U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
CENTERS FOR DISEASE CONTROL
NATIONAL INSTITUTE FOR OCCUPATIONAL
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ADVISORY BOARD ON RADIATION AND WORKER HEALTH

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TBD-6000 WORK GROUP

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TUESDAY
NOVEMBER 3, 2015

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The Work Group convened via teleconference at 1:00 p.m. Eastern Time, Paul L. Ziemer, Chair, presiding.

PRESENT:

PAUL L. ZIEMER, Chair
JOSIE BEACH, Member
JOHN W. POSTON, Member

ALSO PRESENT:

TED KATZ, Designated Federal Official
DAVID ALLEN, DCAS
BOB ANIGSTEIN, SC&A
BOB BARTON, SC&A
DOUG FARVER, SC&A
JENNY LIN, HHS
DAN MCKEEL
JIM NETON, DCAS
JOHN RAMSPOTT
WILLIAM THURBER, SC&A

C-O-N-T-E-N-T-S

P-R-O-C-E-E-D-I-N-G-S

1:03 p.m.

MR. KATZ: So let's get started. Welcome, everyone. This is the TBD-6000 Work Group, and we are addressing GSI today.

There's an agenda on the website, on the NIOSH web page under the EEOICPA section, Board's scheduled meetings, today's date and some other materials as well, and Paul will address that when he begins the meeting.

Since we're talking about a specific site for agency-related people, please speak to conflict of interest and we'll do roll call now beginning with the Board Members, with the Chair.

(Roll call.)

MR. KATZ: Okay then. It's your meeting. Let me just remind everyone on the line to mute your phone except when you're addressing the group. Press *6 to mute your phone, *6 to come off of mute, and it's yours, Paul.

CHAIRMAN ZIEMER: Okay. Thank you

very much. Thank you everyone for your presence with us today on the phone lines. I just want to start by quickly -- well our focus of course today is GSI. I want to quickly summarize the documents that should be available to you for this meeting.

First of all, the documents from NIOSH called Discussion of Remaining Issues for Sanford Cohen & Associates Review of Battelle-TBD-6000 Appendix BB, and that was dated July 10th, 2015.

We have -- from our contractor documents, this is SC&A, a document called Review of Responses to the Sanford Cohen & Associates Review of Battelle-TBD-6000 Appendix BB Response Paper. That's dated September 11th.

We also have from SC&A the issue resolution matrix which has been updated to September 25th, 2015. Also, we have from the co-petitioner, Dr. McKeel, the paper dated July 10th, 2015 entitled, A Critique of the David Allen/DCAS/NIOSH Discussion of Remaining Issues to Sanford Cohen & Associates Review of

Battelle-TBD-6000 Appendix BB.

Also, I have an additional paper I want to identify that although it's not included, I don't think on the website as a paper for this meeting. I believe all the folks have it. It actually is an email from John Ramspott dated July 23rd, 2015 and it is entitled Subject Preview of New NIOSH White Paper GSI, July 10th, 2015.

I believe all of the Work Group Members received that document as well. I do want to get an approach -- you all have the agenda, which basically just identifies the documents that would be addressed that was on the agenda. This is one of the three public comments that I received from John Ramspott and Dr. McKeel.

My suggestion, is that rather than go through these documents on the agenda, I suggest that we actually go through the issues sequentially, and there are four issues that are dealt with by SC&A, by NIOSH and by the co-petitioner, Dr. McKeel and by Mr. Ramspott, and

these are Finding 2, Finding 5, Finding 6 and Finding 10.

My suggestion is that how we proceed is to begin with SC&A. We all have as the starting document the NIOSH document, and what they have proposed on each of these issues and so -- and I don't think we necessarily have to review that document to begin with --

MR. KATZ: I'm sorry Paul. I'm sorry one second. Is that traffic noise on your phone?

CHAIRMAN ZIEMER: No, that's not here. I hear it.

MR. KATZ: Well then someone else doesn't have their phone muted. Would everyone else please mute your phone?

CHAIRMAN ZIEMER: Right. It sounded like a siren.

MR. KATZ: Yeah, it did. So press *6 to mute your phone everyone else, thanks.

CHAIRMAN ZIEMER: Yeah. So if that would be agreeable, what we would do there and I

would ask, unless Dave had some starting points, is ask Bob Anigstein to provide his critiques and conclusions. I would ask Dr. McKeel to add his comments and conclusions and questions beginning with Item 2, then likewise Mr. Ramspott.

Then can we do 5 and do the same thing, then 6 and 7? I wonder if that would be agreeable with the Work Group, to do it in that manner?

MEMBER BEACH: Paul, this is Josie. I think that sounds like a great plan forward, path forward.

CHAIRMAN ZIEMER: Okay.

MEMBER POSTON: I agree Paul.

CHAIRMAN ZIEMER: Okay. Then let's proceed on that basis and we'll deal initially with Item or Finding No. 2, and let me ask Dave Allen do you have any preliminary comments you want to make before we hear from SC&A?

MR. ALLEN: I don't really have any comments. Do you want me to give you any background on the finding or just let Bob jump in

to --

CHAIRMAN ZIEMER: Well, if you have anything about the documents you might to add or anything you want to highlight before Bob takes off on his critique?

MR. ALLEN: I don't think I have anything to highlight, and I think as Bob discusses it, it will give you all the background on this particular finding.

CHAIRMAN ZIEMER: Yeah, okay. Then Bob, you want to proceed then with Finding 2.

DR. ANIGSTEIN: Yeah. Give me one second. Yeah. Let me put my slide show on, on the LiveMeeting. One second.

(Pause.)

CHAIRMAN ZIEMER: While you're doing that, Ted I don't have access to LiveMeeting, probably because my computer is not able to link with NIOSH for the last couple of weeks, and probably the invitation --

MR. KATZ: Paul, I sent you that in that

in an email to both of your addresses this whatever, around noon today.

CHAIRMAN ZIEMER: Oh okay. So let me -- I was out all morning, as you know, and so I haven't seen that. Let me see if I can --

MR. KATZ: Let me know if you have trouble with it.

DR. ANIGSTEIN: So does everyone see the --

MR. KATZ: Well, Paul is not on yet Bob.

DR. ANIGSTEIN: Excuse me?

CHAIRMAN ZIEMER: That was this morning Ted?

MR. KATZ: Yeah. That was probably around noon even.

DR. ANIGSTEIN: Yeah. I just sent -- I just sent a preliminary copy. I was working on it at the last moment, so I just sent a preliminary copy to Ted and to Paul in case you want to redistribute it. Then we'll have the usual distribution by Nancy Johnson, I guess, after the

meeting.

MR. KATZ: Bob I don't -- it hasn't come in to me.

DR. ANIGSTEIN: Ted, it hasn't?

MR. KATZ: No. I'm looking at my email right now and I don't have anything --

DR. ANIGSTEIN: That's funny thing, because I thought -- let's see.

CHAIRMAN ZIEMER: I don't either.

DR. ANIGSTEIN: What, shall I interrupt now and try to send it again?

MR. KATZ: Well, let's see if Paul can't get on --

DR. ANIGSTEIN: It definitely went out.

MR. KATZ: I believe you, but it's probably stuck in some server somewhere between you and me.

DR. ANIGSTEIN: Okay.

MR. KATZ: So no worries, Bob. I don't think there's anything you can do about that. But

Paul, are you able to get online? Do you even have a computer --

DR. ANIGSTEIN: Hold it. I can try to send it again from my regular email account. Maybe that will go faster.

CHAIRMAN ZIEMER: Ted, the last thing I got from you was this forwarding the update of the DCAS website. It was sent out at 11:09. Did you send it to me?

MR. KATZ: Yeah. I sent it to both your addresses afterwards, so let me --

DR. ANIGSTEIN: Let's see now. Who is missing -- John Poston is missing it?

MR. KATZ: So everybody is missing it.

(Simultaneous speaking.)

DR. ANIGSTEIN: Well, but I mean do you -- do you see the LiveMeeting?

MEMBER BEACH: Yeah. It's on LiveMeeting. You're on.

DR. ANIGSTEIN: So it's the same thing.

CHAIRMAN ZIEMER: Yeah. I can't get

it Bob, simply because I can't link into the --

MR. KATZ: Hold on. Let me just send it to you again Paul.

CHAIRMAN ZIEMER: Okay.

DR. ANIGSTEIN: I can -- should I send it to -- was it John Poston who can't get it?

MR. KATZ: No, John has it, I think, doesn't he?

MEMBER POSTON: No, I don't. I'm trying to get it but --

DR. ANIGSTEIN: Should I just email it to you?

MEMBER POSTON: Yeah, that would be great.

DR. ANIGSTEIN: Okay, hold on. I'll put the phone down for a moment.

MR. KATZ: Paul, which computer are you on?

CHAIRMAN ZIEMER: Comcast.

MR. KATZ: Okay. So I'll just send it to you and John Poston again, the link.

CHAIRMAN ZIEMER: Okay.

MEMBER POSTON: Okay. I've got the link in my calendar and everything, and I'm just not having any -- I also went to --

MR. KATZ: Sometimes you have to click on it twice. The first time -- that's what I have to do. The first time I click it doesn't work, and then I just repeat the step and then it works. Why don't you try that?

MEMBER POSTON: Right click or left click?

MR. KATZ: Left click, yeah. On the link that says presenters.

CHAIRMAN ZIEMER: Here, it just arrived Ted.

MR. KATZ: Okay. Okay.

CHAIRMAN ZIEMER: Why don't you go ahead Bob? I'll open it while you're talking.

MR. KATZ: Yeah Bob. I don't know what's happened with your email, but maybe the same thing that's happened to my email, because mine

went out at 12:48 and never arrived. So okay. So Bob, are you going to bring up your presentation whenever? Bob, are you on the line?

MEMBER BEACH: It was up.

MR. KATZ: Yeah. Now it's an email folder. Bob, are you on the line?

DR. ANIGSTEIN: Yeah.

MR. KATZ: So just you can bring up your presentation.

DR. ANIGSTEIN: Okay. I had turn it off to be able to send it.

MR. KATZ: Oh, I see.

DR. ANIGSTEIN: Let me put it on again. Okay. I didn't want it disconnect, so everybody saw all my email mechanisms. Anyway, everyone okay now?

MR. KATZ: Yes.

DR. ANIGSTEIN: Okay. Now is it okay? I just went through -- well, Dave's going to interrupt anytime. Let me just go through the issues. Okay. Finding No. 2, the betatron

operator beta doses. The occasion was this was originally done by SC&A several years ago, and we had occasion -- I had occasion now to review it, looking at Dave's analysis.

So made some updates, that made it more -- the original turned out to be an overestimate, so we made some more precise assumptions. The first thing we did we had used this continuous exposure of uranium for four shots during the day with no --

It was just easier to calculate. But Dave came with this intermittent exposure model, which we reviewed and actually it's a very good solution, a very clever solution to this problem. So I applied this now to uranium.

Now Dave used it for steel, but he did not apply it to the uranium analysis. I now applied it to the uranium analysis, so that resulted in somewhat lower doses which you have your buildup for 60 minutes, for 15 minutes during the set up time for the next shot, so it decays and

it builds up again.

So and then we also we did everywhere. We had the new capabilities, more computer power a new MCNPX version. So we did the photo activation using the actual size disk. The original one was a smaller disk to give you quicker results, but they were sort of on the high side.

So we used the realistic disk only 18 inches in diameter to get the photoactivation, and made other -- some other corrections. So net result was that the doses are now somewhat lower, a few percent lower than we had previously calculated, which had been shared and I shared that -- I shared the new calculations and the spreadsheet with Dave so he knows where we're at.

Then for the skin doses from the irradiated steel, we verified the NIOSH model and basic -- this now to the betatron operator, and we agreed that this is a reasonable approach. It was again the intermittent irradiation and we got exactly the same results. It was a difference of

less than a percent because we calculated betatron beam intensity differently.

So the NIOSH estimates are claimant-favorable. I mean they're bounding, they are claimant-favorable. NIOSH, with no objection, if NIOSH wants to adopt a somewhat lower estimates, which I think are more realistic than we have adopted, that we have derived. So shall I just go on to the next finding?

MR. KATZ: I think Paul wanted to run through the findings sequentially, your comments on the finding and then Dr. McKeel's.

DR. ANIGSTEIN: Oh, we're going to go each finding at a time?

MR. KATZ: Well isn't that -- Paul, isn't that what you wanted?

MEMBER BEACH: That's what he said Ted.

CHAIRMAN ZIEMER: Yeah. I want to go through Finding 2, so let me first ask Dave Allen if he has any comments on the SC&A comments.

MR. ALLEN: No, I don't. Like Bob

said, I saw his calculations and what he did there, and we don't have a problem with any of that. Just a tiny bit of background there. Originally, it was the one meter -- one meter dose rates weren't accounted for and we agreed and said we would add those.

One other minor difference and then Bob found a couple of other issues, as he just discussed. So I think we're in agreement on all that.

CHAIRMAN ZIEMER: Okay. Let me go to Dr. McKeel's on Finding 2. Now some of those were questions for clarity.

MEMBER POSTON: Paul, Paul. This is John Poston. I hate to interrupt. I'm still having trouble. Ted, could you send me the email or --

MR. KATZ: Okay, John. So I'll send it to you again, yes.

MEMBER POSTON: Okay, thank you. Sorry Paul.

CHAIRMAN ZIEMER: Anyway, Dr. McKeel are you on the line?

DR. McKEEL: Yes Paul, I am. Are you ready for Finding 2?

CHAIRMAN ZIEMER: Yeah, sure.

DR. McKEEL: Okay. Well, as a prelim let me mentioned that when you reviewed the documents that I had submitted, you said my paper was dated 7/10. That was the same day that Dave Allen's came.

CHAIRMAN ZIEMER: The charts?

DR. McKEEL: Mine was dated 7/19.

CHAIRMAN ZIEMER: Yeah, the title actually yeah.

DR. McKEEL: Mine is dated 7/19.

CHAIRMAN ZIEMER: 19th. That's --

DR. McKEEL: And then the other thing is yesterday, and I apologize for having gotten it in late but I do want to have it on the record that it was submitted. I submitted another paper to you and all the Members of the Work Group to be

distributed to the whole Board by Ted Katz. It's my review of SC&A's response to Dave Allen's 7/10 paper.

So in that, I go into my comments on how SC&A saw this problem and that paper, the 9/11 John Mauro/Bob Anigstein paper from SC&A. So for Finding 2, my comment is that as far as I can see, this issue has been discussed for several years.

But it was pretty clear from the SC&A paper that they were basing this on uranium slices, and my comment is that that is a -- that's really not an adequate way to look at betatron uranium beta dose because GSI, as documented in the purchase orders and by many workers there, states that there was a mix of ingots and dingots, which of course were much larger and the one sent by Mallinckrodt to GSI still have their rough coats of adherent slag on them.

So I don't think that slices capture the full spectrum of uranium form that was sent in. So that's the first thing.

The second comment is there are absolutely no records existing that anyone has that shows the mix of slices, ingots and dingots that were sent to GSI by Mallinckrodt over the 13 year operational period.

The second thing is that I believe in those beta dose calculations, that all along NIOSH and SC&A have ignored the longer-lived activation products in both, particularly in the steel activation product and I know that there are two main fission products from uranium. But I'm not sure about all of the activation products of uranium.

I will mention that as far as the steel activation exposures, that not only have they confined that activation product half-life to two hours, which is unrealistic, and I think that's shown by Dr. Guo and Ziemer's paper in 2004, where they studied activation of surgical instruments by Linac.

They're also contradicted by Vincent

Kuttemperoor, Milwaukee School of Engineering, data from 1974 and '75, where he showed that there many longer-lived than -- longer-lived products of steel activation, apart from --- that had half-lives longer than two hours.

A final comment is SC&A here is recommending that NIOSH adopt lower Table 3 values, commenting that their earlier estimate -- where earlier calculations were an overestimate. Well, this is a -- if NIOSH should decide to do that, then this would be a very claimant-adverse result because those lower doses would then probably be incorporated in a revised Appendix BB Version 2, and they would wind up in a new PER.

So the doses assigned to the radiographers actually in the -- since betatron radiographers are being assigned layout man doses anyway, then what it would mean is that everybody at GSI, except the admin people, would be assigned lower doses and that would be claimant-adverse and unfavorable.

So I'm very much opposed to accepting those lower doses. I guess that's my comment.

CHAIRMAN ZIEMER: Thank you. I wonder if either Dave or Bob have any responses.

DR. ANIGSTEIN: I'm sorry. I didn't quite catch that.

MR. KATZ: Bob, he was just -- Paul's asking if you or Dave Allen have responses to Dr. McKeel's --

DR. ANIGSTEIN: Right. Well I have a -- yeah, I do actually. I don't know if Dave wants to go first.

MR. ALLEN: No. Go ahead, Bob.

DR. ANIGSTEIN: Okay. Well first of all, as far as the types of uranium metal, now we agree yes, there may have been dingots. However, this is claimant-unfavorable or would result in lower doses because the dingots do not exhibit the Putzier effect. The Putzier effect is only exhibited where you have uranium shapes such as derbies that were cast at Mallinckrodt, who first

sit around for a while.

They sit around for a few weeks, so that the progeny builds up. So you start off with uranium separated from the progeny. So the progeny builds up, you know, the main progeny being thorium-234 with a 24 day half-life. So that builds up over a period of time, and we assume 100 percent buildup for Putzier effect, a conservative overestimate.

Then during the recasting, they tend to migrate to the surface and you get this increased beta activity on the surface from these beta-emitting radionuclides, daughter products.

Now with the dingots, that doesn't happen because you start off with the uranium, with the uranium tetrafluoride putting into this bomb with magnesium, and you end up with the magnesium taking up -- you get magnesium fluoride and uranium metal.

It never goes through that stage where there is a buildup and you have a Putzier effect.

So by not considering the dingots, we're making a higher estimate of the doses.

And then as far as the ingots, if the ingots come not slices but as higher ingots and if by any chance again they were made from the derbies and they sat around for a time and built up and then you have the Putzier, which would not -- now not be limited to the edge, I still believe that the -- ours is more claimant-favorable because first of all the dingots have the rough surface, not a smooth metal surface, then there are some impurities like slag that would actually not contain uranium primarily, and they would absorb the beta radiation from the uranium metal.

So by assuming that it's pure finished uranium, we get a higher beta dose and also with the slices, we assume there would be some positioning and some handling, and we are making a very, very claimant-favorable assumption that half the time the -- during half of the 15 minute setup time, the operator has his bare skin, his

hands and forearms in physical contact with the uranium, and that's probably, you know, way overstating it but it's a safe assumption.

So with the dingots that weigh tons, they wouldn't be handling it with their hands. They will be -- the entire thing would be handled by a crane and the one thing we know about the ingots that they were -- they had these corner shots, and this is one worker whom I interviewed and actually corresponded with by mail to make sure that he agreed with my interpretation on the phone, simply says he came in.

He was on the day shift. He came in one morning and the weekend night shift had been doing the corner shots and he just noticed that they had done these four corners, which was most likely to determine how much of the end should be sawed off, because of the end of the ingot tends to be kind of crappy.

It has the slag mixed into it. It's not a good metal. So they typically saw it off, take

the middle part of the ingot, that's the good part, and the other goes back for remelting with the next batch. So this was the one time that this happened, and again it would not require.

So even though it may have happened, it may have been done more than once. The skin doses would be lower, because they would have very little reason for keeping their hands on that ingot which weighs several tons and would be handled by a crane. So that's basically --

And then the other comments Dr. McKeel made --

DR. McKEEL: Can I reply to that? You said a lot, and I need to reply while I still remember what you said.

DR. ANIGSTEIN: Wait a minute. Let me finish. Excuse me. But why don't I just finish? I have my list.

DR. McKEEL: Okay.

DR. ANIGSTEIN: And then the last one which is short, speaking about the assumption about

the activation products only are done in two hours. You're referring to Appendix BB Rev 0 from June, I think it was or July 2007.

The current calculations, both done by NIOSH and by SC&A, give about six primary daughter products. They account for over 99 percent of the activation of the steel, and we carry them out for as long as they are.

So there's no two hour cutoff. Some of them -- the primary one is iron-57, which is I forget now, but I remember it was in the order of minutes and others such as molybdenum-99 I think and another one quite long, manganese are quite long-lived and go into -- they go out for days, the half-life is into days, and all of those are accurately accounted for.

In some of the analyses by NIOSH is actually over-accounted for because they just assume that it's irradiated long enough to achieve equilibrium. So that's a very conservative assumption. Okay. I'm done.

DR. McKEEL: Right. Well I have several comments to that. Number one, I disagree with your comment that since an ingot had to be handled by a crane that there was no hands on touching of that and that is absolutely different from what the workers testified, because once the crane was put --

Actually what happens here is there's a chain man that has to put the chain around the dingot and then the crane lifts it up, and then the workers who are dealing with that whole thing somebody, either the chain man or the betatron operator, the people who are assisting, have to put their hands to move and swing the ingot around.

So they definitely are touching it. It's not all done with a hands-off crane operation, to place it right in the place where the betatrons can hit it.

I guess the other comment is I think some of your comments about the buildup, I understand the beta dose might be absorbed by the

slag and I agree with that. However, what I'm not certain about is that I've ever seen any data dose measurements on ingots or dingot unsliced.

So I think this is -- these are modeling results you must be talking about. So I can't comment further about that.

But I would say that -- oh, and I guess the final question is you could answer quickly hopefully is the information about the activation daughters, and giving credit for the entire -- for the entire spectrum of activation products, that is covered well in Appendix BB Rev 1 I think?

DR. ANIGSTEIN: I believe it is.

DR. McKEEL: Okay.

DR. ANIGSTEIN: Also in the review, because it's always where we have some comments on their comments. So I believe it's all in the review that came out December 10th, 2014. I know I'm just thumbing through it right now.

DR. McKEEL: Well, shouldn't that information be in Appendix BB because really and

truly, no matter who writes a White Paper, the only documents that really figure in dose reconstructions and Probability of Causation are the two revisions of Appendix BB, Rev 0 in 2007 and Rev 1 in 2014.

So that's why whether that's in Appendix BB Rev 1, which I don't remember seeing and of course I may have missed a lot of things.

DR. ANIGSTEIN: I just finished thumbing through it and Dave, correct me if I'm wrong. But no, the activities are not listed. The radionuclides, the steel activation products I don't believe are listed on the --

DR. McKEEL: Then I will leave my statement as it stands. My understanding is that if it's not changed, then it would be the same as in Rev 0, which is a two hour cutoff and --

DR. ANIGSTEIN: The results have been -- the specific information, the detail of the calculations does not seem to have been listed. But the results are definitely incorporated.

I can attest to that, because we have reviewed in detail the NIOSH calculations and I can attest to the fact that they did use six radionuclides.

DR. McKEEL: That's fine. May I ask you to please after the meeting see that that paper and that reference is sent to me. I'd appreciate it very much.

CHAIRMAN ZIEMER: David Allen, do you have any other comments on Bob's comments?

MR. ALLEN: No, I don't.

CHAIRMAN ZIEMER: You're okay with what he said?

MR. ALLEN: Yeah.

DR. McKEEL: I have one other comment about this, and that is the interview that Dr. Anigstein mentions about cutting off the corners of the betatron slices, that is absolutely brand new to me, and I don't think it's fair to bring up interview comments that haven't necessarily been published.

Now if that has been published, that's a different matter. But I never have heard that information and I know, as a matter of fact, the gentleman that has the four corner uranium NDT scenario at GSI drew that four corner shot scenario on a napkin, and I digitized that and put that in one of my White Papers.

So maybe the same man was doing the same thing. That man never to me mentioned anything about cutting off the corners of that, and he said he cut most of his uranium work on the night shift. So that's just a comment.

CHAIRMAN ZIEMER: Okay, thank you. Bob, I think you had raised that before though. Maybe you can --

DR. ANIGSTEIN: Sure, two comments. One is I think you, Dr. McKeel, referred to this betatron operator by his initials. That's not the same one I'm referring to. I can't speak his name, but that's not the person that I interviewed.

DR. McKEEL: Is that --

DR. ANIGSTEIN: And second of all -- as far as the cutting -- let me continue.

DR. McKEEL: Is that interview published?

DR. ANIGSTEIN: Excuse me?

DR. McKEEL: Is the interview you're referring to published?

DR. ANIGSTEIN: The interview with the name redacted was part of a report I believe in late 2011.

CHAIRMAN ZIEMER: Maybe you can offline send that reference to Dr. McKeel.

DR. ANIGSTEIN: It's a little -- I can -- I wonder if I can send it afterwards. It's a little hard for me to be doing this now when I'm on the phone.

DR. McKEEL: I understand that.

DR. ANIGSTEIN: So I'll put that down as an action item to -- just a second. Okay, just a second. Let me just say I'll pass it on to Ted.

MR. KATZ: That's fine Bob.

DR. ANIGSTEIN: Right, to send reference to --

MR. KATZ: John Ramspott, I don't know if you could understand Paul. You know, Paul, your voice is kind of garbled. Your phone is not the greatest, but John Ramspott, Paul's just asking if you have --

CHAIRMAN ZIEMER: I had it on speaker phone. Is this better now?

MR. KATZ: Much better.

CHAIRMAN ZIEMER: Yeah, okay.

MR. RAMSPOTT: That is definitely much better now. This is Jim Ramspott.

CHAIRMAN ZIEMER: Probably giving some reverberation or something, yeah. I was just asking if John Ramspott has some additional comments on Item 2. I know that some of the revisions have been handled by SC&A. There definitely was an issue on the six short business that was corrected, I believe.

DR. ANIGSTEIN: Yeah. Now I just want

to add one more response to Dr. McKeel, about the cutting off of the ingots. I never suggested that GSI personnel would not know about that because it was not done at GSI. This was something that would have been requested by Mallinckrodt or Weldon Spring, where the operations later took place, to give them an idea of how much bad metal there was at the very end of the ingot. This is standard practice.

DR. McKEEL: I've never seen that information. I've never seen that information, and I've never seen it --

DR. ANIGSTEIN: Okay. That's why we have Bill Thurber, who actually started off as a metallurgist and he started off his career with uranium casting. Am I correct Bill? Bill Thurber.

MR. THURBER: That's right.

DR. McKEEL: With all due respect, I don't think Bill Thurber is as strong a reference as information directly from Mallinckrodt and/or

GSI.

DR. ANIGSTEIN: Well, wait a second. We don't have information -- GSI would not have the information as to the cutting of the ingots. That's not there --

DR. McKEEL: Well, you said something about GSI told you that they had cut off the corners.

DR. ANIGSTEIN: Say again?

DR. McKEEL: I believe you said that somebody at GSI told you in an interview that they had cut off the corners of the uranium --

DR. ANIGSTEIN: No, no. I never claimed that.

DR. McKEEL: So what did you say?

DR. ANIGSTEIN: I simply said they were making -- they were shooting the corners. That's all he told me. There were four corners.

DR. McKEEL: We know that, yes.

DR. ANIGSTEIN: Okay. That's the only thing and Bill --

DR. McKEEL: Different interpretations.

DR. ANIGSTEIN: Yeah. We interpreted that as being the only reasonable reason they would be doing that.

DR. McKEEL: Well, we think it's because Harold Thayer, who was the president of Mallinckrodt, wrote in his definitive work on uranium handling at Mallinckrodt, that it was done to define the borderline between the slag and the underlying pure uranium.

We brought that up many times. I know we're not going to settle it today, but that's another plausible explanation for why --

DR. ANIGSTEIN: It really doesn't affect the model.

CHAIRMAN ZIEMER: Okay, let's proceed here. Again, I'll ask John Ramspott if he has any comments on this issue.

MR. RAMSPOTT: Yeah, I appreciate it Paul. This is John Ramspott. Actually looking at

Dave Allen's White Paper dated September of 2010, Dave did a great job of explaining exactly what happened at GSI and Mallinckrodt, and Dave, you got 100 percent correct.

It clearly states in this document that the data that first went over to GSI and hopefully everybody realizes, I mean there were ingots -- no, there were derbies and then there were ingots and then there were dingots. So there's different time lines that probably need to be addressed with this, what happened when and how.

It clearly states in here Dave, and maybe you can look at it again, but the whole process or the whole reason for sending that over to GSI, the process itself left a lot of slag on there. GSI was going to -- the purpose for GSI to take a look at the metal is to determine how big the slag is. Everybody seems to be disagreeing were they clean or weren't they.

I think we need to go and Bob, if you're saying a clean one gives a worker more, I guess beta

dose, then that's probably what they should get. But if you're going to do that with a slice, I think cutting out a whole ingot or the dingot didn't go over there clean too.

You don't know that and that's the problem. But the workers should get the benefit of the doubt. Dave, you quoted your information from Fleshman and Hilliard 1967. So they were in fact out at Mallinckrodt.

So we're not talking about anybody, and I don't mean to impugn anybody else's metallurgical background or what have you, but you got it from guys that were down at Mallinckrodt, Dave. I think you have it correct.

And it does say here after separation the dingot, they're using the term dingot now because it's later on time, was scalped by machine all surfaces. Not just the top, but we're talking about all surfaces. That's exactly what your document says.

So when we start to mix these products

up and no one knows what went over there, dingots, derbies, ingots. I mean the most you can do is go with the time line.

I think you have to give the workers not less but more, and you know, your document actually said this concentration being produced, higher than normal beta dose rates and then decayed to a normal dose rate with a half-life of 24.1 days.

So I think you already wrote a good paper on it Dave, and I wish everybody else would maybe read it and use it, because the fact that these guys were dealing -- they were shooting corners, and I never heard anybody ever say anything about cutting off corners. They shot corners because that was the easiest route to do, to see how thick whatever was on there was. Nobody knows how thick that slag was anyway.

So that's another fact that I hope gets brought out. So I just hope this paper gets reviewed and the workers get the highest dose, not less. Appreciate a chance to comment on it and

we'll get into shooting distances. That's a whole different thing. Are they shooting it from six or from six feet, nine feet? That's a whole different topic. I appreciate the opportunity. Thank you.

CHAIRMAN ZIEMER: Thanks John. I'd like to ask a question, Dave. Now SC&A suggesting use of a more conservative value. On that one issue, what is NIOSH's intent there?

MR. ALLEN: Well, this whole issue is betatron operator beta dose, and we had a model. It was reviewed. Like I said before, we had left off the one meter dose rate. Bob had noticed and we added that in. We changed the exposure time to eight hours instead of seven and a half hours per shift, and then Bob noticed that the --

I think it was the beta spectrum was not quite right for the model and changed that we agree it's not, you know, what was there before is probably not as accurate as what he's got now. So we're essentially intending on using the numbers that Bob has got in his latest reply.

I just wanted to respond slightly to some of these issues, and that was that -- I just want to say that this whole issue is beta dose. The amount of beta radiation coming out of the uranium slab has got almost no range. It's a very small range.

So the only active part that you actually get beta dose is right at the surface of it. So the size, the thickness of a uranium ingot, dingot, et cetera doesn't change much as far as what the beta dose would be coming out of it.

As far as what John Ramspott was saying, it's true. I think he's referring to a White Paper for TBD-6000, but I'm not sure. However, we did give the workers the benefit of the doubt by not assuming that's what they got because this puts the A effect, as we've called it all along, that concentrates the beta sources on the surface of the uranium.

That's the assumption we're making. They got something over at GSI that had the beta

daughters all concentrated on the surface. If they actually machined the surface like they normally did with the dingot, then those would be stripped off before they got to GSI.

If they sent dingots over, they didn't build up that Putzier effect and they wouldn't have this high of a dose rate. If they sliced it up, it would just be the outside edges and not the fresh cut part that had this.

So essentially what we did was say yeah, they got lots of shapes and sizes. I think the worst case assumption and that's all the beta nuclides are concentrated on the surface and that's the model we used.

CHAIRMAN ZIEMER: Right. Okay, thanks, Dave. Let me ask Board Members if they have any questions on any of the items that were discussed. Also, has Wanda come aboard? I guess not, okay.

MR. KATZ: No, and I have no reply from her by email either. Okay. I'll ask John or

Josie, any questions or issues on Item 2? What I'd like to do is just, on this particular one it appears that SC&A and NIOSH are in agreement or would you call that agreement?

I think SC&A was comfortable with what NIOSH was proposing; isn't that correct?

DR. ANIGSTEIN: Absolutely. They wish to verify with their current, we have no objection to that.

CHAIRMAN ZIEMER: They're slightly more claimant-favorable.

DR. ANIGSTEIN: Yes, slightly more claimant-favorable. So if they wish to go with that rather than refining it and chopping it up. So either way is fine.

CHAIRMAN ZIEMER: Okay.

MR. ALLEN: I think we already said we'd go with the SC&A refinements, since they pointed out the old one has a bit of an error.

CHAIRMAN ZIEMER: But it doesn't change the bottom line very much is what you're

saying, right?

MR. ALLEN: Not big, no.

DR. McKEEL: This is Dan McKeel. But it does lower the dose assigned, and that's a backwards, you know. You had four years to decide this, and now it's last. You're changing it lower because it's, quote, a better number. I guess you could argue another ten years and make it better than that.

CHAIRMAN ZIEMER: I think they're saying that it was a calculational error; is that correct?

DR. ANIGSTEIN: Yeah. There were some erroneous assumptions that we caught on reviewing, you know, Dave sending his spreadsheet and reconciling it with mine and I saw there was a discrepancy that was corrected.

DR. McKEEL: This is Dan McKeel. My final comment on this if you all, and I'm talking about the Board, several Board Members, SC&A and NIOSH assured the full Board on December the 11th

before they voted to deny the GSI SEC that all of these -- those reconstruction issues were settled, that NIOSH could do it and that, you know.

I understand that routinely you all make -- allow such a statement to be made and then take several years to actually work out the numbers. So you know, and you can basically do as you feel you must. But I certainly disagree with what you're doing. Thank you.

CHAIRMAN ZIEMER: Yeah, I understand that. That has been the practice, but if it's agreed that the dose can be reconstructed, that does not always mean that they have achieved that. In fact, there could be cases where that was found not to be the case, in which case you'd go the other way. But anyway, I understand your point.

MR. RAMSPOTT: This is John Ramspott. Can I make one quick comment?

CHAIRMAN ZIEMER: Go ahead, John.

MR. RAMSPOTT: For you to change something now and to call it fact and mathematical,

it's actually guessing on an unknown. No one knows how many slices were there, how many ingots were there, how many dingots were there.

To change something now based on unsolid, unconfirmed information, that does move you backwards.

CHAIRMAN ZIEMER: Yeah, John. We changed things from Rev 0 to Rev 1 also. So and also keep in mind, this does not --

(Simultaneous speaking.)

CHAIRMAN ZIEMER: This will not affect people whose cases have already been adjudicated. The ones who have gone forward under Rev 1, a fair number of people, that doesn't affect them. It will only affect the cases if it changes, if it would change their results in a positive way.

MR. RAMSPOTT: The going forward with a change based on unknown is still in my opinion not the right thing to do. We don't know. There's a lot of things we don't know.

CHAIRMAN ZIEMER: Well, this is the

nature of dose reconstruction.

MR. RAMSPOTT: Guess and go forward, even though you don't know?

CHAIRMAN ZIEMER: No. It's not guess and go forward. It's the process that has been defined by the law as how we proceed if there's information missing. But this is part of the larger picture of how -- as you know, on almost every site there are unknowns and you have to handle them in some way.

Right now, we have on this particular item between SC&A and NIOSH, there was an assumption, an incorrect assumption observed and that correction when made slightly will reduce the doses for some folks.

But that doesn't mean it shouldn't be done. Claimant-favorable doesn't mean that if you make an error it shouldn't be corrected. So that's the process.

This still would have to go to the Board, but let me ask Subcommittee or Work Group

Members, does anyone wish to take an action at this time as far as a recommendation to the full Board? Again, I'm asking if anyone wishes to take a motion?

MEMBER BEACH: Paul, this is Josie. Based on the discussion here today, I think that I agree that we should move forward on this and accept NIOSH's and SC&A's -- the calculation that's been put forth and close this item.

CHAIRMAN ZIEMER: Okay John?

MEMBER POSTON: Yes.

CHAIRMAN ZIEMER: Okay, and I agree with that. So the Work Group recommends that we close Issue 2 and recommend that that can be handled as described. Okay. Let's go on to, let's see, SC&A, you took them in an order of -- I think you took them in the order of what you felt was importance. Was that --

DR. ANIGSTEIN: No, I took them in the order of Dave's report.

CHAIRMAN ZIEMER: Oh yeah, right, Dave's report, which was Finding 10 was given

second, right?

DR. ANIGSTEIN: Exactly.

CHAIRMAN ZIEMER: Yeah, yeah. So let's proceed with that. Let's go with Finding 10. So Dave, any preliminary comments on Finding 10?

MR. ALLEN: I'm trying to refresh my mind. You jumped on there before I was ready.

CHAIRMAN ZIEMER: Oh okay. Finding 10 and Betatron Operator Gamma Dose.

MR. ALLEN: Yeah, and I think Bob's got a presentation there. I think -- I don't think I need any preliminary.

CHAIRMAN ZIEMER: Okay. You want to proceed then?

DR. ANIGSTEIN: Okay. Shall I go ahead?

CHAIRMAN ZIEMER: Yeah.

DR. ANIGSTEIN: Okay. It's on the screen. So I just summarized here. I took the liberty of summarizing the NIOSH response and then going with our reply, and the NIOSH said that the

betatron operator gamma dose, because this is a full photon, we don't even know -- I would actually relabel it just photon dose, because we don't know whether it's gamma, X-rays or what it is. We just know it's, you know, electromagnetic radiation and that the -- it only comes into play for the skin of the hands and forearms of the betatron operator because others, like for the layout man, other operations are more bounding. So this would not come into play.

So it's only for the skin of the hands and arms and NIOSH maintains that it should only be half of the time, because they would be -- the hands and the forearms would be in front of the body at least half the time and therefore the body would shield it.

I disagree with that, and here's an example of the betatron operator and clearly his hands are -- one hand is high up and likewise the forearm. The other hand is -- perhaps is about at the side of the body. It's a little hard to see

with it shielded. The betatron itself at this moment is up here shooting forward at this casting.

It's probably unusual that the casting would be so far overhead of the betatron because this is -- I believe we were told this is the largest casting GSI ever made. But clearly, in this case, there would not be a safe assumption that his hand would be normally in front of his body.

If you just -- I was just thinking about it sitting at my desk. Unless you tuck your elbows in touching each other and hold your -- clasp your forearms together, your hands are at the side of the body not necessarily in front. So we considered that not -- I mean it could happen some of the time, but the more conservative assumption is to say that it would be exposed all the time, not just half the time.

Therefore the dose would end up -- we both agree, both NIOSH and SC&A agreed on the air kerma dose coming from the betatron. It will be 210.225 rads per year, and then this is the

conversion factor taken from OCAS-001, OCAS-IG-001 I guess it is, of .654 rem per rad for low energy air kerma, and so we end up with the dose.

Our recommended dose from this scenario is 6.687 rem per year. That's all I have to say on Finding 10.

CHAIRMAN ZIEMER: Okay, yeah. So there's a substantial change there and both of you have agreed that that would be the case. That's my understanding. Let me -- Dave, did you have any other comments on that?

MR. ALLEN: Yeah. I'm not sure what you meant right there when you said both of us. We agreed to use the air kerma and we proposed a 50 percent factor and that's what SC&A disagreed. That's one point of disagreement today I think we're going to have.

Bob, could you put that picture back up by chance?

DR. ANIGSTEIN: Say again?

MR. ALLEN: Could you put your picture

back up that you had a moment ago?

DR. ANIGSTEIN: Sure.

MR. ALLEN: Thank you. I think my point, part of my point is, I mean you've got to remember this entire scenario is based on the idea that you had this low energy photon source at somebody's back the whole time, so that their body shielded the film badge.

But if you look in this picture, you see at least two out of these three guys do not have their back to the cone of the betatron. I think that 100 percent is already very favorable to come up with this number, and generally if their back -- just like the guy working on the axle there, if his back is to that cone, his hands are going to be at least somewhat out front, somewhat shielded most of the time. I still think that using that 100 percent PA, you know, to come up with this whole scenario and a 50 percent factor for the hand use is very favorable.

MEMBER BEACH: So this is Josie. I

have a question. SC&A says they should have their -- the dose would be at 100 percent of the time hands and arms. NIOSH should say in 50 percent; is that correct?

MR. ALLEN: Yeah. We both said 100 percent. We'd estimate it by saying 100 percent of the time their back was to the betatron cone, and then NIOSH says 50 percent of the time their hands were shielded with their bodies, and SC&A is saying it's potentially never shielded with the body. Does that make sense Josie?

MEMBER BEACH: Yeah, it makes perfect sense, thanks.

DR. ANIGSTEIN: So the bottom line, which I didn't know here is that the dose proposed by NIOSH would be to take that, our 6.687, divide by 2 but then add the -- I guess would it would be this 500 millirem per year that is not -- that is at the threshold of the film badge reading for the other half. So maybe 250.

So I'm just speculating. They would

come out around -- you know, I'm just doing it quickly in my head, they would come out around 3.5, 3.6 rem per year somewhere around there. A little more than half of ours. Do you agree with that Dave?

MR. ALLEN: Yeah, roughly half. That's true.

DR. ANIGSTEIN: A little over half, because you're adding in a little --

MR. ALLEN: Accounting for the small amount of dose they get with their hands in front of the body.

DR. ANIGSTEIN: So --

CHAIRMAN ZIEMER: Okay. Let's go ahead and get back to McKeel's comments.

DR. McKEEL: Dan McKeel. I'm commenting on the Finding 10. I guess here's my comment. In the SC&A paper, they showed one very atypical casting, one image. There are many, many, many images that have been put into the record on GSI betatron operators interacting with the

castings at the head of the betatron machines.

My comment is that all of these assumptions, including the one that the back was always towards the cone, are absolutely refuted by other photographs. If you think about it, a lot of the castings were much smaller. The person in between the beam cone and the target, they were rotating their body in a 360 degree arc, and their arms the same thing.

They were in -- you know, the range of motion of an arm is 180 degrees, from straight down to straight up, and I'm sure in lifting and in pulling down and so forth they used all those positions. The hand can not only flex and dorsal flex, but it can move sideways and the fingers can move and so forth.

So I am absolutely certain that the best model would be 360 degree rotation of the torso, the arms and the hands, and I understand the dose we're talking relates to forearms and hands. But I would say, even more so, these are the most

flexible parts of the body. They'll rotate in all directions, particularly given the combination of the two.

So I think that these -- this 50 percent factor that NIOSH proposes is, I don't know how to put it, but it's not scientific. It is not claimant-favorable; it's claimant-unfavorable, and I think it's a factor of convenience.

It sounds good; it sounds halfway in between zero and 100. But actually, it's not a good factor and I think it should be abandoned and I guess that's kind of what I have to say.

The other comment that the real dose that's delivered also depends, as Dr. Anigstein said, he's assuming what we're talking about is photons. But you know, I have given this Work Group numerous papers which show that chronically -- that the components in particle accelerators acting at this high MeV voltage are chronically activated, and chronically give off whatever this radiation is, even after 15 minutes that Jack

Schutz said he could measure it.

Another radiographer at GSI said he had been able to measure the off beam current with a survey meter. But in any case, the literature clearly shows you should be able to measure some off beam current in all sorts of accelerators.

So that particular part of this modeling is off target as far as I'm concerned. That's it. Thank you.

MR. ALLEN: This is Dave Allen. I just wanted to point out that I think Dr. McKeel made my point there, that certainly -- it's almost certain they're rotating around, they're moving around. There's no way the badge was always shielded by the body.

The starting point for this analysis was the badge readings of about 500 millirem a year. This analysis that we're using results in that being caused by ten rad per year to the back. If they're rotating around pretty evenly, then we're looking at more like 1,000 rather than 10,000

millirem.

DR. McKEEL: The point I'm trying to make here is one that -- Paul said that you have to make assumptions in doing dose reconstructions. I understand that. But unfortunately John Mauro is not here today, because one of the points he's made repeatedly is, yes, you may have to make assumptions, but the assumptions can -- have to pass the test of plausibility.

What I'm saying is that you all seem to focus on whether the overall result is claimant-favorable, and I would agree that that's a good thing and that's certainly compliant with the law. However, you know, the sufficient accuracy term which to be quite honest, the Board Chairman and Dr. Neton have had a very difficult time actually defining what that means.

That certainly encompasses to me the concept of plausibility. So sufficient accuracy/plausibility all go together and yes, I agree with Dave. You know, but you have to also

go on what's written in papers and what's said in a meeting, and what's said in the meeting was by one Board Member and by Dave Allen and by Bob Anigstein, that everybody agrees that the assumption that the worker's back is always to the cone of the betatron is perfectly acceptable.

Well, it's not acceptable to me and I don't think scientifically it's acceptable either. So I guess that's -- I'll let it go at that.

CHAIRMAN ZIEMER: Sorry, I was on mute. So then Dave, is one of these assumptions --

MR. KATZ: Paul, you might want to use your hand phone function.

CHAIRMAN ZIEMER: Oh, is this better?

MR. KATZ: Yes, yes.

CHAIRMAN ZIEMER: Is one of these assumptions bounding in your mind Dave?

MR. ALLEN: One meaning what? I'm sorry, Paul.

CHAIRMAN ZIEMER: Well, now for example, the 100 percent back to the material

versus 50 percent versus some other --

MR. ALLEN: I think the highest, the absolute highest would be what Bob is suggesting, which is 100 percent with you back to the cone and your hands are always at your side or behind you. I was just trying to get a little more reasonableness in here in pointing out that we're being -- and I think Dr. McKeel did a good job pointing it out.

CHAIRMAN ZIEMER: Well the issue -- the problem with that is plausibility. It's claimant-favorable but probably not plausible, is what I hear you saying I think, right?

MR. ALLEN: Well, I think we are getting beyond the realm of plausible.

CHAIRMAN ZIEMER: In what sense?

MR. ALLEN: With your -- the men in there the whole time with their back always to the machine and their hands always exposed --

CHAIRMAN ZIEMER: Yeah. So you're saying that's not plausible, right?

MR. ALLEN: It's getting to that point. I don't know if I can go as far as to say it's implausible, but it's certainly --

MEMBER BEACH: Paul, this is Josie. I suspect that somewhere between 50 and 100 percent. I don't think it's as low as 50 and maybe not as high as 100 percent. But I tend to agree with SC&A to the higher level.

DR. NETON: This is Jim. Dave, is it possible to ascribe a distribution to this exposure mode?

MR. ALLEN: Anything's possible, but I don't want to -- in all honesty, I don't want to belabor this too much, because as Bob said, it's just going to affect the hands and forearms.

DR. NETON: Yeah. It's not a big issue, I mean as far as --

MR. ALLEN: As far as the number of claimants it affects now.

DR. NETON: Yeah, and given that I'd be inclined to acknowledge that 50 is probably at a

lower bound. Not a lower bound, but it could be higher than 50 without -- now it's possible it could be higher than 50.

DR. McKEEL: This is Dan McKeel. May I please make a comment?

CHAIRMAN ZIEMER: Sure Dan, go ahead.

DR. McKEEL: You know, everybody talks about it's not going to increase the dose very much. But it actually turns out that among all the compensable cancers that are available and are broken down by NIOSH in its IREP kind of consolidated data, it turns out that basal cell carcinoma of the skin, 56 percent of those cancers are compensated.

So skin dose is highly determinative on who's going to get paid and who's not going to get paid. And it turns out that in PER-057, there are actually 196 cases that were examined. While 100 of them were -- had PER POCs greater than 50 percent and they hopefully will get paid, that still leaves half the group that were denied and will not get

paid.

It's quite fascinating actually that I obtained all those dose reconstruction development reports with a FOIA request. I got just the summary reports. There were lots of it that was deleted.

But what I did get were the pre- and post PER total doses and the pre- and post PER POCs and a case, who Mr. Ramspott and I know who that is, who had the very highest dose of all 194 claims that were sent to me, to the PER.

It was a gentleman who had the highest total dose of all other people by a factor of twofold amazingly. His POC jumped from 42 percent to 48 percent, and the reason why -- and he had skin cancer, and when we investigated what type of skin cancer, it turns out he had squamous cell skin cancer, which is compensated at the rate of 1.8 percent.

Now biologically in 2015 terms, that is a terrible mistake that those compensation rates

are so wildly different, because in the last five years there have been many examples of skin cancers which have been dissected, DNA determined and so forth and histologically, using immunohistochemistry, have features of both squamous and basal cell carcinoma.

The point I'm trying to make is skin dose is one of the most important compensable cancers in all of the EEOICPA. So the -- whether these doses are high, low, intermediate, getting this as right as possible, as correct as possible is really, really important.

So I would say that it's Dr. Neton's idea that maybe a distribution should be calculated. It seems to me you could calculate a distribution if you assumes 360 degrees rotation of the torso and arms and trunk and so forth and so on.

You all are brilliant at doing that sort of thing. Maybe you could come up with a more accurate dose. The point I'm trying to make is it

is very, very important for skin dose. That's why I'm spending so much time and I think you all are too, on determining and getting these skin doses as correct as possible. Thank you.

CHAIRMAN ZIEMER: Okay. Thanks for that comment. Jim, when you were talking about a distribution, you were talking about a distribution around a 360 degree type of thing, a fairly complex distribution.

DR. NETON: Oh, I wasn't sure. I just threw it out there for discussion purposes. I mean a distribution between 50 and 100, I mean a uniform distribution. It gets complicated when you start adding these distributions in those separately. This of course would only affect skin cancers of the forearms and hands.

Dr. McKeel is right. Basal cell is a very highly compensated cancer, but the cancer would have to appear on the forearms or hands for this dose.

CHAIRMAN ZIEMER: Right, right.

DR. NETON: That's sort of not really relevant though. I mean if it is true, you have to get the dose right.

CHAIRMAN ZIEMER: Right, right.

DR. NETON: I don't know. I mean --

CHAIRMAN ZIEMER: We don't know a priori, yeah --

(Simultaneous speaking.)

DR. ANIGSTEIN: Speaking for SC&A, it seems like a reasonable compromise.

CHAIRMAN ZIEMER: To go with what, a distribution?

DR. ANIGSTEIN: A distribution from between 50 and 100 percent.

MR. ALLEN: Well, this is Dave, I think Jim or somebody said something about what, a uniform distribution?

DR. NETON: Yeah. That's what I was talking about.

DR. ANIGSTEIN: Yeah. I would go with that.

MR. ALLEN: So I mean a uniform distribution between 50 and 100 will give you exactly a 75, and I would -- for ease of dose reconstruction --

DR. ANIGSTEIN: Well, if I can point out something about the nature of these distributions, it's not that simple. That would be -- if the compensation was based on the average, I would agree that it would be the same as a 75.

But seeing that IREP takes the 99th percentile and pulls all the distributions together, without actually running IREP it's not possible to determine what -- you know, you would have to do it experimentally. You have to do it once with a distribution and then try it several times with a fixed value, different fixed values to see what the -- where it comes in. I suspect it will be over 75.

MR. ALLEN: Okay. I'll withdraw that comment. I would be very interested in the opinions of the Work Group on this issue right now.

CHAIRMAN ZIEMER: Well, I think what we're trying to get a feel for is to say okay, it's unlikely that it's 100 percent. That's awfully close to implausible, even though claimant-favorable, that maybe 50 percent is -- I think we're trying to find something that seems to be more fair and yet plausible.

I think I would be comfortable with 75 percent being more plausible or a distribution type of thing which would -- could still be -- would intuitively seem claimant-favorable but yet plausible. John, what are your feelings on this, Poston?

MEMBER POSTON: I've been trying to speak for a while.

CHAIRMAN ZIEMER: You have to take it off of mute, John.

MEMBER POSTON: Well, that was one of the problems, that I couldn't get a word in edgewise.

CHAIRMAN ZIEMER: Oh.

MEMBER POSTON: I certainly agree with Josie that it has to be between 50 and 100. Whether it's going to be 75 or 80, I'm not sure. But these calculations are easy to do. I mean we did these a long time ago back in Oak Ridge for photons, you know. We had a rotational exposure scenario and you can do it all however you want. It's not that difficult to do.

The question about exposure to the hands is a little difficult, because then you have to make some assumptions. But of course most of the phantoms we have don't have hands. But we ought to be able to figure that out.

I think it's a fair way to go about it, to get it done and be as realistic and as claimant-favorable as possible.

CHAIRMAN ZIEMER: Okay. I'm trying to see where we're at. I'm looking for a recommendation.

MEMBER BEACH: My recommendation is that we accept SC&A's proposal, unless they're

going to do another calculation on this.

CHAIRMAN ZIEMER: This proposal being 100 percent?

MEMBER BEACH: Yes, because I'm not hearing NIOSH -- well, if we're going to go another route.

CHAIRMAN ZIEMER: Well I think NIOSH -- I don't know if Jim was suggesting the distribution from 50 to 100.

MEMBER POSTON: Well there's one thing about 100 percent. It can't be any bigger than that, that's for sure.

CHAIRMAN ZIEMER: Well, I agree that would be bounding on that, whether it is plausible.

MEMBER POSTON: Well, I think we all agree it's not necessarily plausible, that they're going to be facing --

CHAIRMAN ZIEMER: Well, let me -- I want to ask Jim Neton this question again though. On bounding, Jim, we do want plausibility as well as -- I mean, yeah, it can be bounding, but not

plausible.

DR. NETON: Right. I just don't know how easy this is to integrate a distribution into the input file for IREP. It gets a little bit -- I think that's what Dave might be hinting at. I don't know.

I would prefer to go with a fixed number to be honest, but I don't think 100 is right.

MEMBER POSTON: I don't either.

DR. NETON: But then you know is 75 acceptable? I mean it seems like 75 would be a reasonable number, but then you know there's no real fundamental basis for that other than it seems claimant-favorable.

CHAIRMAN ZIEMER: Well, in the absence of anything that we can hang our hat on, we may have to go with the 100 as being --

DR. NETON: I guess I wouldn't be averse to that. I'm just -- maybe in the absence of any information that we could use to get more specific with the number, I wouldn't be against

using the 100 and just being very certain that we're claimant-favorable.

CHAIRMAN ZIEMER: Josie, I think you were supporting that. John, what's your feeling on that?

MEMBER POSTON: Well, I'd be willing to go there because if for no reason there can't be any more than that. Certainly that's the upper bound.

CHAIRMAN ZIEMER: Okay. Well, I guess I'll go ahead and support that and we'll make that our recommendation, that that's 100 percent of the time the back is to the material and that maximizes the dose to the patient, to the worker.

MEMBER POSTON: Yep.

CHAIRMAN ZIEMER: Okay. That will be our recommendation on Issue 10, and that will close that; correct?

MEMBER BEACH: That's correct.

CHAIRMAN ZIEMER: Oh, I didn't -- hang on just a second. I just -- I omitted John

Ramspott. John, did you have any items on 10 that you were concerned about or have you we taken care of your concerns with this action?

MR. RAMSPOTT: I definitely agree with that approach and the one item that, you know, obviously you guys are the experts. But the distance, I'd make some -- it might help this even seem more realistic, that email I sent you --

CHAIRMAN ZIEMER: Right, that had -- yeah, I was going to ask you about this.

MR. RAMSPOTT: Can we go through this right now because the betatron --

CHAIRMAN ZIEMER: Yeah. Is that the issue of the thickness of the material to be --

(Simultaneous speaking.)

MR. RAMSPOTT: Yeah, that's my point. Yeah.

CHAIRMAN ZIEMER: Yeah. I was going to ask Dave about that. Did you read John's email on that and does that affect your model?

MR. ALLEN: I don't believe I got

John's email.

CHAIRMAN ZIEMER: This goes back to July. Didn't this go to NIOSH?

MEMBER BEACH: Yeah, it sure did.

DR. ANIGSTEIN: Paul, if I can interject, I think I could speak to that.

CHAIRMAN ZIEMER: Yeah, go ahead.

DR. ANIGSTEIN: Okay, because I interviewed -- I had one or two conversations with [identifying information redacted] on this matter, and one of the workers, a radiographer now deceased, was under the impression that she used a string, which was you could actually see it. There was a photograph, which is attached through the casing of the -- the outer case of the betatron, right next to this aluminum collimator cone.

CHAIRMAN ZIEMER: Right.

DR. ANIGSTEIN: And that is used to mark off the distance. He was under the impression that well, if it's six foot distance, so then that string of six was wrong. No, that's not correct

because I asked [identifying information redacted] about that.

That string is already taken -- the length of the string takes into account the distance to the internal target, the little tiny platinum target that's inside the vacuum of the betatron, of the donut, evacuated donut, which makes perfect good sense because the radiation emerges from that by the inverse square law and -- well not quite, it's forward-scattered. And therefore that's the distance you want to know how far you are from that, not from the outer shell.

So by using that distance, which is actually way back in 2008, earlier or even 2007, we were using -- the workers were calculating the distance to the metal from that point on the outer surface of the betatron, and we got lower, as you might imagine, because now there's another 20-odd inches going back into the machine to get to the target.

So we ended up -- first we compensated

for it by the inverse square law but since we're redoing it anyway, we redid the MCNPX calculations to go back and the distance -- for the distance that we're using is actually much more conservative than the one John Ramspott is proposing, where you take the distance from the betatron shielding and then subtract the thickness of the metal.

So it's already a fairly conservative calculation that's done. So there would be no reason -- if we adjusted it, we would end up with a lower intensity and lower doses.

Is that --

MR. RAMSPOTT: Paul, this is John Ramspott. Can I make a comment on this?

CHAIRMAN ZIEMER: Sure.

MR. RAMSPOTT: Since it's my topic that I brought up and the reason -- and I heard what Bob said. But I also know that [identifying information redacted] is also the same guy that said you never flip a betatron head. We all know now that that happened.

DR. ANIGSTEIN: Oh, wait a minute. We're talking about two different things.

MR. RAMSPOTT: No. We're talking about principle and accuracy of an individual giving a statement, when he wasn't there doing it, and that's [identifying information redacted].

DR. ANIGSTEIN: But he was the one who -- but the string was not created by the operator. The string was furnished by Allis-Chalmers.

MR. RAMSPOTT: A string? Bob, they told me they replaced those strings too because they got broken.

DR. ANIGSTEIN: Okay.

MR. RAMSPOTT: I've got no fewer than six living betatron experts. One of them happens to be [identifying information redacted], who's not on the phone today. He had a medical appointment, who confirmed for me this principle that they would -- and if you recall, [identifying information redacted] the guy that actually helped with the shot records.

He's the guy that really convinced me, and all these other gentlemen had good recollections, they definitely measured the thickness of the casting. They knew that. They had that on their shot logs, and they would bring a camera in whatever that distance was, because the film is on the other side of the casting.

DR. ANIGSTEIN: Understood.

MR. RAMSPOTT: And I'm talking about Terry Dutko and I'm talking about [identifying information redacted] and I'm talking -- I mean, I'm talking about guys that did this stuff. They definitely measured it and in the dying man's affidavit that I attached with my email, [identifying information redacted] was considered to be the premier betatron operator at GSI, the best.

In his dying affidavit, which his son shared with -- I believe with DOL when he filed a claim, said that. This was a long time ago; this was before we ever even brought up this topic. So

that tells me that he was telling it right the first time, before he ever knew it would become a topic.

DR. ANIGSTEIN: Well, the point is the calculation that we and NIOSH have shared is more claimant-favorable because it takes away. Yes, we don't account for the thickness of the metal, but we must -- it's way overcompensated by the 20-odd inches, I think it's 21-22 inches.

So we're saying that the betatron, the platinum target inside the betatron, deep inside that ceramic donut, is six feet from the surface of the metal. Now you're saying we should take the six feet from the outer casing of the betatron, which is about 20 inches further closer to the metal.

MR. RAMSPOTT: I'm talking about the body of the individual in front of that betatron.

DR. ANIGSTEIN: Oh no. That's not -- that's not part of the model. We're talking about --

MR. RAMSPOTT: Wait a minute, I thought

we were talking about a man's arm and legs and forearms and hands.

DR. ANIGSTEIN: Yeah, and that is not based on the distance. That calculation is based entirely on the fact that the film badge reading, 99.9 -- over 99.9 percent of the readings are ten millirem or less.

So the -- I know, this is a little complicated point. It's a little hard to get, because the discussion about Issue 10 is about how is it possible, how much dose can you get to the hands, assuming the man has his back to the betatron and his body shielding the film?

So we're just saying under the worst possible conditions. The worst possible condition is that you have low energy photons coming off this betatron and we just say 30 kiloelectron volts because below that there is no dose. Now we've got these calculations.

MR. RAMSPOTT: I know this is a complicated issue. If everybody's agreeable to

the 100 percent, I don't have a problem. I just wanted to know --

(Simultaneous speaking.)

MR. RAMSPOTT: If you're convinced it's not, if everybody's still recommending the 100 percent, I'm totally happy with that decision.

DR. ANIGSTEIN: The distance does not -- has nothing to do -- in this particular calculation, the distance does not factor into it.

MR. RAMSPOTT: Okay. I guess the main thing right now is the 100 percent, and if that's what everybody is agreeable to, I certainly am. I was just curious, you know. You guys are the experts. I have to rely on your expertise on something like this. I just asked a question, does it come into play and --

DR. ANIGSTEIN: No.

MR. RAMSPOTT: Since we're giving them 100 percent, if you're going to give them 100 percent like it sounds like, it's a moot issue for me. So I appreciate a chance just to comment on

it. I was always curious, what big difference would it make? But it sounds like it's being taken care of with 100 percent, so thank you.

CHAIRMAN ZIEMER: I had my mute on, sorry. We're ready to go on to the next issue, which is 5.

Bob, are you ready to go on 5?

DR. ANIGSTEIN: Yeah.

CHAIRMAN ZIEMER: Go ahead.

DR. ANIGSTEIN: Okay. So Issue 5 is I'll just restate the scenario for everyone's recollection, including mine. We already agreed, NIOSH and the Work Group and SC&A agreed that during the radium era, which is from 19 -- late 1952 when we start coverage for GSI to the end, NIOSH decided to extend it to the end for simplicity reasons, to the end of 1962, even though the radium was probably gone around May of '62.

But during the radium era, we decided on this triangular -- and that's already been accepted by everyone. The triangular

distribution with three points, the highest being the AEC limits on exposure, which were either 12 rem or 15 rem depending on the year and the midpoint of the triangle was based on calculated exposures later using -- that's another issue that's been resolved -- later using MCNP model for the exposure of the operator inside this enclosure in No. 6 building, and then the lower end would be assuming these are one and a half times to two millirem distance would be out in the open, for exposure out in the open.

Okay. So that's settled, and then the question came up, yes, but he can also -- and I brought up this, and I noticed when I saw the calculations done by the final results in Appendix BB Rev 1, I said wait a second, during this period of time, there is zero neutron dose and zero beta dose.

I said but if the same operator who works with the radium is also going to be spending time in the betatron building, then he would be

picking up neutron and beta dose. His photon dose remained the same because the AEC limits were observed according to the GSI supervisor who testified about the GSI letters, corresponded with GSI.

So that 12 and 15 rem, he doesn't pick up anything more of the type of radiation that would be picked up on the film badges, which are primarily medium to high-energy photons. But he could also be getting neutron dose, and there was no measure -- there was no monitoring of neutron dose and he will be getting beta dose from handling uranium and handling irradiated steel. Plus after -- during the betatron radiography.

So the question remains, and this was discussed at the last Work Group meeting and the Work Group recommended that some credit be given for time spent in the betatron building during the same shifts or alternate shifts of the radium radiography.

So now we're just discussing what

fraction of the time is reasonable to account for? So I summarized the NIOSH calculation. NIOSH says that there should be 15 minutes between each shot, each radiographic exposure using radium, because that was the agreed upon value for the betatron radiography for the large castings.

For the thinner casting, they actually used 12 minutes and therefore reproducing the implicit calculation there. So they do 15 minutes a shot and there are ten shots per shift.

That means 150 minutes or two and a half hours per shift are in between -- this is the set-up time, and then the radiographic exposures themselves take 30 percent of a shift at 2.4 hours and you take these two, 2.4 and 2.8, 2.5, subtract it from eight hours.

There's only 31, sorry 3.1 hours left over and you divide by eight, and that adds up to 38.75 percent of the shift. However, our estimate is based on the fact that the one and only radiographer from the radium era that was available

to be interviewed said in an interview, which I was -- not an interview which anyone else had participated in, but I did document it in a report in late 2011 or early 2012.

It was -- it took place on September 27th, 2011 and he said he spent -- this man now worked in a chemistry lab during the weekdays, but he moonlighted as a radiographer. He had radiography experience outside of GSI. So they hired him to do radiography on the weekends, and he said he spent 50 to 60 percent of his time in the betatron building, and the rest presumably working with radium.

And his film dosimetry records -- and that does not reduce his exposure because his film dosimetry records that he furnished us, it's AEC Form 4, are consistent with that. You could say well he worked -- he said he worked 80 to 90 percent of the weekends and one or two shifts.

So he could either have 40 weeks with one shift or 90 times 2 would be 180 shifts a year,

and assigning the film badge records that were reported for him and extrapolating this, what would be a full time radiographer, it falls right into this distribution that's been agreed on.

So this does not reduce his overall dose, but it would allow him to get the beta and neutron dose that we already agreed on that the betatron operator gets. Then the further argument, this is what -- one argument is -- this man's testimony I think is the strongest argument, and also is this plausible. I mean could the man have been mistaken?

Well, how long does it really take? It took him 12 -- according to the same gentleman, it took him 12 to 15 seconds to transport the radium source from the lead pig and position it for the exposure, then another 12 to 15 seconds to remove it, because you don't move the film while the radium is exposed. It would give you a blurred image.

And so the radium, the pig, the lead pig containing the radium was right there in that

little building in the No. 6 building, the little open roofless structure. The film was probably stored nearby. Probably had the film in his radiographer's office and I checked the exposure rate, the dose rate in that office.

Would that be enough to fog the film and no, it was a very low dose rate. The films would probably be stored there as needed. In other words, you bring in a few films for that day's shooting.

And then there was no reason to run out after each shot and develop the film. It can wait until they accumulate if some of the shots are long. The average shot is 14 minutes and the longest shot will be 70 minutes. That's what the GSI officials told the AEC inspector.

So he could easily have waited for -- get a few shots, waited for a longer shot and got out and did that. So the 60 percent still allows ten percent of each shift. So it's like 45-50 minutes for all this in between. We think that

this is a plausible upper bound, claimant-favorable.

We originally said 70 percent but we agreed with NIOSH. Okay, that is the actual exposure time not total time. So adding another ten percent of the time to the radium radiographer is plausible, and giving him -- leaving him 60 percent.

Then again, the difference is now does it need to -- do they need to reposition the casting with the crane and the answer is no, because you have a big chunk, large plates say. You'll be moving the film. The casting would stay and you simply move the little stand that the radium sits on and you move the film appropriate -- to the appropriate location.

And so you don't need very much time. Only when the casting has to be removed and a new casting put in, then you need another -- there will be more time spent on that. So it's a reasonable argument.

The other objection raised was, well, should he, during his time, the 60 percent of his time that he spent in the betatron, is that bias? Is that a bias to assume he did all the radium radiography? And my response is that it's not, that it's perfectly reasonable, because the maximum amount of time, the maximum hours of radiography based on the purchase records, is 437-1/2 hours per year.

So that ends up to be 13.5 percent of a full-time worker, assuming, you know, we had 3,250 hours per year is what we assumed. So, consequently, he could easily have been assigned all the radium, uranium radiography. If you say, well, that should be pro-rated, well, then the argument that a single radiographer was involved in all the uranium radiography is equally plausible or implausible, because you could say, well, he doesn't work all the time. Maybe others were doing it.

But that's delimiting. We don't know

who did the reviewing in radiography. So we assume that however many hours of uranium radiography there were in a given year, any worker working there during that time would have been exposed to that.

So it's just as plausible to say that this one -- this 60 percent of his shift spent in the betatron building encompassed -- I mean, it wasn't uranium all the time, but it wasn't that much uranium radiography. But it would encompass the uranium done during that year.

So that's our proposal, is the 60 percent, which would give you -- 60 percent would take the distribution of the photon doses that we already agreed on and add to that 60 percent of the -- no, add to it all of the beta and neutron dose from uranium handling for a given year, depending on the hours of uranium allotted for that year, and then the remaining of that 60 percent would be steel, which is lower. I mean, there are no neutrons given off by steel, and activated, whether it's activated or not. There is some neutrons.

There is some neutron dose in the control room of the betatron, and also the beta dose from handling steel or uranium.

CHAIRMAN ZIEMER: Okay, thanks. Dave has comments on that.

MR. ALLEN: Yeah, this is Dave. Quite possibly we discussed this last time and the Work Group weighed in and said they just thought that we should add some amount of time in the betatron to the radium radiography. And I think SC&A had agreed that 70 percent is probably too high, since that was based purely on the exposure time.

My task was to come up with a number and I came up with one in every part with the 38.75 percent based on the 15 minutes in between. I thought it was reasonable and something we had to -- we could at least hang our hat on some information.

That comes out to be almost 40 percent. Bob now is talking about 60 percent. So we're in the right -- we're pretty close, you know, too close

not to come to some agreement on some number today. Like before, I'd just like to get an opinion out of the Work Group on that.

But the bigger issue on this one is that uranium biasing. I can't find -- I mean, Bob's saying that's a small percentage of its time, I think is what he implied there. But it's still 400-some hours a year. If it were a task that took ten minutes or an hour or something a year, then anything's possible and you go with the worst case.

But when you're talking about a bigger percentage of the year, we would normally go with the norm or the averages or whatever, what usually happens. That's essentially what we want to do, is go with whatever percentage of the betatron operator dose and not bias it towards all uranium with enough steel to make up the difference.

That just doesn't seem like it's plausible at all that one guy did all the radium radiography and in his spare time went over and did all the uranium radiography and then worked on

steel for the rest of his year.

DR. ANIGSTEIN: My comment on that is, during these earlier years, the betatron was not that busy. The very, very heavy use of the betatron came after the new betatron building was put in. Because at that time, remember, some of the Eddystone facility was still working, was operating.

By coincidence, the Eddystone facility shut down in the year after the radium era ended. So the betatron was very heavily used in '64, '65, '66. But it's not implausible to say maybe the same person shuttled back and forth. Okay, now he's doing radium. He's finished with the radium work for the day and now he walks over to the betatron, which is in a separate building outside there, and does -- and all we have from uranium, H.O. -- I'm just making up a name -- you do the uranium work.

So it's not like you have full-time crews in both places. And the uranium work,

apparently, according to the gentleman I interviewed, was done by one person at first and later they decided to speed it up and to put on two or three people.

And since we don't know who did what, we're always assigning -- I agree with you; as Dave pointed out, one person can't be in two places at the same time. He can't be 100 percent in the betatron, 100 percent in the radium or 100 percent on layout. But once we divide up his time, we should assume that he was doing the work that would give him the highest dose.

That's part of his job assignment and it's, you know, logistically plausible that you can be in that room. And since, again, the highest uranium, the highest uranium work in the betatron is 13.5 percent, and most of it is probably more like ten percent or less, and he's in there 60 percent of the time. That's not unreasonable.

CHAIRMAN ZIEMER: And are you saying that that distribution will be the same each year

for each person?

DR. ANIGSTEIN: No. It would be based on whatever is the uranium work for that year. You know, the uranium hours differ year by year.

CHAIRMAN ZIEMER: Okay. And then you're proposing that the other part be, what is it, 40 percent? No.

DR. ANIGSTEIN: Yeah. I would say, yeah, 40 percent. Forty percent of your time is spent with radium; 30 percent doing the exposures and then ten percent setup and overhead work. Setup and development and so forth.

CHAIRMAN ZIEMER: So the spread of that would change each year, depending on the uranium value?

DR. ANIGSTEIN: Exactly, just like it is in the current model for the betatron operators. Their dose changes year by year.

CHAIRMAN ZIEMER: Right.

MR. ALLEN: Yeah, Paul, this is Dave. I think the difference is that right now we have

a betatron operator estimate based on the kind of work that was going on in the betatron, whereas what SC&A is recommending at this point is one person doing all the radium radiography and all the uranium radiography and filling in the rest of his time with steel radiography in the betatron.

And there's really no reason to believe that one person did, you know, all that stuff. Otherwise, we wouldn't have the estimate we had for the betatron operator.

DR. ANIGSTEIN: But we wouldn't -- but it's not impossible, and as long as one person could have done it, it's not even implausible.

(Simultaneous speaking.)

MR. ALLEN: -- if it's even possible. Credibility and plausibility kind of goes out the door and we're just talking physically possible.

CHAIRMAN ZIEMER: Okay. Let's have others weigh in on this.

MR. ALLEN: But you would have to have somebody that's supervising and coordinating to

get this one person on all these highest exposure jobs.

DR. ANIGSTEIN: No. They had a supervisor. You had a resident supervisor in the betatron building. This is the deceased gentleman who was a metallurgist and also a supervisor, and he had his office in the old betatron building.

MR. ALLEN: Yeah, but --

DR. ANIGSTEIN: So he presumably was in charge, and then someone else, there would be some roving supervisor that would be involved in the radium work. As a matter of fact, there was one -- I take it back. That was it. The one who's on record, who had talked to the AEC, was the overall supervisor for all the radiography. And his name appears on some of the reports, even some of the dosimetry reports as who it was mailed to.

So he had attended some schools. He had some special training. All of that is in the FOIA that GSI submitted to AEC to support their application, you know, support their

qualifications for the cobalt. Remember, they were only asking for AEC approval for the cobalt work. They did not need anyone's approval for the betatron.

But so you had one supervisor overall, a senior person in the company, who -- I mean, you were using experienced radiographers. They did not need someone supervising, watching over their shoulder everything they did. They simply said, here's your duties for today.

CHAIRMAN ZIEMER: So I can sort of see a person doing all that on a given day, but on an extended basis, it would be a little hard to imagine, like for a year. It seems like it's got to be distributed over multiple people. Do you see what I'm saying?

DR. ANIGSTEIN: Yeah, and my point is I'm not even sure if the betatron was necessarily operating during the time that the radium radiography was going on, because that old betatron, in those early years, apparently was not

that busy.

I don't know that, but it's not that -- later, in the later years, those last three years, when GSI, the Granite City foundry, got all the work that had previously been done at Eddystone, then it was very, very busy. That's where all of the overtime came in, even though we're assigning the overtime to the earlier years by consensus.

But that overtime of 50 -- the range was 50 to 80 hours; we settled on 65 as the consensus number -- really applied to the new betatron era.

CHAIRMAN ZIEMER: Okay. So we've got two issues here. One is the 60 percent versus 40 percent issue. The other is this 400 -- is it 400 hours a year?

DR. ANIGSTEIN: I think there's only one issue. Oh, I'm sorry. You're right. Forgive me, Paul. You're right.

CHAIRMAN ZIEMER: I mean, on the first issue, you know, you're adding in the additional -- the Work Group had recommended that NIOSH come

up with a value for that. That's where, Dave, you came up with the 38.5 percent, right?

MR. ALLEN: Yeah, that's right.

CHAIRMAN ZIEMER: And then NIOSH -- or SC&A, in their review, said that perhaps it should be as high as 60 percent. Is that correct? This is the beta from steel, I think, right?

MR. ALLEN: This is the percentage of the time that somebody was working -- that a radium worker was also working in the betatron.

CHAIRMAN ZIEMER: Oh, okay. Percentage of time that they were working in the betatron.

DR. ANIGSTEIN: Right.

CHAIRMAN ZIEMER: So, we're close to 40 percent or 60 percent or somewhere in between. That's one issue. The other issue -- is it the specific number of hours per year on the other issue?

MR. ALLEN: The other issue is the uranium radiography and the hours per year varied

by year.

CHAIRMAN ZIEMER: Yeah, per year, right. So the --

DR. ANIGSTEIN: That's agreed on. Where we don't agree is, if the worker spent an X percentage of his time in the betatron building, is it plausible that, during that time, he did all the radium, if he was involved in all the uranium radiography over the course of a year, or only a fraction of that uranium radiography.

In other words, the solution that Dave is proposing would assume that the betatron was operating all the time and the uranium radiography was just interspersed among the steel radiography at random. And then the radium worker walks into the betatron building and some of the uranium radiography would be done during the time that he was in the betatron building, and some of the uranium radiography will be done during the time he was in the No. 6 building working with the radium.

So I understand Dave's position and our position is it's not unreasonable that the uranium radiography was only on the order of a maximum of 13.5 percent -- sometimes it's a much smaller percentage of that time -- that it's not unreasonable that during the 60 percent of his shifts that he spent in the radiography, in the betatron building, he could have done all the uranium that happened to have come in during that period of time.

CHAIRMAN ZIEMER: Okay. While we're pondering this, let me get Dr. McKeel's comments.

DR. McKEEL: This is Dan McKeel. Can you hear me?

CHAIRMAN ZIEMER: Yes.

DR. McKEEL: Okay. These are my comments on Finding 5. I think the Work Group needs to understand that that lone radiographer that Dr. Anigstein mentioned, who gave him his interview about the radium work, entrusted me to be his personal representative, which I still am,

for his film badge records, which we had to obtain through the FOIA process.

And Dr. Anigstein asked himself a question earlier on. He said, one thing that has to be considered is can you actually trust everything that that particular worker had to say? I think you can. I think he's a very honest person.

However, what I want you all to consider is, how well can you trust the data that really has been collected about that person? For example, we asked for his complete R.S. Landauer Program 208-4 film badge records.

What we first got back was pretty complete data for 1964 through 1973, with the exception of '64 and '66. The 1965 data was very legible. Subsequently, we got the 1964 data; that was way less legible, but at least it seemed to be fairly complete. And I'm talking about now the weekly film badge records from GSI that NIOSH obtained under contract with Landauer in January of 2008.

But, interestingly, that second time around there was no, zero, 1966 data for this gentleman. And so I went through several communications and finally the DCAS Director, I believe, it wasn't quite clear who sent it, but I got a one-page record for one week in 1966, and that's all the data we could get for that gentleman.

So, I tell that story because his regular film badge data was not complete, at least what was supplied to me. Also, I'd like to comment that that individual is very well-known to both Mr. Ramspott and I. We have interviewed him, between us and individually, I wrote him a series of questions about his film badge records, particularly that 1966 one.

So we've corresponded and talked and met in person extensively. And my take on that is, I have asked whether this gentleman, what he remembered about his betatron experience at GSI. How long he worked, which buildings he worked in, and in particular did he have anything at all to

do with the uranium NDT work from Mallinckrodt while he was employed at GSI.

And we could never get a positive reaction about that. So when I hear from Dr. Anigstein, which of course I believe, that back in 2011, in September, this same person said that he split his time 60 percent in the betatron area and the rest of the time doing radium NDT work.

DR. ANIGSTEIN: 50 to 60.

DR. McKEEL: Well, 50 to 60, fine. That's more specificity than we ever listed. Now, it certainly could be this was different times and Dr. Anigstein is an expert interviewer.

But the other comment is that that gentleman is not the only gentleman that we all know that worked at GSI during the radium era who was a radiographer. And let's just say that [identifying information redacted] is the person's initial. I'm sure that will be redacted as well. But that person is well-known to us, and he was a supervisor. But he also made regular trips down

to the radium radiography building in Building 6. So he had a lot to say about what the activities were down there, and he also didn't know very much about the betatron activity versus the radium activity and who did what when.

And as a matter of fact, it's almost a total black box, except for a few deceased workers, who actually worked -- what was the size of the radiographer group at GSI between 1952 and 1962? Or really in '63, actually, when the radium sources were stopped using in 1962. They started using cobalt, and then the radium -- and then the Landauer film badge records started to come in on a weekly basis in 1964.

So we really don't know very much about who did what in that case. This gentleman that we're talking about, his earlier film badge record really was a one-page summary. There were never any film badge records found. The vendor was not identified clearly. So, all we have is a 18-quarter summary of film badge data. We don't

have any data on any betatron radiographer between 1958 and 1952. So, you know, some of the things we're talking about today was critical actually to both issues.

One thing we can say, I think, unequivocally, and that is that one individual did not do all of the radium radiography and all of the betatron uranium radiography during the radium era that lasted ten years. And there is no positive evidence, I don't believe, from any interview I've ever seen or any conversation I've had with [identifying information redacted], that he in fact did any, a single uranium shot while he was a betatron operator at GSI.

Finally, there's comment that Dr. Anigstein made twice during this presentation, that during the early years the old betatron building was not very busy. And I want to say that I think that is -- not only is that not substantiated, but I think it's really not helpful to make those kind of comments.

You know, "not very busy" is not what I have heard. Now, not very busy perhaps compared to the peak year after the Eddystone Castings Division moved its operations down to Granite City. That may be true. But I just want to put on the record again, there is zero, Z-E-R-O, no extant data on the quantity of castings that were shot at GSI with the betatrons or with the radium for any year.

We have no -- just there is no information about that, and there really is no way. We have 109 film badge records from mostly GSI radiographers, but that includes some GSI supervisors who really probably never operated the betatron machines themselves and so forth. But that's out of a workforce that varied between three and five thousand people over 13 years that GSI held its contract with Mallinckrodt.

So, what we're talking about here is really and truly guesses. And then we get into plausibility and so forth and so on. So, here's

what I would say. The most plausible -- let's put it this way. The highest dose, most claimant-favorable assumption that you could make was that betatron radiographers spent -- during the radium era -- spent one percent of their time doing betatron work. Because the betatron values have now been demoted tenfold from what they were back in 2008.

So, now you would think, based on the latest models, that betatron operators got very low doses but the radium other workers, the layout men, they got the highest doses, and that dose is being assigned to the betatron people. So the assumption that would be the most favorable would be that they did betatron work one percent of the time; 99 percent of the time they did radium work.

Well, that's not plausible either. So, the truth of the matter is we're trying to assign a number which really cannot be ascertained. It is, at the very best, a guess. And another way to look at this that I've looked at it since 2005,

is that it is time to use some assumptions as long as it doesn't go over into the area of implausibility.

And I think trying to assign a dose based on the testimony of a single person, who probably did not do any uranium radiography and who really, for us, can't remember very much about anything about his betatron work, but seems to remember an exquisite amount about his radium work, to put a whole scenario on that one person's testimony seems very scientifically questionable to me. And I would assert that it's not defensible and it's not plausible.

So, I don't know how this will all come out. My feeling was that when you get to that point of implausibility, then you've also got to get to the point where we can't really calculate that dose with any sufficient accuracy. And that gets us into the area that I'm sure you all do not want to get into, which is that, at GSI, a lot of doses have been assigned in that way at GSI. And, you know,

that's one of the reasons I continue to believe and fight for GSI should have been awarded an SEC ten years ago.

So, I'll let it go at that. The other thing I have to point out is that when you're talking about the uranium work and the peak loads, and in the old betatron years there wasn't very much, it wasn't very busy, I'd like to remind you that what the purchase orders actually show is that the peak year for uranium NDT at GSI was 1962, which actually is the year the radium era ended, and it is also before the work came in from Eddystone, which was primarily steel castings. There wasn't any uranium work that came in from Eddystone.

So, the uranium work was actually diluted out as a percentage of the total in 1963 to 1966. So, in 1963, '64, '65 and '66, the uranium hours actually were on the decline. And of course, in 1966 the AEC contract was over. So that's where I'd like to leave it. Thank you.

CHAIRMAN ZIEMER: Okay. Dan, thank

you. Let's see. Well, let me ask Dave or Bob if there are any responses or comments on those issues, or Board Members.

DR. ANIGSTEIN: I have some comments, unless Dave wants to go first.

CHAIRMAN ZIEMER: Okay, go ahead.

DR. ANIGSTEIN: Okay. Two things. One is, about the fact that this gentleman, the radium radiographer, we only had one that we knew, did not do any -- he does not recall doing uranium work. The contract from Mallinckrodt specifically said that the uranium work must be done Monday through Friday from 7:30 until 4:00, something like that.

They apparently would -- they wanted to avoid having their costs increase, or at least the productivity, the return of the money they assigned decrease by having workers who would be getting a shift differential. Presumably, because the workers in the evening and possibly the weekend workers would get a higher pay rate, and therefore

for the same number of dollars they would do less work on the uranium. At least that's what in the -- I'm just speculating for the reason, but that was in the contract.

So if these gentleman only did the betatron work on the radiography on weekends, he most likely would not have been doing uranium work. But I'm just using him as a surrogate for the full-time radiographer that would work, you know, normal shifts and might very well have been doing uranium work.

So the fact that he does not recall the uranium work does not discredit that assumption. And that's one thing. And I think Dr. McKeel misunderstands what we're doing here. The time assigned to the radiographer that he would spend in the betatron does not decrease his exposure to the radium. We have already assigned his radium exposure with a triangular distribution. We are simply now adding neutron dose and skin dose to the photon dose, which there's no disagreement on.

That's already been established.

So, what Dr. McKeel is arguing is actually a reduction in the dose given to these workers. I don't think that's what he intends.

DR. McKEEL: Okay, well, let me --

DR. ANIGSTEIN: And as far as -- let me just say one other thing. And as far as the plausibility of his film badge, the film badge records for those 18 quarters, this was done by this company, I think it was called Nuclear Consulting Company, Corporation. It was just one gentleman really.

CHAIRMAN ZIEMER: No, no --

DR. ANIGSTEIN: Let me finish, please.

CHAIRMAN ZIEMER: Well, I'm not going to let you finish. We've gone over that issue many times.

DR. ANIGSTEIN: Okay, I'm sorry. I didn't realize it was you speaking.

CHAIRMAN ZIEMER: We don't need to rehash that.

(Simultaneous speaking.)

CHAIRMAN ZIEMER: The radium doses will be assigned a surface. So we're talking about some add-ons here for the neutrons and the betas. And I think we were close on the betas, right, between the two of you, between SC&A and NIOSH. Was that the 38 percent issue?

DR. ANIGSTEIN: Yeah. Right now, we're on the 60 -- we're on two things. We're on the 60-40, 60-30, round numbers, 60-40 issue. And whether during that 60-40 time, should all the uranium work over the course of the year be given to the same worker? Or should it only be a fractional part? That's the two things I was separating out.

DR. McKEEL: Dr. Ziemer, this is Dan McKeel again. I'd say that, from our rosters, we do know that there were lots more than one radiographer present at GSI in those first ten years. So, to have one person assigned all of that dose --

CHAIRMAN ZIEMER: Well, that's what I saying, too, Dan. I can see a person on a given day rather than on an extended basis. It wouldn't make sense to me. But, anyway, can we -- I wonder if we can deal with these two pieces separately. Is that possible? How badly are they linked in your mind, Dave?

MR. ALLEN: I'm sorry, Paul. You were a little too garbled there. I couldn't understand what you said.

CHAIRMAN ZIEMER: Sorry, I've got to get that speaker thing. I wonder if we can separate these two issues. Do you think they're linked or can they do the -- can we deal with the 60-40 issue and then the other?

DR. ANIGSTEIN: No, they're not. They're complimentary, but they're not linked.

CHAIRMAN ZIEMER: Yeah, that's what I'm thinking. I'm trying to get a feel, for example, would it make sense to both of you if we said, okay, why don't we go with something like 50 percent

instead of we're at 60 and 40 and it's an estimate anyway?

MR. ALLEN: This is Dave. I'm not going to have an objection to whatever the Work Group recommends on that particular parameter.

DR. ANIGSTEIN: Yeah, I would go with the 50, because that's within the range that this worker said. He said 50 to 60. So, 50 is okay.

CHAIRMAN ZIEMER: How about John? How about Josie?

MEMBER BEACH: I would agree with the 50 percent.

CHAIRMAN ZIEMER: Okay, John? I wonder if John's on mute now.

(Pause.)

CHAIRMAN ZIEMER: Not hearing anything. John, are you there? Are the rest of you hearing me? Am I on mute?

MR. KATZ: No, I hear you. I don't have an email from John Poston saying "I'm signing off" or anything.

MEMBER BEACH: Well, he may have just grabbed a quick break.

CHAIRMAN ZIEMER: Yeah, okay.

MR. KATZ: We've been going for a while.

CHAIRMAN ZIEMER: Okay. I'm not really sure how to handle the next part, though. I mean, we've already got two of us that agreed on 50 percent, so I think we go with that.

MEMBER BEACH: And Dave agreed with that also.

CHAIRMAN ZIEMER: Yeah, and so did Bob. I mean in terms of the Work Group Members. What's our -- clarify for me now, Dave, what are you guys recommending for the other issue?

MR. ALLEN: Okay. Well, you know, assuming we're settled on this 50 percent thing, it's basically saying that the radium radiographer went to the betatron and worked half of his time. Our assumption is that means he gets half of the betatron operator doses.

CHAIRMAN ZIEMER: Okay, right.

MR. ALLEN: That simple.

CHAIRMAN ZIEMER: So that fixes your other parameter?

MR. ALLEN: Now, Bob has a different opinion on that he gets half of the betatron operator doses.

CHAIRMAN ZIEMER: Okay. What's the implication for you, Bob?

DR. ANIGSTEIN: The implication for me is that this -- I'm saying that it's plausible that during that 50 percent of -- if that matter is accepted at 50 percent -- that during that 50 percent of the time on the betatron, he may have done all of the uranium work for that year, because the uranium work is at most 13.5 percent of the total time.

So it's not implausible that the uranium came in, or he was assigned that uranium work, during the time that he was absent from the radium. And, you know, I mean, I could invent

reasons which are --

CHAIRMAN ZIEMER: No, no. I'm trying to get a feel for how far apart you are.

DR. ANIGSTEIN: Well, it would be -- most of the neutron and beta dose received by the radiographers, the betatron operators, comes from the uranium. That's why in the years when they do less uranium and they do only -- the beta dose goes down significantly.

So, in a slightly exaggerated sense, you will be cutting his beta dose by half. In reality, he'll get a little more than half, because you'll still be getting something from the steel. But you would be, in simple terms, saying you're cutting his neutron dose and his beta dose by half. In reality, it's a little less than -- he'll be getting a little more than half.

And the handling of the uranium is by far the biggest contribution to the beta skin dose, at least to the hands and forearms.

CHAIRMAN ZIEMER: I was on mute again.

So your 60 percent was from beta dose from the steel, right? So that's going to go to -- if that goes to 50 percent.

DR. ANIGSTEIN: Right.

CHAIRMAN ZIEMER: Now, what's the implication --

DR. ANIGSTEIN: It's a little more complicated. In other words, what he will be getting is, for the betatron operator that is 100 percent in the betatron, his dose comes from all the uranium work for the year and then whatever shifts are left over, which is most of the time.

Most of the time is spent on steel, no matter how heavy the uranium work is. The uranium work is a maximum of 13.5 percent of the time. So, most of the dose comes -- most of the time is based from the steel. But by far the biggest dose during the years of heavy uranium radiography, and heavy means 13.5 percent, comes from the uranium.

So, by saying, no, he only did half the uranium work, that means he only gets half the

uranium dose, the field dose being much smaller except in the final years, when there was very little uranium work.

CHAIRMAN ZIEMER: Well, no, but --

DR. ANIGSTEIN: And by the way, that doesn't count. I take it back.

CHAIRMAN ZIEMER: No, no. The 50 percent that we were talking about is using 50 instead of 60.

DR. ANIGSTEIN: Okay, which is a compromise.

CHAIRMAN ZIEMER: That was in the first part, yeah. Okay. Now, where does that leave you on the second issue? That's what I'm asking.

DR. ANIGSTEIN: My position doesn't change; it's just that it's a different number. But the position is -- and also what's important to remember is, as it happens -- and let me just flip through that -- the uranium -- there was far more uranium work.

As it happened -- the radium era, okay.

The uranium work decreases steadily. '52 to '57 is the highest. '58 is somewhat lower. '59 to '60 is lower. '61 is actually higher than the previous three years.

So, when you end, by coincidence, the number of shifts devoted to uranium between 1952 and 1962 is 35. It varies between -- round numbers between 35 and 55 shifts a year. '63, when the radium era is over, it drops to ten, again I'm rounding off, and it steadily goes down.

So, the uranium work as a contribution to the dose is really important, by coincidence, during the radium era. So, by reducing the amount of uranium exposure during that time, you're reducing the doses significantly.

CHAIRMAN ZIEMER: Okay. Let me ask it in a different way. I'll ask both you and Dave. And Bob, on the -- I'm just going to refer here now to the -- to Dave Allen's paper, very end of the paper. And, Dave, it's Item 5 on the last page of your document. "Biasing of data trend dose

fraction toward uranium work," alright?

MR. ALLEN: Yes, I'm following.

CHAIRMAN ZIEMER: Yes, okay. What I'm asking you and what I'm asking Bob is, how much is it biased in your model versus Bob's?

MR. ALLEN: Are you asking for what the difference would be in the numbers?

CHAIRMAN ZIEMER: I think I'm asking what the difference is in the numbers and how far apart they are.

DR. ANIGSTEIN: For the dose to the hands and forearms, it's almost a factor of two.

MR. ALLEN: No, no, no. For the hands and forearms?

DR. ANIGSTEIN: Yeah, because --

MR. ALLEN: Oh, okay, the whole overall. Yes, you're right.

DR. ANIGSTEIN: Yeah, right. Because the steel does not make that much of a contribution to the hands and forearms. Whereas to the other skin, because the radiation is longer range, it's

like 50-50 between the steel and the uranium. So it's not that drastic a difference.

But to the hands and forearms, the vast majority of the -- for the '52 to '62 period, the vast majority of the dose to the hands and forearms is from uranium. So by cutting the uranium work in half, you cut the dose by maybe 40 percent, depending on the year.

CHAIRMAN ZIEMER: When you say you're cutting the uranium work in the half --

DR. ANIGSTEIN: In other words, I'm saying that we should let the worker do -- the uranium worker -- assume the uranium worker, during that 50 percent of his time in the betatron, did all the uranium work that the betatron did that year. And by saying he only did half the uranium work, his dose goes down almost a factor of two.

CHAIRMAN ZIEMER: Where does the half come from? Who's cut in half?

DR. ANIGSTEIN: Because his dose, the dose to his hands and forearms --

CHAIRMAN ZIEMER: No, I'm saying where did you get the half to start with?

DR. ANIGSTEIN: No, no, I'm saying that. It comes from the uranium. So if he only worked half -- in other words, there are -- let's see. There were -- for instance, in this first period, '52 to '57, there were 54.7 shifts of uranium work. Or we can do it in hours, which makes more sense.

So let's say, in round numbers, let's say they had 400 hours of uranium work done. 437, okay. Let's say there's 400 hours of uranium hours. Did he do 400 hours of uranium work during the time that he was in the betatron? Or did he only do 200 hours on a year to year, per year? That's where the half comes in.

CHAIRMAN ZIEMER: Okay. Is that showing up in your table, Dave?

MR. ALLEN: No, these issues were related. I'm trying to think of what table I have here.

CHAIRMAN ZIEMER: Well, trying to pick out where this difference is arising between your two

MR. ALLEN: This is why I had the order on my report. You know, the findings were out of order, it seemed like, because of the interrelation between these. You can't really come up with all the numbers for one issue without knowing what the numbers are going to be on another issue. That's why you don't see numbers in there.

CHAIRMAN ZIEMER: Right.

MR. ALLEN: So, I mean, Bob, I think it's a reasonable guesstimate right now that it would be around 40 percent. The numbers used in what I'm talking about would be, for hands and forearms, really about 40 percent lower than the numbers he would propose.

They would both be considerably higher than what you would see today in Rev 1, or any of the numbers in any of our reports. Essentially, what it comes down to is Bob's would be very close

to 100 percent of the betatron operator dose plus 100 percent of the radium operator dose. Because as he said, hands and forearms, almost all the dose is from the uranium.

DR. ANIGSTEIN: Exactly.

CHAIRMAN ZIEMER: Okay. But your percentage values are arising out of assumptions, then?

MR. ALLEN: I'm not sure what you mean by that, Paul.

CHAIRMAN ZIEMER: Well, the hours that you're assuming of exposure per year.

MR. ALLEN: Well, they came from our analysis of the purchase orders that we had. That's been well-established all along on what we did there.

CHAIRMAN ZIEMER: Yeah.

MR. ALLEN: I'm just saying, if we're saying he worked in the betatron half the time, you get half of the betatron operator dose.

CHAIRMAN ZIEMER: Yeah.

MR. ALLEN: That's all I'm saying.

CHAIRMAN ZIEMER: That's an assumption, though.

DR. ANIGSTEIN: No, Dave is saying that it's half of a full-time betatron operator dose.

MR. ALLEN: Basically Bob's asking us to change what the assumptions are we've gone with before with the betatron operator dose.

CHAIRMAN ZIEMER: That's why I'm trying to pin that down. Where is that coming from?

MR. ALLEN: It originally came from purchase orders from Mallinckrodt. We have an estimate of these uranium work hours are per year. We estimated what the dose per shift of uranium work you would get, and the dose per shift for steel work. And then based on 3,250 a year minus the uranium work hours, that's the steel work. The uranium work hours was the uranium work hours, and putting that all together we came up with a betatron operator dose.

Now, for hands and foot and for maybe some others, the uranium work is a higher dose.

CHAIRMAN ZIEMER: Yeah, yeah.

MR. ALLEN: And I'd say there's no reason to bias it. As you said, you can believe one person did all the radium and all the uranium on a particular day, but not on an extended basis. And I'm agreeing 100 percent with that, saying there should be no biasing. It's simply, if he worked in the betatron building half the time, he got half the full time betatron operator dose. That's all I'm saying.

CHAIRMAN ZIEMER: Okay. Now, on average that would seem to make sense for the group.

MR. ALLEN: Yes.

CHAIRMAN ZIEMER: Okay. And, Bob, what you're proposing would basically say that every person -- you're sort of saying every person has that chance, but when you're working with the population, would you assign it to every person?

DR. ANIGSTEIN: Yeah. But I guess my

philosophy, my thoughts about dose reconstruction in general is, you know, we're not calculating doses to the average person. You're calculating doses to the highest plausible, highest reasonable doses. So, not knowing what person did what, you make the bounding assumption.

So, you know, when any particular person comes up for dose reconstruction, you don't know which one, whether he did all of the uranium work or none of it.

CHAIRMAN ZIEMER: Yeah, understood.

DR. ANIGSTEIN: So it's not implausible that since the uranium work that took, again, on the order of ten percent of the total work during --

CHAIRMAN ZIEMER: Well, the way I was viewing it, it's not implausible for a day but I think it's implausible for a year.

DR. ANIGSTEIN: But there's only a limited number of days they did uranium work, 50 days of the year max.

CHAIRMAN ZIEMER: Well, you know, you'd still have to be saying that one person --

DR. ANIGSTEIN: Yeah, it's --

CHAIRMAN ZIEMER: Not knowing who it was, but that one person could have done that, they would be the only one doing that 50 days a year.

Well, that's the issue, then. We need to get some feedback from the Work Group.

MEMBER BEACH: Yeah. Bob, this is Josie. It's a tough one, because I can see both sides of the issue. And I think, again, it's somewhere in the middle. But they're apart 40 percent, so it's a tough one.

CHAIRMAN ZIEMER: So I think, then, under the current NIOSH model, which was actually based on the earlier assumption that we made on that, was it not, that the Work Group made?

MR. ALLEN: The doses for the betatron operator, assuming somebody was 100 percent betatron operator, those assumptions have been hashed out, yes. Is that what you mean?

CHAIRMAN ZIEMER: Yeah, yeah. Hadn't we agreed on a position that -- I'd have to go back into the notes and records, but hadn't we agreed on a position about how much time a typical worker would spend there?

MR. ALLEN: Well, we calculated for 100 percent of the time working there, but it's percentage of time with uranium, with short shots, with long shots. We did all that based on essentially averages.

CHAIRMAN ZIEMER: Right, right. That's what yours is based on, right?

MR. ALLEN: Yes.

CHAIRMAN ZIEMER: Bob, are you seeing that differently?

DR. ANIGSTEIN: I'm not sure. I think I lost what was being said just now. Can you restate that?

CHAIRMAN ZIEMER: Dave, do you want to restate that?

DR. ANIGSTEIN: Well, I think Paul

asked about the assumptions that went into the betatron operator dose, the current estimate for betatron operator dose. And I said, yeah, you know, the parameters had been hashed out as far as how much time was uranium work versus steel work, how much steel work was long shots versus shorts shots, et cetera.

DR. ANIGSTEIN: Yeah. But I don't think there's any disagreement on that now.

MR. ALLEN: Right. Well, I think it was a question from Paul, and I've tried to answer it and that's how I answered it.

DR. ANIGSTEIN: Yeah, okay. Okay. No, the only remaining issue is --

CHAIRMAN ZIEMER: Those were parameters agreed to, but are you saying that this is an additional?

DR. ANIGSTEIN: No, let's see. We just settled Issue 2, which was how to calculate the skin --

CHAIRMAN ZIEMER: No, I'm talking

about previously. Not today. Previously, we agreed on parameters for betatron operators.

DR. ANIGSTEIN: I think the only thing that we agreed on previously was the photon dose, the triangular distribution for the radium workers. That's the only thing, I believe, there was firm agreement.

MR. ALLEN: No, wait, wait, wait. I think Paul's talking about betatron operator now.

CHAIRMAN ZIEMER: Yeah, betatron.

DR. ANIGSTEIN: Right, okay. I don't think we had firm agreement on the betatron operators dose. I think all of that is being settled today.

MR. ALLEN: We had firm agreement on a whole lot of parameters.

DR. ANIGSTEIN: Okay. We did on the work hours.

MR. ALLEN: We passed files back and forth, I don't know how many times, trying to make sure our math was all right.

DR. ANIGSTEIN: Yes.

MR. ALLEN: And you found an error or two that we had to correct.

DR. ANIGSTEIN: Yeah, for the skin dose.

MR. ALLEN: For the skin dose.

DR. ANIGSTEIN: Right, right. No, no, that's fine.

MR. ALLEN: But, I mean, are you trying to say there was not firm agreement with how many short shots, long shots?

DR. ANIGSTEIN: Oh, yeah, no, no. That wasn't an issue. I misspoke. No, certainly there was. Certainly there was.

CHAIRMAN ZIEMER: Well, I'm still trying to get a feel for how to handle this particular issue, as to whether or not this is a new assignment that has to be made on the work hours assigned to these folks or is it a change from what we had previously agreed on?

DR. ANIGSTEIN: No, I don't think

there's any -- anything that was previously agreed on still stands. This is just one last wrinkle that has not been worked out.

CHAIRMAN ZIEMER: So it boils down to whether or not we want to assign everybody that dose as if they were doing what you described all the time.

DR. ANIGSTEIN: Yeah.

CHAIRMAN ZIEMER: Let's see. I guess I need to get Jim Neton's expertise on the bounding issue. Is that what we would really mean by bounding in this case?

DR. NETON: Well, I mean, I agree with Dave on this. It's a real stretch to assume that the radiographer did all of the uranium work all the time. That's what we're saying. Every piece of uranium work that was done at GSI was done by a radiographer. That's what Bob is saying, and I don't buy that.

DR. ANIGSTEIN: Well, if we forget about the radium work for the moment, we've already

agreed that all the uranium work that came into GSI was done, for any given betatron operator, he was on duty and participating in that work, because we just take -- the total number of uranium hours determined from the work orders. That's how long the uranium was being handled. And we've already decided to give the maximum dose to a betatron operator, that he did all of those shifts. So that's already been -- that's established. That's already agreed on.

DR. NETON: Right. But that's --

DR. ANIGSTEIN: And now I'm saying --

DR. NETON: It's for an operator, not radiographer.

DR. ANIGSTEIN: Yeah. But now I'm saying --

DR. NETON: He's saying there's no class -- the betatron operators did none of the uranium work, is what you're saying.

DR. ANIGSTEIN: No, no, no. I'm saying --

DR. NETON: Who did it, then?

DR. ANIGSTEIN: Pardon? No, I didn't say that. I'm saying it was agreed on that, if we're considering the betatron exposure scenario, we're saying he did all of the uranium work for that year. Participated. There was more than one person doing it.

DR. NETON: Right. But he was a betatron operator by job function.

DR. ANIGSTEIN: Okay, right. And now --

DR. NETON: And now you're saying none of the betatron operators by job function did uranium work.

DR. ANIGSTEIN: Wait a second, yes. I'm in agreement. I agree.

DR. NETON: That seems very unlikely to me, Bob.

DR. ANIGSTEIN: Hold it. Let me -- no, you're not allowing me to clarify. We agreed that the betatron operator would do all of the uranium

work that came in that year. But what I'm saying is, suppose that betatron operator divided his time between the betatron and the radium radiography.

And my argument is there is still plenty of time, over the time that he was assigned to the betatron, there's plenty of time to have done that radium radiography that was only 50, 60 a year.

DR. NETON: But I think it's unlikely, if he's doing it 50 percent of the time, that that's true.

DR. ANIGSTEIN: Well, I'm saying it's not implausible.

DR. NETON: And I say it's a stretch.

DR. ANIGSTEIN: Okay. But I was trying to clarify the issue.

DR. NETON: I understand. But you're saying that none of the betatron operators did uranium work, and I find that to be totally implausible.

DR. ANIGSTEIN: Say again?

DR. NETON: None of the uranium

betatron operators who were assigned to do that job did any uranium shots, none.

DR. ANIGSTEIN: No, no, no. Just the opposite. I'm simply saying that -- the point is a radiographer -- my understanding is radiographers did both radium, both isotope work and betatron work.

DR. NETON: Was there any betatron operators who did not do radiography?

DR. ANIGSTEIN: They did not do -- they both did radiography. That's what a betatron does.

DR. NETON: No, but I mean just operate the betatron only.

DR. ANIGSTEIN: No, no, no. A betatron operator was by definition a radiographer. That's how they were referred to. They didn't simply sit at the controls of the betatron. The radiography men, they set up -- there was generally a three-man team, and they would set up -- they would position the betatron,

position the film, markup where the exposures were being taken, then, of course, everybody would retreat to the -- they would either leave room or retreat to the operator's office, with the ten-foot shielding, with ten-foot walls during the actual shot.

So they were considered radiographers. The radiography can be done with the betatron, or radiography can be done with the isotope source. And they did both, and it required the same sort of skill. I mean, the betatron operator had to have the additional skill of knowing how to set the controls, but the main skill and judgment was, how do you position the shot, how do you mark it, where do you put the film? And that's what the radiographer was.

DR. NETON: But I thought I heard Dr. McKeel commenting that they talked to people who did source radiography and they didn't recall doing the betatron work.

DR. ANIGSTEIN: Well, the one

gentleman that I spoke with said he did half and half; 50 to 60 percent of the time in the betatron, and the other time they worked with radioactive sources. And all of the people that I spoke with, including the meeting in Collinsville back in 2007 and later discussions, they were all -- because they were all called radiographers and they seemed to be mostly -- they did the betatron work primarily.

That's what we talked about it. The whole focus was on the betatron during those early times. We thought that was -- we didn't even know they had radium until we got the AEC records.

DR. McKEEL: This is Dan McKeel. May I make a comment to Dr. Neton's comment, please?

CHAIRMAN ZIEMER: Certainly, go ahead.

DR. McKEEL: Yeah. I mean, no. The gentleman that I was referring to, [identifying information redacted], said he definitely did something with the betatron. He was a betatron radiographer. He was a betatron operator. What

I was trying to say is that when we tried to pin down exactly what he did -- in other words, did you shoot turbine blades, did you shoot -- what exact kind of casting did you shoot, and in particular did you shoot any uranium? He really didn't remember any of the betatron work that he did.

But he was certain that he was a betatron operator. And as a matter of fact, Terry Dutko, who is deceased, wrote this Work Group many notices that explained that in the department that did radiography at GSI, you know, there were betatron operators who also did isotope radiography. There was an ultrasound department. There was a Magnaflux component. There are lots of different kinds, as everybody knows, of non-destructive testing work that goes on at big steel factories, and GSI was like everybody else. They used a lot of them.

The ultrasound people did a lot of the layout location work and so forth. But what I think we're arguing about is nobody, zero, not

anybody -- for instance, the one person that gave the best descriptions of the corner shots, let's call him [identifying information redacted], said, number one, contrary to what the paper work said in the Mallinckrodt purchase orders, that he shot all of his uranium on weekends and night shifts.

And so that information, that the uranium was shot during the daytime, clearly it's there on paper, but clearly it wasn't done that way. We've tried to make that point over and over and over again. The idea of accepting what's written on paper in a procedures manual and weighing that against what is actually said by the workers, you need to come down on the side of the workers, recognizing that their recollections are not perfect after 50 years and so forth.

But, anyway, that's my comment to Dr. Neton. This man was a betatron radiography operator. He just doesn't remember what particular betatron work he did.

CHAIRMAN ZIEMER: Okay, thank you.

Jim, any more clarification needed? I'm trying to get a feel for whether or not what SC&A is proposing is true bounding.

DR. NETON: Well, it's certainly a higher dose. I mean, there's no doubt about that. But I just don't see, if a person spent half his time in the betatron area, that 100 percent of that -- he did 100 percent of the shots, of the uranium shots. It just seems --

MR. ALLEN: Jim, just to clarify, I mean, we've already said that one person in the betatron 100 percent of the time did 100 percent of the uranium shots.

DR. NETON: That's true.

MR. ALLEN: All we're saying now is we don't believe you did 100 percent of the uranium shots and 100 percent of the radium shots.

CHAIRMAN ZIEMER: Yeah, right, right.

MR. ALLEN: That's where we have a difference.

DR. NETON: Right. That's a better

way of putting it.

CHAIRMAN ZIEMER: Okay. I'm wondering if we're at a point where we can come to closure on this. I'll just voice where I am on it. And Josie. I don't know if, John Poston, you're back or not. We lost you for a while.

MEMBER POSTON: Yeah, I've been here.

CHAIRMAN ZIEMER: Oh. We had a vote and we couldn't get you to vote.

MEMBER POSTON: Oh. I haven't left the room. I guess I was asleep. I didn't think I was asleep, but I guess I was.

CHAIRMAN ZIEMER: Okay. So, I guess at the moment I'm personally coming down with NIOSH's position on this. I don't see any reason not to, at the moment. Josie, where are you on this?

MEMBER BEACH: Yeah, I think I'm going to agree with that also, Paul.

CHAIRMAN ZIEMER: John, how about you?

MEMBER POSTON: I agree.

CHAIRMAN ZIEMER: Okay. So, Dave, we're going to recommend that the NIOSH position on this be where the Work Group will make the recommendation.

Now, let me ask folks how they're doing here. We have one item left to discuss. What's the number here? We've got number six, right? So, Bob, do you want to --

DR. ANIGSTEIN: Sure.

CHAIRMAN ZIEMER: Everybody okay to go a while longer?

MEMBER BEACH: Sure.

CHAIRMAN ZIEMER: I've assumed you've taken breaks as needed.

MR. RAMSPOTT: Dr. Ziemer?

CHAIRMAN ZIEMER: Yes.

MR. RAMSPOTT: This is John Ramspott. Could I make one real quick comment?

CHAIRMAN ZIEMER: Yes, John.

MR. RAMSPOTT: Regarding the betatron and betatron operators and the isotope operators.

The FOIA material that everybody has, Dr. McKeel found, 1,000 pages.

In their licensing information, General Steel, an officer, actually claims and is explaining to the Atomic Energy Commission why they should get isotopes, and clearly states the background of a number of the people that will be working with it, with the isotopes, and clearly state they have betatron background, and that's why they should be considered for this isotope work.

CHAIRMAN ZIEMER: Right.

MR. RAMSPOTT: That's in the FOIA information, been there, documented, proof on paper. So there's no doubt that these guys did both of it. What we're arguing is, how much?

CHAIRMAN ZIEMER: Right, right, exactly.

MR. RAMSPOTT: So these are union jobs, so they didn't send -- they're telling the AEC, they're not going to just give us anybody. So these guys -- that's why they had to do it all, and

they could easily do it in between the betatron shooting, because it took time.

Some of those shots, do you think they'd let a radiographer sit there for two hours while they did one of those big, long casting shots? Not the GSI I know. They'd have had them down in 6 Building or out in 10 Building in a heartbeat.

I mean, we have isotope supervisors that clearly stated that they did it in 10 Building. I've got workers saying they used isotopes out there. They roped it off. They didn't do all the isotope work down in 6 Building by any means, you know, especially the radium. That was a small source.

The cobalt-60, 80 curie we can't prove where they did that, because we can't find the licensing. But the radium, they just did it everywhere in that plant. They would not let a radiographer just sit there and read the newspaper for two hours while they're shooting a big old turbine.

CHAIRMAN ZIEMER: Right, and we're not assuming that at all.

MR. RAMSPOTT: So it's very plausible. Bob is 100 percent correct. There's a two-hour window of them going to do something else. There's no doubt about it. To me, it's very clear. Bob's 100 percent correct. That's all I have to say right now. Thank you.

CHAIRMAN ZIEMER: Okay, thank you. Okay. Let's go ahead with Item 6.

DR. ANIGSTEIN: Okay. Item 6, we're close to agreement, that the NIOSH, this is now the layout man's beta dose. So, the NIOSH model is that they developed this intermittent exposure model, where the steel was, there would setup time, exposure time, setup time for the next time, exposure time again.

We just assumed the shots were somewhat overlapping, both NIOSH and SC&A take the limiting assumption they were all in the same spot on the same piece of metal. They're also in agreement

that the layout man would do one casting, spent much of his shift on casting. We got that very clearly from this deceased supervisor that was there.

He explained that he sometimes would -- however, he wouldn't do it all day long because they would say, "Hey, here's a rush job. Mark up this casting." And he will get this freshly irradiated casting out of the betatron, and he would walk over to the other casting and mark that one out. And that took like a total of ten percent of his shift.

So we're in agreement on that. However, we were not in agreement -- NIOSH maintains that whether it's a short shot or a long shot -- meaning, whether it's a thin piece of metal or a heavy piece of metal -- it took the same amount of time to mark it up. Therefore, it should be -- because 90 percent of the shots were short shots, therefore 90 percent of the time was spent marking up short shots. Okay.

So our position is that we accept the model. I won't go into detail as to why we accepted

the model, but we don't agree with part of the long shot time, because the thicker steel, the long shots were thicker steel.

In other words, you're laying out the surface, but what's behind that surface? Is it thin pieces -- is it thin steel or thick steel? Thick steel would have more defects. The workers that participated in the last meeting specifically said, and I'm just excerpting from the transcript of their testimony, "the bigger the casting, the more defects."

Now, he did say the missile tubes for Polaris submarines were high quality and fewer defects, and in Dave Allen's report he erroneously assumed that these had to be heavy castings. Now, they were thin tubes, because they were used to guide the missile with compressed air while it was being launched. It was not like a cannon, which had to have thick walls because you have explosive powder inside.

And it just so happened that

[identifying information redacted] (phonetic), who was a former -- actually he used to be a full-time SC&A employee, and now he's an associate, was a [identifying information redacted] -- [identifying information redacted] was his rank. He was an engineering officer on [identifying information redacted], and he couldn't give me an exact number, but when I said, well, the range of casting was -- five inches was considered a thin casting and 12 inches was a thick one. He said they were definitely less than five inches. So therefore the fact that [identifying information redacted] missile tubes had fewer defects does not mean that thick castings had fewer defects.

Then finally there was something that my colleague Bill Thurber found and passed on to me from the American Foundry Society, the informational website, and they referred to cavity defects. Basically, he said you -- the full quote is, "You see on the X-ray a defect which is due to a cavity, and the cavity defect is partially a

function of the section thickness." In other words, the thicker it was the more, in Mr. Thurber's opinion, is the larger, the more complex the casting, the more likely there are defects.

So, our position is, well, the maximum likely would be to say that you had divided up the way we divide up the shots. In other words, the long shots took 75 minutes or 60 minutes for the actual shooting, 15 minutes to set up. So there was the production time of 75 minutes. For the short shots, we settled for 12 minutes of setup time and three minutes of shooting, so it was 15 minutes. So there would be five to one. The least would be what NIOSH is proposing, one to one, which is -- let's come to a compromise.

Let's say it's three to one was -- a long shot takes three times -- a single long shot takes three times as much time to mark up as a single short shot. So if you had N long shots and 9N short shots, you know, then the actual fraction of time would be three times as long for the -- so it would

be 3N, whatever N is, for the long shots versus a total of 3N plus 9N. And so you end up with 25 percent spent on the -- 25 percent of the total time of the layout man's time spent on the long shot. And that that -- and then the results, and here's where we did the history of this.

Our original calculation of dose to the layout man was 1.89 rads per year to the hands and forearms, 1.14 to whole body. Then we were looking -- after the last Work Group meeting, I said, well, let's see -- let's keep our scenario, which was considered to be implausible because it involved, you know, a constant supply of fresh shots, which was beyond the capacity of the betatron.

But let's employ the intermittent model, which we accepted, intermittent exposure model proposed by NIOSH, but let's apply it to our scenario. Now we get much lower than the original, because the intermittent scenario, the intermittent exposure, which is scientifically correct, results in much lower doses.

Then we compared this now to the Rev 1, Appendix BB, Rev 1. Here, the numbers, 807, 463, that is copied from there, and here are the numbers that are now being proposed by NIOSH, and here is what we suggest now.

So our suggested, using the NIOSH scenario, is actually higher than if we had kept our original assumption but employed the NIOSH model, the NIOSH intermittent exposure algorithm. So we think that this is a plausible, reasonable value.

And then we point out also, what is the net effect of this? Well, this is the rads per year skin dose, and here is the total exposure, 9R per year photon exposure, which would be added to the skin dose with appropriate factor. But it's a little less than one, not much less than one.

So we're talking about a small fraction. We're talking about effects on the hands and forearms, for which it wouldn't be used anyway because the betatron operator will be the

limiting exposure.

So we're talking about 224 millirem compared to 9R external exposure. So it's a small difference. The difference between NIOSH and us is not that far apart. But it's a small, I should say -- what I meant to say is it's a small contribution.

So I just wanted to get the idea of the size of this, of exactly what we're talking about.

CHAIRMAN ZIEMER: Okay. Dave, any response here?

MR. ALLEN: Yeah, I was just going to say, I think when SC&A originally reviewed this they -- well, when we originally came up with this, we had the ratio based on the number of shots rather than the exposure time.

SC&A had a ratio based on the exposure time, which didn't make any sense to me because the amount of time it takes to mark it up and then to do it, how long it takes to shot through that steel. They have built a reasonable case to believe that

the thicker steel might have more defects and therefore will require more markup. Therefore, I think what Bob's got here is reasonable and I'm more than willing to go with it. Did I lose everybody?

CHAIRMAN ZIEMER: Okay. Let me go ahead and get some other comments at this point. Again, I'll ask for Dr. McKeel and John to comment.

DR. McKEEL: Yeah. This is Dr. McKeel, Dan McKeel. Can you all hear me?

CHAIRMAN ZIEMER: Yes, Dan.

DR. McKEEL: Okay. I'm commenting on Finding No. 6. I do want to comment that, you know, sometimes in these discussions it's amazing to me that the discussion has a different tenor than the written papers that we're discussing. For instance, in their most recent paper, 9/11/15, where SC&A is commenting on Dave Allen's 7/10 paper, they say this about Finding No. 6:

"Perhaps the most complex of the remaining dose construction issues for GSI," which, you know, and now we're late in the day and

everybody's tired, and now we get down to, well, I think we're in substantial agreement and basically we've had no discussion.

So I'll try to make my comment extremely brief. I want to get down to the bottom line. The bottom line on this finding is that SC&A is suggesting that perhaps NIOSH would like to use its new data in Table No. 4.

So I would ask you all, I don't know -- I don't have LiveMeeting up, but if you all could put Table 4 of Finding No. 6 up on the screen, that would be very helpful. It's titled "Annual Doses to Skin of Layout Man from Beta Rays Emitted by Irradiated Steel." And Dr. Anigstein was just talking about some of the data in that table.

Anyway, I'll describe it. It's got these columns. It's describing the skin on the hands and forearms and the rest of the body in two rows. And it's comparing those between SC&A 1 and 2, which is kind of interesting. SC&A 1 is a scenario described by SC&A in 2014. And the

comment is made further that SC&A recalculated using intermittent exposure algorithm. So I understand that it's what Dave Allen had proposed.

So what I want to focus on is, when everybody is talking about reasonably close, to me, in my background, I look at the data that's being presented. And just like I looked at the data between the betatron and the other worker doses that were modeled in 2008 versus those in 2012, I was struck by the fact that the agreement was extremely poor. And it was poor from 2008 to 2012 and extremely poor between NIOSH and SC&A.

This table strikes me the same way. So, for instance, let's say SC&A 1 and SC&A 2, you know, for the hands and the forearms, 1.89, 0.278. Wow, that's a sixfold difference. Rest of the body, 1.14 and 0.178. Again, fivefold differences.

Let's look at NIOSH 1 and NIOSH 2 for hands and forearms, .807, .264. And for the rest of the body, .463 versus .147. The absolute

magnitude of differences there is 400 percent and 300 percent, fourfold and threefold.

Those are tremendous variations. And then the requirement is -- or the suggestion for this finding is -- well, NIOSH could consider using the data in the new column, which apparently SC&A -- it says, "NIOSH 2, Recalculated by SC&A using betatron beam intensity based on MCNPX simulation and assuming 25 percent marking up long shots."

Well, wow. There are some more new assumptions, and so forth. What disturbs me tremendously is that every time there's a new recalculation, it's way away from the previous calculations.

These numbers have been all over the map. And I'm going to be honest with you. In the world of biology, where I think there's more variation and variability inherent than there surely is in a radiation dose, for goodness' sake, the data that's come up with in these calculations based on assumptions that I think are extremely

weak and challengeable, it just blows me away.

But the overall bottom line is that what's being proposed by SC&A is that they lower the NIOSH 1 doses by a factor of two. And again, I think that's claimant-unfavorable -- or a small contribution to the overall dose. Once again, it's skin dose and these skin doses really should apply not just to the arms and the forehands.

I mean, it's naive to think that a betatron operator doesn't bend over and have his face close to that target from time to time. So this really -- these doses should apply to all of the exposed skin.

But in any case, the hands and forearm, you can get skin cancers. You commonly get skin cancers there. Back of the hands is one of those common locations. Forearm, people work out in the sun and they work in their workplace with their sleeves rolled up. So they get big doses to the hands and the forearms. So, cutting the dose by 50 percent, that's a bad thing for workers. It's

not claimant-favorable, and I don't think it's any more plausible than accepting what NIOSH has in the NIOSH 1 column.

So I'm strongly encouraging that the highest dose here is SC&A 1, which is a scenario described by Anigstein and Mauro, recalculating using intermittent exposure algorithm.

So what I'm not hearing is SC&A endorsing and championing its own dose reconstructions. I mean, I would like to hear some discussion of Table 4 from both SC&A and NIOSH and why your new column at the end of the table should be accepted. Thank you.

(Pause.)

MR. KATZ: Paul, you might be on mute. Paul, do we still have you?

MEMBER BEACH: Doesn't appear to be so.

MR. KATZ: Well --

CHAIRMAN ZIEMER: Sorry, I got offline for a minute. I pressed the end call button instead of the mute button.

MR. KATZ: I thought so.

CHAIRMAN ZIEMER: I cancelled myself out. I did hear the end of Dr. McKeel's comments and he's challenging SC&A to explain the change in their numbers. So maybe you can do that, Bob.

DR. ANIGSTEIN: Sure. The change is entirely due to the intermittents -- what we did early in the game, we were trying to keep it simple. There was a lot of calculations to do, so we just assumed that the steel was continuously exposed, with no downtime.

Actually, in the activation with the delayed gammas, what we did is we did a fairly elaborate calculation of the intermittent exposures, because that was a way of handling that. With the electron, with the beta, we did not. We just did a labor-saving simplification. Couldn't think of any quick, accurate way of doing it.

And Dave and his colleagues came up with this algorithm, this saw-toothed curve which very

accurately takes into account the fact that the exposures are intermittent; there's exposure time, there's the setup time. And I see no reason for disregarding that.

So I took Dave's algorithm, which I even wrote up a mathematical derivation of that as an appendix because Dave previously gave a sort of heuristic explanation of it, and I wasn't -- for my own benefit I had to derive it. I thought it was correct and I thought it was perhaps a different, alternate way of proving it or presenting it, but the results are the same.

And therefore I saw no reason. I said -- first, I was trying to hang onto my original. I said, well, let's see -- I agree that there was intermittent and let me see what would happen if I took my original model and then applied the intermittent algorithm to it, and it went way down.

CHAIRMAN ZIEMER: Which you would expect.

DR. ANIGSTEIN: Because it was now a much

more realistic, more scientifically accurate. The same assumptions, all the same parameters except instead of being continuously irradiated, we explicitly accounted for the fact that, you know, that there were setup time in between the shots.

And so that's what the SC&A 2 is. And the NIOSH 1 is more like SC&A 1, only somewhat different because they, again, they used the same exposure scenario, the 30-hours continuous irradiation that was in the original -- that was in Rev 1, only they made some other assumptions. They left out the one meter, other things that made it lower.

So then NIOSH 2 is the latest, which takes into account the intermittent exposure and also this alternating casting scenario, which it turns out to give you a higher dose than our model. And the only difference would be -- the reason it appears lower here is that we differ on the, you know, 90 and 10. Originally, we had the 36-64 mix

of time, exposure to the long shots and the short shots. And the NIOSH 2 was the 10 and 90.

And now the new one, which it now has been -- I heard Dave saying that's reasonable, is the 25 percent. So instead of 10 to 90, it was 25-75. So this seems like -- because it turns out that those long shots account for most of the dose. So more long shots gives you a higher dose. So it's not inconsistent with what we did before, because if anything I would say the thing to compare would be the SC&A 2, which is actually in one way more conservative because it assumes 36 percent on long shots instead of 25 percent, and yet that gives you less than using the NIOSH scenario.

And I was very surprised by this outcome, by the way. Using the NIOSH scenario and the -- both cases the intermittent radiation, and now we agree to the somewhat higher time spent on the long shot. So we're just getting scientifically more accurate.

One was a bounding overestimate and

NIOSH found a way of refining it, and I think everybody's doing their job the best they can and we're coming up with a -- it seems to be a very reasonable solution.

CHAIRMAN ZIEMER: Okay, Dave, any other comments on that?

MR. ALLEN: Yeah, I don't think I have anything to add.

CHAIRMAN ZIEMER: Okay. Board Members, questions or comments?

MEMBER POSTON: None for me.

MEMBER BEACH: No, Paul. This is Josie. I have no questions.

CHAIRMAN ZIEMER: These numbers, the current two numbers in the last column, basically differ by 100 percent, or one's double the other. I think what I was understanding when you were talking about them being small -- or I don't know if you said small difference -- that's my clock ringing in the background, sorry. The difference, the absolute difference in the two is about .2 --

what is it, are you in rems there?

DR. ANIGSTEIN: Rads.

CHAIRMAN ZIEMER: Or rads, okay. Or .2 rads per year. The beta is a small fraction. Basically it's a small fraction of the total dose being assigned, is what you were saying, I guess. It's around five percent or -- no, less than that. Two percent?

DR. ANIGSTEIN: Correct.

CHAIRMAN ZIEMER: Okay. Other comments on this or any recommendations?

DR. McKEEL: Dr. Ziemer.

CHAIRMAN ZIEMER: Yeah.

DR. McKEEL: This is Dan McKeel again. For clarity, would someone please explain what is the rationale for suggesting that the new column data, .405 rads per year and .0224 rads per year, is more correct than, say, NIOSH 1, which is twice as high, .807 for hands and forearms versus .405, and rest of body .0463 versus .224? I mean, you know, for most scientists, it does not make sense

for --

CHAIRMAN ZIEMER: I guess I'll have to ask Dave to comment on that.

DR. McKEEL: -- is that two calculations one year apart, 2014 and 2015, differ by, you know, NIOSH 2, .0264 and .0147? This differs by four and three hundred percent.

CHAIRMAN ZIEMER: Right.

DR. McKEEL: I don't understand that.

CHAIRMAN ZIEMER: Yeah. I'm saying, Dave, maybe you can comment on what is different there.

MR. ALLEN: Yeah, I think I can comment on that. If you look at NIOSH 1 and SC&A 1 on there, both of those were using that 30-hour continuous irradiation approximation. Essentially, that is an approximation that, I think, SC&A came up with originally and thought it was definitely a simplifying approximation. And thought it was -- knew it was bounding.

I don't think any of us realized how

bounding it was. After those two numbers came up, I came up with this intermittent exposure algorithm and ran that through the numbers to see just what the effect of an exposure for so long followed by changing film, et cetera, then followed by exposure, this intermittent exposure.

And the results you see from that are SC&A 2 and NIOSH 2. That essentially shows you that that simplifying approximation actually ends up being quite a large overestimate that I don't think any of us realized just how much we were overestimating using that.

DR. McKEEL: Well, Dave, I understand that. This is Dan McKeel again. I do understand that and I do understand what I wrote to myself as I was reading a 30-hour continuous exposure, that I would say that that was a totally implausible thing to assume from the outset.

But, in any case, what I'm still asking you is, in the finding that SC&A, Finding 6, SC&A's proposing that you adopt the new data in the sixth

column of that table, .405 and .224. And I guess what I'm trying to figure out is just do you -- I mean, the bottom line is, do you accept that as the most accurate among all those numbers they have?

MR. ALLEN: Among all those numbers, yes I do. The lower numbers were based on assuming that ten percent of the marked up castings were for long shots. I think they've made a reasonable case as to more defects occurring in the long shots. Therefore, it should be a bigger number than ten percent.

And I think he came up with a reasonable reason it should be closer to 25 percent. Especially, the new column versus the SC&A 2 and NIOSH 2.

DR. McKEEL: So do I understand the NIOSH is recommending that new data be used?

MR. ALLEN: Yes.

DR. McKEEL: Okay, thank you.

CHAIRMAN ZIEMER: Okay. Any further comments? Board Members, any recommendations?

John.

MEMBER POSTON: Oh, I'm not sure what to recommend.

CHAIRMAN ZIEMER: Well, one possibility would be to recommend accepting this recommendation, which I think both SC&A and NIOSH have agreed that they're satisfied with, which would be the values in the last column.

MEMBER BEACH: The new values, the .405 and .224?

CHAIRMAN ZIEMER: Mm-hm.

MEMBER BEACH: Yeah, Paul. This is Josie. I would agree with that and recommend that.

CHAIRMAN ZIEMER: John, are you agreeable?

MEMBER POSTON: Yes, I'm okay with it.

CHAIRMAN ZIEMER: Okay. And I would support that as well, and we will make that our recommendation.

I want to ask Dave and Bob, are there any other issues that you're aware of? With these

four, I believe that completes the issue resolution for the matrix.

DR. ANIGSTEIN: Yes. And I also have -- I prepared a quick summary of the matrix.

CHAIRMAN ZIEMER: Yeah. We all received that. I don't think we need to go through it, because everything else would be either closed or in abeyance. And with these issues, and we would take them to the Board, but we are recommending closure on these issues, then, with those agreements.

MR. ALLEN: I'm not sure who you're asking, Paul. This is Dave. That's the way I understand it.

CHAIRMAN ZIEMER: Well, that will be our recommendation. Ted, we would bring this to the full Board at the next meeting, I believe, right?

MR. KATZ: Right, Paul. Do you need assistance from either Dave or Bob in preparing any material for that session?

CHAIRMAN ZIEMER: I'll let them know if I do. I'll go ahead and summarize our recommendations. And I guess we'll need to determine, and we can do this offline, whether you want any preliminary presentations by NIOSH and SC&A.

MR. KATZ: Right. That's my question to you, whether you will require that.

CHAIRMAN ZIEMER: I probably will.

MR. KATZ: So, I mean, I think generally what we've done is have SC&A draft that in a situation like this, where we're already long in the tooth in the issue resolution, generally speaking. NIOSH doesn't have to present unless there's -- normally NIOSH presents only if there's still some open issues. There aren't here.

CHAIRMAN ZIEMER: Okay.

MR. KATZ: So certainly, Bob, John Mauro, can work with you and prepare an SC&A presentation to cover sort of the details, and you could cover the Subcommittees.

DR. ANIGSTEIN: So it also then open or allow proceeding on a revision of the document.

MR. KATZ: Right, right. And I guess it would be good for you to hear whatever you can from Dave and Jim about their plans for that. You can make that part of your presentation.

CHAIRMAN ZIEMER: Right, right.

(Phone interruption.)

MR. KATZ: Somebody's phone is impossible. Bob?

CHAIRMAN ZIEMER: Say it again?

MR. KATZ: I think Bob's phone was --

MEMBER BEACH: It might have lost a battery or something.

MR. KATZ: Something went wrong. So, Bob, anyway we can talk to Bob offline. We don't really have to do this online with Bob to help him understand what needs to be prepared to support your presentation, Paul.

CHAIRMAN ZIEMER: Okay, okay. With that, then I think we'll adjourn the meeting. I

want to thank everybody: SC&A, NIOSH and Dr. McKeel and Mr. Ramspott for their input on this. I know the petitioners still have concerns and I'm aware of that. But hopefully we can move ahead and get some additional cases dealt with and try to bring things to closure.

MR. KATZ: Right.

CHAIRMAN ZIEMER: Thank you, everybody. And we're adjourned.

(Whereupon, the above-entitled matter was concluded at 4:42 p.m.)