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

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ADVISORY BOARD ON RADIATION AND WORKER HEALTH

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SAVANNAH RIVER SITE (SRS) WORK GROUP

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WEDNESDAY
FEBRUARY 5, 2014

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The Work Group convened in the Montreal Room of the Cincinnati Airport Marriott, 2395 Progress Drive, Hebron, Kentucky, at 9:00 a.m., Mark Griffon, Chairman, presiding.

PRESENT:

MARK GRIFFON, Chairman*
BRADLEY P. CLAWSON, Member
JAMES E. LOCKEY, Member
PHILLIP SCHOFIELD, Member*

ALSO PRESENT:

TED KATZ, Designated Federal Official
DAVID ANDERSON*
MATT ARNO, ORAU Team*
BOB BARTON, SC&A*
EULA BINGHAM*
ELIZABETH BRACKETT, ORAU Team*
HARRY CHMELYNSKI, SC&A*
JOE FITZGERALD, SC&A
DeKEELY HARTSFIELD, HHS*
MIKE MAHATHY, ORAU Team
ARJUN MAKHIJANI, SC&A*
JIM NETON, DCAS
TRISH QUINN*
JOHN STIVER, SC&A*
TIM TAULBEE, DCAS
BOB WARREN*

*Participating via telephone

AGENDA ITEM PAGE

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

(10:03 a.m.)

MR. KATZ: Let's get started. It's time now. This is the Advisory Board on Radiation and Worker Health, the Savannah River Site Work Group. And let's go right to roll-call. For all agency-related personnel on the call, please speak to conflict of interest as well. Should we run through it? So let's just start with the Board Members.

(Roll call.)

MR. KATZ: Okay then. That covers attendance. The presentations -- well, the materials, the background materials, that are being discussed should be posted on the NIOSH website under today's meetings under the Board section for today. There are presentations there on the Live Meeting page that I believe was distributed to the petitioners. I have also sent to the petitioners the copies of the presentations being made today by email because I wasn't sure that they would have that live connection, Live Meeting connection.

And, Mark, it's your meeting.

CHAIRMAN GRIFFON: Okay. Ted, thank you. And since I had to join by phone, I also asked as we move ahead in the meeting, if Brad can help facilitate the meeting since sometimes it is difficult to do this from the phone.

But I think everyone has the agenda. I just wanted to check the order. I think we should get right into the couple of main items of the neptunium and thorium. And I think we're going to start with NIOSH's presentation and then sort of the White Paper responses to SC&A's finding or comments on those. So I think that is how we are going to proceed is the neptunium/thorium issues first and then matrix issues. And then I think we will, oh, yes, the last item talks about the completeness of subcontractor bioassay records. So, with that, I guess I can turn it over to NIOSH to start off with the neptunium issue. Is that correct, Tim?

DR. TAULBEE: Sure.

CHAIRMAN GRIFFON: Okay.

DR. TAULBEE: Sounds good. Okay. Thanks, everybody.

This first presentation is going to be kind of focusing on the radiological monitoring for neptunium in Savannah River. So I am going to start out with a little bit of the process of how neptunium was -- how it was used in Savannah River. And then I am going to get more into the radiological monitoring.

So this is kind of an overview of my presentation. The neptunium process is the radiological controls at Savannah River, specifically the special hazards bulletins in DPSOP-40, personal monitoring for neptunium, the bioassay, whole body counting, and then the coworker model that we developed -- well, actually, my team, being led by Mike Mahathy and Matt Arno and Liz Brackett. They're the ones who actually did the lion's share of this work on the coworker model and, actually, on the neptunium work. So I'd like to thank them, first of all, for their support in this. I couldn't have done it, couldn't do this presentation without them

And then the comparison of the coworker models for neptunium that we did.

So neptunium processes at Savannah River. The overall goal is the protection of plutonium-238. They produce plutonium-238 through an in-gamma reaction, where a neutron is absorbed by neptunium, emits a gamma ray, and becomes neptunium-238. Neptunium-238 then beta decays to plutonium-238.

The production of plutonium-238 using neptunium started back in 1961. The production ended in July of 1984. Now, that doesn't mean that all of the documentation and data that we have for neptunium ended in 1984 because it certainly continued on. There was still some processing that you'll see a recovery of neptunium, not processing, just recovery of it, that we'll talk about a little bit. But the main processes involving neptunium were the manufacture of the targets, the irradiation of the targets and the reactors, and the chemical separation of plutonium-238 from the neptunium.

So this is a flow diagram of the materials flowing at Savannah River. And it's very busy, but I am going to walk you through this kind of step by step a little bit of where the neptunium comes from, how it is produced, and then how it is handled and how plutonium is produced.

So you can actually trace the beginning of the neptunium going back to enriched uranium that is coming from Y-12 to the 321 building. At the end of this red bar that you see is a block representing the 300 area at Savannah River.

The uranium was extruded in the 321 extrusion press and made into tubes. These would be the Mark 16 and Mark 22 fuel tubes that are sent to the reactors: to the assembly area first, where they are staged; then into the reactors; then into the disassembly area, after they are irradiated.

After they are irradiated, they actually contain both neptunium or uranium-235 and neptunium-237. This is through successive neutron captures of U-235 capturing a neutron, becoming U-236; U-236 capturing a neutron, becoming neptunium-237 -- actually uranium-237 and then decaying.

So this is the introduction of neptunium back in 1961 time frame. Neptunium is -- then these irradiated fuel elements are dissolved in the HM process of the H Area Canyon. You can see the HM process there in 221 building. And coming out of the canyon side is neptunium nitrate. And that is sent to the HB-Line, which is in the top levels of the H Canyon.

The neptunium is then converted to neptunium oxide, from nitrate to oxide, in the HB-Line and sent over to 235F. This is the billet fabrication lab. From 235F, the billets are assembled. And then they are sent back up to 321M, that same extrusion press, where the billets are extruded into tubes vis-a-vis the Mark 53 targets that are then sent to the reactors, to the assembly area, where they are staged before putting into the reactor. After they come out of the reactor, they are in the disassembly basin and where they're separated.

Now, instead of following that previous path, going over to the HM process, this is where you have a neptunium target that has a lot of plutonium-238 in it. This went to the end of the canyon, what is called the frames. This was an additional module that DuPont put into the canyons in order to separate out plutonium-238 from the neptunium targets.

Next from the frames, they actually cycle through the frames. So in the reports that we see, we see a first cycle stage of how much plutonium they were able to extract and then a second cycle and how much plutonium came off of there.

They did this a couple of times. And then once they extracted the maximum amount of plutonium that they could, then they sent the plutonium to the HB-Line, but they also sent the neptunium nitrate to the HB-Line. So the neptunium nitrate coming from the frames is blended with the neptunium nitrate from the HM process, sent over or converted to oxide, sent over to the 235F. And the whole cycle starts again.

For completeness, there is one other area where neptunium comes in from. This would be from depleted uranium targets.

MR. KATZ: I'm sorry. I should have reminded everyone on the line. Can you mute your phones, everyone listening? So if you don't have a mute button, press *6 to mute your phone. And then to take it off of mute, you just press *6 again. Thanks.

DR. TAULBEE: So the processes I just described to you make up about 97 percent of the neptunium nitrate being handled at the Savannah River site. The other three percent is actually coming off from the depleted uranium plutonium-239 series, going over to the F Area Canyon and from the PUREX process. You can see that coming into the 221F Canyon. And then the neptunium nitrate is being sent over to the HB-Line again.

So this is the basic process that is going on at the Savannah River.

MR. KATZ: I'm sorry, Tim. Sorry. There's someone on the line who has an open line. Can you mute your phone? Press *6 to mute your phone, whoever. You have background noise, someone talking in your office. Thank you.

DR. TAULBEE: So going on to the next slide here, what I want to focus on here is the three main areas where this neptunium is being handled: the HB-Line. And this mission, the mission of the HB-Line, was to convert from neptunium nitrate to neptunium oxide, which also kind of --

MR. KATZ: Okay. Mark, can you hear everyone?

CHAIRMAN GRIFFON: Yes, I can.

MR. KATZ: So it's on their end.

CHAIRMAN GRIFFON: I hear the background comments, too, yes.

MR. KATZ: Yes. Thanks. --Okay.

DR. TAULBEE: So this HB-Line was actually toured by the Advisory Board back in 2010, when we went there on site. As I mentioned, the two main sources, 97 percent are coming from the HM process of enriched uranium and then from the frames of dissolving these Mark 53 targets. Generally, about three to four kilograms per month are coming from the HM process. And I am going to say that this material has a low plutonium contamination. And I'll explain why that is important in a minute.

From the frames dissolving the Mark 53 targets, you get about 8 to 10 kilograms per month, or about 74 percent of the total. And this has significant plutonium contamination in it because this is where they're making the plutonium-238.

So how much contamination is coming from the frames? This particular chart here is showing the -- I'm sorry. Yes. Okay. This is actually the plutonium contamination not coming from the frames. This is coming from the HB-Line 235F. So I apologize. The title of this is wrong. Anyway, what I want to get to here is the average plutonium weight percent. And this was done on a per-month basis. They would tabulate the minimum, the average, the maximum. And you're looking at a weight percent of .16 for January of 1974 down to .03 for April of 1974, which are very small quantities because you are looking at -- you know, in the first case, you are looking at 99.84 percent pure neptunium. And in the bottom, you are looking at 99.97 percent pure neptunium.

Plutonium contamination is important because of the specific activity. Plutonium-238 has a specific activity of 17.1 curies per gram. Neptunium is .00069 curies per gram. So, even when you have 99.95 percent pure neptunium and only .05 percent plutonium, the plutonium alpha dominates the exposure scenario here. You have about 12 plutonium alphas to every one neptunium. So from a dose standpoint, plutonium is the main hazard here. It's not until you get to really what I will call ultra-pure neptunium that the neptunium begins to dominate the exposure. They're at about equal radioactivity if you're at alpha emissions when you get to 99.995 percent pure.

So the reason that I am pointing this out is that Savannah River was controlling a lot based upon plutonium bioassay during the 1970s time period. So let me talk here briefly of why they were controlling for plutonium.

If you look at 235F building, the next slide that I have here, you will see that the green box is the neptunium facility. The red boxes here are the plutonium facilities within the building. You are looking at the plutonium fuel fabrication facility. Those are blocks 8 and 9 there in the red. And then box 11 is the plutonium experimental facility.

The yellow box 14 down here is the men's change room. Box 18 is the women's change room. And so within this building, you have one room. Actually, it's two rooms there. They are subdivided. It is not well shown on this particular diagram, but you have one area of neptunium exposure. And you've got three main areas of plutonium exposure within this building.

This is a picture of the actual glove box line, the neptunium glove box line. Just for your general frame of reference, these are workers within the glove box. One of the things I would like to point out is that you will see that they are wearing white regulated clothing to work in this particular room, what I am presuming are supervisors that are wearing smocks and shoe covers. The technicians are all wearing the white regulated clothing. They are also wearing neutron dosimeters. Those are the belly button dosimeters that you see down here in the lower corner there because there is a significant gamma and neutron dose rate coming from this neptunium that's inside the glove boxes.

This is the back side of the glove box line. On the front side is where the operations are primarily going on. But at the end, when they take the billets out of the line, and as you can see them being staged there on the floor, there is some work that is done on the back side. We have some documents that we have seen that are talking about one to two hours per week of work on the back side of the line versus the remainder, 35 or so hours, on the front side.

Some of the general observations from that photo is that this is a relatively small glove box line. We are looking at tens of workers, not hundreds, which --

MR. KATZ: Hold on. This must be

--

CHAIRMAN GRIFFON: Okay. You're getting feedback.

MR. KATZ: A lot of feedback. So somebody has not muted their phone. *6, please. Everyone on this phone should mute their phone. Please press *6. Let's see. Is that better? Yes. The echo is gone. Okay.

Carry on. Thanks.

DR. TAULBEE: Okay. As you'll see, this was a relatively small glove box line. You are looking at tens of workers, not hundreds. This is part of why we don't see hundreds of bioassay samples for neptunium at the Savannah River site.

This is a regulated radiation area. As I mentioned, the supervisors are wearing the white lab coats with shoe covers. Operators are wearing regulated clothing, neutron dosimeters. Along the glove box line, it is hard to tell from the previous picture, but there are shadow shields due to the high gamma dose rate that I will talk about. And then, as you saw in the picture, the billets are bagged for transfer to the 321M building for further testing and evaluation and then ultimately extrusion.

Here are some of the controls from 235F. As I mentioned, the billets are surveyed. These are high gamma dose rates. If you look at some of these dose rate levels at three inches or eight centimeters, you are looking at, some of them, up to an r per hour, or a rem per hour, type of dose rate. Neutrons are significant. These are ten millirem per hour. This is the reason for those neutron dosimeters, fixed alpha contamination on these billets coming out. But they are monitoring for both the gamma, the neutron, and the alpha contamination coming off of these billets. The remarks off to the side show that most of these billets in this particular section that I grabbed here are going to storage.

What I want to contrast these dose rates with is at the same time, in that same glove box line, they were occasionally making plutonium billets as well. These were also surveyed before they were transferred to 321M. But you'll notice they have a much lower gamma dose rate but a much higher neutron dose rate. So, from looking at just the gamma dose rates, you can figure out whether the billet in particular question was a plutonium one or a neptunium one.

Some of the other controls that are in 235F. You've got the engineered controls, which are the glove boxes. We've got workplace radiation monitoring. These are daily control surveys. And these are things where they check the high-volume CAM samplers. They change the air filters. They look at the manipulator collars in the

PuFF control room. The step-off pads -- that's SOP -- to clean areas, those are checked.

Leaving each of these regulated rooms into the regulated corridors, you are required to monitor your hands and feet. Those are posted on the doors that we see there from those pictures. And so in that area, there's a step-off pad, going from the regulated corridors into the clean areas. Those were being checked for contamination.

You've got floors in the process rooms that are being checked. You've got the gloves that are being checked and then disc smears of the bioassay stations. So these are daily checks that are going on within this facility, mostly because this is a high-risk facility in a sense. You've got a lot of plutonium operations. You've got neptunium operations. You've got high gamma dose rates going on. So there's a significant Health Physics presence here.

We have some routine air monitoring going on. Room 107 here is the neptunium room. 107A is the process side. 107D is that maintenance side that I showed you pictures of. If you look, they're monitoring for beta gamma or fission products, as they labeled there. The alpha is being controlled to .2 times 10 to the minus 12 microcuries per cc.

So that is actually the modern-day DAC level. Typically, nowadays, we control rooms in modern era to a tenth of a DAC, but this is back in 1967. They're controlling this to a DAC level. So the arrows that you see going through, those are representing weeklong samples; whereas, the others are daily samples. So this is all in the air-monitoring records.

For personal monitoring, to work in these areas, you had to wear a dosimeter. This is due to that high gamma dose rate. And it was significant when we look at some of those readings that we're getting off of there. Workers that we have interviewed have also confirmed this because they were swapped out. They would get burned out after several months of working in this area. And so a new crew would be coming in or if one person was the one being burned out, he would be rotated out. And they would go work in other areas where they weren't getting such a high gamma dose rate, high gamma and neutron dose rate. And that makes sense from what is going on here, which also plays into why we don't just see a very small grouping of neptunium bioassay for the workforce, but in the 1970s, we see a little bit larger than what would fit into that room. And I'll get to that data here in a minute.

From a bioassay standpoint, if you look at DPSOL 193-302 from 1978, workers in 235F were under bioassay categories C and W. C meant two plutonium samples per year.

W meant one neptunium sample per year.

Switching now from 235F, going to 321M, billet extrusion, that particular process involved the receipt of the billets that had been bagged. They surveyed the billets. They helium leak-checked them. They outgassed them, preheated them, extruded them into a long tube. And then the tubes are surveyed for shipment to the reactors.

Well, how do we know these were surveyed? We've got the survey records here that we've looked at examples of. In this particular case, we've got four neptunium billets from 235F reading 700 millirem per hour at 3 inches. This confirms with the previous log that you saw of the surveys in 235F about these billets.

Reading on down, less than ten dpm alpha, less than ten counts per minute beta gamma smearable on the billets. One of the billets, number three, was probed at the end of it. And it's 1,500 dpm alpha but less than 10 dpm alpha smearable. So this is at 1,500 dpm alpha fixed, alpha contamination. So this is a smear that's been taken in 321 building upon receipt.

Here is the extrusion press and the operator that you'll see. You'll notice that he is wearing brown clothing, not white. That's because this particular picture is of a composite billet of uranium aluminum being extruded, not neptunium in this particular case. And they did the separation of the brown clothing for uranium and the white clothing for plutonium and fission products, mostly for the laundry purposes, to keep the laundry separated so that they weren't laundering uranium-contaminated clothing with plutonium-contaminated clothing.

This is the extrusion press. This would be a billet going in. The flames are due to the lubricant being ignited.

This is an encapsulated billet going in. And you've got an encapsulated fuel tube that's emerging from the die.

These fuel tubes are then surveyed. This is an example of where the surveyor surveyed 12 neptunium tubes being shipped to 105P reactor, less than 10 dpm alpha, less than 10 counts per minute beta gamma on exterior surfaces.

Next slide. So let me talk a little bit about the radiological controls and methods that they were using from 1972 to 1990. Since 1956, Savannah River had these Special Hazards Bulletins and DPSOP-40. This was what governed their radiological monitoring practices. And this covered work in regulated areas, investigating radiological contamination incidents, protective clothing, injury in regulated areas, disposal of contaminated waste, fires in regulated areas, and radiological exposure control.

Now, on this slide, I plan on talking about four of these. And that is the work in the first three and then the seventh one: radiation exposure control.

So let's look at work in regulated areas. There are three basic parts to this bulletin: definitions, basic procedure, and responsibilities. And I want to look at each of these individually.

By the way, let me back up one slide here. Back to the other one, you'll notice the date. It's hard to read in the upper right corner. But this would be -- I believe that's six, right? Yes. June of 1971. So this is in the area of time period that we are interested in from the 1970s, 1972 forward.

So in this time period, they had definitions for their clean zones, for the regulated zones, for the radiation danger zones. And it all had to do with contamination control levels. The clean zone was where no radioactive materials are handled, where the radiation contamination levels are equivalent to natural background. And they had their regulated zones, which they defined here as where the radiation level doesn't exceed 300 millirads or 50 millirems per hour and the contamination is below acceptable levels as specified by Health Physics supervision. That's where that ten dpm that you're looking at on some of these surveys. In the other areas, it will be 20 dpm.

You've got special work permits. These are written instructions for work and regulated and radiation danger zones, includes instructions for control, radiation, and contamination exposure to personnel, job plans, a detailed step-wise instruction. Written before the job is performed, it describes work to be done and specifies radiation contamination controls and safety requirements. Job plans for work and regulated and radiation danger zones must be approved by Health Physics supervision.

And the basic procedure here, you go through. We've got the same thing as the radiation danger zones. You can use operating procedures or job plans or special work permits within those particular areas. This all kind of predates what we refer to now as radiation work permits. They were using in place of that their operating procedures, special work permits, and job plans.

For work in the regulated or radiation danger zones, what I want to highlight here is partway down in that first paragraph where the Department's supervision controls access to the regulated and radiation danger zones by locking entrance doors or posting appropriate signs and barricading the zones with yellow/magenta tape, rope, and chain.

So these are areas. These regulated zones aren't ones that you would just be wandering into. This was confirmed during our interviews with workers back in August of this year when we asked specifically about the controls in 235F, for example, where you couldn't just wander in. And in this case, that building, you had to go through the change rooms to get to these zones.

The other point I want to bring out here is the reviews of the job plans on specific monitoring requirements and Health Physics. They were one of their responsibilities, to review the job plans or special work permit, and specify monitoring requirements and add additional precautions and protective clothing and equipment.

So I just want to briefly mention here the protective clothing. I mentioned the white and the brown. And you can see the definition there in the lower corner:

whites to be worn in locations that may be contaminated by plutonium, fission products, or other artificial radionuclides. Neptunium would fall into that. Brown is to be worn in locations that may be contaminated by uranium. This is 1972. At this time period, there really weren't any areas of thorium exposure, but in the earlier versions of this one, you'll see where that says uranium and thorium.

Next I want to talk a little bit about DPSOP-40, the control guides. This leads into what the limits were for this time period. And this is June of 1971. And for external radiation, they said to look at Special Hazards Bulletin number 7, which I'll get to next. For internal radiation, they used the tech standard. It was DPSTS-RH-0-07. That was the controls for internal radiation.

What you see listed below here is also the airborne radioactive concentrations. This conforms with those air-monitoring data that I was showing you earlier, where for the plutonium, you are looking at 2 times 10 to the minus 12. Neptunium actually had a higher DAC value for -- or I'm calling it DAC. It's not a DAC. This was a concentration level that they were controlling to. They were controlling to 4 times 10 to the minus 12. That's significantly higher than what we would have for our current neptunium DAC values, but, nonetheless, for each of the radionuclides that they were dealing with, they had airborne control levels that they were using.

So let's look at the external first. This is Special Hazards Bulletin number 7. And I knew you can't read the one on the left. So I blew up the parts that I wanted to focus on. The section 103 is the plant radiation control guides, where it's 3 rem per quarter or 3 rem per year. They had a maximum three rem. But they would allow them to get that entire three rem in the quarter. So this is where the workers are talking about they are being rotated out. They bumped up against three rem. They were moved out for the rest of the year. And this is again -- this was 1975 time frame.

If you departed from these guides, you had to have approval. Savannah River plant personnel had to have the Department's superintendent approval and Health Physics Section supervisor approval. Savannah River Laboratory required the research manager of the division involved and the Radiological Science Division research manager. That's the Health Physics equivalent for SRL-773A. And for Savannah River construction, you had to get the field project manager approval to exceed these limits.

So now let's look at the internal monitoring. This is DPSTS-RH-0.07. And the part I want to highlight here is down here at the bottom. And it has to do with the monitoring of personnel. And all personnel entering areas in which they will receive a sustained radiation exposure rate of greater than one millirem per hour or intermittent exposures that will accumulate to greater than 25 millirem in one week shall be required to wear either a film badge or a thermoluminescent dosimeter somewhere between the waist and the neckline. And that will become important here in a minute.

Number 6 is where we get to the internal contamination. Personnel who can be exposed to internal contamination by radioactive materials other than normal background in the normal course of their work shall submit voidings to be analyzed for suspected contaminants. The frequency of submission of voidings shall be established by the Health Physics Division, taking into account such factors as the likelihood of exposure, the sensitivity of the detection method, and the maximum permissible volume burdens listed by the AEC, NCRP, and ICRP.

So Health Physics wasn't establishing bioassay, just kind of at random. They were looking at what was the potential for exposure, what was the sensitivity of the detection method, and what was the permissible body burden. And this is August of 1969.

So let's look at some of the bioassay control. This is the actual procedure. I have highlighted the first one. This would be category G. This would be people working in the 221H B-Line, 221F B Line, JB-Line 235F. And, to read that, it says, "All personnel assigned to process section in building 235F and all assigned personnel to other facilities." They required two plutonium bioassay per year, one fission product, and one whole body count. This particular procedure is 1971.

If you look down at the bottom, the note there is saying, "Neptunium analysis is performed when required by area Health Physics." Neptunium has never been detected without at least an equal amount of plutonium. This is the plutonium contamination I was talking about earlier, where it's the dominant hazard. They were seeing it from their 10 and 11 years of experience. They were always seeing whenever there was an exposure that there is at least an equal amount of plutonium. So in 1971, they weren't monitoring for neptunium, as I'll point out here in a minute. They were monitoring for the plutonium. If the plutonium came up positive in a neptunium area, then they looked for the neptunium.

You will see 321M. You've got plutonium, one per year; four enriched uranium. And then they've got also whole body counts for enriched uranium.

Back up. If you look at the top, it says, "Routine bioassay sampling infrequencies, excluding Construction Division." This is for the normal, routine DuPont and Savannah River Laboratory folks. This is on page 2, page 3 of this particular procedure, "Bioassay Sampling Frequencies for the Construction Division."

MR. FITZGERALD: Now, this would be, just for clarification's sake, the DuPont Construction Division?

DR. TAULBEE: This would be all of the Construction Division that was --

MR. FITZGERALD: Maybe I should recast that. In the early days, it would have been all DuPont --

DR. TAULBEE: Exactly.

MR. FITZGERALD: -- Construction Division, but over time into the later '80s --

DR. TAULBEE: Into late year '80s

--

MR. FITZGERALD: You started getting --

DR. TAULBEE: -- began to separate.

MR. FITZGERALD: You started separating, getting --

DR. TAULBEE: With the subcontractors.

MR. FITZGERALD: -- non-neutron personnel as part of that?

DR. TAULBEE: That is correct. This --

MR. FITZGERALD: But this would apply.

DR. TAULBEE: This would apply to --

MR. FITZGERALD: This is? What year is this?

DR. TAULBEE: This is 1971.

MR. FITZGERALD: Okay. At that time --

DR. TAULBEE: Yes.

MR. FITZGERALD: -- not for all?

DR. TAULBEE: Right. But you still have done electric and the --

MR. FITZGERALD: That was --

DR. TAULBEE: -- Shaw folks, but they were actually considered based upon our interview with [identifying information redacted], --

MR. FITZGERALD: Right.

DR. TAULBEE: -- that they were at that time considered DuPont.

MR. FITZGERALD: So you had this evolution where it got more heterogeneous as time went on?

DR. TAULBEE: That is correct. That is correct. So this would be from this time period, the Construction Division was required to leave one plutonium sample every three years and when terminated. Other radionuclides are specified by Health Physics in construction job plans. This is why I took that time earlier to go through who was reviewing the job plans, who was approving them. Health Physics was approving them. Here is where it would be specified if they were working in the neptunium area or some other area what their bioassay would be.

If you look down at the bottom here, whole body and chest counting, new employees who worked in radiation zones at other installations where radioactive materials are handled were required to take a whole body count and a chest count. This count is preferably made on the same day as their entry physical examination. Whole body counts and chest counts shall be made whenever an employee bioassay sample except tritium indicated yet a confirmed uptake or when he has been involved in a contamination incident and a count is considered necessary by Health Physics supervision. This is why we get whole body counts for Construction

Division employees. We see them. A) they either came from another facility and they were monitored them or they were involved in a contamination incident and they were monitored then. And then a count is required when terminating for those employees who had a previous count at the Savannah River site. Again, this is 1971.

Now, that was Rev 5 of this procedure. The next one that we have a complete copy of is Rev 8. Revs 6 and 7 we've been having difficulty getting a copy of, although we have got one of a different procedure in 1973 and we've got one that's labeled Rev 7. But it's not the complete procedure. It's just that one table page. It doesn't have these other details.

What you'll see here, this is actually 193-302T, which is February of 1985, but this is a duplicate of the Rev 8, which was approved in January of '78. So this would be January 1978.

They changed their formatting, but you still have the same general thing here. You have 235F, personnel assigned to the process areas. This is that CW category. And the categories are on the next page that I'll go to here in a minute. HB-Line, you have D category. So we've got CWD that we need to pay attention to. And then 321M, we have all personnel assigned to charge prep casting, machining areas, B and H, and then all other personnel B and G. So we're looking at B, C, D, and W as the ones that I want to focus on.

So you'll see plutonium code B, one per year; C, two per year. That would be your 235F people. D, this would be your HB-Line folks, where they're working with plutonium-238 and neptunium contaminated with plutonium coming off of the frames that is heavily contaminated with plutonium, four plutonium samples per year, so quarterly. So the frequency is commensurate with the exposure potential is what I'm getting at here. Neptunium, W, one per year, down there at the bottom. Okay?

This is 1978, 1985, and then 1993 or 1989. Again, that table was applying to plant workers and to Savannah River Laboratory people.

The next page is where you have the Construction Division monitoring. It didn't change much from 1971 to 1978 here: plutonium, one sample every 3 years, other radionuclides, as specified by Health Physics and construction job plans. So from 1971, at least through 1989, they were using the job plans and then the plutonium monitoring of one every three years for the Construction Division monitoring. Okay?

Bioassay control summary procedure basically prescribes the monitoring by the work area. Monitoring frequency based upon the procedures is based upon the potential for exposure. You can see that from the procedure. You're not seeing monitoring for the plutonium in the reactor areas, where everything is encapsulated. You are only seeing it in areas where there is a potential for exposure. The sampling frequency is based upon that potential; for post-1978, neptunium urine bioassay for the highest exposure potential area, 235F, where they're actually handling the neptunium oxide and putting it into the billets.

So now let me talk a little bit about radiological incidents because what I've been showing you is effectively the rosy picture of everything going right, nobody ever gets exposed. Well, that's not the case in a processing area. You're going to have radiological incidents. You're going to have accidents. Things aren't always going to go right.

But they had a procedure for handling this and for investigating this.

And I want to focus on that very first part here. It's causes for an investigation: acts or conditions which caused or could have caused radiation or contamination hazards, incidents of contamination which require costly cleanup or they concern Health Physics. Incidents that cause internal body contamination are of concern to Health Physics or Medical, exceeding criticality control limits.

The responsibilities for notification of incidents is any individual who is aware of the circumstance, like one of those in item 101, reports it promptly to his supervision and Health Physics supervision. This conforms with what we heard in the interviews back in August of this year of the safety culture. This would be back in 1972 for this particular update, where everybody had a responsibility of if something happened, they were to report it to their supervisor or to Health Physics.

From this, we basically have a series of incident reports that are available. The top tiers, the special hazards investigations, these are serious incidents that were initiated upon the request from either the Department or Health Physics. And these are where a committee was formed. When they sat down, they evaluated what happened and root causes and published a formal report. And we have all of these special hazards reports that were done. We have a copy of them in the SRDB.

There is a next tier down of reports that didn't make it up to the special hazards investigations. In other words, a committee wasn’t formed, but it was evaluated by the supervision or by Health Physics.

And these are reported by area, basically. There's a series of reactor incidents. There's a series of separations incidents, a series of fuel fabrication incidents. For separations incidents, it's typically a 272 code. So it would be DPSP-the year, say 1974-272. And then they were sequentially numbered.

And then there are summary reports that we have captured for the SRDB, where they went through all of the reports in a year, all of these incidents, and summarized how many of them were personnel contamination, how many of them were exceeding criticality controls. And so they did analysis on all of these reports. DPST were from this 700 area.

The final one is the Health Physics logbooks that would also have these reports.

Now, within the monthly technical reports, Joe, you have seen and, Brad, you have seen, where there are incidents that are outlined in those reports. It can be a combination of any one of these. We have seen where some of them are special hazards investigations, some of them are this next tier down of the Department or area incident reports. Some of them actually appear to be just Health Physics, be just in Health Physics logbooks.

So there was an incident-reporting scheme that was going on from 1972 at least forward, actually predates '72.

But I want to go through some of these incidents. Especially I've wanted to focus on neptunium, and I wanted to try and focus on construction or maintenance type of incidents that we found in the works technical reports. And Mike is the one who has done the extraction of these records from the reports that we have.

We have requested more when we were down at the site in November going through the monthly technical reports. We have requested more of these reports so that we can get a larger feel of them. But let's go through this one.

One construction worker continued installation of plutonium-neptunium partitioning equipment in the JT-3 process cabinet in room 311. This would be on the HB-Line in 1972.

Transferable contamination was measured up to 10 to the eighth dpm per square foot a lot. And gamma radiation exposure rates to 100 mR per hour were measured in the cabinet. Plastic suits were worn for personnel protection. And contamination huts were used for contamination control. Again, this is 1972.

Even with these precautions, as one employee undressed following work, he contaminated his hair to 80,000 dpm and his right cheek to 30,000 dpm. A second employee contaminated his coveralls to 40,000 dpm when a seam in his plastic suit failed. Bioassay analysis indicated that neither employee assimilated radioactive material.

Now, what I want to point out here with this particular incident is, one, the levels are extreme, I mean, from these contamination levels here, but one of the things that workers have told us, especially construction trades workers, when we have interviewed them is they talked about training and the lack of training that they had that it was OJT and they would follow whatever the guy in front of them did whenever they were putting on protective clothing and taking off protective clothing. This is a classic example of where they weren't properly trained, that they would end up contaminating themselves while taking off their equipment. So it's fully consistent with what workers have been telling us, but the incident itself was documented. This is coming out of controlled contamination hut. Health Physics is checking them. They find the contamination. And they do follow-up for bioassay.

Looking at another incident in 235F --

CHAIRMAN GRIFFON: Tim?

DR. TAULBEE: Yes, sir?

CHAIRMAN GRIFFON: This is Mark Griffon. Just one question on that. Did you, by any chance, cross check to see if the bioassay data was actually in the database?

DR. TAULBEE: From these incident reports, we don't know who the construction worker was. Okay? These are generic within the monthly reports. They just will define one construction worker.

For us to try and find this, we would have to go to effectively the January 1972 bioassay and try to identify everybody from those logbooks to try and find who this worker was and cross-check that.

CHAIRMAN GRIFFON: Okay. So you weren't able to. Okay. All right. Thanks.

DR. TAULBEE: You are correct. The answer is no, we were not able to cross check that.

Let's look at 235F. This would be November of 1974, again, in the area of interest or time period of interest. Two maintenance mechanics and a separations operator received nasal contamination to 420 dpm, 25 dpm, and 30 dpm, respectively. Due to a process cabinet glove failure while working in neptunium compact operating room, that room that I showed you earlier with those workers in it.

The maintenance mechanic with the highest nasal contamination also had contamination to 10,000 dpm on his wrist. There were five other persons in the room at the time. Their nasal smears were all negative.

Bioassay sampling for the three persons with positive nasal smears were initiated. A survey of the room identified

1 failed glove and 14 contaminated gloves. The failed glove was contaminated to 8 million dpm alpha with levels of up to 100,000 dpm on the other 14 gloves. The floor was contaminated to 100,000 dpm.

Again, what you see is a very serious contamination incident that happened from a glove failure within that room. But, again, the monitoring was there. Nasal smears were taken. Bioassay follow-up was conducted.

October 1978, same area, 235F. An operator working in the neptunium line incurred nasal contamination of 190 dpm when a cabinet glove failed. The glove was contaminated to 10,000 dpm and the floor to 2,000 dpm, or 0.1 meter2. Room airborne activity remained less than the regulatory control guide, at that point 2 times 10 to the minus 12 microcuries per cc. A follow-up chest count of the operator indicated less than minimum detectable amount in the urine samples were negative. So, again, follow-up --

DR. NETON: Tim, what would have prompted the nasal smear? Was that a routine one in the area or was it because they had identified an off-normal?

DR. TAULBEE: To be honest, I'm not sure of that. I can tell from my experience working in a plutonium facility at Mound, any time we exited the building going through the change room, we left a nasal smear. It was a question we didn't ask the workers from 235F that I wish we had, but we should be able to do follow-up and confirm given that --

DR. NETON: That certain cabinet failed. So --

DR. TAULBEE: Can we --

MEMBER CLAWSON: Jim, from my experience, something triggered that. Something went off. If you had that high of levels, something triggered and went off if

--

DR. NETON: Yes. I was just curious.

MEMBER CLAWSON: Nasal smears for us are very, very --

DR. NETON: Well, that's a --

MEMBER CLAWSON: For one thing, they don't like to do them for one thing. So something had to trigger these to get into this --

DR. TAULBEE: Well, you don't want it at a plutonium facility. I mean, I know every plutonium facility I've been in and worked in --

DR. NETON: I mean, it's something we need to probably look into.

DR. TAULBEE: We will. We will certainly look into that.

MEMBER CLAWSON: Well, one other thing, too, Tim, you have these reports, but there is a report before this that calls out -- there should be an official one that calls out the names. And that's where you could cross-check, make sure that the bioassay went that way.

DR. TAULBEE: The only ones that call out the names are the special hazards investigations. Others don't necessarily call out the names. Now, within each individual worker's file, you will see we had investigation reports. We see this in dose reconstruction. We'll see the official report that will have their name in it. What typically got forwarded up and rolled into the monthly reports don't contain their names. And that's easy for us to get to. To get to the individual reports, we would have to go through all, you know, 50-60 thousand workers from the Savannah River site and pull each of their files.

MEMBER CLAWSON: This is a scrub. This is so that they can put it out to everybody and --

DR. TAULBEE: That is correct.

MEMBER CLAWSON: And usually when they have an incident like this, like I say, it doesn't matter what level. You've got a breakdown of who was there or why. This is so that they can put it out there.

DR. TAULBEE: That is correct.

MEMBER CLAWSON: This is the monthly report.

DR. TAULBEE: You are right. There is a report. But the only way we can get to those, like I said, is in the individual dosimetry files today. And Mike has cross-checked some of these. And those that we have been able to confirm, the report is in the bioassay or in their dosimetry file that we get from the site. But we haven't been able to cross check all of these. And, again, these are neptunium ones specific that we are trying to find.

So we have gone through HB-Line incidents, 235 incidents. Let's look at a 321M incident. Alpha contamination to

200,000 dpm was detected in a 1.5-millimeter-wide and 1.5-centimeter-long crack in the cladding of an extruded neptunium tube. No transferable or airborne contamination is detected. Gamma exposure rates to 200 mR per hour measured 45 centimeters from the tube.

So on this tube that is being extruded, they were inspecting them, looking for contamination, looking for defects, looking for problems. This goes to a QC methodology that is going on there along these tubes.

Another one, 321M, transferable contamination to 3 million dpm alpha per 1,000 square centimeters was detected on the hood furnace floor, valves, and manifold fittings upon completion of a neptunium billet outgassing. This would be where the outgassing failed. No particulate airborne radioactivity was detected in the work area. This is from our interviews. If you recall, back in November, they were talking about when they did these neptunium extrusions. Health Physics was there. Air monitoring was being conducted because they were concerned about it. They didn't see anything getting airborne here. Employees wore appropriate respiratory protection. All equipment was decontaminated to less than 500 dpm alpha.

So those are a flavor of some of the incidents. There are more. We are compiling all of them that we can find from these monthly reports from the special hazards investigations and from the logbooks that we have and basically just to cross check and verify that this seemed to be well-controlled that they were monitoring for these exposures, they were looking for them, and then were reporting the incidents when they occurred.

From 1990 to 2007, a radiation work permit system was implemented in 1990.

Savannah River implemented a new radiation control manual, WSRC-5Q, in 1991. This replaced the DPSOP-40 and the special hazards bulletins that I showed you. Our interviews with workers discussed that, in their opinion, DOE took their rad control manuals and put them into a rad control manual. And basically that was one of the interesting comments that came out of that. So these early documents were the predecessor to your rad control manuals from 1992, 1994, and then from 1995 codified under 10 CFR 835.

So let's look at the neptunium monitoring data, specifically bioassay data and whole body count that we have. We have divided this into three time periods. 1961 to to 1969, urinalysis -- this would be separations, chemical separations, of the urine sample to extract the neptunium; and then a gross alpha count of your neptunium extract. 1970 to 1989, we only have limited urinalysis. So during this time period, we looked primarily at the whole body counts of workers. Post-1990 to present, there is urinalysis. In this time period, they were using alpha spec.

So, again, just to refresh your memory that DPSOL procedure 193-302, monitoring was prescribed by area. Monitoring was prescribed for construction trades workers and their job plans. It wasn't -- they weren't done necessarily by area. It depended upon what job they were doing.

So here is the neptunium-monitoring data that we do have for 1972 to 1989. This is urine bioassay. On the left column, this is the number of neptunium samples identified from the works technical reports. In these reports, every month, they would list the number of samples that they analyzed. And so from the 1972, you can see they analyzed 22 neptunium bioassays for that particular year.

From the logbooks that we have been able to collect in urine samples because some of the neptunium were actually in americium logbooks, some of them were in enriched uranium logbooks, some were in plutonium logbooks, we have been able to recover 20 of those 22 samples that they reported.

We don't have any identification from '75 to '78 as to how many samples were taken. They didn't report it in the works technical reports. They picked it up again in 1979. Now, we know in January of 1978, that they started sampling everybody in 235F, once per year, but we don't have the data or how many of those samples were actually taken. We do from '79 up through 1985. The asterisks here are we don't have December of that year. So we have like October or November. So we don't have the actual final count. We have requested these reports. That was part of why we were down there in November, was extracting this information out of the vault because these technical reports are actually still classified. So we have to extract these tables out of them.

Off to the right, you see the number of samples we have. And it's not a lot, but still in this time period, we're looking at 333 neptunium urine samples during this time period.

This is the breakdown that Mike was able to put together for me of by area where these samples come from. And so if you look at -- the totals is the easiest way to look at this particular table in my opinion of the 333 neptunium samples that we have been able to extract out of logbooks.

By the way, there are different places these bioassays are reported. One is in the logbooks, which we don't have a complete set of. The other is the individual bioassay records. This is individual personnel files. This is what we get from the Savannah River Site when we do a dose reconstruction. That is one place it is kept. The other is a bioassay, a duplicate set of those cards that's maintained by Records Department down at Savannah River Site.

So we've got these logbooks, the individuals' files, and then the separate set that, to be frank, we haven't actually located. So we rely upon the individuals' bioassay cards primarily and the logbooks to come up with this data.

What you see here from this data set is that most of the data is coming from 235F; next, the HB-Line, 50 samples over this time period; 321M, 40 samples. 773 and 772F, 49 is misleading here because 88 and 89, where they began to do some studies with immobilization of glass vitrification, which I'll talk more about during the thorium side of the discussion today. If you take those out, you will see that it's 20 less than that. So that's why I left it in that.

MR. FITZGERALD: Seven seventy-two was the lab?

DR. TAULBEE: Seven seventy-two is the process lab, --

MR. FITZGERALD: Right.

DR. TAULBEE: -- where they would take a sample of the neptunium oxide from HB-Line and analyze it by its constituents. So they break it down by how much 238, how much 239, how much plutonium-240, 241, 242, and they would do a breakdown, chemical breakdown, of the actual neptunium.

MR. FITZGERALD: Was it possible to figure out the number of workers this represents or is that difficult?

DR. TAULBEE: We could from this, sure. We didn't --

MR. FITZGERALD: I am sure there are some repeats. I was just curious as to

--

DR. TAULBEE: Yes.

MR. FITZGERALD: We know there are tens of workers, as you pointed out earlier in the --

DR. TAULBEE: Right.

MR. FITZGERALD: -- 235. When you see 36 samples, I'm wondering --

MR. MAHATHY: In '88 and '89, 235 in maintenance voted for -- we have a comment. It says only three employees were in each building.

DR. TAULBEE: Right.

MR. FITZGERALD: Yes.

DR. TAULBEE: From that time period. But you see 36 here. And keep in mind that due to that high gamma dose rate, they are rotating people in and out.

MR. FITZGERALD: Yes.

DR. TAULBEE: So, even though you probably couldn't fit ten people in that room, you might change out three different crews over that time of the year.

MR. FITZGERALD: Yes. So the operational impact is being seen here as far as the number of samples.

DR. TAULBEE: That is correct. That is correct.

So from a dose reconstruction standpoint, the neptunium dose reconstruction methods, I can actually see four different ways that we could develop a coworker model based upon the data that we have to estimate neptunium exposures from 1970 to 1989. First, we could use the limited bioassay. Based upon what we have seen, the frequency and so forth, high-risk type of areas, there's not a large number of people. So we're sampling what I believe to be the people that were actually exposed. So from a coworker standpoint, somebody intermittent through the facility would be less than those folks in my opinion.

Another method would be to ratio

the neptunium from the plutonium bioassay given that the plutonium activity is between two to ten times greater than the neptunium activity. If I were doing an epi study, this is how I would do it, to be quite honest. Based upon that plutonium contamination in the additional sampling frequency of plutonium, you've got two per year going on and four per year on the HB-Line. This would be the more sensitive method. You would see the -- even using, you know, an average here of, say, three or four based upon those data tables and the weight percent, we could come up with a really good estimate for HB-Line and for 235F that's probably below the neptunium detection limit here because the plutonium is so much more sensitive. So you could come up with a really sensitive measure.

You could also interpolate between the urine bioassay points in 1969 to 1990. We're not talking about extrapolation. We're talking about interpolation. We've got urine bioassay up through '69, and we've got urine bioassay post-1990 and some in between. And I'll show you that in a minute.

Another is to use the whole body count data to develop a coworker model. And this is the most claimant-favorable.

We chose to use the whole body count data because at the time, we didn't have complete information on the actual plutonium to neptunium ratio. We only had the sampling that I am showing you here.

When we went back to the site in November to the vaults, started going through all of those, we started seeing that they were reporting this plutonium/neptunium ratio every month. And so we started gathering large amounts of data, which is why for an epi study, I would use that now, instead of what we have done. But the coworker model from whole body counts is certainly more claimant-favorable.

Based upon those procedures, we got confirmation that the workers in the neptunium areas were required to have whole body counts. If you read those procedures that we've got, they're required to do a whole body count and a chest count every year, shift employees two per year -- so those would be those technicians -- the day employees, one per year. So, again, the whole body count frequency is based upon potential for exposure.

And the other reason that we chose the whole body counts was neptunium doses calculated are claimant-favorable upper bounds but not unreasonably high as to be insufficiently accurate. And the reason I say that is if you look at the 50-year equivalent doses for some of these, urinary/bladder, you're looking at 350 millirem. You're looking at kidneys at nearly a rem; red bone marrow, 10 rem.

Highest is bone surfaces, 268, but that's over 50 years. Divide that up. You're around five rem per year. So these aren't outrageous doses, especially when you consider their gamma doses. You know, their gamma doses are getting around three rem per year, and they're being rotated out.

So using the whole body count is not really unreasonable for these particular workers.

DR. MAKHIJANI: This is Arjun. May I ask a question?

DR. TAULBEE: Sure.

DR. MAKHIJANI: You said that you could calculate the doses using the plutonium bioassay. Have you made a comparison between the doses as calculated and the method that you propose: whole body counts?

DR. TAULBEE: No, we have not, but I'll show you here --

DR. NETON: I'm sorry. Which

methods are we talking about? The whole body counts and the other methods that you --

DR. TAULBEE: Yes. The whole body counts versus using the plutonium as a ratio methodology.

DR. NETON: Yes.

DR. TAULBEE: Go ahead.

DR. NETON: I believe that they would be lower, but, you know --

DR. TAULBEE: Right. I think the next slide will really kind of show that.

DR. MAKHIJANI: If I might have a follow-up before you move to the next slide? This is Arjun. The bone surface dose of 250 millirem over 50 years, you said it would average 5 a year, but I presume that the doses in the early years would be much higher and the doses in the latter years would be lower.

DR. TAULBEE: Yes, that --

DR. MAKHIJANI: So is there an

order of magnitude that you can give us as to what the doses in the first three or four years would be?

DR. TAULBEE: I would have to go through and calculate that. I am just doing this as an example that I don't feel these doses are unreasonably high. That is all that I am trying to show here.

DR. MAKHIJANI: Well, we are talking 15, 20, 30 rem in the first few years. It might be -- I don't know what unreasonably high is, but they are pretty significant doses. I just want to say that for the record.

DR. TAULBEE: Sure. And I acknowledge that the first few years are going to be frontloaded for these. So yes. My simplification here is just that: a simplification.

If you get into the next slide, you will see this is the coworker model that Matt Arno and Mike and Liz have put together. The red is the 50th percentile. This would be neptunium in urine coworker model that they have come up with. And I think it is fantastic here.

What you will see is in 1970, it jumps up a lot. This is because we are using the whole body counts from 1970 to 1989. What I have overlaid here is the actual neptunium urine dpm per day results that we have. So these are one person, one sample or one person, one statistic results, effectively, where we have taken people that have multiple neptunium samples in a year and averaged them together.

And what we're looking at here is a box plot. The lower bar there is a tenth of a percentile. The lower part of the box plot is 25th percentile, the 50th percentile. The top of the box plot is 75th percentile. And then the top is the 95th percentile.

So what you can see here is that

our whole body count methodology is encompassing the urine data that we see. So we believe that these whole body counts are, in fact, bounding based upon the data, the limited data, the 330 samples that we have been able to analyze.

DR. NETON: Tim, I'm not quite clear on what you're graphing here. The red line is the whole body counting, using the whole body counting data.

DR. TAULBEE: What the urine would look like based upon --

DR. NETON: Based upon an intake calculated from the whole body count, we would infer what the urinary concentration would be?

DR. TAULBEE: That is correct.

DR. NETON: Okay.

MR. FITZGERALD: Tim?

DR. TAULBEE: Yes?

MR. FITZGERALD: You know, I know on the last data capture, there were additional -- what seemed to be additional NP bioassay results that were identified if I'm not mistaken. Were they retakes or something? I was wondering if --

DR. TAULBEE: There were some retakes in there, yes.

MR. FITZGERALD: I was wondering if that is going to change the 303 or is that yet to be addressed?

DR. TAULBEE: Actually, I don't know whether it is going to change it or not because we would have to look at those people and see if we already have those results.

MR. FITZGERALD: Yes. So that is yet to be done?

DR. TAULBEE: Yes.

MR. FITZGERALD: Okay.

DR. TAULBEE: That's correct. We don't have that data yet. But it was only, I want to say --

MR. FITZGERALD: It wasn't that

many.

DR. TAULBEE: It was around 20 --

MR. FITZGERALD: Okay. It wasn't that many.

DR. TAULBEE: -- 20 or so. It wasn't that many samples.

MR. FITZGERALD: Yes.

DR. TAULBEE: So this is our current coworker model. This is what we have proposed. I mentioned that you could do an interpolation. If you draw a line just from 1969 to 1990, it still fits between the data generally. It is much lower. It's not the method that I would use. In fact, we were using the whole body count because I think it is claimant-favorable. It is reasonable. It is bounding. And it is fair.

So that was our coworker model. And I am going to briefly go through this part because this is really a discussion that is part of the SEC Work Group. And this is our coworker model comparisons. But I think it is important for this worker to hear and understand. In RPRT-56, we developed -- actually, we stratified all of the data that we had for the monitored workforce and to construction trades workers, non-construction trades workers, and those that we couldn't determine whether they were construction trades workers or not.

It is important to note that from 1974 to 1989 in this model, there were no unknowns. All of our unknowns were prior to 1974. Everybody post-1974 we could categorize into one or the other.

So we developed two coworker models: one based upon just construction trades workers, one based upon non construction trades workers. And we applied a statistical test called the Peto-Prentice. And, again, this is all being evaluated by the SEC Work Group, at a significance level of less than .05. We didn't see any comparison year that was less than .05 for a p-value. So we can't conclude that they were different. We don't know. There isn't enough difference between the model developed for construction trades worker and the model developed from the non-construction trades workers to say that there is any difference between the two.

Again, this methodology is being discussed in the SEC Work Group and there are some consideration of is there sufficient power to detect anything. And that is all a discussion for the statisticians and such.

What I want to get to here -- but I think that is important for you all to understand here from a construction-monitoring standpoint, a) that we did have data in these particular years that we could actually compare construction trades and non-construction trades.

So I want to talk briefly here in closing a little bit about construction exposures and construction personnel monitoring. Dosimeters are required for working in regulated areas.

One of the things that came out of our construction worker interviews is that construction workers noted that one day an area would be a regulated area posted one day. And then the postings were removed for the construction work. And this is true. The site did this at different times. We have seen it in the works technical reports. And I want to give some examples of this because this is an actual procedure for the use of supplementary TLD badges to monitor the work areas. And the purpose of the procedure was to provide instructions for using these TLDs. So let me read this bottom part here, "Work is sometimes performed in the proximity of plant operating facilities by personnel who do not and are not required to wear Savannah River plant personnel monitoring badges. These personnel may include construction, subcontractors, pulpwood harvesters, et cetera. To provide exposure dose records which verify the radiation exposures to such personnel do not exceed the limits in DPSTS-RH-0.07, less than one millirem per hour dose rate and less than 25 millirem dose per week, Health Protection places supplementary TLD badges at representative locations in and around the work areas." So while they might have not have been monitored individually, Health Physics was monitoring the area that they were working in.

Let me give some examples here that we have been able to pull out of the records. This is a case of TLD badges for construction trades workers. You can see here in the central part this is new tank construction. This is in the tank farms. Here is the location of the TLD badges around the filled tanks versus where they are working. So they're monitoring between.

Here is another example, new building being built, site 4, 724-7G building. Here is the TLD badges. They're around the fenced area from the area that they were working in. So they would carve out areas for construction to go in and work. So the area was posted as regulated, de-posted. But around the perimeter, they were monitoring to make sure it didn't need to be posted.

Another example at the tank farms, you've got new tank construction down here. You've got badges here, new building up here. You've got badges around.

So what I want to bring out of this is that the radiological records and the construction personnel interviews are actually consistent. Okay? They're not one or the other. What the construction workers told us is true. The radiological records that we see are true. There is monitoring going on, but it's not personal monitoring for these workers.

There are times when construction trades workers were not monitored because of the low potential. There are times when they were monitored but they didn't know it because of these remote badges that were going on. The monitoring is of the workplace, not them personally.

In the case of neptunium due to the very high photon dose rate at one r per hour, I would contend that all construction trades workers that had a potential for neptunium exposure were personally monitored. You wouldn't have gotten near those billets in these areas without wearing a badge. They wouldn't have done one of these carve-outs for around this neptunium area. The dose rates were just too high. You wouldn't have been below 25 millirem per week in any of those areas.

And so, with that, I would be happy to answer any questions.

MEMBER CLAWSON: Tim, you were saying that they had the film badges out on the outside of the area. And this is why you feel that the construction workers were saying that they weren't monitored, so forth. So with the doses for that, how did the construction workers come up with -- did they monitor everybody that went in and then gave them that dose or just said, "No"?

DR. TAULBEE: In this time period, 1970s and the early 1980s, there wasn't the requirement of 100 millirem per year. And so if they were less than 25 millirem per week, those badges, those areas, they were in compliance that everybody on the work site was giving less than their 3 rem per year and their 5 rem per year regulatory requirement. So they were assured of that is what they were doing.

I don't think that they put these doses in any of these construction trades workers, these files.

MEMBER CLAWSON: So in a way, they were monitored to be under 100, but we don't have any data on -- we don't have any TLDs.

DR. TAULBEE: We don't have any TLDs.

MEMBER CLAWSON: And, just as we saw by --

DR. TAULBEE: But we can be assured it's less than this 25 millirem per week.

MEMBER CLAWSON: We're assured that it's 25 per week?

DR. TAULBEE: Less than 25 millirem per week, which comes out to a significant dose. It's about a rem a year, a little over a rem a year, actually.

MEMBER CLAWSON: Well, as you remember in some of the interviews that we had, some of these people would be working in this one area, which may have our perimeter badges and so forth, versus then they would go someplace else and come back in. I think it would be very hard to be able to put a good handle on where they're at.

But my other question is, too, I have seen where they have what they call background, which they separate and take off of those outside badges. Do you know if they did that on these?

DR. TAULBEE: They removed the background based upon where the TLD badge recs were from this particular case. So around these tank farms, they would be taking the -- which tank farm area it was, they would be taking the badges from that control area, where they would be going into that fenced area, where they would be taking the background from there off of -- but, again, I mean, this is a significant dose.

Yes, it is significant. It's 25 millirem per week. So it could be 1.2 rem per year.

That is an unmonitored exposure. But it's personally unmonitored. But for a group of workers, it is monitored. We know it is less than that.

If you look at some of these data points, you can see these doses are millirem per hour, are quite low. Some of them are zero. Some of them are not distinguishable from background. But others near certain areas are higher. We have not to date gone through and determined what a dose would be from trying to grab all of these instances where this occurred. But what we assign for construction trades workers, if you remember, is we take the plant workers, their external dose. And we take that dose and multiply it by 1.4. So we're taking workers within the regulated areas and assigning their doses to these construction trades workers when we believe that they were in an area that they should have been monitored. So I believe we are covering this particular dose.

But what I wanted to try to show here is what construction trades workers are telling us and what we see in the records are consistent. They're fully explained.

MEMBER LOCKEY: Were there any examples where the perimeter or the peripheral doses were higher than you would have expected?

DR. TAULBEE: You can go through some of them. And you will see some badges. And they will have them circled in the records, some of the fence line ones, where they would be doing follow-up and adjust. So yes, you do see some of that.

MEMBER CLAWSON: And, Tim, you realize this would be set up like a new construction site, that one right there.

DR. TAULBEE: Yes.

MEMBER CLAWSON: This is for a

site. But also in the interviews, it was: We were brought in to repair this road coming in. There were no outer fences there. There was nothing like that. And we had dug up all of this area. And we leave that night. And we come back the next day. And the whole area is roped off. And now we're under different regulations.

This puts a real pretty picture on everything, but it doesn't take in the whole picture. I agree with you this shows how some of the construction areas were done in a construction site, a new building coming on and so forth, but it does not cover all of the instances that were in the interviews because when they dug up the pipes that they didn't realize and stuff like that, then whole things change from that standpoint.

DR. TAULBEE: Right. What you saw and what you just described is they dug into the pipes. They got into something that wasn't expected. And over the night, Health Physics came in, roped off the area, set new restrictions, new PPE requirements to go into the area, et cetera. So there is monitoring that is going on. Otherwise, it would never have been known that they got into that. So Health Physics is actually monitoring on the peripherals when they are not there or whatever to identify that, hey, they ran into some contamination and they changed it. They modified the job plan to show, hey, we've got to make a regulated area here.

MR. FITZGERALD: And new construction, for example, in 235F would have been a regulated area.

DR. TAULBEE: I'm not sure of that.

MR. FITZGERALD: That's the only part that kind of --

DR. TAULBEE: If you go back to that building or that --

MR. FITZGERALD: Yes.

DR. TAULBEE: Let me go back here to that picture.

MR. FITZGERALD: We can isolate it perhaps. I just --

DR. TAULBEE: You've remember seeing some of the pictures --

MR. FITZGERALD: Yes.

DR. TAULBEE: -- where the cork was capped. And that's what I think they were doing here within the 235F when they were building PuFF and PEF.

MR. FITZGERALD: It's the gray area in the middle here.

DR. TAULBEE: These red areas here, these we've got photos -- we've requested them; we don't have them in possession yet -- of when they were doing the construction in here, in this part of it. They were still working here in this --

MR. FITZGERALD: Right.

DR. TAULBEE: -- neptunium area

here. But what we see is a lot of the duct work that is being worked on is capped, looks like going into that side of the building during this time period.

Also, I have got some question as to how much production they were doing in that time period. It seems to have decreased some during the PuFF and PEF construction work.

MR. MAHATHY: It was very small.

DR. TAULBEE: Yes.

MR. FITZGERALD: Yes. I would be kind of interested in knowing what the monitoring regime was for that new construction. It lasted what, a year or two?

DR. TAULBEE: That would be, actually, about three years.

MR. FITZGERALD: Yes. So --

DR. TAULBEE: It should be in the job plans.

MR. FITZGERALD: Right.

DR. TAULBEE: And that is where we would have to look for that.

MR. FITZGERALD: And, you know, just validating --

DR. TAULBEE: I think it's like a week --

MR. FITZGERALD: Validating what the regime was, bioassay regime, and what they, in fact, were because I think the stress report workers understand they're being monitored probably same as the operators, but these guys I think fall into this gray area where if they capped off the ventilation system and whatnot, they might have been handled as a separate --

DR. TAULBEE: But would you agree these guys are at a higher risk than those guys doing the construction?

MR. FITZGERALD: Yes. I was going to say I think it's sort of an intermediate. I can't see that as sort of being carved out, but it would be something where you might do some surveying and maybe put them on a limited monitoring of some sort.

DR. TAULBEE: Okay. But, I mean, from our current coworker model, we are using these guys' data.

MR. FITZGERALD: As limiting.

DR. TAULBEE: As a limit.

MR. FITZGERALD: As bounding.

DR. TAULBEE: As bounding.

MR. FITZGERALD: Now, do we know who those -- you know, that crew that came in and did all of that construction, do we know who they are?

DR. TAULBEE: The crew that came in and did the construction?

MR. FITZGERALD: Actually did. You know, if you could, in fact, be able to --

DR. TAULBEE: I don't know. I believe we could find that from the job plans and the EDWS determined who was going in.

MR. FITZGERALD: That would be a --

DR. TAULBEE: The off-site construction folks --

MR. FITZGERALD: Yes.

DR. TAULBEE: -- I don't think we could. Remember all the pictures of outside in the trenches, where they are digging for -- to lay new piping. I don't think we can actually -- I don't think we would be able to identify those folks. I think they were being monitored based upon that perimeter type of monitoring.

MR. FITZGERALD: You have different grades of monitoring. Obviously those people are running outside the building.

DR. TAULBEE: Right.

MR. FITZGERALD: Right.

DR. TAULBEE: I think the ones inside the building we could probably get identified.

DR. MAKHIJANI: This is Arjun.

MR. KATZ: We hear you, Arjun.

DR. MAKHIJANI: When we did interviews with workers a couple of years ago, it might not have been exactly this case. I don't remember. But they had said that, you know, they were in an area of new construction where it was presumed that it was clean, that they would not be exposed, there was no exposure potential. But then, in retrospect, it was discovered that they did, indeed, have exposure potential.

It might have been the same 235F, but I don't remember. We'll have to revisit that interview to check. And I don't know whether it happened more often or it was just in this one instance.

Have you looked into it, Tim?

DR. TAULBEE: No, I have not. I don't have who it was that mentioned that particular interview, but we can certainly follow that up and look and see if it was 235F. I doubt that it was because from what I saw from the photos, the new construction was pretty significant. But that part of the building had never been used before.

DR. MAKHIJANI: Oh, okay.

MR. FITZGERALD: I tend to remember something about trench work that was done outside of the new construction that did not cover it. I'm not even sure it was anything with neptunium, but --

DR. TAULBEE: A trench makes sense.

MR. FITZGERALD: So that seems to ring a bell.

DR. MAKHIJANI: I think Brad was there during that interview as well. Brad, do you remember?

MEMBER CLAWSON: What? I'm sorry, Arjun. About?

DR. MAKHIJANI: I think, Brad, you were there during that interview when construction workers mentioned that, you know, they were working in areas thought to be clean that turned out to not be.

MEMBER CLAWSON: Yes. I kind of spoke about that a little bit earlier --

DR. MAKHIJANI: Yes.

MEMBER CLAWSON: -- especially tying in because, you know, one of the things that I get into this is we do this new construction, call it retrofit or whatever else like that, but tying in, tying a new facility into the old one, how they were there but also -- and we have heard numerous of the operators say if it was a real hot job, they brought construction workers in there because they could burn them out and send them on their way, where the operators, they wanted to be able to maintain them for the year.

So a lot of times on these production processes, if there were problems with it and they needed to fix them or whatever else like that, they brought construction workers in there. Now, to what level that they were monitored and stuff, I'm sure that they had a pretty good monitoring. But there's a lot of other things along with it in that respect.

But yes, Arjun, I was there when they were talking about that it had been out-trenched and outside the building and then they came back and they couldn't go back in because it was too hot.

DR. TAULBEE: Brad, I think you just perfectly identified the scenario here for this HB-Line incident where a construction worker was doing the installation where normally maintenance folks would be here in the process cabinet in this particular room. And they got contaminated because of the poor training that the construction trades workers have talked to us about, the OJT type of scenario.

This is definitely a high-risk job. They set up a contamination hut on the outside that they were monitoring of the airborne in there. They were padded in plastic suits taking them out. This would be a case where construction workers would be burned out.

The key here is that when things went wrong in here and they got contaminated, bioassay analysis was followed up for these employees. So they were used on some of these high-risk jobs, like the construction workers said they were and the operators have told us that they would be used. And due to poor training, they would inadvertently contaminate themselves, but there is follow-up here with Health Physics. And so when we see their record, we get their information.

MEMBER CLAWSON: I agree with you, Tim. And I do with that. One of the things that has been hardest for me to understand in Savannah River because this is unique in some ways because when we refer to people as construction workers versus DuPont workers, in the earlier years, DuPont had their own construction people, plus outside construction workers. And they actually all came from the same halls, everything else like that. And this is why sometimes when we say DuPont versus construction, to tell you the truth, I really can't get my hands around how we would ever even separate that out.

So I just want to make sure that when we're -- they were all construction workers to a point, but they had in-house trades that would go in and do some of this stuff. Like more new construction I think kind of went to the outside construction workers, certain ones went back and forth.

Idaho struggled to try to figure out how to separate them out. And I still haven't figured it out because I still fight with it.

DR. TAULBEE: I think if you look at the actual plant population and numbers of workers is when you really begin to see where the separation begins to occur. And it begins to occur in the 1980s because you see the population of construction workers really ramp up, I mean, huge, compared prior it seems really stable.

It seems like they were using your Dynalectric, your B. F. Shaw for your pipefitters. It seems like they were using them pretty consistently up until you get to about the 1980s. And then you see the population really go up. And that's where I think you see some of the subcontractors that we'll talk about later on today, so forth. And maybe that's where we need to focus on the evaluation.

And I think that's where we're having trouble getting our head around some of this because until that time period, they were really more in-house. Even though they were coming out of the union halls, there wasn't the massive number of subcontracts being let. And so that is what I think is causing us difficulty.

MEMBER CLAWSON: I agree with that, but also when you jump back into the earlier years, where you had facilities being built, then --

DR. TAULBEE: Oh, it was huge then.

MEMBER CLAWSON: -- you have this whole, whole different construction.

DR. TAULBEE: Yes.

MEMBER CLAWSON: But then inside, you still have this little nuance of construction, of DuPont construction and --

DR. TAULBEE: I'm really talking about --

MEMBER CLAWSON: Right.

DR. TAULBEE: -- the 1960s. That --

MEMBER CLAWSON: Right. I just --

DR. TAULBEE: -- early time period is hundreds of thousands of workers.

MEMBER CLAWSON: Yes. But once we look at this as a whole and you look at it from the individuals that have been there on the site and so forth like that, that is one of the things that we always need to take into consideration when they're talking to us about this because they see the whole spectrum.

DR. TAULBEE: Yes.

MEMBER CLAWSON: And whether co-op construction or they get some really dazed looks on their face with this, yes, I worked at a trades home, but I was on the site for 30 years as a pipefitter.

DR. TAULBEE: Exactly.

MEMBER CLAWSON: And so that's where I just -- it's very difficult. This site is unique in that standpoint versus any other site.

CHAIRMAN GRIFFON: And, Tim, this is Mark Griffon. Can I ask one question? And then I want to sort of path forward on this. The first question is for the neptunium coworker model, how do you do assignments? In other words, you mentioned that likely not that many people were involved in some of these processes where exposure potential was high. But how do you distinguish who gets neptunium internal exposure assigned and who doesn't? And have you thought about that?

DR. TAULBEE: This is outlined in OTIB-81. And it's done by area, just like the bioassay was, to where if we identify a person being in an area, as like H area or 235F, then we would assign the neptunium coworker model if they don't have any neptunium-monitoring data. So it's done on a person-by-person basis and time period of where they were working basis as well.

DR. MAKHIJANI: Tim, this is Arjun.

MR. KATZ: Yes. Go ahead, Arjun. We can hear you.

DR. TAULBEE: Yes?

DR. MAKHIJANI: You know, this is a little bit from memory since the last time I looked at worker records in this area was some months ago. But in the worker records that I have looked at, the area of work is generally not mentioned. There may be a general mention of the area or like in the compensation claim, but the area of work is often not known for that particular time. It may not be noted in that along with a particular bioassay sample. So how do you determine who to assign it to, you know, --

DR. TAULBEE: Okay. All --

DR. MAKHIJANI: -- whether a worker was -- you can tell when a worker was present if it's in their file, but can you tell if a worker was present if it's not or not because it's not in their file?

DR. TAULBEE: Based upon, the TLD monitoring, yes, we can identify where it was that they were working. And, you know, we did this before with the -- we proposed it under the thorium SEC, the original one. And I know you guys did an evaluation of worker locations ––

DR. MAKHIJANI: Right.

DR. TAULBEE: -- and found errors. We went back since then and have evaluated all of those errors that you have identified. I think it was 140 of them or something like that. And we have found no errors that we could not describe post-1961. So all of the errors that were identified that we couldn't resolve after going back and doing the follow-up on your preliminary analysis, there was all of them we could resolve post-1961.

And, in addition, all of the bioassays actually do have location listed on them. I think you said a minute ago that bioassays don't have location, and that's not true. All of the bioassays have a location. Whether it's in the logbook, whether it's a whole body count, or whether it's on their card, there will be a location listed for it. I am sure you are going to find one or two here and there where it's not, but you will be able to see others on that card showing which area it came from.

DR. MAKHIJANI: I think maybe what I am remembering is the location is not necessarily connected to the radionuclide because what you are proposing for a neptunium dose reconstruction are not whole body records in which neptunium is directly listed. Actually, thanks for that correction. From my memory, since neptunium is not listed in the file, how do you know which worker was exposed to neptunium based on the record which is in front of you, which does not actually have neptunium mentioned in it?

DR. TAULBEE: Well, from the whole body count, there is an area listed that they came from of why they are being whole body counted and --

DR. MAKHIJANI: Yes, but there is many more than one radionuclide in that one particular area. The areas listed are fairly general.

DR. TAULBEE: That is true. But from F area, -- for example, that would be the 235F people -- they would be encompassed in that group. And so we looked not for -- on the whole body count, when we looked for the neptunium, we looked at the region of interest, where the protac peak would appear. Okay? That was what we analyzed. And that is outlined in OTIB-81. And there is some methodology on how we did that. And those counts because we have raw count data and we have the efficiency for that neptunium peak in there, we can determine what the detection limit is. And that is what we have ended up using.

DR. MAKHIJANI: Yes. But I think that doesn't address the issue at hand. If neptunium is not mentioned in the whole body count record and you are attributing -- or protactinium, for that matter, and you are attributing a neptunium dose from presumed peaks, how do you know who to attribute it to when there are a lot of other radionuclides present.

DR. TAULBEE: I'm not understanding your question because in this case, you've got the whole body count for that person. That's what you're looking at. And if it's in 235F or in F area, then we're going to attribute those counts from that peak to that person.

DR. MAKHIJANI: But it's not a -- all I'm asking is, how do you identify a person with neptunium because neptunium is not in the record and protactinium is not in the record? There’s an area name and a count that identifies a bunch of radionuclides but generally does not identify neptunium or protactinium. So how do you make the connection.

DR. TAULBEE: We make the connection by basically being claimant-favorable. In this case, working in that area, we're going to take those counts and that region of interest and assume that they are neptunium, whether they were actually exposed or not, because they worked in that area, F area, for example. We're not going to assign it for somebody who worked at the P reactor, for example.

DR. MAKHIJANI: Okay. That clarifies it better. Thank you.

MR. FITZGERALD: And, just going back, you're pointing out that it is location-driven. And you resolve the issues revolving around those locations on the site, as you say. Is that going to be a supplement to 81 or how is that -- you know, clearly you walk through rather rigorously to look at exposure potential related to the areas that were being keyed by SC&A as being possible additional areas or areas that were missed. Is that addressed somewhere or will be addressed somewhere?

DR. NETON: Well, it seems like we need to. I mean, if our basis is going to be that the --

MR. FITZGERALD: This is a complete set.

DR. NETON: -- records track properly --

MR. FITZGERALD: Right.

DR. TAULBEE: We have a draft report. That's never been an issue.

MR. FITZGERALD: Okay.

DR. NETON: Yes. I would say that it would be important for us to demonstrate that somehow.

DR. TAULBEE: Okay.

MR. FITZGERALD: That just follows from there.

DR. NETON: Yes, sure.

MR. FITZGERALD: I mean, we would want to --

DR. TAULBEE: Yes, yes.

DR. NETON: Otherwise the basis is still valid for --

MR. FITZGERALD: Right, right, right. And this goes, I think, to Mark's earlier question about path forward because, really, if the areas are complete and you are making that presumption, very conservative presumption, then that would be, you know, the avenue. But then without getting into the statistics, that would be certainly an approach. Right?

DR. TAULBEE: Yes. One of the other things we have identified within those dosimeter codes is there's a Department code that actually specifies 235F, sub within the area. There's the area codes that would identify F area versus H area versus M area reactors. There's other codes that identify Department code that's the next tier down that will actually --

MR. FITZGERALD: Is that is both OTIB SOPs, the 5th and the 8th, or was that just the 8th? I think we had a question on it earlier.

DR. TAULBEE: Which?

MR. FITZGERALD: Did codes show up in both earlier and later editions of the DPSOL, the 1293?

DR. TAULBEE: In this case, this is the bioassay --

MR. FITZGERALD: Right.

DR. TAULBEE: -- as to who is monitored and how. What I was talking about was the external monitoring.

MR. FITZGERALD: Yes. There was an area code.

DR. TAULBEE: Yes. That's these here.

MR. FITZGERALD: Okay. Right, right.

DR. TAULBEE: This is 1977 version.

MR. FITZGERALD: Okay. So that's the --

DR. TAULBEE: Here you can see when you have a Department code of 209, there on the HB-Line --

MR. FITZGERALD: Okay.

DR. TAULBEE: -- versus 205 that you --

MR. FITZGERALD: Right.

DR. TAULBEE: -- put in 5F building. So this is one that Kathy collected that is --

MR. FITZGERALD: Right. So that is the --

DR. TAULBEE: '77.

MR. FITZGERALD: -- '77 version of it. Okay.

DR. TAULBEE: Yes. And here is

an '84 version of it.

MR. FITZGERALD: Okay.

DR. TAULBEE: And then we've got a 1990 version.

MR. FITZGERALD: Okay. It carried forward.

DR. TAULBEE: Yes.

MR. FITZGERALD: Okay.

DR. TAULBEE: So we've got multiple ones.

CHAIRMAN GRIFFON: Tim, this is Mark Griffon again. Before we break, I just wanted to summarize, well, one question and then to sort of maybe have you and SC&A restate sort of the path forward on this issue because I missed a little bit of the exchange in the last minute or so.

But one question, for individuals, I think you said the area will be tied to the area in OTIB-81. And that's tied to dosimetry files. And I do have to refresh myself on OTIB-81. But, aside from that, if a person doesn't have dosimetry, if they're not badged, are you saying that they would not have access to these areas and, therefore, would not get neptunium assigned or is there another method for handling those people or what's -- so for the inside people, you don't know where they were or do you know? Are there other ways to know if they would have access to these areas?

DR. TAULBEE: Based upon all of the radiological controls and monitoring the procedures that I see and these dose rates coming from the neptunium billets and the neptunium oxide, I do not envision that they could have worked and gotten into one of these areas where there is neptunium exposure. That would be greater than the guys with the hands in the gloves. Well, actually, I can't envision them getting into those areas and being exposed to neptunium without having been personally monitored, to be quite honest.

DR. BINGHAM: Why do you say that? This is Eula Bingham. Why do you say, "envision"? I don't understand. Why do you say you can't envision?

DR. TAULBEE: Because the requirement for monitoring was in all regulated areas. And a regulated area was defined as an area where somebody would be at a dose rate of greater than 1 millirem per hour or greater than 25 millirem per week. And that was a requirement for somebody to put on and wear a personal dosimeter badge. Due to these dose rates from these glove boxes from the neptunium and even from the tubes, the billets themselves, we're talking about r per hour type of dose fields. People would have been monitored. Even if they were construction or a subcontractor, they would have been personally monitored for gamma radiation based upon these dose rates. And that's why I say that.

DR. BINGHAM: And that's what DuPont says or who says that?

DR. TAULBEE: That is what the procedures for requiring monitoring were.

DR. BINGHAM: Well, I'm asking, what is your basis for assuming those procedures were followed? Worker interviews? The industry says -- I'm sorry. And I don't know you. I don't know whether you -- I couldn't tell. I don't have a sheet. I don't know whether you work for DuPont or one of the industries or -- I'm sorry. And I don't know why you say that.

DR. TAULBEE: Okay. My name is Tim Taulbee. I work for NIOSH.

DR. BINGHAM: Just because there's a reg at one of these places, my experience has been that that is not what happens frequently.

DR. TAULBEE: We are basing this upon what we see in the records of the large number of workers being monitored, in addition to worker interviews, where we talk to operations workers, we have talked to construction trades workers about their monitoring. And when they were working in these types of areas, they were wearing a badge.

DR. BINGHAM: It sounds like it's quite different at Savannah River.

CHAIRMAN GRIFFON: Okay. We may need to -- I don't know if SC&A has reviewed that issue as well. We may need some follow-up on that. I wasn't involved in the worker interviews. I know SC&A and I think Brad was in on a lot of them, but yes. I think that's one part that I at least need to think about further.

MR. FITZGERALD: Yes Mark, there are some summaries on the interviews. Certainly DuPont's procedures were a different kind than we have seen at other DOE sites. And the interviews seem to track that the construction workers, in fact, in these regulated areas did get monitored.

But there are some issues and questions that we still need to look at, but in general, they seem to track from the feedback we got from the interviews.

CHAIRMAN GRIFFON: Okay. Let's just then go on to the next question, which is what is the path forward regarding this issue from both NIOSH's standpoint and further? I heard some discussion, Joe, between you and Jim and Tim -- I couldn't quite make it all out -- about an addendum to OTIB-81. So what are the next steps for NIOSH? And then what does SC&A have to do to further consider this as well? If you can both tell the next steps so that I can track some actions going forward.

MR. FITZGERALD: Yes, Mark. Joe Fitzgerald. Yes. From the SC&A comments from before, we questioned whether, in fact, NIOSH in OTIB-81 had captured all of the locations of potential neptunium exposure potential such that you could use a location-specific way to apply the coworker model. And I think what Tim was pointing out is that they had dispositions, what was over 100 locations I think we had identified in those comments, and were able to rationalize that none of those, in fact, were evidence of exposure potential based on the operational records and whatnot.

And what I had asked is, since that was the entry point for applying the coworker model, it would be very useful to see that dispositioning of all of those additional locations just so we could confirm that we agree with how that disposition was handled and that there is a basis for saying that a particular location had no historic neptunium exposure potential, obviously a very critical question if you are going to apply location-specific means to apply the coworker model. And once we get past that point, then it's more of a process question of, you know, which model you apply and whether that model is statistically valid. But, you know, this is the starting point of the process. I think it is important to agree that the locations were, in fact, a complete listing.

DR. TAULBEE: Mark, this is Tim Taulbee. I envision our task is to publish this draft report that we have from the further analysis.

Now, again, this was based upon our analysis. And SC&A's original review is based upon thorium. Now, we can expand that and do some statistical analysis of neptunium areas if you want, of neptunium bioassay and the dosimetry codes that we see, if you would like that. We can certainly do that if you would like that added.

CHAIRMAN GRIFFON: It sounds like we need that added, yes.

DR. TAULBEE: Okay.

CHAIRMAN GRIFFON: Others' thoughts on that?

DR. MAKHIJANI: Mark, this is Arjun. Can you all hear me?

MR. KATZ: Yes.

CHAIRMAN GRIFFON: Yes.

DR. MAKHIJANI: Okay. I never know whether I am on mute or not.

There are a number of other issues that are raised by NIOSH's response that is being discussed today. Are we going to go on with that discussion? Is your question specific to the issue that was just being discussed or is it general path forward related to the NIOSH document that we are discussing today?

CHAIRMAN GRIFFON: I was talking about path forward for the neptunium issue.

DR. MAKHIJANI: Yes, right. So there are a number of other places, like this finding 5, where NIOSH says, you know, coworker model is applicable if these two conditions are met. And we have had some discussion about that before. And, you know, SC&A obviously, you know, had been involved in some of these things. And we would obviously have to discuss some of these things. And it would need review beyond the one point that was discussed in my opinion. I don't know if Joe agrees. He is the task manager for this.

MR. FITZGERALD: I actually was addressing the whole thing in the context.

DR. MAKHIJANI: Oh, you were? Okay.

MR. FITZGERALD: The more narrow piece that we're addressing right now. We haven't gotten into the various findings, which I find on the agenda is sort of the next item.

CHAIRMAN GRIFFON: Right.

MR. FITZGERALD: So I am just addressing the presentation and the process that Tim has laid out and the comment that, you know, he did mention the dispositioning of the locations. And I think this would be pertinent to that.

CHAIRMAN GRIFFON: Okay. Yes. I apologize. So let's get into those in our next question.

MR. FITZGERALD: Yes, the next --

CHAIRMAN GRIFFON: Okay.

DR. NETON: I do have a question about what we just talked about, though, which is the dispositioning of the locations. I think there might be a little disconnect here.

MR. FITZGERALD: Okay.

DR. NETON: You specifically I thought were saying that we needed to demonstrate or describe how we know which locations were the only locations that neptunium was processed?

MR. FITZGERALD: In the context of the questions that were raised in earlier SC&A review that said that how do you know we have a complete listing. We offer some examples of other locations.

DR. NETON: Right.

MR. FITZGERALD: And I think that was --

DR. NETON: I think Tim did a very nice job demonstrating that, at least on this presentation. But do we need to write that up further to say this is the flow path of the neptunium processing at the site?

MR. FITZGERALD: Yes. I sensed there was another set of more detail, which was basically, you know, these other locations that were identified and ruled out.

DR. TAULBEE: But that wasn't neptunium. That was thorium.

MR. FITZGERALD: Oh, I thought it was in the context of neptunium.

DR. TAULBEE: It was the context of the thorium --

MR. FITZGERALD: Okay.

DR. TAULBEE: -- standpoint, where you identified 140 discrepancies.

MR. FITZGERALD: Right.

DR. NETON: That's location.

DR. TAULBEE: That was location for dosimeter code.

MR. FITZGERALD: Right.

DR. NETON: That was ability to identify a person that had worked in a thorium area. That is different than I think what Joe is talking about.

DR. TAULBEE: Well, he's wanting to translate --

MR. FITZGERALD: I'm just trying to say that I think there is a rationale for pinning down, as you have done, so diagrammed, that this is exclusively the areas --

DR. TAULBEE: See?

MR. FITZGERALD: -- that you would recognize a worker's --

DR. TAULBEE: Exactly.

MR. FITZGERALD: -- neptunium exposure potential. And I think that was very helpful, but I was saying that --

DR. NETON: There's two --

MR. FITZGERALD: -- are these the -- you know, what is your filter on the locations?

DR. NETON: That's two different pieces. The first piece is how do we know that these are the true locations where people work with neptunium.

MR. FITZGERALD: Right.

DR. NETON: And the second piece is how do we know who we can ascribe to those locations.

MR. FITZGERALD: Right.

DR. NETON: So there's two pieces there. I don't know that we --

DR. TAULBEE: The latter piece is the one that --

MR. FITZGERALD: What triggered

it was your description of the thorium, which seemed like it was an --

DR. NETON: Yes, right, but that's the thorium location badging description.

DR. TAULBEE: That's the badging.

MR. FITZGERALD: Right.

DR. TAULBEE: And that's what I’m talking about these dosimeter codes that we have for --

MR. FITZGERALD: Right. That's thorium. Just a question of how you filter in terms of who you are going to apply this on the --

DR. TAULBEE: That's right. How we filtered it is based upon the material flow --

MR. FITZGERALD: Right.

DR. TAULBEE: -- that you see that I went through as well as we add in 773A because they were the research arm. They were the ones that came over and analyzed there at the 300 area, the tubes and --

MR. FITZGERALD: Right.

DR. TAULBEE: They were acquiring the cutting, the 222 that you see the sectioning. Those samples would go back over --

MR. FITZGERALD: Scrap metal and --

DR. TAULBEE: -- to 773A for analysis for electron microscope scanning, that type of thing, and then the 772 analyzing the process samples coming out of HB-Line.

MR. FITZGERALD: So the facilities that are listed in your flow diagram were, in fact, the --

DR. TAULBEE: Are, in fact, the --

MR. FITZGERALD: -- the specific facilities for which workers are going to be assumed to have an exposure potential if --

DR. TAULBEE: Right. That is correct.

MR. FITZGERALD: -- that example --

DR. TAULBEE: And we would identify those workers based upon their dosimeter badge code that they would have been monitored being working in one of those regulated areas within those buildings.

MR. FITZGERALD: Right, which answers I think what Jim was saying, the second item, so we know --

DR. TAULBEE: That's right.

MR. FITZGERALD: And that would be the badge code.

DR. TAULBEE: That is correct.

MR. FITZGERALD: So, Mark, I didn't quite grasp it, but that is, in fact, the answer to how the workers will be identified.

MEMBER CLAWSON: There's one other part that I wanted everything to go through for this. You brought up something, Tim, it kind of triggered it. When that cam up there failed when you put the helium or whatever to it, now, that tube is going to be taken out. They're going to have to cut that open. You know, they're going to have to peel that all out. And they're going to have to take all of that out. Where was that?

DR. TAULBEE: 235F.

MEMBER CLAWSON: 235F.

DR. TAULBEE: The rejects were all sent back to 235F. They're broken apart. Some of them, if they weren't able to do that, they sent them back to the frames and dissolved them back down and just completely started over, effectively.

MR. FITZGERALD: Now, one clarification on that question of scope, though, we talked about the CTWs that were involved in new construction in 235F, some of whom would probably have been subcontractors. How would they be earmarked for inclusion as exposure potential? If, you know, they weren't a 235 worker, they might have been brought in for whatever electrical work or whatever. How would you capture that.

DR. TAULBEE: They are going into the regulated areas. They had to go through the change rooms. So they would have been badged. And so we would have captured it at that point.

MR. FITZGERALD: Okay. So the assumption here -- and this gets back to an earlier comment we heard on the phone -- is programmatically, in this case programmatically, the assumption is being made that they would be captured by having been in the regulated area?

DR. TAULBEE: That is correct.

MR. FITZGERALD: And I guess one question we were talking about earlier is just trying to pin that down a little better as to the regime, the actual control, that was being exercised for that construction, just trying to make sure that, in fact, that was a regulated area. There were facets of that construction that were not. There might have been on the outside.

DR. TAULBEE: Well, I think --

MR. FITZGERALD: Yes.

DR. TAULBEE: -- when they open, when they -- you remember that picture of the big --

MR. FITZGERALD: Right.

DR. TAULBEE: -- hole that they knocked through the wall. I'm pretty sure that that area was not regulated.

MR. FITZGERALD: Right.

DR. TAULBEE: I mean, there was really no --

MR. FITZGERALD: And then the assumption there is that the exposure potential was not there.

DR. TAULBEE: That's correct.

MR. FITZGERALD: So, therefore, it wouldn't have the neptunium potential anyway.

DR. TAULBEE: But if they went in through the changers into the regulated corridors --

MR. FITZGERALD: Right.

DR. TAULBEE: -- into the rooms, they would have been badged. And, you know, even if --

MR. FITZGERALD: They will be captured. Yes.

DR. TAULBEE: -- on this side of the wall, they were doing this work, but then they needed to go on the other side of the wall to finish that work type of scenario, they would be going through. And we actually do see some of that in some of the incident reports where they would be cutting through the roof.

MR. FITZGERALD: But were you --

DR. TAULBEE: Cut through the

roof when --

MR. FITZGERALD: In terms of their records, though, because, again, we're talking a location-specific filter for identifying people, would they be identified by facility that you would actually be able to know that they were 235 regulated zone, even though they were CTWs?

DR. TAULBEE: Construction trades workers actually fall into an interesting area on that scenario. And this was one of our solutions back when we were posing the issue with the Class of thorium was that we were just including all construction trades because if they came out of the central shops --

MR. FITZGERALD: Yes.

DR. TAULBEE: -- and that's where they were badged, then it wouldn't say 235F.

MR. FITZGERALD: No, it wouldn't. That's what I'm trying to say. So --

DR. TAULBEE: And that's why we

included all of them back even under that first Class.

MR. FITZGERALD: Okay.

DR. TAULBEE: It's a new --

MR. FITZGERALD: Anybody who was in the construction trades during that time frame --

DR. TAULBEE: Right.

MR. FITZGERALD: -- could have been in 235F, will be if they have a --

DR. TAULBEE: We would assign them neptunium.

MR. FITZGERALD: We would assign a neptunium dose.

DR. TAULBEE: Yes.

CHAIRMAN GRIFFON: Okay. That is helpful, actually. So let me just summarize. And then I think we should take a break.

DR. TAULBEE: They would be badged to get --

CHAIRMAN GRIFFON: But it seems

like, Joe, unless SC&A has questions, further questions, on the areas and the approach using job codes, you know, I think NIOSH sort of has their approach laid out. So the only follow-up, I would still reserve some chance to follow up on this question of the unbadged people, but I think that last exchange does to some extent answer some of that, that anybody that was out of the construction trades during a certain time period, you would assume that they got that or could have been in those areas.

DR. TAULBEE: Badged construction trades workers, though.

CHAIRMAN GRIFFON: Badged construction. Okay. Yes. Still, it has the question of not badged. But so I think on this issue, anyway, you know, it's sort of if SC&A wants to further review those locations and that criteria, I think it's in your court, Joe. Is that accurate or --

MR. FITZGERALD: Yes. I think,

you know, just on face value, I think the facilities that are cited in the flow diagram are pretty comprehensive. I think we would want to confirm, you know, on the programmatic side. Certainly on the programmatic side, the assumption is -- and we have not from interviews or anything found any disconnects or contradictions that, in fact, you know, people that went in a regulated zone were included. You know, we have been testing that by talking to people that would have been in those zones. And we haven't found any exceptions. And that's kind of the one validation that is important, that you can assume that they did go in the facility. They would have had to go in a regulated zone if it was intentional. So that theme we have been testing and have not found an exception to yet.

And that also speaks to Professor Bingham's comment that, you know, again, we don't want to assume that a program or people follow regulations because we found too many exceptions in other sites. But in this particular case, we have been testing that, trying to find if there were exceptions. We hadn't found any to date.

So yes, we'll confirm the facilities as a path forward. And I think the one element I would like to hear more about is the new construction of 235, just trying to pin that down a little better. I think we kind of got close to that, didn't quite finish confirming how that construction was handled and how the workers were monitored and how they fell into a regulated zone or a non-regulated zone. You know, were people outside the building digging the ditches? Were they sort of in this other controlled arena, which would have been handled differently? And was there a potential there?

I mean, I think that's a little

bit of a gray area, but that's the only one I can think of.

CHAIRMAN GRIFFON: Okay. That sounds good. And what I would propose now is if we can break until 1:15. Is that okay with you, Paul? And then we'll pick up on the second item on the agenda.

MR. KATZ: Yes, Mark.

CHAIRMAN GRIFFON: Is that okay?

MR. KATZ: That sounds fine. We certainly can be ready by 1:15 or even 1:00. So that's good.

CHAIRMAN GRIFFON: All right. Give me to 1:15.

MR. KATZ: Yes. No, no. I understand. Yes.

CHAIRMAN GRIFFON: All right.

MR. KATZ: Will do.

CHAIRMAN GRIFFON: Okay.

MR. KATZ: So thanks, everyone else on the line. And we'll reconnect close to 1:15.

DR. BINGHAM: And the second item is?

MR. KATZ: So the next agenda item is the response to the SC&A report review of the methods. The agenda for the meeting is on the NIOSH website under the --

DR. BINGHAM: Okay.

MR. KATZ: -- Board today. So you could see all the rest of the items there.

DR. BINGHAM: Yes.

MR. KATZ: Okay. Take care.

(Whereupon, a luncheon recess was taken at 12:06 p.m.)

A-F-T-E-R-N-O-O-N S-E-S-S-I-O-N

(1:15 p.m.)

MR. KATZ: Before you take over, Mark, just let me remind everyone on the phone to mute your phone. Everybody mute your phone. And if you don't have a mute button, press *6. And that will make the audio quality a lot better for everyone else, particularly everyone else on the phone. Thank you.

And, Mark, go ahead.

CHAIRMAN GRIFFON: Okay. So, just to pick up on the agenda where we left off, I think the next item we are going to cover is the NIOSH White Paper on the neptunium issues. Is that accurate? And, if so, Tim, I think you can start us off, right?

DR. TAULBEE: This is more of our responses to the comments.

CHAIRMAN GRIFFON: That's right, response to the SC&A, yes.

DR. TAULBEE: Okay. How do you want to do this? Do you want to go through each individual --

CHAIRMAN GRIFFON: Yes, I think we should go back and forth, Finding 1, and then, you know, you can sort of give your response to the finding and then have a discussion. Right?

MR. KATZ: Right.

DR. TAULBEE: Okay.

CHAIRMAN GRIFFON: But then give SC&A an opportunity in between each finding. Don't go through the whole, you know --

(Laughter.)

DR. TAULBEE: Okay.

MR. KATZ: Okay. One by one, right?

CHAIRMAN GRIFFON: All right. Yeah, sounds great. Okay.

- DCAS RESPONSE TO SC&A REPORT

DR. TAULBEE: Okay. The first one, the first finding, SC&A's -- basically

I'm going to read it here -- "SC&A has concluded that NIOSH's methods for comparing the measurements of two sets of workers requires the monitoring protocols of the two sets of workers to be the same. NIOSH has not established that there were protocols for whole body count monitoring of either non-construction trades workers or construction trades workers using whole body counts during the '72 to '90 time period, and if so, where they comparable. It appears unlikely that either group as a whole is routinely counted, except for fast scans in the mid-to-late-1980s, which is not relevant for the neptunium dose reconstruction."

Well, to start out in our response, from the worker monitoring data, they were collected in the past to demonstrate compliance. So this is all compliance-based monitoring or retrospective data. So we don't really have the opportunity, if you will, to have matching protocols. But in this particular case, we do happen to have what their monitoring protocols were.

And as I pointed out earlier in my presentation, they're not the same. That the routine workers were actually -- day shift were only monitored for whole body count one per year. And the technicians were monitored twice per year from a whole body count standpoint.

Construction trades workers, as I outlined earlier in DPSOL 193-302, they were monitored when they came onto site, or as their job plans were specified, or if they were involved in a contamination incident.

But the goal here is to estimate the workers who were not monitored. So, I guess from my standpoint, I am not sure why the two protocols have to be the same. If we've got workers being monitored from both groups, some are routine, some are for-cause sampling, if you will, that the for-cause sampling would tend to indicate that these people were exposed due to some event, a high-air sample or a nose smear or something like that, versus a routine, which is you are expecting somebody to have not been exposed. But they would then be caught during this routine monitoring.

So it comes down to are the unmonitored workers more likely to be workers who had a lower potential for significant intakes? Or are they monitored completely at random? This is how we apply the coworker model.

DR. MAKHIJANI: Hi. This is Arjun. Could I say something about why that is there?

DR. TAULBEE: Sure.

DR. MAKHIJANI: If Harry is on the line, he may want to amplify. But the finding about the further monitoring protocol required to be the same is not about the coworker dose estimation. It was about under what circumstances you can compare the distributions of two groups of workers.

So if you're comparing non-construction and construction workers, our finding was that you can't have a valid comparison unless the monitoring protocols are the same. It’s not about the actual coworker calculation, dose calculation.

Harry, are you on the line?

DR. CHMELYNSKI: Yes, I am, Arjun.

DR. MAKHIJANI: Maybe you might want to amplify as to why we arrived at that conclusion.

DR. CHMELYNSKI: Well, there's a lot of reasons. In the routine monitoring, we're pretty sure we're going to pick up things. And when we do it on a cause basis, that assumes that we know all the incidents that occurred for these workers that were not routinely monitored. So you're sort of dealing with an incomplete data set. And the issue here was whether one could compare construction workers, for example, with on-site workers by using these data collected under two different protocols.

And there what we're talking about basically is can you use the hypothesis test to compare apples and oranges. Well, maybe. I'm not sure what the conclusions that you draw from that tell you, though.

DR. NETON: Yeah. This is Jim. I think that we are getting into some areas here that were subject of discussion on the RPRT-53 issue that is taken up by the Working Group. So I'm not sure it would be fruitful for us to really hash this about too much in this meeting.

DR. MAKHIJANI: Yeah, Jim, I agree. This is Arjun. I only raise that point because, the way Tim presented it, it was not about comparison and OPOS but about dose calculations and what doses you assigned and who had more exposure potential. Whereas, in this finding, that was not the issue.

DR. NETON: Yeah. I would argue on Tim's side on that one, but I won't take it any further because, again, I don't think we are going to solve it in this particular meeting. So I would say we just defer that one to the SEC Issues Work Group discussion, if that’s okay. I mean, I --

CHAIRMAN GRIFFON: Jim, I'm okay with that, putting it in the SEC Work Group discussion, but --

DR. NETON: And I think, I might point out a number of these are going to fall that way. There are some that don't, but I don't want to --

DR. MAKHIJANI: Yeah. You know, we had the SEC Work Group teleconference a few days -- a week or two ago. And our report is essentially done. You know, the mechanics of sending it out, type setting and sending it for DOE review remain. But, just to remind you of our finding, principal finding in this regard, which is pretty settled, is -- you know, of course, it's subject to review by the Board and the Working Group, but internally in our team -- which is that we didn't feel that OPOS should be used as a general method for comparisons or for making coworker models, except in the circumstance where you could average incident-related samples and put that as a single point in a distribution of individual bioassay samples. So we didn't actually agree. Our finding was that we don't agree with the NIOSH approach.

DR. NETON: Right. And I remember that. And that OPOS is just one piece of the issue. I think the bigger issue is this practical significance and, really, in my opinion, comes down to comparing the dose received or the intakes received by the two populations. And that is something that we will take up at the Working Group level.

DR. MAKHIJANI: Right. And we haven't addressed the internal dose piece of that at all as yet.

DR. NETON: Exactly.

DR. TAULBEE: Okay. Well, Finding 2 is actually following right along the same lines here.

DR. NETON: Yeah, I would say that, unless --

DR. TAULBEE: Do we want to defer Finding 2 as well?

MR. FITZGERALD: I think so. I think it's the same, pretty much the same issue.

DR. TAULBEE: Okay. Finding 3 is that NIOSH has not demonstrated that 30 samples in each comparison group would be sufficient to simultaneously maintain low levels -- for instance, less than 10 percent each of type I, type II errors -- in determining whether construction trades workers or non-construction trades worker sample distributions are the same or not. The issue is moot, in this case, for neptunium only because the minimum number of samples of 30 for comparison to be valid is not available for construction trades workers in any year from '72 to 1990.

Now, in our response -- and this -- actually, is Matt Arno on the line?

MR. ARNO: Yes, I am.

DR. TAULBEE: Matt, were you the one who wrote up this particular response? Because, if so, I am going to defer to you.

MR. ARNO: Finding number 3?

DR. TAULBEE: Yes. Or was this Nancy?

MR. ARNO: Well, actually, that was, I guess, mostly drafted by Nancy Chalmers.

DR. TAULBEE: Okay. And Nancy is not online.

DR. NETON: Yeah, I would again say that this one is very much tied in with RPRT-53 and where we're going with sufficient accuracy. And many of these findings in this particular neptunium discussion are like that. And I don't want to cut this short, but I really don't know that we're going to be productive and argue about the Peto-Prentice test and the power and that sort of thing at this meeting.

DR. TAULBEE: Well, maybe it would better, Mark, if we just try to identify the ones that are specific for Savannah River here.

DR. NETON: I mean, there are some. I mean, but --

CHAIRMAN GRIFFON: Yeah, that's fine. I also think overall we have to think about how the SEC Work Group work is going to impact on us moving along on the SEC issues. So that's fine, Tim, if you can --

DR. TAULBEE: I'm going to try and do this quickly. It looks like Finding 4 is also an SEC, if everybody is in agreement with that.

DR. NETON: Yeah.

MR. FITZGERALD: I think 5 as well.

DR. TAULBEE: Five is routine monitoring again. Yes.

DR. MAKHIJANI: This is Arjun. Sorry. I was on mute. I didn't realize I was on mute.

On number 3, there is one, an SRS-specific aspect to that, which is all of the OPOS samples as they resulted for neptunium had less than 30 samples in that period. And if the SC&A finding is along the right line, then, you know, a lot of things are moot about whether you can actually calculate the dose or not, because then you can't make the comparisons. And that would be a situation specific to Savannah River, assuming you accept the OPOS method. It's just about whether you have the right minimum number of samples.

So, to some extent, I think it is SRS-specific. Mark, I don't know how you want to proceed to parse some of these things, but pieces of them are specific to Savannah River, in my opinion.

CHAIRMAN GRIFFON: No, I think we should try to discuss those as appropriate. Tim, do you have any discussion on that part of it?

DR. TAULBEE: Well, the minimum sample sizes is a guideline that our statisticians use. It's not a hard and fast rule. I mean, they look at the distribution. And if it seems to be falling a log-normal pretty steadily with, you know, even ten samples or something along those lines, then they'll call it a valid distribution. These aren’t being analyzed by untrained people. They're looking at the data and making some professional judgments as to whether the distribution fits or not.

So I guess I disagree with SC&A's position of we have to have 30 samples in order to do a comparison, because I don't think we do. I think you look at the distribution itself and see how it's looking.

DR. MAKHIJANI: Well, that's not exactly what we said. What we said was that 30 samples are often insufficient, and that sometimes even 50 or 70 samples may be insufficient and 35 may be perfectly good, actually.

Harry might want to explain, he did a pretty extensive analysis that the number of samples is not the only criterion. And you don't necessarily, you know, say that there is some statistician who is going to make a pretty, you know, expert judgment for every case as you go along. There are some specific circumstances and calculations that you have to do to know what the power of the result is.

I don't know, Harry, I think you did a lot of work on this particular question.

DR. CHMELYNSKI: Yes. And, to tell you the truth, it wasn't us suggesting 30. It was NIOSH in their instructions for how to do the OPOS calculations and can use them to compare different groups of workers.

The reference they use for that sample size of 30, I think, is pretty much a hokum reference, but certainly it’s a number that a lot of statisticians pin their hat on for no good reason because usually it is meant for applying it to normal distributions.

The same reference that NIOSH quotes for the sample size of 30 has in it a chapter that's about 30, 40, 50 pages long. It tells you how to compute the sample sizes depending on what the variability is. But, yet, all of that was ignored.

DR. TAULBEE: Sir, in this particular case, we don't have the ability to prescribe how many samples we get. This is retrospective sampling. We have what we have.

DR. CHMELYNSKI: I agree. And at some point, somebody has to make the decision that we don't have enough to make the decision. That's all we're saying. Where do you draw that line?

DR. NETON: All right. And I can say that this issue of practical significance needs to be worked out before we can say that. And that's where we ended up at the SEC Work Group meeting. Until one can define what is a practically significant difference, this is not really relevant. I mean, you can't answer that question.

DR. MAKHIJANI: Well, I can't agree with that.

DR. NETON: Why not?

DR. MAKHIJANI: There is a question of practical significance of the size of the dose. And, as I mentioned in the SEC Work Group, you have to address that not with some arbitrary hundred or 200 millirem number. You have to address that in relation to the uncertainties of the dose calculation and how much you know.

DR. NETON: Exactly.

DR. MAKHIJANI: If you don't have the right number of samples to make a comparison, which is what we were saying, that in the case of neptunium, which is specific to this circumstance, there is no year in which you have sufficient samples to come to a firm conclusion that these two distributions are the same. So you can actually use non-construction worker data for construction worker dose estimates based on the hypothesis that NIOSH has produced.

So the further issue of practical

significance as to what is the uncertainty is is kind of moot until you can settle the first question, in my opinion.

DR. NETON: No. I disagree, Arjun. See, we are getting into the SEC Issues Work Group area, but the way the process was set up was to do an initial screening for significance between the actual bioassay distributions themselves. But the proof of the pudding is when you generate a model that predicts the dose, the intake per year, using all of the data. And that's where the rubber meets the road. And that, in my opinion, is where we need to go to demonstrate a significant difference.

You know, if you take one year and you can say, "Yes, they're different," the next year, "They're not different," but we amalgamate all of those bioassay results into a distribution over a time period, fit it using bioassay models, and then you can say, does that difference in that one year make a big difference in what we would assign the construction versus the non-construction? That's really the end result. So I'm going to try to steer this discussion and the SEC Issues Work Group meeting down that path more and just looking at these base comparisons of the coworker distributions themselves to try to establish what is practically significant.

MR. KATZ: So, then, Mark, this is Ted. This is clearly sort of central ground for the SEC Issues Work Group discussion that has been ongoing. And it probably doesn't work for you. You haven't even been attending that, right?

CHAIRMAN GRIFFON: No, but that's fine. I mean, I let it go a little bit because it's good for me to hear this background. And we can take it up further there. I don't have a problem with that.

Arjun, is that okay?

DR. MAKHIJANI: Oh, that's fine

with me. It's entirely your discretion.

CHAIRMAN GRIFFON: But keep raising any -- if you see Savannah River-specific things, bring them up. And we'll try to at least discuss them here a little bit.

DR. MAKHIJANI: Yeah, well, Mark, that's what I was trying to do here, because I do think that a great deal rides in terms of what distribution you are going to use to make these comparisons. And if you are going to a priori assume that you can put all the samples in one distribution, that's kind of begging the question that was initially raised in all of these comparison reports.

So that's why I'm saying that in this particular case, in all years, the comparison did not have a sufficient number of samples. So I don't know if you can resolve the question by simply putting all of the samples together. That's one thing.

I think the other discussion is likely to be rather long because we haven't even started talking about internal dose yet. So, I mean, that said, you know, it's entirely your discretion. I just raised it because I thought it was Savannah River-specific in part.

CHAIRMAN GRIFFON: Yeah, no, at least we have the issue on the record. I'm not sure we can resolve much further right now.

DR. MAKHIJANI: Sure.

CHAIRMAN GRIFFON: Yeah. Okay. All right. Tim, go ahead, then. I think you said Findings 4 and 5 were also similarly SEC Work Group issues or --

DR. TAULBEE: That's my thought as well.

CHAIRMAN GRIFFON: Joe or Arjun, do you generally agree with that?

DR. MAKHIJANI: Yeah, I agree with that.

CHAIRMAN GRIFFON: Okay.

MR. FITZGERALD: Yes.

DR. MAKHIJANI: Oh, no. Five I have an issue with. Sorry. I was looking at 4 when I said yes.

The two bullet points that are in 5, at the bottom of the page, just about the footnotes there, "Unmonitored individuals are members of a monitored population who are not monitored completely at random." And that these two bullets, these conditions, one of these conditions, have to be satisfied and then we're okay to develop a coworker model. However, we know that construction workers were monitored differently than non- construction workers, or so the records indicate. So the first bullet is not applicable because it was not at random. And the differences were not at random.

And the second is an assumption that we have had a long debate about at many sites. For instance, this was also asserted at Nevada and many places, that unmonitored individuals had no or less potential for exposure. And I also believe that that is a very questionable assumption, including at Savannah River Site.

So if neither of these conditions apply, then NIOSH is essentially saying here that they don't have a coworker model. One of these conditions has to be shown to be true. You cannot assume them to be true, which is what I think NIOSH is doing.

DR. TAULBEE: Well, let me try and further explain this a little bit, then. From the first bullet, "Unmonitored individuals are members of a monitored population who are not monitored completely at random." Okay? So these would be people we know are in a regulated area, that went and conducted their work, but for whatever reason, maybe they were an intermittent person who went into the 235F building, for example, and were potentially exposed to neptunium. We can identify them as such a worker, but they were not monitored for neptunium.

What we're doing with the coworker model is taking the workers who worked in that facility, those guys standing there at the glove box who left a sample once per year. And we're applying their dose to that person. So that’s one application of the coworker model.

The other assumption here is that unmonitored individuals were unmonitored because they had no potential for exposure to radioactive materials. This would be the scenario where we've got somebody who didn't even work in 235F. We have identified them. They weren't monitored for neptunium. We don't see any bioassay for them. We have identified they work at the P Reactor. So they meet condition two there, we would not apply a neptunium dose to that particular person. Okay? So this is the application of this coworker model.

Now, when we throw in the construction trades workers into this group, they can actually fall into one or the other. They went into 235F. Their job plan was such that Health Physics looked at it and said, "We don't think you need to be monitored for neptunium," because maybe they were doing work in the PuFF facility or PEF facility. And so they did feel like they did need to be monitored for plutonium. And so they were specifically monitored for that.

When we look at a badge -- so there was a reason why Health Physics felt this person didn't need to be monitored because they didn't feel there was a potential for neptunium. When we look at their film badge, we see they worked in 235F. And we don't see neptunium monitoring. We’ll look at this. And since they were in that building, we would apply a neptunium dose, that coworker model, to them.

So these are the assumptions on how the construction trades workers fall into this. Okay? We know they weren't monitored the same. We know that they were not monitored routinely, except for plutonium, by the way. There it was once every three years.

With the whole body counts, if there was a contamination incident, then we know that they were monitored. But applying this coworker model, we feel, is a bounding upper estimate for these construction trades workers.

MEMBER LOCKEY: So if a construction trade worker went in to the monitored area, they would be assigned as if they were working that area?

DR. TAULBEE: That is correct.

MEMBER LOCKEY: And can we

identify who those construction workers are?

DR. TAULBEE: Yes, by the badges. If they went into that regulated area, then we would know that they went into -- 200F area is the global one that we would look at.

MEMBER LOCKEY: So, by default, any constructions trade workers would be assigned that --

DR. TAULBEE: If they were badged in the 200 area. Yes, 200F area, for example.

MEMBER LOCKEY: Okay.

DR. TAULBEE: And we actually expand that out to central shops as well because we know sometimes they were dispatched out of central shops to go up there. And so they would be badged out of central shops.

MEMBER LOCKEY: And that applied to DuPont and non-DuPont workers?

DR. TAULBEE: That's correct.

That's correct.

MR. FITZGERALD: Just to clarify, -- I know we talked about this before -- so for CTWs, construction trades workers, you would include them in if they were badge-coded for that area, plus the central shops.

DR. TAULBEE: Right.

MR. FITZGERALD: That would be the universe of what they would get credit for.

DR. TAULBEE: Right, that's correct.

MR. FITZGERALD: Okay.

DR. TAULBEE: Yes. In general, if we can't identify what area they worked in, we would probably assign neptunium anyway. But if we can place them in the P Reactor, no, we're not going to assign that. So it kind of works both ways.

There are some codes where it’s 000, you might remember some of those from the early thorium discussion. We don’t know

--

MR. FITZGERALD: Is this going to be treated in the draft you're talking about? Because I think that's helpful to have that kind of --

DR. TAULBEE: It's in OTIB-81. Correct?

MR. FITZGERALD: For the CTWs?

MR. MAHATHY: We haven't put that -- yes, we do have codes, but we don't have the response.

DR. TAULBEE: We don't have the -- okay. We don't have that actual nuance of the construction trades in there.

DR. MAKHIJANI: We don't have the what? I missed Mark's last words.

DR. TAULBEE: We don't have the specific instructions for construction trades in OTIB-81.

DR. MAKHIJANI: Okay.

MR. FITZGERALD: But that's where you're going with this.

DR. TAULBEE: Right, that's where it goes.

DR. MAKHIJANI: This is Arjun. One of the problems with what you said, or the issues with what you said, Tim, is that, you know, you're speaking as if workers were monitored regularly for neptunium. But the records actually -- there are very few records that actually say neptunium or even protactinium, so that is, you know, as we said before in the earlier morning session, at least for me that's a significant issue because we actually don't have records that say people were monitored for neptunium.

There's a presumption that they were monitored for neptunium but you don't know exactly what they were exposed to. So, when somebody was not monitored, in that respect they are sort of similar to somebody who was monitored in respect of neptunium, because nobody's got neptunium in most of the records. So, you don't have an idea, actually, whether there was an exposure difference between the people who were not monitored and those who were monitored because almost no one was monitored for neptunium.

DR. TAULBEE: Arjun, I will disagree with you on that point. The whole body count monitors for a large number of radionuclides. We’ve got the full spectra. We can look to see what their potential neptunium exposure was. Yes, they won’t have a specific region of interest labeled neptunium but we know where that peak appears and we know what the counts are within that peak. So, these people ––

DR. MAKHIJANI: Yes, my ––

DR. TAULBEE: We know, sir, that these people were whole body counted. We know that. That’s from the records. And these people were whole body counted. We can evaluate their whole body record.

DR. MAKHIJANI: I’m not

questioning that, Tim. I've seen these whole body records, and you've seen them, so there's no question. I'm not questioning at the moment whether you can infer a neptunium dose. A lot of the discourse was what were the Health Physics people thinking and when did they monitor and not monitor people? That's what this Finding 5 is about, not whether we can actually interpret the records to infer something from them.

So, if Health Physics people were making some decisions, as you presented, to monitor or not monitor somebody for neptunium, that presumes that they were actually monitoring for neptunium, and they would have indicated that in the record. There are radionuclides that are indicated in the records of whole body counts, you know, chromium-51, whatever. And you can actually see the designations of those radionuclides. But I'm not saying you can't infer dose. That's a separate question.

What I’m saying is you can’t infer what Health Physics was thinking about monitoring neptunium when they, themselves, didn’t leave any trace of what they were thinking.

DR. TAULBEE: I believe the records show that they do show what their trace was. If you look at the bioassay control procedures from the 1971 era, they clearly indicate that neptunium exposures were only monitored when the plutonium was positive. Okay? That’s in those bioassay procedures. That was their trigger, was off of the plutonium.

Now, when we get to 1978, the bioassay control procedure, it identifies workers in the 235F building as being monitored for neptunium.

DR. MAKHIJANI: But there are hardly any bioassay records.

DR. TAULBEE: There are very few workers.

DR. NETON: That’s because there

are very few workers, Arjun. You have to look at the population of potentially exposed. You can't make these generic decisions about how many people were monitored relative to the potential exposure population.

DR. MAKHIJANI: Okay. I mean, I --

DR. NETON: Few monitoring records does not imply that they didn't adequately monitor. That just doesn't follow.

DR. MAKHIJANI: No. All I'm saying is that --

DR. NETON: That's what you said.

DR. MAKHIJANI: -- you can't presume that they were adequately monitored.

DR. NETON: Because of few monitoring results.

DR. MAKHIJANI: Because we've had this discussion at many sites, that individuals were unmonitored because they had no exposure potential.

DR. NETON: That’s a different subject ––

DR. MAKHIJANI: And we’ve often come to the conclusion that it wasn’t right.

DR. NETON: You just changed the subject, Arjun. You said that we have very few monitoring data, therefore they weren’t adequately monitored. I disagree with that statement.

DR. MAKHIJANI: No, no, I didn’t say they weren’t adequately monitored.

DR. NETON: Okay. Now you agree they were adequately monitored.

DR. MAKHIJANI: No, I said you can’t infer what was in the mind of the Health Physicist.

DR. NETON: We have the procedures that tell you exactly what was in the mind of the Health Physicist.

DR. MAKHIJANI: Okay.

DR. NETON: All right? I don’t

understand the logic. It's not --

DR. MAKHIJANI: Well, my statement, again, is we're talking about what was in the mind of the Health Physicist in relation to neptunium exposure for workers who were monitored or not monitored. And the records actually don't show neptunium exposure, almost any records, so it's very difficult for me, at least. Maybe you can, you know, maybe you can infer more than I can, obviously you can, but I can't tell the difference between what somebody was thinking when they didn't put neptunium explicitly in any of the records they left behind, except for those few bioassay and some whole body counts.

DR. NETON: Well, how many bioassay records do we have, Tim?

DR. TAULBEE: Three-hundred and thirty-three.

DR. NETON: There's 333 bioassay records, Arjun, that are saying neptunium.

DR. MAKHIJANI: But we’re not using them for dose reconstruction.

DR. TAULBEE: No, they’re all lower than the whole body count estimation.

DR. NETON: They’re lower than using the whole body count results which are more claimant-favorable. But if you saw Tim’s graph they track fairly well.

DR. MAKHIJANI: Okay. I guess I have no more. I don’t want to drag this out.

DR. TAULBEE: Okay.

MR. FITZGERALD: Think we’re on 6.

DR. TAULBEE: Number 6. This finding, it’s “NIOSH coworker model for construction trades workers for neptunium for the period of ‘72 to ‘90 would often lead to results that are very claimant-unfavorable.” I guess I disagree with this finding from the standpoint of claimant-favorability.

The data that we have from the whole body count data is clearly very high, from all of the actual neptunium data that we have, for workers with their hands in the gloves that were doing this particular work.

Any time you try to define claimant-favorability and unfavorability and stratify a coworker model -- and this is really part of the SEC Work Group, the stratification issue -- one group when you stratify is going to be more claimant-favorable because you'll be assigning a higher dose, and the other one would be claimant-unfavorable assigning a lower dose.

It doesn't really apply in this case because we're proposing that we use the one coworker model. When we did a comparison between the two, we did not see any difference between the two distributions. We can discuss power and all that later in the SEC Work Group, but we don't have any reason to do this stratification. So, to try and say that the construction trades workers would be very claimant-unfavorable, I just don't agree with that particular basis.

We've got the monitoring records as to who was monitored and why. We showed that the plutonium contamination in the neptunium feed build is at least as equal to the activity of the neptunium. And that was their basis for monitor, at least from the 1971 through the 1978 time period, where you saw in there that little footnote at the bottom talking about neptunium never being higher than –- or plutonium was always an equal activity.

Constructions trades workers were monitored once every three years for plutonium, so claimant-favorability and unfavorability really depends upon whether the SEC Work Group decides that we should stratify construction trades versus non-construction trades, in my opinion.

Jim, anything to add?

DR. NETON: Well, I think we need to focus this specifically on the neptunium issue. And if you look at the process that Tim outlined today, it seems to me that the workers who were directly handling and machining, and whatever, the neptunium sources themselves would adequately –- their exposures would adequately be bounded for the non-monitored workers, unless one can show us some different exposure circumstance where they were in a higher exposure scenario. And I'm having difficulty identifying that.

DR. TAULBEE: And not been bioassayed.

DR. NETON: And not been bioassayed. I mean, this particular –- this focus on the neptunium, which is the subject here, and based on what we know about the process, I just find it hard to envision that an unmonitored worker would have been more highly exposed than the workers who were directly working with the materials on a daily basis.

CHAIRMAN GRIFFON: Joe or Arjun, you got any comments on that?

DR. MAKHIJANI: Well, you know, I -

MR. FITZGERALD: I –

DR. MAKHIJANI: Sorry, Joe, go ahead.

MR. FITZGERALD: No, I was just going to say this is going to come from the statistical discussion that we have yet to have. So, I think, again, we could spend a lot of time going back and forth on it, but I think that's a lot of what's at the root. I'm sorry, Arjun, go ahead.

DR. MAKHIJANI: You know, I've said this before, but we had this discussion about, you know, the general assumption that unmonitored workers had less exposure potential than monitored workers, and even in regard to construction and non-construction workers. And, you know, we showed before that as –- if you –- in most cases that may well be true, but for certain groups of construction workers it didn't look true in regard to particular radionuclides.

Now, we haven't got enough data on neptunium to actually look at this question for construction workers, at least we didn't think so, but in the case, which is another finding further down –- but in the case of –-and I think NIOSH agreed with that, that we don't have data to compare groups of construction workers with other groups of construction workers.

But in the case of tritium, where we did have some information for some periods, we found that for pipefitters, for example, if I'm remembering correctly, they were different than other construction workers, and they were also different than non-construction workers. So, I think when you have a paucity of data for construction workers and you know they're not the same, electricians and carpenters are different than pipefitters, and that's not, you know, randomly looking for people who are higher exposed, it's going by the physical and technical situation of what jobs these people did.

I don't think that you can presume that somebody who was machining was less exposed than some particular construction worker who was fixing the equipment.

CHAIRMAN GRIFFON: Just to go back to Jim's statement, I mean, I think, from my standpoint, the only compelling argument I've heard that there could be a situation where -- well, non-monitored workers, but you may answer this that they were probably monitored -- could be higher than the others, was the circumstance or the testimony about bringing in construction workers to do some of the dirtier tasks because they could burn them out, you know. But in that case, Tim, I think you gave examples where they actually did have –- you know, they did monitor those folks.

So, you know, if they were monitored and we could crosswalk that and say even these worst cases, clearly, they were –-you know, the construction workers were brought in for potentially higher exposure tasks but they weren't monitored. If we can confirm that point, I think I would probably be in agreement with what Jim said earlier.

DR. TAULBEE: Okay. How would you want us to crosswalk that, Mark?

CHAIRMAN GRIFFON: I'm not sure. I'm just talking right now. I'm not tasking anything. But, I mean, I just –-

DR. TAULBEE: Because I think it can be done, but it's going to be a weight of evidence type of scenario.

CHAIRMAN GRIFFON: Yes. Right, right, right.

DR. TAULBEE: Just looking at multiple records and just presenting, you know, volumes of data to --

CHAIRMAN GRIFFON: Yeah, I'm not ready to ask for that task yet.

DR. TAULBEE: Okay.

CHAIRMAN GRIFFON: I'm just thinking out loud about the one circumstance that I can conceive where those workers could get higher exposures.

DR. TAULBEE: Well, if you recall, a couple of years ago when we started down the path of the stratification or non-stratification for construction trades, and then within construction trades it's by job type, we proposed tritium to start with. And my next move was to actually look at tritium, do as much comparisons as you wanted, then go to uranium where we have another plethora of data, look at that. Look at plutonium then where we have more data, not as much as uranium, but pretty close.

And when it comes to construction trades we know there's a routine monitoring there. But at the time, instead of going through each of those, because this was going to be a lengthy evaluation, you had asked us to look at americium, curium, californium, neptunium and the fission products, and so that's how we've jumped to neptunium here.

And, I mean, I understand Arjun in saying that, you know, we don't have a lot of data in order to try and satisfy further down. We get to where we have zero samples for a particular trade. And the reason is, is that the neptunium exposures were really confined to small, general areas. So we don't have this large population that we can do that evaluation effectively.

So, we’ve got to try and do some kind of a weight of evidence, or reliance upon the procedures and the monitoring that we see. Otherwise, we should jump back up to uranium and plutonium and do the evaluation that Arjun is proposing for those.

DR. NETON: In this particular limited instance, I mean, you have to have some sort of a rationale for stratification. I mean, you can’t go around proving negatives all the time, that they weren’t more highly exposed. I mean, you have to look at on face value for this limited purpose operation and, you know, I don’t know. I think that you can’t just make up potential high-exposure scenarios, or say that you can’t –- you know, this is not bound. In this particular instance, I think we’ve got the waterfront covered. Yeah, I don’t know.

CHAIRMAN GRIFFON: And, again, Jim, I wasn't trying to task or make, you know ––

DR. NETON: Yes. No, I agree.

CHAIRMAN GRIFFON: But I also don't think I'm making it up. I think you guys heard this from the interviews you did. And Tim agreed that this did happen, so I don't think that that's a complete hypothetical, you know.

DR. NETON: Yeah, we also have to remember these are chronic exposure models that we're assigning here.

CHAIRMAN GRIFFON: Right, right, right.

DR. NETON: If they were present there for 10 minutes doing a job or assigned to that area, they're going to get a chronic exposure for the entire year of operation for neptunium.

CHAIRMAN GRIFFON: I agree, and I think it is –- I think several of these things come down to weight of evidence arguments, and we may have enough evidence already. I’m not looking for more –- necessarily looking for further validation of it.

DR. NETON: Okay.

CHAIRMAN GRIFFON: So, okay.

MR. BARTON: Could I ask a clarifying question here? This is Bob Barton. It’s about the data set that’s currently being proposed for the coworker model.

Now, as I understand it, the data that we have are in vivo records that were pulled from claimant files that we have. Is that correct?

DR. TAULBEE: Yes.

MR. BARTON: Okay. So, I mean, would it be fair to say that, essentially, the data set that we have kind of represents an entire cross-section of the site of, you know, people who were in the controlled areas. I'm not talking about people who never entered a radiological area, but the data that we have really represents a cross-section of the entire site. Is that correct?

DR. TAULBEE: That is correct.

MR. BARTON: Okay. I mean, I guess I would ask has any comparisons attempted to be made between the people who were actually in these neptunium areas and who have in vivo data versus the rest of the population? Because I heard it just said that, you know, the people who were involved in this stuff and who were exposed were probably rather limited. And I guess just logically I would think you would find those people in the upper tail of this distribution of value since probably a significant portion of them never even entered these areas where neptunium exposure was possible.

DR. NETON: I think Tim did a

comparison of the people that had neptunium bioassayed to the generic in vivo model. Right? I mean ––

DR. TAULBEE: Just on that one graph, just showing the neptunium urinalysis versus the in vivo model that we came up with.

DR. NETON: Right.

DR. TAULBEE: I think what Bob is asking is have we done a comparison of the people for which we have whole body counts in the F Area, M Area, H Area, and A Area to everybody else? And the only –- that comparison would be those four groups versus reactors.

MR. BARTON: So, you're saying the majority of the records you have are in these –- I mean, when you say, like, F Area, I mean, that's a pretty significant portion of that site.

DR. TAULBEE: Yes. That is correct. And, yes, when you look down the breakdown of the whole body counts that were used in this analysis, and Matt Arno, please correct me if I'm wrong here, but the vast majority of the in vivo counts that we used in the analysis were from F, H Area, and specifically the HB Line, M Area, and 235F. Is that correct, Matt?

MR. ARNO: Yes, it is.

DR. TAULBEE: Okay. I want to say, and this is off the cuff here, I want to say it made up like 75 percent of the data.

MR. ARNO: I don't remember the exact number but it's definitely over half.

DR. TAULBEE: Okay.

MR. BARTON: You know, I'm wondering, and I'm just kind of thinking here. I wonder if it would be illustrative to take those workers that we know have neptunium urinalysis records, presuming that –- I guess it was triggered off of plutonium so you can't really say for sure whether they were the highest exposed, the neptunium workers -- but that would give you a starting point to try to make some comparisons and assure that those people who were on the bioassay program were also, you know, represented in the distribution of in vivo counts that's being proposed.

Of course, this whole issue is just –- it's sort of establishing that data completeness facet. I mean, there are the people that we wanted to grab, are they actually in that distribution? Where are they in that distribution? And then that kind of points to how you would implement a coworker model to assure, when you don't know who necessarily were the highest exposed neptunium workers, or if there's a potential that an unmonitored worker had a significant intake, you know, how you then apply that coworker intake to assure that you're going to bound that dose.

DR. TAULBEE: Well, I think from

the first part of your comment or question there as to can we identify those workers that have the bioassay and the in vivo and do that comparison? I think that's doable. It's certainly doable. From the standpoint of -- I'm trying to think of the second part of your question there -- of applying that from the coworker, I think that's where we were talking earlier in our opinion that these workers, that coworker model, and especially using the whole body counts that we've proposed here, would be a bounding type of scenario for somebody who was unmonitored for neptunium in these areas. Does that help any?

MR. BARTON: Yes, it does. Thank you.

DR. TAULBEE: Okay.

DR. NETON: I think we need to be a little careful here and remember that we're talking about deciding whether these are SEC issues or not, as well. And sometimes, you know, we can make a decision on that without really going to the complete, full degree of analysis on some of these areas. You know, the question is do we have enough neptunium data in some way or another -- enough data to evaluate neptunium exposures and generate a coworker model. I think Tim is showing that we've got several options. We've proposed the most conservative, claimant-favorable option at this point.

DR. TAULBEE: So, should we move on to Finding 7?

CHAIRMAN GRIFFON: Yes, yes.

DR. TAULBEE: Okay. This one I believe is actually part of the SEC Work Group, as well, because it's talking about the statistical validity of the test, along with Number 8. Do you agree, Joe?

MR. FITZGERALD: Yeah, I think those are all the same.

DR. TAULBEE: Okay. Number 9 is

one where this is actually Savannah River-specific. And this is, I think, just a misunderstanding between what we're proposing here and what I think Arjun was trying to talk about earlier.

DR. MAKHIJANI: Oh, that would have been Joyce.

DR. TAULBEE: Oh, okay.

DR. MAKHIJANI: Yeah, well, I kind of stood in a little bit for her.

DR. TAULBEE: Okay. And this is are we giving preference to the results in the I-131 region over results obtained using chest geometries to calculate the neptunium body burdens and intakes in the period when results were reported in units of count rate. NIOSH did not explain why the in vivo results obtained from the 40 centimeter geometry were preferred over the results obtained from the chest count geometry-derived neptunium-237 intakes.

What we've got actually is a

whole body count that is -- when they did the chest count they were using Phoswich detectors, and so they were looking at a lower energy portion of the spectrum. At the same time they were doing the chest count they were doing these whole body counts. And this was earlier a big detector with a 40 centimeter arc and in the latter time period they were on a table, on a stretcher, and there was multiple sodium iodide detectors underneath the body below.

So, you know, the preferences to use the results from the I-131 region of the spectrum rather than a specific geometry. The in vivo measurements are based on the 230 to 290 keV region of interest as shown in the Figure 1 of the SC&A report.

Neptunium-237 has five different gammas in this region with a summed abundance of .08 percent. Protactinium has an additional two gamma rays with a summed abundance of .06 percent. However, in contrast, proactinium-233 has five gamma rays with a summed abundance of 51 percent in the 300 to 400 keV region of interest. So, we’re looking at a little higher region of interest that’s two orders of magnitude greater which allows for the MDA to be two orders of magnitude smaller. So, this is why we’ve preferenced this I-131 region, is because that’s where the protactinium would appear.

Now, from what you saw from the gamma dose rates coming off of these billets, the protactinium was present, it was growing in very rapidly. So, this is what we were triggering these whole body counts off of, because of this MDA two orders of magnitude smaller.

So, the gamma ray abundance from neptunium-237 in the 230 to 290 region of interest is simply, in our opinion, too low to allow for a reasonable use of the data. So we opted for the higher region of interest. That's the basics of why we chose the I-131 region of interest for our evaluation.

MR. FITZGERALD: That helped me, but Joyce isn't here. I think that would be the real closure we need on this thing, so as I said -- I might have said a little earlier, we're certainly going to focus her on this the next couple of weeks.

DR. TAULBEE: Okay.

MR. FITZGERALD: And make sure that we have a final closure on the item. But, yeah, I thought that was very helpful. Hopefully, it will be for her, too.

DR. TAULBEE: Matt, do you have anything to add to that?

MR. ARNO: No, that covers it.

MR. FITZGERALD: Anyone on the phone from SC&A? Again, I think that's something I'd like to make sure Joyce takes a look at, but any other comments?

DR. MAKHIJANI: Yeah, I agree

with you, Joe. This is Arjun, that and Finding 10, also I think is along similar lines.

DR. NETON: I think a lot of these findings are going to be in vivo-related.

MR. FITZGERALD: Yeah, she really focused on this section and, unfortunately, the timing wasn't good for her to be on this call. So I would suggest, 9 through 15, if we can defer those and have her -- rather than talk about it and have to go back and have her treat it again -- just go ahead and have her provide that response to you.

DR. TAULBEE: Okay. Sounds good to me.

DR. NETON: Might go beyond 15, 16.

MR. FITZGERALD: Well, 15 definitely. I wasn't sure about 16.

DR. NETON: Sixteen is, again, in vivo -- iodine and chromium in vivo –

MR. FITZGERALD: Okay.

DR. TAULBEE: Actually, let me speak to this one just a little bit here, because the findings --

CHAIRMAN GRIFFON: Wait, which one are you on?

DR. TAULBEE: Number 16, I'm sorry.

CHAIRMAN GRIFFON: Sixteen, okay.

DR. TAULBEE: It says assuming neptunium-237 doses to workers who had I-131 or chromium in vivo counts but no exposure potential to neptunium-237 is scientifically unreasonable even though it may provide a claimant-favorable result.

The only reason that we're using those regions of interest is because that's how they're identified on there. We're actually not worrying about whether they were exposed to I-131 or chromium-51. We're just looking at that region of interest. The actual potential for exposure has nothing to do with why we were using that region of interest. So, just so that you all understand.

MR. FITZGERALD: I kind of got that, but not quite sure --

DR. TAULBEE: We weren't trying to say people were exposed to neptunium were also exposed to iodine and chromium.

MR. FITZGERALD: Unlike some sites, you actually do have the curves, you have the data from the whole body counts so you can infer from those results --

DR. TAULBEE: That's correct. We have the actual data.

MR. FITZGERALD: Right, you actually have the data.

MR. KATZ: Okay. So, that takes us through 16.

DR. NETON: Seventeen's the same thing.

DR. TAULBEE: No relevant whole body count data available.

MR. FITZGERALD: Right, 16 and 17

are related.

DR. TAULBEE: Okay. All right. Number 18, the finding is there are sharp discontinuities between the intake estimates using the in vivo data and the urinalysis.

CHAIRMAN GRIFFON: Wait. Did we go over Finding 17, or –

DR. TAULBEE: Yeah, we've lumped that in with 16.

CHAIRMAN GRIFFON: Oh, okay.

DR. NETON: That was an in vivo –

CHAIRMAN GRIFFON: All right. All right. Sorry. Go ahead, it's 18.

DR. TAULBEE: Number 18, there are sharp discontinuities between the intakes estimated using in vivo data and urinalysis, with the former being much higher than the latter. NIOSH has not explained whether these discontinuities resulted from sudden changes in actual exposure conditions. If not, the discontinuities may indicate a problem with our approach of using whole body count data to estimate neptunium body burdens and intake rates as described in RPRT-56.

The observation, we fully understand the discontinuity. The discontinuity has to do with our switch of using from urinalysis data, where we have abundance from 1961 through 1969, you know, from 1972 or -- yeah, 1972 to 1989 we only have 333 samples. In that earlier time period we have several thousand samples, so they were doing a lot more neptunium monitoring in the 1960s.

When you look at the bioassay control procedures from that 10 years of experience, they never saw neptunium exposure that didn't have an equal amount of plutonium. They really started triggering off of the plutonium and not monitoring as many people for neptunium directly.

Because at the time we were doing this coworker model we didn't know what that plutonium-neptunium ratio was or how it behaved over time, we chose to use the whole body counts. So, there is a disconnect, because the site stopped doing a lot of urine-specific neptunium bioassay, just triggering off of plutonium, but we do have a whole body count for the same workers that are doing this particular work.

So there is a discontinuity, a higher MDA if you will, because the site wasn't using really the whole body count as their dose of record for this particular person. The site was basically assigning zero unless there was a positive plutonium, then they would do an analysis for neptunium. And if the neptunium was positive, assign a dose. That's why we have so few samples between really 1971 time period to 1978.

What we chose to do, we know these same workers were being monitored whole body count, so we chose to use the whole body count, results in a higher MDA. That's the reason for the discontinuity. That's the reason for that big jump up that you see.

When we assign the intakes we're giving claimant-favorable dose in that time period, with a higher MDA, to the workers that were in that particular time period. But we don't feel that those doses are unreasonably high, as I showed earlier with those organ dose assignments.

When we get back into the 1990 time period when we have alpha spec and MDA drops below again, then we start using it again. That line that I showed if we were to interpolate between the two, you're looking at almost an order of magnitude difference decrease over the 1970s and '80s in the actual coworker model that we see.

So, these discontinuities aren't anything that is a problem, really. It's just showing our methodology and how we changed and how we're being claimant-favorable to make sure that this dose during this time period is actually bounding.

Any questions on that? Joe?

MR. FITZGERALD: None from me. Anybody on the phone? I thought that was a pretty good explanation in the paper.

DR. TAULBEE: Okay.

MR. FITZGERALD: I guess not.

DR. TAULBEE: And 19 follows along that same line.

MR. FITZGERALD: Nineteen is the same, yeah.

DR. TAULBEE: Yeah, for the discontinuities.

CHAIRMAN GRIFFON: Okay. So it seems, on the balance, a lot of these things are going to the SEC Work Group, and the remaining ones are kind of issues that Joyce has to look at further.

MR. FITZGERALD: Yeah, interpretation of region of interest. But I think, again, those are kind of pretty technical questions on the in vivo data interpretation.

CHAIRMAN GRIFFON: Right.

MR. FITZGERALD: We can respond to those in writing when we provide a response.

CHAIRMAN GRIFFON: Okay.

DR. MAKHIJANI: This is Arjun. And that would include this last one, 19, I think.

DR. TAULBEE: Yes.

MR. FITZGERALD: Right, all those.

CHAIRMAN GRIFFON: All right. Is there anything else to be discussed here on these responses?

MR. FITZGERALD: We're fine from here, Mark.

CHAIRMAN GRIFFON: Okay. Then I think we should move on to the next item, if that's okay with everybody.

MR. KATZ: Yeah.

CHAIRMAN GRIFFON: And I think that involves -- Tim will take the lead.

DR. TAULBEE: Yes. Give me just a few minutes here.

CHAIRMAN GRIFFON: Sure, sure.

DR. TAULBEE: I need to log back into Live Meeting here.

CHAIRMAN GRIFFON: Hey, Ted, I'm also looking at the time. Do we have any time constraints on the Board?

MR. KATZ: We do. We have to break by no later than 5, would be the latest.

CHAIRMAN GRIFFON: Okay. Okay. Because I think we may want to -- we'll let Tim do this presentation.

MR. KATZ: Yeah. We'll need to schedule another meeting.

CHAIRMAN GRIFFON: Yeah. And then we may want to also move that last item up, but let's let Tim go forward here, and then we'll see where we're at time-wise.

MR. KATZ: Yeah, that makes sense to me.

CHAIRMAN GRIFFON: All right. Okay.

DR. TAULBEE: Okay. All right. Apologize for that. So, now this next one is to talk about thorium at the Savannah River Site post-1972. Some of this is going to be a repeat from the Board meeting that we held, was it December of last year, December 2012, some of these slides, but it kind of refreshes everybody's memory a little bit about the thorium.

So, I'm going to over the thorium inventory, the processes involving thorium, the radiological controls from '72 to 1990, the alternate bioassay method, the bioassay control procedures, specifically for the thorium areas, the americium-curium-californium-thorium comparison, and then the thorium from 1990 to 2007.

Okay. So, if you recall, when we

look at the thorium inventory at Savannah River over the time period of 1955 through 2007 era, this is what it looks like. This is kilograms of thorium. And you can see that post-1972 time period it’s pretty stable, there at about a little under 10,000 kilograms of thorium.

Well, this particular thorium that’s there onsite that’s making up the bulk of the inventory is in the receiving basin for offsite fuels. This is encapsulated spent nuclear fuels from offsite reactors, from Elk River, for example. These reactors, when they shut down, they sent their fuels to Savannah River for storage. So these are thorium fuel elements stored under water. The fuels are repackaged under water and they’re store under water. Here’s a couple of pictures of the RBOF building, spent storage in the repackaging basin, so all of the work here that’s being done with thorium is under water. There is, as I would contend, no potential for exposure to this thorium at the Savannah River Site.

So, if you go back to the inventory and you strip out the water-stored, encapsulated spent fuel from the thorium inventory, this is what it looks like. And you can see, post-1972, it’s extremely small compared to what they used to deal with. However, there is still some inventory. The inventory, as I said, is very small.

This is now, if you look at the scale, this is from zero to 1,000 kilograms. You go back a scale, this would be less than that first tick on your graph. Okay? Let me point this out here. This first tick here is 5,000 kilograms. I’m going to one-fifth of that first tick and that’s the thorium inventory that we have at Savannah River. These other ones going off-scale are the big years of production. Post-1972, we’re down here under 400 kilograms, and when you get to 1985 time-frame through 1989 time-frame it goes even lower, it goes down to less than 50 kilograms. Okay? So, we are talking about in this time period thorium used in research. This is not a production type of scenario. This is thorium being used in research.

Here’s the actual thorium inventory. As I mentioned, there’s low inventory, it’s at minimal locations. The bulk of it here is in 773A; ‘73 you’ve got 154 kilograms, goes all the way down 1986-87 time-frame to 5 kilograms. So there’s not much thorium there.

Two-hundred kilograms, just for your frame of reference, of thorium oxide would be 10 two-liter bottles of thorium oxide. So the inventory that you’re looking at there in 773 would fit on this end of the table easily. This is a very large chemical building. Okay? So, you’ve got small labs in this building that are using the thorium.

Other areas, 235F, during the startup of PuFF they used thorium as a stand-in for plutonium. And we’ve been able to see some pictures of the actual thoria spheres that they pressed together to simulate plutonium. Four kilograms, very small. 772F lab, again very small.

M Area had some thorium but, again, 23 kilograms is pretty small for thorium. This 23 kilograms here would fit in one two-liter bottle. That’s all that we’re talking about here. A Basins, L Basins, and RBOF, this is all encapsulated.

MR. FITZGERALD: What was the M Area operation, again? I can’t remember.

DR. TAULBEE: The M area is where the extrusion presses were, where the uranium fabrication was. So there were times --based on this particular inventory, especially post-76 time period, it would -- it’s really -- help me out here, Mark.

MR. MAHATHY: From what we saw, they did do extrusion in the ‘60s and that was storage that they were getting rid of. It’s smaller each year.

MR. FITZGERALD: Okay.

MR. MAHATHY: So, they didn’t do anything with it in the ‘70s.

MR. FITZGERALD: Right.

DR. TAULBEE: Right. Now, we did see, in the late ‘60s here, that they were using some thorium in the M Area as a stand-in for those neptunium extrusions, by the way.

MR. FITZGERALD: Right.

DR. TAULBEE: So, we did see that, but that was back in the 1960s, not in this time-frame. Okay? So, we have minimal locations. This is the total inventory, the green is 773A, and then the non-storage area is all of the other areas. So, you can see 773A is where the thorium was really being worked with on the site at this time period.

And it’s also interesting to note here that the inventories from ‘73 to 1990 are less than the inventories from 1990 through 2007, so there’s more thorium in 773A in the modern era than there was back in the ‘70s and ‘80s.

So, what were they doing with this thorium? Well, in ‘72, there’s the Alpha Material Laboratory which used thorium oxide as a surrogate for plutonium-238 when they were testing out glove boxes. In ‘73 they used gram quantities of thorium dioxide were used in the hot cells to test vapor deposition. From ‘77 to 1980, and this is where we interviewed all those folks back in August of this year. They were working as part of the alternate fuel cycles, and the Thorium Fuel Cycle Technology Program.

There were several projects that were going on, and if you recall from their discussions, they were talking about using gram quantities, very small quantities, but using lots of them. You know, baking small little fuel pellets and dissolving down four or five of them at a time inside their fume hoods. And this is the work that they were talking about doing with the thorium.

And some of the other examples of research that they were doing as part of this thorium fuel cycle study, mechanical grinding in the high-level caves. And this was a study of effects of heat treatment on the thorium oxide, conceptual testing of the flow sheets of the Elk River fuel in the high-level caves, analysis of off-gassing of the spent foreign fuel from the Elk River fuel. They took some of the Elk River fuel from the RBOF, sent it to the high-level caves and cut it, actually, and they were actually looking at the tritium that would be coming off and whether that could be an issue or not.

Hanford prepared and encapsulated 30 fuel rods with 80 percent thorium oxide and 20 percent uranium dioxide for irradiation in the reactors. SRS received the rods in 1979 and stored them in a cage in 773A. This entire program was cancelled in May of 1980 before they could be irradiated. So they were never irradiated, nothing was ever done with them. They were sent back to Hanford.

Other knowledge that we know, the plutonium or PuFF, Plutonium Fuel Form Facility, 1980, this thorium was used as a surrogate for some of the work. It was used in hot cells of PuFF. If you remember those two red boxes on each side, those are the hot cells, the center part was the control room which had manipulator arms. The Galileo Project, thorium was used as a surrogate for plutonium during the testing of it.

From 1990 to 2010, this is that increase from very small quantities, 5, 10, 20 kilograms of thorium to 200 kilograms of thorium, is thorium was used as a surrogate for plutonium and other radionuclides to test methods for Defense Waste Stabilitization and Immobilization. So glass vitrification is what they were using it for in the 1990s. And I'll get into that in more detail here in a little bit.

Again, radiological controls, I went through this earlier with the neptunium. I'm not going to go through them all again, but if you recall, we've got all of the same work and regulated areas, protective clothing, radiation exposure control.

What we have for dose reconstruction for thorium in this time period in 773A is a large number of workers were monitored for americium, curium and californium. A review of the bioassay method during the development of the coworker model for this americium-curium-californium revealed that thorium would come through in the analysis, and the alpha emissions would be counted as if they were americium-curium-californium.

This is where actually Sam Glover helped us out looking at their chemistry process, and going through and figuring out would the thorium come through. Because what we found is in a later procedure they added thorium as a possible concern -- or not a concern but an acknowledgment that thorium would come through in this analysis, that this was a -- byproduct is the wrong word. What word am I looking at? It’s not a contaminate, it’s –

MR. MAHATHY: Surrogate?

DR. TAULBEE: No. We’re using it as surrogate but it’s -- it came through. If you look at the actual publication by Butler & Hall in Analytical Chemistry in 1970, they talk about a procedure that was developed for sequential extraction of plutonium, neptunium and uranium with tri-isooctylamine, TIOA, followed by extraction of thorium, americium, curium, berkelium, californium and einsteinium with bidentate. Compared with previous methods, the new procedure is simpler, requires less analysis time and gives you better recovery. The recovery of americium-curium-californium from 250 milliliters of urine or 20 grams of feces was 90 percent.

The alpha-emitting actinides from thorium through einsteinium extract indicating an excellent gross alpha analytical procedure. The data showed that in the analysis, americium-curium-californium, any contaminating plutonium, neptunium and uranium must be removed.

At this laboratory, thorium, berkelium and einsteinium are not present in biological samples in sufficient quantities to require separation or routine identification by alpha spectrometry.

Because they were working with so little bit of thorium they didn't view this as a problem in their bioassay method. So they didn't take any efforts to try and remove the thorium, so it came through in the analysis.

So, no effort was made by the lab to remove the thorium contaminant from the urine samples. Why? The activities are much lower. It wasn't viewed as a significant contaminant. Thorium was used as a surrogate because it was less hazardous than plutonium, safer to use.

So, effectively, what we have with this americium-curium-californium method is that it doesn't contain plutonium, uranium or neptunium, but does contain thorium, americium, curium, californium, einsteinium and berkelium. So, this is the method that we are proposing to use, is these americium-curium-californium gross alpha method that contains thorium, because they didn't do any chemical separations against it and they knew that it came through in their procedure.

If you go back to DPSOL 193-302 1971, who was monitored for americium, curium and californium? The top line you'll see 221F where some of the separations were done, and selected 772F people because they were doing some of the analysis for the americium-curium-californium.

Down here at the bottom, 773A, they were getting two americium-curium-californium samples per year. Who was being monitored? Analytical chemistry, high-level caves, building services, these would be your maintenance guys, radiation control, and your maintenance personnel.

In 773A, Category W, the next line down, selected clerical supervisory personnel and selected 100 Area personnel were given one sample per year. So, again, the frequency, high-level caves and the building services, rad control, maintenance personnel, are sampled more frequently than your clerical personnel in 773A, but they're both being monitored. But was everybody in 773A monitored? No.

If you go to the second line down that I've highlighted, 773A reactor engineering group and 777 M personnel were not monitored for americium-curium-californium. They didn't have an exposure potential to it. They weren't working with it. It was just the people in the analytical chemistry, high-level caves, radiation control, maintenance personnel that were really the ones that had the potential for exposure, and they were being monitored more frequently for this potential exposure.

This is 1971. Again, construction trades workers, you've seen this before, other nuclides as specified by Health Physics and the construction job plans. Okay? So, there wasn't any routine monitoring for americium, curium, californium, or thorium for construction trades. But if they were doing work in that area, the Health Physics reviewed these job plans and decided they needed to be monitored, they were monitored. But it would be in the job plans, their monitoring frequency. Okay?

MEMBER LOCKEY: What do you mean if they decided --

DR. TAULBEE: They did an evaluation of the job to see if there was a potential for exposure to americium-curium-californium, and then they would apply the monitoring.

MEMBER LOCKEY: And then they were monitored?

DR. TAULBEE: That is correct. Let's see, did I jump ahead? Yes. I've got to go back, sorry. That was 1971, 1978, discussed that earlier. Again, if we look at the 773 here at the bottom, and I think I've outlined this on the next one, yes.

Oh, let me go up here. 773A, minimum potential, they were in bioassay category A right here. 773A, selected analytical chemistry division, separations chemistry division, high-level caves, radiation control, building services, maintenance personnel. This was that other group that we talked about there. Reactor engineering, selected clerical and supervisory personnel, and then they identified a group of maximum potential selected personnel.

So, let's look at all these categories here. Minimum Potential A, one sample every three years of plutonium. Analytical chemistry, high-level caves, C and T, two plutonium per year, one americium-curium-californium per year. Reactor engineering, A, E, and L, one plutonium every three years, enriched uranium one per year, L, four natural uranium. Okay? Clerical supervisory personnel, B, one plutonium. Maximum potential exposure, C, F, L, and U, C two plutonium, F two enriched uranium, L four natural uranium, U two americium-curium-californium.

So, people they viewed as having a maximum potential for exposure in 773A they monitored americium-curium-californium and thorium twice per year. Others, analytical chemistry, once per year. You'll notice here in 1978 that the clerical personnel dropped off from that particular monitoring scenario. Okay? Again, construction trades workers by job plans.

So, again, bioassay control is prescribed by the work area and based upon the potential for exposure, which division they're working in, which group. Construction trades workers were under job plans.

Our dose reconstruction methodology, we propose to use the americium-curium-californium-thorium bioassay results to reconstruct the thorium doses. Given a particular cancer, NIOSH will use the radionuclide -- americium, curium, californium, or thorium -- that results in the highest dose to that organ of interest. So, the people that are monitored here we're going to evaluate their organ, or their cancer, where their cancer site was, and assign that alpha dose to one of these four radionuclides, whichever one is higher. If thorium is higher, then we'll assign it.

Here is a table of americium-curium-thorium doses that I can go through here and try and show you what these doses are. In this particular case, if a person had bone cancer, we run through and we evaluate. If the dose -- or based upon those bioassay results of that americium-curium-californium-thorium result, if we assume it's all americium, the dose to the bone would be 18.9 rem. If it's all curium, it's 15.2 rem. If it's all californium, it's

36.58 rem. If it's thorium Type-M, this would be M-class solubility, it's 37 rem. Thorium Type-S, it's 37.9 rem. In this case, we would assign 37.9 rem due to thorium.

Moving on to the kidney. Here you can see that thorium is the highest, but in Type-M category, not in Type-S. Lung, in the lung particular case, it's Type-S, obviously. It's staying there in the lungs. But these doses are not incredibly large, they're reasonable. These are doses that we can assign. They're actually less than some of the plutonium missed doses that we have assigned. So these are what we consider to be reasonable doses for an example dose reconstruction.

So, like we did with neptunium, we compared the bioassay for two different groups of workers, construction trades, non-construction trades, and the non-construction trades and unknowns. In this particular case, instead of evaluating a few hundred samples of whole body count, the total number of americium-curium-californium bioassay that we have is about 17,000. So we have a lot more data here for this.

So, let me -- this is a table directly out of the RPRT-455. So, let's look at 1978. I've highlighted it here just to try and show the amount of data that we have. In total of all workers that we have data for, we have 306 americium-curium-californium-thorium bioassay results from 1978. This is comprised of 228 people, one person, one statistic.

So, this is the number of people that these 306 samples is divided amongst. Sixty-six of the bioassay were from construction trades workers that we've identified, making 49 construction trades workers, these are samples/workers. Non-construction trades workers were 232 workers -- or 232 samples amongst 171 workers. And then when you add the unknowns in here, we add in eight more unknowns in that particular case. This is non-construction trades plus unknowns, 238 plus 8 gets you to 240. So there weren't many unknowns but we did have some in here that we didn't know whether they were construction trades or non-construction trades.

So, here's the data that we have, 1978. If you look at the worker and bioassay proportions, if you look at the total site population of all workers, non-construction workers, there were about 6,000: 5,944 in 1978. There were 1,900 construction trades workers. The population ratio is about .33, the bioassay ratio is about .27.

Remember the monitoring frequency of construction trades is based upon the job plans. What we can see here is that their bioassay frequency is actually about the same based upon the actual population on the site.

The reason I would attribute this to -- the reason I'm trying to point this out here is if the job plans weren't properly evaluated and people were not monitored, construction trades workers were not monitored for americium, curium, californium or thorium, we wouldn't be seeing in this previous example here 49 construction trades workers that are actually monitored for americium-curium-californium. A total of 66 samples, so some of those job plans indicated sampling is more than once, or they're involved in an incident and left more samples.

So, the job plans here for construction trades are actually following what the actual plant population distribution is, even though they weren't on that routine monitoring. Those job plans is how they were identifying who would monitored.

When we did our comparison of the Peto-Prentice, and again this is that less than .05 evaluation, there was only one year that the significance was greater than .05. Okay? This was 1985. However, the significance -- the Peto-Prentice -- I'm going to mess this up without Nancy here. The Peto-Prentice has to be less than .05 and the Peto-Prentice has to be less than the Holm cut-off. That's how that had to work out. Is that right, Mike?

MR. MAHATHY: Yes.

DR. TAULBEE: Because that one there is less than .05, but it wasn't less than the Holm cut-off. The Holm cut-off is another statistic of repeated analysis of the same group, and I'm sure Harry and Nancy and Tom will all be discussing this as part of the SEC Work Group, but I just wanted to show these results. We had one year that showed there was a statistical difference between the two distributions.

When you fit the data in this time period, and this is what Jim was getting at earlier here of looking at the whole picture of the whole error bounds. What you've got here is the blue is the -- and these red -- or not the red dots, the green dots are covering up the blue quite nicely here -- are all monitored workers versus the construction trades workers are in the red. There's 1985, by the way. And then the green here are the non-construction trades workers.

These are the two models. Three of them are all following on top of each other, all monitored workers, non-construction trades, and on non-construction trades and unknown. And then when you evaluate the construction trades workers separately it is slightly higher, mostly being driven up by this one sample point here when we did the two intake models.

But if you look at the actual

error bounds, this is the errors bounds upon the central -- the lower of the two curves. You can see that the uncertainty that we apply to this is pretty large, and construction trades workers would still be bounded by this, by the uncertainty of what we’re looking at here.

So, again, this is being discussed by the SEC Work Group. This is the actual big case that they’re evaluating, not so much neptunium because this is where we have more data than we have for neptunium data.

So, construction trades workers from ‘72 to 1989, we have 1,600 samples. Non-construction trades we have 7,500 samples. Unknown, 422. Recall, again, construction trades were only monitored based upon job plans. I contend that if construction trades workers were never monitored, then we would not have 1,600 bioassay samples for construction trades workers. But we do, so this is why I feel that we can estimate their dose.

Okay. Now, this is a little bit of a break. That was up to 1990. That's in that time period where the inventory is very low, 1990, now the inventory goes up to 200 kilograms. Actually all the way up to 400 kilograms at one point.

What we originally proposed, and this where I'm -- I guess I should apologize to you all. What we originally proposed was we'd use the whole body counts to bound the thorium exposures. We are changing that. The reason, though, is that although these doses are bounding, the assignment of the whole body count missed dose result in some significant doses in a modern era that we just don't believe occurred given the radiological controls at the time. This is the time period of 10 CFR 835, lots of radiological controls going on. This is a modern era.

What we're proposing to use is an air sample concentration which is 10 percent of the plutonium DAC as a maximum potential for exposure. And this 10 percent of plutonium DAC is the cut point for when they would people in respiratory protection.

Now, our argument as to why we feel that this is appropriate is a weight of evidence approach. So if you'll bear with me on this, this is going to take a little bit of time to go through.

If you go back to that inventory, you'll see in the '87, '88, '89 time frame, 5 kilograms, 17, 42, jumps up, 207, 208, 206, way down here, 399, 299, type of time frame, so we're looking at, what, a factor of 20 higher. In some cases it's even higher than that, up through 2003. So, again, when you look at the volume of the activity, 200 kilograms is 20 millicuries, maybe 10 two-liter bottles on the end of the table. I mean, this isn't a huge amount of thorium actually when you divide it up amongst labs. 773A is a fairly large building with a very small volumetric source term.

Based upon our review, the primary work involving thorium during the 1990s was the Defense Waste Processing Research. Thorium was used as a surrogate in place of plutonium and other actinides in vitrification research. And let me give you some examples of this.

This is one of compositions and durabilities of glasses for immobilization of plutonium and uranium by Dr. Bibler, Dr. Meaker here. And I extracted another excerpt from this.

“In the initial studies, thorium and uranium were used as the actinides. Because of the low radioactivity of these elements, the glasses could be prepared and tested on bench top.”

Let’s look at some of the other research that we’ve been able to identify within this. And I'm just giving a sampling here. There are more of these reports that are out there. We're hoping to get them all into the SRDB once the reviews get done. I've highlighted, again, names, Dr. Meaker here.

"Homogeneous glass processing region defined for a lanthanide borosilicate glass composition for the immobilization of plutonium using thorium as a surrogate." You can see over here on the next one clearly identified thorium oxide, Pu02 surrogate. Here's all the glasses that he was making. Here's the thorium content, weight percent, 20 weight percent, 30 weight percent, whether it's homogeneous or not.

Another one by Dr. Meaker, Neptunium immobilization and recovery using phase-separated glasses. Again, they used thorium as a stand-in for neptunium here. Thorium loading exceeds 10 percent oxide, high thorium loaded glass is 15 weight percent. Again, some of the names down here, Bibler, Peeler. Effects of uranium in thorium. Dr. Peeler. “In this study, glasses are designed and selected to assess the impacts of U-308 and thorium oxide on various glass properties of interest.” This is 2003. So, this is what’s going on in the 1990s into the 2003 era.

This is the thorium handling procedure for 773A for the glass technology, from the glass technology manual. “Procedure applies to all immobilization technology section personnel who handle depleted uranium and/or thorium.” I want to go through this handling operation so you get a feel for what it is that they’re doing.

“Depleted uranium, natural uranium and/or thorium may be used in a chemical hood, minimum face velocity of 60 feet per minute, or on a bench top if these elements are in the form of a hydrated nitrate compound, in a solution or a solid block, depleted uranium and/or thorium containing glasses. It is recommended that the defined work area on a bench top be covered with paper before work is initiated."

Next section. "Size reduction of depleted uranium and/or thorium glass for subsequent durability testing should be carried out inside double-heavy-duty bags. Glass should be placed inside the double plastic bags and hit with a hammer several blows until the glass block is reduced to adequate non-respirable size. Non-respirable size reduction should be carried out in the chemical hood, if possible, minimum face velocity 60 feet per minute, or on a bench top." It is recommended, again, to define the area on the bench top.

"Depleted uranium, natural uranium and thorium in a powdered oxide or finely crushed glass." So, before we were talking about big chunks of thorium, or in a solution. Then they can work with it on a bench top. Here we're talking about thorium oxide in a fine powder.

"May be used in a chemical hood," not on bench top. "Minimum face velocity 150 feet per minute. After the use, the chemical hood should be smeared to check for contamination. If contamination is found, contact the Health Physics Office and decontaminate before further use." So, when they were working with the fine powder, had to do it inside a hood, had to check for contamination afterwards.

Bottom one, "The indicated handling of depleted uranium, natural uranium, and thorium, given in Steps 531, 534, agrees with the definition set forth, Table 2.2 of Manual 5Q, Radiological Control, which is in compliance with 10 CFR 835."

So, there's three components to

the radiological control program here that I want to talk about. And this is the radiological survey log sheets. They have these log sheets that involve daily wipes, or daily checks, weekly checks, monthly, and quarterly. Air sample log sheets, ASLs, daily, weekly, and they have two different defined locations, less than 2 percent of DAC and less than 10 percent of the DAC.

Again, this is modern era. Routine workplace sampling to less than 2 percent of the derived air concentration performed in general areas to provide a reasonable assurance those non-radiation workers located in close proximity to the radiological buffer areas, that they're not exposed beyond 2 percent of the DAC.

Routine workplace air sampling to document radiological conditions, changes, detect gradual build-up of radioactive material, verify engineering controls, and identify likely sources of airborne exposure to radioactive material. The routine workplace air sampling in non-airborne radioactive areas provides a general assurance that workers are not chronically exposed to airborne levels greater than 10 percent of the DAC. So, this is what we’re using as our basis for our dose assignments in this time period.

Radiological work permitting system is issued in 1990. Let’s look at some of these radiological survey log sheets. This would be C-Wing, and these are paper towel smears, down here is paper towel smears .1 meter squared, disk smear is per 100 square centimeters. Daily routine inspection of gloves, vacuum gauges on glove boxes in use, smear survey of control point step-off pads and laboratories in C-Section, see attached sheet for location. Here’s a map of the contamination, or the rooms where these surveys were done, where these triangles are in the C-Wing. All smears less than 200 dpm alpha, this a paper towel smear so divide by 10, this is less than 20 dpm alpha which is the modern standard for alpha contamination control.

We have another one, this is the weekly results, again paper towel smears, labs C-103. By the way, I meant to point out, I highlighted C-114, you'll see why in a minute. I'm going to pick on it a little bit. Lab C-103, C-114, all areas smeared less than 200 dpm alpha. Perform survey of all low-level drain systems, all sinks smeared less than 200 dpm alpha from smear survey of all clean and chemical hoods in the area, all smeared less than 200 dpm alpha. Radiation survey of labs updated the tags. So, this is a weekly, daily routines you saw before. These are weekly routines in these labs where they're checking the sinks, checking the hoods within the laboratories.

B-Wing, again paper towel smear, daily smear, control point step-off pads, floors, hood, lips, all disc smears less than 10 dpm alpha except number 18 was 30 dpm alpha, number 16 was 20 dpm beta gamma, so those are over here, 16 and 18. Okay?

Let’s look at the air monitoring, and I know you guys can’t read this so I’m going to blow it up here. But this is the air samples within each of the rooms. Okay? What I’ve highlighted here is C-114. So, this is the bottom, this is C-114, the DAC location, this is translation of all that data there. Got the location number, the carrier number the sample was in, the activity to .6E to the minus 3. This is the initial count. This sample was started on 7/5/1995 at 8 a.m. and stopped approximately, what is that, six days later, 9 a.m., so this would be a weekly air sample that’s going on. And this count was 711 at 1:00 in the afternoon, so about 5 hours afterwards. So, this is what I call the initial count. The DAC value was .158, but this off an initial count so you've got a lot of radon on that sample. Twenty-four hours later, you're down here at the -- above the MDA, just barely, 1.9U to the 14^{th}, the DAC level is actually less than 1 percent of the DAC, .01. So, 24 hours, the actual true count on this is less than 1 percent of the DAC. We're proposing to assign 10 percent of the DAC as a chronic exposure. Again, that was lab C-114. Why was I picking on C-114? This is why, and let me read this. This is -- you'll notice here this name here, D.K. Peeler.

"As requested, we have evaluated the potential for volatilization of uranium and thorium compounds while making samples of glass and furnaces in lab C-114 of Building 773A." So, C-114 in this time period, in 1996, was definitely using thorium in that lab making these glass samples.

"The furnaces are on the bench

top in the lab and not in radiohoods. The ultimate concern is the potential for airborne radioactivity in the lab. Airborne or even significant surface radioactivity contamination has not been and should not be a problem in lab C-114 in its current role for the development work making surrogate glass samples."

Discussion. "Preparation of surrogate glass samples using uranium and thorium oxides has been going on in this lab for some time with the furnaces on bench tops outside the radiohoods. From communications with D.K. Peeler, the researcher for this work, uranium oxide and thorium oxide used in the glasses are high purity reagent grade chemicals; therefore, radionuclide impurities are not a concern. Also, the oxides of uranium and thorium are very stable at the temperatures used in the furnaces. Volatilization of uranium or thorium will not occur.

Historical radiological survey and air sample data for the lab were reviewed and new smears were taken on the upper exterior surfaces of the furnace when hot air escapes during the operation. All smear data met clean area limits. Air entering the lab from the outside corridor moves past the furnaces on the way to the radiohoods where it is exhausted from the room. The air sampler in the lab is positioned next to one of the hoods and should detect airborne radioactivity which might escape the furnaces.

The past nine months of air sample data show only background levels. This is a clean, well-run laboratory with no history of radiological problems. The evidence noted above supports the operation of furnaces on the bench top to make the surrogate glass samples. HPT supports the continued use of the lab in its current mission with the furnaces outside the radiohoods.”

So, Health Physics here is doing an analysis of thorium use in this lab and determining there’s no potential for exposure. The potential for exposure is there, but it’s being monitored, it’s being controlled, is what I should say. Sorry.

So, the radiological work permits, I wish I could show them here but these are Official Use Only, lots of Personal Privacy Act data. I wanted to go through the sections of them because I think they’re important, and I do have some here that I can show the Board Members, but I can’t show them in public because of all the names on them. But there’s a requester section which identifies the tasks to be performed, there’s a radiological control operation section which identifies the monitoring requirements, and then the approvals. Each of these RWPs have sign-in sheets which have the RWP number, the name, the Social Security number, the department and craft of the worker, the work location, the time in and time out, so all this data is in the RWPs that are available.

We’ve only collected a few examples to show you all here the radiological survey log sheets, the air sample log sheets, and radiation work permits. They’re typically filed together through the 2003 time frame. In EDWS, the database system that both Joe and I have access to, there’s two record sets that I’ve identified, there’s a QH series which has 2,695 records/boxes of this data. QR series which has 7,651 records/boxes. The reason I say records/boxes, well, we’ll get to that in a minute.

Within this group, this is for the whole site, within this group the QR 600 series pertains to Savannah River Technology Center, or 773A. Within this group, there’s 407 records/boxes for this one building.

Some of the records contain 200 pages which would be on folder in a box, others contain 2,500 pages which is an entire box, so we're looking at somewhere between roughly 40 boxes and 400 boxes of radiological monitoring data in this building that are available. So, what we're proposing to do is assign this 10 percent of the DAC. We feel that they were covering the building pretty rigorously, they were meeting compliance with federal regulations, modern federal regulations. We've demonstrated the work that was going on there with this glass mobilization. We've got one evaluation where Health Physics specifically came in and looked.

When we assign the 2E to the minus 13th microcuries per CC air concentration to a worker in 773A, these are the doses we'd come up. For the lung we're looking at about 700 millirem, for the bone we're looking at about 5 rem thorium Type

M. so, this is the doses that we are proposing to assign.

I know we had put in our previous response of the whole body counts, what we were using, and lots of these findings are related to the whole body counts. Because of the questions and in order to solve them we would end up resulting in even more conservative assumptions. We just got to doses that we didn't feel were warranted or reasonable given all of these other radiological controls that we have for this building in this time period.

So, in summary most of the thorium on site was stored in waste or it was waste/storage encapsulated fuel, very low unencapsulated inventory, more thorium inventory in the 1990s and 2000s than the '70s and '80s, minimal use in certain defined areas, mostly 773A, knowledge of the process. We went through and we looked at the different processes. Through interviews with SC&A and Brad from the Board here, they talked about doing gram quantities of this. Post-1990 it’s mostly used as a surrogate for Defense Waste Processing. Radiological controls procedures are in place, routine monitoring, daily, weekly of the workplace, survey data, air sample data available. This is all in electronic PDF format, meaning PDF, it’s electronic but it’s not a database. It’s not something that we can immediately start searching. We’ve have to code it.

1972 to 1989 we’ve got this alternate bioassay method for americium/curium/californium/thorium, is a gross alpha for thorium. The doses are reasonable. 1990 to 2007, compliant radiological control program, air is controlled to 10 percent of the DAC and that’s what we propose assigning. Any questions?

CHAIRMAN GRIFFON: Thanks, Tim.

Joe or -- do you have any questions now, or –

MR. FITZGERALD: I was going to defer to the folks on the phone. I did not work as much on the original thorium paper, but we have three of the four authors I think available. Anyone have any comments before we get into the specifics?

CHAIRMAN GRIFFON: And short of what’s in the findings, we don’t have –

MR. FITZGERALD: Yes, right, right.

CHAIRMAN GRIFFON: Preliminary, yes, yes.

MR. FITZGERALD: General stuff.

MR. BARTON: This is Bob Barton. I do have a question on the presentation. And it was sort of towards the beginning, it was a slide entitled Bio. I think it showed the -- I guess the schedule for -- you were giving a letter designation and it would say whether you had -- no, not quite that one.

DR. TAULBEE: Not this one?

MR. BARTON: This one right here. No, no. It showed the -- it had designations TUV I believe, and that was the amount of bioassays per year that you were to be scheduled on. Yes, there we go, that was it, one back.

DR. TAULBEE: One back. That one?

MR. BARTON: Yes, right there. Okay. So, I see if I'm reading this correctly in 773A the -- okay, so the maximum potential worker would have been scheduled for two AM/CM/CF urinalysis samples per year if you were the maximum potential group. But I also see a V, but I didn't see anybody assigned to the four samples per year. So, my question was, is there a group of workers either in 773A or somewhere else on the site that would have been actually assigned a schedule that would be four samples per year, which would be significantly double the maximum of source worker at least based on that past slide.

DR. TAULBEE: Let me look that up here, just a second here. This is in the SRDB, by the way.

MR. BARTON: I was just curious if they had that designation so I was wondering is there a group of workers that weren't in 773A that were -- had a higher exposure potential to those trivalent actinides that were maybe in another location and how does that location relate to any potential thorium, you know, laboratory experiments or operations that could have been taking place, or was there another area of the site where they were doing operations specifically with these trivalents that posed a significant -- enough exposure potential to warrant four samples a year as opposed to the two for the maximally exposed individual in 773A?

DR. TAULBEE: I do not see anybody where they used the V category.

MR. BARTON: Okay. So, it was available there but nobody actually feel into it.

DR. TAULBEE: That's the way it's looking, yes.

MR. BARTON: Okay.

DR. TAULBEE: They might have been using it in an earlier version.

MR. BARTON: Now, as far as the work performed actually with the trivalent actinides, I kind of got the impression but maybe I was misunderstanding your presentation, that the actual monitoring for those three which may include some alpha from thorium as well, was that focused on the 733A area, or was that, again, sort of a site-wide thing that they measured similar to the in vivo counts for neptunium that we discussed earlier? Was it site-wide or was it really more focused on this set of specific laboratory areas?

DR. TAULBEE: It was focused on

the 773 area primarily. However, there were other areas, I'm trying to think here. Let me see, is U one of them? Yes, if you look up on the slide that I've got up here, 221F, Selected Personnel, I can't -- maybe I can point to it with the cursor here. Here we go. If you look at this particular line, their bioassay category was C and U, so some people in 221F would be monitored two plutonium per year, and two americium/curium/californium. This is due to the actinide, what was the laboratory F area?

MR. MAHATHY: 772?

DR. TAULBEE: No, no, no, not 772. There's the Separations for high-level transuranics. I can't remember the name of –

MR. MAHATHY: I don't remember the last –

DR. TAULBEE: There was a special part of the F canyon that was used for some of these separations of americium/curium/californium.

MR. MAHATHY: MFFP.

DR. TAULBEE: MFFP, Multipurpose Fuel –

MR. MAHATHY: Facility.

DR. TAULBEE: -- Facility. So, that was a –

MR. BARTON: Okay. That would be more focused on the actual trivalents, not necessarily -- I mean, was there any thorium exposure potential in that operation, as well? I guess, what I'm asking is have we gotten to like what percentage of the available data set the coworker distribution was directly for 773A versus, you know, maybe some of the other areas at the site. I don't know if that information has been looked at or not. I was just curious.

DR. TAULBEE: We haven't looked at it in a specific standpoint mostly because the vast majority of the americium/curium/californium is coming -- or the bioassay is coming from 773A.

MR. BARTON: Okay. So, suffice it to say that the majority of the data is coming from there. We just don’t have an exact –

DR. TAULBEE: Yes.

MR. BARTON: But the majority was focused on those laboratories.

DR. TAULBEE: Absolutely.

MR. BARTON: Okay, thank you.

DR. TAULBEE: And these were the same labs that were using the thorium.

MR. BARTON: Okay, thank you. That was my question.

DR. TAULBEE: Yes, okay.

CHAIRMAN GRIFFON: Okay. Can I ask that we take a quick comfort break.

DR. TAULBEE: Sure.

CHAIRMAN GRIFFON: I know we’ve got a lot to get through, but take maybe just five minutes, if we can limit it to five minutes.

DR. TAULBEE: Okay.

CHAIRMAN GRIFFON: And then return, and we may want to reorder the final agenda, too. Come back at maybe 3:15.

MR. KATZ: It's 3:12 right now, so –

CHAIRMAN GRIFFON: Okay, mine says 3:10, 3:17, whatever, five minutes.

MR. KATZ: Yes, we'll be very precise about this.

CHAIRMAN GRIFFON: Okay. All right.

MR. KATZ: Some time before 3:20.

CHAIRMAN GRIFFON: Okay. All right.

MR. KATZ: Okay.

(Whereupon, the proceedings went off the record at 3:12 p.m., and went back on the record at 3:22 p.m.)

MR. KATZ: Mark, Jim Lockey's still out of the room but if you want to talk about just reorganizing the afternoon, that’s fine.

CHAIRMAN GRIFFON: Yes, sure. Yes, I was thinking I would like to move that last item up maybe just to discuss it now, the subcontractor question.

MR. KATZ: Yes.

CHAIRMAN GRIFFON: That way in case if people have to leave, and then work our way through, I think there’s 30 findings on the other -- the thorium piece, so I wanted to get through that first. And maybe even look at our calendars, too, to think of a next date.

MR. KATZ: Yes. No, I think we should do that.

CHAIRMAN GRIFFON: Yes.

MR. KATZ: In fact, maybe since –

CHAIRMAN GRIFFON: We can do that right away once Jim comes back in, if you want.

MEMBER CLAWSON: He’s on the phone.

MR. KATZ: Okay, thanks. Brad was just saying Jim's on the phone. So, Jim's back in the room with us, so why don't we -- you want to schedule first?

CHAIRMAN GRIFFON: Yes. Yes, let's look at calendars.

MR. KATZ: So, folks, look at your calendars and let's see when we can meet, because we have -- we know we'll have plenty of material ready. Joyce -- Joe thought Joyce would be ready in about three weeks.

MR. FITZGERALD: I would think so. I'm going to talk to her when she gets back, but certainly she can address this if she has the availability.

MEMBER LOCKEY: You're talking about February or March?

MR. KATZ: So, I guess we're beginning the end of February. Right? I mean, right now we're on the 5th, so the week of the 24th, is that enough time for Joyce?

MR. FITZGERALD: That probably would be pushing it. I would think maybe the latter part of that week would be better.

MR. KATZ: Right, that's what I was thinking, the 26th?

MR. FITZGERALD: Which would be on the 27th –

MR. KATZ: 27th, 28th. How are those dates for folks?

DR. NETON: I'm available, if we're talking about doing a teleconference.

MR. KATZ: That's February. Yes, we could do it by teleconference. Right. And we'd have Live Meeting again so you could present.

CHAIRMAN GRIFFON: Yes, those are okay for me.

MR. KATZ: So, 26th, anybody have a problem with that, or the 27th?

MEMBER LOCKEY: Teleconference?

MR. KATZ: Yes, teleconference.

CHAIRMAN GRIFFON: So, the 26th

then, Ted?

MR. KATZ: Yes, why not? Let’s do the 26^{th}.

MEMBER LOCKEY: We’re talking February?

MR. KATZ: That’s February 26^{th}, and let’s -- we can start at, let me see, for westerners folks let’s start at 10 a.m. Is that okay for you folks out west?

MEMBER LOCKEY: Yes, 10 a.m. Eastern Time?

MR. KATZ: Yes.

CHAIRMAN GRIFFON: Okay.

MR. KATZ: Okay, 10 a.m. the 26^{th}, another meeting. And I’ll get that posted.

CHAIRMAN GRIFFON: Okay. And then if we could, if it’s not too disjointed, if we can just move for a second to the last item on the agenda. And I’m not sure who can open up this topic, whether it’s Joe or Tim, but I think we should discuss this one in case there’s any actions that need to be considered. I think it would be good to do that now before people have to leave or whatever.

MR. FITZGERALD: Yes.

MR. KATZ: Go ahead, Joe.

MR. FITZGERALD: Thank you. This is Joe. Yes, I, I guess, added this to Tim's list on the agenda, and primarily because he and I have been dealing with this issue I think since last August. It involves really sort of a basic question of how the subcontractor records or database, that pedigree, the same question we deal with almost every SEC site, how it was validated. And the question arose in an interview we had with a former HP who we have talked to several times in the past, who kind of clarified the status of how subcontractor records were maintained at Savannah River.

And as I recall, and Tim can correct me here because, again, he has been addressing, I guess, the question of the completeness of the database. What this individual mentioned was that, you know, at Savannah River you had several types of construction trade workers and contractual arrangements. Clearly, you had DuPont construction workers who were pretty much treated from a dosimetry standpoint the same as DuPont employees. They were included in the database, and there wasn't much distinction made. And you have some -- I think it was mentioned a little earlier, like Shaw Construction and some other subs that were basically doing work for DuPont exclusively and fairly frequently in the earlier days.

The reason there's a concern is that toward the mid to late '80s, similar to other DOE sites, this isn't exclusive to Savannah River, the Department at its sites started using more and more first, second, even third tier subcontractors to handle a lot of the work, including radiological work. So, one of the subjects we raised with this interviewee was since he was very much familiar with the way the records were maintained and all that, was how the subcontractor files were maintained. And he indicated that yes, you had DuPont Construction subcontractors who basically were historically and traditionally kept in the same bin as employees, but then you had some of these other subcontractors from the outside, let's put it that way, who were maintained in the company files, meaning that the information was filed in my company and maintained that way.

And I think that was sort of a – not so much a revelation, but sort of an issue that we wanted to address from the standpoint of how complete were the company files? In other words, understanding how complex things began to get in the late '80s into the '90s, how sure was he? Could he recollect how complete these subcontractor files were at Savannah River given the fact that more and more reliance was being placed on the subcontractors coming in.

And maybe a secondary question that came up a little later was how sure was he that these records, the individual dose files that were in these company files, that they were, in fact, migrated to the electronic database that Savannah River maintained, and for which the records, in fact, are the ones that NIOSH has obtained and is the bioassay records that are being used. So, sort of two questions, the completeness of the so called company files that were developed and maintained, and then sort of a secondary question of to what extent were these completely migrated into an electronic database?

And I will switch to Tim, because I think the real -- the first question. I mean, this is sort of kind of developed as part of the interview process, wasn't by design, but sort of these tidbits started coming together, and it was -- and we re-interviewed this individual because we wanted to clarify some questions that both of us had really on what he really meant, make sure we clearly understood what he meant. And maybe to draw him out a little bit on his recollection. And this is, again, 20, 30 years ago, so it’s a challenge of what he remembered as the process by which these found there -- the individual dose files found their way into an electronic database that we’re now relying on.

But the first question I want to come back to really, and I think we’ve touched upon this in the past, Tim, is what NIOSH has done, because this is really a first principle sort of question, which is the validity of the database, in this case the subcontractor database, and what -- in terms of the pedigree and the completeness of that file, what NIOSH had done in the past to validate the completeness of that file, because I think that is the first question. And the second question is, does this change anything, or does it necessitate any additional review? So, maybe you can start with the first question.

DR. TAULBEE: Sure.

MR. FITZGERALD: Rather than jump in the middle of it all.

DR. TAULBEE: Let me go back to what it was we presented I believe it’s the December 2008 time frame where we did this early evaluation.

MR. FITZGERALD: Right.

DR. TAULBEE: And this was where we took the electronic database, and we were comparing from the dosimetry files that we had, the quarterly reports. These are large-scale printouts of the numbers of workers in a given time period, were they showing up in the electronic database? Keep in mind that this comparison that we were doing was from the 1960s up through 1975. And we looked at construction trades workers, but one of the things that -- what we found was that in the hard copy records of the dosimetry, we found more records than were in the electronic database. Part of that was because one of the things that [identifying information redacted] didn't talk about when they were forming that early HPAREH data set, if a person never came back to the site, they never re-entered their records. So, it was only when a construction trades or an employee came back that they re-put them in there, so there was a discrepancy as far as the number of workers. And we had more paper copy records than what was in the electronic database. But we only evaluated up through 1975.

What I'd like to -- it sounds like, if you all want us to do that, we can evaluate it in the more modern era starting say 1975, 1980, 1985. I don't recommend trying to do this on an every year type of basis just because the -- it gets to be too much. There's a lot of data in the hard copy records that we have in-house in the SRVB, and to compare that against what's in the electronic database is very time consuming. So, if we could limit it down to just a few years to do a sampling type of standpoint, that was how I would recommend doing this verification or validation of what it is that we see from hard copy records to this electronic records. So, that answers one part of your question that you're getting at.

But if the subcontractors themselves -- and this is where [identifying information redacted] was making the statement that he felt they had all been migrated into the current database. I'm not sure exactly how we go about verifying that other than trying to identify some people who were clearly subcontractors and pulling their records, and looking to see what do we have? Do we have a complete complement of what’s in the electronic database? Do we have the hard copy records? Was this person expected to be monitored? And I’m not quite sure how we want to go about doing that.

I thought it would be pretty easy to identify -- try and identify a group of 50 or 60 workers, I mean, request their records and then see what we get and compare that to the electronic databases, both the bioassay database which is HPRED that he was talking about, as well as the HPAREH which is the external dosimetry databases. And that was where we began to run into a little bit of a roadblock of how do we identify these people? And this is where I think earlier on we were talking about going with -- talking with CPWR to see if we can identify any of those workers. And then trying to go to the site. And it just began to run into a whole bunch of issues of do we have, you know -- it’s kind of commissioning a study that if they’re not claimants, do we have rights to their particular –

MR. FITZGERALD: Yes, this is not an epi –

DR. TAULBEE: This isn’t an epi review, that’s right. So, I’m not sure where that’s going to go from that standpoint. We could try to go through another option, is we could go through NOCTS and try to identify subcontractors, pull all of the subcontractors that we have that are claimants, that we can identify and evaluate their records, in particular, against the electronic records, against the hard copy and see what we get. That’s something that is possible to do.

MR. FITZGERALD: Yes. And I actually thought, you know, putting this on the agenda was sort of an opportunity to kind of think out loud on this a little bit. I agree it’s not necessarily a straightforward issue. I think you can bracket it by time frame which you have already proposed, which I think is a good idea to kind of keep it –

DR. TAULBEE: Yes, that particular part of the study is easy for us to do. We can do that now based upon the records we've got.

MR. FITZGERALD: Right.

DR. TAULBEE: It's that second part of your question dealing with just the subcontractors –

MR. FITZGERALD: Well, and that's kind of raised –

DR. TAULBEE: -- that's really difficult.

MR. FITZGERALD: -- by the issue that we heard that, you know, he thought most of them, or all of them were migrated, but he wasn't sure, and the hard copies apparently have been destroyed. There might be microfiche versions left.

DR. TAULBEE: There’s microfiche versions.

MR. FITZGERALD: There’s a little uncertainty there, so I think you sort of do have the sampling process, and we have used that technique at other sites faced with the same circumstance. You do the best you can, you take, you know, what’s a good number? You know, we’ve taken 20, 30. I remember we did this at Los Alamos, we did it at Mound, even, I think. But just take a sample of workers most likely to have exposure potential and just see if one finds them in the database or not.

DR. TAULBEE: Okay.

MR. FITZGERALD: And one can go from there. Now, how you do that is the -- and this is what we’ve been sharing, you know, ideas, the best way to put it. Try to be representative, which that’s easy to say but harder to get to, which is representative of not only time frame, but job types, and maybe locations, perhaps. But, you know, just trying to be representative of that, and that's where I felt that perhaps drawing from several sources might give you a diversity a little bit, maybe NOCTS for a third of this, maybe CPWR for a third, and maybe a third from some other source, but just basically have a pretty good suite of individual subcontractor workers with radiological exposure potential, not necessarily dose. And then go ahead and search by identifier against the database. And there's no magic number, but if you get 50 percent or 95 percent, I think that would be an indicator either way that you're either in fairly good shape, or not so good shape. And that would be at least an indicator back and you can go from there.

Actually, I was more -- that I can actually see easier than trying to figure out, it's like proving a negative, trying to figure out whether or not the filing system actually captured the various and sundry subs that were at the site, because I know most sites, particularly as you get into the ‘90s, it got to be where you had all kinds of subs, even second, third tier subs were coming in and out, and I don’t know if anybody was systematic would have been Savannah River, but I don’t know whether that was the case or not. So, that part of it is more difficult in my mind to demonstrate that you could capture all these second and third tier subs. I don’t know how to do that except maybe to sample using individuals that came in as second and third tier subs.

DR. TAULBEE: Well, that’s where I was -- you were trying to get at with the potential help from like CPWR or something.

MR. FITZGERALD: Yes, somebody like electricians who worked for, you know –

DR. TAULBEE: This particular

company.

MR. FITZGERALD: Who worked for Shaw, was brought in by Shaw, and they were subcontractor, Shaw is a subcontractor, that would be a second tier. And if they’re in the system, I’m pretty confident that that system is pretty complete. And if one could find those identifiers in the electronic database, then –

MR. MAHATHY: You know, we did look at people interviewed from Shaw.

DR. TAULBEE: Right. We have a significant number of NOCTS claimants that worked for B.F. Shaw, and we have radiological records for them.

MR. FITZGERALD: Yes.

DR. TAULBEE: And the same for Dunne Electric, and so forth.

MR. FITZGERALD: But, actually hearing that this was, you know -- his comment that he felt all this was migrated was actually a bit of a saving grace because

I think originally I was concerned that you'd be looking through paper files trying to do the same thing. This way I think you have a test of saying okay, you know, let's see if one could actually run the identifiers and sort through the electronic file and find those names, which once you have the names, at least that part, the process part of it it's faster, yes.

DR. TAULBEE: True. I'm concerned about how we identify those names.

MR. FITZGERALD: Yes, the sampling process itself. I mean, is there any other thoughts on the phone? I think Tim and I have been kicking this around for a few months, but the sampling plan, how you pick the sample, I agree completely is probably the trick in this, that's not as straightforward as anything else. I mean, I think the result is, you know, the pathway is clearer than the actual sampling.

DR. MAKHIJANI: Hi, this is Arjun.

Can you hear me?

DR. TAULBEE: Yes.

DR. MAKHIJANI: So, I agree with what Joe has just said, but I’m wondering whether we can find the names of a few of the smaller subcontractors and some workers who worked for them maybe from among the claimants to see -- to check whether the smaller subcontractors are adequately represented. So, I understand the difficulties of kind of trying to compile a list of subcontractors and doing the representative, however you might do that, but it might be worthwhile to make sure that the smaller subcontractors are represented properly in a less complete way at least.

MR. FITZGERALD: Yes, I think that’s kind of what we were saying, that your second tier -- how do we get to those second tier companies that would be smaller. And if they’re represented, then I think the confidence level goes way up.

DR. TAULBEE: Right.

DR. MAKHIJANI: Yes. So, what I was saying is rather than looking at individuals is good, but maybe we should start with -- a parallel path would be to have the names of a few smaller subcontractors and find claimants from among them. Maybe we're saying the same thing, I don't know.

MR. KATZ: You are saying the same thing, Arjun.

MR. FITZGERALD: Yes.

DR. MAKHIJANI: Okay.

MR. FITZGERALD: We would look for the small companies and then try to run against the database. You can't run the companies, but you can run the individuals.

MR. KATZ: Right.

DR. TAULBEE: How do we identify those small companies?

MEMBER CLAWSON: I think, basically, you'd end up going to -- because part of this, where this came up from is when we did interviews at Savannah River, the electrical people were the ones that we were talking to. They know who the subs were. My understanding is that there was approximately five or six major companies that did business out there, and then there were subs underneath them. Those subs may be working for four or five different companies out there, but they got all their people from the hall. So, what I would say is do -- also bring kind of a level of confidence to the claimants, I would utilize some of those people's areas of expertise. You know, I know that Kerhoot (phonetic) could probably help us get some subcontractor names. And I know there's a couple of more locals out there that could give us some major ones and who their subs were underneath them. I think we're going to have to ask some of the people, even some of the people at the site, the gal that we went and saw that one day, she started going through a list of subs she -- well, there was Shaw, and then there was these that were underneath them, and we went through there. Utilize the people that actually worked out there, I guess is what I’m saying, to be able to pull these out. But to make sure to the claimants that they know how in depth we’re looking at it. It’s not bad to use them as a reference of who were some of these second tier subs.

DR. NETON: What do you do when you get the list of the subcontractors that you want to pursue? What’s the next step?

MR. FITZGERALD: You can’t guarantee they’re going to be in NOCTS. I mean, that would be –

DR. TAULBEE: This is different from subcontractors. Then we have to identify who was working for the subcontractors.

DR. NETON: I don’t know how you do that. That’s my point.

DR. TAULBEE: I’m not sure either.

MEMBER CLAWSON: You know, this is true, but if you remember what they said in the record that all the people that worked for this subcontractor, all their names were put into a bundle in that contractor’s folder.

DR. TAULBEE: You know, that’s what [identifying information redacted] was saying before, then he said all of that got melded into the database.

MEMBER CLAWSON: Right. So, it may have been -- we don’t even know for sure if it’s spread out from that.

DR. TAULBEE: That’s what we’re trying to evaluate.

MEMBER CLAWSON: Right.

DR. TAULBEE: But, see, we’ve lost that tact. We know the people -- the people that made it into the database, yes, we can identify them because they’re in the database.

MEMBER CLAWSON: Right.

DR. TAULBEE: But now we’re trying to evaluate did everybody make it into the database? That’s the problem. That’s what I’m trying to figure out.

MR. FITZGERALD: Well, the only uncertainty, the one possible out would be if the equivalent of those company files still reside in microfiche, that they actually, you know, recorded that before they ditched the paper. It’s not clear. He couldn’t recall to what extent that that was done. You know, two sets of those microfiche exist, but –

DR. TAULBEE: Yes. And I think I know what happened with those microfiche, by the way. The one set of microfiche went to record storage and that’s where I’m not sure where they went. The other set that came back to Health Physics, they cut for each person and put them into those jacketed microfiche so there’s microfilm or there was, because when you go to pull the records, you will see where this is former microfilm. It’s been cut and put into the individual jackets. So, when they retrieved the records for us, they pulled that card and they copy all of the records off of there, but if the main ones are still intact, then I think maybe you’ve got what you were just pointing at, you’ve got all of this company together. But when they went back to Rad records, they cut them and put them into individual jackets.

MR. FITZGERALD: So, the only possibility is if central records maintained the original format.

DR. TAULBEE: We can ask.

MR. FITZGERALD: Well, I remember when we talked about it with him that was sort of like you know he didn’t know, so it’s one of these questions I guess we need to ask and find out. Otherwise, I think it is a challenge, sort of like you have to then go to different sources to figure out historically what were your second tier subcontractors. And as Jim pointed out, either through the union hall or somebody, find out who might have worked for them, but that’s a little bit more amorphous to me, as far as –

DR. TAULBEE: Now, we can evaluate the claimants from that standpoint, because in the claimants’ files we get the DOL file, which typically would have that subcontractor that’s identifying, verifying employment –

MR. FITZGERALD: Right.

DR. TAULBEE: -- out there at the site. So, we could identify some contractors, it’s just I don’t know if that type of a sampling strategy would be sufficient for you all. And if it is, then great, that’s something we can do.

MR. FITZGERALD: Well, I think the Work Group has to figure out, because it’s a judgment call. I mean, I think you can do a lot but, you know, the question of the pragmatic, how practical is it?

DR. NETON: I think you're going to start to go with NOCTS if we can identify the subcontractors that various claimants worked for and generate a list. And if it seems to include smaller subcontractors to a certain extent, that's a start. I'm not saying that's the end product, but that's a place to start. If we have none -- well, we know we have some already, but we have very few additional small people, then we might behave differently. I don't know. I mean, it's an easy thing for us to do, it's a computer search.

DR. TAULBEE: And that would actually be the quickest for us to do, because going back to the site, remember everything that we've requested back in November and December is sitting in a big queue to be reviewed, so if we can mine through NOCTS at this time and get as much, I guess preliminary data as possible that could help us inform decisions in the future.

MEMBER CLAWSON: Well, I see no problem with that. It would give us a better feel for where we’re at. We just -- in my opinion, we need to address the issue because even with CAM, the question of did they get migrated in, he felt they did to say for sure they did, that’s where the issue –

DR. NETON: Well, that – because, I mean, we can now identify they’re in there if we have bioassay records for them. If it’s not there, it doesn’t mean it’s missing. But if it’s there, it certainly is an indication –

MR. KATZ: Right. And that would make a sensible first step.

MR. FITZGERALD: Now, the only fly in the ointment would be this other question of whether the sub file was complete, because if they're not in upstream they're not going to be in the electronic database anyway. And I don't disagree, that's kind of a -- it's like proving a negative. But on the other hand, with subcontractors that kind of is the issue, whether they captured who was on site or not. And this is where I would think reaching out to the -- whether it be CPWR, somebody who was intimately familiar with the union hall and could serve up here are some second tier companies that were hiring, or did, in fact, use our members or whatever the case may be. And running that to see if, in fact, those companies show up. I mean, if you're missing whole companies, then yes, that's a problem.

DR. TAULBEE: Just know what the whole company was.

MR. KATZ: Yes, a three-person whole company.

MR. FITZGERALD: I'm telling you,

some -- toward the late ‘80s into the ‘90s you got some pretty small companies that were doing piecemeal stuff, but –

DR. TAULBEE: And if they weren’t working in a rad area, they’re working in a clean area –

DR. NETON: I was going to say, the presumption that they had to be monitored is not necessarily true.

MR. FITZGERALD: Yes, and that’s another issue. But, you know, that would be -- I think the NOCTS plus that would be -- and this is the Work Group, I think, has this. That would probably answer both questions, whether or not the migration happened. And, secondly, whether the companies were reflected in Savannah River’s files or not in the late ‘80s. Are you saying the late -- mid ‘80s to when? Because I think he pointed out that if we didn’t go to the early ‘90s, you were -- on HPAREH, you probably didn’t have a complete set.

Remember he kept saying that?

DR. TAULBEE: yes.

MR. FITZGERALD: I got the sense they were evolving this thing and was complete by ‘94 or something.

DR. TAULBEE: I just think it was like ‘97 is what he said. We’ll have him correct –

MR. FITZGERALD: Some point it was complete.

DR. TAULBEE: He said it took about a decade.

MR. FITZGERALD: Yes, to complete and make sure it was –

DR. TAULBEE: To get everything into the records, yes.

MR. MAHATHY: And that’s a fact, what did other people do?

MR. FITZGERALD: So, you would probably want to take that –

DR. MAKHIJANI: Migration took a long time, yes.

MR. FITZGERALD: Yes. But I would think those two sources would -- it’s not going to be a perfect answer, not any -- but it will be an indication that the reflection of the companies on site was fairly complete at the Savannah River level, and the migration was fairly complete. And say fairly because, you know, subcontractors it’s wishy, but at least that indication is there.

MR. KATZ: Mark, is this making sense for you?

CHAIRMAN GRIFFON: Yes. I’m a little -- I’m trying to feel out a path forward. I mean, I hear review -- the review NOCTS part makes sense. The checking with CPWR, I think was another parallel step that could be done. And I thought I heard, and Joe just said two, but I’ll add on a third, which was to check with the site to see if they retained any of this microfilm in central records.

MR. FITZGERALD: That would be nice, but we're not too sure –

CHAIRMAN GRIFFON: Yes, that's -- I don't know how hard or easy that is, but if you can look at this –

DR. TAULBEE: We can send a letter to the site and see what they say.

MR. FITZGERALD: Right.

CHAIRMAN GRIFFON: Yes, and I was thinking if it's possible before our next meeting in three weeks, I mean, maybe we can–

MR. FITZGERALD: We might have to fly down and actually look through the microfiche ourselves.

CHAIRMAN GRIFFON: Well –

DR. TAULBEE: I can tell you we're not going to get an answer back in three weeks from the site.

CHAIRMAN GRIFFON: Well, not an answer but maybe a little more direction on the approach, or the sampling approach so we can all, you know, make sure everyone is in agreement with how -- you know, at least you might have more information on -- it's one of those pieces. That's all I was suggesting.

DR. TAULBEE: I think we can get started on the NOCTS evaluation. The other, I doubt.

CHAIRMAN GRIFFON: Okay.

DR. TAULBEE: But we're not going to have a report ready for then. I mean, I'm sitting here trying to think is it possible for me to get a report ready by the Advisory Board meeting in April, and I'm not sure I could for that. But just knowing all the reviews and everything that has to go through, so –

MR. FITZGERALD: Even for NOCTS.

DR. TAULBEE: Even from the NOCTS side. But I think we can get a preliminary start going from that –

MR. KATZ: It doesn't have to be a

very formal report.

(Simultaneous speaking.)

DR. TAULBEE: Yes, internal reviews is just –

(Simultaneous speaking.)

DR. TAULBEE: But I do think by the Work Group meeting in three weeks we will at least be able to know whether or not we can produce something that would make some sense. I’m going to need to talk with the team a little bit and see what it is we think we can do. How does that sound, Mark?

CHAIRMAN GRIFFON: That’s good. That’s all I can expect.

DR. NETON: Our IT team is good, but sometimes we stretch them to the limit. Because this, I suspect, would be sort of a keyword search in each file.

DR. TAULBEE: Yes.

DR. NETON: It’s not like a searchable file at this point.

DR. TAULBEE: Yes.

MEMBER CLAWSON: Tim, the lady at the records center there, she seemed to be pretty well on the ball about it. Would it be out of character or -- I think she kind of felt what the issue was, and just to talk to her and see what possibilities, how we could double check this, because they didn't have it by -- you know, when me and you talked to her a little bit about it she was able to pull up a few different things, but she may have some ideas, too, that may help us from a site standpoint to be able to pull this information up. Because if she can check out the folders for the contractor, because she's the one that explained to me maybe what he was saying was these contractors, we didn't send their dose out to each individual, it went into a folder for them, went to a contractor, and they gave them -- they went to each one of their employees and told them.

DR. TAULBEE: Those are their dose

reports.

MEMBER CLAWSON: Right. And there might be something from there. It might not hurt to try to -- I know things at Savannah River are hard.

DR. TAULBEE: But I'm thinking that this is all -- what she was pulling up and showing us was all 1990s time frame, so I think they can pull that up from that time period. I'm not sure about prior to that.

MEMBER CLAWSON: Right.

DR. TAULBEE: But we'll certainly ask her.

MEMBER CLAWSON: Because I know that she started going through a list of contractors that they had.

DR. TAULBEE: Yes.

MR. FITZGERALD: Yes, somebody's got a pretty complete listing, I would think.

CHAIRMAN GRIFFON: Okay. So, I think at least you have a path forward there. And are we ready to go back to the thorium responses to the -- or to SC&A's findings? Is it okay to move on to that now?

MR. KATZ: Yes, I think so.

CHAIRMAN GRIFFON: Okay. And, again, it's 4:00 now. If we don't get through all these, I -- you know, we are scheduling another meeting.

MR. KATZ: Right. Maybe we could just run for 45 minutes.

CHAIRMAN GRIFFON: Okay. That sounds good. All right. So, I'll turn it over to, I guess, Tim, do like we did before with the neptunium.

DR. TAULBEE: Sure. I think we are still going to run into some of the OPOS type of questions here.

CHAIRMAN GRIFFON: Sure.

DR. TAULBEE: So, we'll skip over those. The first question, or the first finding is that NIOSH characterized various thorium storage processing activities in its latest addendum to the Evaluation Report. However, NIOSH’s catalogue of places and times where such activities were carried out is not complete. More complete description of the source term is needed for scientifically reasonable thorium dose reconstructions by the methods proposed by NIOSH.

I mean, we’ve got a lengthy response here of trying to respond of what all we know of the thorium operations that are going on in this time period from 1972 to 2007. And, you know, breaking it into two parts of ‘72 to 1990.

What we have found is all of the work that we’ve seen has been focused on on 773A. There is a few that we’ve pointed out here in our response of 235F, of fabricating thoria spheres, and these come out to, you know, about 300 grams each. They’re pretty small. And that kind of makes up for that whole 4 kilograms in the 235 building that we were talking about.

Some of the other areas from the, you know, the Elk River dissolution and the high-level caves, those workers are covered from that bioassay methodology we were talking about, the americium/curium/californium, and thorium methodology, so I'm really not sure here what more you all are looking for for us to identify and catalogue what processes were going on in here.

This is a chemistry laboratory, chemistry research building. You've got B-Wing and C-Wing, actually, and then you've got the high-level caves in E, and then there's a machining area in the back. We're only looking at 200 kilograms max during this time period, and some years we're looking at 5 kilograms in the building. These are small quantities. These are, you know, literally can fit here on this table around us. So, I think we've done a pretty good job of describing this, so I guess I would go throw back to you all what more information are you looking for here in addition to what we responded?

DR. MAKHIJANI: This is Arjun. Can you all hear me?

MR. KATZ: Yes, Arjun.

DR. MAKHIJANI: Yes. I think we have considerably more information now, I'm speaking a little bit from memory about our report, but there's considerably more information points in the use of thorium as a surrogate, more detail than we had before. What we were looking for is a level of detail of the work that was done compared to who was monitored and where. And I think NIOSH has provided quite a bit more detail, and the Work Group can decide whether once it's reviewed in relation to worker records or not, I mean, that's a prerogative of the Work Group. But I think there is now quite a bit more detail.

DR. TAULBEE: Okay. So, can we consider that one closed?

DR. MAKHIJANI: Well, I mean, that's up to the Work Group. In a sense we asked for this detail to compare this with monitoring records available, and whether people who were there were actually monitored. Now that we have the detail, there's a potential to do that, but maybe the Work Group wants to consider it closed or not, I mean, that's up to Mark and the rest of the Work Group Members, or whether they want this reviewed in a sense. I mean, I don't know how -- it certainly is much more detailed than before. I can't vouch for its completeness or not because we haven't looked at all these documents that you've cited, or any related documents. Because you've done a lot of document recovery in the last year and a half, and done this analysis, and we haven't gone over those documents. I think this is very responsive.

All I’m saying is that the Work Group might want to decide whether this is enough, or whether they want it reviewed, and whether they want it reviewed in relation to available dosimetry records.

DR. NETON: This is Jim. I would say that wasn’t part of the finding was tying it to dosimetry records. I mean, the finding was that more complete description is needed, and it sounds like –

DR. MAKHIJANI: Right. That what I say, responsive to the finding. It’s just that, you know –

DR. NETON: So, I don’t know –

DR. MAKHIJANI: Hard for us to sign off on the completeness of it without looking at it. Maybe it’s enough for the Work Group and that will be -- I mean, Joe is the task manager. I’m just speaking up because some of the earlier work was done –

MR. FITZGERALD: Now, the 5-1, that table basically has been updated.

Right? Or is that the same table you had –

DR. TAULBEE: No, it’s the same table.

MR. FITZGERALD: Same table. It hasn’t changed then.

DR. TAULBEE: No.

MR. FITZGERALD: It’s pretty much the same.

DR. TAULBEE: Right. I mean, during my presentation I went into more detail of what was happening in 1990 to 2007.

MR. FITZGERALD: Right.

DR. TAULBEE: And then from our interviews back in August when we talked to workers, they kind of confirmed what we were talking about with the thorium fuel cycle, the small quantities and the dissolution, and so forth.

MR. FITZGERALD: Right.

DR. TAULBEE: So, I mean, Arjun is right, we have added a little bit of -- we have added information as to what was going on, but that's a combination of interviews as well as the –

MR. FITZGERALD: But it really hasn't changed the baseline that you presented in the OTIB.

DR. TAULBEE: No.

MR. FITZGERALD: Yes, I would certainly defer to the Work Group, but we spent August and October to November just going ahead and validating against worker interviews to make sure this was -- that we did not miss anything. And I think what's in the description is pretty complete, so we don't have any -- I don't have any problems with the scope of facilities that were described and the history of this. And you've added the post-19 -- I guess post-2000, 2007, right?

DR. TAULBEE: Yes, post-1990.

MR. FITZGERALD: Yes, 1990.

DR. MAKHIJANI: And I might add

that our finding wasn't that the -- isn't the description was incomplete. It was in relation to places and times where such activities were carried out, and the relation to scientifically reasonable thorium dose reconstruction. So, I think those things are all connected in these three sentences in the finding, so I think there is more detail here that's very useful and worthwhile.

MR. FITZGERALD: Yes. And really the interviews were focused both on neptunium and thorium in terms of essentially confirming the time frames and the type of operations, and source terms. And I think uniformly they did that, so that is a source of validation over the past six months.

MR. BARTON: Could I ask a clarifying question? This is Bob Barton. I just heard mention of Table 5-1 in TIB-81, the coworker model TIB. Did I hear that that is not currently -- that table is not currently up to date as far as a complete source term and which facilities would be assigned a thorium coworker dose, or is that table in its current form, I guess Revision 2, is that up to date as far as NIOSH's position that the way a thorium potential -- a source of potential could have occurred, and these are the facilities and associated dosimetry codes that would be used to assign thorium intake. Is that table up to date, or does that need to be updated?

DR. TAULBEE: I believe it's up to date. I need to check on that right now.

MR. BARTON: Okay. Because I did have a few clarifying questions on that, in particular, because to me that's a major piece of this whole puzzle for both thorium and neptunium, because it pretty much specifies which dosimetry codes you're going to use to identify workers who were at the particular area, and then once you associate them with a particular area, then you have your radionuclide you're concerned with that in Table 5-1 as to who is going to be assigned what intakes.

And I guess one of my main questions was the dosimetry codes that are listed there, and for some facilities there are a lot of them, I guess where did those -- what's the genesis of those? Was there a central reference that listed those dosimetry codes? Were they pulled from experience? I guess, where did those come from?

DR. TAULBEE: Those dosimetry codes actually come from a series of different reports within DPSOP-40, DPSOP-47, and they were used by the dosimetry group for where badges were assigned. So, we have a series of tables. These changed over time, so we've got these codes by pre-January 1973, and then we have January 1973, we have old code, new code. These are all documents that we've been able to pull out of Health Physicist's files. Kathy Demers was able to pull a bunch of these from her epi studies that she did, so we've got a 1973 version, a 1977 version of these codes, a 1984 version of these codes, a 1990 version of these codes, and a 1992 version of these codes. So, that's what the genesis of that table was.

MR. BARTON: Okay. I mean, just looking at them, I mean, you'll have multiple facilities that kind of use the same code even in the same time period, so I guess I was kind of wondering, you know, was this done based on, you know, the best of our knowledge to this point, or it sounds like it's kind of a combination of the SOP reports and some practical knowledge, but may not actually be a complete listing of dosimetry codes and locations. Do I have that correct?

DR. TAULBEE: No, I believe this

to be pretty complete. Is it 100 percent foolproof? No, but we're covering about every two to three years for these codes. And one thing to keep in mind, this isn't the only means that we have for identifying where people worked. We do have bioassay data, as well, which also identifies the particular code, or not code but location for a particular worker.

Also, one other thing to point out is that the assignment of these internal doses to coworkers, at Savannah River when -- the use of these coworker models that we've developed is actually going to be somewhat limited. And the reason I say that is, is back when we did the initial evaluation of the report, 80 percent of the workers have some bioassay in their files, so there's a large number of people that have monitoring data for the Savannah River site that are claimants that we have. So, there's a few instances where we have run into somebody worked in an area that we don't have bioassay for them and we would apply these models, so they're actually applied to a very small number of workers. But, in general, these codes that I was discussing earlier, this is what we would use when we get these various variations of them.

MR. BARTON: So, for example, if you had a worker who you didn't have records for, say they had multiple codes in their monitoring file but no internal monitoring data, how is the table going to be applied to say, you know, they had two different codes throughout their employment and one code specifies, you know, for example, applying thorium, and the other code doesn't specify applying thorium. Would that be parsed into the worker's different time periods of employment, or the fact that he worked in that area at one time mean he was assigned a coworker intake for his entire employment? I guess that wasn't clear reading that section how this Table 5-1 is actually going to be implemented.

DR. TAULBEE: We would apply it based on the dosimetry codes that they had at that time period because they did change, and they did -- one area would mean one -- or one code would mean one area for one specific time period, and then it will change, and that code meant for a different area. So, you have to interpret it, the dosimetry with the date, as well as the actual code value. And if a person worked, for example, and this is not uncommon, a person worked at a reactor, say P reactor, and we have the dosimetry data for that time period, we would not be assigning a thorium or neptunium dose, for example to that worker. But then we've got a dosimetry code showing them working in 200F, for example, that we would apply the neptunium dose to that particular worker if they didn't have monitoring in the time period that neptunium work was going on. Or if they went to work in 773A, went to go work at -- in the Savannah River Technology Center during the time period when thorium was going on, then we would assign that thorium dose. So, it's really worker-specific, and we would parse it out.

MR. BARTON: Okay. And in cases where maybe you wouldn't have a specific facility code specified in the monitoring record, or in the rare cases where you have a code that you can't apply this table to, maybe it just slipped through the cracks, you don't know what facility it is, then you would apply the unknown facility which looks like it applies all of the coworker radionuclides. Is that correct?

DR. TAULBEE: That's correct.

MR. BARTON: Okay, thank you.

MEMBER LOCKEY: Joe, what I hear you saying is that based on the worker interview, it pans out and what NIOSH’s presentation was today –

MR. FITZGERALD: Yes, our onsite trips were devoted to neptunium and thorium.

MEMBER LOCKEY: Right.

MR. FITZGERALD: And talking to workers from that era, just trying to verify the time frames, the source terms, and the facility locations, making sure that these facility descriptions, what was being addressed, number one, was valid. So, we talked to a fair number of the former thorium workers, and a fair number of the former neptunium workers on that basis, and I think it all matched up. I mean, that is probably the best validation we could do, and we also looked at whatever documents were available. But I think the documents themselves were the source of the original discussion, so this was sort of another venue to verify what was in the documents, making sure that nothing was missed, and particularly with thorium, because again, sort of had this interesting history at -- and we had a couple of interesting things pop up that we had to run down on the ground making sure we heard the right thing. We did re-interview somebody who came up with a thorium activity that we thought we heard was related to something maybe with weapons or something. It turned out not to be the case, but nonetheless -- so, I think we shook it pretty good.

DR. MAKHIJANI: This is Arjun. I see this OTIB-81, Table 5-1 is, of course, new and there's lots of detail in there. And as I was saying, there's new detail on the table right now, and we haven't reviewed it.

MR. FITZGERALD: You're talking about OTIB-81, not 5-1.

DR. MAKHIJANI: The 5-1 in OTIB-81.

MR. FITZGERALD: Okay. You were saying it's -- it wasn't changed.

DR. TAULBEE: It is up to date.

DR. MAKHIJANI: It’s new.

DR. TAULBEE: Well, it’s new possibly from the last time you all reviewed it. This is December of 2013.

DR. MAKHIJANI: Yes, so it’s –

MR. FITZGERALD: Okay. That’s what I was asking before. I’m sorry.

DR. TAULBEE: I’m sorry.

MR. FITZGERALD: I didn’t communicate very well. I was wondering if it had been updated and revised from the previous edition to be more complete.

DR. TAULBEE: Yes, it has been. I apologize.

MR. FITZGERALD: In which case we probably would need to take a look at that, since 5-1 is sort of integral to this whole question, is matched up to –

DR. TAULBEE: Of who we assign the dose, yes.

MR. FITZGERALD: But to answer a

general question, I think there was a fair amount of validation on the thorium question, at least as far as history, so this would be a final verification on this revised table just to make sure the table is complete.

MR. KATZ: Okay. So, SC&A will review that before the Work Group –

MR. FITZGERALD: Is that the major change in OTIB-81? I'm trying to think –

MR. MAHATHY: It was a minor change.

MR. FITZGERALD: Huh?

MR. MAHATHY: It was a minor change.

MR. FITZGERALD: Yes, I'm saying was 5-1 the -- if there was a change, was that one of the more significant ones to look at?

DR. TAULBEE: I'm actually not sure which one you looked at, whether you looked at Rev 0 or Rev 1, or Rev –

DR. MAKHIJANI: Yes, this is Arjun. I think Bob and I are looking at Rev 2, and 5-1 is a new table in Rev 2.

MR. FITZGERALD: Right. It’s a much -- it’s a bigger table.

MR. BARTON: Yes, that’s my understanding, it’s not in Rev 0, Rev 1. It was in the revision of OTIB-81 that was –

MR. FITZGERALD: Yes, we can look.

DR. TAULBEE: I believe this is from the last Work Group where you were asking us to identify who we would assign workers -- who we would assign these coworkers models to, so this was –

MR. FITZGERALD: Right. This is the mechanism. This is the mechanism. Mark, does that make sense?

CHAIRMAN GRIFFON: Yes, that’s fine. That is an option, the right tick so that somebody is going to look at that.

MR. FITZGERALD: Yes.

CHAIRMAN GRIFFON: And I think we

probably should move on to the next one.

DR. TAULBEE: Is Finding 1 closed?

MR. KATZ: So, Finding 1 they're going to -- SC&A has an action.

MR. FITZGERALD: Just to look at –

DR. TAULBEE: Right.

MR. KATZ: We'll close it at the next meeting assuming all goes well.

DR. TAULBEE: All right. Number 2. Let's see. Significant amounts of thorium were involved in some activities such as using thorium as a surrogate for plutonium-238. NIOSH's argument that the amounts of thorium involved were far smaller than those of other radionuclides is not relevant to the feasible thorium dose reconstruction. Thorium-232 exposures need to be considered on their own right, and SRS during the '72 to 2007 time period, as they have been at other sites, and at SRS during the period prior to October 1971.

In our response to Finding 1 we

discussed the use of the thorium research surrogate activities. The amount of thorium activity is small as shown in Table 5-2 of the addendum. The maximum activity of thorium not in waste in a year ranges from .4 millicuries to a maximum of 39 millicuries. We’ve revised the methodology to bound the thorium dose exposures, potential dose received from exposure to thorium during the period starting 1990.

The methodology is discussed in our response to 27. That’s that latter time period, that post-1990 time period, where we have the maximum. I mean, we were looking at this 200 kilograms that’s running around there. We do feel that the small activity needs to be considered and taken into account. This is why we believe these doses are small. They were well controlled in that post-1990 time period. In the earlier time period, people were working with the thorium, using the thorium as the surrogates were monitored with this americium/curium/californium, and thorium bioassay methodology. These are people in the analytical chemistry division, people in the high-level caves, et cetera. So, I do feel that this methodology is appropriate, even though thorium was being used as a surrogate for plutonium-238.

MR. BARTON: If I could comment, this is Bob Barton again. I actually kind of see the notion that it was very small compared -- relative to the operations of the site. I kind of see that the opposite way. It’s very similar to neptunium. Essentially, what we’re talking about is using surrogate monitoring for a very small operation, but still we need to be able to reconstruct doses to it. And when I say surrogate monitoring I’ll tell you what I mean, because that’s not the usual way we use that term in this program. But, essentially, we’re using a very large data set of -- comprised of people across the site, a little less so in the case of the Am/Cm/Cf data, but essentially we're using a very large worker population that probably wasn't involved in the thorium or neptunium operations because they were so small, to represent people who were but weren't monitored. So, I'm wondering, this is kind of in line with what my comment I made during the neptunium discussion, to what extent were we able to match the thorium workers we do know that they were absolutely there, they worked with the material, they were doing the experiments. It's reasonable to think that they likely had the highest exposure potential, to what extent are they included in this coworker distribution that we built. And, you know, obviously, I think there's some weight of evidence that they have, if they weren't included they certainly weren't systematically excluded. But to what extent were they included for the workers we do know, and then where do they fall in that distribution, as well?

I mean, if we take a look at it in all of the very upper tail, well now you might have a problem trying to apply this distribution to other unmonitored workers who we don't know that could have been exposed at the same levels. So, I see the whole fact that it's a very small operation in terms of worker power out of the fact that now we're having to use all these records for workers who probably weren't involved in it to try to reconstruct the doses to a very small number of workers who were, but we don't know who they are.

DR. TAULBEE: Well, if I can answer part of your comment there, or address part of your comment there, Bob, is that keep in mind the work that thorium going on at the site was in the 773 lab, 773A. Okay? Now, in the chemistry division, the analytical chemistry division, high-level caves, and that's where we had this americium/curium/californium, and thorium bioassay data. Okay? So, those workers -- we're proposing to assign the highest of those four radionuclides to each of those workers that have this monitoring data. So, we're going to end up assigning thorium dose to some people that may not have actually been exposed to thorium, but we can't actually distinguish the people in that building that had that bioassay type, whether they were doing some of the surrogate work with plutonium or neptunium, or one of these others in this time period. So, whether they're using thorium as a surrogate in this time period, so we're going to assign that bioassay result, that gross alpha result to the highest of those four radionuclides. So, these workers were monitored in that time period.

The application of the coworker model is to people who went into that building that we can identify working in a regulated area that we don't have one of these americium/curium/californium, and thorium bioassays for. That's who would get the coworker model. Otherwise, if they worked in that building, they've got this bioassay monitoring, and we're going to apply their data to that person.

MR. BARTON: Right. And I understand that's a very claimant-favorable approach to always use the highest solubility type per organ, and the highest radionuclide. I guess my comment was just kind of geared toward to what extent do we know -- I mean, we know that there was a lot of Am/Cm/Cf monitoring in the 773A area. How many -- I guess how many workers were actually in that area versus how many workers actually handling thorium, and then, you know, the add on to that is if we can identify some thorium workers and say hey, look, these guys worked with thorium.

They're in our distribution of coworker intakes or, you know, bioassay results and by extension intakes. We can more confidently say listen, we know that thorium was a very small operation, but we did catch some of them and they were within the bounds of what our coworker model could assign. And if you can say that with reasonable confidence, then now in my mind at least it becomes more of an implementation issue of where along the curve you assign, do you assign the distribution, do you assign a fixed value like, you know, the 95^{th} or something like that? So, I guess my comment was really not geared towards which radionuclide you assign, it's more geared towards has there been any, I guess, closer look at how inclusive are the thorium workers that we do know were thorium workers? Are they actually in this distribution of Am/Cm/Cf results, because in my mind it is sort of a surrogate issue. And

I don’t assume to find this, but if we did take a look at it and say hey, you know, a lot of the thorium workers that we do know worked with thorium, they’re not in here. Then you start to question how representative that distribution is going to be in actually assigning thorium intakes to the small group of workers who would -- it would apply to because it’s such a small operation. You wouldn’t assume a whole lot of workers were unmonitored, but we still have to take that into consideration.

DR. TAULBEE: So, if I understand what you’re proposing, is that we evaluate the americium/curium/californium results that we have, identify the thorium, the known thorium workers based upon our interviews and those type of people, and then look at their bioassay and see if they have americium/curium/californium, and where those results fall on the whole coworker model. Is that what you’re proposing?

MR. BARTON: I think it would be rather helpful and illustrative to try to get to a point where we're confident that this distribution that we've developed, which includes a whole lot of workers who wouldn't have been exposed to thorium, can be used to represent those workers who were exposed to thorium, but who were unmonitored, and who this whole coworker model is designed to be geared toward.

DR. NETON: Bob, this is Jim. Remember that if it's a worker who we thought was -- should have been monitored and wasn't, they're going to receive the 95^{th} percentile of the distribution, so if you get in the 95^{th} percentile, if a thorium is the 95^{th} percentile, fine. If some other nuclide has a higher 95^{th} percentile, then we're over-assigning it anyway, so I'm not sure there's a lot to be gained by finding out –

MR. BARTON: Well, I guess that

what I’m saying, if you took thorium workers that you knew were thorium workers –

DR. NETON: Yes, I understand what you’re saying.

MR. BARTON: -- that were not in your database, and you see they all would be, in fact, bounded by some upper bound such as the 95th percentile, then great.

DR. NETON: Yes.

MR. BARTON: That’s a great weight of evidence argument. And, you know, in the off chance that you look at it and you say wow, look, these guys that we know are thorium workers that were monitored for Am/Cm/Cf, they’re way up there in the 98th-99th, well, then maybe you have a problem. I’m just saying I don’t know if that work has been done, or if the Work Group or NIOSH thinks that work should be done, but I can’t avoid pointing out.

DR. TAULBEE: I can tell you the work has not been done, but if that’s something that the Work Group wants us to do, then let us know.

MR. FITZGERALD: So, the assumption that you made was the 95th would be conservative enough.

DR. TAULBEE: If it's somebody that we believe should have been monitored like a chemist whom we don't happen to have bioassay data for, then yes, we would absolutely assign the 95th percentile.

DR. NETON: Yes, like I say, if you have multiple distributions in there, if the thorium is the 95th percentile for distribution then we're fine. If some other nuclide is a higher one, then we're also fine. I'm not sure there's a scenario there where we would under-assign a person's dose.

DR. MAKHIJANI: This is Arjun. I think Bob is right, because there are not many workers presumably from the descriptions that you've given that you have some uncertainty as to whether the 95th percentile is adequate or not. And it might not hurt to look at a few workers that are identified as working with thorium in 773A, and just settle the question of what those numbers look like relative to the others. I mean, I don't know that it will be a large amount of work.

DR. NETON: Yes, I don't know how much work it would be, but I guess if the Working Group feels like we need to do that, we can certainly do that.

DR. TAULBEE: Yes. Mark?

CHAIRMAN GRIFFON: I'm persuaded that it would be good to validate it. I also, you know, Tim, if you look at it and realize it's a lot more work than we might have anticipated, maybe report back to us, you know. But I think if it's a quick, fairly straightforward activity to find some known thorium workers and verify that, at least the coworker amount bounds them, then that's I think a worthwhile action. So, I would support it. Others on the Work Group have any opinion?

MEMBER LOCKEY: If you have known thorium workers will you not have bioassay results on –

DR. NETON: No, we're using the gross alpha measurement to cover the three different nuclides, or four, whatever. Yes, I'm not sure this really does it because let's say you've got a guy who was a thorium worker but also worked with other nuclides and has a very high bioassay. It could -- high gross alpha could have come from any of the nuclides. It doesn't mean because he worked with thorium on one occasion he exclusively worked with thorium, so I'm not really sure that that really does anything.

MR. MAHATHY: So, the work was minimal.

DR. MAKHIJANI: Jim, I'm confused. This is Arjun. Are we talking about gross alpha or trivalent actinide data?

DR. NETON: Well, it’s an alpha measurement that’s separated out trivalent actinide, that’s true. But it’s a gross alpha measurement based on a chemical separation, so you’ve got potential trivalent actinides in there. And because the guy was identified as working in a thorium area doesn’t mean he also didn’t work with californium, and einsteinium, or whatever. So, a high bioassay would not necessarily indicate that that was from the thorium intake, so I –

DR. TAULBEE: We can look at this and see what we come up with. I mean –

DR. NETON: Yes. I mean, we can.

DR. TAULBEE: And see what the results come out.

DR. NETON: Yes, I’m not objecting to it. I’m just pointing out that it’s not –

DR. TAULBEE: May not be conclusive.

DR. NETON: It may not be

conclusive either way.

DR. TAULBEE: Yes.

MR. BARTON: Yes. I understand there may be a number of confounding factors. I think even just the first order of being able to say the other workers, at least a fair percentage of the workers we know that worked with thorium, maybe you know the time frame they worked with it, and then you can look and see hey, they're in here. At least they're not excluded from it, and the ones we know that worked with thorium, there's a reasonable percentage of them in here, and maybe you can't make a definitive conclusion about whether something like the 95^{th} percentile would always bound it because you have those confounding factors of perhaps handling the other actinides that are being measured. But, again, I mean it -- as Arjun said, I don't think it would actually require that much work. I mean, if you have a list of workers who worked with thorium, it’s just a simple matter of checking the names off, I would imagine.

DR. TAULBEE: Well, if they’re claimants, yes. But if they’re not claimants, then we have to try and request their data.

MR. BARTON: Oh, I thought these measurements were from log books that transcended just the claimant data. Is this only from data that’s been pulled from NOCTS?

DR. TAULBEE: Wait a minute. Matt, this is a combination of NOCTS and the log books. Correct?

MR. ARNO: The trivalent data is all from log books, none of it is from NOCTS.

DR. TAULBEE: Okay. That’s actually better. Okay, so then we should be able to find those people working with thorium within the trivalent database that we formed. Correct? If I were to give you a list of known people that worked with thorium, we could look them up and get their trivalent data. Correct?

MR. ARNO: Yes.

DR. TAULBEE: Okay. This may be –

CHAIRMAN GRIFFON: Sounds good.

DR. TAULBEE: -- simpler than I was thinking it was.

CHAIRMAN GRIFFON: Ted, can you give me a sense in the realm of how we're doing on time?

MR. KATZ: Well, it's 4:32.

CHAIRMAN GRIFFON: Well, I mean, with -- do folks have to leave, or –

MR. KATZ: Yes, I mean, really about 15 minutes I should be making a move for the door.

CHAIRMAN GRIFFON: All right. Do we want to do one more and then maybe call it – and wrap it up?

MEMBER CLAWSON: Hey, Mark, before

we go on, I need something right here. Tim, what I'm looking at is earlier today we went through the slides of the Savannah River bioassay health physics procedures. And I've been going through something, and I just want to put on the record as understanding. You understand this is a guidance document. It is just merely a guidance. If DOE was to come in and say, you know, what's your program? They could go in and you could lay out everything that tells them well, these people should give this many bioassays, and it tells how to deal with skin contamination, and what forms to fill out. But you realize it still comes down like this one, airborne contamination, health physicists, shift supervisors will consider special urine samples. It's still up to the operational people of how it happens.

DR. NETON: That's what normally happens.

MEMBER CLAWSON: Right. I just

want to make sure, because you were putting up there that these people are going to be bioassayed on this routine.

DR. TAULBEE: This was their procedure. Okay? And it is guidance for the operational area health physicists, and they were -- from what we can tell, they were following this when we go through and we look at a person, but were there exceptions to it? Sure. I’m sure there were.

MEMBER CLAWSON: The reason why I say this is because in reading through this, because I have to go into my experience of it. We have -- we’re supposed to be sampled so many times a year, but because of our past history we don’t have to be, because they haven’t seen this much. I just am looking at this, and I know what you’re saying about this as being a guidance document, for the most part it was probably followed. But in some circumstances you’re going to find out that it was not. We have certain guidance documents in the DOE world, but then our own operations have sometimes more stringent and less. You’re not going to find a whole lot of people to think because –

DR. TAULBEE: That is actually not DOE guidance that you’re looking at. That is–

MEMBER CLAWSON: Savannah River.

DR. TAULBEE: -- Savannah River operations guidance that they were giving – this is from health physics.

MEMBER CLAWSON: Right.

DR. TAULBEE: This is who they were telling their area health physics, this is the frequency these people should be on.

MEMBER CLAWSON: Right. And this is when DOE would walk in and say this is what we’re -- this is our guidance for our people out here. Is there variances? Yes, there is. There’s not -- I just -- because I deal with these on a daily basis, and usually there's another document that calls out exactly where they're at in that, so I just wanted to go on record because I find it interesting. This tells you each one of the steps and everything else like that, what paperwork to fill out for skin contaminations, to have a special request, it has the form here that you use, tells you how to label your bioassay, but as far as being able to use the table of 100 percent, I'd say no. I'd say that would come down to an operational decision, so I just – I'd be very careful with saying oh, yes, this is how many times they pulled bioassay because of this record right here, because you know, little side notes on here, it really comes down to each one of the operations. The health physicist for those areas will call more, they could call more or they could call less. I just worry that -- and I'll tell you why, because if it says that you're going to have two samples, and we have a claimant that comes in and say yes, but I've only been sampled once this year, the next year I wasn't, you know, what are they going to say, non-procedure compliance, or whatever. I want to just go on record because this really is -- this is a wonderful thing, but this is a guidance, you can do it this way, but each -- you'll find out that each one of the health physicists for that operation or that facility, however they broke it down, still has the ultimate requirement of what they can do. And each one of their jobs if they start to see a higher amount they can increase them or decrease them. I just -- I worry about that one where you -- it's going to be this many a year.

DR. TAULBEE: When you look at the bioassay records for the individual claimants that we did, it is generally following this. Do we see exceptions? Absolutely.

MEMBER CLAWSON: Right. I just –

DR. TAULBEE: But -- and I recognize that, but this is the procedure that they were using, call it guidance if you want, but this was their procedure of how they were to be sampling. Were there exceptions? Yes. But what we see in the bioassay records tends to follow that document right -- that series of documents and the revisions, because you’ve got to look at it at each time period because it changed. Sometimes they weren’t monitoring for neptunium, and other time periods they were, so you’ve got to be really careful in your interpretation that oh, well, this says there should be two americium/curium/californium samples per year. If it breaches over one of these revisions, it may or may not be on the side of that revision, so you’ve really got to look at their individual records for each person. And what we’ve seen, it tends to follow what we see here. And we see a lot of enriched uranium monitoring for the people in the 321-M which follows in particular that document. We see a lot of plutonium monitoring, four samples per year, for people in the HB-line. We see a higher frequency, which is what that procedure is showing us. Is it exact? No, there's always going to be variations, but there is that in modern procedures and records. So, this is how we operate in a production facility.

MEMBER CLAWSON: An ideal in procedures, mandatory procedure compliance world, so a health physicist procedure may be deemed a little bit different. They've got the latitude to be able to increase, decrease, whatever. I mean, in our procedure world with one procedure, one, two, or three, it's word for word verbatim, but that's an operationalist procedure. I just -- I don't want to see us, people come in and say yes, but according to this I was supposed to get this many, and I never did, because it can vary. You can -- it can change determination of what it was on. That's all I wanted to make sure.

DR. TAULBEE: And that's in today's procedures, as well.

MEMBER CLAWSON: Right.

MEMBER LOCKEY: That would fit industrial hygiene.

CHAIRMAN GRIFFON: Thanks Brad. One thing you said was the key, that these are the procedures but we're also looking at the records, and a change to indicate that, you know, that thought was being operationalized, you know. So, I think we want to compare procedures versus whether they were assigned, and make sure that's a way to verify that whether they were or were not following the procedures.

MR. KATZ: Okay.

MEMBER CLAWSON: I think I took care of the last 15 minutes.

CHAIRMAN GRIFFON: You were filibustering, you did a good job. I think we should probably wrap it up so Ted doesn't miss his flight.

MR. KATZ: Thank you.

CHAIRMAN GRIFFON: But we have another date in three weeks, so we'll continue on and I will follow that, since we've got plenty of work to do, I want to keep things moving on this Work Group. So, thank you all, and talk to you in a few weeks.

MR. KATZ: Yes, thanks everyone.

CHAIRMAN GRIFFON: Thank you, everyone.

MR. KATZ: Brad for senator.

(Laughter.)

(Whereupon, the proceedings went off the record at 4:41 p.m.)