

THE U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES  
PUBLIC HEALTH SERVICE  
CENTERS FOR DISEASE CONTROL AND PREVENTION  
NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH

convenes the

WORKGROUP MEETING

ADVISORY BOARD ON

RADIATION AND WORKER HEALTH

The verbatim transcript of the Meeting of the  
Advisory Board on Radiation and Worker Health  
Workgroup held in Cincinnati, Ohio, on Aug. 4, 2005.

C O N T E N T S

Aug. 4, 2005

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### TRANSCRIPT LEGEND

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-- (sic) denotes an incorrect usage or pronunciation of a word which is transcribed in its original form as reported.

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-- "uh-huh" represents an affirmative response, and "uh-uh" represents a negative response.

-- "\*" denotes a spelling based on phonetics, without reference available.

-- (inaudible)/ (unintelligible) signifies speaker failure, usually failure to use a microphone.

In the following transcript (off microphone) refers to microphone malfunction or speaker's neglect to depress "on" button.

**P A R T I C I P A N T S**

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

(9:30 a.m.)

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(Technical difficulties occasionally rendered portions of comments made by a speaker unintelligible. Those portions are noted as such.)

**DR. WADE:** With apologies for the lateness of the hour in terms of getting started, but we had technical difficulties, this is Lew Wade. I work for NIOSH. I also serve as the Designated Federal Official of the Advisory Board on Radiation and Worker Health. This is a working group meeting of the Advisory Board. This working group meeting specifically is looking at issues related to the Mallinckrodt site profile and the review of that site profile by the Board and the Board's contractor, SC&A. I would also remind all of you that there is also an SEC petition before the Board that relates to workers at Mallinckrodt. This working group is looking specifically at the site profile, but clearly there are interactions between the two processes as they go on.

1           The Board asked this working group to get  
2           together and it also asked that we conduct the  
3           working group meeting as a public meeting, so  
4           we've noticed this working group meeting. The  
5           public has been invited. There will be no  
6           public comment period scheduled during this  
7           working group meeting. The public is allowed  
8           to listen to these deliberations.

9           The Board did make it a point to say that the  
10          petitioners involved in the Mallinckrodt SEC  
11          petition be invited to participate fully in  
12          this working group, and I see that Denise Brock  
13          is with us. Denise, you only need to let us  
14          know of your interest to speak at any point and  
15          you can speak. You're also welcome at the  
16          table, but I think you're more comfortable --  
17          at least you identified you're more comfortable  
18          where you are.

19          The working group that has been put together  
20          for this consists of Dr. Melius, Mark Griffon,  
21          Wanda and Mike Gibson, who is not here.

22          **MR. GIBSON:** I'm on the phone.

23          **DR. WADE:** Oh, Mark -- Mike is with us.

24          Welcome.

25          It is important that in the conduct of this

1           business there not be a quorum of the Board  
2           present, so I would certainly ask when we go  
3           around that all Board members identify  
4           themselves so that we can police this action  
5           relative to there being a quorum. A quorum  
6           would be six or more Board members. I'm  
7           operating on the assumption that we will not  
8           have that quorum.

9           Now Ray Green could not be with us to -- to  
10          transcribe and produce minutes of this, but his  
11          colleague, Jonica Mueller, is with us and will  
12          ably fill in for Ray.

13          I don't think there's anything else other than  
14          for us to go around and identify ourselves. I  
15          would certainly ask that any Board member, any  
16          representative of SC&A, any representative of  
17          the Federal government identify themselves.  
18          Members of the public are free to identify  
19          themselves or not, as they see fit. But again,  
20          it is terribly important that any Board member  
21          identify themselves, so let's go around this  
22          table. Then we'll do the people in this room,  
23          then we'll do the people on the telephone.  
24          Again, my name is Lew Wade. I work for NIOSH  
25          and serve the Advisory Board.





1 Federal government?

2 (No responses)

3 Anyone else who would like to identify  
4 themselves?

5 **MR. MILLER:** Richard Miller of the Government  
6 Accountability Project.

7 **DR. WADE:** Welcome, Richard. Anyone else?

8 (No responses)

9 Okay, before I turn it over to Mark, just to  
10 sort of put this in context, the Board had laid  
11 out a very specific procedure for this working  
12 group to follow. It included the working group  
13 meeting sometime between July 31st and August  
14 8th. This is that meeting.

15 There is the expectation that SC&A would review  
16 the NIOSH materials presented at this meeting  
17 and would prepare a response to the Board by  
18 August the 16th in anticipation of the Board  
19 meeting scheduled for the end of August.

20 Mark, those are all the introductory comments I  
21 have. Please...

22 **MR. GRIFFON:** My -- my piece here'll be pretty  
23 short, Jim. I -- I think we should -- we  
24 passed around -- I don't know if you got a copy  
25 of this, Denise, but it's the document

1 generated at the last Board meeting -- the  
2 priority issues for demonstrating feasibility  
3 of dose reconstruction for Mallinckrodt. And  
4 there's a list of tasks, and I thought that  
5 probably the best way to work through this is  
6 to start on this list of tasks and have NIOSH  
7 present their materials for each item. And  
8 maybe, if it's okay with -- with -- with NIOSH,  
9 with Jim, I think we'd like to keep it fairly  
10 informal so that we can break in with questions  
11 during your presentation instead of holding  
12 them off until the end or something. I think  
13 it'd be better -- I think it would, you know,  
14 be more workable if we could just interact  
15 while you're presenting. So if that's okay,  
16 I'll turn it over to Jim and let you start with  
17 number one.

18 **DR. NETON:** Okay, thanks -- thanks, Mark. I --  
19 I really -- since this was in the format of a  
20 working group, I really did not prepare any  
21 official Power Point type presentations, but  
22 I'd just like to continue on the conversation  
23 we had at the last working group meeting which  
24 was held by telephone. I think it was -- time  
25 -- time flies. I think it was last week, some

1 -- somewhere thereabouts.

2 Since that -- that meeting, we have distributed  
3 a number of what we're calling our -- our in-  
4 process work products and, you know, we -- we  
5 sent them to the Board and other interested  
6 parties as -- as they were available, so  
7 hopefully folks have had a chance to look at  
8 those documents and formulate some -- some  
9 rough opinion as to whether they're in  
10 agreement or disagreement with -- with where  
11 we're headed.

12 The first -- the first issue on the table is  
13 under item 1(a), the handling of raffinate  
14 exposures where NIOSH has specified the  
15 radionuclide ratios for ore processing,  
16 including non-pitchblende ores. That was  
17 substantially covered, to a large extent, in  
18 the document that was distributed entitled --  
19 let me see if I can -- yeah, it was a 23-page  
20 document. It was entitled "Dose Reconstruction  
21 Approach for Mallinckrodt Uranium Process  
22 Residues".

23 **DR. WADE:** And we have copies of all these  
24 documents if anyone requires them.

25 **DR. NETON:** Yeah, there are copies at the back

1 table available for members of the public and I  
2 have brought extra copies of everything for  
3 people at the -- at the working group table if  
4 they don't have them with them.

5 Let me just see -- I also have it on my laptop  
6 here. I can bring it up if we get to any  
7 specific sections that people want to discuss.  
8 What was the title of that again, Wanda, "Dose  
9 Reconstruction Approach" -- I made -- okay, I  
10 made a PDF file out of it, that's where it is.  
11 Okay, I'll just bring that up and -- there is a  
12 slightly revised version of this that you don't  
13 have, but -- but in essence it was just  
14 corrections of some typographical errors and  
15 that sort of thing, which did not change any of  
16 the -- substantially any of the technical  
17 content.

18 But in that document I think you would have  
19 seen that our approach at -- at this time is to  
20 rely on the radon breath data for workers to  
21 establish the radium intakes for workers. And  
22 then subsequent to radium in the decay series,  
23 we would apply the ratios that were observed in  
24 the K-65 material stored in Silo One at the  
25 Fernald site. There is some -- some discussion

1           in the document that we distributed that --  
2           that leads us to believe that that material is  
3           -- is representative -- it is the material that  
4           was collected at Mallinckrodt, whether it came  
5           from Mallinckrodt directly to Fernald or via a  
6           temporary storage at the Lake Ontario Ordnance  
7           Works, they are actually the K-65 materials  
8           that were collected. You know, we're not  
9           stating that the absolute concentrations are to  
10          be used, but really we're relying on the ratios  
11          of the progeny in those -- in those materials,  
12          in the K-65.

13          But to take a step backwards again, we are --  
14          rather than using the ratio that was proposed  
15          of 100 to one in the profile to bracket the  
16          radium to uranium ratio for workers with K-65  
17          material, we have gone through -- evaluated the  
18          data and we believe that the radium breath data  
19          provide more realistic bounding values for  
20          intakes of radium at the site than applying a  
21          ratio of 100 to one. There's a couple of  
22          reasons for this, and I'll just throw this out  
23          here and we can open it up for discussion, I  
24          suppose.

25          But the -- it became obvious in looking at many

1 of these dose reconstructions -- not many, you  
2 know, looking at the dose reconstructions that  
3 the workers themselves were not only exposed to  
4 K-65 material. So you know, it would be  
5 inappropriate, for instance, to have a worker  
6 who -- who worked with uranium -- pure uranium  
7 materials and then K-65, to apply this 100 to  
8 one ratio because many workers were rotated  
9 throughout the plant in the attempt to keep the  
10 -- their exposures below certain standards, and  
11 the K-65 material had very high -- high dose  
12 rates so the workers were rotated through. So  
13 we -- we believe that just taking the uranium  
14 intake for a worker and then multiplying it  
15 times 100 results in fairly -- fairly  
16 substantial intakes that are actually not borne  
17 out by looking at the air monitoring data  
18 themselves.

19 For example, if you look at an intake of a  
20 worker using bioassay data, in the first one --  
21 and Joe Guido will talk about this later -- his  
22 intake in picocuries per day actually about  
23 equals what the intake was predicted based on  
24 air sample data, within -- within the realm of  
25 what I showed at the last Board meeting, that -

1           - you know, the air sample data somewhat  
2           indicates that possibly the person had no K-65  
3           exposure at all. So to take that intake, which  
4           is -- which is equivalent to the K-6-- which is  
5           equivalent to the air monitoring data and then  
6           increase it by a factor of 100 for the radium  
7           progeny puts it above where you would expect  
8           any intakes from U in the in-plant air  
9           monitoring data. So that's one reason.

10          The second reason, more importantly I think, is  
11          that the K-65 -- the radon breath data are more  
12          -- we believe to be more representative of  
13          reality. It's a -- it's a bioassay measurement  
14          taken on an individual. It's not reliant upon  
15          air concentration data. So that's where we're  
16          at with that.

17          Now we would propose, however, once you get the  
18          radium intakes based on the K-6-- based on the  
19          radium breath, then we still need to apply the  
20          dose fractions from the progeny below radium.  
21          And those fractions would be based on the ratio  
22          of radium to progeny in the K-65 material at  
23          Fernald. So that's where we're at.

24          It's open to discussion, I suppose.

25          **DR. MAURO:** This is John Mauro. First of all,

1 I really appreciate all the material that you  
2 provided to us prior to this meeting, and Arjun  
3 and I and the other folks on the line, Joyce  
4 and Hans, have all had an opportunity to fairly  
5 quickly run through the material within the  
6 context of all the material that came before.  
7 It's been extremely helpful and I really  
8 appreciate the incredible amount of work that  
9 went in.

10 What -- what we have been doing is caucusing  
11 over the past several days and formulating,  
12 certainly just as (unintelligible) in a  
13 situation where they're still formulating and  
14 finalizing (unintelligible) and we're doing the  
15 same. And there are a number of areas where I  
16 think that, for the purpose of this meeting, it  
17 would be helpful to make a distinction between  
18 those areas where you have laid out a strategy  
19 for coming to grips with what I would call site  
20 profile type questions. Here we have certain  
21 data -- in fact, here we have lots of data, and  
22 here's how we plan on prioritizing or combining  
23 and using and -- these data in order to do the  
24 dose reconstruction for a particular worker  
25 where you may have some missing data.

1 My initial impression -- and I'm going to work  
2 through -- I'm -- these are really by way of  
3 introductory remarks and (unintelligible) to  
4 Arjun, who's really been our point man, to help  
5 in an appropriate way to start to engage some  
6 of these issues as we move through them. So I  
7 thought it'd be worthwhile, if it's acceptable  
8 to the Board, that as we move through the  
9 processes we could (unintelligible) -- could  
10 communicate our initial impressions and the  
11 things that we've been thinking about, with the  
12 objective of forwarding the process so we're as  
13 mature down the road as we can as we approach  
14 the end of August.

15 One of the things that I think might be very  
16 helpful today is as we go over some of our  
17 observations and thoughts on some of the  
18 matters, such as the ones you just described,  
19 it might be important -- to the degree we can -  
20 - to parse between those areas where our  
21 concern is with the data itself and its  
22 adequacy, because we recognize that the data  
23 itself and its ability to completely  
24 characterize or to be useful as a surrogate or  
25 as a cohort data for the purpose of dose

1 reconstruction, that goes toward issues that  
2 are of concern from an SEC point of view -- we  
3 recognize that's part of what's on the table  
4 here -- and those items that lean more toward  
5 what I call site profile issues where you might  
6 -- where you may have lots of data, but we may  
7 have certain questions as to how you would use  
8 that data in the -- in the most claimant-  
9 favorable optimal way.

10 So what we would like to do, and I'm going to I  
11 guess leave it to everyone around the table,  
12 when would it be appropriate for SC&A to say  
13 okay (unintelligible) -- for example, put  
14 forward certain ideas and strategies where we  
15 sort of come out right now and our thinking on  
16 it so that is a -- that is a prerequisite. I'm  
17 going to ask Arjun, and certainly the folks  
18 that are on the phone, which I believe is Joyce  
19 and Hans, Joyce looking mainly at the internal  
20 dosimetry issue, the radon issue, the raffinate  
21 issues and the strategies that you are engaging  
22 in, and Hans looking more toward some of the  
23 external dosimetry issues as being the areas  
24 where (unintelligible) us communicating to you  
25 our initial impressions so that we can move on

1 from there.

2 So with that said, I guess -- Arjun, at this  
3 point if there's anything that you want to  
4 bring in or -- or I didn't want to interfere --

5 **MR. GRIFFON:** No, no, no.

6 **DR. MAURO:** When I get this dialogue, I  
7 (unintelligible).

8 **MR. GRIFFON:** Yeah, I mean I -- I expect this  
9 to be pretty informal, so as you have comments  
10 I think just bring them in and bring your  
11 general opinion of a certain issue any time --  
12 you know, any time it comes up. I mean let's  
13 just have a form-- informal discussion. I mean  
14 I -- I was going to ask, you know, Jim, that --  
15 that covers number one. But if we start to go  
16 down 1(a), (b), (c) --

17 **DR. NETON:** Right.

18 **MR. GRIFFON:** -- I think we'll -- we'll pull  
19 out some of these details that -- that we know  
20 are in this report. And I think most -- mostly  
21 what we discuss in this report, you know --

22 **DR. NETON:** Yeah, sure.

23 **MR. GRIFFON:** -- go down these questions, so  
24 Denise has a comment, though.

25 **MS. BROCK:** (Off microphone) I have a question

1 already and I don't want to bog everybody down.  
2 I feel funny asking questions but sometimes I  
3 just don't understand (unintelligible) and I  
4 can't tell (unintelligible) that's why I'm  
5 confused (unintelligible) daily weighted  
6 averages (unintelligible) going to use the  
7 daily weighted averages (unintelligible) radon  
8 (unintelligible) things right.

9 **DR. NETON:** Right, the daily weighted average  
10 values are the air sample data that were  
11 collected in the campaigns on a yearly basis,  
12 usually over a couple of month period. We  
13 believe that the radon breath data are a better  
14 indicator of the intake of radium for the  
15 worker than relying solely on the daily  
16 weighted average.

17 **MS. BROCK:** Isn't that a little bit different  
18 than what you had previously thought at the  
19 last meeting?

20 **DR. NETON:** That's true. That's true that we -  
21 - we had proposed, as a -- as a bracketing  
22 measure, we would rely on the daily weighted  
23 averages. Those still are there. We don't  
24 believe them to be totally unreliable. We just  
25 believe that this approach is -- is a better --

1 a bit more refined estimate.

2 **MS. BROCK:** Then I guess I'm -- I wanted to ask  
3 about the SEC evaluation then. Is that a  
4 living document as well as the site profile? I  
5 mean can it be --

6 **DR. NETON:** I believe Larry or Lew could --

7 **MS. BROCK:** -- altered and changed like this?

8 **DR. NETON:** That's more of a --

9 **DR. WADE:** (Unintelligible) speak to that?

10 **MR. GRIFFON:** Larry.

11 **MR. ELLIOTT:** The -- as -- as you know, Denise,  
12 we have provided supplements in response to  
13 issues raised during Board deliberations on the  
14 evaluation report. And I would see that in  
15 this case we will add another supplement  
16 responding to, again, another set of issues  
17 that have been raised. So is it a living  
18 document? This is a deliberation process that  
19 the Board is engaged in. And as we proceed  
20 through that, the evaluation report will have  
21 to be reflective of that process. I don't know  
22 that we have envisioned evaluation reports to  
23 be living documents, as we speak about site  
24 profiles being living documents, because as we  
25 work through dose reconstruction we identify

1 improvements to methodologies, data  
2 information, the site profiles do change. The  
3 evaluation reports are different in that as  
4 soon as a determination is made about a  
5 petition, then that establishes the conclusion  
6 of the evaluation. Does that help you  
7 understand?

8 **MS. BROCK:** I -- I understand what you are  
9 saying, but I'm perplexed because I -- my  
10 thought, and I believe the claimants' thought  
11 at the last meeting, was that NIOSH was going  
12 to use the daily weighted average and basically  
13 the proof is in the pudding, you can use the  
14 daily weighted average. And then I'm wondering  
15 what caused you to eliminate that. I know you  
16 feel the breath radon is more reliable, but  
17 isn't there only a minimal amount of claimants  
18 that actually had breath radon? I mean how  
19 reliable is that?

20 **DR. NETON:** Well, we -- we estimate around 20  
21 percent of the cases that we have in our  
22 possession where people worked during the  
23 raffinate period have radon breath data. We've  
24 looked at the files, and each -- each person  
25 who has radon breath data, and we have radon

1           breath data for 2,500 individual measurements,  
2           each -- each measurement is -- not all of them,  
3           but almost all of them are labeled with the job  
4           category, title, some indications of what the  
5           process was that the worker was involved --  
6           what the worker was involved in. They are  
7           almost exclusively -- not exclusively, but to a  
8           large extent related to raffinate type workers,  
9           people who worked in Plant 6 with radium-  
10          bearing materials. But we believe that the  
11          samples that were taken were taken on the  
12          target population that were potentially  
13          exposed. I've looked personally through the  
14          files of the cases we have that are not -- do  
15          not have radon breath data. Many of them are  
16          workers such as administrative folks, security  
17          folks, forklift operators. One could argue  
18          whether that should have been monitored or not,  
19          but it makes some sense to us, looking at the  
20          files, of who was monitored for radon breath  
21          and why. And there are actually internal HASL  
22          -- letters to HASL back and forth discussing,  
23          you know, which -- which types of workers would  
24          be monitored and put on the monitoring program.  
25          **MR. ELLIOTT:** I think it's important for us all

1           to recall, if your question comes from the  
2           perspective of your petition, that the class  
3           that you have petitioned for here is -- the  
4           petition is evaluated under our -- our rule,  
5           the SEC petitioning process rule. And in that  
6           rule we are required to demonstrate where we  
7           can do dose reconstruction by capping the dose.  
8           And the particular question at hand with regard  
9           to how we go about doing that, whether it's  
10          using breath radon or whether it's using time-  
11          weighted average air concentration data really  
12          goes to dose reconstruction. We've -- we have  
13          demonstrated, we feel, in our evaluation  
14          reports and the supplements to that original  
15          evaluation report we've been consistent in our  
16          commentary saying we feel we can reconstruct  
17          dose. And I think as we would have proceeded  
18          in doing dose reconstructions, we would have  
19          achieved some of these recognitions that Jim is  
20          bringing forward now as part of this  
21          deliberative process of the Board.

22          **DR. NETON:** I think this gets down to what John  
23          Mauro was talking about earlier, which is --  
24          which is related to -- in an SEC evaluation one  
25          is -- one is trying to make the determination

1           can you bound the doses using -- you have  
2           sufficient data available to bound doses, and -  
3           - and that's one analysis.

4           Now when we get down into actually doing dose  
5           reconstructions where we are now, that's a  
6           slightly different issue as to how best to use  
7           the available data to make a more realistic  
8           determination of what the -- you know, what the  
9           individual doses are to work with. So that  
10          they're actually separate analyses. They  
11          really are.

12         **MR. GRIFFON:** Yes, but -- but -- but it is also  
13         important to note that -- I mean we went down  
14         this line of questioning for you to demonstrate  
15         that you could do it with your method at hand  
16         from the daily weighted averages. You were --  
17         you were questioned by the Board to go back and  
18         look and give us specifics of how you were  
19         going to deal with the raffinate in terms of  
20         the daily weighted averages and -- and  
21         demonstrate to the Board that you could --  
22         could cap the dose, bound the dose. And what -  
23         - the answer you came back with was a little  
24         bit --

25         **DR. NETON:** Right.

1           **MR. GRIFFON:** -- on the other side, so that --  
2           that -- I think that's (unintelligible) --

3           **DR. NETON:** Yeah, I understand the  
4           (unintelligible) --

5           **MS. BROCK:** That's --

6           **MR. GRIFFON:** -- it seems like a -- I mean  
7           maybe you can still answer that first question,  
8           can you bound the dose with the air sampling.  
9           I think you're saying maybe --

10          **MS. BLOOM:** And maybe --

11          **MR. GRIFFON:** -- (unintelligible) we can, this  
12          is a better estimating technique I think is  
13          where you're going.

14          **DR. NETON:** I think that's what I'm saying  
15          is...

16          **MS. BROCK:** And that's exactly where I was  
17          going with that. It was my understanding, just  
18          as a lay person and somebody that petitioned  
19          this, that it was my understanding that you  
20          were going in front of the Board to show them  
21          that you could do it with a daily weighted  
22          average. And I personally don't really know --  
23          I don't understand completely the difference  
24          between that, but I was curious what -- what  
25          specifically will not allow you to use that

1           daily weighted average. And as a petitioner  
2           I'm thinking to myself, since you haven't been  
3           able to do that and now you're switching gears  
4           -- at least in my mind that's what it looks  
5           like -- and you're trying something else, has  
6           this been validated? I mean how do we know  
7           that this is going to work and how do we know  
8           exactly if this is going to work or not. How  
9           do we -- how do we tell the difference and --  
10          and I thought that we would be held to the  
11          daily weighted average, or you would be.

12          **MS. BLOOM:** Maybe -- maybe I could answer  
13          that. I was -- I'm Cindy Bloom and I was  
14          brought in at the last minute to answer that  
15          question.

16          Can you hear me if I turn my head?

17          (Off microphone) And when I started from the  
18          list of priority items to answer, and  
19          (unintelligible) the list that I read down and  
20          the first thing it said is can you tell me  
21          what's in the residue. And I'm going to call  
22          it the residue, the K-65 (unintelligible) not  
23          as raffinate but as K-65 or residue. And  
24          that's so (unintelligible). So first they  
25          answered that question. And as you look down

1           that list of questions you'll see that it says  
2           how are you going to do a dose reconstruction.  
3           And so I looked at all the data and I did look  
4           at the air data, and I did both a -- a fit of  
5           the tabulated data in the CER database and  
6           looked at the daily weighted averages there and  
7           I determined a geometric mean to those. I also  
8           looked at the maximum number or the maximum  
9           time-weighted average exposure in that dataset  
10          and I compared that to other (unintelligible)  
11          data. And some of that's in the -- in the  
12          report that we pulled together. Some of it may  
13          have been updated (unintelligible), but I did  
14          look at that part of the picture.  
15          But then it (unintelligible) here's the breath  
16          radon and I looked at that, and we have a lot  
17          of breath radon data, and so I went that route  
18          and I said you know what, this number is making  
19          more sense.  
20          I also looked at some of the workplace samples,  
21          which we don't have many, but we have one set  
22          of data from Mallinckrodt. We have data from  
23          another similar operation at (unintelligible)  
24          it's not a factor. Depends on (unintelligible)  
25          the radium measurement in air versus the

1 uranium measurement in air for the  
2 (unintelligible) cake operation at Mallinckrodt  
3 where they (unintelligible) residue sampling  
4 and where they were doing (unintelligible) and  
5 I looked at that and I looked at the ratios  
6 there, and they were more consistent -- the air  
7 sampling was more consistent with the breath  
8 radon ratios that we looked at -- the breath  
9 radon (unintelligible) radium 95th percentile,  
10 so it gets hard 'cause you're talking about  
11 these huge groups of data so I hope I'm making  
12 sense, but that fit with the air data that fit  
13 with what we were looking at in terms of that  
14 maximum daily weighted average. But if you  
15 applied the K-65 fraction itself from the  
16 (unintelligible) to -- let's see, we were  
17 actually doing it backwards to start to see if  
18 that was all radium. It doesn't make sense  
19 when you look at the workplace data and the  
20 other information, but you could do that and  
21 we've put some information together on that, as  
22 well. So we've looked at it all, but we're  
23 really trying to answer two questions. Can we  
24 bound the dose? I think so. Can we -- how are  
25 we going to do dose reconstruction? I think

1           that after looking at all the data that  
2           (unintelligible) clear to me that you would use  
3           the bioassay data and (unintelligible) 42 CFR  
4           (unintelligible) --

5           **DR. NETON:** 42.

6           **MS. BLOOM:** -- 42 -- 42. So it -- that says  
7           you'll use bioassay data as -- as your first  
8           piece of information, but you also look at  
9           everything else. So we've really taken the  
10          opportunity to look at all the data and  
11          (unintelligible) really tired (unintelligible).

12          **MR. GRIFFON:** Let me ask John to comment  
13          (unintelligible).

14          **DR. MAURO:** One of the impressions I got, and I  
15          would ask Arjun to develop it in a finer point,  
16          but it's a conceptual problem that we have. I  
17          understand -- you've created a series of what I  
18          call boxes whereby you have labels for job  
19          categories. You have labels for locations in  
20          buildings and facilities within buildings. And  
21          according to each of these designations, you  
22          have a fairly good idea of the types of  
23          activities that took place in each of these  
24          locations as a function of time. And on the  
25          basis of that, you could start to get a feel

1           for what datasets and information might be most  
2           useful for reconstructing doses -- I'll say  
3           internal doses in this case -- to workers who  
4           were in that location at that time. It's a  
5           very structured process and it's a -- it's very  
6           engineered and it's a -- it's almost -- it's  
7           almost like an assembly line. But when I read  
8           the documents I say that the lines -- when it  
9           comes to a real person now, and this is -- this  
10          is more of a conceptual problem -- I say okay,  
11          well, let's say we have a real person and we're  
12          trying to do a dose reconstruction for him.  
13          The problem is that that real person doesn't  
14          really fall into a given box. Not always, and  
15          maybe not often. That is, where he worked  
16          when, and certainly the feedback is not all  
17          that apparent. And so all of a sudden -- and -  
18          - and it's -- it's almost like a fuzzy view I'd  
19          have right now. I say to myself okay, I've got  
20          this person. I -- I know he did these kinds of  
21          jobs and might have been over here sometime and  
22          might have been over there, and then I layer in  
23          that fact that -- and I think of this in terms  
24          of bands. You have people that worked at  
25          certain times with the ore, maybe. And then

1           you have people that worked with different  
2           kinds of ore. Then you worked with the -- I  
3           guess the -- the first dissolution process.  
4           That is another band where you produce the K-  
5           65. Then there's another band of activities  
6           where maybe some different facility or a  
7           different time where the product that comes out  
8           is more of the short-lived progeny coming off  
9           the uranium. And then another band is where  
10          you're actually processing the recycled  
11          residue. So what I'm getting at is all of  
12          these are a flow that placing them in time and  
13          location and -- and marrying it back to a  
14          person. Then on top of that you have an array  
15          of data, lots of data, which is -- it's great,  
16          whereby you've got urine analysis with  
17          fluorometrics for uranium, you've got ratios  
18          that you have a handle on, at least for the  
19          radium to uranium that comes from the K-65.  
20          But then you've got these other ratios where  
21          you have these other short-lived radionuclides  
22          that come out of different bands in the  
23          process. What I'm getting at is -- and this is  
24          an impression initially obtaining and looking  
25          at the data.

1 (The reader should be aware that in addition to  
2 technical malfunctions in the telephone  
3 connections, there were other conversations  
4 taking place on the line at the same time the  
5 speaker was making his statement, which may  
6 have distorted the reporter's perception of  
7 what was being said.)

8 It's not -- it's going to be difficult to place  
9 a person (unintelligible) this person at this  
10 place and this time, and this is the situation.  
11 And on that basis, we think the radon breath  
12 analysis is the best way to get a handle on  
13 what his radium body burden may be, as opposed  
14 to going with his urine analysis and using some  
15 ratio, whether it's 100 to one or 400 to one,  
16 as we -- so what I'm getting at is that we have  
17 -- what I -- and this again -- stepping back  
18 and I would look to others in our group who've  
19 been looking at this a lot closer -- that the  
20 boundaries are not that clear, so that in  
21 practice, when you really have a real person  
22 that you want to do a real dose reconstruction  
23 for, you're going to run into the blurry lines  
24 between the different operations and activities  
25 that you're going to have a hard time coming to

1 grips with.

2 **MS. BLOOM:** John, I think we've looked at that  
3 and we've got some real cases to show you later  
4 to see how that plays out. I think that  
5 because of the way we do dose reconstruction on  
6 this project, the results are interesting. I  
7 think in general the coworker approach bounds  
8 things -- bounds doses, but we have individual  
9 data, we would use individual data first to  
10 address those kind of issues, and we'd use the  
11 other data to supplement it. But I think  
12 later, as we get into those cases, that would  
13 be a better time to -- to discuss that part of  
14 the process.

15 **DR. NETON:** Yeah, I think we're getting ahead a  
16 little bit on the issue. But if you look at  
17 the -- what was broken down for the internal  
18 dosimetry geometry calculations, 30 percent of  
19 -- 37 percent of the cases we have have job  
20 occupation listed as "operator". It's pretty  
21 easy to agree, I think, that those operators,  
22 if they worked in Plant 6, are covered with  
23 this K-65 raffinate exposure methodology.  
24 You've got another 20 percent that are trades  
25 and crafts, so about 57 percent of the workers,

1           in our minds, fall very easily into these  
2           categories where if -- lacking any specific  
3           evidence that they -- that they weren't  
4           exposed, that they would fall under the  
5           umbrella of this K-65 raffinate exposure  
6           approach.

7           That said, remember we have a large percentage  
8           --

9           **UNIDENTIFIED:** (On telephone) Hello?

10          **DR. NETON:** -- of workers have bioassay data.  
11          Hello? Is that Joyce?

12          **DR. LIPSZTEIN:** Hello?

13          **DR. NETON:** Yeah. Joyce, this is Jim Neton.  
14          How are you? I don't think she can hear us.  
15          Well, anyway, I was just going to say -- and  
16          so, you know, we propose -- and we'll get into  
17          this -- that we're going to apply this to a  
18          fairly large percentage of the workers and use  
19          a more -- a broader brush than -- than you  
20          would think because, again, if we don't have  
21          the specific details, operators and trades and  
22          crafts are going to fall under this umbrella.  
23          We also believe the K-65 material intake  
24          calculations are bounding for the other residue  
25          streams in Plant 6. That would be in the

1 Sperry cake and the -- the barium sulfate --  
2 and also the airport cake. There's some fairly  
3 large doses per unit intake that we'll get into  
4 that we -- we can talk about.

5 **MR. GRIFFON:** If it's okay, I was going to -- I  
6 was going to suggest why don't we get to some  
7 of those specifics now. We've got some general  
8 issues on the table and discussion items, but  
9 maybe we can start on a --

10 **DR. NETON:** Sure.

11 **MR. GRIFFON:** -- on -- and you can point to  
12 your report -- step us through it a little bit.  
13 We've all -- we've all reviewed this, but it's  
14 been kind of in a quick fashion, so it may be  
15 useful for everyone to hear. This is just the  
16 ratios that you --

17 **MR. ALLEN:** (Off microphone) (Unintelligible)

18 **MR. GRIFFON:** Uh-huh.

19 **MR. ALLEN:** (Off microphone) (Unintelligible)

20 **DR. NETON:** You need a microphone. Well, in  
21 specifics of handling --

22 **DR. WADE:** Let's just do a check. Can people  
23 on the phone hear me?

24 **UNIDENTIFIED:** Now, yes.

25 **DR. WADE:** Okay. So I mean I think it's

1           important that each of us put the mike very  
2           close and speak directly into it. Okay? Jim.

3           **DR. NETON:** Yeah. Okay --

4           **DR. WADE:** Closer. I think you need to be  
5           closer.

6           **DR. NETON:** Sorry. If -- if you look at table  
7           one on page 5 of the document that we -- you  
8           know, that we -- oh, I'm sorry, I'm working off  
9           the original -- page 4, yeah -- it specifies  
10          the ratios, and Cindy can correct me if I'm  
11          wrong, but I believe those things came -- those  
12          doc-- values came out of the K-65 silo  
13          material. Is that right? Yeah.

14          **MS. BLOOM:** They're based on that.

15          **DR. NETON:** They're based on the silo material.

16          **MS. BLOOM:** They're a little bit higher than  
17          those ratios. It's just sort of eyeballing  
18          things.

19          **DR. NETON:** Right. So --

20          **MS. BLOOM:** (Off microphone) (Unintelligible)  
21          at the ratios.

22          **DR. NETON:** So this would be the ratio that one  
23          would use, whether you -- whether you went as a  
24          multiplier of the radium to the uranium in the  
25          urine or whether we applied the radon breath

1 analyses and came up with our own independent  
2 radium intake value. Then the progeny below  
3 radium 226 then would be apportioned relative  
4 to the radium value.

5 That's what we propose to use. That was an  
6 issue on the table at the last Board meeting.  
7 I think SC&A, and correctly, identified that we  
8 did not specify in the profile exactly what  
9 ratios of the progeny -- it was clearly our  
10 intent to put progeny in there, it just wasn't  
11 specified. When we talked about the 100 to  
12 one, we were not just going to put radium in  
13 there. We understood that there were other --  
14 other progeny to include. This -- this  
15 outlines in more detail what our proposal is.

16 **UNIDENTIFIED:** (Off microphone) May I?

17 **DR. NETON:** Yeah.

18 **DR. MAKHIJANI:** This is Arjun. I'd like to ask  
19 you a question about table one. I looked at  
20 the original Silo One data, the averages, which  
21 may be the -- arguably the more -- most  
22 appropriate values. And because these numbers  
23 -- I don't know how they have been rounded or  
24 adjusted upward, but I think it will make a  
25 significant difference because in the original

1 data the -- the radium was 264 nanocuries per  
2 gram in Silo One, and thorium was 40, so the  
3 ratio is about 6.5, so thorium to rad-- thorium  
4 to radium is bigger, one to 6.5, than what you  
5 have here, one to eight.

6 And -- and similarly, the protactinium and  
7 actinium are bigger ratios to radium than what  
8 you have here, which is one to 80 and, as I  
9 have them, they're also like one to -- one to  
10 65. And the reason I bring that up, although  
11 it appears to be a minor problem, is that -- at  
12 least by my back-of-the-envelope calculations,  
13 just reviewing your document -- the dose to the  
14 systemic organs will be dominated by thorium,  
15 protactinium and actinium. And so small  
16 differences in these ratios will make a pretty  
17 big difference, so you have to have some  
18 demonstrable way to show that the ratios are  
19 claimant-favorable in terms of maximizing the  
20 thorium, actinium and protactinium.

21 **MS. BLOOM:** There -- there was no intention  
22 that these numbers be taken as the final  
23 numbers. We were working really, really  
24 quickly to get something out that you could all  
25 look at --

1           **DR. NETON:** Right.

2           **MS. BLOOM:** -- and to try and just make the  
3 numbers simple. But I think that's a good  
4 comment, that -- that you want to look at  
5 exactly what is in that source term. We looked  
6 at other -- you know, this is the K-65  
7 information. Barium sulfate that they -- they  
8 didn't always process Q-11, the African  
9 pitchblende ores, there. They processed a lot  
10 of other things. So these -- these relative to  
11 uranium are going to be inflated anyway. A lot  
12 of the other material that was processed were  
13 concentrates, which would not have had the  
14 radium in it, and probably would have less of  
15 the other progeny in it, as well. So --

16           **DR. NETON:** Right.

17           **MS. BLOOM:** -- this is just...

18           **DR. NETON:** Yeah.

19           **MS. BLOOM:** The details, certainly we'll take  
20 comments on those and -- and by the time we  
21 turn this out as a final product, it will  
22 hopefully be --

23           **DR. NETON:** I'd like to take a step backwards,  
24 though, and explore the -- the issue of using  
25 the Fernald data. I mean that -- that, to me,

1           was not a foregone conclusion. It was  
2           discussed in some detail, maybe a little detail  
3           at the Board meeting and -- and we indicated  
4           that -- I mean I think Arjun even supported the  
5           fact that we'd go down that path. Now that  
6           we've done that, I guess I'd just like to get  
7           the sense from the working group at least, does  
8           that seem to be a reasonable approach -- and in  
9           SC&A's opinion, as well -- that -- is this --  
10          is this, you know, something that -- that this  
11          is reasonable?

12         **MR. GRIFFON:** (Off microphone) Arjun's got...

13         **DR. MAKHIJANI:** Yeah, this is Arjun. I think  
14          the Fernald K-65 data are a very good starting  
15          point. And then you've taken them in a -- one  
16          direction by doing radon breath data, but I  
17          think -- I think one of the really good things  
18          about this document that you sent us is the --  
19          is the flow sheets. And it's clear that most  
20          of the radium goes away in the first step, so  
21          most of the radium winds up in -- in the K-65,  
22          and so the ratios of thorium to radium are  
23          lower in the K-65 than they are in the steps  
24          where most of the thorium was precipitated out  
25          -- or protactinium or actinium. So I -- I

1 think this problem that I was mentioning is  
2 actually going to be accentuated since you're  
3 using radon breath to determine radium and then  
4 applying the K-65 ratios to that. Whereas in  
5 other areas of the plant where you have the  
6 radium mostly gone, you would have bigger  
7 ratios of thorium, protactinium and actinium to  
8 radium. And there doesn't seem to be a good  
9 way to determine those ratios based on the K-65  
10 silos. There may be other measurements, and I  
11 haven't -- you know, there -- I know there are  
12 some other ratios in here, but I haven't had  
13 time to actually figure out whether -- you  
14 know, how they've been done and whether they  
15 are appropriately claimant-favorable or what  
16 data they're based on and so on. But I think  
17 it'll make a big difference.

18 **DR. MAURO:** I'm sorry to interrupt -- this is  
19 John again. I do have a question, which is a  
20 simpler question which I wasn't quite sure of.  
21 As I understand it, the ra-- in order to  
22 determine the body burden of radium, sounds  
23 like the emphasis is going to be placed on the  
24 data that you have from the radon breath  
25 analysis. But at the same time, I look at this

1           table one and I see that you have this 400 to  
2           one ratio of uranium to radium -- or radium to  
3           uranium, and it seems to me that what we have  
4           here is two different strategies for coming up  
5           with what might be the radium intake --

6           **DR. NETON:** Right.

7           **DR. MAURO:** -- that a person experienced. And  
8           I'm not quite sure which one you've decided on  
9           using and under what circumstances, and which  
10          one might be more limited. Could you help me  
11          out a little bit with that?

12          **DR. NETON:** I think -- I think it depends on  
13          the individual case, but certainly if one takes  
14          -- well, in looking at the workers, we have  
15          come to the conclusion that very few workers  
16          inhaled pure residue material. So if one takes  
17          their uranium intake and multiplies it times  
18          400 to get the radium, that will give you a  
19          much higher intake of radium than we believe to  
20          be the case. And that's when -- I think I even  
21          mentioned at the Board meeting that we would  
22          use the radium -- radon breath to do some  
23          bounding, sort of sanity checks on doing so.  
24          Because one has to remember that this was a wet  
25          process, for the most part, going through. And

1 even when the residues were created, they were  
2 wet -- within the plants. So you know, the  
3 potential for airborne is -- is somewhat  
4 minimal.

5 We believe that -- and so if one takes the  
6 uranium intake, multiplies it times whatever  
7 number -- 400 -- you will start ending up  
8 getting intakes that exceed the air  
9 concentration data that we're seeing in the  
10 plant. And if you look at Table 29 in the site  
11 profile, you'll see anywhere from ten to the  
12 5th, ten to the 6th picocurie per year intakes.  
13 I think there's one or two incidences of ten to  
14 the 7th. If one comes up with an intake of  
15 uranium for a worker that is already ten to the  
16 6th, now you multiply that times 400, you end  
17 up with a couple order of magnitude higher than  
18 what would be supported by the actual air  
19 monitoring data. That's doable, and that --  
20 that is a calculation that can be done to  
21 certainly bound the dose.

22 **DR. MAURO:** That's very helpful. I did not  
23 understand that.

24 **DR. NETON:** But we believe that the better  
25 approach is to use the radon, as I indicated at

1 the Board meeting, to -- to use that to bound  
2 the intakes because we believe -- and almost  
3 any way you look at the radon breath data, it's  
4 going to be biased high. There are problems  
5 with radon breath. There was variability. The  
6 radon background in the air adds to it. The  
7 time of day when you take it, the fact that  
8 workers were not off work for a long period of  
9 time and could have been breathing radon gas  
10 that would be indicating radium body burdens is  
11 going to -- all it's going to work is creating  
12 a slightly larger body burden than you may have  
13 otherwise.

14 **DR. MAURO:** On -- on that matter --

15 **DR. WADE:** Denise, use the microphone, please.

16 **MS. BROCK:** Sorry, John. I just want to make  
17 sure I understand. If you're talking about the  
18 air, would you give the claimant the benefit of  
19 the doubt, would you count that all as uptake?  
20 Or...

21 **DR. NETON:** I'm not sure what you're asking.  
22 If -- if --

23 **MS. BROCK:** When they exhale -- if I understand  
24 this correctly, when they exhale, you're  
25 counting up that there's possibly that in the

1 air, as well. Correct? So are you --

2 **DR. NETON:** That would actually add to the --

3 **MS. BROCK:** So you will not subtract that from  
4 them. Correct? You will go ahead and count  
5 that all as uptake.

6 **DR. NETON:** Right, there's no way we would be  
7 able to subtract that.

8 **MS. BROCK:** Okay.

9 **DR. NETON:** So we would just assume that it was  
10 all -- all -- all related to radium --

11 **MS. BROCK:** Thanks.

12 **DR. NETON:** -- acquisition within the body.  
13 The other thing is when -- Cindy -- Cindy  
14 mentioned this earlier, when you take the  
15 uranium intake calculations and then use the  
16 radon breath, you end up not too far off from  
17 what the air data are telling us anyways. I  
18 mean you'll -- you'll end up in the same ball  
19 park and it -- given the uncertainties of the  
20 data, it's not -- it's not that -- it's not  
21 that we're suggesting that these intakes are an  
22 order of magnitude lower than what the air data  
23 suggests. It's that the approach that we've  
24 proposed provides a more consistent indication.  
25 When one looks at the totality of the radon

1           breath, the uranium intakes and the air data,  
2           using the radon breath in combination with the  
3           uranium data in urine, gives you in the same  
4           ball park as what the air data is telling us.  
5           And that gives us some comfort that that --  
6           that seems to make some sense. Applying these  
7           400 to one ratios tends to take you out of the  
8           realm of reasonableness.

9           **MS. BLOOM:** Well, and the other thing that I  
10          would say on the 400 to one --

11          **DR. NETON:** Speak into the...

12          **MS. BLOOM:** -- is that -- the other thing I  
13          would say on the 400 to one ratio is that if  
14          you're going to start with air data, you  
15          shouldn't be multiplying that times 400 --

16          **DR. NETON:** Right.

17          **MS. BLOOM:** -- and calling it all radium. You  
18          should be going the other way, and so that's  
19          actually going to bring numbers down, I think.

20          **DR. NETON:** Right, that would be my -- my  
21          proposal. We use the air data -- we would take  
22          the uranium data in urine and use that to  
23          estimate intake, and then assume that the  
24          entire air data were some fractionated values  
25          of the alpha in the -- in the radium stream.

1 But we -- we believe that -- that -- we believe  
2 that use the radium -- the radon breath data is  
3 -- is the more defensible scientific approach.

4 **DR. MELIUS:** Can we just go back one second to  
5 Arjun's original comment on the ratios 'cause I  
6 just want to make sure I understand your  
7 response. I think we sort of got off-track  
8 there. And you're saying that those -- you're  
9 going to adjust these now, and then -- that's  
10 all I've heard is you're going to -- there's  
11 some adjustment going to be made. This is just  
12 a --

13 **MS. BLOOM:** This is a --

14 **DR. MELIUS:** -- preliminary (unintelligible).

15 **MS. BLOOM:** Yeah, this is a -- this is a work  
16 in progress. I've collected a lot of different  
17 numbers on -- it sounds like -- I haven't heard  
18 anybody say that we should use the Silo One K-  
19 65 numbers, but if that's -- those are the  
20 numbers we're going to use, then I'll put lots  
21 of significant digits on there, and this was  
22 just to make it easy to say if I multiply by  
23 two I can get 800 rather than 1.578 --  
24 something, so it's for my convenience.

25 **DR. MAKHIJANI:** Yeah, I'm not focused on the

1           specific numbers of the K-65. Generally -- you  
2           know, I think if -- there is a -- and I haven't  
3           looked at the radon breath raw data so I'm not  
4           commenting on the quality of it and questions  
5           about the minimum detectable limit and so on,  
6           but for the moment just accepting the radon  
7           breath data, certainly we've looked at the  
8           method. And for the record, we would agree  
9           that the radon breath method is well  
10          established for estimating radium body burden.  
11          And we had two different SC&A experts examine  
12          this question. They both agreed on this  
13          question, the question of the validity of the  
14          data, the detection limits and so on.  
15          My question isn't about -- isn't about the --  
16          the actual numbers of nanocuries per gram in  
17          the K-65 silos. My question is how are you  
18          going to come up with the thorium 230,  
19          protactinium 231 and actinium 227 numbers? And  
20          since those arise out of your radium  
21          measurement and you're applying a fixed ratio  
22          derived from the K-65 silos, you're saying I --  
23          I know the radium burden in the body because I  
24          can measure it. Just consider one worker for  
25          whom you have bioassay data and radon breath

1 data, and you've got all good data. And then  
2 you're saying you're going to apply the ratios  
3 from the K-65 silos. Thorium is eight times  
4 less and actinium is 80 times less. And so my  
5 first point is it makes a big difference  
6 whether you say thorium is eight times less or  
7 6.5 times less because it makes a big  
8 difference to the dose. So being precise about  
9 that number is very important -- about that  
10 ratio, not the actual value. So I wasn't  
11 taking issue with the specific --

12 **MS. BLOOM:** (Off microphone) No  
13 (unintelligible).

14 **DR. MAKHIJANI:** -- numbers, just the ratios.  
15 The second point, which I think is  
16 methodologically more complicated, is that once  
17 you leave the first step in the Plant 6  
18 processing of the uranium, you wind up in  
19 places where the relative amount of radium is  
20 much lower and the relative amount of thorium,  
21 actinium and protactinium is much higher. So  
22 for -- for instance, in the residues coming out  
23 of the sodium carbonate bicarbonate process, in  
24 the AJ-4, AM-7, in all of those areas, I think  
25 there is a big problem in applying the K-65

1 ratios because there the relative amount of  
2 thorium is much bigger and it will make a  
3 tremendous difference in the dose because the  
4 dose conversion factors for thorium are so much  
5 bigger than radium.

6 Rad-- I did some back-of-the-envelope  
7 calculations, just applying the -- just taking  
8 455 by -- just as a back-of-the-envelope thing  
9 -- to calculate percentages. And radium and  
10 uranium make almost no contribution to the  
11 total dose. The contri-- 95 -- if you omit  
12 lead and polonium and just take those four --  
13 or even if you include them, lead and polonium  
14 make 10 percent -- uranium -- uranium and  
15 radium make less than a couple of percent, and  
16 the rest of it is all -- those three  
17 radionuclides. So my -- where I am,  
18 tentatively at least, from -- from a very  
19 tentative evaluation, is this whole method has  
20 to be geared to ensuring that the values you  
21 come up with ultimately for thorium, actinium  
22 and protactinium have to be the maximum  
23 plausible values, not the values for uranium  
24 and radium.

25 **DR. NETON:** I think we -- we totally agree with

1           that, and -- and I think -- we've stated in  
2           here that we believe that the -- applying the  
3           K-65 ratios -- because it's not that there's  
4           zero thorium or zero protactinium or zero all  
5           the other daughters in the K-65; there are --  
6           and I think we've looked at the airport cake  
7           material. I think Cindy's looked at some of  
8           the thorium contents of the airport cake, which  
9           by far and away is the largest amount of  
10          material. I mean there's 20 -- 25-foot high 3-  
11          acre piles out there at the St. Louis Airport  
12          site, so this -- this is the biggest potential  
13          source of exposure. And if we look at that and  
14          we know that the thorium 230 is in the airport  
15          cake, which is the largest potential source of  
16          intake, and we -- we can demonstrate that  
17          applying the K-65 doses are bounding compared  
18          to -- admittedly, there's more thorium there,  
19          but I think, Arjun, in some cases you're maybe  
20          not totally correct. I think you'll -- you'll  
21          -- I was surprised to see when Joe discusses  
22          these things, polonium 210 is a very  
23          significant contributor to the internal doses  
24          to some of these people.

25          **DR. MAKHIJANI:** (Off microphone) I just

1 (unintelligible).

2 **DR. NETON:** Well, right -- I mean but you've  
3 got to be careful when you generalize across  
4 the board, but -- and when you use 50-year  
5 doses versus annual doses because thorium's got  
6 a short half-life, there's other -- there's  
7 other considerations. But I think it would be  
8 our intent to demonstrate that even under those  
9 circumstances the K-65 residue dose conversion  
10 factors will bound the doses to people working  
11 with airport case and possibly even Sperry  
12 cake. Those are the only other sources you've  
13 got out there is the barium sulfate cakes.  
14 Those are smaller residue streams by far  
15 compared to the airport cake and the K-65.  
16 So...

17 **DR. MAKHIJANI:** I don't think I -- I'm not sure  
18 that I got a response to the question I asked,  
19 which is -- and -- and I just want to be clear  
20 in -- in that I -- I don't think -- okay, let  
21 me make a statement and try to get a response,  
22 agreement, rebuttal, something. Is I don't  
23 think that the K-65 ratios for thorium to  
24 radium -- because we've gone away now from the  
25 ratios to uranium, which is the bioassay data,

1           and we're fixing everything on the ratios of  
2           thorium to the radon breath data.  So now  
3           instead of bioassay data being the central  
4           anchor for dose reconstruction, you've got the  
5           radon breath data, which is available only for  
6           20 percent of the workers, as being the central  
7           anchor for dose reconstruction because you --  
8           you've constructed the amounts of thorium,  
9           actinium and protactinium out of the radon  
10          breath data and not from the bioassay data  
11          anymore.  And -- at least as I read it.  
12          Therefore, those ratios are extremely critical.  
13          And as I read these flow sheets, the ratios in  
14          the areas where you've got these AJ-4s, Sperry  
15          cake, AM-7 of thorium and perhaps protactinium,  
16          actinium in different parts are going to be  
17          bigger than they are for the -- you should  
18          expect them to be bigger because most of the  
19          radium is gone in the first part of the process  
20          -- or almost all of it is gone.  
21          So my question is, for those sets of workers  
22          where you know that their intake of thorium  
23          relative to radium is bigger -- is actually may  
24          be bigger than one to one -- how are you going  
25          to determine those ratios 'cause I don't think

1           the K-65 ratios are -- are reasonable or  
2           claimant-favorable? I'm just making that as a  
3           statement to --

4           **MS. BLOOM:** No --

5           **DR. MAKHIJANI:** -- get a response --

6           **MS. BLOOM:** -- and I --

7           **DR. MAKHIJANI:** -- and not a conclusion.

8           **MS. BLOOM:** -- and I think we agree with what  
9           you're saying. I was just looking at some  
10          numbers now. I do have uranium and thorium  
11          ratios in the AM-7, and certainly we could go  
12          back to the uranium data and apply those  
13          fractions to the uranium data. I think that  
14          would be a reasonable way to go. I need to  
15          look at it a little bit more.

16          Like one concern I have, I think the SEC  
17          question is can we bound it easily. The dose  
18          reconstruction question is then does the answer  
19          make sense or can we get a better answer. And  
20          I think we can use the ratios in the AM-7 to  
21          bound it. I think, based on what we were  
22          seeing from the uranium to radium ratios, I  
23          think that we can get a better number on the  
24          thorium to uranium ratios by considering that  
25          the fact that you've got a uranium background

1 in all these areas and so those ratios really  
2 aren't that high.

3 We've also taken it a little bit farther since  
4 we've written this up and looked at -- we had a  
5 small set of thorium bioassay data and we  
6 looked at that for the Plant 7E workers. They  
7 also had some uranium data, so we've sort of  
8 looked at that comparison, as well. And  
9 there's some arguments to be made there to --  
10 to come up with those numbers. I don't think  
11 we've finalized that yet except to say that I  
12 think the SEC question is answered. We can  
13 come up with a big number. You know, we can  
14 come up with our --

15 **MR. GRIFFON:** Well, we -- we have no doubts  
16 about that, but I -- I think item (c) in one is  
17 where we're -- I mean that's one question we  
18 had in mind before was --

19 **DR. NETON:** Right.

20 **MR. GRIFFON:** -- are there going to be -- and  
21 this is what Arjun's getting at, are there  
22 going to be job-specific ratios or -- or area-  
23 specific ratios. And -- and it seems like -- I  
24 mean I -- I think the Silo One data is probably  
25 bounding in man-- in most circumstances. Now

1           if you have -- are there other areas where this  
2           -- this actinium, protactinium and thorium  
3           concentrates more and would there likely be  
4           workers that were dedicated to those areas, I  
5           don't know those answers, you know, if you --

6           **DR. NETON:** No, I understand that. But I think  
7           --

8           **MR. GRIFFON:** And also, you know, you -- you're  
9           -- when you have the Silo One waste, it -- it  
10          is -- we're all talking about this is a  
11          bounding sort of concentration and ratios that  
12          we're establishing from that, but -- but it is  
13          all the waste coming together, I guess, so  
14          you're -- it's sort of an average, you're  
15          blending it. Right. It might be a higher  
16          average.

17          **DR. NETON:** I think it's higher --

18          **MR. GRIFFON:** Right, right.

19          **DR. NETON:** -- K-65 material, which was not all  
20          the material that was processed. We're  
21          assuming that these workers were inhaling K-65  
22          ratios the entire work time not, you know, when  
23          there were lower amounts of radium. We're not  
24          accounting for that at all.

25          **DR. WADE:** Denise had a comment or question.

1           **MR. GRIFFON:** Right, yeah, Denise.

2           **MS. BROCK:** My question -- I actually have two,  
3           and then maybe I'll ask them both and you can  
4           answer them separately. Number one, I was just  
5           curious, if the K-65 residue that's in Silo One  
6           at Fernald, does that ratio or chemical make-  
7           up, does that change after all of those years?  
8           I -- I'm not sure. I have no idea. That was a  
9           question I had.

10          And the other question I had is to Cindy and I  
11          -- I partially remember this. I was on the  
12          telephone call we had previously, and I'm not  
13          sure where this fits in at, but did I hear you  
14          correctly when you said it's 120th of the --  
15          was it the dose or the -- it lowers their dose,  
16          is that -- do you know what I'm talking about?

17          **MS. BLOOM:** (Off microphone) Not yet.

18          **MR. GRIFFON:** Factor of 20 lower I think you --

19          **MS. BROCK:** Is that what it was?

20          **MR. GRIFFON:** -- said, based on the radium  
21          from the breath data. It might affect the  
22          overall doses by a factor of 20 --

23          **MS. BROCK:** That's it.

24          **MR. GRIFFON:** -- was the statement --

25          **MS. BLOOM:** Rather than --

1           **MR. GRIFFON:** -- (unintelligible) recall.

2           **MS. BLOOM:** -- directly using the K-65.

3           **MR. GRIFFON:** I think so, right.

4           **MS. BLOOM:** Right, right.

5           **MR. GRIFFON:** I think that was your statement.

6           **MS. BROCK:** So does that lower their dose?

7           **MS. BLOOM:** If -- if you look at using the K-65  
8 ratios themselves versus the uranium-- the  
9 radium -- the -- the radium intake to the  
10 uranium intake, and this was for an unmonitored  
11 worker who -- our sense right now is that an  
12 unmonitored worker is likely to be a less  
13 exposed worker, and I know that's, you know,  
14 over -- over -- you know, we're applying these  
15 numbers for the whole work period. I don't say  
16 that there's not unmonitored workers here and  
17 there. I think there are. I've worked in  
18 health physics long enough not to be that  
19 naive, but I think -- overall I think we're  
20 applying these numbers very generously, and it  
21 will -- if you use the radon breath data, the  
22 numbers will be lowered if -- if you start from  
23 the air data and multiply by 400 -- or the  
24 uranium data and multiply by 400, yes, that  
25 will be --

1           **MS. BROCK:** So it won't be as claimant friendly  
2           to do it that way.

3           **MS. BLOOM:** But it's not supportable when you  
4           look at the rest of the data.

5           **MR. GRIFFON:** I think that's what they're  
6           saying is this is now a better estimate --

7           **MS. BROCK:** This is better.

8           **MR. GRIFFON:** -- in their view, right --

9           **MS. BROCK:** Okay.

10          **MR. GRIFFON:** -- and the other one was -- was  
11          reaching over reali--

12          **DR. NETON:** (Off microphone) Over  
13          (unintelligible) bounding --

14          **MR. GRIFFON:** -- right, it was --

15          **DR. NETON:** It was borderline --

16          **MR. GRIFFON:** At least that's the position --

17          **DR. NETON:** -- reasonable.

18          **MR. GRIFFON:** -- that's the position they're  
19          taking on it, yeah.

20          **MS. BROCK:** And does the silo -- does the K-65  
21          -- does that make-up change at all?

22          **MR. GRIFFON:** (Off microphone) (Unintelligible)  
23          second question.

24          **DR. NETON:** Well, that second question is --  
25          that's what -- we need to talk about that, but

1 I think, you know, there's -- there's evidence  
2 that this material was stored in drums over  
3 time. It was placed in drums and it was put  
4 inside a concrete silo. It was not subject, at  
5 least totally, to leeching of -- of rainfall  
6 and that sort of thing, so I think we have some  
7 confidence that these ratios are not -- not  
8 significantly different than the original  
9 ratios that were, you know, present at the time  
10 the material was made.

11 The concentrations will certainly be different.  
12 They've been diluted with different types of  
13 material, bentonite clay and that sort of  
14 thing, but -- but the ratios themselves, I  
15 don't believe there's any good reason to  
16 believe they're substantially different.

17 **MR. GUIDO:** Yeah, I had a comment. From a dose  
18 reconstruction perspective, one thing to keep  
19 in mind -- reality in doing this and I really  
20 understand what you're -- where you're coming  
21 from when you say how do you -- how do you know  
22 that Worker A, you know, where they were in the  
23 plant in all time, and -- and looking at a lot  
24 of other site cases and specifically a lot of  
25 Mallinckrodt cases and a lot of data, I agree,

1           it's very difficult to place a worker.  
2           A lot -- there's a lot of data within the files  
3           which is even inconsistent with each other,  
4           like you -- you know, where -- you don't  
5           whether the person was bouncing back and forth  
6           between areas or whether they changed  
7           assignments. So in the reality of doing the  
8           dose reconstruction, the way it has to be  
9           applied is you have to come up with a bounding  
10          scenario and apply it. And that ends up being  
11          claimant-favorable for a couple of different  
12          reasons.  
13          One, because you're picking a bounding scenario  
14          to give them, and another because you don't  
15          generally turn off the intakes when they really  
16          maybe should have. And in an example we'll  
17          maybe get to later if we look at one of the  
18          cases I did, you know, you might have an  
19          individual who has radon breath data for the  
20          first two or three years of their career, and  
21          then for the last two of three year-- you know,  
22          that -- that data goes away, they never get any  
23          more monitoring for radon breath, but they  
24          might pick up like thorium monitoring.  
25          Well, some sense would say well, that worker

1           probably changed locations. But in doing the  
2           dose reconstruction, in the methods we use to  
3           be claimant-favorable, what we would do is they  
4           would get the intake from that radon stream for  
5           the entire work period, and then it'd also pick  
6           up the other intake from the thorium and you  
7           wouldn't turn off the radium 'cause you really  
8           don't have data to say that it really ended.  
9           So you know, I know it's important to  
10          understand where people worked and what the  
11          ratios are in different areas, but -- to build  
12          the ratio set to understand what's bounding.  
13          But when you actually do the dose  
14          reconstruction, you -- that data is not as  
15          important. You know what I mean? It's -- it's  
16          more important to make sure you have the  
17          bounding set, because we'll never know where  
18          all these folks worked at all times. All we'll  
19          know is the possible datasets and then we can  
20          assure that we're being bounding, we're being  
21          claimant-favorable.

22          **MR. GRIFFON:** Yeah, and -- and we -- and we --  
23          and that's -- and we can see why you would want  
24          to go with radon breath data for that reason,  
25          you know --

1           **DR. NETON:** (Off microphone) Cindy  
2           (unintelligible).

3           **MR. GRIFFON:** -- instead of air sampling area  
4           data or -- yeah.

5           **DR. NETON:** Cindy, you said you have the data  
6           for the airport cake for thorium 230. Do you  
7           have that handy? I'm just curious about the  
8           disparity between the two.

9           **MS. BLOOM:** I do have some -- I do have some  
10          numbers. I was just looking up my calculations  
11          and my numbers in my comparison spreadsheet are  
12          in the wrong rows right now so I need to adjust  
13          those, but I can give you those this afternoon.

14          **DR. NETON:** You don't have a number for the  
15          concentration of thorium 230 in the airport  
16          cake handy right now then?

17          **MS. BLOOM:** I do in odd units.

18          **DR. NETON:** Okay. Well, we -- we --

19          **MR. GRIFFON:** I guess -- I guess --

20          **DR. NETON:** -- can probably talk about that  
21          later.

22          **MR. GRIFFON:** Yeah.

23          **MS. BLOOM:** (Unintelligible) per meter or parts  
24          per million, which would you like?

25          **DR. NETON:** I'd like picocuries per gram, but -

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**MS. BLOOM:** Yeah, that's what I thought. Then give me a minute.

**DR. NETON:** That's what I -- I think -- I think we can -- we can --

**MR. GRIFFON:** Yeah, I guess -- I guess --

**DR. NETON:** -- talk about that --

**MR. GRIFFON:** -- I guess there's general agreement here that -- that applying the fractions if -- if -- if we can get to that point where we're happy with the bounding --

**DR. NETON:** Right, and then we can get to the (unintelligible) --

**MR. GRIFFON:** -- that -- that -- that approach is reasonable, I think.

**DR. NETON:** Right. See, now I --

**MR. GRIFFON:** But the -- the -- I said the general position is that if we can establish these fractions and agree that they're maximizing or bounding --

**DR. NETON:** Right.

**MR. GRIFFON:** -- then the approach to use them is -- is reasonable, you know.

**DR. MAKHIJANI:** Yeah, I'd just like to be clear what "these fractions" mean, because I think in

1           most situations we're going to find that --  
2           it's just my hunch from back-of-the-envelope  
3           calculations that the thorium, actinium and  
4           protactinium are going to be important. And my  
5           concern simply is that those are the  
6           radionuclides for which there is the least  
7           information. There are no direct measurements,  
8           there are no air concentration data, there are  
9           no bioassay data and there are no radon breath  
10          equivalent data, so they're all derivative  
11          numbers. And how -- I think --

12         **MR. GRIFFON:** Even in -- even in the --

13         **DR. MAKHIJANI:** -- there has to be some  
14          assessment on how good those values are and how  
15          confident we are that they'll be maximum  
16          plausible because --

17         **MR. GRIFFON:** Right.

18         **DR. MAKHIJANI:** -- I -- I don't -- I haven't  
19          seen something that allows me to say that we  
20          know that to be confident as yet.

21         **DR. MAURO:** John Mauro. I'd like to just add  
22          one point. Joe Guido's point that you just  
23          made was exactly the question I asked much  
24          earlier about the creation of these boxes and  
25          the boundaries for real people. And the fact

1           that your plan is to give the benefit of the  
2           doubt where the person was and to carry over  
3           the -- let's say the continuation of exposure  
4           on that basis resolves that concern that I  
5           raised much earlier today. Thank you.

6           **MR. GRIFFON:** All right, I think we -- are we  
7           on to 1(b)? Moving right along.

8           **DR. NETON:** I think -- yeah, I think we're --  
9           we can -- we can resolve this issue with the  
10          amount of thorium 230. I --

11          **MR. GRIFFON:** Oh, yeah.

12          **DR. NETON:** -- I thought we'd looked -- we have  
13          looked at the airport cake and we know the  
14          amount of protactinium that was in the -- in  
15          the Sperry cake that we shipped to Fernald --  
16          or shipped to Mound, so I think between those  
17          two we're able to get some consensus maybe as  
18          to what the bracketing values should be for the  
19          thorium 230 and --

20          **MR. GRIFFON:** Okay.

21          **DR. NETON:** -- I think that's good. Okay, 1(b)  
22          --

23          **MR. GRIFFON:** Actually I think 1(c), yeah.

24          **DR. NETON:** -- 1(c) --

25          **MR. GRIFFON:** 1(c).

1           **DR. NETON:** I think we've talked about that a  
2           little bit. We feel that it's going to be very  
3           difficult, as Joe just indicated, to apportion  
4           these to individuals every single step of the  
5           way. I mean it's -- it's just a practical  
6           limitation on -- on doing so and -- in fact we  
7           don't have that for everybody, so our -- our  
8           approach is that if we could come up with this  
9           bounding calculation, these -- these ratios,  
10          and if we could use the radon breath data, that  
11          we would assume that most categories of workers  
12          that at least worked in Plant 6 -- so we're  
13          talking about operators, building trades, all  
14          those types of categories -- we would assume  
15          that they were exposed to this bounding value  
16          of -- of the residue material, the raffinate  
17          material (unintelligible).

18          **MR. GRIFFON:** When you bounding value of raf--  
19          can you point me to...

20          **DR. NETON:** Okay, well, let me -- let me --

21          **MR. GRIFFON:** Okay.

22          **DR. NETON:** Okay. The approach would be you  
23          take the urine data, if it's available, and  
24          come up with the uranium intake. Now that's --  
25          that's a given. Now you've -- you determine

1           what the uranium intake is. Now if you have  
2           radon breath, you do the radium intake and  
3           you've got radium intake, and then we can apply  
4           whatever ratios we decide is appropriate.

5           **MR. GRIFFON:** And in the absence of radon  
6           breath, you use --

7           **DR. NETON:** In the absence of radon breath we  
8           would propose to use the 95th percentile of the  
9           radon breath intakes that were calculated from  
10          the 2,500 samples. And likewise, in the  
11          absence of any uranium bioassay we would use  
12          the 95th percentile of the uranium intakes for  
13          that population of workers. So you've got a  
14          situation -- now that would be for workers who  
15          were potentially exposed working with raffinate  
16          just like anybody else, a chemical operator,  
17          building trades or someone of that nature.  
18          If you have a worker who did not work in Plant  
19          6 but could have frequented it doing certain  
20          jobs, we propose that we would use the  
21          distribution, the -- the distribution of values  
22          for radon breath and uranium bioassay and apply  
23          that to those --

24          **MR. GRIFFON:** The full distribution, you're  
25          saying --

1           **DR. NETON:** The full distribution rather than  
2           picking the 95th percentile. So I think if we  
3           can come up with this -- these fractions, these  
4           activity fractions, I think we've got an  
5           approach here that is workable for --

6           **MR. GRIFFON:** And do --

7           **DR. NETON:** -- almost anyone in Plant 6, and in  
8           Plant Y, for that matter. If someone -- if we  
9           can demonstrate someone only worked in Plant 4,  
10          which may or may not be possible, we would not  
11          apply that ratio.

12          **MR. GRIFFON:** And -- and just to be clear, the  
13          use of the air sampling data now would be to --  
14          as a reality check, as a --

15          **DR. NETON:** Yes, that's exactly right. It  
16          would be -- it would be used to make sure that  
17          we're in the right ball park here. And I think  
18          in our preliminary calculations that's the  
19          case.

20          **MR. GRIFFON:** And that your overall -- like you  
21          were saying earlier, that your overall alpha  
22          intake doesn't exceed the plausible with the  
23          highest air samples in --

24          **DR. NETON:** And actually I think it would be --

25          **MR. GRIFFON:** -- in the plant or...

1           **DR. NETON:** -- it could exceed it. We're not  
2 saying that the air sample data are the  
3 ultimate --

4           **MR. GRIFFON:** Right.

5           **DR. NETON:** -- cap, but are they in the right  
6 ball park.

7           **MR. GRIFFON:** In the right ball park, okay.

8           **DR. NETON:** And if you're three or four orders  
9 of magnitude higher with your intakes, you  
10 might want to wonder. But then as we -- as has  
11 been pointed out in the past, the air samples  
12 are not perfect, either. They might not have  
13 been job (unintelligible) --

14           **MR. GRIFFON:** So there's no situation where you  
15 see those being used for dose reconstruction.

16           **DR. NETON:** At this point I think we would  
17 prefer to stick with the bioassay monitoring  
18 data as our -- our approach and use the air  
19 sample data as -- as --

20           **MR. GRIFFON:** Reality (unintelligible).

21           **DR. NETON:** -- reality checks on what we're  
22 doing.

23           **MS. BLOOM:** It also might give you an indicator  
24 of what was happening over time, you know, and  
25 -- and how to help fit data and things like



1 breath data, we would use urine and breath, as  
2 available, to do intakes. We would use the --  
3 what we call coworker data, which is really the  
4 worker distribution data that we have for urine  
5 and breath, and pick the 95th percentile for  
6 exposed workers and the full distribution for  
7 what we believe to be lesser exposed workers.

8 **MR. GRIFFON:** I think the second part of (d) --  
9 I mean we didn't really discuss too much --

10 **DR. NETON:** Okay, reliability of radon breath  
11 data, we could talk about that somewhat. I --  
12 I'm encouraged that SC&A does agree that --  
13 that radon breath is an appropriate technique.  
14 It was in fact the -- the intake estimates that  
15 were used to establish the body burdens for the  
16 radium dial painters, which everyone knows is a  
17 fairly famous historical exposure cohort from  
18 the early 1900s. The radon breath data we've  
19 looked at. We actually have very similar data  
20 to what we had for the urine analysis. In fact  
21 we have the HASL analytical data sheets.

22 There's four -- I would not -- don't quote me  
23 on this number, but I think there's about 487  
24 individual pages of radon breath measurements  
25 that were reported by HASL to Mallinckrodt.

1           These data sheets contain -- they're not full,  
2           but again, they're like 14-line data sheets, so  
3           they're -- somewhat less than half of each of  
4           them are full, so there's a large number of  
5           radon breath measurements that were taken.  
6           We wanted to make sure that the CER database  
7           was actually reflective of what as in there.  
8           We looked at a few workers. We didn't do as  
9           extensive review as we did with the urine, but  
10          we took one worker and were able to track his  
11          radon breath data back to his original HASL  
12          data sheets. They matched. I think there was  
13          one date that was transposed -- you know, the  
14          date was read wrong; it was 4 instead of a 9,  
15          but in general those appear to be faithfully  
16          reproduced in the CER database.  
17          These values are listed as percent of  
18          tolerance. The percent of tolerance was one  
19          picocurie per liter radon in breath at that  
20          time. That was I think construed to be equal  
21          to what would be a body burden of radium during  
22          that time frame.  
23          The detection limit value is pretty clear from  
24          the HASL reports that they reported nothing --  
25          well, almost exclusively nothing less than .1

1 picocurie per liter. There are some samples  
2 that are listed as .006 picocurie per liter  
3 less than values. We're not quite sure what to  
4 make of that. It's a very small fraction -- I  
5 can't give you the number, but very small  
6 number of them. If you read the original  
7 reports, HASL -- .1 picocuries per liter is --  
8 is a fairly well-established detection limit.  
9 In fact, this technique is still -- I have a  
10 1992 version of the HASL analytical procedures  
11 manual. This exact same technique is still in  
12 there.

13 John has a question.

14 **DR. MAURO:** Yes, I -- I looked at the protocol  
15 and some of the literature behind it. In fact  
16 there was the -- I think it was the Russian  
17 literature -- started with an S, long name --

18 **DR. NETON:** Uh-huh, (unintelligible), yeah, I  
19 won't pronounce it, either, but --

20 **DR. MAURO:** You know the one.

21 **DR. NETON:** -- I know what it is.

22 **DR. MAURO:** Now I noticed in his analysis he  
23 used -- the person would breath oxy-- breath  
24 oxygen beforehand --

25 **DR. NETON:** Right.

1           **DR. MAURO:** -- and there was a very  
2 sophisticated protocol to make sure that you  
3 had control over background --

4           **DR. NETON:** Correct.

5           **DR. MAURO:** -- so that you could get a  
6 realistic measurement. Now in our situation  
7 here, that wasn't done, as I understand it.

8           **DR. NETON:** In the early time frames that was  
9 not done.

10          **MS. BLOOM:** Later on they did --

11          **DR. MAURO:** Later on.

12          **DR. NETON:** After '51, '52 time frame they  
13 adopted the HASL procedure --

14          **DR. MAURO:** Okay.

15          **DR. NETON:** -- with John Harley's 1951 article  
16 in the *Archives of Industrial Hygiene* published  
17 -- I've got a copy of it here -- it goes  
18 through that -- that procedure.

19          **DR. MAURO:** Then my question goes to the  
20 earlier years. In that scenario where you're  
21 dealing with an individual where you're using  
22 the radon breath data before they were using  
23 the oxygen approach, and therefore you could  
24 theoretically have a background level that  
25 could be substantial. It doesn't take very --

1           you know, in this room is probably about one  
2           picocurie per liter right now. Now, when you  
3           do that, if in fact you've used the radon  
4           breath data without subtracting background in  
5           the early years, you may very well come up with  
6           some very aberrant results. Under those  
7           circumstances, what's your fall-back position  
8           in terms of coming to grips with what the body  
9           burden of radium is when you really suspect  
10          that because -- because of the background  
11          complication?

12         **DR. NETON:** We -- we really have no way of  
13         correcting for that and we would assume that  
14         this was equal to the radium body burden. If -  
15         - if you look at it over time, it did go down.  
16         But of course there's a reason for that. In  
17         the -- in the '40 -- late '48, 1949 time frame  
18         this is when they had the campaign to reprocess  
19         the -- the K-65 material from SLAPS, so they  
20         ran through all of the -- or most of the  
21         radium-bearing K-65 material through the entire  
22         digester process. So there's a reason that  
23         those body burdens could be higher, but I -- I  
24         don't think that we would correct those. We  
25         would use them at face values.

1           There are other issues besides just the radon  
2           breath, and we can talk about that a little  
3           bit. The background in air -- there are also  
4           these people that worked in the plants. As  
5           we'll see later, there are very large  
6           concentrations of radon in the plant, well  
7           beyond -- all above a picocurie per liter. I  
8           myself have measured the half-life of radon gas  
9           in the body and it's about 24 hours. They did  
10          adopt a protocol where the workers came in on  
11          Monday morning after being away from the plant  
12          for 48 hours, recognizing they wanted to  
13          ventilate the natural deposition of radon in  
14          their bodies. Unfortunately though, they took  
15          some of these measurements early on in -- in  
16          rooms that had air that had higher than what  
17          you'd expect, and so some of that is  
18          contributing to the background.

19          But as I mentioned earlier, most of these  
20          uncertainties do -- as you mentioned, do bias  
21          the values in a positive direction, not a  
22          negative direction.

23          **MR. GRIFFON:** (Off microphone) Larry's got a  
24          comment.

25          (Whereupon, the microphone available to Mr.

1 Elliott was not functioning and his remarks  
2 were not captured by the reporter.)

3 **DR. NETON:** Right, yes. I'm not -- yeah --  
4 well, we've never done that in any dose  
5 reconstruction so we take that at face value.  
6 But the other issue is there is a -- radon  
7 breath tends to be higher after eating a meal,  
8 what they call the postprandial effect, and it  
9 can be a factor of two higher. So if someone  
10 had breakfast and came in, it could be -- all  
11 of these things, again, add to the elevation of  
12 the data and not -- not negative biases, so --  
13 but we believe it's a fairly reasonable bound.

14 **MR. GRIFFON:** Go ahead, Arjun.

15 **DR. MAKHIJANI:** Yeah. I'm sorry to sound like  
16 a broken record a little bit about this, but I  
17 do feel it's important. And I'm just trying to  
18 understand how these coworker radon breath data  
19 are really going to be used. We -- we've got  
20 radon data for 20 percent of the workers --  
21 about. So for most of the production workers  
22 you're going to wind up using coworker data.  
23 Right?

24 **DR. NETON:** (Off microphone) (Unintelligible)

25 **DR. MAKHIJANI:** Yeah, I'm not -- I'm not saying

1           that the approach that you outlined is not  
2           claimant-favorable, I'm just trying to  
3           understand the approach since this is the last  
4           full conversation we'll have about this. Then  
5           -- then you apply these ratios -- use the  
6           coworker data from radon breath and apply these  
7           ratios. Now if the assumption is that the  
8           radon breath was applied to people who were  
9           vulnerable to radium exposure, which would mean  
10          those who were working with the ore,  
11          pitchblende; those who were working with K-65  
12          material and barium sulfate residues. I mean  
13          those are the ones who I identify as the ones  
14          most vulnerable to radium exposure. Then it  
15          seems -- it seems to me that actually applying  
16          the co-- the coworker approach seems to be  
17          questionable for workers who were working with  
18          other residue because these ratios are not  
19          going to apply because you don't have -- if you  
20          don't have radon breath data for most of the  
21          workers, many of those workers are going to be  
22          in areas where you're handling these AM-7s, AJ-  
23          4s and these various other residues. You don't  
24          have radium measurements for them and we have  
25          sort of an idea what the ratios were, but

1           you're going to apply -- I'm (off microphone)  
2           (unintelligible) difficulties how these numbers  
3           are going to be validated (unintelligible)  
4           those numbers.

5           **DR. NETON:** Right. I understand what you're  
6           saying, Arjun. I think -- I think the way to  
7           look at this is if you have a radon -- a K-65  
8           material intake and you come up with some dose  
9           per unit intake of that material. Okay? Let's  
10          just make a number. Say it's 300 millirem per  
11          milligram intake. I don't know what it is, but  
12          let's just say it's that, and it's based on  
13          these K-65 ratios. And then we can do some  
14          other calculation on these other residues and  
15          demonstrate that this intake calculation,  
16          however we -- we contrive this ratio -- I mean  
17          construct this ratios are higher than the unit  
18          intake per milligram of the other materials,  
19          then it's -- it seems to me that you would --  
20          you've given these people an adequate intake.  
21          You know, you would have to assume that they  
22          would be inhaling -- you're assuming that  
23          they're inhaling this full-time, on a chronic  
24          basis, and if the dose per unit intake that we  
25          construct is bounding, even for these other

1 residues, I think that we've adequately given  
2 these people a representative dose. But then  
3 it gets down to how much material can you  
4 inhale. Does that help?

5 **MR. GUIDO:** I have a comment, but if you're  
6 satisfied I won't say anything.

7 **DR. MAKHIJANI:** Well, I -- I'm -- I'm puzzled,  
8 because I -- you know, actually we -- maybe  
9 this will be answered when you put your dose  
10 reconstructions on the table and I don't want  
11 to hold this up, but I -- I -- I am -- I remain  
12 puzzled as to how this (unintelligible) --

13 **MR. GUIDO:** So I'll comment. One thing we have  
14 to look at, and this doesn't really answer the  
15 question, but in looking at this approach the  
16 one thing you have to look at is if you start  
17 with a higher radium number intake and you use  
18 lower ratios, you might get more dose than if  
19 you -- in fact, in other words, we're -- we're  
20 going to assume that everyone was exposed to  
21 the stream that had -- that had much more  
22 radium in it. Well, the ratios -- the radium  
23 to thorium ratios might be a little lower for  
24 that stream, but the net effect as far as  
25 actinium, protactinium and thorium values might

1 end up being more bounding. And proof of this  
2 is going to be in the calculations, and we all  
3 realize this. But I think conceptually it's  
4 very possible, and we believe it to be true,  
5 that you can start with higher radium/lower  
6 ratios as opposed to lower radium with high  
7 ratios and your answer might still be in the  
8 same --

9 **DR. NETON:** (Off microphone) Come out the same  
10 place.

11 **MR. GUIDO:** -- so that -- that's what -- that's  
12 what we have to prove, I -- I guess.

13 **DR. MAKHIJANI:** Now -- now I think you've  
14 actually clarified something and made my  
15 question bigger, because -- because this --  
16 because the difference in the dose conversion  
17 factors is so large, I think -- I think unless  
18 you can actually validate these numbers in some  
19 way, this qualitative idea that you can have a  
20 higher radium and lower ratios -- because at  
21 least by my back-of-the-envelope, which I'm not  
22 going to stand by these numbers. My back-of-  
23 the-envelope numbers show that that -- those --  
24 the result is extremely sensitive to those  
25 ratios and not to the radium concentration.

1           You can take -- you can throw away the radium  
2           dose if you get the ratios right -- as an  
3           extreme statement. Admittedly extreme  
4           statement in the example that I did. The --  
5           the -- and so if you have streams where the  
6           ratio of thorium to radium is two to one  
7           instead of one to eight or one to six, I think  
8           -- I think that this -- what you've said will -  
9           - will be very far from being claimant  
10          favorable. And you have to be able to  
11          demonstrate that you know these ratios, not  
12          just of thorium to uranium then. You have --  
13          if you're going to use -- the thing that  
14          concerns me -- let me step back.  
15          The thing that concerns me is you have bioassay  
16          data for most of the workers. I think we  
17          settled the bioassay data quality and so on  
18          issues, whether they were fabricated, to a  
19          large extent last time. They're not  
20          fabricated. They're a set of data that -- that  
21          -- that would give you an indication of  
22          uranium. You have them for most workers. Now  
23          we've moving away from that for the most  
24          important radionuclide. We have radon breath  
25          data, 20 percent of the workers, and that is

1 going to become the source of the values of  
2 radionuclides for the most important components  
3 of the dose, not the bioassay data which is a  
4 more complete set of data that you have for  
5 individuals. And I -- I -- I'm -- I remain to  
6 be convinced that this is -- this is a sound  
7 approach.

8 **DR. NETON:** Well, I guess we just need to show  
9 you the numbers. I mean that's --

10 **MR. GRIFFON:** Denise --

11 **DR. NETON:** -- (unintelligible) --

12 **MR. GRIFFON:** Denise has a comment.

13 **MS. BROCK:** I'm confused myself with some of  
14 this and I'd like to ask a question. I have a  
15 -- a document in front of me, it's very hard to  
16 read, and I don't know if this has anything to  
17 do with that, but I'm just going to read part  
18 of it and then maybe you can explain to me if  
19 it has anything to do with what Arjun or what  
20 you all are talking about.

21 It states (reading) It is apparent from these  
22 data that a considerable group of employees  
23 from Plant 6 are exposed to hazardous  
24 concentrations of dust. In Plant number 6 18  
25 employees are exposed to between 375 and 660

1 times the preferred level.

2 And down further it -- this is so hard to read  
3 -- (reading) Employees exposed to 660 times the  
4 preferred daily alpha level inhale in 19 days  
5 the amount of alpha dust which would ordinarily  
6 be inhaled in the full working span of 35  
7 years.

8 So my thought as to coworker data -- and this --  
9 -- I may be way out in left field with this, but  
10 if hypothetically you're one of these workers  
11 and there isn't maybe breath radon or something  
12 on you and you use a coworker, wouldn't this  
13 person be a lot more exposed than just the  
14 typical person? And are they not going to get  
15 a full amount of -- of what they -- they should  
16 be in their dose? Or is this way off in  
17 another...

18 **DR. NETON:** Well, I think that speaks to us  
19 using the 95th percentile of the distribution  
20 and assuming that they were in the most heavily  
21 exposed population. That's what we would do.

22 **MR. GRIFFON:** Okay. I was -- I'm still on 1(d)  
23 --

24 **DR. NETON:** Okay.

25 **MR. GRIFFON:** -- and I've got -- I've got about

1           -- I've got a bunch of questions on that. I  
2 wondered if we wanted to break for lunch at  
3 some point or -- have I got one vote for lunch?  
4 Why don't -- if it's okay with everybody, why  
5 don't we break for lunch now and come back --

6           **DR. WADE:** I'd like to say one thing before  
7 lunch if I might. I mean early on Denise asked  
8 a number of questions that had more of a policy  
9 sense as to where does the SEC process sit  
10 relative to the site profile process. Those  
11 questions have not been lost on us, Denise. I  
12 think we're here today to talk about the -- the  
13 technical issues surrounding the site profile  
14 review. How that relates to the SEC process is  
15 something that certainly the Board will need to  
16 discuss more completely, so your questions have  
17 been heard.

18           **MR. GRIFFON:** All right. I guess we'll  
19 reconvene at 1:00.

20           (Whereupon, a recess was taken.)

21           **DR. WADE:** We've spoken during lunch to some of  
22 the members who are trying to participate by  
23 telephone and they say that you all need to  
24 shout, as I am shouting now, and be close to  
25 the microphone. And again, we value their

1 participation and to maximize it, we need to do  
2 this.

3 I would also ask those on the phone, if anyone  
4 starts to speak that gives you trouble, speak  
5 up and we'll reprimand the person forthwith and  
6 we'll have them speak louder.

7 We will be talking about today some of the  
8 example dose calculations, and those are here  
9 in hard copy. Mike Gibson, I don't know if you  
10 would like us to try and FAX that material to  
11 you -- are you on, Mike?

12 (No responses)

13 Is anybody on?

14 (No responses)

15 Well, my little speech didn't work. LaShawn,  
16 could we...

17 **MR. GRIFFON:** Speak louder.

18 **DR. WADE:** No, I don't think there's anybody  
19 on.

20 **MR. GRIFFON:** (Off microphone) I think we've  
21 got --

22 **UNIDENTIFIED:** We've exhausted  
23 (unintelligible).

24 **DR. WADE:** Not all of them. I can think of a  
25 couple who would -- who will be here.



1 doesn't have a FAX machine on it.

2 **DR. WADE:** Okay. With apologies, those  
3 materials have just appeared today. We'll try  
4 and be clear in our discussions of them.  
5 Again, we've talked about here the need for  
6 people to speak as loud and as aggressively as  
7 I am, but if anyone starts to speak and those  
8 of you on the phone are having trouble, please  
9 shout out so we can make real time adjustments.  
10 My only other question is are there any Board  
11 members other than Mike on the call right now?

12 (No responses)

13 Any Board members other than Mike Gibson?

14 (No responses)

15 Okay.

16 **MR. GRIFFON:** I think Jim wanted to say  
17 something, then we'll get back to our agenda.

18 **DR. MELIUS:** Something that came up this  
19 morning I want to just make sure we're -- we're  
20 clear on in terms of our next meeting, and I  
21 think Cindy and Jim Neton were referring to  
22 sort of the ongoing work and further  
23 calculations and further changes, and I think  
24 that's all fine. But I think it's very  
25 important for the Board that -- that there be

1           good communication between NIOSH and SC&A  
2           beyond this meeting so that we don't get into  
3           our next meeting in St. Louis and have a --  
4           something presented that no one's heard of -- I  
5           mean from both -- either side, either a  
6           criticism that's -- that's new or a new set of  
7           calculations or a new approach, because I think  
8           that's going to put us all in a very difficult  
9           -- or could put us all in a difficult  
10          situation. So you know, to the extent that you  
11          can exchange your, you know, information,  
12          critiques and so forth, I think that's good. I  
13          think we've got the process set up, but I just  
14          don't, you know, think -- you can certainly go  
15          beyond some of the dates involved if that will  
16          help to give a more finalized, you know,  
17          presentation at our next meeting in St. Louis.  
18          **DR. WADE:** Good, and we'll let common sense  
19          prevail in terms of involving the working  
20          group. I think if it's possible, if we know  
21          there's going to be a call, we can let the  
22          working group members know and they could join.  
23          If that's not possible, I think we'll  
24          understand the intent of what Jim's saying.  
25          John, are you comfortable with that?

1           **DR. MAURO:** Yes, any developments whereby we'd  
2           like to discuss certain ambiguities in some of  
3           the issues we're talking about today, or the  
4           degree to which these -- we leave on the table,  
5           as we have so far, certain questions when we --  
6           we're -- 'cause our plan is to prepare a report  
7           to the Board on our understanding and our  
8           position regarding each of the issues that  
9           we're discussing today so that you would have  
10          something well before the meeting. And in  
11          order to get to that point, what we will  
12          probably need to do is to discuss these matters  
13          with Jim. At that time we will get in touch  
14          with you, Lew, I presume, to let you know that  
15          we'd like to open up a conference call.

16          **DR. WADE:** Fine, thank you.

17          **DR. MELIUS:** But that -- can I just add, I  
18          think -- you'll prepare your report, but you  
19          also prepare your presentations. And you know,  
20          we get them at the meeting, you know. You  
21          prepare them the night before or whenever, and  
22          to the extent that those change what's in the  
23          report -- and that may be very appropriate that  
24          there's new information or -- change. I don't  
25          mind as much the Board being surprised by it,

1 but I would be concerned that -- if SC&A  
2 presents something and NIOSH is surprised by it  
3 or hadn't heard it before, and vice versa, so  
4 that -- that -- you know, you both have had a  
5 chance to think about it. And I frankly -- you  
6 know, the few days before the meeting, I don't  
7 want you wasting your time trying to set up a  
8 call. I'd much rather have there be, you know,  
9 communication. I mean you both should be  
10 close, but there may be some new wrinkle or  
11 something that would help to vet or at least  
12 have discussed so that people are prepared to,  
13 you know, respond to it at the meeting, to the  
14 extent possible.

15 **DR. WADE:** With permission -- all right, go  
16 ahead.

17 **DR. MAKHIJANI:** Yeah, as -- as -- Dr. Melius or  
18 somebody is going to be taking a first crack at  
19 the SC&A report anyway and drafting it, I -- I  
20 -- I -- there are a lot of outstanding issues  
21 already, and I actually asked John, are we --  
22 are we going to see some revised thing from  
23 NIOSH in the next couple of days so that we can  
24 look at the resolution of them? Are we to  
25 submit -- I'm not clear on this, I think it's a

1 little vague, if you don't want surprises,  
2 'cause there are big issues on the table. Are  
3 -- are we to send a draft on which then we will  
4 have a conference call? I -- I'm not sure  
5 exactly how you intend to prevent these  
6 surprises.

7 **UNIDENTIFIED:** (Off microphone)  
8 (Unintelligible) rest of the day and then  
9 (unintelligible).

10 **DR. NETON:** I think that -- that's acceptable.

11 **MR. GRIFFON:** (Off microphone) (Unintelligible)  
12 too, yeah.

13 **DR. NETON:** By the -- by the original schedule,  
14 SC&A's review to the Board is, right now, due  
15 August 16th. We're still 12 good days away  
16 from there, and you've had a very good peek at  
17 our position. Now I do admit that we're going  
18 to have to come to grips with some of these  
19 issues, but I would prefer to do that, as Dr.  
20 Melius suggested, with some open dialogue  
21 between us because this process of us  
22 developing a position and then getting a  
23 counterpoint formally, it just really takes  
24 much more time and effort than it would if we  
25 could discuss among ourselves. And I would

1           hope that we could do that without having to  
2           have formal *Federal Register* type noticed  
3           meetings because it just gets difficult.

4           **DR. WADE:** Well, if -- Mark, if it's agreeable  
5           with you and the other members of the working  
6           group, if -- if that's the sense of this  
7           working group, then -- then let John Mauro, Jim  
8           Neton and I sort of work through these issues  
9           as they come up and we'll do the right and  
10          proper thing within the spirit of what's been  
11          discussed here. And Denise, I'll certainly be  
12          keeping you informed.

13          **MR. GRIFFON:** Yeah, I think that's agreeable to  
14          all of us. I mean I -- like Jim said, we just  
15          want -- we want no surprises by the meeting, so  
16          that would be good.

17          All right, I think we'll go back to the regular  
18          agenda here. Item 1(d), we were discussing the  
19          second part of that, the reliability of the  
20          breath radon data, yeah. And I don't know, did  
21          -- I had a few questions on this that I just  
22          have looked at some of the data and a couple of  
23          things came up in my mind. One thing, looking  
24          at the hard copy data versus the CER database,  
25          I noticed that on my rough tally of this data

1           about 25 to 30 percent of the data in those two  
2           years said either lost or not analyzed. And  
3           I'm not sure what that -- what that mean-- you  
4           know, I don't know if you have a sense of what  
5           that meant from the HASL lab standpoint, if --  
6           if they -- well, and -- and -- and second part  
7           of that is how would you handle -- if you had  
8           raw data with someone's name and all you had  
9           from them was something that said lost or not  
10          analyzed, how do you -- you just use coworker  
11          data, I guess, or --

12         **DR. NETON:** Right, that -- that would be our  
13          approach. And I'm surprised it's 25 to 30  
14          percent is --

15         **MR. GRIFFON:** So was I, that's why I tallied  
16          up, yeah.

17         **DR. NETON:** I really don't know, you know, what  
18          happened to invalidate those samples or not  
19          pick them to be analyzed, but we would -- we  
20          would use the data that we have and -- and  
21          develop the coworker distributions then, you  
22          know, follow through that way. Cindy might --

23         **MS. BLOOM:** On some of those "not analyzed"  
24          samples there is indication in the records that  
25          the laboratory was unable to process so many

1 samples, and so some that may not have been  
2 processed may have been excess samples. Also  
3 just a general note on a "lost" sample, that  
4 tends to indicate that something happened  
5 during processing where the sample was  
6 invalidated somehow. It was either the  
7 chemistry didn't go quite right or something  
8 like that. It doesn't mean that all these  
9 samples were physically not found, but that the  
10 --

11 **DR. NETON:** Yeah.

12 **MS. BLOOM:** -- analysis didn't work the way  
13 they had hoped it would.

14 **MR. GRIFFON:** That's a general observa-- I mean  
15 you don't know preci-- for this dataset  
16 necessarily that --

17 **DR. NETON:** No.

18 **MR. GRIFFON:** -- "lost" meant that or...

19 **MS. BLOOM:** No, but I -- I have looked at a lot  
20 of bioassay analyses and -- and it's pretty  
21 typical. "Not sent" or "didn't arrive" or  
22 "blank" might indicate that a sample was  
23 somewhere else, but -- and it's definitely --  
24 it's -- it's a subjective word.

25 **MR. GRIFFON:** I guess what struck me with this

1 was the high percentage. If it was, you know -  
2 -

3 **DR. NETON:** Yeah.

4 **MR. GRIFFON:** -- a few percent, or ten percent  
5 even, I -- but it was 25 to 30 percent for  
6 these years and I thought that was rather high,  
7 especially when you're dealing with a fairly  
8 small dataset already -- well, maybe not that  
9 small, but anyway...

10 There's a -- also wanted to point out that -- I  
11 don't think there's any data in 1956 or '57, is  
12 there, for the radon breath? Any or very  
13 limited, I don't -- I don't know if that's...  
14 Am I right about that?

15 **MS. BLOOM:** I think there were four samples in  
16 '57. The program had pretty much -- had run  
17 down, the reprocessing of the radium was over.  
18 Towards '55 it had wound way down prior to  
19 that, but I think that probably -- my sense is  
20 that they weren't so curious about that  
21 anymore. I can't guarantee that there's not  
22 more data out there, but that was my sense,  
23 that -- that they just stopped measuring for  
24 radium, that they weren't processing that --  
25 doing the reprocessing of the --

1           **MR. GRIFFON:** Okay.

2           **MS. BLOOM:** -- the radium anymore.

3           **MR. GRIFFON:** So that's consistent with the  
4 process history is what you're saying, that  
5 that --

6           **MS. BLOOM:** Yeah, they weren't doing the  
7 pitchblendes anymore, they were getting in  
8 concentrates instead.

9           **MR. GRIFFON:** Right. And -- oh, Arjun, go  
10 ahead.

11           **DR. MAKHIJANI:** Yeah. If we know they were  
12 doing concentrates at -- at -- I think that  
13 would be fine because then you don't have  
14 radium. But if they were doing other ores, you  
15 still have the disproportion of the radium at  
16 the filter stages 'cause that's not dependent  
17 on the grade of the ore, simply the uranium  
18 goes away. And so is it well established that  
19 they were doing only concentrates in '56/'57  
20 or...

21           **MS. BLOOM:** I didn't look at that question  
22 specifically. That was just my sense as I  
23 looked at the different data and that things  
24 did wind down there, and that they had stopped  
25 at some point processing the pitchblende, even

1           though -- and that they were doing some  
2           concentrates later on. Also with the domestic  
3           ores you would have -- even though the ratios  
4           would be the same, the actual intakes would be  
5           lower because your concentrations would be  
6           lower, so -- and I just think they weren't  
7           measuring it. I don't -- and we're not saying  
8           we're not going to account for exposures. I  
9           think we're just going to -- as Joe said before  
10          -- take that line and draw it straight across  
11          'cause we don't know how to fill it in without  
12          data.

13         **DR. MAKHIJANI:** Which line?

14         **MS. BLOOM:** The radon breath analyses results.

15         **DR. MAKHIJANI:** Oh, okay.

16         **MR. GRIFFON:** You're going to -- you mean --  
17          draw it straight across, you mean extend it out  
18          to what years, to -- through '57 or -- yeah.

19         **DR. NETON:** Right, and -- and the numbers go  
20          down. I have some graphs here that were not  
21          distributed. These are just -- what I'm  
22          showing here on the screen --

23         **MR. GRIFFON:** Oh, okay.

24         **DR. NETON:** We did look at the distribution of  
25          radon breath analyses by year, and these are

1 NIOSH evaluations. They may be slightly  
2 different in the decimal place or two because  
3 we did these independently of ORAU team, but in  
4 general what we're showing here is  
5 distributions through '49, '50, '51, '52, '53  
6 and '55 that are fairly -- you know, straight  
7 line distributions again, no real evidence of  
8 truncation of data, that sort of thing. And  
9 this last graph here is a breath radon trend,  
10 which shows -- it's a log scale, but the  
11 concentration of radon in breath went -- the  
12 median value went from about .3 in 1949 down to  
13 somewhere close to .1 in 1955 -- I'm sorry?  
14 Oh, yeah, .2, I'm sorry. Thank you, Arjun.  
15 And you -- you run into a practical issue here.  
16 The radon breath analyses, as we discussed  
17 earlier, have a detection limit of .1  
18 picocuries per liter, so you have a missed dose  
19 issue here anyways. I mean we will assign --  
20 you know, if -- if there were no positives in a  
21 given year, the smallest intake you could infer  
22 would be .1 picocuries per liter, which would  
23 be one-tenth of the body burden and that would  
24 certainly -- at least, at a minimum -- be our  
25 assumption.

1           **MR. GRIFFON:** Arjun?

2           **DR. MAKHIJANI:** This -- this limit of detection  
3 thing, on page 79 of the TBD, Mark and I were -  
4 - were you going to ask about that?

5           **MR. GRIFFON:** Go ahead.

6           **DR. MAKHIJANI:** Well, you -- you say that the  
7 limit of detection was .1, but there was  
8 confidence in readings equal to .5 picocuries  
9 per liter. I don't know what that means, if  
10 the -- and how -- since most of your readings  
11 are between .1 and .5, where does that leave us  
12 in terms of confidence?

13           **DR. NETON:** I think what -- what you're seeing  
14 there is the confidence that these are actual  
15 true -- true radium-derived body burden  
16 estimates and in fact that the concentrations -  
17 - the body burden may actually be lower than  
18 that, but there was confidence that these  
19 values would certainly represent some type of  
20 radium intake.

21           The detection limit, by the way, cited in the  
22 profile, .006, really is the detection limit I  
23 believe that was used by the Massachusetts  
24 Institute of -- MIT and the HASL detection  
25 limit really is .1 -- it's fairly well

1 established in their documents that it's .1.

2 **MR. GRIFFON:** And can -- I'm trying to also  
3 understand the -- would the -- to develop the  
4 radium/uranium ratios, you considered -- I  
5 wonder if these were even going to come into  
6 play. Anyway, you considered the -- the -- the  
7 entire cohort from the CER database to do the  
8 radium ratios. I assume you did the same for  
9 the uranium.

10 **DR. NETON:** That -- that's right, the entire  
11 CER dataset.

12 **MR. GRIFFON:** CER database, and I -- I was  
13 curious whether any attempt was made to look at  
14 the subsection of the uranium CER database that  
15 would apply to those people that were analyzed  
16 via radon breath monitoring. I mean it seems  
17 to me that you should compare apples and apples  
18 to establish this ratio. I'm not sure that  
19 it's intuitively obvious which way it's going  
20 to take the ratio, quite frankly, but I'm just  
21 -- just throwing that out there that -- I don't  
22 know.

23 **DR. NETON:** Well, I would think that it would  
24 increase the uranium -- uranium intakes would  
25 be higher in the production areas of the plant

1           that weren't -- yeah, I mean if -- if plant --  
2           if you're working with uranium metals, your  
3           uranium intakes are going to be -- I mean the  
4           process of -- of uranium. So if we've included  
5           that, our uranium intakes --

6           **MR. GRIFFON:** My -- my sense -- I'm not sure  
7           exactly who got radon breath monitoring, but  
8           I've heard you guys tell me again and again  
9           that the people that worked with the residues  
10          were being pretty favorable because all this  
11          stuff was wet processing, so the chances of ur-  
12          - a lot of uranium dust are probably lower in  
13          those areas than maybe in other -- that --  
14          that's what was going through my mind --

15          **DR. NETON:** Agreed.

16          **MR. GRIFFON:** -- as I was thinking --

17          **DR. NETON:** Agreed.

18          **MR. GRIFFON:** Is -- so if that was the case,  
19          then you could have higher uraniums in your  
20          overall database that are driving the ratio the  
21          other way.

22          **DR. NETON:** But that was the reason that we  
23          went with the radon breath measurements because  
24          you -- you independently calculate a uranium  
25          intake, and then you're not applying any ratio

1 to come up with the amount of radium, and we  
2 still have this issue that Arjun raised about  
3 thorium 230, I'll grant that. But -- but the  
4 radium breath -- the radon breath data gives  
5 you radium intakes independent of whatever the  
6 uranium intakes were.

7 **MR. GRIFFON:** Right, so that -- that's what I -  
8 - I started this discussion by saying I'm not  
9 sure it's relevant anymore 'cause I don't think  
10 you used -- but --

11 **DR. NETON:** Well, if this approach were used,  
12 that's true.

13 **MR. GRIFFON:** Right, right. And -- and so the  
14 radium/uranium ratio in this report was really  
15 considered just to validate it against other  
16 ratios like the silo ratios and things like  
17 that. Is that part of why you presented the  
18 radium --

19 **DR. NETON:** Well --

20 **MR. GRIFFON:** -- to uranium ratios?

21 **DR. NETON:** -- the whole full -- the full  
22 progeny ratios are presented, but we are  
23 definitely proposing to use the ratios beyond  
24 radium for those portions of the decay series.

25 **MR. GRIFFON:** Right.

1           **DR. NETON:** So the silo -- the silo ratios are  
2 relevant if you use radon breath beyond radium.  
3 I mean you've got lead and polonium and those -  
4 - those isotopes, radionuclides. But the --  
5 the analysis, as you can -- as you can read the  
6 document, you've all -- we're trying to  
7 establish these ratios and how you do the dose  
8 reconstructions and then -- you know, the  
9 ratios are established if we were not going to  
10 use radon breath, but then after we decided,  
11 looking at the data, that radon breath were  
12 more appropriate for the K-65 workers -- you're  
13 right, the ratios are not as relevant for  
14 uranium to radium, but certainly from radium to  
15 the other progeny is -- is still relevant  
16 'cause we have to -- we have to be able to  
17 infer the doses -- the intakes for those  
18 nuclides.

19           **DR. MAURO:** Jim, I have a -- I have a -- it's a  
20 really relatively simple question in that -- I  
21 know we've been focusing in on the -- the  
22 radium body burden and the radon breath, but  
23 let's -- let's go back to the worker who worked  
24 with ore, whether it's pitchblende or American  
25 ore. And you have a high level of confidence

1           that that's what he did. Okay? There may be  
2           some possibility that on occasion he may have  
3           worked with some of the residue material.  
4           Okay? And you have urinalysis data for him.  
5           Okay? And that's it. And you've got the  
6           fluorometric analysis, you know what the ur--  
7           the radi-- the uranium is in the urine and now  
8           we're going to say okay, well, what are we  
9           going to assume about this fellow's exposure to  
10          other radionuclides, specifically radium? Now  
11          I could see two paths being taken. One, we'll  
12          assume the one to one ratio, equilibrium with  
13          the -- or alternatively, you're going to --  
14          here's where the judgment comes in. This is  
15          tough call. If -- looking at his work history  
16          there's some ambiguity about whether or not he  
17          did -- he was exposed to some residue. Right  
18          now is it your inclination when those  
19          ambiguities exist, would you say yes, he got  
20          his uranium plus the 95 percentile on the radon  
21          breath, or the one to one ratio with the  
22          radium? In other words, it's going to be a  
23          tough call on criteria for parsing out that  
24          circumstance. Have you -- have you given much  
25          thought on what kind of guidance you will be

1 giving to your dose reconstructors on dealing  
2 with that situation?

3 **DR. NETON:** It's a tough question because it  
4 depends on the situation, and you give some --  
5 you give an example, but it's hard to say from  
6 an example how we'd do it, but certainly he  
7 would at a minimum get the one to one ratio.  
8 But I suspect that if we were not able to  
9 definitively position this worker only at one  
10 to one but he had the potential for much  
11 higher, we would give him the 95th percentile.  
12 We're always going to err on the side that is  
13 the most defensible, and in that case it would  
14 be the 95th. The distribution of doses would  
15 be for someone who -- who was sort of an  
16 ancillary worker that was not near the process  
17 equipment that was generating some of these  
18 dusts and that sort of thing.

19 **MR. GRIFFON:** Just to -- just to go back to the  
20 radium/uranium ratio for a second -- last  
21 question on this sub-- just to understand for  
22 myself, you -- you won't -- there's not a case  
23 now that you -- that you can foresee where you  
24 would use the urinalysis data and just apply  
25 those source term ratios --

1           **DR. NETON:** Well, I --

2           **MR. GRIFFON:** -- I mean you'll use the radium  
3 data or the radium coworker dataset all the  
4 time to generate your radium intakes?

5           **DR. NETON:** That's our intent right now.

6           **MR. GRIFFON:** Okay.

7           **DR. NETON:** Now we do need to go back and --  
8 and look at this issue that Arjun raised with  
9 thorium 230 because --

10          **MR. GRIFFON:** Right.

11          **DR. NETON:** -- it is a little bit vexing, but I  
12 think the -- you know, we need to look at more  
13 than just the fact that thorium 230 is there.  
14 We need to look at the concentration of thorium  
15 230 in the source term and is it even  
16 plausible. We know the ratio of uranium to  
17 thorium in say the airport cake, and it creates  
18 very high ratios. But one needs to look at how  
19 much was there. And given that amount of  
20 projected uranium intake, a person were  
21 required to inhale fairly substantial  
22 quantities of airport cake, we need to -- we  
23 need to look at that to use it as a bounding --  
24 bracketing scenario. So my cautious answer is  
25 yes, we intend to, but -- you know, I'll never

1 say never while this is evolving.

2 **MR. GRIFFON:** Any other questions on 1(d)?

3 Anybody have any...

4 What I was going to propose after this is to  
5 move into item 6 and have you guys present some  
6 of these cases. I think it might be good to go  
7 from 1 to 6 because most of what you're going  
8 to describe in 6 I think continues --

9 **DR. BEHLING:** (On telephone) Mark, can I  
10 interrupt? We're still getting a very  
11 inaudible and fragmented reception for those of  
12 us who are on the phone. Either there's a  
13 problem with the microphone or people are not  
14 speaking into the microphone.

15 **MR. GRIFFON:** Sorry about that, Hans. Is that  
16 better?

17 **DR. BEHLING:** Yeah, you're coming across loud  
18 and clear and so is Dr. Wade, but whenever Jim  
19 Neton and Mauro and -- and others have been on  
20 the microphone, it's very, very fragmented,  
21 words at a time, at best.

22 **DR. MAURO:** Hans, this is John Mauro. Can you  
23 hear me now?

24 **DR. BEHLING:** Yes, I can.

25 **DR. MAURO:** Okay, so the problem is I've just

1 not been speaking loudly and directly into the  
2 microphone.

3 **DR. NETON:** And I guess that's the same thing -  
4 - can you hear me, Hans? This is Jim Neton.

5 **DR. BEHLING:** Yes, I can. When people speak  
6 directly into the microphone, it's not a  
7 problem, but as soon as they withdraw, even by  
8 a matter of inches, then everything becomes  
9 very fragmented.

10 **MR. GRIFFON:** Okay, we will try to pay  
11 attention to that, yeah.

12 **DR. BEHLING:** Thank you.

13 **MR. GRIFFON:** All right. So I think we're  
14 ready to move on to item 6 --

15 **DR. NETON:** All right.

16 **MR. GRIFFON:** -- if you guys want to --

17 **DR. NETON:** We have prepared -- this is going  
18 to be difficult to speak directly into the  
19 microphone when I'm using props, but we have  
20 prepared four dose reconstructions, and  
21 actually these were done by Joe Guido. I'll  
22 set the stage here and then maybe let Joe flesh  
23 out the details of what we have here.

24 But this was a case where -- item 6(a), it  
25 indicated where we had urine, air and breath

1 radon data, how we would do a dose  
2 reconstruction. So here we have a worker who -  
3 - as an example case -- may have had a prostate  
4 and a colon cancer. The person started work in  
5 '51 and -- and completed their work in 1958.  
6 So we pulled out from the database the person -  
7 - in our NOCTS database, our claims tracking  
8 system -- is listed as a chemical operator, and  
9 here you see Joe has pulled out the  
10 designations that appear on the various  
11 dosimetry data forms that -- that are available  
12 from the database. And one can see that this  
13 person worked in a variety of different  
14 positions, even though one -- he's ostensibly a  
15 chemical operator. And I think the chemical  
16 operator designation actually comes from what's  
17 on the EE3 form, the claim form that's filled  
18 out by the claimant. So we can see that he  
19 worked as a furnace room person; a fork truck  
20 operator; dingot, which would be uranium metal;  
21 cleanup; ore room -- that sort of thing.  
22 Data summary -- briefly, we do not deal much  
23 with external dosimetry data in these -- in  
24 these reconstructions, but you can see this  
25 person had a deep dose of -- of 10 rem

1 recorded. Now that would indicate -- that type  
2 of exposure would certainly indicate potential  
3 for exposure to raffinate type materials where  
4 you have disequilibrium of radium and uranium.  
5 And we had no thorium bioassay on this person,  
6 although we didn't have any reason to believe  
7 that he was working in Plant 7E, which is where  
8 the thorium processing work was done. And  
9 there were seven breath radon samples that  
10 ranged from ten percent of tolerance, which is  
11 .1 picocuries per liter, up to .18 -- that's an  
12 odd num-- that must be an average -- yeah,  
13 that's the average, up to 30 percent of  
14 tolerance.

15 And here we have a number of uranium sample  
16 results, most of which were above the detection  
17 limit, and you can see that this person was --  
18 was excreting fairly consistently, over a five-  
19 year period almost, fairly large -- by today's  
20 standards, fairly significant quantities of  
21 uranium. The detection limit here I believe is  
22 ten micrograms per liter -- is that right, Joe?  
23 So anything less than 9.5 picocuries per day  
24 excretion would be undetectable and he only had  
25 a couple of those. There's a few fairly large

1 intakes, doses, in April and July of '53. This  
2 is a summary of his radon breath, as you see  
3 it.

4 And then we get down to the approach. It's  
5 very consistent with what we've been talking  
6 about earlier today. Joe modeled his uranium  
7 intake from his bioassay data, his radium  
8 intake from the radon breath monitoring data  
9 using this document which I provided a copy of  
10 to interested stakeholders of OTIB-25, which is  
11 the -- sort of the historical and rationale  
12 behind converting radon breath measurements  
13 into body burdens. The progeny intake were  
14 normalized to radium based on the ratios that  
15 we described from the Fernald silos. And here  
16 we have the ratios that were used.

17 So one gets down to this relevant column, which  
18 is the intakes, and you can see that a chronic  
19 intake was -- was projected based on the  
20 bioassay for uranium of about 510 picocuries  
21 per day. There -- there is this acute intake  
22 that's been modeled, and that is so that one  
23 can be consis-- have the -- have the data fit  
24 the available information properly. You have  
25 to -- you have to have had a fairly good acute

1 intake early on for these data to fit the  
2 chronic model, so you end up with this 1.8  
3 times ten to the fifth. It sounds like a lot  
4 higher than the chronic, but if one takes the  
5 chronic intake at 510 picocuries per day, you  
6 end up with about an equivalent amount of  
7 intake per year now from that point on. It's  
8 about 1.8 times ten to the fifth picocuries per  
9 year intake, which is very much in line with  
10 what one sees in the site profile for -- for  
11 different types of jobs for time-weighted  
12 average, ten to the fifth, ten to the sixth is  
13 -- is fairly consistent.

14 The radium breath -- radon breath measurements  
15 ended up projecting a radium 226 intake of  
16 seven times ten to the fifth picocuries --  
17 well, 4.4 times ten to the third picocuries per  
18 day in a chronic model, so that gives us 4.35  
19 times ten to the third times 365 -- gives you a  
20 1.6 times ten to the sixth picocurie intake of  
21 radium 226. So you're in the microcurie range  
22 of intake here. Fairly -- fairly substantial  
23 radium intake based on the radon breath model.  
24 Now let me explain a little bit about how that  
25 calculation comes about. You have a radon

1           breath intake that projects a radium body  
2           burden at that time, how much radium is in the  
3           body. One then has to run the IMBA -- the  
4           models backwards and calculate what amount of  
5           radon -- radium could -- should a person have  
6           breathed in to result in that type of body  
7           burden, and that's -- that's how you get  
8           intake. It's just a standard back calculation  
9           of bioassay data to intake. So that's how that  
10          value is arrived.

11          Now you see the thorium 230, polonium 210,  
12          protactinium and actinium intakes are all  
13          ratio'd directly to the radium intake using the  
14          K-65 silo material at Fernald.

15          I'm not sure they show up real well on your --  
16          your -- your handout, yet -- Arjun?

17          **DR. MAKHIJANI:** Yeah, now in this specific case  
18          -- I mean if you look at the work history, the  
19          guy worked in the ore room and also had gang  
20          lead cake, so that would be the K-65 stuff. I  
21          don't know what -- I've forgotten what RAF  
22          means, what is RAF?

23          **UNIDENTIFIED:** (Off microphone) Raffinate  
24          (unintelligible).

25          **DR. MAKHIJANI:** Raf-- so that's -- all cap --

1 caps, okay. I've not seen it in all caps  
2 before. The -- sorry.

3 **MR. GUIDO:** Sorry, I just tried to be honest to  
4 exactly the way it was written in the CER  
5 database. That doesn't mean someone else  
6 didn't transcribe it some other way. But I  
7 tried to be honest to the way it was actually  
8 just in that database.

9 **DR. MAKHIJANI:** Yeah. No, I'm just taking this  
10 at face value, assuming everything is correct.  
11 And so if I -- if I look at this and say pot  
12 room, ore room, raffinates -- which would have  
13 more thorium than radium, gang lead cake --  
14 which would have more radium than thorium, ore  
15 room -- which would have equal radium and  
16 thorium, then how do you decide that the K-65 -  
17 - so this is a specific question. So if you  
18 apply a one to one ratio and say this guy  
19 worked with ore most of the time, then you'd  
20 come up with a much bigger thorium number.

21 **DR. NETON:** Arjun, this is about the third time  
22 we've talked about this, but you know, we  
23 acknowledge that the thorium 230 number needs  
24 to be worked out, and it's still our position  
25 that these values are bounding or are likely

1            bounding. We need to go back and document  
2            this, and I'll -- I'll give you the credit that  
3            it may not be, but we believe they are, based  
4            on certain parameters. For instance, we have  
5            projected that this person has a thorium 230  
6            intake of 545 picocuries per day, so he is  
7            receiving a 1. -- a two times ten to the fifth  
8            picocurie of thorium 230. Now we need to go  
9            back and look at the source term material for  
10           the other, the -- the ore -- the -- sorry, do I  
11           have those? (Unintelligible)  
12           What I'm suggesting here is -- is we've --  
13           we've assigned a ten to the fifth picocurie  
14           intake of thorium 230. We need to go back and  
15           look at the airport cake and those other waste  
16           streams and say is it plausible that a worker  
17           can have a ten to the fifth intake of thorium  
18           230 from a waste stream that has X picocuries  
19           per gram of thorium 230, whatever that is. So  
20           there are physical comparisons that need to be  
21           done here, and I'll acknowledge that that's the  
22           case.  
23           So the -- the bioassay projection models here  
24           are essentially -- you know, the fit of the  
25           data -- I apologize, you probably can't see on

1 a black and white graph and our -- I assume  
2 this is right out of our IMBA software. It's  
3 not very graphically friendly. I mean it gives  
4 you a feel, but you can see the line going  
5 through the data points here. These were  
6 modeled as chronic -- chronic exposures.  
7 Now let's get over to what's of interest here,  
8 the dose table. Based on this level of intake,  
9 we -- we have provided the -- or Joe has  
10 provided the -- now these are not annual doses,  
11 either. It gets very difficult to provide  
12 individual annual doses. Those actually were  
13 used in the probability of causation  
14 calculation run. These are a summation of the  
15 doses from the date of first exposure to the  
16 date of cancer diagnosis, which is the relevant  
17 period that we do for all dose reconstructions.  
18 One can see that there is a fairly substantial  
19 dose from -- I'm having trouble with my  
20 bifocals reading this slide, but polonium 210  
21 gives about 6.7 rem dose to -- this was  
22 calculated to what organ here?

23 **MR. GUIDO:** (Off microphone) Colon.

24 **DR. NETON:** Is this the colon dose? Yeah,  
25 colon dose, I'm sorry. So this is the first

1 cancer that was in the file, so we end up with  
2 a total dose of about 18 rem to the colon. And  
3 then if one models the dose to the -- what we  
4 call the highest non-metabolic organ, that's  
5 the organ that doesn't concentrate any of these  
6 radionuclides, you end up -- I'm sorry, 12 rem  
7 to the colon and about 18 rem to the highest  
8 non-metabolic organ, which in this case would  
9 be the prostate gland -- you end up with  
10 probabilities of causation in the vicinity of  
11 20 percent for the non-metabolic and 26 percent  
12 for the colon. So these are fairly substantial  
13 doses, but the PC -- it's not low, but it's not  
14 past the 50 percent threshold, even given some  
15 of these fairly large intakes.

16 If one goes down and looks at the -- now using  
17 the same data, the same input data, and one  
18 wants to infer what the doses to some of what  
19 we call the metabolic organs -- the dose to the  
20 liver, the bone surfaces and the kidney -- this  
21 is as we've seen in many, many dose  
22 reconstructions. The doses to these organs are  
23 significantly higher, 2,300 -- 20 -- 2,370 rem  
24 to the liver, fairly substantial dose.

25 I -- I -- under almost any circumstance, these

1           -- these values are well above 50 percent. I  
2           don't know if we have the -- you didn't do the  
3           PC values for -- it's -- it's -- for those of  
4           us who work with these numbers a lot, these  
5           values are all well above 50 percent. Bone to  
6           -- dose to bone surfaces, 17,300 rem. The dose  
7           to the kidney is 173 rem, so very much in line  
8           with what we've seen at many other facilities  
9           in situations where you have very large intakes  
10          projected, the metabolic organs are well above  
11          compensability and the organs that do not  
12          concentrate the material don't get there.  
13          Now I will say that we have not included any  
14          external dose in this calculation or any missed  
15          dose due to external, nor have we included any  
16          dose from systemic radon, whether it's  
17          particulate or gas. We -- that's a subject of  
18          another issue here, but that was unlikely to  
19          raise these doses much higher, though, as a --  
20          for a practical matter. These are so large,  
21          the radon doses sort of get lost in the round-  
22          off here, but -- so that -- that's the first  
23          case.  
24          I don't know if there's any questions on this.  
25          This -- these would all change, of course,

1 depending upon the ratios that were used  
2 relative to the -- you know, the source term.

3 **MR. GRIFFON:** Just looking at the --

4 **DR. NETON:** Arjun is very correct. I mean you  
5 look at thorium 230, it is the -- it is the  
6 driver of the dose here for the metabolics of  
7 100 -- 100 rem out of 173 rem for the kidney.  
8 For the non-metabolics, thorium 230 is eight  
9 out of 17 or 18 or so, so it's -- what  
10 surprises us -- what surprises me was the  
11 polonium 210 value, 6.7 rem. I would have not  
12 guessed that, you know, at the start of the  
13 calculations.

14 **MR. GRIFFON:** Can I -- just a question on the  
15 radon breath table?

16 **MR. GUIDO:** Sure, go ahead.

17 **MR. GRIFFON:** Why -- you have three listings of  
18 percent tolerance.

19 **MR. GUIDO:** The CER database in -- has --

20 **MR. GRIFFON:** Right.

21 **MR. GUIDO:** -- two columns of data for each --  
22 an analysis date, and generally the first  
23 column's populated -- once in a while, as you  
24 see on this individual, there's two data points  
25 per date.

1           **MR. GRIFFON:** So you averaged --

2           **MR. GUIDO:** So I averaged those. Going to add,  
3           too, on this case that the ten rem of external  
4           would have -- would make this go over 50  
5           percent. This -- this individual -- this  
6           person has ten rem of external dose, and even  
7           without the modifying factor, that would --  
8           that would be enough, but I didn't include that  
9           in the POC values.

10          **DR. NETON:** Yeah, 'cause the doses -- internal  
11          doses stay the same, but you're -- you're sure  
12          ten rem would put those over?

13          **MR. GUIDO:** Yeah, 'cause they're going from ten  
14          -- they're -- the thing about this case is it's  
15          two cancers, so each one needs to be --

16          **DR. NETON:** Right, yeah --

17          **MR. GUIDO:** -- (unintelligible) 30 percent --

18          **DR. NETON:** -- I think we're trying to keep  
19          that a separate issue, whether it's two cancers  
20          or not. We're trying to look at the individual  
21          cancers here because that's really what we're --  
22          -- yeah. I mean this is an example case and  
23          we're not trying to decide whether this pers--  
24          this particular individual has any  
25          compensability, so -- but I think -- I think if

1 we took the individual cancers at face value  
2 and added ten rem, it would be my guess that  
3 they would not go over --

4 **MR. GUIDO:** No.

5 **DR. NETON:** -- 50 percent. But -- you know,  
6 'cause it -- it's not a linear function, as we  
7 all know.

8 I'd just like to point out a couple of things,  
9 is one is that the intakes that were projected  
10 here are fairly consistent with the Table 29  
11 values for -- for time-weighted averages,  
12 although arguably a little higher. They  
13 certainly aren't lower, and I -- I think if we  
14 actually used the time-weighted average value  
15 to estimate intakes here, we would have likely  
16 had a smaller dose -- in this particular case.  
17 I -- you know, it's -- it's very difficult for  
18 us to generalize to all cases. It's just not  
19 possible. But in this instance, I would say  
20 the radium intake by itself is about there.  
21 The uranium intake is about equal to Table 29  
22 values. But when you put them together, you  
23 end up with a slightly higher intake because we  
24 have separate estimates of intake. And again,  
25 I -- you know, this -- and that's -- that's

1 just for the radium and the -- and the --  
2 radium. You start adding in the thorium 230  
3 source term of ten to the fifth picocuries per  
4 year, you end up with some fairly substantial  
5 intakes here.

6 **DR. MAURO:** Just for clarification, if you were  
7 to use -- now what I understand is if you were  
8 to be using the previous method, you would be --  
9 -- the approach would have been to assume the --  
10 you would have used the urinalysis for the  
11 uranium and, given his job descriptions, you  
12 would have assumed 100 times that concentration  
13 for radium in the urine, and then back-  
14 calculated what the intake would have been.

15 **DR. NETON:** Right.

16 **DR. MAURO:** In this case you're going with the  
17 radon -- the actual -- for this worker you have  
18 radon exhalation data --

19 **DR. NETON:** Right.

20 **DR. MAURO:** -- and you have some value for what  
21 the radium body -- and you're saying that's  
22 what makes the difference, along with some of  
23 these other ratios you used --

24 **DR. NETON:** Right.

25 **DR. MAURO:** -- so that we had a small

1 difference. Now, the question becomes if this  
2 worker did not have radon breath analysis and  
3 you would have had to have gone with the 95  
4 percentile, would that have had a substantial  
5 effect on the dose and the amount of radium  
6 taken in?

7 **DR. NETON:** You make a good straight man, John.  
8 That's my next example.

9 **DR. MAURO:** Oh.

10 **MR. GRIFFON:** (Off microphone) I figured that  
11 was (unintelligible) ask for one of those.

12 **DR. NETON:** We didn't rehearse that.

13 **MR. GRIFFON:** (Off microphone) But there it is.  
14 Right?

15 **DR. NETON:** It's our next example, but -- so --  
16 it's -- it's a good point, though. You raise a  
17 very valid point here.

18 One thing I'd like to point out, though, is --  
19 and Arjun brought this up. If you look at this  
20 person's work history, it's pretty clear that  
21 he worked in a lot of different areas that were  
22 raffinate, no raffinate, maybe some thorium  
23 higher than radium -- it's hard to say. This  
24 guy was all over the place. I bel-- I suspect  
25 that, you know, based on the time-weighted

1 cards we have on a person like this, we could  
2 apportion based on time. It gets to be very  
3 unwieldy, though, and -- and then one gets down  
4 to exactly how closely do you parse these  
5 people's work histories out. I mean because we  
6 have it doesn't necessarily mean we have to use  
7 it all, you know. I mean it becomes very  
8 cumbersome at some point.

9 So let's -- let's move on to number two, which  
10 is exactly the same case, but we -- Joe assumed  
11 that we had no -- we just didn't have access to  
12 the radon breath data. Where is it?

13 **MR. GUIDO:** Make a comment there --

14 **UNIDENTIFIED:** (Off microphone)

15 (Unintelligible)

16 **DR. NETON:** I've got -- thank you.

17 **MR. GUIDO:** -- in looking for these cases for -  
18 - for active claimants we had all the data on,  
19 I could not find one that was, you know,  
20 clearly a ore/raffinate worker who didn't have  
21 radon breath. I had to go this route. Not  
22 that there isn't one out there, but I looked  
23 through the 129 claims we had and couldn't find  
24 it, so...

25 **DR. NETON:** Okay. So this -- the demographics

1 on this case are identical 'cause it's the same  
2 case and we had all the same information, same  
3 bioassay for uranium in urine, applied the same  
4 ratios, got the same uranium projection --  
5 although I'm not sure it's not just a cut and  
6 paste of the original analysis. But what we  
7 did was we did not have -- what, did I miss  
8 something here? I want to show the -- okay,  
9 there's the uranium in urine. Okay, the  
10 approach, uranium intake from uranium bioassay,  
11 radium intake from 90th (sic) percentile of CER  
12 radon breath analysis, and then the progeny  
13 were normalized to radium. There's the ratios,  
14 and there's your projected intakes based on the  
15 95th percentile. And you see he has 8.78 times  
16 ten to the third picocuries per day, so they --  
17 he ends up with about 3.2 times ten to the  
18 sixth picocuries intake per year of radium 226,  
19 which is higher than I think the first case,  
20 but not ridiculously higher. I mean it's in  
21 the same ball park.

22 Now that -- that shows you the radon breath  
23 ranges give pretty high projected intakes. I  
24 mean 'cause the sensitivity of this technique  
25 is not -- it's better than some cases, but it's

1 not as good as whole body counting, for  
2 example. You can get down much lower.

3 **DR. MAKHIJANI:** (Off microphone)

4 (Unintelligible)

5 **DR. NETON:** That was using the 95th percentile  
6 of -- of the radium.

7 So anyways, let's move on to the doses. This  
8 would be --

9 **DR. MAURO:** Jim, I'm sorry, this is John Mauro.  
10 When you pick the 95 percentile, you work with  
11 the entire population of radon breath data --

12 **DR. NETON:** Correct.

13 **DR. MAURO:** -- and not try to parse it in any  
14 way.

15 **DR. NETON:** No.

16 **DR. MAURO:** Okay, thank you.

17 **DR. NETON:** We've looked at that. It's very  
18 difficult to parse those values. We have 2,500  
19 samples. Once you start breaking it out by job  
20 description, it -- it's tough to do.

21 The bottom line dose here is that his colon  
22 dose is now 22 rem. I think it was what, 12  
23 rem before? His dose is about doubled here.  
24 And I suspect, as Arjun has pointed out, much  
25 of it is due just because of the larger radium

1 intake, which has jacked up the amount of  
2 thorium intake.

3 As a matter of fact, let's go back and look at  
4 that thorium intake. Yeah, if you -- if you  
5 have more -- his thorium 230 now is 1.1 times  
6 ten to the third picocuries per day times 365 -  
7 - it should be about double. I'm having  
8 trouble with my calculator. Yeah, he's at four  
9 times ten to the fifth, I think you've got two  
10 -- so it's about -- it's a little -- again,  
11 Arjun has correctly pointed out thorium 230 is  
12 a driver nuclide here in these calculations,  
13 very sensitive to that. But again, we're  
14 assigning a four times ten to the fifth  
15 picocurie intake of thorium. We need to do our  
16 homework and come back and convince folks, as  
17 we believe, that these values are plausible  
18 bounds of thorium intakes for these workers  
19 based on the other waste streams. That's --  
20 that's what we need to do, and I totally agree  
21 with that. I totally agree we need to do that.  
22 Okay. So again, even though the dose has  
23 doubled here, neither -- neither of the colon  
24 nor the prostate gland are above 50 percent.  
25 However, I'm not convinced if you add in -- you

1           might add in the ten rem plus missed dose and  
2           be over 50 percent. I'm not sure that's the  
3           relevant part of this conversation. I mean  
4           that -- these are just how they came out. I  
5           don't think we need to model these doses to  
6           where the PC comes up. It's just for  
7           information only.

8           **DR. MAKHIJANI:** But if you take this specific  
9           example and you add up the probabilities of the  
10          two cancers, in the first case where you had  
11          the data, the person is non-compensable. And  
12          in the second case where you don't have the  
13          radon breath data, the person becomes  
14          compensable. No?

15          **DR. NETON:** (Off microphone) He was non-  
16          compensable under both cases.

17          **DR. MAKHIJANI:** Oh, you don't add up the  
18          probabilities.

19          **DR. NETON:** Speaking if they were individual  
20          cancers, the pers-- the individual cancers  
21          themselves, if taken separately, were non-  
22          compensable. If they were taken collectively,  
23          I believe they would have been compensable  
24          under both scenarios.

25          **MR. GRIFFON:** But I -- I think his point stands

1           that --

2           **DR. NETON:** But the point is that --

3           **MR. GRIFFON:** -- the POC is doubled with --  
4           when you don't have the data. Right?

5           **DR. NETON:** Right -- well, I think this is --  
6           this is something that is -- is -- is an issue  
7           with this program. The less you know, the more  
8           you have to infer. And when we infer in a  
9           claimant-favorable, that's what happens. I  
10          mean --

11          **MR. ELLIOTT:** But these examples weren't  
12          designed or derived to demonstrate  
13          compensability. These examples were designed  
14          to answer the questions that were raised at the  
15          Board meeting that -- and we were charged to  
16          come back to you all with answers for,  
17          demonstrate how we would treat certain data  
18          streams.

19          **DR. NETON:** But -- but Arjun is correct in  
20          pointing out that where we have workers who  
21          should have been monitored and weren't and we --  
22          we estimate doses, the doses will be higher.  
23          And this is not necessarily just relevant to  
24          Mallinckrodt. It's relevant across all the  
25          dose reconstructions we've been doing.

1           **DR. WADE:** Denise?

2           **MS. BROCK:** I just want to make sure that I  
3 understand. When you have two separate  
4 primaries, when I looked at that I guess I was  
5 thinking, too, that you add the two together,  
6 even though we're not discussing  
7 compensability. Is that correct, though, you -  
8 -

9           **DR. NETON:** Right.

10          **MS. BROCK:** -- you add the two together.

11          **DR. NETON:** They're both considered. It's not  
12 additive, but you're right, they are -- they  
13 are -- there's a formula that we use to --

14          **MS. BROCK:** Combine it.

15          **DR. NETON:** -- combine them.

16          **MS. BROCK:** Okay. Thanks.

17          **DR. NETON:** Yeah. We just wanted to segregate  
18 those, just because we're not really discussing  
19 compensability here.

20 Okay. And then if one looks at the alternative  
21 organ doses that -- that Joe has calculated --  
22 liver, bone surfaces and kidney; these are what  
23 we would call metabolic organs -- the doses  
24 have gone up, as well, and -- about doubled,  
25 and again, these dose-- these organs are all

1           compensable, you know, under both scenarios.  
2           Well, the doses are very high under both  
3           scenarios. So that -- that -- it demonstrates  
4           our -- our approach when we don't have radon  
5           breath data and we have radon (sic) in urine  
6           data.

7           Okay, any -- any other questions on this --  
8           this specific case?

9           **DR. MAKHIJANI:** (Off microphone)

10          (Unintelligible) Is Joyce on the phone and does  
11          she have any questions?

12          **DR. NETON:** I'm not sure. I'll speak directly  
13          into the microphone. Arjun has asked if Joyce  
14          Lipsztein is on the phone and she might have  
15          any questions.

16          **DR. BEHLING:** (On telephone) No, Joyce -- I got  
17          an e-mail from Joyce -- this is Hans Behling --

18          **DR. LIPSZTEIN:** (On telephone) I -- I'm in  
19          (unintelligible) Hans.

20          **DR. BEHLING:** Oh, okay, you are on --

21          **DR. LIPSZTEIN:** (Unintelligible) yes, I'm on.

22          No, I don't have any questions now. I think  
23          that's okay. When you -- I don't see the  
24          slides you have (unintelligible), Jim, but when  
25          you back off the (unintelligible) radium from

1           the radon in breath, so you took an account of  
2           how many years the guy had been working --  
3           right? -- for the cumulative radium in the  
4           bone?

5           **DR. NETON:** We did this -- Joyce, we're having  
6           a lot of trouble hearing you, but I think your  
7           question is did we take into account the number  
8           of years the person was working, and we did  
9           this on an annual basis. The radon breath was  
10          assigned per year based on the values that were  
11          measured or inferred.

12          Is that right, Joe? I think that's what you  
13          did.

14          **MR. GUIDO:** Yeah. Yeah, I wasn't sure what her  
15          question was. I mean I know this -- the one  
16          thing that's strange about this --

17          **DR. NETON:** Speak directly into the mike.

18          **MR. GUIDO:** One thing that's strange about this  
19          case is the radon breath data is only available  
20          for the first -- what is it, the first four  
21          year-- three years of employment, and yet we  
22          gave him -- that's the exposure based on a  
23          chronic, and extended it all the way out to the  
24          end of the employment. So I wasn't sure if  
25          that was your -- your question about the

1 duration of the exposure. It was for the  
2 entire employment period, even though the radon  
3 breath monitoring ended, you know -- and one  
4 could postulate why, but you know, you really  
5 can't determine a good enough reason to turn  
6 off the dose, as we talked about earlier. So  
7 does that -- does that help or does that  
8 totally miss what you were asking?

9 **DR. LIPSZTEIN:** It's very -- I can hardly hear  
10 you.

11 **MR. GRIFFON:** (Off microphone) She can't hear  
12 you.

13 **MR. GUIDO:** Well, I can talk a little louder --  
14 I can talk loud.

15 **DR. WADE:** Go ahead.

16 **MR. GUIDO:** I'm not sure if the answer to your  
17 question is -- you know, in this specific case  
18 the radon breath monitoring data was only  
19 present for the first three years, yet the  
20 intake that was assigned was assigned -- you  
21 know, using that data for the entire employment  
22 period. So -- I mean is that an answer to your  
23 question, 'cause we were -- or not?

24 **DR. LIPSZTEIN:** Yeah, yeah, because I was  
25 thinking -- I was -- what I wanted to know is

1           that if you considered each -- as if it was  
2           just one year intake or the whole life because  
3           the radon would accumulate in the skeleton so  
4           what you see from the radon badge would  
5           (unintelligible) his whole working period.

6           **MR. GUIDO:** Right, for -- so for this intake  
7           assessment we used the -- the three years -- so  
8           it was based on the three years of data, so we  
9           didn't postulate any data further out, but we  
10          did assign a chronic intake and it -- you know,  
11          it continued on beyond -- but the -- but the  
12          level of the chronic is based on the three  
13          years of data.

14          **DR. LIPSZTEIN:** Oh, okay. Okay, that -- that  
15          was my question, yes. Okay.

16          **DR. NETON:** Okay, should I move on to example  
17          three then?

18          All right, the third -- the third example I  
19          think has to do with the thorium workers, and  
20          we haven't discussed this much. By thorium  
21          worker here, we mean people who worked on the  
22          special project in Plant 7E, I think it was, to  
23          -- to take the airport cake which had thorium  
24          230 in it and concentrate it to ship to Mound.  
25          Now this was a -- a wet chemical process that,

1 to the best of my knowledge and looking at the  
2 data, never took the material to dryness. This  
3 was a thorium nitrate solution I think was  
4 actually what ended up being shipped to Mound,  
5 but it was -- the task at hand here was we have  
6 a thorium worker. We had uranium and thorium  
7 analyses and radon breath, which I'm not sure  
8 was relevant here. Let's see, this was to --  
9 example internal dose asks for Plant 6 -- Plant  
10 7 thorium extraction worker.

11 So it turns out then in looking through the  
12 database, we have found I think it's about 70  
13 bioassay samples that were analyzed for thorium  
14 230, and specifically for -- for workers -- I  
15 believe they were in Plant 7, although there  
16 might have been an indication that some of  
17 these workers were Plant 6 and moved over to 7,  
18 but in this time frame these were HASL results  
19 in the data files for workers. So we have 70  
20 bioassay samples. This particular person has a  
21 bioassay sample, so let -- let's just go  
22 through this.

23 Ionium of course is the historical name for  
24 thorium 230. This particular case had a  
25 pancreatic cancer, who started work in '49 and

1 ended shortly -- '58 plus with a break in  
2 employment at one point. This was a laboratory  
3 technician. He had -- his dosimetry data  
4 indicated he was a chemist, a Plant 7E worker,  
5 a technician, a process Plant -- so there's a  
6 lot of indication here that this person worked  
7 in Plant 7E where the thorium extraction  
8 process was done. He has, again, a fairly high  
9 external dose, 8.2 rem, which is consistent  
10 with working with some material that had some  
11 high photon activity rather than just straight  
12 uranium.

13 There was one thorium bioassay sample that was  
14 -- the result was 1.4 disintegrations per  
15 minute per liter. The person actually did  
16 have, it looks like, seven radon breath  
17 samples, which is interesting. So -- he also  
18 has uranium bioassay. So here a worker has a  
19 number of uranium bioassay samples; in the  
20 early days many of them above the detection  
21 limit, and after 1955 they were all less than  
22 detectable. Here is a summary of the radon  
23 breath data that appears to be increasing over  
24 time, somewhat substantially -- ten, 20, 40,  
25 20, 60, so that's interesting. And now we have

1 thorium in urine data, so if we -- and we used  
2 the -- these ratios -- okay, the approach, we  
3 analyzed the uranium from the bioassay data,  
4 the radium intake was from the breath data  
5 monitoring. The polonium was intake --  
6 normalized to radium based on the ratios, and  
7 then the thorium intake was from thorium  
8 bioassay. So you're going to have to explain  
9 some of these normalized ratios that you used,  
10 I think, 'cause I don't think we've gone over  
11 these before -- Joe or Cindy.

12 **MR. GUIDO:** Yeah, you mean the -- those are  
13 basically the ratio to radium or the ratio to  
14 thorium, and so I guess the terminology I used,  
15 when I said normalized, that's just basically  
16 you're applying those ratios. The polonium  
17 isn't present in -- the -- the thorium ratios  
18 don't include polonium, so I went ahead and put  
19 it in, at least on the radium 'cause there was  
20 radium -- radon breath monitoring. And this,  
21 again, is an example of being very claimant  
22 favorable because here -- the person -- if you  
23 look at their data on their card, they're  
24 clearly a -- a 7E worker. I mean they -- they  
25 worked -- I mean most of the data was tagged

1 Plant 7E. However, there was radon breath  
2 monitoring data, so we went ahead and said well  
3 -- we gave him the radon -- the radium exposure  
4 from that scenario, also. So it's probably  
5 double -- double -- you know, giving him twice  
6 of some things, but you can't really split it  
7 apart to say when he did one and when he did  
8 the other.

9 **DR. NETON:** Okay. So here is the projected  
10 intakes -- (unintelligible).

11 **DR. MAKHIJANI:** I just -- I just want to  
12 understand these numbers. So what you did is  
13 you just carried the radium through the '58  
14 from the time that there was the radon breath  
15 data and then the thorium 230 for '55, '57, you  
16 derived from that one --

17 **MR. GUIDO:** Exactly.

18 **DR. MAKHIJANI:** -- sample.

19 **MR. GUIDO:** Exactly.

20 **DR. MAKHIJANI:** Now how does that work when you  
21 have one sample in the beginning of the period,  
22 when did production start, how did production  
23 progress in terms of its volume, because that  
24 seems to me right in the beginning of the  
25 period. Right?

1           **MR. GUIDO:** Yes -- yes, it is. Well, it was  
2 assigned as a chronic intake with the -- you  
3 know, using that one sample 'cause that's --  
4 that's the only data we have for it, so...

5           **DR. NETON:** So you raise a point, this was  
6 early -- earlier on in the process, but you  
7 know, what amount of intake per day would it  
8 take to get up to that value, given the amount  
9 of time that -- that the person had -- had  
10 worked. Here's the radium bioassay projections  
11 fit. There's the uranium projection.  
12 And then let's look at the dose to the  
13 pancreas. This is 110 -- the rem dose to the  
14 pancreas, 75 percent of the dose is contributed  
15 to by the thorium 230. The rest of the intake  
16 values are very low contributors to this  
17 person's pancreatic dose.  
18 Now at 110 rem, this person -- if one were to  
19 do a calculation, PC is right at 50 percent.  
20 Now if we look at the alternative doses, what  
21 we call the metabolic doses, we've got the  
22 highest non-metabolic actually in here at 130,  
23 and that's -- that's going to be similar to the  
24 dose to the pancreas -- it should be, I can't -  
25 - it should be right -- well, very close. Now

1 the dose to the liver, the bone surfaces and  
2 the kidney are much, much higher, which is what  
3 you'd expect for an organ that concentrates, to  
4 some extent, thorium 230. Although  
5 interestingly, the -- the bone surface dose is  
6 also driven, to a large extent, by the actinium  
7 227, which is not a surprise -- a fair amount  
8 of daughters, progeny, related to actinium 227  
9 that are alpha emitters. Actually that's the  
10 largest component of the dose, isn't it? Yeah,  
11 so that's the --

12 **DR. MAKHIJANI:** Jim, in the site profile, in  
13 Table 29F, it says that the thorium production  
14 started in July 1955 and your sample's from  
15 April '55.

16 **MS. BLOOM:** We definitely have information that  
17 they started in March --

18 **DR. MAKHIJANI:** (Off microphone) Okay.

19 **MS. BLOOM:** -- of '55, so I'm not sure if --

20 **DR. NETON:** That may be production --

21 **MS. BLOOM:** -- if that was better --

22 **DR. NETON:** -- versus --

23 **MS. BLOOM:** Yeah.

24 **DR. NETON:** -- pilot operation.

25 **MS. BLOOM:** Yeah. But the program did start up

1 in March. It -- it didn't start before 1955,  
2 in January, but we definitely saw something  
3 that indicated March was the start-up date.

4 **DR. NETON:** Now one point of interest here, I  
5 suppose, if one looks in these values at the  
6 ratio -- 'cause remember, this is airport cake  
7 material. One can look at the ratio of uranium  
8 to thorium in these samples -- or in these  
9 projected intakes, and they vary over time, but  
10 the projected uranium intake is about 300  
11 picocurie. These are per day, I assume, here.  
12 So you know, there are some fairly large  
13 discrepancies here of thorium, but again, this  
14 was a -- this was a process that was  
15 concentrating the thorium into a thorium  
16 nitrate solution. So these are not necessarily  
17 relevant to the -- the airport cake product  
18 itself, but I think one doesn't see a ratio  
19 higher than 100 to one, probably. Yeah, so you  
20 know, you're below 100 to one ratio here, which  
21 I think is not that inconsistent with some of  
22 the airport cake material.

23 Again, we need to -- we need to look at the  
24 airport cake material and see what the actual  
25 concentration of thorium 230 was in the source

1 material and the plausibility of getting higher  
2 intakes than -- than what we've estimated for  
3 the radium guys.

4 Okay, I think case three -- or four -- I've  
5 actually forgotten what case four was, but it's  
6 a thorium worker where we have no bioassay --  
7 or without thorium bioassay. We have uranium  
8 and breath, and the uranium and breath  
9 calculation, of course, would end up being the  
10 same. And the thorium and protactinium are  
11 normalized to uranium intake based on ratios.  
12 I think this -- this is where you applied this  
13 ratio, Joe?

14 **MR. GUIDO:** Yeah, there's a -- there's one  
15 point of clarification here. The thorium --  
16 this individual has four intake periods bec--  
17 one of it's because there's a break in  
18 employment and such, but for the '55 to '57  
19 period, which would be the period of the  
20 thorium operations, for this case we said well,  
21 again -- you know, this is a thorium worker,  
22 but we don't have thorium data. So what we did  
23 is the thorium 230 is based on 100 times the  
24 uranium, and that did not make it into the  
25 approach paragraph there, I apologize for that.

1 But that's where -- that's the only difference  
2 between this case and the others. The examp--  
3 so the purpose of this is just to demonstrate  
4 what would we do if we're convinced it's a  
5 thorium worker but we don't have thorium data,  
6 so we give it the 100 to one ratio, which is  
7 going to make the exposures higher.

8 **DR. NETON:** Now what is the basis for the 100?  
9 You might want to explain that.

10 **MR. GUIDO:** Yeah, that's from the -- the  
11 document here. You know, we're saying what the  
12 ratio of thorium 230 to uranium and -- where  
13 did those numbers come from, Cindy?

14 **MS. BLOOM:** That's based primarily on our  
15 initial look at the AM-7 -- the -- the airport  
16 cake.

17 **DR. NETON:** Right, okay. So in this particular  
18 case, using that 100 to one ratio to uranium,  
19 the bioassay projections are the same, the  
20 doses are presented here and again it looks  
21 like they about doubled over what was projected  
22 without bioassay. Thorium 230 is driving the  
23 calculation with 100 -- 200 rem out of 227  
24 total, and the PC value of course is well over  
25 50 percent in this case -- 67 percent.

1           If one looks at the alternative organ doses --  
2           not the -- well, the -- the non-- that's the  
3           non-metabolic one I just showed. These are the  
4           metabolics and these are all of course higher  
5           than the last example, and the PC -- well, we  
6           didn't calculate PC value, but they're all --  
7           they're all very substantial doses. For the  
8           most part, when you get above 100 rem or so,  
9           it's pretty -- depends on the case, but 100 rem  
10          will certainly get a PC of 50 percent or  
11          greater for most -- most calculations. I think  
12          I'm safe to say that. So again, the metabolic  
13          organs under this scenario are also  
14          compensable.

15          But what we have here is a picture of some  
16          fairly substantial intakes. We knew that  
17          Mallinckrodt was a messy operation. These  
18          intakes are large. It's not surprising that  
19          they're -- they're coming out large with very  
20          large doses. That's what we expected.

21          **MR. GRIFFON:** Okay, I think we can -- if  
22          there's no more questions on the cases, I think  
23          we can go back to the -- to item number two,  
24          which is the handling of the radon exposures.  
25          Jim, maybe you'll --

1           **DR. NETON:**   Okay.

2           **MR. GRIFFON:**  -- give us an intro.

3           **DR. MAKHIJANI:**  (Off microphone)

4           (Unintelligible) Joyce (unintelligible).

5           **DR. NETON:**  Joyce, are you still on the phone?

6           **DR. LIPSZTEIN:**  I'm still on, but I can't --

7           now I can hear you.  I couldn't

8           (unintelligible).

9           **DR. NETON:**  Okay, I need to speak loudly, I  
10          guess, because we want to make sure that you  
11          hear -- hear what I'm saying.

12          **DR. MAKHIJANI:**  Joyce, this is Arjun.  I -- I  
13          sent you that little list.  I don't know -- I'm  
14          relying on you here to ask the questions  
15          mainly, and I'll fill in, but -- so please  
16          speak up if you can't hear.  All right?  Thanks  
17          a lot.

18          **DR. LIPSZTEIN:**  Okay.

19          **DR. NETON:**  Okay.  On the first issue, which is  
20          item 2(a), resolve whether sufficient radon  
21          data are available, this was the result of the  
22          profile not actually addressing or utilizing or  
23          summarizing, rather, all of the -- all of the  
24          radon data that were available in the CER  
25          database.

1 We've gone back and analyzed those data -- I  
2 believe there are around 5,000 radon samples  
3 that were taken over -- over the relevant  
4 period here. And I've actually provided those  
5 -- the -- a document to the stakeholders that  
6 shows the results of those summary analyses,  
7 providing geometric mean standard deviations  
8 and relevant percentiles -- I think 84th and  
9 95th percentiles -- and along with some  
10 statistics that demonstrate goodness of fit.  
11 As has been the case with almost all these  
12 analyses, the data fit a lognormal distribution  
13 fairly well. We are proposing to use the  
14 distribution of the radon measurements in the  
15 facility to assign radon intakes to workers.  
16 Now -- so that, for instance, if a person were  
17 a worker in the Plant 6, they would be assigned  
18 a radon intake equal to the 95th percentile of  
19 the radon -- dose radon measurements in that  
20 plant by year.

21 That said, we need to recognize that radon is  
22 the largest contributor of dose to the lung.  
23 We have done almost all the lung cancer cases  
24 in our possession already. And if I'm not  
25 mistaken, I think all of those have been -- I'm

1 not sure -- I'm pretty sure all those have been  
2 compensable, and that's driven by maybe factors  
3 other than radon, just -- just the -- the  
4 uranium intakes. I mean any time you get  
5 actinide intakes deposited in the lung, such as  
6 you have at Mallinckrodt, the lung doses are  
7 going to be very large, and that's been the  
8 case here.

9 So when we propose to provide these 95th  
10 percentile distributions, we would apply them  
11 to lung cases that -- if necessary, to add to  
12 the dose to move them over 50 percent. We  
13 don't believe that's necessary in this case.  
14 Then we have to get to the relevant issue,  
15 which is do we start adding radon tissue doses  
16 -- that is what I would call systemic tissue  
17 doses -- to -- to the dose reconstructions to  
18 account for any dose that may be present due to  
19 radon gas or daughters.

20 **DR. MAURO:** Jim, it's John Mauro. I have one  
21 question regarding the -- the radon database.  
22 If I recall in your write-up, within that  
23 database you excluded radon measurements  
24 associated with when they were cracking the  
25 lids, or is that data included in there?

1           **DR. NETON:** That data is included. I think  
2           that the write-up actually said that we did not  
3           exclude it, or something to that effect.

4           **DR. MAURO:** Oh, I misunderstood. Thank you.

5           **DR. NETON:** Yeah, so in some sense -- you know,  
6           we're assuming a chronic exposure to the 95th  
7           percentile of -- of the dataset that more than  
8           likely includes short term, episodic instances  
9           or incidents that could have occurred that were  
10          measured, you know, at that time. So you --  
11          and you get some fairly high radon intakes in  
12          the -- in the early periods, 1949-'50. After  
13          that, it drops fairly well. I thought I had it  
14          plotted but I guess I don't have it here.

15          **MS. BLOOM:** But you might -- you might have  
16          something on a file called "MCW preliminary".

17          **DR. NETON:** Well, I don't -- I don't have it on  
18          my -- Arjun has it. I have a spreadsheet for  
19          radon here, let me just -- I think that's radon  
20          breath, yeah. I don't know what that is there.  
21          For some reason I don't know what the -- well,  
22          anyway, the data --

23          **DR. MAURO:** (Off microphone) I think you do.

24          **DR. NETON:** -- are summarized -- do I?

25          **DR. MAURO:** I think -- I think you do have it

1 in this document right here (unintelligible).

2 **DR. NETON:** What's the document called, John?

3 **DR. MAURO:** It's called "Draft Statistical

4 Analysis of Airborne Radon and Coworker

5 Bioassay --

6 **DR. NETON:** Right.

7 **DR. MAURO:** -- and External Data". One of the

8 tables I believe is the -- by year, the radon

9 measurement data.

10 **DR. NETON:** I think this is it right here, hang

11 on. I've worked with so many files in the last

12 ten days I can't keep them straight. And so

13 has my col-- so have my colleagues, all of whom

14 recog-- okay, yeah, here it is.

15 There's a table, here we go -- yeah, this is a

16 penetrating dose, external shallow, missed dose

17 -- here we go, summary of statis-- of radon in

18 breath, airborne rad-- I'm getting there. Bear

19 with me, please.

20 Table 7, Summary Statistics of Airborne Radon,

21 Picocuries per liter. You can see in this --

22 the 50th percentile -- we calculated and

23 measured -- let's just -- they're -- they're

24 very close. That was just to demonstrate the

25 goodness of fit. But we started off with the

1           50th percentile somewhere in the mid-30  
2           picocuries per liter '48, I'm not sure what  
3           happened there in 1949.

4           I think what's more relevant, actually, if you  
5           go over -- we don't have the 95th percentile on  
6           here, but if one looks at the -- the 84th  
7           percentile, as you get out to the extremes of  
8           the distribution the values obviously get  
9           higher, and with the GSDs fairly large,  
10          particularly 1949. This is where we've had,  
11          you know, a massive influx of the K-65 material  
12          going through. And I think you can get  
13          somewhere upwards of almost 1,000 picocuries  
14          per liter at the 95th percentile in '49.  
15          Now that sound-- that is a lot, and the lung  
16          dose is going to be huge from that. But -- and  
17          we can talk about this in part (b), but if we  
18          look at the radon dose to tissues, it's -- at  
19          least from the dissolved gas perspective, it's  
20          .6 millirem per picocurie per liter of radon  
21          gas in the -- in the tissues themselves, so it  
22          would -- it would add, at 1,000 picocuries per  
23          liter continuous exposure, somewhere around 600  
24          millirem dose. That's not trivial, it's not  
25          zero. For the metabolic organs it's very small

1 compared to what we've calculated. For the  
2 non-metabolics it may indeed be worth  
3 considering.

4 That would be the worst case. I think as you  
5 go down from there, when you get into the 100  
6 picocurie per liter, 95th percentiles give you  
7 a 66 millirem. Now we need to discuss that,  
8 whether or not the gas is relevant or the  
9 daughters, but -- but we are proposing that we  
10 use the 95th percentile of the distribution and  
11 then just assign it to workers in the plant.  
12 Very similarly to the radon breath analyses, we  
13 would take the 50 -- the full distribution and  
14 apply it to people who did not appear to have  
15 worked full time in Plant 6, those who were  
16 ancillary support workers, that sort of thing.  
17 So that's where we are. We had hoped to get  
18 this more refined than that, but it just  
19 becomes difficult to definitively document --  
20 when you start -- when you start parsing the  
21 worker job activities too finely, it becomes  
22 difficult to -- to demonstrate definitively  
23 that you -- you know, you've done that  
24 properly. So we are -- we are proposing to use  
25 at least these two distributions. There's a

1 possibility of a third, but we're not there.

2 **MS. BROCK:** I have a question that's probably a  
3 really stupid question. Maybe I'm just not  
4 understanding. When -- I know you say that the  
5 lung dose with radon a lot of times is very  
6 high, and I -- I think that all the lung  
7 cancers so far have been compensable, so I  
8 guess I'm confused. When you talk about other  
9 tissues, are you referring to organs as well,  
10 and is it -- when you use this model, the  
11 breath radon model, to dose reconstruct the  
12 non-metabolic cancers other than lung or  
13 something that wouldn't seem as compensable,  
14 are the workers -- are the claimants going to  
15 be at a disadvantage using this because of the  
16 radon breath model? Would they be better off  
17 with the daily weighted average? Could you --

18 **DR. NETON:** This is somewhat different -- it's  
19 a somewhat different issue than the radon  
20 breath. This is -- this is a dose pathway that  
21 really was not addressed in the site profile.  
22 This is in response to an issue that was raised  
23 by SC&A in their review, who indicated that  
24 radon gas itself, the progeny, the daughters,  
25 are known to cause large doses to the lung and

1           in general the systemic organs, the doses  
2           removed from the lung, the soft tissue. The  
3           doses frankly have been ignored in every  
4           calculation I've ever seen. They're just  
5           assumed to be trivial.

6           Now for -- but for Mallinckrodt, in -- in cases  
7           where you have these very high gas  
8           concentrations, it's possible to get doses to  
9           the systemic organs that are -- not zero,  
10          there's some value. Now we need to make a  
11          decision whether we're going to address the  
12          doses to those tissues and how we're going to  
13          account for those doses. So this is a separate  
14          pathway from the radon in breath. It's a --  
15          it's a --

16          **DR. LIPSZTEIN:** Hello?

17          **DR. NETON:** -- very separate issue.

18          **MS. BROCK:** Thank you for clarifying that  
19          because it's really confusing for me.

20          **MS. BLOOM:** Well, one other thing I would say  
21          is that the radon in air has to go with the  
22          radon that's going into your lungs and exposing  
23          you from going into. The radon in breath has  
24          to go from the radon coming out from the radium  
25          already deposited in you, so those are two

1 different exposure --

2 **MS. BROCK:** Oh, okay.

3 **MS. BLOOM:** -- pathways. In one we use to  
4 measure radium and we're not looking at  
5 anything to do with the intake of radon  
6 separately.

7 **MS. BROCK:** Okay. Thank you.

8 **MS. BLOOM:** Uh-huh.

9 **MR. GRIFFON:** I think I heard Joyce, yeah.

10 **DR. NETON:** Joyce, did you have a comment?

11 **DR. LIPSZTEIN:** Yes, Jim, I'm talking about now  
12 the doses to the (unintelligible) tissues from  
13 the radium daughters. What did you -- I tried  
14 to get your results that you sent and I  
15 couldn't reproduce them. Did you just change  
16 the half-life in lung for ten hours for  
17 (unintelligible), for example?

18 **DR. NETON:** I'll let Dave Allen address that  
19 issue because he's the one that did the model.

20 **MR. ALLEN:** Hi, Joyce. I did quite a bit with  
21 this. I used the lead 214 and determined -- I  
22 -- I saw the models and determined the dose per  
23 unit intake for .0015 micron particles, and  
24 then I did it again for .25 micron particles,  
25 both assuming a 10-hour absorption half-life in

1 the lungs for the lead.

2 **DR. LIPSZTEIN:** Right.

3 **MR. ALLEN:** Also I assumed a 13-hour absorption  
4 half-life for the bismuth 214 that in-grew in  
5 the lungs.

6 **DR. LIPSZTEIN:** Uh-huh, yes, I saw that. Yeah.

7 **MR. ALLEN:** Okay. And I also had the bismuth  
8 214 behaving as its own biokinetic model rather  
9 than assuming it behaved as the parent. And  
10 then I had to apply an attached fraction to  
11 decide how much was .0015 micron versus .25  
12 micron, and also applied the equilibrium  
13 factors that are in the paper there.

14 **DR. LIPSZTEIN:** I -- I didn't worry too much  
15 about the -- the smallest particle size because  
16 you (unintelligible) fraction and it's only ten  
17 percent of the other one because I think the  
18 10-hour half-life is only applies to the  
19 attached fraction. But it doesn't matter  
20 because it's so small, the -- the fraction due  
21 to it, so the most important would be the .25  
22 (unintelligible) that you calculated. But I  
23 couldn't reproduce this. I -- I tried to and  
24 my numbers don't get to the same ones that you  
25 do and I don't know what -- how -- let's say --

1 just (unintelligible) the lead 214. Did you do  
2 something else besides changing the  
3 (unintelligible) the absorption parameters from  
4 the respiratory tract from ten minutes to ten  
5 hours?

6 **MR. ALLEN:** Joyce, I only caught about half of  
7 what you said there, but I mean obviously you -  
8 - you're saying you didn't -- you couldn't  
9 reproduce the same numbers I got. Could you  
10 tell me if you were at least in the same ball  
11 park as the numbers I got?

12 **DR. LIPSZTEIN:** Yes, but for -- it's the same  
13 order of magnitude, but what shocked me is the  
14 -- the dose to the bone surface because I got a  
15 dose that was half of the one in the kidney and  
16 you practically got nothing at the bone  
17 surface.

18 **MR. ALLEN:** If -- if it's --

19 **DR. NETON:** Okay.

20 **MR. ALLEN:** -- all right with the members of  
21 the Board here, this -- this is getting kind of  
22 difficult. If -- you know, Joyce is saying  
23 that the numbers are in the same ball park,  
24 maybe this is one of those situations where we  
25 could call off-line and have a conversation.

1           **DR. NETON:** Yeah, I think --

2           **DR. LIPSZTEIN:** Okay. Okay.

3           **DR. NETON:** Yeah, we -- we could work with  
4 that.

5           **DR. LIPSZTEIN:** Yeah, okay.

6           **DR. MAKHIJANI:** Let me try to -- since we have  
7 talked about this, at least, let me see if  
8 we're formulating the issue right that is to be  
9 resolved. When -- when we talked about it in  
10 preparation for this meeting, Joyce pointed out  
11 that the unat-- there's a small fraction of the  
12 radon daughters, the lead and the bismuth, that  
13 are mobilized rapidly and you need to take that  
14 into account so that the 10-hour and 13-hour  
15 half-life doesn't apply uniformly because for  
16 the very small particles there's a few percent,  
17 according to ICRP-65 Annex B that says that's  
18 mobilized rapidly, but it doesn't say how much.  
19 Did I get that right, Joyce?

20           **DR. LIPSZTEIN:** Yes. Yeah, uh-huh.

21           **DR. MAURO:** This is John Mauro, I -- I'd like  
22 to just step back a little bit from this for my  
23 own benefit so I could come to grips with this  
24 issue, recognizing it's a new issue. We, SC&A,  
25 did include in one of our reports -- in fact, I

1 think it had to do with the Y-12 report where  
2 it started. I'm not quite sure when we first  
3 put this in. I'm not --

4 **DR. LIPSZTEIN:** I can't hear you, John.

5 **DR. MAURO:** It might have been this one, but --

6 **UNIDENTIFIED:** (Off microphone)

7 (Unintelligible) cannot hear you.

8 **DR. MAURO:** Let me -- let me explain what my  
9 perspective is. We did a calculation using an  
10 ICRP model that presented doses to organs other  
11 than the lung so -- per picocurie per liter.  
12 Okay? That was incorrect. First let me get  
13 this on the record. We agree with -- with  
14 NIOSH that there are other -- there are other  
15 ICRP models -- documents that recommend against  
16 doing that and we -- we have since learned that  
17 and we agree.

18 However, we've had lots of conversations  
19 regarding this matter subsequent to that, and  
20 the nature of those conversations led us to the  
21 point where though there are -- there is  
22 currently no accepted ICRP model for deriving  
23 the doses to organs other than the lung or the  
24 respiratory tract, those doses are still not  
25 insignificant. And the actual numbers that we

1 had in our report, which -- which we derived  
2 using these ICRP models that we shouldn't have  
3 used, are probably not that bad -- perhaps high  
4 by a factor of two or three, but the doses are  
5 -- given that there are other doses, such as  
6 the ones we've been talking about, the doses to  
7 these other organs are not insignificant.  
8 For example, as I understand it -- and please  
9 correct me if I'm wrong -- when dealing with  
10 1,000 picocurie per liter of radon in the air,  
11 assuming 50 percent equilibrium with progeny,  
12 the doses to these other organs could be on the  
13 order of a rem per year when you consider both  
14 the diffused radon into soft tissue together  
15 with these short-lived progeny, the portion of  
16 which might actually make it to these organs.  
17 Correct me if I'm wrong or if I -- am I off by  
18 an order of magnitude or am I in the right ball  
19 park, more or less? And if I am, is a rem per  
20 year to these organs something that is not  
21 insubstantial (sic), that's some thing that  
22 might be important if there are not other  
23 contributors? In my mind, if I'm correct with  
24 the one rem per year on that order, it's  
25 something that we just can't put aside.

1           **DR. NETON:** Well, I -- I think I indicated  
2           about five minutes ago that we believe it's  
3           probably about 600 millirem per year, just  
4           based on the gas distribution alone. And I'm  
5           puzzled -- I don't know that your numbers agree  
6           with our numbers within a factor of two. I  
7           think there's substantial disagreement in your  
8           calculations versus ours from the gas model.  
9           But with that said, the relevant issue is do we  
10          include it. I find it difficult to imagine  
11          scenarios where a worker receives 1,000  
12          picocurie per liter radon intakes and does not  
13          -- is not going to have ten to the sixth, ten  
14          to the seventh picocurie per liter -- or per  
15          day per year radium intakes and -- and other  
16          associated -- so I -- I think, though, it's  
17          relevant, and for completeness purposes I would  
18          be hard pressed to argue against adding the  
19          dose.

20          **MR. ALLEN:** I will.

21          **DR. NETON:** Dave -- Dave Allen may. But I  
22          think just from a transparency perspective and  
23          to indicate its relevance, I don't know how we  
24          could not.

25          **MR. ALLEN:** This -- this is Dave Allen again,

1           and as Jim pointed out this morning I think,  
2           he's actually measured and I think a number of  
3           people have measured that the gas -- radon gas  
4           in the body dissolved in the tissues is  
5           eliminated from the body with about a 24-hour  
6           half-life.  If somebody is breathing 1,000  
7           picocurie per liter air, then there's going to  
8           be a substantial amount of radon gas in there,  
9           yes, but it's going to be coming out in their  
10          breath for days.  And our approach right here  
11          is if this is occurring every day like you  
12          would give them credit for if you assumed 1,000  
13          picocuries per liter, then there should be a  
14          substantial radon breath measurement that we're  
15          assuming is radon -- or radium, I mean, which  
16          is going to be substantially higher for any  
17          organ than the radon gas is going to be.  So by  
18          not subtracting the background radon that these  
19          people have been breathing, we're already  
20          overestimating this by a great deal.

21          **DR. MAURO:**  I would say that's a very good  
22          point and thank you.

23          **DR. NETON:**  Very good point, Dave.  I'm -- I'm  
24          glad you're here.

25          **MR. GRIFFON:**  But that of -- that of course

1           assu-- I mean the radon issues would be in the  
2           same areas as the radium monitored workers, is  
3           that -- that's an assumption there, I think,  
4           that you have radon breath data for those  
5           people that would be in the areas where these  
6           radon exposures are of concern?

7           **DR. NETON:** Well, that --

8           **MR. ALLEN:** That's somewhat of an assumption,  
9           yes, but I mean if we're going to allow credit  
10          for somebody breathing 1,000 picocuries per  
11          liter all year, then some of those got breath  
12          analysis and the coworker would have -- you  
13          know, same story with the coworker data.

14          **DR. NETON:** I think Dave raises a good point.  
15          I mean if you -- you know, I think it's the --  
16          the -- the Oswalt\* solubility constant, not to  
17          get too technical here, is about 1,000th for  
18          radon partitioning between the atmosphere and  
19          soft tissues, so you would end up with an  
20          equilibrium concentration of about a picocurie  
21          per liter in your body and ventilating that.  
22          And with a 24-hour half-life, you would easily  
23          end up with about two-tenths to maybe three-  
24          tenths of a picocurie per liter of radon gas in  
25          your breath on Monday morning when you showed

1 up for your radium -- radium analysis. So  
2 that's a very good point that that -- you know,  
3 by assigning the 95th percentile to these  
4 workers, it does end up bounding the --  
5 bounding the whole -- the whole picture. I  
6 think that's a -- that's a very interesting  
7 approach.

8 Okay, that was good. All right. And then that  
9 -- that gets us away from having to model  
10 things that have never been modeled before  
11 because, you know, I'm very reluctant to start  
12 modeling things outside the ICRP's  
13 recommendations.

14 **MR. GRIFFON:** Arjun has a comment.

15 **DR. MAKHIJANI:** Yeah, I mean this is -- this  
16 argument is a new argument and it seems  
17 reasonable on the face of it. It's an  
18 important issue because it goes to trying to  
19 model something, as Jim said, that has never  
20 been modeled, which is not a happy proposition  
21 given that there's no recommended ICRP thing.  
22 So this is a very important thing -- I just --  
23 I just am saying this because I think this is  
24 an important item that needs to be sorted out  
25 very soon because quite a lot could turn on it.

1           **DR. LIPSZTEIN:** Arjun, can you repeat again  
2           what (unintelligible)?

3           **DR. MAKHIJANI:** Yeah, Joyce, I don't know if  
4           you picked up what -- did you pick up what Dave  
5           said?

6           **DR. LIPSZTEIN:** No, no, that's  
7           (unintelligible).

8           **DR. MAKHIJANI:** Okay, what Dave said is that if  
9           you're breathing in hundreds of picocuries or  
10          1,000 picocuries constantly of radon, then some  
11          fraction of that remains in the body for quite  
12          a long time and it would show up in many of the  
13          workers who had radon breath analysis, and so  
14          you'd have had very high results in the tens of  
15          picocuries per liter maybe, or higher even, of  
16          -- of -- of radon in the breath. And that  
17          would be attributed as a radium intake -- first  
18          of all, they're not seeing that in radon  
19          breath, and it would be attributed as radium  
20          body burden, so anyway it'd be very  
21          conservative.

22          **DR. LIPSZTEIN:** But they took the radon breath  
23          measurements after Saturday and Sunday.

24          **MR. GRIFFON:** Yes.

25          **DR. NETON:** That's correct, Joyce, but radon --

1 radon has about a 24-hour half-life in the  
2 body.

3 **DR. LIPSZTEIN:** Yeah.

4 **DR. NETON:** And so if you come into equilibrium  
5 with 1,000 picocuries per liter, you're going  
6 to have somewhere about a picocurie per liter  
7 in your tissues. And if you -- if you decay  
8 that out over the weekend, I still think that  
9 you're going to end up having measurable  
10 amounts of radon in your breath on Monday  
11 morning that would be attributable to radium  
12 intake.

13 **DR. LIPSZTEIN:** I'm not sure, and I don't know  
14 how you can come out of the modeling anyway.

15 **DR. NETON:** I'm sorry, I didn't understand what  
16 you said.

17 **DR. LIPSZTEIN:** I don't know how you can  
18 (unintelligible) the modeling anyway because  
19 you have -- you have something that is  
20 attributed -- attributable to radium and  
21 something that could be of the radium itself,  
22 so (unintelligible) measures, so you have to go  
23 out to modeling (unintelligible) again, and --  
24 and the model is not -- is not going out of  
25 ICRP modeling. We are not doing that. The

1           only thing we are doing is putting another  
2           half-life in the lung, that's all.

3           **DR. NETON:** Right, but a half-life is based on  
4           one publication that -- I don't know.

5           **DR. LIPSZTEIN:** Yeah, (unintelligible).

6           **DR. NETON:** But do you not agree that the radon  
7           breath measurements would bound and be higher  
8           than just modeling the radon dose to the  
9           tissues?

10          **DR. LIPSZTEIN:** I'm sorry, can you repeat --

11          **DR. NETON:** If you assume radon breath  
12          measurements on Monday had a component of the  
13          radon gas that they breathed at the workplace  
14          and we would then be conservative in assigning  
15          those to radium intakes, not radon intakes.

16          **DR. LIPSZTEIN:** Uh-huh. Yeah, but -- but you  
17          don't know how much comes from one and how much  
18          comes from the other.

19          **DR. NETON:** I know, but if we assume that it's  
20          all from -- from radium, the doses to the  
21          organs are going to be much higher than the  
22          doses that are from the radon daughters.

23          **DR. LIPSZTEIN:** Right, that's true.

24          **DR. NETON:** I think that's the point, that --  
25          you know, per unit intake, you're going to have

1           -- if you assume a much higher radium burden,  
2           you're going to give higher radium doses than  
3           if you -- just from the radon, so -- we -- we  
4           can work this out I think and --

5           **MR. GRIFFON:** I think that we --

6           **DR. LIPSZTEIN:** I think (unintelligible) the  
7           numbers on (unintelligible).

8           **DR. NETON:** We'll have to -- we'll have to  
9           develop a -- an approach and a position on this  
10          --

11          **MR. GRIFFON:** Yeah.

12          **DR. NETON:** -- but I think -- I think this is  
13          very well worth -- worth fleshing out, and I  
14          don't think it would be that difficult to -- to  
15          document in fairly short order. I mean at  
16          least the approach.

17          **MR. GRIFFON:** I think I -- I agree with Arjun  
18          that I'd like to see it laid out. It sound --

19          **DR. NETON:** Sure.

20          **MR. GRIFFON:** -- sounds reasonable. The other  
21          question I have is, you know, there might be a  
22          -- a cut-off where you're not able to detect it  
23          in radon breath, and it might still be fairly  
24          significant dose. It might be a couple hundred  
25          rem -- millirem --

1           **DR. NETON:** Right, but remember we're assuming  
2           a minimum of .1 picocuries per liter as a  
3           detection limit for -- for radon in breath.

4           **MR. GRIFFON:** Right.

5           **DR. NETON:** And even if it's less than that,  
6           we're going to assume that that's the minimum  
7           that a person breath-- is exhaling.

8           **MR. GRIFFON:** Oh, okay, yeah.

9           **DR. NETON:** See what I'm saying? So --

10          **MR. GRIFFON:** So your cut-off's -- yeah.

11          **DR. NETON:** -- so that the cut point is going  
12          to be above whatever you're saying is in the  
13          radon breath to begin with.

14          **MR. ALLEN:** Yeah, I think --

15          **MR. GRIFFON:** That's right, 'cause you're doing  
16          the coworker --

17          **DR. NETON:** Yeah, yeah, yeah.

18          **MR. GRIFFON:** I was thinking if they had their  
19          own data.

20          **MR. ALLEN:** I think the simplest approach to  
21          demonstrate it would just be to go through  
22          these four examples we already have here on the  
23          table, and I could simply assume, you know, the  
24          coworker radon inhalation and then sub--

25          **DR. NETON:** Compa--

1           **MR. ALLEN:** -- you know, for those years and  
2           then subtract that -- what would be coming out  
3           from the radon inhalation from the radon breath  
4           analysis, which would lower the radium intake  
5           and simply compare doses. And I -- I'm pretty  
6           confident what the answer's going to be on  
7           that.

8           **DR. NETON:** Yeah, I think (unintelligible) some  
9           -- yeah -- something of a 30-minute effective  
10          half-life versus radium --

11          **MR. ALLEN:** Right.

12          **DR. NETON:** -- is going to be much  
13          (unintelligible). We'll work on that. We'll  
14          take that as an assignment.

15          **DR. WADE:** Yeah, I mean I think we'll leave  
16          here with the understanding that NIOSH and SC&A  
17          will have further discussions on this issue  
18          prior to SC&A preparing their report.

19          **DR. MAURO:** Yeah, I'd like to add that this  
20          strategy for resolution appears to be in the  
21          right direction. The arguments that I've heard  
22          seem to be a way to get by this issue in a --  
23          in a claimant-favorable and scientifically  
24          valid approach. I'd like -- certainly we need  
25          to see the write-up, but I'm impressed with

1           this line of -- this strategy as being the  
2           solution.

3           **DR. WADE:** So I would encourage NIOSH to  
4           prepare materials as quickly as you can on this  
5           issue, share them with your colleagues prior to  
6           their issuing a report.

7           **MR. ALLEN:** And who should I work with on this?  
8           I'm assuming I'm going to work on this one.  
9           Right, Jim?

10          **DR. NETON:** That's correct.

11          **DR. WADE:** Jim -- Jim as your point of contact  
12          to John, and then John can --

13          **MR. GRIFFON:** Yeah.

14          **MR. ALLEN:** Okay.

15          **MR. GRIFFON:** I think we're on to number three,  
16          aren't we?

17          **DR. NETON:** Yes, number three. Okay,  
18          application of correction factors for external  
19          doses to organs. It was raised in the profile  
20          review that there were certain geometries that  
21          -- Hans, are you there?

22          **DR. BEHLING:** Yes, I am.

23          **DR. NETON:** Okay, I'll try to speak into the  
24          microphone.

25          Tim Taulbee, are you on the phone?

1           **MR. TAULBEE:** Yes, I am.

2           **DR. NETON:** Okay, good, we've got key players  
3 here.

4           So, you know, it was -- we modeled, as -- as  
5 indicated in the draft Technical Information  
6 Bulletin we put out, using this Attila  
7 software, what the differences might be to the  
8 -- the photon -- what the different photon flux  
9 ratios might be relative to a lapel badge  
10 versus a -- a lower torso organ when people are  
11 working with a non-uniform exposure geometry.  
12 And I think we had three examples. One was a -  
13 - working on a -- on a derby or something of  
14 that nature. One was cleaning up a spill, and  
15 the other one was -- I forgot what it was now,  
16 but it was another close geometry situation --  
17 a tank, right -- a tank -- oh, yeah, a pot, ore  
18 pot geometry. And those Attila -- those Attila  
19 calculations indicated to us that it is  
20 theoretically possible at least for a lapel  
21 badge to -- to underestimate a person's dose to  
22 a lower torso, and by that I mean the organs in  
23 the trunk below the lung, by up to -- well, by  
24 half. You'll be off by a factor of two if you  
25 use the lapel badge. It could be twice as high

1 to the lower torso under those modeled  
2 geometries. There were some differences, but I  
3 think the highest was -- 2.1 is what I recall.  
4 So that said -- and I should point out that we  
5 did not model the actual dose to the individual  
6 organs. The intent of this Attila run was to  
7 model the variation in the photon flux relative  
8 to the badge. So in other words, we modeled  
9 what the response to the badge on a lapel would  
10 be if it were worn on the appropriate portion  
11 of the thorax, the lower torso. So -- and then  
12 that's the number we would use to convert to  
13 organ dose. So I don't want there to be any  
14 mis-- misconception that we were trying to  
15 model organ doses. We're saying the flux ratio  
16 is a factor of two difference, therefore the  
17 dose to the badge would be a factor of two  
18 difference.

19 So we -- we -- Tim Taulbee and Greg Macievic  
20 have written that into a Technical Information  
21 Bulletin. We're proposing to use that factor  
22 of two to adjust badges -- badge results for  
23 certain classes of workers.

24 In going through the cases that we have to  
25 process, it appears to us that about 57 percent

1 of the workers, of the cases that we have, this  
2 correction factor may be applicable. That is  
3 workers who were identified as chem-- operators  
4 and building trades type folks. It would not  
5 be possible for us to determine with any degree  
6 of confidence that they weren't exposed to  
7 these close-in -- what we call close-in  
8 geometries.

9 There are a remaining class of workers that we  
10 believe -- administrative in nature and  
11 security guards, those type of folks who were  
12 not working with these close-in operations --  
13 that these factors would not be applied.  
14 That's our proposal. It's certainly open for  
15 discussion, but I think that summarizes it in a  
16 nutshell.

17 Tim Taulbee, is there anything I've forgotten I  
18 need to add into this?

19 **MR. TAULBEE:** Nope --

20 **DR. NETON:** Okay.

21 **MR. TAULBEE:** -- not that I'm aware of,  
22 although there could be questions.

23 **DR. NETON:** Yeah, sure.

24 **DR. MAURO:** Hans and our crew got together and  
25 had numerous discussions on this matter. And I

1           guess we walk away with the concept that yes,  
2           your factor of two to account for the  
3           particular adjustment that is of concern here  
4           does satisfy our concern.

5           However, Hans Behling has pointed out that  
6           there are two other adjustment factors, and  
7           perhaps others, that probably need to be  
8           brought to the table at this time. One of them  
9           goes toward a concern we raised in our task  
10          three report -- in fact, a couple of them do --  
11          whereby other adjustment factors might be in  
12          order, especially for lower energy photons,  
13          that could actually -- and I'm -- I'm giving  
14          you sort of like the preview, and I'd like Hans  
15          to speak to this -- could have another factor  
16          of two to perhaps factor of three effect on the  
17          multiplier. And I think that we'd like to sort  
18          of air that out today, and I'd like to give  
19          Hans an opportunity to -- to -- to discuss  
20          this.

21          **DR. NETON:** Okay. Before -- before we jump  
22          into this -- this discussion, which I think  
23          could be quite lengthy, I'd like to suggest  
24          that this may fall into that category of is the  
25          profile adequate and are we doing a reasonable

1           job versus can we reconstruct doses for  
2           Mallinckrodt workers. In other words, I think  
3           we all have an agreement that the badge is the  
4           appropriate starting point, and we have a very  
5           large percentage of workers that were  
6           monitored. How we adjust those doses is -- is,  
7           in my mind, a refinement of the dose  
8           reconstruction and not an ability to do them  
9           with sufficient accuracy. But that's certainly  
10          open for discussion. I don't know.

11         **DR. WADE:** Well, I think we should hear from  
12         Hans. I mean I think you make your point, and  
13         John made it earlier, but I think let's get it  
14         on the table while we're here and then we can  
15         make that judgment.

16         **DR. BEHLING:** Am I on?

17         **DR. NETON:** Yes.

18         **DR. BEHLING:** Okay. During the last Advisory -  
19         - full Advisory Board meeting that took place  
20         on July 5 through 7, I presented a summary  
21         report on our task three assessment, which  
22         looked at all of the various procedures that  
23         were used in dose reconstruction, including the  
24         Implementation Guide 1 that deals specifically  
25         with external dosimetry issues. And I made a

1 couple of points then and said I wasn't going  
2 to discuss any of the technical issues because  
3 we had at that point in time not really had a  
4 discussion with NIOSH and without any potential  
5 technical findings, which is the normal  
6 protocol. But given the fact that the SEC  
7 petition for Mallinckrodt is somewhat imminent  
8 and pressing, it was a internal decision on the  
9 part of John Mauro and Arjun and myself to  
10 perhaps air a couple of issues that may have a  
11 significant impact on -- on the impending SEC  
12 petition.

13 And let me just talk about two particular  
14 points. First of all, I do agree with the  
15 multiplier of two that deals with the geometry  
16 that Jim Neton just explained, which  
17 essentially does nothing more than make a  
18 correction for certain tissues that are much  
19 closer to the source term than the lapel badge,  
20 mainly tissues such as the male testes, the  
21 colon, the rectum, the prostate, et cetera,  
22 which would certainly be -- be covered by this  
23 multiplier of two that Dr. Neton just finished  
24 discussing.

25 However, there are a couple of issues that go

1           beyond that, and one of them is the issue of  
2           the uncertainty surrounding the response of a  
3           film badge or TLD to a radiation field. In the  
4           OCAS Implementation Guide 1 we -- we talk about  
5           different components of uncertainty and yet in  
6           the end restrict ourselves to really only one.  
7           And the three components are laboratory  
8           uncertainty, radiological uncertainty, and  
9           thirdly, environmental uncertainties. And of  
10          course the laboratory uncertainty deals  
11          specifically with the processing of the  
12          individual badge in terms of film development,  
13          the time of exposure, the temperature of the  
14          bath and so forth and (unintelligible) to find  
15          an uncertainty for that. On the other hand,  
16          the implementation guide does provide a very,  
17          very difficult process by which this  
18          uncertainty needs to be calculated, and we've  
19          already mentioned that to NIOSH.  
20          What is really not included in the uncertainty  
21          in numerical terms is the second component,  
22          namely the radiological uncertainty, and that  
23          incorporates, among other things, angle of  
24          dependence. In other words, when we calibrate  
25          a film badge or a TLD, we usually have a single

1 point source that's mono-energetic, such as  
2 cobalt or cesium, and then the badge in  
3 question is pointing at the source term at a  
4 zero degree angle. In other words, the face of  
5 the badge points directly at the beam, and that  
6 gives you the maximum response on the part of a  
7 film or TLD.

8 Once you rotate the film or TLD on its own axis  
9 in any form that deviates from zero degree  
10 angle, there is a significant reduction. And I  
11 pointed that out in our task three report. And  
12 so for instance, when you look at a photon  
13 energy of about 110 keV -- and I'm quoting this  
14 directly out of a textbook, (unintelligible) --  
15 the -- at 90 degree angle, a -- a film  
16 dosimeter would only respond to about 16  
17 percent of what it would respond to in terms of  
18 a zero degree position. And so angle  
19 dependence is a very critical element that has  
20 to be looked at, especially for very low energy  
21 photons. The angle of dependence does diminish  
22 with increased photons and at one MeV can be  
23 somewhat ignored. But for very low energy  
24 photons, angle of dependence is a very, very  
25 critical issue.

1           Also the issue of back-scatter. It's uncertain  
2           from looking at some of the procedures whether  
3           or not the back-scatter is incorporated into  
4           the dose calculations, including the DCF. In  
5           my task three report I identified the  
6           variability of back-scatter as a function of  
7           photon energy, and of course the size of the  
8           medium which serves as the back-scattering  
9           source. And they can contribute a significant  
10          amount of -- of dose that may or may not be  
11          currently being taken into consideration.  
12          So on the -- on the issue -- and of -- I guess  
13          thirdly I want to mention is another issue that  
14          was mentioned in the implementation guide but  
15          not necessary (sic) addressed and that is the  
16          environmental uncertainty. And on  
17          environmental uncertainty are issues that, for  
18          instance, look at the response of a dosimeter  
19          based on ambient temperature, especially in a  
20          very hot and humid environment where moisture  
21          can potentially introduce a certain level of  
22          uncertainty, as well as temperature.  
23          So those are the three major components, and in  
24          combination they will significantly exceed, I  
25          believe, the uncertainties that's currently

1 being assigned to both film and TLD under the  
2 guidance contained in the Implementation Guide  
3 1.

4 Having said that, let me move on to the second  
5 and perhaps more important issue that is also  
6 something that I identified in the task three  
7 report, and that is I looked at the dose  
8 conversion factors and I've come to the  
9 conclusion that there is a systemic problem  
10 here that affects the accuracy of dose  
11 conversion values. I have looked over the  
12 implementation guide and fully concur with the  
13 methodology that was used in arriving at these  
14 DCFs, but also concluded that the methodology  
15 is inappropriate for the use in dose  
16 reconstruction when the starting point is  
17 actually a -- an empirical measurement that's  
18 registered on a film or a TLD.

19 And in preparation for this particular  
20 discussion, I had asked Arjun to perhaps -- or  
21 John -- to distribute to you one of the pages  
22 from the Implementation Guide Appendix B that  
23 identifies those conversion values. And the  
24 one that I think exemplifies the issue most is  
25 the dose conversion value for the female

1 breast, and I will briefly first ask if the  
2 Board members have been given a copy of that  
3 particular page.

4 **DR. MAURO:** Hans, this is John. I have to  
5 apologize, I did not hand it out. I do have it  
6 in my hand. What -- what page number was that  
7 in OCAS-1?

8 **DR. BEHLING:** It's on page 67.

9 **DR. MAURO:** Okay, I have -- I'm holding it in  
10 my hand now. Perhaps we could have a copy made  
11 and -- and pass it around, if that's not a  
12 problem. I -- Hans, I'm going to be getting a  
13 copy of it. It looks like it should be ready  
14 in a minute or two.

15 **DR. BEHLING:** Okay, I might want to just  
16 already start --

17 **MR. GRIFFON:** Wait --

18 **DR. BEHLING:** -- the conversation because --

19 **MR. GRIFFON:** You know what, Hans --

20 **DR. BEHLING:** -- (unintelligible) --

21 **MR. GRIFFON:** Hans, can I interrupt? This is  
22 Mark Griffon.

23 **DR. BEHLING:** -- to a lengthy discussion, but  
24 let me (unintelligible) --

25 **MR. GRIFFON:** It's hard to interrupt Hans.

1           **DR. BEHLING:** -- by pointing out  
2           (unintelligible) I've elected to use the female  
3           breast as the sample that best exemplifies the  
4           concern I have regarding the DCF for the  
5           following reasons.

6           It turns out that the female breast is  
7           anatomically at the location most people would  
8           be wearing either the film or TLD, and so  
9           therefore we can eliminate one of the issues  
10          about location because they turned out to be  
11          coincidental in terms of location for -- for  
12          moni-- personnel monitoring. And so let me go  
13          through and identify --

14          **MR. GRIFFON:** Hans, can I interrupt a second?

15          **DR. BEHLING:** Yes.

16          **MR. GRIFFON:** This is Mark Griffon. We're --  
17          we're just going to -- we're getting a copy,  
18          and it's a good time for us to take a break.

19          **DR. BEHLING:** Okay.

20          **MR. GRIFFON:** So would you mind if we can get  
21          the copy and then we'll address this on the  
22          other side of the break. Also I -- I want to  
23          keep in mind -- I think, my opinion at least,  
24          is that this is a -- an issue -- a program-wide  
25          issue. I don't know that it -- it reflects on

1           this discussion that we're having about  
2           Mallinckrodt. I think it could affect many  
3           sites if it af-- you know --

4           **DR. BEHLING:** Yes, (unintelligible) --

5           **MR. GRIFFON:** -- if we -- if we go that route.

6           **DR. BEHLING:** -- (unintelligible) --

7           **MR. GRIFFON:** But we'll hear -- on the other  
8           side of the break you can lay out the issue, at  
9           least, and then we'll move on from there I  
10          think.

11          **DR. BEHLING:** Okay.

12          **MR. GRIFFON:** Is that okay? Okay. Let's  
13          break.

14          (Whereupon, a recess was taken.)

15

**C E R T I F I C A T E   O F   C O U R T   R E P O R T E R****STATE OF GEORGIA****COUNTY OF FULTON**

I, Steven Ray Green, Certified Merit Court Reporter, do hereby certify that I transcribed the above and foregoing from the day of Aug. 4, 2005; and it is a true and accurate transcript of the testimony captioned herein.

I further certify that I am neither kin nor counsel to any of the parties herein, nor have any interest in the cause named herein.

WITNESS my hand and official seal this the 23<sup>rd</sup> day of August, 2005.

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**STEVEN RAY GREEN, CCR**

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