

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.

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TRANSCRIPT LEGEND

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

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

(10:00 a.m.)

1
2WELCOME AND OPENING COMMENTSDR. LEWIS WADE, DFO3
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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

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

4 (no response)

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

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

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

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

25 **MS. HOWELL:** This is Emily Howell with HHS,

1 no conflicts.

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

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

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

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

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

12 **MR. SCALSKY:** Ed Scalsky, ORAU, no
13 conflicts.

14 **MR. MACIEVIC:** Greg Macievic, OCAS, no
15 conflicts.

16 **MR. NELSON:** Chuck Nelson, OCAS, no
17 conflicts.

18 **MR. CLAWSON:** Brad Clawson, Board, no
19 conflicts.

20 **DR. ZIEMER:** Paul Ziemer, Board, no
21 conflicts.

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

25 **MS. THOMAS (by Telephone):** This is Elyse

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

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

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

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

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

11 **DR. WADE:** Other NIOSH/ORAU team members?

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

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

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

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

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

21 **DR. WADE:** Other SC&A members?

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

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

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

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

5 (no response)

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

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

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

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

15 **DR. WADE:** Welcome, Jeff.

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

18 **DR. WADE:** Good morning, LaShawn.

19 Other federal employees?

20 (no response)

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

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

1 **DR. WADE:** Good morning.

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

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

6 **DR. WADE:** Welcome, John.

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

10 (no response)

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

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

20 **DR. MELIUS:** Thank you.

21 **PURPOSE OF MEETING**

22 The main focus of this meeting is to
23 talk about the neutron issue at Hanford, and
24 we have a -- Hans, after -- if I can get this
25 right -- Hans, after our last work group

1 meeting, prepared sort of a summary of, a
2 slight update of the original SC&A comments
3 pertaining to the neutron issue. And we now
4 more recently received a response from
5 NIOSH/ORAU. So that will be the main focus.

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

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

19 Hans and I were talking a little bit
20 just beforehand and what we thought we'd do is
21 let him sort of just briefly give an overview
22 on the issues that were raised in the SC&A
23 review. And then we thought for the more
24 detailed discussion it would be better to go
25 into that sort of split into three different

1 areas and spend time on that and so do it that
2 way. They are separate, and I think that
3 might be the most efficient way of dealing
4 with these technical issues.

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

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

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

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

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

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

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

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

6 **OVERVIEW**

7 As Dr. Melius has mentioned what I'd
8 like to do is just give a very brief overview,
9 a few minutes, and then because of the fact
10 that the neutron/photon dose ratio was
11 fragmenting into three areas, that is the
12 eight single-pass production reactor, the
13 closed tube N reactor and, of course, the 2,
14 300 Areas have all three different independent
15 neutron/photon ratios that were derived by
16 NIOSH/ORAU. And so we will probably want to
17 discuss each of them separately.

18 What I'd like to do is address the
19 issues that I raised on behalf of those three
20 neutron/photon ratios, and then offer the
21 people here from ORAU to present their point
22 of view before we go on to the next one
23 because all of these things are quite
24 technical issues. And if we were to go
25 through the whole thing first on my part and

1 then follow that by your response, we might
2 forget what the major issues were. So for the
3 sake of simplicity and practicality we'll do
4 it in three independent stages.

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

13 Bob, are you on the phone?

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

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

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

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

21 **MR. ALVAREZ (by Telephone):** Okay.

22 **DR. BEHLING:** Let me start out by saying
23 that the Hanford site is a very, very complex
24 site. And since 1950 and up into the end of
25 1971 a neutron dosimeter was used. That is

1 the NTA film dosimeter. And it was concluded
2 in 1972 based on AC studies that the NTA film
3 dosimeter for neutron detection was
4 questionable because it had certain
5 deficiency.

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

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

24 One of the problems that were, there
25 were several problems identified, but the key

1 problem is that for this dosimeter to really
2 function properly one has to really understand
3 the neutron spectrum that is being monitored.
4 And we know the neutron spectrum is quite
5 complex.

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

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

22 And I want to caution you what the
23 threshold value is. It's not a single moment
24 in space where once you exceed 300 keV of
25 proton energy, the neutron will always be

1 registered. It's a probabilistic event, and
2 the way to describe it is to simply give you
3 an analogy.

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

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

24 And it's really a question of what you
25 consider a threshold value because it is not

1 an issue of an all or nothing issue.
2 Obviously, when you get to a one MeV according
3 to Hine and Brownell who says that
4 approximately 75 to 80 percent of the
5 interactions will deliver enough of an energy
6 (telephonic interference) so as to give you a
7 track that can be countable. But even at one
8 MeV, it is not 100 percent certain that you
9 will actually get an interaction that results
10 in a visible charge.

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

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

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

17 **DR. WADE:** Hans, please continue.

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

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

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

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

20 Anyway, let's go back and just briefly
21 review some of the issues here that we're
22 going to discuss this morning. In the process
23 of trying to reconstruct doses, neutron doses,
24 prior to 1972, NIOSH in their TBD elected to
25 segregate the areas where neutron exposures

1 were possible into three discrete areas. The
2 eight single-pass reactors, the N Reactor,
3 which is a closed loop, also production but
4 also generate electricity, and the two and 300
5 Area that involved plutonium production and in
6 finishing.

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

19 TBD

20 So with that I would like to perhaps
21 then start by briefly going over the technical
22 basis document that was issued, and I don't
23 have the dates in front of me. But I'm
24 working on the, or this report that I've
25 written reflects the technical basis document

1 that was issued in 2004. And I fully
2 understand that ORAU has issued a revised
3 version of the TBD back in November, I
4 believe, of this year.

5 But the report that I had written
6 really reflects the original report. So if
7 there are changes, I will have to accept the
8 fact that some of the changes may have
9 accommodated some of the issues that were
10 raised here. But this discussion reflects the
11 TBD as it was written as rev. one back in
12 2004.

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

17 **MR. NELSON:** May I make a suggestion?

18 **DR. BEHLING:** Yes, please.

19 **MR. NELSON:** You know we're talking about
20 three different areas, the two and 300 Area,
21 the N Reactor and the eight single-pass
22 reactors. The 200 Area and the N Reactor are
23 current as you'll see in the response. The
24 basis for determining neutron/photon ratios
25 are based on NTA, not NTA film, but

1 multipurpose TLD badges. So I think in the
2 interest of resolving the issues and getting
3 through the most items, I think if we go in
4 reverse order there where we feel we're
5 stronger, then perhaps we can resolve those
6 issues sooner in the meeting and get through
7 more of the discussion if anybody's amenable
8 to that.

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

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

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

21 **EIGHT SINGLE-PASS PRODUCTION REACTORS**

22 On page four you have the first group,
23 and that is an assessment of the
24 neutron/photon ratio for the eight single-pass
25 production reactors. And one of the things

1 that was done here was to use NTA film and
2 say, okay, we will use NTA film and compare
3 the response of NTA film to the photon
4 exposures associated with people who may have
5 been exposed to both neutrons and photons at
6 the production reactors.

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

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

1 one through five.

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

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

21 But the method five is the method that
22 is considered by ORAU to be the most accurate.
23 And what that does is to subtract the tracks
24 on the control neutron badge. So again, if a
25 person had a photon dose of about 100

1 millirem, under method five those seven
2 individuals that were assessed would have a
3 neutron/photon ratio of 0.09. Or in other
4 words there would be nine millirem assigned to
5 the neutron dose.

6 And as you see down here on the page I
7 just simply summarized that, and ORAU
8 concluded that since we don't really know
9 which method is perhaps most accurate, why
10 don't we just look at all of the five methods
11 and then see what we can come off, what comes
12 out of it. And they concluded that it fits in
13 lognormal distribution. And based on all five
14 methods they concluded that the geometric mean
15 that should be used is 0.1. In other words
16 100 millirem photon dose buys you 11 millirem
17 NTA dose. And of course, they have a
18 geometric standard deviation in the 95th
19 percentile.

20 **DR. POSTON (by Telephone):** Hans? Hans?
21 Hans? John Poston here. I guess I'm having
22 trouble figuring out what's wrong with what
23 you just said. I would expect mostly thermal
24 neutrons being present for around these
25 reactors I would expect a whole lot more of

1 photons than neutrons. And I know that it
2 takes about a factor of 100 more thermal
3 neutrons to produce one rad of absorbed dose
4 than it does fast neutrons. So everything
5 that you said makes sense to me. I'm trying
6 to see what's wrong with what my intuition
7 tells me.

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

12 **DR. POSTON (by Telephone):** Okay.

13 **MR. NELSON:** This is Chuck Nelson. Not to
14 be rude here, but cut to the chase. I mean,
15 we're gonna sit here and talk about all the
16 technical limitations and problems with NTA
17 film, and our response right away is that we
18 realize there's a lot of limitations and
19 problems with NTA film so that's one of the
20 reasons I thought perhaps we could pass over
21 some of that discussion so that we can get
22 down to what the actual response was because
23 our response didn't really deal with, we
24 basically acknowledge that that's an issue,
25 and we wanted to summarize why we felt that

1 the numbers that we have are claimant
2 favorable, some of which were just now brought
3 up.

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

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

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

1 0.11 should be modified in order to reflect a
2 deficiency on the part of the NTA film.

3 And this deficiency is reflected by a
4 single comparison between a tissue equivalent
5 proportional counter and NTA film on top of
6 the 100 KE reactor which yielded a ratio of
7 0.28 or 28 percent efficiency. So in other
8 words the 11 percent ratio was then divided by
9 0.28 to come up with the 0.141 ratio. And
10 that is the method by which this ratio was
11 then delivered.

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

24 Finding number two is the questionable
25 accuracy of recorded NTA data, and again,

1 we're talking about the seven individual
2 workers who were primarily assigned to
3 reactors. We don't have a full understanding
4 of their assignments throughout this period of
5 time for which these data were collected. And
6 of course, the potential exists that they may
7 have been assigned to areas where there were
8 no neutrons which tends to inflate the photon
9 component; and therefore, in the process
10 reduces the end gamma ratio.

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

17 Finding number three, the assumption
18 that method five was technically most correct,
19 and this is an issue that I can't quite
20 understand. When you look at the first table
21 there, and you see method one through five,
22 and you go from a ratio -- this is
23 unadulterated, that is raw neutron/photon
24 ratio -- you go from method one where the
25 ratio is 0.43 to method five which is 0.09,

1 and you realize that the difference is one of
2 subtracting the response on the part of
3 control badges.

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

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

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

25 **DR. POSTON (by Telephone):** I don't know. I

1 just know that when you're measuring at very,
2 very low doses, plus or minus 100 percent is
3 the typical acceptable --

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

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

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

25 Here we're trying to address a

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

12 One of the things that I wanted to
13 point out was, and I include it in my write
14 up, was the 28 percent. If you look at Table
15 2 in my handout, you see, and it's written in
16 bold, that that 28 percent was based on a
17 single measurement. As I've said that
18 compares the tissue equivalent proportional
19 counter to the NTA film, but it was measured
20 on top of the 105 KE reactor. And you see the
21 28 percent corresponds to the relationship
22 between 470 over 1700 millirem which then
23 gives you the 28 percent.

24 On the other hand if you look at the
25 front face or if you look at the X-1, and I'm

1 not sure I even know what that location is,
2 you find that the NTA film reads zero. So
3 again, here is a situation where a data point
4 was selected that is possibly correct, but
5 what is the relationship between a
6 neutron/photon dose response on top of the
7 reactor where it's not likely that the
8 majority of work exposure may have taken
9 place. And of course, if you take it in front
10 of the reactor, you have essentially a
11 relationship that can't be even measured
12 because the NTA film registers nothing.

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

1 the N Reactor.

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

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

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

1 neutron/photon ratio.

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

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

20 And what we did in the TBD or what was
21 done in the TBD was to use the available data
22 to come up with what was felt to be a claimant
23 favorable neutron/photon ratio. Given that we
24 realize there are limitations to it, and that
25 the 28 percent that was applied was very

1 limited and was based on a single set of pair
2 measurements, and there just wasn't much data
3 available. So that number was used, and it
4 was felt that it was claimant favorable.

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

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

23 **MR. SCALSKY:** This is Ed Scalsky. I think
24 one of the things that we have to be aware of
25 is that the people at that time were aware of

1 all these problems. They made extensive
2 surveys around the reactor. They started with
3 the 305 reactor, and they went into the 105-B
4 reactor when it went critical. They did
5 complete surveys along the front face of the
6 reactor. They timed people when they went in
7 there to do work, they made measurements.
8 And, in fact, from 1950 to '57, I guess, one
9 of the things they did is that they made the
10 survey. When people went into work, they
11 started a stop watch, and they based their
12 time on the highest dose rates that they could
13 find in there.

14 **DR. MAURO:** And so they're neutron
15 measurements?

16 **MR. SCALSKY:** Neutron measurements.

17 **DR. MAURO:** With NTA film?

18 **MR. SCALSKY:** No, with instruments.

19 **DR. MAURO:** Okay, this was instrumentation.

20 **MR. SCALSKY:** Instrumentation also.

21 **DR. MAURO:** (Unintelligible).

22 **MR. SCALSKY:** Well, I don't know about
23 (unintelligible). They had a (unintelligible)
24 type instrument, BF-3 with cadmium covered and
25 non-cadmium covered.

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

3 **MR. SCALSKY:** Yes, they are recorded.
4 There's a couple of, we're in the process of
5 getting additional data, logbooks. We have a
6 couple of logbooks right now. The HEW 199L
7 goes from 11/21/44 to 12/29/44. And the HEW
8 507L goes from 9/10/45 through 5/3/46. And
9 these logbooks give the details of all the
10 surveys that were made at that time.

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

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

22 **MR. NELSON:** That was a report. It was
23 called "Achievement and HAPO Monitoring". It
24 covered 1944 to 1954, and it was basically a
25 summary of all the controls that were in place

1 from the beginning of the time they started
2 the reactors. It actually included a lot of
3 different work areas, but it had a specific
4 section on monitoring at the reactors.

5 **MR. ALVAREZ (by Telephone):** I guess perhaps
6 I'm not being clear. I'll restate my
7 question. Subsequent to 1954, around
8 beginning in the, let's say '56, '57 timeframe
9 when the power levels were increased
10 dramatically in these reactors and they began
11 to observe deterioration of the bioshields and
12 things like warping and other phenomena
13 affecting the physical state of the reactor,
14 et cetera, there was concern expressed, at
15 least by the engineering people, about the
16 potential for an increased leakage of photons
17 and neutrons. And my question is after 1955,
18 '56 were there any sort of specific studies
19 performed to look at doses that might have
20 been received from the deterioration of the
21 bioshield and other problems associated with
22 increasing power levels?

23 **MR. SCALSKY:** I would expect that based on
24 the logbooks that they've had, that they've
25 made surveys on a continuing basis and I see

1 no reason why it should have stopped, you
2 know, at 1950 or '55 or any other time.

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

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

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

22 **DR. MAURO:** This is very important, and as
23 what you're saying is there's a body of data
24 out there that measured neutron, I guess
25 fluxes, was it just energy distribution or was

1 it just dose?

2 **MR. NELSON:** It's dose ranges.

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

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

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

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

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

1 maybe had boron and cadmium or --

2 **MR. SCALSKY:** Well, it had two chambers
3 actually.

4 **DR. ZIEMER:** But that was really rough
5 spectral analysis in a sense, probably fast
6 and maybe epithermal and thermal or something
7 like that. So there were a lot of different
8 detectors and all of them had limitations. It
9 really wasn't until you got to the Bonner
10 spheres and you're up toward the end of the
11 '50s and into the '60s before those started to
12 get -- I don't remember the dates, maybe
13 Poston would -- but there was a lot of
14 attention given.

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

25 The limitations were known very early

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

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

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

25 So I think if you can get a hold of

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

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

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

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

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

25 **MR. SCALSKY:** I can't say that the .28 is a

1 good number.

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

5 **MR. ELLIOTT:** That's the issue.

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

8 **DR. BEHLING:** Well, I think there is more
9 because you can look at the Table 2 that I
10 have, and obviously the difference between Top
11 23 when you have the 1700 versus the 470 that
12 gave rise to the 28 percent was not obviously
13 matched by the front phase or the X-1 location
14 meaning that the ratio will shift as a
15 function of neutron spectrum.

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

23 So we realize that no single number
24 will ever do justice. What you hope for is to
25 perhaps take a claimant favorable number and

1 say that on average if a person spends time in
2 the containment, and he wanders from one
3 location to the other over time or different
4 reactors, that a single number will perhaps
5 provide a bounding relationship. But not,
6 there will be no single number that will
7 capture the truth.

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

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

1 to.

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

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

21 See, the way I look at it is, and if
22 we don't really know -- we ran into this
23 problem at Bethlehem Steel -- it's almost like
24 a policy issue. If we have a situation where
25 you have this variability, you have workers,

1 you're not quite sure where the workers
2 worked, but there are some locations where
3 consistently the ratios were above one. I
4 won't even use five because that's pretty
5 high. But let's say consistently above one.

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

20 But I guess we've developed a
21 practice, and I think we agree --

22 **DR. NETON:** I think what you're saying here
23 is the evolution of our process.

24 **DR. MAURO:** Yeah.

25 **DR. NETON:** This Hanford document was

1 written, one of the first ones that you
2 reviewed, and a lot of water's gone under the
3 bridge since then. And we've evolved our
4 position particularly in the area of photons.
5 I mean, I think there is a TIB out there now
6 that you'll read about later that's in our
7 response, TIB-20 I think, that essentially
8 takes that position. If you don't know any
9 better and the person should have been
10 monitored, in our judgment they were more
11 exposed and should have been monitored, then
12 the 95th percentile is probably the appropriate
13 measurement.

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

1 think you would agree that unmonitored workers
2 then may --

3 **DR. MAURO:** Full distribution would be
4 better.

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

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

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

1 mostly reactors that were closed for that
2 purpose.

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

11 **DR. MAURO:** Was it neutron?

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

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

25 **DR. NETON:** That's another issue. When you

1 start getting into the neutron/photon ratio
2 business, when you've got non-detectable
3 badges at the detection limit, you can't take
4 the 95th percentile, the badge and the 95th
5 percentile in my mind of the neutron/photon
6 ratio and come up with what I would consider a
7 reasonable estimate.

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

12 **DR. ZIEMER:** That's from your report?

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

16 "Hanford NTA film was processed
17 independently from the beta/photon film even
18 though the NTA film was typically exchanged
19 along with the beta/photon film. Prior to
20 1957, NTA film was housed in the two-element
21 beta/photon dosimeter holder along with the
22 beta/photon film."

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

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

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

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

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

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

12 **MR. MACIEVIC:** That's right.

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

22 Meaning that for those individuals who
23 where the potential ratio was one or higher,
24 you may have not even processed the NTA film
25 based on the failure of the photon dose to

1 have been less than 100 millirem, which means
2 there's the potential of a lot of data missing
3 that on the basis of this policy was simply
4 not bothered to be read.

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

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

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

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

1 ratio.

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

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

23 **MR. NELSON:** That threshold value was
24 established for reactor facilities not for
25 plutonium facilities because they felt that

1 neutrons weren't as significant in the reactor
2 facilities. So instead of counting all these
3 badges, they set a threshold at which now
4 those are the ones we're going to target, and
5 we'll look at those and see if we can
6 specifically see neutrons on those.

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

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

25 **DR. BEHLING:** I think if you have faith in

1 it, John --

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

7 **MR. SCHOFIELD:** How good is the
8 documentation that these people spent their
9 time at the reactor and didn't go over to the
10 200, 300 Area to work with the plutonium? I
11 mean, shielded gamma is pretty easy so I mean,
12 you know, you have guys who almost any --
13 they're gonna be floaters. They're going to
14 spend a lot of time here, but they're going to
15 spend a heck of a lot of time here
16 particularly times when they're short they
17 need to generate a lot of this overtime. They
18 will pull people from here to fill in over
19 here. Unless that's well documented, there
20 are people who have potential for a large
21 neutron dose being missed in their records.

22 **DR. NETON:** I assume there'll be logbooks
23 not only recording the neutron but the photons
24 simultaneously so you're going to have an
25 instantaneous ratio here that documents the

1 neutron/photon ratio independent of the badges
2 themselves, I would think.

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

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

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

23 **MR. NELSON:** Well, Jim, if you look at the
24 records associated with the claims, they're
25 actually very good in that they'll have the

1 dosimeter records, and they'll show the area
2 where the guy works. I'm not saying they're
3 100 percent complete regarding showing every
4 movement, but it does, for many of the years
5 it shows, okay, the guy left 100 Area and
6 moved over to the 200 Area.

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

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

1 variable.

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

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

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

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

1 **DR. NETON:** I think we agree with that.

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

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

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

11 **DR. GLOVER:** At 2,000 and something.

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

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

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

22 **DR. NETON:** And we agree. We need to go
23 back and look and see if we can, if full
24 distribution is applicable or whether
25 something like the 95th percentile is more

1 appropriate. I think we're all in agreement.

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

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

19 **DR. BEHLING:** And, in fact, that's a good
20 point because among the things that I brought
21 up in my write up on page three was the actual
22 changed frequency from January 1950 through
23 December 1950. So it's for the full year of
24 1950 the frequency for badge exchange was
25 weekly. So if you apply that it didn't match,

1 it didn't meet 100 millirem for that year, you
2 could be missing an awful lot of photons and
3 neutrons.

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

16 **DR. ZIEMER:** As if it was in operation.

17 **DR. GLOVER:** Exactly.

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

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

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

12 **MR. NELSON:** Yes.

13 **DR. ZIEMER:** Okay.

14 **DR. MAURO:** Let me see now. You measure
15 photon. He has his NTA film, and he has his -
16 -

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

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

24 **DR. BEHLING:** No, they --

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

1 They didn't measure it. I just wanted to
2 understand, okay.

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

5 **MR. NELSON:** Right.

6 **DR. ZIEMER:** You're putting in a neutron
7 value which is half the detectable limit which
8 will be what?

9 **MR. NELSON:** About roughly 25 I believe.

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

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

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

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

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

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

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

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

1 of those?

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

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

22 **MR. SCALSKY:** Would be less than five
23 percent.

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

25 **MR. NELSON:** I don't think he's saying that

1 it would represent a neutron to photon ratio.
2 He's not saying that.

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

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

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

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

18 **MR. SCALSKY:** And as Chuck said, the dose
19 reconstruction process involves several dose
20 components, you know, the missed photon and
21 neutron doses, and it took into consideration
22 frequency of changes when they applied all of
23 these. And they used the MDL over two times
24 the number of zeros or the less than MDL over
25 two. So we do feel that all the evaluations

1 are favorable to the claimants when we take
2 all these things into consideration.

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

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

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

24 **MR. NELSON:** You talked about that Peterson
25 and Smalley report. That was in 1960, so they

1 had some dose reads that would support a one-
2 to-one NP ratio. Of course, that's what the
3 reactor operated. So as Ed mentioned, you
4 know, there's a lot of times when people are
5 receiving photon dose and receiving no neutron
6 dose. And we're taking that photon dose and
7 applying those NP ratios. So I feel like that
8 in effect most of the photon doses were
9 relative to when there wasn't much of any
10 neutron dose. So I think that by itself is
11 claimant favorable.

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

21 So if we're talking about a
22 significant degradation of shielding, then you
23 should be seeing these higher energy neutrons
24 which would have been seen by NTA film. He
25 made a general conclusion about that. He said

1 that NP ratios of about one with minimal
2 shielding. So there's a hole, a beam coming
3 out of the reactor, and you're seeing NP
4 ratios of about one.

5 **DR. MAURO:** This is concrete shielding?

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

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

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

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

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

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

24 **MR. NELSON:** No, that was another reactor.
25 I didn't bring that one up. You're probably

1 thinking of another report that they talk
2 about, an ORNL 2195 which was --

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

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

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

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

25 The degradation, my understanding is,

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

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

23 We've got to give the best. And Sam
24 brought up a very good point. There's
25 probably only 75 that we're going to have to

1 do the best estimate and stuff like that. But
2 when we walk away from this we want to be able
3 to know that we've done it the best that we
4 can. And there's a consensus of the problem.
5 Both sides we are and we're not, but we need
6 to really look at what we're putting on for
7 them.

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

12 **DR. BEHLING:** At various times, yes. In
13 1950, it was weekly. Thereafter it was
14 bimonthly, and after that monthly. So it
15 changed, the exchange frequency varied over
16 time.

17 **MR. NELSON:** I don't think that decision was
18 made to eliminate those ones at a threshold of
19 100 millirem until, it's in that report when
20 they started doing it. So initially they were
21 reading all of them. So the report will tell
22 you when they decided that, and I don't
23 remember the date offhand. So initially they
24 read them all.

25 **DR. GLOVER:** This is Sam Glover again. One

1 thing that doesn't come out is that they
2 actually spoke to people who were monitoring.
3 They actually, when they entered these areas,
4 they had people with them. And we're going to
5 actually talk, our hope is to talk to [Name
6 Redacted], 1947. He's still around, and also
7 to talk to additional folks.

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

19 **N REACTOR**

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

22 Okay, the N Reactor, obviously it was
23 somewhat different. It was a closed loop. It
24 was used not only to produce plutonium but
25 also generate electricity for the on site and

1 also tritium production. The N Reactor began
2 operation only in December 1963 so it was the
3 last one to come online.

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

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

23 Apparently in 1960 Peterson and
24 Smalley studied the other reactors and
25 realized that there were problems associated

1 with neutron doses. And if you look on page
2 9, Table 3, you will see the neutron/photon
3 ratios for the reactors. As you see, and
4 already mentioned, I think Chuck just
5 mentioned it briefly, that for the B reactor
6 the neutron dose rate of 25 millirem per hour
7 was matched by photon dose rates of 25. So
8 you have as a matter of empirical evidence a
9 ratio of one. And I assume these reflect
10 instruments rather than NTA film. Is that
11 correct?

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

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

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

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

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

22 But based on the fact that these
23 calculations were made in 1960 and the N
24 Reactor went operational in 1963, ORAU took a
25 leap of faith and made an assumption that,

1 well, they would have clearly made those
2 modifications in a production reactor that has
3 yet to operate. So on that premise, and it's
4 a leap of faith, they decided to reduce the
5 0.41 neutron/photon ratio by a factor of seven
6 and ended up with the neutron/photon dose rate
7 ratio of 0.06. So that is the basic premise
8 for assigning a neutron to photon ratio that
9 is seven-fold lower than those for the single-
10 pass other eight reactors.

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

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

1 characteristics than the first five reactors.

2 **DR. BEHLING:** Well, anyway, that pretty much
3 sums up all of the concerns that were raised
4 on behalf of the eight single-pass reactors
5 have been passed on the pipeline because that
6 became the starting point for the N Reactor
7 which was then subsequently modified by way of
8 reducing the .41 ratio that NIOSH had arrived
9 at by a factor of nearly sevenfold to go from
10 .41 to 0.06. And that was strictly based on a
11 calculational method that we may not even
12 realize ever took place.

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

16 **MR. NELSON:** Okay, thanks, Hans.

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

21 Bob, this is Ziemer, were you saying
22 there was no neutron shielding added on those
23 --

24 **MR. ALVAREZ (by Telephone):** No, to the best
25 of my knowledge what they were doing to

1 prevent further degradation of the bioshield
2 was to add thorium on the fringes of the
3 reactor to reduce the heat loads. It was the
4 thermal, the thermal heat that was actually
5 causing the degradation of the Masonite
6 basically. And there was evidence that it was
7 combusting. This is how hot they were
8 running, you know, and how hard they were
9 running these reactors.

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

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

1 thermalized --

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

4 **DR. ZIEMER:** These aren't measured values.

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

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

20 **DR. BEHLING:** But the thing I want to
21 caution you is that those numbers on the
22 right-hand side are theoretical. They're not
23 real. And if you go to the next page, I took
24 a quote again from the TBD, and I quote:
25 Since the report was issued in 1960, and the

1 first of the Hanford reactors were shut down
2 starting in '64 with the last single-pass
3 reactor being shut down in '71 -- and I
4 highlighted -- it is possible that the
5 additional shielding was only installed in
6 some reactors (later running reactors) and not
7 installed in others.

8 So NIOSH admits that there's
9 uncertainty about whether the recommendations
10 by the Peterson Smalley were ever implemented.

11 **DR. ZIEMER:** I got you.

12 **MR. NELSON:** That's correct.

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

23 And what they did in this test, it was
24 in November and December of 1970 and January
25 of 1971. And they were testing these TLDs so

1 they assigned them to workers working in the N
2 Reactor area. And the results you'll see on
3 page, of the report, the responses, I believe
4 it's on page three. There's a table there at
5 the bottom. It has different badge readings -
6 - because I'm using some of my notes here. I
7 don't want to confuse everybody.

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

20 So if you do look at the neutron to
21 photon ratio from that table, you'll see
22 they're well below the recommended values
23 assigned in the TBD. So we said, well, that's
24 not a whole lot of data. It's pretty
25 uncertain, three millirems, pretty slow,

1 although we know NTA film does like slow
2 neutrons.

3 So what we did recently over the last
4 month or so, contacted DOE, and they provided
5 us all the data that they had for the Douglas
6 United Nuclear workers. So this data focuses
7 from 1972, when TLDs were implemented, until
8 1986 towards the end of the operation of the N
9 Reactor. And you'll see that table on page
10 four.

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

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

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

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

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

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

24 So if you look at the results of this
25 table, I want to clarify that it is 50

1 millirem photon and zero millirem neutron. If
2 they had anything that exceeded those
3 thresholds, that's what this data depicts.
4 And if you look at what the geometric mean out
5 of 245 workers, then you'll see that the
6 geometric mean was .03, GSD of 4.14 and 95th
7 percentile of .34. All those numbers are less
8 than what the TBD recommends.

9 So when I'm asking more questions
10 about the data, I did find out that the
11 preferred analysis was greater than 50
12 millirems photon and greater than 50 millirems
13 neutron. And you won't find this on this
14 table, but I did want to put out the analysis
15 was done and the results are .06 as a
16 geometric mean which is exactly the same as
17 the TBD. A GSD of 2.88, the TBD recommends
18 3.0. And finally, the 95th percentile came out
19 at .35 which is very close to the .37 as
20 recommended in the TLD, I mean in the TBD.

21 So the data that we do have is real
22 data. It's using TLD data, and I think the
23 basis by which the TBD assigned or came up
24 with the neutron to photon ratio is again like
25 the single-pass reactors uncertain. And we

1 think this data would more represent what an
2 appropriate neutron to photon ratio would be.
3 And that's using actual data.

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

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

23 Now, and you don't have the ability to
24 separate and say, well, let's assume a person
25 worked there for a period of during a

1 refueling outage or extensive maintenance
2 outage. At what point do you segregate the
3 neutron from the photon exposure when, in
4 fact, there was no chance for a neutron
5 exposure?

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

15 **MR. NELSON:** I actually don't have a great
16 answer for that one. I do want to clarify
17 though. Prior to 1972 that's when we would
18 apply those neutron to photon ratios. After
19 1972 we're going to use the actual neutron
20 records. So what you're questioning then
21 would be prior to 1972, just to clarify it.

22 **DR. BEHLING:** Right, and I agree that for
23 these workers where you have TLD data you
24 wouldn't go to neutron/photon ratio anyway.
25 You'd use the original empirical data. But

1 you're basically stating that the 0.6 as
2 geometric mean is therefore representative of
3 a pre-1972 timeframe when NTA film was used;
4 and therefore, justifies your assumption of
5 0.06 as the best and reasonable assessment for
6 neutron/photon ratio.

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

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

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

16 **DR. NETON:** And if you take the 95th
17 percentile, you're going to be selecting those
18 workers who were --

19 **DR. MAURO:** Yeah, but how did get that, that
20 95th, in other words, let's say -- let me see
21 if I get this right because I always have a
22 problem when you use collective dose and
23 parameters in retrospect. You merge from
24 collective dose and then say, okay, now I'm
25 going to use that value and apply it to a real

1 person. Because in other words what you're
2 saying, because whenever you work with a
3 collective dose, you're really having a
4 measure of the average, and we're not
5 concerned about the average. We're concerned
6 about the guy who might be at the high end.

7 Now to get now the ratio, in other
8 words I see, how did you get, for example, the
9 1.04, the 95th percentile of ratio of 1.04, did
10 you take like individuals, let's say we have
11 like, did you take 246 real people?

12 **DR. BEHLING:** Here these are. There's this
13 20 workers, ten workers and 14 workers, and
14 they have dosimetry records that fall into
15 these categories and you simply pair them.

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

24 **DR. BEHLING:** No, it's the distribution for
25 these workers right here. You have in this

1 timeframe, ten, 20 workers, ten workers, 34.

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

6 **DR. BEHLING:** Number of workers.

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

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

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

15 **MR. SCALSKY:** A hundred and seventy-two.

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

22 And you're saying the upper 95th
23 percentile was .34. Is that a correct way to
24 read this? In other words, as close to the
25 highest? Because I was afraid I was looking

1 at a parameter that was an expression of the
2 uncertainty in the collective neutron to
3 photon ratio as opposed to the real individual
4 variability between or among workers.

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

7 **DR. NETON:** (Unintelligible).

8 **DR. MAURO:** What I'm getting at is that if
9 you really have -- I'm in complete support of
10 what your argument for this data set, in other
11 words, if you have 170 workers, and for every
12 one of those workers you've got a real
13 measurement of neutron and photon dose. And
14 then you make a plot of the neutron to photon
15 ratio for every worker, and you say the upper
16 95th percentile, the highest dose or the
17 highest value because the 95th percentile would
18 be close to the highest value, of the neutron
19 to photon ratio for all those workers is .34,
20 then I think you've got a rock solid argument.

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

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

24 **DR. BEHLING:** You may have a person who
25 worked there for three months, and it's only

1 in the last, the first week or the last week
2 that he had reasons to be exposed to neutrons.
3 So the balance of time was done when the
4 reactor was shut down, and he's part of that
5 aggregate.

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

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

19 **DR. BEHLING:** Well, it's a question of, you
20 know, for instance, when you have a power
21 reactor, the number of people going to
22 containments during the time when the reactor
23 is up and running is very few. It's a handful
24 of people. When the reactor shuts down, you
25 bring in the contractors by the dozens, and

1 that's when you get the big gamma exposures
2 but no neutron. And I don't know to what
3 extent these numbers here are tainted by an
4 exposure that was exclusively, or at least a
5 part of it, exclusively photon where there was
6 no need for monitoring for neutron because the
7 reactor was shut down. And this is the
8 difference between NTA data and this data.
9 And that's why --

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

14 **DR. BEHLING:** But still it could have --

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

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

1 that.

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

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

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

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

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

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

25 **DR. MAURO:** I wanted to just make sure I

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

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

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

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

23 **DR. BEHLING:** Well, this is a yearly
24 aggregate. You know, you see 1973. If we
25 broke it down by wear period where it's a

1 monthly, then I would potentially say that's,
2 you're starting to get closer and eliminating
3 -- let's assume for 1973 a worker was
4 subjected to photon field during the outage of
5 maybe several months. And you discard that
6 and say, well, when did he receive his neutron
7 dose.

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

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

19 **MR. NELSON:** No, what you'll see is,
20 especially for the early years when the guy
21 went into an Area, you'll see, it's a log
22 book, and you'll see where he went in with a
23 pencil dosimeter and what his recording was in
24 and out. And it'll have a column for each.
25 It'll say K Reactor, keV, you know, depending

1 on what reactor he worked in. So it will
2 assign him directly to that particular
3 reactor.

4 **MR. SCHOFIELD:** Oh, okay.

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

8 **MR. NELSON:** Yeah, we can --

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

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

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

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

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

1 **DR. BEHLING:** And so we're using this data -
2 -

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

8 **DR. BEHLING:** Yeah, what this --

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

19 So the neutron activities of these
20 reactors need to be matched up with what they
21 were making based on their relative neutron
22 activities. And I contend that I just don't
23 believe you can extrapolate the neutron to
24 photon ratios from the N Reactor with those of
25 these original ones because of their, mainly

1 because the shielding is so totally different,
2 and you had constantly degraded shielding
3 problems going on.

4 **DR. BEHLING:** But, Bob, this is Hans. This
5 table here that Chuck had supplied us with has
6 a singular purpose, and that's to apply some
7 credibility to the neutron/photon ratio of
8 0.06 that was originally derived by the Peter
9 Smalley methodology. And this table right
10 here provides data post-1972 using the TLD
11 data that suggests 0.03, which is a factor of
12 get too smaller. And therefore, the attempt
13 here is to give credibility to the pre-1972
14 neutron/photon ratio for the N Reactor only.

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

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

22 **MR. ELLIOTT:** Further exploration is
23 necessary.

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

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

5 **DR. WADE:** We're going to break for ten
6 minutes. We'll maintain contact but go on
7 mute.

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

10 **DR. WADE:** We're back.

11 **DR. MELIUS:** I'm not sure whether this is a
12 plan or a proposal, but I plan to work through
13 lunch. I think we can finish up about 1:00 or
14 1:30, something like that so I think that's
15 easier than breaking and then coming back so
16 unless there's strong objections. We will
17 take a break around, right at one o'clock so
18 Ray can run next door and make sure there's
19 somebody covering that meeting, at least the
20 beginning of it.

21 **HANFORD 200 AND 300 AREAS**

22 I think we're on to the third one,
23 yeah.

24 **DR. BEHLING:** For those who have my handout,
25 I'll skip to page ten and simply make a few

1 opening statements that starting in 1945
2 Hanford began production of plutonium nitrate
3 at the Plutonium Finishing Plant, that's in
4 the 200 Area and also lots of work was done in
5 the 300 Area that involved potential neutron
6 exposures.

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

16 To come up with their neutron/photon
17 dose ratios for the two and 300 Areas, again,
18 we're talking about pre-1972. Post-1972 you
19 had your TLD, and therefore, empirical data
20 will be used to assign neutron doses for those
21 workers who were part of the two and 300
22 production areas. To do so what NIOSH has
23 done is said let's take a look at the 1972,
24 post-1972 data, and determine what
25 neutron/photon ratios might come from that

1 dataset and then extrapolate it backwards in
2 time and assume that we can apply these
3 neutron to photon ratios to all periods all
4 the way back to the 1940s.

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

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

1 95th percentile value of 2.47.

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

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

19 So the question is to what extent are
20 we biasing the selection of 186 paired neutron
21 and photon dosimeter readings by selecting, I
22 accept that the TLD very nicely can measure 20
23 millirem photon dose. The question is how
24 reasonably accurate is the dose as low as 20
25 millirem for neutron since we, I think,

1 identified 50 millirem as the MDL value. So
2 that's one of the issues. And I think in
3 their response they did look at the revised
4 matched dosimeter readings that looks at 50
5 millirem neutrons as a revised number. So
6 I'll let them talk about what they found.

7 But the more important finding in
8 behalf of the two and 300 Area neutron
9 exposures are based on the fact that since
10 1944, these facilities have been in operation,
11 and of course, I would concur with their
12 assessment under one condition, and one
13 condition only, that the facilities as they
14 exist post-1972 were, in fact, identical for
15 all previous timeframes which we know they
16 were not.

17 And in my write up I provided a number
18 of statements that come directly out of the
19 TBD that talked about the revisions to these
20 facilities. Many of these things early on,
21 especially in the early '40s and '50s were
22 very, very manually driven processes including
23 the area where we had a lot of these -- what
24 is it called? The 500 foot line involving
25 glove boxes where people were basically

1 standing there and pushing this material from
2 one glove box to the next and in essence there
3 was very little mechanization or remote
4 methods by which these processes were
5 performed.

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

20 And quite honestly when I look at some
21 of the data including that which was provided
22 by Corley in 1972, and I included his
23 assessment. If you look at his tables which
24 are included as, I believe, on the last page,
25 17, you end up with neutron/photon ratios that

1 were in most instances significantly above
2 one.

3 So even though for the proposed
4 neutron/photon ratio that NIOSH has derived of
5 0.73, I believe perhaps a more central value
6 would be a value greater than unity based on
7 Corley data. And of course, that may or may
8 not even include some of the earlier ratios
9 that might have been defined for which we have
10 no data that go back into the '40s and '50s
11 based on the fact that so many changes had
12 been made to these facilities that would have
13 affected both neutrons and photons.

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

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

21 **MR. MACIEVIC:** We looked, the 186 paired
22 dosimeter readings that the numbers were
23 based, obviously based on genuine numbers.
24 There was another that came up with the
25 original ratio of the .73. We also looked at

1 later, in 2000, at a little larger group of
2 247 paired readings and came up with a
3 standard deviation, a geometric mean, .7, and
4 a 95th percentile of 2.1, which is very close
5 to what's the numbers that we came up with.

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

15 And what you get is on all the, at the
16 95th percentile, all of the neutron calculated
17 neutron doses are higher than the measured
18 field measurements. So they're all higher.
19 And there's only two claimants where, if you
20 use the geometric mean, where the measured
21 neutron dose is greater than the calculated
22 neutron dose.

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

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

11 **DR. MAURO:** That's post-1972?

12 **MR. MACIEVIC:** Right, post-1972.

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

25 So ours, the study they did was a

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

12 **DR. BEHLING:** How were those values
13 determined?

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

16 **DR. BEHLING:** Especially in the '40s and
17 '50s that you just cited.

18 **MR. MACIEVIC:** Yeah, the report is U.S.
19 Atomic Energy Commission. It's a letter,
20 Attention: Mr. O.J. Elgert, October 20th,
21 1972, and it is a discussion of what they did.
22 And this one doesn't, unfortunately, have a
23 title to it. But what they used in the study
24 was the neutron doses were looked at for 26
25 long-time plutonium workers were reviewed and

1 the methodology that they used to determine
2 what the neutron dose was during that period,
3 so --

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

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

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

22 **MR. NELSON:** What years?

23 **MR. MACIEVIC:** This is 1972.

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

25 **MR. MACIEVIC:** The date of the report for,

1 what the report summarizes is that for the
2 previous years they felt like --

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

5 **MR. MACIEVIC:** I'm sorry?

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

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

19 **MR. NELSON:** Basically what they did is they
20 looked back, and they said based on the type
21 of shielding that was used and the type of
22 activities that were performed in the earlier
23 years, they actually applied different
24 reduction factors. And let me read what they
25 are. It says, from 1960, approximately one-

1 third reduction in the neutron to photon ratio
2 is assumed for the period of '50 to '60 when
3 only lighter shielding was used. Lighter
4 shielding did not attenuate x-ray radiation,
5 in particular, or gamma radiation as compared
6 to the shielding in place after 1960.

7 Then they assumed another ten percent
8 reduction in the neutron to photon ratio from
9 1948 through 1955 when there was essentially
10 no other shielding like Hans mentioned in
11 those glove boxes when they were passing
12 material through when there was only plastic
13 windows, for instance. So the results of the
14 1972 study said these numbers are bounding,
15 and they provided, as Greg mentioned, some
16 upper boundary values of NP ratios based on
17 those reductions based on information they had
18 in that study. And all the numbers that they
19 use are actually lower than the ratios that we
20 present in the TBD.

21 **DR. BEHLING:** Let me ask you a question
22 regarding the issue of shielding. Obviously,
23 I would assume that the dominant gamma
24 component would be the 60 keV americium-241
25 component. Is that correct? Which is not a

1 very penetrating photon either. So I would
2 have to look at, for instance, the material in
3 question and see what the impact is for
4 reducing the neutron component but which
5 significantly also impacts the 60 keV photon
6 because that has a very, very limited
7 penetrating power, too.

8 **DR. NETON:** I think that some significant
9 shielding though at 60 keV is not the dominant
10 emission at that point. Some of the lesser
11 plutonium energies come through. You know,
12 plutonium does have higher energy than photons
13 --

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

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

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

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

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

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

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

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

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

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

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

23 So they did this and their conclusion
24 is that they weren't, they did not modify
25 their conclusions and the report was not to

1 modify any of the years for the exposure, on
2 the exposure record. And in 1972 only to
3 modify those where they had the specific
4 information about the jobs that would require
5 them to change any doses. So, and that's all
6 in several of these, I'd have to give you the
7 official title of the report, but it's Atomic
8 Energy Commission report that was issued, I'll
9 have to find that.

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

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

23 **MR. NELSON:** The results of the AEC studies
24 suggest, it actually applies neutron to photon
25 ratios as looking back at them, and the

1 numbers actually, the neutron to photon ratios
2 are lower in those earlier years based on the
3 type of shielding. So they actually looked at
4 the type of shielding and the controls in
5 place and the type of work that was being
6 done.

7 And they came up with the conclusion,
8 using NP ratios, and they were indeed less for
9 each of those years, one-third reduction from
10 '56 to '60 and a ten percent reduction from
11 '48 to '55 based on the type of shielding that
12 was in place at those facilities.

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

15 **MR. NELSON:** Those are just, I'm just giving
16 you the results of the study, and I'm not sure
17 of that.

18 **DR. MAURO:** What were the ratios?

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

22 **MR. MACIEVIC:** They're fairly close.

23 **MR. NELSON:** He's reading that straight from
24 the report.

25 **DR. ZIEMER:** Are these going to be made

1 available to everybody?

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

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

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

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

18 **DR. WADE:** And I'd point out to all that
19 sometimes documents are shared within the
20 working group, Board members, SC&A. We need
21 to always be cautious of Privacy Act material
22 in those documents. The documents should be
23 clearly identified as to whether or not they
24 could contain such material, but I caution
25 everyone just be careful, particularly when

1 we're working very quickly in real time,
2 mistakes can be made.

3 **DR. ZIEMER:** These are DOE or AEC?

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

6 **DR. ZIEMER:** I assume none of this is
7 classified.

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

19 But everything in the O drive should
20 be considered to be part of the system of
21 records that has, may have Privacy Act
22 information in it. And we're not redacting
23 any of that. We're holding that in that O
24 drive so that everybody can see it. So if you
25 pull out of that well, you need to make sure

1 your Privacy Act controls have been applied.

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

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

21 They're very close to a factor of two.
22 They're well higher than a factor of two,
23 higher than the geometric mean. So it's
24 showing that if we use that data right there,
25 it's an overestimate for those. If we were to

1 take that same data and apply it and try to
2 determine what neutrons were, using that post-
3 '72 data with the old ratio we're using, it's
4 way high. Does that make sense?

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

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

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

22 **DR. MAURO:** So this would make for a, I
23 guess just to sort of speculate, a pretty good
24 coworker model for post-1972. That's what I'm
25 hearing, but not necessarily for pre-'72 until

1 we take a look at these other records to see
2 how well it also bounds pre-'72.

3 **MR. NELSON:** The one conclusion that the
4 report makes though is that there was a
5 reduction in the neutron to photon ratio, and
6 they understood all the shielding that was in
7 place and the controls that were in place for
8 the years prior to '72. It's in that report,
9 the 1972 AEC report.

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

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

20 But if you look, go through those
21 numbers, you find for that dataset of 20
22 employees -- in fact, it's not quite 20
23 because they're skipping numbers there, number
24 two through 20 and so there's 17 of them --
25 but if you look at those, you'll find

1 consistent neutron/photon ratios in excess of
2 one. Again, the letter is incomplete because
3 it doesn't really give you a full
4 understanding of how these numbers came to be
5 and what was the technical basis. But
6 clearly, there are numbers here that would
7 suggest a neutron/photon ratio in excess of
8 one for a good number of the people.

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

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

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

22 **DR. BEHLING:** Neutrons.

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

24 **DR. BEHLING:** Fifty-one of gamma.

25 **DR. ZIEMER:** -- of gamma. Isn't that what

1 they're saying?

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

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

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

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

14 **MR. NELSON:** Right.

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

18 **SODIUM 24**

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

21 Bob, are you still on the line?

22 **MR. ALVAREZ (by Telephone):** I am.

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

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

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

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

11 "Fourteen of the 59 were assigned to
12 the reactor areas furthest upstream. We take
13 this to mean the B Reactor. Therefore, were
14 not regularly exposed to drink the water
15 supplies which have been used as reactor
16 coolant." The next sentence says, "excluding
17 these subjects." In other words they excluded
18 them from the study, and our understanding is
19 why they excluded them from the study is
20 because they weren't exposed to the drinking
21 water.

22 And it says Sodium-24 instances then
23 jumped from 31 to 40 percent when you excluded
24 those individuals from the study. We actually
25 talked to some of the people that were

1 involved who were the authors of this
2 document, and he said that the understanding
3 was always that it was from the reactor water,
4 and so that was our take on the report. We
5 didn't get the same thoughts when we read that
6 document that you did.

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

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

25 **MR. NELSON:** Well, I think you're going back

1 to the previous issue where we looked at
2 single-pass reactors. And to try to add more
3 credibility to the neutron to photon ratios,
4 we are digging into some of the historical
5 documents such as radiation surveys and all
6 that. This particular paper didn't drive that
7 to happen though.

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

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

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

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

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

25 **MR. NELSON:** So we are looking over all that

1 different chaining. We're going to look
2 further and, as cautioned earlier, there's a,
3 we didn't throw the number out but --

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

7 **DR. GLOVER:** Just over 35 million documents.

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

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

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

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

1 would use.

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

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

19 **MR. ALVAREZ (by Telephone):** As I asked
20 before in the previous conference call, the
21 dose reconstructions that were being done for
22 claimants were based on the assumption of
23 inhalation and ingestion. And the question I
24 posed is what was the data that you had to
25 support that assumption. And are you saying

1 now you have data? Because at the time I
2 could not get an answer about what data did
3 exist. And are you saying now you actually
4 have data that positively affirms that Sodium-
5 24 levels, especially in let's say upstream
6 workers, B Reactor, whatever, were due to
7 ingestion of river water?

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

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

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

25 **MR. NELSON:** There was also a statement made

1 that the B Reactors --

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

9 **DR. NETON:** I think there was --

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

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

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

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

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

5 **WRAP-UP**

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

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

10 **DR. MELIUS:** Yeah, the other issues.

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

1 annotations made. So they're held up in ORAU
2 at that point.

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

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

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

22 **MR. ALVAREZ (by Telephone):** May I suggest
23 relative to the environmental dose issue is
24 that the times that I've been involved in the
25 discussions about that, the persons who were

1 knowledgeable about that weren't present, and
2 I feel like we've deferred discussion on the
3 environmental dose issue. So I'd like to see
4 if we can also spend some time to discuss that
5 at some future date.

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

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

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

25 Okay, any other comments, questions?

1 (no response)

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

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

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

8 **DR. ZIEMER:** -- okay.

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

13 **DR. WADE:** April 5th.

14 **DR. MELIUS:** April 5th.

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

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

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

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

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

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

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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.

STEVEN RAY GREEN, CCR**CERTIFIED MERIT COURT REPORTER****CERTIFICATE NUMBER: A-2102**