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U.S. NUCLEAR REGULATORY COMMISSION

PUBLIC MEETING RE: CHANGES TO RADIATION PROTECTION GUIDELINES

NOVEMBER 3, 2010
LOS ANGELES, CALIFORNIA

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UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

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RADIATION PROTECTION STANDARDS WORKSHOP SERIES

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PUBLIC MEETING ON THE POTENTIAL CHANGES TO THE NRC'S RADIATION PROTECTION REGULATIONS AND GUIDANCE

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WEDNESDAY, NOVEMBER 3, 2010

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LOS ANGELES, CALIFORNIA

The Workshop Series met at the Four Points by Sheraton, LOS ALAMOS International Airport, 9750 Airport Blvd., Los Angeles, California, 90045, at 9:00 a.m., Daniel E. Hodgkins, Community Health Network, Vice President, Community Benefit and Economic Redevelopment, facilitating.

PRESENT FROM THE NRC:

JOSEPHINE PICCONE, PH.D., Director, Division of Intergovernmental Liaison and Rulemaking

KIMYATA MORGAN BUTLER, PH.D., Health Physicist/Project Manager, Division of Intergovernmental Liaison and Rulemaking

DONALD A. COOL, PH.D., Senior Advisor, Radiation Safety and International Liaison

ALSO PRESENT:

ELLEN ANDERSON, Senior Project Manager, Nuclear Energy Institute

DAVID APPLEBAUM, University of California Los Angeles Medical Center

RICHARD BURKLIN, M.S., Health Physicist, EHS&L AREVA

SCOTT CARGILL, ASNT,, Radiation Safety Officer, Quality Assurance/Quality Control, Valley Industrial X-Ray and Inspection Services

ERIC GOLDIN, Southern California Edison

COLIN DIMOCK, Radiation & Laser Safety Manager, UCLA

LYNNE FAIROBENT, Manager, Legislative & Regulatory Affairs, American Association of Physicists in Medicine

CHARLES GOMER, PH.D., Professor & Radiation Safety Officer, Department of Pediatrics, Children's Hospital Los Angeles

ROGER GREGER, Conference of Radiation Control Conference Directions, California Department of Public Health

KATHLEEN KAUFMAN, Director, Radiation Management, Office of Applied Sciences, Los Angeles County Department of Public Health

KAI LEE, Associate Professor of Clinical Radiology, University of Southern California Medical Center

RALPH MACKINTOSH, PH.D., Chief Physicist, Radiation Oncology, Hoag Memorial Hospital Presbyterian

MELISSA MARTIN, M.S., President, Therapy Physics, Inc.

DONALD MILLER, M.D., Chair, Professor of Radiology, American College of Radiology

CHARLES PICKERING, Director of Safety and Occupational Health, City of Hope Medical Center

LEONARD SMITH, M.S., Certified Health Physicist, Perkin Elmer, Council on Radionuclides and Radiopharmaceuticals

GEORGE M. SEGALL, M.D., SNM, Veterans Affairs Medical Center

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

(9:00 a.m.)

MR. HODGKINS: Good morning. Heedfully you'll be exercising your voices a little bit more than that through the next two days. Welcome. My name is Dan Hodgkins. I'm the facilitator for this meeting, and I'm real excited to be here.

This is the two day stakeholder workshop on the potential changes to NRC's radiation protection regulations and guidance and a lot of the international Commission on radiological protection publication 103. Is that good?

I wanted you to know, I have absolutely no background in, what is this topic? Physics? Something like that. I have no background. Why I've been chosen is as a facilitator, and so what We're going to have is a participatory meeting here and this participatory meeting will include panelists, but as well as the audience.

Okay? And we'll go through some of the ground rules a little bit later, but first, I have the distinct pleasure of introducing Dr. Piccone, who will give you your introductory mark. Dr. Piccone?

DR. PICCONE: Good morning, and welcome. My name is Josie Piccone. I'm the Director of the

Division of intergovernmental liaison and rulemaking at the Nuclear Regulatory Commission.

Among other things, my Division coordinates the review and planning of rulemaking activities related to waste, materials, transportation, storage, disposal, medicine, and security.

We prepare regulatory analyses including cost analyses on the impact of proposed regulations. The staff and I welcome you to the second of three facilitated roundtable workshops regarding potential changes to NRC's radiation protection standards.

Changes, potential changes to move towards the international radiation protection standards. The first workshop was held last week in Silver Spring, was well attended. A lot of interaction and discussion. And We're hoping that that will be the case today, as well.

The purpose of this meeting is to understand the implications of making potential changes to NRC's radiation protection standards. However, it is important to note that the Commission has not directed the staff to move forward with rulemaking.

Rather, the Commission has directed the

staff to interact with stakeholders and glean information on the potential impacts of the Rule so that the Commission can make an informed decision on any proposed rulemaking.

So, we need your help, and I encourage you today to be candid. I have some experience with some of you, so I know that that's the case. And, please feel free to share your comments, perspectives, from your areas of expertise.

We are looking for detailed information on the potential impacts, the burdens, the benefits, of any regulatory changes. I also want to encourage you to provide comments in writing to the Federal register notice, the Federal register is open until the end of January, 2011.

And, we will be accepting comments until that time. So, again, I welcome you. I hope you have a very productive couple of days. And, I want, again, to express my appreciation for you taking your time out of your busy schedules to participate in this. And with that, I turn it back to Dan, who will talk about agenda and rules of play, I think.

MR. HODGKINS: That's right. Thank you so much. Okay. So, good morning again. As I said, Dan Hodgkins. I actually in my real life am a hospital

Administrator, so pretty familiar with hospital issues, staff, those kind of things.

But, We're going to talk a little bit about the ground rules for today's discussion. What We're going to do, is We're going to invite the panelists to have some discussion regarding each issue, and then we'll open it up to the audience.

Now, I got to introduce a couple people here. Sorry. This guy is taking pictures for prosperity, or for my mom. She'll be so proud I'm hanging out with physicists. Okay. First of all, Troy Day, Transcriber.

And, we really need you to talk into the microphones, okay, so probably the first part I'm going to be testing that out and so for audience members, please speak into the microphone. We have a couple portable mics that we can use too, in case it gets to be, you know, you're standing there and there's a big line or something like that.

So, whatever makes everybody comfortable. But speak directly into the microphones. For you guys here, you can't do the side thing, all right? It looks cool, you know, it looks like a, a great discussion kind of prompt, but you got to speak directly into the microphone, okay, or else our transcriber can't hear

it.

PARTICIPANT: And, just in case, if for some reason someone asks a question and it's not on the microphone, if the person answering could repeat the question, then we'll be sure to get it on the tape, as well.

MR. HODGKINS: Terrific. Okay. The other thing is that sometimes, maybe you don't want to stand at a mic or say something. Kim has cards. Kim's right there. We also have cards so that you can submit a question, you know, for the panelist, or just to say some things.

And we'll be discreet as possible with those, because those might be some situations that occur. Now, some other housekeeping. Bathrooms are out the door. You can go right or left. We will try and take breaks at the most appropriate time.

However, we do want to keep it pretty much on time. As the agenda does say, it's open to flexibility, but I think because it's public comment, we do want to be as consistent as possible with the agenda as possible.

Which means, like, We're going to practice here just a little bit, okay. We're going to practice with introductions. So there's like, almost twenty

panelists, so each one of you take one minute. That's twenty minutes. Take three minutes, and that's an hour.

So when you do those kind of things you got to be respectful of the time and that's what I'll be doing, okay? So, for the panelists, We're going to try something here. I want you to introduce yourself, and then how about, what do you expect to get out of today?

Okay, and how you might want to participate or what you want to hear about or what are those issues and we'll go around, so introduce yourselves so we can test out the mics, so this is just a practice round, okay, and what you want to get out of the day and who wants to start?

We're just going to go around the room. Mr. Mackintosh, would you be kind enough to start?

PARTICIPANT: What you need to is push the green button on the mic--

MR. HODGKINS: Green button. Push the green button once, let's practice. There you go. Now let's try it. Not working. You push it down, then let it go. Try it. Oh, look, the red light--is that me? Sorry.

DR. MACKINTOSH: Now it's on. All right. My name is Ralph Mackintosh, in spite of my name tag,

which says Robert. I am the chief of the physics section at Hoag Memorial Hospital, Newport Beach, California. And, my goal here today is to see that we implement regulations that are practical and reasonable.

MR. HODGKINS: And so we'll look for you for some practical and reasonable comment. Next?

DR. SEGALL: My name is George Segall, and I'm here as a representative of the society of nuclear medicine. We have a 16,000 membership representing nuclear medicine, physicians, technologists, and scientists.

I'm also a physician, chief of nuclear medicine at the veteran's hospital in Palo Alto, and chair of the radiation safety Committee at Stanford University. And I'm here to give input from the physicians perspective as a representative of the society.

MR. HODGKINS: Thank you very much. Did the audience hear that? So, Kai, into the microphone. Push it towards you. We're going to get this down.

MR. LEE: My name's Kai Lee, I'm a physicist with the university of southern California medical center. I'm here to listen and also want to see if the public opinion really counts.

MR. HODGKINS: Okay. You know, and it sounds like We're going to be competing with something next door. So, thank you. Go ahead.

DR. SMITH: Hello, I'm Leonard Smith. I'm here to represent the Council on radionuclides and radiopharmaceuticals. We are the major manufacturers of materials that are used for medical diagnostics, therapy, life science research, and quality control.

And, we have an interest on regulations, how they apply to people who are handling radioactive materials, as well as the environmental regulations, and we have a concern in our industry that increasingly the industry is becoming more global, so our products go all over the world and also our staff and customers are all over the world.

And, it's, we see a great benefit in regulations becoming more international regulations, but We've recognized that there are practical differences in different areas that also need to be accommodated and we have plenty of ideas of how that could be done.

MR. HODGKINS: That would be great. In the Washington D.C. forums, we did hear a lot from an international perspective as well. So, I look forward to hearing more from you on that.

MR. APPLEBAUM: Hi, good morning. My name is David Applebaum. I'm the health physicist radiation safety officer for Harvard UCLA medical center, and I'm here to listen and learn.

MR. HODGKINS: Thank you. Anything specifically you want to learn or listen to?

MR. APPLEBAUM: I certainly like to know how the ICRP view is taken by the individuals in this room and particularly what an impact will have on other hospitals other than my own if the NRC decides to go in that direction.

MR. HODGKINS: Thank you. Colin?

MR. DIMOCK: I'm Colin Dimock. I'm the radiation safety officer at UCLA. I'm here to give the perspective of a large research institution on how these regulations, if they're enacted, would, if they were made regulations, how they would impact our operations.

MR. HODGKINS: Terrific. Thank you.

MR. GOLDIN: Good morning. I'm Eric Golden with Southern California Edison. I'm mostly interested in how our radiation protection performance fits in with other folks in the radiation safety business.

MR. HODGKINS: Thanks. Hey, Eric, and I think we saw that in D.C. too, and that was a really

good conversation as far as from the medical viewpoint, the industry, that what are the similarities and differences, so, really count on you to kind of highlight those. Interesting conversation in D.C. for sure. Kathleen?

MS. KAUFMAN: Yes, I'm, I'm not, I guess this mic's working, it's kind of blinking on and off. I'm Kathleen Kaufman, I'm Director of L.A. County radiation management. I'm also here representing the conference of radiation control program directors, particularly regarding how these changes might impact x-Ray users.

And, I'm very curious to hear how some of these things would be regulated since I'm a regulator, and particularly when we look at things like, like, five rem over ten years, how exactly are we going to, going to do that from a regulatory perspective if that's the decision.

MR. HODGKINS: Thank you.

MS. ANDERSON: Good morning. I'm Ellen Anderson from the Nuclear Energy Institute. And I'm here to represent basically the power reactor section of, of the community and We're here basically to, to learn about the insights from the other stakeholders as to how they feel about the potential changes to the

regulations.

MR. HODGKINS: Thanks, Ellen. Familiar face, and you know, there's a few familiar faces. I think one of the things that I'd say is that, you know, there were some conversations in D.C. that probably need to be continued here or amplified so I really count on those folks who participated in the past to kind of help represent those folks at all so it's not three separate meetings but there's some continuity between the three and I'm looking to people in the audience and folks on the panel to help us do that, and Ellen, you're the ringleader. All right. Robert?

MR. GREGER: Good morning. I'm Robert greger, I'm a senior health physicist with the state of California. I'm here today representing both the state of California and the conference of radiation control program directors, where I'm the chair of the suggested state regulations for essentially the part twenty regs.

I'm here to, as many other people have indicated, to hear what everyone has to say and in particular from the conference of radiation control program director's standpoint, to generate information on a position that the conference may take.

MR. HODGKINS: Thank you.

MR. PICKERING: Good morning. I'm Chuck Pickering, from the city of Hope National Medical Center, and our institution is heavily involved in research and development of new radiopharmaceuticals as well as interventional radiology procedures, where people get significant doses. So, I hope to at least provide some of that perspective.

MR. HODGKINS: Terrific.

DR. GOMER: And I'm Chuck Gomer from Children's Hospital, Los Angeles. And I'm here also to participate in the potential discussions on the impact of these possible regulation changes as it effects both our staffs, our patients, and how the pediatric community can learn from this, this two day workshop.

MR. HODGKINS: And, you know, if I could just comment on listening and talking, because I, as I go through, I see that there's a lot of folks from health care here.

You know, I think it's pretty remarkable sometimes if you're just quiet a little bit, the next thing you know, someone says something that you wanted to say, and I hope that that's the truth here. But seriously if you don't hear what you want to hear, step up to do that.

On the other hand, let's not be redundant, okay, so if I hear some redundancies I may stop you. And I don't want to be rude, you know, and you can tell me so because this is a conversation, this is not a presentation. You know, I like to call it not the sage on the stage but the guides on the side.

All right, so that's what this meeting is about and hopefully we can get that going. Next?

MR. BURKLIN: Good morning. I'm Rich Burklin. I work for Areva in Richland, Washington. We make nuclear fuel for commercial reactors. Areva is an international company. We send people all over the world, and we are interested in, from an international perspective as well. I'm here mostly though to provide input from a fuel fabricator's perspective.

MR. HODGKINS: Excellent. And since you're under represented, we need more conversation from you, okay? Next.

DR. MARTIN: Good morning. My name is Melissa Martin. I'm also one of those healthcare people, as you classified us. I am, I run a consulting medical physics group providing medical physics services to many facilities throughout California.

I'm RSO at three medical institutions, and I would, not to beat the drum, but yes, I'm here for

the same concern that's been expressed before, how do we, what effect this is going to have on the interventional and nuclear medicine people when We're combining exposures and what impact does it have.

I'm also the administrative Council chair of the AAPM, and Government relations Committee is part of the administrative Council for the physicists.

MR. HODGKINS: Welcome.

MS. FAIROBENT: I'm Lynn Fairobent, and I'm the manager of legislative and regulatory affairs for the American association of Physicists in Medicine, and two points. One, the purpose and major focus of this roundtable was to be on medical, so you are going to hear a lot of redundancy, more than likely, in the comments today.

Secondly, I was at the Washington workshop, and I am most interested to hearing the differences between what was raised from the primarily the nuclear reactor focus, which is what the D.C. primary focus of the roundtable was to be, and looking forward to hearing, or reading, the transcript from next week's meeting, which has an industrial focus for the Houston meeting.

Couple of concerns, I think we need to keep in mind that NRC cannot operate in an isolated

world in the regulatory regime and in the Federal system, and that we need to be sure that what's said here today is transferred for other agencies and for state adoption, or consideration.

MR. HODGKINS: Thanks, Lynn.

DR. MILLER: Good morning. My name is Donald Miller. I'm an interventional radiologist and professor of radiology at the uniform services university in Bethesda, Maryland.

I'm here representing the American college of radiology, which is a professional association representing approximately 34,000 radiologists, radiation oncologists, interventional radiologists, nuclear medicine physicians, and medical physicists.

I am vice chair of the safety Committee of the American college of radiology and I am here primarily to hopefully provide some perspective on the potential effect of the proposed regulations on interventionalists.

MR. HODGKINS: Thank you.

MR. CARGILL: My name is Scott Cargill. I'm, apparently I'm the lone wolf industrial radiographer here in, representing this meeting. Yes, there'll be a lot more in Houston, obviously. My, my biggest hope out of this meeting is A, to learn some

of your side as well, obviously the medical side is not my preview.

But, to also encourage not only those here that are obviously offering input, but those that aren't here, to become involved with regulatory affairs. It's very easy to see a reg or a law come down the pipe and rail against it.

But if we don't offer our input, the regulators have no basis, they have no idea what it is or how it will effect us in unforseen ways. So, hopefully, we'll all have some input and help the NRC see the light.

MR. HODGKINS: Thanks so much. You mean, on the microphone? The light on the microphone? No--okay, and here's the point, is that, we just got a sense of just introducing yourself, you know, there were some issues that came up, you know.

It was a good conversation, probably just did last a half hour, but that's kind of how we'll facilitate this conversation. All right, and the real conversations, we'll open it up to the audience then at that point, and you'll have an opportunity as well to discuss the issue at hand and to have some input, okay?

With that, I think I'm going to turn it

over as far as to Donald Cool to introduce the first topic and some background and then we'll take it from there. Dr. Cool?

DR. COOL: Thank you, Dan. All right, now, listen. The first challenge for me for the morning is to see if I can make the computer work. Somewhere on here--all right. There we go. Yes.

First thing that we thought we would do is try to provide a little bit of background on the history of recommendations, the history of the regulations, so that we all have a reasonably similar starting point in terms of the discussions that We're having today on possible changes.

In the one sense--

MR. HODGKINS: Hey, Don?

DR. COOL: --yes?

MR. HODGKINS: I have one question.

DR. COOL: Yes.

MR. HODGKINS: Can you tell them why you're standing in front of there? Like, who are you to be standing up in front of everybody.

DR. COOL: Well, I'm just some guy they pulled off the street. That's me. I'm Donald Cool. My present position is the senior advisor for radiation safety and international liaison in the Office of

Federal and state materials environmental management programs of the Nuclear Regulatory Commission.

That's probably the longest title in existence. In one sense, I have a very unique position because I have the opportunity to get involved in lots of different issues in radiation protection and many of the things that our agency does on the international.

I also have a bit of background with NRC. I know many of you are on the table for many years of activities. Been with the NRC for twenty eight years, done uranium fuel licensing, worked materials licensing inspection issues. Worked on our Office of research in the rulemaking group.

Directed the NRC's program of licensing inspection for all byproduct materials, and now, most recently, this position in a variety of different activities. Unfortunately, one of the things that that means in the twenty eight years is that I was around the last time we revised part twenty.

Somehow, I had wished that this was going to be my daughter's turn at the wheel doing this, but she was smarter and she decided to be a math teacher in high school. So, here I am, once again, and that's the process and just a little bit of background of why

I am here, what We're going to try and do today.

So, let's start with some things and most all of this is in or was in the Federal Register notice, so hopefully it's not necessarily new, but gets is all acquainted with the process. The international Commission on radiological protection, ICRP. You're going to hear a lot about them today, and their recommendations.

Who are they? Well, they're actually an independent charity, chartered in the United Kingdom, have been in existence since the mid 1920's. Originally focused on medical uses of radiation, coming out of the very early days when, as people were starting to use the early x-rays and other things, they discovered that skin reddening and other effects were happening in some of the radiologists.

And so they were chartered under the international radiological society to be an independent group that could start to put together some recommendations. Over the years, they've done that a whole bunch of times.

The ones that We're going to be particularly interested in start in 1959, ICRP's publication two. There was an update of that, actually a very significant change, that happened in 1977,

ICRP's publication twenty six.

There was another Revision of that that happened in 1990, ICRP publication sixty. And then most recently, the update that was finished at the end of 2007, ICRP publication 103. So there are a number of sets of recommendations that have happened over the years.

Those recommendations have reflect changes in the science, they reflect the changes in our understanding of the effects of radiation. Have-- reflected changes in what people thought would be prudent safeties for protecting individuals.

The most recent recommendation, this is with the ICRP had on, ICRP said what their intention was in publication 103 was to consolidate and update all the things that have happened since 1990. They were very fond during the development process of talking about all the different numbers of guidance and materials and things that have been put out in different forms for different specific kinds of uses and this was an effort to try and consolidate all of that, to update the science.

But, in the end, they found no major fundamental changes in the understanding of radiation risk. There were new tissue weighting factors, and

radiation weighting factors reflecting continued development and understanding how different portions of the body react to radiation, the degree to which cancer and other issues are developed.

Overall, the detriment radiation risk still about 5% per sievert, as in 5% per 100 rem. You will find us being mostly in U.S. units today, although I know one of the issues that everyone would love to have is, Don, when are you going to finally have NRC move to the metric system.

Not anytime soon, I think is probably the answer, because that actually gets you to the U.S. Government's metrication policy and that's way above my pay grade. But, roughly, overall, the same detriment.

I think it's probably important right now to note that that reflects the difference between ICRP 103, 2007, ICRP publication 60 in 1990. The radiation detriment that was associated with the recommendations from 1977, ICRP publication 26, was 1.25 per sievert.

So, there was a change in the understanding of radiation risk that happened between `77 and 1990. There's been no change since 1990. Why is that important? Because the regulations that are in place today are based on the 1977 recommendation.

So, their underlying, technical basis is actually an older understanding of radiation risk, and those risks have changed. That's one of the things that the staff will have to consider, and part of what we will be looking for, input and discussions on, is changes in light of the underlying science.

One of the next things that happened in ICRP publication 103 was a move from a process base to a situation base. So you say, what's that? Well, most of you have probably heard of practices and interventions. The language that was in place back in 1977, it was a practice if you were doing something, you were intervening, if you had something that was not the way you wanted it to be and you wanted to fix it.

Seems very logical, but for a lot of people was kind of difficult to explain. ICRP moved to a situation based. Basically three situations. Planned situations, any place where upfront you could do the planning for what you intended to do. So, most everything that We're talking about here in licensed activities is a planned situation.

There are existing situations. It exists, it's out there, you have to decide whether or not you want to do something to improve it from a radiation

protection standpoint. One of the most obvious ones is radon in homes. It exists, it's naturally Occurring, but the United States, as most every country in the world, has programs associated with radon in homes to try and deal with that situation.

And then there are emergency exposure situations, something bad has happened and you need to take immediate actions to try and return the situation towards a more normal situation. Provide protection for the individuals involved.

The ICRP was finally trying to have stability, that is, the fundamental principles, as in exposures should be justified, radiation protection should be optimized, that is, doses should be low as reasonably achievable, taking into account all the different factors that may come into play, economic, social, and otherwise.

And, exposures should be limited, at least in situations where you can do the planning upfront. The dose limits were unchanged. Again, that's a reflection of ICRP's publication 103, to publication 60 in 1990. That's not a reflection that goes back to ICRP's publication 26 in 1977.

Hence, another reason for some of the discussions that We're having here today. So, how does

that translate to NRC's regulatory requirements? 10 CFR part 20, Rule that you all know and love, I'm sure, our standards for protection against ionizing radiation.

Contains definitions, requirements for radiation protection programs, a requirement that licensees reduce exposures as low as reasonably achievable using procedures and engineering controls. It has occupational dose limits, it has public dose limits, it has requirements for monitoring, and it has requirements for what has to be labeled.

It has requirements for what you have to report to us, et cetera, et cetera. All that material is in there. In addition to that, there are the agreement state regulations. Agreement states are states which under section 274 of the atomic energy act, have formally entered into an agreement with NRC and they assume the regulatory control for the materials under that agreement.

NRC relinquishes control. That is, we don't have control. California is an agreement state. We don't come and inspect and license any of the byproduct material facilities in California. Now, one of the things that is excluded from the agreement is the power reactors.

So, for those of you who have come up the coast from Diablo Canyon, et cetera, yes you have an NRC license. That's because the reactors are limited to NRC jurisdiction. But for many of the things that we will talk about today, it's actually the states that have the regulatory authority, have the regulatory requirements.

Those requirements have to be adequate and compatible, and there is this wonderful process for looking at what is adequate and compatible and defining what it is, how strict that needs to be, in some cases, like dose limits, and some of those things which have incredible transboundary implications, it has to be essentially identical.

And, there are other things where they do not have to be quite so closely aligned, the states can in fact be more restrictive in certain situations, and that occurs. There are, in addition to that, in the NRC regulations, specific requirements in part 30 and the whole series of those numbers and part 40 and 50 and 60 and 70, for by-product materials and source materials in the reactors and waste disposal and fuel cycle facilities.

Some of those also contain requirements that are related to radiation protection. In fact,

some of those requirements were not updated the last time NRC changed the regulations, hence why We're in a bit of an interesting situation today.

The last time we did part 20 was completed in 1991. It took twelve years, because the effort was actually started shortly after ICRP put out publication 26 in 1977. That update changed the things that were in part 20. It changed things that were cross-references in many of the other places.

So, if you go back and look at the old Federal Register, that's actually a cover from the original publication in, from the Office of Federal Register. Lots of those sorts of changes. But it did not go and change some of the other requirements, where there were separate explicit dose criteria or radiological criteria in some of the other parts.

So, there are places in the NRC regs that still go back to ICRP publication 1 and 2. That includes some of things in the byproduct program, for doing generally licensing and the requirements that have to be looked at there. That gets you to think like the waste classification, and the waste disposal.

It gets you to what's considered as the ALARA design criteria for reactors, part 50, Appendix I. So there's some stuff out there that is very, very,

very old. And then there's the stuff that's in part 20, which now goes to 1977, but in addition to that, there are licensees today who are using the, through specific license amendments, the updated methodology and scientific information that came out from 1990 and the years following ICRP publication sixty.

Because, in fact, due to some of the changes in the science, it was advantageous for some types of licensees, particularly the uranium fuel fabrication facilities, to move to adopt those newer dose coefficients and things as part of their program.

The NRC Commission agreed that we should allow licensees to do that if they made that in totality for their program. There was no cherry picking allowed. If you were going to use the newer methodology you had to use the newer methodology.

But the net result of that is, that if you look at the NRC activities, there are three generations of recommendations and scientific information that are all in place and operational at the same time today. By the way, the situation is this, just that bad, if you look at the larger, Federal Government scheme.

You have the Department of Energy, who is just still in the process of updating some of their

regulatory requirements to adopt ICRP publication 60, or pieces of it. The occupational piece came out a year or so ago. They're still working on the public piece.

You have some of the organizations that are with ICRP 26, 1977, like ourselves, and you have things that go all the way back to ICRP publication 1 and 2. EPA is generally applicable environmental standards, like 40 CFR 190, and some of the other things, still based on ICRP 1 and 2.

The Federal guidance for members of the public still goes back to ICRP 1 and 2. The occupational guidance actually now has been updated and reflects ICRP 26. OSHA, their regulations and radiation protection are a copy of the NRC regulations from 1966, and are still ICRP publication 2.

So, within the Federal family, there's also a huge discrepancy, and just so that we can have this as a point of reference, there are lots of discussions going on, not only within NRC, but with all the agencies about what is necessary to try and move an update so that we can try and improve the consistency in this process.

Now, can I promise you that EPA will update their requirements and OSHA will update their

requirements and we will all move to a new place where We're all the same and happily arm in arm with everything exactly identical? No. I can make no such promises. I have no such control over some of the other Federal agencies.

But we are in a dialogue on that discussion. So, we put out part 20 in 1991. There were three years to implement it in 1994, it was a significant change. The rest of the world had started into the process of adopting ICRP publication 60.

The European union had adopted their Directive for basic safety standards. The international atomic Energy had adopted an update of their basic safety standards, and the rest of the world moved towards ICRP publication 60. New dose limits, all the dose coefficients, all that information.

By the time we got to around 2000, the NRC staff started looking at this issue. There had now been enough time for people to have gotten comfortable with implementing the changes made in 1991, they said, well, is it time for the NRC to start updating part 20 again, because the rest of the world is doing this, where do we need to go in this process.

The U.S. is beginning to get questions,

hey, when are you going to get around to updating your requirements? We took a look at the process. We actually went to our commissioners in 2001 and provided them some background and said, Commission, yes, the rest of the world has moved, but we think it's probably a good idea wait right now because we know ICRP is already beginning to talk about what a new consolidated update set of recommendations might look like.

And there was some really interesting discussions going on at that point which could have made substantial changes in the ICRP recommendations. So we suggested, rather than us starting the process now, let's wait, let's see where ICRP comes out, so that we don't end up behind the 8 ball again and have another regulation that is just coming to finishing up when ICRP gets around to putting a new set of recommendations out, and We're behind once again.

Commission said, that's probably a good idea. Monitor what ICRP does, don't expend any resources working on a technical basis for a new rulemaking, let's wait and see. All well and good. We worked on that. Little did we know it was going to take ICRP seven years to get done with the recommendations.

Because they didn't come out until December of 2007. Staff, as good staff, keeping track of all their due dates and requirements, we went off and we did an analysis and we went to the Commission in December of 2008, said, Commission, yes, there are a whole series of issues which seem to warrant at least a consideration of whether NRC should change it's regulatory requirements.

We recommend to you that you have the staff begin a dialogue with the stakeholders and begin developing the technical basis that would be necessary for any regulation change. Remember, the Commission told us not to expend any resources developing a technical and regulatory basis back in 2001.

So, all of the underlying work that would be necessary to support a Rule wasn't being done. That's what we recommended to the Commission. Commission, on April 2nd, thankfully, it was not April Fool's Day, said, Commission, staff, we agree with you. Go off and start to explore the implications of appropriate and scientifically justified.

Nice, large, big words. Why do I have those words on there like that? That's explicitly what the Commission told us in that staff requirements memorandum, how the Commission gives the staff

guidance.

Greater alignment. Notice that doesn't say adopt. This is not a question of whether We're going to go adopt it and We're just asking all of you to say nice things before we go off and do that.

No, We're not there. It's a question of what may be appropriate, and what are the benefits and the burdens and the implications of revising any of that regulatory framework.

The system is working today. People are not being overexposed. There's not people dying of cancer in large quantities that all the epidemiologists and otherwise finding that the radiation protection system works.

So, there's adequate protection. So, what are the benefits, what are the implications, what are the right things to do at this point, given all of the things that have happened scientifically and otherwise for the United States to do?

So, staff--

MR. HODGKINS: Can we interrupt and just see if there's any other historical perspective?

DR. COOL: Sure.

MR. HODGKINS: Okay. So, from the panel, I mean, you've just heard a historical perspective on

how we got here today, and I guess there may be some historians--I don't want to rewrite history. But, is there some input that anybody has as far as a historical perspective and we'll just go around the table as far as meaningful or cogent to this conversation. Who's going to start? Kathleen, I'm going to start with you in the corner.

MS. KAUFMAN: My only comment on it is that it takes the states, or at least some states, including California, some years to implement changes in order to align with what NRC has done.

So, our Revision of part 20 was implemented into our regulations in 1994. So, it, it's a little bit later. It certainly was a, a, a, there were some changes in part 20 that impacted our, our licensees.

And, We've made some changes subsequent to the even 1994. So whenever we do that, we always run into dual issues. One, is how is it impacting our licensees. And two, is how are we going to regulate that.

And so that's, a, a, a, as I mentioned before, that's kind of our main concern for this as well.

MR. HODGKINS: Ellen, any historical

perspective? So you're just going to pass? Robert? Pass? Charles? Pass? Charles? Nothing? No historical perspective that you want to add? Okay. Now, let's throw it up into the audience, as far as, is there any historical perspective you want to add? Can you get to the microphone please?

PARTICIPANT: Thank you very much. The ICRP recommendations are all base don the linear no threshold assumption.

MR. HODGKINS: Can I just interrupt for one second? You got to identify yourself first.

PARTICIPANT: My name is Carol Marcus. I'm a radiation biologist and a nuclear medicine physician and spent two terms as a consultant to the NRC.

MR. HODGKINS: Welcome.

PARTICIPANT: The linear no threshold was adopted in 1959, mainly on political grounds because many countries wanted to see an end to atmospheric nuclear testing. There were never data supporting the idea that every atom had a finite possibility of killing you with cancer.

It was just a convenient assumption, and unfortunately, I think, has been frozen into pseudoscience. Today, there are several thousand papers on radiation hormesis, that is, beneficial

effects at low does.

No question about moderate and high dose. Those are dangerous. But, there appears to be a tremendous lack of really good evidence of any bad effects at low dose. I have here two textbooks written on radiation hormesis.

I find it amazing that ICRP simply will not even look at this subject. It reminds me of when the catholic church said the earth was flat and Galileo said no, it was round, and they nearly killed him. I think we have to look at science.

As Dr. Cool says, the commissioners want us to look at science. Unless there is compelling evidence that people are dying from five rem radiation, I don't think we should be really considering change at all.

MR. HODGKINS: Thank you. Hopefully we will not get to the Galileo part in this program. Okay. Anybody else from the audience want to add a historical perspective? Maybe not going as far back as Galileo. Anybody? Okay. So--yes, please.

PARTICIPANT: If you want to take my picture I've got to button my jacket up.

MR. HODGKINS: Got to look good for mom.

PARTICIPANT: There you go. My name is Chad

Mitchell, I'm a medical physicist. I'm here representing the U.S. Navy Bureau of Medicine and Surgery. I just want to quickly point out that in ICRP publication 103 in table 8.7.1, it does say uncertainties are considerable and knowledge of these biological effects is growing but is currently insufficient for radiation protection purposes. So, you want to go so far as hormesis, but just to say that the ICRP, Dr. Cool clearly pointed out recommendations. Thank you.

MR. HODGKINS: Thanks so much for your input on the historical perspective. Dr. Cool, take it away.

DR. COOL: Okay. Thank you. And, just to follow up on that, the, the couple of comments that we had. ICRP in publication 103, the gentleman just noted parts of the work, was actually kind of careful, I think, in saying that, yes, it was based on a linear no threshold assumption for purposes of constructing a regulatory program.

They did not actually go and say they entirely and completely believed it, and in fact some of the other things they said, particularly around the use of collective dose, would lead you to believe that it's maybe or maybe not.

So, that's out there. I would welcome as we go through these discussions that we talk about the implications. If we wanted to go to something besides a nonlinear system, what would that mean to the regulations or otherwise? So, we'll see how that proceeds.

So, to finish off the sort of general introduction and why We're here today, okay. Phase one, the first year or so, coming up to now, we made numerous presentations to different organizations, many of your societies and different groups would come out and talk to.

Those were nice sort of one on one interactions. We've heard a lot of input and information. We invited a bunch of comments, people provided some comments on the record. We had a dedicated web address by the way. That is still active, still useful.

You will continue to find it in the current Federal register, so you can use that for sending us comments. All of that comes together in what We've nicknamed phase two. That's where we are today.

To get all of the groups around the table. Now, we can't have everybody all around the table

simultaneously, so as was mentioned by Dr. Piccone a little bit earlier, we had a first meeting in D.C. There was a bit more reactor flavor.

In fact, there was one whole day devoted to the reactor issues, which are not going to be repeated here in L.A. We are in L.A. these couple of days and we have rather deliberately tried to provide more spaces for the different medical groups because you are a huge and very important constituent.

And next week, on Monday and Tuesday, we'll be down in Houston, and our poor lone colleague here, we will have many of the folks in well logging and radiography and other industrial groups down there to provide us a bit more of a focus from that standpoint.

Having said that, this is not a medical meeting. And what I'm very much in hopes is that everyone can listen to each other, reflect to each other, tell what will work and not work from their particular perspectives.

We have found that it is so useful to engage the variety of people around here in the various discussions. What will, what will work in a particular situation or not. Our objective is to hear from you on the issues and options.

In many sense, I'm going to hold up a mirror when a question is asked and said good question, what do you think. The whole point of this is to try and explore in detail the uses and the develop the information that's going to be needed by the staff when we go back to the Commission late next year with some recommendations on how to proceed on some of the key issues.

Now, why did I say that sort of carefully and slowly? In one sense, and this sounds a little bit facetious, it's not sufficient to just say no or just say yes or all of that. I'm sure if we wanted to just do a poll, we could go around the room, we could go through each of the issues in about fifteen minutes or so.

We could have yes no yes no yes no, we would have had our little bit of a straw poll and we could all leave. Unfortunately, that doesn't help to actually write down why. It's not possible for us as the NRC staff to go back to the Commission and say there should be no change to the dose limits, there should be an update to the science, there should be whatever the things might be, because everybody said so.

Okay, very nice, we have to explain to

them why. What was the reason behind it. Both the pros and the cons. Now, in many cases, certainly in D.C., most everyone was saying we don't really think you should change the dose limits.

Okay, I understand that too. I need for you to help understand why from this technical and scientific standpoints, the impacts that are associated with change and why that is not appropriate policy for the Commission to have.

I'm not saying this with any bias. I don't have a view yet. Okay, so we all have our own personal views and things, all that's fine. But we have to develop a record to be able to provide some recommendations, and there are other things going on.

The Commission is well aware that the rest of the world has moved to adopting these updated recommendations. The Commission gets pressure from external sources, particularly internationally, to move to update the requirements.

Just on Friday of last week, a two week special international atomic energy agency mission, call it integrated regulatory review service mission, came in, they spent two weeks looking at the NRC regulatory programs related to the reactors.

One of the things they looked at in detail

was regulations and guidance, and one of the things they reported out is a specific suggestion was for the Commission to continue and complete it's process to updating it's requirements to align with international recommendations.

So the Commission is getting other views, and so what has to come together is a fully informed discussion in order for them to make some decisions. So what will come next? We'll say this now, we'll say this again at the end.

Let's spend a couple days, We're going to develop some information, the staff will have to go off and assemble all those viewpoints and discussion. We go to the Commission with an issues paper. The Commission will have to give the staff some direction on how to proceed.

That could range from, We're not going to do a rulemaking at all, just don't bother doing anything, to do a rulemaking and on these key issues take this sort of direction based on the policy materials that you've provided to us.

Once we have that direction, and if it is for doing some type of rulemaking, then the staff will have to complete the development of the technical basis, prepare a proposed Rule, and then it goes into

the formal administrative procedure process of notice and comment and comment resolution.

So this is by no means the end of the discussion. It's only another point in the discussion. And that completes what I wanted to do in terms of background, see if there were any questions on the process and activities before we start to get into the first of the technical issues. Thank you, Dan.

MR. HODGKINS: Thanks, Don. And as far as what We're trying to do at this point, you know, is the process. But, one of the things I want to say is if you have some input into the process, we need it, we want it, and at the end of the day, today you'll have an opportunity. At the end of tomorrow you'll have an opportunity as far as some feedback.

But, what I'd like to do right now is, again, go around the room and, and just get your feedback as, is, if this is good process to go through, and if there's any recommendations to change it at this point. And Lynn, you want to start?

MS. FAIROBENT: Sure. Hey, Don, are the slides from these workshops posted on the website? Because I had difficulty finding them if they are.

DR. COOL: They will be, in the wonderful ways in which the electrons help us, they are in the

process of being posted. Kim, are they now up? For the first meeting. What happens is at the conclusion of the meeting, we all went back to white flint, and we immediately started the process of getting all of the materials from the first meeting into our document management system and made publically available. It doesn't happen in one day, but they are, should be available now.

MS. FAIROBENT: Kim, are they under the, a session number that's in the Federal Register, because if so, I could not find them this morning. Kim, Kim said they have a unique session number. Could you guys provide that?

MR. HODGKINS: Is there an answer to that question?

PARTICIPANT: I'll provide it to you during one of our breaks. I'll look it up and provide it to you.

MR. HODGKINS: So, just the point is, posting it on the internet and the website as many places as people can find it.

PARTICIPANT: And the transcripts from the first meeting will be available somewhere around November 12th or thereafter. And, ten to twelve days after this meeting, and after the Houston meeting. So

there's a ten day turnaround on the transcripts.

MS. FAIROBENT: My point is that I think that the slides would have been beneficial for those perhaps who could not be here to have ahead of time if they were attending today's meeting or next week's meeting, and as we all know, and I sit on the atom's users group, it is not always easy to find it when a session number's changed depending on when it's posted or what is posted.

So, perhaps Don, maybe NRC as they did for the cesium chloride issue and safety culture, perhaps it would be worth a separate dedicated website on this issue and all the materials could just be posted once, just as a potential change for process.

DR. COOL: Okay, thank you. I think it's quite possible for us to TR and put it on the web pages that we have for radiation protection. We're mandated by our internal procedures to have it in that wonderful document management system. So, rather than an or, I think it's an and. But with that, it's a good suggestion. Thank you.

MR. HODGKINS: Thanks, Lynn. Hey, let's change it up and go around the other way. Melissa? Any comment on process? Comment on process?

PARTICIPANT: Well, I, I think that's an

excellent idea, that you, getting the public input before, before you go ahead with the regulations. The NRC's been doing this type of thing for a number of years now, and I think it's very helpful.

MR. HODGKINS: Okay. Thank you.

PARTICIPANT: Don, thank you for the overview. It was very helpful. The, the issue I wanted to bring up, and it was in some of the background material, related to the risk estimates that you mentioned. And just for clarification purposes, NRC is, is looking at this ICRP suggestions, but are the risk estimates U.S. risk estimates versus worldwide estimates, and what differences are there? And is that significant in our discussion and in our thoughts.

DR. COOL: An excellent question, excellent question. Because the answer is, no, not exactly. So, let me use just a moment to explain a little bit, and we will get into more of it later in a couple of places.

Currently, the ICRP is working on updating their dose coefficients and calculations based on the tissue weighting factors and radiation weighting factors. They use a worldwide average sort of mixture person so that the relative rates of cancer induction in various organs and tissues represent sort of the

statistical average throughout the world.

We know there are differences in Asian populations and Caucasian populations and other things. In parallel with this, going on right now today, with the lead of the U.S. environmental protection agency, is work to looking at updating the dose coefficient and the radiation risk estimates based on a U.S. population.

They will use, I understand it, the same tissue weighting factors, generally speaking. They will use the same radiation weighting factors. However, they will use updated and U.S. information related to the various statistical induction of cancers in the U.S. population.

They will also more explicitly bring in some of the risk information from the National academy of sciences BEIR VII report. That work has been ongoing, as I said now, for a couple of years. They have actually been through their science advisory Board process, developing what they nicknamed the blue book.

It's a rather massive document which is their methodology for radiation risk estimation. That will eventually be used to update their risk numbers in Federal guidance reports 13, as EPA moves directly

from radiation exposure to risk.

They will also be updating Federal guidance report eleven, the dose coefficients. So there is an ongoing process. I am told that for the most part the changes are very minor, and very small. But there will be some small differences.

One of the ones that I think many of you will want to keep particularly watchful over is the radiation risk number that's associated with beta particles and very low energy gamma, or x-Ray. The fluoros, tritium, some of those things. Because, the BEIR VII report and through the science advisory Board, EPA is looking at changing the Unit coefficient, which is a one for ICRP, to 1.7 to 2 for tritium and very soft x-Ray.

So, that could potential have some rather significant implications in tritium dosimetry and issues and we know that nobody ever worries about tritium anyplace--no, okay--and no one ever has any low energy x-Ray that they worry about, okay, so stay tuned.

What I'm telling is materials, they are publically available through the EPA website. I'd have to do a bit of searching to get you a specific web address for those materials, but they have gone

through the science advisory Board process. They are not final.

So, it's not that they have actually changed those numbers yet, but that there is a strong consideration and it actually has been recommended and approved by EPA science advisory Board. Excellent question that we'll need to keep in mind. Thank you.

MR. HODGKINS: Is there any followup you want from that? Okay. Terrific, so We're focusing sort of on the process. For you physicists, what's a small change, when you're talking about atoms and itty bitty bitty things, what's a small change? All right, Charles. Any process questions? Pass? Pass? You'd like to say something? Microphone.

DR. SMITH: This is Len Smith. Small change, with 10% is definitely small change, but it's a factor of two, 100% is a big change.

MR. HODGKINS: Okay.

PARTICIPANT: Question. What do you mean by very low energy x-Ray? How do you define very low?

DR. COOL: That's also a good question. Unfortunately, it has been long enough since I read the EPA thing that I can't tell you what energy range that actually applied to. We can try to find out and get back to you, but I don't want to quote a number

right now because I don't remember.

MR. HODGKINS: Followup? Okay. Process, process. Now opening it up to the audience. Is there any process issue that you, is there a better way for us to conduct this meeting, for future meetings or information that you feel like would have helped you be informed in this situation? You're good?

So, you get the idea how this is going to work? Comfortable? Good, because now we get a ten minute break. And before we start the meeting of the program, just to give you guys and opportunity to do that. Now, it is a ten minute break. Last time in D.C. it went to fifteen. I'm saying it's ten.

So, it's 9:35. Let's do 9:45, we'll be back in the room. Appreciate it. Bathrooms out there. You can get coffee, I think, in the back, there, and have a nice ten minute break. Thank you.

(Whereupon, the above entitled matter under investigation went off the record at approximately 9:35 a.m. and returned at approximately 9:45 a.m.)

MR. HODGKINS: Okay, We've got people in their seats, so I'm going to turn it back over to Don and he'll take over.

DR. COOL: All right. Welcome back,

everyone. Now we'll start to talk about the first of the major issues that we had on the agenda. The process that We're going to use here, I'm going to tee this up if you will with a short background on the discussion.

Then, we'll get to the options that were in the Federal Register notice and available for you. And at that point we will go to the discussion, start working through all of your views on those options.

You will see in the slides that there are several slides at the end, which are the specific questions we had in the Federal Register notice. When we've gone through all of the discussion that you want to have around the options and the issues and the things that you want to raise, we'll use those questions just as a way of making sure that we've touched any points or any other ideas that people want to bring up so that we have the record complete.

So, the first topic, effective dose and numerical values, we've sort of combined these two because they're pretty well linked, almost inexorably linked in the sense that this is where we look at what's happened in the updated methodologies for calculating dose and the kinds of doses and the kinds of representation that we would use in the regulation.

So, what is total effective dose? I was asked in the run up to these meetings, somebody said, can you help me understand what TEDE actually is, versus what TED is. Okay. That's, that's a really good question. Probably worth is all making sure We're on roughly the same page to start with.

ICRP, 1977, said that the limit should apply to the sum of the effective dose equivalent from external exposures and the committed effective dose from internal exposures, as in, the limit applies to the sum of all the kinds of exposures the body could get.

Now, the NRC, being a good regulatory agency, said, well we can't write that entire phrase out every time we use it in the regulations. And so, like all good Federal organizations, we created an acronym. Hence, TEDE and CETE and TODE and some of those other things.

And, I know comedy hasn't worked so far yet, but I don't mean a little fuzzy bear and I do not mean an amphibian. Okay. Well at least a couple people laughed that time. All right.

But it is fundamentally, the external dose and as the NRC originally put it, it was the external dose as the deep dose equivalent, as in the point

that's most highly exposed on the body, usually the collar badge, although sometimes it would have to be the top of the head, if you were in a field that was directly over your head, et cetera.

And, the internal exposure from the committed effective dose equivalent, the dose from the intake of the radionuclides integrated over fifty years at it moves through the body. Some radionuclides are gone long before that, so the integral is effectively only a year or a few months.

Some radionuclides hang around almost forever. Calculation is truncated to fifty years. So, that's what TEDE was in the regulations. Now, there was one change, just a couple of years ago. The NRC amended our definition to actually allow the effective dose from external exposures rather than mandating that it had to be the deep dose equivalent.

There are a number of standard calculational methodologies that are out there, the nrcp has put out some. Many of the states use standing formulas that's 30% of the badge, collar badge or otherwise, in situations where, like, in interventional fluoroscopy cardiology, you're wearing your lead apron, that's covering all of the critical organs in the body.

And, so this dose up here on the collar really isn't representative of the risk that's being posed in that exposure environment. So, that's now allowed with using one of the approved methodologies.

It doesn't mean that you have to, because of course, if you really want to use the badge on the collar, we'll accept that. We all know that it's even more overly conservative, et cetera, than the otherwise, but it's an acceptable demonstration.

One of the things that goes on, of course, is that there is some differences in the implementation amongst various states and other organizations. We have heard that as an issue popping up over and over again.

So, what's total effective dose? What happened here? You dumped the word equivalent. Well, as the recommendations move to publication 60 into 103, the underlaying methodologies for the calculation changed a little bit. I'm not going to try and get into the details of the physics, that's not my area.

But the detailed dosimetry, the recommendations are now couched in effective dose. And they talk about the effective dose, and it's still, the effective dose from external exposures and the committed effective dose from internal exposure.

So, that underlying approach of summing all of the doses together is still in place. But they've used a different term. It's also updated tissue weighting factors, radiation weighting factors. You're no long using Q and RBE's, you're using the tissue and radiation weighting factors, hence, some of the slight adjustments in the terminology.

The underlying concept is still very much the same. Now, remember that I told you that ICRP always wrote out that long phrase. ICRP in publication 103 and some of the publications that come out in support of that over the last year has sometimes used the word effective dose applying to the totality of it.

And, has sometimes actually used total effective dose when they wanted to make good and sure that everyone knew they were talking about both internal and external. Hence, one of the reasons that the NRC staff has put on the table, do we change from TEDE to TED. Or, perhaps even just ED.

Total effective dose or effective dose, so that when we start talking about the doses that we have here, I'll pick on Rich for a minute, when they're talking about it in Areva and they say what the dose was, their colleagues over in Paris actually

know what they're talking about.

Because they're using the same words in the same discussion. So, it's quick schematic, I'm not going to try and go through this because I've already generally explained it. You take the exposures, you work it through the male and the female phantoms, and, by the way, you do that for each one.

You apply the weighting factors, you get to the equivalent doses, you average it all up, you apply the tissues, you come up with an effective dose. You'll notice that there is no more nice little merge phantom with the nice cones and cylinders and things.

It's not the voxel phantoms, little 3-D dimensional units from all of the CT's and MRI's over the years. And, very detailed dose calculation. I will be just a wee bit satiric here.

That doesn't mean that there isn't great uncertainty with all of this, but the modelers have gotten very good at modeling a particular methodology.

But, it's still a generic person. There is no such thing as the reference adult male or the reference adult female. I know I am not one. I weigh too much. Most other people are not either, because there's all the variations.

And that's part of the reason that for a

prospective assessment and a regulatory, the program in all of that, these make good units. It doesn't make such a good Unit, if you know the details of a particular individual, and you want to actually go ahead and figure out exactly hat was happening for a particular person, like, the dose rate construction that was happening at Hanford.

Their effective dose, and ICRP in fact says this, I thank you to Carol Marcus who reminded me of that, that during the break. ICRP says, effective dose is not really the right thing to use when you're going back and doing retrospective epidemiology and other things because it's based on all these standard assumptions about this standardized sort of individual which doesn't represent the reality.

If you want reality, and you can, you're actually trying to do that, use the information that you have. Okay. Talked about the radiation weighting factors. The only major change here is in neutrons, which almost none of you actually have to deal with.

It went from a rather step function sort of thing to a smooth curve algorithm that people can use, my friend over in DOE are much more interested in this for some o the activities they have but also note that all of the different photons and what not in ICRP

are still one.

And, as I mentioned, there is some discussion going on at EPA about whether that number for tritium and some of the lower energy, and We're going to try and work on getting the answer to what is low energy, maybe, too. And that's one of the things that we'll have to keep in our discussion.

Slightly more interesting is what happened with the tissue weighting factors. Now, the sum of the weighting factors has to be 1.0. We've decided that a whole human being is still a whole human being and you can't sum to greater than one. But within that, there have been some adjustments because the understanding of the relative cancer incidence and mortality estimates and the genetic contribution has continued to evolve as there's been continued to be updated dosimetry and the follow-ups to Hiroshima and Nagasaki, miacc, and lots of other populations that have been evaluated.

The big one is right here, the weighting factor that was associated with the gonads. Went from 20% of the total to 8% of the total, reflecting the view internationally now that the relative contribution of hereditary effects on subsequent populations is not as great as had been previously

estimated because there was not much knowledge associated with F1 F2 following generations and what might be the translated effects.

So, that number came down a bit. So if something came down, something also had to go up. Female breasts from .05 to .12. That's the biggest jump. Recognizing the increase sensitivity of female breast tissue and the induction of cancers there.

And then, there were some other adjustments, and there were some adjustments in what constitute the remainder, all of the other organs for which there is some basis for radiological induction of cancers and malignancies in those particular tumors.

So, you still end up with a 1.0, but the numbers have changed. The dose coefficients that ICRP is currently working on represent the Unit that is used to calculate the exposure to an effective dose in this reference adult individual, or one of the other references that ICRP has.

And lest anybody think that reference man is still out there as a single sort of defined unity, there's now reference males, and reference females. There are embryo fetuses, there are neonates, there's one year olds, there's five year olds, there's ten

year olds, there's fifteen year olds, there's adults.

There are multiple phantom calculations that are available to look at various age groups at various times. Most of that, not quite so important in typical demonstrations of compliance for a regulatory activity, but its all out there and information is available and continuing to be assembled.

It's of course based on the tissue and radiation weighting factors, the types of radiation, the nuclear decay scheme for each isotope, all of that gets cranked through to providing new, updated dose coefficients. That's what ICRP is in the process of doing today.

The first of those sets of dose coefficients will be available about this time next year from ICRP's Committee two. And the additional ones until the entire set of data is complete going out until 2014. That's one of the reasons that we, as an NRC staff in fact suggested to the Commission that there was no point in coming back to them with any policy issue recommendations because one of the key pieces of what would likely be a technical basis wouldn't even start to be available until 2011.

And, of course, one of the things that we will have to think about is, do we go with the ICRP

set of numbers, or do we go with the slightly different set that's being developed by EPA for the more U.S. population.

So, one of the questions on the table is going to be, international consistency, U.S. consistency. Does it make any difference? What might the differences be? What might the implications be?

By the way, at the moment, part twenty, based on ICRP's set of calculations from the late seventies and early eighties, slightly different from the current Federal guidance report eleven which was put out by EPA in the mid nineties.

So, there are a bit of differences now. So it's not a matter of, that, we have been alighted with EPA, we haven't been aligned internationally. In fact, we have previously been aligned international, question is whether we should continue to use those numbers or look at the harmonization within the United States.

So, they're in the process of doing that. EPA is working through that process, most all of that work is actually being done down at oak ridge. Keith Eckerman and his group down there are doing those calculations. We and EPA and DOE and others provide a fair bit of the funding to get all that calculational

work done.

Through a special memorandum of understanding, through our interagency Steering Committee on radiation standards. Just to reemphasize the point that I made and answering the question before the break, there are slight differences in the U.S. and the world cancer incidences and mortalities.

And so, there will be some changes in the numbers. Very small numbers, like many people, you may believe really the only significant figure is the exponent, then those changes may for the most part be below that level of sensitivity. But it is a question that we'll have to consider.

So, the options that we would like to talk about. First, always with a regulatory change, there's the possibility that you don't bother changing. We've finally gotten used to TEDE's and TODE's and CEDE's and all of that sort of stuff, we could just stay with those numbers.

We could even stay with those numbers if you wanted to change the underlying tissue weighting factors, radiation factors, and those sorts of things.

Second option, change to align with the terminology. Move to using the word effective dose. Again, you could of could not associate with that, use

updated tissue weighting, weighting factors, dose coefficients and things like that.

Or, because this is a terminology question for the most part, one of the other possibilities is move to effective dose but allow people to use either term for at least some period of time so as to reduce the possible impacts on record keeping and the reports and all the forms and all of that stuff that goes on with the activities.

Goes along with that, I'm going to flip back to that, some questions and options that are associated with the dose coefficients that we need to consider. And, those really boil down to, do you bring the new tissue weighting factors, radiation factors, into part twenty?

They exist today, they're actually in the definition section, so they're a part of the regulation. Do you go ahead and update all the material that's in Appendix B? All the annual limits of intake and derived concentrations.

Right now, they're part of the regulation. Do you see if there's a way to get them out of the regulation so that they're not so directly tied to rulemaking? Which, actually would be rather complex, because some of them get used as triggers for other

regulations and if something is used as a trigger, then the triggering value has to be in the regs.

So, my lawyers have on the first round of asking my questions, said, no you've got to leave it in the Rule. But, we'd like to open all of this up for discussion. Those are the options, and let's see how people feel.

MR. HODGKINS: As far as the options, you want to take them one a time, or all together? How do you guys feel? One at a time, or all together?

DR. COOL: I think we--I think we take them as a set and let people, and again, let me, let me just do my little pitch, here. It's not only just yes, no, or 1A, or 1B or 1C. It's 1B because of this, that, and the other things to help explain and understand the implications that go along with it. Because, it's not simply yes or no.

MR. HODGKINS: Excellent. So, is there anybody on the panel who wants to start the discussion? You think we should just go around? All right, let me put it a different way. We're going to go around the table. Who would like to start as we go around the table, to react to that? Excellent.

PARTICIPANT: As chair of my clinical radiation safety Committee, we, we deal with total

effective dose equivalent and TEDE issues all the time. To the extent that the numerical calculations that go into calculating a TEDE versus a TED are different, it makes more sense to maintain different terminology to indicate the formulas, in fact, are different.

To amalgamate different computations under a single term would sort of defeat the purpose of the whole concept of determining radiation risk as based on TEDE or TED. So I believe that until there's alignment in the numerical weighting factors and radiation quality factors, inherent in these two terms, they should remain unique.

MR. HODGKINS: Robert? Scott.

MR. CARGILL: Well, on this particular subject, I pretty much going to rely on the medical side here more than anything. In my industry, industrial radiography, we have no internal intake. We have an internal intake, we got bigger problems than the exposure.

So, I'm going to be calling some of you guys to come help. Just form what George has said, I'd almost say allow use of either term. My personal belief is, is, almost less regulation is better. Let the industry drive itself.

Obviously, as a regulatory agency and the Federal Government, We've got to set some rules. Give the, give the industry the tools to work how they need to. If we have both terms, we, different calculations, let the industry decide which one is best for that situation.

MR. HODGKINS: Thank you. Next?

PARTICIPANT: I'm going to respectfully disagree--

MR. HODGKINS: You got to turn your mic--

PARTICIPANT: It is on.

MR. HODGKINS: Hey, you know what, and, your name first.

DR. MILLER: Donald Miller. I'm going to respectfully disagree to some extent. Just in the limited viewpoint of interventionalists, our badges that we wear give you different readings depending on whether you're determining dose equivalent or effective dose, and the regulations are written differently and it becomes very confusing.

On the other hand, ICRP developed a concept of effective dose now twenty years ago. If we assume, and I think it's a really reasonably realistic assumption that it takes ten years for Federal rulemaking to proceed from beginning to a final Rule,

by the time this Rule comes out, effective dose will have been around for thirty years, and you propose to perhaps ignore something that's now been in process around the world for thirty years.

Well, all current scientific publications dealing with radiation doses and risks are stated in terms of effective dose. And so it seems to me that going to effective dose is the most reasonable thing to do on a forward looking basis.

Now, I agree that with the current states regulating in terms of effective dose equivalent, and an NRC regulation in terms of effective dose, that's going to cause confusion and difficulty. But the solution for that is for the states to move to effective dose as well, not for the NRC to remain back in the 20th century. Thank you.

MR. HODGKINS: Thank you. Is there, do you want an opportunity to respond to that? Is that a, fair?

PARTICIPANT: I just wanted to clarify that I wasn't promoting continuation of the TEDE per se, but rather supporting the maintenance of the term as long as we are using those calculations. Moving to uniform standard is a different issue, but to the extent that we have two different standards, we

shouldn't confuse the issue by using on terminology for two different standards.

PARTICIPANT: That, I certainly agree with.

MR. HODGKINS: Lynn, can we move onto you?

MS. FAIROBENT: Yes, I have to agree with both Dr. Segall and Dr. Miller. Using the same term to mean different things is, is just a nightmare. I, I also have to agree, from a scientific standpoint, we are behind the times.

However, I do not want to see NRC being the sole entity, regulatory entity, making the decision to change. We have to have consistency across the Federal system and the states. And this comes into play not only in understanding what needs to be implemented as a licensee, but it also can cause confusions when individuals are moving from one licensee to the other.

And we don't have a dose registry for medical occupational exposed workers today in the U.S., that's a whole different question. But we need to understand what the differences are, are and what the lifetime dose calculations are.

And I think it's just problematic.

MR. HODGKINS: As far as, is there a historical perspective there as far as that having

happened previously?

MS. FAIROBENT: Previously, the methodology was much simpler. Historically, we did have somewhat of a dose, occupational dose registry for medical licensees, and then that was discontinued.

I just think that as we continue to go forward, one has to ask, as We're writing stuff for scientific publications, we do it one way, in order for peer recognition, as we deal with our regulatory regime, we may be dealing with a different. It's just confusion.

MR. HODGKINS: And, and the solution, though, then, to the confusion would be, just to press, A, B, or C, from your perspective?

PARTICIPANT: B.

MS. FAIROBENT: I'm not sure it's as black and white as that. Because, in this fore, if were to pick one of those and the rest of the world, the rest of the Federal system and the states didn't, then we still maintain that confusion. So, pick one and let's all use it.

MR. HODGKINS: And, so, is that the D? Is that a D? Pick any one of those and I'll use it. Yes?

MS. FAIROBENT: Possibly.

MR. HODGKINS: Okay. Okay. Good. Yes, which

one. That's another round. Go ahead.

DR. MARTIN: I think I would agree with the comments that's been made. From a user's perspective, to have to deal with multiple terms is, it's very confusing for all of us, whether We're the radiation safety officers, whether it's the employees We're dealing with, whether it's the general public.

And if the rest of the world seems to be moving to total effective dose, which is what we use most of the time, when We're dealing with publications, I would endorse moving to that extent.

But, I totally agree, as long as, until we can get to a single standard, we have to recognize at least that both terms are used.

MR. HODGKINS: And so, the one thing, let me say, when we, when you use the term we, that is not the NRC, is we?

DR. MARTIN: That is correct.

MR. HODGKINS: Okay. And so, the we is, who else needs to move before NRC moves, from your sense of recommendation?

MS. FAIROBENT: No, I think I'd like to, well, the states, right now, for those of us that are in agreement states, we need the states and the NRC to agree on what term We're going to use.

MR. HODGKINS: So, your D might be agreement between states and NRC to pick one and move forward?

DR. MARTIN: Yes, and if I had a choice, it would probably be the total effective dose.

MR. HODGKINS: So, kind of 1A, C. Is that right, or, did I say that right? Or, no, 1B--

DR. MARTIN: 1B.

MR. HODGKINS: 1B. Okay. Slash C. Yes?

MR. BURKLIN: Like Lynn, I like--Rich Burklin--like Lynn, I'd like to see consistency, too, but where Lynn is worried about the consistency between different Federal units, I'm worried about the consistency between different countries.

As, again, we send people to, to numerous countries, and, so I would actually take the B option.

MR. HODGKINS: Okay, you--

MR. BURKLIN: Clearly moving.

MR. HODGKINS: So, right now there isn't any consistency amongst the countries, right? Is that what you're saying? And you'd like to bring consistency?

MR. BURKLIN: I would like to be consistency.

MR. HODGKINS: And so, what will that do

for you?

MR. BURKLIN: We, if I get a, if I get a Unit of dose from one country and one Unit, I know what it means. Okay, and I don't have to guess what it means.

MR. HODGKINS: Okay. Hey, just let me say, you guys got to remember as panelists, you're not here representing just your point of view, but the point of view that the public can understand, so that if this goes on the web page like Lynn had suggested, and the public reads it, you know, you want to explain it in a way that my mother, my, want to read it and understand it, okay?

So, I, I don't mean to be rudimentary, but it is who's going to read this and how do we want to be accessible in that information. Okay? Yes. Nothing? Chuck?

MR. PICKERING: Yes, I, I think in general we should be moving towards alignment on most things. And, for the purposes of this discussion, I think that would be my answer to it. Obviously there's an in, in the meantime issue, and for that I would say, you know, we should allow the flexibility for the users to use either term.

And, one way possible to do that in the

written regulation would be, and maybe this is confusing too, but, you know, put it in as TED, parentheses, TEDE for some period of time, allowing us, the users to, you know, use the one we want to however we negotiate that, either in the licensing process or with our regulators.

And as long as We're consistent with that, in, in how we internally define it, I think that would be fine.

MR. HODGKINS: You want to comment on that?

PARTICIPANT: I, I, I'm not sure if I misunderstand the question, or if We're talking about two different things. My understanding is that effective dose equivalent and effective dose are not the same thing.

We're not talking about renaming them, We're talking about substituting one quantity for the other.

MR. HODGKINS: Clarification. Is that your understanding, Chuck?

MR. PICKERING: Yes, but in, in practice, you know, We're looking at a badge reading, primarily, and We're having to deal with that in terms of how we calculate this, whether we, you know, We're using the deep dose, or We're using effective dose for the, off

the, how we calculate the badge reading. It's sort of how we define it and how we use it in practice.

PARTICIPANT: Just, just the point that the same badge reading, the same actual, physical badge reading means two different things, depending on whether you're interpreting it as effective dose equivalent or effective dose.

The conversion factors are different. The same badge reading gives rise to two different numbers, depending on which one you use. So we need to be clear.

MR. HODGKINS: So, this seems to be an issue. I saw some heads nodding. Does anybody want to add, as far as if your head was nodding, it means you are thinking something. Yes?

PARTICIPANT: Dr.---so, effective dose equivalent might be using the Webster formula for example, so that you're, you're, if you only have an external badge and you're wearing a lead apron, then you're actual reading would be about a third for that. Is that, have I got that right, that that would be effective dose equivalent?

PARTICIPANT: Let me just read you two sentences from NCRP report 122. It says, to get effective dose equivalent, you divide the badge

reading by 5.6. To get effective dose, you divide it by 21. Okay?

PARTICIPANT: My own--this, this issue I think has, has a considerable potential impact on the interventional radiologists. So, I, I don't know what the answer is. I don't--but I do know that, that interventional radiologists is where we do see real doses to the people, more so than, I think, in almost any other thing that we regulate.

They seem to get higher doses. And so I think this has the potential to impact that group. And so I think we need to hear more from that group about the impact that it would have, and whether they could live with just effective dose rather than a TEDE.

I have one question for NRC, and that has to do with have, have they requested information from the companies that currently provide dosimetry to get a feel for how many people exceed two rem in a year?

And, and not that we would ask for specific names or anything like that, but the companies might also be able to say, well, this X number of these people who exceed two rem in a year, X number are badged in a hospital, or X number are badged as radiographers.

Or, or something like that. To see how--

and that way, you'd have an idea of how many people this really is likely to impact. I, I realize I'm moving ahead a little bit into dose, but the terminology is, I mean, whether you use the TED or a TEDE, it has the potential to really impact a group of people.

MR. HODGKINS: Ellen?

MS. ANDERSON: I can give you some data from a power reactor perspective. We're actually working--Ellen Anderson, from NEI--We're actually working with EPRI, the electric power research institute, to come up with a list of--we actually know that in the year 2009, again, power reactor perspective--we had 39 people in our industry go over two rem.

We have identified--we know who they are, We're identifying where they received it, and most importantly, what did they do to receive that. So that we can actually look at the processes and the, any, any technology that we can do to preclude that from Occurring in the future.

MR. HODGKINS: So, Ellen, just a clarification, too, because I think we started that, there was an isolated situation and it's really not isolated because the nuclear, your business too has

the same exposure rate, so now we've got two groups instead of just one.

MS. ANDERSON: Well, 39 out of how many? Thousands. So.

PARTICIPANT: The issue is of interest, and we can discuss it later about how many people are effected because it does have an effect on interventionalists. If you want to do it now, I'm happy to do it now.

MR. HODGKINS: Don, your call.

DR. COOL: Let's do it now.

PARTICIPANT: Okay. First of all, it's not just interventional radiologists. If you look at NCRP report 160, out of the 7.1 million interventional fluoroscopy procedures they estimate were done in 2006, two thirds of them were interventional cardiology procedures, essentially all of which are done by cardiologists.

And of the remaining one third, some of them were procedures done by cardiologists, some by vascular surgeons, and some by interventional radiologists. So, in fact, interventional cardiologists are probably more affected than anybody else.

Now, with regards to how many people go

over any arbitrary dose limit, there is in the international atomic energy agency, a research project that's currently ongoing called the information system on occupational exposure in medicine industry and research, which is abbreviated ISOEMIR, just because it's difficult to pronounce.

And that includes a working group on interventional cardiology, which I am privileged to be a member of. And a report on what we've done so far was presented at the European EPRI meeting this summer.

I'm going to read to you just two sentences. Compliance with continuous individual monitoring is often not achieved in interventional cardiology. Reasons for noncompliance with monitoring range from simple negligence to deliberate avoidance because of the fear of exceeding some dose threshold that leads to regulatory or administrative investigation, often as a result of an above the apron dose value being used as a surrogate for effective dose with no correction.

And I can tell you, and I'm prepared to cite chapter and verse but I don't want to waste a lot of time, that many, many, many interventionalists do not wear badges. So, to say how many people go over

any arbitrary number is a pointless question, because if you turn in a badge that you haven't worn, there's no way of knowing.

MR. HODGKINS: Okay. Lynn, then Melissa.

MS. FAIROBENT: Don, to--Lynn Fairobent, AAPM. Don, to follow up on that, we often get the question, well, the rest of the world has adopted the lower dose limit, why is it not problematic, and obviously interventionalists are oftentimes cited. Is this study going to help us address that question from regulatory framework?

DR. COOL: Okay. This is Don Cool. Let me jump in just for a second here on two things. Any piece of data helps, of course. We are trying, through several forms, to get additional information on dose distributions, number of individuals and different dose ranges.

In some of the medical areas and places that are not currently required to report their doses to NRC. We have talked to an number of the states to see what information that they may have. We are in discussions with some of the dosimetry processors and the nrcp, the National Council on radiation protection and measurements, to see if we can enter into some sort of contractual arrangement with them to help try

and gather information to help support that.

We are also talking with folks in the nuclear energy agency over in Paris, France to try and get information from a number of regulatory countries over there who have been using the lower dose limits to see what information is or is not available.

Having said that, I suspect what We're going to happen is what's happening with the ISOEMIR program that Don Miller just referred to. They're getting started, they're trying to gather information. There's lots of we believe this or that, there are no hard quantitative numbers that put people in particular ranges.

But I think it does tell us that there are, are or is, an issue there, and that at the moment, it would appear that there are certain behaviors which from a regulator, of course, and Katz and Bob Greg aren't sure the same way, when you start to hear people are not monitoring things, we did all sort of vibrational, but it is issue that we need to look at.

And we, I'm going to hold up the mirror now and say, okay, We're trying to gather some data. Are there things that you can share with us from ISOEMIR, from some of your own institutions, that

would help us understand the particular circumstances.

And I'm making that pitch up because I think that you're going to be able to flip it in your notebook and immediately give us those distributions for UCLA or whatever it is today. But, you have the two hour drive back and you go back to your institutions and we would love for you to provide to us some nicely scrubbed, so we don't have any personally identified information, but that gives us information on actual experiences that would help us, because that's the only way We're really going to get there.

PARTICIPANT: Just as a follow up on the ISOEMIR, the, the project involves surveying the regulatory radiation regulatory bodies around the world, and one of the conclusions was that less than 40% of regulatory bodies could provide occupational doses, and reported annual median effective dose values often less than .5 millisieverts were lower than expected considering validated data from facility specific studies, indicating that compliance with continuous individual monitoring is often not achieved in interventional cardiology.

MR. HODGKINS: Thank you. Roger.

MR. GREGER: Just as a anecdotal comment on

this, having sit and every month and look at these with the radiation safety Committee at the doses. I would estimate that, what I've observed, is that of those interventionalists who are compliant with wearing their badge, that as, as high as 50% of them would exceed two rem in a year. I think we are in danger of establishing regulatory limits which will encourage noncompliance.

PARTICIPANT: Of course, we have to consider that the formulas that we use to estimate effective dose from badge readings are deliberate overestimates. Again, from NCRP 122, likewise, dividing blank by blank to obtain a conservatively high estimate of effective dose is recommended.

So, and they say it should be no higher than three times what it actually is. So I suspect that the actual doses are lower, but that's not what We're seeing because of the formulas We're using. And in fact, that--that email does not include the effective weaning of thyroid shield.

And when you wear the thyroid shield, you're overestimating again, by half.

PARTICIPANT: I think the other thing that we often don't take into account too is the fact that many people practice at multiple institutions, and we

do not do additive tracking of their doses either.

MR. HODGKINS: Noted. Yes?

PARTICIPANT: Question for Don. Basically, of course, the Nuclear Regulatory Commission regulates exposure to byproduct, from byproduct material. Of course, the doses We're talking about are external exposures from x-Ray sources.

So, how do we make the connection? I mean, you're saying we wish to be consistent with EPA, which is going to take into account that x-Ray exposure. So how do we justify our conversation when We're focusing on exposures from non byproduct material?

DR. COOL: Another very good question. And, by the strict application of the jurisdiction NRC has, most of this conversation is outside of our, our purview. But there are two connections which I think make it relevant and why I'm very interested to get this pursuit.

The first is, our connection with all of our agreement state programs. And having alignment with those programs, and knowing that the states will apply a single consistent regulatory approach on both sides of the house because they have the regulatory jurisdiction for all of the radiation, both byproduct materials and machine produced.

So, there's one very important connection. The second connection which I believe is growing rapidly, is multimodality, where fluoro and other material, other procedures, are being combined with PET and CT and a variety of other things.

Which means that we have, although I cannot cite you specific numbers, growing number of individuals who would fall under the NRC's dose limit because they are receiving contributions to their occupational exposure from both licenced and unlicensed sources.

And our regulations require that the dose limit be respected by the sum of al of the exposures to that individual and the licensee, both licensed and non licensed. So anyone doing multimodality, to the byproduct and the x-Ray contributions from the work that they do, would have to be included in the calculation.

So, it's becoming closer and closer and closer until it's all together, notwithstanding how the atomic energy act reads.

MR. HODGKINS: Okay. Did you want to add to the conversation?

DR. MARTIN: This is Melissa Martin. For the record, I think we have two problems, and I would

just bring sort of to reiterate, when you get when you start looking at the axle operations in a medical center, in general the purpose of these regulations to a great deal were started with the idea of protecting the public, protecting unknowledgeable people that did not know about the risk of radiation.

I think we have to really take a look at who We're trying to protect. These operators, particularly when you get into your interventional physicians, these people were trained very much in radiation safety, and to impact the practice of medicine by trying to devise or lower a limit we are all convinced is not very accurate with out estimates, at this point, we know that we are greatly overestimating the amount of radiation that a physician is actually receiving by the current methodology used to calculate it.

And, granted, they're conservative measurements, but if We're now trying to deal with real world, we need to come up with a better model. Because, we do have practices now where we have the thyroid shields. We wear the lead aprons. We have, you know, great radiation protection devices.

And so, using a badge outside the collar may not be a very good indication of what that

physician has, but again, I think we really have to watch impacting the practice of medicine because I would agree with the other comments.

If we start writing something that is too hard to comply with, or too restrictive, the dosimeters stay on the wall.

MR. HODGKINS: Okay. Chuck, we ended with you. You want to comment?

MR. PICKERING: Yes, yes. I agree with Melissa, in, in, in practice, you know, we use these badge readings really as a tool for how well We're doing and, and don't' want to lose that either. And so, I agree, and the other way we practice, you start to compare people.

You see people, you know, and we'll get into this I'm sure later, when we get into dose, you got a new interventionalists. We know their dose is going to be much higher early on in their career, and it will go down over time.

So, it, it's a tool for us as practicing radiation safety professionals. We see these doses, we go out and we do our investigation, and we help people lower their dose. Is the dose real, is it accurate? That's very important obviously for regulatory purposes, but in practice, it's, it's a nice tool.

So, I would hate to lose the over the badge, over the apron badge, and I would encourage us all as we do when we do see people starting to get up there, we go investigate. If it makes sense for us then to switch a practice, use a different calculation, that we think is maybe more accurate, then we do that.

And, so we always start with, you know, the most conservative and move to more reality as we approach some limits for, for the, the, the very reason we've been talking about, that we got to keep people working.

And that's a, sort of the standard in our practice, to, you know, start with conservative, conservativism and move closer to reality. I don't know if I've answered anything with that, but I, I think we definitely need to--I, I'd like to see us standardize the practice of, you know, wearing a badge over and under.

And, many places don't for cost savings until they are forced to it on, doses start to get close to a regulatory limit.

DR. COOL: Okay. As we continue to pursue this particular discussion, I think one of the things that would be useful--several people have mentioned

now there is of course a degree of conservatism in how you estimate the exposure.

And one of the things that we've heard before and is clearly in the conversation here today, although it hasn't maybe been explicit yet, is the fact that there are different process that are accepted.

And, there is some inconsistency in the approach of those, so to the extent that you would like to provide a view on what the regulation should specific include regarding the calculation of the effective dose, what mechanisms there may be to help facilitate a more uniform approach to this, while maintaining the appropriate conservatism, would be useful as we continue around the dialogue.

MR. HODGKINS: Thank you, Dan. Colin, did you want to add to the conversation?

MR. DIMOCK: Yes, I just wanted to address what Chuck said. This is Colin Dimock from UCLA. I, I just wanted to say as a general Rule, the UC systems are moving away from double badging because getting good compliance with double badging has proved to be almost impossible.

We see, we consistently see results that clearly show that the badges are not being worn

properly. And, when we do investigations of that, it, it causes one to, to question how well the monitoring is going as a general Rule.

Not that everything isn't perfect at UCLA for the record, there. But I also want to say that I think all the hospital people here knew coming in that interventional cardiologists, interventional radiologist was going to be the 800-lb gorilla from the hospital perspective.

We all knew that these are the people who get the big doses and that these are the people where we have compliance issues to show that, that We're doing the right thing and all this. And I find it-- later We're going to talk about this potential, going from five rem to two rem and all that business which effects that.

But I find it interesting that, from a philosophical perspective, what We're talking about whenever we talk about the radiation protection limits and how we calculate all this, is the relative risk versus the relative public benefit of these things.

And, we, in terms of say, the five and two rem issue, We're talking about should, in the worst case scenarios of our estimates, should we allow these interventionalists to have a level of risk that's

just, you know, somewhere below people working in agriculture.

Or, should we force them to remain below people who were working in public works or something, you know, something like this, where we have people who are allowed to experience far greater risk in other industries, in many cases aren't even providing anywhere near the per capita public good that these interventionalists are, are offering up.

So, I think there's a real case, philosophically, for allowing interventionalists to continue their work, which will help us in monitoring those interventionalists, will, which will keep us on top of doing the best practices, ALARA, if you will. I think that that is all tied together.

MR. HODGKINS: Thank you. Any other comment, then? Yes.

PARTICIPANT: Yes, just, just for the public record, I, I do not want anyone to get the impression, should they look at this transcript or hear this discussion, that interventional radiologists or cardiologists as a cohort just have total disregard for the regulations.

They do not. But, I think as Colin just said, we have to recognize what it is that their job

functionality is in the practice of medicine, that the patients that they are treating are ill, that-- oftentimes that the procedures they are doing are lifesaving procedures.

And, I know if I was the patient undergoing treatment, I would hope that either my interventional radiologist or cardiologist would continue with that procedure to complete it from a practice of medicine standpoint and not stop because they were afraid they were going to bump up to a regulatory limit.

MR. HODGKINS: Scott?

MR. CARGILL: Okay. I hate to be the fly in the ointment, but I'm, I'm relying on a lot of what's going on here to help educate me, you know, in a greater detail about the topic, and the topic right at the moment is TED versus TEDE.

We'll get to the two-r thing later, because I've got a lot to say about that one, but A, B, or C, guys.

MR. HODGKINS: Thank you, Scott. Roger, we'll start with you. Or, begin again with you.

MR. GREGER: Okay. I, you know, going to wear my CRCPD hat. And I heard a couple of comments or questions on potential differences between state

regulations and NRC regulations in this arena. I am, am the chair of the working group that writes suggested state regulations for the conference of radiation control program directors.

When we write those regulations, we try to be consistent with NRC as much as possible. Don Cool had made a comment that the NRC doesn't regulate x-Ray exposures unless the individual is also getting byproduct material exposures.

The states, the agreement states, do regulate x-Ray exposures, and we regulate it with the same limits, dose limits, as we regulate byproduct material. We don't differentiate between the two.

Now, so hopefully we will be consistent with NRC in, in terminology, dose limits, et cetera. Now, I did say they were suggested state regulations, and states aren't obliged to follow those regulations and so there may be inconsistencies from that standpoint.

But, hopefully, most or all states, you know, will comply or will reflect the suggested CRCPD regulations or the NRC regulations. Some states just adopt NRC regulations the way they are. But, our intent is to be consistent between the agreement states and the NRC.

MR. HODGKINS: Thanks. Ellen?

MS. ANDERSON: Ellen Anderson from NEI. From a power reactor perspective, we believe that we need to be consistent with the international standards. However, we want to--and, being consistent means that we want to ensure that we have, We're using the most updated science available to us.

However, we do want to ensure that if we were to adopt TED from an NRC perspective, that that would be adopted across the Federal family so that We're all speaking the same language.

MR. HODGKINS: Okay. Kathleen?

MS. KAUFMAN: I, I agree with what, what Ellen just said. My only concern on using TEDE is interventional and we just need to ensure that it includes the ability to adjust the dose for an equivalent dose if someone's wearing an apron.

I, I, I generally agree that we should go with 1B, that we should be in lined with international regulations. But I do think that we need to ensure that the, particularly interventionalists, but there could be others as well, that, that, that it's going to work for them.

And, and somebody mentioned they weren't wearing badges. I'd be curious to hear from the other

RSOs if they think their interventionalists aren't wearing the badges. One of the things that we do during inspections is look and see, are we seeing kind of consistent doses among interventionalists.

If we see one that's particularly high, we might ask further questions. Not even just for the interventionalists, but also for their patience. Because if they're getting that dose, their patients are maybe getting a higher dose as well.

MR. HODGKINS: So, B with a little C.

MS. KAUFMAN: Correct. B with a little C.

MR. HODGKINS: Okay. Now, you did raise up one other issue. Does anybody want to speak to that other issue, as opposed to, you know, the interventionalists or the tag wearing--Chuck?

MR. PICKERING: You'll be happy to hear that our interventionalists are wearing their badges. We're nowhere as big as UCLA, so we have a small group. We work very closely with, intimately them. We're in the room with them often.

And, so they are, and we do see that in their badges, so we have a history of that. WE'RE probably maybe an exception to larger facilities.

PARTICIPANT: Yes, I'd also like to say that at Children's, We're not nearly the size of--from

a pediatric point of view, our cardiologists, cardio cath labs, is where the action is. And again, the inservices that are given by myself but also by the physicians really points to the fact that they are concerned, and exactly for the reason that cast mentioned, is what the kids get also is reflective on their badges.

Actually, for again, the younger cardiologists versus those with more experience. There really is a correlation to that, and it's an important one.

PARTICIPANT: I'd like to commend you for being in the interventional suite with your physicians. I think that's what's making the big difference, and why your docs are wearing their badges. It's, it's unusual in my experience. Most of the hospitals I've worked at, the RSO has never been in the interventional suite, and when he conducts an investigation, he says here's a form, fill it out.

And, that's, that's clearly not the way to do it. The way you're doing it is to model, really.

DR. MARTIN: Melissa Martin. I would just like to reiterate, and I don't want to give a false impression of all to go. I would like to think, and from what I've seen, many interventionalists wear

their badges.

One item I have seen correlated very much though is the sometimes the higher badge readings on the interventionalists are due to the most active members of the staff. And, so, you know, that is what you expect to see.

I would agree, as RSO, I expect to see those badge readings on the interventional staff, and again, sometimes the highest ones are just due to the potentially the best operator in the Department, and therefore they are going to have the highest badge readings.

And I want to reiterate, I just don't think we want to adopt something that's going to inhibit the practice of medicine based strictly on a badge reading.

MR. HODGKINS: Eric, your turn. Passing? Colin?

MR. DIMOCK: I just want to add a couple comments. First, I, I want to second what Lynn said earlier, about this isn't meant in any way to reflect that we think there's a poor performance on the, the part of the interventionalists.

There's a lot going on there. And to second that, and, and maybe getting a little off

topic, but the monitoring in the hospital environment has become increasingly challenging for, across the Board, as we see people working in multiple locations.

We see x-Ray producing machine now are quite mobile and they are being found in places where traditionally they weren't. It's no longer a situation where we can say, well, here's our radiology Department, there's where we need to monitor and whatnot.

And, and not just the docs, but there's a lot of ancillary personnel who get involved in these procedures as well, and, you know, we, we do our due diligence to monitor this, but it is an increasingly more and more complicated and burdensome issue to try and keep up with all that.

But, really, it's those interventionalists that, when we talk about those upper limits, they're the ones that We're, they're top of our charts for that.

MR. HODGKINS: So did you make a choice as far A, B, or C?

MR. DIMOCK: You know, before I made that choice, I'd want to know what Mr. Miller has to say about the implications of B for interventionalists.

DR. MILLER: I, I was going to vote for B,

because I think that effective dose is the way to go, historically, from effective dose equivalent. And, the concern is whether we should lower that from five or fifty to twenty, which is a separate issue.

But, I would say moving forward, as I said earlier, I think we need to go to effective dose across the U.S., both Federal and state.

PARTICIPANT: And I, I basically agree with that, with the caveat that there's other dose limit issues related and we need to make sure that we give people the appropriate regulations so that they can do the jobs they need to do.

MR. HODGKINS: Leonard?

DR. SMITH: As I--this is Len Smith--as I said in my introduction, our need is for manufacturers and distributors of radioactive materials increasingly need for there to be uniform international regulations, and that's because our business is global.

We have sites all over the world where we manufacture and distribute and of course, our customers are all over the world. CORA provides something like 70% to 80% of all the radioactive materials that are used worldwide.

And, the other thing that's happened is

that staff are being transferred from one site to another, from one country to another, so there's a practical need for us to have a uniform regulation. We don't see that moving to T would greatly impact the actual dose commitment We're assigning to our occupationally.

We could be surprised, of course, we don't know what all the calculations are going to work out to be. But given that the, our expectation is that there isn't going to be a great difference. We would like to see an alignment with TED. So, we prefer option B.

MR. LEE: I'm Kai Lee from USC Medical Center. I would like to vote for B, for the reason that oftentimes, I was asked to calculate the dose to the patient receiving radiation from external sources as well as from internal sources, as in the case of CT, PET CT and spec-CT.

And, maybe I'm dumb. I always had trouble calculating CTET and tell the patient what I need. So, having TED makes my job a lot more, lot easier and also I can also pull up in the literature as Dr. Miller said, both the publications on TED and then show to the patient what they're getting.

And so, for that reason, I like to have a

more uniform and updated reporting of the doses not only to the personnel but to the patient as well.

DR. SEGALL: George Segall, society of nuclear medicine. I'll reiterate the first point I made, that as long as the methodology for that underlies these terms remains different, we should maintain the different terminology.

I think there's a few additional points we need to consider. The correction factors that are used to determine what the radiation exposure are of paramount importance. All of our interventional fellows at Stanford, for example, have badge readings exceeding five rem per year, worm outside the apron.

It's those correction factors and the different methodologies you use that has the biggest impact. So there needs to be understanding of that perhaps a refinement of those methodologies involving the correction factors.

The second thing is, we are perhaps inappropriately applying this concept of TEDE or TED to vary heterogeneous populations. To people who work with fluoroscopy, where We're using correction factors to practitioners in nuclear medicine where there are no lead aprons and no correction factors but quite different radiation exposure spectrum, to cyclotron

operators.

It's another population where they get considerable dose, different quality of radiation and certainly one in which it's only time distance and not so much shielding is protecting them because they're not wearing aprons.

I'm not quite sure where this is going except to state that what goes into radiation exposure is quite different among populations and before saying we are going to adopt this term or that term, realize that the correction factors are paramount importance and these terms must have the same biological meaning to very disparate populations.

MR. HODGKINS: Ralph? No comment. Okay. So We're done with the panelists, and now We're going to open it up to the audience. If there's anybody who would like to comment on your options here, if you'd go up to the microphone and make sure you speak direction into the microphone and introduce yourselves first. And we'll start to the left.

PARTICIPANT: Hello. My name is Troy Edger from Alpha Omega Services. I know some of you here, but I wanted to first thank the NRC for having this. It's not too often I get to talk to the NRC and not be billed for it, so.

Anyway, what, what I, I prefer B, and the reason being is We're a source manufacturer. We are a source handler, and we deal internationally. So, for us, 1A, you know, we have to do reports sometimes for international. So it's, it's difficult for us to do all the conversions and the rest of the stuff.

And, the reason why not C, is, I have a difficult enough time just trying to remember one thing at a time, let alone having two different things that we can use. Anyway, I, just, that, that was my comment.

MR. HODGKINS: Hey, can I just ask for some, just a little bit deeper on that, too. So, as far as from what you've heard from the panelists, is there some things that are resonating with you or things that, you know, you just sort of disagree with, or what? So, your opportunity.

PARTICIPANT: From an ALARA point of view, I would just, you have problems with the cardiologist, you know, just sort of listening to that. I just wonder why you don't, you know, you're thinking that maybe the badges aren't reflective of what they're actually getting.

How come you don't use, you know, personal dosimeters so you can actually have a, you can, data,

you know, record, maybe each time that they're doing a procedure or something like that.

Because we, as a source handler, what we do, we always have personal dosimeters, because I want to know, first of all, I want them to know that they know what kind of field they're in, but also what they're getting as their handling the source, so that they can actually say hey, you know, I was in a 100MR field and, you know, maybe I could, if I was this way, or this way, you know, wouldn't have been exposed as much.

And I just was wondering because there's a lot of RSO's here. Just wondering about that.

PARTICIPANT: Well, in fact, every interventionalists has at least one badge. It may not be a real time reading badge, most of us have two. The problem is that We're not wearing them primarily because We're afraid that we'll get too close to the dose limit and won't be able to work after, say, October or November. Which is bad for us and even worse for our patients.

PARTICIPANT: Yes, but if you know, real, I, I'm talking real time. So if the person knows, they want to do what's best for the patient, but they also want to make sure that they're going to be able to

work as well. I mean, they, you know, I don't know. It just seems like something that would be a simple, simple thing to do.

PARTICIPANT: Unfortunately, the source of radiation for us is the patient. It's scattered from the patient, and I cannot get any further from the patient than arm's length.

MR. HODGKINS: Okay. Good. Next one--and, by the way, also, we have cards here. Somebody just wants to ask a question and then I stumble over trying to read it. All right. Go ahead.

PARTICIPANT: Yes. I'm Roger Pedersen. I work at the Nuclear Regulatory Commission in the Office of nuclear reactor regulation. Listening to the conversation here, about this particular question that Don put up, it seems to me that We're, We're confusing a couple of different things.

One, one's the basic quantity of dose, and the other is what we call that, what the terminology is. Back when, when ICRP 103 was still in draft form and out for consultation, the question came up, why was the ICRP changing from effective dose equivalent to effective dose.

The answer I heard was that it was to improve communication, that it was clearly just a

terminology change, that there were a number of member states that didn't even have different words for the concepts of effective and equivalent.

So, a total effective dose equivalent didn't make a lot of sense to those countries, those languages. So the purpose of going, just to an effective dose, was just a shorthand. The, the quantities that they represent were basically the same thing.

They were both the summation of a dose or the energy deposited into the various tissues, times the radiation weighting factor, times tissue weighting factor. So, you know, we can separate out the terminology, the term, effective dose equivalent or effective dose, from the underlying quantity, which of course would depend on which weighting factors you choose, what set of weighting factors you choose.

Now, we, you could stay with a effective dose equivalent or in the NRC terminology, a total effective dose equivalent. And change those underlying weighting factors.

So the, I guess, part of the question I think that's being proposed here is, the, the costs and the benefits, or the impacts and possibly the benefits of changing from effective dose equivalent or

total, total effective dose equivalent to just total effective dose.

It seems to me like the major benefit that's been somewhat articulated here is that, is that by changing the terminology, by changing the term, you make it very clear what set of weighting factors that you're, you're basing that underlying quantity on.

But that, the comment that was made earlier, that doesn't necessarily have to be that, we can keep TEDE, we can keep total effective dose equivalent, and mandate the updated tissue weighting factors and radiation weighting factors.

Or, we could adopt a total effective dose term, and let that be calculated using older weighting factors until new weighting factors could be put into place. So there's a range of options here I think that We're trying to explore what the costs and the benefits are to that whole spectrum.

MR. HODGKINS: So, do, do the panelists want to react to that at all, or is it just another comment that's, okay, we'll add it to our comments? No reaction there? Okay. Thanks. Next?

PARTICIPANT: Hi, I'm Chad Mitchell. U.S. Navy Bureau of Medicine and Surgery. Just a quick comment. Very highly educated room full of folks here,

and that's important. I've heard the term alignment used very often, and so there are some representatives of multinational companies here who say that we need to align with these other standards.

We are here to decide what's right and not what's necessarily easy, so every slide so far has said U.S. NRC on it. So, it's, it's very nice if the paperwork becomes easy, but that should not be an argument that sways the NRC in making this decision.

And, and similarly, you could extrapolate that to, what is, you know, we've gone off on the tangent of the whole body limit, and similarly, it should be the answer that's right for this nation, not necessarily whether it aligns with other nations.

MR. HODGKINS: Thank you. Any comment from the panelists, then? Reactions? And just, you know, before you sit down, I'm sorry, is there some other things that resonated with you or that you disagreed that, with, that you'd want to comment on at this particular point?

PARTICIPANT: No, sir, I, I would say other than the fact that, as Dr. Cool brought up, the tissue weighting factors will drastically effect allies and decks and things that I, I definitely cannot calculate in my head in this forum.

And so, by simply saying, you know, A or B or C, that winds up changing tables and tables of information that effect the way people go to work in industrial settings, particularly.

MR. HODGKINS: Okay. Thank you.

PARTICIPANT: Hi, Joe Takahashi from Northridge Hospital. If the new weighting factors have scientific basis, then I think the total effective dose should be the one that we should go to. But, the problem is that the film badge readings only tells you what the badge was exposed to.

It doesn't tell you the effective dose, and therefore when the regulatory agencies come around to inspect us, they just look at the badge reading and that's what they're going to ding you on if it's a high reading.

Therefore, I mean, there's got to be some mechanism where you tell the film badge reader I mean, companies, that they have to use the appropriate formulas because of the protective equipment that you're using.

I mean, what most radiology wearing a apron, interventionals, you're wearing a thyroid shield and a lot of them also wear lead glasses. And therefore, you know, they have more protection and

that badge reading doesn't reflect that.

I mean, at Northridge right now, we are using Webster's formulas for the interventional radiologists. But even that is very conservative because they do wear the thyroid shield as well as the lead glasses.

And so, there's got to be some mechanism where you tell the regulatory agencies how to judge what that reading of the film badge is.

MR. HODGKINS: Okay. Don't go anywhere--

PARTICIPANT: If I could follow up with you for just a second, because what you said's quite interesting. I had a conversation with one of the representatives from one of the big dosimetry processors, and I asked her what do you report out to the user when they send in the badges.

And what she told me was, we will report out whatever that licensee requests to be reported out. We will report out the dose on the badge, we can report it out with someone of the calculational things, the Webster formula or several other formulas which they have build into the system.

Is that your experience, or is your experience that they are giving you simply badge readings which are causing you compliance issues?

PARTICIPANT: I think for the x-ray people, if that's the case, then why can't we then use Webster formula for all our radiology groups, departments? Because they wear lead aprons when they take their x-rays, and a lot of the technologists, of course, when they do it, they're supposed to be at least six feet away, and therefore the exposure is somewhat small.

But in, in survey, in, I mean, surgery and so forth, where they do the fluoroscopy, I mean, I think one of the biggest problem is that how many people are actually wearing their badges. This is where, I think, is the, the bugaboo in saying what kind of readings are they really being exposed to.

And the other item with fluoroscopy and interventional work is that we don't know what kind of doses to the hands they're receiving, and I guess the, the study, it doesn't have to do anything with extremities, correct? Are we looking at extremity doses on this new terminology, so forth?

PARTICIPANT: At this moment, we are not looking at extremity doses. There is a separate criteria for extremity doses that has not been proposed for any change, and the skin of the whole body contributes only a fraction of a percent to the total.

PARTICIPANT: Right, okay.

MR. HODGKINS: Excellent. So is there any other comments that you want to make as far as resonating with what the folks said? Were there any other comments you wanted to make as far as the panelists and the comments, reactions, things resonated, you disagreed with?

PARTICIPANT: No. I mean, all it is is that if the, you know, the regulatory agencies, like, we were inspected by L.A. county, if they allow us to use the Webster formulas for the radiology Department, then we have no problems.

MR. HODGKINS: Thank you. Okay. Yes?

PARTICIPANT: In California, we do allow people to use the Webster's formula if people are wearing lead aprons, but I don't think that's true in every state. I think there are some states who, who don't allow that.

MR. HODGKINS: Next? Microphone. Introduce yourself, sir.

PARTICIPANT: Sure. Ralph Anderson with the Nuclear Energy Institute. This is a reflection on the really first class discussion that's been going on. I'll just mention as an aside, I had the opportunity to attend the first workshop in Washington, D.C., and

I came out here with the thought that given the folks that were going to participate that we would have a much more robust discussion of the significance of some of these changes, and that is coming to pass, so I just wanted to commend everybody for their, the depth of their discussion.

It seems to me that a, a very important issue that needs to accompany simple options like 1A, B, or C is reflective of the type of discussion that, that's been held, and that is, so much of this relies upon the practice, to be able to answer some of the very basic questions about making even, changing part twenty at all or leaving it alone.

And I think that as NRC goes forward, that issue needs to come forward to the Commission, that they need to get a much better appreciation of the diversity of practices, not only between the different applications and uses of radioactive material or radiation, but even within those practices, I, I was very intrigued to understand how different it is from state to state, from facility to facility.

And, and so I, I just propose that one, that issue should be very well highlighted for the Commission in considering even the basic decision of whether to change the regulations or not.

Secondly, I think it stresses to me again how paramount it is that if NRC proceeds to a proposed Rule, that Rule must be accompanied with all of the supporting regulatory guidance. We, we just can't do another big Rule change with guidance to follow.

We, we need to know what the regulatory expectation is of how we will apply that new Rule. And then, a final point is, in regards to implementation, and I think we learned this when we went through the last time around on this in 1990 through `94.

We really need to synchronize the implementation date so that the allowance of the states to do their job so that we are all implementing at the same time, rather than having the staggered implementation that we had last time around. So, I just wanted to make those comments.

MR. HODGKINS: Thank you. Anybody on the panel want to react to that? Add to that?

PARTICIPANT: Ralph, I'm a little confused on your last point, on synchronizing the implementation date, because the basis for why we, if one would think of it in this way, have a staggered implementation date, is that the states do need to reflect their own legislative and regulatory processes in order to be able to adopt anything once NRC has

developed it.

Unless NRC were to defer their effective implementation date to the last state who's able to incorporate and adopt this, I don't see that we could have a single implementation date.

PARTICIPANT: Okay, first of all, just to clarify the point, independent of whether we see it differently, all of the nuclear power reactors in the United States, part fifty licensees had to implement NRC regulations long before the states were even revising their regulations.

So, it, it created a dualityu, just in that situation, alone. We had ain implementation date set in part twenty for NRC licensees, and then the states were off doing things entirely differently.

Notwithstanding the last state or entity that figures that they're going to get there, I think that needs to be better take into account in formulating the Rule and having the discussions about implementation dates.

I propose as a starting point, they should be uniform. That might be an ideal that can't be achieved, but we shouldn't' start off as a starting point like we did last time to say, well, I want you to all implement it by this date and I want you to all

implement it by that date.

To me, that, that just creates a lot of difficulties. There are people that cross over between various types of licensees and even between states, for instance, if you live in Kansas City.

MR. HODGKINS: You mean everything is up to date in Kansas City? Did you want to comment?

PARTICIPANT: No, I think I'd like to yield to Bob and to Don to talk about from the legislative and regulatory processes because I, I don't know that that's doable.

PARTICIPANT: It, it, in general, it is not doable, as, as you've commented on, Lynn. Every state has a slightly different process for adopting regulations and, and the time period it takes for them to adopt those regulations are highly dependent upon the state's process.

I would agree that it would be, with Ralph, that it would be a goal that we should try to achieve and we should look at ways that we may be able to do that. However, we, we may want to do so only for the most significant portions of, of the regulations and the changes.

One thing that, that has been done in the past is NRC has for instance with the increased

controls security requirements, has dictated a very short interval in which to impose those requirements and I believe, although I don't have the, the exact statistics at hand, I believe that all the states were able to achieve that regulatory change in short order.

But, it was done by issuing emergency orders in many cases. So, it circumvented the normal regulation adoption process. I could see the possibility for that being done for some of the most, the more significant portions, but whether that could be done for, could be justified as an emergency needs for all of the changes, I think, would be problematic. But, I do agree that we should look at that.

MR. HODGKINS: Don?

DR. COOL: Thank you. A couple of interesting points here. And, as with most everything, it is more complicated than the discussion actually reflects today. The last time NRC did part twenty, we put in a three year period for licensees to have implementation.

And, licensee could choose a date up to that three year mark where they would adopt, for their particular program, all the requirements. So what you had over a period of time, and it was one of those lovely curves that, you know, here's the starting

point, very few people, very few people, very few, right close to the end as everybody said, oh my God, it's coming.

So, you have the opportunity for phased implementation. Next to that, is the whole question of adequacy and compatibility and the state's regulatory processes. And to be perfectly, or try to be fair to the states.

States have a variety of processes. Some of them are legally mediated, go to their legislatures for votes of approval before they can change the regs. In some states, the legislators meet only every other year.

That presents some interesting complications to the process. The presumption generally is that there is a three year period for states to move to adopt adequate and compatible regulations.

Now, that three years happened in the case of previous part twenty to more or less match the three years that we gave licensees except of course, when the state adopts the regulations, they give their licensees a period of time.

So, there was the additional rolling time of a state licensee implementing it. But there's the

complication that I'm going to point out, not all requirements have the same designation for compatibility. And so part of this discussion, and I would welcome people to suggest their views, which of these things are of such an importance for their to be consistency and otherwise communication between states on opposite sides of the river in Kansas City.

You don't even have to go that far in D.C., is it D.C. or is it Virginia? I mean, they're right across the river, or, hop across Georgia Avenue and be in Maryland. Different requirements at different times.

And, which pieces should be compatibility B, that designation means essentially identical, essentially no flexibility in how it is stated, versus things that might be compatibility C, where there is much more flexibility, there are other opportunities to make adjustments.

The states could in fact impose additional requirements or an alternate way of imposing the requirements. Which of these become important, what compatibility should it be, and why, because I will be very frank with you, and I'm sure Bob and Cass would reinforce this.

States do not like it when NRC says

compatibility B. They want flexibility to do the things they think are most important. So it becomes very complex in terms of the timing and designation. Things like exactly what calculation is allowed for an effective dose, have been a C.

There are opportunities, there are alternatives, and that's why you see some differences in the current regulatory field. And I know Josie wants to add to this.

DR. PICCONE: The one thing I will add to Don's discussion is because the compatibility designations are so important, that there is a joint NRC agreement state standing compatibility Committee that goes through a process and determines the compatibility level for each portion of a revised or new regulation, so that these determinations are made through a process and jointly with the agreement states.

MR. HODGKINS: Yes, Leonard.

DR. SMITH: Leonard Smith, CORA. I'd like to pick up on what Ralph said about doing things, once, we know that we're going to have to wait until 2014 for ICRP to publish their numerical values and weighting factors.

And, the idea of going through a change

with TED soon and few years later making another change, and going through a series of changes like this seems to be something we definitely want to avoid.

It seems, from CORA's perspective, we think the actual timing of the change is not that important. It's the changes that are occurring don't, don't really change our operations that much.

So, the idea of waiting until some convenient year to implement the changes where everybody could do it together would be great. I think if NRC could delay, they could propose, promulgate a regulatory change but not implement it until, say, three years time, so that the states would have time to do it in conjunction. That would be great.

MR. HODGKINS: Thank you. Who was first?

PARTICIPANT: Doesn't matter.

PARTICIPANT: I guess now I have two comments. In response to the comment that was just made, the problem with that is that we're always chasing--changing technology. So, if you say we wait until everybody gets caught up to the current standard state of the art, you never get there, it never happens.

The reason I came up here originally to

the microphone was I had heard the Webster formula referenced a couple of times and NCRP 122 quoted actually a couple times so far this morning. Both of those to my understanding are based on ICRP 26, tissue weighting factors and TEDE concepts.

So, the folks that have voted for 1B up on the, on the Board there, with the implication that TED is calculated using the updated set of tissues and organs and tissue weighting factors. As a regulator, that says to me that the Webster formula no longer would demonstrate compliance with the regulation, based on, on TED.

So, yes, what we're looking for is, you know, is that in fact necessary? Would the webster formula still be sufficient to demonstrate a compliance with a quantity that we could call TED or we could call TEDE?

Or, should we in fact not put a Rule into place until all of this guidance is updated? We'd have to, we'd have to update all of our reg guides, and those other things, those weighting factors. It's not just the Webster Rule or NCRP 122, but the, the EPRI methodology, the multibadge methodology, the ANSI standard 1341 methodology.

That's, that's a significant amount of

work. Or, is there a strategy in which we can put a Rule into place and then update all of these other supporting documents at a, at a future time? That's--

MR. HODGKINS: So, anybody from the panel want to deal with that question?

PARTICIPANT: Both the Webster, which is a one badge algorithm and the Nicholson which a two badge algorithm are gross overestimates--well, gross is probably my point of view and not a regulatory point of view, but--let's just say, overestimates of effective dose.

And, in fact, if you look at the recent literature, there's a paper by Yarvin in radiation protection dosimetry in 2008 review and I believe ten different two dosemeter algorithms.

On average, they all overestimated by between two and four times, overestimate effective dose by between two and four times and by a maximum in terms of certain circumstances of ten times.

So, that research on what is the best algorithm is ongoing, and there is no one best algorithm at this point. Probably best demonstrated by the fact that there are ten different ones available.

PARTICIPANT: Clarification. You said effective dose. Do you mean effective dose, or

effective dose equivalent?

PARTICIPANT: Effective dose.

PARTICIPANT: So, the study is actually, compared it to effective dose, calculated using the--

PARTICIPANT: Correct.

PARTICIPANT: Okay.

MR. HODGKINS: Ellen?

MS. ANDERSON: Ellen Anderson from NEI. When, when NEI submitted their comments to NRC on behalf of the industry back in March, March 31st of this year, we suggested, we recommended actually that the Commission consider not just revising the regulations but reforming the regulations, which would include revising the standards, the guidance and everything, together with the regulation.

We don't want to be chasing the regulation with updated reg guides down the road. We need to do it all at one time.

MR. HODGKINS: Thank you. Yes?

PARTICIPANT: Yes. I went to the restroom, came back, and all of a sudden we're talking about the, you know, when agreement states adopt the rules and all the other stuff, well, we do have some experience because we fall under the NRC.

We also have a facility in Louisiana and

such, in California, and typically that's the speed in which things get adopted. California is usually, usually the last, sorry, Kathleen. But, but, like, when the IC's came, we were first, we were first given the orders from the NRC.

So, all of our facilities went, went for the orders that were given by the, by the NRC regardless of what the state of California or Louisiana told us. But, in the case of osmething like, if we're going to be looking at our badges, from a regulatory person coming in inspecting us, what would you do?

If we say, all right, you know, we watch what the NRC does all the time, okay, these are the new rules and regulations. WE'RE going to adopt those.

And if they're saying that, hey, we want your reports to be in TEDE, and your rules and regulations don't necessarily specifically apply to that, how are you going to, how are you going to look at our reports and how are you going to, you know, look at what we're doing?

MR. HODGKINS: Hot potato.

PARTICIPANT: Yes, I think the answer is, we don't know that right now. But, and, and, that's something that, that has to be worked out. I think we

all recognize that. Because, if, if what the NRC was saying would be in conflict with a state regulation, a state could find that you are non compliance with them under that circumstance.

But, you know, that's not something that we'd like to do, and so we need to do give thought to that, that very issue.

PARTICIPANT: Yes, but see, I was always sort of taught that, you know, the NRC is a minimum. You know, typically, if there's anything else that's added, would be the state, the state could make it more restrictive, but if, in the case of the NRC coming down and whatever their new regulations are, it's more restrictive, really, that, if I'm going beyond what they're saying, I still should be okay.

I mean, that's, that, that would, if you told me you were going to write me up or something, that would be my justification for you, saying, you know, I don't necessarily agree.

PARTICIPANT: No, I don't believe the states would ever try to regulate you or cite you for doing too much. I mean, you know, that's not what I was referring to. I was, at this point, I don't think we know exactly what the differences may be, and so we're, we're really speculating and probably shouldn't

be speculating.

You know, my comment before which, I think is still my comment, is we have to look at this and be reasonable between the states and the NRC.

MR. HODGKINS: Okay. Now, some of you were in D.C. and I just want to open it up, I think we got to comment this conversation has been very rich, and, but from the D.C. perspective take off whoever you're representing here now and if you could just comment on, was there some other perspective from the D.C. conversation that you'd like to move forward, or at least, you know, present as another point of view or another comment.

Anybody who was at D.C., anything to add? Okay--yes. We've got one add.

PARTICIPANT: Yes. Ralph Anderson, with NEI. There was some discussion, it picks up on a comment that Ellen Anderson made, and I know it's a continuing struggle within NRC between technical staff and legal counsel.

But, all of this suggests to me to find ways to minimize what is in regulation and maximize what are captured in tables or references or guidance that can be much more readily changed going forward.

So, that was a discussion that occurred in

D.C. that, you know, I think should continue to play forward, that, there ought to be more flexibility in implementation through guidance. It also allows licenesees then to propose alternatives.

And, I, I think that's a thought that should carry itself into the next version of part twenty.

MR. HODGKINS: Anybody from the panel want to comment on that particular perspective? Okay. Let's--can we now do a check step with the questions?

PARTICIPANT: I think, I think we should look at some of the questions because I think we've gotten to most of them but there are a couple of things that we, relooking at this might trip the people that, in terms of the impact of complying with the options, I think there's been at least a fair bit of discussion.

A lot of you have talked about the issues of formulas, and, and the different pieces there. One of the things that, and I think it would probably be in one of the additional questions, so, let me stop there, Dan, and see if there's anything else that people wanted to add on the impacts of the terminology and then We're going to go to the numeric numbers in the next question, so.

MR. HODGKINS: Yes, Eric?

MR. GOLDIN: As a, as a, I'd like to think of myself as a scientists. It's always good to see us improving science that keeps us employed, but one of the impacts is just changing terminology can have a large cost impact on us.

It's taken us years to get people to try to understand what TEDE is, and if we change to TED, it's going to cost a lot of money just to change training programs, software, dose assessment software for emergency planning, and all kinds of procedures and records and reports.

And for the last part twenty change, I believe the number was on the order of a million dollars per licensee to make those changes.

MR. HODGKINS: Okay. Other comments? Questions, concerns from the panelists? Anything from the audience? Okay, let's move on.

PARTICIPANT: Let me actually ask Dan's question a different way. To what extent do you agree or disagree on the impacts of changing the records and reports and your communication with your workers, your publics, and your patients?

MR. HODGKINS: Chuck?

MR. PICKERING: I think from a medical

institution standpoint, I don't think it's going to be much of an impact at all.

MR. HODGKINS: Okay. Anybody else? Panelists? Audience? Okay. PARTICIPANT: Good. That, that helps. That reinforces, that was actually the question I was going to, I didn't realize it was the next slide. Because records and reports as Eric has, has pointed out, there are lots of things that have to be written down.

And, there would be an impact associated with changing some of those. This would, again, I suspect, be one of the factors in how long people had to go about making the changes, but was actually one of the reasons that option C had been on there.

Whether there was some period of time that should be allocated to make that change, because procedures and things are updated periodically anyway, and it's easier to do that. Now, one of the things in this discussion today was a much better focus on the fact that the underlying technical term is different.

And so, there is a bit of discrepancy there when you allow some added period of time. But are there any more thoughts in terms of the timing of implementation that would be necessary to mitigate changes to records, reports and things, given that

most everyone seems to believe that we should be moving in the direction of updating the terminology? Yes, Melissa?

DR. MARTIN: Melissa Martin. A question I have, and, is, I heard the idea floated by another person, or, you said the dosimetry providers that read out the personnel dosimeters on a routine basis could provide us dosimetry using whatever modifying factors were chosen by the facility.

I was, I was wondering if that would actually be acceptable or are any institutions taking that option? Because all of the facilities I know of, we always just get the straight readouts and then we as a facility have to apply the modifying factors.

And, I was just wondering from a regulatory point of view, is that something you've actually seen, and would it be acceptable?

MR. HODGKINS: Chuck?

MR. PICKERING: Yes. We get it that way, Melissa. We get the raw data, and then they do the calculation for us. We get both, right.

MR. HODGKINS: Anybody else? Comment?

PARTICIPANT: No, I was just going to say, we, we do see that as well. There are facilities who use an over and under the badge and there are problems

with that in terms of them mixing up the badges. I mean, I think you could a big red thing over badge, under badge, and they get it right, but.

But, we also see them ask the, the dosimetry provider to do the calculation. And then they have two readings, they have their original raw reading and the calcualted reading and we certainly accept the calculated reading.

MR. HODGKINS: Any other comments? Yes?

MR. LEE: Kai Lee of USC. We have had a discussion for over an hour on TEDE versus TED, but we seem to lose sight that both terms are just indexes, indexes of risk. And when you have an index, one of the primary purposes of that is as we said, find out the risk.

If we have updated scientific data on what it, risk index should be calculated, we should go for the updated version. The second purpose is that we need to communicate among ourselves in the U.S. a well as our colleagues around the world.

And, also, with out patients, you know. And we use different terms even among ourselves, how are we going to, how are we going to communicate with each other? So, for that reason, I think we should move forward and adopt one term rather than using two

terms concurrently.

MR. HODGKINS: Thank you. Anybody else? Audience? Yes, Ellen.

MS. ANDERSON: I want to go back to Don's original question about anticipated impacts on records and reports. And you're going to hear me say this several times in the next couple of days, the whole issue is change management.

If we're going to adopt these changes, we're going to, we have to ensure that we have proper change management plan, which includes communications and training as well as the proper time to budget any changes that have to be made.

Something as simple as these records and reports, if it involves any software, the software development revisions will have to be made, have to be done, and they're going to have to be QC'ed after the changes are made, so that takes time.

And then, obviously, all this has to be done before we can implement any of these changes. So, it does, the change management portion of this is very important.

MR. HODGKINS: Thank you. Any other comment? Next question, please.

PARTICIPANT: Okay. Then the other thing,

just to try and focus on a little bit, we have the numerical values, and most of the discussion I believe we've been having here was completely combining these two. You change the term, you change the underlying values that are associated with it.

And so, the implementation question really becomes here, it's a timing issue, and I'm interested in any of your ideas specifically related to this, because we will be in a very unusual circumstance, that we will have some of the new dose coefficients in another year.

But there will be some that won't be available for two years, and some that won't be available until actually more like three years. Now, most of the radionuclides that people bump into will be in the first set, for most of the questions.

But, some of the interesting things that you use in some of your medical applications may well not be.

And if there's any advice that any of you would like to give on how to move forward, and I will put in, already recognizing Ralph Anderson's comment from the microphone, they would be really nice if this could move from the regulation to a guidance document which would shift the sort of burden of proof a bit.

So, any other specific things on that implementation, because it is a rather difficult issue and makes the timing of implementation more difficult.

DR. GOMER: Just for--there we go. Chuck Gomer, Children's Hospital. Will the standard PET associated radionuclides be within those, that first group that you talked about? Because that is really where most, a large bit of concern could be.

PARTICIPANT: I would actually guess that some of those PET isotopes might not be in the first group. Again, this is something that separately, later, we can try to go back, call Keith Eckerman, and say, hey, what's going to be in volume one.

But I suspect some of the typical PETs are not in, going to be in volume one that first becomes available.

MR. HODGKINS: Lynn?

MS. FAIROBENT: Just to follow up on Ellen's comment. I would hate to see us have to change procedures software, design, implementation, record keeping multiple times to reelect the phase in of the availability of the numerical values and weighting factors.

I think that and the, especially in the healthcare industry right now, and I hate to bring it

up, but as of yesterday's elections, with the Republicans taking over control of the house, their number one priority, they've already stated it, is to undo healthcare reform.

None of us know what's going to happen but we have a shrinking pot of money, and all of these cost things, not only for the licensees and the user community, but also for the states and also for NRC, and as a Federal taxpayer, I like my tax dollars to be spent wisely.

MR. HODGKINS: Ellen?

MS. ANDERSON: I see--Ellen Anderson, NEI--I see three components to this. I see originally we were, a discussion that we had with Don, or Don with us, was, we talked about the EPA numerical values, and the fact that they were gonna be based, they are based on the U.S. population.

Then, I see this group of values that are going to come out of 2011 and I see a group is coming out 2014. So, I see like, three different separate entities here. What I would, if it was, if I was the project manager on this project, this is how I would handle it.

I would look at what the EPA puts out, and I would look at the, the, the totality of the 2011 and

2014 values coming out of ICRP. I would do an analysis of the two to see what the differences are, if there weren't many differences, and then I'd go from there, rather then, you know, what's EPA going to put out.

Because, obviously, if we want the best science for the U.S., we want to make sure we have the right numbers. And again, if there isn't that much of a difference, then, and then go with the, go with the international standards. That's how I would look at it, do it one shot.

MR. HODGKINS: Okay--

PARTICIPANT: Actually, if I can follow up on that. That's a very good question. It didn't actually make it to the screen. And, and Ellen's just expressed a view which I think says unless there were significant differences, have international consistency, run with the ICRP numbers.

How does the rest of the group feel about that, because we know there will be some little differences, and it's too soon to tell. But, go ahead and speculate from, because that's what this is an opportunity for, and which would be a benefit or not so good in terms of the things that you do.

MR. HODGKINS: Is this where you want participation?

PARTICIPANT: Yes. I'm sorry. Yes.

PARTICIPANT: Yes, I would along with, with, I, I think that we ought to push for international consensus.

MR. HODGKINS: Your mic's off.

PARTICIPANT: I think we should go along with the international consensus. Again, we don't want to have to translate a dose in France to a different dose over here, which could happen with different weighting factors for different, for, for different tissues.

One thing that occurs to me, and, although I'm in favor of consistency, this would, is inconsistent. If the EPA came out with different values, it might be something to consider of applying the international values for occupationally exposed individuals and U.S. for general public.

MR. HODGKINS: Okay. Leonard?

DR. SMITH: Yes. I, I essentially agree with Richard. There's not a great difference we would want to see the international consensus line dup with, with.

MR. HODGKINS: Other panel members? Yes, George.

DR. SEGALL: Just to support the second

half of what Ellen said, and that is we should wait until both, the data from both groups, are complete, and then make a comparison rather than making sort of a rolling phase in or on the fly adjustments.

PARTICIPANT: So, if I can follow up on that, this group would seem to be suggesting to NRC that no decision on the coefficients be made until all the calculations have been completed, as in, don't start work on a change until 2014.

MR. HODGKINS: Lots of nods. Nods are nonverbal and can't be recorded by the recorder. Just to point out.

PARTICIPANT: Yes.

MR. HODGKINS: Anybody else? Let's take it to the audience. Oh--go ahead, David.

MR. APPLEBAUM: Yes. David Applebaum, Harvard UCLA Medical Center. Yes.

PARTICIPANT: Okay, so everyone has just said yes. From a developing the rules standpoint, that means that you';d be saying to us, don't start developing a proposed Rule until 2014, because that's when the technical basis would all be complete. Is that satisfactory in terms of timing for some of the things that you do?

And, to what extent are things like all of

these numbers something which can be done at the same time or separately? In the computer lingo, I think, how much of this is hardwired into your codes, versus how much of this is go to a lookup table?

PARTICIPANT: Don, Don, I have a question for you. Under the current 10 CFR 20, we are able to apply to the NRC to change the dose guideline, so that in the event that uranium was one of the early radionuclides, and, in the event, and I don't know which way this is going to happen, let's just say the dose, the dose coefficient is reduced.

In other words, the doses are going to be less but the same intake. Well, then, obviously we want to jump on that. Okay. Just being selfish, but could we not do that under the existing 10 CFR 20 saying yes, we would like to use this, the new numbers?

PARTICIPANT: Probably. It's standing Commission policy to allow Amendment requests to do that.

PARTICIPANT: Perhaps I could display my own ignorance, as someone who has nothing to do with the regulatory development process, but you could begin working on the regulation without knowing which set of numbers to use, or, could you put them in the

guidance document down the road?

Are you suggesting that you're not even going to begin working on the regulation until 2014 so it wouldn't be promulgated until probably 2025?

DR. COOL: In a way, that is actually what I am asking. By procedure and by following what needs to be done in the Administrative Procedures Act, we have to have a complete technical basis. And anything that is going to be in the regulation has to be available for public comment.

So if we were to say that all of the dose coefficients, all of the things that are in Appendix B to Part 20, were going to be in the regulation, and needed to be available for public comment, then at least we could not be to the stage of a proposed rule before they were all available.

Now, you have suggested there are some other flavors. One flavor is if you were able to move it to a guidance document, could you be moving soon? Yes, that's a possibility. Could we be starting to write other pieces of the rule and leave that piece until later? That is another possibility.

Those are different policy questions, and that is actually why I asked whether or not the question on the final set of numbers to be put in

should be, at least in part, decoupled from the question of putting a new tissue weighting factor, radiation weighting factor, or even not those, and moving the terminology and the limits and other things.

Josie?

DR. PICCONE: Don, if you could get to that -- the statement that it is going to take 10 years or more -- if you can speak to that. You mentioned that historically, but it certainly is not the plan to take 10 to 12 years to do this rulemaking.

DR. COOL: What Josie asked me to do was to disavow the suggestion that the rule wouldn't be done until 2025. And I am quite pleased to do that. We have no plans to let the rule take as long as it did last time. That is part of the reason that we are starting this process now, so that we have a better idea.

So that once we begin an actual Administrative Procedures Act rulemaking process that it could be something at least closer to our nominal expectation, which is two years. Develop a rule, put it out for comment, and a year later have a final rule to the Commission.

Now, this one might need a little more

time, because I suspect people would like a little bit more than a normal comment period and some other things. But that is the normal staff process. That is why asking the question about what is in the technical basis becomes very important. If all of this has to be in a technical basis for a rule, then you don't start the rule until later, because we hope to do it quickly. If you want to separate some pieces, then it differs in another way.

MR. HODGKINS: Yes, Don.

MR. PICKERING: But the framework of the regulation, I think you probably have a good idea what it is going to look like now. The numerical values are always changing, in constant flux over time, and so it seems to me there is another flavor there to proceed. I like the idea of moving the numbers into a guidance document, if that's possible.

DR. COOL: Okay. Appreciate that view. I guess the scientist's side of me has to say the numbers don't actually move all the time. They just happened to move once about every 15 years, and we didn't do it last time, so we are 30 years out now. I really suspect that ICRP isn't going to go do another revision of this for at least another 15 years or so. But if we wait around long enough we can be there,

too.

MR. HODGKINS: Troy, did you want to add anything? No? You're good?

Okay. Anybody else from -- oh. Richard?

MR. BURKLIN: Don, are you working with other groups, too? So, for instance, on the -- we use ICRP-60A, etcetera, we were the first ones in the industry actually to get permission to do it. But I couldn't use it, because we had to do things in totality, as you mentioned earlier.

So there wasn't the software available at that time for us to interpret the bioassay, and so there are different software programs out there who do model, for instance, bioassay results. And they would need -- it is going to take them obviously some time, too. So are you -- is there some cooperation being done with groups like that?

DR. COOL: I guess the most appropriate answer for that is not at the moment. There is two bits to that. There are a number of codes that the NRC staff looks at and uses, and we are already looking at considerations to try and update those for methodology and to actually try to unwire things like the dose coefficients and stuff, so that they can be programmed now, and you could pull in whatever numbers

are agreed to.

We do not have formal cooperation with a sense with some of the vendors that may be supplying software for your whole body counters and some of the other things. The good news is is if we would proceed through this, and this was the direction to be taken, even in a rulemaking sort of type of approach there would be a couple of years, which hopefully organizations and vendors like that would utilize to be doing those calculations.

But there is not much that I think I could do to specifically try to get XYZ Corporation who does your dosimetry processor to actually update their software, unless you've got some bright idea, and I would welcome that, too.

MR. HODGKINS: Did you want to respond to Don?

MR. BURKLIN: I never have bright ideas.

MR. HODGKINS: Audience member?

MR. HEDGER: I probably need some education. I am Troy Hedger from Alpha Omega Services again. I run a business, and to me, you know, listening to some of this, maybe I missed a process somewhere along the line or something like that. But it seems to me like what -- you know, all of these

different numbers, are you sure it is not a Make Work Program?

When the ICRP -- when they come up with these numbers, do they not -- do they not include the United States? Are we that different? Or, you know, do they not do regions already when they come up with their numbers?

DR. COOL: It does include the United States.

MR. HEDGER: So why don't we use those numbers?

DR. COOL: It is just averaged with all of those.

MR. HEDGER: Okay.

DR. COOL: There is not a -- I guess the way to put it, as best I understand the way the calculations are done, they do not do a calculation for an Asian population and a calculation for a North American population and a calculation for a European population. They take an average of the characteristics of those together when they run the code.

So it's not like there is a set for the U.S. that we could go just pull out from them. That's why Oak Ridge National Laboratory, the same group that

is doing the calculation for ICRP, is also doing runs with the more U.S.-specific data associated with it.

MR. HEDGER: But wouldn't those -- shouldn't -- I mean, if Oak Ridge is doing it, then shouldn't they do it at the same time knowing that we are going to end up having the situation? I mean, it is a national lab. I mean, our tax dollars go towards it. It seems like we create a lot of our own problems. I mean, I just -- you know, just think -- I think it should be run a little bit smoother. That's all.

DR. COOL: Well, that's actually a very good point, and I believe the reality is that when the system has all been set up they will do the runs back to back. So essentially it is being done in parallel. They don't have to go through another programming step of development time before the second set would be available.

MR. HUFFERT: Hi. Tony Huffert. I'm with the U.S. Nuclear Regulatory Commission, Office of Nuclear Regulatory Research. I just wanted to address the one comment about the ICRP taking into account some of the U.S. information when they developed their dose factors.

Yes, there are three different

organizations in the world that prepare these dose factors. It's the United States, and typically United Kingdom and Germany. For decades it was the U.S. that did this research, but the ICRP actually recognized that they needed to have backups to Oak Ridge.

As an example, they are currently revising some of the dosimetry for iodine. The NRC is actually assisting with this effort by providing funding to Oak Ridge to take into account the U.S. diet when it comes to foodstuffs. For example, there has been some information available over time that the U.S. was very high in stable iodine through health programs.

For example, our diet contains a large amount of stable iodine in bread and in other foodstuffs. So what we have been doing is working with the ICRP folks and take into account our diet. This then goes into an ICRP committee, which then evaluates the other models that are available. For example, there is new information that is coming out of Russia after the Chernobyl accident.

As a consensus, they then developed these new biokinetic models and agreed upon. This information is also subject to peer review. There is a new article that has been I think published last month in Radiation Protection Dosimetry on some of

this research. So the actual process of developing just the biokinetic model takes many years. It takes into account a lot of data that is international, and that is just one small part of the equation that is used to develop these dose factors.

But in addition, after the ICRP does develop these dose factors for international use, it is then the EPA that will then develop some guidance, and the NRC can accept or reject that.

Does that help with some background?

MR. HODGKINS: I see some heads nodding yes. Thank you.

Is that the last question?

DR. COOL: This is the last question. And I think we have addressed the view, but I would open it up for any other things before I have one other comment to make.

MR. HODGKINS: Any other comments, questions, concerns, things that you were waiting to say but didn't get a chance to say, before we close this part of the discussion?

(No response)

All right. Let's move on.

DR. COOL: Okay. then, let me make one note. Charles had mentioned a little bit ago, he

said, "You know what most of the framework is going to look like." And I want to say no, this is my first reminder to you, that there are still a lot of things that are up in the air. We will go to the Commission a year from now with some policy recommendations.

When the Commission has given us some direction on the policy, we will know a little bit better what the frame is. But at the moment, I don't know what the framework, and the message behind that is this has been a fantastic discussion this morning. And as you think about it over lunch, and as we go through the afternoon and tomorrow and the additional issues, I suspect some of this will come back up again.

Let's bring it back up and add some more to that record, because it is still open. And when you leave today and spend your two hours on the L.A. freeways getting back to wherever you are, you will think of something and, you know, quick, take a little voice note on your SmartPhone or whatever it is, and all that sort of stuff, because our comment period is open all the way through the end of January.

And we really do want to keep hearing from you as you keep developing ideas. And so this is the first time you have heard me say that. You will hear

me say it at least four more times.

MR. HODGKINS: Yes. George?

DR. SEGALL: I have forgotten who said this in reference to communication, but -- I'm paraphrasing the quote -- it says the biggest problem with communication is the misunderstanding that it actually occurred. And so before we break for lunch, I wanted to ask Don to summarize what you -- and you began to do that, what you felt were the consensus of the panel on this first issue.

DR. COOL: Sure, I will try, very briefly at a high level. This group I think has reached a conclusion for the most part that moving to effective dose terminology and the actual quantity that is associated with it -- and that was a new component this time -- is an important thing to do.

There was not a lot of negative impact seen in terms of introducing the new terminology, although there was a clear recognition that the timing of bringing things in and the change management that was associated with that would be important.

There was a considerable view that we need to see what all of the similarities and differences are in things like the dose coefficients before making a final decision on that, the similarities between EPA

and ICRP. And there was an, I think, fairly substantial view that it would be really nice, NRC, if you could extract those numbers from the reg, so that that could be in guidance as a process for licensees to adopt rather than be triggered by the regulation.

I think I have forgotten a few things, but I think those are the key points. And now, George and others, if I have missed an idea, now is your shot at it.

MR. HODGKINS: I think that is a lot of nos. I see those heads going the other way for the first time.

DR. COOL: Kass?

MS. KAUFMAN: One quick comment on making it a guidance document. We get a lot of flack about underground regulations, and I don't know if that would be considered an underground regulation or not. I don't know.

DR. COOL: So let me hold up the mirror and ask everybody to reflect on that, maybe not before we go eat lunch, but there will be some additional time.

MR. HODGKINS: Melissa, did you want to add to that a little bit?

MS. MARTIN: I was just going to follow up

with Kass's comment. I think the important idea is that when the regulation comes out, if those tables are to be in guidance, the guidance must be available at the same time.

MR. HODGKINS: Okay. And as Don said, there is going to be more time in this day and tomorrow, and actually for longer, for comment.

But it is lunch time, and we are about four minutes over our agenda. You guys are good. Either you're good or you're just hungry.

Now, here is the situation. Lunch is on your own. Are there restaurants that they put in their folder, do you know? I think there are some out on the table that Cindy has, but lunch is on your own.

I am going to say it is 12:05. Okay? I will give you guys the benefit of the doubt. We are supposed to be back in the room, then, at 1:05, and I look forward to future discussions at 1:05.

Thank you very much.

(Whereupon, at 12:03 p.m., the proceedings in the foregoing matter recessed for lunch.)

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

(1:25 p.m.)

MR. HODGKINS: Welcome back, everybody.

So as I said to some folks, we have set -- we have already set up some heat for this afternoon. Some people were complaining about -- or making statements about the temperature here, so we are turning it up.

And then, there will be coffee at the break, but it will be after the break. So for right now you are going to have to settle for water. Water.

So now occupational dose limits. We will start there. And I would like to have Kim take the stage, and we are going to do the talking points with Kim. And then, once again, same process, open it up to the panelists, panelists to audience, audience back to the panelists.

And so did that work pretty well for this morning? Okay. Any comments, concerns, wishing it would go faster, slower? How are we doing with that process? Okay?

(No response)

All right. Kim, take it away.

DR. MORGAN-BUTLER: Thank you. So good afternoon. I am Kimyata Morgan-Butler with the U.S.

NRC. I have spoken with most of the panel members either via e-mail or directly on the phone, and I am glad that you all made it and that you are here with us today.

I am going to go briefly over, as Dan mentioned, the occupational dose limits. Just a brief introduction -- this topic almost introduces itself, because everyone has a background in this topic. And then, I have the pleasure and the luxury of turning it over to Dan and Donald Cool. I have given presentations other places where Don -- Donald hasn't been there, and this is a luxury that I will be able to turn it over when the questions come to him. So I look forward to that.

So the NRC -- well, actually, what I am going to do is first go over just a little bit the dose limits, the applicability of the dose limits, what the international recommendations are at this point, and some of the implementation high points for the international community. And then, I will go through the regulatory options, and then hand it over to them.

So the NRC's occupational dose limit is five rem per year per individual, and this applies whether an individual works at one facility or

multiple facilities. The licensee is required to subtract a person's exposure from other places of employment as they go along, so it is additive from place to place. It is -- as Don mentioned earlier, it is based on a radiation risk of one times 10^{-4} per rem, and this is based on ICRP-26 from 1977.

The NRC has a provision, which is the plant special exposure provision, which allows an adult worker to receive an account separately from other doses received under -- sorry, it allows an adult worker to receive doses in addition to and accounted separately from doses received under the occupational dose limit.

And so this is an additional five rem of doses in unique circumstances. So just to give an example of the requirements under this plant special exposure -- and there are many -- it must be an exceptional situation. It must be, as outlined here, a unique circumstance. It has to be in writing before the exposure.

There is also what -- what I may consider informed consent of the worker. The worker has to know the purpose of the exposure, has to know how much they may be exposed to during that point, and they have to be counseled on how to keep the exposures as

low as reasonably achievable. And it also takes into account the lifetime dose.

So Don has said on many occasions that only one licensee ever applied for a plant special exposure to the NRC, and the licensee ended up not using it because there are a plethora, a list of these conditions that are placed upon a plant special exposure.

So the NRC occupational limit applies to the total effective dose equivalent from all sources under the control of the licensee. And it is important to note that certain types of licensees are required to report occupational doses to our radiation exposure information and reporting system at the NRC.

And so the licensees that are required to report to REIRS, as we call it, are the power reactors, the radiation -- the radiography technicians, also some of the fuel cycle licensees, and licensees from fuel flow reprocessing, ISFSI storage, and those types of licensees.

So there are certain types of licensees. What is absent are the medical licensees. Medical licensees, as it was mentioned this morning, at one point had a voluntary requirement -- or maybe it wasn't a requirement, but we did hold information on

medical exposures in the REIRS database at one point, but we no longer require it. And if you send it in to us voluntarily, we don't report it to the REIRS database.

MS. KAUFMAN: It says, "The TEDE from all sources under the control of the licensee." I don't think it is -- I think it is all sources, period, because even if you look at the Q&As from Part 20 they have to ask their employees if they are working at other locations. And they have to add it together. So am I missing something here?

DR. MORGAN-BUTLER: Well, each licensee is required to subtract other exposures from other -- exposures from other licensees from their yearly -- from the worker's yearly exposure level.

DR. COOL: Kass, that is a good question. You have -- for occupational exposure, you have to account for the exposure from all of the different employers or licensees. This means sources under their control, so you are not responsible for the exposure they may have gotten in a medical procedure, as a result of the natural radiation from the bag of fertilizer at Home Depot, and other sorts of sources.

MS. KAUFMAN: So it should say "under the control of a licensee."

DR. COOL: Yes.

MS. KAUFMAN: Not "the licensee."

DR. COOL: Okay.

DR. MORGAN-BUTLER: Okay. The ICRP recommendations right now is 10 -- or recommendation for the occupational dose limit is 10 rem over five years with a maximum of five rem in any one year. When the NRC made the change to 10 CFR Part 20 in 1990 -- in 1991, we didn't adopt the dose limit. But when the ICRP recommendation came out in 1994 international, the rest of the world -- internationally, the rest of the world adopted that dose limit.

So let me restate that again. ICRP -- they came out with their recommendation in 1990. Most of the world went to that level. In 1991, when the NRC changed our Part 20, we didn't make that update. Okay? And that was based on the fact that we didn't have a chance to vet it within our system at that time.

And the change for the occupational dose limit is based on a radiation risk of five times 10^{-4} per rem, and the ICRP -- in ICRP Publication 103 that didn't change. The recommended limit did not change from ICRP-60.

So in terms of international implementation, the ICRP recommendations adopted in some form by all countries. So it was adopted by most countries, with the exception of the United States, in some form or another. Some may argue that the five rem per year meets some -- a part of the requirement, but we didn't adopt the 10 rem over five years.

And some countries have adopted a single limit of two rem per year, and this has progressively been the case over the last few years, that instead of adopting an average that countries have adopted a single limit.

The ICRP, when they first made the recommendation of 10 rem over five years, with no more than five in one year, they did that for flexibility, so that licensees could plan their programs a little better or, you know, make provisions within their program. But, however, recent feedback has shown that most licensees are able to stay under two rem per year.

So, with that, I will go into just the three options that we are going to discuss. There is, first, the no change option, and that will just allow the dose limit to remain at five rem per year. There is also Option B, which is to change the current

regulation to align with the current ICRP Publication 103. And then, the third option is to change the current regulation to align with the approach adopted by some of the other countries, which is a dose limit of a straight two rem per year.

And with that, I will hand it over to Dan.

MR. HODGKINS: Okay. Okay. Now I'm ready. So, again, we can start this way. I don't think -- from the last time, we took them all at the same time and had a discussion. We didn't take it A, B, and C. We took it all at the same time. And we started just with a round robin with everyone. And so is there anybody who is ready to jump in? And then, we will just go around the table in any orderly fashion that you so choose.

Scott?

MR. CARGILL: All right. Well, I'm going to start this off with a couple of questions, one to the NRC and one for -- I have a unique advantage over those that will meet in Houston. I have got a lot of Ph.D.s here.

(Laughter)

So my question here -- I can't remember the gentleman's name from the U.S. Navy, but he did bring up an excellent statement in what benefits this

nation. We are talking about alignment with the rest of the world, essentially, the international community.

I'm going to start off with a question. Why change it? Why change it at all? Is five R proven? Do we have data showing that in 50 years of, in my world, industrial radiography we damaged people with five R limit? Are we seeing people becoming sick and with cancers and all of the other issues at two R, three R, four R?

So my question right now to the medical side here, you guys know the mechanics better than I do, is there or has there been an issue at five R?

MR. HODGKINS: Honest question. Any answers from the panelists?

DR. GOMER: I am going to bring in another question directly related to that that hasn't been brought up here yet, and that is the actual age at which the exposures occur. And the risk factors of someone -- an occupational individual being exposed at age 20 for a variety of years versus someone who is at the age of 50 or 60 being exposed, and the significance of the risk there, and how that would affect this.

I also was going to -- I had written down

also, what would changing from five to two actually mean from a safety point of view to this nation, occupational users? And is there a written estimate of what that change would do?

MR. HODGKINS: And with Don's permission, and maybe you do want to jump in here, I think part of this is a discussion amongst you folks as to what that means, not necessarily from a perspective of the NRC right now. You know, I think they will jump in, and Don obviously will at any point.

But, so what I would really like to do is have you folks discuss, you know, these issues amongst yourselves first before we jump in to NRC.

Ralph?

DR. MACKINTOSH: You got it right. Thank you.

MR. HODGKINS: Even though it says Robert, I know you're Ralph.

DR. MACKINTOSH: All right. I think there are several issues. First of all, I would like to say that I thought we already operated under ALARA, which says we operate all our programs as low as reasonable. And if we are already operating as low as reasonable, then why change the standard?

I don't want to start operating as low as

Odious.

(Laughter)

Secondly, I think there is a danger here of not looking at the cost, and I think we very carefully have to look at, is there a cost? Are we going to pass some unfunded mandate here that has medical costs, maybe shielding costs? Just badging is a cost. Regulation cost? And what is the actual economic cost, and what is it going to do to medical practice?

Are we going to change medical practice? Is that going to be to the patient's benefit, or to the patient's detriment -- our changes in medical practice? Will physicians work faster? Will they do fewer procedures? Will new procedures not be introduced because they have a burden of radiation with them?

The other thing I think we should look at is we talked about new science, and I will introduce my friend John Cameron's name. I know that Carol likes that.

(Laughter)

And I am a believer in radiation hormesis. But I think if we are going to look at science and say "Science is going to lower the dose," then

shouldn't we also look at science and say, "Shouldn't we be using true indicators of TED?" And if we are regulatorily going to lower the limits, then we need to be allowed to calculate realistic values of what actual doses are being given.

And if Webster's way overestimate -- if you are going to let me use an estimate that is down by a factor of five, then okay. But I don't see anything right now that compels us to lower this from any scientific value.

MR. HODGKINS: Thank you.

Panelists, anybody want to jump in? Or should we just move through the -- Melissa?

MS. MARTIN: It's Melissa Martin. I would just basically support what Ralph said. I -- most of us have set our programs up to function as low as reasonably achievable. But I don't -- I would like to think we are not going to create a situation which is going to have a huge economic impact on our facilities for what I don't see any data that demonstrates the real need to make the change. I think, as scientists, that is what we are looking for.

I would support what the earlier gentleman said. I haven't seen any problems dealing with the current regulation.

MR. HODGKINS: Okay. That was Scott.

Yes, Chuck.

MR. PICKERING: Yes. I think we should just throw out C altogether. There is no basis at all for going to two rem anywhere, scientifically or otherwise, or even an ICRP, really. I think it is a simple way of trying to get to 10 rem over five years, but I don't think it makes any sense for this country.

I do like the concept at least of averaging doses. If we are going to try to -- and I am not proposing this at all, because I -- my real view is I think we should leave it alone, as others have said. I do kind of like the idea of averaging for the reason I mentioned earlier, and that is, again, the learning curve of interventionalists, cardiologists, and others. And I believe we see it very strongly in that group, but I believe it is there in other workers as well, that your dose goes down as you gain more experience.

MR. HODGKINS: Okay. Scott?

MR. CARGILL: I don't want to muddy the waters on this, but then why don't we bring back the banking system and minus what -- n minus five minus 18, whatever it was. We got rid of that 20 years ago. I mean, none of us here -- all of us here in fact,

our primary focus is radiation safety, protecting our people. That's what my focus is -- keep my guys safe.

I've got a guy that taught me. The guy is sitting at well over 50 R in 30 years of doing this. I can't say he is better for it or not, but he is still kicking. In 18 years of doing this, I have got seven and a half r. I'd like to think that those that came before me in the scientific community set realistic standards, and that I am going to be healthy for at least another 18 years.

The question is --, the NRC has got to answer this question -- should this nation align with the international community? On one level, I see alignment as beneficial. My company recently got bought by an international company. They started asking questions in sieverts, and now I'm starting to scratch my head wondering, am I really the dummy here in the room?

But the question is, realistically, should we align? I do not feel that it is beneficial, as far as a radiation safety standpoint. Show me where that extra three R a year, which I would like to think most of us don't approach anyway -- like you say, we already work at as low as reasonable, what kind of complications and costs -- I'll tell you some costs,

and I honestly -- take whatever internal costs that you can imagine, throw them out the window, because they really don't count. Where the real cost is going to come is to our nation's infrastructure, our nation's economy, not our local economy, our nation's economy.

What is that bridge that fell down in Minneapolis a few years ago? When we build things in this country, we build them with a life cycle of about 50 years. We don't build them to go back out there next month and work on them again, and next month work on them again. A lot of the infrastructure in the European nations, that is exactly how they are built. They are built with an intent of an annual maintenance program.

Walt Disney built California Adventures right here in Anaheim. The main waterlines for their rides were built with a 50-year life cycle. You can't do that without inspection, industrial radiography, and various other forms of inspection.

Now, we have -- I have heard comments here. You shook a little bit there, Don, but I shivered. When we start talking people not wearing their badges, in my world, that shouldn't happen. That should not happen. And if anybody is allowing it

to happen, that scares me.

Industrial radiography, we deal with high dose gamma sources all day long. We are out in the dirt, we are out in the mud, we are out in the rain. We are not talking rocket scientists out there who are using it. But we can do it safely, and our guys can wear their badges, so I expect the doctors to do the same at least.

And I just recently had a heart procedure myself, and I really thank that doctor for doing what he did. But I know we can all do it safely.

Back to the question, two R or five R, I see no reason to change U.S. regulation to meet the international expectations. We have no -- I see no advantage to meeting their goals in life, and we should be focusing only on ours and what is safe for our people.

I think that might just do it for me.

MR. HODGKINS: Thank you.

George?

DR. SEGALL: I support what the previous speakers have said. The society believes that the 5 rem standard should stay. I have also looked at some individual records at Stanford University where we monitor 200 radiation workers. And we looked at data

for 2008, 2009, and the current year projected to the end of 2010.

All together we find that about three percent of that total number would exceed two rem per year, which is a small number. If you look at the category where the individual is likely to exceed that level, it occurs among physicians who use fluoroscopy. And, in 2010, that is projected to be six out of 150 workers, or about four percent.

When we look at our cyclotron operations, a number smaller group of four individuals, one individual will exceed that two rem -- a two rem limit this year.

They are not large numbers, but we feel that with the five rem limit and ALARA we are administering a strong radiation safety program. Whenever everyone exceeds a constraint in our practice of one rem per year, we do an investigation to make sure techniques are adequate, machines are operating properly, and in a few cases where the limits are exceeded and it is not due to poor technique or poor equipment, it is because of a very busy practice where physicians are getting a lot of good medical training, which ultimately serves the patient good.

These are not low level -- sorry, I didn't

want to say low level and confuse terminology. These are not technologists and others who have no choice in the amount of radiation exposure they achieve because of the way something is structured. These are only physicians, or, in the case of the cyclotron operator, a person in a supervisory capacity who understands the risks and is in complete control of the environment and doing what is medically or scientifically necessary and appropriate.

So we feel that the five rem limit should stay. I also personally would say that the averaging method, which is preferable to -- less preferable than A, but definitely preferable to C, is still problematic, because many of the physicians who exceed the limit are fellows.

And I am not quite sure how we would take into account their future career plans. They are only under our auspices for one or two years. We could easily say, "Fine, we'll let you get five per year, because we are going to assume you're going to get zero in the next three years."

So it becomes very complicated to use an averaging method. So for logistical reasons and scientific reasons, the society strongly supports maintenance of the current regulation of the five rem

per year limit.

MR. HODGKINS: Melissa?

MS. MARTIN: I was -- just to go back to what Dr. Segall -- the Society of Nuclear Medicine -- the other group that you see the same type of dosimeter readings coming from is when the PET facilities go in new, their readings are much higher for the first year.

And then, again, they develop more comfortable work habits, develop procedures that allow them to do lower doses, and so fairly consistently you see the doses go down in the second through fifth year. But that first year they may very well be over the two. Rarely are they going to hit the five. So it has never really been a problem.

And, again, they usually develop better working procedures, and they go down the second to third year. But somehow we have to allow that first year of training to happen.

MR. HODGKINS: Kai?

MR. LEE: Melissa made me to talk, because we started the PET CT two years ago. Our nuclear medicine technologists never had a jump in exposure. In fact, I looked over the records of all our nuclear medicine technologists' exposures. We run a very busy

department. They get no more than 100 mr per year, including those technologists who do PET CT, and those technologists doing cardiac perfusion studies.

So I am opposed to changing from five R to two R, because we are getting no more than 100 mr per year. If I tell my tech, "Hey, the law says the limit is changed from 5,000 to 2,000 mr per year now," they are going to laugh at me, because they said, "We are only getting 100 mr per year."

So by changing the regulation, you are not going to change -- reduce patient -- the people's exposure. You are not going to change our way of work. In fact, you might encourage problems with the cardiologist and intervention radiologist. At my institution, the intervention radiologist is getting roughly 1.7 R per year.

Now, if they say, "Hey, I am getting close to two, I better start hiding my badge." So by changing regulation you are giving -- you are actually counterproductive. So instead of wasting our resources on enforcement, it is better that we spend our resources on education.

MR. HODGKINS: Thank you.

Anybody else?

(No response)

So let's move around the room. Donald?

DR. MILLER: First, just a side issue. The question was raised earlier, why are interventionalists even involved in this discussion, and the answer is in one of the slides that Kim showed earlier, which is that licensees are responsible for exposure from licensed sources and also from unlicensed sources.

And so the RSO is dealing with a regulatory framework from the NRC for all individuals who have both licensed and unlicensed exposures. And because of that, everybody who has unlicensed exposure is under the same regulatory framework. So we are all affected, even if we never use a radioisotope or are even near one.

So I agree, essentially, with everything that everybody has said. I have a philosophical conflict as an ICRP member that I ought to support the ICRP and --

(Laughter)

-- the 20 millisievert limit, but I can't bring myself to do it.

(Laughter)

The question or the point was raised earlier that physicians ought to be wearing their

badges. The reason that we don't, in general, is that, as you know, there is an investigation level at 10 percent of the limit.

And many of us are on an almost monthly -- sometimes a monthly basis said -- told we are over 10 percent of the limit. What are you going to do about it? And we fill out paperwork. Because the RSO is not aware that there is an expected range of dose for an interventionalist, and that range does not include zero, unless we are not working.

If you lower the limit from five to two, you lower the 10 percent investigation level from .5 to .2. That means that essentially every interventionalist in the United States is going to be subject to one of these investigations every month. This is not, as Kai has pointed out, going to encourage wearing badges. It is counterproductive. People need to wear badges, because as has been pointed out, it is important as a safety and health measure.

We don't want to do something that is going to make that more difficult or less likely to be done. So under those circumstances I think there is really no question that the ACR is definitively against anything that is going to make the

availability of interventional services to the American public less available. And that is what is going to happen.

OSHA, which is responsible, as you know, for occupational radiation exposure for those areas where the NRC does not have jurisdiction had a stakeholders meeting about five years ago on this same subject. And I was at that meeting and I said to them, "Okay. Suppose you lower the limit, and you have a lot of interventionalists who run up against the limit in, say, October or November. Who is going to take care of the patients with heart attacks and strokes and ischemic legs in December?"

We don't have a pool of interventionalists who have not been doing cases we can call on. And if they haven't been doing cases, you probably don't want to call on them in the first place.

(Laughter)

The regulators in Europe have a somewhat different approach to the problem. When one of these fellows was asked, "Well, what do you do when the most experienced guy comes up against the limit?" He says, "Well, you just send in someone who is less experienced." I don't think most Americans would consider that an acceptable response.

MR. HODGKINS: Okay. Anybody -- yes, Kai?

MR. LEE: Yes. I would like to add that there is hope coming for the intervention radiologist, also from experience. We moved from a 1932 hospital to a modern hospital two years ago. We changed our equipment from good old imaging intensifier to now the new digital imaging receptors.

I measured exposure rate coming from the X-ray machines at the image -- from the receptor. It changed from 3.5 R per minute down to 1.7 R per minute for new equipment. So that even without any kind of regulation to tell the doctors to reduce the dose, to hide their badges, technology will bring the exposure down. So there is no reason for government to step in to give some artificial limit to them.

MR. HODGKINS: Okay. Any other comment? Ellen?

MS. ANDERSON: We support the statement made by the NRC in SECY-08-0197, that five rem per year limit provides adequate protection. However, just for your information, you know, we also obviously support the ALARA concept. We implement the ALARA concept.

But also, for the record, you know, we also establish something called administrative dose

limits within each one of our sites. Each company has their own limit, and some of them are about two rem per year, some a little bit under, some a little over, whatever, but we do have that.

And if in fact we were to go to a two rem per year limit, we would never be working to that limit, so that administrative dose limit would be something very much lower than two rem per year, say, 1.25, 1.5 rem per year. So we would be going from a limit of five to a de facto administrative limit of less than two.

MR. HODGKINS: Okay. Any other comments? So, Lynne, you want to take it from here?

MS. FAIROBENT: Kai, just to follow up, though, I think it is great, and University of Southern California Med Center is great, and it is large, and it is able to have state-of-the-art equipment all the time. However, a lot of community-based hospitals are not as fortunate in being able to have the latest, the greatest, and the best as soon as it hits the marketplace.

The other thing I would say is from the interventional side, oftentimes we feel, as radiation safety professionals, you know, everybody will say, "Well, it's so easy. Hang more lead on the physician,

protect them from the radiation."

That's not -- that is actually not the case. Dr. Miller and myself have been actively involved in the past several years with a group looking at -- titled the Multi-Specialty Occupational Health Group. And it is a group that has brought interventional radiology and interventional cardiology, along with medical physicists, to the table.

As you might know, it is not always easy to get the radiologists and cardiologists at the same table, but one of the things we are looking at -- and I think we have to keep this in perspective -- radiation isn't the only risk that we all operate in. And perhaps hanging lead on the physicians sounds great. It reduces the radiation risk, but it also causes increases in other occupational health injuries.

And so we need to keep in mind, as we look at radiation regulation, the total hazards involved no matter what our discipline or modality or our professional practice area is, because I think there are tradeoffs that we do not look at. We tend to regulate somewhat in isolation. We don't regulate in an all hazards approach. And I think that is

something that we have to -- we need to keep in mind as we talk about potential changes.

I would tend to say -- and Melissa can chime in, too, but I would think that AAPM's position will be that without the scientific evidence to show any real benefit to reducing from the five rem per year. Now, we will have a fraction that our scientists, they are peer researchers, and from that viewpoint we all want the best science. But from a practical implementation place, in a community practice, I don't think it is as clear to -- and I don't see a cost-benefit analysis.

MR. HODGKINS: Okay. Any reactions? Comments?

(No response)

Melissa, do you want to take it from here? Oh, did you want to say something, Kass?

MS. KAUFMAN: I just want to clarify a couple of things. One is that I think we all agree that we don't want to impose a dose limit that is going to interfere with the practice of medicine. I mean, I think that is pretty universal.

But I did want to clarify just a couple of things. One is, Lynne, actually the hospital that Kai Lee is talking about is a county hospital. And so it

primarily handles indigent patients, so they don't have money.

The other thing is what -- somebody mentioned something about shielding. We approve the shielding design on every facility in the county, and we have never seen a place shield for five rem in a year. They generally shield for 500 millirem in a year. So I don't think shielding would be an issue relative to any of this in terms of a cost.

Relative to 2B, it is not -- which is averaging over five years, boy, that one seems really tough in terms of how we would monitor that. I'm not sure how we would review that during our inspections. I think it would be really difficult for the licensees to keep track of it. I'm not sure if NRC had some ideas on how that would work, or how it has worked in other countries, because I am having a hard time wrapping my mind around how we would actually implement that.

MR. HODGKINS: Okay. Chuck?

MR. PICKERING: Kass, I have given that some thought, and I think the only way to do it would be for the dosimetry companies -- and, of course, it is not just external, it is everything, but for them to provide us with a running five-year average on the

dosimetry reports.

MS. KAUFMAN: If they use the same company, if you have people who work at different facilities that use different dosimetry companies, or they come to you and they have used a different dosimetry company, I wouldn't say it's not doable, but it does sound -- does sound kind of tough.

And this is a question. I heard that some countries have gone to one dosimetry company or everybody reports their doses to one central location. Has anyone actually done that yet? Because that seems like the only way that this might work is in a much smaller group of people.

DR. COOL: Okay. It will work better once it's on. I turned it off, so you wouldn't hear me choking over here in the corner. No, not grumbling. Not grumbling at all.

A couple of points. There are a number of countries that have moved to national registries of dose, where everyone is reporting in their doses to some central registry, sometimes run by the regulatory authority, sometimes run by a technical service organization or some other group for the regulatory authority.

That does give them an opportunity to be

able to see all of the different inputs, if an individual is working for multiple licensees. I have not heard, although it may be happening, that there is a single dosimeter process. Now, it wouldn't necessarily surprise me in some place like France, where there is EDF and they run all of the reactors, that there might be a single processor, but I don't know that to be the case. But there are a number of places that have moved to single registries.

As we continue the discussion a little bit, you have picked up on one of the questions that goes along with any possibility of averaging. Some of us have been around -- I think Scott maybe remembers -- we had 5N minus 18. And you had two different forms, so that you always had the dose history and you were chasing the dose history around.

It would seem that some system like that would, again, be necessary if you were looking at average doses, so that you could track them over multiple years, as well as the question of multiple employers in a year. So that is something to elaborate on a little bit more as we continue the discussion.

MS. KAUFMAN: Well, I have one quick followup question. Would the five years -- at the end

of the five years, does it start over again, or is it rolling?

DR. COOL: And that is also a very good question.

MS. KAUFMAN: It's rolling?

DR. COOL: And the answer is it depends on the country. There are some countries that are doing a rolling five, and there are some countries that are doing discrete five-year periods, and it all resets at the end of five. So if you look internationally you will find both.

MR. HODGKINS: Ralph?

DR. MACKINTOSH: Two things. One is, as we compare ourselves to other countries in the world, in order to compare apples to apples, is there another industrialized country with high quality medicine and high usage of interventional radiology who has a private practice model?

(Laughter)

MR. HODGKINS: A rhetorical question, nonetheless.

DR. MACKINTOSH: Because now you are not comparing the same -- the same thing. If you've got a socialized -- and you are going to rotate physicians evenly to spread the usage out versus a private

practice model where one physician or more may do a large number of cases, I don't know if we can make direct comparisons.

The second thing is -- and I think people have alluded to this -- the fact that everything we do is on a risk-benefit curve of some kind, for years I taught radiation therapy, and I always put up this chart that showed the different activities we did in life and the risk-benefit. And it started out with, you know, smoking takes one year off your life, and it went down to taking a shower takes 10 days off your life, or something, or being a schoolteacher takes one day off your life.

And I would always make the point to my class that in order to be socially acceptable, you give up 10 days off your life and you take a shower once in a while.

(Laughter)

And I think we need to keep that really in mind, that there is a risk and a benefit. We are not talking here -- we are talking occupational. We are not talking about uninformed people who do not know that they are assuming a risk, and that they weigh that risk, an informed risk against benefit they derive, and the benefits their patients derive.

And I think that is why I would like to see us -- we have all made that choice, and we continue to make that choice. And until scientific evidence tells me that that risk is too great, I am happy with the choices I have now.

MR. HODGKINS: It begs the question, what is the risk in taking a shower? Slipping?

DR. MACKINTOSH: Slip and fall. It's the number one place for cause of accidents in the home is in the shower, yes.

MR. HODGKINS: There you go. You physicists.

Melissa?

MS. MARTIN: I would like to follow up on what Kass sort of alluded to, whether it is the inspection -- inspector trying to review records or whether I am the RSO trying to review records.

As Dr. Miller alluded, or several people have said, when the physicians are in their last year or two of fellowship, maybe the first year of practice, that's when their exposures are the highest is when they are really intensely getting their training.

So in my -- as the RSO, then, going to have this person come in to practice at this facility,

and three or four years down the road be going, "No, you can't practice the next six months, because now you have hit your 10 rem." On the other hand, if I get inspected the first year that they are there, they are going to be well over the two rem. And you don't know when they are going to hit their 10.

I just think it is going to be very difficult to actually comply with Option B.

MR. HODGKINS: Okay. Richard, your turn.

MR. BURKLIN: Yes, I also would favor no change in the dose limit, to keep it at five rem. I think we can talk -- we will talk about constraints tomorrow, so I will have some comments probably then. But part of the reason is for -- this is coming from being a fuel fabricator is that if we lower the dose from five rem to another -- to a lower number, then it is likely that other thresholds will change.

So, for instance, we have to monitor at a certain percent of the limit. If you lower the annual limit, most likely the threshold for monitoring internal dose and monitoring for external dose will both go down. If you lower the dose limit, then people who are exposed to airborne radioactivity will have to don -- may have to don respirators at a lower level.

Additionally, there are other parts of the regulations that are, at least in part, based upon five rem. So, for instance, in Part 70, where we have to analyze the -- analyze conditions for like an intermediate consequence event, that intermediate consequence event from 25 rem, is partially based on that it is five times the annual limit. So if we were to reduce that limit again to five, the question is, is that going to carry over into Part 70?

MR. HODGKINS: Okay.

MR. BURKLIN: And other parts.

MR. HODGKINS: Response to that? Anybody want to add to that? Charles, do you want to give your comments on A, B, or C?

DR. GOMER: I agree. I think it should stay where it is at the five. I haven't heard of any protection reason why changing it would have any significant benefit to the occupational users.

MR. HODGKINS: Thank you. Reactions? Chuck?

MR. PICKERING: Yes, I would be fine leaving it just where it is for all the reasons we have talked about. I think we can -- Richard mentioned we will be talking about constraints later. I think we can meet the spirit of ICRP through the

use of properly set constraint levels, as we are already doing now.

And they don't have to necessarily drop just because other limits drop, but I think we clearly know what kind of doses people get for the work they do. And we also are allowed to set constraints by worker group as well. They don't all have to be one level for the entire operation. We can have a level for interventionalists and another level for lab workers or whoever they may be.

MR. HODGKINS: Okay. Comments? Bob?

MR. GREGER: The CRCPD does not have a position at this point in time. We are just trying to listen to what everyone has to say.

MR. HODGKINS: How about Bob? Does he have an opinion?

(Laughter)

No.

(Laughter)

Ellen, anything to add?

MS. ANDERSON: I already mentioned that we support no change. However, I did want to say something in response to something Kass said earlier, and that is we -- in the power reactor sector, we do have a database where we actually track dose from

plant to plant.

We have a number of transient workers that go from plant to plant during refueling outages, and so it is very important that we keep track of how much dose they pick up. That database is called PADS, personnel access dosimetry -- data system. Anyways, it figures I'd go brain-dead when I went to say that.

Anyways, we use that, and it is actually administered by the Nuclear Energy Institute. We have a consultant that actually administers that for us. So when a person comes to the site, we can go back into PADS, we can find out how much dose they have received for the year, so that we can determine how much they can receive at the site when they come in for their refueling outage. So we do that, and we have been doing that for quite a while.

I have actually -- we didn't have an automatic subtraction system per se to -- if we decide -- if for some reason NRC decided to go to B. However, we have already actually gone back -- gone through to look at that to see what it would cost to do that, and we could support that. However, at this point, we really don't support B. We would -- you know, again, this whole issue of adequate protection, we believe we are there and that we shouldn't make any

changes.

MR. HODGKINS: Thank you.

Kass, anything more?

MS. KAUFMAN: CRCPD hat, we're not taking a position. And Kass Kaufman, too. I still feel like we are missing a little piece of data, and that data is how many people actually exceed the two rem every year, and what kind of work are they doing. And I don't know that, and it seems to me that that is a piece of data that we would need to know before any decision was made.

I do think if the decision is made to go either to B or C that the -- that the action levels, though, should -- in guidance should certainly be increased. In other words, if it now says 10 percent of the maximum permissible dose, I think that would have to go up to 50 percent or whatever, something like that.

MR. HODGKINS: Okay. But just to your point, Kass, as far as, Ellen and George, didn't you give some sense of that as far as how many go over two? And just for the sake of, you know, reiteration, can you say that again?

MS. ANDERSON: Sure. In 2009, within the power reactor section -- sector, we had 39 people go

over two rem.

MR. HODGKINS: Out of?

MS. ANDERSON: Thousands. Several thousands.

MR. HODGKINS: Okay. And George?

Repeat your question.

DR. GOMER: It was over two, but the question was, what was that range, or how high over two were those levels?

MS. ANDERSON: And I don't have that data.

MR. HODGKINS: Okay. Thanks, Ellen.

George?

DR. SEGALL: At Stanford University, it was four percent of all radiation workers, mostly physicians using fluoroscopy, one cyclotron operator, and the total radiation exposure was in the order of about three rem per year.

MR. HODGKINS: Donald?

DR. MILLER: Were all of the fluoroscopists wearing badges all the time?

DR. SEGALL: Of course not.

(Laughter)

DR. MILLER: That's just the point is that when we say we have data, we really don't have data. We just don't know.

MR. HODGKINS: Scott?

MR. CARGILL: From the industrial radiography side, and obviously I can only talk about my company, we talk about the -- running the 10-year average, and what not. This may actually -- should be something NRC states could be looking at. We need a national registry, if you are going to make something like that work. And I -- since we have so many medical people here, one of my pet peeves is the patients.

If I go to Doctor A today, get an X-ray, go to Doctor B tomorrow, get an X-ray, neither of these two guys know what I have had. So from a medical side, you know, the patients aren't being tracked at all.

But for the industrial side, I have been tracked -- I've got the last five years of data from my company. We're looking at about three to five percent break the two R barrier. Anything over two R I start getting kind of concerned no matter which way it goes. I check on it. Obviously, this guy is working a lot of hours, hot sources, etcetera. I make sure that it's not a -- what's the word I'm after? I make sure they're doing what they're supposed to do and do it right.

Nobody has broken three R in five years at my company. I still prefer leave it at five R, for all of the reasons I have given earlier, and as well as having that little safety margin, just keep my guys out of violations, anything along those lines as well.

So as an industry, we want to keep it at five. It gives us a good buffer, keep it as much as we can as low as we can. And on those rare occasions where a job comes up, we get a little more radiation than we would like, we are still doing all right.

MR. HODGKINS: Kass?

MS. KAUFMAN: Scott --

DR. COOL: Would it be possible --

MS. KAUFMAN: I'm sorry.

DR. COOL: Just to intervene quickly, would it be possible for you to share some of that data, without any of the personal information, separately offline to help us for the record?

MR. HODGKINS: Kass?

MS. KAUFMAN: Yes. And my question was, how many radiographers does your company have?

MR. CARGILL: That is kind of a little hard to track. We are a cyclic industry to begin with, as you are aware. But right now I am well over 110 badged people. That is, like I say, a cyclic

thing. Back in 2005 I had 55. So, but I do have them down -- it is running about three to five percent, no matter how many people I have. And it is just really a matter of the workload.

MR. HODGKINS: Kass, anything else to add before we move on?

MS. KAUFMAN: No.

MR. HODGKINS: Eric?

MR. GOLDIN: I would like to make a couple of comments in two areas. One is, having been the subject myself of administrative dose limits, I did a report about, I don't know, five years ago or so, on decommissioning dose. And fortunately we are not decommissioning any plants, significant number of plants these days, but back then there were, if I remember, between 2- and 300 people nationally who exceeded two rem per year, and there were a couple dozen who exceeded three rem per year.

We are not seeing that anymore, but the point is that we still see some people who do exceed, as Ellen mentioned, two rem per year. Now, these are usually highly skilled, highly experienced people that you want doing this particular work, whether it's refueling or reactor head inspections or whatever for a powerplant, and it reduces the collective exposure

by using the experienced people. And that's what you want, rather than bring in inexperienced people and run the total dose up.

The second thing that, again, as Ellen mentioned, I would like to build on -- and this is where my personal experience comes in -- if you have a two rem per year limit, an annual limit, the individual powerplant is going to have to set an administrative control level significantly lower, like Ellen mentioned, of one or one and a half rem, or something like that.

The radiation work permit will have a lower number, because you never want to approach your administrative dose control level, and a technician in the field will apply his or her own limit to the dose received, and pretty soon you've got a worker who has for the year maybe 500 millirem worth of work. And that is just not going to work for some of the high dose jobs.

MR. HODGKINS: Okay. Any reaction to those comments? Colin?

MR. DIMOCK: So representing UCLA, we have a few thousand employees who are working with radioactive material or radiation-producing machines. Of that group, the two rem limit, if it were imposed,

would affect maybe one to two dozen. The vast majority of them would be interventionalists of one kind or another.

Our cyclotron pharmacists do a pretty good job, and they keep their doses pretty low. But it is possible that some of those would fall into that group as well.

I -- we pretty much support no change, as changing it would only affect that specialized group of people's ability to do their work, which is very important work and highly skilled.

MR. HODGKINS: Okay. David?

MR. APPLEBAUM: David Applebaum, Harbor-UCLA Medical Center. I agree with all of the comments I have heard already. We are looking at on the order of one to two percent of our film badge users exceeding the two R per year limit, and they are interventionalists. And if I have a heart attack, I don't want my doctor leaving in the middle of an operation.

MR. HODGKINS: That's a good plan.

MR. APPLEBAUM: So I support the five. No change.

MR. HODGKINS: Colin and David, I didn't get a chance -- anybody else, any comments on that?

Leonard?

MR. SMITH: Leonard Smith, CORAR. We have a bit of a dilemma on this. As I mentioned earlier, we have -- our businesses are international. It's a tremendous advantage -- an advantage to us to be able to align with ICRP. It would even be a greater advantage if we could comply with the two rem a year, because then there would be no -- no problems with dealing with workers in other countries and our customers, and so forth, in other countries.

However, in the manufacturing and distribution sites in the United States, there are about one to two percent of people who are getting regularly more than two rem a year. And our best estimate now is that that -- their doses might be ranging up to about 3.5 still. There are a few people still at that level.

It is very likely that as time goes by operations will modernize. And then, another thing is that the dosimetry would improve, so that we would be making better estimates and not overestimating doses. And so we would expect that these dose levels will come down, but we think it would take a long time.

So our fear about this is that we should keep a five rem limit for quite a while, maybe a

decade or so. But in the meantime we probably need to have a constraint level that would be constantly encouraging licensees to be reevaluating their operations on a regular basis, and looking for continuous methods to reduce dose.

I mean, it is really essentially the same as an ALARA program. But we think it might be a good idea to have a two rem constraint. And, again, I like -- Richard, you mentioned it, too, perhaps a constraint might be something to look at. And when we come to that session tomorrow, I would like to elaborate on that.

MR. HODGKINS: Terrific. Anybody else, comments on Leonard? Yes.

MR. BURKLIN: I will just -- well, actually, it may be more along Eric's line. I work for AREVA, as I have mentioned. AREVA has a limit of two rem, not in a year but in a 12-month period. Okay? So it is even more -- more restrictive.

With that, then, of course the section -- or the division that I work in set their constraint at 1.4 rem. And, of course, our plant doesn't let anybody get to 1.4 rem, at least we try not to. We will remove them from the workplace before they -- before that. So, again, we have a lower limit.

So the limit is -- for us is five rem, for NRC, but we are able to work within the two rem limit.

MR. HODGKINS: Thank you. Kai?

MR. LEE: Pass.

MR. HODGKINS: Pass? George?

DR. SEGALL: One of the strategies for lowering the radiation exposure to any one worker is to share it. Other people have mentioned that. So if one worker were to get three rem per year in a hospital, it is entirely feasible that, were the limits reduced, that hospital would require two workers.

So logically you would assume that each, then, would only get 1.5 rem per year, but people, being who they are, it is more likely that each of those individuals would approach the maximum of two. So, paradoxically, you would be increasing radiation risk to your population, because it has gone from three rem total to now four rem total.

And using the simple math of radiation risk from ICRP, whether you use the one or the five per 10^{-4}, you run into the very interesting but very real paradox of actually increasing the risk in your total population.

MR. HODGKINS: Comments? Yes. Donald?

DR. MILLER: Of course, that illustration assumes that there are extra people floating around who can do the jobs. The Society for Cardiac Angiography and Intervention, which represents the interventional cardiologists, has about 5,000 members. The Society of Interventional Radiology has also about 5,000 members. There are far fewer members of the Society of Neuro-Interventional Surgery who are the interventional folks who do things in the head, probably no more than about 600.

At one hospital -- I forget which one it was -- there were 14 to 20 people who were over the two rem limit. How many hospitals in the United States do we need to go with that number of people before we run out of people -- interventionalists to take care of patients?

MR. HODGKINS: Scott?

MR. CARGILL: Actually, the same goes with the industrial radiography side. I mean, I'm not making a brain surgeon here, but it takes us at least a year to two years to make a radiographer. Legally speaking, I can make one in two months, but to make one, certify him, qualify him, put him out there and actually do the job well, that is a minimum one to two years.

And when we see an increase in workload, I just don't get to go to the nearest Walmart and pick up a body. Okay. Yes, we do, but --

(Laughter)

-- it actually does take us a year to get him trained up.

(Laughter)

Seriously, we are -- they last -- they are actually better workers.

We are in the same boat. We really are. You just don't make a qualified Level 2 radiographer. It takes time, it takes experience, and it takes training. It is obviously a lot less than that neurosurgeon, but we are in the same boat. You just don't magically get to duplicate your efforts.

The overriding theme I have heard from the other sectors here is the same in that we put our experienced guy out there. He is going to do the job well, he is going to do it right the first time, and hopefully the exposure will be as low as reasonably and as possible, versus the guy is getting close, okay, send in the B team, he is going to take longer, and then your guys' side of the fence -- maybe not do the job as well. My side, that means he goes and reshoots the weld. Your side, hold on, I like my

doctor, I really do.

(Laughter)

So there is a lot to be said here, and we need to allow our best people to operate. We don't need to hobble them.

MR. HODGKINS: Leonard?

MR. SMITH: Len Smith, CORER. Yes, we have a similar situation in manufacturing, and also the distribution world. Basically, we rely very highly on radiation workers, a small cadre of radiation workers, who are specifically trained to do certain maintenance operations around, etcetera, these production accelerators, and also maintaining some of the manufacturing equipment, decontaminating where you have to go in behind the shielding and take this equipment apart.

And I remember quite a few years ago, it must be 20 or so years ago, NCRP asked us on this whether there was any benefit in reducing the dose. We did an evaluation in a manufacturing facility and figured out that if you did try to get down to two rem a year limit, you would almost double the actual collective dose that you were getting in your community.

I would expect that to be a smaller number

now. It wouldn't -- we wouldn't double now, but we would definitely increase the collective dose. So hopefully over the next couple of months we can put together a study to get some information of that nature.

And it is not just the fact that the person is less skilled, it is also that when you have three people doing a job, instead of one, they are all just going into the operation and coming out of the operation, getting unnecessary dose, which is non-productive dose.

MR. HODGKINS: Okay. Any comment? Lynne?

MS. FAIROBENT: Not a direct comment to Leonard's comment, but from the Washington meeting there is a couple of points that were brought up that I don't think we have heard today, and just to bring them up in case other people have comments.

One of the DOE contractors brought up the fact that we are pretty much all looking at external dose, we are not talking an awful lot at the internal burden. But when DOE -- first off, when DOE looked to go and implement the changes in 2006, they had received the same types of comments that NRC is seeing through this process -- significant increases in recordkeeping, potentially adversely impacting the

operation of facilities, and DOE at the time concluded to stay with Option 2A, not changing the annual limit.

One of the DOE contractors brought up the fact that of course they will live with the cost of doing business as a DOE contractor, because they choose to be a DOE contractor. But in the interim dose arena, it could actually be problematic. Bioassay frequencies may have to be increased, for example, from once every two weeks to perhaps a higher frequency. More people may need to have to have bioassay protocols employed on them than they do now at the higher limit.

Dr. Atcher, who is representing the Society of Nuclear Medicine, had a different twist on it from the medical side. And I sort of hesitate to bring it in, but I think it is also reflective of any of the professions that are here.

As we increase the dose limit, if we really need to keep individuals' doses to a lower level, one way of doing that easily, as we have all mentioned, is you bring more people in. Hopefully, we have more trained people to do that. We run the risk of collective dose.

However, in the health care industry, because of the way reimbursement and stuff is handled,

we would not necessarily be reimbursed to hire more people to maintain a lower dose. So it is those sorts of cost tradeoffs that don't easily or routinely enter into NRC's types of cost-benefit analysis.

I don't think it is that different for any of the industries. I think we all suffer from the same factor. We have limited funds, whether it's coming off your profit margins, whether it is going to the ratepayers for an increase in the power industry, or fuel cycle vendors. I think we all suffer from some of the same trade points.

And then, the other point that was not mentioned -- there are two -- one from the reactors. If we go to this five rem average over a time period, one of the reactors brought up the differences between spring and fall outages. If you are a utility with a spring outage, you are at the front end of the lower dose, and you may be good for the transient workers that go plant to plant to do it. If you are a fall outage plant, you might not be so lucky.

You may have more people that are impacting or approaching the administrative limits or the two rem per year limit. And then, what do you do? Again, it is the same thing. It takes time to train these skilled workers, no matter what the field or

discipline is.

And then, from the industrial radiography side, it was brought up that our practice of industrial radiography -- and, Scott, perhaps you can correct me if I misheard -- but we use -- we tend to use higher activity sources than other countries. So it is not so easy to -- even in that industry to do a comparison of how they may have -- internationally are meeting the lower annual limits versus how we would be able -- or if we could meet them in this country.

So I just wanted to bring that up. And then, from one of the manufacturers and distributors, they said that if they were constrained to a two rem limits, perhaps it might limit their commercial opportunities. They may not be able to look at new policies, procedures, products to bring to market, because of perhaps some constraints in the lower dose limits.

So I hadn't heard any of those things being brought up today, and I just wanted to throw them out in case somebody wanted to comment in those areas as well.

MR. HODGKINS: Thanks so much, Lynne. Appreciate that.

Anybody want to comment that from the

panel, from those comments? Leonard?

MR. SMITH: Well, I just want to confirm another point. Don brought up the business of the skill of the physician, and that, too, is a problem in our industry. The people have to get -- keep practicing doing these operations. Otherwise, the -- you know, if their skill level goes down, their dose will go up.

MR. HODGKINS: Okay. Ralph, you are going to close the loop here as far as going around the panel. Make it good, buddy.

(Laughter)

DR. MACKINTOSH: The pressure is on. Ralph Mackintosh. There are three groups of people I have seen that -- in my career that approach the limit. Number one, as Melissa has talked about, is young radiologists who are learning. The second group is middle aged radiologists with big practices.

(Laughter)

And the third group is old radiologists who just don't give a damn.

(Laughter)

And I have two quick anecdotes. One I -- I actually, once in my career, had to suspend a radiologist. And I finally convinced him, when he

developed a leukopenia, that maybe he was getting too much radiation. Who knows how much because he was -- he was at four and a half at my institution, and practicing in multiple institutions.

The other one was a gentleman who showed me his hands, and he had lesions on his hands and had a couple of operations, because he used to count out radium needles on the palm of his hand before he implanted them. So who knows what dose? But, in balancing that, he was 88 years old. So maybe there is something to this radiation.

MR. HODGKINS: Thank you. Anybody dare to comment on Ralph?

(Laughter)

Melissa, whoa.

MS. MARTIN: I would just reiterate the -- or add to Ralph's folklore at this point, but the physicist that was my original trainer out of graduate school constructed cesium sources to be used for brachytherapy in his garage, and he died at the ripe old age of 96. So maybe the radiation does preserve something.

(Laughter)

MR. HODGKINS: Don, do you want to close up the -- let me just say we are going to take a break

before we hear from the audience, because it is right at break time, which is perfect I think. So think about what you want to say as far as audience participation and reaction to this. And I will let Don close it before the break.

DR. COOL: Thank you. There will be a number of things that I think we will want to discuss a little bit farther to help the staff develop the record they will need, and so you can be thinking about a number of those things.

This morning there were a couple of questions that, thanks to the great efforts of Tony Huffert of our staff, I am actually able to give you an answer to. So let me just quickly fill you in on those.

The first was the RBE factor for betas and very low energy photons that I talked about that EPA was looking at. In discussions with EPA staff this morning, and with Oak Ridge National Labs, with Keith Eckerman -- I think Tony has actually talked to both of them today -- what EPA is looking at is for photons less than 30 keV. So most of your fluoros are probably okay.

For beta, less than 18 keV. So tritium is in, but probably not a whole lot else. And their

reason specifically for revisiting this is that post the BIER VII report that there has actually been continued scientific evidence, and they are continuing to try and develop a scientific basis for the different RBE. And they are, in fact, in the process of conducting some more biophysical and biological research on this, following up on what their Science Advisory Board provided for them. So that is one of the questions.

The other question that came up that I wasn't able to give you a real good tight answer to was -- Kass, first question. Go ahead.

MS. KAUFMAN: I'm so sorry to interrupt you, but on the -- on the low energy -- now I forgot my question. It was a --

(Laughter)

MR. SMITH: The 18 keV? Is it the 18 keV you are asking -- is that the maximum energy or the --

MS. KAUFMAN: Oh. Are they thinking that -- I think you said there was an increased risk at these lower energies versus what we are thinking now, is that -- okay.

DR. COOL: Yes, that's correct. And --

MR. HODGKINS: So you asked and answered your question?

(Laughter)

MS. KAUFMAN: Always good to have confirmation.

(Laughter)

MR. HODGKINS: But is there anybody that -- I mean, for the sake of record, can you clarify that? Just because it was kind of an ask and answer. So your question was, and the answer is?

MS. KAUFMAN: My question was, are they thinking that these lower energy photons and beta particles have a higher risk than what we currently think? And I believe --

DR. COOL: The answer is?

MS. KAUFMAN: -- the answer is yes.

MR. HODGKINS: The answer is yes. Good.

DR. COOL: The answer is yes.

MR. HODGKINS: I guess we've got Len before Kai, so hang on a second.

MR. SMITH: I was trying to anticipate your question, and it's a different question. The 18 keV for the betas, is that the average energy or the maximum energy of the betas?

DR. COOL: I suspect it is the average, because we all know that there is a .5 beta max out.

MR. SMITH: Right. Because tritium would

be over 18.

DR. COOL: Yes, I think it is the average.

MR. SMITH: It must be the average.

DR. COOL: I believe it is, but I don't think they actually told Tony that. So I'm running on an assumption of what I remember from my physics courses many years ago.

MR. HODGKINS: Okay. Kai?

MR. LEE: Did I hear you right that you define low energy photons as those below 30 keV? That means you are including all diagnostic X-rays.

DR. COOL: Part of the reasoning for my mentioning it is so that people would be aware, because it is not just NRC doing some things. And, I don't know, there is maybe no polite way to say this. What happens over in EPA in developing some of these underlying bases often doesn't get the same visibility. So I wanted to make sure that some of this was visible for you.

The second thing that I want to --

MR. HODGKINS: Before you go on, though, Kai, I've got to call you out a little bit, just because you did a grimace, which a grimace can't really be said over the phone -- I mean, over the speaker. So is there a reaction to that that you want

to put on record?

MR. LEE: I'm not sure about putting it on record, because --

(Laughter)

-- if you want to increase the risk value associated with X-rays, now what is -- that means you are raising the risk of all X-ray procedures. Is there any real justification for that?

DR. COOL: That would be a question best answered by the EPA folks. They believe they have scientific evidence indicating a greater risk with those very low energies in terms of induction of lesions and effects within the cell that the radiation transits.

MR. LEE: I mean, considering that we have been using X-rays since the turn, well, of the last century, have we really observed any risk from proper use of X-rays to allow -- to make us increase the risk weighting factor for the X-ray machine?

DR. COOL: I'm going to hold up the mirror after a while. I'm going to let people discuss it. Kass?

MS. KAUFMAN: I think there have been some studies that have shown an increased risk from diagnostic X-rays in cancer. Now, you know, how valid

those studies are, and how many they are, and all of that, I don't know. But I think there have been a few studies that have purported to demonstrate that.

DR. COOL: Okay. So let me quickly go to the second one, and then you can go to the coffee, because it is back there.

The targets for the ICRP dose coefficients and the question of which radionuclides were going to be included -- 2011, for adults, occupational, most commonly used radionuclides, old version, the only PET isotope perhaps in there being carbon.

So stay tuned. 2012, coefficients related to the public, which is a much broader age group, because that includes the young children and everything within their calculations.

2013, coefficients associated with intake by wounds, lesions, and other forms.

And, in 2014, the rest of the occupational radionuclide values, which would include, at that point, the PETs like fluorine and oxygen, stuff like that.

So it is going to be a while before we will have the new numbers for many of the things that are now rapidly coming on in the medical field in PET and various modalities.

And, with that, I would invite us to go to break.

MR. HODGKINS: Let us go to break for 15 minutes. I am going to say it is 2:40, and 15 minutes would be 55. Five minutes to three we will come back in.

(Whereupon, the proceedings in the foregoing matter went off the record at 2:36 p.m. and went back on the record at 3:00 p.m.)

MR. HODGKINS: Okay. I think we have adjusted the temperature in the room a little bit again, and there is coffee in the back of the room. Feel free to get up and use -- you know, have as much as you want, or as little as you need. And that's a good thing.

So what we are going to do is open it up to the public, and I see one gentleman at the microphone right now, and someone lining up behind him. All right? And so if everybody is ready, let's start. Name? Okay.

MR. HUFFERT: Tony Huffert, NRC. I provided some information to Don Cool earlier about the conversation I had with the EPA and ORNL staffs. One thing I forgot to give Don in my notes was that when I talked with Keith Ericman I asked him why

30 keV, and he said, "Be careful here, Tony. It's only a scoping analysis, and what they're doing is some fundamental research around that energy range."

So it could be higher, it could be lower, but that's roughly the directive that he received from the EPA, who gave them the funding and the project to look at this. So please don't consider the 30 keV photon as a limit for lower energy.

I had two questions. One was for Dr. George Segall. You had mentioned in one of your statements that if you have one person that is roughly a three rem per year, and then you go to a lower dose limit -- let's say a two rem per year -- and you have two people that are now doing the job, you could potentially end up with a situation where you have a total of four rem for the two workers.

Can you provide a little more explanation about why the two people would be getting two rem each as compared to the one person at three rem? The reason why I'm asking this question is I'm not questioning your statement; it's just that I'm asking the question to find out, if I was to do an analysis in, let's say, some type of regulatory document that Don Cool asked me to do, how could I actually make a statement that is defensible in writing?

DR. SEGALL: I understand you asking the question, and I have to admit I don't have the data. I think this is an impression that we get from the collected expertise here that a strategy for keeping measured doses low is not to actually decrease radiation exposure, but not to wear your badge consistently or take other inappropriate shortcuts.

And so what I am suggesting is that people, if the work is shared, will actually prolong procedures, because they are not bumping up against the limit, and hurrying through a procedure, for example. But the mere fact of observation will alter the phenomenon, so I'm not quite sure how to get you that data.

But let me think about it, because I think it is a very real issue, and having data addressing that would be very helpful and important.

MR. HUFFERT: Yes, it would. Thank you.

The last question is to Dr. Leonard Smith. You mentioned that the NCRP had done an evaluation of a manufacturing facility with basically a resultant doubling of the collective dose. Do you have any information about that NCRP report? For example, was it a commentary or a report, a number, what year it was, who some of the authors might be, etcetera?

MR. SMITH: Yes. What I told you is that we had done a survey for the NCRP. So CORAR had gotten their member companies to evaluate their dose distributions. We pulled all of that information and gave that collective information to NCRP.

So we do have that survey somewhere, but it is -- it is quite old. It was about 20 years ago, I think. I think what we probably need to do is a similar thing this time around, too. It's very useful, yes.

MR. HUFFERT: Okay. Thank you.

MR. HODGKINS: Don't sit down yet, because although you asked two specific questions, you started with a general one, a comment and clarification. And so how about, for the panelists, is there any reaction from the first, second, or third issue that you want Tony to respond to, or not, or what? Are you all ready to move on? Yes, Melissa first, then David.

MS. MARTIN: Just one example. I have seen what -- I would like to speak to Dr. Segall's comment. The facility -- say they establish their patient load for nominally one PET tech. If they wanting to reduce that PET tech's dose, they will bring on two. But then shortly thereafter they have extended hours, they have increased the number of

patients, and they are doing more patients and both techs are now up to at least half of what the first one started with.

So that's how you get -- I mean, that data is what brings those techs up to receiving basically the same -- twice as much, not one and -- not half as much.

MR. HODGKINS: Okay. Any other response, then, to something else? You were just waving at me. Thank you. Thank you, Tony.

Comments? Let's go to the second person at the microphone, please. Name first.

MS. MARKUS: Carol Markus, UCLA. The only reason the NRC seems to be potentially pushing this two rem decrease is uniformity. And I don't see any virtue in uniformity per se, especially uniform acceptance of something that isn't smart to begin with.

This country led the world in nuclear and radiation science. We should not be copying somebody else who doesn't have, let us say, a complete scientific view of the picture just to be uniform.

We have the same problem of uniformity with NRC's medical regulations. Many states have much better regulations than the NRC, but the NRC is wiping

them out and demanding uniformity. And I think you really have to look at the basic ideas behind this insistence on uniformity. That is the first question -- comment.

Secondly, I am delighted to hear that the members of the panel want to keep the five rem rule. Obviously, so do I. I don't think there are any convincing data that five rem is hazardous, so that decreasing it will decrease hazard.

I would like to just point out, though, that even if you believe LNT, as some of the people in NRC I guess do, as long as you do your activities ALARA, and you have to bring in more and more workers to get the job done, while the individual cancer dose would go down somewhat with a lowering to one or two rem, the total number of cancers stays exactly the same.

The number of cancers induced by worker activities using radiation-producing machines or radioactive material stays exactly the same. So the NRC is not accomplishing anything except increasing the cost of activities.

If you don't believe in LNT, then it is really sinful, because you are lowering from a safe dose to a safe dose. You have no benefit at all. You

are not decreasing risk, but you are causing a lot of headache and increasing cost and very possibly depriving patients of procedures that are life-saving or morbidity-saving.

So I certainly support continuation of the five rem. But I would like the NRC to think about this fixation with uniformity.

MR. HODGKINS: Thank you. Panelists, want to react to that at all?

(No response)

Okay.

MR. TAKAHASHI: Yes, I have one question and one comment. I agree with the not keeping or actually keeping the dose limit at five rem. But I'm wondering about, from the interventional radiologist group here, that they exceeded the two rem. Now, was that the raw badge reading, or was that the corrected badge reading?

DR. SEGALL: At Stanford, it is the corrected badge reading. Most of them are over five rem, if you don't correct. But it would be inappropriate not to employ some correction.

MR. TAKAHASHI: I guess I'd better get the medical director to make sure that our interventional radiologists wear their badges then.

(Laughter)

MR. HODGKINS: Yes. Dr. Miller?

DR. MILLER: If you do not correct the over-the-apron badge reading, you will overestimate effective dose according to strand and active radiologic of 2008 by an average of 69 times, if you don't wear a thyroid shield, and by an average of 130 times if you do wear a thyroid shield. And so I hope it's corrected.

MR. TAKAHASHI: Part of my former life, I was a radiation chemist at a cyclotron facility. And I got, what is it -- over six years I almost got 10 rems. But the research work was very interesting, so I didn't mind it.

But looking at the operations side over there, the people who were the operators, depending upon their on-time hours that they were operating the cyclotron, then, you know, the dose went up because of the activation of the positive particles that were being generated.

Now we have the negative ion cyclotrons, and so if you have the negative cyclotrons you don't have the activation of the deflector assembly. You still have the activation within the central region. And, you know, most of that has to be the copper --

the short-lived coppers, isotopes, so forth. But I'm just wondering what kind of cyclotrons you have at Stanford.

DR. SEGALL: Excuse me. It's medical cyclotrons, self-shielded, 11 meV, I think it is pretty standard.

MR. TAKAHASHI: Yes. So it's the Cyclotron Corporation's RS-112 or 114. So those are I believe negative. Yes, so they're -- yes, so I'm surprised that you see that kind of over two rem dose.

DR. SEGALL: One out of four.

MR. TAKAHASHI: Yes, but the -- you know, for the chemists everything is automated now. When I was a chemist, I mean, I had separatory funnels, everything else. And so my extensions, and so forth, went into that -- the hood. And so that's where I got most of my dose is the fact that I couldn't shield the upper body and doing it -- everything remotely. But --

DR. COOL: Just to follow up on that just a bit, and to see if any of the other panel members or otherwise would like to contribute to it, during the Washington meeting, one individual representing sort of PET organizations and groups was saying that they have very significant doses.

She did not provide specific percentages of individuals who were over two rem, but I think the thrust of her statements were that there were a number of individuals who were up very close to five rem each year. I took it to be the individuals who were processing the targets into the actual doses to be administered who were receiving that, and I just wondered if that matches or doesn't match with some of your experience to help us validate whether that is an area which, until a week ago, hadn't been on our radar screen as an area having fairly significant doses.

MR. TAKAHASHI: Well, I don't know. I mean, UCLA -- I mean, at the cyclotron that was replaced because of the Northridge earthquake, they had more legs on there, so they had multiple targets. I mean, in the original cyclotron we only had one target. So we had to go in and exchange a target to create another isotope.

But, you know, we still had enough downtime where, you know, we let the short-lived -- especially the aluminum activation -- decay away. But, you know, I don't know. Colin can tell you what kind of dose these people get over there at the cyclotrons.

MR. DIMOCK: I don't really see our

cyclotron chemists, if you will -- I don't really see them hitting the five rem. Some of them will border the two rem, somewhere in that. But I also consider our chemists to be pretty darn good at what they do at this point. They are very skilled, and they are able to keep their doses down, because of that skill. I think that we are running lower than some of our counterparts.

MR. HODGKINS: Chuck?

MR. TAKAHASHI: That also could be due to the fact that you have multiple chemistry units set up. So you don't have to change a hot source, because now these new cyclotrons are open -- you know, they are made so that you can insert multiple chemistry systems to operate in a consecutive manner, so that, you know, that is the other thing.

MR. DIMOCK: I think our setup is pretty good in general, even though it may on the surface look a little antiquated compared to some of the more modern systems. It has been refined over the years to be very effective for shielding.

Now, there is -- when we are talking about hand dose, there is some hand dose associated with doing that chemistry. But as far as whole body dose goes, we are able to keep it down significantly lower

than that five rem.

MR. HODGKINS: Chuck?

MR. PICKERING: From my experience, these people work incredibly hard. And it was mentioned earlier about putting lead on people. They are also lifting a lot of lead in Tungsten pigs, but they get a lot of dose. Again, my experience is not that they are pushing five, but they are definitely, as Colin said, over two.

And a lot of it is, again, in some of these places cost is, you know, a big issue, so they can't go hire a second person to share the dose. And so they have one or two people that really carry the burden.

MR. DIMOCK: And the other thing is, as Carol pointed out earlier, if you do hire more people you are not actually lowering the number of cancers you generate from that. Of course, wearing lead for PET operations isn't such a hot idea anyway, since the --

(Laughter)

-- 511 keV goes through that pretty well.

MR. HODGKINS: Yes?

MR. SMITH: Yes, another detail about some of the manufacturing operations with cyclotrons,

production cyclotrons. There are still some machines that are the positive ion beam machines, and they -- you get a lot of dose from them, because the beams are not very easy to manipulate.

So usually the targets are internal, so you have go in -- pull the targets from outside the machine. There is much more scattering of radiation, so the machine itself gets activated. They are older machines and they need more maintenance.

So the people who get the highest dose are the folks that work on those machines. But it is only a matter of time before they will be phased out and the new negative ion beam machines will be used and the doses will go down. Those machines can very easily be used in a production mode with external targets, which also reduces the dose.

MR. HODGKINS: Okay. Can we take it to this mic over in the corner? That's you.

MR. ANDERSEN: Okay. Ralph Andersen with Nuclear Energy Institute. First of all, I will speak in an area that I don't know much about. Don, I thought the anecdotes about the accelerator-based doses had to do specifically with the fluorine-18 production, and the need to be able to get right in and get the stuff extracted, packaged, and shipped,

because of its relatively short half-life. I thought that's where they were saying the limiting factor was that would be severely impacted by 20 millisievert a year dose limit.

DR. COOL: That is also my recollection, although I took that individual's discussion as being an illustrative example, that there might be others. But that was the one that she was specifically referring to.

MR. ANDERSEN: Yes, I just wanted to comment that I think that was where it was rather than on the issue of residual activation in the cyclotron components.

I just want to speak to a couple of things real quick. We had talked -- Ellen earlier had mentioned some data, as have some others. First of all, I will comment, there are several classes of licensees, as you are aware, that religiously report our data every year. NRC compiles that every year, and files it -- publishes it in a NUREG.

So everything I am about to say, the data is actually on the NRC website in a NUREG. She had mentioned that in 2009 there were 39 workers at nuclear powerplants that were greater than two rem. There were, at that same time, about 70,000 monitored

workers, so somebody had asked that question, that represents less than one one-thousandth of the workforce, or less than a tenth of a percent.

The more important issue, though, is that if you look at the trend lines for the data that is reported by the various licensed communities, and I suspect that the same is true in the other licensee categories that don't report the data, what really strikes you is when you look back over the last 20 years, and particularly even the last 10 years, and say, "Well, what has been the effect of the existing NRC regulatory framework? What has occurred without making those additional changes?" and what you see is a continued downward trend in collective dose and a continued downward trend in number of people greater than any given value -- but we will just pick two rem -- and a significant reduction in the average dose that workers receive.

And, you know, I would contend to you that the space that we are all working in is the space that we are continually integrating new practices, continually learning from experience, continuing to refine our technologies, continuing to refine our ALARA technologies as well, such that that is probably true somewhat universally is that the dose per work

has probably been on a continued improving trend.

You know, one thing I do understand in the medical area, I was part of the NCRP committee that put out the report on public dose. And Fred Metler and I spent a lot of time talking about the medical arena.

As I understand it there, one of your challenges is that the workload has gone up. So the data itself would not necessarily show a continued improving trend, because you are actually doing a whole hell of a lot more procedures than you did 10 years previously.

At nuclear powerplants, we are not doing 10 times the maintenance that we used to do. In fact, we are doing considerably less. So that would need to be taken into account in analyzing the data.

But I think NRC really owes itself to take a look at the data that it has. I know that it is looking to extract data from other communities, and I know, anecdotally, that this might be in the works. But NRC did publish a reg guide -- or, excuse me, a NUREG in the mid-'90s on the specific issue of a lower dose limit that actually contained a lot of good information. And we need to resurrect that NUREG and look at updating it and making it part of the

technical basis for consideration of a policy decision like that.

I will say that the conclusion that was arrived in that NUREG is that the end result that was desired, in terms of managing risk, was already being achieved under the existing framework.

Don, you were going to -- you looked like you had something to say.

DR. COOL: Well, I was going to mention Ralph brought up the NUREG that was done in the early '90s, shortly after the last revision of Part 20. We, through our Office of Research, are actually -- I think we have just issued or are about to issue a contract to a group to do an update of that NUREG. So thank you for your thought. I think it is a wonderful idea.

(Laughter)

MR. ANDERSEN: Second point -- not to confuse the issue -- is we also have another interesting organization in the U.S. called the National Council on Radiation Protection. Lest it not be forget, they actually published NCRP Report 116, in which they proposed alternative recommendations to what the ICRP had proposed finally in 1990.

There was a tremendous amount of

contention internally on the main commission about the right framework to reflect their overall goals of managing lifetime risk. And partially as a result of that, the U.S. took a different point of view then, even in that recommending scientific body space.

And if you read NCRP Report 116, it actually recommends that people's individual dose be limited to their age in years, such that when they finally reach that level then, at that point, they be limited ideally to no more than two rem a year.

But what is most important is that in the discussion in the NCRP report it talks very significantly about the offsets and the impacts of letting dose limits dictate the delivery of societal benefits as well as delivery of benefits to the individual themself of being able to continue to work.

Unemployed people are at a very, very high health risk compared to employed people. And one of the issues was limits that actually cause people to become unemployable for all or part of a year or even for the remainder of their professional life.

But it is another document that I commend that contains some very thoughtful information derived by the NCRP on this notion of reducing dose limits and potential impacts. Also, it raises the idea that

there are alternatives to B and C.

Final point I wanted to make is that the -- we should not also overlook that the limits themselves never were and never are intended to define the difference between safe and unsafe. ICRP is very clear of that. Their judgment is based on comparisons to safe industries relying on an assumption of LNT. But they are really a point that is picked somewhat arbitrarily to sort of be a radiological analog of other safe industries and the risks that are incurred into other safe industries.

And more often than not, the comparative detriments are fatal cancers on the one hand and physical deaths on the other hand. So there is -- you know, there is -- we talk about the very subtle differences in taking Japanese atomic bomb survivor data and translating it to typical people in the United States. Just be aware that there was a lot of translation to even come up on this notion of acceptable risk from radiation exposure.

And I -- you know, I worry that we are obsessing too much collectively, as a community, around the world, on the notion that somehow this two rem a year or 10 rem in five years is some bright line above which it is evil and bad, and below which

everybody is just fine. That was never the point. ICRP is very clear on that in both ICRP-60 and ICRP-103.

Thank you.

MR. HODGKINS: So, Ralph, you said a lot. And so I want to give the board, the panel, a chance to react to that a little bit and -- or not. Anybody want to echo/confront Don? Yes, go for it, buddy.

DR. COOL: Well, I actually am going to put Don Miller on the hot seat for just a moment. Do you know if NCRP is looking to do an update of 116 and their recommendations?

DR. MILLER: I don't.

MR. HODGKINS: Short answer.

DR. COOL: Because I was not aware of one, but Ralph has brought that up very appropriately as another piece to be considered. And so that's an interesting piece there.

Thank you.

MR. HODGKINS: Yes.

DR. MILLER: Just one brief point. The doses to operators in interventional fluoroscopy are not going down, not only because the workload is increasing but also because the procedures themselves are becoming increasingly complex. And complexity is

a major determinant of radiation dose.

MR. HODGKINS: Okay. If there are no other comments, we will go to the man who has been very patient.

MR. CAMPBELL: Mike Campbell, ONCure Medical Corp. My concern is with -- if B or C is adopted, the increased cost due to shielding. I mean, currently we designed at 10 percent of the limit to ensure compliance with A.

And while it would also meet B and C, to me it doesn't seem like a stretch that a regulator would require a design to be 10 percent of the limit if B or C is adopted. And the reason that it is a concern for a linear accelerator, the shielding takes about 30 to 50 percent of the budget, and any increase in cost like that is going to severely take away from the -- what machine we could actually put in there and what procedures could be done in the room.

MR. HODGKINS: Okay. Comments? Reactions?

(No response)

And, you know, I -- the audience, too, is allowed to participate at this point, too, even with reactions. So you don't just have to stand at the microphone to ask a question or to react to one thing.

You know, converse. That said, nobody wants to converse. Ralph?

DR. COOL: But we do ask that you come to the microphone, because I will remind you that we are making a transcript.

MR. ANDERSEN: Yes. This is a comment in the form of a question. But looking at the timeframes involved for evolving this rulemaking and recognize that there is really a large body of what I'll call new science that is coming into focus in the area of radiation biology, is NRC looking to continue to track the emerging science post BIER VII? I mean, BIER VII is slowly receding into the background.

And by the time we get into the real rulemaking phase on the schedule, some of the schedules that we have talked about, there may not be a BIER VIII by then, but there is certainly going to be a lot more emergent science that has come out since then. Is there thought or effort in regard to continuing to track that?

DR. COOL: There is --

MR. ANDERSEN: I'm thinking especially of the Department of Energy low-dose radiation project, as well as other related efforts in Japan and France and a few other countries.

DR. COOL: There is a short and simple answer. It's yes. Irrespective of where we are in this particular rule process, various people within the staff are paying very close attention to what is happening with UNSCEAR, the United Nations Scientific Committee Effects of Atomic Radiation, carefully tracking and going to each of the symposiums that DOE is doing on their low-dose program, and other activities, to try and stay well abreast of the developments.

MR. HODGKINS: You wanted to react, Melissa?

MS. MARTIN: I would just like to follow up with what Mike Campbell said. I think we -- for those of us that do a lot of shielding design, shielding design is a significant cost, or shielding construction is a significant cost for all of your -- whether it's diagnostic imaging, PET facilities, or therapy facilities particularly, we all design right now to basically some fractional number of the maximum permissible limit, so that we know we are hopefully never going to get there.

If that limit drops, and if the same fraction is applied, then, yes, we will definitely affect the cost of construction of all medical

facilities.

MR. HODGKINS: Anybody else? Microphone number two.

MR. FLAGOR: I'm Gail Flagor with GE Inspection Services. I'm an industrial contractor, same category as Scott Cargill is. I would hate to see the changes made from the way it is now. It would impact our business tremendously.

Currently, I have five licenses that we work under, four different states plus an NRC license. And our dose rate right now for all of our radiographers throughout those licenses is less than one R per year, subject to change. It depends on our work scope, how much work we are actually doing and everything.

I heard the comments about building shielding or adding new shielding. It is an impossibility in a field service like we provide. We have to use existing shielding, whatever it may be, to help keep our dose down.

We already have our own controls in, and every company in this business does that. If we approach certain limits, whatever each company sets up, then we go into an investigation already to see why this person is getting a -- close to the two R or

one R, or whatever it is, each company has set out.

So that's my comments on that.

MR. HODGKINS: Okay. Reaction from the panelists? Scott, do you want to add anything to that?

MR. CARGILL: Actually, I was going to ask this at some point, but I will ask this of the NRC now. In our industry, we do report to the REIRS program. What has REIRS shown in the last few years? Are you aware of what trend might be? Are seeing a lot of two R plus exposures? Or how has that been running?

DR. COOL: Okay. Good and fair question. REIRS shows the same thing for the reactor industry that Ellen and Ralph were talking about -- a very sharp decline, just a few left. There are a larger number -- I can't quote you an exact number -- of individuals in the industrial radiography area that are exceeding two rem per year.

But the information and the way it is reported to us, at least as I see it, as one of the users, can't immediately tell whether it is the same individuals reported every year, although we can have our contractor pull that information.

One of the things that complicates it a

bit for me, why I like to say I'm holding up a mirror now, is companies that report to NRC are the NRC licensees. You're a licensee in the State of California, you're providing the information to California. And so one of the things that we were having to continue to work on is assembling all of the bits and pieces of the data, because it is not in fact a national database.

We see only a small fraction. In fact, NRC licensees are less than 20 percent of the total byproduct materials licensees in the United States. That is what we are seeing in the industrial radiography area. We are continuing to see a number -- and I don't think it has significantly changed over the last few years. I am looking at Tony.

Our expert in the REIRS, radiation exposure database, is not here at this meeting, so I can't look at Doris and have her immediately confirm the answer to the question like I could last week.

Tony, could you help me?

MR. HUFFERT: Tony Huffert, NRC. You're right. Doris isn't here. If you want to, I can make a phone call. But we are currently doing an analysis on the licensees other than the reactors in the REIRS database, and we are trying to find out where these

numbers lie at basically different cuts -- five rem, four rem, three rem, two rem, one rem, etcetera -- to help answer this question.

That analysis has not been done yet. We are currently doing it.

One thing that Don did mention is that we have roughly 20 percent of our licensees captured. Well, it is my understanding that totally we have 320 to 350 organizations reporting to REIRS system. But, overall, I think there are tens of thousands of licensees that could provide information.

So we do not have all of the information that we need at this time to provide a full answer to some of these questions, and that is why Don is holding up the mirror. If you have this type of information, it would be very helpful to share with us, so we can do the analysis to help answer some of these questions better.

MR. CARGILL: All right. I have no -- my company has submitted that NRC-5 to you guys for years.

That said, the next piece of this point for me, regulations are written to either eliminate or correct a deficiency. I think we all here agree that is our question. Where is the deficiency? And

without any clear-cut five R is that magic number or not, I don't believe we want to see this change. We all pretty much agree A is our vote, for lack of a better term.

That would be contingent upon something showing us all, as a community, where is that magic line at? After that, then we can all sit around and fight over how many of us were going to get put out of business, or how much it is going to cost to stay in compliance.

I am aware of -- I have been running around the country the last few years as the RSO and meeting with other companies. I have no doubt industrial radiography, we are going to see two R plus. I would rather see -- I would love to promote, and I would hope the NRC would jump behind this idea, to promote not through regulation but through initiative or in some kind of a program to build the ALARA concept of safety culture.

I know NRC has some kind of a safety culture thing going right now. I would love to see something like that more so than I would like to see a hard-cut regulation that I may have to hang myself on later.

Like I say, I know some good programs out

there. I know some not-so-good programs. I would like to see our industry, my industry, get better. There is no doubt. I can't imagine none of us wouldn't agree with that statement. The only way that is going to happen is through safety culture, better training, better programs, better approaches. I believe that's all I've got to say.

MR. HODGKINS: Thank you, Scott. We hope there will be more tomorrow, if not yet today.

Anybody want to react to that from the panel, as far as I think it kind of started with, you know, the -- a question about what that limit is or why, and then went on to the culture of safety. Anybody?

(No response)

With that, back to the microphone.

MS. MARKUS: Carol Markus, UCLA. Don, a question for you. I don't understand why NRC needs all of this data about the radiation doses of every radiation worker or group in the United States. It has nothing to do with risk. It has nothing to do with an intellectually valid reason to change what we have now, other than creating a lot of work and spending a lot of user fee money. What do you need these data for?

DR. COOL: Okay. Unfortunately, part of the requirements that we have to meet are to prepare a regulatory analysis of our options of benefits and impacts. And one of the things that helps make the argument for or against -- it doesn't matter at the moment which option we are talking about -- is the actual experience occurring in the industry in the various sectors at this time.

So we need some of this data in order to be able to put together the argument, irrespective of whether it is leave it alone, here is where people are, and here are other factors, or change it, here is what the impacts are going to be. Part of our requirements are to have a backfit analysis, a regulatory analysis that looks at benefits and impacts in quantitative measures as much as possible.

So part of what we are doing is looking for the data. And that is separate from a requirement to have a sound scientific basis for the proposal as well.

MS. MARKUS: Thank you.

MR. HODGKINS: Okay. Are you sort of standing by the microphone?

(Laughter)

MR. MITCHELL: Thank you. Chad Mitchell,

U.S. Navy, Bureau of Medicine and Surgery. So great discussion here. Everybody has hit all of the points that I was hoping to -- going to -- that would get hit this afternoon.

The Navy possesses the assets that are contained in this room already, so we are already a microcosm of the situations you are describing. So I want to make sure no one walks away with the understanding of, well, I heard a radiographer guy say that they get one or two, or I heard the power industry say that they stay below two, because the Navy has those assets.

And, yes, we do stay below two rem on all of them very easily. The highest exposures in the Navy are medical, and, very specifically, they are the interventionalists we have been talking about.

So just to reiterate the whole discussion all over again and refocus us on the fact this is not a vulnerable population. These are well-educated, well-compensated people who are aware of the risks of what they do. And they provide a very valuable service. They have a substantially long training pipeline. It would be very difficult to replace them.

So, trust me, those are the highest exposures you are going to find.

MR. HODGKINS: Thank you. Comments from the panel? Don?

DR. COOL: I think it's time to start working through some of the questions, some of which I think we have touched and some of which perhaps we will want to say a little bit more. And before I actually change the one on the screen, I am going to pose a question to you which is not on your slides, and which will inevitably get me in trouble, but I'm going to do it anyway.

There has been a high degree of consistency in people saying we should leave the dose limit at five rem. Okay? All well and good. A number of people saying there is no scientific basis that is associated with that change. Okay? I understand the statement.

If you were to now write the paragraph that describes why that is appropriate, given the change in radiation risk that underlies the current Part 20 to the radiation risk which underlies the more recent recommendations -- that is one times 10^{-4} per rem, or one per sievert, to five per sievert, five times 10^{-4} per rem, what would you say?

Because one of the things, again, that we will have to do is present a case, and one of the

arguments that has already been presented to the agency is there is a scientific basis. It was so long ago you have forgotten. How would you write that answer?

MR. HODGKINS: And let's start with the panelists, and then we will open it up to -- no. You know what? Let's start with the audience.

(Laughter)

Carol put her knitting down.

(Laughter)

She is knitting a scarf. We are so --

MS. MARKUS: My grandchildren are being deprived.

(Laughter)

Well, the first thing you have to look at I think are where these numbers come from, the one point something times 10^{-4}, the five times 10 to the -- it comes from high-dose rate, high-dose survivors of the atomic bomb. We are talking about low-dose rate, low-dose people. I consider five and below low dose. And I don't think there is a great deal of scientific validity to these estimates to begin with.

Number two, we have had multiple studies of radiation workers, studies of people working on nuclear submarines. If anything at all, we show

decreased rates of carcinogenesis in these populations, not the theoretical increase that the LNT would suppose.

So without a database to really support the science, I don't really think that the change in estimates that occurred because of a change in the estimates of radiation from the bomb are very important. I could start with a paragraph like that, Don.

(Laughter)

MR. HODGKINS: All right.

DR. COOL: Recognize once upon a time Dr. Markus was actually a consultant, was actually having to help us write some of these paragraphs.

(Laughter)

We still know where you are, Carol.

(Laughter)

MR. HODGKINS: George?

DR. SEGALL: I would include in that paragraph that one of the strategies to lower occupational dose is to share that dose with more radiation workers, and that this doesn't reduce population risk for cancer.

MR. HODGKINS: Colin, you were just going to --

MR. DIMOCK: I would also look at ICRP-103 and quote in there where it says that they recognize that LNT is not necessarily a proven thing, but they are using it effectively for convenience.

MR. HODGKINS: For --

MR. DIMOCK: In this paragraph.

MR. HODGKINS: Okay. Don?

DR. MILLER: I would add that if you lower the dose limit, you will increase the cost of constructing health facilities, you will increase the cost of operating health facilities, and you will decrease the availability of certain kinds of medical care to the population of the United States.

MR. HODGKINS: Scott?

MR. CARGILL: Actually, I would start off -- start your paragraph with this thought before I even put pen to paper. What is the definition of one curie? And let me ask you this --

DR. COOL: A gram of radium.

MR. CARGILL: -- how did Madame Curie count 37 billion disintegrations in a second without supercomputer? We are basing this -- our entire radiation protection program is based on, as Carol is saying, data from World War II. Nowadays we are getting some data out of Chernobyl. Those are really

our only data points other than nuclear testing and our guys out in the trenches when they let them off. I mean, how many people have volunteered, here, go ahead and hit me with five R a day and let's see what happens?

So to start off with, how sound is our science? How much of it is just taken for granted?

MR. HODGKINS: Panelists? Go for it, Chuck. I see you being tentative.

MR. PICKERING: Yes. I think the -- we have strong evidence to show that most of what I'm hearing is we are in and around that two R range. We are not talking about too many people at five, because our practices that we employ every day are working.

MR. HODGKINS: Okay. Anybody else from the audience want to help -- oh, Leonard, do you want to write the letter?

MR. SMITH: No.

(Laughter)

But I would like to make a comment. Don, you were comparing risk estimates that were made 30 or so years ago, and if you actually look at the errors on those risk estimates back then they are way broader now than the modern method of evaluating those risks.

And I think you will find the top end of

that range is -- was actually no -- really no different than what you have now. So the -- one could argue that there has not been really an increase in risk estimates over that period.

MR. HODGKINS: Okay. Back to the audience, as far as can you add to this letter that -- or statement that Don is trying to create? Yes, excellent.

MS. BLOOMER: Okay. Well, I can't even tell if it's on. Rather than adding to the -- to the paragraph, there seem to be a larger number of larger institutions that are here. And I don't know what the demographics were when you were in headquarters, but I would caution you to make sure, before you write that paragraph, that you get input from a lot of the smaller entities that are out there, where changing to B or C could potentially cause great harm to them and their ability to maintain their industry the way they see it.

There are a lot of Mom and Pop operations, radiographies, doctors with just small practices that I don't see represented here, and the impact, especially 2B, could have on them could be substantial.

MR. HODGKINS: You are?

MS. BLOOMER: I'm sorry. Tammy --

DR. COOL: For the record.

MS. BLOOMER: You knew who I was.

DR. COOL: I know who you are, but our poor transcriptionist does not.

MS. BLOOMER: Tammy Bloomer, NRC, Region III.

MR. HODGKINS: Tammy, you know, you made the statement you've got to go ask these Mom and Pops places. I'm going to guess that you have a sense of what they are going to tell us. And so short of representing them, what is your speculation as to how it is going to impact them?

MS. BLOOMER: Was that a short joke?

MR. HODGKINS: Was that a short joke? No.

(Laughter)

MS. BLOOMER: And it's all anecdotal, but I would -- we have had a little bit of practice with smaller operations implementing things like NSTS, where they have to go in electronically and deal with databases that we have asked to have maintained nationally. And they have chosen either -- they have either chosen or have no capabilities to do that electronically.

So if you put in an electronic system that

they have to check to make sure that somebody isn't over their 10-year or their -- yes, their five-year range, you are going to have problems. And they are going to tell you that they are not going to be able to do that.

Additionally, if you decrease to two rem, and then they have much smaller ALARA programs in many cases, if at all, there is the potential that you will -- they will not be able to maintain that. So with the number of fines and issues associated with inspection, they are going to have -- they are going to be put out of business, is what I think they would tell you.

MR. HODGKINS: Okay. Thank you.

How about the panelists? Because what she is saying is, can you advocate for someone that may not be in your own situation, but situations that you have heard that listening to what you have said so far today, that you could take on with some reasonable, you know, amount of authority, or even, as you have called it I think anecdotally, how they might react to these kind of things? So I want you to broaden your representation.

MR. CARGILL: Well, it has actually been said already. On the medical side, it is across the

board, all of our industries. Essentially, it comes down to those Mom and Pops are going to cut corners. It's an absolute guarantee. That film badge will sit in the truck, or sit on the shelf, or sit on the board, or whatever.

It is going -- when rate alarms came up years ago, the fear was that this rate alarm would in some way cause our radiographers to quit using their survey meters. Now, whether that has happened a lot or not, that is up to the NRC and the various states to answer, if they have found that to be, but that would be the biggest fear.

If we start putting it out there like that, these Mom and Pops have very low profit margins, they will cut corners. And I don't believe that is the goal of regulatory change.

MR. HODGKINS: Okay. George, and then --

DR. SEGALL: I think a letter should also address the ICRP recommendation for dose averaging as having huge logistical issues that would impose a huge regulatory burden on a licensee in the absence of a national registry for worker dose.

I am very concerned that the regulatory responsibility lies with the licensee, if there is no national registry, because an individual physician who

goes from employer to employer -- sorry, radiation worker, if there is no adverse impact for not being truthful in reporting, and the licensee bears the total regulatory responsibility and the enforcement penalties because an individual chooses not to disclose, I think is an undue regulatory burden.

So until we have a national registry, I think Option B, the ICRP method, is not workable in the United States.

MR. HODGKINS: Ralph?

DR. MACKINTOSH: In a previous incarnation, before I worked for a larger institution and had seven or eight staff physicists and dosimetrists, I was what they call a circuit writer, and I covered four hospitals and about eight different radiology practices all across Southern California.

And I would say that they would -- the burden would go up with the small size of the practice. Certainly, the level of compliance tends to be less at a small practice. You don't have the ability to spread out dose among multiple people, because you may only have one of each. And the economics of having to put in the latest equipment or add shielding or any of these mitigating factors will add a significant burden to these practices.

The second thing I want to say that would be in any paragraph I would start out is that we do not practice radiation safety in the United States based on any limit, any set number. We practice based on ALARA. And we all strive to make the dose as low as reasonably achievable, not under some magic number.

MR. HODGKINS: Thank you.

Don, do you think you've got the material to write your letter?

DR. COOL: I've got a start.

MR. HODGKINS: All righty.

DR. COOL: And this is the second time I am going to say this. As you spend the two hours after we finish here driving back across the L.A. freeways, or eating in the hotel, or wherever you may be, and you think of some more things, send me all those good words for the paragraph, because we are going to have to write one.

So let's go on to some of the questions that we had there just to make sure that we have touched them. I think we have touched most of them. This first one -- anticipated impacts for the dose histories -- and Ralph was just mentioning, and some others have already mentioned, the complications that would come along with anything that required a

multiple year, an average, or otherwise.

But I would ask, at this point specifically, if there is any additional thoughts that people would want to add on this question.

MR. HODGKINS: Colin?

MR. DIMOCK: So one issue I know that has come up with the UC system -- not all of them, I won't speak for them universally, but many of the UCs -- is we have been forced by our administration to abandon the collection and storage of Social Security Numbers, which is really, as I see it, the only way to effectively track these back to an individual for one-to-one mapping.

There were some issues where, out at the hospital site, Social Security Numbers escaped in mass, and the expense of that response is huge. And so they basically sent the message we are just not doing this anymore. So that is one issue that will come up if we try and do one. And that is not to say that I am against doing one.

MR. HODGKINS: Yes?

MR. BURKLIN: Well, that -- in the bank account days, my recollection is that when we tried to get histories in the past, and you right away just say -- you don't necessarily get a response. Certainly,

you may not get a timely response; there is a good chance you won't get a response -- I'll start over again.

MR. HODGKINS: All right.

MR. BURKLIN: Okay? Back when we had the bank accounts and we have to right away, for histories for someone -- because someone would come to your plant and they know they worked at a particular location, but they don't know what dose they got. So you have to now write to that location and get that dose.

That company may or may not reply to you. If they do not reply to you, then you are forced to assume conservative assumptions about the doses they may have gotten. And with the lowering of the dose, that can become all more important.

MR. HODGKINS: Okay. Analysts, anybody else? Audience? Carol? Microphone, please.

MS. MARKUS: Carol Markus, UCLA. One thing you ought to just consider is in purpose -- 20.1001, when it describes the purpose of Part 20, it says at the end, "However, nothing in this part shall be construed as limiting actions that may be necessary to protect health and safety."

So does that mean if an interventional

radiographer has an emergency patient it doesn't matter what his radiation dose is, he can just go ahead and do it?

DR. COOL: Let's hold up a mirror for views around here.

MR. HODGKINS: Comments? Yes, Donald.

DR. MILLER: I have no idea what it means, but if a patient comes to me and needs the procedure and I'm there, I'm going to do it. I consider it as a violation of the Hippocratic Oath to walk away.

MR. HODGKINS: Anybody else? Yes, Ralph.

DR. MACKINTOSH: Not necessarily an answer to that question, but to this one. I wonder, first of all, you have to have a national database or something to deal with this. But what does that do to the hiring practices and transfer from job to job practices of the individual? One, does one employer use up all of the rights to an individual who then tries to change jobs and discovers his value to his next employer is less, and, therefore, it affects his earning potential?

Or do you have people changing jobs and not reporting where they previously worked? There is a lot of issues there that have to do with mobility and what are the consequences for the individual and

his employability.

DR. COOL: That's a good question. Let me hold up the mirror again for a second, because today each individual should be being controlled to a limit of less than five rem per year. How are you doing it now? The numbers just change if you are using an average basis or something.

So how do you do that now? Because several of you have intimated that that is a problem, but we haven't actually talked about what has happened or needs to happen collectively in the radiation protection community for those individuals who work multiple places.

DR. SEGALL: George Segall. We ask for records from the individual or identification of the institution. Many times we don't get that data, so we have to make an assumption, but there is no adverse impact to the individual for not being truthful or not reporting. So we make an attempt to collect the information from the organization where the individual was training or employed, but since there is no regulatory penalty for not reporting to a subsequent employer, we often do not have the data.

MR. HODGKINS: Leonard?

MR. SMITH: It really depends on how much

room you have to operate. If you have a five rem limit, and you have individuals that are typically getting two -- say, one and a half rem a year, it -- then they can be doing multiple jobs, and it is easy to administer.

But if you now change that limit to two rem, it becomes very difficult to -- it can become impossible, and you would, in fact, be stopping them. So it is a very different situation when you are operating near the limit as opposed to way below it.

MR. HODGKINS: Bob?

MR. GREGER: Rob Greger. I think I am going to be the senior health physicist from California for this answer or this comment, because I don't think it is going to be a very popular comment. But one thing that you can do, Don, in this particular situation, when we inspect, we ask the question of whether -- if it is a situation where there is a good likelihood the person is working someplace else, we ask the licensee that question. You know, have you checked to see if this individual worked someplace else?

Now, I have to be very honest, and I don't think we have done a good job of asking that question for interventional radiologists. Well, we have asked

that question when we have some reason to suspect that the individual works in multiple locations.

But if the NRC wants to solve that problem, it seems to me that the simple way to do that is add the interventional radiologists to -- well, I guess I'm going to have to say that is crazy. I was going to say to the list of licensees that have to report annual doses. But seeing as how you don't regulate X-ray usage, you can't do that.

Okay. Well, let me -- that's good, maybe.

(Laughter)

MR. HODGKINS: You again have asked and answered your own question.

(Laughter)

MR. GREGER: It happens that way sometimes. Let me go -- because I want also to comment on Carol Markus' question or observation of the purpose of the regulations. And she raises a very good point there, because we do interpret that purpose to allow exposures to first responders, other personnel in bona fide radiation emergencies. And we don't hold them to the five rem limit today.

And there are higher numbers that are recommended limits, but there is no regulatory limit on what people can receive in a radiological

emergency.

And I had -- up to this moment had never considered that, you know, you may have a medical emergency that might fall into that area, but that certainly is a possibility.

DR. MILLER: Let me propose an illustrative example that has nothing to do with radiation. Let us suppose you come to the hospital with a severe contagious infectious disease, severe acute respiratory syndrome as, for example, the epidemic in Toronto in 2003 or whatever it is.

And you show up in the emergency room with a highly contagious, transmissible disease, and you expect to be taken care of, even though you pose a risk of injury and/or death to everyone around you, including all of the health care workers with whom you will come in contact.

As far as I know, in the United States there is no regulatory agency for germs. And so you are entitled to expect, and you do expect, and you will receive, medical care, regardless of the risk to the people providing it to you. Why is radiation any different?

MR. HODGKINS: Colin?

MR. DIMOCK: I just wanted to quickly

point out that Mr. Greger's suggestion for the NRC, which was aborted midway, because they don't handle the dose for -- is a very good solution for California, since we do track that dose here as part of California.

MR. GREGER: Yes. Unfortunately, California doesn't keep those records, though. But I guess I could amend that after a few more moments of thought, and one could find a more appropriate federal agency to mimic the NRC's collection of dose for the X-ray field for certain high-risk individuals.

MR. HODGKINS: Lynne is raising her hand now.

(Laughter)

MS. FAIROBENT: Bob, without congressional legislative change, there is not a federal agency that has the authority today over those who use that -- other radiation-producing machines. That authority only exists in the states, except for mammography. Thank you. Except for mammography.

MR. HODGKINS: Melissa?

MS. MARTIN: Well, one point I think we kind of went over was what Colin said a while ago. That is not the first time I have heard that. University of California is not unique. I have heard

that in multiple medical centers, that the administration, particularly of these larger systems, have made the decisions that we cannot track the radiation -- we cannot have the Social Security Numbers, just the tracking number.

So as soon as you eliminate that, I don't see how in the world you are going to have a federal database of people, because you have no other way to track them.

MR. HODGKINS: Okay. Comments? Holding up here, as Don would say. Yes, George.

DR. SEGALL: To rephrase what other people have said, I think it is just not a good idea to lower limits to what is the de facto limit, because it does not allow for variability in certain exigencies. In my own industry where we have a film badge that can be splashed with a radionuclide, unknownst to the worker, the readings can be quite high. But we really do not have a method to expunge that from the record.

And so we should not set a limit where that ceiling actually is right at where many workers may be. So we concentrated on how few workers went above two rem per year, and we all recognize it is less than five percent.

But it would be very important to know how

many approach that level, because if we are routinely operating at 1.8, 1.9, for a substantial number of people, then it becomes a real regulatory issue when minor situations exceed that limit.

DR. COOL: A good thought.

MR. HODGKINS: Ready to move on to --

DR. COOL: Let's -- yes. Unless there is something else, let's move on. I think the next several questions have been fairly thoroughly hashed, but I will give everyone a quick opportunity.

Anticipated impacts of the dose limits are decreased. I think we have gone around and around on that. Information about actual dose distributions. We have talked about that from a number of groups and, again, let me encourage you, if you have information about your own particular facilities that you can share with us, with all of the personally identifiable information removed, so that we aren't in that -- that will help us develop our regulatory basis and information.

George made a very good point that it is not just those above but those that are approaching. So it is the whole distribution and range which becomes important.

Potential impacts on patient care has been

addressed throughout this discussion.

This is the last one I think, and you have touched on it, but I will give people one last chance, because, in fact, we specifically were thinking what happens or should there be a more uniform reporting, because there is today the requirements for certain classes of licensees to report and other classes not.

That can be viewed as a bias for or against certain licensees. It certainly has limited our ability to make some of these analyses. It also has potential impacts, and I would invite you to take any last thrashings on that question.

MS. FAIROBENT: Don, I think -- it is Lynne Fairobent with AAPM. I think I have to almost put that in the same category as the discussions going on which aren't directly relevant to this, but the need for a national event reporting system or database in the medical field.

If NRC should require this, and if for some reason the compatibility level chosen was less than A or B, the states would not necessarily have to do this. Since we do not have a single regulator in this country, like others that have a national database, we have different challenges in the regulatory world that have to be addressed.

And, yes, it might be nice for NRC to regulate -- to put something in place like this, but, again, I go back to I think it has to be consistent and uniform and everybody would have to agree to it.

That then raises the question of, which one of the multitude of federal agencies that regulate the use of radioactive materials or machines that produce radiation is appropriate? Would they all agree to let one or the other host it? Would they agree to upload and share information that they may currently be capturing? Would the 50 states who may or may not have a variety of systems be willing or able, under their state-enabling legislation, to share that information? So I think there is a whole series of questions.

In concept, yes, I think it would be great. I'm not so sure that it is doable at -- it is always doable. We could find a way to do it. I don't know that we could it in our lifetime.

MR. HODGKINS: George?

DR. SEGALL: I think to report all occupational exposures requires a justification of the need to know all exposures. I don't think there is a regulatory need, and I think there are serious privacy issues when you collect identifiable data that can be

shared with agencies. There are many examples of when such data can be shared.

And unless there is a compelling societal need to report all exposures, as opposed to exposures that exceed limits, I believe there are privacy issues that are going to be paramount.

MR. HODGKINS: Ellen?

MS. ANDERSON: In addition to that, not only is there a cost to actually establish a national database, there also is a cost to maintain that database, and who would pay for it. Again, if it goes back to the licensees, then that will add to your bottom line. So something to think about -- the actual cost for this.

MR. HODGKINS: Okay. Anybody else? Audience? Anybody, any comments?

(No response)

That is the last question. That was a --

DR. COOL: That was the last question on the screen. Now it is the time for all of the questions that you might wish we had put up on the screen but didn't, if you have any.

MR. HODGKINS: Carol? As Carol goes to the mic, Len, do you want to take it over?

MS. MARKUS: Carol Markus, UCLA.

MR. HODGKINS: Go ahead.

MS. MARKUS: Just a quick -- I do radiation damage lawsuit consultations, have for a long time. And what I would worry about is that if the NRC set a limit at two rem, people who got doses above two rem when it was legal to get them, and got cancer because 46 percent of men and 38 percent of women are going to get cancer anyway, that this would start a whole slew of radiation damage lawsuits.

You know, I was exposed to a dose that the NRC now thinks is dangerous. And that was your fault, Westinghouse, or whatever. And they're suing. I would not like to see this.

But, in fact, NRC's regulatory limits are often looked at safety limits by the courts and by juries. And you would be opening up a Pandora's Box of radiation damage lawsuits, I fear. So I think it is something to take into account -- how a change would actually be interpreted and what that effect would be on litigation.

DR. COOL: Thank you.

MR. HODGKINS: Len?

DR. COOL: Good point.

MR. SMITH: I have a question concerning occupational dose limits, the extremity annual dose

limit, 50 rem averaged over 10 square centimeters. This was based on ICR -- NCRP recommendations, and, of course, is different from the ICRP recommendation, which is the same dose limit but averaged over maximally exposed one square centimeter.

Is the reason that we are not discussing this at all because the NRC is considering -- is intending to keep the current limit?

DR. COOL: Actually, yes. At this moment, we haven't seen or had any requests to put that on the table. There wasn't anything in the updated international recommendations that would place that on the table, because ICRP did not change it. And, in fact, we had gone through that process several years ago, because of some particular issues, and specifically gone to the NCRP for some recommendations and how to deal with those issues.

So at the moment, that is not specifically on the table. But let me use that to raise a question for people to think about. Not related to extremity dose, but related to Len's dose, dose to the eye. Okay? That is another value which, in the ICRP recommendation, has not changed yet. And I say that because the ICRP is currently looking at the data that is available, because there is a considerable body of

data that suggests that cataracts' opacities are occurring at dose levels lower than previously thought, and that, in fact, rather than being a deterministic, as in either cataract or no cataract, when you exceed a certain total dose number, that it may be more of a stochastic effect like cancer, with increasing probability of opacity to the lens of the eye.

Now, what I do not know is whether the ICRP Main Commission, in their meeting last week, received an updated report from their committee that looks at these issues, and whether there is any information forthcoming that might put something on the table.

I understand that the Main Commission is considering revising its recommendation. I don't know exactly what it will be. No one will quite say, although several people have speculated that it would move from the 15 rem to five rem. And I place that on the table, one, for your awareness, and, two, for any reaction at this moment, because if that occurs over the next year or so, as it might well, it would be in a timeframe when it could be considered as we continue to develop recommendations for our Commission.

MR. HODGKINS: Donald?

DR. MILLER: Just a point of information. This has been looked at relatively recently by the International Atomic Energy Agency, which is running a research study called RELID. I forget what it stands for. And they have run a number of studies on various continents looking at radiation dose -- I'm sorry, at possible cataract changes in interventional cardiologists, nurses and interventional cardiology suites.

And the most recent one was from Malaysia. The previous one I think was from South America. And they have demonstrated an unequivocal increase in the prevalence of cataracts in interventional cardiologists and nurses compared to age and sex-matched controls.

And this -- Elsie Avanya, who is the chair, Professor Avanya, who is the chair of Committee C3, the ICRP, is well aware of these findings, is involved in them, and he is -- was at this meeting last week, and I'm sure that he has conveyed this information to the Main Commission.

But, as with Don, I have no idea what conclusion they have drawn from that or what they are going to do, but I highly suspect that the limit will be lowered, and probably dramatically lowered.

MR. HODGKINS: Other comments?

MR. SMITH: Don, I see a problem with the technology, the dosimetry technology. My understanding is that monitoring a dose through a lens of the eye is problematic when you are dealing with high energy beta emitters, where people are inadvertently exposed to them.

And I believe the processors have quite a problem getting the dose right. See, it is not a problem when you are operating at 15 rem. But if you reduce to five rem, you are going to run more and more into that problem.

MR. HODGKINS: Anybody else? Comments, concerns, questions, retributions?

(Laughter)

DR. COOL: Yes. At this point, we are having a bit of competition. It sounds an awful lot like the guy down in South America who announces soccer games. I am waiting for the goal.

(Laughter)

Rich?

MR. BURKLIN: Yes. Don, statements were made about protecting the privacy of those people who are not on a national tracking system right now. However, there is a ton of us that do send in -- that

do send in NRC-4 forms -- NRC-5 forms with Social Security Numbers.

I know that other identifications can be used -- for instance, I have checked and you can use driver's license numbers, which would not necessarily be unique. Is the NRC doing anything with respect to that concern of privacy?

DR. COOL: I don't know specifically. I know that the database is secure, limited, specific access, authorization access, and otherwise, to protect the Privacy Act information, as all federal agency systems are, and we know that all of the federal agency systems do a perfect job in protecting all of the information.

I don't know whether there has been any recent examination by the contractor for any changes associated with that collection. I don't believe there has been.

MR. HODGKINS: So I have a question that, if you would allow a layperson to ask you, is that, you know, you talked a lot today about the science, yet some of the conversation that got started was -- and I think, George, you kind of did an anecdote, you know, where you speculated that two people would increase versus one, and that is not based in science,

that is based in kind of your intuition, as a scientist. Observation, okay?

So can the only thing that impacts our discussion today be science, or can it be observation? Because you seem to, you know, kind of let go of observation, and you just want the facts. Yes?

DR. SEGALL: Medicine is facing this issue right now, and there is an increasing demand for evidence. But evidence is very difficult to gather -- good evidence. And I believe that the consensus of expert opinion is a reasonable substitute when evidence does not exist.

MR. HODGKINS: So are there examples that you saw here today where a reasonable amount of people are gathered that would be considered experts that you wouldn't need the data to support it? I would be curious to see what the panel thinks about that.

(No response)

Or not.

(Laughter)

Carol? Put her knitting down again.

MS. MARKUS: Carol Markus, UCLA. We don't really need to provide the NRC evidence that a five rem limit is safe. The NRC needs to provide us with evidence that it is not. So I think you have to kind

of look at the negative half of the question that you asked.

MR. HODGKINS: Okay.

MS. MARKUS: The NRC has not provided us with a good set of incontrovertible data showing that there is a significant risk at five rem that justifies reducing dose. Its only reason for doing this is to be just like everybody else, or what they think is everybody else, which isn't to many of us an appropriate reason.

MR. HODGKINS: But doesn't it, then, respond to George's -- how did you say it, George? A reasonable amount of people, scientific?

DR. SEGALL: A consensus of experts.

MR. HODGKINS: So that --

DR. SEGALL: I think we have achieved that remarkable consensus here.

MR. HODGKINS: But the consensus of experts outside of the United States differs.

MR. CARGILL: Yes.

MR. HODGKINS: They're wrong and we're right.

MR. CARGILL: Yes, but --

MS. MARKUS: I think we are right in America. What they do in Europe is their problem.

They have a different level of medical care there. We would not be happy with it.

MR. HODGKINS: Yes. Scott?

MR. CARGILL: Essentially, what -- Carol is hitting it right on the head. You are comparing the United States, which is, what, the second, third largest entity in the world, to 50 states that -- or 50 countries that sit inside of Texas? We are talking completely different microcosms here.

MR. HODGKINS: Okay.

MR. CARGILL: I agree with George. We have an assembly of experts. I believe we all agree that changing it just for the fun of changing it is obviously the wrong approach.

But we all also need to recognize the NRC's position here. They are being asked -- staff is being asked to present reasonable cause not to do what the international community is asking them to do. So we are being asked to provide Don here and his associates with the ammunition to go back and say, "We feel we have done enough. We don't need to do no more."

MR. HODGKINS: Okay. Donald?

DR. MILLER: I think we haven't achieved consensus. I think we have achieved unanimity. I

haven't heard a single dissenting voice, and I think that is a very strong statement in and of itself, considering that the NRC has invited us all here today.

Also, while we have not presented perhaps reams of evidence, we weren't asked -- we were asked to present ourselves and not make presentations, but provide our own expert opinions, which we have done. We have also given you some evidence, people have shown you graphs and gone through their own databases and cited the literature, and so on.

MR. HODGKINS: Thank you. Leonard?

MR. SMITH: Yes. I wanted to say a similar thing. I mean, there is a lot of data that we have that we could potentially produce to show what happens when you constrain people, a group of people, at a lower dose level.

And there was a time when we were working on cyclotrons, for example, where probably two-thirds of the work was done by these less skilled people. And we had a lot of information back in those days on how much unnecessary dose they had gotten, and how the collective dose went up very greatly.

So we have referred to the study that we did, the survey that we did for the NCRP. That was

partially based on actual evidence from previous years, and then the speculation of what would happen if there was a reduction in dose at that particular time.

So we do have that past evidence there. And I say "past," I mean, there are ongoing operations where health physicists might do a study around it. And they have a skilled person do the operation, it is a routine operation, and he is away on vacation, and they get a less skilled person to come in and do it. And it is amazing what a difference that makes.

MR. HODGKINS: Okay. Well, thank you for indulging me.

Don, do you want to wrap up, and then I will take over, or do you want me to -- yes.

MR. ANDERSEN: Yes, I would just like to make one final comment. Ralph Andersen with NEI. I wanted to reflect on a comment that Dr. Markus made.

As a matter of regulatory process -- and correct me if I'm wrong -- inevitably any decision to change the limit will in fact be a backfit. Certainly, it is a change in regulatory position. I think it is pretty hard to dispute that it is not. It is obvious on the face of it, which merely means that you would have to do a backfit analysis if you intend

that it will apply to existing licensees.

And, again, you will have to help me out here. I know we have a backfit provision for reactors. Are there similar provisions for other types of licensees?

DR. COOL: There are for fuel cycle. There is not for byproduct material.

MR. ANDERSEN: Okay. So at a minimum, you would need to demonstrate a substantial benefit to health and safety to implement the rule, however you got there, as a policy decision, as a matter of process.

So I would suggest that in the information gathering, perhaps in the Texas workshop or perhaps tomorrow or perhaps under the rubric of other business, you should make sure that you are collecting the explicit information that you are going to need to perform that analysis, because inevitably you will need to perform it if you go forward with the change.

I would also contend, by the way, that the imposition of constraints, or even the change in methodology, in fact are backfits. Those were conclusion -- the change in methodology was a conclusion reached in the previous change to Part 20, if I'm not mistaken, that it was a backfit and there

was a need to justify Part 20 as a backfit.

So I would just comment, for the rest of you that wouldn't be familiar with those, NRC has specific provisions in its regulations that spell out a procedure by which NRC has to justify making such a change. And if they can't justify it, they can make the change.

MS. FAIROBENT: Yes. Lynne Fairobent with AAPM. I just want to make a couple of final comments, too. I agree with everything that Ralph just said regarding the backfit analysis, but also we need to consider that, you know, in the U.S. we don't live in isolation.

We are in a global economy. There are a number of categories of licensees who are not necessarily around this table today who routinely have to deal with import/export. For them, the cost of maintaining two systems, two recordkeeping -- and I think Richard mentioned this from AREVA -- is a cost of doing business to them. That may be a negative cost for them.

So we do have to keep that in mind. I think also that as the U.S. -- and I can't remember who it was that mentioned it at the D.C. workshop -- it might have been Michael Boyd from EPA -- certainly

can go back in and look at the transcript when it's posted, but the comment made is the U.S. advocates certain positions on the international community basis, and we look to perhaps buy into the IAEA basic safety series standards.

We are certainly a member state for ICRP recommendations, and we look at standards internationally for consistency, and yet we sit here and perhaps our own rules we are advocating that for some reason should be different.

I am not saying I agree with it, but I think when we look at the whole political climate, of which the rulemaking and the regulatory process also lives in, it is not just a U.S.-based focus. So I think those are a couple of things that we need to keep in mind.

MR. HODGKINS: Rob?

MR. GREGER: Okay. Rob Greger, State of California this time. We have got two problems in keeping the five -- at least two problems in keeping the five rem dose limit. One is the factor of four increase in radiation risk. That is on the table. You know, whether one wants to dispute it or not, it's there.

And the second one is the lower dose

limits from -- recommended by ICRP and used in a lot of portions of the world. It seems that there may be a solution that recognizes that the vast majority of our licensed work and occupational workers don't exceed two rem. But there are certain members of the community, particularly the medical community, where people do exceed two rem on a relatively frequent basis, and perhaps with good justification to do so from an overall safety standpoint.

And so maybe the -- I hope I don't answer my own question and --

(Laughter)

-- blow myself out of the water here while I am talking, but, you know, maybe the answer is a dose constraint of two rem with a couple of hoops to jump through to exceed that but with, you know, those hoops being defined and maybe the most you do is, you know, get approval of someone maybe within your organization and then maybe report it to your regulatory agency.

You know, that way we would be able to have a good knowledge level of the degree to which the two rem criteria constraint is exceeded, still maintain the five rem overall dose limit, but come close to addressing the other two issues by showing

that we don't have very many people exceeding the two rem limit, and that we are well aware of the people that do exceed it.

MR. HODGKINS: Thank you very much.

Any comments on that? Reactions?

(No response)

I think we have -- someone from the audience would like to say something.

MR. TAKAHASHI: The five or two rem dose is sort of a risk-based idea, and so that if we are going to reduce the dose as a -- sort of a quasi-regulatory side, what is the justification? I mean, Carol was talking about cancer induction in the population, and she was saying somewhere between 30 to 40 percent, if you live long enough. I use 20 to 25 percent, if you live long enough, you are going to get cancer.

And so if you look at one or five times 10^{-4} per rem, and we are going from five to two, you know, we are looking at hundredth or a tenth of a percent of more cancers. And so how do we justify that burden of reducing it?

And especially in the medical field. If we are seeing that kind of procedures that are complicated, and Stanford has a very -- you know, some

of their procedures are fairly complicated because they are the medical center in the Bay area. And, therefore, why do you want to restrict or, you know, constrain them by reducing the dose from five to two?

MR. HODGKINS: Chuck, did you want to add?

MR. PICKERING: Yes. I was going to agree, again, with Rob. I totally agree that that is probably a good way to go -- keep the five, build in constraints at two-ish. I think that is well in the spirit of it, and to me that is alignment.

MR. HODGKINS: Lynne?

MS. FAIROBENT: I don't really want to get into the debate on the issues of constraint. But it is a great lead-in to tomorrow's discussion.

And, Don, just in the morning remind me that I have real heartburn on it, in case I forget.

DR. COOL: Like you would --

MS. FAIROBENT: Otherwise, we are not going to get out of here in the next five minutes.

(Laughter)

DR. COOL: Somehow I can't quite imagine, Lynne, that you are going to forget that. But I will be pleased to remind you, should you somehow forget.

Let me do a quick synopsis, then, as we did -- as we did before. This has been a fantastic

discussion throughout all of the afternoon. Clearly, there is a lot of people who are in agreement that they would like to see the dose limit left as it is. There has been a variety of reasons that have been put forward on the record.

I am not going to try and capture all of them, but it impacts in a number of areas. Certainly, the various interventional areas have been mentioned, some radiography and other things, large economic burdens associated with making some of those changes, implications that it could result in more people doing things that they shouldn't support in terms of non-compliance because of the perception that it would impact their ability to do different things, a view on the science that the change in risk was not seen by a number of you as being a credible basis upon which any change could be justified, a number of issues associated with averaging or other dose recordkeeping, dose databases and things, a view expressed by a number of people that the whole ALARA process/safety culture process is really where protection is at.

And we just finished with a discussion here about constraints as one possible tool in that, and that will be one of the key things that we will want to engage on tomorrow. I am going to invite

everybody to think a lot about that, because we will have a good opportunity to do that tomorrow.

Some issues raised with regards to -- and I use the word "transient worker," because that is the word that tends to get used in the reactor industry. But the whole multiple location, working for multiple licensees, even at the same time, has been brought up in a number of places. So it has been a very robust discussion. It has been incredibly useful for us.

Let me use this as a plug, once again, for those of you who may have some data information to take the opportunity post-meeting to send that to us on the record so we have that available to work on our assessment.

And I would be remiss if I didn't remind everybody, leading into what Dan is going to -- you've got it, so I'm going to let you do it, Dan.

MR. HODGKINS: Okay. First of all, two things on your table. One is the speaker list, the panel list, so you do have everybody's name, address, and phone number, should you want to personally follow up after this meeting.

And the second piece of paper is the evaluation. It is really important for us to get the evaluations from this meeting. We have changed the

process from the previous meeting to today, and so part of what we just did is summed up the content. And so what I would like the panelists to do is talk about the process, is this a comfortable process for you, or are there some things that you would like to see changed for tomorrow? Okay.

And I'm going to ask the panelists just to do a round robin real quick. Ralph?

DR. MACKINTOSH: I'm happy.

MR. HODGKINS: Happy? Went exceedingly well. Happy. Terrific. Excellent.

(Laughter)

God, you guys. Okay. Good. Good. All right. Well done. Good.

Now, audience, too, I mean, as far as do you feel like you got enough time to say what you wanted to say? We will give it to the guy at the microphone.

MR. PEDERSEN: No. I was going to wait until you got done with this process. I just wanted to remind Don of something, but since I've got the microphone in my face right now -- you have asked several times to provide information outside of this particular format. You might want to tell them the preferred method of providing that information, so it

all doesn't show up in your e-mail account.

(Laughter)

DR. COOL: Do not send it to my personal e-mail account, although I will send it to the right place if you do. I put an e-mail address on the slide earlier. It's in your slide set -- rgs4rp@nrc.gov. But you each have copies of the Federal Register notice, which has about four different methods. None of them are necessarily preferred. They will all get on the record.

But thank you, Roger. That's a good reminder.

MR. HODGKINS: With that said, good meeting today. We will continue, then, tomorrow. Please think about questions, comments, concerns, constraints, for tomorrow's meeting.

You are adjourned almost promptly at 5:00. Is it 5:00? Early?

(Whereupon, at 4:42 p.m., the proceedings in the foregoing matter were adjourned, to reconvene at 8:30 a.m., the following day.)