed, covered up with a new concrete berm at several intervals during the GSI residual period. The very fact that ORNL found residual uranium in the OBB during the DOE FUSRAP cleanup, in fact, confirms the uranium contamination levels must have been far higher in times past. There

is no credible, scientifically defensible method available, absent real measured air intake or urinary uranium bioassay data, to quantify intake exposures at GSI.

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Figure 1 – Airborne Uranium at Simonds Saw and Steel During and After Rolling Operations [FIG. 1 data omitted].

MCKEEL: DCAS is comparing apples (Simonds-Saw rolling mill) to oranges (GSI NDT radiography) with two different operations and two different facilities that are not comparable physically or with respect to what operations they performed at all. Simonds-Saw data would also not pass Board SD criteria. Rolled steel is cleaned by scraping and polishing, whereas uranium cast ingots and dingots sent to GSI from MCW were in their raw encrusted form before cropping and vertical lathing were performed later after Betatron NDT radiographic inspection was performed and the reports and x-ray films were returned to MCW Uranium Division. All of those vital records have been lost or destroyed.

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**Evaluation of Other Sources of Surrogate Data**
As described earlier, monitoring data associated with the movement of cold uranium metal is limited. A review of the data from AWE facilities indicate that most data are associated with actual airborne causing activities, rather than simply moving the metal. Also, some sample results that are associated with moving the metal are positively biased by nearby work with uranium metal. In searching the available data from a number of AWEs, however, a few examples were found.

MCKEEL: These facilities are not comparable to GSI. Two produced uranium slugs (not a product used at GSI) and the other produced uranium billets (a minor uranium metal product used at GSI). These surrogate data would not pass the Board SD criteria, so citing them is immaterial to NIOSH being able to demonstrate now that it can bound GSI uranium intakes with sufficient accuracy and thus make a valid recommendation to deny SEC-00105. That demonstrably cannot be done by DCAS/NIOSH at the current time.

Also, this belated advancement by DCAS/NIOSH of other surrogate intake data is "too little and too late." They have had three chances (June 2007 to October 2012, the Path Forward for GSI from October 2010 to January 2012, and the response to SC&A's development of a new alternate uranium intake model for GSI (which DCAS roundly rejected in the Allen 8/21/12 response paper) to develop a valid uranium intake method at GSI.

What has been shown is that the TBD-6000 and other surrogate data that DCAS can produce is inadequate to pass Board SD criteria because it is so scant and so different from the unique uranium operations at GSI. And as Mr. Allen and DCAS admits, GSI made no real attempt to monitor air intakes or to perform urine uranium bioassays, or to

monitor the exposed work force with adequate film badges except to a few Betatron-isotope radiographers (n=89 of a work force of at least 3,000 in a given year) for 3 of the 13 covered period years and an even smaller number (n=19 workers) during part of the residual period of July 1, 1966 through 1973 when GSI ceased operations. Other owners owned and maintained the GSI property and buildings during the entire residual period up through 1993. ORNL made an expedited (and inadequate and too limited) assessment of residual radioactivity in the OBB and NBB only. The finding of no residual uranium in the GSI New Betatron Building is easily understood now that more detailed facts of the multiple cleanups, power washing, rewiring and paneling have been laced on the record. The full extent of uranium contamination of the GSI Old Betatron Building was obscured by the 1984 cleanup, concrete berm installation in the shooting room, and power washing in 1984 by the Power Blasting Company. ORNL and DOE did not even survey the majority of the areas in the transport pathways to and from the loading dock and the Old and New Betatron facilities where the NDT radiography work on MCW uranium took place at GSI from 1953 through June 1966.

**Heald Machine Company (SRDB 40986 page 10, Figure 2 in this paper)**.
At the Heald Machine Company, air samples were taken while machining uranium metal **slugs**. Values ranged from 1 to 11 dpm/m3. It is likely coolant was used to cool and lubricate the uranium while it was being machined so air samples while machining were not necessarily representative of uranium metal handling. However, coolant is normally supplied by a fixed nozzle on the machine. Thus, dry uranium metal would be moved to the machine prior to machining. If significant airborne contamination was caused by this movement, it would still be present while machining the slugs. Although this activity may not be directly applicable to the movement of cold uranium metal, they do provide an indication that actual values are relatively low.

MCKEEL: This was a slug production facility not justifiably similar to GSI operations. The data is very scanty, insufficient to bound intake doses.

**Chambersburg Engineering Co (SRDB 10048 page 39, Figure 3 in this paper)**
At Chambersburg Engineering approximately 150 hot uranium **slugs** were forged into washers during a two day test. The slugs were dry heated and no ventilation was provided for the work. A summary of the air samples are provided in Figure 3. The average air concentration while loading cold uranium slugs into a furnace was 69 dpm/m3 while loading one slug every 15 minutes and increased to 77 while loading one slug every two minutes. The maximum air concentration while loading cold uranium into the furnace was 174 dpm/m3. Air concentrations after heating and while forging were higher and it is possible some of that airborne contamination caused by this work interfered with samples taken while loading the furnace.

MCKEEL: This was a slug production facility not justifiably similar to GSI operations. The data is very scanty, insufficient to bound intake doses.

**R. W. Leblond Machine Tool Co. (SRDB 10634 page 11, Figure 4 in this paper)**

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A test was conducted at Leblond to evaluate a hole boring machine. Air samples were taken while boring a hole into a uranium billet with a rapid bore machine. Coolant was used while boring the hole but air samples were taken while loading the dry billet onto the machine. The first thee samples on the data sheet (Figure 4) were taken as breathing zone air samples while "hooking hoist to billet and placing billet into position on machine". The remarks section of the data sheet indicates there was no ventilation on the machine and very little air movement. Coolant used during the boring reduced any possible interference from nearby operations. Together, these issues make the Lablond samples the most directly relevant samples to the work at GSI. One of the samples measured 9 dpm/m3 while the other two samples had results that were labeled as "nd" which stands for none detected.

MCKEEL: This was a uranium billet production facility not justifiably similar to GSI operations. The data is very scanty, insufficient to bound intake doses.

**Conclusions**

While it is difficult to find air sample data representative of moving cold uranium metal, it must be realized that this movement is inherent with every operation involving uranium metal. If the movement were to cause high levels of airborne uranium, it would in most cases continue to be present during the tasks for which samples were taken. The most relevant samples to GSI discussed in this paper are those taken at Leblond, which involved moving an ingot to a boring machine. Because this data set contains only three samples collected over a one day period, it is not a very robust sample set. Samples taken at Chambersburg Engineering while loading cold uranium slugs into a furnace were as high as 174 dpm/m3. While it is very possible some of this airborne activity was caused by nearby operations, it is not definitely known. Therefore, it is possible that handling cold uranium metal could cause airborne activity this high. This is relatively close to the 198 dpm/m3 used in Appendix BB.

The value used in Appendix BB, therefore, appears to be bounding without increasing it by a factor of 2.9 as suggested by SC&A in criterion 1. It also appears to be a plausible upper bound when the degree of uncertainty is taken into consideration, rather than implausibly high as implied in SC&A criterion 5. The process of moving cold uranium metal without special controls or ventilation is a function of the physical characteristics of uranium metal and not a function of the time frame in which the samples were taken (criterion 4). While the processes described in TBD-6000 are based on sources of

airborne contamination with greater potential to generate airborne activity than merely the movement of

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uranium metal, they do include the movement of metal and therefore represent work at GSI in part (criteria 3). Lastly, it is NIOHS's position that, while it is difficult to find air samples that perfectly match the exposure condition at GSI, the value used in Appendix BB is both plausible and bounding. It is believed that this paper provides justification for its use and applicable portions of this justification will be incorporated in the next revision to Appendix BB (criterion 2).

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**Figure 2 – Airborne Uranium Data Sheet from Heald Machine Company**

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**Figure 3 – Airborne Uranium Summary from Chambersburg Engineering**

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**Figure 4 – Airborne Uranium Data Sheet from Leblond**