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UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

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ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

(ACRS)

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RADIATION PROTECTION AND NUCLEAR MATERIALS

SUBCOMMITTEE

+ + + + +

WEDNESDAY

AUGUST 18, 2021

+ + + + +

The Subcommittee met via Video Teleconference, at 9:30 a.m. EDT, Ron Ballinger, Chairman, presiding.

COMMITTEE MEMBERS:

RONALD G. BALLINGER, Chair

VICKI BIER, Member

CHARLES H. BROWN, JR. Member

GREG HALNON, Member

WALTER L. KIRCHNER, Member

JOSE MARCH-LEUBA, Member

JOY L. REMPE, Member

MATTHEW W. SUNSERI, Member

ACRS CONSULTANT:

STEVE SCHULTZ

DESIGNATED FEDERAL OFFICIAL:

CHRISTOPHER BROWN

ALSO PRESENT:

STEVEN GARRY, NRR

SCOTT MOORE, Executive Director, ACRS

JENNIFER WHITMAN, NRR

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P R O C E E D I N G S

9:30 a.m.

CHAIR BALLINGER: Good morning, everyone. The meeting will now come to order.

This is a meeting of the Radiation Protection and Nuclear Materials Subcommittee of the Advisory Committee on Reactor Safeguards. I'm Ron Ballinger, Chairman of today's Subcommittee meeting.

ACRS members present are Charles Brown, Greg Halnon, Jose March-Leuba, Walt Kirchner, Joy Rempe, and our consultant, Steve Schultz. If I've missed anybody, please let me know, but I think I have everybody.

During today's meeting, the Subcommittee will discuss Draft Regulatory Guide DG-1377, Measuring, Evaluating, and Reporting Radioactive Material in Liquid and Gaseous Effluents and Solid Waste, Revision 3, which is Revision 3 of Regulatory Guide 1.21. The Subcommittee will hear presentations by and hold discussions with the NRC staff from NRR and other interested persons regarding this matter.

The rules for participation in all ACRS meetings, including today's, were announced in The Federal Register on June 13th, 2019.

The ACRS section of the U.S. NRC public

website provides our Charter, Bylaws, agendas, letter reports, and full transcripts of all full and subcommittee meetings, including slides presented there.

The meeting notice and agenda for this meeting were posted there. We have received no written statements or requests to make an oral statement from the public.

The Subcommittee will gather information, analyze relevant issues and facts, and formulate proposed positions and actions, as appropriate, for deliberation by the full Committee.

The rules for participation in today's meeting have been announced as part of the notice of this meeting previously published in The Federal Register.

A transcript of the meeting is being kept and will be made available, as stated in The Federal Register notice.

Due to the COVID pandemic, today's meeting is being held over Microsoft Teams for ACRS and the NRC staff. There is also an MS Teams telephone bridge line allowing participation of the public.

When addressing the Subcommittee, the participants should, first, identify themselves and

speak with sufficient clarity and volume, so that they may be readily heard. When not speaking, we request that participants mute your computer microphone or phone.

We will now proceed with the meeting, and I would like to start by calling on -- let's see, Jennifer Whitman is, I hope, here.

MS. WHITMAN: Yes.

CHAIR BALLINGER: Jennifer, are you here?

MS. WHITMAN: I am here.

Good morning, Mr. Chairman and Members of the ACRS.

Can you not hear me?

CHAIR BALLINGER: Jennifer, are you here?

MS. WHITMAN: I am here.

MR. BROWN: I'm going to call Ron.

CHAIR BALLINGER: Yes, she is.

MS. WHITMAN: All right. Can you hear now?

CHAIR BALLINGER: I'm going to call on Jennifer Whitman, Acting Deputy Division Director, NRR/DRA, for opening remarks.

So, Jennifer, the floor is yours.

MS. WHITMAN: Okay. Can everybody hear me now?

MR. ROCHE-RIVERA: Yes, we can.

MS. WHITMAN: All right. So, good morning, Chairman and Members of the ACRS. I'm Jennifer Whitman, the Acting --

CHAIR BALLINGER: Hello. Yes.

MS. WHITMAN: -- Deputy Director of the Division of Risk Assessment in NRR. I want to thank you all for allowing us to present to you today the changes we've proposed as Revision 3 to Reg Guide 1.21, Measuring, Evaluating, and Reporting Radioactive Material in Liquid and Gaseous Effluents and Solid Waste.

The Division of Risk Assessment has the technical lead for the Agency in the areas of radiation protection and radioactive consequence analysis. Our staff develops and updates guidance documents, performs technical reviews of licensing applications, and oversees the implementation of the reactor oversight process in the radiation safety areas. DRA staff provides guidance and support to our regional inspection staff in addressing complex radiation safety technical and policy issues.

And Reg Guide 1.21 was last updated nearly 12 years ago, and our staff identified a need to bring our guidance up-to-date with current standards and

practices. So, today, you'll hear from the staff how the updates to the Reg Guide provide detailed guidance on how to meet NRC radioactive effluent control program requirements and how we addressed the public comments that were received on the draft when we published it for public comment.

Now, I'll introduce the technical lead for this Reg Guide revision, Steve Garry. He's a Senior HP in DRA in NRR and has been with the NRC since 2006. He has more than 25 years of experience in HP work, including work at several nuclear power plants. And while Steve was the lead for this project, I want to note and thank the many other HPs in NRR, NMSS, Research, and the Regions that have supported this Reg Guide update.

We're looking forward to answering any of your questions that you may have. And with that, I will turn it over to Steve.

MR. GARRY: Okay. Thank you, Jennifer.

Yes, welcome, everyone, and thank you for the opportunity to kind of showcase our radioactive effluent and environmental monitoring programs.

As Jennifer said, this is Revision of Reg Guide 1.21. This will be Revision 3. Revision 2 was issued in 2009.

And with that, we'll go to the next slide, Mike.

Okay. So, what we're going to talk about today, we're going to talk about the purpose of Reg Guide 1.21. We're going to review the effluent regulations, the effluent Tech Specs, the effluent reports that are submitted by the licensees, the analysis of those reports generated into effluent trends, and then, we're going to discuss important changes to the Reg Guide. And then, we're going to discuss the resolution of public comments, as time permits.

Next slide.

Okay. So, the purpose of Reg Guide 1.21 is, as the title says, measuring, which means that the plant has the requirements to measure the radioactive effluents, to evaluate the impact of those effluents, and to report the amount of radioactivity that's discharged in liquid and gaseous effluents.

In addition, we're going to discuss the reporting of solid rad waste shipments, and then, finally, we're going to discuss the assessment and reporting of public dose as a result of the release of those effluents.

Next slide.

Okay. We use a risk-informed, performance-based approach in this. We started that back in 2009. The regulations talk about principal radionuclides. And in 2009, those principal radionuclides were identified as those radionuclides that contribute more than 1 percent of the dose or 1 percent of the total activity released.

We offer the aspect that the licensees can select their lower limits of detection. And there are acronyms at the end of this slide, if anyone would like those, or please feel free to speak up and I will explain any acronym. LLD is the lower limit of detection; in other words, how sensitive the instruments are to be able to measure the radioactivity.

And there's, basically, two criteria for that. There's the original LLDs that the NRC issued back 30 years ago, all of the more updated MARLAP system of determining lower limits of detection. And briefly, MARLAP is the Multi-Agency Radiation Laboratory Accreditation Protocols, which basically originate or use the concept of a data quality objective. In other words, what are you trying to do with this measurement? And based on what you're trying to do with it, that kind of drives how

sensitive your instruments need to be to achieve that objective.

We incorporate the risk-informed decisionmaking on residual radioactivity. And basically, what we're saying there is that if there's a leak or a spill or some residual radioactivity on the site, that the licensee should do an evaluation of the risk involved with cleaning up that residual activity.

CHAIR BALLINGER: This is Ron Ballinger. I'm sorry, I was "Lenovo'ed" originally with my computer.

But, in looking at this, is there any risk of what I would call creeping sensitivity, where instrumentation sensitivity becomes better with time? And is there any risk of the licensees being racheted by this?

MR. GARRY: No, because they're allowed to use -- you know, a Reg Guide is one acceptable method. Other methods are acceptable, but a Reg Guide provides acceptable methods. And if licensees want to use a different method, they're allowed to do that. They just need to have a good technical basis for that.

And we're actually offering more flexibility by offering the selection of the LLDs

based on more current guidance given in MARLAP.

CHAIR BALLINGER: Thank you

MEMBER KIRCHNER: Ron, this is Walt Kirchner.

CHAIR BALLINGER: Yes?

MEMBER KIRCHNER: I was going to ask the same question, too. And I'll construct an analogy. About a decade or so ago, I was much involved in the Great Lakes and water quality standards. And what evolved over time was that the capability of the measuring technology just increased and increased. That was all for the better. But it did result, Ron, in just what you're proposing or supposing. And that is that one started getting at detection levels that set limits for releases that were well below what naturally occurred in the Great Lakes, notwithstanding the pollutants, and so on and so forth. And then, you had -- how should I say? -- a situation where the technology was driving the regulatory system to standards that were, basically, in some cases perhaps not achievable.

CHAIR BALLINGER: Yes, I think I would agree with that. I mean, I think Joy would probably chime in, because I think something similar to that is happening at Fukushima.

MS. WHITMAN: This is Jennifer Whitman.

I'd ask that we let Steve continue because he does discuss the regulations, and we're aren't changing the regulations and that's where the limits are derived from. And so, if we let him continue through, I think you'll see that, with no changes to the regulations, I don't think what you're talking about will be a concern.

MEMBER REMPE: So, this is Joy, since my name was mentioned.

As you go forward, when I looked at the Reg Guide and slides, there's very little discussion about the amount of tritium that's released, the limits on that. And if you could discuss a little bit about how you selected your limits for the amount of tritium in releasable water, I would appreciate it. And also, if you considered what is being done internationally with other plants, because that is the biggest concern with what Ron is mentioning, with the water that's been released and how the Japanese are dealing with it. The other isotopes they've taken care of. Okay?

CHAIR BALLINGER: In deference to the staff, they actually in the Reg Guide use tritium as an example of activity versus does, which is

important.

MEMBER REMPE: Right.

MR. GARRY: Yes, tritium is actually fairly easy to detect. You can use liquid scintillation counting and get down to something like 500 picocuries per liter pretty easily. With advanced techniques, you can go lower. But we don't drive them lower and lower on that. We have an LLD that was established back in the late 1970s of 10,000 and 20,000 and 30,000 picocuries per liter. You know, the EPA Drinking Water Standard is 20,000 picocuries per liter.

MEMBER REMPE: That's the point I wanted to get to. So, I'm glad you mentioned that, because EPA actually has a very limiting value. And they thought about that they could raise it, is my understanding, and they left it at the 20,000 picocuries per liter. And I just am wondering how the NRC compares to what EPA is requiring, and was that thought about much in your preparation of this Reg Guide update?

MR. GARRY: No, because we stayed with the standard that was set back in the late '70s, which is 20,000 and 30,000 picocuries per liter for environmental monitoring.

MEMBER REMPE: Okay. Because, yes, the EPA actually acknowledged that they could have gone higher and they left at 20,000. But I just was curious if you thought about increasing things at all, but I guess you didn't?

MR. GARRY: Well, we're trying to provide stability as much as we can without making the licensees rachet back and forth to different values, and so forth. And the 20,000 is, obviously, the EPA Drinking Water Standard. So, my thought is that there really is no need to drive that --

MEMBER REMPE: Oh, we definitely don't want to go lower, but, I mean, you could have gone a little higher, I guess is the question, but I guess you didn't think about doing that at all?

MR. GARRY: No, because we wanted stability, and there was no need. It's readily detectable at 20 and 30 thousand picocuries per liter. So, we don't need to drive it higher to save any costs by the licensees.

MEMBER REMPE: Thank you.

MR. GARRY: Okay. So, moving on, then, we adopted the MARSSIM, which is the federal agency Multi-Agency Radiation Survey and Site Investigation Manual data quality objectives. So, we're allowing

licensee flexibility to go review the other federal agencies' standards and reevaluate the program, if they wanted to, based on data quality objectives.

And then, with tritium leaks and spills, there's always an issue of risk communication and notification of local authorities of spills and leaks. So, that's another aspect of our risk-informed, where, basically, some jurisdictions want to know a lot about leaks and spills. Some jurisdictions don't need as much information. So, risk-informed allows them to choose when they need to be making those communications.

Next slide, please.

Okay. So, I want to briefly review our regulations. We have quite detailed regulations. Some confusion has been generated in the fact that there are two separate sections of the regulations. There's 10 CFR 50.36, and for lack of a better word, I'll call those general Tech Specs that apply to the operation of the plant with limiting conditions of operation, and so forth. And that's what people commonly refer to as Tech Specs.

But, after that section, 10 CFR 50.36, at the very end of that section, there's a new section, another section. And that section is commonly

confused, but that's because it's labeled 10 CFR 50.36a, where that "a" is not in parentheses. It's part of the title. And so, that's where the regulations requiring Tech Specs on effluents originate.

And what it says there in 10 CFR 50.36a(a) is, basically, the objective to keep the releases to unrestricted areas as low as reasonably achievable. In order to do that, each licensee and each applicant for a design certification or a manufacturing license has to include Tech Specs that, in addition to complying with the applicable provisions the dose limits -- and 10 CFR 20 is the standards for protection against radiation. Paragraph 1301 of this chapter is the dose lots. So, bottom line is, there is a regulation saying, licensees, you need Tech Specs on effluents, and they need to be incorporated in Tech Specs as part of the general Tech Specs.

Next slide, please.

So, what 10 CFR 50.36a, then, also says, that not only do you have to have Tech Specs, you have to submit a report to the Commission annually. You have to tell us the quantity of each of the principal radionuclides released to unrestricted areas in liquid and gaseous effluents in a previous 12 months. So,

there's a transparency aspect here where the licensees have to submit a report to the NRC. And I'll show you what we do with those reports.

Next slide, please.

Okay. So, let's talk about what the public dose limits are now. Now this is a very sensitive issue because this is release of radioactive material into the unrestricted area. And the consequences of those releases, then, we have a series of limits to control the dose to members of the public. The NRC establishes a highest level of 100 millirem of total effective dose equivalent, and that applies to not only nuclear power plants, but to materials licensees as well. So, that's a general high-level number that applies to any NRC licensee.

In addition to that, EPA has regulations. And in 40 CFR 190, the EPA established a limit of 25 millirem to the whole body and organs, with the exception for thyroid of 75 millirem. And again, that's the EPA high-level value.

Okay. So, under the regulations, the licensees needed to propose, and we accepted, Tech Specs. In Tech Spec 5.5.4 in the administrative section of the Tech Specs, we set the nuclear power plant annual dose criteria. And what that criteria

is, now that's not a limit, but that's a criteria. We expect them to operate within these criteria. If they don't, then we have exceptions in what they need to do. But they need to operate within the 10 CFR 50, Appendix I, ALARA design criteria.

Now, just briefly, 10 CFR 50, Appendix I, is a requirement by the NRC that, when they propose a new nuclear plant, they have to add enough rad waste processing systems to keep the doses to the members of the public as low as reasonably achievable. So, they then specify specific limits.

So, for air dose, which would be the dose at the site boundary, even if there's not a person there, it's an air dose limit of 10 millirem gamma or 20 millirem beta. And then, to locations where there are actually people, the liquid effluents can result in no more than 3 millirem total body dose or 10 millirem to any organ. And for gases, radioactive gases, there's a specific limit on iodines and particulates of 15 millirem. So, those are, call them "the operating criteria" that the plants need to meet in order to be deemed the effluents are as low as reasonably achievable.

Next slide.

Okay. Another section of the Tech Specs

lay out that licensees are required to have a radioactive effluent controls program. And it specifies that that program should be put into an offsite dose calculation manual. In other words, you can consider that a licensee procedure that says: Here's how we will control effluents. Here's how we will measure them. Here's how we will report them.

And this effluent controls program needs to conform to the regulations. 10 CFR 50.35a has to be implemented by procedures, maintain doses to the public as low as reasonably achievable, and if the program limits are exceeded, to take specific remedial actions to get back into compliance with -- not compliance -- conformance with Appendix I.

Next slide, please.

Okay. So, let's take a look at -- and this is all laid out in Tech Specs. Now I'm taking these slides from NUREG-1431, which are 10 standard Tech Specs for a Westinghouse-designed plant. So, the Tech Specs require, 554, maintain monitoring instrumentation. Okay, so the plants have requirements to keep their equipment working and to perform surveillance tests, and use set points that are calculated in accordance with the ODCM. But this program will limit the instantaneous release of

radioactive effluents to concentrations within 10 times the 10 CFR 20, Appendix B, annual average concentrations. So, they are allowed a short-term higher-level release than the annual average, but only for a short period of time. And that's based on the 10 times Appendix B.

There was a change to the NRC regulation 10 CFR 20 back in 1991 where the old public dose limits were 500 millirem. That got lowered to 100 millirem. And as a result, we had to change Tech Specs and we maintained the same level of effluent control as was there previously, in spite of the fact that the dose limits had been reduced; that the program needs to monitor, sample, and analyze liquid and gaseous effluents, as you would expect.

Next slide.

The controls program continued here, that the liquid effluents, they need to limit the public dose to 1.5 millirem per quarter or 3 millirem per year. The idea being there that, if you have a release rate early in the year, you need to get back into an averaging system to where you're going to end up at the end of the year with no more than 3 millirem to the total body.

The program requires the licensees to keep

track of the doses on a 31-day basis. And every month, they have to calculate the doses from their effluent releases and make sure they're in compliance and cumulate those doses, so that, as they go, we know where they are as they approach the end of the year. And on a monthly basis, they need to use their rad waste effluent treatment systems to keep the releases every 31 days, not to exceed more than 2 percent of Appendix I. So, we're establishing Tech Specs that are more and more stringent and more and more guaranteeing that they're going to be able to meet the design criteria at the end of the year.

Next slide, please.

Okay. For gaseous effluents, to limit the instantaneous dose rate, so if they're releasing the waste gas decay tank noble gases, the instantaneous dose rate can be no more than 500 millirem per year or, in hourly terms, .057 millirem per hour. And for iodines and particulates, the releases can be no more -- iodine and tritium and particulates, the releases can be no more dose rate than .17 millirem per hour.

Next slide, please.

So, we have the air doses then, the 5 millirem gamma and 10 millirem beta. That's the quarterly limits. The annual limits are the ones we

talked about earlier from Appendix I, 10 millirem gamma, 20 millirem beta.

The organ doses, the quarterly doses are limited to 7.5 millirem, the annual doses to 15 millirem.

And I think just to comment, back in the early days in the late '70s, or whatever you consider early days, there was a lot of concern about the release of iodine. And so, they were tracking here the quarterly and annual doses to make sure that no member of the public exceeded the ALARA criteria. And then, again, the Tech Specs require the compliance with the EPA dose limits, which rarely get challenged because the Appendix I limits are much more restrictive.

Next slide, please.

Okay. And ODCM, the Offsite Dose Calculation Manual, has to be established, implemented, and maintained. Now these ODCMs are pretty comprehensive. They're typically 2 to 5 hundred pages procedure, instructing the plant staff how to measure and do these dose calculations, and not only on effluent controls, but it also establishes the environmental monitoring program. So, they calculate the potential impact, based on the effluent release

rates, and then, they go out in the environment and they take samples and they measure the radioactive effluents that could exist out in the environment. The ODCM has all these equations, methodologies, parameters to calculate the dose, and it contains a description of what information needs to be reported to the NRC in the annual effluent and environmental reports.

Next slide, please.

Okay. So, once the licensees complete an annual cycle, they're required to submit these annual effluent and environmental reports. And they submit them annually to the NRC. The environmental report has to be reported to the NRC by May 15th, and the effluent report has to be reported to prior to May 1st.

Now what we do with these reports is we make them all publicly available. So, they're posted on our NRC public website. And here's an excerpt below. The excerpt below shows each plant with a hyperlink to their reports. So, for example, ANO-1 and -2, you could click on that link, and it will take you to their reports.

So, next slide, please.

So, here's what it looks like. This would

be the ANO annual reports. And you can see, for each calendar year, you can see what they released and what the doses from those releases are by clicking on these hyperlinks.

And similarly, the environmental reports. If you want to see the sampling and the analysis and the concentrations that are being measured in the environment, you can click on whichever year you'd like, whichever plant, and you can see this data.

Next slide, please.

So, here's a typical effluent report. It includes an introduction, supplemental information, but it has a section on gaseous effluents, liquid effluents, and solid waste. And it's got a section on doses, the radiological impact to man. And it's got a compilation of the meteorological data. Not all of them have that, but that's available in the ANO report.

Next slide, please.

And here's the annual environmental report. So, Section 3 here will cover the sampling program that tells you what samples are being collected. Typically, it's grass, milk, water, drinking water, vegetables, direct radiation. There's a whole slew, whatever they're monitoring for the

environmental program, they're describing it here.

Then, they analyze it and interpret the trends of those results and report those. And then, they put together a radiological environmental monitoring program summary. And then, they report, for example, some of the samples might get lost. Maybe the milk cow stopped milking, the garden didn't produce in the winter, whatever. If there were any deviations, they explain the justification why they had to deviate from the required program.

And then, there's the monitoring results. That will give you the concentrations of each radionuclide that's detected. And the Tech Specs require them, the ODCM requires them to do an inter-laboratory comparison result and a dosimetry comparison report.

Next slide, please.

And again, all these detailed reports are available on our website that you can look at any plant for any of the more recent years.

Okay. Once we get all those reports, we compile a summary of all those reports in this document called NUREG/CR-2907, Radioactive Effluents Summary Report from Nuclear Power Plants.

Next slide, please.

Okay. So, here's what's in this summary report. And this is a very well-designed and very explanatory discussion of what's happening. So, in the introduction, we talk about the purpose and the scope. We talk the source of the data is directly from the plants. We talk about the limitations of the data. Then, we go into a description of the data; the measuring of radioactivity in effluents; the dose units and limits; the radiation dose to the public, and other sources. And then, we get into the detail: the effluent data, the radioactive material, and liquid and gaseous effluents, short-term trends, long-terms trends, a summary reference. And again, this is all put together, essentially, as a summary report for not only NRC staff, but for the public and, also, for the plants to use to compare it to other plants.

Next slide, please.

So, you might ask, what has been the trend of the releases of radioactive effluents over the last 35 or 40 years? You can see, back in 1975, that the BWR gases were approximately 50,000 curies per year, and the current is about -- I don't know; what is that? -- it's 50 curies. And PWRs, similarly, went from about 5,000 curies down to about 1 curie.

Now this is a phenomenal decrease in the

amount of radioactive effluents by, roughly, a factor of 100 to 1,000 decrease in the amount of radioactive effluents. You can see the continuing progress that the plants have made in reducing their radioactive effluents.

You may ask, what is the cause of that; what happened? Well, there are basically two criteria for the noble gases. First of all, fuel performance. In the early days, the fuels had a lot of leakers, and when a fuel leaks, it releases noble gas into the reactor coolant system, and that ultimately has to be degassed and ultimately released. So, there were a lot of fuel leakers, so there was a lot of noble gas to deal with. Those fuel pens, the fuel engineering has improved dramatically, and the number of fuel leakers now and the foreign material control programs, and so forth, have really cleaned up the reactor coolant system gases and led to a decrease.

A second reason is the additional, especially for the BWR, the advanced off-gas systems, the charcoal delay systems that hold up these gases. Now some of these gases are very short-lived, like two hours or four hours, or so forth. So, a holdup of 5 or 10 days will do a great deal in reducing the amount of radioactivity that's released. So, a lot of credit

goes to the plants and the plant design that have added these new effluent processing systems. And that's why PWRs have a waste gas decay tank, and the BWRs have the charcoal delay systems. So, I just wanted to acknowledge the decrease by a factor of 100 to 1,000 over the last 40 years.

Next slide, please.

Similarly, liquid effluents. Look what's happened with the liquid effluents. They have decreased by, roughly, a factor of 100 to 1,000. And again, the same reasons. If the fuel is not leaking, then you don't have as many particulates to deal with. You still have activation products, but you don't have as many fission products. So, the fuel performance has led to a decrease.

In addition, the plants have added better liquid rad waste processing systems. They've gone to better resins, so that the resins will absorb these particulates before they get released. And they've gone to reverse-osmosis systems to, again, filter the release as much as you can. And as you know, tritium cannot be filtered, and it really doesn't do a lot of good to hold up tritium because it's got like a 11-year half-life. So, nevertheless, there's been a factor of 100 to 1,000 decrease as well in the liquid

effluents. So, the sophistication of the radiological effluent monitoring and control programs at the plant have really improved over the last 40 years.

Next slide, please.

CHAIR BALLINGER: This is Ron. This is Ron.

So, the clear message here is don't fail the fuel?

MR. GARRY: That's the No. 1 message, yes.

CHAIR BALLINGER: But, for comparison purposes, I think -- and my memory escapes me here -- a nuclear power plant can only result in a dose to the public which is some fraction of a number. And so, my question is, for the fleet, how do the annual releases compare, annual dose -- excuse me -- compare with the average annual dose from background radiation to the public compared to that rule limit? I think it's 1/10th?

MR. GARRY: Well, we don't have a criteria as compared to background. We have a criteria as compared to our most restrictive limit, which is the 10 CFR 50, Appendix I, criteria.

CHAIR BALLINGER: Yes, I understand that, but I guess what I'm trying to get a feeling for is the actual impact of the fleet on the annual dose that

the public would receive in any case.

MR. GARRY: Okay. Well, basically, the tritium doesn't cause very much dose. It takes a lot of tritium to cause dose, especially when you consider the fact that a lot of the tritium is released in the liquid effluents to rivers or lakes. So, when it's released to a river, it, basically, flows downstream quite quickly and you don't get a buildup in the environment. However, if they're discharging to a lake, then there is a buildup of residual tritium in that lake. And nevertheless, the licensees still need to meet the regulatory limits on doses. And we're going to discuss that in a little more detail here in a few minutes.

CHAIR BALLINGER: Thank you.

MR. GARRY: Okay. So, why do we need to revise Reg Guide 1.21? Well, first of all, we have a process called a periodic review, where we look at the existing Reg Guides that we have issued and we review them and determine if there's a need for an update. And in our review, periodic review of Reg Guide 1.21, we identified that we needed to provide an update. And there are basically six areas that were driving the need for that update.

We, one, needed to provide guidance and

acceptable methods for calibration of the accident range containment radiation monitors and the accident range effluent monitors. That guidance had been contained in an old NUREG, and we wanted to bring it forward to the current Reg Guide that would be a little more publicized.

MEMBER REMPE: So, this is Joy.

On this first one, after what happened at Fukushima, it was difficult to use the monitors because there was so much release. And so, when you think about your accident range effluent monitors, and they did say in the Reg Guide that you had to consider a core melt, do you consider what needs to be done in such extreme situations? Or how do you take into account the difference in isotopic content that might occur and the changes because, suddenly, your background's higher and to monitor additional releases? Have those types of considerations been considered?

MR. GARRY: Yes. As far as Fukushima goes, you know, that, basically, was a disaster. They lost electrical power. They didn't have monitored effluent release paths because the buildings, basically, blew up. So, the scope of that accident was far in excess of a smaller accident where the

accident range monitors would be useful, because they lost electrical power; they didn't have a monitor release path.

MEMBER REMPE: So, in your accident release -- this is, again, the Reg Guide says you consider a core melt accident -- what kind of frequency do you have for a cutoff frequency for how far down you go?

MR. GARRY: Well, I don't know how to exactly answer that. What we have is like Three Mile Island was a core melt, and in that there was a release of noble gases, and those noble gases, basically, bypassed containment. Basically, some of the gases were absorbed in the water that was on the floor. The reactor coolant drain tank overflowed to the floor of the reactor building. The sump filled out. They pumped the water over to the aux building. They have valve leakage, and so forth, that the gas came out of the water, and then, got exhausted from the auxiliary building and went past the accident range effluent monitors. So, that was a monitored release of a core melt. And that's, basically, the design of this.

Similarly, if there was a different type of accident -- let's say a LOCA -- where you have a

double-ended pipe break, or whatever, then the later is going to be released to the reactor building and the radiation is going to be released to the (audio interference), sitting there watching and monitoring. And that happened at TMI. The TMI containment high-range monitor went to about 800R per hour. So, they knew, basically, how severe the gas was in the reactor building, and they knew that the noble gas being bypassed through either the letdown system or through the containment sump was monitored as well by the aux building exhaust ventilation.

MEMBER REMPE: Now again, we're supposed to be going to a risk-based regulatory regulator, and I guess what I'm hearing is, well, we've looked at, basically, what we saw at TMI and we think we can accommodate that or design basis accidents such as the LOCA.

MR. GARRY: Right. The General Design Criteria 60 and 64, essentially, established design requirements where the plant has to have this type of instrumentation.

MEMBER HALNON: Hey, Steve, this is Greg Halnon.

Wasn't this No. 1 the subject of some industry interaction and some white findings in the

last, say, three or four or five years?

MR. GARRY: Yes. Vogtle got a white finding for their containment high-range monitor calibration.

MEMBER HALNON: Does this resolve the -- I guess I don't say "misunderstanding" -- but the lack of clarity in the industry, so it will be clear for what has to happen to present that?

MR. GARRY: Well, we gave a training course to our NRC inspectors on how to inspect the containment high-range monitor calibration. The basic mistake made at Vogtle was that they changed the calibration geometry. They had a misconception that the monitor should be checked at 17R per hour. Now, as their source decayed, they couldn't get 17R per hour. So, they mistakenly said, well, we know how to get that back up to 17R per hour; we'll just slide the source closer to the instrument. Well, when the plant does a calibration, they're really doing a calibration check, and a calibration check is, hey, is that instrument working properly? That's the real question.

So, to know if it's working properly, you have to compare it to something. And you should compare it to what the manufacturer told you was the

right comparison, the right conventionally true value. Well, Vogtle didn't do that. They didn't understand the calibration process. And so, they slid that source closer to the detector, so that they finally got it to read 17R per hour, which was not the objective. The objective is to see if it's operating properly.

MEMBER HALNON: So, the guidance you have here will clarify or at least prevent that from happening in the future?

MR. GARRY: Well, it will provide them as much guidance as we can as to how to get that. Now we may in the future give more guidance on calibration of instrumentation, but, for now, what we did is we carried forward the calibration criteria that's laid out in NUREG-0737 into this Reg Guide, so that it's prominent information.

MEMBER HALNON: Okay.

MEMBER REMPE: Does the information indicate how often the calibration has to be done and that it has to be in this traceable source, and all of that type of information?

MR. GARRY: Yes. The only time the containment high-range monitors can be calibrated are during outages. So, that's the periodicity of it.

And typically, the plants are on an 18-month or a two-year fuel cycle. So, that's how often it's calibrated.

Most of these containment high-range monitors are very good, stable instruments. They're ion chambers that perform well for a long period of time. So, fortunately, the calibration check, all they have to do is verify that it's still working right.

MEMBER REMPE: And so, you have something that says you've got to do it at least every two years to give them that flexibility and they do have to show that their source is -- I mean, we used to have to buy or send back our sources to show that they were NIST traceable when we were doing checks on monitors. Do you guys have those kind of requirements?

MR. GARRY: Yes. Well, Tech Specs themselves have a criteria on post-accident monitoring systems, and that includes a containment high-range monitor, that they need two of them and they need to be recalibrated or they need to have a calibration check every refueling outage.

MEMBER REMPE: Okay.

MR. GARRY: Okay. Another update we wanted to give in the Reg Guide is on recommendations

for reviewing and updating the long-term annual average chi-over-Q and D-over-Q values. As we all know, with climate change and so forth, the weather is changing, or at least some people believe it is. So, we wanted to have better guidance on updating their long-term annual average chi-over-Qs and D-over-Qs. So, we'll talk about that a little later.

There has been some confusion in the industry on reporting of low-level waste, two aspects of that: the classification of the waste and the reporting of the shipments. So, we're going to talk about that in more detail in a little bit, too.

We wanted to clarify environmental guidance for monitoring iodine in drinking water. We're going to talk about these things in more detail.

We need to provide guidance on making changes to the effluent and monitoring environmental programs when transitioning to decommissioning. We've had several calls from licensees saying, hey, what do we need to do with our ODCM now that we're going into decommissioning? So, we wanted to give some guidance on that.

And then, we wanted to incorporate guidance from Regulatory Issue Summary 2008-3 on the return and the reuse of previously discharged

radioactive effluents.

Next slide, please.

We're going to go into detail on some of these things.

Okay. The calibration of the accident range monitors. Post-TMI, NUREG-0737 has item II.F.1, Additional Accident Monitoring Instrumentation. There's three sections of it: how to monitor noble gas; how to monitor iodine and particulates, and how to do the containment high-range monitoring.

Next slide.

So, we carried that guidance from NUREG-0737 into the Reg Guide. And basically, on the high-range noble gas effluent monitor, it's typically monitored with an ion chamber or GM detector which read out in units of dose or count rate, MR per hour or counts per minute. And we're explaining that the manufacturer performs the initial design calibration. The manufacturer provides the instrument response factor based on xenon-133, and that the licensees, all they need to do is this periodic calibration check with a solid source to ensure proper operation.

Next slide.

We have iodine and particulate sampling and analysis. The NUREG-0737 recognizes that real-

time, live monitoring of iodine and particulates is not practical. Therefore, licensees need to have procedures for the collection and analysis of charcoal cartridges.

Now, remember that the normal operating plant never has to do iodine/particulate sampling using their emergency instrumentation systems. They need to have procedures on how to collect a hot sample and how to analyze it; and that the iodine releases during a dose assessment during the first few hours of an accident can be calculated based on petitioning or scaling factors to the noble gas. And we give some references in there as to how to determine those scaling factors.

Next slide, please.

And finally, the containment high-range monitor. The high-range reading is 10 million R per hour. Remember, TMI went up to 800 R per hour. And this monitor is used for two purposes.

The first purpose is in the core damage assessment models. Now I think you probably know pretty well the TMI history, but the bottom line was, in the first few hours of TMI, they did not know what the status of the core was. They didn't know if the plant was going to blow up. They didn't know if they

needed to evacuate. They didn't know what they needed to do.

As a result of that, NRC issued some post-accident sampling criteria, and that sampling criteria required the plants to have to go grab reactor coolant samples and analyze them. There was a lot of technical difficulties with that.

As a result of that, the vendors, a couple of years later, made some Topical Report submittals to the NRC saying, "We don't really need to do all that post-accident sampling if we have an alternative method." And that alternative method is a core damage assessment model, and that takes input like core exit thermocouple temperature readings, reactor coolant system pressure and temperature. And one of the inputs is the containment high-range monitor. So, we're describing that in the Reg Guide.

But the manufacturer is going to do the primary initial calibration for this, and then, the manufacturer is going to give the instrument response factor. And then, the value is 1 times (audio interference); it's 11 amps per hour.

But the licensees need to just perform this periodic solid source calibration in the 1-to-10-hour range, and the I&C staff will do the electronic

calibration above 10R per hour.

Next slide, please.

Okay. Chi-over-Qs and D-over-Qs. As you know, chi-over-Q is the dispersion factor, how the radioactive effluent disperses after it's released from the plant vent, and the D-over-Qs, which are the deposition rates of the iodines and the particulates. The previous guidance was, if the chi-over-Q changed in a non-conservative direction by 10 percent, then the licensee should go back and adjust their computer codes to use a more updated chi-over-Q.

So, our meteorological staff reviewed this and approved the change. That's going to be, for lack of a better word, ratcheting the licensees to making changes to the computer codes too often. The whole overall accuracy of this whole system is not within plus or minus 10 percent. So, we allowed in the revised Reg Guide that they need to update the computer codes if the dispersion factor increases, or decreases in a non-conservative direction by 20 or 30 percent. So, that will give them a little better relief from ratcheting their changes to their computer programs just based updated weather patterns.

Next slide.

MEMBER HALNON: Hey, Steve, this is Greg

Halnon again.

On that last slide, there's a Reg Guide 4.28 coming out using the ARCON model for offsite. Is there any effect or is there a synchronization needed to be done, or at least a reference between those two before that Reg Guide gets issued?

MR. GARRY: The meteorological staff put out that, and I looked at that this morning, Draft Reg Guide 4.28. That's for control room doses and onsite dispersion.

MEMBER HALNON: Okay. Well, the new revision is looking at being able to use that for the new reactors, SMs, for offsite.

MR. GARRY: Right.

MEMBER HALNON: So, I just wanted to make sure that those two don't conflict with each other, once they get issued.

MR. GARRY: Yes, this is for offsite dispersion during routine effluent releases. The other is for onsite dispersion during accidents.

MEMBER HALNON: Okay.

MEMBER KIRCHNER: But I think Greg is right that the proposal is to use the other for the small reactors, small modular reactors, because of the anticipation that they're going to pull in the

exclusionary boundaries and such. So, the (audio interference) would be used once you've crossed the site boundary.

MEMBER HALNON: Correct. That's right. Thanks, Walt.

MR. GARRY: Okay.

MEMBER HALNON: Yes, I think you've got to look at it from the perspective of it being broader than what it has been traditionally been used as. So, my question was just to make sure they're synchronized and that there's no conflict there.

MR. GARRY: Okay. No, I reviewed it this morning. I didn't see a conflict in it. And it was prepared by the meteorologist group.

MEMBER HALNON: Okay. We'll be doing 4.28 in the future, when it gets through public comment, and we'll look back at this to make sure and just give you a second check on it.

MR. GARRY: Okay. Thanks.

Next slide.

Okay. Low-level waste shipment. Basically, there's two changes that aren't being made here. One is reporting waste classification. I'd like to describe waste classification.

That is a concept of how, for lack of a

better word, risky or dangerous this rad waste is to be disposed into a licensed low-level waste disposal facility. So, that lift into the ground as a rad waste needs to be determined when the waste is in its final form.

As you know, most or a lot of the waste from a nuclear power plant is now sent to a rad waste processor. In the old days, the waste was sent for direct disposal. It was put into 55-gallon drums, a lot of it, and taken to a landfill and it was direct disposal. The truck went from the power plant to the waste disposal facility. In most cases, the waste could be classified because it was in final form. It was in the 55-gallon drum. That was the final form. The resin was in a 55-gallon drum.

Currently, due to the cost of low-level waste disposal, most waste is sent from the power plant to a waste processor, and they will process that waste into a lower volume for volume reduction. And they've achieved some huge volume reductions. Resin, for example, is essentially melted or burned down into ashes. And so, the volume is, let's just say, a factor of 100 decrease in the volume. At the same time, there's a factor of 100 increase in the concentrations of the radioactive materials in the

ash. So, the waste classification can be much different after waste processing.

Similarly, for dry active waste, which is, basically, SeaLand containers of clothing and paperwork and garbage coming out of the plant that's slightly contaminated. That, again, is incinerated. So, you get a SeaLand container which is roughly 1,000 cubic feet. When they get done incinerating that, that's going to be down to 3 or 4 cubic feet, and the concentrations will have increased by a factor of 100 or so. So, the waste cannot be classified until it's in final form.

The previous version of the Reg Guide asked the licensees to report the waste classification. And the licensees have told us, hey, we can't do that because it's not in final form. And the processor who sends the waste to the low-level waste disposal facility, that processor is the one that's going to classify the waste. As a result, we have removed from the Reg Guide the table that tells us what the waste classification is. So, that's one concept.

Another concept is, we had a couple of licensees who did not want to report the waste shipped from the plant. They wanted us to track the waste

that's actually disposed in the low-level waste disposal facility. Well, there's two problems with that.

First of all, that waste is already being tracked by DOE. The Department of Energy tracks the low-level waste disposals into the licensed low-level waste disposal sites. So, we did not want to have redundant requirements with DOE to track the amount of waste going into the landfill.

And the second thing is we want to know what waste is being generated at the plant and is out on the public roads. So, if there was a rad waste shipping accident on the roadway, whatever, if we got asked by politicians or someone as to, hey, how much waste is leaving these nuclear power plants, we would have a reporting of the waste shipped from the plants. So, we clarified that again in the Reg Guide.

CHAIR BALLINGER: This is Ron Ballinger again.

Is there any -- and it's probably from my ignorance -- a risk of losing track of who owns what waste when they ship stuff to a processing facility? Does the processing facility maintain -- what do you want to call it? -- a unique chain of custody and not combine waste from individual plants as they

incinerate?

MR. GARRY: Once the waste goes to the processing plant, my understanding is that the waste is now transferred to the waste processing, and it, essentially, becomes the -- first of all, the processors are licensed by the states. Most of the processing is in the State of Tennessee, and the State of Tennessee has licensed the waste processors to receive the waste. They have waste acceptance criteria saying you can only receive it if it's in the proper shipping container, if the VOP shipping categories are properly completed, the waste manifest forms are completed.

And there's quite detailed tracking of this waste. It starts with the waste manifest forms. That's the NRC Forms 540, 541, 542 that identify the radionuclides, the quantity of the radionuclides, the LLDs. It's very well-tracked.

A lot of these requirements are in 10 CFR 20, which is the standards for protection against radiation. It's, specifically, in Appendix G, golf, Appendix golf, which has the manifesting and shipping requirements. And that establishes the tracking and the traceability of the waste.

CHAIR BALLINGER: Okay. Thank you.

MR. GARRY: Uh-hum.

And then, just to make it a little simpler, in the Reg Guide, we generalize the description of the rad waste into wet waste, dry waste, activated waste, and other waste. So, that's a change, although it's not a big change. It just makes it a little more intuitive as to how to report which shipments as which category.

Okay. Environmental monitoring. We updated the environmental monitoring requirements. Most of the effluent and environmental requirements originated in a couple of documents back in the late '70s called NUREG-1301 and -1302. And that laid out a minimally acceptable environmental monitoring program.

And part of that was a criteria for sampling for iodine-131 in drinking water. Now that is not a cheap analysis to do. That costs -- I don't know -- $3,000 per analysis, something like that. And it needs to be done if it's appropriate.

And the guidance on whether it's appropriate was a little confusing. So, basically, we have simplified it and said, basically, that in order to do this expensive analysis -- we don't use the word in the Reg Guide -- iodine-131 in drinking water, you

need to do it if the estimated dose is more than 1 millirem per year. You need to do it every two weeks. If you don't expect to see iodine-131 in drinking water, then you can change that to a monthly analysis.

So, that should clarify and remove a lot of the environmental sampling frequencies for iodine-131 and allow them to do the analysis using a gamma spect system rather than a resin column.

Next slide, please.

Okay. Leaks and spills. I think, as everyone knows, there's been a lot of attention in the last 15 years on leaks and spills. And one question that continually got asked is, do they have to clean it up? And so, we wrote a SECY paper back in 2013 entitled something like "Remediation of Residual Radioactivity During Operations."

And basically, the guidance or the consideration that we gave in the SECY paper was that it could be detrimental to the operation of the plant to have them try to remediate leaks and spills underneath the plant. With all the electrical wires and the conduits and the piping, and everything else, we don't really want them digging up dirt because there's a little bit of tritium, or mostly tritium, maybe a little strontium, in there.

So, the Commission agreed with us that what we should do is have them evaluate the feasibility of prompt remediation. So, for example, if there was a spill that -- at a plant where I used to work, there was a small oil spill. It wasn't radioactivity, but it was an oil spill. It went down the storm drain, but it sat in the sump at the bottom of the storm drain. So, it was feasible to take the cover off of that manway and go down and recover that oil, so that it didn't get discharged out into the environment. So, similarly, evaluate the feasibility of prompt remediation.

In the radioactive world, that, basically, has been done at several plants where they have established groundwater monitoring wells. And they have taken some of those wells and, using those wells, they have pumped back the tritium from the groundwater back to the plant, so that it could be monitored and discharged into the approved discharge pathways.

So, there are several plants that have done that. Brunswick is pumping back, and so forth. There's several plants that are pumping back and monitoring, and then, releasing.

But there is no specific prompt remediation requirement. That should be evaluated,

but you don't necessarily have to remediate it.

MEMBER HALNON: Steve, this is Greg.

Just be de fact -- and I'm just looking, I think it's on page 17, and it may not be a new issue -- but the statement is, "If the spill's properly remediated" -- the example, within 48 hours -- la, la, la, it doesn't have to be reported in the annual report. Is that a new issue or is that something that has been existing for --

MR. GARRY: Well, that's kind of guidance that we have given over the last 14 years to public meetings, and so forth, that we want to, basically, give them the incentive to capture it, if they can. And the incentive is you don't have to report it if you can get it cleaned up right away.

MEMBER HALNON: So, isn't that kind of de facto setting a requirement of some type? I mean, by putting it within 48 hours, I can just see a CNO or a site VP driving his team to take actions to clean things up within 48 hours, just so that they can stay within the non-reporting requirement.

MR. GARRY: Yes, that's kind of the objective, is to encourage them, so to speak. If they can clean it up right away, they don't have to report it. The 48 hours is arbitrary, as you well point out,

but that's the guidance that we had issued back in 2009.

MEMBER HALNON: Okay. It just seems a little soft and ambiguous to say that's just an example. And then, you say prompt remediation is not a requirement. However, it looks like it's being strongly encouraged through this --

MR. GARRY: That's about right.

CHAIR BALLINGER: Yes, this is Ron again.

Along those lines, in the spirit of risk-informing something, might the time to clean up or requirement to clean up a spill be dependent on the severity of the consequences?

MR. GARRY: Sure.

MEMBER HALNON: I mean, why just put 48 hours on the thing and just leave it at that?

MR. GARRY: Well, first of all, a Reg Guide is an acceptable method. It's not a requirement. It's, like you say, encouraged or it's guidance on what we find is appropriate. Can the 48 hours be, you know, three days or four days? Yes. So, it's not a hard-and-fast requirement. It's guidance.

CHAIR BALLINGER: Yes, yes, I hear you, but in the military we call that being "volun-told."

(Laughter.)

MR. GARRY: Well, there's probably some similarities there.

MEMBER HALNON: I was more concerned with the fact that it provides just some ambiguity to what goes into the annual report and what doesn't. You know, what if it is three days or four days? Who makes the decision that it was promptly remediated, so that it doesn't have to be reported? So, to me, it muddies up what is in the annual report and what is not.

MR. GARRY: Yes, you could also consider it flexibility. I understand what you're saying. No matter what number we put there, we wanted to give some kind of guidance. We wouldn't want to just say, "prompt" and have somebody say, "What does that mean? In the current shift? Or does that mean in the next 12 hours? What do you mean `prompt'?" Because we --

MEMBER HALNON: Yes, I agree, and that's why maybe the time to do is, for lack of a better term, a deterministic period, as opposed to risk-informed, which looks at consequences, as Ron mentioned. So, it just seems to me that you might want to take a look at that and see if there's an opportunity to better the language in a risk-formed

way as opposed to a deterministic way.

MR. GARRY: Okay. We can discuss that, yes. It's something I haven't really thought much about. So, thanks for pointing that out.

MS. WHITMAN: And, hey, Steve, this is Jen Whitman.

I don't think we've received any public comments on this, and I don't know that there's been, I guess, questions or concerns from industry about this threshold of 48 hours. Is that correct?

MR. GARRY: That may be a reflection of the fact that the industry has gotten so much better at minimizing release and dealing with spills, that as a practical matter, it doesn't happen very often.

Something that I haven't discussed is we do on our web page provide a list of leaks and spills at each of the plants with the maximum contamination levels measured and the current levels, the current maximum level. So, we're transparent with the public about leaks and spills.

And when we talk about leaks and spills, we're basically talking water leaks with tritium in it.

MEMBER HALNON: Yes, you know, I guess I wasn't implying there's a problem. I'm implying that

you may not know there's a problem because you don't know what's not being reported in the annual report because people may be cleaning up some significant leaks fast enough, promptly enough, that they can say, okay, we got that one done; we don't have to report it. Thank you.

MR. GARRY: Yes. You know, we rely a lot on the Resident Inspectors and the daily review of the Corrective Action Program entries, and the expectation that, if there's a leak or spill, right away they would put it into the Corrective Action Program. It would get reviewed by the Resident within a day or two, and then, the Resident has good contacts with the Regional HP Inspectors. So, if we had a massive leak, or whatever, that we would quickly know about it, and not wait for the annual report.

MEMBER HALNON: Okay. Well, I agree that the parallel path is there. However, the data reduction in the annual reports, does it take that into consideration?

MR. GARRY: Yes, we have a Reg Guide on reporting or measuring the impact of these leaks and spills. It's Reg Guide 4.25, which is a method of estimating the offsite impact of an onsite leak.

MEMBER HALNON: Okay. Well, I think the

comment still stands. Maybe that's an opportunity there that we can clarify in the future. If it's not a problem, you know, a pervasive problem, I'm sure that it's certainly been part of the discussions in the site VP office when a leak occurs.

MR. GARRY: Yes, yes.

Okay. Any other discussion of that?

CHAIR BALLINGER: Yes, this is Ron again.

We have a break that's scheduled for now, but I see there's only a few slides left, except for the backup slides. And there were very few public comments. So, I would propose that, unless other members want to have a break now, that we just continue to the discussion and have our break before we have the going-around-the-table discussion.

MEMBER HALNON: I'm fine with that, Ron. This is Greg.

CHAIR BALLINGER: Yes, I don't hear a groundswell of objection. So, thanks.

MR. GARRY: Okay. All right, great.

So, like I say, we've had several requests from licensees and inspectors as to what are they supposed to do when we go into decommissioning. And the first thing I want to point out is that the NRC's reactor oversight process transitions from NRR to NMSS

for decommissioning inspections. So, I work in the Office of Nuclear Reactor Regulation. So, this goes over to the decommissioning group. However, we still get the calls because the plant's typically still operating when they want to know, hey, we're going to be headed into decommissioning; what should we be doing?

And as you know, the NRC has got a new rule coming on decommissioning and the criteria for going into decommissioning. And that's mostly security-related and some of the revision of Tech Specs and the requirements for surveillances, and so forth. It really doesn't affect the effluent program as much as you might expect because we have the effluent program already set up to be flexible. The Tech Specs require the licensees to maintain their ODCM, and that means, when significant plant changes occur, they need to update the ODCM accordingly.

So, the second bullet here, then, is that the licensees need to update their ODCM to decommissioning status. They need to evaluate the effluent release pathways. We're going to talk about that a little bit more in the next slide.

They need to update the source term, because the principal radionuclides are likely to have

changed. The radioactive iodines have decayed. They're going to decay off in the first 30 to 60 days. Most of the noble gases have been released or decayed off.

So, the effluent monitoring needs to recognize that, and you need to update the ODCM and determine whether or not you want to continue, or when you want to discontinue, iodine monitoring, and when you can discontinue noble gas monitoring. You need to recognize that krypton-85 is likely a new principal noble gas radionuclide. And then, you need to maintain your Part 72 ISFSI effluent reporting.

Next slide, please.

So, what does the update to the ODCM involve? Well, the old effluent release pathways are being dismantled. Ventilation systems are being removed. Fans are being shut down. New effluent release pathways -- I noted the word "effluent release pathway" -- how is it getting out? Well, you've got to open hatches, roll up doors, and demolition activities.

You've got new principal radionuclides. We talked about that a little bit. We're approaching zero releases of iodines and noble gases. We're going to, basically, particulate and alpha activity. As

you're cutting open primary systems, there may be alpha activity that's now in a form that can be released; whereas, previously, it was contained inside of an operating system, an operating pipe.

Particulates, which you can think of as dust, radioactive dust, is being released. So, you need to think about how you're going to be monitoring particulate activity.

You can reevaluate your radiation exposure pathways. So, for example, there's no iodine milk pathway anymore because there's no iodine. They're still drinking milk, but there's no iodine in it. So, you don't need to be monitoring for environmental iodine.

But you need to continue your normal exposure pathways, which are the primary ones. What are you breathing, what are you eating, and what is the direct radiation? And then, you need to identify if there are any new, significant exposure pathways, created by the fact that you're now in a decommissioning mode rather than an operating mode.

Next slide.

But the point, then, is that it doesn't take a rule change to do this. We've already got in Tech Specs a system set up on how to modify your ODCM.

And basically, it's very simple. You do an evaluation and you get the plant manager to approve it. And then, you need to submit that revised program to the NRC, along with the next annual environmental report.

Next slide.

Okay. Then, we've got Regulatory Issue Summary 2008-3. The background on this is that Wolf Creek had discharges to, what I'll call -- I think it's a Coffey County Lake -- I'll just call it the Wolf Creek Lake. So, they discharged tritium into the lake, and then, the intake structure takes suction from that lake and brings that radioactive tritium back into the plant. And Wolf Creek used that lake water in their fire tanks.

And as you would expect, they run fire drills. The fire team will come out and use water from those fire tanks and spray it around the site in a drill. And the inspector said, well, you know, you're spraying tritium around here.

So, we did an evaluation and we worked with our Office of General Counsel, and we put out this Regulatory Issue Summary 2008-3 that, basically, said that, if you have properly discharged radioactive tritium, and subsequently, returned that liquid effluent, you do not need to double-count it as a new

effluent discharge, but you do need to take a look and see if, as a result of a new activity, such as spraying water around, is there a new, significant exposure pathway? And if there is, then you need to include it in your dose assessments.

And we do not expect a thorough, high-level, detailed calculation. You can use a bounding assessment because we know in the first place that you're spraying water around that, if somebody were to drink it, it would get 4 millirem a year. So, we understand that the risk of there being a new, significant exposure pathway is pretty minimal. And so, you can use a bounding assessment.

Next slide, please.

Okay. So, Ron, how would you like to handle this? Would you like to take a break now or would you like to go ahead and discuss this? Or would you rather just have a roundtable discussion?

CHAIR BALLINGER: I guess I would ask, is there a discussion that's going to take place related to the public comments? This is the only slide that says 31 public comments, et cetera, et cetera. Is there a significant amount of discussion that's going to take place here? If that's true, then we should probably take a break. If it's going to take very

little time, then this is the last slide, right?

MR. GARRY: Yes. Yes.

CHAIR BALLINGER: So, what's your opinion?

MR. GARRY: Well, I think we've mostly discussed the public comments that we've already gone through to a certain extent. We have the time. I'm happy to go through all of the public comments in detail or we can go straight to ACRS discussion.

CHAIR BALLINGER: I guess 16 of 31 comments were minor. That means that the rest of them were not minor. I think maybe it's probably best, so that we don't just tax people's ability to sit here, I would suggest that we take a 15-minute break and come back at -- what time is it? 10:55. So, 10 minutes after the hour. So, we will recess until 11:10.

(Whereupon, at 10:53 a.m., the foregoing matter went off the record and went back on the record at 11:10 a.m.)

CHAIR BALLINGER: Okay. It is 11:10. So, we're back in session.

So, can we get the presentation back up on the screen?

MR. GARRY: Okay. Thanks, Mike.

How would you like to do this, Ron? Would

you like me to go through each of the slides?

CHAIR BALLINGER: At your discretion. I would think we would want to focus on any public comments that were significant and how they were resolved.

MR. GARRY: Okay. That's fine. I wouldn't say they're significant. I'd say they're more than minor. So, let's go through them.

CHAIR BALLINGER: Okay.

MR. GARRY: Okay. The Public Comment 4.1, this individual's comment was: "When evaluating new, significant exposure pathways" -- and this is during decommissioning -- "given that the effluent doses are ever decreasing, what is the words in Reg Guide `total dose reference value' to be used in determining if there is a new, significant exposure pathway?"

Okay. Some of these comments took a little more explanation. So, we started by saying that the common exposure pathways, and the primary ones, if you want to consider that, are the inhalation, breathing, eating, and direct radiation, as described in Reg Guide 1.109.

Reg Guide 1.109 was written back in 1974, I think, and revised in 1979. And it gave all the mathematical equations on how to calculate the doses

from each of the radionuclides through each of the primary or common exposure pathways.

Within the exposure pathway, there's different routes of exposure. So, for example, under ingestion, you could be ingesting water, fish, meat, or vegetables. So, there are equations on how to calculate each of these.

In addition, a site may have unique specific exposure pathways, such as if there was a local farmer who was eating his goat meat or chicken meat, that might need to be evaluated. The whole criteria here in the first place was, basically, under your land use census, to evaluate the exposure pathways, and if you find something, for lack of a better word, important, then you should include it. And so, we've given a criteria of 10 percent of Appendix I is a criteria, which it's acceptable value to see if there's a new, significant exposure pathway.

Now significance is relative. It's significant with respect to the ALARA criteria. It's not significant with respect to a dose limit. So, that's how we resolved that comment.

Next slide.

Solid waste reporting. Again, we discussed this during the presentation, but the

licensees wanted us to ask them to report the solid waste disposed, not the waste shipped. And it's very clear that standard Tech Specs require reporting of the solid waste released from the plant, not the waste disposed. Previous versions of the Reg Guide said the same thing, that you need to report the waste shipped. And we note that DOE already tracks the solid waste disposed in the licensed waste disposal sites. So, really, there was no change needed to the Reg Guide because it was correct in the first place. We just didn't meet the objectives of the licensee to change the reporting requirement.

Next slide.

Waste classification. We talked about that as well. We removed the reporting of waste classification because it was pretty much immaterial anymore, because the waste is primarily being shipped for waste processing. So, we accepted that comment and removed the reporting of waste classification.

Next slide.

Iodine sampling. We talked about that. Again, the comment was to give more detail on the iodine-131 sampling frequency, what LLD should be used, which receptor age group. Should it include ingestion of fish? And how is it different than

calculating doses from effluents based on projected 31-day doses?

And we clarified it by saying that, if the calculated dose is more than 1 millirem -- and then, we had to go into detail -- to a person in the most sensitive age group, then perform environmental sampling analysis twice monthly with a low limit of detection of 1 picocurie per liter, which, basically, means they need to do the resin column analysis, but that's only if the calculated dose is more than 1 millirem per year. If it's not, then sample and analyze monthly using a gamma spect analysis with a higher LLD. So, I think that will answer the public comment.

Next slide.

Okay. There was a comment -- and this was kind of arbitrary or semantics -- they wanted the term "release and discharged" reversed. They wanted the release to be to the offsite environment and a discharge to be onsite. But we did not accept that comment. We note that the terms are arbitrary. We wanted to remain consistent with the previous revision of the Reg Guide, in that we're going to call it discharge is a effluent discharge to the offsite area, and an effluent release is a release from the plant

system structures and components to the onsite area.

MEMBER HALNON: Hey, Steve, this is Greg.

I got a little bit confused on definitions for onsite and offsite. Is it consistent through the Reg Guides? Does this change any of the definitions for onsite/offsite?

MR. GARRY: Not that I'm aware of.

MEMBER HALNON: Okay. It may have just been me, but I'll go back and look at it again. But there's a couple of places that use onsite and offsite, and it seemed like it wasn't consistent, but I may have read it wrong. Just check out line 997 and 2571 and make sure that you're satisfied it's consistent.

MR. GARRY: Okay. Give me those numbers again?

MEMBER HALNON: I think it's 997 and 2571, or thereabouts.

MR. GARRY: Okay. Great.

MEMBER HALNON: How's that?

MR. GARRY: All right.

MEMBER HALNON: It's as precise as I can get.

MR. GARRY: That's good. Thanks.

Okay. Next slide.

Okay. This is a public comment on licensed versus unlicensed radioactive material. The commenter said that, look, we're not doing it the way you really describe it. We're doing doses -- we're not calculating dose from prior year effluents. We're only calculating doses based on current year effluents.

So, the comment "not accepted" means that I did not need to revise the Reg Guide to challenge him on calculating prior year doses. Because it's kind of an indirect calculation, and I'll explain that here now.

NRC and EPA dose limits apply to both licensed and unlicensed material. It includes current year effluents which release this year; current year direct radiation, which you could give someone from storage of radioactive material onsite or from BWR SHINE, and prior year accumulated radioactivity in the environment. So, the dose limit does apply to prior year effluents.

Now environmental monitoring programs are designed to monitor the environment, which includes both current year discharges and any, let's call it, leftover prior year accumulated radioactivity. And the environmental monitoring program has a reporting

requirement that says that, if you detect radioactive material in the environment at a level that exceeds reporting requirements, then you need to inform the NRC. And those reporting requirements, the levels of, basically, tritium in the environment are based on the Appendix I dose criteria.

So, the bottom line is, if they have an environmental monitoring program that detects tritium in a lake that were to exceed 20,000 picocuries per liter of tritium, if that lake is used for drinking water, then they need to send us a report saying that we are starting to push the Appendix I criteria of 3 millirem. So, 3 millirem is 3 percent of the NRC dose limit and, roughly, 10 percent or 12 percent of the EPA dose limit.

So, although the licensees are not calculating dose from previous year effluents, they are monitoring for it and are reporting to us if the levels start approaching Appendix I. And this is explained in our public comment response matrix.

So, what we do is we take a list of all the public comments and we answer each of those comments, and we put that in ADAMS and make that publicly available as to how we resolved those public comments. If I were to try to put too much detail in

the Reg Guide, then it gets real wordy.

Okay. Next slide, Mike.

Okay. Updating chi-over-Qs and D-over-Qs. There was an inconsistency in the timeframes specified for updating long-term chi-over-Qs and D-over-Qs. One paragraph said five years, and later it said five or more years. So, they say that it should be based on five or more years. We accepted that comment and revised the text accordingly.

Okay. The reporting in Tables A-1 and A-2 had a carryover from, basically, back in 1975 saying: report the percent of the limit. But it never said what limit you're talking about. And the licensees had questions saying, report of what limit? And we've changed it to remove the percent of a release rate and percent of a concentration, because it's, basically, way, way lower than those limits, and replaced it with Tables A-4 and A-5, which require reporting of the percent of the dose limit of the dose criteria that the limit -- the dose criteria in 10 CFR 50, Appendix I, and EPA dose limits.

We looked at the previous effluent reports, and licensees were confused. They put asterisks in there, and they didn't how to calculate that; how to report that. So, we intended, back in

2009, to get rid of it back then. And when we added the Tables A-4 and A-5, in the last few minutes or the last few days, we didn't get that removed from the table. So, we accepted the comment, deleted the percent of the release rate, and replaced it with reporting the percent of the ALARA criteria and the EPA dose limits.

Okay. Reporting of solid waste. We've talked about that. No, this is a little bit different. They said there was an inconsistency. There's two sections of the Reg Guide that talk about reporting of solid waste, and one included the "green is clean" solid waste shipments and the other one did not. So, we accepted the comment. We revised Section 9.3 to exclude solid materials such as "green is clean" waste that is accepted in Section 6 of the Reg Guide.

I think as you know, "green is clean" waste is waste that is potentially contaminated, but it really can't be identified as to whether it is or not at the plant because the levels are so low. So, they ship it as "green is clean" to a waste processor, and there's no need for them to report to us the shipments of the "green is clean" waste.

The next slide.

Solid waste descriptions. They're not consistent. Again, we've generalized that to be wet waste, dry waste, activated or contaminated waste, and other radioactive waste.

The next slide.

Reporting of ISFSI effluents. There was, in Rev. 2 of it, there was text deleted with respect to the reporting of effluents from independent spent fuel storage installations. And we didn't delete it. There is a section of the Reg Guide on reporting ISFSI effluents. It's in Section 9 of the report. So, we added a footnote back at the front of the Reg Guide on the objectives that we're not removing the requirement for or the guidance on reporting ISFSI effluents. It's that that guidance is provided in Section 9.

Okay. Carbon-14 doses. This was an important comment. The question is, how do we report carbon-14 doses? That's the basic question. And do we need to include those doses in Appendix I?

Now, just to explain that, Appendix I is an appendix that tells you how good your rad waste processing systems need to be. They need to be good enough that the doses from those effluents do not exceed Appendix I. And the Appendix I calls out specific radionuclides; namely, noble gases, iodines,

particulates, and tritium. Carbon-14 is not included in that. Carbon-14, as you know, is part of a global warming situation. It comes out as carbon dioxide. You really can't filter it. You can't absorb it. You can't remove it. And therefore, a rad waste processing system is not going to reduce the amount of carbon-14. And it's not included in Appendix I because of that.

However, it is included in the public dose limits of EPA, 25 millirem per year, and NRC of 100 millirem per year. So, the licensees need to calculate carbon-14, let's call it, separately and put it into the total dose that could be compared to the EPA and the NRC dose limits. So, that was a real nice cleanup that I think we did there.

Okay. I guess that's the end of the slide show. With that, I'll turn it back over to Mr. Ballinger.

CHAIR BALLINGER: Thank you very much.

If there are not other immediate comments from the members or our consultant, I think we need to now get the public line open for public comments. Tom, can you get the public line open?

MR. MOORE: So, Member Ballinger, this is Scott Moore. We're doing public lines in this meeting

by them calling directly into --

CHAIR BALLINGER: Ah.

MR. MOORE: And I'm not sure who is the one telephone number that's called in, but if that isn't a member of the public, then maybe if it's a member of the staff or somebody else, then we don't have any public callers.

CHAIR BALLINGER: Ah, so the 707 is the call-in number? Yes, yes. Okay. Well, I guess we waited a little bit and nobody has made a comment. So, I guess there aren't any public comments. So, I guess the next thing to do is to have discussion amongst the members.

When I reviewed this document to see if we should have a presentation, the risk-informing issue was important, but, as it turns out, the risk-informing aspect was incorporated in Revision 2. And as far as I know, we never wrote a letter on this document, on Revision 2.

It doesn't change much in terms of the wording in Revision 3. And so, that's my current comment. I'd be curious about whether the members think we should write a letter or not. So, are there members that would like to make a comment? In particular, should we write a letter, and if so,

what's important?

MEMBER HALNON: Ron, this is Greg. I've got a few questions for Steve. But, to answer your question, I don't think that we need a letter on this, but, you know, I'm pretty new on the ACRS. So, I'm not sure of all the background, why we would need one. It seems like it's pretty comprehensive and a good job.

So, let me get through just a couple of my questions, and then, you can clear my list of items. None of them will take very long.

Steve, we're doing a lot of work on Part 53, and it's got a lot of references to ALARA. I just wanted to put that in your head to make sure that, somewhere around line 1728, I just made a note that it drew me to think about how we're using ALARA in the Part 53 regulations and whether or not this Reg Guide would be part of that discussion. So, just keep that in your mind. It's not anything that I think you have to take any action on, but --

MR. GARRY: Okay.

MEMBER HALNON: But it does talk about ALARA levels and we're using ALARA in a more distinct regulatory way in Part 53.

The other question I had was just

editorial. And when you went through the Reg Guides at the beginning -- I'm trying to find the line reference -- but you just had a list of Reg Guide numbers. Normally, we see the titles next to them, just for your editorial completion.

MR. GARRY: Okay.

MEMBER HALNON: It's the related ones, yes.

And then, finally, I just had a question. Did you have an opportunity to tabletop this with the industry working group on this?

MR. GARRY: No, but we did communicate with NEI, and NEI did a really good job of sending it out to the plants for discussion. And that's why we received so many comments, is that the document was well-reviewed by the industry, particularly effluent group.

There are two groups within rad protection and the industry. The occupational and, basically, the public are the effluent group. We call the occupational group the NEI Radiation Protection Forum and their Task Force, and then, we also have what used to be called RETS REMP, the Radiological Effluent Technical Specifications Radiological Environmental Monitoring Program group, which got renamed to be the

REEW, the Radiological Effluent and Environmental Working Group.

And so, they have task forces and this document was sent to that task force and to their members for their review. So, we got a really good, thorough industry review of the document.

MEMBER HALNON: Okay, yes, and that was my impression, reading the detailed comments, that certainly there was some really brainiacs behind the comments. So, that's good.

That reference I was mentioning to you, it's in the background section starting at 436, line 436.

MR. GARRY: Okay.

MEMBER HALNON: It's just you've got five Reg Guides or three Reg Guides and two NUREGs there. That's it.

Ron, in my personal opinion, I wouldn't necessarily think a letter would be written. And then, I'll leave it to the other members to also make the comments.

MEMBER MARCH-LEUBA: Hey, Ron, this is Jose.

You guys know I have a different philosophy. I think positive letters also have value.

And in my opinion, there should be a record that the ACRS looked at this guide and approves of it. It doesn't need to be a 12-page letter. I mean, let's write a half-a-page letter where it says: we reviewed this guide. This guide is intended to calculate doses to the public in place of reuses. And we lead with the staff approach. That doesn't take that much to do.

MEMBER HALNON: Yes, I agree, Jose. This is Greg. I didn't even think about that, but I agree with you.

MEMBER MARCH-LEUBA: Yes, let's get into the business of writing short letters. You don't need to cut and paste the whole SER or Reg Guide into a letter. That's my opinion.

Thank you.

MEMBER REMPE: So, this is Joy.

If we are going to go along that path, I guess I'd like to have the staff comment on whether waiting -- because our next meeting is September -- does that adversely affect any of the planned schedule for issuing a Reg Guide? Because having to suddenly wait for a, quote, "positive letter," where somebody who is not present at today's meeting might come up with a last-minute non-positive comment, I don't know.

I mean, can this adversely affect things, is one question I have.

And then, I guess I just want to follow up on what I mentioned about the EPA Drinking Water Standard. I guess the 4 millirem per year is based on a maximum contamination level of 20,000 picocuries per liter for tritium. And I guess, in 1991, the EPA said that if they used better ways of calculating the dose calculations, they could actually have a much higher, a factor three higher, concentration of tritium per liter.

And again, I guess I've heard from some folks offline here that the staff doesn't usually challenge the EPA standards. But did the staff discuss this and say, "Yeah, we know it's still kind of low, but we're just going to go with the flow because of regulatory stability."?

And I guess no one from industry was concerned about it, but it can raise some concerns later if you have some sort of event. I mean, at TMI, they had to do something about the tritium concentrations in the water. And was this discussed, and they just decided, "Well, we hope we don't have another accident," and cross our fingers and move on? Or did it just not get to that level?

MR. GARRY: Well, the gist of the Reg Guide is to do the measurement and do the calculation. They use the dose methodologies that are described in the ODCMs. And those dose methodologies are, basically, based on the ICRP 2 international recommendations, which establish a method of calculating the dose.

They are required to use the 10 CFR 20 organ weighting factors, but the organ weighting factor for tritium for the whole body is one. So, it really doesn't matter too much there.

Like you said, the EPA has looked at the way to calculate the dose. Particularly the radiation weighting factor for tritium I think is based right now on an RBE at 1.7, and EPA has determined that the correct value should be 1.0.

But, then, more recent in this literature says that, well, that may not be true; that's only for non-organically bound tritium. Organically bound tritium has that higher dose factor. So now, you're having to divide the tritium intake into two components to calculate the dose each way. So, it's never been challenged and never been a limitation on effluents. So, we haven't really addressed that, Joy.

MEMBER REMPE: Okay. So, I guess, again,

I thinking on factors beyond this Reg Guide or about issues beyond this Reg Guide. But I guess what you're trying to tell me is that there's still a lot of uncertainty in this, and that's why you just left it alone?

MR. GARRY: Well, I wouldn't say uncertainty, as much as there is precedence.

MEMBER REMPE: Okay. And then, what about if ACRS decides to write a letter? Does that impact anything that you have planned in your schedule for getting this out the door? Does it matter if you have to wait until after September, for example?

And actually, right now, I don't know; I guess we can add something and change our agenda, but that does require making changes to our agenda, if we wait until September. So, it might be October. And I just am kind of trying to understand how a decision to write a letter impacts things for ACRS as well as the staff.

MR. BROWN: So, if I can just -- Joy, Chris Brown.

Currently, I have been in contact with Research. We have it scheduled right now for October, but if we could move it up to September, it really depends on the schedule and the members.

MEMBER REMPE: Okay. So, does that impact things if you guys have to wait until October, just because we've decided we want to write a nice letter? That's a Steven question, by the way.

MR. GARRY: Okay. Well, I'm not sure. I think that I'm not real familiar with how the ACRS impacts our schedule. I think that if you said, okay, we have issues with this Reg Guide and we want to discuss it at the full Committee meeting, then that would definitely impact our schedule. If, on the other hand, I don't hear any objections, I think we would proceed. We would probably issue the Reg Guide in September-October.

MEMBER REMPE: So, you're planning to issue this Reg Guide in September, and it would be an after-the-fact thing.

And Scott, I see, has his hand up. And so, Scott, can you answer or provide comments on this topic?

MR. MOORE: Yes. We've already published the September agenda in The Federal Register. And, Larry, you can correct me if I'm wrong, but we can't add items to the agenda once we've published it. We can take items off, but we can't add new items to it.

MEMBER REMPE: So, we're waiting until

October. And then, I understand what your point is, Jose, but, again, this is not the full Committee that's here today. And I just want to kind of bring that point up, as we go around the table, because I'm not hearing any concerns expressed by members about what's in this Reg Guide. So, that's why I'm thinking, naw, I don't think we need to do this because the letter is just a nice letter, but there is always some risk that somebody may think about it and come up with something at the last minute. Plus, the agenda for October is full.

MR. GARRY: Yes, I think the first question is, does the Subcommittee want this to go to make another presentation to the full Committee?

MEMBER MARCH-LEUBA: This is Jose.

I am not proposing that the staff make another presentation. I'm proposing that we write a letter during the full Committee. And the reason is ACRS only speaks through letters. So, it does appear ACRS is silent on this Regulatory Guide. And I think, I mean, it's a matter of process or administrative, if you want to call it that way. But, as of today, the ACRS is silent on this.

MEMBER REMPE: What about this alternative, where Ron comes to full Committee and he

says, "We had the meeting and the Subcommittee said they're happy with the letter," and it's just some sort of a notation in how we record what happens at P&P?

MEMBER MARCH-LEUBA: If you remember, that's what I proposed last P&P, that that would be one way to do it. It's probably easier to write a short letter, but I will love that: that in P&P, one of the items comes and says, "As required by the Bylaws, which were modified recently, I asked the Subcommittee present in August, and we decided not to write a letter, but we approve of the guide." And that becomes a position of ACRS that the staff can get from the record.

MEMBER REMPE: So, I would accept that approach rather than having a letter.

CHAIR BALLINGER: That was what I was actually planning on doing, should we not write a letter. So, I'm fine with that.

MEMBER MARCH-LEUBA: I'm fine either way. I'm just seeing that, as of today, the ACRS is silent on this Reg Guide.

CHAIR BALLINGER: Now that I look at the list, we have pretty much, except for Vesna, we have everybody.

MEMBER MARCH-LEUBA: Yes, but this is Subcommittee. We cannot --

MEMBER REMPE: And Dave Petti is not here, too, right?

CHAIR BALLINGER: Yes, yes, you're right. You're right. You're right. Sorry.

MEMBER SUNSERI: So, this is Matt. Yes, let me weigh in on this a little bit here.

What we're trying to do is we're trying to create policy in a Subcommittee meeting, which isn't going to work. So, whatever we do here won't be sanctioned. We need to have this discussion during a full Committee meeting.

In September, we're going to have an opportunity to have a retreat. This would be a good topic for it. Jose keeps bringing it up about these good letters. We keep turning him away. So, we need to get this finalized forever or change the way we're doing business, but we can't do it during a subcommittee meeting.

So, what I'm proposing is, we just conduct business like we normally conduct it now, and that we decide in the future whether or not we want to write these beneficial letters.

And I would just remind everyone, a "no

review" has been perfectly acceptable, and, in fact, we don't have to weigh in on every topic. Only when we have issues is it necessary for us to weigh in.

CHAIR BALLINGER: Good idea.

MEMBER BROWN: Can I make an observation, Matt? This is Charlie.

MEMBER SUNSERI: Sure.

MEMBER BROWN: I mean, I agree with you we don't have to do something on everything, every item we review in a subcommittee. I think I've made that comment before because I've faced that on a number of things that I've had to review.

I did do a comparison of Rev. 2 to Rev. 3 paragraph by paragraph. That took a while, but it looked to me like, other than the stuff they brought up in the meeting, it was just the accident range stuff, which was a whole new paragraph on how to address that, which they covered pretty thoroughly. It didn't seem to plow any new ground relative to doses or what people can have, you know, what they're allowed to do or not do. So, everything seemed to be fairly stable.

I may have stated that wrong because I couldn't actually go look at everything they ever talked about. That would have taken too much time.

The other change was they had a new Section 8 talking about changes to effluent and environmental programs, which didn't really set any limits. It just said, if you're going to change stuff, here's some things to think about. I may have paraphrased that a little bit too much. So, this was a pretty benign set of changes to me relative to going through a number of the items and some the tables.

If we don't do a letter, we ought to get this issue set up for ourselves in terms of how we want to handle these more benign reviews, if that makes sense. I wouldn't do anything on this. I don't think any major changes were made.

Could the staff confirm that I'm either ignorant or one way or the other?

MR. GARRY: Yes, this is Steve Garry.

I don't think there were any real significant changes. I think it was an improvement, and I don't think there was anything real controversial. I think we had a good public licensee review of the Reg Guide, and I think we responded to their comments. So, as far as I'm concerned, I agree that this is not a significant change.

MEMBER BROWN: I mean, no dose limits, no absorb limits. We fundamentally are following

existing allowances. I didn't see you all change anything from that standpoint.

MR. GARRY: No, that would require a change to the regulations.

MEMBER BROWN: That's what I thought. So, that's why think this is, from this standpoint, that's the most important thing, is: did this review fall out any things where we were far too restrictive or we weren't restrictive enough? And what I got out of your all's discussion was that there were no changes in those types of calibrations relative to restrictions.

MR. GARRY: Yes, I agree.

MEMBER BROWN: Okay. Thank you.

That's my observation, Matt.

CHAIR BALLINGER: Okay. Other member comments?

Steve Schultz, do you have a comment that you would like to make?

MR. SCHULTZ: Hi, Ron. Can you hear me?

CHAIR BALLINGER: Yes.

MR. SCHULTZ: Yes, I would just like to weigh in, since it's Subcommittee, in a sense that the overall evaluation by members here has indicated, and through Steve's just recent comment associated with

what the intent was here with regard to update of the Reg Guide, it's pretty clear to me that there were some important issues that were addressed, identified, and then, addressed in the revision.

You mentioned, Ron, earlier that, while the risk-informed approach was done in Rev. 2, not so much here. But I think in terms of what has been done, risk-informed, performance-based changes have been made, either subtle or not so subtle. I think both the staff and industry have a better understanding of what needs to be done and what improvements can be made. So, with regard to regulatory guidance, I think it has been done in an appropriate way with regard to a risk-informed approach.

As Steve indicated, the good interchange between NEI, interchange with regard to the public comments, and then, I think the staff's response to the public comments was extremely thorough, their evaluation of them and how they handled it in terms of changes and describing what would be done and what did not need to be done with regard to the guidance presentation as it stands.

So, I thought, overall, the work has been really well done here in terms of identifying

regulatory changes, the Reg Guide changes, and this has been an excellent exchange between the industry and the staff on this.

And, Steve, I thought excellent presentation today, very well-organized, and an appropriate level of detail that really communicated the whole picture of what needed to be done and what has been done to better move forward with this.

And I'd agree with Greg that going forward into Part 53 is an important transition. There's, again, some subtle changes, or not so subtle changes that are associated with that with regard to effluent releases that are going to be important to both maintain and perhaps change in some ways.

MR. GARRY: Yes, it's a significantly different design.

MR. SCHULTZ: Definitely,

CHAIR BALLINGER: Yes. Thanks.

Okay. Jose, is your hand being up a residual or is it up?

MEMBER MARCH-LEUBA: It's no longer up.

CHAIR BALLINGER: It's no longer up?

Okay. Other comments from members?

(No response.)

I'm getting the gist -- well, we'll have

to take this offline. But my general impression is no letter. Unless there's an objection to that, we'll have that discussion.

But, if that's all there is, I'd like to personally thank the staff for doing a really great presentation. In my time on the ACRS, we hadn't had a presentation related to this. So, I thought it was very informative and the Reg Guide was well-written.

So, if there aren't any other comments, we are adjourned.

(Whereupon, at 11:51 a.m., the meeting was adjourned.)

Revision of RG 1.21, Rev. 3

ACRS Presentation

Measuring, Evaluating, and Reporting Radioactive Material in Liquid and Gaseous Effluents and Solid Waste

Steven Garry, MS, CHP
Sr. Health Physicist
Radiation Protection and Consequence Branch
Division of Risk Assessment
Office of Nuclear Reactor Regulation

August 18, 2021

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- Purpose of RG 1.21
- Effluent Regulations
- Effluent Technical Specifications
- Effluent Reports
- Effluent Trends
- Important Changes to RG 1.21, Rev. 2
- Public Comments

Purpose of RG 1.21

- Provide guidance on:
  - Measuring, evaluating, and reporting radioactivity in liquid and gaseous effluents
  - Reporting solid radioactive waste shipments
  - Assessing and reporting public dose

Risk-Informed and Performance-Based Approach

- Principal radionuclides > 1% by dose or activity
- Selection of LLDs (NRC or MARLAP)
- Risk-informed decisionmaking on residual radioactivity
- Environmental monitoring for I-131 if needed
- MARSSIM – may use Multi-Agency Radiation Survey and Site Investigation Manual – Data Quality Objectives
- Risk-communication - Notification of local authorities of spills and leaks

Effluent Regulations

- 10 CFR 50.36 (differs from 10 CFR 50.36a)

§ 50.36 Technical specifications.

(a)(1) Each applicant for a license authorizing operation of a production or utilization facility shall include in his application proposed technical specifications in accordance with the requirements of this section. A summary statement of the bases or reasons for such specifications, other than those covering administrative controls, shall also be included in the application, but shall not become part of the technical specifications.

§ 50.36a Technical specifications on effluents from nuclear power reactors.

(a) To keep releases of radioactive materials to unrestricted areas during normal conditions, including expected occurrences, as low as is reasonably achievable, each licensee of a nuclear power reactor and each applicant for a design certification or a manufacturing license will include technical specifications that, in addition to requiring compliance with applicable provisions of § 20.1301 of this chapter, require that:

Effluent Regulations (Cont'd)

§ 50.36a Technical specifications on effluents from nuclear power reactors.

(2) Each holder of an operating license, and each holder of a combined license after the Commission has made the finding under § 52.103(g) of this chapter, shall submit a report to the Commission annually that specifies the quantity of each of the principal radionuclides released to unrestricted areas in liquid and in gaseous effluents during the previous 12 months, including any other information as may be required by the Commission to estimate maximum potential annual radiation doses to the public resulting from effluent releases. The report must be submitted as specified in § 50.4, and the time between submission of the

Public Dose Limits and Criteria

- 10 CFR 20.1301 Annual Public Dose Limits
  - NRC - 100 mrem TEDE
  - EPA
    - 25 mrem whole body and organs, except
    - 75 mrem thyroid

- Tech Specs 5.5.4 - NPP Annual Dose Criteria
  - Operate within 10 CFR 50, Appendix I ALARA design criteria
    - Air dose – 10 mrad gamma or 20 mrad beta
    - Liquids – 3 mrem total body or 10 mrem any organ
    - Gases – 15 mrem iodines and particulates

Standard Technical Specifications

NUREG-1431 - Westinghouse

5.5.4 Radioactive Effluent Controls Program

- Contained in ODCM
- Conforms to 10 CFR 50.36a (Tech Specs for effluents)
- Implemented by procedures
- Maintain doses to public ALARA
- Remedial actions if program limits are exceeded

Standard Technical Specifications (Cont'd)
NUREG-1431 - Westinghouse

- 5.5.4 Radioactive Effluent Controls Program

  a. Maintain monitoring instrumentation functional with surveillance tests and setpoints per ODCM

  b. Limit instantaneous release concentrations to 10X the 10 CFR 20, Appendix B annual average concentrations

  c. Monitor, sample, and analyze liquid and gaseous effluents

Standard Technical Specifications (Cont'd)

- 5.5.4 Radioactive Effluent Controls Program (continued)

  d. Liquid effluents - Limit public dose to 1.5 mrem/qtr or 3 mrem/yr total body

  e. Determine doses on a 31-day basis and year-to-date cumulative doses

  f. Use effluent treatment systems to keep releases per 31 days not to exceed 2% of App I

Standard Technical Specifications (Cont'd)

- 5.5.4 Radioactive Effluent Controls Program (continued)

  g. Gaseous effluents - Limit instantaneous dose rates:

  - for noble gases to less than
    - Whole body - 500 mrem/yr (0.057 mrem/hr)

  - For iodines, tritium, and particulates
    - Any organ - 1500 mrem/yr (0.17 mrem/hr)

Standard Technical Specifications (Cont'd)

- 5.5.4 Radioactive Effluent Controls Program

  h. Air doses –

  - Limit quarterly dose to 5 mrem gamma and 10 mrem beta dose
  - Limit annual dose to 10 mrem gamma and 20 mrem beta dose

  i. Organ doses – from iodine, tritium, and particulate doses

  - Limit quarterly dose to 7.5 mrem
  - Limit annual doses to 15 mrem

  j. Limit doses per EPA standards

  - 25 mrem/yr total body and any organ (except thyroid)
  - 75 mrem/yr thyroid

Technical Specification 5.5.1 ODCM Offsite Dose Calculation Manual

- An ODCM
  - shall be established, implemented and maintained
  - contains effluent controls and environmental monitoring program
  - contains methodologies and parameters to calculate dose
  - contains description of information to be included in annual effluent and environmental reports

Radioactive Effluent and Environmental Reports

- Submitted annually to NRC
- Posted on NRC public web site

A - G	H - P	Q - W
Arkansas Nuclear One 1 & 2	H.B. Robinson 2	Quad Cities 1 & 2
Beaver Valley 1 & 2	Haddam Neck*	River Bend 1
Braidwood 1 & 2	Hope Creek 1	Salem 1 & 2
Browns Ferry 1, 2, & 3	Indian Point 2 & 3	San Onofre 2 & 3*
Brunswick 1 & 2	James A. FitzPatrick	Seabrook 1
Byron Station 1 & 2	Joseph M. Farley 1 & 2	Sequoyah 1 & 2
Callaway	Kewaunee*	Shearon Harris 1
Calvert Cliffs 1 & 2	LaSalle County 1 & 2	South Texas Project 1 & 2
Catawba 1 & 2	Limerick 1 & 2	St. Lucie 1 & 2
Clinton	McGuire 1 & 2	Summer
Columbia Generating Station	Millstone 2 & 3	Surry 1 & 2
Comanche Peak 1 & 2	Monticello	Susquehanna 1 & 2
Cooper	Nine Mile Point 1 & 2	
Crystal River 3*		

Annual Reports

- Radioactive Effluent Reports:

  | 2019 | 2018 | 2017 | 2016 | 2015 | 2014 | 2013 | 2012 | 2011 | 2010 | 2009 | 2008 | 2007 | 2006 | 2005 |

- Environmental Reports:

  | 2019 | 2018 | 2017 | 2016 | 2015 | 2014 | 2013 | 2012 | 2012 errata |

  | 2011 | 2010 | 2009 | 2008 | 2007 | 2006 | 2005 |

Annual Effluent Report
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U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

NUREG/CR-2907, Vol. 24

Radioactive Effluents from Nuclear Power Plants

Annual Report 2018

U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

NUREG/CR-2907
Annual Effluent Summary Report

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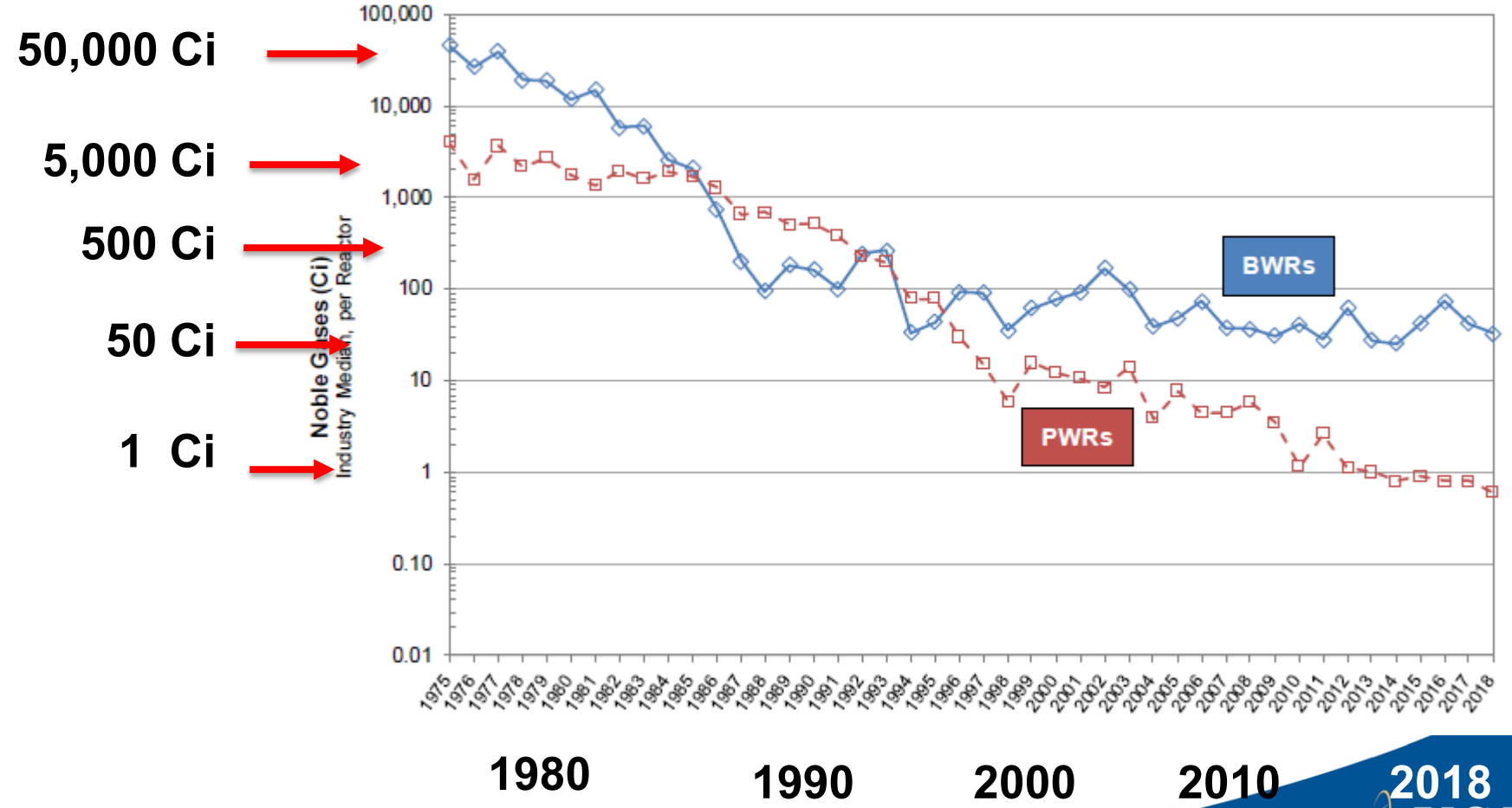
Noble Gas Effluent Trend - Median



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Liquid Effluent Trend – Median

Cr-51, Fe-55, Co-58, Co-60, Nb-95, Ag-110m, Sb-124, Cs-134, Cs-137

1 Ci

0.1 Ci

0.01 Ci

0.001 Ci

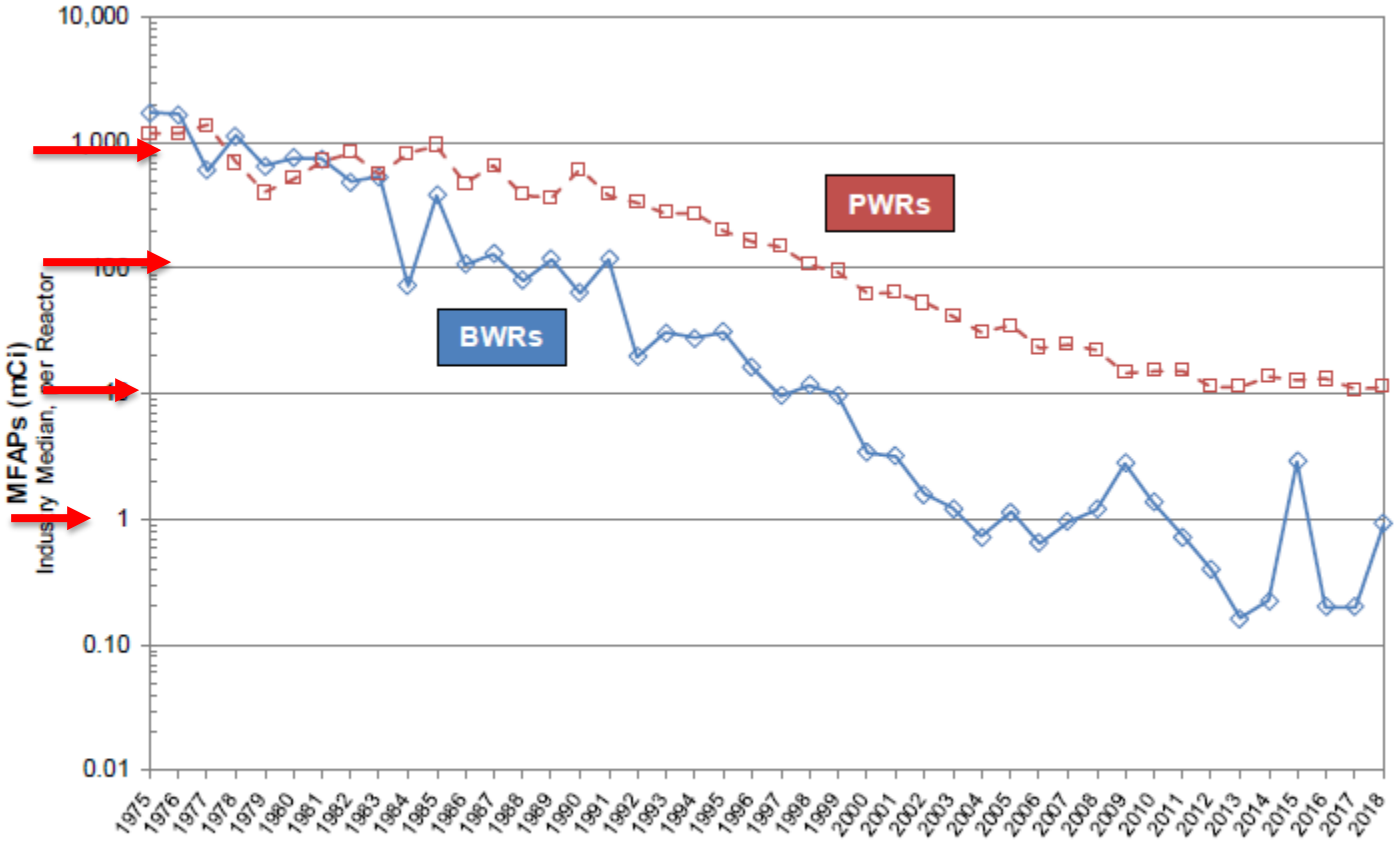

Figure 3.16 Long-Term Trend in MFAPs in Liquid Effluents

RG 1.21 - Reason for Revision

The periodic review identified a need for an update:

1. Needed guidance and acceptable methods for calibration of accident-range containment radiation monitors and accident-range effluent monitors,

2. Needed updated guidance on recommendations for reviewing and updating long-term, annual average χ/Q and D/Q values,

3. Needed to clarify reporting requirements for low level radioactive waste (LLW) classification and shipments,

4. Needed clarification of environmental monitoring requirements for iodine (I) -131 in drinking water

5. Needed to provide guidance on making changes to effluent and environmental programs when transitioning during decommissioning, and,

6. Needed to incorporates Regulatory Issue Summary 2008-03, "Return/Reuse of Previously Discharged Radioactive Effluents"

Calibration of Accident Range Monitors

Post-TMI - NUREG-0737

- Item II.F.1, Additional Accident Monitoring Instrumentation
  - II.F.1-1, Noble Gas Effluent Monitoring
  - II.F.1-2, Iodine and Particulate Effluent Monitoring
  - II.F.1-3, Containment High Range Monitoring

II.F.1-1 Noble Gas Effluent Monitoring

- High range noble gas monitor
  - Ion chamber or GM detector, mR/hr or CPM
  - Manufacturer performs initial design calibration
  - Manufacturer provides the instrument response factor based on Xe-133
  - $\frac{uCi/cc}{mR/hr}$ or $\frac{uCi/cc}{cpm}$ $(Xe-133)$
  - Licensees perform a periodic calibration check with solid source to ensure proper operation

II.F.1-2
Iodine and Particulate Sampling & Analysis

- Real-time (live) monitoring is not practical
- Licensees develop procedures for collection and analysis of charcoal cartridges
- Iodine releases can be calculated based on partitioning (scaling) factors to noble gas

ITEM II.F.1-3
Containment High Range Monitor

- High Range reading is 10 million R/hr
- Output used in Core Damage Assessment Models
- Manufacturer provides the instrument response factor ~ 1E-11 $\frac{amps}{R/hr}$
- Licensees perform a periodic solid source calibration check in the 1 – 10 R/hr range
- Perform electronic calibration above 10 R/hr

RG 1.21 - Meteorological Data Updating χ /Qs and D/Qs

- Revises guidance on recommendations for reviewing and updating long-term, annual average χ/Q and D/Q values
  - Previously, update χ /Q if non-conservative by 10%
  - Meteorological staff reviewed and approved change
  - RG revised, update χ /Q if non-conservative by 20-30%

LLW Shipments

- Removes reporting of waste classification
- Clarifies reporting requirements for shipping low-level radioactive waste
- DOE tracks LLW disposals
- Generic description of waste types
  - Wet waste (resins, filters, evaporator bottoms)
  - Dry waste (dry active waste)
  - Activated waste (irradiated components)
  - Other waste (bulk, soil, rubble)

Environmental Monitoring

- Clarifies environmental monitoring requirements for iodine (I) -131 in drinking water
- Perform drinking water sample analysis:
  - Monthly if estimated I-131 dose is < 1 mrem/yr
  - Bi-weekly if estimated I-131 dose > 1 mrem/yr

Leaks and Spill Remediation

- SRM-SECY-13-108, Remediation of Residual Radioactivity During Operations
- Evaluate feasibility of prompt remediation
- Prompt remediation is not a requirement

Decommissioning Programs

- ROP oversight transitions to NMSS for decommissioning inspections
- Update ODCM to decommissioning status
- Evaluate effluent release pathways
- Update source term
  - Principal radionuclides are likely to have changed
    - Iodines have decayed
    - Most noble gases have been released or decayed off
    - Kr-85 is likely a new principal noble gas radionuclide
- Maintain Part 72 ISFSI effluent reporting

Transition to Decommissioning

- Update ODCM
  - Old effluent release pathways are being dismantled (e.g., ventilation systems being removed)
  - Evaluate new effluent release pathways
    - open hatches, rollup doors, demolition
  - Identify new principal radionuclides
    - approaching zero releases (Iodines, noble gases)
    - Particulates and alpha activity may dominate
- Re-evaluate radiation exposure pathways
  - Continue normal exposure pathways (Inhalation & ingestion, and direct radiation
  - No iodine-milk pathway
  - Identify (bound) any new significant exposure pathways greater than 10% of App I

Decommissioning Programs

- Groundwater monitoring may need to be increased in support of license termination
- Maintain and update 10 CFR 50.75(g) record keeping for leaks and spills
- Decommissioning-related RGs
  - RG 4.22, Decommissioning Planning During Operations
  - RG 1.185, Standard Format and Content for Post-Shutdown Decommissioning Activities Report
  - NUREG-1757, Consolidated Decommissioning Guidance

Regulatory Issue Summary 2008-03, "Return/Reuse of Previously Discharged Radioactive Effluents"

- Informs licensees that discharged and subsequently returned liquid effluents to do not to be double-counted as a new effluent discharge
- A new significant exposure pathway is a pathway that exceeds 10% of 10 CFR 50, App I criteria
- Bounding assessments may be used

Public Comments

- 31 public comments received
- 16 of 31 comments were minor editorial comments
- Detailed comment-response information will be published with the final revision of RG 1.21, Rev. 3

CLOSING DISCUSSION

Questions

and

Comments

Acronyms

- 10 CFR 20 – Standards for Protection Against Radiation
- ALARA – As Low As Is Reasonably Achievable
- Appendix I to 10 CFR 50 – Design Criteria for keeping effluents ALARA
- C-14 – carbon-14
- χ/Q – concentration of effluents at downwind location, (uCi/cc), per unit release rate (uCi/sec)
- D/Q – Deposition rate of effluents at downwind location, (uCi/m^2-hr) per unit release rate (uCi/sec)
- DOE – U.S. Department of Energy
- RG – Regulatory Guide
- MARLAP – Multi-Agency Radiological Laboratory Analytical Protocols

Acronyms (Cont'd)

- ISFSI – Independent Spent Fuel Storage Installation
- mrad – radiation (energy) absorbed dose
- mrem – a measure of radiation dose in tissue (roentgen equivalent man)
- NPP – nuclear power plant
- ODCM – Offsite Dose Calculation Manual
- STS / TS – Standard Technical Specifications / Technical Specifications
- TEDE- Total Effective Dose Equivalent
- LLW – Low Level Waste
- GM detector – Geiger-Muller radiation detector
- RASCAL – Radiological Assessment System for Consequence Analysis

Backup Slides

Exposure Pathways
Public Comment # 4.1

- Comment:
  - When evaluating new significant exposure pathways, with the effluent doses ever diminishing, what is the "total dose reference value" to be used in determining if a new "significant" exposure pathway exists?
- Resolution: Comment accepted.
  - The common exposure pathways are inhalation, ingestion and direct radiation, as described in RG 1.109.
  - There are "routes of exposure" within those exposure pathways; e.g., ingestion of water, fish, meat, and vegetables
  - A site may have a unique specific exposure pathways; e.g., such as ingestion of goat meat or chicken that may need to be evaluated
  - A "total dose reference value" of 10% of Appendix I (consistent with RIS 2008-03) is an acceptable value for determining if a new "significant" exposure pathway exists

Solid Waste Reporting
Public Comments # 5, 6, 7

- Comment:
  - Licensees should report solid waste "disposed," not solid waste "shipped" from the plant
- Resolution: Comment not accepted.
  - STS require reporting of solid waste released (shipped)
  - Previous versions of RG1.21 also provide guidance that the solid waste "shipped" from the plant should be reported
  - Note: DOE tracks solid waste disposed in licensed waste disposal sites.

Waste Classification
Public Comment # 8

- Comment:
  - Waste classification (for disposal) should not be reportable.
- Resolution: Comment accepted.
  - Waste cannot be classified until processed and ready for disposal.
  - Formerly (1970s, 1980s), solid waste was processed on-site, and then sent for direct disposal (without off-site processing). In this case of on-site processing and direct disposal, waste classification was performed and could be reported.
  - More recently,
    - waste disposal fees have increased to the point where off-site waste processing is cost effective
    - Off-site processing has become technologically enhanced and effective
    - Therefore, licensees do not need to report waste classification.

I-131 Environmental Sampling
Public Comments # 9 and # 21

- Comment:
  - Explain I-131 sampling frequency, LLDs, receptor age group, fish ingestion, calculating dose from effluents, projecting 31-day doses
- Resolution: Comment accepted.
  - If calculated dose is greater than 1 mrem/yr to a person in the most sensitive age group, perform environmental sampling and analysis twice monthly with a 1 pCi/L LLD.
  - If not, sample and analyze monthly with a 15 pCi/L LLD

Terminology - Release vs Discharge
Public Comment # 10

- Comment:
  - A “release” should be to the off-site environment
  - A “discharge” should be to on-site areas
- Resolution: Comment not accepted.
  - Note: The terms are somewhat arbitrary
  - Consistency with Rev. 2 is important
  - Discharge is to off-site
  - Release is to on-site

Licensed vs Unlicensed Material
Public Comment # 12

- Comment:
  - Doses from prior year effluents are not calculated
  - Doses are only calculated based on current-year effluents
- Resolution: Comment not accepted.
  - NRC and EPA dose limits are from licensed and unlicensed material
    - Includes current-year effluents, current-year direct radiation, and prior-year accumulated radioactivity in environment
    - Environmental monitoring program monitors both current-year discharges and prior-year accumulated radioactivity
    - Environmental monitoring program has reporting requirements based on Appendix I criteria

Updating X/Qs and D/Qs
Public Comment # 13

- Comment:
  - Inconsistent time-frames specified for updating long-term X/Qs and D/Qs
  - One paragraph says 5 years vs later paragraph says 5 or more years
  - Should be based on 5 (or more) years of data
- Resolution: Comment accepted.
  - Text has been revised accordingly

Tables A-1 and A-2 Reporting
Public Comment #14

- Comment:
  - Reporting % of limit
  - Recommend deleting % of limit
- Resolution: Comment accepted.
  - The reporting of % of release rate and % of concentration have been deleted and replaced by Tables A-4 and A-5 which require reporting % of NRC 10 CFR 50 Appendix I and EPA dose limits.

Reporting of Solid Waste
Public Comment # 15

- Comment:
  - There is inconsistency between Section 6 and Section 9 on reporting of "Green-Is-Clean" solid waste shipments

- Resolution: Comment accepted.
  - RG section 9.3 has been revised to exclude solid materials (such as Green-Is-Clean waste) that are excepted by RG Section 6

Solid Waste Description
Public Comment # 16

- Comment:
  - Solid waste descriptions are not consistent between Section 6 and Section 9.3
- Resolution: Comment accepted.
  - Waste categories have been generalized to:
    - Wet radioactive waste
    - Dry radioactive waste
    - Activated or contaminated radioactive waste material
    - Other radioactive waste

Reporting of ISFSI effluents
Public Comment # 17

- Comment:
  - Why was text deleted in the Objectives with respect to reporting 10 CFR 72.44(d) ISFSI effluent reports?
- Resolution: Comment accepted.
  - Reporting of ISFSI effluents is contained in RG 1.21, Section 9.0
  - A footnote has been added to the "Objectives" that provides a pointer to ISFSI reporting guidance in Section 9.0

Carbon-14 doses

Public Comments # 27 and # 28

- Comment:
  - Are C-14 doses to be included in the dose calculations for compliance with TS, 10 CFR 50, Appendix I?
  - How are carbon-14 doses to be reported?
- Resolution: Comment accepted.
  - C-14 is not included in 10 CFR 50, Appendix I ALARA criteria:
    - Air dose of 10 mrad gamma and 20 mrad beta
    - 15 mrem from radioactive iodine and particulates
  - C-14 doses are reported separately, and are included in dose limits when demonstrating compliance with both:
    - EPA 40 CFR 190 limits (25 mrem/yr) and
    - NRC public dose limits (100 mrem/yr)