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

WORKING GROUP MEETING

ADVISORY BOARD ON

RADIATION AND WORKER HEALTH

HANFORD

The verbatim transcript of the Working Group Meeting of the Advisory Board on Radiation and Worker Health held in Cincinnati, Ohio on March 26, 2007.

C O N T E N T S

March 26, 2007

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.

-- (phonetically) indicates a phonetic spelling of the word if no confirmation of the correct spelling is available.

-- "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.

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(By Group, in Alphabetical Order)

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THOMAS, ELYSE, ORAU

P R O C E E D I N G S

(10:00 a.m.)

WELCOME AND OPENING COMMENTS

DR. LEWIS WADE, DFO

DR. WADE: Welcome, this is Lew Wade. This is the meeting of the Hanford work group, the work group on the Hanford site profile, of the Advisory Board. What I'd like to do is first begin to identify Board members on the line. Then we'll go through some introductions. When we do the introductions, I'll have the NIOSH/ORAU team introduce themselves. When you do, please identify any conflicts you have relative to Hanford.

We'll then have the SC&A team identify themselves. We'll ask for other federal employees who are on the line by virtue of their employment. We'll ask about members of Congress, their representatives, their staff or workers' representatives who are, or workers who are with us, and then we'll begin the deliberations.

First, to deal with Board quorum

issues, are there any Board members on the call? Any Board members on the call connected by telephone?

(no response)

DR. WADE: This work group is chaired by Dr. Melius. Members Clawson, Ziemer, Poston and Schofield, Phillip is a new addition, Josie is also with us, Josie Beach. Josie is conflicted at Hanford, but you know the Board's rules allow conflicted Board members to have comment if those comments would help the deliberations. So at the Chair's request or with his permission, Josie can contribute as she sees fit. Obviously, she wouldn't be voting or make any motions as it related to Hanford.

Let's go around the table and identify here. Again, for those NIOSH or ORAU members or SC&A members please identify your conflicts.

This is Lew Wade. I work for NIOSH and serve the Advisory Board.

DR. NETON: This is Jim Neton. I work for NIOSH, and I'm non-conflicted at Hanford.

MS. HOWELL: This is Emily Howell with HHS, no conflicts.

MS. BEACH: Josie Beach, and I am conflicted at Hanford.

DR. MAURO: John Mauro, I'm with SC&A. I am not conflicted.

DR. BEHLING: Hans Behling, SC&A, no conflicts.

DR. MELIUS: Jim Melius from the Board, no conflicts.

MR. SCHOFIELD: Phillip Schofield from the Board, no conflicts.

MR. SCALSKY: Ed Scalsky, ORAU, no conflicts.

MR. MACIEVIC: Greg Macievic, OCAS, no conflicts.

MR. NELSON: Chuck Nelson, OCAS, no conflicts.

MR. CLAWSON: Brad Clawson, Board, no conflicts.

DR. ZIEMER: Paul Ziemer, Board, no conflicts.

DR. WADE: Let's go out to on the telephone, and we'll start with members of the NIOSH/ORAU team.

MS. THOMAS (by Telephone): This is Elyse

Thomas, and I'm with the O-R-A-U team, and I have no conflicts with Hanford.

DR. WADE: NIOSH/ORAU team on the telephone?

MR. FIX (by Telephone): This is Jack Fix. I'm considered to have a conflict of interest with Hanford.

DR. WADE: Other members of the NIOSH/ORAU team?

MR. LaBONE (by Telephone): This is Tom LaBone. I have no conflicts with Hanford.

DR. WADE: Other NIOSH/ORAU team members?

MR. ELLIOTT: This is Larry Elliott. I have no conflicts with Hanford.

DR. WADE: We're going to move on to SC&A.

MR. ALVAREZ (by Telephone): This is Bob Alvarez. I have no conflicts with Hanford.

MS. BEHLING (by Telephone): This is Kathy Behling. I have no conflict with Hanford.

MR. ANIGSTEIN (by Telephone): This is Bob Anigstein. I have no conflicts at Hanford.

DR. WADE: Other SC&A members?

MS. BRIGGS (by Telephone): This is Nichole Briggs. I have no conflicts.

DR. WADE: We're having trouble hearing you, Nichole, if you could make an adjustment.

MS. BRIGGS (by Telephone): This is Nichole Briggs. I have no conflicts.

DR. WADE: Thank you. Other SC&A team members?

(no response)

DR. WADE: Other federal employees who are on the call by virtue of their employment?

MS. HOMOKI-TITUS (by Telephone): This is Liz Homoki-Titus of Health and Human Services, and I have no conflicts.

MS. CHANG (by Telephone): This is Chia-Chia Chang with NIOSH. I have no conflicts.

MR. KOTSCH (by Telephone): Jeff Kotsch, Department of Labor.

DR. WADE: Welcome, Jeff.

MS. SHIELDS (by Telephone): LaShawn Shields, NIOSH.

DR. WADE: Good morning, LaShawn.

Other federal employees?

(no response)

DR. WADE: Members of Congress, their staff, workers, worker representatives, any of those friends with us?

MR. SCHMIDT (by Telephone): This is Kelly Schmidt with the United Steel Workers.

DR. WADE: Good morning.

Anyone else who wants to be identified on the record as being on the call?

DR. POSTON (by Telephone): Lew, this is John Poston. I'm a little bit late.

DR. WADE: Welcome, John.

John is a member of the working group. The working group is now complete. Anyone else who wants to be identified?

(no response)

DR. WADE: Again, relative to telephone etiquette, please if you're not speaking, mute your phone. If you are speaking, speak into the handset as opposed to a speaker phone. Be mindful of any background noises, flushing toilets or things like that that might take place and don't go to sleep. We had one snorer. We can't have any of that.

I think, Dr. Melius, it's all yours.

DR. MELIUS: Thank you.

PURPOSE OF MEETING

The main focus of this meeting is to talk about the neutron issue at Hanford, and we have a -- Hans, after -- if I can get this right -- Hans, after our last work group meeting, prepared sort of a summary of, a slight update of the original SC&A comments pertaining to the neutron issue. And we now more recently received a response from NIOSH/ORAU. So that will be the main focus.

If we have time at the end we may sort of do sort of a quick factual or update, logistical update of where we stand with some of the other issues because some were pending further work in updates. But most of the time should be spent on the neutron issue.

We will decide as we go along how we're doing in terms of time and decide whether it's worth it to take a lunch break or not in terms of timing and so forth. However, we will let our transcriber, Ray, make sure that his fellow staff person showed up at the other meeting at one o'clock.

Hans and I were talking a little bit just beforehand and what we thought we'd do is let him sort of just briefly give an overview on the issues that were raised in the SC&A review. And then we thought for the more detailed discussion it would be better to go into that sort of split into three different areas and spend time on that and so do it that way. They are separate, and I think that might be the most efficient way of dealing with these technical issues.

So with that I'll turn it over to Hans unless somebody else has, somebody has questions. Yes.

MR. NELSON: Yes, John Nelson. I have copies of the NIOSH responses if anybody needs a copy.

MR. ELLIOTT: Are they on the web, too, Chuck?

MR. NELSON: I don't believe they went up. They went on e-mails to all the working group members, so I don't know if they're on the web.

DR. MELIUS: They also went out on the web in the Hanford area I have on an e-mail list.

DR. BEHLING: In conjunction with that offer, I did bring with me four copies of the report that I issued a few weeks ago and which will be the focus of this discussion. If anyone would like to have a hard copy, I have four copies available for anyone who would like to have a copy.

MR. NELSON: It's also in that packet I just gave --

DR. BEHLING: To some extent, it's not in its entirety, and it doesn't track the way I would like to perhaps approach this.

OVERVIEW

As Dr. Melius has mentioned what I'd like to do is just give a very brief overview, a few minutes, and then because of the fact that the neutron/photon dose ratio was fragmenting into three areas, that is the eight single-pass production reactor, the closed tube N reactor and, of course, the 2, 300 Areas have all three different independent neutron/photon ratios that were derived by NIOSH/ORAU. And so we will probably want to discuss each of them separately.

What I'd like to do is address the issues that I raised on behalf of those three neutron/photon ratios, and then offer the people here from ORAU to present their point of view before we go on to the next one because all of these things are quite technical issues. And if we were to go through the whole thing first on my part and then follow that by your response, we might forget what the major issues were. So for the sake of simplicity and practicality we'll do it in three independent stages.

Now also I did want to mention the fact that Bob Alvarez had also submitted some comments, and there were some issues responding to his comments. And I don't know how we're going to integrate that into the discussion, but let's try to do my work up front and then hopefully there'll be time for Bob Alvarez on this.

Bob, are you on the phone?

MR. ALVAREZ (by Telephone): Yes, I am.

DR. BEHLING: Are you available for discussing this some time later on in the morning or early afternoon?

MR. ALVAREZ (by Telephone): Yes, I am.

DR. BEHLING: Okay, so we'll try to do it that way.

MR. ALVAREZ (by Telephone): Okay.

DR. BEHLING: Let me start out by saying that the Hanford site is a very, very complex site. And since 1950 and up into the end of 1971 a neutron dosimeter was used. That is the NTA film dosimeter. And it was concluded in 1972 based on AC studies that the NTA film dosimeter for neutron detection was questionable because it had certain deficiency.

And I'll just briefly identify what those deficiencies are. The NTA film actually measures neutrons by allowing a neutron to collide with the component of the film that contains hydrogenous material, namely hydrogen. And in order for a neutron to essentially manifest its impact on that dosimeter it has to impart a certain amount of kinetic energy that will in turn be handed over to a proton.

In other words a hydrogen atom and, of course, it is the hydrogen atom because of its charge, it has a single positive charge, will then produce a certain impact on the film that is measured optically under a microscope. And these tracks are then counted, and there's a correlation between the number of tracks and the exposure.

One of the problems that were, there were several problems identified, but the key problem is that for this dosimeter to really function properly one has to really understand the neutron spectrum that is being monitored. And we know the neutron spectrum is quite complex.

Even for a single reactor we know that the neutron spectrum changes as a function of power level as well as a function of location. And so you can go into a given, a single reactor, and measure a different location under different power levels and even over time, and realize that the neutron spectrum will change due to moderation effects.

One of the things that is recognized is that for a single track to be essentially observed on this photographic film, it has to at least have 300 kilo-electron volts of kinetic energy on the part of the energized proton in order for that track to be visualized under microscope. And we often talk about the issue of a threshold value.

And I want to caution you what the threshold value is. It's not a single moment in space where once you exceed 300 keV of proton energy, the neutron will always be registered. It's a probabilistic event, and the way to describe it is to simply give you an analogy.

If you think of a neutron as a cue ball on a billiard table, and it has a certain amount of energy, depending on which angle it strikes the other ball will determine how much kinetic energy you'll impart. And so if you have a neutron that's exactly 300 keV, and it hits the other ball dead on where it is able to transfer 100 percent of its kinetic energy to the hydrogen atom, then you will have the threshold effect of producing a track.

On the other hand you could have a one meV neutron, and if it only glances off the proton, it will only give up part of its kinetic energy. So the threshold is really not a key energy value that above which 100 percent it is obviously a probabilistic event. And so when we talk about a threshold, you'll see throughout the TBDs that have been issued by ORAU and NIOSH, you will see values that identified a threshold value, 500, 700.

And it's really a question of what you consider a threshold value because it is not an issue of an all or nothing issue. Obviously, when you get to a one MeV according to Hine and Brownell who says that approximately 75 to 80 percent of the interactions will deliver enough of an energy (telephonic interference) so as to give you a track that can be countable. But even at one MeV, it is not 100 percent certain that you will actually get an interaction that results in a visible charge.

(Whereupon, the telephonic connection failed and was then reconnected.)

DR. WADE: Hello, this is the working group. We had a brief technical difficulty. Dr. Poston, are you still with us?

MR. POSTON (by Telephone): Yes, I am.

DR. WADE: Hans, please continue.

DR. BEHLING: So in addition to the limitation that reflects the energy, needed energy to impart a track, there are other issues such as angular dependence. If we look at certain studies, we realize that if the neutron that is being detected by the film comes on an angle that is other than normal, there is reduced response on the part of the

NTA film, and there are other issues that cause everyone to recognize the fact that NTA film was perhaps not the way to go in reconstructing doses.

On the other hand we will say that the TLD, the Hanford multipurpose TLD that was introduced in January of 1972 is probably as best as you're going to get. But I would also caution you that neutron dosimetry is something that is very, very complex, very difficult and from my own personal experience it's probably every dosimetrist's nightmare to have to monitor for neutrons.

It is not an easy task to do. Even the state of the art TLD badge has certain limitations, but it is, in fact, the best we can do; and therefore, we will accept the fact that the Hanford TLD was probably the neutron dosimeter that we will put some faith into.

Anyway, let's go back and just briefly review some of the issues here that we're going to discuss this morning. In the process of trying to reconstruct doses, neutron doses, prior to 1972, NIOSH in their TBD elected to segregate the areas where neutron exposures were possible into three discrete areas. The eight single-pass reactors, the N Reactor, which is a closed loop, also production but also generate electricity, and the two and 300 Area that involved plutonium production and in finishing.

And potential exposures there resulted from, principally from the Alpha N reaction or the N Alpha reaction that you get when you have an Alpha interacting with a low Z material such as fluorine or any other materials, and that produces obviously a neutron. And for all three different areas you do have different neutron spectra, energy spectra that has to be looked at in terms of how does the NTA film respond to that and what are the potential deficiencies associated with these different spectra.

TBD

So with that I would like to perhaps then start by briefly going over the technical basis document that was issued, and I don't have the dates in front of me. But I'm working on the, or this report that I've written reflects the technical basis document that was issued in 2004. And I fully understand that ORAU has issued a revised version of the TBD back in November, I believe, of this year.

But the report that I had written really reflects the original report. So if there are changes, I will have to accept the fact that some of the changes may have accommodated some of the issues that were raised here. But this discussion reflects the TBD as it was written as rev. one back in 2004.

For those who have my handout, I would like to essentially start with page four because I think the first three pages are nothing more than an overview.

MR. NELSON: May I make a suggestion?

DR. BEHLING: Yes, please.

MR. NELSON: You know we're talking about three different areas, the two and 300 Area, the N Reactor and the eight single-pass reactors. The 200 Area and the N Reactor are current as you'll see in the response. The basis for determining neutron/photon ratios are based on NTA, not NTA film, but multipurpose TLD badges. So I think in the interest of resolving the issues and getting through the most items, I think if we go in reverse order there where we feel we're stronger, then perhaps we can resolve those issues sooner in the meeting and get through more of the discussion if anybody's amenable to that.

DR. BEHLING: Well, as I said, my response to this was really based on the 2004 TBD, and I do have some concerns about the issues that you brought up in the response here which tends to ignore what was stated earlier. So I would like to at least follow the protocol as I identified it earlier.

MR. NELSON: That's fine. I was just interested in getting through more issues, and that's fine.

DR. BEHLING: I think we can easily get through here.

EIGHT SINGLE-PASS PRODUCTION REACTORS

On page four you have the first group, and that is an assessment of the neutron/photon ratio for the eight single-pass production reactors. And one of the things that was done here was to use NTA film and say, okay, we will use NTA film and compare the response of NTA film to the photon exposures associated with people who may have been exposed to both neutrons and photons at the production reactors.

And one of the things that caught my attention was the fact that we're really dealing here with seven workers who were monitored between 1950 and '61. And these workers were described, and I have very little additional information, as workers who were, quote, primarily assigned to Hanford reactors. And there's an issue here because if they were assigned to in addition to Hanford reactors, they may have been assigned to areas where there was essentially no neutron exposure which would potentially obviously add photon exposure but no neutron exposure.

So the issue is one of having a set of data involving seven workers who had been primarily assigned to the Hanford reactors and using that data. And these seven workers were assessed, as you see in Table 1 here, by five different methods. They are defined as method one through five.

And just to again to abbreviate the discussion as it needs to be, method one was the response on the part of neutron/photon ratios where the photon exposure was compared to the neutrons as registered on the NTA film with no background subtraction. In other words these seven workers had exposures by the neutrons and photons, and there was no subtraction from a control badge that involves the neutron exposure.

And what you have, as you see at the bottom, an average value, average neutron to photon ratio for method one as 0.43. Or in other words if the person on average had a photon dose of 100 millirem, his neutron dose would have been 43 based on that protocol. And there were several other methods that are very well described in your handout, in your recent handout, and I won’t go through it.

But the method five is the method that is considered by ORAU to be the most accurate. And what that does is to subtract the tracks on the control neutron badge. So again, if a person had a photon dose of about 100 millirem, under method five those seven individuals that were assessed would have a neutron/photon ratio of 0.09. Or in other words there would be nine millirem assigned to the neutron dose.

And as you see down here on the page I just simply summarized that, and ORAU concluded that since we don't really know which method is perhaps most accurate, why don't we just look at all of the five methods and then see what we can come off, what comes out of it. And they concluded that it fits in lognormal distribution. And based on all five methods they concluded that the geometric mean that should be used is 0.1. In other words 100 millirem photon dose buys you 11 millirem NTA dose. And of course, they have a geometric standard deviation in the 95th percentile.

DR. POSTON (by Telephone): Hans? Hans? Hans? John Poston here. I guess I'm having trouble figuring out what's wrong with what you just said. I would expect mostly thermal neutrons being present for around these reactors I would expect a whole lot more of photons than neutrons. And I know that it takes about a factor of 100 more thermal neutrons to produce one rad of absorbed dose than it does fast neutrons. So everything that you said makes sense to me. I'm trying to see what's wrong with what my intuition tells me.

DR. BEHLING: Well, I haven't said what's wrong yet. I'm only verbalizing what NIOSH did. So I haven't gotten to that part yet, Dr. Poston.

DR. POSTON (by Telephone): Okay.

MR. NELSON: This is Chuck Nelson. Not to be rude here, but cut to the chase. I mean, we're gonna sit here and talk about all the technical limitations and problems with NTA film, and our response right away is that we realize there's a lot of limitations and problems with NTA film so that's one of the reasons I thought perhaps we could pass over some of that discussion so that we can get down to what the actual response was because our response didn't really deal with, we basically acknowledge that that's an issue, and we wanted to summarize why we felt that the numbers that we have are claimant favorable, some of which were just now brought up.

DR. BEHLING: Well, I think we can still get through it, but let me go through and explain to the people what was done here.

So we're, at this point, at this juncture, we recognize that the relationship between NTA film and photon dosimeters was one in which the geometric mean was 0.11 as a ratio. In recognition of the energy deficiencies that defined the NTA film, NIOSH did the following: They looked at a comparison between an NTA film and a tissue equivalent proportional counter for the 100 KE reactor and came to the conclusion that the ratio between the observed response on the part of an NTA film and the photon was 28 percent.

And that was based on a single measurement of a single reactor, and it was done on top of the reactor. That's on page five. So what they then did, they said, okay, the neutron/photon ratio that was based on the seven individuals, that we just discussed, of

0.11 should be modified in order to reflect a deficiency on the part of the NTA film.

And this deficiency is reflected by a single comparison between a tissue equivalent proportional counter and NTA film on top of the 100 KE reactor which yielded a ratio of 0.28 or 28 percent efficiency. So in other words the 11 percent ratio was then divided by 0.28 to come up with the 0.141 ratio. And that is the method by which this ratio was then delivered.

So having said that, this is what they did, and let's go quickly through the findings, one through five, and it won't take long. The first finding that I have on page five states the paradoxical use of NTA film. We all came to the conclusion that NTA film was not very good. It can't be used for reconstructing individual doses for any given claimant. But somehow or other the paradox here that I wanted to identify is the fact that we saw fit to use NTA film to develop a ratio method. So that's finding number one.

Finding number two is the questionable accuracy of recorded NTA data, and again, we’re talking about the seven individual workers who were primarily assigned to reactors. We don’t have a full understanding of their assignments throughout this period of time for which these data were collected. And of course, the potential exists that they may have been assigned to areas where there were no neutrons which tends to inflate the photon component; and therefore, in the process reduces the end gamma ratio.

We also -- and I won’t go through this as Chuck had already mentioned -- where there are issues involving interdependency and all these other things. And I have a discussion here about Hine and Brownell which we won’t go into.

Finding number three, the assumption that method five was technically most correct, and this is an issue that I can’t quite understand. When you look at the first table there, and you see method one through five, and you go from a ratio -- this is unadulterated, that is raw neutron/photon ratio -- you go from method one where the ratio is 0.43 to method five which is 0.09, and you realize that the difference is one of subtracting the response on the part of control badges.

What that really suggests that, in essence, let's go back and just use simple numbers. If I had a photon dose of 100 millirem, under method five I would only get nine millirem assigned to me for a neutron dose. Under method one I would get 43 millirem. So the difference between method one and five were just nothing more than subtracting the control badge value, would be essentially an 80 percent dose, or neutron dose, was measured by control badges. And that's hard for me to accept.

DR. POSTON (by Telephone): That's totally within the realm of the anticipated error which is on the order of plus or minus 100 percent, at that level.

DR. BEHLING: Well, we have here a geometric standard deviation which I assume accounts for that. I believe these are all raw numbers that do not necessarily reflect the uncertainty associated with it.

DR. POSTON (by Telephone): I don't know. I just know that when you're measuring at very, very low doses, plus or minus 100 percent is the typical acceptable --

DR. BEHLING: I agree with that, but I don't believe that error is the reason for using method five as the most likely or most accurate measurement. I think the uncertainty has been addressed in the standard, geometric standard deviation.

DR. POSTON (by Telephone): Well, I'm not arguing that point. What I'm arguing is that those could be the same number as far as we're concerned. That difference is not unanticipated.

DR. BEHLING: Finding four, we've already discussed the issue of the seven workers that were, as I said, primarily worked at Hanford, but the more important thing was the issue of the 28 percent. But here we again, as I mentioned in my opening statement, if you go into a single, a given reactor and measure the neutron/photon ratio, you will see it change drastically as a function of location over time, over power levels that may be operating.

Here we're trying to address a

neutron/photon ratio for eight reactors over many years at many locations, and to adjust the relationship from neutron to photon ratio using NTA. We take the single value of 28 percent, a single moment in time, a single location, and we give credence to that as the way in which we're now going to address all neutron/photon ratios. And of course, finding one is the (unintelligible) neutron spectra and the issue of the photon energy deficiencies that define the NTA film.

One of the things that I wanted to point out was, and I include it in my write up, was the 28 percent. If you look at Table 2 in my handout, you see, and it's written in bold, that that 28 percent was based on a single measurement. As I've said that compares the tissue equivalent proportional counter to the NTA film, but it was measured on top of the 105 KE reactor. And you see the 28 percent corresponds to the relationship between 470 over 1700 millirem which then gives you the 28 percent.

On the other hand if you look at the front face or if you look at the X-1, and I'm not sure I even know what that location is, you find that the NTA film reads zero. So again, here is a situation where a data point was selected that is possibly correct, but what is the relationship between a neutron/photon dose response on top of the reactor where it's not likely that the majority of work exposure may have taken place. And of course, if you take it in front of the reactor, you have essentially a relationship that can't be even measured because the NTA film registers nothing.

So that is basically the summary of my concerns. It's the limited data involving the comparison of the seven workers, the method by which that data was accessed using five different methods and using the geometric mean among the five instead of perhaps using method one, which when in doubt might be more claimant favorable, and the issue of the relationship for adjusting NTA inefficiency that is the 28 percent which was based on a single comparison in a single moment in time for the 105 KE reactor that then applies to all reactors including, as we'll see shortly, the N Reactor.

And with that I'll turn the discussion over to --

DR. MAURO: This is John Mauro. Could I just make one point also? Because in following all this with Hans a thought came to my mind, and that is to step back and ask myself the question, given the data, given the assumptions and the concerns that were raised, there's another layer. And that has to do with do you feel that this .28 and the conversion factors for adjusting for the NTA film captures all workers? You see?

Remember, I think one of the things that we lose sight of very easily is that you may have 1,000 workers, and you may have come up with a technique that would be okay for some workers, maybe even 50 percent of the workers, but is it a bounding analysis for all workers who may have not been monitored properly or monitored for neutron? So confounding, superimposed on this, which really the points that Hans made really challenges whether or not the data are adequate and appropriate to come up with this neutron/photon ratio.

I ask another question. Even if they are do they capture and place an upper bound on all workers? Maybe they're okay with some workers. And remember, our mandate is we have to make sure that we give the benefit of the doubt to all the workers that are working, or as the theme's been going, 95 percent. So I think that's part of the story, too. And I guess with that I'd like to stop and leave it to you folks.

MR. NELSON: This is Chuck Nelson. I just wanted to say that Hans actually did a very nice job in laying all that out in the document in the findings. And he definitely has some good points that he's making about the limitations and problems with NTA film. They're well recognized. They were recognized by Hanford as well.

And what we did in the TBD or what was done in the TBD was to use the available data to come up with what was felt to be a claimant favorable neutron/photon ratio. Given that we realize there are limitations to it, and that the 28 percent that was applied was very limited and was based on a single set of pair measurements, and there just wasn’t much data available. So that number was used, and it was felt that it was claimant favorable.

So in our response we basically say we don’t have any conceptual difference of opinion in all these particular areas with angular response issues with limitations on the NTA film. So what we did is we started to dig into some records closer because there’s a lot of opinions that in data and reports around the reactors that neutron levels around the reactors were controlled such that there wasn’t high neutron levels, where there wasn’t significant gamma levels.

So what I’d like to do is turn it over to Ed Scalsky. He’s got some good points he’d like to make about the single-pass reactor facilities and tell you what we’re doing right now to look at some of the data to help support that these numbers are in fact claimant favorable.

MR. SCALSKY: This is Ed Scalsky. I think one of the things that we have to be aware of is that the people at that time were aware of all these problems. They made extensive surveys around the reactor. They started with the 305 reactor, and they went into the 105-B reactor when it went critical. They did complete surveys along the front face of the reactor. They timed people when they went in there to do work, they made measurements. And, in fact, from 1950 to ’57, I guess, one of the things they did is that they made the survey. When people went into work, they started a stop watch, and they based their time on the highest dose rates that they could find in there.

DR. MAURO: And so they’re neutron measurements?

MR. SCALSKY: Neutron measurements.

DR. MAURO: With NTA film?

MR. SCALSKY: No, with instruments.

DR. MAURO: Okay, this was instrumentation.

MR. SCALSKY: Instrumentation also.

DR. MAURO: (Unintelligible).

MR. SCALSKY: Well, I don’t know about (unintelligible). They had a (unintelligible) type instrument, BF-3 with cadmium covered and non-cadmium covered.

MR. ALVAREZ (by Telephone): And this is Bob Alvarez. Are these data recorded somewhere?

MR. SCALSKY: Yes, they are recorded. There's a couple of, we're in the process of getting additional data, logbooks. We have a couple of logbooks right now. The HEW 199L goes from 11/21/44 to 12/29/44. And the HEW 507L goes from 9/10/45 through 5/3/46. And these logbooks give the details of all the surveys that were made at that time.

MR. ALVAREZ (by Telephone): Now subsequent to that, you know, when they started to significantly raise the power levels to these reactors and the shielding, bioshielding, began to degrade and the engineering studies subsequently pointed out an increased leakage of photon and neutrons. Are there data with respect to that time period?

MR. SCALSKY: I believe there are data. The HW-33533, I'm not sure. Whose was that, Chuck? Do you recall?

MR. NELSON: That was a report. It was called "Achievement and HAPO Monitoring". It covered 1944 to 1954, and it was basically a summary of all the controls that were in place from the beginning of the time they started the reactors. It actually included a lot of different work areas, but it had a specific section on monitoring at the reactors.

MR. ALVAREZ (by Telephone): I guess perhaps I’m not being clear. I’ll restate my question. Subsequent to 1954, around beginning in the, let’s say ’56, ’57 timeframe when the power levels were increased dramatically in these reactors and they began to observe deterioration of the bioshields and things like warping and other phenomena affecting the physical state of the reactor, et cetera, there was concern expressed, at least by the engineering people, about the potential for an increased leakage of photons and neutrons. And my question is after 1955, ’56 were there any sort of specific studies performed to look at doses that might have been received from the deterioration of the bioshield and other problems associated with increasing power levels?

MR. SCALSKY: I would expect that based on the logbooks that they’ve had, that they’ve made surveys on a continuing basis and I see no reason why it should have stopped, you know, at 1950 or ’55 or any other time.

MR. ALVAREZ (by Telephone): I see. Because I just heard reference to one report it stopped in 1955. I was curious what went on beyond that especially during this period when, as I said, when they were experiencing these problems of deterioration of the bioshields.

MR. SCALSKY: No, we’ve only had, we’re just now getting a lot of this data in. We have made requests to get this data, and we are getting it in. So it’s taking a little longer time than we had anticipated.

MR. NELSON: It’s going to take a lot of time and resources to go through all these documents and pick all this information out. So it’s not going to be a little uptaking to go through and try to re-create every situation throughout all those years prior to the implementation of the TLDs.

DR. MAURO: This is very important, and as what you’re saying is there’s a body of data out there that measured neutron, I guess fluxes, was it just energy distribution or was it just dose?

MR. NELSON: It's dose ranges.

DR. MAURO: Okay, the dose that does capture the full range of the energy distribution.

MR. NELSON: That's what we're not sure about. I don't think at this point we can say that we know the neutron energy spectrum at the reactors because it changed wildly.

DR. MAURO: But this instrument that was used -- I'm not familiar with the instrument you're referring to -- captures the full range. In other words it says dose --

MR. ALVAREZ (by Telephone): Was it a gold foil instrument?

DR. ZIEMER: Let me insert here. Neutron instruments historically have had somewhat the same problems as the film badges. But people knew from the front end that there was spectral dependence in terms of dose, and you want to relate what you saw on the NTA film was dose, and so you needed to know the spectrum. So there are a lot of things you could do, and some of them were crude. You could do threshold foils, and those were done in the early days. The Chang and Eng was maybe had boron and cadmium or --

MR. SCALSKY: Well, it had two chambers actually.

DR. ZIEMER: But that was really rough spectral analysis in a sense, probably fast and maybe epithermal and thermal or something like that. So there were a lot of different detectors and all of them had limitations. It really wasn't until you got to the Bonner spheres and you're up toward the end of the '50s and into the '60s before those started to get -- I don't remember the dates, maybe Poston would -- but there was a lot of attention given.

And let me get a little soap-boxy here, but I always remember [Name Redacted] who's kind of the father of TLD. He used to say anything worth doing is worth doing poorly. And what he meant by that was even if you couldn't measure whatever it was, say neutrons, very well, you ought to try to measure them as best you can and then -- and I think Mr. Nelson mentioned -- these issues were known very early on.

The limitations were known very early

on, and great amount of effort to try to define those spectra under different power. This is throughout the system under different power levels, under different leakage levels and so on. I know it was going on at Oak Ridge. Based on what I know about Hanford it was going on there.

And keep in mind what they were doing in terms of trying to limit worker exposure and getting these ratios. So if you knew something about the gamma, you at least knew roughly where you were overall, a very different purpose. Now, we're trying to say how can I use that information and make a correct decision on compensation.

And that's the struggle here I think. And to do it with a few numbers doesn't give us a lot of confidence. But if we can find these early spectral depictions, even though those early ones are going to be crude, but at least you'll have some idea. Actually, the higher energies are kind of easier to do, and those are the ones that delivered the most dose anyway.

So I think if you can get a hold of

those, those will be very helpful. I don't think -- and Bob Alvarez asked the question -- I don't think we know completely what's available, do we?

MR. SCALSKY: Not yet. We are constantly seeking new information.

DR. ZIEMER: But our confidence on bounding these for purposes of compensation will be very much enhanced if we can get some of that information with the early measurements. They certainly were trying to do what you're talking about.

MR. SCALSKY: Yeah, and some of these early measurements they used the long* counter which you know is useful for (unintelligible) case estimate. So there is some data on that we'll continue to get.

DR. MAURO: Am I correct in understanding then this number .28 is really what we're talking about, is that .28 a good number? And will this new information help us to support that number as being a good bounding value or is some other value more appropriate? Is that really what we're zeroing in on?

MR. SCALSKY: I can't say that the .28 is a good number.

DR. MAURO: No, no, I'm not saying it is or isn't. I'm saying that, in other words the research --

MR. ELLIOTT: That's the issue.

DR. MAURO: -- or is there more to it than that?

DR. BEHLING: Well, I think there is more because you can look at the Table 2 that I have, and obviously the difference between Top 23 when you have the 1700 versus the 470 that gave rise to the 28 percent was not obviously matched by the front phase or the X-1 location meaning that the ratio will shift as a function of neutron spectrum.

As you degrade the spectrum, you approach raising zero response for the NTA film with obviously, I mean, if you get much below the neutron energies of 300 keV, your NTA film has no chance of registering, and yet your photon badge will register whatever down to a few tens of keV.

So we realize that no single number will ever do justice. What you hope for is to perhaps take a claimant favorable number and say that on average if a person spends time in the containment, and he wanders from one location to the other over time or different reactors, that a single number will perhaps provide a bounding relationship. But not, there will be no single number that will capture the truth.

DR. NETON: I think this is the crux of the issue. You kind of avoided it in your discussion. We didn't assign a single number. We assigned a distribution, and in fact, the upper 95th percentile of that distribution was .62. And that was assigned to workers, not a single value. And then the question becomes -- and we've been down this path many times in many working groups -- is it appropriate for NIOSH to assign a distribution with their best estimate, which this was.

We looked at all the data and said this was our best estimate of what it could be but given the uncertainties it could go as high as .6 something at the 95th percentile. Or is it SC&A's opinion as it has been in the past that we need to assign a 95th percentile to everyone? And that's what it comes down to.

DR. MAURO: I think there’s some very productive discussions on this when this came up on other sites, and there’s almost like a procedure that’s inherent. And that is if you have a site of highly variable, let’s say neutron to photon ratio was extremely variable which it sounds like it is, then the question becomes do we have people that may have worked -– is there a location that may represent a neutron to photon ratio of five, because I think I’ve run across some of those.

And is it possible, is it plausible, here’s where the judgments come in, that that five was predominant at that location because of the nature of the activities that took place there and that there were workers that may have worked there for extended periods of time where they experienced the neutron to photon ratio of five?

See, the way I look at it is, and if we don’t really know -- we ran into this problem at Bethlehem Steel -- it’s almost like a policy issue. If we have a situation where you have this variability, you have workers, you’re not quite sure where the workers worked, but there are some locations where consistently the ratios were above one. I won’t even use five because that’s pretty high. But let’s say consistently above one.

And we have workers, and we’re not quite sure where they worked. What do you do? Do you assign the full distribution? And I think where we came out on this -- and Jim, you correct me if I’m wrong -- is that when you’re in the difficult situation, you have no choice but to give the guy the upper end. I think that you go with the full distribution when there was good reason to believe that, no, it’s unlikely this guy, the nature of his job was such that perhaps there’s no reason to monitor him or that we had good reason to believe that he spent time in lots of different places.

But I guess we’ve developed a practice, and I think we agree --

DR. NETON: I think what you’re saying here is the evolution of our process.

DR. MAURO: Yeah.

DR. NETON: This Hanford document was written, one of the first ones that you reviewed, and a lot of water's gone under the bridge since then. And we've evolved our position particularly in the area of photons. I mean, I think there is a TIB out there now that you'll read about later that's in our response, TIB-20 I think, that essentially takes that position. If you don't know any better and the person should have been monitored, in our judgment they were more exposed and should have been monitored, then the 95^{th} percentile is probably the appropriate measurement.

Now, we don't have a position on that for neutrons yet, but I think we need to go back and look at this. I think what Ed suggested with these logbooks and everything is fine and good, but we've got to look at it and see is a single value with a distribution appropriate or not. And I would suggest that in some cases it may be. For instance, if we've not been successful with you guys at least in making the case that some, the workers that were more highly exposed were monitored, and if we can demonstrate that, I think you would agree that unmonitored workers then may --

DR. MAURO: Full distribution would be better.

DR. NETON: -- the full distribution would be more appropriate.

MR. ALVAREZ (by Telephone): There also appeared, at least in sort of a general process history perspective, an increased number of people who were brought to bear to do maintenance and repair on these reactors especially beginning in the mid- to late-‘50s through the period in fact when they were ultimately closed. And there’s some data that indicates how many people were doing what when.

But it just appears to me that there were people working on all different aspects of these machines especially in the, what would be a concern, of course, was during that period of peak production when there was a lot of pressure to keep these reactors operating to their fullest capacities. And the pressures to do that while at the same time, you know, because maintenance repair required mostly reactors that were closed for that purpose.

DR. GLOVER: Hey Chuck, this is Sam Glover. The numbers escape me a little bit, but based on obviously Hanford's and SC&A's evaluation, we're looking at that. When you look at the cases, only 62 cases have used a best estimate. I think 62, something like that, and over 2,000 have used the 95^{th} percentile. So it was at about 2.62 --

DR. MAURO: Was it neutron?

DR. GLOVER: Yes, the NP ratio, I think it was 2.62. Very few have used the actual geometric mean and distribution. And I think Chuck, we've captured this in our discussions.

MR. MACIEVIC: This is Greg Macievic. One of the things you offered, that NP ratio of five. You also have to look at the film itself and when you're developing this ratio. That number came about due to going to the detection limit of the film at 20 millirem. So now your variability goes way up. Your NP was five, but you were not how solid is that five.

DR. NETON: That's another issue. When you start getting into the neutron/photon ratio business, when you've got non-detectable badges at the detection limit, you can't take the 95th percentile, the badge and the 95th percentile in my mind of the neutron/photon ratio and come up with what I would consider a reasonable estimate.

DR. BEHLING: On the other hand I did fail to mention something that did catch my eye, and it's on page two, and I'll quote because it's taken directly from the TBD.

DR. ZIEMER: That's from your report?

DR. BEHLING: Yes, and I'll read it for those that don't have the report in front of them. And in the TBD it states the following:

"Hanford NTA film was processed independently from the beta/photon film even though the NTA film was typically exchanged along with the beta/photon film. Prior to 1957, NTA film was housed in the two-element beta/photon dosimeter holder along with the beta/photon film."

And I'm going to come back to this issue when we talk about the 200 and 300 Areas because that's a very critical statement here.

But the thing that I wanted to point out here is the following statement a little further down. “The Hanford policy to process NTA film varied historically but basically involved the practice to read all NTA film for the 200 West plutonium facilities and, for other Hanford facilities, to process the NTA only if the photon dose was at least 100 millirem.”

Now, there’s a certain bias associated with it especially for those individuals for whom perhaps the neutron/photon ratio was greater than one. Which meant that if his photon dose was less than 100 millirem, his neutron badge wasn’t even read according to that policy.

MR. MACIEVIC: But in what we used, we used all the values that we had for (unintelligible) on the 200, 300 level, but all the values that were used were actual readings from the badge and not, if there was a number there, we used it. I may be misinterpreting what you’re saying, but we did not have a cutoff of a certain value except to say we used the minimum detectable on the badge.

If there was a reading on the beta/gamma, we used that reading and then we used whatever the neutron reading was to come up with that lognormal distribution. We didn't, we cut off at 20 and also at 50 to take a look at how distributions were and how you can cut out some of the variability by going up to 50 millirem with a badge.

DR. BEHLING: I think you're referring now to the 200, 300 Area which is an issue in the third component.

MR. MACIEVIC: That's right.

DR. BEHLING: I'm going back to the production reactors. And according to the policy statement here is that we always associate a neutron component along with a photon component. The two are not divorceable. Therefore, if we see a photon response that's less than 100 millirem, we may not even bother with the NTA processing, the processing of the NTA film.

Meaning that for those individuals who where the potential ratio was one or higher, you may have not even processed the NTA film based on the failure of the photon dose to have been less than 100 millirem, which means there's the potential of a lot of data missing that on the basis of this policy was simply not bothered to be read.

DR. ZIEMER: Were there actual cases in your charts where you show that ratio being greater than one? I don't recall it.

DR. BEHLING: There are, there are evidence, and in fact, the TBD has for certain areas the ratio was as high as five-to-one in select, rare instances, yes.

MR. NELSON: Yeah, I think it's plutonium facilities.

MR. ANIGSTEIN (by Telephone): This is Bob Anigstein. I'd like to interject a comment on this. Hans said that there was data missing. I'd like to put it more strongly and say that that indicates there's a potential bias in the data because if low photon readings meant that the NTA film wasn't read, you could conceivably have situations where you have photon readings below 100 millirem, and yet you have high neutron readings, and those would be automatically discarded. And these would give you a very high neutron/photon ratio.

MR. SCALSKY: That was a study by Watson that came up with that particular value. They did a study of 66,000 NTA film, and what they were trying to do was economize. And they found that you would not, if you had a high gamma, you would have, or if you had a high neutron, you would have a high gamma. And they concluded that it'd be one in 10,000 where you would get a high neutron without a high gamma. And that's why they came up with that.

DR. MAURO: There was a certain amount of wisdom in that decision at that time whereby you would not miss a significant neutron component. That's important if the data are out there that demonstrate that, great. But right now I guess on face value the argument that Bob just made, you know, sort of is self-evident. That is, if it turns out the actual data on which that judgment was made was sound, I think that's very important.

MR. NELSON: That threshold value was established for reactor facilities not for plutonium facilities because they felt that neutrons weren't as significant in the reactor facilities. So instead of counting all these badges, they set a threshold at which now those are the ones we're going to target, and we'll look at those and see if we can specifically see neutrons on those.

DR. MAURO: So let me see if I understand. The wisdom behind the decision was, okay, if a person has a gamma of less than 100, there really is no need to read the neutron component because it's likely for reactors that the neutron to photon ratios is relatively low. That's under point one or on that order. And on that basis they really weren't that concerned about that ten millirem and really changed things too much as opposed to the fact that possibly it was five to one in that case.

Well, you're saying in that particular circumstance as for the reactors having a five to one ratio associated with the 100 millirem photon dose is probably very unlikely. That's what I'm hearing. I think that's an important point, and I think that if that's true --

DR. BEHLING: I think if you have faith in it, John --

DR. MAURO: No, no, I'm just posing the question. I understand the argument you're making, and if the data support it, that's right. But of course, we haven't seen that data.

MR. SCHOFIELD: How good is the documentation that these people spent their time at the reactor and didn't go over to the 200, 300 Area to work with the plutonium? I mean, shielded gamma is pretty easy so I mean, you know, you have guys who almost any –- they're gonna be floaters. They're going to spend a lot of time here, but they're going to spend a heck of a lot of time here particularly times when they're short they need to generate a lot of this overtime. They will pull people from here to fill in over here. Unless that's well documented, there are people who have potential for a large neutron dose being missed in their records.

DR. NETON: I assume there'll be logbooks not only recording the neutron but the photons simultaneously so you're going to have an instantaneous ratio here that documents the neutron/photon ratio independent of the badges themselves, I would think.

MR. SCALSKY: Well, you have to watch where these measurements were made.

DR. NETON: Right. But what I'm saying is it would be unusual to me if someone would go and measure neutrons without measuring photons at the same time. And if you have that type of data, then you don't have to rely on these badges anymore.

MR. MACIEVIC: That last argument though if you were now saying that you don't know where the person is, then this discussion about the individual areas doesn't really help you because now you're going to have to say is there a site NP ratio. And are you going to now make some upper percentile for everybody at the site and assign neutron doses to secretaries and everything else? Because that gets into some very fuzzy areas which I think with these records and that we'll be able to identify more what the worker did.

MR. NELSON: Well, Jim, if you look at the records associated with the claims, they're actually very good in that they'll have the dosimeter records, and they'll show the area where the guy works. I'm not saying they're 100 percent complete regarding showing every movement, but it does, for many of the years it shows, okay, the guy left 100 Area and moved over to the 200 Area.

And there's an actual entry into their dosimetry file that says that. And there's also x-ray records. On x-ray records it has work area. So when the dose reconstructor is looking at this, he's picking through all this data and noting the fine details on the work location, and that's the information that we have. And for the Hanford site it's pretty good. It's very impressive.

DR. MAURO: Bob Alvarez did make a point though that struck me, and I don't know the history of the Hanford facility. It sounds like in 1956 something special happened. That is, they kicked up the power level of the reactors, and apparently from reading the site profile there was a lot of problems with regard to, I guess, the tubes. There was warping and in other words what we're dealing with is a very variable, time and space variable.

So I think that the, what I heard was, well, if you know you're in the reactor area, you're pretty confident that the neutron to photon ratios were below one. I mean, I guess that's what this says. But then at the same time I hear, well, wait a minute. I don't know if we can jump to that given the experience, that is, we have a highly variable nature in time and space amongst these seven or eight reactors. Was it the (unintelligible) reactors?

So all I'm cautioning is that these occurrences where the reactors weren't performing as well as you'd like may play on all this and have some influence on what you're going to pick. Because remember, I'll go back to what I said in the beginning, that is, remember, we have an obligation to make sure that all the workers that moved through the system we're going to give the benefit of the doubt. So we're not looking for a collective dose or the average dose, we're looking for the right thing to do for just about everyone.

DR. BEHLING: And let me add something here because of comments made earlier by someone on the other end of the table. And that is to date we have used, obviously, the 95th percentile for dose reconstruction. But I want to caution everyone. When you have most of the dose reconstructions probably involve claims where you tend to maximize doses, and sure, you can be generous then because you can give them the 99th percentile as long as you know the bottom line is we don’t pay up and the POC’s less than 50 percent.

The concern that I have in applying neutron/photon ratios applies to best estimates, and that’s the bottom line. Anything else doesn’t really matter because we know when you start out with the assumption that we’ll maximize everything, oh, you can generously give them the 99th percentile value because it doesn’t matter. The bottom line is we don’t pay. So I wanted to look at only those cases where best estimates were used and then determine which is the appropriate neutron/photon ratio because that’s the only place where it matters.

DR. NETON: I think we agree with that.

DR. MAURO: And could I ask a question then? I know we've done a lot of Hanford studies, cases. Have we run across many realistic cases?

DR. BEHLING: I'd have to ask Kathy, but she would have to --

MR. ELLIOTT: I think that's why Sam framed his comment earlier that there's only been 65 claims done under best estimate.

DR. GLOVER: At 2,000 and something.

MR. NELSON: I think the number was 72. This is a very cursory review, but it takes awhile to get that detail. I think the number was 72 in over 3,000 Hanford claims.

MR. ELLIOTT: We don't disagree with you, Hans. That's where we need to focus our attention. It affects a small number of the population.

DR. BEHLING: No doubt, and that's the only population that I want to address here.

DR. NETON: And we agree. We need to go back and look and see if we can, if full distribution is applicable or whether something like the 95th percentile is more appropriate. I think we're all in agreement.

MR. MACIEVIC: We have to remember that when you're doing dose reconstruction, the person has, if you know he was in a reactor area, has no neutron and now very low, and he's got low photon or none, you're going to get all the missed dose and all that added into the photon dose which is now then going to be multiplied by that NP ratio which is going to be a much higher dose than just using the values that are right there off of the original data.

MR. NELSON: I think Ed was eventually going to get to that, but yet missed dose is very significant in the early years. If they're on a weekly change out schedule and you have high detection limits when you multiply that all through, you're assigning very significant doses, photon and neutron missed dose.

DR. BEHLING: And, in fact, that's a good point because among the things that I brought up in my write up on page three was the actual changed frequency from January 1950 through December 1950. So it's for the full year of 1950 the frequency for badge exchange was weekly. So if you apply that it didn't match, it didn’t meet 100 millirem for that year, you could be missing an awful lot of photons and neutrons.

DR. GLOVER: This is Sam Glover again. There was a brief comment made about that they aren’t divorced. Actually, the NP ratio, there is a divorcing. Most of the time, there’s only neutrons when the reactor’s on. I think that needs to be made very clear that when the reactor’s off, and there’s still a lot of photons, you know, you’re activating stuff, still a lot of photon generating circumstances around. These guys are getting photon dose, and we’re still going to apply this NP ratio.

DR. ZIEMER: As if it was in operation.

DR. GLOVER: Exactly.

DR. ZIEMER: Could I ask? Maybe, Greg, you could answer this. In the case where that policy was enacted for the reactors where if it was below 100 millirem, they were assigned a zero neutron. Is that correct? For the reactor areas? At least in a certain time period. Can you spot that readily in the record?

MR. NELSON: What it was is they, if it was below 100 millirem, they didn't read the NTA badge.

DR. ZIEMER: Yeah, but what did they enter? Did they enter a zero I think you said? Is that easy for you to -- well, let me just ask it this way. So a zero shows up in the neutron column. You're still putting in a half of the minimum detectable or something, right, for that number currently? Is that what we're doing?

MR. NELSON: Yes.

DR. ZIEMER: Okay.

DR. MAURO: Let me see now. You measure photon. He has his NTA film, and he has his --

DR. ZIEMER: No, if he's only got a 50 millirem photon, then they would, zero would have been entered.

DR. MAURO: Now the problem becomes, what I'm hearing is now in theory zeros entered. You could in theory fill in that blank by going one-half of the MDAs for neutron if --

DR. BEHLING: No, they --

DR. MAURO: No, they're not doing that.

They didn’t measure it. I just wanted to understand, okay.

DR. ZIEMER: So you are doing it for neutrons though, right?

MR. NELSON: Right.

DR. ZIEMER: You’re putting in a neutron value which is half the detectable limit which will be what?

MR. NELSON: About roughly 25 I believe.

DR. ZIEMER: Yeah, so actually, actually, you’re almost giving a bigger ratio anyway because you’re below 100 on the gammas, and you’re going to be assigning 25. So you’re already up in that same ratio or above where you would --

DR. BEHLING: Well, not quite because for the eight single-pass reactors the N/gamma ratio is .41. So if you measured 100 millirem, what you would get if you apply the ratio would be 41 millirem.

DR. GLOVER: I think it made -- This is Sam Glover again. We use an NP ratio. The neutron measurement is recorded, and we look at that. It’s there on the sheet, but an NP ratio actually assigns the dose to a worker.

So we actually don't use that recorded neutron, the NTA film. I think that needs to be made clear.

MR. NELSON: Prior to 1972 when NTA badges were used and TLDs did not exist, we only look at the photon dose. If they worked in one of the neutron areas, we apply the neutron to photon ratio to that photon dose and to the photon missed dose. And you assign a neutron dose to that worker for all the years that he or she may have worked in those areas.

DR. BEHLING: Are we through with the first eight single-pass reactors?

MR. NELSON: I think so. I mean, we had some, we talked about a lot of these points, but I think there's some bullets in here that identify why we felt that neutrons weren't as significant as one might think in those areas. And they were brought out by various people in the room talking about when you work around these reactors and refueling the reactors, the reactors were shut down. You weren't working in a neutron field.

Do you want to cover the rest of the bullets? Give you a fair chance to hit each of those?

MR. SCALSKY: Okay, we mentioned the fact that all Hanford reactor exposures scenarios involving neutron exposures also involved significant photon exposures. The higher energy neutrons associated reports and beams where shielding may have been inadequate would be detected by the NTA. There was a judgment made by [Name Redacted] who worked there in early 1947. And in his report his judgment was that less than five percent neutron radiation component of the recorded whole body dose in the Hanford reactor facilities had, well, that the exposure to neutrons would only be less than five percent at the reactor facilities in all of the (unintelligible) dose.

DR. MAURO: That's an aggregate parameter. In other words in the aggregate when you're looking at all workers and all exposures, the contribution to the collective dose --

MR. SCALSKY: Would be less than five percent.

DR. MAURO: Yeah, I always like to caution.

MR. NELSON: I don't think he's saying that it would represent a neutron to photon ratio. He’s not saying that.

DR. BEHLING: We have to be very careful here. And I’m going to bring this up when we get to the third portion because as I pointed out when I read that statement earlier, the NTA film was handed out to people separately from their film dosimeter. Meaning that if the reactor was down, and you knew it was going to be down for the next six months, you wouldn’t have any NTA film assigned because there would be no reason to.

And so what you have to be very careful about is comparing the NTA film error where this dosimeter was issued totally independently of the film dosimeter that measures photons. As you pointed out, when the reactor shuts down, you’re going to have residual fission products that continue to obviously expose people. But my gut feeling is, without knowing for sure, that you would stop issuing NTA film so that the person would have no reason to have a zero under his neutron dosimetry because what would be the point?

Now that changed, and I'll bring that up later when we talk about the post-'72 timeframe when we have the Hanford multipurpose dosimeter. That dosimeter was an integrated dosimeter, and it didn't matter whether you were exposed to neutrons or photons or both. You were given that dosimeter.

And you have to be very careful because I'm going to bring that issue up when we talk about the data that involves the two and 300 Area. I just want to clarify this. So we're not mixing things up here. For the early periods when NTA film was used, NTA was only issued when there was reason to issue it because they were two independent separate dosimeters.

MR. SCALSKY: And as Chuck said, the dose reconstruction process involves several dose components, you know, the missed photon and neutron doses, and it took into consideration frequency of changes when they applied all of these. And they used the MDL over two times the number of zeros or the less than MDL over two. So we do feel that all the evaluations are favorable to the claimants when we take all these things into consideration.

They did make dose rate measurements. There was a study by Peterson and Smalley, you know, they did make dose rate measurements at the elevator of the B-Reactor. And there they found 30 millirem per hour neutrons, 25 millirem per hour gamma. And they used this to determine additional shielding that was needed.

But they've had an extensive radiation protection program, both up on top of the reactor, on the front face of the reactor, and it was a continuing process along with extensive training. So everybody understood what was going on, not only the workers, but the health instrument people in understanding the instruments that they were using, the reactors. And they were looking for voids. They were looking for ways to constantly improve the shielding on it.

And I think that's all. Are there any other... Chuck, do you --

MR. NELSON: You talked about that Peterson and Smalley report. That was in 1960, so they had some dose reads that would support a one-to-one NP ratio. Of course, that's what the reactor operated. So as Ed mentioned, you know, there's a lot of times when people are receiving photon dose and receiving no neutron dose. And we're taking that photon dose and applying those NP ratios. So I feel like that in effect most of the photon doses were relative to when there wasn't much of any neutron dose. So I think that by itself is claimant favorable.

There was the B hole test reactor measurement, Whipple, 1949. Do you have any notes on that, Ed? But what I have here is that there was a test hole they put on the reactor, and they said, so we're talking about a hole that was made in the reactor, and there's a beam coming out of the reactor. And they said a significant amount of flux was 1.3 MeV neutrons.

So if we're talking about a significant degradation of shielding, then you should be seeing these higher energy neutrons which would have been seen by NTA film. He made a general conclusion about that. He said that NP ratios of about one with minimal shielding. So there's a hole, a beam coming out of the reactor, and you're seeing NP ratios of about one.

DR. MAURO: This is concrete shielding?

MR. NELSON: We're talking about the B Reactor so it's all the shielding that makes up the B Reactor.

DR. MAURO: I just, I'm thinking in terms of as the shielding increases the standard depending, of course, on the material, but I would assume it's concrete, you're going to sharply reduce your gamma but not necessarily your neutron. So what you just said seemed to sound like the opposite.

DR. ZIEMER: Well, this is a beam though, wasn't it?

DR. MAURO: Yeah, I mean, help me out so I don't misunderstand you.

DR. ZIEMER: This is an unshielded beam, from the report, it sounds like.

DR. MAURO: I thought I heard something about shielding was increased incremental --

MR. NELSON: No, that was another reactor. I didn't bring that one up. You're probably thinking of another report that they talk about, an ORNL 2195 which was --

DR. MAURO: Yeah, 'cause I remember reading that one. Okay, that threw me a little bit.

MR. CLAWSON: Didn't these reactors have an outer skin on the outside of the concrete to be able to, I don't think you could actually drill right into the, and get a complete beam. You're going to have some rebounding. You've got an outer shielding on it.

MR. NELSON: That's one of the things that in the response was that these reactors actually had very significant shielding. And there's a discussion there, and it talks about all the shielding that made up the B Reactors. I don't know if we need to cover that or not.

MR. CLAWSON: Here's the question. All this different shielding, and they've got quite complex into it, what pushed them into that situation to be able to do, they must have had an issue there, and they must have had a problem. So they were trying to correct a problem by putting more shielding on and so forth.

The degradation, my understanding is,

is of the heat of it. They weren't able to cool it the way that they wanted to, and there started to become degradation. Also understand into it that they also had ports on this outer shielding that they could actually pull out to be able to get to some of the piping and so forth like that to be able to work it, which a lot of that was done while it was operating and under full power.

You know, looking at it from a worker's standpoint, and no disrespect to anybody, but the thing is, is you've got to look at this as an individual that has worked in this situation. He's been hands on out there. He knows actually what went on. And for us to be able to give a limit here and take this, it's very confusing for them to be able to say how are you able to do my dose like this. So the thing that I always want to look at is what put us into these situations with the shielding and so forth, and can we really accurately do this.

We've got to give the best. And Sam brought up a very good point. There's probably only 75 that we're going to have to do the best estimate and stuff like that. But when we walk away from this we want to be able to know that we've done it the best that we can. And there's a consensus of the problem. Both sides we are and we're not, but we need to really look at what we're putting on for them.

One thing I wanted to ask is this 100 MR that they would take, and then they'd read the film badges and so forth, was that on a weekly basis they had to get 100 --

DR. BEHLING: At various times, yes. In 1950, it was weekly. Thereafter it was bimonthly, and after that monthly. So it changed, the exchange frequency varied over time.

MR. NELSON: I don't think that decision was made to eliminate those ones at a threshold of 100 millirem until, it's in that report when they started doing it. So initially they were reading all of them. So the report will tell you when they decided that, and I don't remember the date offhand. So initially they read them all.

DR. GLOVER: This is Sam Glover again. One thing that doesn’t come out is that they actually spoke to people who were monitoring. They actually, when they entered these areas, they had people with them. And we’re going to actually talk, our hope is to talk to [Name Redacted], 1947. He’s still around, and also to talk to additional folks.

And so Ed’s going to go out with us next week. And I think they’re going to talk about some additional interviews. Again, these were based on interviews of the actual reactor people. They felt that for anybody this was a very claimant favorable number. And what Chuck and everybody are trying to do is, okay, let’s go back and get additional numbers, do some additional interviews to verify and validate for everybody here that that it truly is a claimant favorable number.

N REACTOR

DR. BEHLING: Are we ready to go to the N Reactor?

Okay, the N Reactor, obviously it was somewhat different. It was a closed loop. It was used not only to produce plutonium but also generate electricity for the on site and also tritium production. The N Reactor began operation only in December 1963 so it was the last one to come online.

And what NIOSH did was basically say, well, there's enough similarity for the N Reactor, and we can compare it to the other eight single-pass reactors so why don't we use that as a starting point. So let's go back and say what did we decide for the eight single-pass reactors. And we can apply that and then modify certain changes because there are differences.

So as a starting point toward the N Reactor they went back and said let's go and use the 0.41 neutron/photon ratio as the geometric median value for an N-gamma ratio for the eight single-pass reactors, and that's our starting point. And they say, well, you know, this reactor didn't come online in 1963 and post-dates studies done by Peterson and Smalley that we already talked briefly about in 1960.

Apparently in 1960 Peterson and Smalley studied the other reactors and realized that there were problems associated with neutron doses. And if you look on page 9, Table 3, you will see the neutron/photon ratios for the reactors. As you see, and already mentioned, I think Chuck just mentioned it briefly, that for the B reactor the neutron dose rate of 25 millirem per hour was matched by photon dose rates of 25. So you have as a matter or empirical evidence a ratio of one. And I assume these reflect instruments rather than NTA film. Is that correct?

MR. NELSON: I believe so. I'm not 100 percent sure about that.

DR. BEHLING: I don't either, but given the doubt that these are absolute values, if, in fact, these were based on NTA film, then the real ratio would obviously be considerably higher yet. I would say, give you the benefit of the doubt and assume these were instrument measured. But you have clearly here evidence of a ratio that is not .41 as is the median value proposed by NIOSH, but here you have values for the B reactor of 1.0. And you go for the C reactor; it's 1.2 and so forth. So we do have higher values. Now --

MR. NELSON: Just for clarity of the range of that I believe is it .2 to 1.2 so there was a wide range from...

DR. BEHLING: So it does point out another fact that, for instance, among the different reactors, you have different values, as we mentioned, over time and space. And in different facilities a single value may or may not be appropriate unless it's a bounding value for all reactors.

But then what they did, they said, okay, we have a problem here so let's decide on how to fix it, and let's put some shielding on there. And it was based on calculational methods that you see the right-hand side of Table 3 give you neutron to photon ratios that are much reduced. And on that basis, and it's strictly based on a theoretical calculation because if you read my quotation, no one really ever followed up. Some of those shielding modifications were never made.

But based on the fact that these calculations were made in 1960 and the N Reactor went operational in 1963, ORAU took a leap of faith and made an assumption that, well, they would have clearly made those modifications in a production reactor that has yet to operate. So on that premise, and it's a leap of faith, they decided to reduce the 0.41 neutron/photon ratio by a factor of seven and ended up with the neutron/photon dose rate ratio of 0.06. So that is the basic premise for assigning a neutron to photon ratio that is seven-fold lower than those for the single-pass other eight reactors.

MR. ALVAREZ (by Telephone): I think it's important, too, to note that there was no additional shielding added to these original five reactors. What they did to reduce the heat load on the bioshield was to put thorium in the fringes so it would absorb more heat to reduce the deterioration.

But, you know, by the late '50s there was evidence, at least in one report, where the bioshield was actually smoldering. So they were not, and the K Reactors and N Reactor, of course, did not use bioshields made of a composite of cast iron and Masonite. Masonite was the big problem. They went to concrete, and thus, had improved shielding characteristics than the first five reactors.

DR. BEHLING: Well, anyway, that pretty much sums up all of the concerns that were raised on behalf of the eight single-pass reactors have been passed on the pipeline because that became the starting point for the N Reactor which was then subsequently modified by way of reducing the .41 ratio that NIOSH had arrived at by a factor of nearly sevenfold to go from .41 to 0.06. And that was strictly based on a calculational method that we may not even realize ever took place.

And so that's my criticism, and those are the issues. So I guess I'll pass the baton on to Chuck.

MR. NELSON: Okay, thanks, Hans.

DR. ZIEMER: Could I ask for clarity on a point? I was trying to correlate what Bob Alvarez stated versus the table you were citing.

Bob, this is Ziemer, were you saying there was no neutron shielding added on those --

MR. ALVAREZ (by Telephone): No, to the best of my knowledge what they were doing to prevent further degradation of the bioshield was to add thorium on the fringes of the reactor to reduce the heat loads. It was the thermal, the thermal heat that was actually causing the degradation of the Masonite basically. And there was evidence that it was combusting. This is how hot they were running, you know, and how hard they were running these reactors.

So their sort of work around, if you want to call it that, was to put thorium in the fringes which would absorb more of the heat load coming off the reactor. And to the N Reactor, I just scratched my head when you are using the shielding values of the N Reactor. It just doesn't make any sense because the shielding of these reactors, these first five reactors, were totally different and had these unique and difficult-to-solve problems.

DR. ZIEMER: But if you look at the table, it appears that the photon dose is influenced very little. Whereas, the neutron dose drops by an order of magnitude that suggests that they put low Z material in the beam. Or they thermalized --

DR. BEHLING: Well, I want to caution you. These were theoretical calculations --

DR. ZIEMER: These aren't measured values.

DR. BEHLING: These are not measured empirical values. These were only theoretical calculated values by Peterson and Smalley. And if you go to the next page, Paul, on --

DR. ZIEMER: But even there, if it was thorium that you were using in the calculations, I don't see how you would get this kind of a change in, I mean, thorium's a pretty dense material. It'd have very little effect on fast neutrons, and it would have a lot of effect on photons. So even theoretically they're talking about something different than I here Bob talking about. So I'm a little confused about how that relates here.

DR. BEHLING: But the thing I want to caution you is that those numbers on the right-hand side are theoretical. They're not real. And if you go to the next page, I took a quote again from the TBD, and I quote: Since the report was issued in 1960, and the first of the Hanford reactors were shut down starting in ’64 with the last single-pass reactor being shut down in ’71 -- and I highlighted -- it is possible that the additional shielding was only installed in some reactors (later running reactors) and not installed in others.

So NIOSH admits that there’s uncertainty about whether the recommendations by the Peterson Smalley were ever implemented.

DR. ZIEMER: I got you.

MR. NELSON: That’s correct.

What we did is, I agree with a lot of what Hans has said there. NTA film is very uncertain. There’s issues with it. So what we did is we looked at some data that we do have. And we went to Nichols, 1972. The title of that document is “Hanford Multipurpose TLD Field Test and Evaluation”. And this was done on Douglas United Nuclear Workers. We call them DUN workers. They were the operators of the N Reactor.

And what they did in this test, it was in November and December of 1970 and January of 1971. And they were testing these TLDs so they assigned them to workers working in the N Reactor area. And the results you'll see on page, of the report, the responses, I believe it's on page three. There's a table there at the bottom. It has different badge readings -- because I'm using some of my notes here. I don't want to confuse everybody.

But what you see is if you look at each of those individuals, those are the only readings that had any recordable neutron dose that was a slow neutron dose of three millirem. And if you look at, these were monthly reads on these individuals. There were a total of 38 monthly reads. And out of the 38 these are the only ones that showed any positive neutron dose. So we agreed, you know, it's not a whole lot of data. It's 38 readings and we have little-to-no neutron dose.

So if you do look at the neutron to photon ratio from that table, you'll see they're well below the recommended values assigned in the TBD. So we said, well, that's not a whole lot of data. It's pretty uncertain, three millirems, pretty slow, although we know NTA film does like slow neutrons.

So what we did recently over the last month or so, contacted DOE, and they provided us all the data that they had for the Douglas United Nuclear workers. So this data focuses from 1972, when TLDs were implemented, until 1986 towards the end of the operation of the N Reactor. And you'll see that table on page four.

There are a couple typos on this table I would like to clarify. Where it says number of workers, so the first column where it says number of workers, it should say worker records. So there wasn't, if you look at the bottom, there wasn't 30,189 workers. That was worker records. So that was the results of TLDs, whether they be quarterly or monthly.

The second column and the third column are, let's make that the third and fourth column where it says Deep and Neutrons, that is dose. And as Han graciously pointed out, that is millirem, millirem. Thank you.

And the last column would represent what the neutron to photon ratio would be.

Just grossly looking at this data from all these records and say would that be picked as a neutron to photon ratio? And if you follow that down -– we're looking at .003. The TBD recommends .06 as the geometric mean. So that number certainly is quite lower than the TBD.

So we wanted to look at it further. That's all workers at the N Reactor. So our next column, columns depict, let's look at these workers, and let's establish a criterion by which we can determine how much neutron dose and determine a ratio from these people and let's set a threshold. So we set the threshold at, it's 50 millirem neutron and 50 millirem photons.

And there again -- we found this out last week -- when they ran this, they ran this two different ways. One of them was 50 millirem photons and zero millirem neutrons. And that's actually what this table depicts. It is this misleading, and I'm going to cover when we run it for 50 millirems photon and 50 millirems neutron what the actual results are.

So if you look at the results of this table, I want to clarify that it is 50 millirem photon and zero millirem neutron. If they had anything that exceeded those thresholds, that's what this data depicts. And if you look at what the geometric mean out of 245 workers, then you'll see that the geometric mean was .03, GSD of 4.14 and 95th percentile of .34. All those numbers are less than what the TBD recommends.

So when I'm asking more questions about the data, I did find out that the preferred analysis was greater than 50 millirems photon and greater than 50 millirems neutron. And you won't find this on this table, but I did want to put out the analysis was done and the results are .06 as a geometric mean which is exactly the same as the TBD. A GSD of 2.88, the TBD recommends 3.0. And finally, the 95th percentile came out at .35 which is very close to the .37 as recommended in the TLD, I mean in the TBD.

So the data that we do have is real data. It's using TLD data, and I think the basis by which the TBD assigned or came up with the neutron to photon ratio is again like the single-pass reactors uncertain. And we think this data would more represent what an appropriate neutron to photon ratio would be. And that's using actual data.

DR. BEHLING: May I ask a question about that? As I'd already mentioned earlier when we talked about NTA film, it was only, I assumed it was only issued when there was a justification for considering that there was a need for monitoring a person for neutrons. Now that we go into the post-'72 era where we have the Hanford multipurpose TLD, it's a dosimeter that was assigned to everybody whether you have a chance to be exposed to neutrons or not.

So now let's take a look and assume that the Douglas United Nuclear workers were assigned to the N Reactor, but as you mentioned, the reactor needs to occasionally be shut down for maintenance, for refueling, for all the things that are required. Now the neutrons obviously cease to exist at that moment in time. The photons continue.

Now, and you don't have the ability to separate and say, well, let's assume a person worked there for a period of during a refueling outage or extensive maintenance outage. At what point do you segregate the neutron from the photon exposure when, in fact, there was no chance for a neutron exposure?

In other words I would assume that many of these workers were assigned to work involving fixing valves and all these other things when the reactor was shut down, and you have essentially compromised the true neutron to photon ratio by introducing into the denominator a high photon dose that is not associated with any neutron exposure. And to what extent do these data reflect that?

MR. NELSON: I actually don't have a great answer for that one. I do want to clarify though. Prior to 1972 that's when we would apply those neutron to photon ratios. After 1972 we're going to use the actual neutron records. So what you're questioning then would be prior to 1972, just to clarify it.

DR. BEHLING: Right, and I agree that for these workers where you have TLD data you wouldn't go to neutron/photon ratio anyway. You'd use the original empirical data. But you're basically stating that the 0.6 as geometric mean is therefore representative of a pre-1972 timeframe when NTA film was used; and therefore, justifies your assumption of 0.06 as the best and reasonable assessment for neutron/photon ratio.

And as I said, when I looked at the data, and I realized what the differences between TLD neutron dosimetry and the NTA is the selective assignment of NTA film which is lost once you cross over into 1972.

DR. NETON: Wouldn't you agree though that this represents a collective neutron/photon ratio of --

DR. BEHLING: Sure, yes, I agree. I agree.

DR. NETON: And if you take the 95^{th} percentile, you're going to be selecting those workers who were --

DR. MAURO: Yeah, but how did get that, that 95^{th}, in other words, let's say -- let me see if I get this right because I always have a problem when you use collective dose and parameters in retrospect. You merge from collective dose and then say, okay, now I'm going to use that value and apply it to a real person. Because in other words what you're saying, because whenever you work with a collective dose, you're really having a measure of the average, and we're not concerned about the average. We're concerned about the guy who might be at the high end.

Now to get now the ratio, in other words I see, how did you get, for example, the 1.04, the 95th percentile of ratio of 1.04, did you take like individuals, let's say we have like, did you take 246 real people?

DR. BEHLING: Here these are. There's this 20 workers, ten workers and 14 workers, and they have dosimetry records that fall into these categories and you simply pair them.

DR. MAURO: Okay, so this isn't, this geometric standard, this 95th percentile represents of all of the workers, the hundreds of workers that comprise, 95 percent of them had a neutron to photon, of those workers, had a neutron to photon ratio less than 1.04. Am I reading that correctly? Or is this a parameter on the collective dose?

DR. BEHLING: No, it's the distribution for these workers right here. You have in this timeframe, ten, 20 workers, ten workers, 34.

DR. MAURO: Oh, these are the number of records then? Okay, I must have missed that. So the first column is records. And then the column that's called number --

DR. BEHLING: Number of workers.

DR. MAURO: So what I'm seeing --

MR. SCALSKY: Excuse me. It's really 172 workers there, and it's 245 results. There are some duplicate, you know, one person from one year, and then you've got another one the next year.

DR. MAURO: Okay, so over all these years you have 245 workers?

MR. SCALSKY: A hundred and seventy-two.

DR. MAURO: Okay, 172 workers, then so what you're saying is you've got data for these workers, real workers. And you're saying that you make a plot, and the upper 95th percentile of the -- so therefore, you've got 172 measurements of neutron to photon ratio.

And you're saying the upper 95th percentile was .34. Is that a correct way to read this? In other words, as close to the highest? Because I was afraid I was looking at a parameter that was an expression of the uncertainty in the collective neutron to photon ratio as opposed to the real individual variability between or among workers.

MR. NELSON: I don't know if I followed all that, but does represent, Jim?

DR. NETON: (Unintelligible).

DR. MAURO: What I'm getting at is that if you really have -- I'm in complete support of what your argument for this data set, in other words, if you have 170 workers, and for every one of those workers you've got a real measurement of neutron and photon dose. And then you make a plot of the neutron to photon ratio for every worker, and you say the upper 95th percentile, the highest dose or the highest value because the 95th percentile would be close to the highest value, of the neutron to photon ratio for all those workers is .34, then I think you've got a rock solid argument.

DR. BEHLING: No, you don't. You're missing my point again.

DR. MAURO: Okay, help me out. Help me out.

DR. BEHLING: You may have a person who worked there for three months, and it's only in the last, the first week or the last week that he had reasons to be exposed to neutrons. So the balance of time was done when the reactor was shut down, and he's part of that aggregate.

So for a large part of his -- for instance, had he been give NTA film they would have said, well, the reactor's shut down. We're not going to incorporate this measurement as a time period during which neutron exposure could have happened. Therefore, in that column neutron exposure is blank as opposed to some value or zero if it was below detection level. Here, I'm not sure you can make that distinction.

DR. NETON: Don't you think the upper end of that distribution is driven by people who were neutron exposed?

DR. BEHLING: Well, it's a question of, you know, for instance, when you have a power reactor, the number of people going to containments during the time when the reactor is up and running is very few. It's a handful of people. When the reactor shuts down, you bring in the contractors by the dozens, and that's when you get the big gamma exposures but no neutron. And I don't know to what extent these numbers here are tainted by an exposure that was exclusively, or at least a part of it, exclusively photon where there was no need for monitoring for neutron because the reactor was shut down. And this is the difference between NTA data and this data. And that's why --

DR. NETON: The higher end of the distribution with a high neutron/photon ratio has to be driven by people who were neutron exposed.

DR. BEHLING: But still it could have --

DR. NETON: Let's assume there, Hans --

DR. BEHLING: Let's assume we're talking about a quarterly dosimeter. I don't know, maybe monthly. But a large part where everybody with data, an exposure that was received during the time the reactor was shut down which means that you're tainting the whole spectrum for the entire population because these DUN workers were there really to support an outage or to do maintenance work as opposed to going into -- for NTA film you have that.

You know when there was reason to say, oh, for this period, this monitoring period, for this week, month or whatever timeframe, there is a zero or some positive value. And you know very well what that period was. You lose that sensitivity when you go to the multipurpose dosimeter. And that's why --

MR. ALVAREZ (by Telephone): May I ask a question? Are we talking about default values that are going to be applied relative to neutron/photon ratios for workers who were working at the five original production reactors?

MR. NELSON: We're talking about the N-Reactor right now.

MR. ALVAREZ (by Telephone): Just the N Reactor, but these values are not going to be applicable for workers who worked at the other reactors. Is that correct?

MR. NELSON: At this point we haven't tried to apply that, no.

MR. ALVAREZ (by Telephone): You haven't. Okay, thank you.

DR. MAURO: I wanted to just make sure I understand the dispute that we have on the table because I want to make it clear in my head. It sounds to me that, Jim, you're saying that okay, we have 170 workers that worked on the N Reactor. We have some real data for them. In the upper 95th percentile, the neutron to photon ratio for those workers was .34. Hans is concerned, well, this may not be a representative distribution.

MR. NELSON: One clarification -- I don't want to interrupt you, but the 172 are those workers that had recordable neutron dose, right, Ed? Remember that you --

MR. SCALSKY: Yeah, there's a lot more workers than that. They're not included in that part of the analysis.

DR. MAURO: So these are the workers that had 50 millirem. So you had 50 millirem is your threshold. You get those workers, and now I guess the dispute I'm hearing is that perhaps these workers were really outage workers.

DR. BEHLING: Well, this is a yearly aggregate. You know, you see 1973. If we broke it down by wear period where it's a monthly, then I would potentially say that's, you're starting to get closer and eliminating -- let's assume for 1973 a worker was subjected to photon field during the outage of maybe several months. And you discard that and say, well, when did he receive his neutron dose.

Well, it may have been only for one month out of 12. And that's the critical thing that may be missing here when we aggregate data by the year as opposed to by work period. And so I don't have much faith in the 0.03 because it is a yearly aggregate.

MR. SCHOFIELD: I've got a question. How, on the claimant's record system, does it really break down which reactor they were at and how much time like maybe they spent on one reactor or maybe one of the other ones?

MR. NELSON: No, what you'll see is, especially for the early years when the guy went into an Area, you'll see, it's a log book, and you'll see where he went in with a pencil dosimeter and what his recording was in and out. And it'll have a column for each. It'll say K Reactor, keV, you know, depending on what reactor he worked in. So it will assign him directly to that particular reactor.

MR. SCHOFIELD: Oh, okay.

DR. MELIUS: It seems to me that we can get this, we have this data, right? So it can be looked at and --

MR. NELSON: Yeah, we can --

DR. MELIUS: -- we can get more on the work histories and whatever and what these work --

MR. NELSON: I honestly didn't do a very good job in representing that because there is an error in there and there's a few things. So we can work that to make it more easily, we can analyze it further if necessary.

DR. ZIEMER: Now on the best estimate people you're still using their actual values for the years when we have both?

DR. BEHLING: No, no, again, Paul, these data are here for '72 on forward because of the use of the Hanford multipurpose dosimeter. But the intent for us to do here is to look for the N Reactor exposures prior to '72.

DR. ZIEMER: Well, that's what I'm getting to.

DR. BEHLING: And so we're using this data --

DR. ZIEMER: For the best estimates you're just using the actual values. And the question is arising can you use these ratios for the other groups at either lower or upper estimates.

DR. BEHLING: Yeah, what this --

MR. ALVAREZ (by Telephone): Well, I mean, I would urge caution about that because, for example, the original five production reactors which, you know, during the 1960s, from let's say from the mid-'60s on, were primarily involved in producing thorium. And a great deal of thorium was produced from these reactors, which meant that they had to have a higher neutron flux, more driver rods, to be able to do that in a reactor like that.

So the neutron activities of these reactors need to be matched up with what they were making based on their relative neutron activities. And I contend that I just don't believe you can extrapolate the neutron to photon ratios from the N Reactor with those of these original ones because of their, mainly because the shielding is so totally different, and you had constantly degraded shielding problems going on.

DR. BEHLING: But, Bob, this is Hans. This table here that Chuck had supplied us with has a singular purpose, and that's to apply some credibility to the neutron/photon ratio of 0.06 that was originally derived by the Peter Smalley methodology. And this table right here provides data post-1972 using the TLD data that suggests 0.03, which is a factor of get too smaller. And therefore, the attempt here is to give credibility to the pre-1972 neutron/photon ratio for the N Reactor only.

MR. ALVAREZ (by Telephone): Okay, I'm sorry to have wasted your time.

DR. BEHLING: And I'm raising the question that I'm not yet convinced that this value has, is a sound technical value that we can apply here because of the issue that I just mentioned.

MR. ELLIOTT: Further exploration is necessary.

DR. MELIUS: Yeah, it should be resolvable to the extent possible by looking at the data.

And I’m sensing we should take a break. Give Ray a chance to get caught up with all that he’s missed this morning. Why don’t we take a ten-minute break which means 15 minutes.

DR. WADE: We’re going to break for ten minutes. We’ll maintain contact but go on mute.

(Whereupon a break was taken from 11:57 a.m. until 12:13 p.m.)

DR. WADE: We’re back.

DR. MELIUS: I’m not sure whether this is a plan or a proposal, but I plan to work through lunch. I think we can finish up about 1:00 or 1:30, something like that so I think that’s easier than breaking and then coming back so unless there’s strong objections. We will take a break around, right at one o’clock so Ray can run next door and make sure there’s somebody covering that meeting, at least the beginning of it.

HANFORD 200 AND 300 AREAS

I think we’re on to the third one, yeah.

DR. BEHLING: For those who have my handout, I’ll skip to page ten and simply make a few opening statements that starting in 1945 Hanford began production of plutonium nitrate at the Plutonium Finishing Plant, that's in the 200 Area and also lots of work was done in the 300 Area that involved potential neutron exposures.

And NIOSH provided us with some neutron/photon dose ratios that are defined in Figure 1 of my handout which comes directly from the TBD. And you will see, in fact, the majority of the neutron/photon dose ratios for the two and 300 Areas center around the value of between zero and one, but you will see outliers where neutron/photon ratios were, in fact, measured that had a value of five.

To come up with their neutron/photon dose ratios for the two and 300 Areas, again, we're talking about pre-1972. Post-1972 you had your TLD, and therefore, empirical data will be used to assign neutron doses for those workers who were part of the two and 300 production areas. To do so what NIOSH has done is said let's take a look at the 1972, post-1972 data, and determine what neutron/photon ratios might come from that dataset and then extrapolate it backwards in time and assume that we can apply these neutron to photon ratios to all periods all the way back to the 1940s.

And so what they did was to take a look at 15 long-term workers -- and I'm on page 11 here, and I always like to highlight the key words here that define the issues. They used 15 long-term workers who were monitored by the HMPD post-1972 all the way to 1991. And they were able to select 186 matched dosimeter readings where both the recorded photon dose and the neutron dose at least registered a dose of 20 millirem.

And on that basis they assessed that data and said let's take a look at that 186 paired measurements, neutron/photon measurements, in behalf of 15 long-term workers and then come up with a value. On that basis they came up with a neutron to photon ratio that you see at the bottom of page 11, which I boxed out, and the geometric mean for those 186 paired measurements is 0.73 as the geometric mean, and of course, we have your geometric standard deviation of 2.1 and a

95^{th} percentile value of 2.47.

So those are the numbers that they propose to use for assigning neutron doses to the 200 and 300 Area production workers prior to 1972 when NTA film was used. And obviously, we have concluded that that's not a functional or viable dosimeter. So the question then is this a reasonable approach. And I think I described that as probably the most credible of the neutron/photon ratios. But nevertheless I did find a couple things that I found questionable.

And so finding number one is the data selection. And the data selection of using period photon/neutron dosimeter readings that were at least 20 millirem each has a certain level of credibility problems because the MDL value for neutron dosimeter is 50.

So the question is to what extent are we biasing the selection of 186 paired neutron and photon dosimeter readings by selecting, I accept that the TLD very nicely can measure 20 millirem photon dose. The question is how reasonably accurate is the dose as low as 20 millirem for neutron since we, I think, identified 50 millirem as the MDL value. So that's one of the issues. And I think in their response they did look at the revised matched dosimeter readings that looks at 50 millirem neutrons as a revised number. So I'll let them talk about what they found.

But the more important finding in behalf of the two and 300 Area neutron exposures are based on the fact that since 1944, these facilities have been in operation, and of course, I would concur with their assessment under one condition, and one condition only, that the facilities as they exist post-1972 were, in fact, identical for all previous timeframes which we know they were not.

And in my write up I provided a number of statements that come directly out of the TBD that talked about the revisions to these facilities. Many of these things early on, especially in the early '40s and '50s were very, very manually driven processes including the area where we had a lot of these -- what is it called? The 500 foot line involving glove boxes where people were basically standing there and pushing this material from one glove box to the next and in essence there was very little mechanization or remote methods by which these processes were performed.

And when I looked at the number of changes, it struck me that the post-1972 neutron/photon dose rate ratios may not necessarily apply depending on what changes had occurred from a very manually driven operation to a remote controlled operation. That also obviously had to include significant changes to things such as shielding, engineering controls and other things that would have potentially mitigated perhaps both neutrons and photons. And the question is to what extent can we rely on the post-1972 data and apply it to the very early years, especially the 1940s and early ‘50s.

And quite honestly when I look at some of the data including that which was provided by Corley in 1972, and I included his assessment. If you look at his tables which are included as, I believe, on the last page, 17, you end up with neutron/photon ratios that were in most instances significantly above one.

So even though for the proposed neutron/photon ratio that NIOSH has derived of 0.73, I believe perhaps a more central value would be a value greater than unity based on Corley data. And of course, that may or may not even include some of the earlier ratios that might have been defined for which we have no data that go back into the ‘40s and ‘50s based on the fact that so many changes had been made to these facilities that would have affected both neutrons and photons.

And so I will turn this over and allow you to provide us with some insight as to how you think these changes might have modified the neutron to photon ratio.

MR. NELSON: Greg Macievic of NIOSH is going to actually respond to this particular concern.

MR. MACIEVIC: We looked, the 186 paired dosimeter readings that the numbers were based, obviously based on genuine numbers. There was another that came up with the original ratio of the .73. We also looked at later, in 2000, at a little larger group of 247 paired readings and came up with a standard deviation, a geometric mean, .7, and a 95th percentile of 2.1, which is very close to what's the numbers that we came up with.

But the key that what we did that I feel, we feel, that is a claimant favorable number is that if you look, we took the geometric mean and the 95th percentile and applied it to claimant values that where the numbers were, compared the measured dose with the dose that was based on what you come up with if you apply these statistical parameters.

And what you get is on all the, at the 95th percentile, all of the neutron calculated neutron doses are higher than the measured field measurements. So they're all higher. And there's only two claimants where, if you use the geometric mean, where the measured neutron dose is greater than the calculated neutron dose.

DR. BEHLING: Can you explain, these measurements, were they pre-'72 measurements where we talked about --

MR. MACIEVIC: These are going back on the, to show on the 186 paired readings to go back and say, okay, now that we've come up with this ratio, let's go and use the actual values and apply these numbers to them. And you see that in all cases for the 95th percentile, the neutron dose is bigger than the dose that was actually measured. And in several cases you've got, we could get up to a factor of two on some.

DR. MAURO: That's post-1972?

MR. MACIEVIC: Right, post-1972.

Now in going to pre-, when the U.S. Atomic Energy Commission did their study and looked at ARCO doing their study, when they determined that they had a problem with the neutron doses in several of the Areas in there, they had a potential problem, they went back and did an analysis for several time periods and looked also at the neutron/gamma ratio that was involved in these during these periods with the variation of shielding and come up with a maximum neutron to gamma ratio of 2.3.

So ours, the study they did was a

bounding value study. They knew the fact that they didn't know the actual workers' location all the time. They didn't know all the shielding modifications and all the other things that we discussed were a problem with using NP ratio, they said, okay, let's do a study and do a bounding value on this. And they came up with, from '48 to '56, an NP ratio of 1.4; '56 to '60, 1.56; and 1960 to the present, 2.3. And we have that number higher than the value that's already there.

DR. BEHLING: How were those values determined?

MR. MACIEVIC: From the study there is a report --

DR. BEHLING: Especially in the '40s and '50s that you just cited.

MR. MACIEVIC: Yeah, the report is U.S. Atomic Energy Commission. It's a letter, Attention: Mr. O.J. Elgert, October 20th, 1972, and it is a discussion of what they did. And this one doesn't, unfortunately, have a title to it. But what they used in the study was the neutron doses were looked at for 26 long-time plutonium workers were reviewed and the methodology that they used to determine what the neutron dose was during that period, so --

DR. BEHLING: You don't know whether it was NTA film, instruments --

MR. MACIEVIC: They did look, no, unfortunately, it does not say that. They were looking to see whether or not under the conditions they had that, whether or not they would have exceeded their three Roentgen per year administrative level from, if these conditions by doing the variations for these conditions then those NP ratios that they would violate this. And they found that they didn't in those cases. And I can get you the exact --

DR. BEHLING: But it would be most important to determine how those numbers were derived because that's really the crux of the problem is that you don't have much faith in the earlier measurements.

MR. NELSON: What years?

MR. MACIEVIC: This is 1972.

DR. MAURO: That's the date of the report.

MR. MACIEVIC: The date of the report for, what the report summarizes is that for the previous years they felt like --

DR. ZIEMER: Wouldn't that have been a three Roentgens per quarter maybe.

MR. MACIEVIC: I'm sorry?

DR. ZIEMER: Were they even using Roentgens in '72?

MR. MACIEVIC: No, that was the value that they were using in the early years to, knowing that they didn't have the NP ratio down, that they limited the Areas to three Roentgens to make sure that they weren't exceeding any neutron dose for the photon by using that as the photon limit. And they did a study in '72 to make sure that that actually was the case, that nobody from those previous years went over that value based on the study they did, and I will get you the report.

MR. NELSON: Basically what they did is they looked back, and they said based on the type of shielding that was used and the type of activities that were performed in the earlier years, they actually applied different reduction factors. And let me read what they are. It says, from 1960, approximately one-third reduction in the neutron to photon ratio is assumed for the period of ’50 to ’60 when only lighter shielding was used. Lighter shielding did not attenuate x-ray radiation, in particular, or gamma radiation as compared to the shielding in place after 1960.

Then they assumed another ten percent reduction in the neutron to photon ratio from 1948 through 1955 when there was essentially no other shielding like Hans mentioned in those glove boxes when they were passing material through when there was only plastic windows, for instance. So the results of the 1972 study said these numbers are bounding, and they provided, as Greg mentioned, some upper boundary values of NP ratios based on those reductions based on information they had in that study. And all the numbers that they use are actually lower than the ratios that we present in the TBD.

DR. BEHLING: Let me ask you a question regarding the issue of shielding. Obviously, I would assume that the dominant gamma component would be the 60 keV americium-241 component. Is that correct? Which is not a very penetrating photon either. So I would have to look at, for instance, the material in question and see what the impact is for reducing the neutron component but which significantly also impacts the 60 keV photon because that has a very, very limited penetrating power, too.

DR. NETON: I think that some significant shielding though at 60 keV is not the dominant emission at that point. Some of the lesser plutonium energies come through. You know, plutonium does have higher energy than photons --

DR. BEHLING: They're very, very small.

DR. NETON: -- even though they're small fractions, but if you look at the ratio of attenuation of the 60 versus the higher energy ones, they become the dominant ones.

DR. ZIEMER: They may be the only ones getting through even though they're a small percentage.

DR. NETON: I know that for a fact with whole body counting, for example, you could start to see the plutonium photons while over the --

DR. BEHLING: But the yields, I looked at the yields for some of the higher energy photons. They're so, so small.

DR. NETON: I know, but then you look at the differential ratio absorption between 60 keV and, say, 200, three, 400 keV.

MR. CLAWSON: The records that you were using, what was that, what were they designed for? Why did they, what did they bring this up for? Was this just to check what they'd already done?

MR. MACIEVIC: Well, they had determined that there was a higher neutron exposure than anticipated, and they were going back to find out whether or not they needed to modify the previous doses that they had based on their current finding. And this was what triggered this study to be done, and it was 1972.

DR. BEHLING: Is it reasonable to assume that that study prompted more neutron shielding which means that post-1972 data would actually then suppress the neutron component? I mean, to me it would make sense that the 1972 AC or DOE study was prompted by the need to look at the neutron component.

And, of course, if that was truly the motivation, you would then introduce more neutron shielding which means that post-1972 you’ve suppressed the neutron component meaning that your neutron/photon ratio is probably lower than in all previous times prior to this study and its recommendations. Is that a reasonable conclusion?

MR. MACIEVIC: Well, there had to be, if here in the conclusion that the study was deliberately designed to maximize dose estimates. In general, the study provides reasonable assurance that the Hanford administrative practice of controlling gamma exposures to three Roentgen per year was indeed effective in preventing personnel from receiving exposure in excess of established limits. The total penetrating dose as maximized by the study appears to be less than twice the penetrating dose as measured using the best available state-of-the-art procedures.

So they did this and their conclusion is that they weren’t, they did not modify their conclusions and the report was not to modify any of the years for the exposure, on the exposure record. And in 1972 only to modify those where they had the specific information about the jobs that would require them to change any doses. So, and that's all in several of these, I'd have to give you the official title of the report, but it's Atomic Energy Commission report that was issued, I'll have to find that.

DR. BEHLING: I would very much like to look at that because like I said, even in the early times when they were relying heavily on film dosimeters, their ability to assess exposures to photons was at least reasonable and respectable, but what they didn't know was what was the neutron components.

And so any kind of modification early on whether it's in '56 or in the '60s would have probably been geared towards the reduction of the neutron component. Meaning that the post-'72 data has been tainted by attempts to mitigate neutron exposures.

MR. NELSON: The results of the AEC studies suggest, it actually applies neutron to photon ratios as looking back at them, and the numbers actually, the neutron to photon ratios are lower in those earlier years based on the type of shielding. So they actually looked at the type of shielding and the controls in place and the type of work that was being done.

And they came up with the conclusion, using NP ratios, and they were indeed less for each of those years, one-third reduction from ’56 to ’60 and a ten percent reduction from ’48 to ’55 based on the type of shielding that was in place at those facilities.

DR. BEHLING: Were these theoretical calculations or empirically derived?

MR. NELSON: Those are just, I’m just giving you the results of the study, and I’m not sure of that.

DR. MAURO: What were the ratios?

MR. NELSON: Greg had their letter. These are, the one in our response is a little bit outside of those, but they’re fairly close.

MR. MACIEVIC: They’re fairly close.

MR. NELSON: He’s reading that straight from the report.

DR. ZIEMER: Are these going to be made available to everybody?

MR. ELLIOTT: That's what I was just going to raise a comment here.

DR. ZIEMER: Does SC&A have any of this?

MR. ELLIOTT: There's been a lot, Chuck, your team has introduced a lot of documentation here in this discussion, and I don't know if we're starting to create a folder or already have a folder on the O drive for Hanford. If you will, point out for the working group members where these things are on that O drive. We can send an e-mail around later, and everyone's attention to those particular documents that have been introduced today.

MR. NELSON: We haven't compiled them on the O drive, but we will.

DR. WADE: And I'd point out to all that sometimes documents are shared within the working group, Board members, SC&A. We need to always be cautious of Privacy Act material in those documents. The documents should be clearly identified as to whether or not they could contain such material, but I caution everyone just be careful, particularly when we’re working very quickly in real time, mistakes can be made.

DR. ZIEMER: These are DOE or AEC?

MR. MACIEVIC: AEC. The one I have right here that has the --

DR. ZIEMER: I assume none of this is classified.

MR. ELLIOTT: Let me just add a caution to what Lew’s valid comment was a moment ago. Anything that’s in the Hanford folders on the O drive should be considered as being Privacy Act protected. If you pull anything out of that, whether it’s my folks, ORAU’s folks that are going to submit in front of the working group, we need to have it reviewed for Privacy Act. If it’s SC&A pulling out of that O drive, they need to work it through their channels.

But everything in the O drive should be considered to be part of the system of records that has, may have Privacy Act information in it. And we’re not redacting any of that. We’re holding that in that O drive so that everybody can see it. So if you pull out of that well, you need to make sure your Privacy Act controls have been applied.

MR. NELSON: I think one of the things that Greg talked about that may have not been, I don’t know how well it was received, but what was done is that they looked at several other cases, and they said, okay, using the neutron to photon ratios that we have, we took those and applied them directly to the photon readings starting in 1972 on. Then we compare them -- so we’re taking that ratio.

We don’t do that in dose reconstruction. If it’s post-1972, we look at the neutron results, and we look at the photon results, and we use those actual numbers. If we took those photon results that we do have, and we apply the geometric mean to the cases that we have, you know, actual data, we’re seeing that the results of the neutron that we would apply at a minimum, a factor of two with the exception of two cases.

They’re very close to a factor of two. They’re well higher than a factor of two, higher than the geometric mean. So it’s showing that if we use that data right there, it’s an overestimate for those. If we were to take that same data and apply it and try to determine what neutrons were, using that post-’72 data with the old ratio we’re using, it’s way high. Does that make sense?

DR. MELIUS: Yeah, I think it makes sense. I think it’s still begs the question of what was going on pre-’72 which is really the time era we’re interested in. I mean, I think it’s helpful information.

DR. MAURO: What was interesting is that that distribution which was created from the data post-1972, and then when used to test or validate against real numbers, you’re finding that this distribution itself is very conservative. So imbedded in the process they used to pick those numbers obviously while it was hot, otherwise you would have gotten a 50 percent split.

MR. MACIEVIC: And, yes, their intention was is to put an upper bounding number on the ratios they used.

DR. MAURO: So this would make for a, I guess just to sort of speculate, a pretty good coworker model for post-1972. That’s what I’m hearing, but not necessarily for pre-’72 until we take a look at these other records to see how well it also bounds pre-’72.

MR. NELSON: The one conclusion that the report makes though is that there was a reduction in the neutron to photon ratio, and they understood all the shielding that was in place and the controls that were in place for the years prior to ’72. It’s in that report, the 1972 AEC report.

DR. ZIEMER: Well, I think we need to have that reviewed.

DR. BEHLING: Did you look at the correlated letter and the associated data that, I think, on page 23? Because if you look at those, and again, it’s a question because I don’t really know when they talk about column number three that’s identified as Calculated Maximum Hanford Dose and has the footnote b associated with it, how that was done.

But if you look, go through those numbers, you find for that dataset of 20 employees -- in fact, it’s not quite 20 because they’re skipping numbers there, number two through 20 and so there’s 17 of them -- but if you look at those, you’ll find consistent neutron/photon ratios in excess of one. Again, the letter is incomplete because it doesn't really give you a full understanding of how these numbers came to be and what was the technical basis. But clearly, there are numbers here that would suggest a neutron/photon ratio in excess of one for a good number of the people.

MR. MACIEVIC: I don't have that letter available right now.

DR. BEHLING: In other words for those of you who have it, if you look at employee number two, if you subtract column two from column three, so you subtract 110 minus 51 and then the balance of that, which would be 59 over 51, you end up with a ratio that's greater than unity. That's what I'm getting at.

DR. ZIEMER: I was trying to understand. It looks like they're saying that he got something like 58 --

DR. BEHLING: Neutrons.

DR. ZIEMER: -- millirem of neutron, 51 --

DR. BEHLING: Fifty-one of gamma.

DR. ZIEMER: -- of gamma. Isn't that what they're saying?

DR. BEHLING: Yes, I interpret that table to mean --

DR. ZIEMER: The footnotes are a little bit unclear as to what they --

DR. BEHLING: As I say, I want to caution everyone because I don't know how these numbers came to be. But at least if you take them at face value, the neutron/photon ratio would be greater than unity for these 17 people for many, for most of them.

DR. MAURO: So we have to reconcile, I guess, this information with your information.

MR. NELSON: Right.

DR. BEHLING: I guess I have nothing more to say. If we want to squeeze in Bob Alvarez's portion at this point, and ––

SODIUM 24

DR. MELIUS: Yeah, I think that would be appropriate.

Bob, are you still on the line?

MR. ALVAREZ (by Telephone): I am.

DR. MELIUS: If you want to sort of just briefly summarize the concern that you raised, and then we'll certainly --

MR. ALVAREZ (by Telephone): As I mentioned previously, there was I guess information on the public record regarding the potential exposures to neutrons to reactor workers, particularly for the first five production reactors. And as I mentioned, these reactors underwent problems particularly of deterioration of their bioshields and structural stress on reflectors, graphite distortion, et cetera, because of the wear and tear and increased thermal output of these reactors that caused a series of, I guess, engineering evaluations to be done about the bioshield indicating that the leakage rates were going up, and they were taking various steps to mitigate this.

And I suggested, based on some preliminary information relative to the first whole body counts that the Sodium-24 levels that were being measured there, at least as I understood the reports, suggested that these Sodium-24 levels may not have come from the ingestion of reactor water but may have been due to thermal neutrons. So that’s in summary what I, the issue I raised.

MR. NELSON: Yeah, when we read the reports, our take on the reports are that the Hanford technical staff did associate it with drinking water giving, for instance -- if I can read directly from the report, but let me go ahead and do that. It said, “Sodium-24 has been observed only in reactor employees during the last quarter of 1960. Fifty-nine Area workers were examined. Sodium-24 was detected in 18 of these employees.” That’s 31 percent.

“Fourteen of the 59 were assigned to the reactor areas furthest upstream. We take this to mean the B Reactor. Therefore, were not regularly exposed to drink the water supplies which have been used as reactor coolant.” The next sentence says, “excluding these subjects.” In other words they excluded them from the study, and our understanding is why they excluded them from the study is because they weren’t exposed to the drinking water.

And it says Sodium-24 instances then jumped from 31 to 40 percent when you excluded those individuals from the study. We actually talked to some of the people that were involved who were the authors of this document, and he said that the understanding was always that it was from the reactor water, and so that was our take on the report. We didn't get the same thoughts when we read that document that you did.

MR. ALVAREZ (by Telephone): Well, I guess the issue in my view still hinges on the availability of data relative to neutrons and neutron flux and exposure data that were occurring. And while it may be correct that the whole body data may not be indicative of exposures to neutrons, I don't think that that necessarily rules out the possibility that neutron exposures were occurring and might have been significant.

And what I noticed in the response, which I'm glad to see is that there's further work being done to look at this issue, am I correct? I mean, are you still assuming that neutron exposures to reactor workers during the first, at the first five production reactors were not significant? Or not significant as measured? Or --

MR. NELSON: Well, I think you're going back to the previous issue where we looked at single-pass reactors. And to try to add more credibility to the neutron to photon ratios, we are digging into some of the historical documents such as radiation surveys and all that. This particular paper didn't drive that to happen though.

MR. ALVAREZ (by Telephone): I see. So are you doing anything to look into the problem of the deteriorated shielding of these reactors to ascertain whether or not workers might have been receiving more neutrons than supposed or expected?

MR. NELSON: Like I said we are looking at other documents, and the deterioration of the shielding is also going to lead to more of a photon component as well.

MR. ALVAREZ (by Telephone): I'm sorry. I didn't hear what you said.

MR. NELSON: The deterioration of the basic, of some of the shielding, is also going to lead to an increase in the photon component as well.

MR. ALVAREZ (by Telephone): That's true.

MR. NELSON: So we are looking over all that different chaining. We're going to look further and, as cautioned earlier, there's a, we didn't throw the number out but --

Sam, how many documents are there? Records are there for Hanford that we can get our hands on? Was it 3.5 million documents?

DR. GLOVER: Just over 35 million documents.

MR. NELSON: Thirty-five million documents. So the effort's going to be quite involved, and --

MR. CLAWSON: So you'll have that out by next week?

DR. GLOVER: We have actually some very good assistance at looking at the technical documents.

DR. NETON: I think the bottom line with this issue, Bob, is that we don't see any credible evidence that Sodium-24 in reactor operators could be used to reconstruct neutron doses at Hanford right now. But we certainly are aware of the significant neutron exposures that may have occurred, and we're looking into them. But the mechanism using activated Sodium-24 to reconstruct those doses is probably not a reasonable approach that we would use.

MR. ALVAREZ (by Telephone): That's fine. My concern has more to do with the initial TBD which seems to dismiss the potential risks from neutrons out of hand for these reactor workers. And that you're sort of looking at this is fine with me, satisfactory to me.

DR. GLOVER: One other is that they do assign -- Sodium-24 activates very well. Anybody who's done neutron activation analysis stuff, it's always a problem. And for the people who didn't, they were from above and beyond the levels, and they were assigning those as inhalation doses. So there are obviously, Sodium-24 can be derived from other occupational exposures so that assigning internal dose from Sodium-24 inhalations. And that's discussed in the TBD.

MR. ALVAREZ (by Telephone): As I asked before in the previous conference call, the dose reconstructions that were being done for claimants were based on the assumption of inhalation and ingestion. And the question I posed is what was the data that you had to support that assumption. And are you saying now you have data? Because at the time I could not get an answer about what data did exist. And are you saying now you actually have data that positively affirms that Sodium-24 levels, especially in let's say upstream workers, B Reactor, whatever, were due to ingestion of river water?

MR. NELSON: What you just said is that ingestion of water for upstream reactors was due to river water?

MR. ALVAREZ (by Telephone): Well, I mean, they might have been drinking at home. You know, there were all these studies done that looked at both workers at the site and workers at home. So what I'm trying to find out is what data are you relying on to provide some affirmation that these mixed Sodium-24 levels were from drinking contaminated water.

DR. NETON: I think, Bob, that's the basis of this study. I mean, they looked at people upstream and downstream, and there was a direct correlation between Sodium-24 levels and their relationship along the river to the reactors.

MR. NELSON: There was also a statement made that the B Reactors --

MR. ALVAREZ (by Telephone): I guess what I'm trying to ask, and maybe I'm not being very clear, is were there any studies done about ingestion of potable water onsite would contain the activation products? I'm aware of the environmental studies that were done. In general terms, I'm --

DR. NETON: I think there was --

MR. ALVAREZ (by Telephone): What I'm trying to find out is were there studies onsite ascertaining exposures from drinking potable water onsite?

DR. NETON: I don't think it's in this study, Bob, but I think they refer to it in here. That it was fairly well understood that there was Sodium-24 in the potable water, drinking water, at the reactor sites.

MR. NELSON: And there was specific discussion that the levels at the B Reactor, which is upstream of the reactors, was the same as background levels.

DR. NETON: They did measure the water, and there was definitely Sodium-24 in the drinking water at those reactor facilities.

MR. ALVAREZ (by Telephone): All right, well, I mean, I don't have much more to say about this other than I'm generally gratified that you are looking more seriously into this.

WRAP-UP

DR. MELIUS: Are there any other technical issues or updates that we have?

MR. NELSON: When you're asking for updates, relative to the other issues?

DR. MELIUS: Yeah, the other issues.

MR. NELSON: I think I can give you some update on that. I know that we, what we're waiting on as far as SC&A analyzing for the internal comments. We're waiting on the procedures to be completed. And this has taken some time. And we're making headway, and the procedures have been updated. They've been back and forth between OCAS and ORAU to make those changes as represented in the responses. And the hold up at this point is providing annotations to all these documents as requested by the Board. So there is progress being made. We've gone back and forth, but the latest hold up in getting those procedures signed by OCAS is having those annotations made. So they're held up in ORAU at that point.

DR. MELIUS: And there's also as I recall, I don't remember the specifics, there's something about the environmental dose, too? Is that?

MR. NELSON: I don't have a specific update for that to be honest with you. I guess OCAS is overwhelmed actually with all the neutron to photon issues, and I'm not prepared for that.

DR. MELIUS: One other thing I would ask sort of post-meeting if, Hans, if you have time and Chuck and everybody could sort of get together and at least let's share what documents are sort of critical that have been identified here. So we make sure they get up on the O drive, and we can move forward from there. And then we'll keep in touch in terms of timing issues and so forth in terms of another meeting.

MR. ALVAREZ (by Telephone): May I suggest relative to the environmental dose issue is that the times that I've been involved in the discussions about that, the persons who were knowledgeable about that weren't present, and I feel like we've deferred discussion on the environmental dose issue. So I'd like to see if we can also spend some time to discuss that at some future date.

DR. MELIUS: As I recall it was a combination of the person wasn't available, but there's also something going on in terms of an activity, an updating of a report or something, that we were waiting on also. But that's one reason I wanted to identify some of these updates and figure out where we were so we get the right people at the next meeting.

MR. NELSON: Also, I'd like to propose that we're actually going to do an update to the issues and responses, and we're going to go to each subject matter expert and try to give you any updates if they exist and give you a better --

DR. MELIUS: Okay, if you could circulate that, that, too. But if we could just get together on how many documents. Once we leave and all go our separate ways, not that you don't stay in touch, but it comes up.

Okay, any other comments, questions?

(no response)

DR. MELIUS: I'd like to thank everybody --

DR. ZIEMER: Do we know, you're going to wait until you get the documents before you set another meeting time and --

DR. MELIUS: We're going to see what the timing of the documents and so forth.

DR. ZIEMER: -- okay.

DR. MELIUS: So we'll give an update at our, I'll check in with Chuck and Hans and Arjun and everyone before the, our next conference call which I can't remember the date on that.

DR. WADE: April 5th.

DR. MELIUS: April 5th.

DR. ZIEMER: Well, that's coming up pretty soon, but I'm thinking about prior to our face-to-face in Denver --

DR. MELIUS: I suspect we're not going to have another meeting before the Denver meeting of this work group. I think just given the timing and so forth on that.

DR. WADE: I'm also thinking, I'm thinking of the meeting after the May meeting, possibly July maybe to go to Hanford to talk about that as a Board.

MR. ELLIOTT: The SEC evaluation report should appear and be distributed sometime mid to late May?

DR. WADE: Well, we can end this call. Thank you very much. We're going to break the contact now.

(Whereupon, the working group meeting concluded at 1:00 p.m.)

CERTIFICATE OF COURT REPORTER

STATE OF GEORGIA
COUNTY OF FULTON

I, Steven Ray Green, Certified Merit Court Reporter, do hereby certify that I reported the above and foregoing on the day of March 26, 2007; 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 1st day of July, 2007.

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