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

+ + + + +

ADVISORY BOARD ON RADIATION AND
WORKER HEALTH

+ + + + +

URANIUM REFINING ATOMIC WEAPONS EMPLOYERS
(AWEs) WORK GROUP

+ + + + +

THURSDAY
JANUARY 22, 2015

+ + + + +

The Work Group convened via teleconference at 12:00 p.m. Eastern Standard Time, Henry Anderson, Chairman, presiding.

PRESENT:

HENRY ANDERSON, Chairman
DAVID KOTELCHUCK, Member

ALSO PRESENT:

TED KATZ, Designated Federal Official
DAVE ALLEN, DCAS
JENNY LIN, HHS
JOHN MAURO, SC&A
JIM NETON, DCAS
JOHN STIVER, SC&A
BILL THURBER, SC&A

T A B L E O F C O N T E N T S

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

12:01 p.m.

1. WELCOME AND INTRODUCTIONS

MR. KATZ: This is the Advisory Board on Radiation and Worker Health, the Uranium Refining AWEs Work Group, formerly TBD-6001. And we're talking today about DuPont Deepwater Works Site Profile Review.

The materials for this meeting are posted on the NIOSH website under the Board section, under Meetings, today's date. You click on today's date and you should be able to find the materials that we're discussing to follow along.

Since we're speaking about a site, when we do roll call, please speak to conflict of interest. And I know already we'll be lacking one of our three Board Members for this Work Group. But let's get started, beginning with the Chair.

(Roll call.)

Andy, it's your agenda.

2. DISCUSSION

CHAIRMAN ANDERSON: Okay. It's been awhile since we got together. This was a little bit delayed moving forward. But I think what we'd like to do today is close out various issues. We did have a productive initial discussion and went through the various findings and had some comments. And NIOSH was going to get back and then SC&A was going to look at those comments. Hopefully, today we can resolve them.

Could we start with just a quick overview from SC&A on the review and findings of the site quickly?

MR. THURBER: Yeah, I can do it.

CHAIRMAN ANDERSON: We have then Findings 2 and 4 to 7 to resolve.

MR. THURBER: Right. I can do that.

Regarding Finding 2, it appeared to us in looking at the calculations that NIOSH had used two different assumptions in converting workdays to calendar days, one for inhalation and one for ingestion. And we thought that those should be the same. Not a big deal, but just a matter of tidying up something there.

A second thing we commented on was the fact that the method used to calculate doses in the DuPont document was quite different than the way the doses were calculated in TBD-6000. And we felt that a discussion of that was appropriate to explain why the approach was taken. And it results in substantially lower doses than if you'd used the procedures, the generic procedures, in TBD-6000.

A third point that we raised questions about is, in attempting to describe the variation of beta dose with distance, NIOSH

took some published data from NRC and fit a curve to that data so that they could have a numerical relationship to use in the modeling. And what they assumed was that the geometric mean was a millirem per year -- I'm sorry, a millirem per hour at a distance of 100 centimeters from the source, and a geometric standard deviation of five.

There's an additional constraint on that number because the graph that they presented showed that the curve from the NRC data and the curve that they developed based on this log-normal distribution, and the assumptions I just mentioned, crossed at a particular point. We tried all kinds of different ways to try and reconcile this mathematical curve with the curve to fit the measured data. And we just couldn't do it and we ask that NIOSH provide us some insight into just how they had developed that curve.

There is one more point which I'd like to mention which I think should be covered, and it's new. But in the table for the residual period, NIOSH presents exposure data for both inhalation and ingestion exposures. And the procedure they used for the ingestion exposure results in a value that's about 100 times higher than the inhalation exposure. And that's quite different than what we've come to expect all along.

That is to say, the inhalation exposure is generally perceived to be higher than the ingestion exposure. And we think that that should be explained a little more clearly so that everyone understands that. That kind of summarizes it, Henry.

CHAIRMAN ANDERSON: How about the other findings?

MR. THURBER: I think, with regard to the other findings, as we'd indicated in the

White Paper that we'd provided, that those were pretty much resolved based on the changes that were made in Revision 1 to the DuPont TBD.

This last point that I mentioned about the difference between the -- or the very high value of the ingestion dose does kind of speak to -- it kind of leaves one of those findings, I think Finding 6, a little bit open-ended. But if that's going to be clarified, then that can stay closed, if you will.

CHAIRMAN ANDERSON: Any questions that anybody has? David?

MEMBER KOTELCHUCK: I'm a little bit --

CHAIRMAN ANDERSON: You're kind of a little --

MEMBER KOTELCHUCK: Yeah, I'm a little at loose ends trying to follow as we go through. Now, I did not get an opportunity to read this -- a long time ago -- but not to

review it recently. I was having trouble on our machine.

Let's stick to one finding at a time. I mean, you talked about ingestion and inhalation. I see the data that you present here on Finding 2. And you said that it is unusual that ingestion is so much larger than inhalation.

Are you going to suggest why? Or have you and maybe I didn't follow?

MR. THURBER: With regard to Finding 2, I think that the focus in discussing that should simply be on whether the conversion of workdays to calendar days was done consistently for inhalation and ingestion.

MEMBER KOTELCHUCK: Okay.

MR. THURBER: That should be the focus of our discussion on Finding 2. This other point about the ingestion being much smaller than the --

MEMBER KOTELCHUCK: Much larger.

MR. THURBER: I'm sorry, much larger than the inhalation. That can come with regard to a subsequent finding.

MEMBER KOTELCHUCK: Okay.

MR. THURBER: But for this first one I think we should confine it to discussion strictly to whether this conversion from workdays to calendar days, which is always a nuisance, I might add.

MEMBER KOTELCHUCK: Right.

MR. THURBER: And consistently causes confusion. But whether it was implemented consistently in the data that was presented.

MEMBER KOTELCHUCK: Right. And you are saying which is the preferred one, the correct one, is per calendar days?

MR. THURBER: Right. Well, we believe that the data -- since this work was

done in the period prior to -- since the work at DuPont Deepwater, the operational part, was done prior to 1950, typically, at least in TBD-6000, the assumption is that in that period there were 48-hour work weeks. And therefore we think that the conversion should be based on 300 workdays per 365 workdays.

MEMBER KOTELCHUCK: Okay.

MR. THURBER: I'm sorry. Three hundred workdays per 365 calendar days.

MEMBER KOTELCHUCK: Yes.

MR. THURBER: And that factor should be applied both to inhalation and to ingestion. It looked to us, as we tried to reconstruct the numbers, that that assumption was made of 300 workdays per 365 calendar days for the inhalation data and not for the ingestion data. That was our take on it.

MEMBER KOTELCHUCK: All right. Thank you.

CHAIRMAN ANDERSON: Did NIOSH have comments on this?

DR. NETON: Yeah, this is Jim. I think I can get it started on this one. The way it was calculated for the inhalation intake was just to strictly use 2,400 hours of inhalation per year. That's why you get that number, right, and you verified that that's how that came about.

It didn't go through an immediate step of calendar days. If you just take 2,400 hours per year times that rate, you'll get the number that's in the TIB.

As far as the injection goes, we assume the 250 workdays to do that calculation, which is consistent with what we've done all along for these injection intakes. That's been pretty standard operating procedure. Even though the workdays were slightly longer in the earlier periods, we've always used the 250 days

to do the calculations.

MR. THURBER: What you're saying, Jim -- this is Bill Thurber -- is that typically for ingestion you have not used the assumptions that are in TBD-6000.

DR. NETON: No, I think we have. There are longer workdays.

MR. THURBER: But you just said you used 250 workdays for ingestion.

DR. NETON: Yeah, there were 250 longer workdays per day, giving you those 2,400 hours.

MR. THURBER: Right, but 250 workdays is based on a 40-hour work week.

DR. NETON: Yeah, well --

MR. THURBER: And not a 48-hour work week.

DR. NETON: Yeah, that's correct. But we assume only five days per week exposure, not six days per week.

MR. ALLEN: We're not assuming eight hour workdays in the early years.

DR. MAURO: This is John. Just a quick comment. Notwithstanding that fact that the two numbers come from, let's say, different venues, it seems that they should be the same though. In other words, if you're going to use a certain number of work hours per calendar year. CHAIRMAN ANDERSON: Especially if the ingestion is by hour.

DR. MAURO: Yes, they should be the same.

MR. ALLEN: This is Dave Allen. They're not different. The misunderstanding here is the assumption that it's an eight-hour workday. The length of the workday does not enter into the airborne calculation. You can have whatever workday you want, multiply it by a different number of hours per workday and get whatever number you want. The number we're

using is 2,400 hours per year.

The assumption we've always used is that is 250 9.6-hour days. If you want to say it in workdays, then we're using 250 days in the airborne calculation and in the ingestion calculation. There's no inconsistency here. The problem is workdays do not enter into the airborne calculation.

DR. MAURO: I have to say I'm a bit confused because, in the end, the way I look at it is pretty straightforward. A person is at some place inhaling radioactivity for a certain number of hours per year. And the number of hours per year he's ingesting should be the same thing. Am I hearing that they are? Or are they not?

MR. ALLEN: They are.

DR. MAURO: They are actually the same. Bill, I guess does that seem to make sense?

MR. THURBER: No. I must say I remain confused.

DR. NETON: You've got to go back and look at TIB-9. TIB-9 produces a value. That 0.2 multiplier produces a value that comes out in ingestion intake per day.

MR. THURBER: Right.

DR. NETON: Okay. The air concentration, the inhalation value, doesn't need to go through that intermediate step because you know it's 2,400 hours times the air concentration and the breathing rate gives you intake without going through that -- you have to go through that intermediate step for --

MR. THURBER: Where does 2,400 hours come from?

MR. ALLEN: It comes from Battelle-TIB-5000 where they analyzed work hours per year for various eras. They decided it was higher in the early years.

MR. THURBER: No, no. I understand that. In the later years, the assumption is a 40-hour work week. So you have five days, 50 weeks. That's 250 workdays per 365 calendar days. That's for times after 1956 or whatever the cutoff is.

DR. NETON: Right.

MR. THURBER: For the early days, the assumption was a 48-hour work week, which is, what, 3,000 hours a year?

DR. NETON: Twenty-four hundred.

MR. THURBER: Twenty-four hundred, I'm sorry. And for the intermediate period it was for 2,200.

DR. NETON: Yes.

MR. THURBER: Is that all consistent?

DR. NETON: Right. But what we're saying is it does not equate to six eight-hour workdays. It equates to five 9.6-hour workdays

is the way we've done it.

DR. MAURO: I think I got it. What you're saying is --

MEMBER KOTELCHUCK: I see.

DR. MAURO: -- in an interesting way the ingestion is based on a per workday. It doesn't say how long that workday is. It just says, listen, this is the intake -- in other words, you simply take the airborne concentration and times by 0.2 and you get the intake --

DR. NETON: Per day.

DR. MAURO: -- per day. And inherent in that relationship, it's silent and irrelevant how many hours there are in that day. And as a result, you end up with this unintended consequence which appears that there is an inconsistency, but not really.

DR. NETON: Not really because the 2,400 hours could be 250 9.6-hour workdays.

(Simultaneous speaking.)

MEMBER KOTELCHUCK: Right. The 9.6 is what equalizes the two regimens of calculation.

DR. MAURO: I think it's as simple as you're working with a workday and you're not defining -- when you're doing the OTIB-9, 0.2, you're just talking about a workday and you're really not talking -- and that's very general. It's almost like where how many angels can stand on the head of a pin. You're simply saying "look, as a rule of thumb, 0.2 times the concentration gives you the ingestion per day."

We didn't go any further than that to say, "well, is that a long workday" or "is that a short day?" So it almost bypasses the issue of how many hours per day, which is important when you're doing inhalation under TBD-6000. Do I have that right?

DR. NETON: That's basically what it

comes down to which is the artifact of using --

DR. MAURO: It's an artifact.

DR. NETON: -- when you have to do per calendar day.

MR. THURBER: Let me understand this. If you have an airborne concentration and you multiply it by 0.2, you get so many dpm per day for ingestion, right?

DR. NETON: Correct.

MR. THURBER: And what kind of a day is that? That's a workday.

DR. NETON: Yes.

MR. THURBER: It's a workday, right?

So one needs to take that number and somehow adjust it to the number of calendar days, right?

DR. NETON: Correct.

MR. THURBER: Okay. So help me continue with the example, then. In the document, in TKBS-0006, the air concentration

at the 95th percentile was quoted to be 3,198 dpm per cubic meter, and that is the 95th percentile of the assumed distribution based on the geometric mean of the available data and the GSD for that data.

DR. NETON: Correct.

MR. THURBER: So if you take that 3,198 dpm per cubic meter and multiply it by 0.2, you get 640 dpm per day. And you just said that's so many dpm per workday. Okay. Now, how do you adjust that number to convert it to calendar days?

DR. NETON: It's 250 calendar workdays in a year.

MR. THURBER: So there are 250 calendar workdays in every year.

DR. NETON: Correct.

MR. THURBER: And it's just that the number of hours per workday varies.

DR. NETON: Right.

MR. THURBER: Okay.

DR. MAURO: And it's silent with regard -- right.

DR. NETON: This is the way we typically -- this is the way we've done this for --

MR. THURBER: Yeah, yeah. Okay. I'm good with that.

DR. MAURO: Yeah. What this is is an artifact of the fact that we've come to this calculation from two different directions. In one case, the number of hours per workday is explicitly addressed in TBD-6000. When the number of hours per workday is not explicitly addressed and it's almost like it's irrelevant.

We all agree that the 0.2 works as a reasonable approach for intake per day. But we really never talk about how long the day is.

DR. NETON: Yeah, it kind of gets lost in the wash.

DR. MAURO: It gets lost in the wash.

DR. NETON: And you take the 95th percentile to begin with.

DR. MAURO: And do you know what?

DR. NETON: Two hours plus or minus is not --

DR. MAURO: And you know what? I agree completely. It's just a matter that it leaves us in this place where someone looking at it says, "What?" But when you hear it this way, you can say let's just leave this one alone. We're at a level of precision that is good enough.

MR. THURBER: That wasn't the point though, John.

DR. MAURO: Okay.

MR. THURBER: The point was, and we made that point in our discussion, that the difference was not a big deal. The only

question that I raised was, was the calculation done consistently for inhalation and ingestion? It wasn't that it was a big deal in terms of whether one number is going to be significantly different than another.

DR. MAURO: Bill, I agree with completely. A third party looking at this is going to react the same way. They're going to say, "What's going on? This doesn't seem to make sense."

But the way you explained it, it's understandable that this could be one of the unintended consequences of coming at the problem from two different directions, a difference that makes no difference in reality. But it can cause these kinds of confusion.

CHAIRMAN ANDERSON: At least I think I understand it now.

MEMBER KOTELCHUCK: Yes.

CHAIRMAN ANDERSON: So to close this

one out, do we think the Site Profile should have a little explanation somewhere at this? Or is this just because we've delved so deeply into it and we're just vetting it to say now it makes sense? The tables and the estimates, even though it looks like ingestion is out of proportion, it's right. Is that just something --

MEMBER KOTELCHUCK: Yeah.

CHAIRMAN ANDERSON: That's my question. And I would suspect this is probably present in a number of other Site Profiles and we just haven't picked up on it before. I mean, do we need a statement or a brief mention in there about this or not? That's kind of my question.

DR. MAURO: I guess, speaking from SC&A's perspective, if I may, to me, it's not essential. However, speaking from putting Jim's hat on, I would say it wouldn't be a bad

idea just so that other people who are not -- I don't know if there are too many other people who are going to look at it like this. But having a footnote explaining that this is -- I'm not sure.

MEMBER KOTELCHUCK: I'll tell you, if you'd like -- I mean, I believe this was referred to you by the Dose Reconstruction Subcommittee, wasn't it?

MR. KATZ: No, they're two independent efforts, Dave.

MEMBER KOTELCHUCK: Okay. Well, then I think it should be somewhere in the record, and it really doesn't matter where as long as someone looking into it in the future could find it. And wherever you say it should be. But I do think there should be some record of this discussion.

MR. KATZ: There's the transcript and --

MEMBER KOTELCHUCK: That's true.

MR. KATZ: And there's the finding resolutions. And given that this is sort of a minute technical matter that is not of interest to the public, I think, I think it's probably adequate that it has to be captured in the --

MEMBER KOTELCHUCK: In the transcript.

MR. KATZ: In the issue matrix. Yeah, the transcript, but also the issue matrix.

(Simultaneous speaking.)

MEMBER KOTELCHUCK: Okay. That's fine. That's good enough.

CHAIRMAN ANDERSON: -- between the two is whether we keep it in abeyance or close it out. If now we've got it covered, and I would say we probably do with the transcripts and then the matrix, then we could say we've now closed this one out.

MEMBER KOTELCHUCK: I think we can say that. I agree with you.

MR. KATZ: Right. And it's actually not -- I mean, there's nothing to fix. So it's not an abeyance.

MEMBER KOTELCHUCK: Right. It was correct from the beginning and now we understand that they are not inconsistent.

MR. KATZ: Right.

CHAIRMAN ANDERSON: If we were to say there needs to be some text change in the Site Profile then we would want to know that it actually occurred. And that's why I'm saying it might -- in any case, never mind. I would just say I think we can close this one.

MEMBER KOTELCHUCK: Yes.

DR. NETON: This is Jim. I would say that this is going to fall under the category of maybe the next time we revise the TIB for some other reason that it would be

prudent to maybe put that in there. But we wouldn't go and issue an entire new review.

MEMBER KOTELCHUCK: No, no. I agree.

DR. MAURO: Absolutely.

MEMBER KOTELCHUCK: All right.

CHAIRMAN ANDERSON: Okay. Moving right along, Number 4. So that one we have closed. Now, do we need a vote?

MR. KATZ: You just did. You just spoke.

CHAIRMAN ANDERSON: Yeah, both of us said yes.

MEMBER KOTELCHUCK: Right. You asked the two of us.

CHAIRMAN ANDERSON: Okay.

DR. NETON: I think Number 4 is going to fall right in line with our previous discussion because for external we've never really worked out of workdays. We typically

just multiplied it times the number of hours worked in a year. I mean, there's no reason to go back per calendar day. If you've got an mR per hour reading and you know they've worked 2400 hours, that's what you assign.

MEMBER KOTELCHUCK: Right.

DR. NETON: There's really no value in converting it to dose per calendar day and then multiplying it.

MEMBER KOTELCHUCK: Right. Which is to say that this too is resolved.

DR. NETON: I think so.

MEMBER KOTELCHUCK: Yeah, the calculation is --

MR. THURBER: There was no open issue with regard to that.

DR. NETON: Four was okay? I'm sorry.

MR. THURBER: Four was okay, yeah.

CHAIRMAN ANDERSON: Okay, so four is

closed.

DR. NETON: I'm sorry. I was looking at four and I saw those 300 days again and it came out with the right answer.

MR. THURBER: We came out with the right answer, but not the way you would have done it.

DR. NETON: Exactly. I got you. Sorry.

CHAIRMAN ANDERSON: Okay. Finding 5.

Four is closed.

DR. NETON: Five is probably going to require a little more discussion.

MR. THURBER: Right. And the point that we made is that -- the fundamental point was that the numbers that were used in the Site Profile for DuPont were quite a bit lower than if you'd taken the numbers from TBD-6000.

DR. NETON: Right. And that's, I

think, the second issue under 5. The first issue though is how did we really get to where we were with the beta exposures using that graph.

MR. THURBER: Oh, the figure. Yeah, if you want to cover that here, fine. Yes.

DR. NETON: Is that a different finding?

MR. THURBER: Well, it was -- No, no. It's that finding. Yes, it is.

DR. NETON: Well, anyway, let me start there because I think that's harder issue to explain.

MR. THURBER: Okay.

DR. NETON: If you recall, in our last meeting we agreed that the uncertainty on the dose was really related to our uncertainty of the person's position in relation to the source term. Right? So, I mean, the GSD of five that we assigned for the external dose

really had more to do with we weren't sure where the person was in relationship to the drum or the ingot or whatever they're working with.

And we agreed that that was fixed. We were assigning a certain dose at one meter for external, with GSD of five, and I think there's no problem there.

When you start calculating beta doses, though, which we never discussed during that meeting, it's a little trickier. But what we've done is -- and Dave can correct me if I'm wrong here -- first, we had to extrapolate to figure out what the dose rate from the beta exposure would be at one meter, because NRC graph that was in Figure 2 stopped, I think, at 30 centimeters. That extrapolation yielded a result of, I think it was one millirad per hour at one meter. So that's our starting point for skin dose, for non-penetrating dose.

But then we had to figure out what would be the dose for the similar that we did for the photons for a person who was positioned closer to the source. Using that GSD of five calculation, it can be calculated that the person would spend 17 percent of their time at one foot or closer to the material.

So we assigned a one-foot dose using that GSD of five. We calculated the one foot dose, and I forget what that came out to be.

DR. MAURO: One hundred and fifty?

DR. NETON: No, 2 mR per hour at one foot. But that means the person was at one foot or closer. Then we said, well, we will assume they were at one foot 50 percent of the time and 50 percent of that time they were touching the material itself. So we assigned the contact dose rate that was in a previous table -- I forget what table that was -- for 50 percent of the 17 percent of the time, and 50

percent of the 17 percent of the remaining time was at one foot. That's what we've done and that's consistent with the way we handled the external exposure.

DR. MAURO: Okay. Let me see if I've got that.

DR. NETON: I know I've probably confused everybody.

DR. MAURO: I'm trying. I'm working hard. So you've got this one meter photon dose of one mR per hour.

DR. NETON: Right.

DR. MAURO: Then you say what?

DR. NETON: Well, the photon dose wasn't one mR per hour.

DR. MAURO: What?

DR. NETON: The beta dose was one mR per hour.

DR. MAURO: Okay. But somehow I remember the last time we spoke about, and bear

with me. We tried to revisit all this, quite frankly, this morning. And I remember that this was a way. Assigning a distribution, like as you opened up, was really a way to deal with distance, not -- with how long was he at some distance, as opposed to saying he's all the time at this particular distance where we know exactly what the -- in that case, the photon doses -- at that location.

So you assigned an uncertainty distribution on the dose rate at that distance. But really you were doing that to accommodate the fact that the uncertainty doesn't lie in the dose rate, it lies in how much time you're spending at a given distance. Am I making this more confusing?

DR. NETON: No. That's exactly right.

DR. MAURO: Okay. Now, now you know that, but that was all photon, right?

DR. NETON: Right. It was a photon dose with a GSD of five on it.

DR. MAURO: Right. So now you've got a nice distribution for photon. Okay. So that, in effect, tells me how much time you're spending at different distances. Once you do that, embedded in that is, what you really are saying the time you're spending at different distances.

So now you have time spent at difference distances because of that initial assumption with regard to photons. Now you're going to translate that to how much time -- he's going to spending the same amount of time when you're dealing with the beta dose. Is that what you're doing? Now you're going to the beta dose and doing the same thing. You get the time from that and you know what the exposure rate is at each one of those distances. And thereby you get your

distribution for the beta dose. I'm trying to conceptually understand it.

DR. NETON: And remember, John, what we said was, with that GSD of five, that it would imply that the person was within one foot 17 percent of the time.

DR. MAURO: Right. There you go. That's what I'm getting at. So that really gives you the time the person is at different distances. Does it have any effect then on the fact that we're dealing with beta or gamma? Of course, the field itself, as a function of distance for beta and gamma, changes dramatically differently as you move away. But you're not talking about that.

DR. NETON: Right.

DR. MAURO: You're talking about the time that they're at a given distance. And I'm starting to get there.

DR. NETON: Yes. So we're saying,

if the person has a GSD of five on their dose and they're within one foot or closer 17 percent of the time, that's what we're saying. And then we took the dose rate for the beta and the gamma at one foot and assumed that that person was there at one foot half the time and contact dose half the time.

DR. MAURO: And the contact dose was on the order of what? One hundred and fifty mR per hour?

DR. NETON: Actually we used, which I think is probably a bit of an over estimate, but we used the table for bare uranium metal. Table 5, I think.

MR. THURBER: Yeah, that was the 233 millirem per hour.

DR. MAURO: Oh, metal.

DR. NETON: Remember this facility did a lot of some different forms of uranium, processed a lot of different forms of uranium.

DR. MAURO: Okay. So you went with the upper end one.

DR. NETON: They did eventually make some metal, but not like -- that's why this is not really applicable, TBD-6000, to this site.

DR. MAURO: Yeah.

DR. NETON: That's another issue. But it's probably an overestimate to assume that they were always in contact with a metal slab.

DR. MAURO: Gotcha. Because you're dealing with U3O8. You're not dealing with pure metal.

DR. NETON: Yeah, and it's not a huge difference. I mean, UO2 is 207 versus 233 for a metal slab.

DR. MAURO: Yeah, that's a small difference.

DR. NETON: So you're not talking major differences.

DR. MAURO: Yeah.

DR. NETON: And since we didn't know what chemical form they were necessarily working with all the time. And it's even a little more complicated than that, because if you think about the stuff that's going to be in the drum, all those betas are going to be attenuated on the outside going out but not only from the surface. So we believe that this is a pretty conservative estimate.

That gets me into why we didn't use the TBD-6000 numbers, because TBD-6000 was people working with metals 100 percent of the time.

DR. MAURO: And they're naked. They're not inside the barrel.

DR. NETON: They're bare metals. Whenever they worked with them they were always working with bare metal, and usually doing mechanical stuff up close and personal as

opposed to a drumming operation, you know, that sort of thing. This is the reason we didn't end up using the TBD-6000 numbers. I'm not sure if that all helps, but that's the thought process behind this.

MR. THURBER: No, that helps a lot. And basically we were asking for that kind of an explanation as to why you didn't use TBD-6000. And as I say, I understand what you did.

We had, as I mentioned, problems in trying to reconstruct the red curve in Figure 2, because we took the information that you provided, namely that the geometric mean of the beta distribution was a millirem per hour and that was the dose at a meter, and the GSD at five. And we also noticed that the two curves, the curve for the measured data and the curve for the calculated -- or the intersection for the calculated curve and the measured curve, coincided at a point. I think it was 10

centimeters or 15 centimeters. I forget which. And with that constraint, we just couldn't recreate that red curve.

DR. NETON: Yeah, I think Dave might be able to shed a little light on that.

MR. ALLEN: Yeah, just backing up a little ways to the last meeting, the agreement or the thought process that was agreed to in the last meeting was essentially centered on gamma dose. It was Findings 4 and 5. So it was really intended to apply to both gamma and beta.

And that agreement was that we would call the one meter dose rate the geometric mean of the distribution with a GSD of five as the sole number for this dose rate. And the GSD of five would be associated with the distance, much like John Mauro said earlier today already.

That same process worked well for

beta dose for the skin. So we took this NRC graph here and extrapolated it back to one meter to get that one meter beta dose rate, and then simply 2,400 hours times that dose rate with a GSD of five, just like we did for the gamma dose rate.

The problem is that agreement had no means of determining an extremity dose. There's no way to really do that without the stuff that we did that we talked about a minute ago. But that actually comes after this graph.

This graph was simply a mechanism to say that the curve from the NRC is not a log-normal curve. We fit that curve actually using an exponential type of function to get the one meter dose rate. But with the agreement we had, it had to fit in with IREP. It had to fit into a log-normal.

So we used that one meter dose rate and the GSD of five, which was already agreed

to. And this Figure 2, it's essentially to see how that behaves with this graph.

And you can see it's not a log-normal. It doesn't fit it perfectly, but it's not terrible. It's overestimating in some areas; underestimating in other areas. It crosses a couple of different times. So it's not a terrible fit even for those close-in regions of that graph. That's all the intent of that was for.

DR. NETON: That curve was not used for anything other than to demonstrate that the GSD of five was a reasonable approximation.

CHAIRMAN ANDERSON: It's a validation.

DR. NETON: Sort of, yeah. We never used that curve for anything other than to say a GSD of five is not fictional or arbitrary. It does have some basis in reality.

DR. MAURO: I think I get it, and I

understand following your logic sequence.

MR. ALLEN: I thought it would be clearer with that in and demonstrate that. It probably would have, in hindsight, been better if I hadn't put the figure in there.

DR. MAURO: Bill, are you okay with this?

MR. THURBER: Yeah, I am fine with that explanation.

DR. MAURO: Yeah, I am also. I could see you could tie yourself in a knot with something like this. But I understand.

DR. NETON: We talked about this a lot. Some of these last, not last, but the finishing details really can tie you up in a ball.

DR. MAURO: Yeah, I know.

DR. NETON: I think we've gotten the doses bounded here pretty well.

DR. MAURO: Yes.

DR. NETON: Especially since, again, this is not a pure uranium slab.

DR. MAURO: Right.

DR. NETON: It's a drum.

DR. MAURO: You're starting off high right off the bat.

MEMBER KOTELCHUCK: All right.

DR. NETON: I think that covers it. I don't think there's anything else.

I mean, I guess the Work Group needs to decide what we want to do here.

MEMBER KOTELCHUCK: Henry.

CHAIRMAN ANDERSON: Yeah, I don't quite know. I mean, I think that that's a pretty good explanation.

MEMBER KOTELCHUCK: Seems good to me for 4 and 5, right?

CHAIRMAN ANDERSON: Yeah. I don't know -- I don't have anything other than that to recommend. So I think it's --

MEMBER KOTELCHUCK: I'm comfortable and I would say let's resolve both of those.

CHAIRMAN ANDERSON: Is SC&A okay with that?

MR. THURBER: I'm okay with that, yeah.

DR. MAURO: And it's the same situation as the last one.

CHAIRMAN ANDERSON: Yeah, it's technical -- it was worth discussing. I mean, I know more about it than I did before.

DR. MAURO: Yeah.

CHAIRMAN ANDERSON: And that's very helpful.

DR. MAURO: And the degree to which you think any more explanation is needed at some time when maybe you might edit it; it's another one of those circumstances. But as far as we're concerned, I think the record that we're creating right now, and the matrix that's

being created right now, does in fact get on the record why we feel everything is okay.

CHAIRMAN ANDERSON: Yeah.

DR. MAURO: To the degree to which you want to say something eventually, certainly that's your call.

MEMBER KOTELCHUCK: Exactly. But we have the document. So are we up to -- Henry, Andy, are we up to 7?

CHAIRMAN ANDERSON: I think five and six go together.

MEMBER KOTELCHUCK: Yes, they do. It's the same.

CHAIRMAN ANDERSON: Ted, just before I forget it, on the last two, is this something that we should just -- we can send the transcript to the Dose Reconstruction group. Is this something that --

MR. KATZ: Yeah, we can do that. I think, because the transcript may not be ready

for the next Dose Reconstruction Subcommittee meeting, what would be helpful, and we need to have it anyway, since I think it's easier for, Jim, for you or Dave to do this, if you would just update the matrix with a brief of this explanation for how this is closed out. That would be very helpful.

DR. NETON: The question is, is there a matrix? I don't remember.

MR. KATZ: Or just then as memo in response to the last SC&A document.

DR. NETON: Okay.

MR. KATZ: And then I can send those on to the Dose Reconstruction Subcommittee so they can see what happened with respect to DuPont. And then John, at the next Dose Reconstruction Subcommittee meeting, can explain how these were closed out, or Dave. And that will allow the Dose Reconstruction Subcommittee to complete its consideration of

those cases.

DR. NETON: My end goal here is to get this in the BRS. They're piling up rapidly. I mean, this is my third Work Group meeting in less than a week. But I think, ideally, we'd like to get this --

MR. KATZ: Yeah, absolutely. But I just think, as an interim measure, if we have a brief memo, for the record or whatever, that would do fine. Like SC&A's memos work, yours would too, Jim, just explaining how we closed the various findings that we will have closed today.

DR. NETON: Okay.

MR. KATZ: That's what I'll share with the Dose Reconstruction Subcommittee, along with the SC&A report.

DR. NETON: Good enough.

MEMBER KOTELCHUCK: Good.

MR. THURBER: This is Bill again. I

realize it wasn't essentially on the agenda, but do you all want to discuss the question of the big difference between the inhalation dose in the residual period and the ingestion dose in the residual period?

DR. NETON: It's a good point, Bill. I just forgot about that one.

MR. THURBER: And it's new. It has not been on the table. It's just, as I was going back through this today, actually, I said, gee, how you got the numbers is very clear. There's no question.

The way you got the number for the ingestion dose was different from the airborne concentration times 0.2, the methodology we discussed earlier. And clearly that results in a much higher number. Now, that's claimant-favorable and all those good things. But it's certainly a different approach.

And it's not part of our matrix, if

you will. And if you all aren't prepared to discuss it, that's understandable, too, because it's --

CHAIRMAN ANDERSON: Or which committee does it fit with? You could say it's kind of generic. I mean, the issue really is the 0.2 kind of, or different from -- I mean, times 0.2 is pretty easy to understand. And this is now a little different.

DR. NETON: Dave could say a few words, I think. But the difference of not using 0.2 here is the fact that we would prefer to use measured surface concentrations as opposed to inferring a concentration using air sampling.

CHAIRMAN ANDERSON: That's right. You're doing a measurement.

DR. MAURO: Jim, this is John. When Bill and I were discussing this this morning, we were saying, well, the 0.2 multiplied by the

air concentration to get intake per day, of course, we've covered that very thoroughly.

And my recollection is that all I have to do with an operational period, where you're grinding uranium, you're doing whatever you're doing, you know what your airborne dust loading is, you know that the stuff is accumulating on the ground and you've got activity airborne settling on food. So it's an operation.

And after a lot of struggle, of course, as you recall, the 0.2 came out. All right. We're okay with the 0.2. But now you're applying it to -- here's where -- stay with me -- we say, well, now we're in this realm of the residual period where you're really not producing anything. Nothing is falling out of the sky because of your production.

But what you really do have is

you've got a resuspension and redeposition activity going on, which, of course, could have associated with it some ingestion. But the mechanism, to a certain degree, is different. In one case, you've got the airborne activity because you're grinding away. And the other one you've got the airborne activity mainly because it's being resuspended.

And I guess, in our mind, is, okay, well, is there any reason why the 0.2 shouldn't work during the residual period? We recognize that the airborne activity is the declining as a function of time, or not; it depends on what you want to assume.

But the 0.2 factor seems to be applicable there just like -- or is it? And Bill and I were talking about this. And then you go to the 5512 approach, which is a whole different strategy. And then you go to that because now you're working in the residual

period.

And if in fact you do do that, you come up with intakes that are substantially different than the 0.2 approach. And we were left with, what I would call, incongruity that would be nice to resolve, if for no other reason than to get the record straight on this.

MR. ALLEN: Yeah, John, this is Dave Allen. I think the same thing you just said, just in other words: at TIB-9, when we came up with it, and what you all looked over, I think, in the Procedures Work Group for quite a while, was based on the airborne settling out. The operations with some radioactive material being the primary source of the airborne, it's settling out causing some contamination, that contamination being ingested.

But I think it was actually DuPont; I think it was this TBD where they pointed out that it falls apart when you get into the

residual period.

DR. MAURO: Yeah.

MR. ALLEN: The whole methodology. So essentially we could not use --

DR. MAURO: I hate to do this to myself, but as we thought about it, what is it about the residual period? I forget because there's so much history here; why would it break down during the residual period? You still have airborne activity, but it's being -- I think it has something to do --

MR. ALLEN: I can answer that one easy, John.

DR. MAURO: Good, please.

MR. ALLEN: During the operational period you have some operation that's creating the airborne. That airborne is creating surface contamination, and that surface contamination is being ingested. TIB-9 just takes the whole process in one factor.

DR. MAURO: One big load, right.

MR. ALLEN: And equating that airborne to surface to ingestion.

DR. MAURO: Yes.

MR. ALLEN: However, when you get into the residual period, you no longer have this other source of airborne and it's purely resuspension of the --

DR. MAURO: Ah, you don't have both. Because you do have resuspension and generated during operation.

MR. ALLEN: You do, but the resuspension is always going to be a small piece of it.

DR. MAURO: Right, right.

CHAIRMAN ANDERSON: And it's related to what's embedded in the --

DR. MAURO: Right.

MR. ALLEN: So the way to look at it is that the ingestion is truly related to the

surface contamination. In TIB-9, we related that to the airborne which caused that surface contamination.

DR. MAURO: Yeah.

MR. ALLEN: That airborne is gone in the residual period.

MR. THURBER: Wouldn't you then think that the residual period number would be lower? And it's much, much higher.

MR. ALLEN: No, actually you would think -- the common sense would be that, if the ingestion is caused by contamination, the day you stop operations, the contamination doesn't change unless, of course, there's a cleanup of some kind.

DR. MAURO: Yeah, but the air goes away. Yeah, I think I've got it.

MR. ALLEN: The air goes away, but the ingestion rate should --

DR. MAURO: So the 0.2 can't work

because the air just went away.

MR. ALLEN: Right.

DR. MAURO: Okay. Good. By the way. we did get your ingestion rate number. You know, your outcome of your approach, and it came in on the order of some fraction of a milligram per day, something like 20 or 30 or 40 micrograms per day.

So the strange thing about it was the actual number, in my world of understanding ingestion, seemed to be in the right place.

MR. ALLEN: Yeah, and what did we get? Like I said, since TIB-9 kind falls apart for the residual period, and we actually had contamination measurements as a starting point, it really couldn't be used and reverted back to what Jim used from the NUREG, I believe.

DR. MAURO: Nine, yeah.

MR. ALLEN: Yeah.

DR. MAURO: The 009.

DR. NETON: And that 0.2 value using this 1.1 times E to the minus 4 meter squared per hour ingestion value. And it was consistent with the TIB.

MR. ALLEN: Well, during operation.

DR. NETON: TIB-9 during operation.

DR. MAURO: During operation.

DR. NETON: I think that 1.1 times E to the minus 4 is a pretty good number.

MR. THURBER: But, still, is it reasonable to assume, during the residual period, that the ingestion is 100 times more than the inhalation?

MR. ALLEN: I don't know if that factor is good and reasonable. I think there is --

MR. THURBER: That factor comes directly from the table, Table 10.

(Simultaneous speaking.)

MR. ALLEN: I think the 500 is

pretty much a fixed number.

MR. THURBER: That factor of 100 is comparing the two numbers in Table 10.

DR. NETON: You have a point there, and, like you say, it's certainly claimant-favorable. But it might merit some scrutiny.

MR. ALLEN: It's something that we really don't have any common sense numbers to. Like I said, the common sense approach was the ingestion rate won't change when operations stop. But the airborne essentially goes away.

DR. MAURO: Yeah.

DR. NETON: In which case, you have the same ingestion and zero airborne, which is more than a factor of 100.

DR. MAURO: Yeah. I've got to say, intuitively -- I do a lot of this -- the story that emerges, I hear what you're saying and it sort of rings true. But it is, again, one of those elusive things that unless you were

following it, the history of how this unfolded, and you find yourself at the end, all of a sudden ingestion is the dominant one and not inhalation. And it does sort of stop you in your tracks.

MR. ALLEN: It does, and it stopped me in my tracks, too. And my final conclusion, in my own little mind, was that whoever sorted out what ingestion or inhalation rates would be in a shutdown facility. I don't think there's any common sense experience with these kind of numbers.

DR. MAURO: Yeah. Although your numbers, you're in the range of an ingestion number when you come out at the end. We took your activity and turned it into a mass, in terms of what are you talking about, milligrams per day from material, from a surface, that I think has been -- Bill, am I correct? This has been cleaned up.

MR. THURBER: Yes.

DR. MAURO: So what you're really saying is we've got a site, no more operations going on. The potential resuspension is extremely small, 10 to the minus 6. And that's a good number because the surface itself was cleaned up. So we're not talking about readily removable stuff.

All I can say is that, notwithstanding everything we're talking about, that end number which -- what was it again, Bill? We did it by hand on the phone. Twenty milligrams? I mean micrograms.

MR. THURBER: I think it was.

DR. MAURO: I think it was 20 micrograms per day, or something like that. And I play in the world of inadvertent ingestion a lot. It's coming in in the right place. I don't know. I guess, Bill, I'm sort of okay.

MR. THURBER: I have no judgment. I just point it out as something that seemed anomalous.

CHAIRMAN ANDERSON: It kind of depends on what's the route for the ingestion, if it's people touching the surface and then getting it on their hands versus the settling out on -- so does the residual need to get suspended in order to either be inhaled or ingested? And if not --

MR. ALLEN: Well, I think that's it. It has to be resuspended to be inhaled. But it doesn't necessarily have to be to be ingested.

CHAIRMAN ANDERSON: Right.

DR. NETON: I think part of this is we took -- you know, many samples were much less than 500 dpm per 100 square centimeter. We took that to be the gospel.

CHAIRMAN ANDERSON: Yeah. That's the issue.

DR. MAURO: Yeah. The high end number. Use the upper end number.

DR. NETON: But certainly, if you assume that it was that contamination throughout the entire plant, you end up with a much higher ingestion rate. Because I strongly suspect that the deposition model that we used didn't come up with these levels of contamination on the floor.

DR. MAURO: Do you know what would be helpful, in my mind, for me? Some language about one of the outcomes of this approach is this hundredfold difference and the reason for it. I mean, in other words, it's something that emerged from the process. And when you think about it, it makes sense, because on first blush you would say, like David just said, he was surprised, too.

But then when you start to think about it a little bit more, you probably could

explain it a little bit why that would occur in the residual period as opposed to the operational period.

MR. ALLEN: The only part of that, John, is that the 1.1 times 10 to the minus 4th factor is applicable to about any facility, I think. And meanwhile we're applying it to contamination that was left over after scabbling. You know it's not that loose.

DR. MAURO: Right.

DR. NETON: We're assuming this 500 is completely loose contamination.

DR. MAURO: Yeah, yeah.

DR. NETON: Not only that, but many of the values were much less than 500. You're almost getting a sensitivity of the measurement method, you know, 500 dpm per 100 square centimeters alpha is -- I don't know how --

DR. MAURO: They get down to 100. Yeah.

DR. NETON: So when you're talking direct measurements, yeah, it's --

CHAIRMAN ANDERSON: The upper bound is --

(Simultaneous speaking.)

DR. NETON: -- a missed dose, I would say, but maybe some kind of a technology shortfall for ability to measure alpha contamination of direct survey measurement instruments. I agree. It's worth pursuing and considering, but I don't know where else to go with it on this particular -- I remember it distinctly now. This is the one where we used the deposition model and it just doesn't work.

DR. MAURO: Yeah, I remember when this came up.

MR. ALLEN: The problem with this one is we have survey information after the cleanup, which is our best starting point, and the deposition model wouldn't apply because it

would be operational --

DR. NETON: We did that in one case and we got a finding on it. And I thought it was in this site.

MR. ALLEN: I don't think it's this one.

DR. NETON: There was another site where we've done that and then we realized -- actually, I remember reviewing something and going, it's circular logic. You take the positive material, resuspend it and then you let it come back down on the ground. It just didn't make any sense.

DR. MAURO: I remember that. I don't know if this is the site or not.

DR. NETON: Anyway. But I don't know what else to say on this, other than --

MR. THURBER: It sounds like the misleading assumption, if you will, because it was so conservative, is that using the 500.

(Simultaneous speaking.)

DR. NETON: -- numbers that are fairly low to start with.

MR. THURBER: If the stuff is, if the contamination is bound, and I think that the document actually said something to that effect -- I can't remember for sure -- then 500 conceptually could be way too high.

DR. MAURO: And I think the 0.2 number is not something you use during the residual period. It's only during the operational period.

MR. ALLEN: Right. I mean, we have used it for operational airborne to determine ingestion.

DR. MAURO: No. That's what I'm saying. And now that you moved into the residual period where completely different mechanisms are at work, you wouldn't apply the 0.2. And you had to find a different way to

come to grips with this. I think the answer somewhere lies in there.

MR. ALLEN: Yeah. I think, actually, this was the site where we did that incorrectly, really. And you're the ones that pointed that out.

DR. MAURO: Yeah.

CHAIRMAN ANDERSON: Okay. Good discussion. It sounds like a Dose Reconstruction Subcommittee issue. I think we've got it covered here.

DR. NETON: Yeah. And even with the 30 dpm, which sounds high, I mean, the F1 value for uranium, the more soluble form, I think is 0.02. So you're talking about a two percent -- so 6 dpm per day across the GI tract. It's pretty small.

MEMBER KOTELCHUCK: Yes.

CHAIRMAN ANDERSON: Okay. Any other comments or questions?

MEMBER KOTELCHUCK: No.

CHAIRMAN ANDERSON: So I think that closes this Site Profile out. Are there any public comments people would like to make?

(No response.)

MR. KATZ: I don't think we have any public members on the line.

CHAIRMAN ANDERSON: Oh, okay. Then any other issues for the Committee?

MR. KATZ: No. I think until the other sites -- there's more work for this Committee --

CHAIRMAN ANDERSON: Oh yeah. Right. But I don't think there's anything --

MR. KATZ: It's not ready.

CHAIRMAN ANDERSON: It's not ready. I was going to say, we don't need to use this to pick a date.

MR. KATZ: No, I don't think so. And I don't think we're ready for that yet.

But Jim will let us know when that other stuff is ready.

CHAIRMAN ANDERSON: Okay. One more Site Profile down.

MEMBER KOTELCHUCK: Very good. Thank you.

CHAIRMAN ANDERSON: Unless there are other comments, we'll close out the call.

MR. KATZ: No, that's good. And, Andy, at the next Board meeting you could just report out that we closed this work.

CHAIRMAN ANDERSON: Will do. Bye-by, all.

(Whereupon, at 1:05 p.m., the above-entitled matter was concluded.)

1

2