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SUBCOMMITTEE ON WASTE MANAGEMENT AND
SUBCOMMITTEE ON REACTOR RADIOLOGICAL EFFECTS

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UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

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SUBCOMMITTEE ON WASTE MANAGEMENT

AND

SUBCOMMITTEE ON REACTOR RADIOLOGICAL EFFECTS

Nuclear Regulatory Commission
Room 1046
1717 H Street, N.W.
Washington, D. C.

Thursday, January 16, 1986

The meeting of the subcommittees reconvened at 8:30 a.m., Dr. Dade W. Moeller presiding.

ACRS MEMBERS PRESENT:

DR. DADE W. MOELLER
DR. MAX W. CARBON
DR. CARSON MARK
DR. WILLIAM KERR
DR. FORREST J. REMICK
DR. PAUL G. SHEWMON
MR. JESSE EBERSOLE

PUBLIC NOTICE BY THE

UNITED STATES NUCLEAR REGULATORY COMMISSIONERS'

ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

THURSDAY, JANUARY 16, 1986

The contents of this stenographic transcript of the proceedings of the United States Nuclear Regulatory Commission's Advisory Committee on Reactor Safeguards (ACRS), as reported herein, is an uncorrected record of the discussions recorded at the meeting held on the above date.

No member of the ACRS Staff and no participant at this meeting accepts any responsibility for errors or inaccuracies of statement or data contained in this transcript.

P R O C E E D I N G S

(8:30 a.m.)

DR. MOELLER: The meeting will now come to order. This is a continuation of the combined meeting of the ACRS Subcommittees on Waste Management and Reactor Radiological Effects.

I am Dade Moeller, Chairman of the Subcommittee. We have with us Jessie Ebersole, Max Carbon and Forest Remick. Other members of the ACRS, we anticipate Carson, Mark and Bill Kerr, and perhaps Paul Shewmon later this morning. We have as consultants Richard Foster, Don Orth, Martin Steindler, Ron Kathren and Mel Carter.

Today, the agenda is a full one, much the same as it was yesterday. We're going to begin with a discussion of 10 CFR Part 20, with the first presentation being by the NRC staff. Then we'll hear from the AIF on this matter, plus the coverage of several other topics underway within the AIF.

Then, this afternoon, we're here on the potential for deregulated disposal of very low level wastes and hear about a guide being developed for obtaining regulatory approval to dispose of very low level wastes by alternative means.

Then we'll close out today with discussions of the environmental consequences of higher fuel burnup,

discussion of 10 CFR 61 and a discussion of radiation worker recordkeeping assessments.

In the way of commer:'s related to yesterday's meeting, I thought a couple might be in order. We talked, of course, some ab.ut alternatives for low level rad waste disposal. Let me just make a couple of statements of what I understand the current situation to be.

I am told that the Low Level Radioactive Waste Policy Amendments Act of 1985 requires that radioactive wastes containing radionuclide concentrations above Class C must be placed in a DOE supervised disposal site.

Now, the implications for this are that the NRC has been assigned the responsibility for licensing these facilities. And this same act requires that within 12 months, the NRC must identify the scope of methods other than shallow land burial, meaning alternatives; and that within 24 months, the NRC must provide technical information for the states to proceed with alternate disposal practices.

So I think what we heard yesterday was a reflection of some of the implications of that act.

In terms of the High Level Waste Programs, we need to keep in mind the programmatic questions that the NRC staff has given to us for us to address. We're not going to be able to address all of them at this meeting. But, in due

time, I think we must try to address these questions which, in general, ask if the staff is proceeding in the proper direction and are there any voids in their program.

DR. CARBON: Excuse me, Dade. What they said they're doing yesterday, the law says they have to do.

DR. MOELLER: That's my impression, yes.

DR. CARBON: And they can tell a state how they can substitute.

DR. MOELLER: Well, more if a state comes in with a proposal to establish low level waste disposal sites or a facility that is not shallow land burial, they must be in a position to review and comment on the satisfactory nature on the technical specifications.

DR. CARBON: The way you read it, it seemed to me to set forth that the NRC is going to do it.

DR. MOELLER: I don't know that that is precisely correct. I'm not reading from the act itself, but I understand it's a direct quote. It says:

"Within 24 months, the NRC must provide technical information to force the states to proceed with alternate disposal practices."

MR. EBERSOLE: May I comment?

The same problem in the Nuclear Fire Industry a long time ago. And they had to do something. They devised a little mechanism called the Standard Review Plan, which

is: I'm not going to tell you how to do it, but I'm going to tell you how I'm going to look at it when you do do it. And it has to be done that way.

DR. CARBON: In this case, the NRC is trying to figure out how to do it.

MR. EBERSOLE: The Standard Review Plan is an alternative. I know they said it.

DR. CARBON: They're trying to figure out how to do it according to what I was questioning yesterday that that's what NRC should be doing. But, from the words given there, it sounds like they are doing what they should be doing.

MR. EBERSOLE: Then that gives them a feel.

DR. CARBON: I don't think it's an alternate one.

MR. EBERSOLE: They're saying that was the way they got around this big problem. They couldn't tell them how to do it, so they told them how they were going to look at it.

DR. MOELLER: They will, as I understand it, need to modify 10 CFR 61 so that it offers criteria for licensing of alternate disposal methods and the criteria specified in 10 CFR 61 as I would understand it must be such that if these criteria are met, then the EPA standards will also be met. And they thought, again, in developing 10 CFR 61, that it was a universal standard that would apply to any disposal

method.

They found, I guess, subsequently, that it will have to be massaged and modified to some degree to make it fit whatever the new proposals are. And they're trying to begin to zero in on which ones will be most viable.

Well, they didn't tell us yesterday that they're meeting with the states on a regular basis, according to what we were told a few weeks ago, particularly when ONNI went out on December 13th and met with the NRC staff. They are in communication with these Indian tribes. This is on high level, of course, but on low level and high level both, they're in periodic meetings. I don't know whether they're quarterly, with the states. They're really trying to maintain touch.

Something, too, we didn't discuss is that through the Nuclear Waste Management Fund, I gather that the Indian tribes can come to DOE and ask for financial support in order to hire technical experts and, indeed, they're doing this. And they have built up pretty good consulting staffs to represent their position and to, you know, critique and evaluate what DOE and NRC come to them with in the way of proposals.

One other item that came out of the December 13 meeting, or consultation, or whatever it was, was that this subcommittee needs to plan a meeting, in my opinion,

sometime soon with DOE where we would hear all the details about their proposal for the monitored retrievable storage facility, and we'd also hear direct from them what they plan to do as contrasted to what the NRC is telling us they're planning to do.

The NRC staff has encouraged us to set up one on one communications with them. Carson?

DR. MARK: You mentioned the fact that they're hiring expert consultants to advise them. Now, if we hire an expert consultant, we can pay him whatever we can pay him. Are they limited in that respect?

DR. MOELLER: I don't know. And I don't know even a ballpark of how much money we're talking about.

DR. MARK: Could one of our fellows, or so forth, possibly get some data on that? We want consultants. We have consultants, but if the Yakima Indians can pay him 500 bucks a day, it would be something we ought to know.

DR. PARKER: I can offer some advice on that. The State of Tennessee got $1.4 million for assistance in evaluating the MRS proposal. They were spend that in any way they wanted to. They were not limited to consultants.

DR. MOELLER: It's millions in that case.

DR. PARKER: I think the Indian tribes, if memory serves me right, there was something like $300,000 in that case. The $1.4 million was the State of Tennessee just to

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evaluate the MRS option.

DR. MOELLER: One other thing, Owen, now that we're getting into some of these subjects, if you -- and I'm sure you will -- can get a hold of a copy of this Low Level Radioactive Waste Policy Act Amendments of 1985 --

MR. MERRILL: I think we have it.

DR. MOELLER: Owen says he thinks we have it. Let's get it run off so we can read it and see what it says.

DR. REMICK: Dade, can I ask you a question?

You said the NRC has responsibility for licensing. What about the agreement state?

DR. MOELLER: The agreement state will license the facility. And I'm told, and I think this is correct, that probably the agreement states will license more of these than the NRC. However, the NRC, as you so well know, must approve the policies and practices employed by the state.

So, in essence, the NRC has to accept the state.

On today's meeting, I don't think we will necessarily be writing any detailed reports. So, once again, I would encourage you to challenge the speakers. Let's make our thoughts known orally, the exception being Bob Alexander. He has special status and he's grandfathered.

Okay. The first presentation will be by Bob Alexander, who is Chief of the Health Effects in Occupational Radiation Protection Branch, in the Office of Nuclear Regulatory Research. He's going to be discussing with us the rewrite which has now been published of 10 CFR Part 20. Bob...

MR. ALEXANDER: Thank you, Dade.

After, I guess, some 12 years of appearing before the subcommittee, I have learned over the years to look forward to these meetings. We staff in Radiation Protection gain a lot from the meetings with this subcommittee in several ways. Sometimes, mistakes we're making are uncovered here. I'd much rather have them uncovered here than in the public comments later.

Very often, helpful suggestions of what we should be doing, what we don't need to be doing, are made, that we can take advantage of. And, on more than one occasion, this subcommittee has been helpful in obtaining resources for a viable radiation protection program in the NRC Office of Research.

Today, if my understanding is right, I have roughly two hours, if we need that much, to explain things to you about our proposed new 10 CFR Part 20, which is the agency's basic radiation protection standard.

We think it's a very important radiation

protection standard in that the influence of 10 CFR Part 20 is seen outside the purview of the agency's licensees as well as the agreement states, for example, in the 28 or so agreement states follow these regulations very carefully.

As a matter of fact, all the other states do also. These regulations are used considerably by other federal agencies within our country.

And then Part 20 also has quite a lot of influence abroad. I know of some countries where NRC regulations are adopted as national regulations, sometimes with very little change.

So a major change such as we are undertaking is a very important consideration. As we always do, we're seeking public comment on our proposed regulations. I'll bring you up to date on the status of that, if I might, Dade, to begin with, so we'll know exactly where we are.

We published, and the Commission approved, the proposed rule I believe in November. And the initial publication or comment in the Federal Register was dated December 20th with comment closing period of April 21st.

There's a little confusion about that which I'd like to explain to you. We didn't release this publication because it had 177 errors in it by GPO, some of which were embarrassing, and others even misleading.

So we insisted on a reprinting. That did not

become available until January 9th.

So if you review the proposed Part 20 yourself, be careful to review the version dated January 9th. I believe Dr. Brodsky informs me that there are only six typographical errors, none of which are embarrassing or misleading.

MR. BRODSKY: That's not officially certified.

DR. MARK: Do you have a QA program on this?

MR. ALEXANDER: We don't. We don't get to review these publications. What we can do is hold up the release, Dr. Mark. They do let us look at copies before they mail them out to about 12,000 people on our mailing list. That's not a satisfactory way of doing business. This was a case in point.

But I think the important thing is that the date of the document that should be reviewed by ACRS members is January 9, 1986 and the public comment period, the closing date that is in effect, is May 12th, not April 21st; because we wanted a full 120 days for public comment.

Before we get into the discussion of the document itself, I'd like to point out something about the importance of the public comment period that we're attaching to this particular regulation.

We attach great importance, of course, to the public comment period for all regulations in the regulatory

guide, so I don't mean to take anything away from the importance attached by the staff to the others.

But this one is especially important for a special reason, I think. The changes that we're proposing are not without cost. We're estimating the cost at, I think, $33 million for the initial year, plus an additional cost annually of a few million dollars.

DR. MARK: Is the 33 million figure in the NRC total budget?

MR. ALEXANDER: This is cost to the affected licensees.

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So the regulation will not be without cost. There will be some cost to the NRC as well in retraining of inspectors.

DR. REMICK: How many licensees enter into that $33 million figure? Several thousand?

MR. ALEXANDER: We have between 9000 and 10,0000 licensees, and then the agreement states have a similar number, I think a few more. So we might be talking something more than 20,000 licensees that will be directly affected.

DR. REMICK: So we're talking about more than a couple thousand dollars on the average per licensee?

MR. ALEXANDER: If you like, that would be like averaging my income with Teddy Kennedy's. Many of these licensees have a gauge, for example, which is completely shielded, and there's no hazard at all. It's unlikely that anyone at that place will ever know that this change has taken place.

Contrast that with a nuclear power plant.

DR. REMICK: How many would have a health physics program that would have to seriously considering changing the procedures or personnel or records? I'm just curious.

MR. ALEXANDER: We can run through that.

DR. REMICK: I don't want to divert discussion.

MR. ALEXANDER: I think it's a very good

question, the magnitude of this thing. There are approximately 100 reactor sites right now that are far enough along to be looking into that, and more than that, there are research reactors, which we'll have to check and see what they have to do differently. In the fuel cycle business, they're down, I think, to between three and five uranium mills now. Thanks to our Canadian brethren, there are not too many mills. We still have two conversion plants operating, although one of those is shut down right now.

I don't know exactly how many. It must be on the order of 20 different work sites, where nuclear fuel work, such as fabrication, is going on. We have half a dozen or so radioactive waste disposal sites. We have a fairly large number of people in the radiography business and the total number of workers there could exceed 10,000.

DR. REMICK: Would hospitals be largely affected?

MR. ALEXANDER: The hospitals will be affected. We have, I think, about 3000 medically licensed facilities. Then you double that for the agreement states.

DR. MOELLER: Well, the hospitals and the universities.

MR. ALEXANDER: Yes. Universities, I forgot. That's a terrible oversight before this group. Many universities will be affected by it.

MR. KATHREN: Also, Bob, the agreement states

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themselves will be affected in the sense that they will have to change their regulations to match your charges. I don't know if you factored that cost into that $33 million.

MR. ALEXANDER: I don't know. The agreement state people in this area are very concerned about that. At my encouragement, the health physics society has written two letters to the governors of the states, not just the agreement states, but all states, pointing out that these changes are in the wind, and there's an educational program that their license reviewers and inspectors must go through. And those people, they have close to zero budget for travel outside the state.

How we're going to educate them, I don't know.

Wayne Kerr, in our Office of State Programs, and Don Nussbaum are devising a program whereby some NRC resources will be used to take many programs to them on a regional basis, hoping they'll be able to come in for some training in this area.

DR. MARK: What fraction of these people or what selection of these groups have been in on the proposed changes, so that they don't come out of the blue.

MR. ALEXANDER: I'm grateful that you asked that question. I believe any other rule that I've ever worked on in all these years, the answer would be almost none. We haven't worked that way. We haven't been allowed to work

that way. But that has not been the case for the new Part 20. We received special authorization to have extensive contacts with affected licensees during the development stage of the regulations. They'll hold for a period of more than two years. The staff people assigned to develop this regulation conducted visits, site visits all over the country. I believe it might be safe -- I think the estimated number of health physicists actually interviewed was on the order of 1000. About 1000 people, I believe, have been -- held discussions with them.

DR. MARK: So they're not going to be surprised or shocked by the changes.

MR. ALEXANDER: I did not say that.

(Laughter.)

Those 1000 will not be surpised or shocked, but I believe the shock -- that's a very, very small sample of those affected. I believe that there will be shock waves, yes.

DR. CARTER: Bob, can I ask you a question? What's the implementation schedule now? What are the mechanics, for example, for maybe, in general, but specifically for the agreement states? Do they all have to fold into this thing at a given time, or is this spread over a period of time?

MR. ALEXANDER: The agreement states will be

expected to incorporate what we call the items of agreement in 10 CFR Part 20. Not everything is considered to be that important, but certain items are.

Before I answer that question, let me answer another one. It's one that I know the answer to much better, and that is, what is the NRC going to do about implementing it? We can deal with that Then I think you can see that that's far enough in the future that what the agreement states do, it's too early to ask them.

What we're proposing is a five-year period, during which the final rule would have been published in the Federal Register with an effective date five years in the future, after which the NRC inspectors would start inspecting against the new regulations.

So there would be a five-year transition period, during which the old Part 20 would continue to be in effect. The new Part 20 would have been voted by the Commissioners to be the new rule. That might be one of the things that this gorul would want to deliberate as to whether that's a practical suggestion of ours to make.

Our inspectors tell us that it would be difficult, and our licensees tell us there might be difficulties in the siting, of which one of these regulations has to be complied with or to what extent a licensee would be allowed to choose between the two

regulations that he wanted to comply with.

If I meet with you again after the public comments are in, I'll be able to answer that question better about whether the five years is a good idea or not.

We expect, and I'm guessing that I'll get 3000 letters of public comment. We think it will take two years to resolve those public comments. So I believe we're talking about seven years before the first inspection against this regulation will be made. Then I believe probably at some point after that, probably the agreement states would wait until it's all signed, sealed and delivered and in effect, before they would move.

So we're talking about sometime in the future. The question is whether or not the ICRP recommendations that we're implementing will still be in effect by the time the new regulation goes into effect.

(Laughter.)

MR. KATHREN: Bob, with that point, let me ask, what sort of communication, if any, do you maintain with ICRP and NCRP? For example, do they give you some advance information of their thinking or consult with you at all?

MR. ALEXANDER: I think the answer to the first is yes; the answer to the second is no.

Communication with NCRP, I'm responsible for. I represent the NRC to the NCRP as the liaison representative

for that agency, and they keep me apprised of their activities, primarily by sending me drafts of their reports to be reviewed and to seek Staff comment on them.

So we're very satisfied with that. The ICRP, one of the members of the NRC Staff is on Committee 4. To the extent that information about their activities becomes available to him, he shares it with the rest of us on the staff.

MR. KATHREN: That's not a member of your staff, though, I take it.

MR. ALEXANDER: Our representative on Committee 4 is Dick Cunningham on the NMSS staff.

What I was starting to say about the importance of the public comment period is, since there are costs associated with this, financial costs, and since there is another cost that is probably greater than the financial cost, and that is just the personal cost of having to learn a lot of new ways to do things that our licensees believe, in general, are already being done in an adequate matter, just the government leaning on them to learn a lot of new terminology and new ways to express things and measure things and record things, and so forth.

People look for what are the benefits. If I have to pay this price, what do we get out of it? And the question, the one that seems to leap to everyone's mind is,

what is the collective dose? How much is the population risk going to come down, as a result of spending $33 million, plus several million dollars every year?

And that's not an easy question to answer.

The principal reasons for the changes in Part 20 are not to decrease radiation doses. Scientific updating is the principal justification given for this change, and I think as you think to individual health physicists and individual scientists, they would agree that a document originally developed in the light of knowledge in 1957 is certainly out of date in 1986.

Everybody wants scientifically updated regulations, but nobody wants to pay for them.

So under those conditions, we feel, ideally, that the decision as to whether or not to have scientific updating should be made by those who have to pay for it. They can't do that really directly, but they can have a tremendous influence through the public comment period, and so we feel that the public comment period is especially important. We feel it's especially important for us to be responsive to the public comments for this document, since the government cannot make a strong safety argument for it.

DR. STEINDLER: Are you aware of any other organization that has proposed a radical change to its rules of this kind, solely on the basis of being clean, tidy and

neat?

MR. ALEXANDER: I know that pretty much all around the world, various governments are preparing to adopt the current ICRP recommendations in some form, Dr. Steindler. I know the British already have. Their regulation went into effect the first of this year. And I'm not sure the countries know the problem of justifying the changes is as strong as it is in this country.

I think we may have a little bit more of a problem in explaining why this should be done than they would in Britain or other places in Europe.

I think there are some constraints in the OECD to comply with ICRP regulations. That's a justification. We don't have anything.

DR. CARTER: What do you do to try to sell the program, or what have you done, since you've known this was coming for quite a while? What kind of activities and what kind of a reaction do you get from professional groups, and so forth, on the basis that you're trying to argue for a scientific update?

MR. ALEXANDER: I don't think we've really done anything deliberately, but we have done quite a bit. You wouldn't believe how many invitations I get to speak on Part 20. I may doze through the presentation this morning when I get into these slides, I've given them so many times before.

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DR. CARTER: We may doze also!

(Laughter.)

MR. ALEXANDER: But other than those talks, I really don't know of anything else. We made a very strong effort during the development stage to gain participation. The intent wasn't gain support, it was just to try to get the document right. So we're not doing much, really, to try to sell this.

Now there's a confounding factor in this that this group would want to take into consideration, Dade, that worries me a little bit.

Our Commision, on this theory, may have the unhappy choice of choosing whether to be responsive to President Reagan or responsive to the public.

The reason I say that is because --

DR. MARK: Well, it's seven years before it takes effect. You state the problem a little strangely. The public will still be there.

(Laughter.)

DR. STEINDLER: I hope so.

MR. ALEXANDER: I think the decision about the adoption of ICRP regulations in this country will be made by President Reagan probably within a month or two. We've been working for a long time on guidance to federal agencies, which will be signed by the president. This is an

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arrangement made by the Congress back in 1960 and carried over in the formation of EPA in 1970, called FRC, Federal Radiation Council function.

TVA is the only occupational function they hold, and they take a lead in development guidance for federal agencies in the area of occupational radiationm protection.

That has been done. The document is ready for submittal to OMB now. As soon as EPA management releases it, they'll review it.

It's this country's answer to the current ICRP regulations, and it does follow them fairly closely.

The guidance will go back to the EPA Administrator to make whatever changes OMB insists upon and then will be sent to President Reagan for signature.

The basic elements of the current ICRP recommendations are reflected in this guidance.

Now the Nuclear Regulatory Commission, as an independent agency, is not legally constrained to comply with this guidance, but we believe that's almost a theoretical remark to make. It's extremely unlikely that that Commission would not comply with the president's guidance. They don't have to. And I really anticipate a groundswell of negative comment on this proposed rule.

DR. MOELLER: I know, in 10 CFR 20, or at least in the SECY 85-147, mention is made on page 2 of the EPA's proposed guidance for occupational exposures. Is that publicly available? Can we see it?

MR. ALEXANDER: You can. I can furnish that. Do you want me to send Owen a copy? I have a copy of the version that is on the desk of Mr. Thomas, I believe, right now, at EPA. We conducted five hearings. I was one of the hearing examiners. We conducted hearings in five places around the country on this guidance a few years ago and the resounding theme of those who testified was always the same, always the same old phrase over and over and over again:

If it ain't broke, don't fix it.

So people want to know if I have to do this, if I have to learn what the effective dose equivalent is, then tell me why? Why should I do it?

DR. ORTH: Has there been any effort to sort of examine -- "sell" might be too strong a word -- the proposition that better recordkeeping and better quantification of doses and things of that nature might help protect various licensees from lawsuits?

MR. ALEXANDER: Yes. That's another excellent question to bring up, Dr. Orth. To the extent that I feel it's appropriate for me to do so in my little speeches, I mention that. But, strictly speaking, the radiation

liability issue is one between the licensee and the worker; it does not involve the NRC. That's principle number one.

So Mr. Minogue doesn't like for us to get deeply at all into that question, at least as things stand. Until the Commission changes its advice, we're keeping those sort of remarks at arm's length.

But what I do talk about, and I feel perfectly comfortable talking about this, is that when we make the decision about a recommendation to put into a regulatory guide or a constraint to put in on a regulation, the question always comes up:

What are the radiation liability aspects of this rule?

And the answer is always and invariably:

There is no exception to this. We will not consider that in making our decision. We will not consider radiation liability in making that decision.

So, as a result of that policy, our regulations and guidance are designed altogether to enable us to control the risk at minimum interference with the licensee's activities and we can control the risk adequately. I think that's been demonstrated. We can control the risk adequately with a far less stringent program than is needed in the courtroom to present a defense.

Let me give one example. This is, I think, a

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rather good one. This is one I've used, and there are hundreds of others which we could go over if we had time.

The most important matter in preparing for the administration of justice in these cases in the future is the recorded dose, the whole body dose. We feel that we can control that situation by having the licensee measure and record the dose at a depth of three-tenths of a centimeter, he's allowed to go up to one centimeter if he likes and that's it. One centimeter or three-tenths of a centimeter. And we can control the situation with just that information.

That's fairly easy and straightforward to come by. If a worker gets cancer and it happens to be skin cancer, that information is of use in determining the probability that the cancer was caused by radiation only for highly energetic radiation. So that the dose at 3/10 of a centimeter is approximately equal to the dose at the cancer site.

So a licensee who is doing dosimetry, paying for dosimetry, in order to help arrive at the truth in the future litigation cases, would have to have a great deal more information to reconstruct a dose than he is required by the NRC to provide.

We don't require them to record the energy of the radiation. We do require the type of radiation, the beta

radiation. We're pretty sure that that doesn't reach the pancreas, but for photons and neutrons, there's nothing in the record to show what the tenuation by other tissues would be between the surface dose and the site of the cancer.

We also don't record any information about the geometry of the exposure. The geometry of the exposure, as it was shown in NCRP Report 39, can result in errors of a factor of 4, calibrating at one geometry and exposing the worker at another. We don't do any of that. We don't even really consider what the licensee is going to be up against in the courtroom.

I'm glad you brought that question up because I think the answer that I gave you isn't well-recognized.

MR. EBERSOLE: Is the medical world just left off in its corner with virtually no program for on dose accumulation? You all don't look at any medical experience to correlate on the medical dose, which certainly must be a significant thing?

MR. ALEXANDER: If you're speaking of the patient.

MR. EBERSOLE: I know personally I've got great gobs of hours. I'm always a little fascinated by the fact that nobody asks me what happened to you last year or last month.

MR. ALEXANDER: The dose received by the patient

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is not considered in the determination of the occupational exposure status. But I don't know of any place that that's done.

MR. EBERSOLE: I don't know of any medical program. I guess it's just dependent on acquiring the records.

MR. ALEXANDER: The theory is that the medical advantage of the exposure --

DR. MOELLER: You feel good.

(Laughter.)

MR. ALEXANDER: We can get into the slide show if you're ready.

DR. MOELLER: Well, Ron has a question.

MR. KATHREN: Bob, I think I heard you say that the principal benefits and the reason for this revision, which is roughly the first major revision in 30 years, were scientific advantages.

Is that not correct?

MR. ALEXANDER: Scientific update.

MR. KATHREN: Yet, when I look at the table 5 in the Federal Register -- by the way, that's where one of your typos is --

MR. ALEXANDER: Listen, those are not our typos. We only made one typo; 176 of those were the GPO's.

MR. KATHREN: I'm very sympathetic to typos, let

me tell you.

As I look at the benefits of the revision cited, the very first one is annual and lifetime dose to individuals receiving highest exposures will be reduced. And it goes on from there.

I think that there are dose reduction benefits. And by your own statement, there are. But I really wanted to ask about the scientific updating because, in my reading of this, I am very concerned over the departure from the definitions provided by the ICRP and ICRU and which I believe the United States has agreed to use as a signatory to a treaty on these units.

And I think that what you are doing is perpetuating parallel terminology. And that creates in my mind considerable confusion. For example, your use of the term "dose", your use of the term "absorbed dose" greatly differ from the recommendations of the international bodies.

So I make that comment and perhaps ask a question. When you say "scientific updating", why didn't you go all the way and use the correct definitions instead of making your own?

MR. ALEXANDER: Up until this moment, I've been delighted with the questioning.

(Laughter.)

MR. ALEXANDER: You're going to get yours, Kathren.

(Laughter.)

MR. ALEXANDER: Actually, I don't think people realized what might be thought of as a concession with regard to the SI units that is being proposed. There is a statement in the current Part 20 requiring licensees to use the units that are used in Part 20.

That statement, in effect, prohibits the use of the SI radiological units. So, believe me, most of our licensees are very, very much in favor of that prohibition.

MR. KATHREN: That's fine. But it creates several problems that I see.

MR. ALEXANDER: Let me finish this thought.

MR. KATHREN: Excuse me.

MR. ALEXANDER: So the new Part 20, which would allow the use of the SI radiological units, is a step, and a major step in that direction. After this, Part 20 would become effective. Then, licensees would be allowed to use the sievert, the gray and the becquerel, whereas, now they are prohibited from doing so in their records.

They can do it all they want to in their programs but, in their records, they're required to use the rem, rad, roentgen and curie.

MR. KATHREN: They can use the SI units now in

their records as long as they use the old units as the official basis. There's nothing, as I see it, that prohibits the use of the new units now. Reporting is a different story.

But, my question pertains to the promulgation or the redefinition, if you will, of certain firms, one of which is dose. The ICRP and the ICRU very explicitly define dose. The definition in the new or the proposed 10 CFR 20 differs from that definition, and that's what I think is a little disturbing to me, because we've created or we'll be continuing the policy of two different definitions for the same term.

If I write a paper for a scientific journal, that journal is going to require me to use the ICRP definition of "dose". But when I talk to the NRC, I am permitted, if you will, to use a different defintion of "dose". And this could create in my view considerable confusion and open the door to a great deal of error when trying to go from the scientific literature to the regulatory literature.

MR. ALEXANDER: I believe I agree with you.

MR. KATHREN: Then I suspect you will take that comment into account when you make the revisions to this draft for final adoption.

DR. MARK: Ron, could you, for the benefit of one totally ignorant, say a little more about just that point?

What is the difference in the ICRP dose and the ancient terms used by the NRC?

MR. KATHREN: The ICRP, or let's say, the scientific usage of dose, specifically refers to energy-absorbed --

DR. MARK: ergs per gram.

MR. KATHREN: Right. Energy absorbed. The definition, as provided in I think both the present and proposed revisions to 10 CFR, Part 20, used "dose" in a more generic sense so that it can mean not only energy-absorbed but dose-equivalent, committed dose equivalent in the proposed ones, committed effective dose equivalent. It can even mean exposure, that is, roentgens.

DR. MARK: I understand roentgens. I understand rems, which are rbe times the rads.

MR. KATHREN: The quality factor now times the rads. But what this does is it makes a more generic definition of the word "dose"; instead of a very specific one, with a very specific meaning, "dose" now can mean any one of several different things.

DR. MARK: The scientific thing is energy per gram. The dose is rems. And somebody's idea of the rbe times the energy per gram.

MR. KATHREN: Yes, it's a measure of the biological effectiveness or the risk now in the ICRP

method. It's a measure of the dose equivalent or the rem as a unit of the dose equivalent as a measure of risk. The rad may not be a measure of risk.

DR. MOELLER: Bob, as you begin -- thank you, Ron. As you begin, I expressed some comparable views yesterday and I think we, as rad protection people, need to perhaps get up on the soapbox a little more frequently and, in other words, launch an offensive once in a while, instead of being on the defensive.

For example, people are saying, "If it ain't broke, don't fix it."

Well, they say that to us and we put our tail between our legs and go into the corner. And, yet, I'm the world's worst in choosing analogies, but the House of Representatives elects new members every two years. Well, why? You know? Is that necessary? Is it helpful?

The NRC, a couple of years ago, put on this huge push for regionalization or, you know, decentralization. Well, why didn't someone say loudly, as they're saying to you now, "If it ain't broke, don't fix it"?

The NRR has just recently undergone a reorganization. How much did that cost?

A better example is the source term. We're spending, the NRC and its contractors, have spent millions on trying to define the source term for nuclear power plant

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accidents. What was wrong with the old system that we used? Do you know? We have power plants that are operating. They seem to be operating all right, and they seem to have reasonable emergency plans. And the population, the dose they're receiving, isn't absorbitant.

Why are we spending all this money? I think we have to start asking them, you know, throw the question back. Of course, the people asking this, the public or the licensees, are asking us these questions but the same questions, in my opinion, are equally applicable to many other situations which go unchallenged.

DR. STEINDLER: That is the thing that troubles me. In the case of a source term, for example, you can make a reasonable argument that it is based on economics. There is an economic benefit derived from the source term because the other one was overly conservative.

Here it seems to me it is all on the negative side. There are no particular benefits to the public exposure. There is an expense involved which has been estimated variously at 30 million, plus or minus. I have no idea how much it costs to prepare all this, a two, three, or four-year effort. But it strikes me that in this case the ledger is all on the negative side other than tidiness.

Tidiness is nice and all that, but is that enough?

DR. MARK: If they can say it is rational, one might be a little happier to spend some money.

DR. STEINDLER: The implication was that the old one was irrational or not rational, and I haven't heard that. I don't think you have said that.

MR. ALEXANDER: I think the old system has worked very well. I think it has been reasonable.

But if I might be allowed to do so -- I have been speaking to this point as a good NRC representative, but I would like to take off my NRC hat now and mention five reasons to you why I, as a health physicist, think that it

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would be a good idea to go ahead with this change on a safety basis.

MR. EBERSOLE: Before you start, let me ask you a question.

Isn't this cost way down in the regulatory cost environment, you can't even find it? If you can't find it --

MR. ALEXANDER: I don't know if anybody has ever made an estimate of the radiation protection cost, but it is high. It is a very high cost.

Some of these nuclear power plants have health physics staffs of 40 or 50 people.

MR. EBERSOLE: I don't mean that corner of regulatory costs. I am talking about all regulatory costs. You can't even find it.

MR. ALEXANDER: I can't speak to it. I don't know how much it costs, but I know it is expensive.

I justify the new Part 20 on five safety grounds in my own mind, and if I can have five minutes, Dade, I would like to mention those.

DR. MOELLER: I think we should hear them.

MR. ALEXANDER: First, intake limits, radioactive material intake limits. For a number of radionuclides, some of them very important, uranium for example, virtually all of the alphas, the intake limits are being reduced by fairly

large factors; for example, a factor of 5 for uranium.

That means that the information we have today, primarily in this case animal studies, thank god not much on human experience, indicates that the alpha-emitting radionuclides are more carcinogenic than was thought when the intake limits were first established back in the late 1950s.

So for the people who are actually exposed to these alpha emitters, having the intake limits reduced, even though it will be expensive, for their employees is a very good thing, and I am highly in favor of that.

Second, the external dose limit.

I want to speak for a moment and put this on an annual basis for simplicity of discussion. We have quarterly limits, 3 rems per quarter, but let's make the discussion simple by talking about annual limits. We allow 12 rems per year from external sources.

The best information we have from the Nagasaki survivors and other informatior on occupations indicates that if someone were to actually get 12 rems per year -- let's say that someone worked in the industry for a long time and his average dose was 5 rems per year, in some years going up as much as 12 and in other years less, but his average dose was 5 -- that we would associate his cancer fatality risk at on the order of 5 percent.

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5 percent is probably not considered by anybody to be a very safe occupational risk. It is just not one that anybody is very comfortable with.

Now, it is true that no one gets 12 rems per year, and it is true that lifetime dose limits are low, at least with respect to a 5 rems limit.

But I don't like to have a regulation that allows 12 rems per year, an average of 5 rems per year, and I really believe that the elimination of this 12 rems per year upper limit will result in a reduction in the average dose, probably not in the medical institutions, where about half the collective dose takes place. Where the other half takes place is in nuclear power plants, and their average is about .65 per year, which I think is a little bit too high.

I would like to see them get it down to .5 per year, and I really think that reducing the limit that the government allows to 5 rems per year will result in a reduction in that .65. I don't know whether it will get it all the way down to .5 or not.

DR. REMICK: .65 or .5 of what?

MR. ALEXANDER: The .65 rems per year, that is the average dose among the nuclear power plant workers.

The reason I am making those statements is because the ICRP 26 criteria for risk, acceptable risk, is 10 to the minus 4, which says that in industry it would be

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considered safe if no more than one out of 10,000 people would lose their lives per year because of their occupation. That is considered to be a safe industry by the ICRP and others.

We tend to accept that 10 to the minus 4 criterion, and, roughly speaking, the annual dose associated on a lifetime basis with 10 to the minus 4 would be .5 rems per year on the average.

So that is what we would really like to see, and I believe that reducing the 12 down to 5 -- that is the upper limit contributing to the average -- would be a step in the right direction and will help. So I am very much in favor of it.

DR. MARK: I want to complain at what I think may have been someone misspeaking. You referred to the Nagasaki-Hiroshima data as the best data you have. That is not data at all in rads per year. It is data only on absolute rems per event.

I understand you can't use that as a good analogy on so many rems per year.

MR. EBERSOLE: I had the same objection. I don't see any connection here between sometimes or random.

MR. ALEXANDER: The risk factors used these days for evaluating hazards from radiation assume that when the radiation energy is imparted to human tissue, that there is

no recovery and that the risk then of the cell that was irradiated becoming malignant continues until the end of some plateau period, which might be a lifetime or it might be 25 years.

DR. MARK: So you have got 100 rems at Nagasaki. It is the same as if you had 12 per year for eight years. I don't know if that is true, but that is the assumption made.

MR. ALEXANDER: It is not quite that simple. There are two factors to consider in a risk for exposure. The two factors that are considered are the magnitude of the dose and the number of years of time at risk after the dose is received.

So if you have 100 rems and in one case it is given as a single exposure to a young person, the time has to be factored into that. That is a large risk.

The same 100 rems given to an older person with less time to live would be a smaller risk.

Aren't the same 100 rems spread out over a working lifetime so that the number of years of risk following each exposure becomes progressively smaller?

DR. MARK: Maybe I object to glossing over the fact that Nagasaki-Hiroshima were exposures which could not confidently be reinterpreted in terms of 5 rem per year.

MR. ALEXANDER: I know the error band is large,

but I really think that that die is cast. I doubt if in our lifetimes we will ever see people stop using those risk factors.

DR. MARK: Maybe that is too bad.

MR. EBERSOLE: Don't the cells die and regenerate chemically very consistently?

MR. ALEXANDER: The mitosis rates are different, of course, for different cells.

MR. KATHREN: What they have done, Bob -- very simply, what they have done is they have equated risk with the dose and they have said that that risk -- and they have looked at different kinds of risks -- to be really simple about it, they have said that the dose equivalent received -- and I am using that term in the new strict sense -- takes into account the biological effectiveness, and it takes into account the distribution of the radiation over the body.

They have said that any unit of dose equivalent is proportional to risk. So it is a risk of getting a fatal cancer over the lifetime of the individual.

They don't take into account whether or not that individual receives it at age 1 or age 10 or age 70.

MR. EBERSOLE: Or whether they get it in a single shot?

MR. KATHREN: That is right. It is time

integrated.

MR. EBERSOLE: Is that biologi:ally accurate?

MR. KATHREN: No. It is not biologically accurate.

DR. CARTER: The main thing, though, the main point, Carson, it is independent of dose rate. That is essentially what they are saying, and that is your contention. That is not necessarily correct.

DR. MARK: It is not necessarily correct. Neither it is obviously wrong.

MR. ALEXANDER: We can go on to my third point, which is even more fun, and that is the protection of the embryo and fetus.

DR. PARKER: What would be the effect if there were major changes and a reevaluation of the Hiroshima and Nagasaki data?

MR. ALEXANDER: I think the changes will be important changes. You are talking about probably something on the order of a factor of 2 for a change.

DR. PARKER: That is the question. Are you going to revise this within the year when the new data comes out?

MR. ALEXANDER: I don't think so. I am sure you would still be within the error band.

But I think that factor of 2, while it might not affect regulations right away, will affect other things.

For example, I suppose the medical community, in making decisions about diagnostic or screening procedures, would have to balance the risk of causing cancer against the risk of identifying a cancer.

A factor of 2 I suppose would make quite a difference in decisions about how often surgery should be done and things like that. I think that factor of 2 will have a lot of effect, but I wouldn't expect much effect in regulations.

Now, what you might see --

DR. PARKER: It will change your risk factors?

MR. ALEXANDER: That is what I am saying.

DR. PARKER: This is risk-based, which it is supposed to be. I don't see how you can not change that.

MR. ALEXANDER: For example, the main aspect of the new system that is risk based are the weighting factors that are used to multiply organ doses by to make them additive.

Now, those weighting factors won't change very much if that factor of 2 is changed because of the way they are obtained. They are obtained in a conventional way from being a weighting factor. You add up the risk factor for each organ, then you divide back through by the total, and that gives you your weighting factor for that organ.

So the thing that would change the effective dose

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system would be new information about the danger of radiation itself to a particular organ, not those risk factors.

DR. PARKER: That would still leave it with exactly the same number. If what you said were true, it would be twice as effective and therefore you have got to change something by the factor of 2.

MR. ALEXANDER: What you would change would be the limit.

DR. PARKER: That is exactly my point. Are you going to have to do that?

MR. ALEXANDER: Let me speak to that.

The ICRP's limit is 5 rems per year, whole body. That is the one we are recommending. It is the effective dose equivalent, the weighted dose equivalent. The 5 rems per year is the upper limit of the doses that can contribute to the average.

Think with me a minute about a limit and an average. The regulatory focus is on the average, not on the limit. The average to be sought is a half rem per year. That is associated with an acceptable risk. The limit is the upper limit of the dosage that can go into the derivation of the average.

When you are talking about changing a number that virtually no one is allowed to receive, I don't think a

factor of 2 in the risk factors would cause the ICRP to precipitously reduce their upper limit to 2.5, and unless they did I don't think we would.

DR. PARKER: I guess I am still confused. You are talking about this .65 now per year.

MR. ALEXANDER: That is the average.

DR. PARKER: I understand. You are concerned about that. That factor of 2 doesn't seem to bother you.

I am confused as to why one does bother you and the other doesn't. If we are saying the risk is increased by a factor of 2.5 under the system might be 1 rather than .65 --

MR. ALEXANDER: Now, if you are asking me personally, yes, then I would want to see the average lowered below .5, but if you were asking me about the rate covered in the regulation, I doubt if that will change.

DR. MOELLER: Let's go ahead.

DR. CARBON: Excuse me. Just one question.

Suppose we could all agree that these two points were important. Could we not simply -- could that not be accomplished very simply by just changing the present Part 20, changing those two numbers?

MR. ALEXANDER: Absolutely. One of the meetings I was invited to speak to recently of an industrial group, a young man from one of the utilities I invited to speak, and

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I was very attentive. As a matter of fact, they got behind, and I graciously gave up my time in order that we could listen to him.

And that is exactly what he said. He said, gee, we don't want out-of-date scientific bases for the regulations. Technically up-to-date regulations. You didn't have to start over, you didn't have to wad up the regulations and start over and give us new paragraph numbers and everything like that so that we would have to change all of our computer systems. Just go in and pick out the two or three things that you are worried about and change them.

And I wouldn't be surprised if we don't get a lot of public comment saying to do just that.

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DR. CARTER: I was going to divert you on this one, too, Bob, because so far I think you have been tying the system without a drastic change. I don't know about your other three points.

MR. ALEXANDER: Let's get into the intriguing discussion about protection of the embryo and fetus. It is no laughing matter, of course, but it is an extremely difficult matter.

The reason I find it intriguing is that there are so many different viewpoints that are nontechnical that come into play on the protection of the embryo and fetus. Even religious viewpoints enter into these decisions.

It might be interesting to start out this discussion -- remember, I am speaking now as a health physicist as opposed to a representative of management, but it looks right now like we may have a situation in this country where it will be perfectly legal to take the life of an embryo, but it will be a violation of federal regulations to give it 501 millirems.

So with that as a starting point, we can look into some of the other problems with the protection of the embryo and fetus.

The major issues we have dealt with are invasion of privacy and equal employment opportunity.

Now, there are other regulations, other laws that

govern people in our country on those two issues, and for years we have tried to figure out how can you protect the embryo and fetus without violating the equal employment opportunity law.

We are not sure that is possible. We even had that reviewed by the Department of Justice. We are not sure that that is possible.

And if one of the things you get into quickly -- the suggestion is quickly made, do that by applying your regulation only to fertile women, if you do that then you get immediately into violations of the invasion of privacy laws.

DR. CARTER: But, Bob, this is not necessarily a real new argument. Again, it is the individual o group of individuals that are making the decision. In one case presumably it is the mother to be, and in the other it is a third party as far as whether you should legally do it or if you can do it in a regulatory sense.

I see it as two completely separate issues.

MR. ALEXANDER: They are separate issues, and some of us suspect that the final decision in this area will have to be made by the Supreme Court, not by the NRC or the EPA or anyone else.

Up to this point, the policy at our agency has been one of informed consent. We have taken the position

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up to this point to get our licensees to educate the affected people as best we can, and we provide a regulatory guide for that purpose, Reg Guide 8.13, and leave it entirely up to the mother as to what should be done about that.

That way we avoid the invasion of privacy issue, and we avoid the equal employment opportunity issue, and we rather like that position.

DR. STEINDLER: Isn't that equivalent to abdicating your responsibility, however?

MR. ALEXANDER: That is the view that has prevailed, Dr. Steindler, in the Interagency Committee that we worked on so long to develop the Presidential guidance. It establishes a 500 millirem limit for the entire gestation period for the embryo-fetus, and if our Commission complies with the new guidance, then we will make that a regulation.

Now, the only real concession that is made, the only nontechnical consideration that is applied to this decision is the following:

Both the Presidential guidance and the NRC proposed rule would not apply this limit until the mother herself declared herself to be pregnant to her employer. Until that declaration is made, she might look like a dirigible walking around the plant, but until such time as she goes to her employer and says "I'm pregnant," then he

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would be allowed by the Nuclear Regulatory Commission to use the 5 rems per year limit.

So that baby could receive 10 rems, couldn't it? If it was conceived in October, it could receive 10 rems.

But if the woman declares herself to be pregnant, then at that moment the dose limit for the woman and for her fetus becomes a half rem per year.

That is the position we are taking, and I imagine that we will catch a lot of public comment on the position we are taking -- abdication of responsibility. There are others who feel just the other way; a bunch of guys like us shouldn't have anything to say about a woman's decision about her body.

DR. FOSTER: Bob, isn't a major driving force for the language here the probability of a lawsuit for, let's say, a defective baby?

I am thinking here of the fact that obstetricians are major targets at this point for lawsuits. The insurance for baby doctors has gone so sky high because of successful lawsuits that the newspapers at least are saying that OB's are leaving the medical profession in droves, and it is going to be hard to find an OB in practice in a few years because of successful lawsuits on defective children.

What I am saying here is how you write the language in this particular one may have a heavy bearing on

the legal suits which are produced from defective children born to mothers who will claim that they got more than the limit for whatever reason.

MR. ALEXANDER: I think you are absolutely right, and I suppose those legal considerations in the end will be the deciding factor on the decision made by the licensees themselves.

We do not let those considerations enter into our decisionmaking process. That is considered to be a matter between the employer and the worker. We have not considered those points that you just brought up.

DR. FOSTER: Are you saying, then, that licensees, like utility power reactor operators, may then instigate their own limits, which are more restrictive?

MR. ALEXANDER: Yes, and I think that is exactly what will happen. Just the way you stated it. Exactly what will happen.

I think that the pregnancy testing is becoming much easier and much cheaper than it has been in the past, and we know of some companies that do pregnancy testing despite the invasion of privacy problem and despite some of the objections that are raised. They don't want to take a chance. 10 percent of babies that are born in this country have some sort of genetic defect. I say genetic. I am not sure. Have some sort of defect. Only 90 percent are free

of such defects.

So that legal consideration is a very strong one, and the latest information we have is -- with the microcephaly problem, the small head, sometimes associated with severe retardation -- is the limiting factor. I suspect that this regulation, this half rem per year that we are talking about for years and are struggling over, will never be paid much attention to. The people considerations that the licensees impose on themselves will be far in excess of anything that the Nuclear Regulatory Commission would ever impose.

DR. MOELLER: Max?

DR. CARBON: How many fetuses would you expect to see more than 500 millirem in the U.S. today to mothers who are in occupations under the control of the NRC?

MR. ALEXANDER: Now, we have the second question that I won't enjoy trying to answer.

You know, we have no data at our agency. We don't collect very much in the way of data. We can tell you how many workers in certain industries give between 1 and 2 rems or between 3 and 4 rems and how many terminate -- a few questions like that. But we don't impose very much in the way of reporting requirements on our licensees. We simply don't have that kind of information.

What we do is just make all kinds of

assumptions. We have done that in studying this question.

I don't have the answers, but the numbers of people affected are very small.

DR. CARTER: You can put upper limits on it, on the numbers of women employed and of child-bearing age.

MR. ALEXANDER: That is what we do. It is small.

I do think it is important to mention in the nuclear power industry that the feminine workforce is increasing as years go by, and it is also important to mention that in the medical community a large percent -- a preponderance of the workers are female. But there usually the doses are very low. Hardly anyone gets more than -- I think the average dose for those workers is close to 200 millirems per year.

DR. CARBON: Wouldn't it be pretty much the case that people who get high doses in the nuclear industry are jump workers who work here, the place shuts down, they go here, shut down?

MR. ALEXANDER: Transient workers should be broken into two categories. I don't like to lump them that way. There is a group of transient workers that gets fairly low doses. These are not the highly skilled workers. They get them at the labor halls.

But the highly skilled ones, such as those who

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work for Westinghouse, GE, Babcock & Wilcox, Combustion Engineering, and that just spend their working lifetimes going from one shutdown plant to another, they are the high dose group. They are the ones.

We don't know exactly how many people we are talking about.

We think there are on the order of 1000 of those, no more than 5 percent females. That's not a bad answer to your question.

DR. CARBON: It's certainly a very small percent, that 5 percent.

MR. ALEXANDER: The people who challenge this regulation are not people who it would occur to ask the kind of questions you're asking. Nobody in NOW is going to ask those questions. That is the principle of the thing. A bunch of men deciding how much dose those women can get is not acceptable. And I'm sure that we're going to hear from them. But I think, particularly because of the microcephaly problem, and it is a good idea, a dose limit to protect the embryo fetus -- and I use that as a safety argument.

Now the next one is much less important, but nonetheless real.

Extremities. The greatest exposure of extremities is considered by a lot of radiobiologists to be important, and we all know that in extreme cases people have lost their limbs as a result of radiation exposure.

We certainly don't want anything like that to happy.

The ICRP feels that the limitation of 75 rems per year is too much radiation for people to receive on a year by year basis. And the consideration there is not cancer.

It's nonstochastic damage to the tissues of the extremities, particularly the hands. They feel that should be reduced by a third down to 50 rems per year, and to the extent that they're right, as far as I know, they are, then I support that.

And I would add to my consideration here that the dose determination to the extremities are not done well, not done well at all. A recent study performed by us in investigating this question showed that the ring badges that a worker might wear when he's working with a valve or a pump or something like that can be as much as a factor of 400 less than the dose received by the fingertips of that worker. So the dosimetry is terrible, and I think conservatism is suggested, when dosimetry is poor.

So I support reduction of extremity dose limits from 75 rems per year down to 50 rems per year.

So those are the four justifications I give for Part 20 for worker protection.

And then in the area of public exposure, this one will be a little controversial, but I'll mention it, as things stand right now, if a licensee has an accident, such as the one that we just had out at the conversion plant, so that people off-site receive exposures, the regulations that we have not don't really provide a dose limit. So that when these accidents happen, there will be no violation of NRC

regulations, as the result of that accident.

One of the things we expressly wanted to do to correct that, so that if there is an accident such as that and someone gets more than 500 millirems as a result, that would be a violation of our regulation. Then we could deal with it differently.

MR. EBERSOLE: Are you talking about the case where the tank ruptured? We're always fascinated by the particular hazards.

DR. MARK: The real ones.

MR. EBERSOLE: Right. It's usually obscured. The chemical hazards.

MR. ALEXANDER: Now that's one. I like to talk about jurisdiction. This is a particularly interesting one. When you release UF6, ilt hydrolyzes very quickly into UO2F2. That's what's inhaled by the exposed individual.

DR. ORTH: Plus the hydrofluoric acid, don't forget that.

MR. ALEXANDER: That one is a little bit more straightforward, Dr. Orth, in that the hydrofluoric acid at least has its own molecule, and it clearly falls under the purview of OSHA, but with the UO2F2, you have a molecule. With the uranium atom under the jurisdiction of the Nuclear Regulatory Commission and the fluorine atoms under the jurisdiction of OSHA or perhaps NSHA and the Department of

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Labor. So our regulations tend to follow those lines of jurisdiction.

MR. EBERSOLE: I think that that's terrible. There should be an overlap.

MR. ALEXANDER: Before the accident -- let me hasten to explain, before the accident, we had this reviewed by ELD, the Staff legal advisers. They told us that they believe that we ought to consider the chemical toxicity of the materials that we license.

They pointed out that the Atomic Energy Act talks about protecting the health and safety of the public from nuclear materials. It doesn't expressly say that it's all radiological. So at least to a certain extent, I think we a being reasonable in that regard. We don't know exactly where we would come down on this questionj, but we're not unmindful of the chemical toxicity.

And let me say just this one thing.

With regard to uranium itself, for all of these years, for soluble uranium, the intake limit is based on chemical toxicity to the kidney, despite these questions.

MR. KATHREN: The point is, that's low enrichment or unenriched natural uranium.

MR. ALEXANDER: That's the 5 percent enriched.

DR. STEINDLER: The issue in the case of UF6 is not the fact that there's a chemical toxicity to

uranyl fluoride. It's the fact that UF6 splits apart, and you can call it whatever you want to, into a material which you claim not to have any responsibility for, and that's the thing that's killing the people.

There are a fair number of kilograms of uranyl fluoride.

MR. ALEXANDER: The second verse of the song that I just sang was that ELD says that we do have responsibility. It hasn't bee thrashed out in court court.

DR. STEINDLER: The point I'm making is, you don't license HF. If you track uranium in this instance, you'll never get to controlling the real issue, unless you also are willing to talk about the chemical hazards that accompany the use of licensed material. If you're willing to do that, then you can finally get to it. If the only thing is you do, is you sit on uranium like the Magic Dragon and follow it through, you'll never get to the real problem in the case of UF6.

MR. ALEXANDER: I agree. All I can say in our defense is that at least in the case of chemical toxicity to the kidney, we have followed that very closely. That's not a complete difference.

DR. STEINDLER: It's a non sequitur to getting involved.

DR. MARK: Financial uranium. The chemical

toxicity dominates the alpha activity hazard.

MR. ALEXANDER: If it's in soluble form.

DR. MARK: Well, fine.

At what percent do those cross, when the alpha hazard becomes dominant?

MR. ALEXANDER: Using the recommendation, the scientific data base that we follow now, that chemical toxicity changes, changes to radiological bone cancer problems at an enrichment of 5 percent.

MR. EBERSOLE: Was this stuff running around in tanks on the highway?

MR. ALEXANDER: The type of container that ruptured is used as a shipping container.

MR. EBERSOLE: So we have that potential for a crackup on the highway.

MR. ALEXANDER: I wouldn't like to say yes to that, for two reason. That tank was being deliberately heated. I guess a tank could be heated in a gasoline fire connected with it.

MR. EBERSOLE: The tank wouldn't have been designed for a collision impact or anything like that?

MR. ALEXANDER: Oh, those tanks are qualified.

MR. EBERSOLE: Are they qualified for hypothetical impact damage? They could be just rolling along, just collilde two of them at 80 miles an hour.

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MR. ALEXANDER: I would be guessing, since I haven't looked them up. That's true for any type of shipment that I've ever dealt with. The answer is almost undoubtedly yes.

The other point is that this tank was overloaded. You have human error involved too. It was under too much pressure.

MR. EBERSOLE: Administrative error. You can always argue that you shouldn't have had that error.

MR. ALEXANDER: I thought they normally used a factor of 10 pressure.

DR. MOELLER: Rod. And then I think we've got to look at 10 CFR 20.

MR. KATHREN: One impact of the cost of this, Bob, you said $33 million, and I did a calculation, and I hope it's correct, I assumed that all of that cost would be borne by the reactors, the power reactors. I just assumed this. And I said that they're going to pay for it all. And there are 66 reactors, just going down the assumption trail, producing -- and I know this is high -- 1000 megawatts electrical and a capacity factor of 70 percent, da-da, da-da.

And I ended up, if they paid this entire cost in one year, no spread at all, it would amount to somewhat less than 1 cent per kilowatt hour. And if only half the costs

went to the reactors, and it was spread out over five year,s which is probably a more realistic estimate, the cost is then less than 1 mil per kilowatt hour.

So I think that puts another perspective.

Somebody raised the question of how much does this cost in the aggregate.

MR. EBERSOLE: Down in the noise.

DR. REMICK: But I would question the 33 million, with the number of licensees. 33 million, to me, is small, when I look at just the time it takes to read the new document, and the typical installation people reading and understanding it. You know, really.

MR. KATHREN: The reading is cheap.

DR. REMICK: You're talking about tens of thousands of people reading and understanding it.

DR. CARBON: And 33 million is 33 million.

DR. FOSTER: I would submit that those of us who live in the Pacific Northwest, 1 percent per kilowatt hour is exorbitant, and even 1 mil is highly significant.

MR. KATHREN: That's about a 3 percent 1 mil is about three percent of the cost, the commercial residential cost per kilowatt hour in our area, which is largely BPA power, which is, of course, very cheap. And if you look at Consolidated Edison's rates, 1 mil is probably insignificant in the aggregate.

DAVbw

I'd like to make this point, that I don't think that cost of 33 million, it depends again on how you want to look at it, and I believe, Bob, just looking at your table about concerns and benefits, I believe, if anything, you've understated the benefits.

But that's only my opinion.

MR. ALEXANDER: You felt I understated them?

MR. KATHREN: Yes, sir.

DR. MOELLER: Okay. We've got 30 minutes.

What should we do? Go through your charts or have general questions?

MR. ALEXANDER: I'm learning more from the general questions, but I'm here to do whatever you want.

DR. MOELLER: Why don't we have any general questions or comments?

I guess I found on the planned special exposures, that although I thought I understood them in the SECY document on page 5, I did not understand it.

MR. ALEXANDER: Let me discuss it for a moment then.

The planned special exposure is intended to provide flexibility, where flexibility is justifiable. I don't look at it as a procedure that exactly replaces the 5 times N minus 18 formula. The present rules allow 12 rems per year, provided that the average dose to the individual

does not exceed 5.

So you have an upper limit and an average that you're looking at.

Now what we're doing here, so that provides a great deal of flexibility, and it's used considerably and has been used more in the past.

It's been used considerably. And most of the people that I thought were in on the original establishment of that system feel that it's been abused. It was never intended that anyone would get more than 5 rems per year on a regular basis, but that has happened, particularly among the groups I mentioned earlier.

So flexibility, without the planned special exposure is gone without the 5 rems per year upper limit. The new system doesn't include anything about an average at all. It just talks about that upper limit.

Then there's an implication that the average should be .5 rem per year. That is made in the ICRP 26 document, not in the new Part 20..

The planned special exposure is intended, then, to provide the flexibility that is lost, but it's to be administed in such a different way that I don't think they're comparable -- I don't think they're even comparable, even though the original intent in both cases was the same.

DR. MOELLER: Let me read you, though, the

sentence. Unfortunately, it's not in the 10 CFF 20. It's in SECY 85-147 of April 22, 1985.

Here's what the sentence says:

"Under this proposed provision, and individual's dose, due to all planned special exposures, may not exceed a value numerically equal to the annual dose limits in a year or 5 times the annual dose limits in a lifetime."

MR. ALEXANDER: Those are the two limitations on the use of the planned special exposure. Let me state them in different language, if you like.

DR. MOELLER: "Do not exceed the annual dose limit a year" is 5 rem then. The planned special exposure should not exceed 5 rem.

Now 5 times the annual dose limits in a lifetime --

MR. ALEXANDER: Let me explain, Dade. I think everybody has gone through the ordeal of getting language approved through legal channels, and so forth. Sometimes it's not as clear as it can be, when it's stated verbally, so let me try.

The dose limit is 5 rems per year for routine conditions. If an extraordinary occurrence occurs, such that it would appear for the overall safety of the

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community or the workforce in general, for example, to use a very expert welder, whose capability is the best of anyone available, an additional 5 rems -- up to an additional 5 rems, could be allowed for that man to do that welding job, without exceeding NRCs regulations.

The same thing might come up again later in the year, and you'd want to use that man again. It might come up a third time, but the first limitation on the plant special exposures is that the man cannot get more than an additional 5 rems from all of those planned special exposures in any one year. So no more than 10 rems in any one year, including the routine 5 rems per year that he would be allowed under the regulations, plus an additional 5 rems per year for these very special exposures.

DR. MARK: Is this called out whether this is calendar year or 365 days?

MR. ALEXANDER: Calendar year.

DR. MARK: So then he could do on on December 31st and another one on January 1st.

Isn't that a bit ridiculous?

MR. ALEXANDER: Not at all. We're seeking lifetime control here. And as Dr. Carter as pointed out, we don't think that the dose control issue is a serious one. So over a two-year period, whether the guy gets his dose on December 31st and January 1st, we think the risk would be

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approximately the same than if it were distributed equally over a two-year period.

The second restriction is that this fellow can't get this extra 5 rems every year. He can only go up to 25 rems of planned special exposure. After that he is through. He can never receive any more.

The justification, I think, for the 25 rems is even if you look at the worst case that is only a 10 percent addition to a lifetime dose. If you consider a person that might work for 50 years and receive 5 rems per year, might get in an extreme 250 rems, that would only be a 10 percent addition to the maximum dose that that person could receive.

So what we are saying there is a virtual maximum of 250 rems per year, he is at risk for 275 rems per year, that is not a dramatic increase. The strains under which this planned special exposure can be used are so strenuous that we would believe that additional risk would be justified on a public safety or perhaps a worker population safety basis.

We really don't think today that this planned special exposure provision will be used at all. Let me say why.

The conditions under which it can be used are not conditions that the nuclear power industry will like very much. They have to -- right now they don't really have to do anything if somebody goes up to 12 rems in a year, and

under this planned special exposure restriction, the justification for the exposure has to be made in advance and approved at a high level within the plant, recorded, documented, which is something they don't like to do at all, then subject to review by our inspectors. And if the inspector is not satisfied with the justification presented for that planned special exposure, the plant is subject to citation.

If you have ever visited one of those plants while they are preparing their maintenance, their outage, for everything they are going to do, they have those charts all around the walls and meetings are held. If you think they would deliberately plan something that would require all of that for the regulatory commission, I would be very surprised if that ever happened, and I will bet you, if it ever does, that it will be something that really needed to be done to prevent an accident.

So I think there is a tremendous difference between the planned special exposure provision and the old 5 times N minus 18. I think that proposal is a good one.

DR. CARTER: You are pushing in this direction and have been for some time now for various reasons. Let me ask you a question that might have some practical significance.

For example, what kind of events might it take to

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preclude these regulations from going into effect? In other words, how could they be stopped?

For example, if your public comments are overwhelmingly against them, for example, what impact does this have on your practice?

I presume there could be court cases and this sort of thing.

Have you given that any thought? Is this inevitable or isn't it?

MR. ALEXANDER: The first answer is: we think the only way that any of our regulations like this would be set aside by a judge is if we failed to follow our own procedures.

My job is to do everything I possibly can to make sure that we follow our own procedures, that we don't violate anything, that we do everything right.

So we are giving a lot of attention to that because we could lose the whole thing that way.

Another way we could lose it is if, when we come back with the effective rule, if the CRGR would recommend to the EDO that this whole thing be dropped -- that would be our recommendation to the EDO -- it would be up to him to decide whether or not to accept that recommendation.

But it has been accepted many times. So I don't think that would really surprise anyone.

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Another way would be to get it to the Commission and it failed to get three votes. It has to have three. Now, that one is the $64 question -- older ones will know what I mean when I say the $64 question -- because if one of those Commissioners -- if his staff man says, look, if we have got 3000 negative letters here saying if it ain't broke don't fix it, nobody wants to do this, and not everybody believes that there is going to be much risk reduction anyhow and the cost is reasonable, but on the other hand, five years ago the President signed guidance to federal agencies saying that this ought to be done, but, by the way, you don't really have to do it because you are an independent agency and you report to Congress instead of the White House -- I wouldn't guess what any one of the five Commissioners we have now, how he would react to that advice.

But you have got to have three votes to make something like this go into effect.

DR. MOELLER: Forrest.

DR. REMICK: We are on general questions about this?

DR. MOELLER: Yes.

DR. REMICK: Am I correct that the current Part 20 basically addresses only routine releases?

I thought you indicated a little earlier that it

was going to be modified and you would now incorporate accidents in there.

MR. ALEXANDER: Not directly. What the regulation does is state in unequivocal terms that if anyone receives an exposure in excess of 500 millirems, that that would be a violation of NRC regulations. It doesn't use the word accident anywhere, so that that applies to routine operations or accidents.

The reason I put emphasis on the accidents is there are other much more stringent regulations that control routinely effluent positions. You have 40 CFR 190 of the EPA, which has a 25 millirems per year limit, that applies to some facilities. In our own Appendix I, Part 50, we have what amounts to an 8 millirems per year provision.

So those would always be in control. But if there is an accident and if our regional people felt that a citation was in order for exceeding the public dose limit now, there will be such a limit.

DR. REMICK: The point I am trying to get to is it seems to me that that is a dramatic change from Part 20, and I wonder if that is really spelled out for public comment.

DR. MOELLER: Let me comment, too, because I am with Forrest.

You are establishing in the new revised 10 CFR

20 a 5 millirem limit for the general public, but the example you gave us was an accident, and I would not think it would apply in an accident.

MR. ALEXANDER: The reason we got interested in that was because of those releases in Arizona of tritium. There were measurable levels of tritium in the pool. When we attempted to correct the situation through the statement in Part 20 now, about the 500 millirems, it wouldn't stand up in court.

DR. MOELLER: Now, if a nuclear power plant had an accident and someone receives then more than 500 millirem, you are going to cite them?

MR. ALEXANDER: Yes. I am sure the citation would be considered, even if it was a very small accident.

My point is if they got 9 millirem we would probably cite them.

DR. MOELLER: But the implications here are bad in one sense. I think again I am saying what Forrest is thinking. You are telling the public that if in a major accident anyone gets more than 500 millirems it is terrible.

DR. REMICK: And I wonder -- I have two concerns.

Do you adequately notify people that Part 20 is being changed? To me that is a dramatic change.

Then I ask the next question: how does that fit in with the Commission's safety goal, which covers the routine as well as accidental releases?

MR. ALEXANDER: Now, I have a third difficult question. See, I have a brief reprieve, though.

I believe you asked some question just before you asked -- I was so shaken by the safety goals issue that I forgot the first question.

DR. REMICK: Well, one is I see this as a dramatic change of your treating accidents. I could be wrong, but if that is such a change, I think somewhere up front of the release in the Federal Register that should be made abundantly clear. Part 20 now includes accidental releases.

MR. ALEXANDER: I don't think that is a change. For example, if a worker right now -- if an accident occurs and a worker gets 4 rems during that accident, then the regulations have been violated. He receives more than 3 millirems, so there was a violation of the regulations.

If there is a plant accident and someone in the public gets 30 millirems due to this accident, the 40 CFR 190 limit is 25 millirems. We impose that limit on Part 20. So it would be a violation.

But there is a hole in the regulation for facilities to which 40 CFR 190 and the appendix do not

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apply. We are talking about reactors. We are talking about other types of facilities. You have got a hole in the regulations. So we don't have a basis for citations on a dose basis, a public dose basis.

That is the hole we are trying to close.

DR. REMICK: So you are saying that Part 20 currently does apply to a number of licensees and nuclear power plants for accidental releases?

MR. ALEXANDER: Part 20 is intended to control routine conditions, both occupational and nonoccupational. There is no statement anywhere in Part 20 that excludes exposure from accidents.

DR. FOSTER: But, Bob, you are really confining this to Part 20. You are not confining it or you are not encompassing the regulations as a whole. You have got your tech specs, and if you have the kind of release which results in doses of greater than 500 millirem, gosh, you are so far over your release limits that the plant is surely going to be cited on that basis.

So what I am saying, there is ample reason for citing a plant for the release without having to rely on a Part 20 type new exposure limit for the public.

MR. ALEXANDER: I suppose that in most cases some sort of negligence that would be a violation of NRC regulations could be found, but we would like to be in a

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position to cite these offenders on the dose basis, also.

For certain types of licenses, we do not have that coverage in our regulations right now.

DR. CARTER: Bob, let me a ask a question in a little bit different way.

I guess basically, are accidents going to be handled differently than routine operations?

It sounds to me if you are going to apply or want to apply routine situations, routine standards if you will, to accident cases, is there going to be a difference between those situations?

Certainly, traditionally we have always allowed larger doses in accidents.

MR. ALEXANDER: It might be a cavalier answer, but if the licensee allows someone to receive more than 500 millirem and we challenge him on that and he says I didn't mean to, it was an accident, that won't get him off the hook. He has still violated the new regulation. That is not the case.

DR. MOELLER: Let me interrupt. To me, maybe we all would have felt better if you had said the following -- and correct me if [illegible]g.

You are saying the revised 10 CFR 20 for the first time puts in there a 500 millirem a year dose limit for individual members of the general public. So you said

you did not have that before, you will now have it.

Then as an example, you might have simply said if you had a facility that is not covered by 40 CFR 190, it doesn't come under the EPA law, then you could apply this limit to them.

And then use as your example that they simply allowed too high a release, continuously, over too long a period of time, and someone got more than 500 millirem. Then you can take regulatory action and not cite it as an accident.

MR. ALEXANDER: This wouldn't make any difference.

MR. EBERSOLE: If there has been a void in this, it came up at about 68 or -9, where the guidelines as to what you could do -- well, let me put it this way: "containment" is a contradictory term. It has to contain radiation but let heat out.

That presents a problem. If one goes, the other tends to go. So containment bottles up the heat source and you have got to get it out. So you can enormously reduce the problems in extreme accident conditions if you would bleed off some of the componentsd.

How do you rationalize limiting the dosage against the background of avoiding an extremely severe dose?

MR. ALEXANDER: That came up in the TMI

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situation.

MR. EBERSOLE: But the hazard was over there. I am talking about preliminary to even damaging the core.

For instance, the GE plants now invoke as a preliminary preventative measure open boiling of the suppression pool and subsequent release to atmosphere, so that we would have only a trace of small radioactive releases.

It is something you should consider as to what sort of preanalysis you did.

We used to say at Browns Ferry we should have a brass cannon to blow open the containment. NRC wouldn't even let us open it. Everybody threw up their hands in horror.

But in a practical sense, you have to face the fact that there are situations where you must release radiation to preserve containment.

MR. ALEXANDER: We recently looked at that question, Mr. Ebersole, in connection with a request from the Commission to develop such guidance in advance for the nuclear power industry in case an accident like TMI happens again, so there wouldn't be delays of waiting for the NRC to make decisions and we could go ahead with advanced guidance particularly of that type.

The staff has recommended against developing

such guidance.

One of the arguments that we gave -- and I believe the Commission has voted on this, too. I believe the Commission decided that the Commission does not have to develop this guidance -- and the reason we gave, along the lines of your question, is that as an accident is progressing, before it actually occurs, things are happening too fast to involve the NRC anyhow.

MR. EBERSOLE: You should already know what you are going to do.

MR. ALEXANDER: And as far as the aftermath is concerned, our experience at TMI, I don't think any special dispensation regarding releases by the Commission were ever necessary.

MR. EBERSOLE: You are talking about releasing the noble gases way after the accident. I am talking about a much more tense situation, where you must release to preclude catastrophic damage.

MR. ALEXANDER: I don't know if the NRC has left us to make that decision or not, and I doubt that we have very many people who want to make that decision.

MR. EBERSOLE: They won't do it fearing the wrath of NRC in case they didn't really have to. It is a probabilistic thing, yet knowing full well if they don't --

MR. ALEXANDER: The safety goals issue that you asked about was raised by Commissioner Asselstine, and the staff prepared its response to the question about the safety goals and the consistency of the safety goals, the lack of consistency between the staff's recommendation for a de minimis level and the use of the de minimis level of 1 millirem for calculations.

And perhaps the best way to handle that would be to submit that document to Dr. Moeller for inclusion in the

minutes.

DR. REMICK: That was another question I had.

How does that de minimis -- proposed de minimis level compare with the safety goal?

So you have a document --

MR. ALEXANDER: That has been documented, and it is my understanding that the staff's recommendation was accepted by Commissioner Asselstine. So I believe that issue has been resolved.

DR. REMICK: With him?

MR. ALEXANDER: With all five of the Commission.

DR. MOELLER: Let's see, we are running out of time. I have a couple more quick ones that I would selfishly like to have clarified.

I am reading from this SECY document again, and I realize it is not the law or anything, but it applies exactly to what we have been talking about, the whole body dose limit of a half rem per year for an individual member of the public.

It says the proposed revision would explicitly set the dose limit at that level, considering all sources of both internal and external radiation other than natural background, which we all agree on, medical diagnosis and therapy, which we have always agreed on -- and then it goes on -- and radioactive material disposed into sanitary

sewage -- they mean sewers -- according to 20.1003.

You are exempting doses that anyone receives due to medically used -- no, you are exempting all radioactive material discharge into sanitary sewers, or is this just an error in this SECY?

DR. CARTER: I noticed that, and I assumed that that referred to exemptions for tritium and thorium.

DR. MOELLER: Well, go on from there and tell us, if you could, quickly what are the rules for handling of medical, radiopharmaceuticals that the patient has received? What are the proposed rules?

MR. ALEXANDER: I am not sure there are any changes.

Diane Flack, are you still here?

Well, although she is not with the Commission anymore, she is doing legitimate work these days, and she worked on this rule for a long time for us. Maybe she would be the best one in the room today to ask whether or not we have made any change.

Would you like for us to come back to you in a couple of minutes, or are you ready now?

MS. FLACK: Let's see. There is a change in the medical area.

DR. MOELLER: You know, at one time they were going to have the medical people hold the wastes.

MS. FLACK: They decided not to do that. I know that because of the potential occupational exposure to the workers if there were spills.

I am trying to jog my mind. In Section 25, it talks about the medical. There is one change, and it has to do with the posting of the rooms. The exception from posting rooms or other areas of hospitals, because of the presence of patients, containing byproduct material would be amended to require a posting of the rooms or areas used for patients being treated with therapeutic quantities of unsealed radioactive material or with radiotherapy sources.

That is the only change in the medical area. That was recommended because it makes it consistent with Reg Guide 10.8.

DR. MOELLER: Thank you.

Mel.

DR. CARTER: But I don't think this speaks to your point. I noticed the same thing.

This is a very distinct difference as far as I can tell. You are exempting background, and you are exempting medical. But then there is this added statement that you are going to exempt certain materials from the biomedical community presumably or the medical community discharge to sewage.

I have never seen that anywhere before.

DR. MOELLER: I never have either.

Well, do check that and let us know.

MR. ALEXANDER: I think the rationale is that when you release materials for uncontrolled release you are saying that regulatory controls -- governmental interference is not necessary for those, and later on if you are doing an evaluation to determine compliance with those limits, it wouldn't make sense to include these de minimis level doses in such an evaluation.

DR. CARTER: But what I don't know is whether these specifically apply, for example, to things that are already exempt now. That is, namely, specified amounts or specified concentrations of tritium and thorium and carbon-14.

MR. ALEXANDER: I believe that is the intent. It is just that broader language is included to provide for the future and we will have de minimis levels established on a wider basis.

DR. CARTER: But again that has never been included before. It is new and different.

MR. ALEXANDER: That is true.

DR. MOELLER: Rod?

MR. KATHREN: Bob, since radiation protection in a sense parallels reactor safety and since in the reactor safety area some qualifications are imposed upon reactor

operators, was any thought given in this to imposing parallel qualifications?

I hate to use the word "licensing" because that is done to reactor operators, but was any consideration given to some sort of qualifications for those responsible for the radiation protection program?

MR. ALEXANDER: Yes, and the decision was that the way we are handling that right now appears to work. We have that covered in regulatory guide.

The only thing we say along that line is if the radiation safety officer has been certified in a reactor specialty by the American Board of Health Physics, then those qualifications are automatically acceptable to the NRC. That certainly doesn't say that he has to be.

MR. KATHREN: That is for licensees or for reactor people?

MR. ALEXANDER: I think that particular reg guide applies across the board -- oh, no, that particular reg guide applies only to reactor licenses. I think that is the only place that we make that statement.

MR. KATHREN: What is wrong with a comprehensive certification then applying to licensees?

MR. ALEXANDER: We don't want to say that we will automatically accept a person's health physics qualifications to be the radiation protection manager at a

nuclear power plant if he has never seen one. We only want to do that in advance for people who someone has determined that they are qualified.

MR. KATHREN: We are not communicating. You have a regulatory guide that says that specialty certification in the field of power reactor health physics is an acceptable qualification for the radiation protection manager at a nuclear power reactor. But there is no parallel radiation protection -- excuse me -- there is no parallel regulatory guide which says that comprehensive certification is an acceptable qualification for the radiation protection manager or officer or whatever.

DR. MOELLER: At a university, a hospital?

MR. KATHREN: Or any other place.

DR. MOELLER: That is a good point. What reg guide is that that covers the nuclear power plant RPM?

MR. ALEXANDER: Is it 1.16?

MR. KATHREN: 1.8, and I think also an 8.8 and a 3.10. I think they are kind of parallel.

MR. ALEXANDER: But those just reflect the 1.8.

DR. MOELLER: I agree with Rod that you might give some consideration to expanding that.

MR. ALEXANDER: I will be glad to share that. I think that would be a good comment for you to make, and it would be a timely one.

I wouldn't mind telling you how that happened, why that happened that way. It is sort of interesting. It goes back quite a few years to when Lester Rogers was here.

Les Rogers and I went to see the American Board of Health Physics and asked them to establish this special certification for reactor health physicists, which they agreed to do, because we wanted to take advantage of the American Board of Health Physics program.

The reason for the specialization was, because of the 100 health physicists who were grandfathered into the American Board of Health Physics program, the people here weren't willing to accept a priori qualifications of those 100 people for anything because they had not been tested. That is the answer.

Now, I think a lot of those are retiring. So maybe we could reopen that question.

MR. KATHREN: I make this point. There are individuals certified in the specialty practice of power reactor health physics who admittedly were comprehensively certified first. You are saying that may not be acceptable and they were grandfathered without examination into their power reactor health physics certification.

So your argument, if it were valid for one, should be valid for the other?

MR. ALEXANDER: They have a different office

director.

DR. MOELLER: Any other questions or comments?

We are at the end of the time.

Richard and then Mel.

DR. FOSTER: Would anything you are doing here in the proposed 10 CFR 20 rules disturb in any way Appendix I?

MR. ALEXANDER: Did you say disturb in any way Appendix I?

DR. FOSTER: Disturb Appendix I. Would that be affected in any way?

MR. ALEXANDER: No. Here is the thing about Appendix I. Appendix I applies to specific plants. That 8 millirem dose I mentioned applies to the dose from a specific plant. The Part 20 dose limit of 500 millirems and the associated reference level of 100 millirems per year apply to the dose received from all plants.

So there is that difference in the application.

DR. MOELLER: Mel and then Carson.

DR. CARTER: As a little bit of a preamble, Bob, I really want to comment on the time ingredient, but having sat -- I am sure you remember -- through the advent of SI units at the Health Physics Society and also the NCRP, which was similar but on a little grander scale, the first thing is in terms of your time.

I don't think, for example, that 30 years or by

the time you get around to implementing these there is going to be any big problem. It is closer to 40.

I don't really think that is too long a period when I think of other fundamental changes in something like radiation protection standards. That is the first part.

The other one related to the proposed five-year implementation and familiarization, or whatever. I personally think that period of time is probably quite reasonable.

I think you are going to need this, and I think, obviously, information and educational programs from the various people that are going to be involved in this -- there are going to be large numbers of them -- are extremely critical as far as minimizing problems, whether they be calculation of doses and what not.

I guess a lot of people in educational institutions have started at least introducing the ICRP philosophy if you want to call it that, or concepts, and the same way with SI units. But that process has sort of just begun. It is going to take a long period of time.

So I guess I would admonish the NRC, for example, and those connected with this to use this period of time, assuming it is five years or a little bit longer, to really mount a substantial program, whether you encourage it, whether you support it in other ways, in terms of the

rather broad educational program, to essentially instruct, inform, and increase the level of understanding, and so forth.

So I wanted to comment on that.

MR. ALEXANDER: I couldn't agree more, but my hopes for being able to conduct such a program are not high.

The reductions -- this is something your committee, I suppose, subcommittee, has to come to grips with again this year, Dade -- the reductions in the health physics program at the NRC are continuing. It now includes the health effects area, also.

The budget, the research budget, technical assistance for the two areas, about three years ago was running around $5 million. That is the occupational health effects area, and we had something over 20 people involved, and what we are looking at right now, the most we could have for this program for fiscal '87 would be $600,000 and an undetermined number of people. It would certainly be less than 12 people.

So these are reductions in the effort, and whether or not those of us in management are making good decisions about this I guess is subject to challenge, but I believe Mr. Minogue stated to Dr. Siess' committee that we may not even have the resources to continue this Part 20

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effort. We may have to or we may decide to withdraw the proposal simply on the basis that we don't have the staff resources to handle all these public comments and to modify the regulatory guides.

DR. MARK: I don't think there's time to get into a discussion. I would merely like to serve notice that I feel discussion is required if there is going to be a followup, and so forth. And that's in your de minimis package.

The only number that is clearly identified there is a tenth of a millirem per year. That is such a ridiculous number that one has to ask how you got it, and explain how you got it.

But, it has really no likely meaning. It's taken from the linear extrapolation of the Baer 3 dose effect curve. If we heard Mr. Rossi, it can be a factor of 100 or so, that level of reading the curve. But, obviously, you can't read any curve at that point and make common sense.

We do refer to the variations which have been suggested as a place to look, which would call out for some possibly 100 millirem or perhaps tens of millirem as a de minimis level. I think that could be better understood.

It seems to me very doubtful that pointing to this level of a tenth of a millirem per year as if it had a legal significance should really be followed through with.

And I think, without asking for comments, I believe this deserves a great deal of discussion. That's all I would like to say.

DR. MOELLER: We are going to discuss de minimis

later today and we'll have an opportunity. Will you be around later today? Why don't we do that, because it is on the agenda.

MR. ALEXANDER: Could you give me a time?

DR. MOELLER: We don't want to ask you to stay all day. Let me see...at the moment, it's right after lunch. Yes, it's 1:30 to 2:30. Joyce Davis will be here.

MR. ALEXANDER: Could I make a few comments at 1:30?

DR. MOELLER: Yes.

Let's do that. Let's take a break and Dave Harward tells me that he doesn't need the entire time. So I don't want to get us too far behind schedule today. Let's take a break.

(Recess.)

DR. MOELLER: The meeting will resume. We have, for the next hour and a half, a schedule of several presentations, beginning with a review of AIF, the Atomic Industrial Forums, activities related to 10 CFR 20. David Harward is there for that presentation.

Welcome, David. You can either sit at this table or stand.

MR. HARWARD: Thank you very much, Dade. It's always a pleasure to appear before your subcommittee. I learned something new in your introductory remarks this

morning. I have been talking to Bob Alexander. Some people at the far end of the table here might have a hard time believing it, but I'm a grandfather and I remember this...

DR. MOELLER: Congratulations. You're even partially bald.

(Laughter.)

MR. HARWARD: We haven't compared notes on that in a long time. We've appeared before this subcommittee on several occasions on the subject of Part 20, first in 1980 when the advanced notice of rulemaking came out, and again in October and I guess November of 1983.

Lionel Bruce, the chairman of our Radiation Protection Subcommittee, made a presentation on what we had found in the Part 20 drafts that we had discussed with the Commission staff over a period of several years.

Bob told you about the informal way in which review was done to get inputs, so they could get the most practical regulations possible.

The committee thinks that was probably one of the best procedures they've ever seen on a rule, particularly because of its high degree of complexity. We'd like to encourage that type of procedure on other future, complex rules.

I would like to just briefly, if I could, summarize a couple of the highlights that we presented at

that time and to indicate that probably some of them have changed. The subcommittee has not had an opportunity to review the recent proposed rule that just came out Thursday, obviously. But I think we know a little bit about what's in there, and maybe I can give you some idea of the kind of things we think were improvements from the earlier drafts that we were involved with.

Getting to one of Ron Kathren's points here on the use of SI units, we did support the staff's position on SI units and thought they should be the primary ones used for the regulation.

The committee has no problem in talking to each other or in talking to other HP's, et cetera. The problem comes when you have over a hundred thousand workers and the general public, who we think have finally become somewhat knowledgeable, if not very much, on the units of rems and possibly curies, and the like.

We probably think there's still a long way to go there. The committee also supported NRC's emphasis on the ALARA concept as it was outlined in the proposed regs at that time, where it made it an industry program rather than a regulatory requirement.

They also suggested the need for a long implementation period for the regulation because of its complexity, and we see where a five-year implementation

period has now been suggested for the proposed rule, and think that would be probably a pretty good time period.

DR. MOELLER: Excuse me, Dave. Your comment on ALARA would be contrary or opposed to what they're doing.

MR. HARWARD: No, we support it. They have in there that it's really a management type program rather than appearing in the regulations where it would be very specific as to what would encompass an ALARA program.

DR. MOELLER: Thank you.

MR. HARWARD: The committee was also very supportive of a de minimis concept in the regulations. We had some disagreement with some of the early numbers for individual exposure. This is another point that we're going to go into in our review coming up.

The committee was also supportive of a provision for the in vivo fetus protection and I doubt if the committee can address exactly how this should read. This is probably, as Bob said, a legal matter. And I'm sure it's going to be battled out in court and in various legal circles in the future.

The committee also believes that the annual limit of 5 rems per year as proposed is a good limit. In fact, the industry has already taken very strong steps to adopt the 5 rem per year limit, particularly through the INPO organization. And that would include, by the way, as I

understand it, provision for their contractors to follow a similar type of rule for their employees.

In addition to that, we recommended that the NRC retain the 3 rem per quarter limit as it was appearing in the current regulations. The committee did express concern about the cost benefit aspects of the rule because it was rather expensive. And after the subcommittee briefing that we gave in October '83, Dade had asked us to get some cost estimates together for presentation to the full committee.

During that presentation, we indicated some of the preliminary estimates that we did come up with. The initial costs to implement at that time were estimated to range anywhere from $9,500 to $708,000 per nuclear power station, and from zero to $420,000 for annual maintenance costs.

DR. CARBON: Excuse me. Would you repeat those numbers?

MR. HARWARD: I don't know if they're still applicable or rot, but $9,500 to $708,000 per station for initial costs, and the maintenance costs were zero to $420,000.

MR. KATHREN: Is that maintenance cost continuous over the life of the plant?

MR. HARWARD: That's my understanding, right, not considering inflationary.

DR. MARK: If one wants a working value, do you take the geometric mean or the arithmetic mean of the numbers?

MR. HARWARD: We didn't come up with an average. That's the next point I'm going to get to.

We also did similar work for a fuel fabrication facility about that same time, or actually a little before, that the National Studies Project contracted with Radiation Management Corporation for a study directed primarily at the recordkeeping aspects of the provision of Part 20.

This study was completed in January 1985 and was published at that time. And they have made available a copy of the Executive Summary for you as a handout. I won't go into it in great detail except to indicate that they also looked at implementation costs of the proposed Part 20 reg, again based on the 1983 August draft that was developed by the Commission staff.

DR. CARTER: Excuse me. The question I have is about the extreme range of values you get, particularly the lower value, the range from zero to a pretty substantial amount of money.

What's the difference?

MR. HARWARD: Why the zero? The zero was the station that had already implemented ICRP 26 regulations on their own, as long as they were at least as stringent as

the Commission regulations. So their implementation costs were virtually zilch; whereas, the 708 or whatever it was number represents a high training cost largely, procedures change and recordkeeping costs.

I believe these are spelled out in more detail in the statement that we made in 1983.

DR. CARBON: The NESP summary seems to have a maximum of 480. It says: the estimated additional and the annual.

MR. HARWARD: That's what I was getting to as my next point. The numbers that I gave you earlier, we had a group of utilities and fuel fabricators that sat around the room for a day trying to come up with some rough estimates, really to answer the question that Dade raised before the whole ACRS.

So, of course, the NESP studies went into great detail and they came up with a $480,000 initial cost and roughly $250,000 a year annual maintenance costs. And the fuel fabrication implementation, very similar to what NRC came up with in the contract that they had on this subject.

This NESP report reviews in great depth the subject of summation of external and internal doses and looks at the cost aspects of this particular change in the regulations.

If you have detailed questions on this particular

aspect of the report, or any detailed aspects of this report, we'll be happy to provide them to you.

The subcommittee and others in the industry will be making use of this report during the upcoming months to develop their own input to the NRC on this rule.

Finally, I'd like to mention one other aspect of Part 20 that is not covered in this rulemaking that is of some concern to the subcommittee and others on some of our environmental committees at AIF.

Sometime ago, the staff initiated development of a residual radioactivity limit for decommissioning power plants. In its comments to the Commission on the proposed rule on decommissioning this past summer, our subcommittee on decommissioning stressed the importance of having such a limit as this available to the industry for developing cost estimates.

As you undoubtedly know, cost estimates are extremely important to utilities when they're dealing with their state regulatory agencies in a rate setting. And the residual limit that might have to be met at an individual facility is extremely important in arriving at a cost estimate.

We would just like to encourage the staff to try to get this standard out as soon as it can. We do understand tt EPA is working on a decommissioning limit of

some type. But they're on an extremely slow schedule. So I would like to make that particular pitch.

Dade, that's about all I have.

DR. MOELLER: Do we have questions for Dave?

(No response.)

DR. MOELLER: Thank you very much. That's great. Let's move on then to the next item on the presentation, which is an Overview of the AIF's National Environmental Studies Project. That will be presented by John Robinson of Yankee Atomic Electric.

Welcome to the subcommittee meeting. It's a pleasure to have you.

MR. ROBINSON: Thank you, Dr. Moeller, members of the subcommittee. I certainly appreciate the opportunity to come in and discuss the NESP program with you here this morning. We hope this session will be useful.

Before I start, I wanted to introduce the NESP staff who are here today. We have Scott Leiper, who is the NESP Program Manager; and Melinda Renner. These are the people really responsible for the day to day management and administration of the NESP program.

I guess I will be introducing the chairman of the task force. And we also have several consultants.

(Slide.)

The NESP program was established back in 1973 in

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response to the National Environmental Policy Act and the rules and regulations that ensued from that act.

NESP started as a cooperatively-funded program that was to provide technical reports to the AIF members, the public, government officials and others that are interested in that type of environmental information. To date, there have been 32 reports published. There are 11 now which we have in the pipeline. We expect that about four of these will be issued very shortly.

The NESP program initially dealt with environmental and sitings issues primarily related to the preparation of environmental reports. Back in 1973, when the program was started, I think the industry was rather low on the learning curve as far as knowing how to respond to the various issues, but some of the earlier reports dealt with issues such as siting, siting alternatives, monitoring methodology, how to assess the report and construction impact on power plants and how to determine the social impacts of power plant construction.

So, at that early point in the program, this was very helpful to those in the industry struggling with trying to come up with ways to meet the requirements.

Over the years now, the program has moved more towards the operational and near-term licensing activities.

For example, now the primary focus of the program is in issues related to radioactive waste, occupational exposure, emergency planning issues, and the important thing about NESP is that it constantly readjusts its focus. They have to look at the program on an annual basis and make sure it is tracking the needs of the industry.

Currently, there are about 95 sponsors of the NESP program.

I should mention that NESP is a program that is operated within the framework of the Atomic Industrial Forum; however, not all members of the forum are NESP members.

NESP sponsors are a subgroup within the Atomic Industrial Forum. The sponsors are generally the nuclear utilities, the architect engineers, reactor vendors, the consultants and service organizations.

I might add, also, that there are several foreign supporters of the NESP program.

DR. MOELLER: How much money are we talking about? What is the typical annual budget?

MR. ROBINSON: Correct me if I am wrong --

MR. LEIPER: Contributions amount to about $500,000. There is other income, sales of reports, a

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couple of other items, something upwards of $600,000 -- 575,000.

DR. MOELLER: Thank you.

Jesse?

MR. EBERSOLE: If I were in the library at that time, could I draw a conclusion as to what that meant?

MR. ROBINSON: The focus of the program has shifted over the years to certainly more than just environmental issues.

MR. EBERSOLE: So it is related more to the atomic issues?

For instance, I would like to cover the petrochemical domain. I think that encourages more badly needed industry.

(Slide.)

MR. ROBINSON: Looking at some of the benefits of the national environmental studies project, certainly the industry avoids duplication of effort. It is cost effective. In some cases it tends to come up with standard ways of addressing environmental issues between companies.

They are also able to pool the technical talent within the industry. Here we get a broader spectrum of knowledge and experience to use to address these licensing or environmental issues.

We also hopefully are able to obtain the best

consulting talent to work on these studies. There is a benefit to having the administrative details handled by the NESP staff.

We also have the contact with the regulatory agencies that enhances the acceptability of these reports. This is a key factor in the NESP program.

We feel that for the program -- the reports to have real value to the sponsor organizations we have to come up with reports that are considered acceptable by the regulatory agencies, and as part of the program, we make sure that each study has a liaison from the appropriate agency, whether it is the NRC, EPA, FEMA. We have got to get their input on these programs.

The other issue, we want to come up with a product or report that is applicable throughout the industry, and here again it is necessary to very closely coordinate the NESP activities with the other industry groups, such as EPRI or INPO or EPI.

DR. FOSTER: How heavily can you use the national laboratories?

MR. ROBINSON: I don't believe we have used them.

MR. LEIPER: We have contracted with Battelle, and I believe Battelle is the only lab that is able to do these studies, not Los Alamos or Oak Ridge. But Battelle

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can, and they have done a couple of studies for us.

DR. MOELLER: And the consultants that you hire work with the NESP staff or with the utilities or the members, and so forth?

MR. LEIPER: They work with a task force specific to each study that is approved for funding.

MR. ROBINSON: I will be discussing that.

(Slide.)

This is how NESP is organized:

We have a Project Management Committee. This is made up of senior nuclear utility executives. Their responsibility in this program is -- they have the responsibility for the overall management of this program. They also oversee the financial management of NESP, and they are the ones that make the final decisions on the NESP program for the coming fiscal year.

The Technical Advisory Group is made up of about 15 senior technical people from the sponsor company organizations. These are usually people that work in the environmental or licensing area.

The responsibility of the Technical Advisory Group is to assess the NESP program needs on a year-to-year basis, establish priorities for the studies, make recommendations to the Project Management Committee for the forthcoming study year.

The Technical Advisory Group also reviews all the reports and approves them prior to the time they are published.

The NESP project staff, which is responsible for coordination between the Project Management Committee and the Technical Advisory Group and the specific study task forces, they also handle the organization of the individual task forces and the administrative details that come from that.

They are responsible for the contractual arrangements with the consultant organizations. Then they are responsible for the publication and dissemination of the task force reports.

Another very important function of the NESP project staff is that they run the annual funding program.

DR. CARTER: A question on your Technical Advisory Group: what sort of people do you have on that group? How widely based are you? Are they still within the industry or perhaps outside?

MR. ROBINSON: It is mainly again -- Scott?

MR. LEIPER: I will address that. John is the chairman of that group.

Most of the members of the Technical Advisory Group are from utilities. Westinghouse is also represented.

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That is about it. They are drawn from our sponsors, which is appropriate because they are the ones who are paying for the studies.

MS. RENNER: It is a perpetual body unless somebody requests to be relieved of the position after a while. But it is a perpetual body, and we feel that it adds continuity to the program.

They know the array of study ideas that come up for consideration, and under John's leadership they go through them and cull out ones that are not worth doing at that time, not timely or whatever, and eventually a significant number of selections are made.

That goes on to the Project Management Committee for final approval of funds.

MR. ROBINSON: The question also went to whether we brought in outside people. I don't believe we do.

MR. LEIPER: On task forces it is different. We tend to use people who are not NESP sponsors occasionally.

MS. RENNER: A significant number of lab people, according to the subject.

DR. MOELLER: And the frequency of meeting depends upon, I guess, the activity?

MR. LEIPER: The Project Management Committee, which is chaired by Bill Lee, the CEO of Duke Power, meets once a year. We have always talked about having a second

meeting. We have never been able to get that many executives together.

The Technical Advisory Group as a rule will meet twice a year, once in the fall. That meeting includes the chairmen of all of our active task forces. The purpose of that is for those chairmen to present the progress of their studies to the TAG. Then in the spring, they meet in late March or early April to go through the study suggestions received.

John is going to get into this cycle, too, and take a list of about 60 and cull it down to about six or eight, which we will be recommending to the Project Management Committee for approval of funding.

MR. ROBINSON: As I was just mentioning, the other important function of the NESP staff is the annual funding. Without this funding program, we could not have a program then getting to the specific task force that is set up for each study.

These people, again, come from the industry sponsors, primarily utilities. They are technical people who are working in the area of expertise required for that study.

We also will try and include liaison from either the NRC, EPA, or whatever agency would have input to this study activity, to make sure their concerns are covered in

the study activity.

Now, the study group task force is responsible for coming up with matching plans or study requirements. They get involved in the preparation of the RFP. They review the contractor's activities during the course of the study and review the final report and the draft report and edit that draft report.

Then on each study we do have a contractor.

(Slide.)

The development of the NESP program plan.

Every year the NESP staff sends out a letter to the sponsor companies, requesting input for the next fiscal year's program. These study suggestions flow in through the NESP liaison that is set up with each of the sponsor companies. Ideas also come from the AIF staff, where they are in constant communications with the regulatory agencies.

So we do have a number of studies that come in as recommendations from the various agencies.

Also, another source is the various AIF subcommittees. This would be the Subcommittee on the Environment or the Health Physics Subcommittee or the Emergency Planning and Siting Subcommittee.

All these sources of ideas on the study program went to the NESP staff. They are organized and sent on to

the AIF senior management for their review, and they get to the Technical Advisory Group.

As Scott had mentioned, the TAG meets once a year to look at the new study proposals. Usually about 50 to 60 studies will come into TAG and probably, after we go through our review process, we will end up with six to eight studies that have real potential for next year's program.

Now, what we look at there is establishing the priorities so that these studies will, first of all, look at the need for the study, look at whether it really has generic importance, how timely is it. We will look at the subject matter and then look at whether or not the study is doable within the constraints of the NESP program with regard to budget and the timing of that study.

Studies that make it through this selection process are then sent on, and they end up with the NESP Project Management Committee, and these are the senior executives of the industry.

They will look at what is proposed by the Technical Advisory Group and again look at it in terms of budget available to do this work. Then they will make their final decision as to what they feel is the critical study area for the industry for the forthcoming year.

So from there it goes into the NESP program plan.

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DR. MOELLER: I gather, from what we heard a few minutes ago, that the number of projects far exceeds what you can support.

MR. ROBINSON: Yes, it does.

DR. MOELLER: By 5 or 10 to 1?

MR. ROBINSON: It usually ends up that we have approval for three or four studies.

MR. LEIPER: Last year we only approved two of the list that we presented. We only had two on our program plan for this year.

DR. MOELLER: Out of how many?

MS. RENNER: About 65 original suggestions.

MR. LEIPER: And there is a finite -- it is not only dollars, it is also staff time and number of task forces we have going. What we usually ask for is a man-year effort of approximately six months from startup to first draft, but that means from the time you start writing an RFP and start putting a task force together to write the RFP until the time it finally is published, it is somewhere on the order of two years, and there is a lot of projects running simultaneously.

MR. ROBINSON: A number of these studies are very similar. They get 50 to 60 studies coming in, but by the time you approve them and look at them, a lot of people have the same idea.

DR. CARTER: John, can I ask you a question about the duration of these things? What is sort of the average time from the time you say go on a project till you get a report?

MR. ROBINSON: I guess that has been quite a range. Typically, the contracts run from six months to 18 months, but there is lag time in there. We have had some studies that have gone for several years.

MR. LEIPER: We had one -- but it will be talked about today by Bill Brown. So we will go into it in detail. But it was because of an action by the Court of Appeals for the District of Columbia Circuit taking a look at Tables S-2 and S-3 of 54.51. We had to wait for a Supreme Court ruling before we decided to go ahead with the study. Otherwise, there was no point in doing it.

So we formed that task force in 1981, I think, and we didn't get the study out until last year.

MS. RENNER: And then I might say there are some which are very streamlined in nature and which, from the time the contract is signed until a draft is available for perusal, could be as short a time as seven months.

A lot of the way we write the RFPs -- the task force writes the RFPs based on the timeliness of the need for the information. If it is something that can be used sooner rather than later, we write them in such a way to

compress that man-year of effort into a shorter number of calendar months.

So we don't have just a set framework. We try to time it based on the need.

DR. FOSTER: Are most of these studies related to some regulatory requirement?

MR. ROBINSON: I would say most of them are in some way tied to the regulatory process. In some cases it might be remotely.

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MR. LEIPER: Existing, anticipated or perceived. Sometimes, it's just a review of the state of the art. The industry is just pointing to a lot of information that exists, but no one has put it in a big pile to try to organize it.

MS. RENNER: Another study we published this summer, which will not be discussed today, but I know Dave Moeller knows about it, was a study where there was a perception that regulatory guidance was lacking in a certain area related to sheltering and evacuation of individuals in emergencies.

In that case, that report was supplemental to existing regulatory guidance.

DR. FOSTER: I'm contrasting that with, say, optimization of plant operations.

MR. LEIPER: It's indirect.

MR. EBERSOLE: When I mentioned a while ago this lack of regulatory guidance in making decisions about radiation research in order to prevent catastrophic consequences, there is a void in the regulatory process here. I got actively involved in this years ago when I found out that at the price of a modest release of radiation, I could increase a very good high level confidence to prevent a core melt.

But everybody said that was pure heresy to let

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anything go. No matter what you could say, the law on the book said you couldn't do it. And we had to adopt a more realistic policy.

I think there would be some importance for AIF to look at this. You know, deliberately allowing certain emissions with the goal of preventing on a probabilistic basis a catastrophe, which would be infinitely worse. That's a floating problem. And it needs to be said. It's been said at meetings of the containment committee on over-boiling of boilers. There are a number of ways to simplify the heat rejection process but these are complicated by the presence of containment.

Are you with me?

MR. ROBINSON: I think Melinda is taking notes back there.

MS. RENNER: May I just say that this happens quite frequently when presentations are made. The audience will sort of ad hoc come up with something about, hey, this would be a good idea if you were to consider this study idea. And we write them all down.

MR. EBERSOLE: This particular incident was in connection with a catastrophic flood at a certain plant, and the obvious solution was to do suppression pool boiling and venting to atmosphere. And it was absolutely stopped by all the regulatory processes.

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But now it's coming on to the scene.

MS. RENNER: That's interesting. Thank you.

DR. MOELLER: Let's let John continue.

(Slide.)

MR. ROBINSON: One thing I just wanted to mention here is we talked about this structure within the task of the project management committee, the technical advisory group, the task forces, and the NESP staff organization.

This has hopefully set up a system of checks and balances so that by the time the studies get through the process here, we come out with a study that really does represent the needs and interests of industry.

There is hopefully enough review and approval in this process to make sure that the end product makes a worthwhile study.

MR. KATHREN: John, how long does it take you to go through this, typically?

MR. ROBINSON: Again, the program plan is reviewed by the various; proposed studies are reviewed by the technical advisory group. A year and probably a few months after that, there is a meeting of the Project Management Committee. They approve the program for the next year and, by the time the task forces are formed and everything is set in motion, we're talking a year at least.

MR. LEIPER: Our fiscal year begins July 1st, and

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assuming that time permits, we begin organizing the task force for the first study on our list of priorities for that year.

It takes something on the order of a month or two to get a task force together and set a date for the first meeting. The purpose of the first meeting is to get a rough cut at what the RFP will look like. Then, Melinda and I split the studies up. One or the other of us translates those notes into English. We send the RFP draft out to the task force for two or three reviews; then it has to go through the technical advisory group and the PMC before we can issue it. And that's a very long time.

Then, the contractor selection process can take something on the order of three months or more. You have to allow time for the contractor to prepare the proposal and adequate time for the task force to review the proposals and come to a decision.

MR. KATHREN: Let me just ask my full question. I note on this list of projects the status of projects. There are basically three that are in the press. Interestingly enough, there are three in the hopper. Reviewwise, I presume this wasn't just happenstance.

MS. RENNER: It's what the traffic will bear as far as what's going out because we are the whole staff.

MR. LEIPER: Plus the secretary and that is how

fast we can keep things moving and get these task forces to arrange their meetings to get people down there.

MR. KATHREN: So you might have three publications and three RFP's coming out within the next --

MS. RENNER: That's correct. Plus all the other ones. The balance, if you have 15 on that sheet -- and I believe there aree 15 -- three coming out, three going in and all the rest are in some stage of development between starting and ending.

MR. KATHREN: That's actually pretty fast compared to what impression I got from this long line.

MR. LEIPER: Well, this is the long line to get the things started. Once it starts, that's what you see there.

MR. ROBINSON: The process is that once the project management committee has established a program for the next fiscal year, assuming the funds are available, then the NESP staff will select a task force chairman. This task force chairman is approved by TAG and, after that, the NESP staff works with the task force chairman to look within the sponsor organizations for the most appropriate people to work on that task force, depending on the subject under study.

Once the task force is selected, they have their first meeting and they develop the scope of work, and they

also come up with a bidders list, looking within the industry to see who is most qualified to handle that particular study.

The NESP staff then has the responsibility to take this scope of work and put it into an RFP, which is then sent back to the task force for their review to make sure all the elements of the program and the study are in there.

It then goes to the technical advisory group for review. It goes on to the AIF senior management and, finally, back to the project management for their final review and approval.

At that point, the RFP is sent out to the qualified bidders.

(Slide.)

After its competitive bidding process, once the contract is signed, these are usually fixed price contracts. The duration is somewhere between six and 18 months and usually involves one to two manyears of effort. After the contractor comes on board, there is an initial meeting with the task force to discuss the scope of work for that particular study. And during the progress of the study, there may be several meetings between the task force and the contractor to review where they're going, the work that's being done.

Finally, they end up with the preparation of a draft report, which is reviewed and edited by the task force. Again, that report goes to the AIF senior management for their review and back to the technical advisory group for their final review and approval.

Then, one more approval process by the AIF management and then, finally, it goes back to the staff for publication and dissemination as a NESP report.

So that is the process. I think we've had enough discussion on that.

DR. ORTH: I've got a couple of questions. One of them, the budget that you quoted obviously doesn't include the utilities and all of their staff. Do you have any estimate of the total amount of expenses that are being plowed into this overall program?

MR. ROBINSON: You know, I have never figured it out but it's probably considerable between the time that the individual task force members spend on these committees. There's a lot of travel involved, a lot of time reviewing reports. It might be interesting to total that up some day, but it's considerable, I'm sure.

MR. LEIPER: It's not as onerous as it may sound. Individual task force members attend usually four meetings. Occasionally, there might be a fifth in the course of an entire study from start to finish. The

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heaviest investment of time for them is reviewing the proposals and reviewing the draft. Inbetween the rest of it, they're just kind of sliding. They look at a couple of progress reports, and that sort of stuff.

DR. ORTH: By the time you went down the list though of having vice presidents and all the rest who are involved, the time adds up.

MR. LEIPER: It does.

DR. ORTH: The second question was an administrative one in terms of do you go out for bidding and you get a contractor, but he, the contractor, is doing this study with utility people who don't work for him...but who are working for him?

MR. LEIPER: The contractor does it himself with his own people. The task force is advisory only.

DR. ORTH: Thank you.

MR. RENNER: There's one other oint we might make and that is that John's technical advisory group, he's been very modest while he's making his presentation, but I may say that they probably have the biggest investment of time of all, because they act as the independent peer review group for all the drafts. Therefore, they have to see everything and approve it before we publish it.

So they do a real yeoman job.

DR. MOELLER: Thank you, John.

We'll move on. The next two presentations, I gather, are as a group and they are on Occupational Radiation Exposure Implications of Backfit Actions and Methods for Improving the Accuracy in Predicting Occupational Doses.

These two items will be presented by Donald Edwards of Yankee Atomic Electric Company, and by Sanford Cohen of SC&A Incorporated.

(Slide.)

MR. EDWARDS: This, I guess, would be the first example of the NESP task force study. It's a little unique in that it consists of two parts, and I'll explain why as I introduce the study to you. The report is not quite out but I'm going to preview the results with you.

(Slide.)

I chair the backfit subcommittee of the AIF. At the time I got involved with this activity, I was looking for ways to bolster the idea that the decision about regulatory backfits required a regulatory process. I'd been working very hard to gather cost data when someone suggested that the idea of the exposure involved with regulatory backfits would also be a significant point.

I didn't see John's presentation, however, before I got involved. So the backfit rule is now out, and we're still working on the report. Nevertheless, I think this is

going to be very worthwhile.

The reason that the report and the study comes in two pieces really is the effect of the nature of the task force that was put together to work with me on this.

Their interests were more in the area of refining the dose estimating capability within the industry for ALARA purposes and then incorporating that into the design process.

So they suggested an additional study and before we withdrew, we did in fact begin this in two pieces.

(Slide.)

I mentioned that I was looking for evidence of the impact of regulation on collective dose, and also the degree to which radiological consequences of backfits had been considered in the past either directly by the staff or for the use of utility information.

You've asked about these task forces. Let me just give you a little bit of the composition of our task force.

(Slide.)

On the task force, 12 utilities are represented, four architect-engineers, a consulting firm, the Nuclear Insurance and the National Lab, Brookhaven has completed or, in parallel with our study, had completed a study entitled Operations Performed to Meet Regulatory Actions of Backfit.

This particular study was a specific data exposure gathering type of operation. We did have a good deal of help from the National Lab.

DR. MARK: Is there anywhere in that someone who would be able to speak from, for or comment from the point of view of what I'll call the employee, the person affected?

MR. EDWARDS: I think so because several of the members of the task force are plant health physicists.

DR. MARK: That's getting close.

MR. EDWARDS: They are very much concerned with the employee groups.

DR. MARK: It would not be a mistake if there were someone -- I'm not saying it's easy or sensible -- who could speak as if he were the company's main maintenance man, or the company'is main operator.

MR. EDWARDS: There was not that type of individual, though a number of the people on the task force are plant people and are not just from the health physics branch. There are plant engineers also. We have close liaison with NRC. A group of individuals work with us very candidly and are very much help; and also INPO.

(Slide.)

I mentioned that this is the background of the licensing group. Let me tell you about our contractor.

(Slide.)

We selected Sanford Cohen Associates of McLean, Virginia. After reviewing 11 proposals that we received, SC&A was the standout in their proposals from the very first review of their proposals.

They had at the time of proposing this work already had extensive experience in collecting worker dose information. They had just completed a study of temporary worker exposure. They knew the plants that had the data that was recoverable. They also knew people and how to work with them. That was a big plus.

I think we were very fortunate in making our choice of contractor.

They also have a strong background in the analysis of NRC regulations and documentation that was very helpful in coming to a working definition of backfits so we could gather data. That gets to be a sticky wicket, in that what was a backfit definition has changed.

They have health physics capability and statistical capability.

(Slide.)

Now, I am going to tell you about Part 1 of the

study, which is the report to come out soon Dr. Cohen will go on and talk about Part 2, which is currently underway.

In the interest of keeping you confused, I have rearranged all the slides that are in your packet. So I apologize.

The scope of work for Part 1 was to first of all identify and catalog backfits for generic multi-plant actions, then define a representative sample of the plants because we only had a limited budget for this study and then from those plants determine what the exposure attributable to these in fact was relative to all the exposure that occurred.

DR. MOELLER: Since you are looking at multi-plant actions, you can compare plant to plant for doing the same job?

MR. EDWARDS: Yes, and then translating those findings for industrywide projection.

So let me show you about selecting the backfit list.

(Slide.)

We looked at backfits for a five-year period between 1979 and 1983. First of all, this seemed to encompass the bulk of the work associated with TMI, which we thought would represent a lot of regulatory activity.

The data before 1979 isn't all that readily

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available, so we kind of had a constraint on the beginning there.

I mentioned the definition of a backfit, and Dr. Cohen's approach was to start with NUREG-0748, which is a list of multi-plant actions, and hopefully avoid controversy as to what regulatory items were backfitted generically.

That was supplemented with I&E bulletins from that period because not all of the bulletins are in the NUREG.

DR. MOELLER: Excuse me. What do the I&E bulletins do? They call attention to --

MR. EDWARDS: At the time, during this time period, I&E bulletins issued by I&E direct licensees to take specific actions.

DR. MOELLER: Okay.

MR. EDWARDS: For example, 7902 had to do with seismic, anchor bolts, and inspections.

DR. MOELLER: I am with you.

MR. EDWARDS: Then we defined multi-plant actions in terms of the origin of the requirement, the number and type of plant involved, and the required actions. This was very important to specify what the activity was that was required by item -- whatever we numbered the item to be.

Then through docket searches of individual

licensees, NRC files, talking to the staff, talking with the task force, we took 260 items, about that, and from that list identified items that were initiated by NRC that produced exposure and that were added for all plants.

A number of items in 0748 are tracked by NRC but are utility-initiated. So those we had to get out.

Also not included in our list under our definition were plant-specific items, SEP items.

And this slide is merely a sample of our list --

(Slide.)

-- of multi-plant actions. We just show you the title, the year it was initiated, who it would apply to, and the descriptions.

This again is very important, and we have got to try to relate the radiation exposure records at the plants to which job was important.

I mentioned that we had a limited budget.

(Slide.)

We selected a representative sample. Early on the task force felt that the characteristic of vendor type and plant exposure history was going to be significant. So we created actually six categories of plants, four by vendor and then the large percentage of vendor -- Westinghouse and General Electric we broke into two subgroups, which represented the plants with exposures

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above mean and below mean. So we tried to get at both of those characteristics.

In all there are 16 units involved in the study. The condition for the selection of a unit would be that no more than two would be included from any single utility in our sample, that multi-unit sites would have at least one unit that had operated through the entire five-year period of the study, and the overwhelming consideration was did the plant have data that was accessible.

So our sample was basically 10 percent Combustion, 10 percent B&W, 40 percent GE and 40 percent Westinghouse, which isn't all that bad in terms of the number of reactor years that were represented in the total population of plants, which was 67 operating units, units that had operated throughout that time period.

We took out the atypical plants. That is generally the older plants -- at Yankee we say the more mature units -- and also TMI 1 and 2.

This next slide is the last page we added to your handout.

(Slide.)

This is just a sample of the data sheet that was built up at each of the plant sites. The contractor visited the plant sites and looked at the list of multi-plant actions and tried to calculated the exposure related to each

of those actions.

Now, the reason I have this up here is this little box down here, where we have the exposure resulting from NRC-initiated multi-plant actions. Then we have another category, exposure on general entry. Finally, the exposure we ascribe to nonmulti-plant actions.

This mixed group here is of interest because we took -- or excuse me -- the contractor took the NRC exposure and divided it by NRC exposure and non-NRC exposure to get a factor, so that these mixed radiation work permits would be allocated one way or the other, and then they summed the result of these mixed exposures to get a total for NRC.

MR. EBERSOLE: Are you going to tell us how optimistic or pessimistic NRC's estimates were as they made the decision to close these?

MR. EDWARDS: That is an interesting result.

MR. EBERSOLE: Aren't they supposed to do a projection of costs?

MR. EDWARDS: In accordance with the backfit rule today, they are to file a formal evaluation assessment of radiation exposure associated with the backfit.

Sandy, I don't think we have got a lot of this. W We weren't able to find it in the files, I guess.

DR. COHEN: I don't think there were formal estimates that were made to a great extent related to

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potentia? regulatory requirements until the last few years.

By few years -- please correct me if I am wrong -- I am talking about the '82 and beyond timeframe, perhaps even '83 and beyond timeframe. In fact, we have been doing some of that through the Office of Resource Management, which is doing cost estimates for the NRC.

MR. EBERSOLE: I can think of a lot of work about missile overfiring and such things. It is almost impossible to think that such things could happen. Yet those are high dose levels.

I just wondered what the findings had been in those areas.

You recall the big flap about steam generators and the reactor vessel against hydraulic forces.

DR. MOELLER: Go ahead.

Oh, excuse me, another question.

DR. PARKER: If you look at your bottom line, I guess the bottom line, as you know, there is a lot of scatter in the data. It looks as though the amount that is attributable to NRC is decreasing.

Is that true?

MR. EDWARDS: During the period of the study there is a trend of that type. That will be in the study.

DR. MOELLER: Now, the '79 data, of course, is for the entire calendar year. TMI did not occur until

March -- whenever it was -- the 29th and 30th. So it is still your highest number.

MR. EDWARDS: For this particular group of plants, yes. I am not sure that is true in all cases.

This is a representative of one of the plants in the Westinghouse low exposure group.

DR. MOELLER: And these data, I gather, obviously were available. But I guess it took a lot of searching and records to put them together.

MR. EDWARDS: I think the availability of the data ranged from the pages of radiation worker data; there were some computer base data recovery systems.

DR. COHEN: I think the generalization that could be made is that these data had to be dug out of the radiation work permit files at individual utilities where those particular individual utilities kept explicit records. There is a lot of words describing what the individual radiation work permits related to.

DR. MOELLER: Thank you.

MR. EDWARDS: The purpose of all this for each of the several plants was to get these numbers.

(Slide.)

When the percentages were available, it was surprising to learn that there was little difference in the mean annual exposure for the two Westinghouse groups and the

two GE groups. There was little difference between CE and B&W or GE and Westinghouse.

So the six-group approach was consolidated into two groups, PWRs and BWRs, mainly because the multi-plant actions were different.

DR. MOELLER: Now, say again? You are saying the high plants and the lower exposure plants, that there was not that much difference? Is that what you are saying?

MR. EDWARDS: There is not that much difference in the results. Remember, the idea was to get the percentage there.

DR. MOELLER: Oh, for the percent now?

MR. EDWARDS: There wasn't that much difference, right.

So for ease of handling, the sample was compressed into two groups, and this is then the result of those two groups.

And finally, those results --

(Slide.)

-- were applied to all BWRs and all PWRs by taking the percentage we derived from the sample as applying to the sample group and applying those percentages.

(Slide.)

And finally, the exposures attributable to all light water reactors.

DR. MOELLER: What is your bottom line? Of course, we see that the NRC backfits -- well, your five-year average was 40 percent. So it will be close to doubling the collective dose. But close.

(Slide.)

MR. EDWARDS: So the first conclusion is that there is a significant impact on exposure by regulatory activities. You would ask is there a downward trend? You can see it. A slight trend.

DR. PARKER: Were you surprised at the results?

I guess I would have thought after TMI it would have been even more of an impact.

MR. EDWARDS: I was expecting something on the order of half. I was surprised it was what it is.

Now, recognize, our number is an appr..imation and an artificial one because of the way we def:ned backfits. We did not characterize the entire regulatory interface. We did not include plant-specific activities because we weren't able to take that with the method we had of taking samples. We couldn't take that back and apply that.

So this is probably an underestimate. For the purposes of bringing attention to the fact that this is a significant thing to consider, I think it is certainly all right.

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DR. MOELLER: Do we have any preliminary indication of what '85 might have been like?

MR. EDWARDS: No. We didn't gather data on those time periods.

(Slide.)

So the conclusion was that it was not a function of vendor, not a function of plant exposure record. PWRs were 38 percent. BWRs were 42 percent. But close.

This pie chart represents the major items that made up that regulatory contribution. You see the seismic upgrade of hangers and anchor bolts, and you see in the I&E bulletins this was the biggest chunk. That is because it was underway during the entire period of the study, and it was continued even after the study. It accounted for about 20 percent a year.

So I think that was the reason PWRs and BWRs were almost up to the same number.

The steam generator inspections for PWRs is the same. This is the inspection. This is the one that was begun in '75.

Now, at that point the seismic upgrade probably has some utility repair work in it. It was very hard to get all of the thing cut. So this might be a little bit.

Also, the TMI-related items, that says 8.8. It should be 7.8.

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(Slide.)

One final slide. These are the results and implications. We did get a comprehensive list of backfits. We did document the impact. I think we justified the importance of making dose estimates, and I think this might be useful to individual plant licensing.

The really interesting thing, I think, that came out of this study for me is what Sandy is going to talk about now; because of the interest in the task force, we're looking at development of a methodology to formalize the analysis of dose in the design process. We think that will be very helpful.

DR. MOELLER: Questions? Martin, and then Richard.

DR. STEINDLER: It's not clear to me just how you intend to use or apply those numbers. What you've apparently done is gone through and collected what I would call the red side of the ledger. What are you going to do with all that?

So it cost you 100,000 manrem to do this job? I'm having a little difficulty seeing what you're going to do with that.

MR. EDWARDS: Let's go back to yesteryear. Remember, when I started the study, my interest was trying to bring the argument in support of the development of the

backfit rule. In '83, that was quite a campaign. I wanted to make it very clear that regulator activities, besides costing a lot, were having a substantial impact on radiation exposure.

So the purpose of the report was in licensing space, primarily.

DR. STEINDLER: If that original goal would have continued, would you have done a similar study to try to identify what the potential manrems saved might have been over some period of time? Say, the life of those plants?

MR. EDWARDS: Manrems saved?

DR. STEINDLER: The backfitting issue has got to have some kind of positive rationale. At the moment, what you've said here is that this is how much it's going to cost us.

MR. EDWARDS: No, sir. What I've said, that's how much it has cost.

DR. MOELLER: And there were studies, Martin, where the committee said: If this costs you 100 manrem to do the backfit and your projections are that it will only save 50 through the improvements, then you should question whether it should be done.

MR. EDWARDS: The point was this whole evaluation never took place. That was the point that the study was trying to make.

DR. MOELLER: Correct. It was not being done.

MR. KATHREN: The backfit basis is more than just a radiological exposure gain. In many cases, there may be other gains, say, safety gains.

DR. MOELLER: Well, this is simplistic. We primarily look at what they've projected it will save in routine and accidental collective doses.

MR. EBERSOLE: You mean you don't consider what it might save in avoiding an accident?

DR. MOELLER: Absolutely. Yes, you do. But I think what Ron was hinting, you don't say, well, it will keep the plant on line X-percentage of the time.

Richard?

DR. FOSTER: My question was kind of along the same way, but asked in a different way. This bottom line here tends to say that if NRC hadn't required you to do these things, that you would have saved about 40 percent of your dough.

My question is, if NRC had not initiated these things, would some of those things have been initiated by the plants themselves in any way?

That's a hard question to answer, I know, but do you have a little feel for that? Might you have done some of these things yourselves?

MR. EDWARDS: I would guess that some of that may

have been done in some way. I'm not sure of the exact scope. I'm not sure of the timing. I know the pressure under which some of the requirements were issued during that timeframe didn't allow for a lot of optimization in terms of schedule. But, conceivably, some of the work would have been done.

But I think that question may be outside the focus of this study, which is merely to document what took place.

DR. MARK: You didn't have on your list a serious steam generator replacement.

MR. EDWARDS: No.

DR. MARK: That was utility-initiated?

MR. EDWARDS: Yes, sir.

DR. MARK: And it was a tremendous factor in dose in that case.

MR. EDWARDS: Yes, it was. But it was included. It is a dose that is not NRC-related.

DR. MARK: I understand why it wasn't there. Doses do happen by utility-initiated moves and they're bigger than anything on this list.

MR. EDWARDS: That was in the dosing record. All we did was operate on that data with percentages.

DR. MARK: Surry wasn't one of the plants you had.

MR. EDWARDS: When we went back and looked at all data for all plants, it was.

DR. MARK: Excuse me.

DR. MOELLER: Thank you, Don. We'd better move ahead.

The next presentation, as we've indicated, is by Sanford Cohen on the methods for improving the accuracy of predicting occupational doses on the basis of what we've learned here.

We will of course break for lunch after this presentation.

(Slide.)

MR. COHEN: I'm Sandy Cohen. I am with the firm called SC&A, which stands for S. Cohen and Associates. So I'm responsible.

I'd like to discuss the second half of this NESP project, which is called Methods for Improving the Accuracy in Estimating Doses.

Before I move on to that though, I'd like to emphasize one conclusion that Don mentioned that I found to be counter-intuitive and I thought was quite interesting.

And that was that TMI initiated requirements only constituted about 8 percent of the total NRC-initiated dose that we found. I thought that was quite interesting and not what I would have expected. I just wanted to emphasize

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that, although Don did mention it.

DR. MOELLER: Thank you. That's an important point.

MR. COHEN: Among the 100,000 manrem that we estimate over the five-year period, roughly, 8,000 manrem was attributable to TMI requirements performed over that five-year period.

DR. MOELLER: You hear so much comment on TMI as if everything is TMI.

MR. COHEN: That's right. And I think this goes beyond what we are talking about. I think that that might also relate to the cost mentioned. But, again, I'm just guestimating. I'd like to address the second part of the study, which is a bit disjointed, if you will, but is related in the link through ALARA.

That is the methods for improving accuracy in estimating your exposures. Let me start out by saying that we're talking only about 50-60 percent complete in this study. So a lot of what I'll be saying is just speculation as to what we'll be doing over the next couple of months.

MR. KATHREN: I have a little trouble distinguishing between health physics and ALARA.

MR. COHEN: Are you suggesting I make that distinction?

MR. KATHREN: Would you be kind enough?

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MR. COHEN: I would call ALARA a subset, a field of health physics, in that ALARA is a concept, an operating concept which says: You will attempt to reduce exposures to as low as reasonably achievable through balancing costs, exposure costs or, as the field of health physics encompasses both ALARA and meeting regulatory limits and concern about decontamination, and even waste management, so I think it's a much broader definition.

MR. KATHREN: But, then if the revised 10 CFR 20 comes into effect, there will be no difference because it requires ALARA?

MR. COHEN: I'd rather not answer that question. Perhaps somebody else can.

DR. MOELLER: You go ahead.

MR. KATHREN: That's the answer though that helps clarify it. Thank you.

MR. COHEN: The objective dose estimating is an essential part of ALARA. In order to carry out the ALARA concept, you have to be able to estimate dosage.

The purpose of this study is to improve the accuracy of that process. A subsidiary purpose is to try to incorporate dose estimates as early as possible into the design process, and I'll mention in a moment to what extent currently that we see that incorporation.

(Slide.)

This is a listing of the scope of work to accomplish this improvement of accuracy of dose estimation. Initially, when we went to the 10 plants for the Part 1 study, we also collected data to indicate to what extent accuracy exists in estimating doses. So this was coupled to the Part 1 study in order to conserve resources, trying to collect examples of dose estimates performed at the plants generally by the ALARA group within the plants, in order to get a feel for the accuracy of those dose estimates and to determine the reasons for inaccuracies.

The next step was to compare the dose estimates to the actual doses. Then to determine the reasons for variations. And then, after understanding the extent to which dose estimates are made and the extent to which these dose estimates are accurate, to try to develop a method that could be used in the industry for making more accurate dose estimates.

Of course, on the bottom, we're talking about through this process and through the development of the method an attempt to focus management's attention on ALARA considerations at the earliest stages of the design process, when it can do perhaps the most good.

(Slide.)

Well, we visited in Part 1 of this study 10 plants. After the completion of Part 1, we also went to

another three plants or so and talked to three architect-engineering groups, and two nuclear steam supply vendors.

Through that process, we attempted to learn what extent quantitative dose estimate is done at the plant, to what extent quantitative dose estimation is done in the design process, and how accurate are these quantitative dose estimates when we found them.

This is a qualitative listing of our findings. The first finding was that very little quantitative dose estimation is done during the design process. Now, bear in mind, what we're referring to is the design process of plant modifications in operating plants. We're not talking about preoperational design plants.

This is all relating to operating plants. We found that when ALARA is factored into the design process, it generally is done through the use of checklists. Those checklists are generally formulated around regulatory guide 8.8.

This then becomes a qualitative dose estimation process as opposed to a quantitative dose estimation process. We found that when historical data are available, if they're available to the plant either through that specific plant or other plants, surveys of other plants, that those historical data are used as the basis for the collective dose estimation.

However, there's a problem frequently in the use of those historical data in that the historical data files do not always contain the details of the work scope or the plant conditions at the time of the estimate, which we can use to correct that estimate for current conditions if those conditions should vary from the original dose estimate.

In fact, we found that when computerized historical data files exist, and they do exist to some extent, they're the biggest culprits. Frequently, they're not sufficiently annotated in order to determine the scope of work or the dose rates at the plant when those historical data are collected.

We found that most quantitative dose estimation is done for near-term exposures. In other words, the installation phase. Typically, at the RW peak days at the plants. And that the subsequent exposures occurred during operation and maintenance, which are frequently ignored.

In terms of the discrepancies between predicted and actual exposures, we found the principal source of this discrepancy is in the manhour estimate.

If you look simplistically at a dose estimate, it's a multiplication of manhours times dose rate. The principal source of discrepancy is in making that manhour estimate.

DR. CARTER: I presume, I would assume, that

these are underestimates of the time required.

MR. COHEN: These are poor estimates of the time required. They're usually underestimates because the slope may not be known, and I'll get to that in the next slide.

DR. MOELLER: That is, to me, well, I guess, if you think on it, maybe it could be anticipated, but it would seem to me that for many of these jobs, they should have been able to predict. You know, if they're bidding on how much it would cost, say, they certainly should have been able to estimate out the hours required.

MR. COHEN: That's not always the case. I'd like to hold off until the next slide, or two slides, and we'll get back to that.

The most reliable sources for manhour estimates we found are the craft supervisors and foremen in the plants. These are the people who essentially have the closest link to the actual work that's being done.

We found another factor that's very important. This is kind of an institutional factor, if you will, and we can't reduce this to an equation. But the aggressiveness of the estimator seems to be very important in the extent to which an accurate dose estimate is made.

So they're aggressive in pursuing the manhour estimates.

DR. STEINDLER: What do you mean to say by that?

I don't quite understand it.

MR. COHEN: It's very difficult to get accurate manhour estimates. The engineering designer frequently doesn't have a feel for the number of manhours it's going to take for modification. The plant health physicists may have no idea. The guy who has the best idea, the efficiency of his crew as to what's going on in terms of experience, mockup training, this sort of thing, is the craft supervisor, the civil engineering supervisor, the electrical engineering supervisor, the foreman of that work that's being done.

DR. STEINDLER: Isn't he also the estimator?

MR. COHEN: No, the estimator is generally the ALARA engineer, or it may be the designer if we integrate estimates into the design process. I'm sorry. I should have made clear who the estimator generally is.

(Slide.)

In terms of the active dose rates, which is the second part of the simple equation for estimating exposure, the source of most discrepancies is usually a poor estimate of the effect of measures taken to reduce exposures, if such measures are taken.

Unanticipated changes in conditions affecting the dose rate may also be an important source of discrepancy. We find that estimators may tend to be overly conservative. That was a point made earlier.

And there's an institutional factor here, which I thought I might bring out. Frequently, a implementation-review is done if you underestimate an exposure, to try to understand the root of that underestimate; whereas, if there's an overestimate, it is not always done.

That is unfortunately a fact. We also found there are several impediments to the incorporation of quantitative dose estimates in the design process. Again, dose estimation is done almost always at the RWP stage, just before the outage, just before the change is going to be

made.

It's infrequently done in the design process. One of the reasons for that perhaps lack of incorporation, is attitude, intrusion into the design process, creating additional paperwork, that sort of thing.

The other is a general lack of experience and exposure assessment amongst the designers. Another is the physical location of the design group. The design group may be at headquarters and not at the plant. Limited experience with operating plants, historically, design is done prior to the plant startup. There is not as much experience in operation as there should be.

Inadequate information, lack of personnel and supporting resources, resource problems.

(Slide.)

Some of the conclusions that I made there are actually based on that collection of data that we made in our Part 1 study of the plants. We attempt to pull out several examples of predictions versus actuals in each of the 10 plants we went to.

This was not a statistically defensible study. We looked for large discrepancies. Therefore, please don't make too much out of these percentages. However, it did give us an indication of reasons and indeed of about 165 individual predictions that we looked at, about 67 percent

of the discrepancies up here could be derived from manhour problems.

Of that 67 percent, about a third were due to work scope not known before the actual exposure had occurred. If you go in, for example, snubbers are a good example, you have to collect a sample of your snubbers initially to determine how much work they're going to do on the snubbers.

Until you have collected that sample and gone into the plant, you don't know how much snubber repair there's going to be. Hangers and anchor bolts are another example. You don't know the extent of the repair. I don't know how to rectify that problem; it's an unknown.

I think that addresses the question that you've asked.

Changes in the work scope is another problem in the manhour area. For example, you may think you're going to change two pump seals. And after you go to the plant, you originally produce your dose estimate for two pump seals and you're going to have to use three pump seals -- unanticipated problems encountered in the performance of the work.

You get a binding of some kind on a piece of hardware. That's another brutal manhour problem. We mentioned conservatisms was the case in about roughly 10

percent of the cases. Poor estimate of work efficiency. Some of these things are rectifiable through these methods. No previous experience upon which to base estimates.

Dose rate problems of those, of that sample, of predictions that we've looked at, dose rate problems was the case in about 30 percent of the discrepancies.

And as I mentioned in our earlier conclusion, exposure reduction measures poorly estimated appear to comprise the bulk of those dose rate estimate problems.

There are also unanticipated changes in conditions affecting the dose rate. Here's one that's kind of interesting. Other causes constituted about 10 percent, 5 to 10 percent of our sample. Counterbalancing errors in manhour and dose rate estimate was very small. It's probably much larger than that.

We looked for large discrepancies. We didn't dissect good estimates and I'm sure, even in good estimates, there are a number of counterbalancing errors.

DR. STEINDLER: What do you call a discrepancy? A factor of 2? A factor of 7?

MR. COHEN: We looked at things that were greater than about 50 percent difference in estimates. We're talking, of course, an estimate of 10 manrem. We would have looked for things that were 5 to 15 manrems actually. Not very rigorous but, again, we were just looking for some

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quantitative guidance.

MR. EBERSOLE: Are they all unit directional?

MR. COHEN: No.

MR. EBERSOLE: So this was discrepancies on either side?

MR. COHEN: That's right. The discrepancy was a percentage of the actual.

(Slide.)

While we are trying to factor some of those lessons learned into the development of a method for improving the accuracy of estimating collective occupational exposure, we're talking about manhours times dose rates. So we're not talking about anything, any elegant. But one can improve these estimates considerably if one develops a systematic procedure that incorporates all of the considerations which you need to go through in making a dose estimate.

We're in the process of developing such a method right now. We haven't completed it, we're just starting.

MR. EBERSOLE: Is there a process where, methodically considering a design modification would theoretically or probabilistically might result in an accident? But there's nothing certain about that. It's a conservatism at the worker level where you say: If I do this, I might avoid an accident which will give me an

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astronomical worker dose.

Do you follow me?

MR. COHEN: I think what you're saying is, is there a system that will take into consideration the potential accidents that could involve a worker?

MR. EBERSOLE: To the benefit of the worker, not the public. I may extend that right to the whole industrial picture. Shall I put redundant limits, which is so that-- what's the gismo you pick off the high level things with? The lift carrier, the crane or the cherry-picker -- so that I have duplicate protection against worker fatalities.

Do you follow me?

MR. COHEN: I do follow you.

MR. EBERSOLE: I don't think there's anything in place or in regulative processes.

MR. COHEN: The regulation 8.8 attempts to incorporate a number of things in it to prevent higher exposure.

MR. EBERSOLE: What about single failure criteria verus worker disastrous exposures, or things like that?

MR. COHEN: I can't think of specific examples.

MR. ALEXANDER: Can I respond to that in part, Dr. Ebersole?

To deal with this problem of factoring worker risk into work that's performed to provide additional plant

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safety, where you have a probability of 1 for the worker risk and a lower probability, we hope, for the public risk, we had a research project performed and the results were published in a three-volume NUREG report, NUREG CR-3665, volumes 1, 2 and 3 in 1984.

This NUREG report was not issued as a regulatory guide but as information to the nuclear power industry, and it was also prepared to help our own staff. In fact, we believe that this report is useful.

I don't know to what extent it was used in this study.

MR. EBERSOLE: What drives you, if anything; to put a second switch on a crane or something is to protect the worker's life. The redundant concept, or the single failure criterion, whatever you do, enhances worker protection. I know of no methodical way to test that.

We're talking about that now, worker protection, but we're not talking about the presumed advantages, for instance, of having to invoke the single failure criterion; if a worker gets killed, it might be a limit switch on a limit switch on a crane or the cherry picker I mentioned, or whatever.

MR. COHEN: You're talking about general risks, not just radiation exposure.

MR. EBERSOLE: To what level of design assurance?

I know of no organized process.

DR. MOELLER: Don Orth has a comment.

DR. ORTH: Many companies, large companies, in their engineering design explanations, do have formal procedures called process hazards review, or various other names, which do exactl, that.

There's categories of accidents in terms of costs. How long it will put you out of business, the changes of a fatality, the chances of major injury. Every aspect of the design is looked at against that for exactly this.

There is an elaborate, long checklist. And what are the chances that somebody will open something and something will happen to him into something else? There is page after page after page of checklists that you go through examining specifically for what you're saying.

MR. EBERSOLE: Isn't there also a chapter on the fact that you can buy insurance or can't buy insurance against certain levels of probability of these things? Isn't insurance the common denominator that says, oh, well, if that happens to him, I have a policy that will cover it.

DR. ORTH: No, because, usually, it's based ignoring the insurance completely on such things as the dollar cost, the amount of time you're out of business, the chances of an accident.

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MR. EBERSOLE: That's an individual company basis?

DR. ORTH: Individual companies do that.

MR. EBERSOLE: There's no universal standard for that sort of thing?

DR. ORTH: No. The companies do off to national safety conferences and talk to each other about the benefits of these things.

DR. STEINDLER: That's not quite true. There's a whole bucket of OSHA regulations, the industrial sector, that are applied to everybody from a small shop to a large shop, which you can argue appropriately represents the baseline minimum kind of standards that you want to set. And people like du Pont and others exceed that by significant margins.

Company selection basis. I can't believe it's totally divorced from monetary issues.

DR. MOELLER: Dr. Cohen, you'd better go ahead.

DR. COHEN: I'm almost finished. As I mentioned, this method that we're in the process of developing has three parts. First of all, it tries to incorporate all the considerations which we need to take into account in making a dose estimate, some of which we feel have been uncovered when we looked at dose estimates and how accurate they were. It has a logic connection between these

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considerations. And it has worksheets in order to put down the numerical exercise that you go through when you actually make the dose estimate.

Just to give you an example very quickly, what do we mean by considerations,

(Slide.)

You need to find out whether you're going to use historical data or a new estimate. Is the scope of work for the current task identical or similar to the scope of work for the historical task? Is there a learning effect curve? Is historical manhour estimate for total RWP sign-in time, or is it for the actual exposure hours?

This is very important because sometimes the manhours encompass the time the guy actually gets to the plant until he finishes his lunch.

So these are what I mean by the considerations on what needs to be taken into account in making a dose estimate.

When I talk about a logic diagram...

(Slide.)

...this is something that one would use to couple together these considerations. In other words, you ask yourself such questions: Are there survey data available for rem per hour? If the answer is yes, then you provide the survey data.

Do you need to make a time correction to the survey data? If so, you make the time correction. Very simple logic diagrams that lead you through considerations and the corrections to these data in order to take into account all the considerations.

And then, finally...

(Slide.)

...you have a worksheet which is just the means by which you actually make those estimates. For example, this is one of the most complicated worksheets which you might end up with. This is for reviewing. You actually break the job up into specific, explicit tasks. You would estimate manhours or, in this case, man-minutes in each radiation zone for each subtask. And you aggregate all of these.

It's rather conventional except that you can easily hook it together with corrections with the logic diagram to put the dose estimation process on a systematic basis.

Finally, the final report...

(Slide.)

...for our study will be issued in a couple of months. It will have an executive summary, introduction, conclusions, a chapter on existing ALARA practices, and existing methods for estimating collective exposure, the

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proposed method that we are suggesting, and how this method would be incorporated into the design process, which, as I mentioned, is one of the objectives here.

Finally, if we have the resources as an option, we're thinking of developing an automated version. So he can do this at his desk.

(Slide.)

The status of both parts 1 and part 2, part 1 is in press or essentially in press, and part 2, there will be a draft in March and a review meeting in April.

Thank you.

DR. MOELLER: Thank you.

Mel Carter.

DR. CARTER: Let me ask you a question about the ALARA. I know there's been an emphasis on this in the last few years. There are people now that are calling themselves this on a professional basis.

My question is, how much actual time is spent in the average plant, say, by the health physics staff, in that kind of operation?

DR. COHEN: I think it varies. Every one of the plants we visited in our task force study had an ALARA group which was headed by someone with the title, ALARA Coordinator, or ALARA Engineer.

Generally, this individual was a health physicist

by background.

In some plants, there were as many as I'd say a dozen people in this ALARA group performing dose estimates, tracking down data, following up on the discrepancies between actual and predicted exposures. Some of the groups were relatively small. A couple of people.

DR. MOELLER: You are correct. The ALARA coordinator engineer reviews every RWP that you say you look at for the projected dose estimates, and your idea here is very intriguing of having this on a computer, a small personal computer that people could be use. It would be very useful.

I see here, the same as we heard from Bob Alexander, that we might need a course or we definitely will need some sort of a training program to equate people with the revised 10 CFR 20.

It would seem here that you positively in order to pass out or, you know, to apply the benefits of your work you need some sort of a program to bring this to the attention of all these people in all the plants.

DR. COHEN: Yes.

DR. MOELLER: Other questions?

Carson.

DR. MARK: A simple question.

We heard some of this perhaps four months ago in a very nice report from someone looking at plant radiological problems for INPO.

DR. MOELLER: Bill Kinley.

DR. MARK: Is there a good liaison between your activities and his? Because they sound as if they ought to be very much in each other's sights.

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DR. COHEN: We have an INPO member on the task force. We have had the benefit of incorporating their work. We have a workbook on radiation exposure.

DR. MARK: Okay, so there is a good liaison?

DR. COHEN: Yes.

DR. MOELLER: Thank you.

Any other questions?

(No response.)

DR. MOELLER: We very much appreciate both of these presentations. They were very enlightening and very important work.

We will recess for lunch and resume at 2:00 o'clock.

(Whereupon, at 1:05 p.m., the subcommittee was recessed, to reconvene at 2:00 p.m., this same day.)

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AFTERNOON SESSION (2:00 p.m.)

DR. MOELLER: The meeting will resume.

We will lead off the afternoon session with two presentations by Joyce Davis, from the General Physics Corporation.

The first one will be on the potential for deregulated disposal of very low level wastes from nuclear power plants. The second presentation will be a guide for obtaining regulatory approval to dispose of very low level wastes.

It is a pleasure to have you with us.

While we are getting ready, I might mention that Bob Alexander had asked -- you know, we left it this morning that he would make a few additional remarks about the de minimis concept. We will do that at an appropriate time.

(Slide.)

MS. DAVIS: My name is Joyce Davis, with the General Physics Corporation.

We are the contractor for two studies that NESP has authorized relating to very low level waste. This is the concept that has gone by the name VLLS for several years.

I spoke to one of these subcommittees several years ago about developments in these areas, and the NESP program at that time was just getting started.

We have now completed the first study, which I am going to be talking about in a moment. It is at the final stage. It has just gone through the TAG review, and we are now making the final changes to the report to make it ready to be printed by NESP.

So it should be out, I imagine, within the timeframe of an order of months. I will talk about that one first.

The second one, the schedule is a little behind the first one on that one. It was started after we completed the first one, but it was a shorter study.

The draft report has just been reviewed by the task group. We are completing a final draft that will go for TAG review. So again that one will be out maybe a month or so after the first one.

This study, the evaluation of the potential for deregulated disposal of very low level wastes from nuclear power plants.

(Slide.)

The purpose is to review the characteristics of low level waste streams generated in nuclear power facilities to determine which may be suitable for disposal by methods other than transfer to an NRC-licensed facility, Part 61 facility, and to evaluate the benefits, risks, and costs of exempting such very low level waste from disposal

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requirements of 10 CFR, Part 61.

This information would be appropriate for use in support of petitions for rulemaking or exemption requests.

Again, one of the bases for the NESP authorizing this study was the idea to have a document that would be useful if there were a rulemaking developed on either generic de minimis or exempting various types of waste streams in the way Part 20 now exempts certain medical wastes from disposal.

I will be talking about that in a little while.

The first study is mainly a technical review of the wastes that have some out of power plants and an evaluation of whether they are suitable for disposal as if they were ordinary trash or ordinary wastes.

The second study, as someone said this morning in the licensing phase, the second study is more related to the regulatory process of applying for such an exemption.

(Slide.)

The first study -- and you have all these viewgraphs in the material handed out. They may not be exactly in the same order, but they are there, and there are probably more there than I can cover in the time allotted. So I will just briefly refer to them.

The approach of the study is outlined on this chart. We reviewed the literature, identified and

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characterized the wastes, identified disposal methods, and then calculate the activity and then look at detection and monitoring waste disposal, costs, volume versus cutoff criteria, and then as a result of that come out with risk-cost-benefit analysis and a draft report summarizing our results.

We also have a chapter in the report on precedence and the concept of a regulatory cutoff. This sort of summarizes where things are today.

DR. MOELLER: And the benefits would include reduced costs for disposal of these wastes?

MS. DAVIS: Yes, also the saving of space at disposal sites.

(Slide.)

This is a chart showing the screening process we used for deciding what wastes might be appropriate for consideration. There are several data bases that have been developed by EPRI and the NRC, a lot of it in preparation for Part 61, after implementing Part 61, to try to identify what are the major wastes coming out of different generators and what is the activity and what are the volumes -- data like that.

There is a lot of data available, and we looked through several of those data bases. One of the problems is that people have characterized, segregated, or identified

these wastes differently in different studies. So it is not always easy.

For example, sometimes like charcoal filters in the air conditioning system, sometimes that is carried as a separate category and sometimes that is put into the trash category.

So in all of these studies we are dealing with approximations and none of these numbers I am going to give you are anything near exact because they have this general problem that you have in collecting data.

We didn't collect any new data on our own. We used existing compilations.

DR. MOELLER: And you are considering only nuclear power plants?

MS. DAVIS: Right. We are limited to nuclear power plants.

Okay, so then we looked at each of the streams, and then we looked at could they be readily broken down or segregated so that they might be considered two separate streams, one of which might be suitable for deregulation and the other one wasn't. And then we characterized their various properties -- chemical, physical, and radiological.

That was used as input then to the rest of the study, which calculated the radiological impacts.

(Slide.)

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This is a summary of the conclusions.

The major conclusion of the study is that several waste streams at nuclear plants are excellent candidates for deregulation. In particular, PWR and BWR compacted trash are the best candidates of the routine waste streams studied.

High volume, low activity, nonroutine wastes, such as soil and sand, are also suitable for deregulation and at the very least generic guidelines on exemption doses or activity levels should be developed for such wastes.

Other waste streams may be suitable for case-by-case exemption.

The study further concludes that the costs and license burial space savings, combined with the extremely low doses involved, clearly justify permitting conventional disposal of the very low level waste streams.

DR. MOELLER: Is compacted trash -- does that have a certain application or definition for a power plant?

MS. DAVIS: Well, again in these data bases, as generally defined, there are generally two categories of trash, compacted and uncompacted. Plants themselves may compact different volume reductions, and sometimes data bases make clear what that is and sometimes they don't.

But we didn't mention it. I will get to it later on in one of these slides, but we didn't look at

uncompacted trash because EPRI was doing a study on uncompacted trash, and I think their report, if it isn't out already, should be out soon.

National Nuclear and TVA -- and I was involved with it as a consultant on that job -- are doing a study on uncompacted trash, bags of trash.

If you took the trash out of the power plant in a bag, National Nuclear developed a bag monitor, like a safe, to stick the bag in. If it was below a certain level, it can go.

So since that study was considering uncompacted trash, we didn't include that in our study.

Also, we didn't include waste oil because utilities -- certainly the Waste Management Group had a study on waste oil going. They also submitted a petition for removing that back to the NRC.

So we looked at things that other people hadn't looked at in detail.

So the major streams that we found that were most suitable for this were the compacted trash. Generally, it is put into a box or a drum and compacted to something either modestly or in a super compacting --

MR. EBERSOLE: Doesn't it make sense to incinerate most of this stuff?

MS. DAVIS: Incineration is an option we looked

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at. We looked at several disposal options, and I will get to that.

We looked at landfill and incineration. But the compacted trash stream, in looking at how it is processed at the plant, if it were going into an incinerator it would probably be still compacted for transportation. It could be anyway. This goes on at the plant. Compaction isn't a treatment process. It is just a handling process at the plant.

MR. EBERSOLE: Incineration is not done at the plant?

MS. DAVIS: No. Actually, incineration is not done anywhere at the moment. It is a possibility.

DR. SHEWMON: Are you talking about trash when you say incineration is not practiced with these wastes?

MS. DAVIS: Yes. There have been exemptions for burning waste oil.

DR. SHEWMON: My impression was that there were systems which did burn low level wastes that were indeed low level, and they wouldn't get the volume of them down? Has that only been in the study stage?

MS. DAVIS: I know that one of the utilities has done something about utilities. We didn't really look deeply into incinerators. We are looking at theoretical methods of disposal.

(Slide.)

This is the conclusions in more specific detail that I gave you as a summary.

The first one, the most important parameter we found in determining the risk of the offsite dose is the total activity disposed of.

So when you do the calculations for the wastes, it doesn't make really any difference to offsite doses, if the dose is transported and the work is onsite, the various pathways we looked at, what the concentrations are. It is the total activity that is important.

Mainly, these wastes are cesium and cobalt activity.

The compacted trash appeared to be the best candidate, and there are some others that we looked at as well that may or may not be.

DR. MOELLER: When you say again compacted trash, do you mean that there would be some sort of a screening station as the compacted trash comes out and people would screen it into that which is acceptable for deregulation and that which is not?

MS. DAVIS: Another part of it is how operationally you handle this, and there are people who do that now with segregation. For example, you segregate out of the production end by trying to have separate waste

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containers for things that are nominally uncontaminated, things that you know are contaminated. There are complicated systems.

Hydro Nuclear, for example, has developed a complex system for shredding wastes, passing it onto conveyor belts over several kinds of detectors to make sure no high activity piece is included.

There are operational ways of making sure that whatever it is is exempted -- that we can define what it is that is exempted. Whatever it is, is included in the stream.

But you see from the stream -- I am going to get to show you some diagrams of actual wastes. Almost 100 percent of the trash that is now coming out of these plants, if disposed of in a sanitary landfill, would not give a dose to anybody greater than 1 millirem a year.

So we have a whole series of conclusions.

DR. CARTER: Let me ask you, of the waste disposed, what you are monitoring. If you do a segregation, I presume everything is tagged well enough with gamma and others so that this is a fairly routine operation.

In some cases do you have betas and betas only, where you would have more difficulty?

MS. DAVIS: Most of the isotope that is of the greatest concern is the cobalt, cesium. The cobalt,

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cesium isotope is easily detectable.

As part of this study, we looked at the lower limits of detection for each of the isotopes. Then we made a dummy waste, consisting of everything just at the lower limits of detection, to calculate what the dose would be if something would happen. So everything was just below where you could detect it, and we found it was below.

If certain waste streams are deregulated, plant right-of-ways to operating and monitoring procedures may need adjustment to ensure and document that only exempt materials are being released from the licensee's control. We didn't really look into that.

(Slide.)

We wanted things that made a difference in large quantities. We wanted it completely definable, so that hopefully somebody could write a regulation, or at least define it in an exemption request. We wanted them to have physical characteristics that were amenable to disposal by conventional methods.

Finally, we looked at things that weren't already being done like compacting trash into oil, which somebody else is already doing, because they are good candidates.

DR. CARBON: What volume fraction is the compacted trash?

MS. DAVIS: It's a large -- I have some charts that have some of the volumes on it.

(Slide.)

This lists them by candidate waste streams by the fraction of the Class A limit. The Class A limit is in Part 61. There's another limit for like low level wastes, considered in Class A.

Naturally, we only looked at Class A waste,

because, obviously, if it's above Class A, then it's not going to be exempt. So we compared each of these waste streams. Using an average of typical one, we compared them to the Class A limit. And you can see this is in a percent. So BWR trash, PWR trash are less than 1 percent of Class A limits. Very little activity.

You see, historically, the utilities have interpreted the regulation that anything that comes out of the plant is "contaminated," and therefore, all this trash is considered to be contaminated.

It's easier to treat it as rad waste, send it off and not have to worry about it. Of course, the situation has changed now, because of the shortage of low-level waste storage disposal space, and the idea that there may not be any place to send it all, so people are starting to look at, say, why are we treating this stuff as radioactive, when most of it really isn't?

DR. CARBON: The BWR and PWR trash is their compacted trash?

MS. DAVIS: Yes. That's compacted trash.

DR. CARBON: That is the compacted trash, and it is less than 1/2 of 1 percent in volume.

MS. DAVIS: Activity. This is Class A activity.

DR. CARBON: Of the Class A, it's less than half a percent by volume?

MS. DAVIS: No. By activity. This is only by activity.

DR. STEINDLER: Is that for the most prevalent isotopes?

MS. DAVIS: That's total activity.

(Slide.)

We then looked at -- here they are, ranked by volume. There's the percent of total volume. PWR compactable trash is 13 percent. Now this is the volume of wastes generated by nuclear power plants. So the trast represents, depending on the type of plant, something like 10 percent.

DR. FOSTER: Is there a simple explanation as to why the boiling water reactor trash is lower than PWR trash?

MS. DAVIS: It's probably the kind of operations.

DR. FOSTER: Intuitively, I would have thought it would be the other way.

MS. DAVIS: Part of it depends -- you see, the BWR, the turbine area is potentially contaminated. So you have the wastes from the whole plant, that's BWR trash.

DR. SHEWMON: You're talking about the slide before this. Orders of magnitude.

MR. EBERSOLE: 50 times difference.

MS. DAVIS: I don't know. I know people have

looked at that, and I think there are reasons, but offhand I don't know.

MR. EBERSOLE: Maybe the PWR trash is dirtier, so it's in a higher category.

MR. KATHREN: There are more PWRs too. Would that have anything to do with it?

MS. DAVIS: I think it mainly has to do with the fact of the size of the plant and the concentration of the activity in the PWR plant compared to the BWR plant. I'm sure in the Part 61 stuff, there's a description.

(Slide.)

This was the ranking based on those various criteria I gave you. This was our ranking of the ones that were probably the best candidates, based on those original criteria without looking at anything else. BWR compactable trash. PWR compactable trash. PWR resins from steam generator blowdown. Condensate and these concentrated liquids. Dirty waste of evaporator bottom. The dirty waste is the things that are collected in the plant, like drains, and things like that, that don't have any leaks and shouldn't be radioactive. Dirty, dirty. And the volume control system evaporator bottoms. And these are categories that have to be defined.

So these were the five most promising categories of routine plant wastes, process wastes. These other two

we looked at. There's a whole other category of waste that we're interested in possibly disposing of. And those are thing that happen once in a while and ar contaminated, because they contained detectable levels.

For example, a few years ago, San Onofre had a spill associated with a lot of beach sand, and they spent $800,000 digging out beach sand and shipping it. There was no guidance as to how much they could dig up, because you could still microscopically detect cesium there.

And so those kind of things are contaminated soil we put in there to represent that kind of case.

Then we found out that there's a category of plants, BWRs, that have a certain type of containment system, that periodically have to sandblast the inside oof this torus. They come out with a lot of sandblasting sand again. After the first time or so, it's just about clean, but it nominally has to be considered radioactive. Disposing of -- that is a large volume and expensive to dispose of, really not radioactive.

So we consider these two cases as typically of the kind of wastes, nonroutine, nonprocess wastes that might be used.

DR. MOELLER: For the third one, the PWR rosins, I presume you're saying they will be all right, or they're a good candidate, I guess so long as the leakage from the

primary to the secondary is not above tech specs.

MS. DAVIS: As you will see, they probably can be generically released. These two might be a category that could be generically released with some control, with some quality assurance on it.

This problem will have to segregated.

(Slide.)

We then have a series of charts, and I have them in the thing. I will only show you these once. But for the different types of trash, again, from these data bases we got the isotopic system, the distribution of isotopes, and as you can see, most of them are cesium and cobalt. They're the big contributors, and when you look at the activity and the limits --

DR. STEINDLER: There was a study out, it's still out, I think, by EPRI that came to the conclusion, at least as I recall it, that there were no transuranium elements in lightwater reactor wastes. You show in both of those PU-241.

Would you care to comment on that?

MS. DAVIS: These are from these data bases, and one's an EPRI data base and one's done by an NRC contractor.

In some cases, there are measurements, I guess, of small amounts of transuranics. They may --

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DR. MOELLER: I've seen, you know, say, neptunium listed, but I don't recall seeing plutonium.

MR. KATHREN: I have two questions.

How do you get the plutonium 241 without getting some lower plutonium isotopes?

MS. DAVIS: Whatever else is there is included in others.

MR. KATHREN: The next question then is, what about the ingrowth of americium 41, the daughter of plutonium 241, although the specific activity is much lower for the americium, it would be interesting to see if this changed the composition?

MS. DAVIS: I don't know, again. These are from these data bases. I don't know if that's actually there or that's the lower limit of detection, and they assume that it was there.

DR. STEINDLER: I'm sorry. Would you say that again?

MS. DAVIS: It may be that these numbers are less than, so that they know that it's less than a certain amount, less than the maximum possible amount.

When we did the calculations, we assumed that it actually was there at the amounts that it's in these data bases.

MR. KATHREN: Don't you think it would be

important to know if that possible ingrowth of americium could alter the composition of this over a period of years from the standpoint of making it perhaps TRU waste instead of very level?

MS. DAVIS: I think that's an important thing, yes, and I can't believe that people haven't looked at that. These are the data bases that are out there. It's the EPRI and it's the stuff that went into Part 61.

MR. KATHREN: I'm sure they did, but it would be interesting to know.

MS. DAVIS: Yes.

(Slide.)

These were the volumes, the masses and densities that we used for each of the waste streams to put into the codes to evaluate the radiological impacts of the combination of various disposal methods.

(Slide.)

Here are the disposal methods we evaluated. We used a code that was developed by an NRC contractor. One of our subcontractors on this project was Dr. Sinale, who developed that code for the NRC, a series of codes that look at very low-level wastes and allows you to do parametric studies very easily, having everything set up with ratios. And he looked at a variety of disposal methods, combined with different types of waste streams. So we took a

landfill as sort of our base case.

And this is what's called a good sanitary landfill, something that complies with the EPA guidelines and is under the control of local authorities and under institutional control for a certain amount of years after the dumping has stopped.

It's covered every night. All the specific requirements for good landfill.

So we assumed each of these streams went to a sanitary landfill. The PWR compacted trash doing a parametric study. We looked at other forms of disposal. We looked at an open dump, which was a bad landfill, municipal incineration and then for the soil, this one shot accidental type disposal thing, we looked at on-site burial. Just to leave it where it is, cover it over or leave it somewhere else on site.

MR. EBERSOLE: I hope you had sought to avoid using the nasty word "dump."

MS. DAVIS: I'm not a person who avoids it. If it's a dump, it's a dump. It wouldn't be something that somebody would go to the NRC and ask them for permission to leave it in a dump.

(Slide.)

But just to compare again, for purposes of comparison, different methods of waste disposal, then we

looked at disposal sites in the Northeast, Southeast and Southwest.

We took the Southeast as our base case, mainly because it's turned out to be sort of the worst case, depending on the overall situation. Which one was worst varied, but most of the time, if you used the Southeast case, you'd come out with the most conservative answer.

(Slide.)

The code has a whole series -- it looks at this whole series of exposure scenarios -- the transport, the transport worker, the population along transportation routes, various kinds of intruders. Intruder Agriculture is someone who goes after the landfill, goes there and builds a farm and lives on top of it, and so forth.

(Slide.)

The results of the inverse code. This code tells you, give the dose rate, what is the maximum concentration you can have in all the waste for that isotope.

So for example, this was set on a unit base of 1 millirem a year. And I underline the most limiting ones.

For the transporter worker, of all the wastes for cobalt 60 that would be allowed in order to give you 1 millirem a year, then each of these other pathways you get the same kind, and then for each isotope, and so for each isotope, there's one pathway that's the worst.

For cobalt 60, it's the transport worker that turns out to be the limiting case.

For example, that's the truck driver. If the truck driver is a plant radiation worker, so you don't worry about 1 millirem to him. Then you would look down here for the next most important worker. In this case, it's the disposal facility operator, 4.93, 6 times 10 to the minus 4. Again, the lower the number, the more stringent the case.

Anyway, as a result, that gave us an idea about what the limiting activity concentration would be in the waste standards, based on assuming a certain volume.

DR. MOELLER: When you say 1 millirem, is that effective dose equivalent or 1 millirem to the organ?

MS. DAVIS: It is either one millirem external or 1 millirem ICRP equivalent.

(Slide.)

Because it turned out we did some parametric studies to see if the concentration made any difference, and it turned out it didn't. You had the same activity. It didn't matter if you had half the volume or twice the activity.

We then came up with this table, which, for each type of location gives you what's the maximum total activity of the isotope to be disposed of in a year. It would be

1 millirem per year.

DR. MOELLER: Excuse me. I don't understand what the difference is, say, in the Southeast landfill versus te Northeast.

MS. DAVIS: Look at the cobalt 60. There's no difference. It's a nonexternal dose. It has to do with the groundwater paths and erosion and things like that.

DR. MOELLER: These are hypothetical. Each one has certain characteristics?

MS. DAVIS: The Southwest one was arid and the Northeast and Southeast have properties. And that was included in the input to the code.

DR. PARKER: That's Part 61 sites, isn't it?

MS. DAVIS: Essentially.

DR. CARTER: Haven't you included a lot of things that aren't going to be in there? Do you have the neptuniam?

MS. DAVIS: We included what we felt NRC would be interested in.

DR. STEINDLER: Aren't those numbers strong functions of what kind of chemistry you've assumed?

For example, your carbon 14 probably is quite different, if you assume carbonate versus some practically inert carbide.

What sort of assumptions have been made in

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areas like that?

MS. DAVIS: The code has all kinds of parameters. We used more or less the standard case similar to the ones used in Part 61.

DR. STEINDLER: I don't have the slightest idea what the code does.

MS. DAVIS: Regardless of the amount of carbon-14 and the limits, it could be off by three orders of magnitude and you wouldn't get any problem.

Again, parametrically when you look at these things, if you are going to be worried about carbon-14 you would have to look at them closely.

DR. FOSTER: On your previous slide, where you were listing the impact scenarios, leachate overflow was the limiting case for the great bulk of these.

What kind of pathway did you really use there?

Leachate overflow -- overflow into some surface stream and consumed as drinking water?

MS. DAVIS: Mainly, yes.

MR. KATHREN: Is this a new code or an old code?

MS. DAVIS: I guess it is about three or four years old.

MR. KATHREN: Fairly recent?

MS. DAVIS: Fairly recent. And in fact, Dr. Sinale has done further developments on it for NRC. Because it deals with more active wastes it was developed at the time of Part 61 or shortly thereafter.

(Slide.)

A final result. That gives you the total activity of the material to be disposed of by isotope, and you can use that for setting some kind of limits.

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This part of the code, which is called impacts, looks -- and we did it for each of these cases. This happens to be PWR trash at a Southeast sanitary landfill, and this one is the one I mentioned with the activity of each radionuclide just below the lower limit of detection.

So this says it has nothing to do with the actual concentrations in waste. We just assumed everything had an activity at the lower limit of detection. You come out with the maximum dose to the transportation worker of 10 to the minus 2 millirem per year.

DR. STEINDLER: Could you tell us what you mean by lower limit of detection?

MS. DAVIS: Again, that was defined. We used an SAI data base that had the list of each of these for the lower limit of detection, and we assumed that it meant that you couldn't detect it if it was below that level and therefore you wouldn't know if you had it or not.

So we, therefore, assumed we had it. We don't know whether we have it or not. But let's assume we have it and see what it means. Just as a screening, just to decide whether there is a problem or not.

DR. MOELLER: But I guess a table showing the lower limits of detection for all the nuclides would have been helpful.

DR. STEINDLER: There's some indication it was

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something other than somebody's state-of-the-art laboratory technique, which is wholly unrealistic.

MS. DAVIS: But you see, we didn't mind being unrealistic as long as it was conservative. This is just to show that something can't escape.

DR. STEINDLER: That level of unrealism that I have just quoted to you is not conservative, on the contrary.

MS. DAVIS: We will look at the actual values, and maybe that will make you feel better. But we did this anyway. We put down some way of figuring out could there be something that is hiding there, that it didn't matter what we did we would have a problem.

At least that shows that you might be able to do something.

(Slide.)

This is based on the data base, on what the concentrations of these wastes are, the activity concentrations. This is microcuries per gram, again total activity.

But for the purposes of using it in calculations, we made a statistical model based on what data was there, and we also plotted the actual data.

This is for the waste stream of PWR resins. This is activity in microcuries per gram, judging what the

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activity level is versus how much of the waste is below that level.

We have one of those for each of the types of wastes in the material we gave out.

(Slide.)

Here is the packaged trash.

MR. KATHREN: Going back to the unit discussion, I just noticed that with tongue in cheek that your units are even different than the earlier presentation, those on the abscissa.

MS. DAVIS: This is the PWR compacted trash. It is in the units of 10 to the minus 5 microcuries per gram. You can see that it is way down in the less than 10. 70 percent of the trash is less than 10 to the minus 4.

(Slide.)

As a result of looking at these dose rate calculations I have shown you, looking at all those paths for each of those types of wastes, the isotopic concentrations I gave you, this is what we came up with.

If the exemption dose rate were set at these various levels; for example, the percentage is 10s of millirem per year; in other words, the dose of the maximally exposed person throughout the disposal process transferring there and intruding many years after for the people who worked the site, all those pathways were set at a tenth of

a millirem per year. 55 percent of the filters, 10 percent of the PWR trash, 35 percent of the BWR trash, and 30 percent of the soil might meet that criteria.

If it were 1 millirem per year -- and again most often that is the truck driver -- we found that the ratio of the truck driver to the workers on site was something like a factor of 5, so that if the truck driver -- if we were not concerned about the truck driver, then this number is really five times lower than that.

If it were 1 millirem per year, 90 percent would be BWR trash and 65 percent PWR trash.

If you made it 10 millirem per year to the truck driver, it would be equivalent to 2 to the onsite worker. This is an approximate 100. Just about all of the trash, as measured and as it appears in these data bases, would be capable of being exempted.

DR. MOELLER: You are saying none of the resin and none of the evaporator materials would be exempt?

MS. DAVIS: This is an approximate zero, yes, the way they are -- at least the way they are defined in the data bases.

Now, if they segregated the resins properly, some of it could go. But if you take the averages as given in the data bases -- and of course just a few dirty ones will raise the average quite a bit.

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(Slide.)

Then we did a population dose estimate. These are all the pathways -- transportation. The occupation, he is a driver. Inhalation air dose. These are in person-rem units, and you see PWR trash. In this whole disposal you get 1 millirem per year. Disposal of all the PWR trash gives half times 10 the minus 5 millirem per year. So it is an exceptionally small population.

DR. CARTER: Let me ask you a question about your dose equivalents to the transportation worker, the driver.

Is that based on a normal working year? Your selection number is either a 1 or a 2?

MS. DAVIS: That number comes from how many trips, based on the volume of the waste and a certain truck capacity. How many trips does the driver have to make in a year?

DR. CARTER: It is not necessarily a full workyear, a person/occupation-day?

MS. DAVIS: If this person is not a radiation worker, there would be no other sources of radiation other than natural background or whatever else he does. If he is a radiation worker, then you will have to worry about it.

DR. CARTER: But you don't have any idea about what kind of period of time you are talking about?

MS. DAVIS: We are talking about over a year,

something like 10 or 20 trips to the dump.

DR. CARTER: That wouldn't be too bad a job to have.

MS. DAVIS: He is doing something else probably the rest of the time. He is driving out to inspect the transmission lines the rest of the time.

Okay.

(Slide.)

This is how the results of the impact code come out. This is for PWR compacted trash at the Southeast Landfill.

This was the transportation max to the driver. It is half a millirem per year, approximately.

Now, this is using the average concentration of waste in curies per cubic meter and the amount that a typical plant puts into the dump, and you come out with the maximum dose to the transportation worker is half a millirem per year.

Then this gives the other pathways, the intruder -- and again, the way this program is set up, it gives it to each of these organs. Then it gives it to the ICRP weighted number.

So that is the one we used as equivalent to the dose in those kinds of pathways.

This one is just an external one, and that is

not all the pathways. I didn't include the whole thing, but that is how the thing works out, and in all cases the transportation worker is the most highly exposed.

(Slide.)

Then the next one, the other workers, the general population, is way down into the 10 to the minus 4's, and so forth.

So we then took it a step further and looked at Southeast Landfill. It doesn't matter if it is trash or PWR resins or what, what the thing being disposed of is, because the cobalt-60 limit is really the most important.

And you see, this tells you that is 3 millirem per year to the driver. This is in curies, .03 curies a year. If the limit is 3 millirem per year, you set it at 1. If you set it at 1, it is .03, et cetera.

Again, we tried several cases, and it scales directly. So this gives an indication, for example, if the utility is interested in deciding whether it wants to apply for an exemption or it has a waste stream to be considered to be disposed of, it gives people an idea of about how much you could have, and if you are below those numbers you might want to consider.

DR. CARTER: How do you expose the driver to tritium and carbon-14?

MS. DAVIS: For those pathways, the driver -- you

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have to go back to that other chart I showed you. In each pathway there was a different dose level and a different isotope. That was the limiting one.

DR. CARTER: I thought you said all these were contained in the driver.

MS. DAVIS: I didn't mean that. I meant that the maximum was in the driver.

You are right. The other ones are whatever is the maximum person. In some cases it is some other worker. In some cases it is someone who inhales it.

DR. MOELLER: Are there additional questions for Dr. Davis?

(No response.)

DR. MOELLER: You are ready now to do the other?

I notice we are running considerably behind.

MS. DAVIS: I will go over this very quickly because it is really just a regulatory thing.

(Slide.)

This was the one on obtaining approval to dispose of low level wastes.

Looking at now an individual request for an exemption from the NRC under 20.302, anyone can apply for an exemption and be allowed to dispose of materials --

(Slide.)

-- in a way other than by sending it to a

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Part 61 licensed facility.

So we are trying to put together guidance to help people prepare applications to do that.

(Slide.)

We got our information from talking to the people at NRC who approve these and reviewing them with the utility people and also in the public document room, looking at past approvals.

(Slide.)

The procedural alternatives available, you can have a generic rulemaking, one which covers the disposal of a specific waste stream, like the one that exists now for the medical wastes. You could have the establishment of a generic cutoff level.

The English have just done that in their adoption of a generic level about which they have some concern.

You can also make an application for approval to disposal of the wastes under 20.302.

DR. MOELLER: This exists then in Part 20?

MS. DAVIS: Yes, in current Part 20.

I will show you the ones that have been approved.

(Slide.)

We looked at what has been approved already, the kind of things tl .t people have asked to dispose of.

Contaminated soil and sand, sludge, waste oil, sediment, secondary side resins, scrap wood, feedwater heater, tube bundles, and roofing material.

Now, most of these -- quite a few of them are one shot or unusual things that don't get in the usual stream of things or that a large volume is very hard to dispose of by sending them to a licensed burial site.

(Slide.)

We then have a summary of the actual cases, and I will show you just to show you that these things have been used.

First of all, in 1981, Oconee 1 and 2, burning waste oil onsite. So you approve that.

The far column shows the estimated maximum dose in millirem per year. That was estimated at the time either by the applicant or by NRC, at the time these were processed.

You see, it is generally fractions of or a few millirem per year.

DR. MOELLER: Were all of these approved?

MS. DAVIS: All of these were approved, yes. All of them that have gone in so far eventually have been approved. Now, there may be a lot of correspondence back and forth to negotiate, and some of them took several years.

(Slide.)

A few of them were processed relatively quickly because there was an emergency and they had to get the pond pumped out or something like that. So far, they have been on a case-by-case basis.

One of the things NRC and we would have liked to develop is regulatory guidance, so one knows in advance, for example, what dose would make this thing apt to be approved and how to make the process as speedy and as efficient as possible.

So after we reviewed all of those cases, we then tried to set up some guidelines for people to use in deciding when something should be done.

(Slide.)

Wastes should be disposed of within the state in which they were generated, and the site is likely to be occupied for some period of time.

DR. MOELLER: And this will be in the form of a handbook or a guide or something like that?

MS. DAVIS: Yes. This report, which will be coming out, will have this guidance, whatever guidance we have developed, as well as on a step by step method for filling out an application and also an example of a typical application in a way. It is hard to be typical of this because, as you can see, there is a variety of things. We

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are trying to pull out the important aspects to make sure that people cover them initially and avoid having to have correspondence back and forth and try to get all the information the first time around.

DR. MOELLER: I presume, though, that the handbook would be of use to other licensees, universities?

MS. DAVIS: Yes. We are talking about that a little bit.

We have based it on, as far as review of the applications that we have looked at, only on reactor points, and the interesting thing that makes it a little different is that a different group in NRC reviews the materials licensees, the reactor licensees. I don't know if one looked at both of them if one would get the same kind of guidance.

Certainly, the procedural stuff should apply to any licensee, and hopefully one would like to think that the overall guidance coming from the agency is the same in general for all licensees.

DR. MOELLER: Do we have additional questions for Dr. Davis?

That is a lot of information, and I very much appreciate it.

MS. DAVIS: If anybody has comments, we would certainly appreciate them. We are going to be issuing this in a short time, and we will have a chance to go over it.

DR. MOELLER: All right. Let's then give Bob Alexander a few minutes now to comment on the de minimis matter.

Bob, if you are here.

Thank you again, Joyce.

MR. ALEXANDER: Let me start by talking about what the NRC staff is doing in a broad way with regard to the question of de minimis levels and then narrow it down to what we are proposing in Part 20. It is very important to make that distinction.

What we are doing in Part 20 is just a tip of the iceberg of what needs to be done by the federal government. Let me tell you first what we feel needs to be done and how we are going about it.

Most of the staff feel that a great deal of resource is being wasted by overly conservative approaches to such things as radioactive wastes and decomissioning of facilities, releasing of materials, releasing of equipment that might have small quantities of radioactive materials connected with it.

The government, by and large, has avoided biting that bullet. We feel that the time has come to bite it, that the squandering of resources in that manner should stop.

The way to stop that, of course, is to establish criteria which everyone can follow in releasing these land structures, materials, and equipment for uncontrolled use. We feel that should not be done unilaterally by any one

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agency, as many agencies are involved.

We have proposed to the Environmental Protection Agency, which has the federal guidance responsibility which I mentioned earlier today -- that was given them by the Congress in the enabling legislation -- we have requested them to use the federal guidance approach in developing Presidential criteria for these questions, and we have received back from the EPA a very positive letter saying that they agree that this question needs to be attacked on a broad basis and that the general guidance approach looks like the way to do it with them.

So we expect them very soon to start. Now, the way that works, the same way it worked with the occupational guidance that will be submitted to the President, very soon and the Interagency Committee will be formed. All of the affected federal agencies will be invited to participate, and criteria will eventually be developed and agreed upon by these agencies for these questions and submitted to the President for his signature, published in the Federal Register as guidance to the federal agencies.

I don't know how long that will take. I know that we started the federal guidance exercise in 1974, and it hasn't gone to the President yet.

But hopefully in this area in which there is great need from a resources viewpoint, from the viewpoint

of reason, it can be done.

But it won't be easy because when you start releasing equipment and materials into uncontrolled channels that have radioactive contamination on them or are incorporated into them, it becomes an international consideration, and I am sure that our Department of State will be involved, and I don't know how it will be worked out that all of our neighbors in other countries can be satisfied with what we are doing.

But we are approaching it in this broad manner, and I believe that in every case where such a limit would be established, a contamination level limit or a dose rate limit or whatever units might be used, whatever measurements might be required prior to uncontrolled release -- I do believe that that would be -- and I believe Joyce would agree that that would be an application of the de minimis concept, levels below regulatory concern.

And, once defined, I believe that a lot of resources that are being expended now to prevent exposures could be channeled into much more productive areas.

Part 20, we are not doing anything like that. We are not proposing anything like that at this time. We are not doing anything that is that important on a unilateral basis.

All we are doing is we have got to pick an area

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where the de minimis concept would be tried out on the public and see if it will be accepted for a very, very narrow application.

What it amounts to is collective dose calculations. That is the person-rem type of calculation that the NRC staff often requires before making a decision about a license application or a license amendment application. The staff always wants to know how many person-rems will you cause.

And if this rule goes into effect, what it would say is that when you do that calculation for the NRC staff you may omit the doses received by individuals who get less than 1 millirem. For many of the types of calculations that have to be done, that is a very large percentage of the dose.

The position we are taking is that the risk associated with 1 millirem per year is so small that it ought not to figure into the decisionmaking process. We figure that the numbers we get to look at, to examine as a result of this rule would be much more realistic and a much better basis for governmental decisionmaking.

Would you like for me to spend two minutes telling them about the position the British government is taking?

DR. STEINDLER: I have one question. My question

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is -- basically -- is the only consideration that you are giving to this issue one based on risk, the only yardstick you guys are using at this point?

MR. ALEXANDER: I believe it is safe to say that that is true.

DR. STEINDLER: At what point or by whom should other issues be brought in to the concern?

They tend to be labeled institutional. Let me give you a trivial one, if you happen to be, I would say, the man in the street.

And that is at this stage of the game, if you try to build a very low level laboratory in which you are doing very low level counting, you can envision the enormous difficulty you will have just buying ordinary materials of construction following a 10-or-15-year de minimis implementation at the kind of risk levels which you agree are trivial, the kind of contaminations broadly based throughout the economy which would be disastrous for somebody. As it is, fallout is playing hell with people trying to put together very low level laboratories.

MR. ALEXANDER: Let's start over. I thought you were asking me whether risk was the only consideration for the 1 millirem cutoff in Part 20.

The answer was yes.

You were asking about the overall residual rate.

DR. STEINDLER: I am sorry. Yes.

MR. ALEXANDER: Risk is only one of many, many considerations that go into residual radioactivity, only one of many.

DR. STEINDLER: So you have a charter to broaden your considerations?

MR. ALEXANDER: We have a request in place to the EPA that has been accepted in writing by the EPA. It is not really in charter form yet, but it sure looks like it is going to happen, and it is long overdue.

DR. SHEWMON: That what is going to happen?

MR. ALEXANDER: That the EPA will form an Interagency Committee to develop Presidential guidance criteria on radioactivity, land structures, facilities, materials, whatever.

DR. MOELLER: Go ahead, Paul.

DR. SHEWMON: Are you through, Marty?

It seems to me at least a year ago there was some question about getting a fair amount of contaminated stainless steel to a steel mill, probably released from a DOE facility into a steel mill, where once it was melted it would be relatively low contamination but there would be contamination.

Was there one case of that, or what is the Commission policy on what level of material can go off and

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go back into the distance so that it has some value?

MR. ALEXANDER: You are striking the nerve there that we are addressing. The Department of Energy has millions of dollars worth of contaminated metal, and they, of course, want the NRC to tell them that they can release it into uncontrolled channels for economic reasons, and they feel that the risk associated is negligible.

And I think steel is only one. I think there are several different metals involved, and literally tons of these metals in perfectly usable form except for very small amounts of radioactive materials.

You probably wouldn't want to build an in vivo counter out of them, but almost everything else it would be perfectly safe to use.

We received this petition, and what we did, we published it in the Federal Register for public comment, as we always do. That is our procedure. We received 3700 letters, almost every one of them saying don't do that, don't let the Department of Energy release that radioactivity through uncontrolled channels.

So our reaction to all of this was to write that letter to EPA and say, look, we have got to -- the government has got to just stop telling people, no matter what the radioactivity level is, to bury it in the landfill, no matter what the value of the material is it

just can't be used again.

And the EPA has responded, we agree, it is time now to establish a national criterion where DOE won't have to petition the NRC.

I think we are going about it right, but what I am trying to make perfectly clear is that we are not doing anything like that in Part 20 right now. But I think the great importance of what we are doing in Part 20 is that the public response to this 1 millirem cutoff for collective dose calculations is positive at all, not overwhelmingly negative.

I think that would be an indication of an endorsement from the public to go ahead with the residual radioactivity criteria development effort that is needed.

On the other hand, if everybody in the country writes in and says, you guys at the NRC must enjoy killing -- this comes out to about 20 deaths -- uou must enjoy killing 20 people per year, and we had a whole lot of that, that would be an indication that we have got to do some public education before we can go forward and probably take this out of Part 20.

DR. MOELLER: Okay. If you can do this in 30 seconds, then we will move on.

(Slide.)

MR. ALEXANDER: What has been done in Great

Britain is to establish a 5 millirems per year limit as a level below which an individual should not be concerned in making personal decisions about his personal conduct or his family. As long as the dose is less than 5 millirems per year, that should not be considered in making personal decisions.

Then when he gets around to designing and operating facilities, they are saying that a person can get a dose from more than one facility. So in the design of facilities, you should use .5 millirems per year as your criterion, and then a person could get -- could be exposed to 10 different facilities that will be less than 5 millirems per year.

Then they have a 100 person-rems limit that goes with the use of the .5 millirems per year limit in their dose calculations. That we don't have.

The two things that we are doing differently -- the three things that we are doing differently is we don't have this one at all. We are not saying anything about that one.

We are not saying anything about this one, 100 person-rems limit, for applying the calculational cutoff, and our calculational cutoff is 1 millirem per year rather than .5.

DR. MOELLER: Okay.

Any questions?

DR. PARKER: Why are you twice as much? What is the rationale?

MR. ALEXANDER: I don't know whether I am happy to hear that question or not, but since you asked it I will be glad to answer it.

That number was selected by the CRGR in connection with a presentation that we made to them. I will refer you to them for the justification for it.

DR. MOELLER: Other questions?

DR. MARK: Well, our plants or sources may be twice as far apart as they are in Britain. So you would only have to go through five facilities.

Are the British applying this also to the release of slightly contaminated steel, aluminum, and so forth?

MR. ALEXANDER: I don't think so. I don't think these are being used in residual radioactivity deliberations.

DR. MARK: Because the Canadians do have a thing of that sort.

MR. ALEXANDER: I am sure they don't have an active one. Whether they are working on one or not, I don't know.

DR. MARK: Now, Marty's question about building a gamma free lab -- the photography industry will be

interested in knowing if they don't have beta particles popping out.

Will there be controls that one can imagine which will allow them to buy grade A steel that has no radioactivity?

MR. ALEXANDER: I think such things might be possible. I know, for example, in the building of shielding for the whole body counters it is very common practice to find steel that was forged before the advent of nuclear weapons. So there are practical ways to avoid radioactivity in materials.

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DR. SHEWMON: You could at least get A-minus steel if you took a modern steel mill which used only ore, and many of them do; whereas, you buy from your local reheat of scrap dealer, you're going to be a lot higher.

DR. STEINDLER: We use a lot of virgin lead.

DR. SHEWMON: And you're not running out of virgin iron ore lately.

DR. CARTER: When you were putting together this cutoff, did you take a look at somewhat higher numbers as far as relative impact on the industry?

MR. ALEXANDER: Yes, higher numbers were considered and proposed. It seems like any number you propose will be considered too high by some people, and too low by others.

DR. CARTER: I think, from a practical standpoint, I suspect most people don't concern themselves at that level at all. Certainly, the people in the business. I figured this was something...I don't think they concern themselves at that level.

MR. ALEXANDER: What people do, Mel, and the reason that these very small numbers can be so important in deliberations, is they are multiplied by numbers like the population of the United States, or the population of the world, for things like noble gases. And then by the risk factor. And you get some deaths per year, which is a large

number, like 20 per year that I just mentioned for the United States, for one millirem.

And people are saying, well, the NRC fellows want to kill at least 20 per year with their 1 millirem cutoff. People attack like that.

So if you say 10 millirem, then that gets to be 200 people per year that the NRC is not interested in.

DR. CARTER: It's a positive number, no matter what you do. In a more practical sense, it makes a difference whether you're sitting on that side of the table or this side, as far as exposure levels.

DR. MOELLER: Thank you, Bob.

Richard?

DR. FOSTER: Can I ask a quick question here? On the 10 CFR 20 version of December 20, when I read through the section here on de minimis collective dose, I didn't know whether I was having problems because of some of the typographical errors that you were talking about earlier, or not. But I'll admit I had some confusion here. It sounded to begin with like you were building a pretty good case for a tenth of a millirem, based on this linear quadratic.

Then, suddenly, I found that, without any transition, we'd gotten out to 1 millirem and there wasn't much of an explanation as to why that switch.

Then I looked over on the figure 1 here and one

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of the levels here doesn't have a 10, or whatever it's supposed to be, for the de minimis level per exposed individual. I didn't know whether that was left off deliberately or whatever.

And I ended up with a feeling that you were throwing out a trial balloon and you were waiting for comments to come in before you ever crystalized on 1 millirem.

Tell me where I went wrong?

MR. ALEXANDER: I don't think you're the one that went wrong. It is a trial balloon, certainly. And we're specifically inviting comments on this whole question.

The sta f had proposed a system very similar to the one the British have adopted after several years of very difficult work. And it took the CRGR a few minutes to decide that it should be 1 millirem, just one number, and that the magnitude should be 1 millirem.

And we simply didn't have time to completely rewrite our book.

DR. FOSTER: Is the next version going to be changed? Or is this the same? You mentioned the January.

MR. ALEXANDER: No, there are no changes. No.

DR. FOSTER: I'll have to admit that I thought one of these numbers must be a typo here because it sounded like you were going for a tenth of a millirem and then

ending up with one. And I wasn't sure what number you were really looking for.

MR. ALEXANDER: We started going for a tenth of a millirem. Our minds were changed to 1 millirem. And the supporting documentation, we just didn't have time to make it fit the new number.

DR. STEINDLER: What's the CRGR? What's that stand for?

DR. MOELLER: Committee for Review of Generic Requirements.

DR. STEINDLER: Is that an NRC committee?

MR. ALEXANDER: It's an advisory committee to the EDO.

DR. MOELLER: NRC is the Nuclear Regulatory Commission.

(Laughter.)

DR. STEINDLER: I read that.

DR. FOSTER: From that response, all I can say is that you've probably stimulated a lot of the kind of comment you need. But you're not going to expect.

DR. MOELLER: Carson?

DR. MARK: Some raffles are not intelligible. This one, where you're going to get 3,700 letters, is it or is it not allowed for members of the ACRS to write?

MR. ALEXANDER: I'd encourage...wherever I've

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gone, I've encouraged NRC inspectors, plant health physicists and absolutely members of the ACRS to please submit individual comments.

There's a misconception that a comment signed by the president of a large organization, or something like that, would carry more weight with the staff than one that was signed by an individual. And that's not true.

DR. CARTER: I've got a question similar to that. How about multiple letters from members?

MR. ALEXANDER: When you said...send somebody down, like I'll do Allen Brodsky, a highly respected health physicist for many years, who has been selected to evaluate these comments, with a completely fresh mind. He hasn't been involved at all up to this point.

We'll put before him these comments. By and large, he won't even know who made the comments. We'll cut them out and put them into the right paragraph so that he doesn't have to do that.

We've got secretarial help to do that, administrative types. But what he'll look at is the rationale submitted by the comment, and not by the name of the commentor.

Unless he goes to a little bit of trouble, Mel, he won't even know who wrote it. And, certainly, if a thousand letters come in with exactly the same rationale,

those thousand letters, he'll treat them just the same as if it was one letter with that rationale.

DR. CARTER: I was being facetious.

DR. MOELLER: Well, if you write two letters, put in two different arguments -- one against and one for.

(Laughter.)

DR. MOELLER: We'd better move ahead. We're right on time, if an hour is a de minimis quantity.

(Laughter.)

DR. MOELLER: The next speaker is William S. Brown of Westinghouse Corporation. He's going to be talking on the AIF/NESP Project. The subject is one that has been of considerable interest to the ACRS. That is, the environmental consequences of higher fuel burnup.

Bill, it's a pleasure to have you.

MR. BROWN: Thank you. I've given you a written handout there that's got a lot of numbers in it. For brevity of time, I will not go into the details of the numbers. What I'd like to cover in this presentation is to give you a little bit of the background -- why are we concerned about higher fuel burnup? Go into the methodology that was used in the study to find out what the environmental impacts would be if we did have higher fuel burnup, and then summarize briefly some of the results. And then give you a little bit of the feeling of the precision

of the results and the sensitivity analyses and the assumptions that we used would affect the results.

Why are we concerned about the environmental effects of higher fuel burnup?

As you are probably aware, 10 CFR 51 requires that an applicant, in their environmental report, discuss the impacts of the entire fuel cycle. And also the transportation aspect of the fuel cycle.

The generic results are given in tables S-3 and S-4 of 10 CFR Part 51.51 and 51.52. Those environmental impacts are all calculated for a fuel burnup, a maximum burnup, of 33,000 megawatt days per metric ton. Currently, utilities are going to higher burnups. And whereas there have been programs looking at the safety implications of higher burnup, the environmental impacts of higher burnup really have not been addressed until this study was put forth.

The reason the study was done, the purpose of the study, was to extend these values so we would be able to have answers to these questions that may be coming up:

Are the impacts at higher burnups going to be applicable to what the numbers are that are already listed in the regulations?

Basically, the study was done trying to use the existing results. There was no effort to try and come up

with or discredit or set up a new set of tables. We're basically trying t~ use the same methodology, the same basic assumptions in the calculations, so that we could extend them to the results for higher fuel.

I would like to just give a brief acknowledgment to the authors of the report as shown on the cover page there of the NESP Report. The contract in this work was done by Myra Spear. Also with the help of Mr. Colin from B&W.

As the result, I, as chairman of the task force, and the rest of the task force, were particularly pleased with the quality of this report and what I think is the good potential usefulness and what I think is good potential usefulness to the nuclear industry.

Let me go into a summary of the methodology. The report was really done in two phases. The first phase was really: let's be sure we understand what was done in the preparation of existing tables, S-3 and S-4. These tables evolved over quite a pe.iod of time. I think the original table, S-3, was in WASH 1248 around 1974, presented a couple of upgrades.

KESLO came into the picture and they were looking at the backend of the fuel cycle on what those impacts would be. So there was a lot of calculational history and words that went into the history of this.

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And so the contractor and the task force says: We'd better understand exactly what was done in the first place so that we have a reference baseline. The intent here was to be able to provide numbers that would be consistent with the methodology. So that, as new numbers were generated, we would have complete traceability and credibility of the values that were going to be issued in the report.

The values in table S-3 were derived from a breakdown of the table which was called table S-3-A. That was given in WASH-1248.

(Slide.)

I see I have a typographical error. It's called table 3-3-A. I meant S-3-A. What was done was for each of the cycles in the fuel parameter, they evaluated what the environmental impacts would be for each one of these parameters. And then, for each of those environmental impacts, they then summed them to come up with the overall summary that was given in table S-3.

I have a later slide which will show you the original values of S-3 and the values that were calculated via the study.

The point I want to make in this slide was that when this study was done, certain of the parameters of the fuel cycles -- for instance, the spent fuel storage and

disposal and some of the waste management -- there were so many different subvariables that impacted, that could impact the environmental effects. We broke it down into components. So each one of these components was looked at to determine what the environmental impact.

Then the numbers are summed. That gives you the final S-3 table. The original NRC staff calculations, they were trying to be conservati" , and so they summed the front end of the cycle. And two alternatives for the backend of the cycle. And they used the greater number, whichever was greater, to allow you to envelop or bracket the environmental impact.

DR. MOELLER: Excuse me, Bill. I was just glancing at this but why don't you have waste management? I presume that includes geological storage. It does? Why don't you have that for both cases?

MR. BROWN: I do have it, I believe. I have F. That was for no recycle, which was basically geological storage of spent fuel; whereas, the waste management on the uranium recycle includes the storage of the high level wastes and transuranics.

DR. MOELLER: I see.

MR. BROWN: To make the calculations for higher impacts, what is necessary is going through the calculations of the annual fuel requirements -- how much ore is

processed, how much separate work is needed? All these impacts have to be evaluated.

And, of course, as you go up to higher fuel burnups, obviously, that changes the amount of ore that has to be reprocessed. The conversion process, the yellow cake production, the whole thing. And so the results are dependent on the assumptions that I made for calculating the fuel requirements.

(Slide.)

So what I've shown on this next slide is that, basically, the reference conditions that the task force has recommended and that the contractor used -- question, sir?

DR. CARTER: A question about the last slide, although I don't think you need to put it up. I wondered why you break out a category for geological storage.

MR. BROWN: It had been considered again in part of the NRC in the reprocessing, although it was limited strictly to the uranium recycling, not the plutonium recycling. But it was one of the values in the tables.

And so, in keeping with the consistency and modeling of the way the NRC did it, we wanted to keep the same parameters in this.

DR. CARTER: Thank you.

MR. BROWN: I've listed on this slide the basic assumptions that were used in calculating the throughputs

and the fuels. Items A through D were identical to what was used in the original table S-3 as done by the staff. Items E through H were modified slightly to represent what we think is today's current conditions.

Later on in the sensitivity study in the report, the contractor went back and looked at all these original assumptions. In fact, in the case of the 18-month refueling cycle, we looked at 12 months, 18 months and 24 months. In the case of the ore grade, we looked at different ones. Different values, to try to represent how these assumptions would reflect in the final end results.

And I've sort of given the rationale down at the bottom of the slide of why the task force selected these particular ones.

As I mentioned, a key factor in trying to extend the extended burnup is to look at what are the critical factors in each fuel element cycle, each of the cycles, the fuel element cycle.

What would be proportional? Because we thought that the approach to get this would be to use a scaling factor of what the contractor called a prorating factor.

(Slide.)

What I have shown here is that mining basically can be considered proportional to the amount of ore that is mined.

Obviously, as you go into the higher burnup you don't have to generate as much ore. Therefore, you should be able to scale the amount of ore that is generated.

Similarly with milling, that should be proportional to yellowcake, in metric tons of ore conversion proportion to yellowcake, and so forth.

So what the contractor did was say, okay, these are the scaling factors that we are going to use to scale the effects of burnup, and we want to normalize those and put them at a unit factor so that we can have a unit number per unit amount of fuel or unit amount of separate work units and then use that as a scaling factor.

Later on in the sensitivity study, we examined whether our assumptions were indeed valid. Is it correct

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to scale? How much error would you introduce?

These numbers over here represent the numbers that were originally chosen for the S-3 table, as given by the NRC staff, and represent the number that was used in generating that table.

So what that says in mining, the annual fuel requirement -- let me back up a minute. I should discuss what was called the reference reactor.

The whole Table S-3 was based on a reference, generic 1000-megawatt reactor, and the annual fuel requirements that were required to support the entire fuel cycle were based on what they called a reference reactor-year.

So everything is normalized, and the Table S-3 is given on the basis of what the impacts are per reference reactor-year. In other words, if you operated this reference 1000-megawatt generic reference reactor, you would get the impact shown in the table.

What they did for modeling that reference reactor-year was they took the initial fuel loading to get the initial loaded fuel, and then they assumed the plant reactor had a 30-year lifetime, and they calculated how much fuel would be required for reloads every year.

So in the case of the amount of ore that would have to be generated, they had to create so many metric tons

of ore for the initial load and an additional number of metric tons for every year, and they annualized that over 30 years and said that for this reactor we would need 91,000 metric tons of ore as an annual reload to support this fuel cycle.

Similarly, 182 metric tons of yellowcake would have to be generated each year to support this reference.

So these are the baseline numbers that are used, and basically what they did then, the contractor said, okay, if there's 1000 metric tons of ore needed, if we divided by 91, that would be the amount of ore for a thousand metric tons of unitized impact, and they can then scale the numbers by the environmental impact.

And I made a little bit of an equation.

(Slide.)

I think this is at the bottom of page 2 or 3 of your handout.

Basically, what I am trying to say is what we are looking for is the environmental impacts and extended burden. They are proportional to the impacts that said unit times multiplied by the fuel cycle parameter requirements and extended burnup.

These are the calculated numbers, how much ore, how much separative work that goes through by the reactor physics, and so forth, how much yellowcake we are going to

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need at 55,000-megawatt-days, and so forth.

So basically, I like to look at it this way. If you know the environmental impacts at 33,000, which is Table S-3 numbers, then all you have to do is scale by the proportion of what the new calculated number is and divide it by the number that is at 33,000. So this is basically how the results were scaled up.

Then we looked at the sensitivity of those scaling factors under the sensitivity study.

Okay, so that basically defines the approach. Let me give you a quick summary.

The table I will give you is really three pages. The original S-1 table was on a single page, but we have expanded it a little bit, and this is directly out of the report.

Incidentally, the table numbers that I used in here in my summary corresponds to the table numbers in the original AIF document.

(Slide.)

Now, remember, this is a summary of Table S-3, and remember, the numbers that we are talking about -- the first column is the numbers that are given in the original S-3 table, and the numbers over here were calculated for extended burnup. We did this in seven cycles -- 33,000, 35, 40, 45, 50, 55, and 60 -- has been in each one of these

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steps.

These particular numbers were then based in this slide here -- based on the equivalent assumptions that were used in the originals. In other words, this would be for a 12-month recycle for ore of .2 of a percent, and so forth.

I will show you a later table where these numbers have changed slightly because of the assumptions that we made in the milling efficiency and the quality of the ore.

The Table S-3 considered the natural resources. That is basically how much land is impacted, how much effluents and chemical discharges of effluents.

The second one talks, too, about the radiological effluents, which would be of more interest to this group.

(Slide.)

Then there is also some of the transportation. The point that I would like to call your attention to is that an extended burnup in this particular case -- the results have shown that the numbers are essentially either very close to almost equal to or in a lot of cases actually less than. Environmental impacts are less at these higher burnups than they are at the 33,000.

One of the main reasons for that is that as you increase higher burnup you are getting substantially less fuel that has to be processed, less ore, less yellowcake, separative work goes up, and there is a tradeoff between

these various parameters.

But as an example, at 60,000 megawatt-days, the fuel requirement is 45 percent less than what it is at the 33,000. So even though the radioactive inventory of, say, the longlived nuclides that are being built up was higher burnup, it is more than compensated by the amount of fuel that is being processed.

Now, remember, this is per reference reactor-year. So when you normalize it to the amount of fuel to support that one reactor per year, the net effects are that they become less.

DR. MOELLER: Excuse me. On that table, why did carbon-14 go down by so much?

MR. BROWN: Carbon-14 --

DR. MOELLER: You know, I can understand --

MR. BROWN: Carbon-14, I think there was a reason for the basic reduction on that. I don't recall right offhand, Dade. Let me look it up when I get through, and I will get you an answer before the end of the talk.

DR. STEINDLER: It is probably assumed on the nitrogen content assumed for the fuel. The nitrogen content in the old S-3 table is fairly high.

MR. BROWN: I think that is right, and the amount of fuel, the throughput of the fuel is being reduced substantially.

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DR. MOELLER: That is adequate.

MR. BROWN: Thank you.

DR. CARBON: May I see the first one?

DR. MOELLER: Is that land for uranium mining?

MR. BROWN: That includes -- that is the major impact, is from the land that is disturbed from mining, the tailing piles, the area that is accumulated for that. It also includes areas for the reprocessing facilities, and every one of these cycles has a component in it.

DR. CARBON: But in the 60,000 case they cut the use almost in half. You got, for example, an overburden moved that is the same, line number 5, and there are others. Permanently committed, the discharged water bodies are the same.

MR. BROWN: So the overburden should be -- well, I may be able to answer that by showing one of the tables. It will be Table 3.2. That should be on page 14 of your handout. I have an abbreviated one here.

Now, all this does is give you -- I have covered the radiological effluents. I am not sure why that should be.

Where you are coming from is since you are using less ore you should be disturbing less ground.

DR. STEINDLER: That is only true if the uranium content of the ore is the same. We haven't mined that kind

of ore for a long time.

DR. CARBON: That is only a tenth of a percent.

MR. BROWN: But I think the point you are making is that basically we have now assumed that the ore is .1 percent great rather than .2. So you would have to really mine twice as much ore.

DR. CARBON: That is not assumed in here?

MR. BROWN: In this table it isn't. But in the next table I am going to show you it is, and let me show you that one.

DR. CARBON: But my question is: are ore contents the same and you are only mining half as much?

MR. BROWN: But again this is normalize per metric ton per reference reactor-year. Although I have to mine twice as much year, I am only through-putting to half that, 45 percent of it, at the end of the year. So the numbers would almost cancel out.

DR. CARBON: Is it going to take the same amount of ore?

MR. BROWN: From each year. But as you go to higher burnup, when you replace the amount of ore to extend it for each year's use, you need much, much less.

DR. CARBON: You have to go to higher enrichment?

MR. BROWN: Oh, yes. You have to go to higher enrichment, which reflects the higher percentage of work.

Basically, you have cut the ore in half, and you have doubled the amount of ore because, as I said, it is only a tenth of a percent, but I think that is what we have accomplished.

There is a lot of interplay on here, and I would like to say that in the original report it is full of appendices. All the calculations that are made, the codes that are used, and the traceability are all in there.

The idea was to make this so that an applicant coming up would have the data base to make those calculations.

DR. CARBON: To what degree do you enrich the 60,000?

MR. BROWN: Something less than 5 percent. The numbers are in the report.

DR. MOELLER: I notice it is on your next slide that the occupational exposure almost goes down by a factor of 2 simply because you are refueling less often, I gather.

MR. BROWN: Yes, refueling less often. There is less transportation of the workers. You cut the shipments of fuel.

DR. MOELLER: How close are we to 60,000 megawatts of fuel? What are we doing today?

MR. BROWN: I believe there have been some particular test assemblies that have gone up in the range of

40 to 50 as specific isolated fuel assemblies.

The main concern here is of course, looking at it from the nuclear safety point of view, can it withstand the additional pressure in the fuel elements? Will it not break up the cladding rupture, and so forth?

Those have been looked at, but the environmental concern hadn't been looked at.

Whereas, the results of this study are basically saying it is a knotty problem, it is not a problem.

DR. MOELLER: In fact, we would encourage it.

MR. BROWN: There is a lot of economic incentive.

DR. CARTER: Bill, let me ask a question. This is also on the continuation of the radiological effluents. You have got a number of fission products listed, and I guess in each case with the extended burnout it leaves you with less, and at the end of that you have got the gasses. Then you have got a category called fission products and transuranics.

What do you include in that category?

MR. BROWN: In the transuranics?

DR. CARTER: The fission products and transuranics.

MR. BROWN: Basically, what was included in there was all the results of the backend of the fuel cycle. So it

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would include all directly the fission products, the increase in fission products, and the amounts of the transuranics that are formed as a result of the extended burnout. So you are getting greater amounts of the transuranics.

As a matter of fact, we looked at it from both the BWR and the PWR, and the boiling water reactor, I think because of the harder neutron spectrum, generates a slightly greater amount of transuranics, and those were looked at and compared with the model.

This, incidentally, was based on the PWR reactor model.

DR. CARTER: But this must be primarily transuranics, either that or the terminology --

MR. BROWN: Which slide are you looking at?

DR. CARTER: I am looking at your effluents, radiological, in terms of curies for gases. In that case, you list a number of things. You have crypton-85, for example. The number is in thousands of curies. Then you get down to the end of that, down to the category called fission products and transuranics. Then that number is considerably less, but the number increases roughly 10 percent.

MR. BROWN: I think what that meant is probably there is a small amount -- I guess you would really call

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the nonvolatiles that are included under the gaseous, but it is probably the nongaseous.

I will have to go back and look again at how that was defined. I will have to go back to WASH-1248 or the NUREG-016 or -216 to find out the details on it.

DR. CARTER: Chances is it is an analytical category, where the transuranics have contaminated a small amount of the fission products.

DR. STEINDLER: I think that is the aerosol effluent.

MR. BROWN: Yes, it is probably the aerosol, from a small particulate that is associated with it, as opposed to the gaseous material.

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Let me move on so I won't hold you all up here.

(Slide.)

Table 15 in your handout is probably easier to refer to than this one because the print is rather small. What we've shown here is the table S-3. Remember, this is the sum fc all the cycles, and a function of each of the burnups that were calculated from 33,000 up to 60,000 that were calculated in roughly 5,000 megawatt day increments.

As compared -- well, that's the wrong table. I'm sorry. I was trying to show the maximum impact table. It should have been the table in front of that. I goofed and got the wrong table. It should be table 3.2, which is page 14. I have it in an abbreviated version here. And in all my clever manipulations, I seem to have misplaced it.

Here we go.

(Slide.)

The point I was trying to show here is we show the maximum numbers that were calculated. And if you look at the table preceding on that page, you will find this effect that you were speaking about earlier, on page 13, where I compare the maximum values with the 10 CFR 51.

You'll notice that up in the Natural Resources area, you'll see the land. And some of these other ones are almost a factor of 2 greater. And that's because of the assumption of the requirements.

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There are some other tables in there and I won't go over them. You can look at them bu., basically, they cover the geological disposal storage of the spent fuel.

There's also a table on page 16 which covers the results of reprocessing the backend of the fuel cycle and what those impacts would be. And also on the uranium recycle.

And the bottom line is the same for all these. The impact is essentially decreasing with time, or in some cases, it's about the same. But the conclusion is consistent throughout.

Let me then address an area that's not given in table S-3. Incidentally, I haven't discussed table S-4. That's the transportation effects. And, for brevity, I didn't include that.

But another area that is currently in the licensing arena is the amount of radon-222 that's relealsed, and also technetium-99.

As a result of fuel cycle parameters, neither of these two are included in table S-3. They are currently open for dispute, if you will, at licensing hearings. And the NRC staff has presented numbers of what they say is the impact. In this case, the impacts are in terms of the amount of material released, the effluent releases.

DR. MOELLER: That's our page 18?

MR. BROWN: It should be. Yes, page 18 is the radon-222 sources.

(Slide.)

The first column shows the number as given by the NRC staff. And that was taken from one of the recert tests that was given from one of the environmental impact statements.

The point I'd like to make on this one -- there's a couple there -- is, one, the stabilized piles. We show a number about 10 times greater. The reason for that is that the original calculations were based on an estimate of 2 picocuries per square meter per second as the evolution of radon in the stabilized pile.

The NRC has just issued a new ruling for uranium tailings. That number is now 20 picocuries. So that's about a tenfold increase in the amount of radon that would be released.

The difference between the numbers here is about 10 percent between our 33,000 and the staff's 33,000, and those results are due to improvements in the two codes that were used. I believe it was due. The yellow cake requirements decreased but the main difference for the 10 percent was the milling conversion.

The original study assumed 100 percent efficiency. Our study assumed 90 percent, which is about a

10 percent increase in the amount of ore and milling that's going to be required. And, therefore, the radon goes up.

Page 19...

(Slide.)

...represents the technetium-99. Here we show the NRC numbers as a function of burnup and the calculated numbers that were here that were done by the study. The prorating factor was based on these two numbers from the staff. The curies per reactor year was .14 in the gaseous phase, and the liquid phase, and then these were then prorated directly.

As a result of the throughput to the fuel, you can see the throughput, again on a per reactor year, although technetium obviously builds up. As you go for increased burnup, as more fission products form, we divide that by the lesser amount of the throughput of the fuel that results. And, therefore, you have the same trend again as burnup increases.

The environmental impact in this case is translated not as an impact, but as a release of technetium.

(Slide.)

The final slide on data is the environmental dose commitment. Again, that's not covered in table S-3. The environmental dose commitment is a result of the ruling on

the S-3 hearings. The staff now makes a prediction of the 100-year whole body dose equivalent and we show the numbers again that the staff has done. Based on the table for the S-3 releases, the environmental dose from the radon and the technetium, and, again, we show how those drop as a function of burnup.

The difference between the NRC numbers and the NESP study numbers were due to the fact that the NESP contractor used an updated code, the RATGAT and LATGAP codes, for going through all these calculations. These are, incidentally, whole body dose equivalents. They're actually calculated on a seven organ basis for every one of them and then converted.

The report includes detailed data in the appendices from every organ, for every burnup. So the entire package is there. And this was the summary table of that study.

So that sort of hits the results. Let me talk just briefly a little bit about the precision and the sensitivity.

When the original work was done by the NRC staff, they tried to make it generic and, therefore, they intentionally erred -- and I shouldn't say erred, but they rounded off to be conservative. And they looked at both the PWR and the BWR model. Took the worst impact for both of

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those and said that is the number that will be used. That corresponded to 35 metric tons of fuel per annual reactor year.

As a result of some of the hearing process on the S-3, it was recognized that that was high. Probably a more realistic number may have been 30. So there is a conservatism in the table S-3 numbers.

Based on that conservatism, since we're using as scaling factors the conservatisms and the precision of the results in this study essentially parallels that which was in the original NRC study. And, therefore, some of the fine little details of trying to adjust to something, say, less than 10 percent precision in some of these numbers was really, if it came out that the sensitivity was less than, say, 10 percent, we said, hey, that's within the accuracy and precision of the original scope.

They looked at several of the other sensitivity numbers that are summarized. On page 6 of my handout, we've already talked about the fact that the ore grade, since we had assumed a 10 percent or a rather than 2/10, we had to use twice as much ore. The milling efficiency changes it by 10 to 11 percent.

We show how the tails assembly...there's a lot of the whole fuel management cycle has changed a lot from the original S-3 table.

There's a lot of different economic incentives that can be pursued by the plant operators and the people who are providirg the fuel, giving tradeoff enrichment with the quality of the ore, and there's lots of parameters back and forth.

The bottom line when looking at these things is it's probably 5 to 10 percent plus or minus the values that we've got here and that identified those on page 6.

In summary then, the conclusion of the study is that the existing tables S-3, table S-4, the environmental dose commitments, the radon, the technetium numbers that we find, we consider they're still applicable to the numbers that are shown for 33,000. They're applicable within the precision of the study to burnups up to as high as 60,000.

This report then gives the applicant the basic information to answer those questions on what will be the environmental impact. We feel this report gives the utility the basis for answering those kind of questions.

That's all I have.

DR. MOELLER: Very well. How much research is underway on higher burnup of fuels? I presume the fuel vendors are --

MR. BROWN: We at Westinghouse are doing quite a bit. As a matter of fact, we have submitted a generic licensing report and I think we just got an SER from the

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staff on that. You can look at it again. It didn't address any of this environmental bit. That's usually...well, I guess the utility, in recognizing these extended burnups, they wanted to answer all the safety questions.

But I see that's the trend here. It's obviously an economic incentive if we're going that way. And I don't really know, Dade, the answer to how far they're going to be going. But we wanted a bracket; 60,000 seems to be an upper boundary limit that seems to be reasonable. That's why the study was chosen.

DR. MOELLER: Frank?

DR. PARKER: Is the economic incentive primarily less down time?

MR. BROWN: Sure, one of it is. Of course, with the 18 months conditions, less down time and I think there's less fuel that's got to be fabricated. You only have to make a reload every 18 months.

DR. PARKER: A technical question.

In the processing, it doesn't make much difference; we're not going to talk about reprocessing. But, in the reprocessing, you used uranium recycle. I think it was fairly clear that the uranium recycle was really a throwaway.

MR. BROWN: I agree, uranium and plutonium. Yet, currently, there is no -- table 3-3 was based on the uranium

recycling only. Even though you're right, it's probably not going to be that way. Their only incentive would have been for plutonium.

Incidentally, part of the environmental impacts originally seen did consider some of the plutonium and they were processing fuel at 150 days instead of a longer time, so that you could get the plutonium out.

Therefore, the amount of metal impacts would be substantially different because you have greater heat release, and so forth.

But the reference again was for the uranium recycle and that's the way the regulations and the regulatory licensing picture is today.

DR. PARKER: Because, you remember, in GESMO, they had all three.

DR. STEINDLER: Have you considered the differences in performance of the fuel in the reactor, and the differences in release rates of the noble gases and fuel failures?

MR. BROWN: From the reactor? No, we didn't. And the reason it wasn't included in the study is because that's not part of the table S-3. The effluent releases and the evaluation of the reactor is covered separately in the environmental report, and it's specifically excluded from the table S-3.

In other words, the licensing people say, here, use the generic and then discuss the reactor. That gets into the Appendix I considerations and all those kind of things.

DR. MOELLER: What Martin says, of course, would have to be taken into consideration. As I listen to this though, and I realize this is a simplistic approach, but if you were in Bob Alexander's position, or if you were part of the group that says we've got to minimize the environmental impacts of nuclear power generation and we need to reduce occupational collective doses, then you might very well define "extended fuel burnup" as ALARA.

DR. STEINDLER: But that was not my question. My point was that the title of the paper is the Environmental Consequences of Increased Burnup. And it only focused on S-3.

DR. MOELLER: It should have had a table for the plant.

DR. STEINDLER: Because there is in effect --

MR. BROWN: I'm sure there will be, but the 10 CFR 51.51 and .52 limits it or excludes the reactor effluence and only includes -- I didn't even discuss transportation but that's given in here also. The conclusion is the same. Yes, it should have said, "environmental consequences of the 10 CFR 50 generic fuel

cycle".

MR. EBERSOLE: What is the physical effect that is established and verified when the reactor is running? Is it deterioration of clouding? It used to be said that the material degradation could be matched to burnup. And that would be kind of one more shape. It's not coming out that way.

MR. BROWN: Basically, I think one of the concerns was the gas buildup and the pressure and could you then get more rupture of the fuel. And I know we've also looked at some of the radiological calculations based on as high a burnup code. The diffusion out into the fuel.

So if you did have a fuel cloud rupture, you would potentially get more radioactive material released.

Now, I'm not a fuel person. I'm sorry that I can't give you more information on that. But it looks like that's the way it goes.

DR. MOELLER: Thank you. Richard, and then Frank.

DR. FOSTER: I'm glad to see that you have used in here what I'll say are very generous types of assumptions. This will undoubtedly allow that table or the modification of it to have more extended use.

As you know, since this is kind of a surrogate standin on licensing procedures for the impact of other

parts of the fuel cycle, what opponents or intervenors will look for are any kind of deviations which will say that this can't be used because of certain assumptions, or some statement in here is not true.

One example of that was in table 4. Table 4 assumes transportation from a reactor to a fuel reprocessing plant. This was written at the time when fuel reprocessing plants were expected to be in existence and it was necessary to change the table in order to make that trip applicable from a reactor to another type of storage facility.

MR. BROWN: I have got a copy of Table S-4. This is again the current S-3 value I have got, and it is probably a little tough to read, but basically this is the current S-4 tables, and here they are as a function.

This summarizes for each of the phases the truck transportation, rail transportation. Fuel, new fuel, reprocessed fuel, and so on are all rolled into this.

DR. FOSTER: I presume that reflects both fewer trips and perhaps higher gamma.

MR. BROWN: The gamma, they looked at the shielding, and basically they said when you transport spent fuel you still have to have the same dose on the outside of containment. Therefore, the people standing by are going to get the same dose.

So although we require perhaps a different cask design or some other shielding, the requirements to meet the dose on the external surfaces will stay the same.

I hope I am saying that right.

DR. FOSTER: I am not too sure about how that one would hold up. If the existing practice was one in which you had less than the maximum dose with the low burnup fuel, you might be able to extend that higher, although I think the original S-4 table calculation was based on the assumption that you did experience the full limited dose at --

MR. BROWN: That is correct. They did do that and carried the same assumption through here. So it really decreases because you are shipping less fuel per reference reactor-year.

DR. MOELLER: Frank.

DR. PARKER: A very simple question.

Does the concern about lack of spent fuel storage reactors have anything to do with driving utilities toward high burnups?

MR. BROWN: I am just guessing. It would be an opinion. The main reason for higher burnup, I think, has been to date an economic incentive from a utility's point of view. But as we are getting more constipated with the waste storage area, obviously there would be a benefit from an extended burnup, also, because you are offloading a lesser amount, and as long as you can extend, yes.

DR. PARKER: But it is not one of the drivers?

MR. BROWN: No, and it wasn't looked at from this point of view.

DR. MOELLER: Thank you, Bill. That was very interesting.

We will now take a break and resume at 4:30.

(Recess.)

DR. MOELLER: The meeting will resume.

We have remaining on the schedule a presentation

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on meeting the waste form stability requirements of 10 CFR 61, by Jay Clancy, with Public Service Electric & Gas.

Then we have a discussion by Scott Lieper and Melinda Renner of several projects underway with NAIF.

So, Scott, we will begin then with Mr. Clancy. That is scheduled for half an hour. And we will finish that, and then perhaps you can give us an abbreviated summary, then, on the remaining items.

I am hoping we can finish in time to have at least 15 or 20 minutes of general discussion.

Welcome, Mr. Clancy. It is a pleasure to have you. We apologize for being late.

(Slide.)

MR. CLANCY: I would like to present to you information on the study on a technical basis for meeting the waste form stability requirements of 10 CFR 61.

This particular NESP study is in a relatively early stage, so the presentation will be somewhat different than the preceding presentations, in that right now we are in the final stages of final review of the request for proposal.

DR. MOELLER: Excuse me. Are you looking here solely at shallow land burial?

MR. CLANCY: That was a major topic of discussion of the task force, in that there is a leaning at the moment

towards other methods than shallow land disposal. So the task force is basically looking at the waste form requirements with a strong leaning toward shallow land burial, although our review of the waste form requirement should be somewhat flexible for other applications; for example, concrete monoliths or prototype options which may be considered.

(Slide.)

A quick review of some background to make sure everyone's memory is fully refreshed.

10 CFR 61 was issued as a final rule in December 1982. The ruling became law in December of 1983. A branch technical position on waste form and waste classification was published in May 1983.

Now, further background information, we need to remind you that the regulation covers not only waste classification but also waste manifesting in a start to finish sense in waste form stability.

The stated intent of the new regulation was to provide regulatory guidance on procedures, criteria, terms, and conditions upon which the Nuclear Regulatory Commission could issue licenses for low level waste disposal.

Now, the bottom line purpose of Part 61 was to ensure that NRC could license burial sites, with the net result being successful operation of low level waste

burial sites.

A little further background information. The NRC felt obligated to issue Part 61 because at one time four or five years ago we did have -- well, actually longer than that -- we had six commercial low level waste disposal sites in the United States. Because of problems occurring at several of the six disposal sites, three of those sites were closed down, and basically, as everyone knows, there is a bit of a potential for a major lack of disposal site capacity crisis looming.

The problems that were occurring at the burial sites that have been closed down were ones that were not situations that jeopardized the health and safety of the public, but rather they were situations where the disposal site was not performing as expected, and the financial and political burden placed upon the host states was significant.

As such, the NRC found it imperative, from their point of view, to make sure that they could license burial sites in the future, the net results being success as opposed to the large headaches that occurred at several of the burial sites that were open.

A lot of the problems associated with the burial sites that closed had a lot to do with waste form stability, in that either the waste form solid itself

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leached its contents quite rapidly or the performance was unpredictable or the container or the waste form itself had a significant negative impact on the disposal site integrity.

So that is part of the issue in Part 61 to remedy that and for a standard issued to license new sites.

Now, the Waste Form Stability Branch technical position suggests to utilities that certain tests must be performed on low level wastes to be sure they can be suitably disposed of at these new licensed sites. That also applies to the existing licensing sites as well.

A February 1985 version of the branch technical position exists at the moment in draft regulatory guide format.

(Slide.)

Now, the technical effort which seems to be needed by the task force and by TAG to examine the draft reg guide practicalities, effectiveness, the benefit in protecting the public health and safety, and the ultimate reg guide should reflect the intent and spirit of the law.

The study could then be used as a technical support by licensees, industry groups such as AIF, EEI, the Utility Nuclear Waste Management Group, and others.

It should be noted that there was a large wave of feeling within the utility industry that the branch

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technical position was more onerous than the regulation itself and may not truly reflect the intent and spirit of the law.

(Slide.)

DR. MOELLER: When was this branch technical position first developed? What were the dates?

MR. CLANCY: May of '83.

DR. MOELLER: I was trying to think if we had seen it. We don't know.

MR. CLANCY: Basically, the effective date of the regulation was December '83, but the BTP came out roughly seven months before that.

Now, the licensee concerns about the interpretation of Part 61 were the basis for the origins of the study.

The Atomic Industrial Forum and the Utility Nuclear Waste Management Group Low Level Waste Subcommittee had several concerns about waste form stability testing requirements. There were scientific and technical community concerns about the validity and the appropriateness of the tasks outlined in the draft reg guide.

We also knew that the reg guide would be issued soon for comment, so we decided that we would try to time our study so we could provide the results of our study to the NRC in a timely fashion, such that we could utilize the

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NRC to improve the regulatory guide.

One more back pedaling here. At the moment, in the light water reactor field, the primary waste forms of course are noncompacted trash, which was mentioned earlier, and a lot of the waste is resins and concentrates, which now arrive at the burial sites, the existing open burial sites, normally in the form of either dewatered resins in carbon steel containers or in high integrity containers, which are polyethylene based containers, thick-walled containers, or they are solidified in primarily Portland cement with various additives and in polymers and in bitumen.

That is what the current crop of waste forms that are delivered to burial sites now are.

Part of the reason for concern is that there are a number of other options beyond Portland cement, beyond asphalt, beyond dewatered resins that may have significant merit in the future; for example, polymers, which this rulemaking has an impact on.

DR. MOELLER: Excuse me. You say anticipated issuance of a reg guide. I know you are not with the NRC, obviously, but do you know if that is underway?

MR. CLANCY: Yes, it is underway. As a matter of fact, we have an NRC staff member on our task force as a liaison, and he provides us with the most current status and paperwork on it.

DR. MARK: The waste is now being handled satisfactorily, or managed at least, under the branch technical position of May '83?

MR. CLANCY: Since the BTP came out and the law became effective in December '83, the licensees at the burial sites have been using it as the tool.

DR. MARK: But you are anticipating that, when revised, it will raise questions?

MR. CLANCY: Not so much that as the existing BTP has requirements in it now which may not truly meet the intent of the regulation.

In a few minutes, I will go into examples of why we believe that is so.

MR. EBERSOLE: What is the life of the polyethylene?

MR. CLANCY: In terms of leachability type tests? The high integrity containers that are used right now, the primary example we could use for reviewing your question, have very strict requirements regarding their use, storage, and handling, plus the ultraviolet radiation.

Right now if you purchase a high integrity container, you have got very strong restrictions as to how long you can keep it outside, how many hours it can spend in the sunlight. There are serious restrictions on the use of polyethylene for waste form stability.

MR. EBERSOLE: How long does it last in the ground?

MR. CLANCY: There are a number of natural laboratory studies, primarily done, I think, at Savannah River and by Brookhaven and some other laboratories, which suggest that it has reasonably good longevity, more favorable than Portland cement.

Like I said, there are some serious caveats in terms of use, storage, and handling.

(Slide.)

The original discussions during the formulation of Part 61 involved the argument whether the regulation should be prescriptive or performance-oriented.

For example, the prescriptive requirement might be all waste has to be solidified in polyethylene. The performance specs would be, okay, there are many permutations, there are many different ways you can demonstrate proper waste form stability to show to us, the NRC, that you meet the successful objective of stable waste forms.

The form tests, the compression tests, et cetera, if you meet the requirements of these tests we will consider your waste form stability adequate.

Part 61, after the discussion went on and Part 61 was issued for rulemaking comment, it proved to be a

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performance specification, if you will, a performance regulation.

It is important to note --

(Slide.)

-- the task force, pretty much the industry, the licensees and the NRC believe that the performance orientation is the correct way to go but the specific choices and the nature of the branch technical position is what the object of discussion is and the suitability of those requirements.

(Slide.)

Examples. A couple specific examples.

For example, right now the best way to put this is the NRC decided that performance requirements were the best way to go, and as I said, it is a pretty good consensus throughout the industry that that is the way to go.

However, there was no body of standards, ASTM standards or other standards, for low level waste forms in shallow land burial. So they had to rely on or borrow the existing set of standards.

For example, the thermal cycling tests for waste forms borrowed from plastic wire insulation because they saw that plastic wire insulation was used underground and for some ASTM basis for thermal cycling requirements. They applied the use of that particular ASTM test for waste

forms, for rad waste.

For example, they applied standard ASTM leachability tests and compression test analysis, and at the moment for elastic material there is no ASTM test that is truly a fair test for elastic material, okay. So the compression tests that are clearly applicable to Portland cement or clearly applicable to asphalt are wonderful, but they don't necessarily lend themselves to translation to other forms.

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If you will, there is some help needed in this particular area. Another example would be biodegradation tests. There are biodegradation tests available for this material now. However, the tests referred to in the branch technical position are tests where the cultures are of aerobic bacteria and bacteria that are not indigenous to any trench environment.

In other words, there are other suggestions that could be made. Accordingly, biodegradation could be of merit to the branch technical position. There are two examples I wanted to give to give you a flavor of it.

There are several other ones. For example, there is a radiation test. The test itself is probably a reasonably valid test, although probably the average dose rate to the media for the period of interest is something less than 10 to the 8th rads. So it has some translational meaning here.

However, there's about 25 years of test data available from the National Labs that suggests that the effect is negligible. So it might be prudent for the branch technical position to reconsider itself, to maybe consider doing away with that particular requirement, because there's a large body of test data that suggests that, yes, indeed, Portland cement, asphalt and other materials have been tested to 10 to the 8th rads.

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Yes, there is in effect, but these are the kind of technical support help that the study would like to provide to the regulatory guide.

MR. EBERSOLE: How deep would they have to dig down into a low level waste installation? What sort of local things would I see?

MR. CLANCY: I would imagine that the average reactor water cleanup resin in the boiling water reactor is on the order of, say, 10 R to a couple of hundred R max. Up to that container.

MR. EBERSOLE: If you just stuck it down in the ground, it's about 10 R?

MR. CLANCY: Ten to 200 R. It's a pretty reasonable range.

DR. SHEWMON: That's when it goes in? Or years later?

MR. CLANCY: When it goes in. That would be a nasty resin, a typical nasty resin. I would say that, at the moment, it would be somewhat dictated by cobalts. The worst fuel performing plants would be dominated more by the fission products with the 30-year half life material than the fuel performance of the reactor in question.

MR. EBERSOLE: There are not likely to be any live animals?

MR. CLANCY: Rabbits and what not? No. However,

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it should be recognized that the mixture of waste forms is quite variable.

DR. STEINDLER: Are you suggesting that somebody who has laid on your compression test that's useful for a last existence but you were supposed to apply it for concrete?

MR. CLANCY: No. I'm saying there are useful ASTM standards which are referred to in the BTP for concrete and asphalt. However, there are no useful standards, or none referred to in the BTP or reg guide for elastic systems.

So there's no way to certify elastic waste forms.

DR. STEINDLER: Is there a performance requirement for the elastic waste form?

MR. CLANCY: No. There's an overall performance requirement of 50 psi compressal strength for all waste forms.

DR. STEINDLER: I guess I'm trying to understand what it is that troubles you. It seems to me that if somebody made 50 psi on me and I went through the various standards and I couldn't find anything, I'd blow it up to 50 psi and see what happened. And if it looked like it hung together, I'd write a little note to the folks at the NRC and say, It looks like it's hung together. Is that too

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naive?

MR. CLANCY: No.

DR. STEINDLER: I mean, that's not my business.

DR. SHEWMON: It's not mine either but 50 pounds inside a balloon may be fine, but it can buckle under.

DR. STEINDLER: I assume those ethylene liners are just that? They're liners of a 55-gallon drum.

DR. SHEWMON: His comment was to the compression.

MR. CLANCY: Right now, there are no approved topical reports for polymer waste forms, at the moment. Part of the reason for the dilemma of no approved topical reports among those waste forms is let's say the lack of specific guidance on it. There's been a lot of testing done on a lot of polymer media and there's no successful topical report approval yet because of the nebulousness of the situation.

MR. EBERSOLE: Are these containers filled with sand or other filler materials when they have that opening load on them?

MR. CLANCY: Generally, no. Take, for example, a resin liner, a typical resin liner. Many of them are simply dewatered. And there is some void space at the top. Some licensees pack waste at the top of the liner to maximize allocation volume. But this is one of the concerns of the

NRC. We just want to take credit for the stability of the container or the waste form itself or both. We want you to demonstrate that it won't cause subsidence problems or whatever. That is part of the specific regulation.

(Slide.)

Now the other concerns are concerns that have been compiled by the waste management groups and some other groups. We'll give you an idea of some more generic concerns.

Many of the tests are not at the topical report level, but the cause and control plan level. This is the level where each plant has its own recipe, its own set of procedures to cook up and pack a particular waste form. The tests and sampling required to ensure that the results of the recipe are correct.

Where there's concern about increased gradation exposure to the rad waste, there's also concern about selective enforcement of backfill requirements. It's kind of a followup on your question.

The NRC in one of the sections -- I think it's 61.52 -- suggests they do want to see the licensee at the burial site backfill each layer of waste, sand and gravel material, pores in the void space inbetween the containers.

Now it turns out, to be fair about it, that the missing burial sites who do backfilling don't do it upon

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each layer. At the moment, the NRC is leaning toward selective enforcement of the backfill requirements, more immediate that they don't like.

In other words, for example, they don't like asphalt so there's pressure on the burial sites when they receive asphalt containers to make sure they can prove that they've backfilled around those particular containers. That's another type of concern.

There's potential overlap of this new regulatory guide on waste form stability. With a future regulatory guide on process control programs, called PCP, although they're talking about the same issue, this issue is more for the vendor or for the utility who has the recipe to cook up the waste.

PCP is how at the working level, once the rad waste comes out of the evaporator, other resins come out of the evaporator cleanup system.

Okay, this is the test requirements and procedures at the working level. And there's concern that there could be, you know, some mismatches. So we want to be sure we put as much input into that as we can so the regulatory guide requirements are as identical as possible.

MR. EBERSOLE: I'm getting a picture that these containers are located on top of some sort of a hill, that they're partially empty and that they're heavy polyethylene,

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and they're hermetically sealed.

Is that correct?

MR. CLANCY: There are high integrity polyethylene that are being put in burial sites right now.

MR. EBERSOLE: When the rains come, they'll want to float up.

MR. CLANCY: Not really because the overburden material on top of the containers will prevent that. Earlier, in Joyce's talk, you saw the comparison of the impact analysis between burial sites. The key issues in that impact analysis are how much water gets out the waste container and how much can actually leach out material out of the waste form. And then how the waste form and the container contributes to things like trench caps subsidence, making big gaping holes in the trench as water gets in.

Those are the kind of concerns that are addressed in this Part 61.

Also, there is concern that tests do not replicate the environment of a disposal trench. In some tests, it clearly is a mismatch between the test and what the actual disposal site environment is.

DR. MOELLER: Are these concerns pointed out in the regulatory guide?

MR. CLANCY: This is a concern that the task force and several of the committees have brought to the

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attention of the task force.

(Slide.)

Going on, some of the test requirements may actually reduce the loading rates and thus increase waste volume. In other words, the final recipe that's allowable can actually cause the net volume increase to increase the total volume of wastes generated by your typical light water reactor.

For example, bitumin systems are relatively efficient in terms of lack of volume increase. In other words, they actually evaporate as they incorporate the resin or the concentrates from the bitumin.

Concrete, on the other hand, generally increases the total volume on the order of a factor of 2. Depending on the nature of the waste stream, the recipe required to meet the test requirements can actually cause a total volume of increase to go up higher than a factor of 2.

In general, at the moment, I should say that many, a large fraction of the existing licensees, do not solidify. They simply package their material in high integrity containers, or dewater the material. You know, depending on the type of waste treatment system built into the plant.

A lot of utilities at the moment avoid such solidification because the penalty in volume increase paid

by the solidification process, part of the concern is how much will some of the unreasonableness of the test requirements force that volume increase factor to go even higher and actually cause a stronger negative incentive for solidification.

Formulating new waste forms to pass tests may require expensive additives and the test results are difficult to reproduce. Some of the test results are very difficult to reproduce.

And also the criteria for defining whether a waste stream is changing and whether a new topical and new process control plan should be developed is somewhat gray. We would like to see that made a little less gray.

MR. EBERSOLE: Did you say that has an impervious clay liner?

MR. CLANCY: Generally speaking, there's an attempt to put lower permeability material into the trench. For example, Barnwell in South Carolina, material is largely silty clay sand. What they do is they get clay material to backfill on top of the waste material.

Out west in Hanford, material is predominantly alluvial sands, gravels, and they bring in clay materials.

MR. EBERSOLE: When they fill it up, do they then cap it with some sort of a roof?

MR. CLANCY: They put low permeability materials

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in the capping material and try to reduce surface water runoff coming into the trenches as well as infiltration.

MR. EBERSOLE: Okay.

(Slide.)

MR. CLANCY: Now the purpose of the study, which is in its relatively early stages, is to develop the technical bases for establishment of realistic sampling and testing requirements for the waste form stability and to provide alternative proposals to demonstrate licensee compliance with Part 61. Also, to give guidance on steps required to meet the intent of Part 61 itself and, finally, to provide information that can help the NRC in assuring an appropriate reg guide on waste form.

(Slide.)

Now, the scope of the study is first to evaluate the bases and intent of the rule itself and to evaluate the results of the industry tests and other data available through the Department of Energy, the National Bureau of Standards, the vendors who have the waste form products for sale, topical reports generated by those vendors that have been submitted to the NRC, or are about to be submitted to the NRC, the utility vendor and disposal site operator experiences existing in proposed state requirements and cost benefit analyses.

It should be noted this first line on here turned

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out to be a relatively large bite of data available from the National Laboratories on waste form testing. The National Laboratories have been testing various waste forms, not necessarily the brand-new ones but they've been testing Portland Cement, polyethylenes, asphalts, and so forth, for a number of years.

There are probably about 25 years of valuable data out there.

(Slide.)

Then we will evaluate the approach taken in the reg guide and determine with the existing draft reg guide if it's feasible, cost beneficial, technically justifiable, dependable in terms of meeting its real intent. Part of the major intent of the reg guide is to provide predictable performance on the waste; in this disposal environment is the branch technical position on the reg guide.

Will it be a dependable provider of that predictability?

DR. MOELLER: Excuse me. Does this mean you prepare an AIF or the NESP group will prepare an alternative to the reg guide?

MR. CLANCY: We're going to provide, hopefully, sufficient input.

DR. MOELLER: In essence, you're rewriting it, is what you're saying?

MR. CLANCY: Hopefully, we can provide enough guidance to eliminate the problems we see and improve on the good framework that's already there.

(Slide.)

The task force turns out to be a popular one. It's kind of a favorite topic for the licensees. I think there were 29 members. I forget the exact number, but it includes 13 utilities, one architect-engineering firm, an NSSS vendor, two waste disposal site operators. I'd just like to note that they're the only two that exist. The two existing operators are on the task force. Three consultants, a nuclear insurer. We have a member, one of our task force members is a researcher who has been doing waste form research for over 20 years at one of the national laboratories.

We like to have some kind of experience like that on the task force. Fortunately, we were given an affirmative answer from the laboratory. We have an EEI utility nuclear waste management group liaison. We have a low level waste management branch, NRC liaison on the task force, as well as an EPRI liaison.

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DR. MOELLER: Do you have then 20 to 25 people at every meeting?

MR. LEIPER: 24 on the Task Force. I don't know what your attendance was last time.

MS. RENNER: Last time we had the pleasure of having Bob Browning of the Waste Management Division of NMSS and Leo Higginbotham and a couple of other persons.

So the attendance was actually a little larger. We invited them to come to brief us on the status of this. They very nicely did so. It was a little larger than usual.

DR. MOELLER: I guess what I was leading to was how efficient is a committee this large?

MS. RENNER: That's a good question. If everyone works and follows our requests for being timely with input, I think it can work to everyone's advantage.

As Jim said, this is a very popular topic, and a number of people expressed interest in participating.

MR. CLANCY: As the chairman, I had some concerns about the number; however, in terms of meeting the objectives of our meetings so far, we've been successful. So, in spite of the number of the potential to exceed the critical mass, we've been doing a pretty good job.

(Slide.)

The general approach for data gathering for the

study will include the "very latest version of the Reg guide" will be supplied from the NRC liaison, the published technical literature, the NRC document files, public data in the Low Level Waste Branch and in the NMSS and various resources of the task force and different industry groups that we have on the task force.

(Slide.)

And finally, the status of the study is, the RFP is on final review by the task force at the moment. The bidder's list has been established by nominations from the task force. If all goes well in the early spring, in a few months we'll have the RFP issued and the award will follow.

Scott and Melinda will suggest an award in the total time on the order of 60 to 90 days.

DR. MOELLER: Of course, we should understand this, I presume, from the earlier presentations this morning, but your committee, this 20 to 25, I had gotten the impression they were rewriting or redrafting or offering a lot of suggestions to the Reg Guide.

What is the RFP to do? Pin all of this down?

MR. CLANCY: To be honest with you, there's enough talen on the task force, if we had lots of time we'd do most of the work on our own; however, we do meet basically the objective of the RFP is to go out and award it to a contractor, to take the data that we have and go

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through it.

DR. MARK: Is there any danger that NMSS might pull up its socks and get the draft data up before you're ready?

MR. CLANCY: We have pretty good communications. They know what our schedule is like. They are pretty much intending to hold until appropriate commentary from us.

DR. FOSTER: Have you considered putting this out as an ANSI standard?

MR. CLANCY: No, we haven't. That's just a suggestion. We'll put it to one of the existing standard bodies for consideration.

DR. STEINDLER: That's one of the things that concerns me is your comment that there's some selective enforcement of the backfill requirements.

We might expect that from the police department in a large city in the Midwest that I happen to live close to, but I guess I didn't expact that from the NRC.

I make that simply as a comment to which you certainly don't need to respond, but I find that distressing.

DR. MARK: You're not alone.

DR. MOELLER: That's it.

Any other questions?

(No response.)

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MR. CLANCY: Thank you very much for your time.

DR. MOELLER: Thank you very much, Mr. Clancy, that was very helpful and useful.

We'll then move back to Scott Leiper and Melinda Renner -- I guess you're on first, Scott -- to describe these other projects.

MR. LEIPER: Melinda and I are going to switch back and forth here a bit.

We have five studies that we'd like to cover in the next 15-20 minutes or so, and we're going to do it rather rapidly, primarily in the intesrest of time.

If anyone here has any specific quesetions on any of the material that we do cover, I'd be very happy to take the time after you're all done and go over them in more detail and provide you with the studies.

DR. MOELLER: Thank you.

MR. LEIPER: Three of those studies have already been published.

I would like to cover them first. Then we will come to two studies which are on this year's program plan, which are not even quite as far along as Jim's study. We have not issued the RFP. In fact, we are still in very shaky form right now. It hasn't even been reviewed thoroughly in either case by the task force.

(Slide.)

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The first study I'd like to discuss is one done and published three years ago, four years ago, almost, the study of a recordkeeping system for inprocessing of transient workers at nuclear power plants.

The driving force behind this study was the realization that transient workers spent an inordinate amount of time being checked into plants, and their medical records, their security clearances, their training records, and their exposure records took a very long time to catch up with them. And you end up with a worker sitting three or four days waiting for those records to catch up, and your down time is longer, your worker's costs higher, your worker morale probably suffers some too.

What we were looking at, was could we computerize this transfer of records? Was it feasible to do so? I think this is an example of exactly how our contractor conducted the study.

It is not particularly important that this remove from the effort, but I think what is important about this study is what's happened since.

The bottom line is that they concluded yes, it certainly was feasible for us to computerize these records, and it would be of advantage to the industry to do so.

The question then became, who's going to do it? And it became kind of a hot potato.

INPO was everyone's first guest. I think INPO felt that it's table was already full. And they were going to need to spend their time and attention on the work they had in hand.

As it turned out, EEI volunteered to provide at least a place for a group to get started. And the Nuclear Employee Data Systems Task Force was organized under the leadership of Art Lundhall, vice president of Baltimore Gas & Electric.

From the very beginning, it was decided that this should be looked into with just a small cluster of companies from the Middle Atlantic States to see whether it was feasible, although we did have a attendance from other companies in the Northern states. Commonwealth Edison, and I think Southern Cal had people involved.

Right now, the companies involved are Baltimore Gas & Electirc, Pennsylvania Power & Light, Philadelphia Gas & Electric, Public Service Electric, GPU and Virginia Power.

About two years ago, IEAL was hired as project manager. Their job was, in effect, to draw up a detailed task force and a detailed request for proposal for the work scope of such a system.

The firm eventually selected to establish this computerized data base was Control Data Corporation.

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Work -- right now the system is not operational, but it is nearing the point where these companies at least will be able to transfer information on transients back and forth rapidly.

There are questions raised about accuracy, security of records, confidentiality of records, and all of that.

These are things that I think need to be dealt with by the NESP people and answered by the NESP people, not me.

But I think this illustrates an example of how NESP operates.

If we find something that needs to be done, we try to put together a task force on those questions, and then select a contractor who can answer them.

Once we have a report, though, our responsibility ends. We are not chartered or organized to carry the results of our studies very much beyond that point.

A few groups, AIF subcommittees, other utility groups that deal with regulators or take action that involves decision by management get involved in this.

The second study I'd like to deal with was published a couple of years back also.

DR. MARK: This program operates this forum independent of the NRC?

MR. LEIPER: Yes. It's utility-run. The idea, at least the hope is that there may be several regional centers and that those centers will be compatible, but there may be some utilities who, for whatever reason, don't feel, because they don't have enough transients or they do most of the shifting around of workers within their own system, that they may not choose to participate.

I would envision it operates sort of like a kettle in a pot. The ripple effect absorbs more and more utilities and eventually everyone will cooperate.

(Slide.)

The second study is Methodologies for Classification of Low Level Radioactive Wastes from Nuclear Power Plants.

The driving force behind this was 10 CFR 61, and at least the industry's perception of what the requirements for waste classification would be under 10 CFR 61, particularly where it was felt by some members of our industry and our task force as being an undue emphasis on radiochemical analysis of individual waste streams.

The objections were that you incur increased worker exposure during sampling and transportation analysis of things like resins and what have you.

There is a certain difficulty in obtaining representative samples of certain kinds of wastes and,

therefore, interpreting the information.

There is limited availability of adequate reliable laboratory facilities and adequately trained personnel, and there is cost.

The NRC itself recognized the appropriateness of alternate approaches to the preparation of waste management methodologies and encourages utilities to prepare indirect methods based on verifiable methodologies.

It's our intent to assist the Staff in establishing verifiable models.

The study assumed a methodology that made certain assumptions that all radionucludes come from failed fuels in the reactor core, that the concentration of these wastes in the reactor coolant -- while they derive the concentrations from Delco, which was used in 10 CFR Part 50, they made conservative heat rate assumptions, and they allocated radionuclides to various waste streams, based on their known physical properties.

They also pegged the scaling factors so developed to measurements of easy-to-measure isotopes, cobalt 60 and cesium 137.

The bottom line here is that NRC appears to be accepting this approach for new plants which have not yet developed a backlog of data.

I think the utility nuclear waste management

group, whose chairman, George Warner, is on our task force, the task force chaired by Al Gould of Florida Power and Light, feels that this report has not been as successful in convincing or in getting the industry to use a scaling approach, cutting down the amount of radiochemical analyses that are required.

As I said, the new plants that NRC appears to be accepting, using this method for new plants, until they build up the data base, and we expect it, we anticipate it, it's certainly appropriate that the method would have to be tested. We have to send off samples periodically to make that the predictions are on target. Immediately after our study, the team 2 of contractors, under the auspices of the Utility Nuclear Waste Management Group, did a considerable data-gathering effort, getting radiochemical analyses of wastes from virtually every nuclear power plant in operation in Canada and the U.S. and checked the predictions of their models against this early data.

The results, at least initially, were that the models were very good.

Only in a couple of instances, I believe there was one isotope of rbidium and technetium-99 that weren't behaving the way they had predicted they would behave.

We fully anticipate this process of gathering data and verifying models will continue to go on.

There are others who have gotten into the act and are providing to fuel programs. I've lost touch with what is current. It's too bad that Al Warner couldn't be here today.

If anybody has specific questions about what we mean here, I'll put you in touch with either one of those individuals, either with a conference call or just give them the numbers.

The third study that was published is S-28, and I'll turn the microphone over to Melinda.

I'm not only not a grandfather, I'm not even a father.

DR. MOELLER: This was called NESP 28?

MR. LEIPER: I counted 25 and 27. The next one will be 28.

MS. RENNER: You should have in front of you a typeset version with a title page and a report number, in any case.

MR. LEIPER: We've got copies, incidentally, of these reports up here, if anyone wants to see them.

MS. RENNER: If I could digress for us one moment from what I was going to talk about in terms of this published report.

Let me just reiterate, that at the start of the whole presentation I was going to pass out to everyone two

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items, which I'd like to call again tc your attention.

One is the publication lists of everything we've published. That's Reports No. 1 through 32.

That represents everything that's in print.

The sheet with the bullets on it, the kind of sheet with the face on both sides, that represents everything we have, in terms of work in progress.

When we were invited to make this presentation, we selected from those past and current pieces of work, those things we felt would be of most interest to the group here. But by no means do we wish to shun the other things on there.

If anyone sees, either on the publications list or the work in progress list, something you have a particular interest in or some colleague of yours might have an interest in, you can certainly get in touch with Tom and me at any point later today or by phone, and we can bring you up to date on those studies too.

DAVbur

(Slide.)

As Scott said, one other published report you may have particular interest in because of the orientation of these two subcommittees, one is called the Characterization of the Temporary Radiation Workforce at U.S. Nuclear Power Plants.

Scott mentioned I was the project manager for this, and I might say that, just coincidentally, we have one of the principal investigators with us, Sandy Cohen, whose company and name appears at the bottom here as a co-investigator on this study.

And, Sandy, if anything is wrong, would you please get up and wave your hand?

This study, as indicated in your handout, was published in May of '84, and you have the prefatory materials and executive summaries and a table of contents to indicate -- which gives you a flavor of what is all about.

I will be very brief in summarizing this and let you look at the executive summary. I have one copy of this, which will go to the highest bidder.

About the time that we were publishing the feasibility study for the transient worker tracking system that Scott described a moment ago, it was also noticed by a number of people in the industry and at the NRC that there was a great deal of criticism being thrown around about the

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treatment of the so-called temporary worker and a characterization of this person as someone who was being exploited by the industry and not being given due regard or equal treatment to so-called permanent workers within the industry -- such things as skilled training, radiation protection training, radiation monitoring, all the things that licensees are responsible for in terms of their own employees.

It was felt somehow that temporary workers or persons who were not permanent to a site were not being given equitable treatment in this regard.

Many of these concerns were getting out because of what I might characterize as somewhat sensational press regarding these persons. There was very little concrete demographic, scientific investigative work to back up some of the claims that were made by interviews with reporters and that kind of thing.

So in 1983, NESP felt that it would be a worthwhile use of time and funds to take a serious look at the universe of these temporary workers to find out such things as who they are, how many there are or were at the time we studied them, where they came from, how they were recruited, age, sex, and demographics, locale, information about them, the types of work they performed at plants, the frequency with which they are used, and the ratio of

temporary to permanent workers at the plant.

So we inaugurated the study in 1983 and Sanford Cohen and another organization coventured on this project.

We felt that even in public meetings that representatives of industry, it was obvious, did not have a grasp of how temporary workers were being treated industrywide. Everyone had a pretty good idea of how these workers were treated at their own places of work, their own site.

Everyone, of course, knew that these workers were being monitored in plants with Part 20 for radiation exposure and also under Part 19 for noticed workers of exposures, which is part of Part 19. But when you started to look at it industrywide, there was no under:tanding of how many workers there were and how your neighbors were treating them.

So in reference to the handout, I would just like to say that some of the things we looked at were why workers were required -- the outage scenarios -- why specialized workers are required for short periods of time on the site, but of course are not required during the time the plant was in normal operation, and a considerable discussion of the types of outages and the types of workers that are used there.

Then we went into really how to define a

temporary worker, and we came up with actually five categories of workers that one might find at a typical nuclear plant during a typical work cycle:

The utility station employee, the guy who is there all the time, is confined permanently to that station.

The utility temporary employee, someone the utility hires, not in a contractor mode but simply as a temporary employee to come in for a specified job.

A nonstation employee who is an employee of the utility but may be an administrative worker or a coal plant worker or hydro worker who is brought onto a nuclear site.

Then you have two classes of contractor personnel:

A permanent employee of a contractor, such as a Westinghouse or a Catalytic, who is a long-term worker in the nuclear industry. He or she may be temporary to a site, but certainly not temporary to the industry.

Then finally you have what would be characterized as a true temporary worker, someone who is in the industry for a brief period of time and may come in and out a number of times but is not a permanent worker of a contractor.

So we looked at the demographic spread of that on page III of your handout. You will see a pie chart that illustrates for the year 1981, which is the year in which

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most of the data was collected, the breakdown of all workers.

In 1981, 116,000 workers were monitored for radiation exposure at nuclear power plants. This is by the licensee. Of those, roughly 49,000 and change were designated as radiation workers because they received occupational doses in excess of .1 rem per year. Those were the workers we were interested in, the 50,000 worker universe.

And this pie chart illustrates what portion of that 50,000 worker universe was attributable to each one of these types of employees.

We then went on to look at the age breakdown, the sex breakdown, the geography, where these workers come from, how far they come to work at a plant, the crafts or the semiskilled or unskilled jobs they perform, how long they work in the industry, how long they work for their employer, and the ways in which they are recruited as the sources of these workers.

The report goes on to give a number of interesting conclusions about that, about the theories that have been looked at.

One thing I think is very interesting is that most temporary contractor personnel are hired out of local union halls. This is an idea that many in industry have,

but I think our study laid to rest the idea that contractors or utilities go and and said we hire people out of destitution or that type of thing.

We also found that training and basic radiation protection of utilities is substantially identical for permanent station employees and for all the categories of temporary workers that I mentioned; in other words, offsite utility employees, temporary utility employees, and both classes of contractor employees.

Another interesting thing was that of the universe of contractors that was polled by the investigators, over 40 percent of those who responded said that they provided radiation protection training to their employees, although that is not required, as you know. So this was given above and beyond the Part 20 requirements of the licensee.

I would point out that we wanted to look at doses sustained by these workers, and to a certain extent we were able to do so in gross numbers.

Unfortunately, one thing we were not able to develop was data on maximum individual exposure of radiation workers by the category of worker who undertook certain jobs.

Let me give you an example. We could not find a temporary worker who also was a steam generator worker, who

also was in our universe of workers for the period of time studied. This is because in 1981 and '82, which were the years we looked at -- remember, the study was kicked off in '83. So we had to take the last couple of years to complete data.

'81 and ' 82 and even today, you cannot sort radiation work permits by both job performed and class of worker. You would have to encode on every radiation work permit whether the guy was your employee or in some temporary capacity. It was very difficult to sort the data that way, and that was one of the things we wished we could have gotten and were unable to do.

Perhaps in a few years, when more sophisticated RWP control systems are in place, that will be repeated.

We are very pleased with the response that this report has received. I personally have noticed a decline in the number of news coverage pieces that have come about since the publication of the report.

And I would also like to say that in public meetings as recently as a couple of months ago, Bob Alexander, whom you saw this morning, has mentioned, that essentially the NRC staff believes the problem of the temporary worker has become a nonproblem. I believe that people are convinced these people are being protected as well as the permanent workers.

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DR. SHEWMON: Do you key on the social security number? How do you keep track of these people? Do you take the dose from different people at different times as they go in and out of the workforce?

MS. RENNER: That is a way that one can do it. Unfortunately, there is some belief that if a worker wishes to do so, social security numbers can be altered. The social security number presented is not necessarily valid.

DR. SHEWMON: There is no particular check on that. One can't check easily on the veracity of it?

MS. RENNER: The worker is supposed to carry his social security number with him to present himself for employment at the next plant.

MR. KATHREN: Do you have any feeling for how many of these people -- I know it would be a guess -- worked at more than one temporary location during a year?

MS. RENNER: Sandy?

DR. COHEN: That is actually in Barbara Brooks' paper. That is her transient workers. She defines a transient worker as one who works in more than one plant during a year. She has the data.

I can't recollect the number. She has data on the numbers who work at two, work at three. I really did not focus on that because the transient worker, according to her definition, is different than a temporary worker that

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we defined for purposes of this study.

MR. KATHREN: That would, I think, be an interesting piece of data to know, how many of these temporary workers are transient workers.

The real question I have, though, something that is used in Japan and in Europe is the so-called radiation passport.

MS. RENNER: Like an aperture card or something like that.

MR. KATHREN: Do you think that would be an appropriate way of perhaps eliminating the problem of the phony social security numbers, et cetera?

MS. RENNER: I know right now there are several commercial ventures going -- if I could defer to Frank Roddy in the back. He is with Bechtel and provided some data for the study.

Did you want to say somebody about that, Frank, because you have a lot of workers that go around to various plants and are temporary workers because they work for Bechtel, not for the plant?

MR. RODDY: I am just going to say that there is a net study for the Midwest Utilities now that is using or plan to use a laser card, a credit card sized thing that would have your entire history, not just your radiation exposure history but your medical, your respirator testing,

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your psychological testing, your security information all on there.

What is imprinted on there would not be erased because there is plenty of room for new data to be added.

MR. KATHREN: And you have to show that or turn that in in order to gain employment?

MR. RODDY: Right, and you would have central data storage in case you lost it.

MR. KATHREN: That also could indicate training?

MR. RODDY: The latest training dates.

MR. KATHREN: This is such a great idea, when is the industry going to implement it?

MR. RODDY: They are right now in the Midwest utilities, 13 utilities of 33.

DR. MOELLER: Very good, thank you.

DR. STEINDLER: Do you have any reason to believe that temporaries or transients are handed -- let me be more crude than necessary -- dirtier jobs than permanent employees of the utility? Do you have any data to back up your belief?

DR. COHEN: We looked at three specific jobs that were performed. One was steam generator repair, and roughly 90 percent of the exposure for steam generator repair came from contractors, both permanent contractors and temporary contractor employees.

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We looked at control rod drive maintenance, and most of that -- 60 to 70 percent of that exposure came from permanent station employees.

We looked at waste management, waste handling, and something greater than 50 percent of that exposure was permanent station employees.

DR. STEINDLER: How do those ratios compare to the employment ratios as opposed to the occupation ratios?

DR. COHEN: The only other thing I can say is that the collective exposure distribution was essentially the same as the numbers of individual distributions.

So I think that also corresponds to the percentage of people doing those jobs. You have roughly the same except for one category of employee. The utility nonstation employees gets slightly lower exposure than the utility permanent employees. But everyone else apportions roughly in exposure to the number of people.

MS. RENNER: I think you will find this report interesting reading because it does get over into some of the behavioral side of our industry.

DR. STEINDLER: Were you able to break down this kind of distribution with utility size; that is, the number of reactors, the number of reactor stations per utility? You just lumped the whole world together?

MS. RENNER: One thing I didn't say, which is

not in your handout, but the universe we were working with in terms of responding was 70 percent of all utilities operating plants during the two years, '81 and '82, and 32 percent of the contractors.

So I think we had at least on the utility side or the licensee side we had a fairly good response.

DR. COHEN: But we didn't do any correlation.

DR. MOELLER: Thank you.

We have two more to go?

MR. LIEPER: Very quickly, yes.

I think while we are on the subject of recordkeeping I will touch on one subject we have underway right now and then turn it over to Melinda again, and she will discuss one final study.

These are two studies which appear on this handout, which you have got.

I need to caution you all that the description of these studies which you see here is a very crude first stab at the scope of work. It is not the scope of work in any formal sense of the word. It is simply the basis on which the TMC approved funding for it.

The task force has considerable latitude as to how the study is to be approached and as to exactly what the bounds of the study are to be. As long as we stick to the general topic, there really isn't anything the task group

can't do.

The study I want to talk about is tentatively titled Guidelines for Radiological Recordkeeping. We have a task force chaired by Mark Milles, of Baltimore Gas & Electric Company, and it is again quite a large one.

The purpose of the effort is to provide the nuclear power industry with an evaluation of its radiation recordkeeping practices, particularly their suitability for use in tort litigation and workman's compensation claims that might stem in the future from work exposure, and we would like for the contractor to place special emphasis on identifying those practices which either create or maintain employee confidence in the adequacy of their health physics programs.

I think the feeling is that that is a positive way of avoiding future claims if the workforce feels they have been fairly treated.

The scope to this study is still under discussion. In fact, it is under discussion even within the forum.

The draft has not yet been released to the task force for its review.

You can see from the enclosure that you have what it is we are going to be taking a stab at, exactly how we are going to phrase our request to the contractor, and

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exactly what is going to be included and what is not going to be included has not been decided on except to go into what I have got here in draft.

With that, I think Melinda can finish off on her study, which is in about the same shape.

DR. MOELLER: This is the airborne release?

MS. RENNER: That is right.

I think I will just paraphrase a little bit of what you see here on No. 2 on this printed sheet that Scott showed you.

The AIF has a standing committee on emergency preparedness. As you might expect, that is a subject that is of great interest to the NRC and certainly to state and local officials.

One component of emergency preparedness is having suitable offsite airborne release dose models to calculate doses released within the emergency planning center.

Right now there is a plethora of mathematical models available to the utility, to the state, to the county, and in some cases, particularly California, where the counties reign supreme in terms of making decisions for offsite actions, to FEMA, to the NRC, to DOE, to anyone who needs an offsite dose model. There are a number that can be selected from.

They all vary in their ability, their powers,

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their assumptions, their meteorological assumptions, pathway assumptions, plume assumptions, and some are for immediate response, and some are for long term, later calculations of doses that are accruing several days after the initial release.

We feel that one consequence of having so many models out there, that many people within the industry and within the government are confused as to the accuracy of these -- what constitutes a good or appropriate dose model?

MR. EBERSOLE: Let me make a comment. I was at the Vogel plant a month or two ago and I heard an absolutely astounding presentation from some meteorological guys based on a thesis which stretches the imagination to believe...which says, from a given meteorological tower, given the known parameters with the single tower and a knowledge of the levels of the wind velocity and direction, they had the capacity to mathematically plot the directional vectors in velocity for a region that must have been 30 miles in diameter.

It was just amazing. And from that, of course, they had the source term. I think it was the most extreme example of an academic extension that I've ever heard of.

DR. SHEWMON: If you think it's stupid, why don't you say it's stupid? Don't call it academic.

(Laughter.)

MR. EBERSOLE: Is that the sort of thing you're going to look at?

MS. RENNER: That presentation you saw would have to have been built upon certain assumptions and certain capabilities of the model. That is it is presumed they were

trying to promote --

MR. EBERSOLE: If I had an anemoneter that was 30 miles away.

DR. MOELLER: This will be very helpful.

In other words, you'll have a contractor review these models and maybe classify them into groupings?

MS. RENNER: Exactly. We'll have a contractor look at all the criteria that have gone into all the existing dose levels. You know, our resources are limited, like everybody else's. So we're going to have to take a selective grouping of plants and look at all the models that are available for that plant. The ones that have been run and the ones that are there, and the ones that have not been run. Look at all the assumptions, all the mathematical input into those, and try to come up not so much with a generic model, if you will, a perfect model, but come up with some fairly healthy criteria for what would constitute a good dose model so that licensees or states, or whoever is looking for a better dose model and who may not have confidence in the one they presently have, will have some criteria with which to select a better one.

DR. MOELLER: Now are you going to look at AERAC for Lawrence Livermore? Are you going to look at FEMA's model?

MS. RENNER: Federal models, state models. The

one problem we may run into is many of these things are proprietary. If a utility or state has had a vendor write a model for them, we're going to have to rely on the cooperation of the owner of the proprietary data in order to be able to look at that model with respect to all the others.

Let me just say two other things. One underlying reason for our wishing to do this study is that if you have a lot of dose models being used in a drill or exercise, and at the end of that drill or exercise, every player comes out with a different number, that tends to reduce the credibility of all the players, particularly with the public.

We feel that one outcome of this would be presumably to promote better use of better models so that the numbers will be, number one, correct. We're not saying below but correct and closer to each other, instead of being orders of magnitude different.

Another thing I might just touch on is there's some work being done within the Commission on the extraordinary nuclear occurrence, the ENO.

I am not in a position to comment on ENO as a legal concept. But one of the items which triggers the announcement of an ENO, extraordinary nuclear occurrence, is the dose level, the site dose level.

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And if you can't have confidence in the dose level that you predict or that you've measred off site, then where do you go, that you should or should not announce an ENO.

This is another area where I think the study will help. And as Scott said, we had our first task force meeting the day before Christmas holidays. I don't have anything more than what you have in front of you and what I've said today. But I do expect an RFP to be put together very rapidly and to be let for bid this spring.

DR. MARK: I think this has fascinating possibilities. When one thinks that perhaps there's the basis of all that cost benefit analysis, that the agency puts out, it's really nice to think that you're having a calculation that might possibly have some relevance. I don't know what basis there is for saying that now.

MR. EBERSOLE: Is the activity limited to just calculating the significant results? Can it be extended to see what you can do to really confirm what the distribution is? I mean, measuring.

MR. LEIPER: It gets into the cost factor. We really have studiously avoided getting into the other measurements because it just far exceeds what our budget can do. That might be something.

MR. EBERSOLE: I just have a little trouble

believing that one should not get into that whole area of real life results.

DR. FOSTER: About a year and a half ago, the NCRP came out with a special report on dose pathway modeling, which includes some of what you're doing. If you are not familiar with that particular publication, I'd recommend it to your group. I think Mel Carter would agree.

DR. CARTER: That's true.

MS. RENNER: We'd be most happy to have that input. Charles White is our chairman and is a hands on emergency preparedness person with a very heavy dose analysis background. And I would hope that Charles would bring that up. There was also a study done, I think, 18 months ago, and I can't recall the author's name. It was somebody at Oak Ridge National Lab, in Nuclear Safety, within the last year.

DR. MOELLER: Owen Hoffman prepared that.

MS. RENNER: It was a very good matrix outline. And that's sort of what we're working toward, if you saw that.

DR. MOELLER: And then you do have, I presume, on this committee, a Nuclear Regulatory Commission Liaison?

MS. RENNER: I should have mentioned that. Erwin Spickler and Jim Ferravent from the Meteorological Group. And because the end users of this sort of thing are

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emergency planners, we have two people from, I guess it's called the Instant Response Branch, over in I&E.

DR. STEINDLER: I had a little bit of trouble trying to figure out how you're going to decide when you've got the right answer if you're not going to use field verification to demonstrate the validity or whatever aspects of the model we're dealing with.

If you put in a uniform set of parameters to 15 models, you will get 15 answers. I don't have a picture yet of the kind of criteria you're going to decide that you want to say to somebody else: Model A is better than Model B, C, D and E.

MS. RENNER: I'm not sure we're going to list them in a hierarchy of better or worse. I think we're simply going to point out what kinds of criteria should go into.

DR. MOELLER: What Owen Hoffman did was he had a matrix. He would put down -- his were more environmental models for routine releases, as I recall. He would put a bunch of factors across the abscissa and then the ordinate was different people's models. You could look down and this model didn't even consider aquatic uptake or irrigation of crops or factors like that.

So you would know if you wanted a model, if you had an environmental situation that had vegetables being

grown, you'd know at least you'd want to choose a model that covered that.

DR. STEINDLER: You might want to. On the other hand, if it requires a mainframe Cray computer and gives you an answer which is six decimal places better than the one you had before, you don't care.

And if that's the kind of guidance that these folks are going to try and put out for their customers, I don't quite see how that's going to get done.

MS. RENNER: You see the third bullet there, which if we knew the answer to, we probably wouldn't have to put it down there. Define to the extent possible a generic model that can be applied successfully.

If our contractor feels that can be done, that will be part of this scope of work. If, at the end of the survey of all available models and their good and bad points and their permeatations, a generic model or models cannot be arrived at, then we will so state.

DR. STEINDLER: Does the industry have an internal standard which says that everybody who runs a reactor has to have a particular kind, level of computer capability, of computer modeling?

MS. RENNER: Not that I'm aware of.

MR. LEIPER: No.

MS. RENNER: I think that's probably driven by

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desire for greater efficiency.

MR. EBERSOLE: Are there any installations that are prepared to make an active traverse with the downwind component of the wastes should they have a big accident?

MS. RENNER: I can't answer that question. I don't know myself. I don't know if there's anyone.

MR. EBERSOLE: I can't really believe that.

DR. MOELLER: Well, again, the subcommittee has heard discussions about this in the past. Probably, as I recall, Savannah River has a whole series of meteorological towers.

DR. ORTH: I was going to mention that at some point here. There are some workshops. Everybody is busily developing models to get together, and I hope you people are going to track those down and find out who is doing what on these workshops.

MS. RENNER: As a matter of fact, that was brought up at our meeting.

DR. ORTH: Second, from the standpoint of checking out the models against data, given a lot of input, you'd have to get the cooperation of DOE, but there have been DOE tests where things have been let loose and they've let people track them, and they have all the meteorological data.

So here's a case in which you have experimental

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results and you have what are the meteorological data and everybody can plug them on in and see if they find out how closely they correlate with what they really observed.

So, again, that will have to get back through DOE.

MS. RENNER: We do have a National Lab representation from Brookhaven on the task force. But, since this is information-sharing time, I'd be very welcome to take any input that anyone here may have in that regard.

DR. FOSTER: About two years ago, Livermore hoped to establish a set of models to be run on an emergency basis nationwide. So if you're familiar with that --

MS. RENNER: You mean for DOE facilities? To be made available to DOE facilities?

DR. MOELLER: It supposedly has been established that they hoped to tie in with certain DOE facilities, but they hope to tie it into nuclear plants.

DR. FOSTER: They have gone some few steps in that direction. But, where a local plant is having a problem, they can fall in with their meteorological conditions, Livermore was hoping to have a system whereby they could run the model on back and tell them what the dose was going to be.

MS. RENNER: I think that exists up at Richland now with Washington Public Power Supply System.

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MR. KATHREN: It does.

MS. RENNER: There's a wide variety of models that we're going to have to look at and that the contractors are going to have to look at. And this harks back to the question Scott addressed when we first got up here. It seems like we have so much talent on the task force, why don't we just go ahead and do the project; with input like this that we would get from experts such as yourselves and people on the task force, why don't we go ahead and do the project?

But the fact of the matter is volunteer effort prolongs things of this type, and that's really why we go out on the contract.

MR. LEIPER: I view our studies as too large, that we expect AIF or EPRI to provide the major infusion of dollars.

DR. MOELLER: Does that complete it? Thank you I know it's been a long day for the committee. But when you think of the time that so obviously went into the presentations by the AIF and the NESP staff, it's been today plus some previous days for them.

So let me place in the record our most sincere appreciation to David Harward and to Melinda Renner and to Scott Leiper for spending almost the entire day with us, being patient as we ran behind schedule, and responding to

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our questions, and providing us with a wealth of information, which you have. It's most sincerely appreciated.

With that comment plus the appreciation to our recorder for whom I know every word and sentence was not all too clear today, let me thank him for his time.

With those remarks, I'll declare today's session recessed and we'll resume tomorrow morning at 8:30.

(Whereupon, at 6:05 p.m., the hearing adjourned, to reconvene at 8:30 a.m., Friday, January 17, 1986.)

CERTIFICATE OF OFFICIAL REPORTER

This is to certify that the attached proceedings before the UNITED STATES NUCLEAR REGULATORY COMMISSION in the matter of:

NAME OF PROCEEDING: ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

SUBCOMMITTEE ON WASTE MANAGEMENT AND SUBCOMMITTEE ON REACTOR RADIOLOGICAL EFFECTS

DOCKET NO.:

PLACE: WASHINGTON, D. C.

DATE: THURSDAY, JANUARY 17, 1986

were held as herein appears, and that this is the original transcript thereof for the file of the United States Nuclear Regulatory Commission.

(sigt) David L. Hoffman /sf

(TYPED)

DAVID L. HOFFMAN

Official Reporter

ACE-FEDERAL REPORTERS, INC.

Reporter's Affiliation

PROPOSED REVISION OF 10 CFR PART 20

"STANDARDS FOR PROTECTION AGAINST RADIATION"

ROBERT E. ALEXANDER
CHIEF, HEALTH EFFECTS AND OCCUPATIONAL RADIATION PROTECTION
OFFICE OF NUCLEAR REGULATORY RESEARCH

JANUARY 16, 1986

REASONS FOR REVISING PART 20

- o UPDATE PRESENT PART 20 PROMULGATED IN 1957
- o IMPLEMENT APPROPRIATE CURRENT RECOMMENDATIONS OF ICRP
- o IMPLEMENT EPA PROPOSED FEDERAL RADIATION PROTECTION GUIDANCE FOR OCCUPATIONAL EXPOSURES
- o IN GENERAL --

  TO ESTABLISH A SCIENTIFICALLY SOUND AND EXPLICIT HEALTH PROTECTION BASIS FOR PART 20 STANDARDS AND OTHER NRC REGULATORY ACTIONS

NEEDED IMPROVEMENTS IN THE PRESENT PART 20

- o UNIFORM RISK BASED STANDARD FOR DOSE & OTHER LIMITS
- o UPDATE NUCLIDE INTAKE LIMITS (MPC'S)
- o DELETE 5(N-18) RULE PERMITTING 12 REMS/YR
- o INTEGRATED LIMITS FOR INTERNAL AND EXTERNAL DOSES
  ESPECIALLY IMPORTANT FOR NMSS LICENSEES
- o PROVIDE EXPLICIT DOSE LIMITS FOR MEMBERS OF THE PUBLIC
- o PROVIDE A CUTOFF ON COLLECTIVE DOSE (PERSON-REM) CALCULATIONS RATHER THAN INTEGRATE OVER INFINITE TIME AND SPACE

RISK COMPARISON: CURRENT 10 CFR PART 20 AND ICRP 26

1. CURRENT 10 CFR PART 20 PERMITS EXTERNAL WHOLE BODY DOSE OF 5 REM/YEAR (IN CERTAIN INSTANCES UP TO 12 REM/YEAR) AND IN ADDITION 15 REM/YEAR TO ANY ORGAN FROM INTERNALLY DEPOSITED RADIONUCLIDES (30 REM/YEAR TO BONE AND THYROID, 5 REM/YEAR TO GONADS).

2. ONLY THE DOSE TO THE ORGAN RECEIVING THE MAXIMUM DOSE (THE "CRITICAL ORGAN") IS LIMITING. RISKS TO ORGANS RECEIVING LOWER DOSES FROM THE SAME RADIONUCLIDE INTAKE ARE NOT CONSIDERED.

3. ICRP-26 LIMITS THE DOSE FROM ALL SOURCES: EXTERNAL PLUS INTERNAL (CONSIDERING ALL IRRADIATED ORGANS) TO 5 REM/YEAR "EFFECTIVE". 5 REM/YEAR "EFFECTIVE" MEANS THAT THE TOTAL RISK TO THE INDIVIDUAL EQUALS TO RISK FROM 5 REM/YEAR FROM EXTERNAL RADIATION ALONE.

4. THE PARAMOUNT CONSIDERATION IS THE RISK TO AN INDIVIDUAL AND NOT THE DOSE TO A SINGLE ORGAN. IF ONLY A SINGLE ORGAN IS IRRADIATED, HIGHLY UNLIKELY IN PRACTICE, THE ICRP DOSE LIMITS FOR THAT ORGAN ARE IN CERTAIN CASES HIGHER THAN PERMITTED BY CURRENT 10 CFR PART 20. THE RISK UNDER THOSE LIMITS, HOWEVER, NEVER EXCEEDS THAT OF 5 REM/YEAR OF EXTERNAL WHOLE BODY IRRADIATION.

5. IN ACTUAL CASES WHERE MULTIPLE ORGANS ARE IRRADIATED, FROM INTERNAL AND EXTERNAL RADIATION, THE TOTAL EFFECTIVE DOSE AND THE RISK WILL BE LOWER UNDER ICRP-26 SYSTEM OF DOSE LIMITATION.

RISK COEFFICIENTS COMPARISON

			Risk per rem
ICRP 26			
CANCER	MODEL USED:	LINEAR ABSOLUTE PROJECTION	12.5×10^{-5}
GENETIC EFFECTS (FIRST TWO GENERATIONS)			4×10^{-5}
BEIR III			
CANCER	MODELS PRESENTED:	LINEAR ABSOLUTE PROJECTION	16.7×10^{-5}
		LINEAR RELATIVE PROJECTION	50.1×10^{-5}
		LINEAR QUADRATIC ABSOLUTE PROJECTION	7.7×10^{-5}
		LINEAR QUADRATIC RELATIVE PROJECTION	22.6×10^{-5}
GENETIC EFFECTS (FIRST TWO GENERATIONS)			3×10^{-5}

NOTE: ALL MODELS ASSUME "NO THRESHOLD"

BRIEF HISTORY OF RULEMAKING

- 1977 PUBLICATION OF ICRP-26
- 1979 NMSS MEMO TO RES SUGGESTED REVISION OF PART 20
- INTEROFFICE WORKING GROUP, SCOPED EFFORT, IDENTIFIED ISSUES
- MARCH 1980 ANPR
- ESTABLISHMENT OF DRAFTING GROUP
- EPA DRAFT GUIDANCE ON OCCUPATIONAL EXPOSURES -- SECY-81-232 & COMMISSION RESPONSE
- MEETINGS WITH INTERESTED PARTIES
- NCRP/ACRS RECOMMEND WAITING FOR NCRP RECOMMENDATIONS, NEG. EDO RESPONSE
- INTERNAL NRC REVIEW, COMMENT, CONCURRENCE

ICRP-26 SYSTEM OF DOSE LIMITATION

- JUSTIFICATION OF ANY RADIATION EXPOSURE
- OPTIMIZATION OF RADIATION PROTECTION
- LIMITATION OF DOSES
  - "EFFECTIVE DOSE EQUIVALENT" CONCEPT
    COMBINES INTERNAL AND EXTERNAL DOSES
    INCLUDES ALL ORGANS, WEIGHTING FACTORS
    BASED ON RISK

MAJOR CHANGES IN PROPOSED REVISION

EXTERNAL OCCUPATIONAL DOSE LIMITS, WHOLE BODY

1.25 REMS/QTR

OR

3 REMS/QTR AND

5 REMS/YR AVERAGE

5(N - 18) FORMULA

CHANGE TO

3 REMS/QTR

AND

5 REMS/YR

AND

"PLANNED SPECIAL EXPOSURES"

5 ADDITIONAL REMS/YR
WITH SPECIAL JUSTIFICATION

25 REMS LIFETIME LIMIT FOR SUCH
EXPOSURES

ANNUAL LIMIT INCLUDES INTERNAL DOSE

0 SLIGHTLY MODIFIED ICRP-26 CONCEPT

OTHER EXTERNAL OCCUPATIONAL DOSE LIMITS

EXTREMITIES:	18-3/4	REMS/QTR	CHANGE TO	50	REMS/YR
SKIN:	7-1/2	REMS/QTR	CHANGE TO	50	REMS/YR
LENS: *	1.25	REMS/QTR, OR	CHANGE TO	15	REMS/YR
	3	REMS/QTR AND			
	5	REMS/YR AVERAGE			

0 CHANGES FULLY CONSISTENT WITH ICRP-26

* TREATED AS PART OF WHOLE BODY

INTERNAL OCCUPATIONAL DOSE LIMITS

QUARTERLY INTAKE LIMITS FOR EACH NUCLIDE	CHANGE TO	ANNUAL INTAKE LIMITS FOR EACH NUCLIDE
(COMPLIANCE PREVENTS MOST HIGHLY EXPOSED ORGAN FROM EXCEEDING ITS OLD ICRP DOSE LIMIT)		(COMPLIANCE PREVENTS RISK TO ALL AFFECTED ORGANS FROM EXCEEDING THAT FROM 5 REMS/YR TO WHOLE BODY)
		LIMITS MUST INCLUDE EXTERNAL DOSE

0 CHANGES FULLY CONSISTENT WITH ICRP-26

INTERNAL OCCUPATIONAL DOSE CONTROL

- O CHANGES WOULD PRIMARILY AFFECT NMSS LICENSEES
- O RISK FROM AIRBORNE NUCLIDES AT NPP'S IS SMALL (98% ORGAN BURDENS <2% OF PERMISSIBLE)
- O INTAKE LIMITS FOR SOME NUCLIDES WOULD BE LOWERED, PRIMARILY ALPHA EMITTERS ENCOUNTERED IN NMSS-LICENSED FACILITIES, E.G.
  - URANIUM - FACTOR OF 6,
  - THORIUM - FACTOR OF 60,
  - AMERICIUM - FACTOR OF 50
- O INTAKE LIMITS FOR SOME NUCLIDES WOULD BE INCREASED, PRIMARILY BETA EMITTERS
- O SPECIAL PROVISIONS IN REVISED PART 20 FOR ALPHA EMITTERS DIFFICULT TO MEASURE AT NEW LIMITS (ANNUAL DOSE CONTROL RATHER THAN 50-YEAR INTEGRATED DOSE)
- O ALL CHANGES CONSISTENT WITH ICRP-26

OCCUPATIONAL ALARA CONCEPT

§20.1 (c) SAYS EXPOSURES SHOULD BE MAINTAINED ALARA	CHANGE TO	REQUIREMENT TO DEVELOP, DOCUMENT AND IMPLEMENT A RADIATION PROGRAM THAT INCLUDES ALARA

INVESTIGATION LEVELS

CONCEPT NOT USED IN PRESENT PART 20	CHANGE TO	INVESTIGATION LEVELS BELOW REGULATORY LIMITS REQUIRED -- SET BY LICENSEE

DE MINIMIS EXPOSURE LEVELS

PRESENT PART 20 SETS LEVELS BELOW WHICH CERTAIN REQUIREMENTS DO NOT APPLY: THESE LEVELS ESTABLISH CONTROL POINTS, NOT TRIVIALITY

RETAIN SIMILAR LEVELS BUT ADD:

PROPOSED PART 20 WOULD SET A CUT OFF LEVEL OF 1 MREM FOR COLLECTIVE DOSE CALCULATIONS

NO DE MINIMIS LEVEL IS PROPOSED FOR INDIVIDUAL WORKER EXPOSURES

UK NATIONAL RADIOLOGICAL PROTECTION BOARD IN JANUARY 1985 ADVISED USE OF THE FOLLOWING DE MINIMIS LEVELS:

5 MREM/YR	INDIVIDUAL MEMBERS OF THE PUBLIC (1% OF ANNUAL DOSE LIMIT FOR PUBLIC)
0.5 MREM/YR	WHERE THE INDIVIDUAL MAY BE EXPOSED TO SEVERAL "DE MINIMIS" SOURCES

PROTECTION OF THE PUBLIC

RADIATION LEVELS IN UNRESTRICTED AREAS

PRESENT PART 20 (TO AN INDIVIDUAL):

- 2 MREMS IN ANY HOUR
- 100 MREMS IN ANY 7 DAYS
- 500 MREMS IN A CALENDAR YR (IMPLIED)

CHANGE TO

RADIATION LEVELS AND RADIOACTIVITY CONCENTRATIONS IN UNRESTRICTED AREAS

- 500 MREMS/YR, EXPLICIT, EFFECTIVE DOSE FROM ALL EXTERNAL/INTERNAL SOURCES
- 100 MREM/YR REFERENCE LEVEL

RADIOACTIVITY IN EFFLUENTS

PRESENT PART 20 (ANY TYPE FACILITY):

- PRESCRIBED CONCENTRATION VALUES, AVERAGED OVER 1 YR
- ADDITIONAL LIMITATIONS IF FOOD PATHWAY INCREASES DAILY INTAKE
- COMPLIANCE WITH 40 CFR PART 190 REQUIRED OF FUEL CYCLE/LWR LICENSEES

CHANGE TO

- PRESCRIBED CONCENTRATION VALUES MODIFIED AND RETAINED

CONTROVERSIAL ISSUES

IN THE PROPOSED

10 CFR PART 20

- Protection of Embryo/Fetus
- Annual Exposure Reports
- De Minimis Levels
- Optional Implementation Period
- Committed vs. Annual Dose

PROTECTION OF AN EMBRYO/FETUS

ISSUE: PROTECTION OF AN EMBRYO/FETUS AGAINST OCCUPATIONAL RADIATION EXPOSURE OF PREGNANT WORKER.

EFFECTS OF MATERNAL FACTORS ON PREGNANCY OUTCOME

Factor	Effect	Number Occurring From Natural Causes	Excess Occurrences Due To Maternal Factor
Radiation Risk			
Childhood Cancer			
Radiation dose of 1000 millirems received before birth	Cancer death	1200 per million	600 per million
Abnormalities			
A. Radiation dose of 1000 millirads received during specific periods after conception.			
4-7 weeks	Small Head Size	40 per thousand	5 per thousand
8-11 weeks	" " "	40 per thousand	9 per thousand
B. Radiation dose of 1000 millirads received during the following period after conception			
8-15 weeks	Mental Retardation	4 per thousand	4 per thousand

EFFECTS OF MATERNAL FACTORS ON PREGNANCY OUTCOME (CONT.)

FACTOR	EFFECT	NUMBER OCCURRING FROM NATURAL CAUSES	EXCESS OCCURRENCES DUE TO MATERNAL FACTOR
NONRADIATION RISKS			
OCCUPATION			
WORK IN HIGH RISK OCCUPATIONS	STILLBIRTH OR SPONTANEOUS ABORTION	200 PER THOUSAND	90 PER THOUSAND
ALCOHOL CONSUMPTION			
2-4 DRINKS PER DAY	FETAL ALCOHOL SYNDROME	1-2 PER THOUSAND (TOTAL BIRTHS)	100 PER THOUSAND
4-10 DRINKS PER DAY	FETAL ALCOHOL SYNDROME	1-2 PER THOUSAND (TOTAL BIRTHS)	200 PER THOUSAND
MORE THAN 10 DRINKS PER DAY (CHRONIC ALCOHOLIC)	FETAL ALCOHOL SYNDROME	1-2 PER THOUSAND (TOTAL BIRTHS)	350 PER THOUSAND
MORE THAN 10 DRINKS PER DAY (CHRONIC ALCOHOLIC)	PERINATAL	23 PER THOUSAND	170 PER THOUSAND

EFFECTS OF MATERNAL FACTORS ON PREGNANCY OUTCOME (CONT.)

Factor	Effect	Number Occurring From Natural Causes	Excess Occurrences Due To Maternal Factor
Smoking			
-	Babies at birth tend to weigh less than babies of non smokers	-	-
Less than 1 pack per day	Perinatal Infant death	23 per thousand	5 per thousand births
One pack or more per day	Perinatal Infant death	23 per thousand	10 per thousand births

PROTECTION OF EMBRYO/FETUS

Principal Alternatives

- Informed Consent (present NRC position)
  - onus for protection on worker
- Lower Dose Limit for all Workers
  - higher collective doses and costs
- Lower Dose Limit for all Women
  - job discrimination, inappropriate limit for some women
- Lower Dose Limit for Fertile Women
  - job discrimination, invasion of privacy
- Lower Dose Limit for Women Known to be Pregnant
  - job discrimination, invasion of privacy, moderate overexposure potential
  - onus for protection on employer
- Lower Dose Limit for Women Declared to be Pregnant
  - job discrimination, higher overexposure potential
  - onus for declaration on worker

EPA IS PROPOSING THE FINAL ALTERNATIVE IN NEW GUIDANCE TO FEDERAL AGENCIES

PROPOSED EMBRYO/FETUS LIMIT

- Provides dose limit of 0.5 rem to embryo/fetus for entire gestation period.
- Declaration of pregnancy would be voluntary.
- Once declared, the responsibility of meeting limit would shift to licensee.
- An additional 0.05 rem to the embryo/fetus permitted if embryo/fetus limit has been exceeded before declaration of pregnancy.
- Women who chose not to declare their pregnancies will be subject to the same occupational limits as any other nuclear worker.
- Consistent with EPA proposed Federal guidelines, NCRP, ICRP, Previous Commission guidance and other Federal agencies.

DE MINIMIS LEVELS

ISSUES:

1. SHOULD CALCULATIONAL "CUTOFF" LEVEL FOR COLLECTIVE DOSE ASSESSMENTS BE ESTABLISHED?

2. IF ESTABLISHED, AT WHAT LEVEL SHOULD THE CUTOFF BE SET?

USE OF DE MINIMIS DOSE CONCEPT

- GENERALLY, DE MINIMIS DOSE MEANS A DOSE WHICH HAS AN ATTENDANT RISK SO LOW THAT IT DOES NOT WARRANT REGULATORY ATTENTION.
- THERE ARE MANY POTENTIAL APPLICATIONS OF DE MINIMIS CONCEPT.
- NEITHER EXISTING NOR PROPOSED FEDERAL GUIDANCE INCLUDES ANY APPLICATION OF DE MINIMIS CONCEPT.
- DE MINIMIS DOSE CONCEPT IN PROPOSED 10 CFR PART 20 REVISION IS VERY LIMITED - ONLY FOR CALCULATIONAL "CUTOFF" FOR COLLECTIVE DOSE ASSESSMENTS.
- COLLECTIVE DOSE ASSESSMENTS ARE A MAJOR CONSIDERATION IN DECISIONS ABOUT:
  - BALANCE BETWEEN INDIVIDUAL DOSE AND POPULATION DOSE IN DETERMINING ALARA.
  - CHOICES AMONG AVAILABLE OPTIONS FOR PROVIDING RADIATION PROTECTION.

DE MINIMIS LEVELS IN UNITED KINGDOM

- 5 MREMS/YR, INDIVIDUAL DOSE FROM ALL NON-MEDICAL, CONTROLLED SOURCES (RISK OF 10^{-6}/YR, MORTALITY)
- 0.5 MREM/YR, INDIVIDUAL DOSE FROM ANY ONE NON-MEDICAL, CONTROLLED SOURCE
- INDIVIDUAL DOSES LESS THAN 0.5 MREM/YR NOT INCLUDED IN COLLECTIVE DOSE ESTIMATES USED FOR APPROVAL PURPOSES IF COLLECTIVE DOSE IS LESS THAN 100 PERSONREMS

THESE LEVELS WILL AFFECT:

- GOVERNMENT APPROVALS
- DESIGN AND PLANNING
- OPERATIONS
- WASTE MANAGEMENT
- DECOMMISSIONING
- THE DEGREE OF REASON EMPLOYED IN RADIATION PROTECTION
- UNNECESSARY EXPENDITURE OF RESOURCES
- DECISIONS OTHERWISE AFFECTED UNDULY BY TRIVIAL CONCERNS
- EXAGGERATED PROTECTIVE MEASURES THAT EXACERBATE OTHER HAZARDS
- PUBLIC UNDERSTANDING THAT RADIATION RISK IS DOSE-DEPENDENT

PROPOSED RULE IN PART 20 WOULD ALLOW A 1 MREM/YR CUT OFF IN COLLECTIVE DOSE CALCULATIONS (QUASI DE MINIMUS LEVEL)

QUASI DE MINIMIS RULE IN PROPOSED 10 CFR PART 20

- 1 MREM/YR CUT OFF IN COLLECTIVE DOSE CALCULATIONS MADE TO OBTAIN NRC APPROVALS (COMPARABLE UK LEVEL IS 0.5 MREM/YR)
- WOULD ELIMINATE CONSIDERATION OF VERY LOW DOSES DELIVERED AT VERY LOW DOSE RATES OVER EXTREMELY LONG PERIODS OF TIME TO EXTREMELY LARGE NUMBERS OF PEOPLE
- COLLECTIVE DOSES CALCULATED FROM INDIVIDUAL DOSES LESS THAN 1 MREM/YR ARE A HIGH PERCENTAGE OF THE TOTAL
- RISKS ASSOCIATED WITH 1 MREM/YR OR LESS SHOULD BE OF NO CONCERN TO THE EXPOSED INDIVIDUAL (ONE-FIFTH OF THE COMPARABLE LEVEL ADOPTED IN UK), ARE TRIVIAL WITH RESPECT TO REGULATORY CONCERN, AND SHOULD NOT AFFECT DECISION-MAKING PROCESSES
- IF A LONG-LIVED RADIONUCLIDE WERE RELEASED SUCH THAT EVERY US CITIZEN CONTINUOUSLY RECEIVED 1 MREM/YR (WORST CASE), THE THEORETICAL NUMBER OF PREMATURE DEATHS PER YEAR WOULD BE ABOUT 21 IN A POPULATION OF 220,000,000 PEOPLE.
- THE US DEATH RATE FROM CANCER IS ABOUT 400,000 PER YEAR AND FROM ALL CAUSES IS ABOUT 2,000,000 PER YEAR.

WHY ESTABLISH CALCULATIONAL CUTOFF DOSE?

- WILL PROVIDE A CONSISTENT BASIS FOR LIMITING THE EXTENT OF ASSESSMENT OF COLLECTIVE DOSES.
- WILL REMOVE SUBJECTIVITY OF UNKNOWNS AND UNCERTAINTIES LEADING TO POTENTIALLY INCORRECT JUDGEMENTS:
  - UNCERTAINTIES ASSOCIATED WITH DISTANCES FAR FROM THE SOURCE.
  - UNCERTAINTIES ASSOCIATED WITH LONG PERIODS OF TIME.
  - VANISHINGLY SMALL RISKS TO THE EXPOSED INDIVIDUAL, I.E., DE MINIMIS.
- WILL SIGNIFICANTLY REDUCE RESOURCE COMMITMENTS.

APPLICATION OF DE MINIMIS CONCEPT TO INDIVIDUALS

- WOULD ESTABLISH **ANNUAL** DOSE LEVEL SO SMALL THAT INDIVIDUALS USUALLY WOULD NOT CONSIDER THE RISK IN ARRIVING AT DECISIONS REGARDING THEIR ACTIONS.
  - APPLICATIONS WOULD BE MUCH BRAODER THAN CALCULATIONAL "CUTOFF".
  - NO REGULATORY ACTIONS WOULD BE IMPOSED FOR DOSES BELOW THIS LEVEL.
  - COST REDUCTIONS WOULD BE APPRECIABLE (E.G., RADWASTE DISPOSAL, EFFLUENT PROCESSING).
- WAS CONSIDERED DURING DEVELOPMENT OF PROPOSED RULE.
- COULD RESULT IN:
  - UNAPPROVED INCORPORATION OF RADIOACTIVE MATERIALS INTO CONSUMER PRODUCTS.
  - RELEASE OF VERY LOW-LEVEL WASTE STREAMS WITHOUT EVALUATION.
  - RAISING LEVELS, AS IN NPP TECHNICAL SPECIFICATIONS, AT WHICH CERTAIN CONTROLS OR EQUIPMENT MUST BE INSTALLED OR OPERATED.
- SUPPLEMENTAL INFORMATION OF PROPOSED RULE DISCUSSES AND SPECIFICALLY REQUESTS COMMENTS.

STAFF RECOMMENDATIONS

- ESTABLISH A CUTOFF LEVEL OF 1 MREM/YR ON INDIVIDUAL DOSES TO BE USED IN THE CALCULATION OF COLLECTIVE DOSE ESTIMATES FOR REG PURPOSES.

- SPECIFICALLY REQUEST PUBLIC COMMENT ON THIS ISSUE AND ON A DE MINIMIS LEVEL FOR INDIVIDUALS.

REPORTING OF WORKER DOSES

ISSUES:

1. SHOULD THE NRC REQUIRE ALL LICENSEES TO REPORT ANNUAL DOSES OF ALL MONITORED WORKERS TO NRC?

2. SHOULD THE NRC REQUIRE ALL LICENSEES TO REPORT ANNUAL DOSES TO WORKERS (WITHOUT REQUEST)?

EXPOSURE REPORTS

- THE NATIONAL INTEREST
  - The Federal Government is Expected to be Informed, and to Disseminate Information, Regarding Health and Safety in the Workplace
  - DOL Bureau of Labor Statistics (radiation exposure not included)
  - Exposure Data are Vital in Planning for the Administration of Justice (Workmans Compensation, Tort Law)

- NRC INTERESTS
  - NRC is Primary Source of Information for Congress, Administration, Other Federal Agencies, State Governments, Labor Unions, Scientific and Industrial Organizations, Special Interest Groups, News Media, United Nations, Foreign Governments, Among Others
  - Data Base for Decisions Regarding: Budget Needs; Research and Standards Development Priorities; Evaluating Licensee Performance; Areas to Emphasize in Licensing; Inspection and Enforcement Priorities
  - Data Base for Factoring Worker Risks into Decisions on Plant Safety Requirements
  - Data Base for Controlling Potential Transient Worker Problems
  - Triggering Timely Corrective Action
  - Data Base for Evaluation of Radiological Risks in NRC-Licensed Activities and Licensee Performance

EXPOSURE REPORTS...CONTINUED

- INDUSTRY INTEREST
  - Unbiased Government Data are Used by Industry to Verify that Safe Working Conditions are Maintained
  - Data are Used by Industry to Identify its Strong and Weak Performers and to Effect Improvements
- WORKER INTEREST
  - Assurance that Health Protection is Adequate, as Supervised by Government
  - Confidence that Adequate Legal Records are Available if Needed
  - Government Termination of Unsafe Conditions

<u>PRESENT WORKER DOSE REPORTING REQUIREMENTS</u>

o ANNUAL STATISTICAL SUMMARY REPORTS--FROM 7 CATEGORIES OF LICENSEES

- LICENSEE IDENTIFICATION ONLY.
- NUMBER OF WORKERS RECEIVING DOSES WITHIN SPECIFIED DOSE RANGES.

o REPORTS ON TOTAL DOSE RECEIVED BY WORKERS WHO TERMINATED EMPLOYMENT--FROM SAME 7 CATEGORIES OF LICENSEES.

- LICENSEE IDENTIFICATION
- WORKER IDENTIFICATION (NAME, SS NO., BIRTH DATE)
- PERIOD OF EMPLOYMENT
- MAGNITUDE AND TYPE OF RADIATION DOSE.

o REPORTS ON DOSES RECEIVED BY WORKERS WHEN LIMITS ARE EXCEEDED

- LICENSEE IDENTIFICATION
- WORKER IDENTIFICATION
- TIME OF EXPOSURE
- MAGNITUDE AND TYPE OF RADIATION DOSE.

o REPORT TO WORKER FROM ANY LICENSEE UPON REQUEST FROM WORKER

- MAGNITUDE AND TYPE OF RADIATION DOSE RECEIVED IN YEAR.

o COPY REPORT TO WORKER WHENEVER INFORMATION REPORTED TO NRC BY NAMED INDIVIDUAL.

STAFF USES OF REPORTED RADIATION EXPOSURE DATA

THE DATA OBTAINED FROM PRESENT REPORTING REQUIREMENTS PERMIT ESTIMATES OF:

- O SIZE OF RADIATION WORKFORCE.
- O MAGNITUDE OF ANNUAL COLLECTIVE DOSE.
- O TRENDS OF EXPOSURES
  - COMPARISON OF DATA BY TYPE OF LICENSEE, AND BY LICENSEE WITHIN EACH TYPE
  - DOSE DISTRIBUTION VARIATION WITH TIME.
- O TRANSIENT WORKER DOSES.

EXAMPLES OF SPECIFIC USES OF REPORTED EXPOSURE DATA

o MONITORING OF TRANSIENT WORKER OVEREXPOSURES

- INDIVIDUAL WORKING AT MULTIPLE PLANTS DURING A QUARTER IS COMMON.

- OVEREXPOSURES ARE KNOWN TO BE EXTREMELY RARE.

o EXTENT OF AIRBORNE RADIOACTIVITY PROBLEM FOR NPP'S WORKERS

- NO OVEREXPOSURES REPORTED TO DATE.

- 98% OF THE REPORTED MEASUREMENT RESULTS FOR INTERNALLY DEPOSITED RADIOACTIVITY ARE LESS THAT 2% OF "PERMISSIBLE" QUANTITY.

- THEREFORE FEW NRC RESOURCES NEED BE EXPENDED FOR PROTECTION IN THIS AREA.

<u>ALTERNATIVES</u>

- CONTINUE PRESENT REQUIREMENTS
  - ANNUAL STATISTICAL SUMMARY REPORTS TO NRC FROM 7 LICENSEE CATEGORIES
  - TERMINATION REPORTS TO NRC FROM 7 LICENSEE CATEGORIES (COPY TO WORKER).
- EXPAND PRESENT REQUIREMENTS TO INCLUDE <u>ALL</u> LICENSEES
- REQUIRE ANNUAL EXPOSURE REPORTS FOR EACH INDIVIDUAL WORKER TO THE <u>WORKER</u> FROM:
  - 7 LICENSEE CATEGORIES
  - ALL LICENSEES.
- REQUIRE ANNUAL EXPOSURE REPORTS FOR EACH INDIVIDUAL WORKER TO THE <u>WORKER AND NRC</u> FROM:
  - 7 LICENSEE CATEGORIES
  - ALL LICENSEES.
- TIMING OF REQUIREMENT FOR ANNUAL REPORTS OF NAMED INDIVIDUAL WORKER:
  - INCLUDE IN FINAL RULE (PART 20)
  - REVISE PART 19 SEPARATELY (IF REPORT ONLY TO WORKER IS REQUIRED BUT NOT IN PART 20).

REPORTING OF WORKER DOSES CONSIDERATIONS

o PRESENT REPORTING REQUIREMENTS PROVIDE INCOMPLETE DATA, E.G.,:

- NO ROUTINE OCCUPATIONAL EXPOSURE INFORMATION IS REPORTED BY MANY NRC LICENSEES, INCLUDING MEDICAL INSTITUTIONS. (MEDICAL WORKERS RECEIVE ABOUT HALF OF THE ANNUAL COLLECTIVE OCCUPATIONAL DOSE).
- NO ROUTINE OCCUPATIONAL EXPOSURE INFORMATION IS REPORTED BY THE AGREEMENT STATE LICENSEES. (AGREEMENT STATES REGULATE LICENSEES HAVING ABOUT 200,000 OF THE 500,000 WORKERS MONITORED).
- DATA SAMPLE FOR INTERNAL EXPOSURES TO ALPHA EMITTERS TOO SMALL AND UNTIMELY FOR STAFF NEEDS.

o THE EPA PROPOSED FEDERAL GUIDANCE WOULD REQUIRE EMPLOYERS TO REPORT WORKER ANNUAL DOSES TO THE WORKER WITH NO REQUIREMENT ON REPORTING TO ANY FEDERAL AGENCY.

- EPA PROPOSED FEDERAL GUIDANCE MAY NOT BE FINALIZED FOR SOME TIME.

STAFF RECOMMENDATIONS

- CONTINUE THE PRESENT REQUIREMENT FOR ANNUAL STATISTICAL SUMMARY REPORTS AND TERMINATION REPORTS FROM 7 CATEGORIES OF LICENSEES WHOSE EMPLOYEES ARE CONSIDERED TO ACCEPT THE HIGHEST RISKS.
- SPECIFICALLY REQUEST COMMENTS ON THIS ISSUE.
- COMPLY WITH NEW FEDERAL GUIDANCE (ANNUAL EXPOSURE REPORT TO EACH WORKER) BY AMENDING REGULATIONS AFTER NEW FEDERAL GUIDANCE IS ISSUED.

OPTIONAL IMPLEMENTATION PERIOD

ISSUE: SHOULD THERE BE A TRANSITION PERIOD, FOLLOWING PUBLICATION OF THE NEW PART 20 AS A FINAL RULE, DURING WHICH COMPLIANCE WITH EITHER THE PRESENT OR NEW PART 20 WOULD BE ACCEPTABLE?

COMMITTED VS ANNUAL DOSE

ISSUE: SHOULD CONTROL OF LONG-LIVED RADIOACTIVE MATERIAL INTAKES BE BASED ON THE DOSE ACTUALLY RECEIVED EACH YEAR OR ON THE DOSE INTEGRATED OVER A PERIOD OF 50 YEARS?

COMMITTED VS ANNUAL DOSE FOR CONTROL OF LONG-LIVED AIRBORNE RADIONUCLIDES BY FEDERAL AGENCIES

- Controversy HIGHLIGHTTED by EPA/DOE/NRC reaction to ICRP-26
- ICRP has always used committed dose to internal organs (50-yr integrated dose), including ICRP-26
- AEC-Reg./NRC have always used committed dose
- AEC/ERDA/DOE have used combination of committed and annual dose
- EPA, in new guidance to Federal Agencies, is proposing combination of committed and annual dose
- 10 CFR Part 20 revision would use combination of committed and annual dose
- Federal agencies are in agreement on this issue
- The degree of protection provided for NRC-licensee and DOE-contractor workers would continue to be virtually the same.

COMMITTED VS ANNUAL DOSE CONTROVERSY IN HEALTH PHYSICS COMMUNITY

- THIS ISSUE INVOLVES CAREER INTERFERENCE, INTERNAL DOSE RECORDS AND REPORTS TO EMPLOYEES IN THE MANAGEMENT OF LARGE DEPOSITIONS; NOT COVERED IN FEDERAL GUIDANCE.

- HEALTH PHYSICS COMMUNITY DIVIDED ON THIS ISSUE.

- ISSUE WILL BE VOTED ON BY THE HEALTH PHYSICS SOCIETY -- THE FIRST TIME VOTING OF THIS TYPE HAS BEEN HELD.

- THE RESULTS OF THIS VOTE WILL BE INFLUENTIAL ON THE STAFF AS PUBLIC COMMENTS ON 10 CFR PART 20 ARE ANALYZED.

CAREER INTERFERENCE: RECORDING: REPORTING

- A WORKER ACCIDENTALLY RECEIVING A SUFFICIENTLY LARGE INTAKE WOULD RECEIVE AN EFFECTIVE DOSE EQUIVALENT LARGER THAN THE 5 REMS PER YEAR LIMIT THE REST OF HIS/HER LIFE.
- SINCE THE RISK FROM THIS DEPOSITION WOULD NOT BE ALTERED BY SUBSEQUENT INTAKE OR EXTERNAL EXPOSURE LIMITATIONS, WHILE CAREER INTERFERENCE COULD IMPOSE SEVERE ECONOMIC (AND OTHER) PENALTIES, PRESENT NRC REGULATIONS (AND THE NEW PART 20) WOULD, AT THE BEGINNING OF THE NEXT QUARTER (YEAR) DISREGARD THE PRESENCE OF THIS DEPOSITION.
- THE LICENSEE WOULD BE REQUIRED TO RECORD THE INTAKE AND AN ESTIMATE OF THE COMMITTED DOSE EQUIVALENT (EFFECTIVE COMMITTED DOSE EQUIVALENT AFTER REVISED PART 20 BECOMES EFFECTIVE).
- THE LCIENSEE WOULD BE REQUIRED TO REPORT THIS INFORMATION TO THE NRC AND TO THE WORKER.
- FOR CERTAIN NUCLIDES DIFFICULT TO MEASURE IN QUANTITIES ASSOCIATED WITH THE DOSE COMMITMENT, RECORDING AND REPORTING OF THE ANNUAL EFFECTIVE DOSE WOULD BE ALLOWED BY THE NEW PART 20, AND LARGER INTAKES WOULD BE ALLOWED UNDER PRESCRIBED CONDITIONS.
- INDIVIDUAL DETERMINATIONS WILL BE CONTINUED FOR DOE WORKERS SO EXPOSED, INCLUDING COMPENSATORY DOSE LIMITATIONS IF CONSIDERED NECESSARY BY DOE MEDICAL AUTHORITIES.
- DOE WILL CONTINUE TO RECORD AND REPORT ANNUAL DOSES.

ESTIMATED COST TO LICENSEES* OF IMPLEMENTING 10 CFR PART 20 REVISION

$33,000,000 INITIAL COST

$ 7,800,000 ANNUAL COST

BASED ON NRC/EPA CO-SPONSORED CONTRACT THAT SURVEYED LICENSEES

* INCLUDES AGREEMENT STATE LICENSEES

PERSPECTIVE ON ESTIMATED COSTS

- MUCH OF ECONOMIC IMPACT THAT IS ASSIGNED TO PROPOSED REVISION OF PART 20 HAS BEEN, IS BEING, OR WILL BE COMMITTED WHETHER OR NOT REVISION IS PROMULGATED.

- MANY LICENSEES VOLUNTARILY IMPLEMENTING RECOMMENDATIONS OF ICRP 26 AND 30, BECAUSE RECOGNIZED AS "GOOD PRACTICE" AND LIKELY TO BE HELPFUL IN MITIGATING LIABILITY CLAIMS

- COST OF SPECIAL EQUIPMENT, SUCH AS LUNG COUNTERS, PROCESS CHANGES, ROBOTICS, AND OTHER MAJOR MODERNIZATION ACTIVITIES, HAVE AND WILL BE "CHARGED" TO THE PART 20 REVISION, ALTHOUGH THEY ARE NOT REQUIRED AND WOULD BE INCURRED ANYWAY FOR OTHER REASONS

- ESTIMATED COSTS TAKE NO CREDIT FOR SAVINGS FROM CHANGES IN TECH SPECS, LIC. CONDITIONS, ETC. THAT COULD RESULT FROM PROMULGATION OF PROPOSED REVISION

BENEFITS OF PROPOSED REVISION

- REGULATION WILL REFLECT ICRP COHERENT RISK-BASED SYSTEM AND USE WIDELY-ACCEPTED CONTEMPORARY SCIENTIFIC KNOWLEDGE
- ANNUAL AND LIFETIME DOSES TO WORKERS RECEIVING HIGHEST EXPOSURES & WORKERS IN URAN. MILLS & FUEL FABR. WILL BE REDUCED
- WILL PROVIDE METHOD FOR SUMMING EXTERNAL AND INTERNAL EXPOSURES -- ESPECIALLY IMPORTANT FOR SOME NMSS LICENSED ACTIVITIES
- PUBLIC DOSE LIMITS ARE CLEARLY IDENTIFIED
- WORKERS AND PUBLIC SHOULD BETTER UNDERSTAND HEALTH RISK BASE AND PROTECTION PROVIDED
- CUTOFF ON COLLECTIVE DOSE EVALUATIONS WOULD ELIMINATE CONSIDERATION OF INSIGNIFICANT HEALTH RISKS
- IMPROVES REQUIREMENTS ON RADIATION SAFETY, E.G., TO PREVENT ACCESS TO VERY HIGH RADIATION AREAS, POSTING OF AREAS USED FOR MEDICAL RADIATION TREATMENTS, REQUIRED APPLICATION OF ALARA
- WOULD INTRODUCE SI (METRIC) RADIATION UNITS INTO NRC REGS

STAFF RECOMMENDATIONS

- CONCURRED IN BY ALL OFFICES INVOLVED
- PROPOSE EXTENDED IMPLEMENTATION PERIOD OF 5 YEARS FROM PUBLICATION OF FINAL RULE
- PUBLISH PROPOSED REVISION OF PART 20 FOR PUBLIC COMMENT
- SPECIFICALLY REQUEST COMMENTS ON CONTROVERSIAL ISSUES
- ALLOW EXTENDED PERIOD (120 DAYS) FOR COMMENT

(2)

AIF/NESP-030

DOSIMETRY AND RECORDKEEPING IMPLICATIONS OF THE PROPOSED REVISIONS TO 10 CFR 20

Prepared for the
National Environmental Studies Project
of the
Atomic Industrial Forum, Inc.

by

RADIATION MANAGEMENT CORPORATION
a subsidiary of
CANBERRA INDUSTRIES, INC.

Project Office, Northbrook, Illinois
Corporate Office, Meriden, Connecticut

L.F. Booth
F.L. Bronson
D.W. Groth

January 1985

PREFACE

The U.S. Nuclear Regulatory Commission (NRC) is currently drafting extensive revisions to 10 CFR 20, "Standards for Protection Against Radiation." The present standards are essentially those adopted in 1960 and are based on guidelines established by the (former) Federal Radiation Council, the International Commission on Radiological Protection (ICRP) and the National Council on Radiation Protection and Measurements (NCRP). Over the years, 10 CFR 20 has been subject to piecemeal changes designed to keep the standards current with scientific and engineering advances in radiation protection and monitoring. This process has led to the introduction, in NRC's own words, of "conflicts and ambiguities." The proposed revisions are intended to modernize the rule and bring it in line with the most recently published versions of ICRP Reports 26 and 30.

There appears to be little doubt that adoption of the proposed new 10 CFR 20 in its present form would force extensive and costly changes in the internal dosimetry and recordkeeping programs at NRC licensed facilities. This study examines in some detail the technical, procedural and cost implications of the proposed changes in these areas for nuclear power plants and fuel fabrication facilities. The findings are intended to provide a basis for substantiating comments on the draft changes currently being prepared by several industry and other groups, such as the AIF's Radiation Protection Subcommittee and the Health Physics Society.

This report concludes that the proposed revisions will correct minor inconsistencies and errors in the present version of 10 CFR 20 and provide for somewhat better tracking of dose. However, the cost of implementing and maintaining the new hardware and procedures will be high for both nuclear power plants and fuel fabrication facilities. The current standards were established to provide a very wide margin of safety for radiation workers, and there is no evidence that the proposed revisions will reduce worker exposure in any meaningful way. The monies that would have to be spent on implementing the changes required by the proposed new regulations could be more effectively spent, for example, on continuing to improve ways of decreasing external exposure.

This study was planned and directed by the industry Task Force listed on the inside front cover; their time, effort and cooperation are much appreciated. Thanks are also due to Charles Kent of the Tennessee Valley Authority and Dave Harward of the AIF Staff, who read early drafts and provided numerous helpful suggestions. Finally, special acknowledgement is due those members of the NRC staff involved in writing the proposed revisions to 10 CFR 20 who took time to review preliminary drafts of this report. Their courtesy in pointing out factual errors and in suggesting technical improvements is especially appreciated in view of the fact that they were not (and are not) in agreement with some of the conclusions reached by this study.

A. Scott Leiper
Project Manager
National Environmental Studies Project

EXECUTIVE SUMMARY

The Staff of the U. S. Nuclear Regulatory Commission (NRC) has proposed major revisions to Title 10, Code of Federal Regulations, Part 20, Standards for Protection against Radiation (10 CFR 20). The draft revisions contain provisions which could affect internal dosimetry and recordkeeping programs at licensed facilities. Although this study was limited to nuclear power plants and fuel fabrication facilities, it is believed that the implications and conclusions will apply to other licensees as well, at a level proportional to the magnitude of each licensee's internal dosimetry and recordkeeping requirements.

The purpose of this study was to assess the impact of the changes on the industry, and to develop information which would provide the nuclear industry with a sound basis for commenting on the rule changes. The basis for this study is the August, 1983 draft of 10 CFR 20. While that draft is still subject to revision, it is assumed that the sections on internal dosimetry and recordkeeping will not change appreciably and that study results will remain valid. However, there are a number of Regulatory Guides which assist in interpretation of the existing 10 CFR 20 which have not been revised for the proposed 10 CFR 20 and therefore could not be factored into this study. The lack of Regulatory Guide revisions may make it difficult for individual licensees to comment appropriately on the proposed regulations when finally published in the Federal Register. It would seem necessary for such guidance to be in place prior to implementation of any new or modified regulations so that there is proper and common interpretation both by the licensee and the Nuclear Regulatory Commission.

Results of the study show that the revisions will require the determination and recording of internal exposure data, and the summation of internal and external exposures, under certain circumstances. These new requirements will result in significant changes to existing internal dosimetry and recordkeeping systems. At both nuclear power plants and fuel fabrication facilities, large expenditures will be incurred for preparing, revising and approving procedures, in modifying routine operations and possibly in the case of power plants, the purchase of additional equipment.

The methods allowed by the proposed revisions for demonstrating compliance with the internal dosimetry provisions will include: 1) determination of intakes and comparision with ALIs*, 2) determination of exposures to airborne contaminants and comparison with DAC-hour limits, or 3) determination of committed effective dose equivalent and comparison to limits. Both air sampling and bioassay technologies can be used to demonstrate compliance with the revisions.

At nuclear power plants, existing state-of-the-art air sampling and whole body counting equipment have adequate sensitivity at the levels required to demonstrate compliance. For fuel fabrication facilities, uranium lung counting system sensitivities will be marginal for detect-

* See Appendix N, Glossary, for definition of ALI and other terms used in this report.

ing 30% of the proposed limits, as required by the proposed revisions, under routine operating conditions. Air sampling sensitivities will be sufficient for this purpose. However, the confidence in the accuracy of all routine measurements at both power plants and fuel fabricators will not be high because of the relatively small activities and doses encountered.

Large uncertainties are encountered when assessing internal exposures. For example, error analyses performed in this study indicate that fission and corrosion product depositions at 30% of the maximum permissible organ burdens (the levels at which internal exposures must be recorded) cannot be measured with whole body counters with uncertainties less than about ± 40%. The uncertainty in measuring 30% of a maximum permissible lung burden for uranium is estimated at ± 90%. Estimating body burdens from indirect bioassays (e.g. urinalyses) or from air sample results introduces uncertainties of factors of 4 or 5, as a minimum.

The current level of internal doses for industry workers is quite low, especially for nuclear power plant workers. The average effective dose equivalent (internal dose) for power plant workers is approximately 10 mrem/year, and for fuel fabrication workers is about 200 mrem/year. The uncertainties associated with determining these small doses are large, ranging from an estimated factor of 2.5 to as high as a factor of 20. The study concludes that fewer than 1% of all workers will exceed both 10% of external exposure limits and 30% of internal exposure limits, the levels at which summation of doses is required. However, as a practical matter, licensees will be required to develop the capability of summing doses for all workers.

The costs of implementing the proposed revisions have been estimated for model facilities. It was assumed that the principal method of demonstrating compliance will be to use whole body counting, supplemented by air sampling when necessary. Data from these measurements will be used to calculate committed dose equivalents or intakes, which may be compared to applicable limits. The costs are based on achieving the same level of confidence in compliance as the facilities currently have. Thus, although some programs which presently exceed the minimum requirements today might comply with the proposed revisions, the same management philosophy would probably require additional expenditures to maintain that same level of competence and safety.

The estimated initial and annual costs for the model power plant facility are \$480,000 and \$250,000 respectively. For the model fuel fabricator, the estimates are \$280,000 and \$60,000. Although the actual effect of implementing the proposed revisions at power plants is less significant from a technical standpoint than for fuel fabricators, the estimated costs are higher. This is due to the large number of workers processed and to the more complicated procedure development process at power plants.

The staff of the NRC has provided several reasons for the proposed revisions. In addition, other potential benefits have been identified

in the course of this study. The more important reasons and benefits include the following (in no particular order of importance):

1) Will correct existing inconsistencies and errors in Part 20;

2) Will provide better tracking of doses, especially for transient workers;

3) Will incorporate the best scientific data and judgement in the form of recent ICRP recommendations;

4) Will account for all modes of exposures by summing internal and external doses;

5) May put internal exposures in a more proper perspective.

Disadvantages which have been identified include the following (again in no particular order):

1) Although many workers will have to be entered into the monitoring and recordkeeping systems, the actual summing of doses will apply only to a very few;

2) There are large uncertainties in determining intakes or internal doses at typical industry levels;

3) In most cases the costs of implementing the revisions will be high;

4) There is no evidence that implementing the revisions will reduce worker exposures.

The study concludes that it is highly desirable to employ a regulatory system which accounts for both internal and external doses in a scientifically valid manner. It is also desirable that the regulations reflect the latest scientific knowledge and judgement, especially if this knowledge corrects serious defects or omissions in current standards. However, based on data developed in the report, it is concluded that internal doses are small, and that summing internal and external doses will be necessary for less than 1% of the total work force. Since the internal doses are already small, implementing the proposed revisions will probably not reduce worker doses.

Further, implementing the proposed revisions will be expensive for power plants and fuel fabricators. Licensees will be forced to spend large sums of money to demonstrate that summation of doses is not required except for a very few cases. Since the resources of licensees are not unlimited, they should be expended in the most efficient and beneficial manner. Those resources which are devoted to radiological protection should produce the optimum results in terms of reduction of exposures to workers, the population and/or the environment. It is the conclusion of this study that the resources which would be allocated to implementing these revisions would be better spent on programs devoted

to reducing total exposures through other means, (e.g., by reducing external exposures at power plants). There is no conclusive evidence that use of current regulations has resulted in inadequate worker protection. Therefore, the proposed revisions should not be implemented until such time that it can be demonstrated that this is the most beneficial expenditure of resources in terms of radiological protection.

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APPENDICES

LIST OF TABLES

LIST OF FIGURES

TABLE 7.2
COST ESTIMATES FOR IMPLEMENTING THE PROPOSED REVISIONS TO 10 CFR 20

		NPP	FFF
Task 1	Study Impact of New Regulations	9,300	10,300
Task 2	Evaluate Changes & Design Program	58,300	37,600
Task 3	External Dosimetry Procedures	2,400	1,400
Task 4	Develop Air Sample Procedures	10,500	6,000
Task 5	Develop Bioassay Procedures	17,000	11,800
Task 6	Develop Record Keeping Procedures	20,600	11,400
Task 7	Implement Task 3	—	—
Task 8	Implement Task 4	—	—
Task 9	Implement Task 5	142,700	35,800
Task 10	Implement Task 6	74,900	55,300
Task 11	Operate Task 3 (Annual Costs) *	—	—
Task 12	Operate Task 4 (Annual Costs) *	63,900	33,500
Task 13	Operate Task 5 (Annual Costs) *	173,100	19,700
Task 14	Operate Task 6 (Annual Costs) *	17,600	8,000
Task 15	Train Study Group for Task 1	9,600	10,100
Task 16	Train Plant Management Personnel	43,500	31,700
Task 17	Train HP and Dosimetry Personnel	41,900	17,300
Task 18	Train all other Plant Personnel	48,600	54,900
Task 19	Train Temporary Personnel	—	—
Initial Costs (1983 dollars)		479,300	283,600
Annual Costs (1983 dollars) *		254,600	61,200

(3)

STATUS OF NESP PROJECTS

PROJECT	JANUARY 1986 STATUS
• **INTACT DECOMMISSIONING OF NUCLEAR POWER PLANTS: A DOSE ASSESSMENT** Chairman: Lionel Lewis, Duke Power Company Contractor: Ebasco Services Inc.	IN PRESS
• **OCCUPATIONAL RADIATION EXPOSURE IMPLICATIONS OF NRC-INITIATED MULTI-PLANT (BACKFIT) ACTIONS** Chairman: Donald W. Edwards, Yankee Atomic Electric Company Contractor: SC&A, Inc.	IN PRESS
• **EVALUATION OF THE POTENTIAL FOR DE-REGULATED DISPOSAL OF VERY LOW LEVEL WASTES FROM NUCLEAR POWER PLANTS** Chairman: Peter S. Littlefield, Yankee Atomic Electric Company Contractor: General Physics Corporation/Envirosphere Company	CAMERA-READY COPY IN PREPARATION FOR PRESS
• **GUIDELINES FOR PRODUCING COMMERCIAL NUCLEAR POWER PLANT DECOMMISSIONING COST ESTIMATES** Chairman: Daniel H. Williams, Arkansas Power and Light Company Contractor: TLG Engineering, Inc.	DRAFT UNDER REVIEW BY TAG
• **CONSTRAINTS ON BWR PIPING SYSTEM INSPECTION, MITIGATION, REPAIR AND REPLACEMENT** Chairman: Robert A. Burns, New York Power Authority Contractor: Nuclear Energy Services, Inc.	SECOND DRAFT UNDER REVIEW BY TASK FORCE
• **A GUIDE FOR OBTAINING REGULATORY APPROVAL TO DISPOSE OF VERY LOW LEVEL WASTES BY ALTERNATIVE MEANS** Chairman: Peter S. Littlefield, Yankee Atomic Electric Company Contractor: General Physics Corporation	FIRST DRAFT UNDER REVIEW BY TASK FORCE

(-OVER-)

STATUS OF NESP PROJECTS (Continued)

PROJECT	JANUARY 1986 STATUS
• **METHODS FOR IMPROVING ACCURACY IN THE PREDICTION OF DOSES TO WORKERS AT NUCLEAR POWER PLANTS** Chairman: Donald W. Edwards, Yankee Atomic Electric Company Contractor: SC&A, Inc.	60% COMPLETE
• **REGULATORY CONSIDERATIONS INVOLVED IN EXTENDING THE OPERATING LIFE OF NUCLEAR POWER PLANTS** Chairman: Dennis L. Cox, Southern California Edison Company Contractor: Grove Engineering, Inc.	20% COMPLETE
• **A TECHNICAL BASIS FOR MEETING THE WASTE FORM STABILITY REQUIREMENTS OF 10 CFR 61** Chairman: James Clancy, Public Service Electric & Gas Company Contractor: To be selected	RFP UNDER REVIEW BY TASK FORCE
• **GUIDELINES FOR RADIOLOGICAL RECORDKEEPING** Chairman: Norman L. Millis, Baltimore Gas and Electric Company Contractor: To be selected	RFP UNDER REVIEW BY TASK FORCE
• **CRITERIA FOR AIRBORNE RELEASE DOSE MODEL SELECTION** Chairman: Charles R. Wike, Jr., Pennsylvania Power & Light Company Contractor: To be selected	RFP UNDER REVIEW BY TASK FORCE

PRESENTATION MATERIAL

OVERVIEW OF NATIONAL ENVIRONMENTAL STUDIES PROJECT (NESP)

PRESENTED TO

ACRS SUBCOMMITTEE

JANUARY 16, 1986

JOHN G. ROBINSON

YANKEE ATOMIC ELECTRIC COMPANY

National Environmental Studies Project (NESP)

- Established in 1973 in Response to NEPA
- Cooperatively Funded Program Providing Technical Reports to AIF Members, The Public, Government Officials, & Others
- Originally Dealt with Environmental & Siting Issues
- Has Moved Toward Environmental Problems of Nuclear Plant Operation & Near-Term Licensing
- About [illegible] NESP Sponsors Currently

NESP Organization

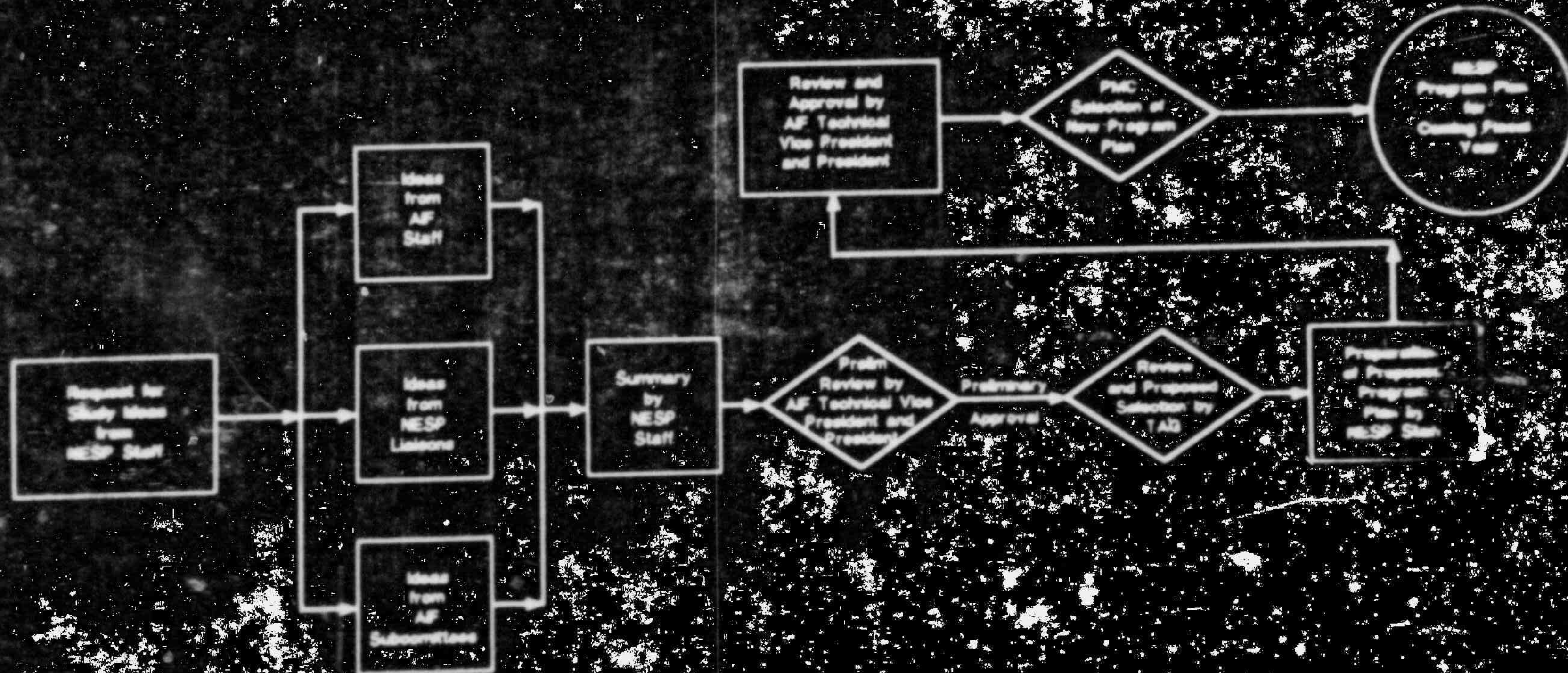
- Project Management Committee
- Technical Advisory Group
- NESP Project Staff
- Study-Specific Task Force for Each Effort
- Each Study Prepared by a Contractor (Following Competitive Bidding Process)

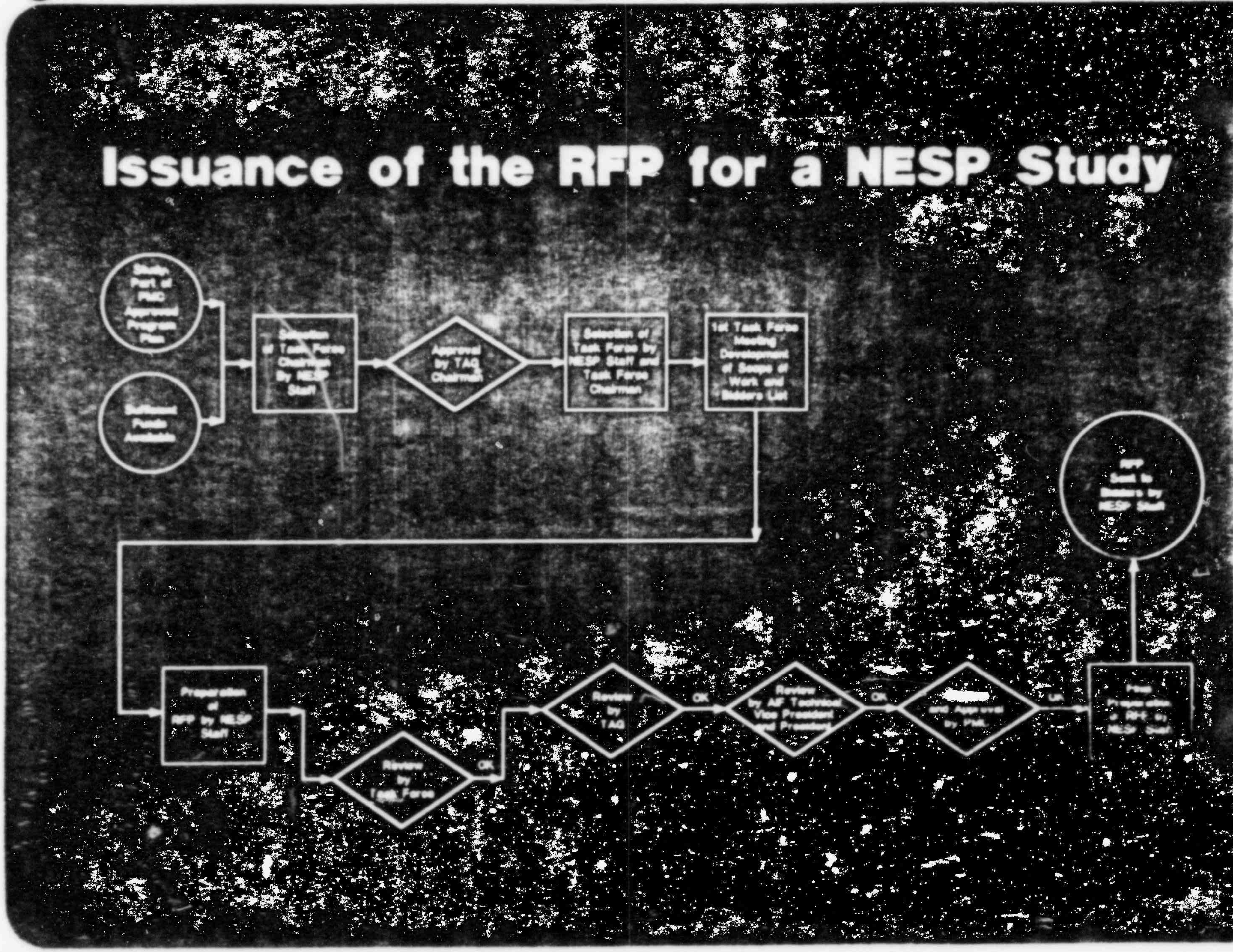
National Environmental Studies Project

BENEFITS

- Industry Avoids Duplication of Effort
- Technical Talent Pooled in Each Task Force
- Best Available Consulting Talent Selected
- Contract Administration Handled by NESP Staff
- Contact with Regulators Enhances Acceptability of Reports
- Produces Objective Studies Applicable Throughout Industry

Development of NESP Program [illegible]




Issuance of the RFP for a NESP Study
Study Part of PMC Approved Program Plan
Sufficient Funds Available
Selection of Task Force Chairman By NESP Staff
Approval by TAG Chairman
Selection of Task Force by NESP Staff and Task Force Chairman
1st Task Force Meeting Development of Scope of Work and Bidders List
Preparation of RFP by NESP Staff
Review by Task Force
OK
Review by TAG
OK
Review by AIF Technical Vice President and President
OK
RFP Sent to Bidders by NESP Staff

Production of a NESP Study Report

ATOMIC INDUSTRIAL FORUM
NATIONAL ENVIRONMENTAL STUDIES PROJECT (NESP)

STUDIES ON

OCCUPATIONAL EXPOSURE AND ALARA IMPLICATIONS OF BACKFITS

METHODS FOR IMPROVING ACCURACY IN ESTIMATING WORKER DOSES

PRESENTED TO
NRC ACRS SUBCOMMITTEES ON
WASTE MANAGEMENT AND REACTOR RADIOLOGICAL EFFECTS
JANUARY 16, 1986

DONALD W. EDWARDS
YANKEE ATOMIC ELECTRIC COMPANY

SANFORD S. COHEN
SC&A, INC.

5

ORIGINS OF STUDY

- AIF BACKFITS SUBCOMMITTEE'S NEED FOR SUPPORT
- STRUCTURE OF NESP TASK FORCE
- SUGGESTION FOR ADDITIONAL STUDY

AIF BACKFITS SUBCOMMITTEE INTERESTS

- EVIDENCE OF IMPACT OF REGULATORY BACKFITS ON COLLECTIVE DOSE
- DEGREE TO WHICH RADIOLOGICAL CONSEQUENCES OF BACKFITS WERE CONSIDERED BEFOREHAND
  - NRC STAFF ASSESSMENTS PRELIMINARY TO IMPOSING A BACKFIT
  - STAFF TREATMENT OF PRELIMINARY UTILITY RADIOLOGICAL ASSESSMENT INFORMATION

NESP TASK FORCE COMPOSITION

CHAIRMAN: DONALD EDWARDS
YANKEE ATOMIC ELECTRIC

- 12 UTILITIES
- 4 A/E,C AND MANUFACTURING FIRMS
- CONSULTING FIRM
- NUCLEAR INSURER
- NATIONAL LAB LIAISON (BNL)
- EPRI LIAISON
- 3 NRC LIAISONS
- INPO LIAISON

NESP TASK FORCE EXPERTISE

- HEALTH PHYSICISTS
- ALARA COORDINATORS/SUPERVISORS
- LICENSING MANAGERS
- ENGINEERING PERSONNEL

CONTRACTOR EXPERTISE

- 11 PROPOSALS EVALUATED BY TASK FORCE
- S C & A, INC. of MCLEAN, VA SELECTED
- EXTENSIVE EXPERIENCE IN COLLECTING WORKER EXPOSURE DATA
- STRONG BACKGROUND IN ANALYSIS OF NRC REGULATIONS AND DOCUMENTATION
- HEALTH PHYSICS CAPABILITIES
- STATISTICAL CAPABILITIES

PART I — SCOPE OF WORK

- IDENTIFY AND CATALOG NRC MULTI-PLANT ACTIONS (BACKFITS)
- DEFINE A REPRESENTATIVE SAMPLE OF PLANTS
- DETERMINE TOTAL DOSE AND DOSE RELATED TO MULTI-PLANT ACTIONS
- PRESENT PROPORTION OF COLLECTIVE DOSE ATTRIBUTABLE TO MULTI-PLANT ACTIONS (BACKFITS)

SELECTION OF GENERIC BACKFITS

- ONLY BACKFITS PERFORMED BETWEEN 1/79 AND 12/83
- NUREG-0748 ("ORANGE BOOK")
- I&E BULLETINS FROM 1/79 THROUGH 12/83
- DOCKET LITERATURE SEARCHES
- NRC FILES
- TASK FORCE INPUT AND SUGGESTIONS

NRC-INITIATED
MULTI-PLANT ACTIONS INVOLVING
OCCUPATIONAL RADIATION EXPOSURES

MPA/IEB #	Description	Year Listed	Plant Class	# of Plants	Related Documents	Licensee Action
A-04	10 CFR 50, Appendix J. Containment Integrity	79	All	54	10 CFR 50	Upgrade or modify containment isolation valves to conform with Appendix J requirements.
A-08	ECCS Evaluation and Upgrade	79	B&W	8	10 CFR 50	Upgrade or modify ECCS to conform with 10 CFR 50.46 requirements
B-02, B-41	10 CFR 50, Appendix R: Fire Protection	79	All	66	10 CFR 50	Upgrade or modify plant to conform with Appendix R requirements.
B-04	Reactor Vessel Overpressurization Protection System	79	PWR	38		Install an Overpressurization Protection System for the Reactor Vessel
B-05	Stress Corrosion Cracking - BWR RCS Pressure Boundary	79	BWR	49	USI A-39 NUREG-0313 IEB 82-03 IEB 83-02	Increased in-service inspections of piping and welds in the Reactor Coolant System.
B-07	Steam Generator Feedwater Flow Instability	79	PWR	26	GL 5/75, 9/2/77 NUREG-0219	Most PWRs redirected the water flow in feed ring of condenser with J-tubes.
B-09	Charging System Pipe Vibrations	79	PWR	15		Increased surveillance of the CVCS for pipe cracks caused by charging pump vibrations.
B-10	Burnable Poison Rod Failure	79	B&W	2		Surveillance of burnable poison rods.

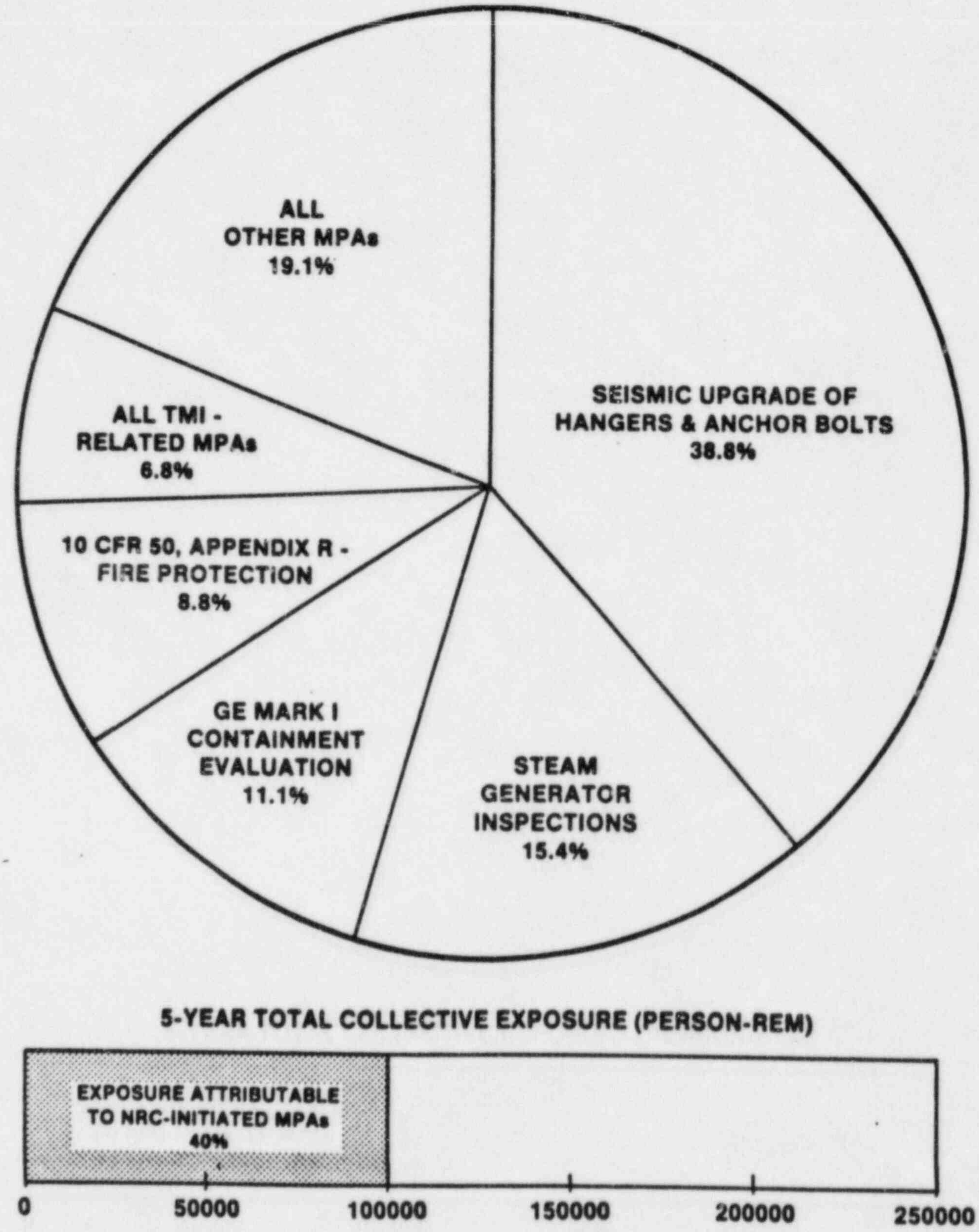
10 PLANT VISITS SCHEDULED

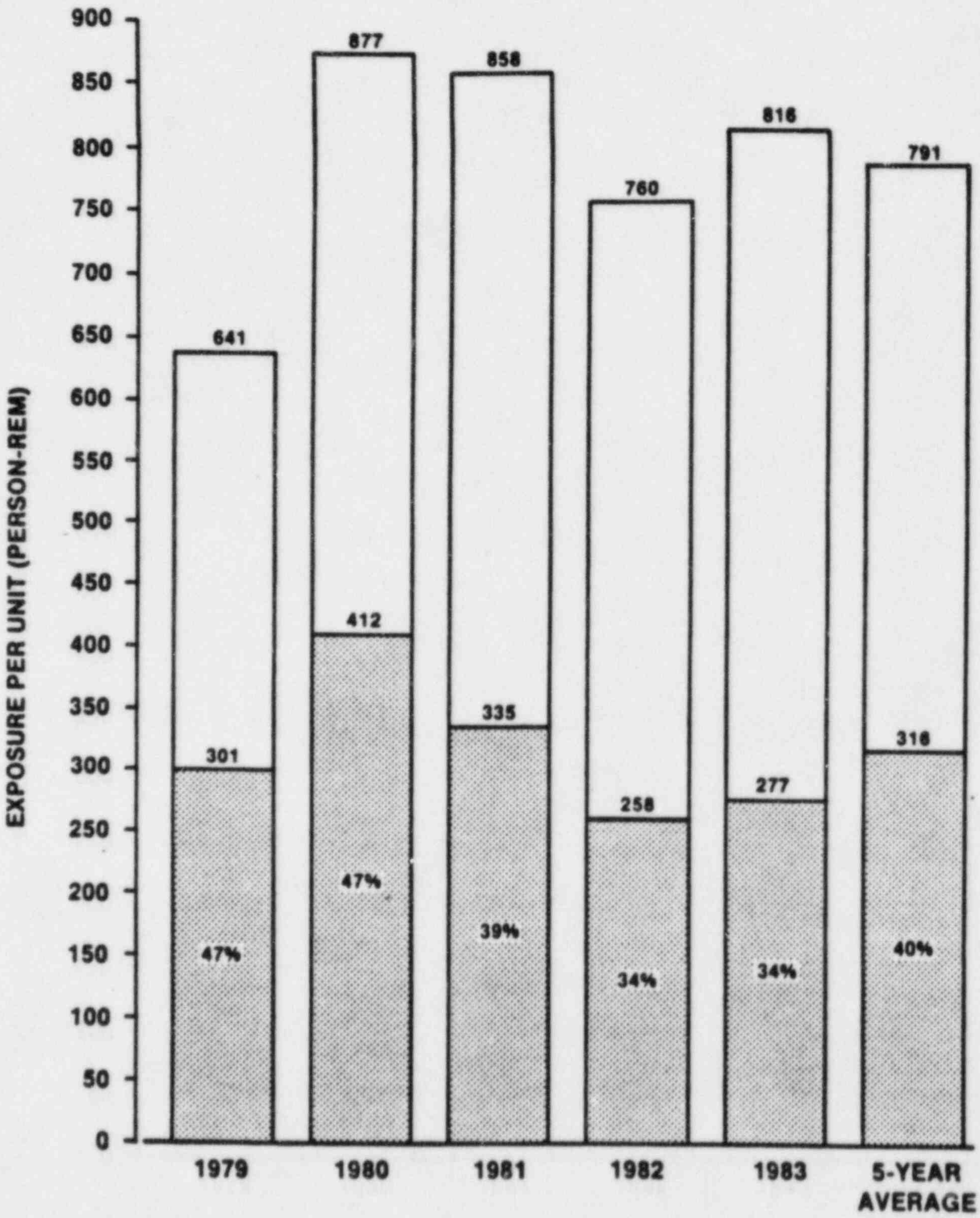
- CE — CALVERT CLIFFS 1 AND 2
- B & W — OCONEE 1, 2 AND 3
- GE (LOWER EXPOSURE) — VT. YANKEE; MONTICELLO
- GE (HIGHER EXPOSURE) — MILLSTONE 1;
BRUNSWICK 1 AND 2
- W (LOWER EXPOSURE) — TROJAN; FARLEY 1 AND 2
- W (HIGHER EXPOSURE) — TURKEY POINT 3 AND 4;
HADDAM NECK

(WITH A BACK-UP PLANT FOR EACH CATEGORY)

PART I RESULTS

- PROVIDES COMPREHENSIVE LISTING OF MOST GENERIC NRC-MANDATED BACKFITS 1979-1983
- DOCUMENTS IMPACT OF BACKFITTING ON INDUSTRY COLLECTIVE DOSE
- SUGGESTS IMPORTANCE OF MAKING DOSE ESTIMATES WHEN CONSIDERING FUTURE BACKFITS
- HAS PLANT-SPECIFIC AND BACKFIT-SPECIFIC APPLICATIONS


ALL
OTHER MPAs
19.1%
SEISMIC UPGRADE OF
HANGERS & ANCHOR BOLTS
38.8%
ALL TMI -
RELATED MPAs
6.8%
10 CFR 50, APPENDIX R -
FIRE PROTECTION
8.8%
GE MARK I
CONTAINMENT
EVALUATION
11.1%
STEAM
GENERATOR
INSPECTIONS
15.4%
5-YEAR TOTAL COLLECTIVE EXPOSURE (PERSON-REM)
EXPOSURE ATTRIBUTABLE
TO NRC-INITIATED MPAs
40%
0
50000
100000
150000
200000
250000



EXPOSURE PER UNIT (PERSON-REM)
900
850
800
750
700
650
600
550
500
450
400
350
300
250
200
150
100
50
0
641
301
47%
877
412
47%
858
335
39%
760
258
34%
816
277
34%
791
316
40%
1979
1980
1981
1982
1983
5-YEAR AVERAGE

REPRESENTATIVE LOW EXPOSURE WESTINGHOUSE PLANT #2

SUMMARY OF OCCUPATIONAL RADIATION EXPOSURES RESULTING FROM NRC-INITIATED MULTI-PLANT ACTIONS DURING THE PERIOD 1 JANUARY 1979 - 31 DECEMBER 1983

MPA/IEB#	Description of Action	Exposure (Person-Rem) 1979	1980	1981	1982	1983	Total	Status*
A-04	10 CFR 50, Appendix J; Containment Integrity						0	NA
A-08	ECCS Evaluation and Upgrade						0	NA
B-02/41	10 CFR 50, Appendix R; Fire Protection	3	0	109	7	1	120	IP
B-04	Reactor Vessel Overpressurization System						0	NA
B-07/12	Steam Generator Flow Instability and Tube Inspections	61	54	136	16	27	294	IP
B-09	Charging System Pump Vibrations	1	1	1	1	1	5	OG
B-17/22	Surveillance of Snubbers	2	<1	9	<1	<1	11	OG
B-20/24	Surveillance and Repair of Containment Purge Valves						0	OG(5)
B-43	PWR Feedwater Line Cracks	<1	<1	<1	7	<1	7	C
B-45	WASH 1400 Event V: PCS Pressure Isolation Valves						0	NA
B-46	Analysis of Turbine Disc Cracks						0	C
B-59	Masonry Wall Design	0	3	<1	0	0	3	OG
B-60	Environmental Qualification of Electrical Equipment	0	0	0	0	<1	0	OG
F-09	Safety Parameter Display System						0	C
F-10	Reactor Coolant System High Point Vents	<1	5	<1	7	0	12	C
F-11	Plant Shielding	0	<1	0	<1	0	0	C
F-12	Post-Accident Sampling System	0	0	0	<1	<1	0	C
F-14	Relief and Safety Valve Testing	<1	<1	<1	2	<1	2	OG
F-15/16	Auxiliary Feedwater System Automatic Initiation & Indication						0	NA
F-18	Dedicated Hydrogen Penetration	0	0	<1	0	0	0	C
F-19	Containment Isolation Dependability						<1	C
F-20	Noble Gas Monitor						<1	C
F-21	Iodine and Particulate Sampling						<1	C
F-22	Containment High Range Monitor	0	1	1	<1	<1	2	C
F-23	Containment Pressure Instrumentation						0	NA

SUMMARY OF THE REPRESENTATIVE PLANT EXPOSURE DATA, CONSOLIDATED INTO TWO PLANT GROUPS

Plant Group/ Year	Total Exposure (person-rem)	Identified Exposure Resulting From NRC-Initiated MPAs (person-rem)	Mixed Exposure (person-rem)	Total Exposure Attributable to NRC-Initiated MPAs (person-rem)	% of Exposure Attributable to NRC-Initiated MPAs
REPRESENTATIVE PWR PLANTS					
1979	4696	1847	756	2201	47
1980	5908	2036	1136	2521	43
1981	7439	2059	1512	2584	35
1982	6866	1406	1399	1766	26
1983	7907	2657	1374	3216	41
REPRESENTATIVE BWR PLANTS					
1979	2598	1108	276	1240	48
1980	7236	3017	1282	3667	51
1981	5992	2212	1010	2660	44
1982	6077	2195	835	2545	42
1983	5248	1213	685	1395	27

ESTIMATED EXPOSURES ATTRIBUTABLE TO
NRC-INITIATED MULTI-PLANT ACTIONS AT PWRs and BWRs

Reactor Type/ Year	(1) Total Exposure (person-rem)	(2) % of Total Exposure Attributable to NRC-Initiated MPAs	Exposure Attributable to NRC-Initiated MPAs (person-rem)
PRESSURIZED WATER REACTORS			
1979	20,137	47	9,464
1980	23,658	43	10,173
1981	27,993	35	9,798
1982	26,275	26	6,832
1983	27,789	41	11,393
5-Year Total	125,852	38	47,660
BOILING WATER REACTORS			
1979	17,651	48	8,472
1980	28,936	51	14,757
1981	25,179	44	11,079
1982	23,885	42	10,032
1983	26,862	27	7,253
5-Year Total	122,513	42	51,593

1. The total exposure is the total dose of record (reported in BR84) for the units that had a full year of commercial operation during the period, not including the nine atypical units excluded from the study.

2. The annual percentages shown for PWRs and BWRs were derived from our sample of 10 representative plants (See Table 1).

ESTIMATED EXPOSURES ATTRIBUTABLE TO NRC-INITIATED MULTI-PLANT ACTIONS AT LWRs

Year	(1) Total Exposure (person-rem)	(2) Exposure Attributable to NRC-Initiated MPAs (person-rem)	(3) % of Total Exposure Attributable to NRC-Initiated MPAs
ALL LWRs			
1979	37,788	17,936	47
1980	52,594	24,930	47
1981	53,172	20,877	39
1982	50,160	16,864	34
1983	54,651	18,646	34
5-Year Total	248,365	99,253	40

1. The total exposure is the total dose of record (reported in BR84) for the units that had a full year of commercial operation during the period, not including the nine atypical units excluded from the study.

2. The exposure attributable to NRC-initiated MPAs is the sum of the exposures calculated separately for PWRs and BWRs (see Table 2).

3. The percentages shown are calculated by dividing the exposure attributable to NRC-initiated MPAs (Column 2) by the total exposure (Column 1).

PART II OBJECTIVES

- GUIDANCE FOR PLANT ALARA PROGRAMS
- PLANT HEALTH PHYSICS PLANNING
- ALARA COORDINATION AND PLANNING
- INFORMATION FOR MANAGEMENT DECISION MAKING
- INCORPORATION OF DOSE ESTIMATES INTO DESIGN PROCESS

PART II — SCOPE OF WORK

- USE DATA COLLECTED DURING PART I (PREDICTED *VS.* ACTUAL DOSE)
- COMPARE DOSE PROJECTIONS TO ACTUAL DOSES:
  - UTILITY
  - NRC
- DETERMINE REASONS FOR VARIATIONS
- PROVIDE WORKABLE METHOD FOR MAKING ACCURATE DOSE ESTIMATES
- FOCUS MANAGEMENT'S ATTENTION ON ALARA CONSIDERATIONS AT EARLIEST STAGES OF DESIGN PROCESS FOR PLANT MODIFICATIONS

SIGNIFICANT FINDINGS APPLICABLE TO PART II

- VERY LITTLE QUANTITATIVE DOSE ESTIMATION IS DONE DURING THE DESIGN PROCESS.

- TYPICALLY, ALARA DESIGN REVIEW CHECKLISTS ARE USED TO FACTOR ALARA CONSIDERATIONS INTO THE DESIGN PROCESS.

- WHEN HISTORICAL DATA ARE AVAILABLE, THEY ARE GENERALLY USED AS THE BASIS FOR THE COLLECTIVE DOSE ESTIMATE.

- HISTORICAL DATA FILES DO NOT ALWAYS CONTAIN DETAILS OF THE WORK SCOPE OF PLANT CONDITIONS AT THE TIME OF THE ESTIMATE.

- COMPUTERIZED HISTORICAL DATA FILES ARE NOT ALWAYS SUFFICIENTLY ANNOTATED.

- MOST DOSE ESTIMATION IS DONE FOR NEAR-TERM EXPOSURES; I.E., THE INSTALLATION PHASE. EXPOSURES INCURRED DURING OPERATION AND MAINTENANCE ARE FREQUENTLY IGNORED.

- THE SOURCE OF MOST OF THE DISCREPANCIES BETWEEN PREDICTED AND ACTUAL EXPOSURES IS THE MAN-HOUR ESTIMATE.

- THE MOST RELIABLE SOURCES FOR MAN-HOUR ESTIMATES ARE THE CRAFT SUPERVISORS AND FOREMEN.

- THE AGGRESSIVENESS OF THE ESTIMATOR IN PURSUING MAN-HOUR ESTIMATES IS IMPORTANT.

SIGNIFICANT FINDINGS APPLICABLE TO PART II (CONT.)

- THE SOURCE OF MOST OF THE DISCREPANCIES BETWEEN PREDICTED AND ACTUAL DOSE RATES IS A POOR ESTIMATE OF THE EFFECTS OF MEASURES TAKEN TO REDUCE EXPOSURES.

- UNANTICIPATED CHANGES IN CONDITIONS AFFECTING THE DOSE RATE IS ALSO AN IMPORTANT SOURCE OF DISCREPANCY. THE USE OF RECENT SURVEYS IS IMPORTANT.

- ESTIMATORS MAY TEND TO BE OVERLY CONSERVATIVE (OVER-PREDICT THE EXPOSURE).

- IMPEDIMENTS TO THE INCORPORATION OF QUANTITATIVE DOSE ESTIMATES IN THE DESIGN PROCESS:
  - ATTITUDES (I.E., INTRUSION INTO THE DESIGN PROCESS, CREATING ADDITIONAL PAPERWORK, ETC.)
  - LACK OF EXPERIENCE IN EXPOSURE ASSESSMENT
  - LOCATION OF THE DESIGN GROUP
  - LIMITED EXPERIENCE WITH OPERATING PLANTS
  - INADEQUATE INFORMATION
  - LACK OF PERSONNEL AND SUPPORTING RESOURCES

SUMMARY OF CAUSES OF DISCREPANCIES BETWEEN PREDICTED AND ACTUAL EXPOSURES

PRINCIPAL CAUSE	NUMBER OF CASES	% OF TOTAL
MAN-HOUR PROBLEMS	110	67
• WORK SCOPE NOT KNOWN	32	19
• CHANGES IN WORK SCOPE	29	18
• UNANTICIPATED PROBLEMS ENCOUNTERED IN PERFORMANCE OF WORK	18	11
• OVERLY CONSERVATIVE IN PREPARING ESTIMATE	11	7
• POOR ESTIMATE OF WORK EFFICIENCY	9	5
• NO PREVIOUS EXPERIENCE UPON WHICH TO BASE ESTIMATES	6	4
• OTHER	5	3
DOSE RATE PROBLEMS	45	27
• EFFECTS OF EXPOSURE REDUCTION MEASURES POORLY ESTIMATED	29	18
• UNANTICIPATED CHANGE IN CONDITIONS AFFECTING DOSE RATE	9	5
• OVERLY CONSERVATIVE IN DOSE RATE ESTIMATE	7	4
OTHER CAUSES	10	6
• ERROR IN ASSIGNMENT OF DOSE	5	3
• COUNTERBALANCING ERRORS IN MAN-HOUR AND DOSE RATE ESTIMATE	5	3

COMPONENTS OF METHOD FOR ESTIMATING COLLECTIVE OCCUPATIONAL EXPOSURE

- Considerations in estimating exposure
- Logic diagram
- Worksheets

SAMPLE CONSIDERATIONS

1. WILL MAN-HOURS BE BASED ON HISTORICAL DATA OR WILL A NEW ESTIMATE BE REQUIRED?

2. IS THE SCOPE OF WORK FOR THE CURRENT TASK IDENTICAL OR SIMILAR TO THE SCOPE OF WORK FOR THE HISTORICAL TASK?

3. IS THERE A "LEARNING CURVE" EFFECT SUCH THAT REPETITIVE OPERATIONS WOULD RESULT IN DECREASING EXPOSURE HOURS? IN A SIMILAR VEIN, IS THE CURRENT WORK FORCE MORE OR LESS EXPERIENCED THAN THE WORK FORCE THAT PERFORMED THE HISTORICAL TASK?

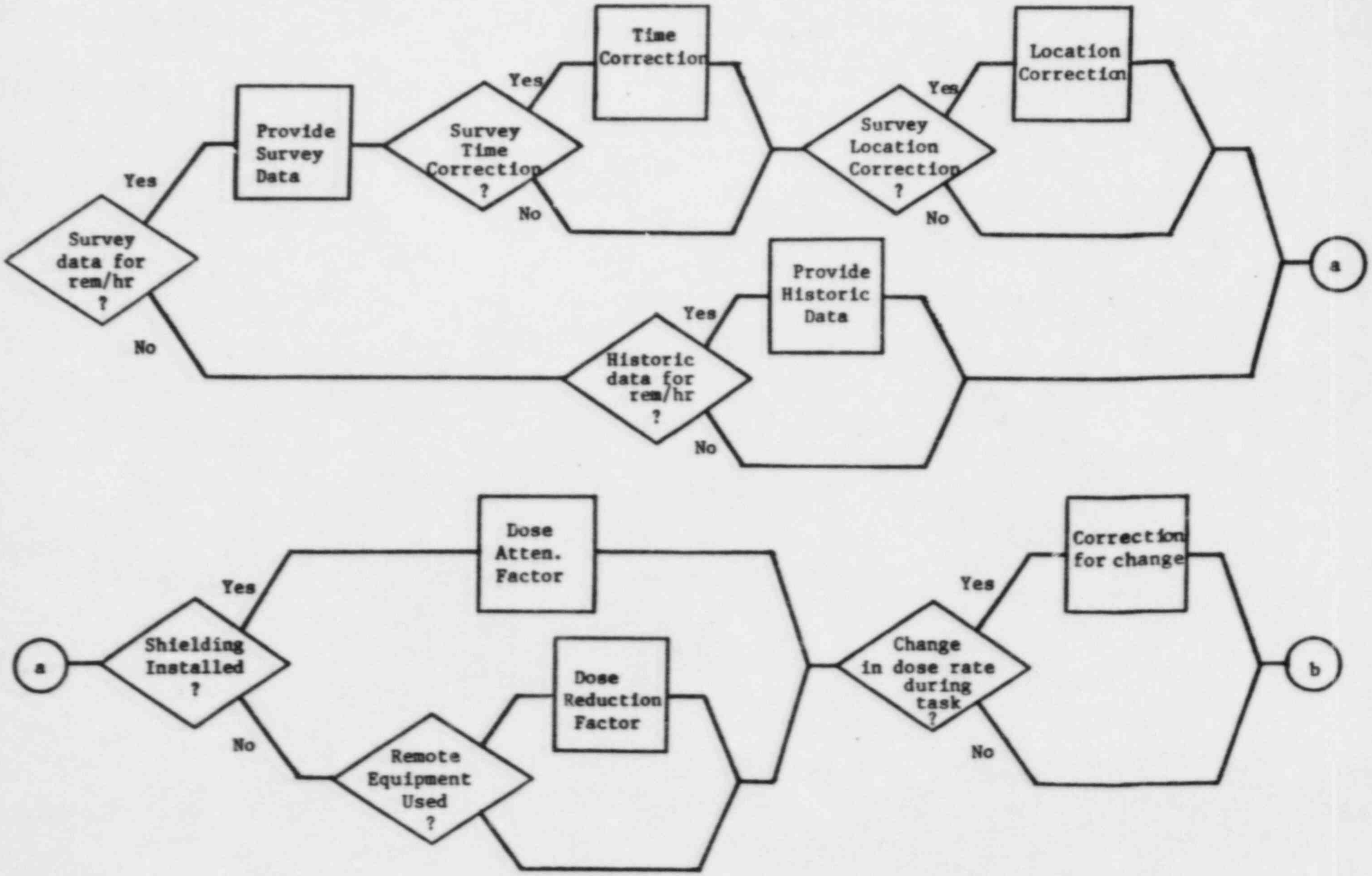
4. ARE THERE JOB IMPEDIMENTS PRESENT IN THE CURRENT TASK THAT WERE NOT PRESENT IN THE HISTORICAL TASK? WHAT ARE THE POSSIBLE CONTINGENCIES THAT SHOULD BE INCLUDED IN THE ESTIMATE?

5. IS THE HISTORICAL MAN-HOUR ESTIMATE FOR TOTAL RWP SIGN-IN TIME OR IS IT FOR ACTUAL EXPOSURE HOURS?

6. DO THE HISTORICAL HOURS INCLUDE EXPOSURE TIME FOR SUPPORT TASKS; E.G., FIRE WATCH, HP COVERAGE, INSPECTIONS, WALKDOWNS, TESTING, ETC.?

7. ARE MEASURES BEING IMPLEMENTED THAT WILL LIKELY RESULT IN REDUCED EXPOSURE TIMES; E.G., MOCK-UP TRAINING, IMPROVED JOB ENGINEERING, ETC.?

8. ARE THERE OTHER SOURCES OF USEFUL MAN-HOUR DATA OTHER THAN THE HISTORICAL ESTIMATE; E.G., TIME STUDIES ON MOCK-UPS, EXPERIENCED PERSONNEL, ETC.?



Survey data for rem/hr ?
Yes
No
Provide Survey Data
Survey Time Correction ?
Yes
No
Time Correction
Survey Location Correction ?
Yes
No
Location Correction
Historic data for rem/hr ?
Yes
No
Provide Historic Data
a
a
Shielding Installed ?
Yes
No
Dose Atten. Factor
Remote Equipment Used ?
Dose Reduction Factor
Change in dose rate during task ?
Yes
No
Correction for change
b

ACTIVITY	ACTIVITY DESCRIPTION	TIME REQUIRED (MIN)	RADIATION FIELD (R/HR)	NO. OF MEN	AVERAGE DOSE RATE IN EACH ZONE (MR/HR) 1000	500	250	100	50	25	10	5	TOTAL EXPOSURE (MAN-REM)
					TOTAL MAN-MIN BY RADIATION ZONE I	II	III	IV	V	VI	VII	VIII	
	JOB PREPARATION												
1	Move equip into cont & checkout	480	0.005 – 1	4				240		240		1440	0.611
	JOB EXECUTION												
2	Remove missile shield	240	0.005	4								960	0.80
3	Remove seismic supports	120	0.025	4						480			0.20
4	Remove elect connect	420	0.025	4						1660			0.70
5	Release blade conoseals	240	0.01-0.5	3		90					630		0.44
6	Remove and store head insul	240	0.1	5				1200					2.00
7	Relax studs	300	0.05	6					1800				1.50
8	Remove and store studs	420	0.05	3					1200				1.00
9	Remove and store RV head	340	0.005-1.0	3	20		180		120			700	1.20
10	Shuffle fuel	7200	0.005	8								57,600	4.80
11	Install RV head O ring	60	0.5	4		240							2.0
12	Clean vessel flange	120	0.5	5		700							5.83
13	Decon cavity	1440	0.025	4						5760			2.40
14	Intall RV head	420	0.005-0.5	2	10			360	10			460	0.81
15	Install and tension studs	1320	0.05	6					7920				6.60
16	install CRD conoseals	120	0.05-0.5	4		240			240				2.20
17	Connect CRD mech	420	0.025	4						1680			0.70
18	Restore electrical conn	240	0.05-0.5	5		120			1080				1.90
19	Restore mech and supports	500	0.005-0.05	4					800	240		960	0.86
20	Repl RV head insul	240		5				1200					2.00
										TOTAL			38.52

OUTLINE OF PART II FINAL REPORT

EXECUTIVE SUMMARY

CHAPTER 1; INTRODUCTION AND CONCLUSIONS

CHAPTER 2; EXISTING ALARA PRACTICES AND METHODS FOR ESTIMATING COLLECTIVE EXPOSURE, INCLUDING FACTORS WHICH CONTRIBUTE TO INACCURACIES IN MAKING THESE ESTIMATES

CHAPTER 3; PROPOSED METHOD

CHAPTER 4; INCORPORATION OF METHOD INTO THE DESIGN PROCESS

APPENDIX; DESCRIPTION OF THE AUTOMATED VERSION (OPTION)

STATUS

- PART I — GOES TO PRESS IN FEBRUARY
- PART II — FIRST DRAFT TO TASK FORCE IN MARCH;
  DRAFT REVIEW MEETING IN APRIL

REPRESENTATIVE LOW EXPOSURE WESTINGHOUSE PLANT #2 (continued)

MPA/IEB#	Description of Action	Exposure (Person-Rem) 1979	1980	1981	1982	1983	Total	Status*
F-24	Containment Water-Level Instrumentation	0	1	7	2	1	11	C
F-25	Containment Hydrogen Monitor	0	0	0	<1	0	0	C
F-26	Instruments to Detect Inadequate Core Cooling	0	0	39	5	<1	44	C
F-36	Automatic PORV Isolation System	0	0	0	0	3	3	C
F-53/32	RCP Seal Damage Due to Loss of AC Power						0	1986
79-02/14	Seismic Upgrade of Hangers and Anchor Bolts	114	40	53	15	46	268	IP
79-11	Faulty W Circuit Breakers in Engineered Safety Systems						0	NA
79-17	Cracking in Stagnant Borated Water Systems	<1	0	0	0	0	0	C
79-28	Malfunction of NAMCO EA180 Limit Switches						0	NA
80-03	Loss of Charcoal from Type II, 2-inch Tray Absorber Cells						0	NA
80-05	Vacuum Conditions Resulting in Damage to CVCS Holdup Tanks						0	?
80-21	Malcolm Foundry Valve Yokes						0	NA
80-23	Failure of Valcor Engineering Corp Solenoid Valves						0	NA
80-24	Prevention of Damage Due to Water Leakage in Containment						0	NA
82-02	Degradation of Threaded Fasteners in RCPB						0	OG
83-06	Non-Conforming Materials Supplied by Tube-Line Corp						0	NA
	Exposure Resulting From NRC-Initiated MPAs	181	105	355	62	79	782	
	Exposure on Mixed and General Entry RWPs	16	30	37	27	31	141	
	Exposure not Related to NRC-Initiated MPAs	37	313	231	263	153	997	
	Total Exposure	234	448	623	352	263	1920	
	% of Exposure Attributable to NRC-Initiated MPAs	83	25	61	19	34	44	

6

ATOMIC INDUSTRIAL FORUM

NATIONAL ENVIRONMENTAL STUDIES PROJECT (NESP)

Study on

"EVALUATION OF THE POTENTIAL FOR DE-REGULATED DISPOSAL OF VERY LOW LEVEL WASTES FROM NUCLEAR POWER PLANTS"

Presented to

NRC ACRS Subcommittees on
Waste Management and Reactor Radiological Effects

January 16, 1986

Joyce Davis

General Physics Corporation

EVALUATION OF THE POTENTIAL FOR DE-REGULATED DISPOSAL OF VERY LOW LEVEL WASTES FROM NUCLEAR POWER PLANTS

(DRAFT)

PREPARED FOR THE

NATIONAL ENVIRONMENTAL STUDIES PROJECT
OF THE
ATOMIC INDUSTRIAL FORUM, INC.

BY

GENERAL PHYSICS CORPORATION
COLUMBIA, MARYLAND

SUBCONTRACTOR:
EBASCO SERVICES, INC.

OCTOBER 1985

CONCLUSIONS

1. THE MOST IMPORTANT BASIC PARAMETER FOR DETERMINING THE DOSE TO PERSONS OFF-SITE DUE TO DISPOSAL OF WASTES AT A SPECIFIC DISPOSAL SITE IS THE TOTAL ACTIVITY OF EACH ISOTOPE DISPOSED OF. ONCE THESE PRIMARY STANDARDS FOR ACTIVITY ARE DEVELOPED, ACTIVITY CONCENTRATIONS AND VOLUMES FOR SPECIFIC WASTES CAN BE DERIVED. THE ANNUAL ACTIVITIES CAN BE DIRECTLY PRO-RATED TO DETERMINE DOSE.

2. THERE ARE SEVERAL WASTE STREAMS AT NUCLEAR POWER PLANTS THAT HAVE TYPICAL ACTIVITY CONCENTRATIONS SO LOW THAT THEY COULD BE RELEASED FOR CONVENTIONAL DISPOSAL WITHOUT UNDUE RISK TO THE PUBLIC. IN MOST CASES THE RESULTING EXPOSURES WOULD BE NEGLIGIBLE, HENCE ALARA.

3. BASED ON THIS STUDY, PWR AND BWR COMPACTED TRASH APPEAR TO BE THE BEST CANDIDATES FOR GENERIC DE-REGULATION.

4. OTHER PWR PROCESS STREAMS MAY BE PROMISING CANDIDATES FOR CASE-BY-CASE DE-REGULATION, DEPENDING ON THEIR FACILITY-SPECIFIC CHARACTERISTICS AND THE POINT OF DE-REGULATION. THESE STREAMS INCLUDE RESINS, FILTERS, AND EVAPORATOR CONCENTRATES.

CONCLUSIONS (CONTINUED)

5. NON-ROUTINE, HIGH VOLUME, LOW ACTIVITY WASTES, SUCH AS CONTAMINATED SOIL AND SAND-BLASTING SAND, ARE EXCELLENT CANDIDATES FOR DE-REGULATION. THESE WASTES ARE GENERATED INFREQUENTLY AND CASE-BY-CASE EXEMPTION MIGHT BE CONSIDERED THE MOST APPROPRIATE APPROACH. HOWEVER, GENERIC CRITERIA FOR EXEMPTING THESE WASTES, SUCH AS LIMITING ACTIVITY LEVELS, SHOULD BE ESTABLISHED SO THAT LICENSEES ENGAGED IN CLEANUP WILL KNOW WHAT ACTIVITY LEVELS ARE "LOW ENOUGH".

6. THE SAVINGS IN COSTS AND LICENSED BURIAL SITE SPACE, COUPLED WITH THE VERY LOW DOSES INVOLVED (WHICH MAY INDEED REPRESENT A NET DOSE DECREASE RATHER THAN AN INCREASE), CLEARLY JUSTIFY PERMITTING CONVENTIONAL DISPOSAL OF VLW.

7. DETECTION CAPABILITIES ARE SUCH THAT FOR ROUTINE EXPECTED WASTE STREAMS GENERATED AT NUCLEAR POWER PLANTS VLW CAN BE IDENTIFIED WITH ASSURANCE THAT NO WASTES WITH ACTIVITIES APPROACHING OR EXCEEDING THE GENERAL REGULATORY LIMITS WILL BE MISTAKENLY CLASSIFIED AS VLW.

CONCLUSIONS (CONTINUED)

8. IF CERTAIN WASTE STREAMS ARE DE-REGULATED, PLANT RADWASTE OPERATING AND MONITORING PROCEDURES MAY NEED ADJUSTMENT TO ENSURE AND DOCUMENT THAT ONLY EXEMPT MATERIALS ARE BEING RELEASED FROM THE LICENSEE'S CONTROL.

STUDY PURPOSE

THE PURPOSE OF THIS STUDY IS TO REVIEW THE CHARACTERISTICS OF LOW LEVEL WASTE STREAMS GENERATED IN NUCLEAR POWER FACILITIES TO DETERMINE WHICH MAY BE SUITABLE FOR DISPOSAL BY METHODS OTHER THAN TRANSFER TO AN NRC-LICENSED FACILITY; AND TO EVALUATE THE BENEFITS, RISKS, AND COSTS OF EXEMPTING SUCH VERY LOW LEVEL WASTES FROM THE DISPOSAL REQUIREMENTS OF 10 CFR PART 61. THIS INFORMATION WOULD BE APPROPRIATE FOR USE IN SUPPORT OF PETITIONS FOR RULEMAKING OR EXEMPTION REQUESTS.

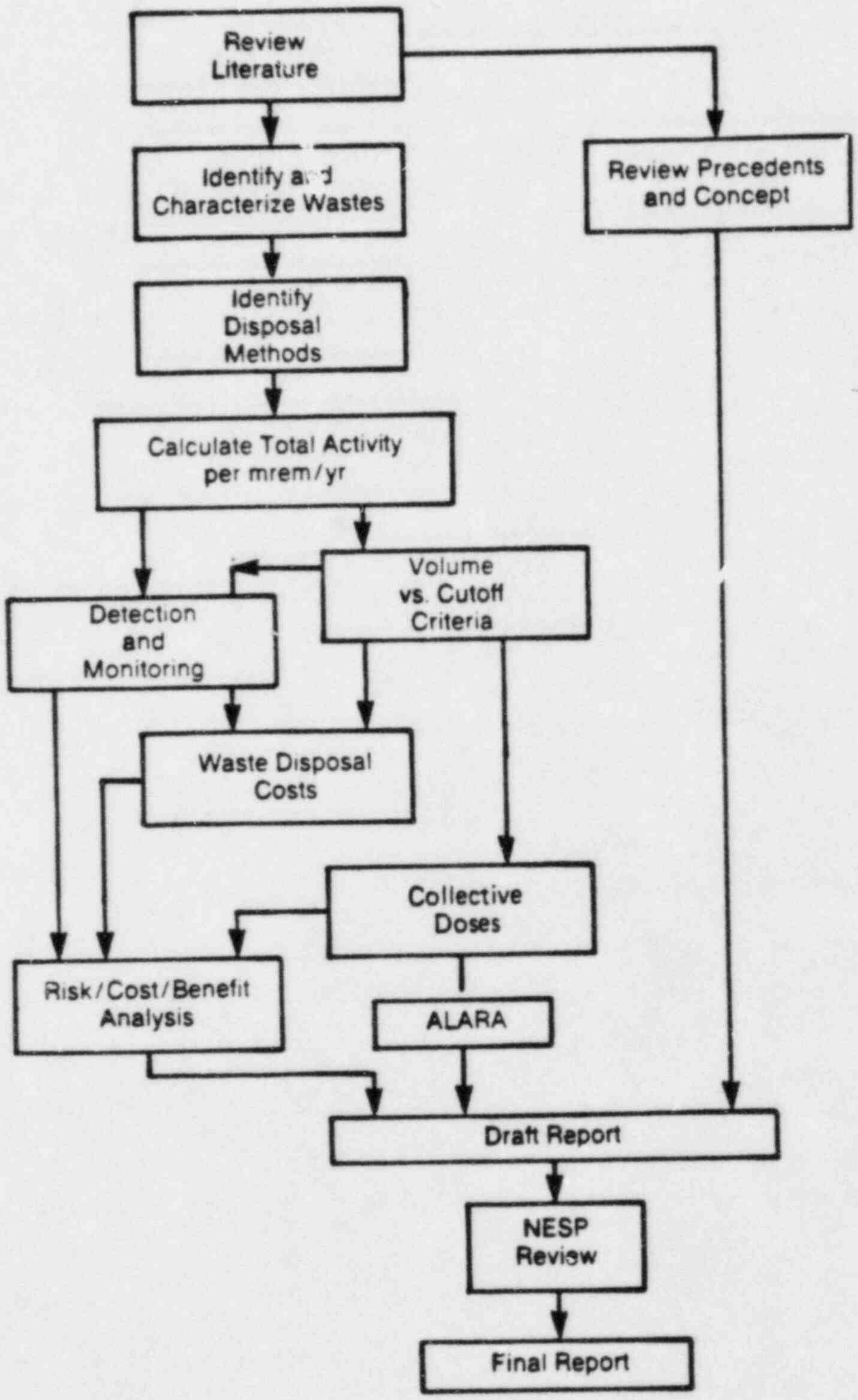


Figure 1-1 General Study Approach

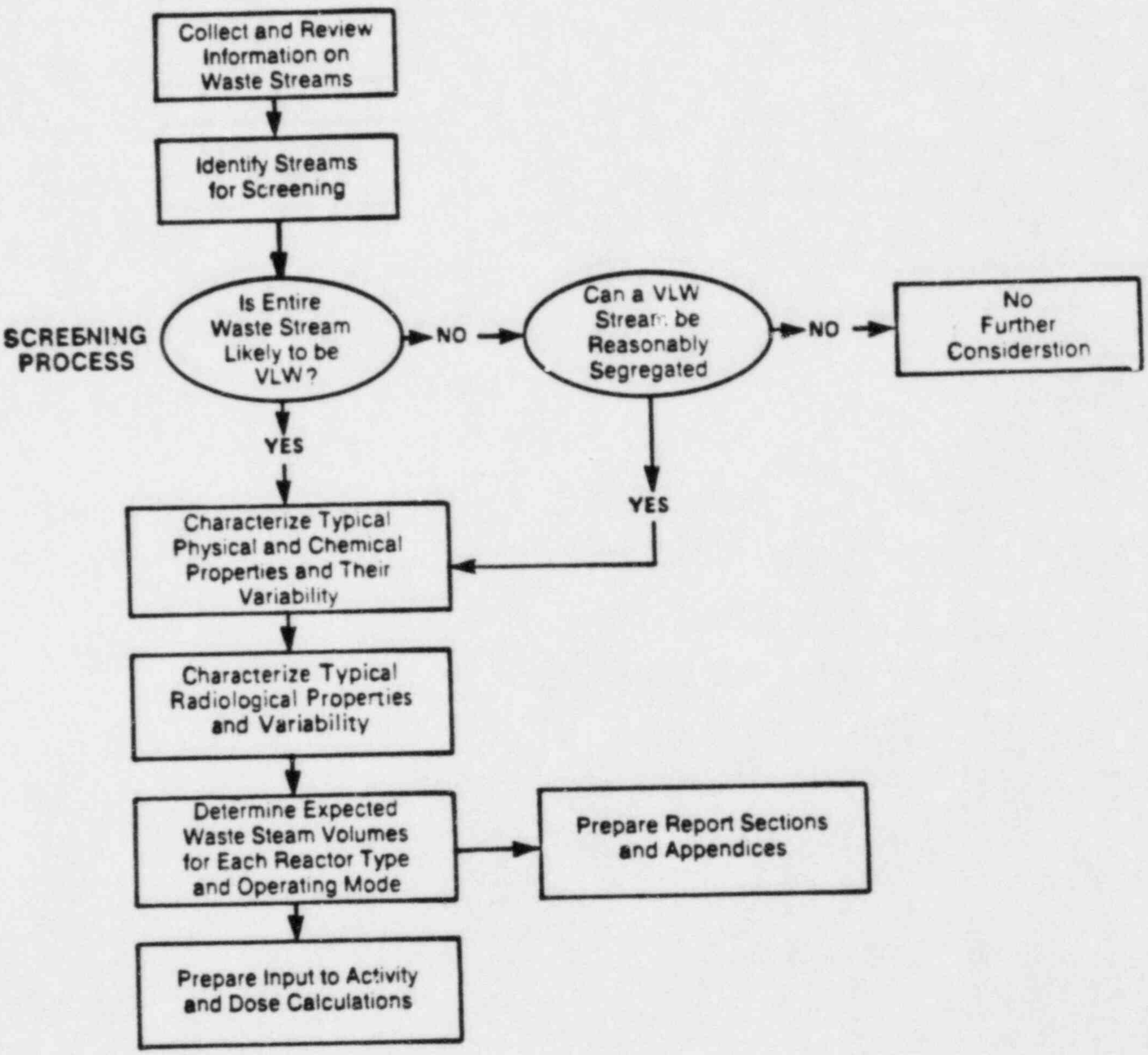


Figure 1-2 Waste Characterization Process

SUMMARY OF CONCLUSIONS

THE MAJOR CONCLUSION OF THIS STUDY IS THAT SEVERAL WASTE STREAMS AT NUCLEAR PLANTS ARE EXCELLENT CANDIDATES FOR DE-REGULATION. IN PARTICULAR, PWR AND BWR COMPACTED TRASH ARE THE BEST CANDIDATES OF THE ROUTINE VLW STREAMS STUDIED. HIGH VOLUME, LOW ACTIVITY, NON-ROUTINE WASTES, SUCH AS SOIL AND SAND, ARE ALSO SUITABLE FOR DE-REGULATION; AND AT THE VERY LEAST, GENERIC GUIDANCE ON EXEMPTION DOSE OR ACTIVITY LEVELS SHOULD BE DEVELOPED FOR SUCH WASTES. OTHER WASTE STREAMS MAY BE SUITABLE FOR CASE-BY-CASE EXEMPTION.

THE STUDY FURTHER CONCLUDES THAT THE COST AND LICENSED BURIAL SPACE SAVINGS COMBINED WITH THE EXTREMELY LOW DOSES INVOLVED CLEARLY JUSTIFY PERMITTING CONVENTIONAL DISPOSAL OF THE VLW STREAMS IDENTIFIED IN THIS REPORT.

SELECTION CRITERIA FOR VLW STREAMS

- THE QUANTITY OF WASTE PRODUCED BY THE STREAM SHOULD BE SIGNIFICANT COMPARED TO THE TOTAL WASTE GENERATION OF THE PLANT.

- THE WASTE STREAM SHOULD BE CLEARLY DEFINABLE AND SHOULD BE CAPABLE OF SEPARATION FROM OTHER WASTE STREAMS.

- THE CONCENTRATION AND ACTIVITY OF THE RADIONUCLIDES SHOULD BE LOW WHEN COMPARED TO 10 CFR 61 CLASS A UPPER LIMITS.

- THE PHYSICAL AND CHEMICAL CHARACTERISTICS OF THE WASTE SHOULD BE COMPATIBLE WITH WASTES DISPOSED OF IN CONVENTIONAL DISPOSAL FACILITIES.

- THE TREATMENT OF CANDIDATE VLW STREAMS SHOULD NOT REQUIRE MAJOR MODIFICATIONS TO THE FACILITY IN ORDER TO QUALIFY THE WASTE AS VLW.

- PLANNED OPERATIONAL CHANGES OR PLANT MODIFICATIONS SHOULD NOT ADVERSELY AFFECT THE CHARACTERISTICS OF THE SELECTED STREAMS.

- IF MAJOR STUDIES RELATING TO DE-REGULATION OF A SPECIFIC WASTE STREAM ARE UNDERWAY, THAT STREAM WILL NOT BE CONSIDERED IN THIS REPORT TO AVOID DUPLICATION OF EFFORT. (E.G., OIL, UNCOMPACTED TRASH)

Ranking of Candidate Waste Streams by Function of Class A Limit

Ranking	Waste Stream	Percent of Class A Limit
1	BWR Trash	0.006
2	PWR Trash	0.33
3	PWR Steam Generator Blowdown Filter	0.5
4	PWR Steam Generator Blowdown Resin	1.3
5	PWR Condensate Resin	2.4
6	PWR Dirty Waste Evaporator Bottoms	3.3
7	BWR Low Purity Waste Resin	7.6
8	BWR Low Purity Waste Filter	7.8
9	PWR CVCS Evaporator Bottoms	21
10	BWR High Purity Waste Resin	37
11	BWR Chemical Waste Evaporator Bottoms	53
12	PWR Dirty Waste Filter	66

Ranking of Waste Streams by Volume*

Ranking	Waste Stream	Percent of Total Volume** (approximate)
1	PWR Compactible Trash (P-COTRASH)	13
2	BWR Compactible Trash (B-COTRASH)	7
3	BWR Concentrated Liquid (P-CONCLIQ)	7
4	PWR Non-Compactible Trash (P-NCTRASH)	6
5	BWR Filter Sludge (B-FSLUDGE)	5
6	BWR Concentrated Liquid (B-CONCLIQ)	5
7	BWR Non-Compactible Trash (B-NCTRASH)	3
8	BWR Ion-Exchanger Resin (B-IXRESIN)	2
9	PWR Ion-Exchanger Resin (P-IXRESIN)	1
10	PWR Filter Cartridge (P-FCARTRG)	0.6
11	PWR Filter Sludge (P-FSLUDGE)	0.2

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* From NUREG-0782, Reference 9. The abbreviations used to identify each stream are NRC nomenclature.

** For all wastes generated by nuclear power plants

Preliminary Ranking of VLW Stream Candidates

Ranking	Waste Stream
1	BWR Compactible Trash
2	PWR Compactible Trash
3	PWR Resins
	- Steam Generator Blowdown
	- Condensate
4	PWR Concentrated Liquid
	- PWR Dirty Waste Evaporator Bottoms
	- PWR CVCS Evaporator Bottoms
5	PWR Filter Cartridge/Sludge
	- PWR Steam Generator Blowdown Filter
6	Contaminated Soil
7	Sandblasting Sand

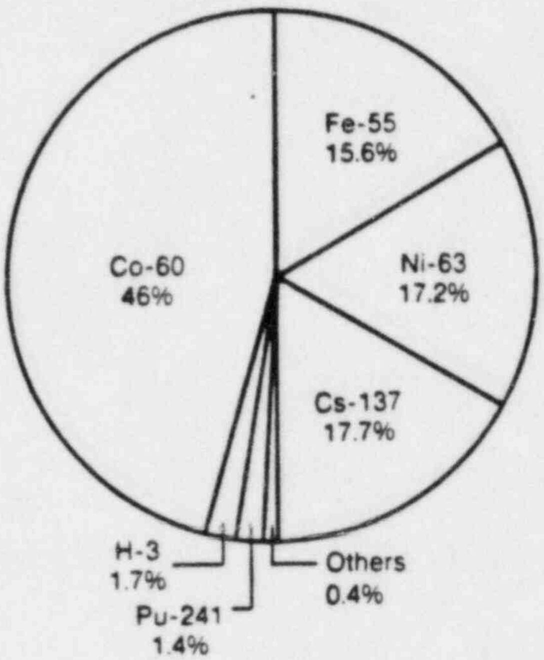


Figure 3-1 Isotopic Distribution for PWR Compacted Trash

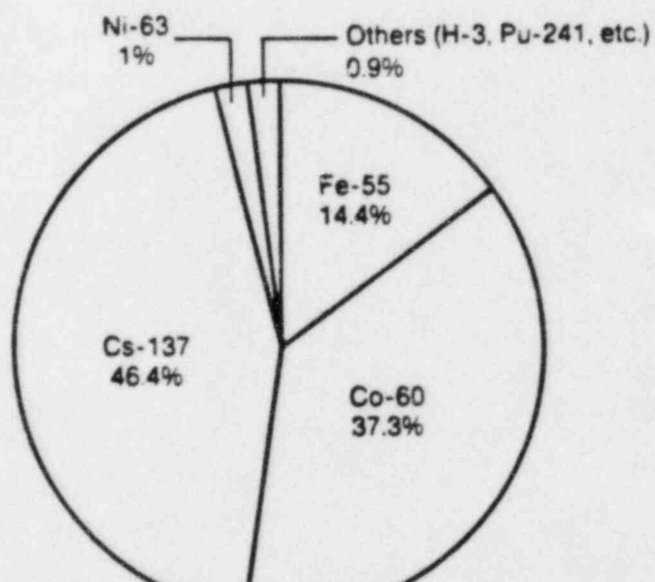


Figure 3-2 Isotopic Distribution for BWR Compacted Trash, Contaminated Soil, and Sand Blasting Sand

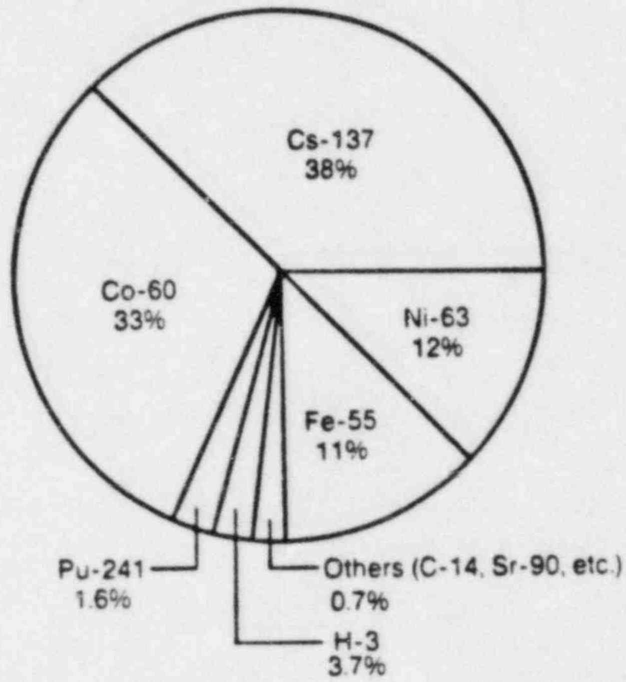


Figure 3-3 Isotopic Distribution for PWR Evaporator Concentrates

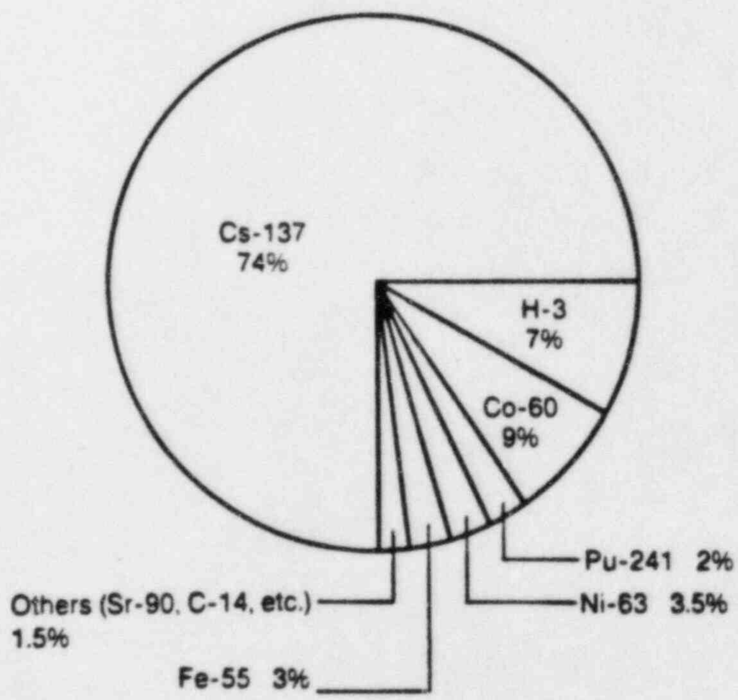
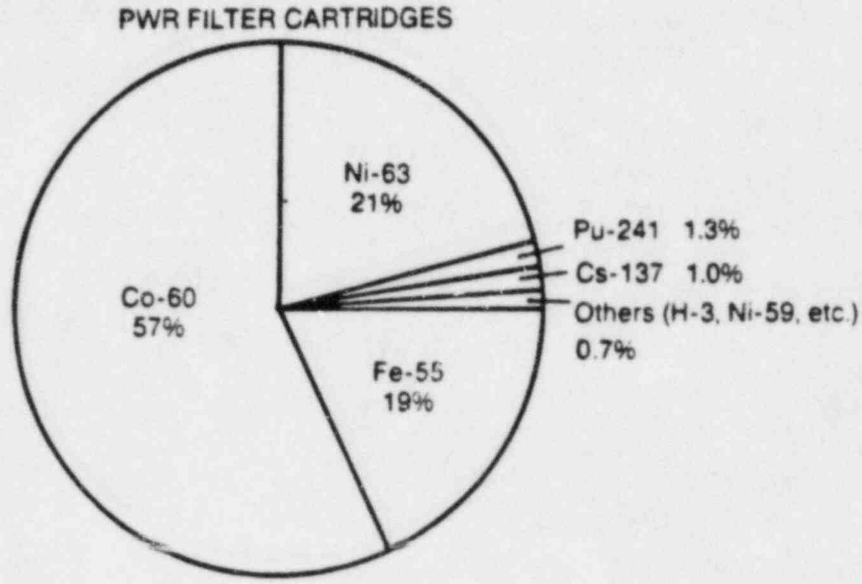


Figure 3-4 Isotopic Distribution for PWR Resins



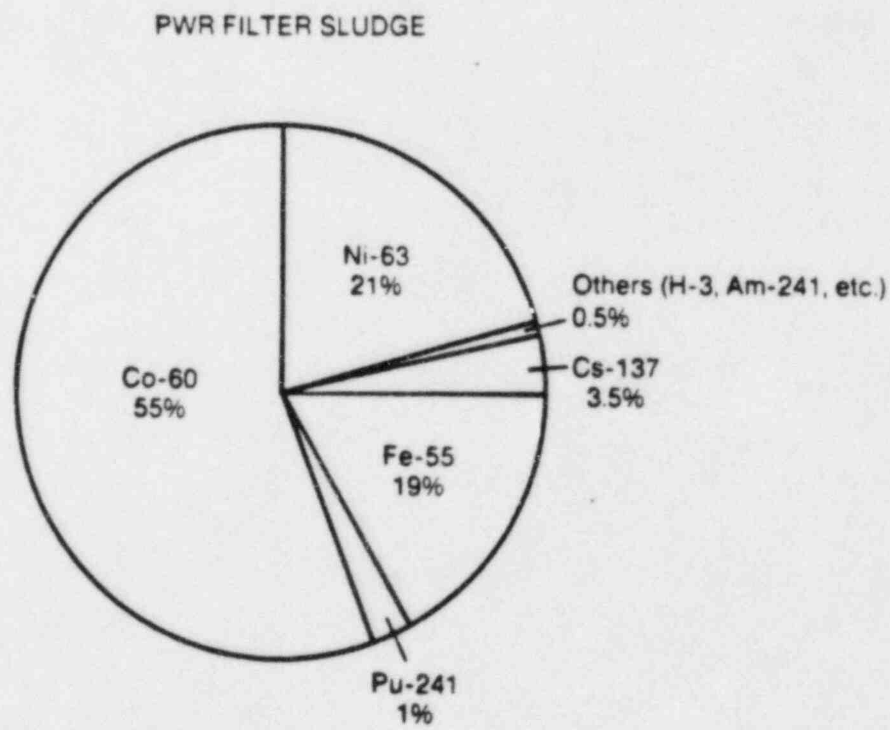


Figure 3-5 Isotopic Distribution for PWR Filters

Waste Stream Volumes, Masses, and Densities

Waste Stream	Volume/yr (m^3)*	Density (MT/m^3)*	Mass (MT/yr)*
PWR Resins			
All resins	35	0.9	32
LRW resins	24	0.9	32
PWR Evaporator Concentrates	68	1.0	68
PWR Cartridge Filters	7.1	0.6	4.3
PWR Compact Trash	140	0.8	108.8
BWR Compact Trash	440	0.8	348
Soil**	320	1.1	358
BWR Sand**	150	1.6	238

*All data is given on a per plant basis unless otherwise indicated. (Ref. 7)

**Volumes and masses are per event

Selected Waste Streams and Disposal Methods

Waste Stream	Disposal Methods
• PWR Resins (two sub-streams)	Sanitary Landfill
• PWR Evaporator Concentrates	Sanitary Landfill
• PWR Cartridge Filters	Sanitary Landfill
• PWR Compacted Trash	Sanitary Landfill Open Dump Municipal Incineration
• BWR Compacted Trash	Sanitary Landfill
• Soil	Sanitary Landfill On-site Burial
• BWR Sandblasting Sand	Sanitary Landfill

SUMMARY OF ENVIRONMENTAL CHARACTERISTICS

REGION INDEX	SITE LOCATION	PRECIPITATION	CHARACTERISTICS
1	NORTHEAST	HUMID	NON-PERMEABLE
2	SOUTHEAST	HUMID	MODERATE PERMEABILITY
3	SOUTHWEST	SEMI-ARID	HIGH PERMEABILITY

Table 5-1
Symbols for Exposure Scenarios

IMPACT SCENARIO	UNITS	MEANING
Transporation:		
TR-MAX	a	maximum impacts to transport worker
TR-OCC	b	total impacts to transport workers
TR-POP	b	impacts to population along transport route
Intruder:		
INT-CO	a	intruder-construction scenario impacts
INT-AG	a	intruder-agriculture scenario impacts
Exposed waste:		
IN-AIR	b	intruder-initiated airborne scenario impacts
ER-AIR	b	erosion-initiated airborne scenario impacts
IN-WAT	a	intruder-initiated waterborne scenario impacts
ER-WAT	a	erosion-initiated waterborne scenario impacts
Incineration and operational		
IC-POP	b	population impacts from incineration
IC-IND	a	off-site individual impacts from incineration
IC-WOR	b	total worker impacts at incinerator
IC-MWR	a	maximum worker impacts at incinerator
OP-POP	b	population impacts from disposal operations
OP-IND	a	off-site individual impacts from disposal operations
OP-WOR	b	total worker impacts at disposal facility
OP-MWR	a	maximum worker impacts at disposal facility
Leachate accumulation:		
LA-OPS	a	operational leachate discharge impacts to individual
LA-OVF	a	leachate overflow impacts to individual
LA-AIR	b	population airborne impacts due to evaporator operations
Ground Water		
INT-WL	a	Intruder Well
POP-WL	a	Population Well
POP-SW	a	Surface Water

a: mrem/yr
b: person - mrem/yr
* From Reference 5

Table 5-2
Concentration of Radionuclides in PWR Resins Buried at a Sanitary Landfill S.E. That Will Deliver 1 mrem/yr Via Each Of Several Exposure Pathways

PWR (ALL) RESINS (35 M***3/YR) AT A SANITARY LANDFILL, SE. (NOTE: THESE CONCENTRATIONS WILL DELIVER 1 MREM PER YEAR.)

Summary of Maximum Radionuclide Concentrations (Ci/M**3) for INVERSE

Impacts Scenarios	H-3	C-14	FE-55	CO-60	NI-59	NI-63	SR-90	NB-94	TC-99	I-129
Transport worker	****	****	****	8.17E-05	****	****	6.59E+03	1.33E-04	9.11E+04	7.86E-02
Disposal facility operations										
Off-site individual	6.01E+04	8.47E+02	2.23E+04	4.90L+02	7.46E+04	2.21E+04	8.94E+01	2.35E+02	1.91E+03	6.23E-01
Facility worker	6.18E+05	1.62E+06	3.28E+03	3.66E-04	1.85E+04	7.21E+03	9.67E+00	5.97E-04	1.57E+03	3.45E-01
Leachate treatment	8.37E+00	8.29E+00	8.64E+02	1.99E+01	4.20E+02	1.33E+02	8.84E+00	2.63E-01	1.61E+00	6.08E-03
Intruder										
Construction scenario	8.69E+04	1.30E+05	3.78E+03	4.48E-03	1.48E+03	6.22E+02	9.90E-01	1.95E-03	1.26E+02	6.14E-01
Agriculture scenario	3.94E-02	6.08E-02	2.86E+03	1.60E-03	7.97E+01	2.53E+01	4.67E-01	6.98E-04	1.13E-02	2.70E-03
Exposed waste										
Erosion initiated	****	1.09E+00	****	****	1.27E+02	6.91E+04	****	6.14E-02	3.76E+00	1.42E-02
Intruder initiated	2.52E+04	1.15E+02	9.47E+04	1.00E+03	1.50E+04	4.77E+03	2.15E+02	7.07E+00	4.47E+02	1.69E+00
Groundwater										
Intruder well	4.03E+01	2.13E+00	****	****	4.45E+02	****	1.19E+05	****	1.32E-01	5.02E-04
Population well	****	4.41E+01	****	****	****	****	****	****	1.49E+00	5.65E-03
Surface water	****	7.07E+02	****	****	****	****	****	****	3.27E+01	1.22E-01
Leachate overflow	9.52E-02	5.37E-02	8.07E+01	4.83E-01	2.72E+00	9.26E-01	7.32E-02	1.71E-03	1.04E-02	3.94E-05
Metal package recycle	****	****	****	****	****	****	****	****	****	****
Limiting Concentration	3.94E-02	5.37E-02	8.07E+01	8.17E-05	2.72E+00	9.26E-01	7.32E-02	1.33E-04	1.04E-02	3.94E-05

**** Effectively no limit (exceeds 1.00E+06 Ci/M**3).

Table 5-15
Annual Activity of Radionuclides Disposed of in PWR Compacted Trash That Will Deliver 1 mrem/yr to The Maximially Exposed Individual

(Curies)

	Southeast Sanitary Landfill	Northeast Sanitary Landfill	Southwest Sanitary Landfill	Southeast Open Dump
H-3	1.39 E+00	1.39 E+00	1.39 E+00	9.35 E-01
C-14	1.88 E+00	2.13 E+00	2.11 E+00	1.71 E-02
Fe-55	2.83 E+03	6.87 E+03	1.01 E+00	1.78 E+01
Co-60	2.86 E-03	2.86 E-03	2.86 E-03	2.86 E-03
Ni-59	9.51 E+01	2.31 E+02	2.36 E+03	4.76 E+01
Ni-63	3.24 E+01	7.88 E+01	7.52 E+02	1.62 E+01
Sr-90	2.56 E+00	6.23 E+00	2.64 E+00	7.14 E-02
Nb-94	4.66 E-03	4.66 E-03	4.66 E-03	4.66 E-03
Tc-99	3.65 E-01	3.94 E-01	3.93 E-01	1.82 E-01
I-129	1.37 E-03	3.34 E-03	5.49 E-02	2.84 E-04
Cs-135	8.78 E+01	8.78 E+01	8.78 E+01	3.34 E+00
Cs-137	1.31 E-02	1.31 E-02	1.31 E-02	1.31 E-02
U-235	5.94 E-02	5.94 E-02	3.47 E-02	1.25 E-03
U-238	4.48 E-01	4.47 E-01	3.63 E-02	1.26 E-03
Np-237	3.49 E-02	3.83 E-02	4.11 E-03	1.21 E-04
Pu-238	7.63 E-02	8.73 E-02	5.81 E-03	1.85 E-04
Pu-239	5.53 E-02	6.33 E-02	4.22 E-03	2.31 E-04
Pu-241	2.22 E+00	2.36 E+00	1.84 E-01	7.11 E-03
Pu-242	5.49 E-02	6.28 E-02	4.17 E-03	1.44 E-04
Am-241	3.21 E-03	7.08 E-03	4.56 E-03	1.30 E-04
Am-243	2.94 E-03	7.15 E-03	4.17 E-03	1.22 E-04
Cm-243	7.98 E-02	7.98 E-02	1.00 E-02	2.36 E-04
Cm-244	1.66 E-01	1.99 E-01	1.60 E-02	3.13 E-04

Table 5-20
Impact of Disposal at a SE Sanitary Landfill of PWR Trash With the Activity of Each Radionuclide Just Below the LLD

TRANSPORTATION IMPACTS

TR-MAX = 6.72E-03 MREM/YR
TR-OCC = 1.34E-02 PERSON-MREM/YR
TP-POP = 1.76E-02 PERSON-MREM/YR

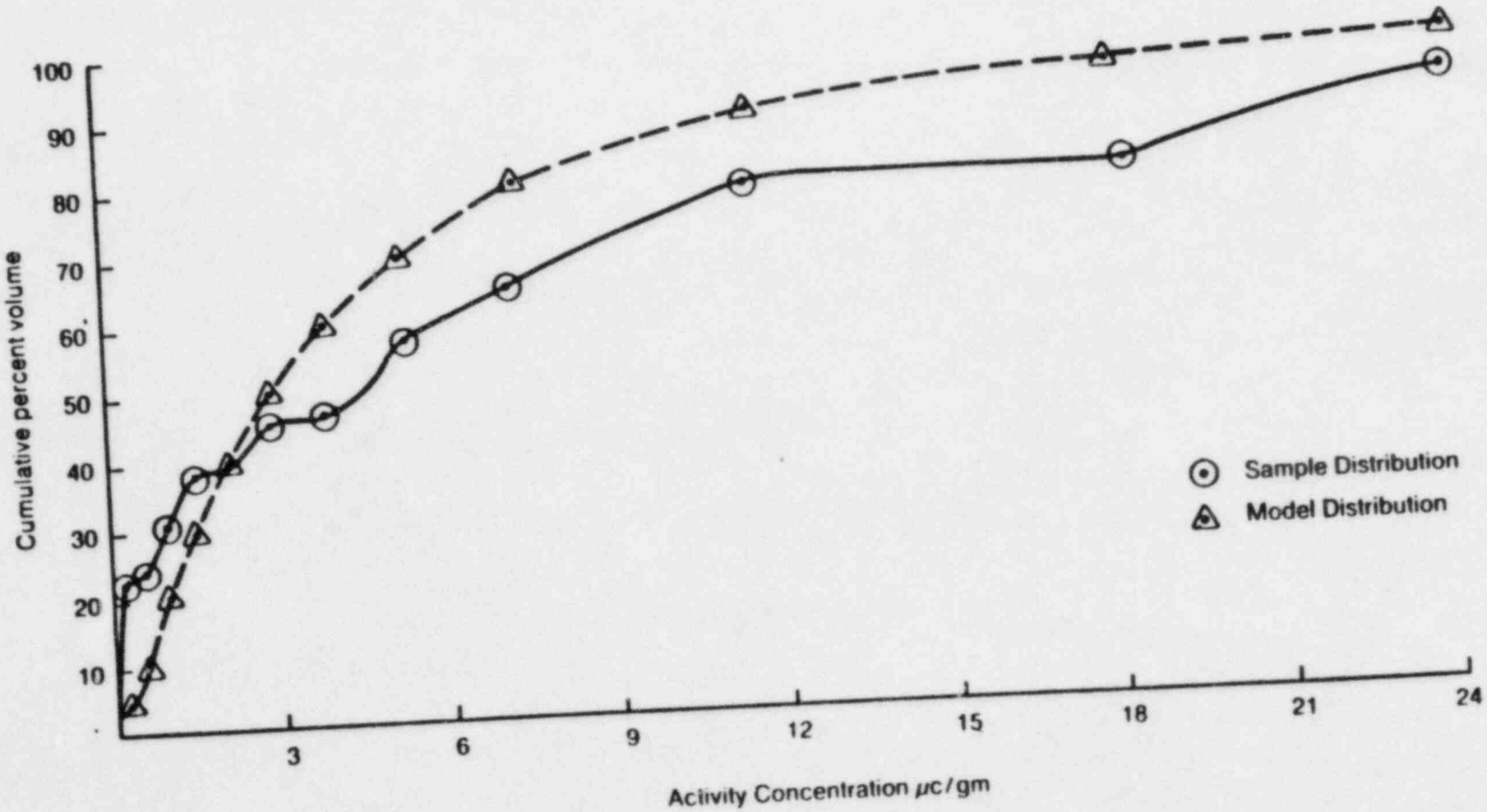
INTRUDER IMPACTS:

SCN	LUNGS	S.WALL	LLI WALL	T. BODY	KIDNEYS	LIVER	RED MAR	BONE	THYROID	ICRP
INT-CO	3.46E-05	2.60E-04	2.60E-04	2.70E-06	2.75E-04	3.79E-04	3.05E-04	8.60E-04	2.61E-04	3.11E-04
INT-A6	8.17E-04	7.40E-04	7.45E-04	7.48E-04	7.56E-04	8.82E-04	7.92E-04	1.47E-03	7.77E-04	7.96E-04

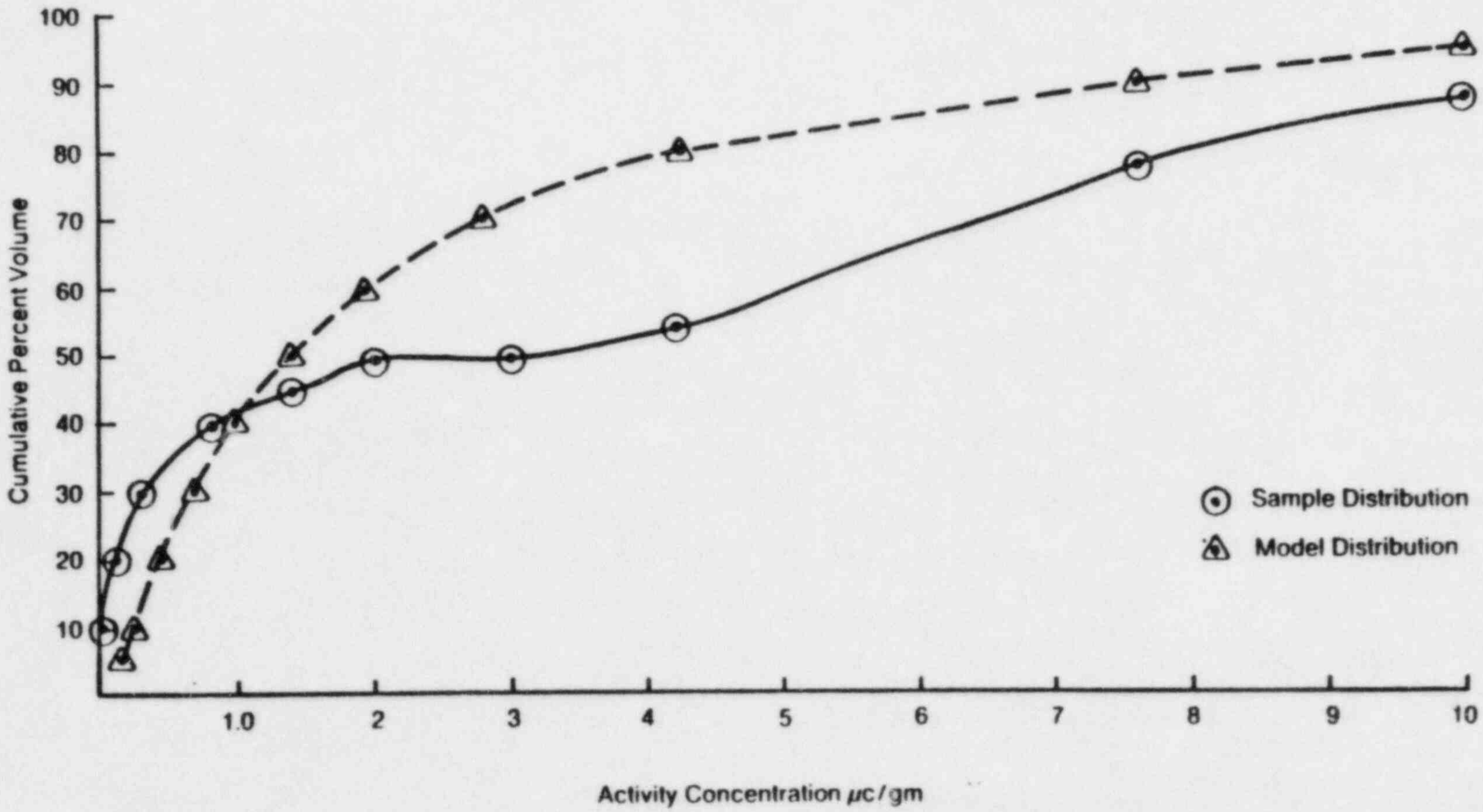
EXPOSED WASTE IMPACTS:

SCN	LUNGS	S.WALL	LLI WALL	T. BODY	KIDNEYS	LIVER	RED MAR	BONE	THYROID	ICRP
IN-AIR	3.95E-05	2.23E-08	2.25E-07	5.19E-06	8.40E-06	6.45E-05	2.45E-05	3.26E-04	8.41E-06	2.64E-05
ER-AIR	1.36E-04	5.59E-08	7.37E-07	1.78E-05	2.88E-05	2.22E-04	8.42E-05	1.12E-03	3.08E-05	9.09E-05
IN-WAT	1.67E-08	3.91E-09	5.19E-08	9.36E-08	1.95E-07	1.46E-06	5.55E-07	7.30E-08	7.04E-08	4.17E-07
ER-WAT	2.21E-06	5.28E-07	9.52E-06	1.67E-05	3.48E-05	2.66E-04	1.01E-04	1.33E-03	1.32E-05	7.54E-05

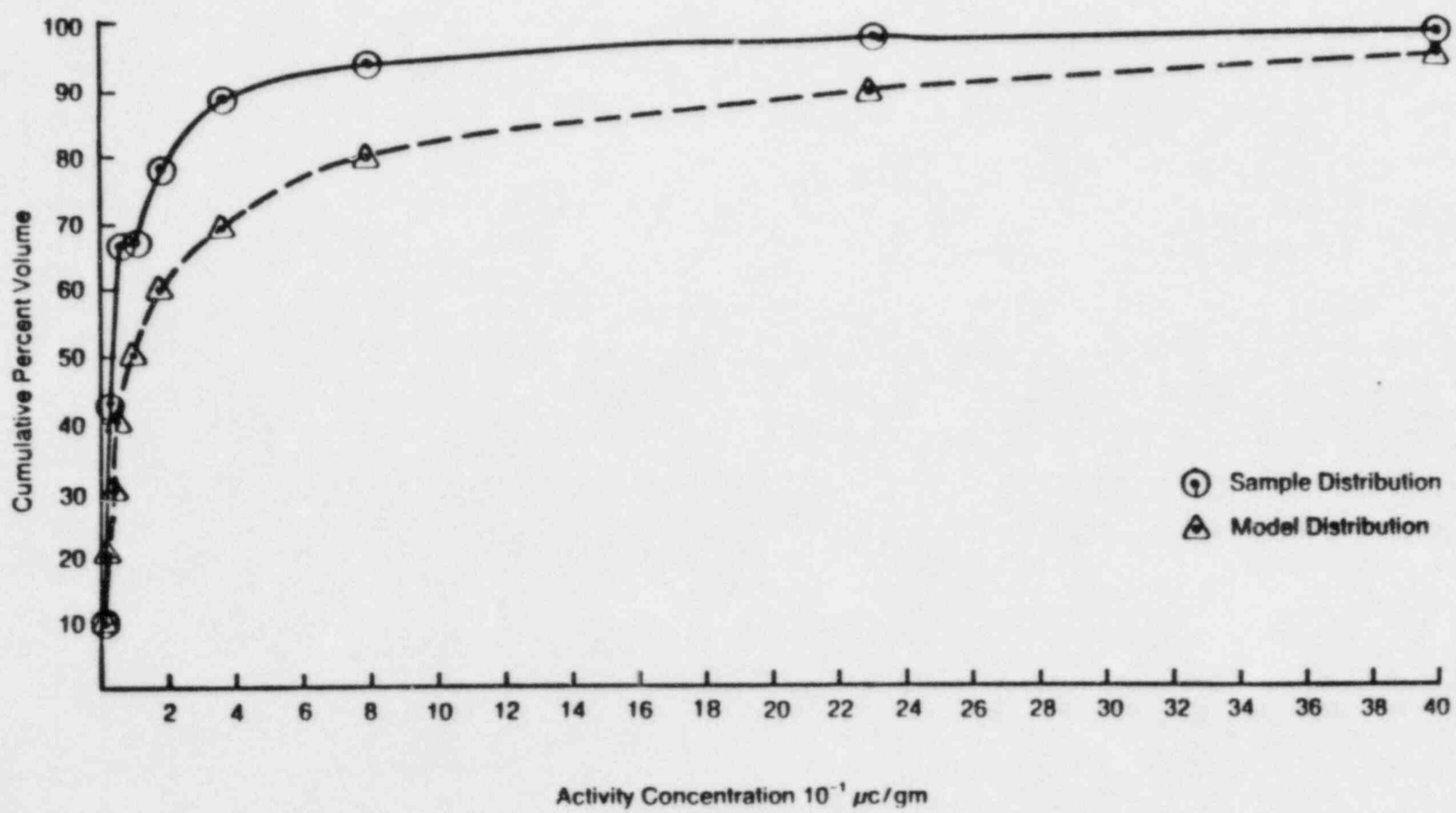
Distribution of activity concentration levels by percent volume for PWR resins.



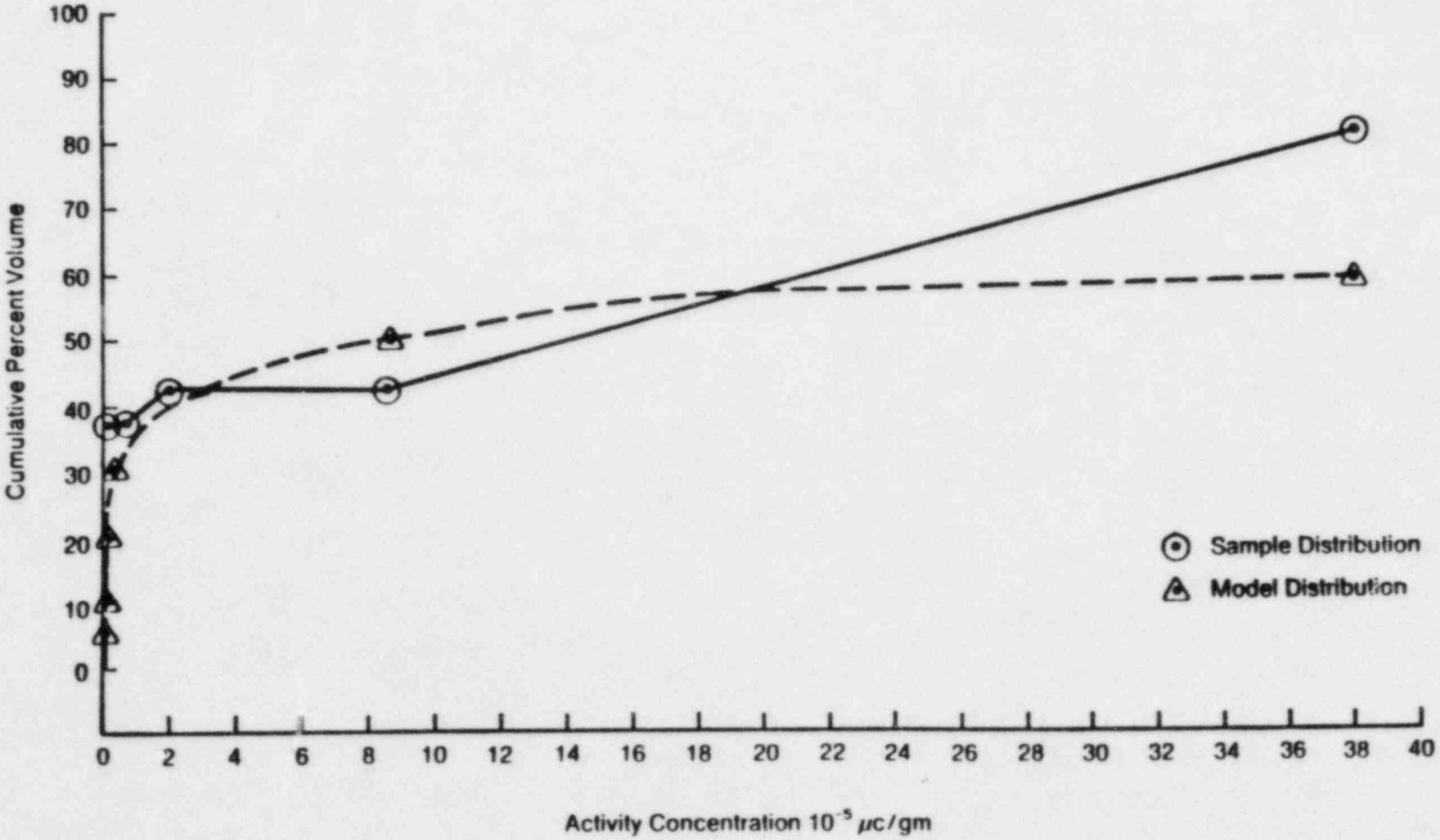
Distribution of activity concentration levels by percent volume for LRW resins.



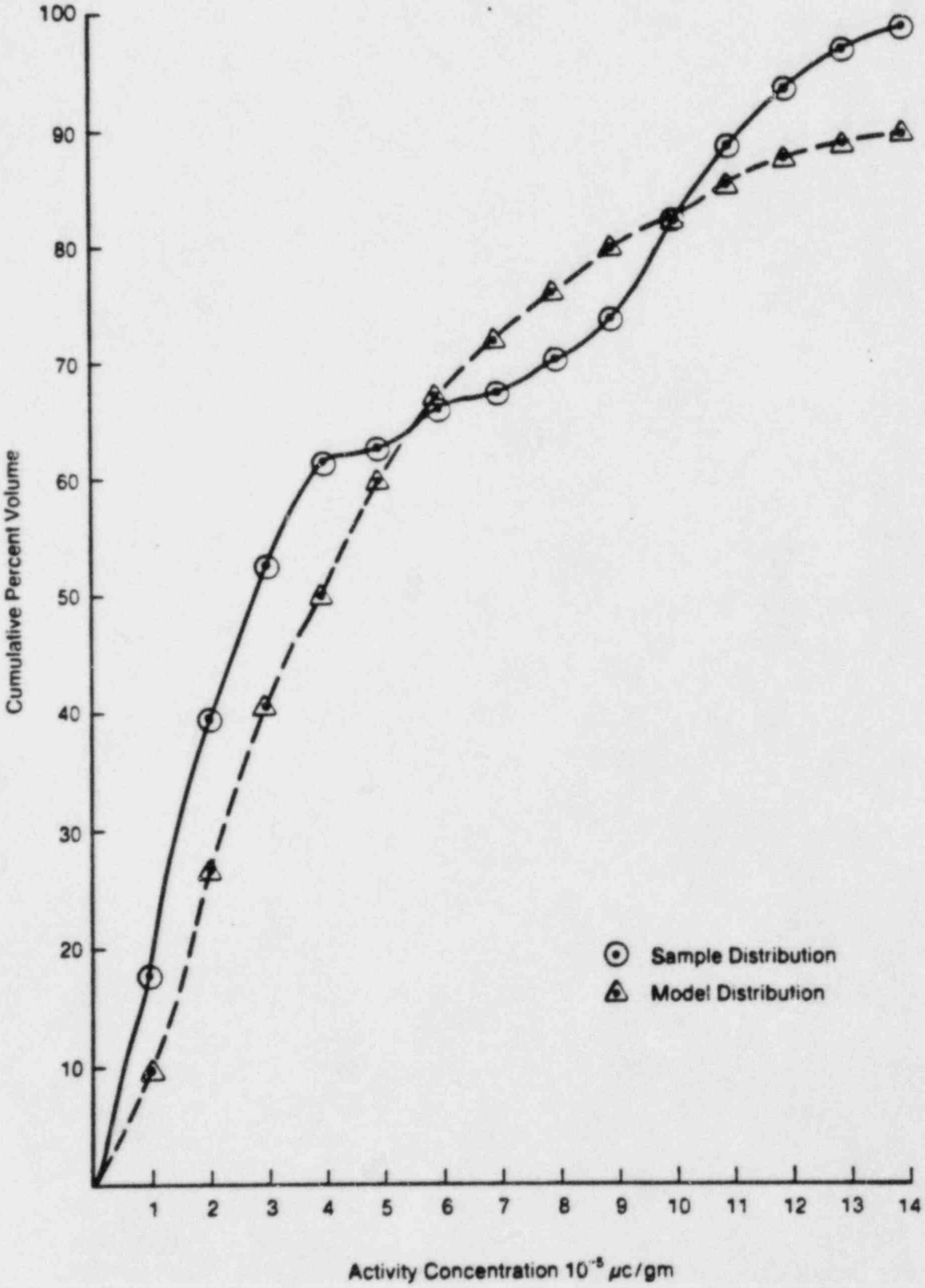
Distribution of activity concentration levels by percent volume for evaporator concentrates.



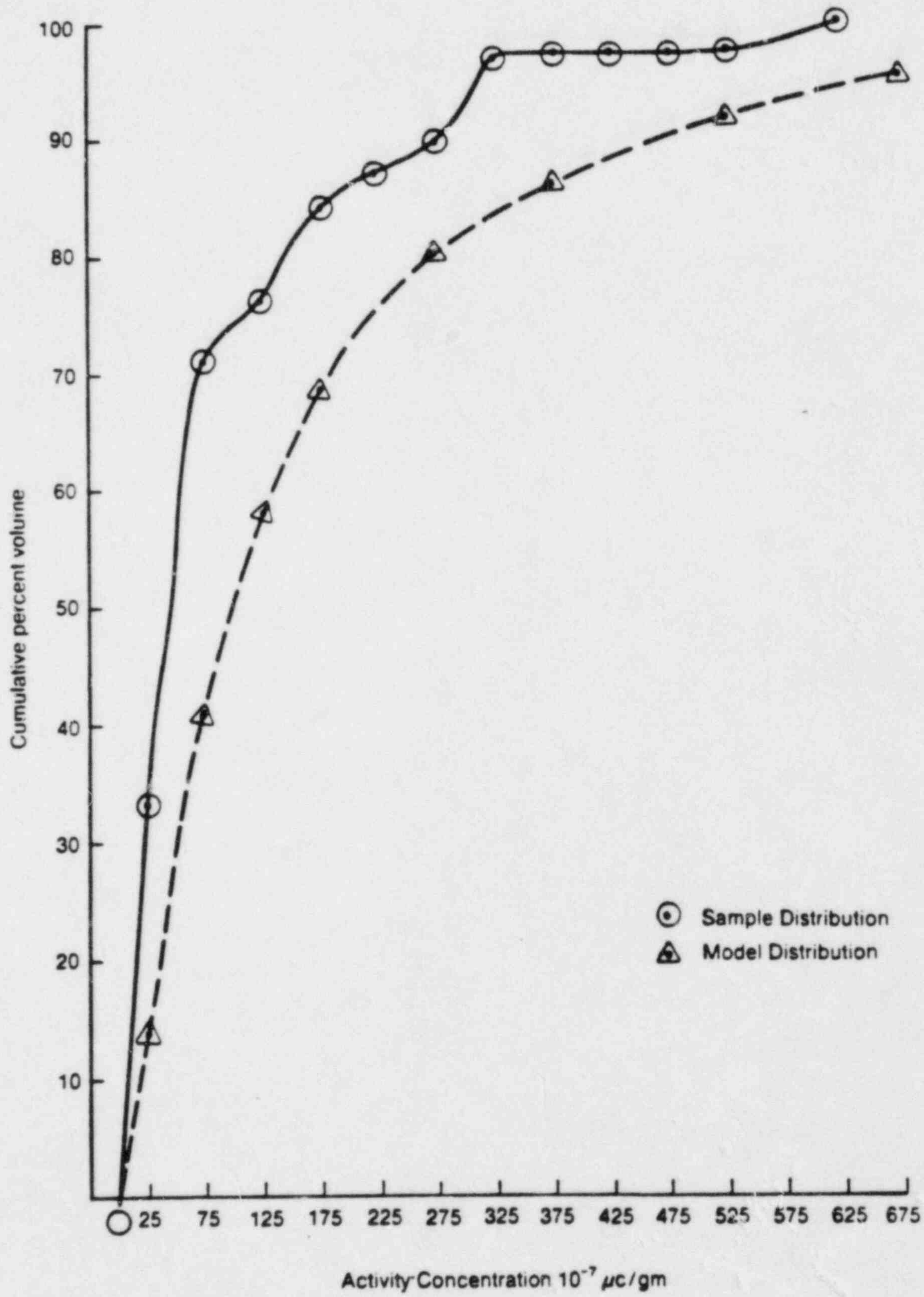
Distribution of activity concentration levels by percent volume for PWR filters.



Distribution of activity concentration levels by percent volume for PWR compacted trash.



Distribution of activity concentration levels by percent volume for BWR compacted trash.



Annual Volumes Available for Disposal as VLW

Waste Stream	Volume Percent at Concentration Level from Table 5-17			
	Exemption Dose Rate			
	0.1	1.0	10.0	50.0 (mrem/yr)*
PWR Resin	0	0	0	0
PWR Evap.	0	0	0	0
PWR Filters	55	80	85	90
PWR Trash	10	65	100	100
BWR Trash	35	90	100	100
Soil	30	65	90	100
Sand	30	90	100	100

*This dose rate corresponds to about 10 mrem/yr to the maximally exposed individual other than the transportation worker.

Population Dose Estimates (Person-Rem)
Via Various Exposure Scenarios for Trash Waste Streams
With Activity Levels That Will Deliver 1 mrem/yr to the Maximally
Exposed Individual

Scenario	PWR Trash	BWR Trash
TR-OCC	1.9 E-3	2.1 E-3
TR-POP	2.5 E-3	2.7 E-3
IN-AIR	8.6 E-9	7.8 E-9
ER-AIR	5.5 E-9	1.3 E-9
OP-POP	1.2 E-9	1.2 E-9
OP-WOR	9.6 E-5	1.0 E-4
LA-AIR	2.7 E-7	8.3 E-8
TOTAL	4.5 E-3	4.9 E-3

Table 6-5
Impacts of Disposal of PWR Compacted Trash at SE Landfill

IMPACTS FOR PWR COMPACTED TRASH (136 M***3/YR) AT A SANITARY LANDFILL, SE
(AVERAGE CONCENTRATION OF WASTE = 2.50E-05 Ci/M***3)

SANITARY LANDFILL

LIFE= 20 OVFL= 1 MSTR= 1
REGN= 2 DATA= 0
IPOP= 1 INST= 10

WASTE: TSH 2E-05 WEIGHT: 1.09E+02 MT DENSITY: 8.00E-01 MT/M3

ID= 1 IA= 1 IK1= 0 IK2= 0 PROCESS= 1
IXS= 1 100 0 1
ICS= 0 0 0 100

**** NUMBER OF PROCESSING FACILITIES = 1 ****

**** NUMBER OF PROCESSING FACILITIES = 1 ****

TRANSPORTATION IMPACTS TR-MAX = 4.75E-01 MREM/YR
TR-OCC = 9.4[illegible]E-01 PERSON-MREM/YR
TR-POP = 1.24E+00 PERSON-MREM/YR

INTRUDER IMPACTS:

SCN	LUNGS	S.WALL	LLI WALL	T. BODY	KIDNEYS	LIVER	RED MAR	BONE	THYROID	ICRP
INT-CO	9.99E-03	9.98E-03	9.98E-03	9.98E-03	9.98E-03	1.00E-02	9.99E-03	1.01E-02	9.98E-03	9.99E-03
INT-AG	2.79E-02	2.79E-02	2.79E-02	2.79E-02	2.79E-02	2.79-02	2.79E-02	2.80E-02	2.79E-02	2.79E-02

EXPOSED WASTE IMPACTS:

SCN	LUNGS	S.WALL	LLI WALL	T. BODY	KIDNEYS	LIVER	RED MAR	BONE	THYROID	ICRP
IN-AIR	7.12E-06	4.65E-07	7.72E-07	1.34E-06	1.99E-06	8.49E-06	3.81E-06	3.70E-05	1.13E-06	4.31E-06
ER-AIR	4.46E-06	1.98E-09	1.71E-08	5.35E-07	8.34E-07	6.45E-06	2.45E-06	3.27E-05	3.83E-07	2.74E-06
IN-WAT	2.99E-07	7.52E-08	1.16E-07	1.57E-07	2.41E-07	3.06E-07	2.49E-07	5.63E-07	2.04E-07	2.69E-07
ER-WAT	2.96E-08	1.48E-08	1.17E-07	1.86E-07	3.72E-07	2.80E-06	1.08E-06	1.33E-05	1.56E-07	7.82E-07

INCINERATION AND OPERATIONAL IMPACTS:

SCN	LUNGS	S.WALL	LLI WALL	T. BODY	KIDNEYS	LIVER	RED MAR	BONE	THYROID	ICRP
IC-POP	.00E+00	.00E+00	.00E+00	.00E+00	.00E+00	.00E+00	.00E+00	.00E+00	.00E+00	.00E+00
IC-IND	.00E+00	.00E+00	.00E+00	.00E+00	.00E+00	.00E+00	.00E+00	.00E+00	.00E+00	.00E+00
IC-WOR	.00E+00	.00E+00	.00E+00	.00E+00	.00E+00	.00E+00	.00E+00	.00E+00	.00E+00	.00E+00
IC-MWR	.00E+00	.00E+0	.00E+00	.00E+00	.00E+00	.00E+00	.00E+00	.00E+00	.00E+00	.00E+00
OP-POP	1.10E-06	1.18E-07	2.18E-07	2.20E-07	2.97E-07	1.02E-06	4.96E-07	4.11E-06	1.97E-07	5.99E-07
OP-IND	1.90E-07	2.05E-08	3.77E-08	3.81E-08	5.14E-08	1.76E-07	8.58E-08	7.11E-07	3.41E-08	1.04E-07
OP-WOR	4.78E-02	4.78E-02	4.78E-02	4.78E-02	4.78E-02	4.78E-02	4.78E-02	4.78E-02	4.78E-02	4.78E-02
OP-MWR	4.78E-02	4.78E-02	4.78E-02	4.78E-02	4.78E-02	4.78E-02	4.78E-02	4.78E-02	4.78E-02	4.78E-02

Annual Isotopic Activity That Can Be Disposed of at a Sanitary Landfill in the Southeast U.S. as a Function of the Annual Dose to the Maximally Exposed Individual

	Annual Activity (Curies)		
Isotope	10 mrem/yr	1.0 mrem/yr	0.1 mrem/yr
H-3	14	1.4	0.14
C-14	19.	1.9	0.19
Fe-55	28,000.	2800.	280.
Co-60	0.03	0.003	0.0003
Ni-59	950.	95.	9.5
Ni-63	320.	32.	3.2
Sr-90	26.	2.6	2.6
Nb-94	0.047	0.0047	0.0005
Tc-99	3.6	0.36	0.036
I-129	0.014	0.0014	0.00014
Cs-135	880.	88.	8.8
Cs-137	0.13	0.013	0.001
U-235	0.59	0.059	0.006
U-238	4.5	0.45	0.045
Np-237	0.35	0.035	0.0035
Pu-238	0.76	0.076	0.008
Pu-239	0.55	0.055	0.006
Pu-241	22	2.2	0.22
Pu-242	0.55	0.055	0.006
Am-241	0.032	0.0032	0.00032
Am-243	0.029	0.0029	0.00029
Cm-243	0.80	0.080	0.008
Cm-244	1.7	0.17	0.017

Associated Press

-al Edwin Meese 3d
news conference.

General invited Mr.
lule an appointment
rtment."

Americans had not grasped the implications of the new budget law.

"The Washington crowd doesn't know yet what's going on," he said, "and if they don't know, you think the folks in the hinterlands know?"

Accordingly, he said, it was too early to tell whether Congress would be spurred to work out a deficit-reducing package of its own later this year to meet the limits under the new law, or whether the lawmakers would simply let the automatic cuts go into effect.

Representative Leon A. Panetta of California, a leading Democratic strategist on budget matters, said the deficit was growing so fast that the cuts announced today would be tiny compared with those required next fall. Like Mr. Gray, he said the "jury is very much out" on how Congress would react to that prospect.

Both Administration officials and Congressional leaders have said that a separate compromise on a package to reduce the 1987 deficit would be more manageable than the approach in the new law, which gives little or no leeway for cuts in a huge number of programs.

mates for the 1987 deficit put it at just over $200 billion, or $56 billion over the legal limit.

Law on Nuclear Waste Is Signed by President

WASHINGTON, Jan. 15 (AP) — President Reagan signed legislation today to provide about $320 million to South Carolina, Washington and Nevada to prevent them from closing the country's only authorized low-level nuclear waste dumps.

The bill, passed in the closing days of the last sess_n of Congress, also establishes penalties for states that fail to arrange for the disposal of low-level radioactive waste produced within their borders.

Low-level radioactive material decays in 10 to 100 years, while high-level waste generated by power plants and weapons plants can remain highly radioactive for tens of thousands of years.

other contracts would probably have to be delayed to make up the 4.3 percent savings, he said.

Larger Cuts Expected

The current round of budget cuts are mandated in the 1986 Federal fiscal year, which began last October 1, by the procedures of the deficit-reduction law, sponsored by Senators Phil Gramm, Republican of Texas, Warren B. Rudman, Republican of New Hampshire and Ernest F. Hollings, Democrat of South Carolina.

The law will require much larger cuts later this year, unless Congress and the President take other action, such as a tax increase, to hold down the deficit in the 1987 Federal fiscal year, which begins October 1.

"They're the cuts that will be devastating, not only to us but to the Defense Department," said Brad Johnson, director of New York State's lobbying office in Washington.

"For every dollar they will cut today," said Representative Schumer "If Gramm-Rudman continues down the track they will cut almost seven dollars in the fall of 1986."

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The New York Times/Jose R. Lopez

James C. Miller 3d, budget director, left, and Rudolph G. Penner, head of Congressional Budget Office, at news session yesterday on budget deficit.

of $3 billion, of which $1.2 billion was economic aid and $1.8 billion was military. Israel has already received the entire economic allocation, but expects a cut of $77 million in military aid, he said.

Referring to the budget-balancing law, the Commandant of the Coast Guard, Admiral James S. Gracey, sent a message to all units instructing them to "slow down spending."

"We don't know yet what the actual impact will be, but it is likely to be very significant," the message said. "Don't conduct routine surface or air patrols except in areas where intelligence indicates probability of illicit operations. Reduce fisheries patrols to 50 percent."

In view of the new fiscal austerity, Admiral Gracey said, "We still have some rough seas ahead."

Endow_ment Grants To Be Cut by 4.3% Under Budget Law

Special to The New York Times

WASHINGTON, Jan. 15 — Federal officials said today that the 4.3 percent reduction in the nonmilitary budget for the current year would be applied across the board for cultural programs, with most recipients having to share part of the cuts but with no programs being canceled outright.

"We will fund all excellent proposals to come to us," said John Agresto, acting chairman of the National Endowment for the Humanities, emphasizing the word "excellent."

Not all endowment grants will be cut by exactly 4.3 percent, he said. Rather, the number of grants within a particular program might be reduced while those in another program might be maintained but with some of the individual grants being reduced in value.

Under the automatic spending cuts required by the new budget-balancing law, $6 million will be pared from the $139 million budget for the National Endowment for the Humanities in the fiscal year 1986 and $7 million will be cut from the $165 million budget for the National Endowment for the Arts.

Other cuts include $8 million from the Smithsonian Institution's budget of $200 million, $1.6 million from the National Gallery of Art's budget of $37 million, and $1 million from the $25 million budgeted for the Historical Preservation Fund.

Neill Heath, a spokesman for the National Gallery, said the museum had not yet decided how to deal with the cuts but would consider a number of alternatives, including the cancellation of some exhibitions.

Frank Hodsoll, chairman of National Endowment for the Arts, told The Associated Press that the cuts "will not significantly hurt the endowment's ability to support the arts."

ATOMIC INDUSTRIAL FORUM

NATIONAL ENVIRONMENTAL STUDIES PROJECT (NESP)

Study on

"A GUIDE FOR OBTAINING REGULATORY APPROVAL
TO DISPOSE OF VERY LOW LEVEL (DE MINIMIS) RADWASTE
BY ALTERNATIVE MEANS"

Presented to

NRC ACRS Subcommittees on
Waste Management and Reactor Radiological Effects

January 16, 1986

Joyce Davis

General Physics Corporation

A GUIDE FOR OBTAINING REGULATORY APPROVAL TO DISPOSE OF VERY LOW LEVEL (_DE MINIMIS_) RADWASTE BY ALTERNATE MEANS

(DRAFT)

PREPARED FOR THE

NATIONAL ENVIRONMENTAL STUDIES PROJECT
OF THE
ATOMIC INDUSTRIAL FORUM, INC.

BY

GENERAL PHYSICS CORPORATION
COLUMBIA, MARYLAND

DECEMBER, 1985

STUDY PURPOSE

THE PURPOSE OF THIS STUDY IS TO ESTABLISH GUIDELINES FOR THE PREPARATION OF APPLICATIONS FOR APPROVAL TO DISPOSE OF VERY LOW-LEVEL RADIOACTIVE WASTES IN A MANNER OTHER THAN BY TRANSFER TO A PART 61 LICENSED FACILITY. THE GUIDELINES MAY BE USEFUL FOR INCORPORATION INTO AN NRC REGULATORY GUIDE.

STUDY APPROACH

THIS STUDY IS BASED ON INFORMATION RECEIVED FROM INTERVIEWS WITH NRC STAFF AND ON PREVIOUS EXPERIENCE COLLECTED FROM NUCLEAR UTILITIES AND NRC'S PUBLIC DOCUMENT ROOM. APPLICATIONS REVIEWED AND APPROVED BY THE OFFICE OF NUCEAR REACTOR REGULATION (NRR) WERE STUDIED, AND PREDOMINANT CHARACTERISTICS IDENTIFIED. THIS INFORMATION WAS COMBINED WITH NRC RECOMMENDATIONS INTO A GUIDE FOR PREPARING 10CFR20.302 APPLICATIONS.

SEVERAL PATHS EXIST WHICH, SINGLY OR IN COMBINATION, CAN LEAD TO OBTAINING REGULATORY APPROVAL OF ALTERNATIVE DISPOSAL METHODS. THESE INCLUDE:

- PETITIONS FOR GENERIC RULEMAKING
  - GENERIC RULEMAKING WHICH COVERS THE DISPOSAL OF A SPECIFIC WASTE STREAM
  - ESTABLISHMENT OF A GENERIC CUTOFF LEVEL BELOW WHICH WASTE WOULD NO LONGER REQUIRE LICENSED DISPOSAL
- APPLICATIONS FOR APPROVAL TO DISPOSE OF WASTES UNDER 10CFR20.302
- APPLICATIONS FOR LICENSE AMENDMENT
- PETITIIONS FOR EXEMPTION OF A SPECIFIC WASTE STREAM FROM THE REQUIREMENTS 10 CFR 61

SPECIFIC WASTE STREAM REGULATION

THE NRC ISSUED REGULATIONS IN MARCH 1981 WHICH ALLOWED THE UNRESTRICTED DISPOSAL OF CERTAIN MEDICAL WASTES CONTAINING VERY LOW LEVELS OF TRITIUM AND/OR CARBON-14 (SCINTILLATION FLUIDS, ANIMAL CARCASSES, ETC.) THE NRC ESTIMATED THAT UNRESTRICTED DISPOSAL OF THESE WASTES WOULD RESULT IN A MAXIMUM DOSE TO AN EXPOSED INDIVIDUAL OF LESS THAN 1 MREM/YR.

ACTUAL OR PROPOSED GENERIC GUIDANCE LEVELS

- FORMER SECTION 304 OF 10 CFR 20. THIS REGULATION ALLOWED A LICENSEE TO BURY, EACH YEAR, UP TO 12,000 TIMES THE AMOUNT SPECIFIED IN APPENDIX C TO PART 20. CERTAIN BURIAL DEPTH AND SEPARATION CRITERIA WERE ALSO ESTABLISHED (THE NRC REPEALED THESE REGULATIONS EFFECTIVE JANUARY 28, 1981. NO RADIOLOGICAL BASIS FOR THE REPEAL WAS PRESENTED IN THE NOTICE).

- RECOMMENDATION BY NRC'S OFFICE OF INSPECTION AND ENFORCEMENT, REGION V, (1981) THAT PART 20 BE MODIFIED TO INCLUDE A CLAUSE LIKE: "MATERIALS, IN WHICH THE RADIOACTIVITY RESULTING FROM LICENSED ACTIVITIES IS UNIFORMLY DISTRIBUTED, AND THE ESTIMATED GROSS ACTIVITY IS NOT GREATER THAN 5 pCi/g, ARE NOT CONSIDERED SIGNIFICANTLY RADIOACTIVE AND THEREFORE MAY BE RELEASED FROM THE RESTRICTED AREA."

APPLICATION FOR APPROVAL TO DISPOSE OF WASTES UNDER 10 CFR 20.302

"EACH APPLICATION SHOULD INCLUDE A DESCRIPTION OF THE LICENSED MATERIAL AND ANY OTHER RADIOACTIVE MATERIAL INVOLVED, INCLUDING THE QUANTITIES AND KINDS OF RADIOACTIVITY INVOLVED, AND THE PROPOSED MANNER AND CONDITIONS OF DISPOSAL. THE APPLICATION SHOULD ALSO INCLUDE AN ANALYSIS AND EVALUATION OF PERTINENT INFORMATION AS TO THE NATURE OF THE ENVIRONMENT, INCLUDING TOPOGRAPHICAL, GEOLOGICAL, METEOROLOGICAL, AND HYDROLOGICAL CHARACTERISTICS; USAGE OF GROUND AND SURFACE WATERS IN THE GENERAL AREA; THE NATURE AND LOCATION OF OTHER POTENTIALLY AFFECTED FACILITIES; AND PROCEDURES TO BE OBSERVED TO MINIMIZE THE RISK OF UNEXPECTED OR HAZARDOUS EXPOSURES."

APPLICABILITY OF 20.302

- ROUTINE SPECIFIC WASTE STREAMS (E.G., OIL, TRASH)
- SPECIAL ONE-TIME-ONLY CASES (E.G., SOIL, SAND)

APPLICATION FOR A LICENSE AMENDMENT

- ON-SITE DISPOSAL INVOLVING A CHANGE TO PLANT TECH SPECS OR LICENSE
- LICENSE AMENDMENT APPLICATION IS IN ADDITION TO 20.302 REQUEST

<u>PETITION FOR DISPOSAL OF A SPECIFIC WASTE STREAM</u>

<u>UNDER 10 CFR PART 61</u>

UNDER 10 CFR 61.6 ANY PERSON MAY REQUEST EXEMPTION FROM THE REQUIREMENTS OF PART 61 BY APPLYING TO THE COMMISSION. THE COMMISSION MAY GRANT THE EXEMPTION IF THEY DETERMINE THAT THE REQUEST "WILL NOT ENDANGER LIFE OR PROPERTY OR THE COMMON DEFENSE AND SECURITY, AND IS OTHERWISE IN THE PUBLIC INTEREST".

- NO PRECEDENTS
- UNNECESSARY IF 20.302 APPROVAL IS GRANTED

WASTE CATEGORIES AND FREQUENCY OF APPLICATION*

Waste Category	Number of Applications Reviewed
Contaminated Sand/Soil	5
Sludge	5**
Waste Oil	3
Sediment	2
Secondary Side Resins	1
Scrap Wood	1
Feedwater Heater Tube Bundles	1
Roofing Materials	1

*Data Supplied by NRR.

**Includes two cases not summarized on Table 3-1, but recently reviewed and approved by NRR.

SUMMARY OF 20.302(a) APPLICATION CHARACTERISTICS

Case No.	Date	Plant	Description of Waste	Disposal		Estimated Maximum Dose (mrem/yr)*
				Site	Method	
1.	03/21/81	Oconee 1, 2, 3	Waste Oil	On-site	Incireration	0.07
2.	08/24/81	San Onofre	Contaminated Sand	On-site	Burial	1
3.	10/05/82	Oconee 1, 2, 3	Waste Oil	On-site	Incineration	0.5
4.	11/09/82	Oyster Creek	Soil	On-site	Burial & Paved Over	3
5.	02/10/83	H.B. Robinson 2	Sediment	Fossil Plant Ash Pond	Transfer from Settling Pond	5
6.	04/28/83	H.B. Robinson 2	Soil	On-site	Burial in a Drainage Ditch	5
7.	04/24/84	Humboldt Bay	Sludge	On-site	Burial in Chemical Waste Disposal Landfill	1.5
8.	07/19/84	Oconee 1, 2, 3	Sewage Sludge	Off-site	Sanitary Landfill	0.2 - 0.6
9.	10/17/84	H.B. Robinson 2	Settling Pond Sediment	On-site	Transfer to Ash Pond	5 5

SUMMARY OF 20.302(a) APPLICATION CHARACTERISTICS (CONTINUED)

Case No.	Date	Plant	Description of Waste	Disposal		Estimated Maximum Dose (mrem/yr)*
				Site	Method	
10.	10/17/84	R.E. Ginna 1	Roofing Materials	Off-site	Municipal Landfill	4
11.	10/18/84	McGuire 1 & 2	Wastewater-Residue Sludge	On-Site	Landspread, Vegetation & Top-soil Cover	1 1
12.	12/15/84	Oconee 1, 2, & 3	Feedwater heaters	Off-site company con-trolled area	Trench burial	0.01
13.	01/31/85	Oconee 1, 2, & 3	Sand	Off-s.te-company Con-trolled area	Trench burial	1
14.	02/04/85	Brunswick 1 & 2	Waste Oil	On-site	Incineration	0.1
15.	02/07/85	Oconee 1, 2 ,& 3 McGuire 1 & 2 Catawba 1 & 2	Wood	Off-site	Sanitary Landfill (Burial)	1
16.	03/11/85	Davis Besse	Secondary Side Resins	Off-site Company Owned	Landspread, Vegetation & Topsoil Cover	4
17.	03/14/85	H.B. Robinson 2	Soil	On-site	Transfer to Ash Pond	0.1

DISPOSAL SITE/DISPOSAL METHOD COMBINATIONS

Disposal Site	Disposal Method	Frequency of Occurrence
On-Site	Incineration	3
On-Site	Burial	4
On-Site	Relocation (Note 1)	3
On-Site/Off-Site C.C.A. (Note 2)	Landspreading	2
Off-Site C.C.A.	Burial	2
Off-Site	Sanitary Landfill	3

Note 1: Relocation refers to relocation of waste from settling pond to on-site fossil ash pond.

Note 2: C.C.A. is an abbreviation for Company Controlled Area.

AVERAGE WASTE VOLUMES

Waste Category	Average Volume	Standard Deviation
Contaminated Sand/Soil	350 m^3	384
Sludge	173 m^3	173
Waste Oil	25.2 m^3	20.2
Sediment	33.000 m^3	38.184
Secondary Side Resins	142 m^3	---
Scrap Wood	19.8 m^3	---
Feedwater Heater Tube Bundles	145 tons (metric)	---
Roofing Materials	90.8 tons (metric)	---

WASTE ACTIVITY AND ISOTOPIC COMPOSITION

CASE NO.	WASTE STREAM	PRINCIPAL NUCLIDES (%)	TOTAL ACTIVITY (mCi)	TOTAL CONC. pCi/gm UNLESS OTHERWISE
1	WASTE OIL	Co-58 (3.4)	0.001	0.7/cc
		Co-60 (4.3)	0.001	0.8/cc
		Cs-134 (20.5)	0.007	4.5/cc
		Cs-137 (71.8)	0.020	
2	SAND	Cs-137	0.05-0.20	0.5
3	WASTE OIL	Cs-134		
		Cs-137		
		Co-58		
		Co-60		
		Total	1.7	-
4	SOIL	Co-60 (50)	5	5
		Cs-137 (30)	3	3
		Cs-134 (5)	0.5	0.5
		Mn-54 (15)	1.5	
		Total	10	

WASTE ACTIVITY AND ISOTOPIC COMPOSITION (CONTINUED)

CASE NO.	WASTE STREAM	PRINCIPAL NUCLIDES (%)	TOTAL ACTIVITY (mCi)	TOTAL CONC. pCi/gm UNLESS OTHERWISE
5	SEDIMENT	Co-60	75	30
6	SOIL	Co-58		0.18
		Co-60 (63)		0.46
		Cs-134 (10)		0.73
		Cs-137 (23)		1.7
		Mn-54		0.16
		Total	0.014	
7	SLUDGE	Co-60 (62)		7.8/cc
		Cs-134		0.08/cc
		Cs-137 (36)		4.5/cc
		Th-234		0.24/cc
		Total	0.49	
8	SEWAGE SLUDGE	Co-58		0.092/cc
		Co-60 (27)		0.17/cc
		Cs-134		0.083/cc
		Cs-137 (45)		0.28/cc
		Total	0.07	
9	SETTLING POND SEDIMENT	Co-60	1700 (over life of pond)	30

CASE NO.	WASTE STREAM	PRINCIPAL NUCLIDES (%)	TOTAL ACTIVITY (mCi)	TOTAL CONC. pCi/gm UNLESS OTHERWISE
10	ROOFING MATERIALS	Co-60 Cs-134 Cs-137 Total	0.30 0.23 0.92 1.45	
11	WASTEWATER RESIDUE SLUDGE	Co-58 Co-60	0.050 0.050	0.12/cc 0.12/cc
12	FEEDWATER HEATERS	Co-60 (79) Cs-137 (15) Total	 6.5	10 1.9
13	SAND	Cs-134 Cs-137 Co-60 Mn-54 Total	1.2 3 0.1 0.05 12.3	15 37 1.2 0.6 150
14	WASTE OIL	Co-60	0.021	4.8/cc
15	WOOD	Co-60	0.7	35
16	SECONDARY SIDE RESINS	Co-58 (34) Co-60 (3) Cs-134 (27) Cs-137 (36) Total	 8.5/every 5 years	3.0/cc 0.08/cc 2.4/cc 3.2/cc
17	SOIL	Co-60 (65) Cd-109 (17) Cs-137 (3.6) Ce-144 (3.6)	 1.3	9 2.4 0.5

WASTE DOSE CONTRIBUTIONS

FOR THE CASES REVIEWED AND APPROVED BY THE NRC STAFF TO DATE, THE ESTIMATED ANNUAL DOSE TO THE MAXIMALLY EXPOSED INDIVIDUAL RANGES FROM 0.01 MREM/YR TO 5 MREM/YR. THIS IS 0.002% TO 1% OF THE ALLOWABLE ANNUAL DOSE TO A MEMBER OF THE PUBLIC (500 MREM/YR).

INHERENT CRITERIA FOR DISPOSAL

- WASTES SHOULD BE DISPOSED OF WITHIN THE STATE IN WHICH THEY WERE GENERATED.
- AGREEMENT STATE APPROVAL SHOULD BE SOUGHT (WHERE APPLICABLE).
- THE DISPOSAL SITE SHOULD BE ONE THAT IS UNLIKELY TO BE OCCUPIED FOR SOME PERIOD OF TIME AFTER DISPOSAL.

INHERENT EXPOSURE CRITERIA

- THE ANNUAL DOSE TO A MEMBER OF THE PUBLIC FROM EXPOSURE TO THE DISPOSED MATERIAL SHOULD BE A SMALL FRACTION OF ANNUAL EXPOSURE TO NATURAL BACKGROUND RADIATION.

- THE ANNUAL DOSE TO A MEMBER OF THE PUBLIC SHOULD BE NO GREATER THAN THE ANNUAL DOSE THE MAXIMALLY EXPOSED INDIVIDUAL COULD RECEIVE FROM EXPOSURE TO RADIOACTIVE EFFLUENTS FROM NORMAL OPERATIONS AT LIGHT WATER REACTOR.

- DISPOSAL OF CONCENTRATED SOURCES OF RADIOACTIVITY THAT MIGHT POSE A SIGNIFICANT HEALTH HAZARD IS NOT APPROPRIATE UNDER 10 CFR 20.302.

DRAFT DOSE GUIDELINES:

- DOSES TO THE TOTAL BODY AND ANY BODY ORGAN OF A MAXIMALLY EXPOSED INDIVIDUAL (A MEMBER OF THE GENERAL PUBLIC OR A NON-OCCUPATIONALLY EXPOSED WORKER) FROM THE PROBABLE PATHWAYS OF EXPOSURE SHOULD BE LESS THAN 1 MREM/YR.

- DOSES TO THE TOTAL BODY AND ANY BODY ORGAN OF AN INADVERTENT INTRUDER FROM THE PROBABLE PATHWAYS OF EXPOSURE SHOULD BE LESS THAN 5 MREM/YR.

- FOR ON-SITE DISPOSAL, THE DOSE TO THE TOTAL BODY AND ANY BODY ORGAN OF AN INDIVIDUAL FROM ASSUMED RECYCLING OF THE DISPOSED MATERIAL FROM ALL LIKELY PATHWAYS OF EXPOSURE SHOULD BE LESS THAN 5 MREM/YR.

OUTLINE OF A 10 CFR 20.302 APPLICATION

I. COVER LETTER

II. SECTION 1.0 - INTRODUCTION

III. SECTION 2.0 - DESCRIPTION OF THE WASTE STREAM

- A. 2.1 - PHYSICAL PROPERTIES OF THE WASTE
- B. 2.2 - CHEMICAL PROPERTIES OF THE WASTE
- C. 2.3 - RADIOLOGICAL PROPERTIES OF THE WASTE
- D. 2.4 - WASTE SAMPLING CHARACTERISTICS

IV. SECTION 3.0 - DESCRIPTION OF THE PROPOSED DISPOSAL METHOD

- A. 3.1 - WASTE GENERATION AND PREPARATION FOR DISPOSAL
- B. 3.2 - METHOD OF WASTE DISPOSAL
- C. 3.3 - LOCATION OF THE DISPOSAL SITE
- D. 3.4 - MISCELLANEOUS CONCERNS

V. SECTION 4.0 - EVALUATION OF WASTE IMPACTS

- A. 4.1 - IDENTIFICATION OF POTENTIAL PATHWAYS
- B. 4.2 - EVALUATION OF DOSES

VI. SECTION 5.0 - LICENSE AMENDMENT INFORMATION (IF REQUIRED)

VII. SECTION 6.0 - SUMMARY

CHECKLIST OF EXPOSURE PATHWAYS

____ GROUNDSHINE - EXTERNAL EXPOSURE FROM STANDING OR LIVING ABOVE THE SITE FOR A STATED NUMBER OF HOURS PER YEAR.

____ INHALATION OF RESUSPENDED RADIONUCLIDES IF THE RADIOACTIVE MATERIAL IS NOT COVERED PROMPTLY.

____ EXTERNAL EXPOSURE TO AN INADVERTENT INTRUDER.

____ INTERNAL EXPOSURE TO AN INADVERTENT INTRUDER.

____ EXTERNAL EXPOSURE OF AN INDIVIDUAL FROM ASSUMED RECYCLING OF THE DISPOSED MATERIAL AT THER TIME THE SITE IS RELEASED FROM REGULATORY CONTROL.

____ INTERNAL EXPOSURE OF AN INDIVIDUAL FROM ASSUMED RECYCLING OF THE DISPOSED MATERIAL AT THE TIME THE SITE IS RELEASED FROM REGULATORY CONTROL.

____ INTERNAL EXPOSURE FROM INGESTION OF FOOD GROWN ON THE DISPOSAL SITE.

____ INTERNAL EXPOSURE FROM INGESTION OF FOOD GROWN ON THE DISPOSAL SITE.

____ INHALATION OF RADIONUCLIDES RELEASED THROUGH INCINERATION OF WASTE MATERIAL.

____ EXTERNAL EXPOSURE OF AN INDIVIDUAL FROM ASSUMED INFILTRATION AND CONTAMINATION OF GROUND WATER.

____ INTERNAL EXPOSURE OF AN INDIVIDUAL FROM ASSUMED INFILTRATION AND CONTAMINATION OF GROUND WATER

ATOMIC INDUSTRIAL FORUM
NATIONAL ENVIRONMENTAL STUDIES PROJECT (NESP)

SUMMARY OF AIF/NESP-032 REPORT

"THE ENVIRONMENTAL CONSEQUENCES OF HIGHER FUEL BURN-UP"

PRESENTED TO:

ADVISORY COMMITTEE ON REACTOR SAFEGUARDS SUBCOMMITTEES ON

WASTE MANAGEMENT
REACTOR RADIOLOGICAL EFFECTS

JANUARY 16, 1986

BY

WILLIAM S. BROWN,
CHAIRMAN, NESP TASK FORCE
WESTINGHOUSE ELECTRIC CORPORATION

AIF/NESP-032

THE ENVIRONMENTAL CONSEQUENCES OF HIGHER FUEL BURN-UP

Prepared for the
National Environmental Studies Project
of the
Atomic Industrial Forum, Inc.

by

ENVIROSPHERE COMPANY
A Division of Ebasco Services Incorporated

New York, New York

John J. Mauro
Raymond Eng
Stephen Marschke
Wallace Chang

and

THE BABCOCK & WILCOX COMPANY

Lynchburg, Virginia

Thomas A. Coleman

June 1985

SUMMARY OF AIF/NESP-032 REPORT

"THE ENVIRONMENTAL CONSEQUENCES OF HIGHER FUEL BURN-UP"

INTRODUCTION

The U.S. code of Federal Regulations, 10 CFR 51.51 and 10 CFR 51.52, requires that applicants for a nuclear power reactor construction permit shall include in their Environmental Report their evaluation of the environmental effects of the uranium fuel cycle activities (Table S-3) and of the environmental effects of transportation of fuel and waste (Table S-4). Table S-3 presents generic per reactor values for natural resources committed, quantities of effluents released, and other environmental consequences of the entire fuel cycle. Table S-4 serves as the basis for assessing the impacts of the transportation of fresh fuel and of waste. The current values in these tables are normalized to a conservatively defined standard (1000 MWe) light water reactor operating for one year, and are based on an assumed fuel burnup of 33,000 megawatt days per metric ton of fuel (MWD/MT).

Several utilities have increased fuel burn-up beyond 33,000 MWD/MT. This study was accomplished to extend the generic environmental assessments of the uranium fuel cycle contained in Tables S-3 and S-4 of 10 CFR 51 to include burn-up up to 60,000 MWD/MT, in order to anticipate any questions that might arise over the appropriateness of applying these tables to higher fuel burnup. In addition the report provides numerical values for Rn-222 and Tc-99, and estimates of the Environmental Dose Commitment at higher burnups, consistent with the data employed by the NRC Staff in Environmental Impact Statements, hearing proceedings, and other licensing documents. To the extent possible, the results are based on the original assumptions and calculational procedures employed by the NRC staff in establishing the existing generic values. The results presented in this summary paper are abbreviated and limited to the environmental impacts associated with extended burnup for Table S-3, Environmental Dose Commitment, and Radon-222 and Tc-99.

Acknowledgement is given to the authors of this AIF/Nesp report, as shown on the title page, for producing a report that is considered by the AIF/NESP Task Force to be of outstanding quality and of important value and use to the Electric Utility members of NESP.

METHODOLOGY AND APPROACH

THe intent of this study was to extend the applicability of the current generic analysis of the environmental impacts of the uranium fuel cycle to include the efffects of higher fuel burnup. This was accomplished in two phases. In Phase 1, the methods used by the NRC Staff in producing the values in Tables S-3 and S-4, and the generic environmental impacts presented in The Staff's Environmental Impact Statements, were explicitly determined and reproduced. In Phase 2, the impacts for extended burn-up were quantified using the same methods. Thus the values for extended burn-up presented in in the report can be considered to be: a) an extension of the current generic impacts,
b) may be traced back to the NRC Staff analyses supporting current environmental assessments, and c) may be used in support of a licensing

amendment or application for extended burn-up.

The individual impacts for each component of the uranium fuel cycle was presented originally in Table S-3A of WASH-1248 and more recently in a proposed rule to 10 CFR 51, Appendix A, "Narrative Explanation of Table S-3" (Ref. 1). For this study, The Table S-3A was expanded for some components of the fuel cycle in order to provide the required level of detail in calculating the environmental impacts at extended burn-ups. Table 2-1 shows the breakdown of the fuel cycle components comprising Table S3-A used in this study. (NOTE: The complete Table 2-1 of the NESP study, which was prepared in Phase 1 of the work, provides the numerical values of each component of the fuel cycle at 33,000 MWD/MT burn-up). The environmental impacts presented in Table S3-A are applicable to an NRC defined conservative reference reactor which envelopes both the BWR and PWR. In preparing this S-3A table, the NRC utilized the concept of the Reference Reactor Year (RRY), which is defined as the average annual fuel requirement of the reference reactor, using those requirements of a BWR of PWR which would have the greatest potential for environmental impact.

For this study, the calculation of the fuel cycle requirements for extended burnup used the same basic approach as that used by the NRC, but updated the front-end fuel cycle parameters to reflect typical fuel cycle conditions currently in effect. Table 2-1A presents the reference conditions used in this study for the extended burnup calculations. In addition, all reactor physics calculations were made using a PWR reactor physics code, and then making scalar adjustments to calculate the RRY requirements for extended burnup. A calculation and comparison of the PWR average lifetime RRY requirements with the BWR RRY requirements showed that the calculation of the environmental impacts based on the PWR model were adequate, and within the required precision of the study.

The environmental impacts of each component of the fuel cycle can be shown to be proportional to one or a combination of several parameters which characterizes the fuel cycle component. These parameters can then be used to "prorate" or scale-up the individual impact values at 33,000 MWD/MT burnup to calculate the impact values at extended burnup. Table 2-2 identifies the prorating or scaling factors used for each fuel cycle component. The "Divisor" value represents the basis of the current S-3A table for 33,000 MWD/MT burnup as given in WASH-1248. This Divisor value, when divided into the Environmental Impact values of Table S3-A, yields a "unitized" environmental impact value. The product of the "unitized" values and the fuel cycle parameter requirement at each selected burnup yields the environmental impact for that burnup.

Mathematically, this "prorating" or scaling-up process can be represented:

$$\left[\text{Env Impact}\right]_{\text{Extend BU}} = \left[\text{Env Impact}\right]_{\text{unitized}} \times \left[\begin{matrix}\text{Fuel cycle parameter}\\ \text{requirements}\end{matrix}\right]_{\text{Extend BU}}$$

$$= \frac{\left[\text{Env Impact}\right]_{\text{33000 BU}}}{\left[\text{"Divisor"}\right]} \times \left[\begin{matrix}\text{Fuel Cycle parameter}\\ \text{requirements}\end{matrix}\right]_{\text{Extend BU}}$$

$$= \left[\text{Env Impact}\right]_{\text{33000 BU}} \times \frac{\left[\begin{matrix}\text{Fuel Cycle parameter}\\ \text{requirements}\end{matrix}\right]_{\text{Extend BU}}}{\left[\begin{matrix}\text{Fuel Cycle parameter}\\ \text{requirements}\end{matrix}\right]_{\text{33000 BU}}}$$

RESULTS

A. TABLE S-3

Table 1 presents a comparison of the environmental impacts in Table S-3 (at 33,000 MWD/MT) with those calculated for a discharge fuel burnup of 60,000 MWD/MT under the same reactor operating conditions and the same fuel cycle operations. In general, most of the the extended burnup impacts at 60,000 MWD/MT are equal to or less than the current (33,000 MWD/MT) values. For a limited number of instances, the extended burnup impacts are marginally greater than the current values. The radiological effluents for natural radionuclide releases associated with the front end of the fuel cycle decrease with increasing burnup. This is primarily due to a reduction in ore and yellowcake requirements as burnup increases.

The release of relatively short-lived fission products from the back end of the fuel cycle decreases with increasing burnup. This occurs because the inventory of radionuclides per MT of spent fuel is at equilibrium and does not increase with increasing burnup,while the MT of fuel discharged per RRY decreases in direct proportion to increases in burnup. The release of relatively long-lived radionuclides is essentially independent of burnup. This is because at higher burnup the increase in radionuclide inventory per MT of spent fuel is offset by the reduction in the number of MT of discharge fuel per RRY.

Table 3-1 presents the maximum environmental impacts per RRY for extended burnup and compares these values with the current Table S-3 values. The maximum values were selected from the results of the individual impacts that were calculated over the range of burnup calculations made from 33,000 to 60,000 MWD/MT. A number of extended burnup impacts are twice the 10CFR51 values, but most of the impacts are within 20 percent of the 10CFR51 values. The principal reason for the difference between the two columns is not due to extended burnup, but is due to the reduction in ore grade (from 0.2% to 0.1%0 assumed in the extended burnup impact assessment). Note that the results in Table 1 for 60,000 MWD/MT were calculated on the same basis as that for the 10CFR51 Table S-3 values (0.2% ore grade, 12 month refueling cycle, 100% milling efficiency).

Table 3-2 presents the impacts of the seven extended burnup levels that were calculated over the range of 33,000 to 60,000 MWD/MT. Each inpact is a summmation of the impacts of the separate fuel cycle components. The trends shown in this table indicate that the impacts typically decrease with extended burnup up to 50,000 MWD/MT in nearly al cases. AT 50,000 MWD/MT a number of impacts reach a minimum and then rise again with burnup increasing to 60,000 MWD/MT. A review of the tabular data reveals that for all practical purposes, the impacts at 33,000 MWD/MT very closely approximate maximum impacts over the range to 60,000 MWD/MY.

Selected results for several of the individual components are shown in the following tables:

1. Deep Geological Disposal of Spent Fuel

The impacts of deep geological disposal of spent fuel as a function of burnup are shown in Table 3-20. The radiological effluents are based upon 100 % release of all gaseous radionuclides, based upon 5 year old fuel. All other (solid form) radionuclides are assumed to be contained. The thermal effluents is based ona 100,000-year heat integration, and is prorated by the long term heat rate of the spent fuel.

2. Reprocessing- U Fuel Cycle

The reprocessing impacts as a function of burnup are presented in Table 3-24. The results show the reprocessng impacts per RRY to be decreasing with increasing burnup. This effect is due to the dominant influence of the strongly decreasing fuel throughput per RRY (the fuel throughput at 60,000 MWD/MT is 45 percent less than that at 33,000 MWD/MT). Although certain impacts, such as fission products and actinides will be increasing with extended burnup on a per fuel assembly basis, these same impacts are all decreasing when normalized on an RRY basis. The difference between the radiological effluents for 33,000 MWD/MT calculated by the NRC staff, and those calculated for 33,000 MWD/MT by this study are due to the use of ORIGEN 2.

3. Waste Management for Uranium Recycle

THe waste management impacts shown in Table 3-29 are the sum of the impacts of the four subcomponents of this parameter(see Table 2-1 for the subcomponents). The results show the extended impacts to be decreasing with increasing burnup, and thus conservative relative to the current values of Table S-3.

B. RADON-222 SOURCE TERMS

Table 3-33 presents the Rn-222 release from each component of the front end of the fuel cycle. THe table includes the values reported by the NRC in a recent EIS, and the values for extended burnup.The extended burnup values were derived by prorating the NRC values by the yellowcake requirement. In addition, for stabilized piles, the values for extended burnup reflect a factor of 10 increase to account for the recent changes in the Rn-222 EPA environmental release standard (Ref. 2).

The results show that as burnup increases, the Rn-222 emissions decrease. This occurs because the yellowcake requirements decrease resulting from the increased efficiency in uranium utilization at higher burnups. At burnups beyond 50,000 MWD/MT, uranium utilization no longer occurs. The approximate 10% difference between the NRC calculated emissions and those of this study at 33,000 MWD/MT is due to the assumption in this study that milling conversion of uranium ore to yellowcake is 90% efficient as opposed to 100% efficient as assumed by the NRC Staff.

C. TECHNETIUM-99 SOURCE TERMS

Table 3-34 presents the Tc-99 releases from the fuel cycle. The release at extended burnup were calculated by prorating the original NRC staff values of 0.14 Ci/RRY in gaseous effluent and 1.16Ci/RRY in liquid effluent by the TC-99 throughput expressed in Ci/RRY. The NRC staff used a throughput of 500 Ci/RRY. THe results show that Tc-99 releases decrease with increasing burnup. THis occurs because the increase in Tc-99 inventory (Ci/MT) in discharge fuel at higher burnup is offset by the reduction in the quantity of discharge fuel (i.e. MT/RRY) as burnup increases. The difference between the NRC staff estimate of 500 Ci/RRY and this report estimate of 462 Ci/RRY for 33,000 MWD/MT is due to: 1) the NRC rounded off its values upward and 2) this study used the updated ORIGEN 2 computer code as opposed to the original ORIGEN code which was used by the NRC staff.

D. ENVIRONMENTAL DOSE COMMITMENTS (EDC)

Table 5-1 presents the 100-year EDC for radionuclide releases from the fuel cycle. THe EDCs in this table are for a 100 year period following release. Accordingly, they reflect the sum of the 50 year dose commitments to individuals exposed to the radionuclides over a 100 year period following the release. The 100 years is used based on recommendations of the Table S-3 hearing board. The doses are expressed as effective whole body dose as calculated from the eight individual organ environmental dose commitments received from liquid and gaseous effluents in the fuel cycle.

The results show that the EDC decrease with increasing burnup. Also, the data show that the EDC for 33,000 MWD/MT calculated in this study is about 20% greater than that calculated by the staff (811 vs 650 man-rem).The main reason for this difference is due to the improvements in the RABGAD and LADTAP codes since the original NRC staff analyses were made. The differences in the Rn-222 dose commitments are due to increases in the Rn-222 source term which results from the assumptions used to model the front end of the fuel cycle. It is concluded that when the differences in the assumptions are taken into consideration, along with the numerous conservatisms inherent in the analyses, the current NRC staff assessment of the EDCs is considered applicable to the nuclear fuel cycle. It is worthy of note to compare the highest calculated EDC of Table 5-1 of 2447 man-rem/year with the estimated US population exposure of approximately 20,000,000 man-rem/year due to natural background radiation.

E. PRECISION OF RESULTS AND SENSITIVITY ANALYSIS

In the generic survey of the environmental impacts of the uranium fuel cycle as presented in Table S-3, the calculated values are meant to be representative of impacts assigned to a fictitious reference reactor, with the results deliberately constructed to generate conservative results and with the impact values presented closer to the upper bound rather than the mathematical average. The NRC results were presented with no more than two significant digit accuracy, and in many cases rounded up to the next convenient number. With this perspective in mind, the level of precision relevant to this study is about 10% at best, or single digit accuracy. Although computer calculations were carried out to several significant digits, their relevancy should be viewed in the context of this generic study, viz.,to provide representative values and establish trends for extended burnup. Thus many subtle fuel cycle parameters or interactions that were beyond the precision of the study were ignored.

In Chapter 6 of the NESP report, the sensitivity of the study results to alternative calculational assumptions and input parameters is analyzed. and the validity of the assumptions reviewed. THe sensitivity analysis covered five areas:

1. Variability in the front-end fuel requirements
2. Assessment of the fuel cycle back end scenarios that influence the quality and isotopic inventory of discharged fuel
3. Sensitivity analysis of the prorating process (scaling factors) to assess conservatism of the original environmental impacts as calculated by NRC, and the validity of relationships as applied to extended burnup.
4. Sensitivity analysis of assumptons used in the transportation analysis (Table S-4)
5. Conservatisms inherent in the methods used to calculate EDC per curie.

The sensitivity analyses showed the following:

1. A revised ore grade of 0.1% assumed in this study versus the original (10CFR51) of 0.2% ore grade would double the ore require ments.
2. A revised milling efficiency of 90% versus the original 100 % would increase the yellowcake requirement by 11%.
3. The enrichment tails assay which may vary from 0.16 to 0.30 weight percent (w/o), versus the assumed 0.25 w/o, results in varying the yellowcake requirement from -16% to +12%, and the separative work requirement from +25% to -9% .
4. Varying the reload interval from 12 to 24 months would vary the yellowcake requirement by about 10%, and the separative work requirement by about 20%.
5. Assuming the once-through fuel mode versus the reference recycle mode would increase the yellowcake requirement by less than 10%.
6. The evaluation of the U-236 poison effect on recycled uranium increases the yellowcake and separative work requirements by about 3%.
7.The assumed 80% plant capacity factor is about 30% greater than the historical industry average capacity factor. Thus the Table S-3 assumptions and predictions are conservative.

In summary, it is concluded that the current values in Tables S-3 and S-4, and the generic analysis of environmental dose commitments of the fuel cycle performed by the NRC staff, are applicable to fuel burnup up to 60,000 MWD/MT. THe conservative nature of the original NRC methodology was evaluated and reaffirmed as still applicable today and as applicable to extended burnup. THe report contains a description of the calculational methods used in the study so that all values may be independently verified.

F. <u>REFERENCES</u>

1. U.S. Nuclear Regulatory Commission, 10CFR51 Appendix A, Narrative Explanation of Table S-3, "Uranium Fuel Cycle Environmental Data", March 4, 1981, <u>Federal Register</u>, Vol46, NO. 40, page 15154.

2. U.S. Environmental Protection Agency, "Standards for Remedial Actions at Inactive Uranium Processing Sites", 40CFR192, <u>Federal Register</u>, Vol. 48, NO.3, page 590-606, January 5, 1983.

TABLE 2-1

STRUCTURE OF EXPANDED TABLE 3-3A

COLUMN	FUEL CYCLE COMPONENT
A	MINING
B	MILLING
C	UF_6 PRODUCTION (CONVERSION)
D	ENRICHMENT
E	FUEL FABRICATION
F	SPENT FUEL STORAGE AND DISPOSAL (NO RECYCLE)
	DECONTAMINATION & DECOMMISSIONING
	LLW
	GEOLOGICAL STORAGE
	POOL STORAGE
	PACKAGING
G	REPROCESSING
H	WASTE MANAGEMENT (U RECYCLE)
	DECONTAMINATION & DECOMMISSIONING
	LLW
	GEOLOGICAL STORAGE HLW, TRU, Pu
	INTERIM STORAGE HLW (20 YR.)
I	TRANSPORTATION

TOTAL = {(A+B+C+D+E+I) + F}
OR — WHICHEVER IS GREATER
{(A+B+C+D+E+I) + (G+H)}

TABLE 2-1A

REFERENCE CONDITIONS FOR EXTENDED BURNUP CALCULATIONS

FUEL CYCLE FRONT END:

A) 80% REACTOR CAPACITY FACTOR

B) 1000 MWe REFERENCE REACTOR

C) 0.25 WEIGHT % TAILS

D) URANIUM RECYCLE

E) 18 MONTH REFUELING CYCLE

F) INCLUDE U-236 NEUTRON EFFECTS

G) 0.1% ORE GRADE

H) 90% MILLING EFFICIENCY

FUEL CYCLE BACK END:

I) UPDATED ORIGEN-2 CODE TO DETERMINE ISOTOPICS

CONDITIONS (A) THROUGH (D) SAME AS NRC USED IN WASH-1248

BASIS FOR SELECTION OF CONDITIONS (E) - (I):

E) 18 MONTH CYCLE CONSIDERED MORE TYPICAL OF CURRENT OPERATIONS THAN THE 12 MONTH CYCLE PREVIOUSLY USED

F) U-236 NEUTRON POISON EFFECT TO MAINTAIN CONSERVATIVE NATURE OF THE REQUIREMENTS

G) 0.1% ORE GRADE - TO REFLECT AVERAGE CONDITIONS FOR THE NEXT 20 YEARS

H) 90% MILLING EFFICIENCY - TO REFLECT AVERAGE CONDITIONS FOR NEXT 20 YEARS

I) ORIGEN-2 TO UTILIZE CURRENT UPDATES IN CODE FOR CALCULATING SPENT FUEL ISOTOPICS AND DECAY HEAT

TABLE 2-2:

PRORATING FACTORS FOR EACH FUEL CYCLE COMPONENT*

Column	Prorating Factor	Divisor
Mining	1000 MT Ore	91
Milling	MT Yellowcake	182
	1000 MT Ore	91
Conversion	MT Yellowcake	182
Enrichment	MT SWU	116
Fabrication	MT Fuel	35
Reprocessing	MT Fuel	35

* The other back-end components are prorated by multiple factors.

TABLE 1:

COMPARISON OF ENVIRONMENTAL IMPACT IN TABLE S-3 WITH THOSE CALCULATED FOR FUEL BURNUP OF 60,000 MWD/MT

	10CFR51 Table S-3 33,000 MWD/MT	Extended Burnup 60,000 MWD/MT
Natural Resource Use:		
Land (Acres):		
Temporarily Committed	100	82
Undisturbed Area	79	63
Disturbed Area	22	19
Permanently Committed	13	11
Overburden Moved (10^6 MT)	2.8	2.7
Water (10^6 Gallons):		
Discharged to Air	160	165
Discharged to Water Bodies	11090	11462
Discharged to Ground	127	122
Total	11377	11741
Fossil Fuel:		
Electrical Energy (1000 MWH)	323	331
Equivalent Coal (1000 MT)	118	121
Natural Gas (10^6 SCF)	135	115
Effluents - Chemical (MT):		
Gases:		
SO_x	4400	4544
NO_x	1190	1219
Hydrocarbons	14	14
CO	29.6	30.2
Particulates	1154	1192

TABLE 1 (Cont'd):

COMPARISON OF ENVIRONMENTAL IMPACT IN TABLE S-3 WITH THOSE CALCULATED FOR FUEL BURNUP OF 60,000 MWD/MT

	10CFR51 Table S-3 33,000 MWD/MT	Extended Burnup 60,000 MWD/MT
Effluents - Chemical (MT) (Cont'd):		
Other Gases:		
F^-	0.67	0.66
HCl	0.014	0.008
Liquids:		
$SO_4^=$	9.9	10.0
NO_3^-	25.8	15.6
Fluoride	12.9	10.8
Ca^{++}	5.4	5.6
Cl^-	8.5	8.7
Na^+	12.1	12.3
NH_3	10.0	7.0
Fe	0.4	0.4
Tailings Solutions (10^3 MT):	240	233
Solids:	91000	88300
Effluents-Radiological (Curies):		
Gases (Including Entrainment):		
Ra-226	0.02	0.02
Th-230	0.02	0.02
Uranium	0.034	0.033
Tritium (Thousands)	18.1	17.7
C-14	24	15
Kr-85 (Thousands)	400	308

TABLE 1 (Cont'd):

COMPARISON OF ENVIRONMENTAL IMPACT IN TABLE S-3 WITH THOSE CALCULATED FOR FUEL BURNUP OF 60,000 MWD/MT

	10CFR51 Table S-3 33,000 MWD/MT	Extended Burnup 60,000 MWD/MT
Effluents-Radiological (Curies) (continued):		
Ru-106	0.14	0.10
I-129	1.3	1.1
I-131	0.83	0.52
Fission Products & Transuranics	0.203	0.227
Liquids:		
Uranium & Daughters	2.1	2.0
Ra-226	0.0034	0.0033
Th-230	0.0015	0.0015
Th-234	0.01	0.01
Fission & Activation Products	5.9E-6	5.2E-6
Solids (Buried on Site):		
Low Level (Shallow)	11300	11300
TRU & HLW* (Deep) (10^6)	11	11
Effluents-Thermal (10^9 BTU):	4063	4026
Transportation (Man-Rem):		
Exposure of Workers and General Public	2.5	1.9
Occupational Exposure (Man-Rem):	22.6	12.5

* Transuranic and High Level Wastes

TABLE 3-1: MAXIMUM ENVIRONMENTAL IMPACTS (TABLE S-3 VALUES) FOR EXTENDED BURNUP

	Extended Burnup	10CFR51
Natural Resource Use:		
Land (Acres):		
Temporarily Committed	1.80E+02	100
Undisturbed Area	1.34E+02	79
Disturbed Area	4.65E+01	22
Permanently Committed	1.93E+01	13
Overburden Moved (10^6 MT)	6.69E+00	2.8
Water (10^6 Gallons):		
Discharged to Air	2.71E+02	160.
Discharged to Water Bodies	1.29E+04	1.11E+04
Discharged to Ground	3.04E+02	127.
Total	1.34E+04	1.14E+04
Fossil Fuel:		
Electrical Energy (1000 MWH)	3.75E+02	323
Equivalent Coal (1000 MT)	1.37E+02	118
Natural Gas (10^6 SCF)	1.43E+02	135
Effluents - Chemical (MT):		
Gases:		
SO_x	5.16E+03	4400
NO_x	1.40E+03	1190
Hydrocarbons	1.81E+01	14
CO	3.44E+01	29.6
Particulates	1.35E+03	1154
Other Gases:		
F	7.53E-01	0.67
HCl	1.36E-02	0.014
Liquids:		
SO_4	1.12E+01	9.9
NO_3	2.62E+01	25.8
Fluoride	1.38E+01	12.9
Ca	6.28E+00	5.4
Cl	9.80E+00	8.5
Na	1.38E+01	12.1
NH_3	1.16E+01	10
Fe	4.66E-01	0.4
Tailings Solutions (1000):	5.85E+02	240
Solids:	2.22E+05	9.10E+05
Effluents - Radiological (Curies):		
Gases (Including Entrainment):		
Ra-226	2.20E-02	0.02
Th-230	2.20E-02	0.02
Uranium	3.72E-02	0.034
Tritium (1000)	1.85E+01	18.1
C-14	1.96E+01	24
Kr-85 (1000)	3.34E+02	400
Ru-106	1.36E-01	0.14
I-129	1.08E+00	1.3
I-131	9.28E-01	0.83
Fission Prod & Transuranics	3.45E-01	0.203
Liquids:		
Uranium & Daughters	2.29E+00	2.1
Ra-226	3.74E-03	0.0034
Th-230	1.65E-03	0.0015
Th-234	1.00E-02	0.01
Fission & Activation Prod	5.90E-06	5.90E-06
Solids (Buried on Site):		
Low Level (Shallow)	1.14E+04	1.13E+04
TRU & HLW (Deep) (10^6)	1.10E+01	11
Effluents - Thermal (10^9 BTU):	4.57E+03	4063

TABLE 3-2: ENVIRONMENTAL FUEL CYCLE IMPACTS (TABLE S-3 VALUES) AT EXTENDED BURNUP

	BURNUP (MWD/MT)							
	33,000	35,000	40,000	45,000	50,000	55,000	60,000	MAXIMUM
Natural Resource Use:								
Land (Acres):								
Temporarily Committed	1.80E+02	1.78E+02	1.71E+02	1.66E+02	1.62E+02	1.59E+02	1.57E+02	1.80E+02
Undisturbed Area	1.34E+02	1.31E+02	1.26E+02	1.22E+02	1.19E+02	1.16E+02	1.14E+02	1.34E+02
Disturbed Area	4.65E+01	4.61E+01	4.50E+01	4.39E+01	4.34E+01	4.30E+01	4.28E+01	4.65E+01
Permanently Committed	1.93E+01	1.90E+01	1.84E+01	1.85E+01	1.79E+01	1.74E+01	1.70E+01	1.93E+01
Overburden Moved (10^6 MT)	6.69E+00	6.65E+00	6.52E+00	6.39E+00	6.36E+00	6.32E+00	6.37E+00	6.69E+00
Water (10^6 Gallons):								
Discharged to Air	2.71E+02	2.70E+02	2.66E+02	2.63E+02	2.62E+02	2.62E+02	2.63E+02	2.71E+02
Discharged to Water Bodies	1.28E+04	1.28E+04	1.27E+04	1.26E+04	1.26E+04	1.28E+04	1.29E+04	1.29E+04
Discharged to Ground	3.04E+02	3.02E+02	2.97E+02	2.91E+02	2.90E+02	2.88E+02	2.88E+02	3.04E+02
Total	1.34E+04	1.34E+04	1.33E+04	1.31E+04	1.31E+04	1.33E+04	1.34E+04	1.34E+04
Fossil Fuel:								
Electrical Energy (1000 MWH)	3.75E+02	3.75E+02	3.71E+02	3.68E+02	3.67E+02	3.72E+02	3.74E+02	3.75E+02
Equivalent Coal (1000 MT)	1.37E+02	1.37E+02	1.35E+02	1.34E+02	1.34E+02	1.36E+02	1.36E+02	1.37E+02
Natural Gas (10^6 SCF)	1.43E+02	1.41E+02	1.34E+02	1.31E+02	1.27E+02	1.24E+02	1.21E+02	1.43E+02
Effluents - Chemical (MT):								
Gases:								
SO_2	5.14E+03	5.14E+03	5.09E+03	5.05E+03	5.05E+03	5.12E+03	5.16E+03	5.16E+03
NO_x	1.40E+03	1.39E+03	1.38E+03	1.37E+03	1.36E+03	1.38E+03	1.39E+03	1.40E+03
Hydrocarbons	1.81E+01	1.81E+01	1.78E+01	1.76E+01	1.75E+01	1.77E+01	1.77E+01	1.81E+01
CO	3.44E+01	3.44E+01	3.40E+01	3.36E+01	3.36E+01	3.40E+01	3.42E+01	3.44E+01
Particulates	1.34E+03	1.34E+03	1.33E+03	1.32E+03	1.32E+03	1.34E+03	1.35E+03	1.35E+03
Other Gases:								
F	7.53E-01	7.50E-01	7.37E-01	7.25E-01	7.21E-01	7.25E-01	7.27E-01	7.53E-01
HCl	1.36E-02	1.28E-02	1.12E-02	1.01E-02	8.98E-03	8.16E-03	7.90E-03	1.36E-02
Liquids:								
SO_4	1.12E+01	1.12E+01	1.10E+01	1.09E+01	1.09E+01	1.09E+01	1.10E+01	1.12E+01
NO_3	2.62E+01	2.49E+01	2.22E+01	2.01E+01	1.84E+01	1.70E+01	1.59E+01	2.62E+01
Fluoride	1.38E+01	1.35E+01	1.28E+01	1.23E+01	1.19E+01	1.16E+01	1.14E+01	1.38E+01
Ca	6.24E+00	6.24E+00	6.19E+00	6.14E+00	6.14E+00	6.24E+00	6.28E+00	6.28E+00
Cl	9.78E+00	9.78E+00	9.69E+00	9.61E+00	9.60E+00	9.74E+00	9.80E+00	9.80E+00
Na	1.38E+01	1.38E+01	1.36E+01	1.35E+01	1.34E+01	1.36E+01	1.36E+01	1.38E+01
NH_3	1.16E+01	1.11E+01	9.86E+00	8.93E+00	8.17E+00	7.57E+00	7.08E+00	1.16E+01
Fe	4.62E-01	4.62E-01	4.59E-01	4.55E-01	4.55E-01	4.62E-01	4.66E-01	4.66E-01
Tailings Solutions (1000):	5.85E+02	5.83E+02	5.72E+02	5.62E+02	5.59E+02	5.56E+02	5.56E+02	5.85E+02
Solids:	2.22E+05	2.21E+05	2.17E+05	2.13E+05	2.12E+05	2.11E+05	2.11E+05	2.22E+05
Effluents - Radiological (Curies):								
Gases (Including Entrainment):								
Ra-226	2.20E-02	2.19E-02	2.14E-02	2.11E-02	2.10E-02	2.09E-02	2.09E-02	2.20E-02
Th-230	2.20E-02	2.19E-02	2.14E-02	2.11E-02	2.10E-02	2.09E-02	2.09E-02	2.20E-02
Uranium	3.72E-02	3.70E-02	3.63E-02	3.57E-02	3.55E-02	3.54E-02	3.54E-02	3.72E-02
Tritium (1000)	1.85E+01	1.84E+01	1.83E+01	1.83E+01	1.80E+01	1.78E+01	1.77E+01	1.85E+01
C-14	1.96E+01	1.94E+01	1.89E+01	1.65E+01	1.61E+01	1.57E+01	1.53E+01	1.96E+01
Kr-85 (1000)	3.34E+02	3.31E+02	3.27E+02	3.17E+02	3.13E+02	3.10E+02	3.08E+02	3.34E+02
Ru-106	1.36E-01	1.33E-01	1.27E-01	1.25E-01	1.18E-01	1.11E-01	1.06E-01	1.36E-01
I-129	1.08E+00	1.08E+00	1.07E+00	1.08E+00	1.07E+00	1.06E+00	1.05E+00	1.08E+00
I-131	9.28E-01	8.81E-01	7.63E-01	6.88E-01	6.22E-01	5.68E-01	5.19E-01	9.28E-01
Fission Prod & Transuranics	3.45E-01	3.31E-01	3.01E-01	2.80E-01	2.59E-01	2.41E-01	2.27E-01	3.45E-01
Liquids:								
Uranium & Daughters	2.29E+00	2.28E+00	2.23E+00	2.19E+00	2.18E+00	2.17E+00	2.17E+00	2.29E+00
Ra-226	3.74E-03	3.72E-03	3.64E-03	3.59E-03	3.57E-03	3.55E-03	3.55E-03	3.74E-03
Th-230	1.65E-03	1.64E-03	1.61E-03	1.58E-03	1.57E-03	1.57E-03	1.57E-03	1.65E-03
Th-234	1.00E-02	9.43E-03	8.26E-03	7.34E-03	6.60E-03	6.00E-03	5.51E-03	1.00E-02
Fission & Activation Prod	5.90E-06	5.81E-06	5.62E-06	5.48E-06	5.36E-06	5.26E-06	5.18E-06	5.90E-06
Solids (Buried on Site):								
Low Level (Shallow)	1.14E+04	1.14E+04	1.14E+04	1.13E+04	1.13E+04	1.13E+04	1.13E+04	1.14E+04
TRU & HLW (Deep) (10^6)	1.10E+01	1.10E+01	1.10E+01	1.10E+01	1.10E+01	1.10E+01	1.10E+01	1.10E+01
Effluents - Thermal (10^9 BTU):	4.57E+03	4.55E+03	4.48E+03	4.48E+03	4.43E+03	4.44E+03	4.44E+03	4.57E+03

TABLE 3-20: EXTENDED BURNUP DISPOSAL IMPACTS FOR THE ONCE-THROUGH FUEL CYCLE

	NUREG-0116	BURNUP (MWD/MT)						
Natural Resource Use:	DISPOSAL	33,000	35,000	40,000	45,000	50,000	55,000	60,000
Land (Acres):								
Temporarily Committed	7.40E+00	7.40E+00	7.23E+00	6.84E+00	7.15E+00	6.63E+00	6.24E+00	5.93E+00
Undisturbed Area	7.30E+00	7.30E+00	7.13E+00	6.75E+00	7.05E+00	6.54E+00	6.16E+00	5.85E+00
Disturbed Area	9.20E-02	9.20E-02	8.99E-02	8.50E-02	8.89E-02	8.24E-02	7.76E-02	7.38E-02
Permanently Committed	7.40E+00	7.40E+00	7.23E+00	6.84E+00	7.15E+00	6.63E+00	6.24E+00	5.93E+00
Overburden Moved (10^6 MT)								
Water (10^6 Gallons):								
Discharged to Air	3.60E-01	3.60E-01	3.52E-01	3.33E-01	3.48E-01	3.23E-01	3.04E-01	2.89E-01
Discharged to Water Bodies								
Discharged to Ground	2.90E+00	2.90E+00	2.83E+00	2.68E+00	2.80E+00	2.60E+00	2.45E+00	2.33E+00
Total	3.26E+00	3.26E+00	3.19E+00	3.01E+00	3.15E+00	2.92E+00	2.75E+00	2.61E+00
Fossil Fuel:								
Electrical Energy (1000 MWH)	1.90E+00	1.90E+00	1.86E+00	1.76E+00	1.84E+00	1.70E+00	1.60E+00	1.52E+00
Equivalent Coal (1000 MT)	7.00E-01	7.00E-01	6.84E-01	6.47E-01	6.76E-01	6.27E-01	5.90E-01	5.61E-01
Natural Gas (10^6 SCF)	1.20E+01	1.20E+01	1.17E+01	1.11E+01	1.16E+01	1.08E+01	1.01E+01	9.62E+00
Effluents - Chemical (MT):								
Gases:								
SO_x	3.50E-02	3.50E-02	3.42E-02	3.23E-02	3.38E-02	3.14E-02	2.95E-02	2.81E-02
NO_x	4.00E-02	4.00E-02	3.91E-02	3.70E-02	3.86E-02	3.58E-02	3.37E-02	3.21E-02
Hydrocarbons	4.00E-04	4.00E-04	3.91E-04	3.70E-04	3.87E-04	3.58E-04	3.37E-04	3.21E-04
CO	2.60E-02	2.60E-02	2.54E-02	2.40E-02	2.51E-02	2.33E-02	2.19E-02	2.08E-02
Particulates	8.80E-05	8.80E-05	8.60E-05	8.13E-05	8.50E-05	7.89E-05	7.42E-05	7.05E-05
Other Gases:								
F								
HCi	1.30E-02	1.30E-02	1.23E-02	1.07E-02	9.62E-03	8.58E-03	7.80E-03	7.17E-03
Liquids:								
SO_4								
NO_3								
Fluoride								
Ca								
Cl								
Na								
NH_3								
Fe								
Tailings Solutions (1000):								
Solids:								
Effluents - Radiological (Curies):								
Gases (Including Entrainment):								
Ra-22f								
Th-230								
Uranium								
Tritium (1000)	1.40E+01	1.40E+01	1.32E+01	1.16E+01	1.04E+01	9.24E+00	8.40E+00	7.72E+0
C-14	1.90E+01	1.90E+01						
Kr-85 (1000)	2.90E+02	2.90E+02	2.73E+02	2.40E+02	2.15E+02	1.91E+02	1.74E+02	1.60E+0
Ru-106								
I-129	1.30E+00	1.30E+00						
I-131								
Fission Prod & Transuranics	5.30E-05	5.30E-05	5.00E-05	4.38E-05	3.92E-05	3.50E-05	3.18E-05	2.92E-0
Liquids:								
Uranium & Daughters								
Ra-226								
Th-230								
Th-234								
Fission & Activation Prod								
Solids (Buried on Site):								
Low Level (Shallow)								
TRU & HLW (Deep) (10^6)	1.10E+01	1.10E+01	1.10E+01	1.10E+01	1.10E+01	1.10E+01	1.10E+01	1.10E+0
Effluents - Thermal (10^9 BTU):	6.60E+02	6.60E+02	6.45E+02	6.10E+02	6.38E+02	5.91E+02	5.57E+02	5.29E+0

TABLE 3-24: EXTENDED BURNUP REPROCESSING IMPACTS FOR URANIUM RECYCLE

	Table S-3A	UNITIZED	BURNUP (MWD/MT) 33,000	35,000	40,000	45,000	50,000	55,000	60,000
Natural Resource Use:									
Land (Acres):									
Temporarily Committed	3.70E+01	9.14E-01	3.70E+01	3.02E+01	2.64E+01	2.35E+01	2.11E+01	1.92E+01	1.76E+01
Undisturbed Area	2.85E+01	8.14E-01	2.85E+01	2.69E+01	2.35E+01	2.09E+01	1.88E+01	1.71E+01	1.57E+01
Disturbed Area	3.50E+00	1.00E-01	3.50E+00	3.30E+00	2.89E+00	2.57E+00	2.31E+00	2.10E+00	1.93E+00
Permanently Committed	1.20E-01	3.43E-03	1.20E-01	1.13E-01	9.91E-02	8.81E-02	7.92E-02	7.20E-02	6.62E-02
Overburden Moved (10^6 MT)	1.00E-01	2.86E-03	1.00E-01	9.43E-02	8.26E-02	7.34E-02	6.60E-02	6.00E-02	5.51E-02
Water (10^6 Gallons):									
Discharged to Air	6.60E+00	1.89E-01	6.60E+00	6.22E+00	5.45E+00	4.85E+00	4.36E+00	3.96E+00	3.64E+00
Discharged to Water Bodies	5.48E+01	1.57E+00	5.48E+01	5.17E+01	4.53E+01	4.02E+01	3.62E+01	3.29E+01	3.02E+01
Discharged to Ground									
Total	6.14E+01	1.75E+00	6.14E+01	5.79E+01	5.07E+01	4.51E+01	4.05E+01	3.68E+01	3.39E+01
Fossil Fuel:									
Electrical Energy (1000 MWH)	4.00E+00	1.14E-01	4.00E+00	3.77E+00	3.30E+00	2.94E+00	2.64E+00	2.40E+00	2.21E+00
Equivalent Coal (1000 MT)	1.50E+00	4.29E-02	1.50E+00	1.41E+00	1.24E+00	1.10E+00	9.90E-01	9.00E-01	8.27E-01
Natural Gas (10^6 SCF)	2.86E+01	8.17E-01	2.86E+01	2.70E+01	2.36E+01	2.10E+01	1.89E+01	1.72E+01	1.58E+01
Effluents - Chemical (MT):									
Gases:									
SO_x	5.40E+00	1.54E-01	5.40E+00	5.09E+00	4.46E+00	3.96E+00	3.56E+00	3.24E+00	2.98E+00
NO_x	2.19E+01	6.26E-01	2.19E+01	2.06E+01	1.81E+01	1.61E+01	1.44E+01	1.31E+01	1.21E+01
Hydrocarbons	5.00E-01	1.43E-02	5.00E-01	4.71E-01	4.13E-01	3.67E-01	3.30E-01	3.00E-01	2.76E-01
CO	5.00E-01	1.43E-02	5.00E-01	4.71E-01	4.13E-01	3.67E-01	3.30E-01	3.00E-01	2.76E-01
Particulates	6.00E-01	1.71E-02	6.00E-01	5.66E-01	4.95E-01	4.41E-01	3.96E-01	3.60E-01	3.31E-01
Other Gases:									
F	5.00E-02	1.43E-03	5.00E-02	4.71E-02	4.13E-02	3.67E-02	3.30E-02	3.00E-02	2.76E-02
HCl	6.00E-04	1.71E-05	6.00E-04	5.66E-04	4.95E-04	4.41E-04	3.96E-04	3.60E-04	3.31E-04
Liquids:									
SO_4	2.00E-02	5.71E-04	2.00E-02	1.89E-02	1.65E-02	1.47E-02	1.32E-02	1.20E-02	1.10E-02
NO_3									
Fluoride									
Ca									
Cl									
Na	9.00E-02	2.57E-03	9.00E-02	8.49E-02	7.43E-02	6.61E-02	5.94E-02	5.40E-02	4.96E-02
NH_3	2.00E-02	5.71E-04	2.00E-02	1.89E-02	1.65E-02	1.47E-02	1.32E-02	1.20E-02	1.10E-02
Fe									
Tailings Solutions (1000):									
Solids:									
Effluents - Radiological (Curies):									
Gases (Including Entrainment):									
Ra-226									
Th-230									
Uranium	3.90E-05		8.74E-05	8.51E-05	8.03E-05	8.09E-05	7.53E-05	7.11E-05	6.79E-05
Tritium (1000)	1.81E+01		1.85E+01	1.84E+01	1.83E+01	1.83E+01	1.80E+01	1.78E+01	1.77E+01
C-14	2.40E+01		1.93E+01	1.90E+01	1.85E+01	1.63E+01	1.58E+01	1.54E+01	1.51E+01
Kr-85 (1000)	4.00E+02		3.34E+02	3.31E+02	3.27E+02	3.17E+02	3.13E+02	3.10E+02	3.08E+02
Ru-106	1.40E-01		1.36E-01	1.33E-01	1.27E-01	1.25E-01	1.18E-01	1.11E-01	1.06E-01
I-129	3.00E-02		2.69E-02	2.68E-02	2.66E-02	2.69E-02	2.66E-02	2.63E-02	2.61E-02
I-131	8.30E-01		9.26E-01	8.81E-01	7.63E-01	6.88E-01	6.27E-01	5.68E-01	5.19E-01
Fission Prod & Transuranics	2.03E-01								
			3.42E-01	3.28E-01	2.98E-01	2.78E-01	2.57E-01	2.39E-01	2.25E-01
Liquids:									
Uranium & Daughters									
Ra-226									
Th-230									
Th-234									
Fission & Activation Prod									
Solids (Buried on Site):									
Low Level (Shallow)									
TRU & HLW (Deep) (10^6)	5.20E-01	1.49E-02	5.20E-01	4.90E-01	4.29E-01	3.82E-01	3.43E-01	3.12E-01	2.87E-01
Effluents - Thermal (10^9 BTU):	7.55E+01		7.55E+01	7.32E+01	7.03E+01	6.83E+01	6.54E+01	6.28E+01	6.08E+01

TABLE 3-29: EXTENDED BURNUP WASTE MANAGEMENT IMPACTS FOR URANIUM RECYCLE

	BURNUP (MWD/MT)						
Natural Resource Use:	33,000	35,000	40,000	45,000	50,000	55,000	60,000
Land (Acres):							
Temporarily Committed	8.94E+00	8.75E+00	8.31E+00	8.66E+00	8.08E+00	7.64E+00	7.29E+00
Undisturbed Area	8.59E+00	8.40E+00	7.97E+00	8.31E+00	7.74E+00	7.30E+00	6.96E+00
Disturbed Area	3.50E-01	3.48E-01	3.43E-01	3.48E-01	3.39E-01	3.33E-01	3.30E-01
Permanently Committed	8.40E+00	8.22E+00	7.78E+00	8.13E+00	7.54E+00	7.11E+00	6.75E+00
Overburden Moved (10^6 MT)	1.50E-03	1.50E-03	1.50E-03	1.50E-03	1.50E-03	1.50E-03	1.50E-03
Water (10^6 Gallons):							
Discharged to Air	6.94E-01	6.84E-01	6.63E-01	6.82E-01	6.50E-01	6.27E-01	6.12E-01
Discharged to Water Bodies	3.88E-02	3.86E-02	3.84E-02	3.83E-02	3.82E-02	3.80E-02	3.80E-02
Discharged to Ground	3.47E+00	3.39E+00	3.22E+00	3.35E+00	3.12E+00	2.95E+00	2.81E+00
Total	4.19E+00	4.11E+00	3.91E+00	4.06E+00	3.80E+00	3.61E+00	3.45E+00
Fossil Fuel:							
Electrical Energy (1000 MWH)	2.29E+00	2.24E+00	2.12E+00	2.22E+00	2.06E+00	1.95E+00	1.85E+00
Equivalent Coal (1000 MT)	8.70E-01	8.07E-01	7.60E-01	7.94E-01	7.38E-01	6.96E-01	6.63E-01
Natural Gas (10^6 SCF)	1.40E+01	1.37E+01	1.29E+01	1.35E+01	1.26E+01	1.18E+01	1.12E+01
Effluents - Chemical (MT):							
Gases:							
SO_x	6.00E-02	5.91E-02	5.70E-02	5.88E-02	5.57E-02	5.36E-02	5.20E-02
NO_x	6.50E-02	6.40E-02	6.17E-02	6.36E-02	6.02E-02	5.78E-02	5.60E-02
Hydrocarbons	2.04E-02	2.04E-02	2.05E-02	2.06E-02	2.03E-02	2.02E-02	2.03E-02
CO	2.90E-02	2.83E-02	2.68E-02	2.80E-02	2.60E-02	2.45E-02	2.33E-02
Particulates	2.01E-02	2.01E-02	2.02E-02	2.02E-02	2.00E-02	1.99E-02	2.01E-02
Other Gases:							
F							
HCl	1.30E-02	1.23E-02	1.07E-02	9.62E-03	8.58E-03	7.80E-03	7.17E-03
Liquids:							
SO_4							
NO_3							
Fluoride							
Ca							
Cl							
Na							
NH_3							
Fe							
Tailings Solutions (1000):							
Solids:	4.20E-01	4.20E-01	4.21E-01	4.23E-01	4.18E-01	4.17E-01	4.19E-01
Effluents - Radiological (Curies):							
Gases (Including Entrainment):							
Ra-226	4.95E-07	4.92E-07	4.82E-07	4.75E-07	4.72E-07	4.70E-07	4.70E-07
Th-230	4.95E-07	4.92E-07	4.82E-07	4.75E-07	4.72E-07	4.70E-07	4.70E-07
Uranium	7.64E-06	7.00E-06	6.86E-06	6.47E-06	6.14E-06	5.89E-06	5.70E-06
Tritium (1000)	6.80E-09	6.41E-09	5.62E-09	5.03E-09	4.49E-09	4.08E-09	3.75E-09
C-14							
Kr-85 (1000)	1.10E-07	1.04E-07	9.08E-08	8.14E-08	7.26E-08	6.60E-08	6.07E-08
Ru-106							
I-129							
I-131							
Fission Prod & Transuranics	3.29E-03	3.11E-03	2.73E-03	2.45E-03	2.19E-03	2.00E-03	1.84E-03
Liquids:							
Uranium & Daughters	5.40E-06	5.09E-06	4.46E-06	4.00E-06	3.58E-06	3.24E-06	2.98E-06
Ra-226							
Th-230							
Th-234							
Fission & Activation Prod	4.50E-06	4.49E-06	4.47E-06	4.45E-06	4.43E-06	4.42E-06	4.41E-06
Solids (Buried on Site):							
Low Level (Shallow)	1.06E+04	1.06E+04	1.06E+04	1.06E+04	1.06E+04	1.06E+04	1.06E+04
TRU & HLW (Deep) (10^6)	1.10E+01	1.10E+01	1.10E+01	1.10E+01	1.10E+01	1.10E+01	1.10E+01
Effluents - Thermal (10^9 BTU):	6.89E+02	6.74E+02	.39E+02	6.67E+02	6.20E+02	5.86E+02	5.58E+02

TABLE 3-33:

One Hundred Year Rn-222 Source Term (Ci/RRY)

Source	NRC*	Extended Burnup (MWD/MT)						
	33,000	33,000	35,000	40,000	45,000	50,000	55,000	60,000
Mining	4060	4462	4439	4350	4283	4261	4238	4238
Milling and Active Piles	1100	1299	1202	1178	1161	1154	1148	1148
Unreclaimed Open Pit	3700	4066	4044	3963	3904	3881	3836	3836
Stabilized Piles	10-100	1099	1093	1071	1055	1049	1044	1044
Total	8960	10926	10778	10562	10403	10345	10266	10266

* From NUREG - 0972

TABLE 3-34:

ENVIRONMENTAL RELEASES OF Tc-99

Burnup (MWD/MT)	Throughput (Ci/RRY)	Gas (Ci/RRY)	Liquid (Ci/RRY)
33,000*	500	0.14	1.16
33,000	462	0.13	1.072
35,000	459	0.129	1.065
40,000	453	0.127	1.051
45,000	441	0.123	1.023
50,000	434	0.122	1.008
55,000	428	0.120	0.999
60,000	424	0.119	0.984

* NRC Staff, Susquehanna Operating License Hearing

TABLE 5-1:

ENVIRONMENTAL DOSE COMMITMENT (Man-Rem)

(One Hundred Year Risk Equivalent Whole Body Dose Commitment)

Source	NRC*	Burnup (MWD/MT)						
	33,000	33,000	35,000	40,000	45,000	50,000	55,000	60,000
Table S-3 Releases	650	811	807	794	770	760	751	747
Rn-222 Releases								
Mining	630	676	672	659	649	645	642	642
Milling & Active Piles	170	181	180	177	174	173	172	172
Unreclaimed Open Pit	550	610	607	595	585	582	579	579
Stabilized Piles	15	165	164	161	158	157	156	156
Total Rn-222	1365	1632	1624	1591	1566	1558	1550	1550
Tc-99 Releases								
Gaseous	3.7	3.4	3.4	3.4	3.2	3.2	3.2	3.2
Liquid	1.10	1.02	1.01	1.00	0.97	0.96	0.94	0.93
Total Tc-99	4.8	4.42	4.41	4.40	4.17	4.16	4.14	4.13
Total Releases	2020	2447	2435	2389	2340	2322	2305	2301

* Source: NUREG-0972

S-4 Summary Table - All Transportation Modes

TABLE 4-1:

SUMMARY OF THE ENVIRONMENTAL IMPACTS FROM TRANSPORTATION OF RADIOACTIVE MATERIALS (TABLE S-4) FOR EXTENDED BURNUP

	1 Current S-4	2 33,000	3 35,000	4 40,000	5 45,000	6 50,000	7 55,000	8 60,000
Heat (BTU/hr)	250,000	250,000	250,000	250,000	250,000	250,000	250,000	250,000
Weight (lbs/truck)	73,000	73,000	73,000	73,000	73,000	73,000	73,000	73,000
(tons/rail)	100	100	100	100	100	100	100	100
Traffic								
Truck (per day)	1	1	1	1	1	1	1	1
Rail (per month)	3	3	3	3	3	3	3	3
Exposure								
Workers (persons)	200	200	200	200	200	200	200	200
Dose (millirem/person)	0-300	0-300	0-300	0-300	0-300	0-300	0-300	0-300
Total Dose (Man-Rem)	4	4	4	4	3.5	3.5	3.5	3
Public (onlookers)	1100	1100	1100	1100	1100	1100	1100	1100
Dose (millirem/person)	0.003-1.3	0.003-1.3	0.003-1.3	0.003-1.3	0.003-1.3	0.003-1.3	0.003-1.3	0.003-1.3
(along route)	600,000	600,000	600,000	600,000	600,000	600,000	600,000	600,000
Dose (millirem/person)	0.0001-0.06	0.0001-0.06	0.0001-0.06	0.0001-0.06	0.0001-0.06	0.0001-0.06	0.0001-0.06	0.0001-0.06
Total Dose (Man-Rem)	3	3	2.6	2.6	2.5	2.1	2.1	2.1
Accidents								
Radiological Effects	Small	Small	Small	Small	Small	Small	Small	Small
Common Causes (years between deaths)	100	126	131	145	157	176	190	202
(years between injury)	10 $475	7 $475	8 $456	8 $419	9 $382	10 $340	11 $315	12 $296

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ATOMIC INDUSTRIAL FORUM
NATIONAL ENVIRONMENTAL STUDIES PROJECT (NESP)

STUDY ON "A TECHNICAL BASIS FOR MEETING THE WASTE FORM STABILITY REQUIREMENTS OF 10 CFR 61"

PRESENTED TO
NRC ACRS SUBCOMMITTEES ON
WASTE MANAGEMENT AND REACTOR RADIOLOGICAL EFFECTS
JANUARY 16, 1986

JAMES CLANCY
PUBLIC SERVICE ELECTRIC AND GAS COMPANY (NJ)

BACKGROUND

- 10 CFR 61 ISSUED AS FINAL RULE DECEMBER 1982; BECAME EFFECTIVE DECEMBER 1983
- BRANCH TECHNICAL POSITIONS ON WASTE CLASSIFICATION AND WASTE FORM STABILITY PUBLISHED IN MAY 1983
- "WASTE FORM" BTP SUGGESTS TO UTILITIES THAT CERTAIN TESTS BE PERFORMED ON LLW
- FEBRUARY 1985 VERSION OF BTP EXISTS IN DRAFT REG GUIDE FORMAT

BACKGROUND (CON'T.)

- TECHNICAL EFFORT IS NEEDED TO EXAMINE DRAFT REG GUIDE VERSION FOR PRACTICALITY, EFFECTIVENESS, BENEFIT IN PROTECTING PUBLIC HEALTH AND SAFETY
- ULTIMATE REG GUIDE SHOULD REFLECT INTENT AND SPIRIT OF PART 61
- STUDY CAN BE USED AS TECHNICAL SUPPORT BY LICENSEES, INDUSTRY GROUPS SUCH AS AIF, EEI UTILITY NUCLEAR WASTE MGMT. GROUP (UNWMG), OTHERS

ORIGINS OF IDEA FOR STUDY

- LICENSEE CONCERNS ABOUT INTERPRETATION OF PART 61
- AIF AND UNWMG/LLW SUBCOMMITTEE CONCERNS ABOUT WASTE FORM STABILITY TESTING
- SCIENTIFIC AND TECHNICAL COMMUNITY CONCERNS ABOUT VALIDITY AND APPROPRIATENESS OF TESTS OUTLINED IN DRAFT REG GUIDE
- ANTICIPATED ISSUANCE OF REG GUIDE FOR COMMENT

MAJOR CONCERN ABOUT DRAFT REG GUIDE

- ORIGINAL DISCUSSION ON PART 61 INVOLVED "PRESCRIPTIVE" *VERSUS* "PERFORMANCE" REQUIREMENTS
  - PRESCRIPTIVE, E.G., "MUST BE POLYETHYLENE"
  - PERFORMANCE, E.G., COMPRESSION, LEACH TESTS, ETC.
- PART 61 RELIES ON "PERFORMANCE" BASIS

TASK FORCE BELIEVES THAT PERFORMANCE ORIENTATION IS CORRECT, BUT SOME SPECIFIC TESTS CHOSEN MAY BE INAPPROPRIATE

EXAMPLES

- COMPRESSION TEST
  - NO TEST FOR ELASTIC SYSTEMS, E.G., POLYETHYLENE
- BIODEGRADATION TEST
  - CULTURES REQUIRED ARE NOT INDIGENOUS TO TRENCHES AND ARE AEROBIC

OTHER CONCERNS ABOUT DRAFT REG GUIDE

- MANY TESTS UNNECESSARILY INCREASE WORKER EXPOSURES AND ARE NOT CONSISTENT WITH ALARA CONCEPT

- SOME SELECTIVE ENFORCEMENT OF BACKFILL REQUIREMENTS

- GENERATORS, NOT SITE OPERATORS, ARE RESPONSIBLE FOR BACKFILL ASSURANCE

- POTENTIAL OVERLAP OF A NEW REG GUIDE ON PCP WITH WASTE FORM TESTING

- TESTS DO NOT REPLICATE ENVIRONMENT OF DISPOSAL TRENCH

OTHER CONCERNS ABOUT DRAFT REG GUIDE (CON'T.)

- CRITERIA FOR WASTE STREAM TYPE CHANGE; MAY RESULT IN EXPENSIVE, UNNECESSARY RETESTING
- MEETING TEST REQUIREMENTS MAY REDUCE LOADING RATES AND THUS INCREASE WASTE VOLUMES
- FORMULATING NEW WASTE FORM TO PASS TESTS MAY REQUIRE EXPENSIVE ADDITIVES
- TEST RESULTS ARE DIFFICULT TO REPRODUCE FOR VALIDATION

PURPOSE OF STUDY

- DEVELOP TECHNICAL BASES FOR ESTABLISHMENT OF REALISTIC SAMPLING/TESTING REQUIREMENTS FOR WASTE FORM STABILITY
- PROVIDE ALTERNATIVE PROPOSAL(S) TO DEMONSTRATE LICENSEE COMPLIANCE WITH PART 61
- GIVE GUIDANCE ON STEPS REQUIRED TO MEET INTENT OF PART 61 ITSELF
- PROVIDE INFORMATION THAT CAN FORM BASIS FOR APPROPRIATE REG GUIDE ON WASTE FORM

GENERAL SCOPE OF STUDY

- EVALUATE BASES AND INTENT OF PART 61 ITSELF
- EVALUATE RESULTS OF INDUSTRY TESTS AND OTHER DATA
  - DOE
  - NBS
  - VENDORS
  - TOPICAL REPORTS
  - UTILITY, VENDOR, DISPOSAL SITE OPERATOR EXPERIENCES
  - STATE REQUIREMENTS
  - COST/BENEFIT ANALYSES

GENERAL SCOPE OF STUDY (CON'T.)

- EVALUATE APPROACH TAKEN IN DRAFT REG GUIDE
  - FEASIBLE ?
  - COST/BENEFICIAL ?
  - TECHNICALLY JUSTIFIABLE ?
  - DEPENDABLE ?
- PREPARE ALTERNATIVE TO DRAFT REG GUIDE THAT WILL DEMONSTRATE COMPLIANCE

NESP TASK FORCE

CHAIRMAN: JAMES CLANCY
PUBLIC SERVICE ELECTRIC & GAS (NJ)

- 13 UTILITIES
- A,E/C FIRM
- NSSS VENDOR
- 2 WASTE DISPOSAL SITE OPERATORS
- 3 CONSULTANTS
- NUCLEAR INSURER
- NATIONAL LAB LIAISON
- EEI/UNWMG LIAISON
- NRC LIAISON (L/L WASTE BRANCH, NMSS)
- EPRI LIAISON

GENERAL APPROACH FOR DATA GATHERING

- LATEST VERSION OF DRAFT REG GUIDE
- PUBLISHED TECHNICAL LITERATURE
- NRC PUBLIC DOCUMENT ROOM SEARCHES
- PUBLIC DATA IN L/L WASTE BRANCH, NMSS OF NRC
- RESOURCES OF TASK FORCE, UNWMG, VENDORS, CONSULTANTS, NATIONAL LABS, NRC, EPRI

STATUS OF STUDY

- RFP UNDER REVIEW BY TASK FORCE
- BIDDERS LIST ESTABLISHED BY NOMINATIONS FROM TASK FORCE
- RFP ISSUANCE EXPECTED SPRING 1986
- AWARD FOLLOWING TASK FORCE ADJUDICATION AND RECOMMENDATION

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AIF/NESP-025

STUDY OF A RECORDKEEPING SYSTEM FOR IN-PROCESSING OF TRANSIENT WORKERS AT NUCLEAR POWER PLANTS

Prepared for the
National Environmental Studies Project
of the
Atomic Industrial Forum, Inc.

by
John P. Hageman
John M. Artz
Glenn B. Humphress

June 1982

QUALITY ASSURANCE SYSTEMS AND ENGINEERING DIVISION
SOUTHWEST RESEARCH INSTITUTE
6220 Culebra Road
San Antonio, Texas 78284

PREFACE

Utilities are currently responsible for establishing their own in-processing procedures for transient workers at nuclear power plants. While each system may have considerable merit, the general lack of compatibility among them poses a continuing problem for the industry. Much time is lost in waiting for and verifying exposure histories, medical records, and security clearances. While many training requirements are necessarily site-specific, effort is also expended in reteaching basic material to experienced workers. These delays, which can keep a worker unproductive for several days, increase administrative cos' decrease morale, and, most significantly, have the potential to lengthen down time.

This report was undertaken by NESP at the behest of the AIF Committee on Power Plant Design, Construction and Operation. It examines the feasibility of establishing a centralized recordkeeping system as a way of expediting in-processing. The result, based on a potential user survey conducted early in the study and a careful consideration of the problems which must be overcome, is a recommended design for a system which, if adopted by the industry, should be both cost effective and acceptable to those who must use it.

Such a system cannot, however, spring into being fully formed. This study recommends a phased approach beginning with a detailed examination of the format and data requirements for worker exposure records, perhaps by the AIF Committee on Power Plant Design Construction and Operation or another appropriate industry organization. Should this prove successful the system could gradually be expanded to include security, medical and training records. Before anything can be accomplished, however, the details of many practical problems will have to be worked out, especially those relating to the degree of standardization of data necessary, and to regulatory acceptance. This report does not solve the problems of in-processing transient workers but, by identifying both the advantages and the pitfalls, it does provide a base from which the industry can move toward practical solutions.

This study was designed and directed by the NESP Task Force listed on the inside front cover. The cooperation of the utilities who participated in the telephone questionnaire (page IV-6) is most gratefully acknowledged. NESP also wishes to express appreciation to the Institute of Nuclear Power Operations, Public Service Electric and Gas Company, and Commonwealth Edison Company for hosting meetings between our contractor and industry representatives to discuss the requirements of a central recordkeeping system, and to Logic Systems Inc., the U.S. Air Force, and the ASTM Task Group on Industry-Wide Control of Personnel Records for Access to Nuclear Facilities for information they shared on the recordkeeping systems they were using or had developed.

A. Scott Leiper
Project Manager, NESP
Atomic Industrial Forum, Inc.

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II. EXECUTIVE SUMMARY

In response to a problem facing the owners of nuclear power stations, the National Environmental Studies Project of the Atomic Industrial Forum developed a Request for Proposal for the study of recordkeeping for in-processing of transient and temporary workers* at nuclear power plants. The problem facing the nuclear power plants was how to efficiently clear and process the large number of workers required for refueling maintenance or special outages. The major problem with the current system is that clearance of the workers is the responsibility of the licensee, while the success of this in-processing effort depends on the cooperation of the workers' past employers over which the licensee has little control. The issue is further complicated by the fact that different licensees have different requirements for the form and extent of necessary documentation. Worker clearances can take several days and require many duplicate efforts, resulting in lost worker productivity, greater staffing costs and, ultimately, more costly outages. The solution under study consisted of a cooperative effort by utilities for developing a common system with a central computerized database which would be available to participating plants in order to obtain basic historical data on temporary and transient workers.

The Request for Proposal was issued on April 22, 1981, and on August 4, 1981, the contract was awarded to SwRI. The objectives of the proposed study were:

(1) To outline the requirements for operating a central computerized recordkeeping system.

(2) To explore potential problems and how they may be overcome.

(3) To provide basic cost and benefit information useful to plant operators for decisionmaking on the establishment of computerized recordkeeping.

SwRI began the study with the following questions in mind:

(1) Is such a system economically feasible?

(2) Is a system of this nature feasible in the environment in which it must operate?

(3) Is a system of this type acceptable to the potential users?

(4) What must the system do to meet the needs of the users?

With these four questions answered, SwRI would then design a system to meet the user requirements while overcoming the major environmental problems.

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*Transient and temporary workers are defined in Chapter IV, Section D.

The information gathering activity began with a user survey designed to gather information about the environment in which a centralized recordkeeping system would be developed and operated. Potential users of the system were surveyed to determine both their willingness to participate in a system of this type and the status of their current operations. Results of the survey indicated that the potential users were receptive to a centralized system and that they were not adverse to computerization. However, the survey also brought several obstacles to light. Much concern was expressed regarding the low level of standardization of in-processing procedures and requirements among plants. Many respondents felt, correctly so, that the current level of standardization was not sufficient for a centralized operation. Further concerns were expressed about the NRC's approval of the system, the necessary level of participation, the privacy of the data, and quality assurance practices needed to ensure the integrity of the data. Technical misgivings were also expressed as the respondents questioned the accuracy, timeliness, completeness and currentness of the data in a centralized system. These issues must be resolved in order to ensure the success of such a system.

With these issues and a host of others in mind, SwRI developed the system requirements and a large number of alternative system configurations. These alternatives were presented to user representatives at three field meetings in Atlanta, Georgia; Newark, New Jersey; and Chicago, Illinois. User reaction to the alternatives was recorded informally by noting comments and formally by having the users fill out forms which were then fed into a computerized decision model to measure their preferences with regard to the system alternatives. The purpose behind assessing user preference was to compare the preferred alternative with the alternative which was deemed optimal by the system designer through a cost/benefit comparison. However, the users selected the optimal alternative in almost all aspects.

Potential barriers to implementation were uncovered during the study. There is currently little standardization in recordkeeping practices throughout the industry. Though a central system would not require complete standardization throughout, it would require at least a standard interface between participating plants. The regulatory climate also caused concern. Many potential participants felt that the success of the proposed system would depend entirely on NRC acceptance. These and other concerns, such as legal and insurance impact, worker impact and industry acceptance, were investigated in detail. These issues constitute barriers to be overcome in order to successfully implement the system, but none were considered insurmountable.

The development effort should begin with an effort to standardize the records used in clearing temporary workers and to determine the level of detail for computerized information. The recommended system should be a centralized distributed computer system which provides services for all worker records not adequately serviced by existing systems. It should begin with exposure records and expand in a phased approach to meet the full requirements of the users for exposure, security, training and medical records. This phased approach will reduce implementation time and promote user acceptance. The cost of absolute standardization of all plant procedures and documentation related to in-processing was not considered in the feasibility cost or cost savings estimates.

The system should be located in a central facility which is capable of providing secure records management for source documents and system backup media. The central facility should be staffed by a system administrator, an independent industry auditor, and a system development team. The user will interface with the system through a variety of terminal options which include hardcopy terminals, CRT screens, and intelligent terminals, or via an in-house computer. The user will request records for workers shortly before or as they come into the plant, and the system will supply the necessary information, if it is in the system. When a worker leaves the plant, exposure information will be supplied to the system to update the worker's records.

Cost estimates were developed for the recommended system which indicated that operating expenses plus the yearly allocation of the sunk development expenses would result in an annual operating cost of

$$\$55,000 + \$6,084P$$
$$(P = \text{number of participating plants})$$

per year for the next five years. This in turn becomes an average of

$$\frac{\$55,000}{P} + \$6,084$$

per year per participating plant. Breakeven analysis was used to determine the minimum number of participants required for economic feasibility. Other factors affecting the breakeven level were also examined; for example, with a small number of participants (three to four), geographic proximity becomes important. If the required number of participants for economic feasibility is met but those participants are sufficiently dispersed so that they do not use each other's information then the purpose of the system is defeated. Further, the cost savings are based on averages, and a small number of participants would have to experience at least better-than-average cost savings for in-processing cost reduction.

Breakeven analysis based on estimated levels of contribution indicated that the system would be feasible for as few as five participants; breakeven analysis based on estimated cost savings indicated the feasibility number to be three. Further analysis of cost savings showed that at a participation level of 37 plants, each plant would have to reduce its in-processing costs by 2.2% in order to cover the cost of the central system. It should be noted, however, that while the system may be economically feasible with three to five participating plants, it may not derive the intended benefits of shared information unless those participating plants are geographically configured in such a way as to be in need of each other's information.

The conclusion of this report is that if the recommended system can resolve the issues raised in the user survey, then it would be economically feasible and that nuclear utilities, vendors, labor pools and individual workers would benefit from system implementation. If the recommended design is followed, it should be acceptable to the users and successful in the environment in which it must operate.

III. BACKGROUND

One of the problems confronting the owners of nuclear power stations is how to efficiently in-process the large numbers of temporary workers required for refueling or special outages. In-processing involves determining the worker's previous occupational exposure history, checking his security clearance, determining his health status, checking his ability to wear and use respiratory protective equipment, and determining his training and qualification for work in controlled radiation areas. In-processing is the responsibility of the licensee, and depends on the cooperation of the worker's present and past employers and other past contracting licensees. It is complicated by the fact that different utilities keep the required information on different forms in varying degrees of detail. In-processing one worker can often take several days and result in a loss of productive time as well as increased staffing costs for the plant operator.

One possible solution to this problem is a cooperative effort by utilities in developing a common or central data base that can be accessed (with discretion) to obtain basic historical data on a worker. A central recordkeeping system (CRS) is envisioned for this purpose. Such a system could help reduce in-processing time and cost for temporary workers.

This report provides information on the potential benefits and costs of a CRS. The following paragraphs present a chronological summary of the events leading to the study documented in this report.

A. Detailed Chronology

In August 1977 a construction trades committee sent a letter to the Edison Electric Institute (EEI) Construction Committee regarding problems with occupational radiation exposure and other issues pertinent to transient craft workers. In response, the EEI Committee undertook a project to establish:

(1) A common file for physical examination records of craft labor.

(2) A repository of radiation exposure records for craft labor.

(3) Procedures for obtaining security background checks for craft labor and the maintenance of a filing system.

(4) Revisions in local union practices to provide "qualified whole workmen," to include skills, training, health physics qualification, radiation records and background checks.

Subsequently, the EEI Construction Committee decided that the interest of the nuclear industry could best be served if member companies having operating nuclear power plants subscribe to a single outside service for record retention and information retrieval under the control of subscribing members. Approximate costs at that time for establishing the repository for records and its maintenance were $9,000 per month to be shared by

all subscribers, with an additional cost of less than $3 for each transaction. A questionnaire was distributed in order to evaluate needs and possible participation. Of the EEI member companies operating nuclear plants, 80 percent responded and 65 percent indicated they would subcontract to this service. The results of the questionnaire clearly indicated that further effort should be made in the matter of centralized recordkeeping. Vendors were invited to submit proposals, and one was selected for consideration. At that juncture the EEI Construction Committee turned over the completion of the project to the EEI Utility Occupational Radiation Standards Group (UORSG). It was felt that the UORSG, being staffed with health physics personnel, would be more competent to develop specifications for radiation exposure records and reports.

In January 1979, the UORSG, by unanimous vote, determined that efforts in centralized recordkeeping on radiation exposures, health evaluation, and security background checks for transient workers were outside the scope of the UORSG. In March 1979, the EEI Construction Committee terminated this project because they no longer thought there was a great need for such a system.

In October 1979, the Steering Group of the Atomic Industrial Forum's (AIF) Committee on Power Plant Design, Construction and Operation was briefed on the delays and wasted man-hours that could be saved by more efficient in-processing of workers at nuclear stations. The AIF Committee decided to undertake a project to improve worker in-processing and was subsequently briefed on the EEI Construction Committee's previous efforts.

In July 1980, the AIF Committee on Power Plant Design, Construction and Operation agreed that there was a large potential payoff to be gained from a computer-based central data file. A draft Request for Proposal to candidate vendors was developed, using a phased approach. Phase A would be a study to define detailed requirements and a cost/benefit analysis for a central management system. Phase B would be implementation of Phase A. Funding for Phase A was provided by the AIF's National Environmental Studies Project (NESP) with industry input to the NESP Task Force consisting of NESP staff and representatives from utilities, the American Nuclear Insurers (ANI), the Institute of Nuclear Power Operations (INPO), the Nuclear Regulatory Commission (NRC), Labor organizations, and consultant companies.

A recent related effort was begun by the American Society for Testing and Materials (ASTM) E10-03-02 Task Group for Industry-wide Control of Personnel Records for Access to Nuclear Facilities. Objectives were to review the CRS concept and recommend standardized records for all radiation workers. The ASTM Task Group met in Houston, Texas, on January 18-21, 1982 to further define its scope and proceed with recommendations. The Task Group has reviewed this report in draft form to include issues from this study which affect standardization of records for nuclear power plant workers.

B. Project Initiation

The AIF Committee on Power Plant Design, Construction and Operation recommended that NESP undertake a project to conduct the Phase A analysis of multiple user requirements for an in-processing system. The AIF Committee felt strongly that this program has the potential to provide significant benefits in increased productivity and cost savings, as well as added assurances of worker health and safety.

As a result of the recommendations of the AIF Committee, the NESP issued a Request for Proposal on April 22, 1981 requiring proposals to be submitted by May 29, 1981. A meeting of prospective bidders was held on May 14, 1981 and proposals were submitted to the NESP Project Manager, Dr. A. Scott Leiper. Southwest Research Institute was awarded the contract and began authorized project work on August 4, 1981.

AIF/NESP-028

CHARACTERIZATION OF THE TEMPORARY RADIATION WORK FORCE AT U.S. NUCLEAR POWER PLANTS

Prepared for the
National Environmental Studies Project
of the
Atomic Industrial Forum, Inc.

by

JACK FAUCETT ASSOCIATES, INC.
Chevy Chase, Maryland

Michael F. Lawrence
Jonathan Skolnik

and

S C & A, INC.
McLean, Virginia

Sanford C. Cohen
David J. Goldin

May 1984

PREFACE

Regardless of the industry or type of organization, prudent management of an available labor supply is necessary to accomplish certain functions without carrying an overhead of workers who are in demand only at specific times. Agriculture, retail sales, construction, manufacturing, education — each has cyclical requirements for extra personnel. The employment patterns in commercial nuclear power plants have these same labor demand characteristics.

The complexity of nuclear power plants requires each utility licensee to have a permanent force of highly skilled workers tc ensure that all plant systems operate safely, efficiently and within regulatory requirements. The supply of such personnel is finite and, as new plants come on line, it becomes increasingly important for each nuclear power plant to train and maintain an adequate permanent work force dedicated to routine operation. However, some plant activities, particularly those associated with scheduled outages, require large numbers of extra personnel, many of whom must have skills and equipment not possessed by the plant's permanent work force. This necessary role is filled, in part, by what are commonly known as "temporary workers."

The nuclear industry has received criticism for using temporary workers, with the implication that workers who seek and obtain non-permanent jobs at nuclear power plants are not treated in a manner similar to permanent workers with regard to skill training, radiation protection instruction, and careful and proper radiation exposure monitoring. In reality, each nuclear utility licensee maintains records on the hiring, training, radiation exposure, health, and security status of all its employees, both permanent and temporary, including contractual workers. Radiation exposures are monitored and controlled in compliance with 10 CFR 20, "Standards for Protection Against Radiation." Each employee, regardless of category, is trained in radiation protection and routinely advised of his or her exposure record under provisions of 10 CFR 19, "Notices, Instructions, and Reports to Workers." The licensee is responsible for complying with these regulations by monitoring exposures and by providing supervision and guidance to all workers. It is the worker's responsibility to follow radiation protection guidance in seeking employment by reporting all past occupational radiation exposure.

Until now, little comprehensive research has been undertaken about the relationship of temporary workers to the nuclear power industry as a whole. Although each licensee knows its own situation, no industry-wide profile has previously been developed. Rather than depend upon the personal opinions of individuals, the Task Force responsible for this study intended that a broad base of information be tapped. Readers of this report will note that subjective conclusions and recommendations are absent. Its purpose was to collect and present previously fragmented data in an understandable manner, in order to help clarify the current role of temporary workers in the nuclear power industry.

The investigators and Task Force for this study wish to thank the following individuals, among others too numerous to list, who generously donated time in developing exposure and other data for the report: Elizabeth Donnelly of Northeast Utilities (now of Southern California Edison Company); Reginald Rodgers of Northeast Utilities; James Duplissey of The Catalytic Corporation; Larry Gardner of Florida Power and Light Company; David Helton of Yankee Atomic Electric Company; Don Howard, Jim Ramage, and Bob Pavlick of Commonwealth Edison Company; Steve Hutson of Baltimore Gas and Electric Company; and Bill Holloran of The Atlantic Group. Dave Harward of the AIF staff provided valuable historical data and helpful technical and editorial suggestions, as did Scott Leiper of NESP. Harry J. Chmelynski of Jack Faucett Associates served as statistical advisor. Finally, NESP would like to acknowledge the cooperation of the U.S. Nuclear Regulatory Commission Staff in providing data and constructive criticism throughout this study.

Malinda Renner
Assistant Project Manager
National Environmental Studies Project

EXECUTIVE SUMMARY

The nuclear power industry is employing an increasing number of non-permanent workers who perform short-term tasks involving radiation exposure at nuclear power plants. These non-permanent radiation workers have been variously referred to as "temporary," "transient," and "temporary-transient." There exists confusion among these terms, and they are frequently misapplied, both within and outside of the nuclear industry. Moreover, there existed little data concerning the characteristics of the non-permanent radiation work force, although a considerable amount of media coverage has been devoted to some selected members of that work force.

The purpose of this study was to define and characterize the non-permanent radiation work force. The study attempted to determine why temporary workers are required, how they are supplied, and their demographics. Moreover, the study compared the training in radiation protection received by permanent and temporary radiation workers, and developed exposure profiles for radiation workers by category. Radiation exposures were also compared between categories of workers for specific high-exposure tasks. The principal findings are summarized below.

It is expected that the information developed in this report will be useful to government and industry officials for providing information on the temporary worker to the media and the general public. Moreover, power plant operational and radiation protection personnel may find the data useful in their planning for radiation protection training and ALARA ("As Low As Reasonably Achievable") programs, and in the design of management information systems.

Why Temporary Workers are Required

Operating nuclear power plants require support from temporary workers to complete assignments in: special nuclear skill areas such as control rod drive maintenance and repair, steam generator repair and maintenance, and health physics technical support; non-nuclear skill areas such as pipefitting and welding; general plant support such as janitorial services; and administrative and management support. This support is generally required by a plant during an outage so that refueling, design modifications, maintenance, inspections, and other activities can be undertaken during that time. Major scheduled and forced outages may last from fifty to sixty days and require on the

average about 750 temporary workers for refueling outages and 250 temporary workers for other types of outages. These estimates vary substantially from utility to utility and outage to outage, based on individual utility employment practices and the tasks to be accomplished during the outage. In 1982, 42 refueling outages and more than 70 major non-refueling outages were undertaken.

How Temporary Radiation Workers are Supplied

Nuclear power plant workers were subdivided into groups based on their supply origin. This resulted in five categories of employees which were defined as follows:

1. Utility Station Employee - Permanent employee of the station;

2. Utility Station Temporary Employee - Individual hired by the station or the utility for a specific project (e.g., an outage), and not with the intent of permanent employment;

3. Utility Non-station Employee - Permanent employee of the utility, who is temporarily assigned for a specific project (e.g., an outage) to the station;

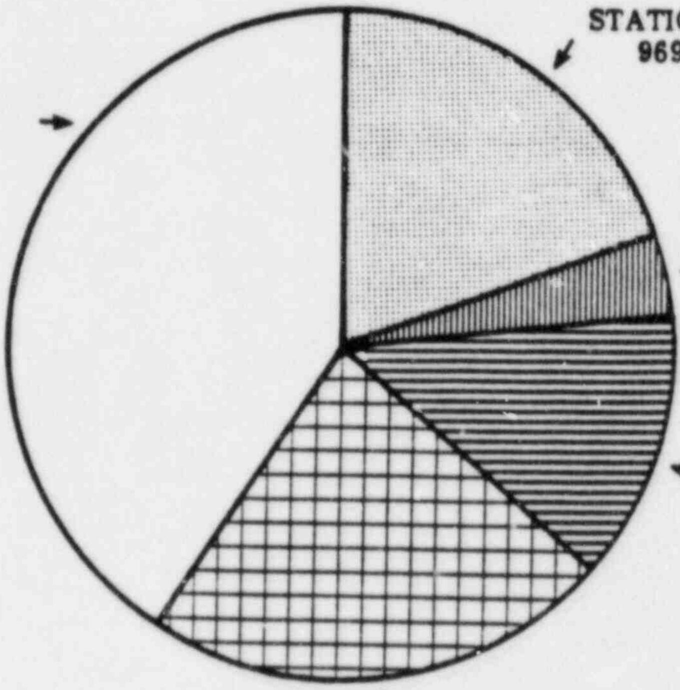
4. Contractor Permanent Employee - Individual in the employ of a contractor, not on the payroll of the station or utility, and hired on a permanent basis; i.e., no explicitly established or implied termination date;

5. Contractor Temporary Employee - Individual in the employ of a contractor, not on the payroll of the station or utility, and hired or contracted for a specific assignment, or with a specific or implied termination date.

In 1981, approximately 116,000 workers at nuclear power plants were monitored for radiation exposure. This study concentrated on the roughly 50,000 of these workers, denoted herein as "radiation workers," who received occupational doses in excess of 0.1 rem/year. The numbers and percentages of these radiation workers in each of the above employee categories are displayed below:

RADIATION WORKERS EXPOSED TO GREATER THAN 0.1 REM

(1981)



The above chart illustrates that approximately 81 percent of the radiation work force were temporary to the station. Approximately 45 percent of the radiation work force were temporary to their employers.

Demographics of Temporary Radiation Workers

The workers temporary to the station were characterized in terms of age, sex, geography, crafts, duration of employment, and recruitment. There are a smaller number of temporary workers of ages less than 20 and greater than 60, and a greater number in the 31-40 year-old bracket, in comparison with the total U.S. work force. Of the temporary radiation workers, 13.4 percent are female, somewhat lower than the U.S. average, but higher than the average in other industries such as construction. Contractors employ a significantly higher proportion of female radiation workers than do utilities. Contractor employees are the most diverse geographically, with 34.5 percent (contractor temporaries) and 41.2% (contractor permanent) from outside of the state in which the plant is located, whereas only 6.1 percent and 17.4 percent of utility temporary and utility non-station employees are from out-of-state.

Substantial numbers of electricians, pipefitters, and mechanics belong to the temporary radiation work force. Utility temporary employees contain the largest proportion of laborers, whereas permanent contractor and utility non-station employees comprise the smallest proportion of laborers.

Most temporary contractor personnel are hired out of the local union halls. For most categories of expertise, pay scales are comparable to other places of employment, such as fossil- fired generating stations, although the hours of available work per worker may be greater.

Training of Temporary Radiation Workers in Radiation Protection

Training in radiation protection by utilities is substantially identical for permanent station workers and for all four categories of temporary radiation workers. However, failure rates on radiation protection training examinations are higher for temporary workers. The NRC requires the licensed utilities, but not their contractors, to train employees in radiation protection; however, approximately 40 percent of those contractors responding to a survey conducted for this study provided some training to their own employees.

Radiation Exposures Received by Temporary Radiation Workers

Radiation exposure profiles of workers by category were synthesized from NRC statistics, information obtained from utility and contractor surveys, and data extracted directly from work permits at several stations. With the exception of non-station utility employees, collective exposures apportion roughly as the estimated proportions of numbers of workers presented earlier in this summary. Non-station utility employees received less collective exposure than their proportion of the total work force in each of the past three years. This result is corroborated by the average exposure data, which indicate that non-station utility employees received, on the average, only two-thirds of the mean exposure to all categories of workers. In two of the last three years, contractor employees received slightly higher exposures (by roughly 20 percent), on the average, than permanent station employees; in 1980, contractor employees and permanent station employees received comparable average exposures. From the contractor survey, it was determined that contractor permanent employees received approximately 35 percent higher average exposures in 1982 than contractor temporary employees.

During the course of steam generator repair and maintenance over the past three years, contractor employees received in excess of 90 percent of the total collective exposure and substantially higher average exposures than permanent station employees. Similarly, contractors received approximately 70 percent of the total collective exposure incurred during decontamination jobs. However, the reverse was true in the course of control rod drive repair/maintenance and waste handling jobs. For both of these jobs, permanent station personnel received approximately 60 percent of the total collective exposure, with no discernable differences in average exposures. In three of the four jobs, non-station utility personnel received trivial collective exposures (approximately 2 percent); for control rod drive repair/maintenance, non-station utility personnel received 9 percent of the total collective exposure. For all jobs, average and maximum exposures to non-station utility personnel were substantially lower than to the other categories of workers.

Charting the Course for Future Research

This study has significantly advanced the state of knowledge and understanding of the temporary radiation work force. However, some questions still remain unanswered. For example, the study was unable to develop data on the maximum exposures of radiation workers by category of worker who undertook certain jobs such as steam generator repair and maintenance. As various utilities upgrade and automate their current radiation work permit information systems, analysts will be able to extract such information which will be useful in radiation protection planning.

The data for this study were developed from surveys of those who hire nuclear power plant workers, and from the various regulatory and management information data bases developed by utilities and regulators. Much additional information on the radiation work force could be obtained directly from workers. Data on worker attitudes on risk, employment alternatives, income, anticipated future work, and many other topics of interest could only be collected through a skillfully constructed survey of an adequate, representative sample of temporary workers. Such an effort would complete the description of this work force, begun in this study, and allow industry and government to develop more equitable and effective policies dealing with worker issues.

The temporary nuclear work force will continue to grow, not only for the balance of this century but into the next, as new nuclear power plants are brought on line and

existing plants age, thus requiring additional maintenance. No effort was made in this study to forecast the future demands for temporary workers or how contractors and utilities would meet these needs. The information collected for this study, along with other information, would allow analysts to develop reasonable forecasts of the total temporary work force and the composition of that work force by skill or craft. However, the skills required of these workers will change over time.

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NESP

NATIONAL ENVIRONMENTAL STUDIES PROJECT

PROGRAM PLAN — FY 85/86

The NESP Project Management Committee (PMC), chaired by W. S. Lee, Chairman and Chief Executive Officer of Duke Power Company, met May 14, 1985 to consider and authorize the studies NESP will undertake during FY 85/86, which begins July 1. Two studies were chosen from ideas solicited early in 1985 from NESP sponsoring organizations, the AIF staff and AIF technical subcommittees. These ideas were screened by the NESP Technical Advisory Group, which recommended an array of potential topics to the PMC. Listed below are the two selected studies, along with a brief summary of the purpose and scope of each. They appear in the order in which they will be initiated, as funds become available from NESP sponsor contributions. Each study will be conducted by a contractor chosen by and under the direction of an *ad hoc* industry Task Force made up of individuals with experience in the appropriate area. Each study is directly applicable to the concerns of operating and NTOL plants. The PMC plans to meet again in the fall of 1985 to consider funding additional studies by NESP during FY 85/86.

1. Guidelines for Radiological Recordkeeping

Background and Purpose

The nuclear power industry keeps records on the radiation exposure of its workers for several interlocking reasons: to comply with NRC and other regulations, to provide the information needed for employers to improve the safety and efficiency of their workers, and to provide itself with the accurate, defensible records required in the event of litigation and claims stemming from worker exposure. For the last reason especially, the nuclear power industry has become increasingly aware of the advantages of taking a hard look at how successfully its current worker radiation recordkeeping procedures and practices are meeting its needs. An evaluation of current industry practice, written in a positive manner and emphasizing those aspects of recordkeeping that help avoid claims by maintaining employee confidence in the adequacy of their health physics programs, could serve the industry well as a guidance document.

Scope

- Describe the worker radiation recordkeeping practices and procedures that would be optimal in terms of regulatory compliance, American Nuclear Insurers' guidelines, INPO good practice recommendations, and instituting operational improvements.
- Review industry (and government agency) litigation and claims experience from the point of view of claims avoidance and the defensibility of records in court.

(over)

Scope (continued)

- Determine the adequacy of existing recordkeeping programs in demonstrating to workers that current radiation protection practices adequately protect their health and safety. Also determine whether the records provide useful data for future epidemiological studies.
- Based on the above tasks, provide guidance on how current recordkeeping systems could be efficiently upgraded to meet the criteria described above.

2. Criteria for Airborne Release Dose Model Selection

Background and Purpose

Utilities and regulators either employ, or are developing, mathematical models for estimating dose calculations in the event of the accidental release of radioactivity into the atmosphere. These models vary greatly in power, assumptions, and purpose, each having its own set of strengths and limitations. One consequence of such a variety of models is that, in a given emergency situation, different agencies could calculate significantly different results. These differences could be at least partially resolved if the bases for them can be identified ahead of time. Such understanding would reduce confusion and improve the credibility of all parties involved. This study would determine the extent to which generic modeling of offsite doses is feasible, and the assumptions, constraints, degree of site specificity, and level of detail necessary for calculating, at individual sites, the doses from accidental radioactive airborne releases.

Scope

- Establish a reasonably complete set of problem situations, comprising such variables as release type, meteorological conditions and local topography.
- Request that a sample of utilities and regulators apply their models to the set of problem situations developed above, compare the results, and reconcile the differences.
- From the results of the above tasks, define to the extent possible a generic model(s) that can be applied successfully to as wide a grouping of sites as possible; identify and discuss the strengths and weaknesses of the generic model(s).

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AIF/NESP-027

METHODOLOGIES FOR CLASSIFICATION OF LOW-LEVEL RADIOACTIVE WASTES FROM NUCLEAR POWER PLANTS

Prepared for the
National Environmental Studies Project
of the
Atomic Industrial Forum, Inc.

by

Joseph A. Lieberman
James B. McIlvaine
Alan D. Miller
Walton A. Rodger

December 1983

NUCLEAR SAFETY ASSOCIATES
IMPELL, INCORPORATED
Bethesda, Maryland

PREFACE

On December 27, 1983 the U.S. Nuclear Regulatory Commission (NRC) put into effect, as 10 CFR 61, new standards and criteria governing the land disposal of radioactive wastes. The new rule defines three classes of low level wastes (designated A, B and C), based on the half-lives and quantities of radioactivity of specified radionuclides and assumed pathway models. Handling, containment and waste form requirements increase from Class A to Class C; wastes exceeding the criteria for Class C are not acceptable for near-surface land burial and will have to be disposed of by as-yet undefined procedures. Under 10 CFR 61, the problem facing the licensee becomes one of properly classifying each waste shipment by preparing a manifest of radionuclide concentrations.

Classification based on direct radiochemical analysis appears infeasible for several reasons. Among them are cost, increased worker exposure (incurred in obtaining and analyzing samples), and the shortage of adequately equipped laboratory facilities with enough qualified personnel to handle a greatly expanded workload. The NRC itself recognizes the possible appropriateness of alternative approaches to waste manifest preparation, and has specifically encouraged licensees to propose indirect methods based on verifiable models. This study develops a practical set of modeling procedures for quantifying the concentrations and amounts of the nuclides present in the wastes from both boiling and pressurized water reactors.

The methodology assumes that all radionuclides in each waste stream ultimately come from failed fuel in the reactor core; their concentrations in the reactor coolant are derived from the NRC's Gas and Liquid Effluents (GALE) code that was the basis for Appendix I of 10 CFR 50. Conservative assumptions are made of the leak rate of reactor coolant. The models developed allocate radionuclides to the various reactor waste streams according to a careful evaluation of their physical and chemical properties. Difficult-to-measure radionuclides can then be ratioed to others (such as Cs-137 and Co-60) whose concentrations can be readily determined.

Throughout the study, maximum use was made of the limited amount of reliable data from nuclear power plant waste streams as a check on the allocation factors developed by the models. Data gathered by Impell Corporation during their work for EPRI was particularly valuable. Special thanks are also due Science Applications, Inc. of Rockville, MD for being willing to share data developed for NRC at Maine Yankee and Vermont Yankee. Several utilities and the EEI-administered Utility Nuclear Waste Management Group provided guidance, or data, or both, throughout the study. Finally, NESP would like to acknowledge the cooperation of the U.S. Nuclear Regulatory Commission staff in providing comments and constructive criticism throughout the study.

One final point should be stressed: it is expected that, as reliable and consistent plant-specific data are developed, the conservative models presented herein will either be validated or modified as necessary. Until that occurs, the provisional use of the methodology of this report for meeting the requirements of existing regulations seems justified. For plants just going into operation, the modeling approach outlined here — or one quite like it — is the only reasonable method available for classifying wastes according to 10 CFR 61.

A. Scott Leiper
Project Manager, NESP
Atomic Industrial Forum, Inc.

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I BACKGROUND AND INTRODUCTION

On December 27, 1982 the US Nuclear Regulatory Commission (NRC) published as a Final Rule in the Federal Register (Vol. 47, No. 248, p. 57446 et seq.) 10 CFR 61--"Licensing Requirements for Land Disposal of Radioactive Waste." This Final Rule was the result of several years of effort to develop regulations covering the disposal of low-level radioactive wastes in near-surface land disposal facilities. Included among the requirements and provisions of 10 CFR 61 are those pertaining to the classification of low-level radioactive wastes by radwaste generators. The effective date for compliance with the classification requirements is December 27, 1983, one year from the publication of the final rule.

Section 20.311 of 10 CFR [Standards for Protection Against Radiation] requires that any licensee who transfers radioactive waste to a land disposal facility or to a waste collector or processor must classify the waste according to the requirements of 10 CFR 61. 10 CFR 61 establishes three classes of wastes, designated A, B and C, nominally based on potential radiologic hazard and determined by concentrations of specific nuclides (Section 61.55, see Appendix A). As generally characterized in the NRC Fact Sheet* accompanying the transmittal of the Final Rule to Commission licensees, Class A waste contains the lowest concentrations of radionuclides and must meet only minimum waste form requirements. Class B and C wastes contain higher concentrations and must meet specified waste form and stability requirements. Class C wastes must be disposed of by the land disposal facility operator using methods that provide additional protection against inadvertent intrusion. Wastes having concentrations of specific radionuclides greater than the limit for Class C are generally considered unacceptable

* Memo: Edward F Hawkins, Acting Chief, Low-Level Waste Licensing Branch, to Commission Licensees, dated February 11, 1983.

for near-surface land disposal. Waste characteristics and waste form requirements are delineated in Section 61.56 of the regulations (see Appendix B). The NRC staff has issued a Branch Technical Position Paper on waste form.*

The NRC has recognized that there are various approaches to meeting the classification requirements of 10 CFR 61. Section 61.55(a)(8) permits licensees to determine, by indirect methods, the radionuclide concentrations upon which the waste classification is based. Such indirect methods identified in the regulations include the use of scaling or correlation factors which infer the concentration of one radionuclide from another that is actually measured, or by the use of radionuclide material accountability, if there is reasonable assurance that the indirect methods can be correlated with actual measurements.

The NRC staff has also issued a Branch Technical Position on waste classification (see Appendix C).** In stating the regulatory position with respect to the requirement that all licensees carry out a compliance program to assure proper classification of waste, the staff notes it is prepared to be flexible in the adaptation of a particular program to a particular waste generating facility. It recognizes the potential for, or possible existence of, "physical limitations," including "difficulites in obtaining and measuring representative samples at reasonable costs and acceptable occupational exposures." These difficulties may be particularly pertinent to the sampling and on-site measurement of spent ion-exchange resins at a number of plants. The staff notes that the "principal consideration for the acceptability of a compliance program will be whether a reasonable effort has been made to ensure a realistic representation of the distribution of radionuclides within waste," and "to classify waste in a consistent manner."

* Memo: Leo B Higginbotham, Chief, Low-Level Waste Licensing Branch to Commission Licensees, dated May 11, 1983.

** Low-Level Waste Licensing Branch Technical Position on Radioactive Waste Classification, May 1983, Rev.0.

Appendix A to the Branch Technical Position on Waste Classification outlines an example program for nuclear power plants which the regulatory staff indicates it would find acceptable. This implementation program consists of a "three-tiered" approach which involves:

(1) Periodic (usually on an annual basis, but more or less frequently depending on plant operating circumstance) analysis for all nuclides listed in Table 1 of Section 61.55,

(2) Gamma spectroscopy of certain nuclides from which waste classifications are correlated, and

(3) Gross radioactivity measurements which correlate activity levels of wastes from similar batches to the gamma spectroscopy measurements.

The example plan also notes that the gamma spectroscopy measurements should be performed on a limited number of samples obtained from individual waste batches. It suggests that this can be done by analyzing waste samples prior to or after volume reduction and/or solidification, analyzing waste drums or liners, or by analyzing influent and effluent samples from the process stream. The plan also points out that other methods which provide reasonable analysis will be considered.

In addition to the waste classification requirements of 10 CFR 61, Section 20.311 (see Appendix D) of 10 CFR (Standards for Protection Against Radiation) also identifies requirements for manifests which must accompany the shipment or transfer of wastes intended for disposal at a land disposal facility. Besides the identification of wastes as Class A, B or C in the manifest, the following must also be shown

- A physical description of the waste
- Waste volume
- Significant radionuclide identity and quantity
- Total radioactivity
- Total quantity of H-3, C-14, Tc-99 and I-129 in shipment
- Identification of waste containing more than 0.1 percent chelating agents by weight
- Estimate of weight percentage of chelating agent if greater than 0.1 percent

The basic objective of this project is to help the nuclear power plant operator satisfy the waste classification and manifest requirements of the regulations or, as noted by the regulatory staff in the Branch Technical Position, to ensure a realistic representation of the distribution of radionuclides within the waste, and to classify waste in a consistent manner. Complying with the classification requirements through direct sampling of the various waste streams and analyses for the nuclides listed in the regulation can entail difficult and expensive sampling and analytical burdens on operating plants. A number of the listed nuclides are either not routinely measured or do not have routine analytical methods available for in-plant use. The increased sampling and analytical requirements can contribute significantly to increased worker exposure, and could be inconsistent with the ALARA principle. In many cases, additional sampling stations and analytical instrumentation and equipment may be required.

This report describes a practical, workable methodology for quantifying the concentrations and amounts of nuclides of concern in nuclear power plant wastes. The methodology realistically reflects the inherent limitations, recognized in the Branch Technical Position (classification), for direct measurement of some of these nuclides. It also reflects the acknowledged need for flexibility and the requirement for a "realistic representation" of the distribution of radionuclides in the wastes. The determination of levels of radioactivity in power reactor waste streams has historically been done more on a qualitative basis than a quantitative one. The use of gamma spectroscopy and/or direct radiation measurements on bulk containers of waste has been the general approach. This has been a function of the physical limitations on sampling inherent in the waste system lay-out and the radiation exposure costs associated with such direct sampling and analysis. The general difficulty in handling and measuring active waste samples is also a factor. Nevertheless, the methods which have been used in the management of these low-level wastes have produced satisfactory results and have not led to circumstances inimical to the public health and safety.

The methodology proposed in this report is in the tradition with which wastes have been characterized in the past and fully meets the intent of 10 CFR 61. The primary feature of the methodology is the development of scaling or correlation factors between more readily measured "key" nuclides and those listed in the classification tables of Section 61.55 that are not readily measured. The basic rationale for the development of appropriate scaling factors is that all of the radioactive material ending up in specific power reactor waste streams originates in the reactor core and is transported to these waste streams by the reactor coolant. The fission product nuclides introduced into the reactor coolant system are essentially a function of the fuel performance. The activation products are dependent primarily on materials of construction and the behavior of corrosion product inventories in the circulating reactor coolant system. The build-up or retention of radioactive material on coolant system cleanup components is a function of component decontamination factors, component operational cycle or run time and, to a negligible extent with regard to most nuclides of classification interest, nuclide decay constant.

Simple models and equations describing these relationships were developed for both PWR and BWR and are described more fully in Section IV. Since this project did not involve the sampling and analysis of coolant or waste stream samples or the acquistion of new data nuclide concentrations in reactor coolant as defined by the GALE code* with 0.12 percent failed fuel for PWR and 60,000 μCi/sec at 30 minutes for BWR were used in the calculations. These assumptions give conservative results in terms of quantities of radioactive material in wastes ultimately shipped for disposal. The other basic feature of the modelling approach used in this report is the calculation of nuclide material balances with the nuclide source term being that contained in the reactor coolant.

The quantity of radioactive material entering the radwaste system is a function of the amount of coolant which leaves the reactor coolant system. For purposes of this study, two reactor coolant system volumes

* GALE [Gas and Liquid Effluents] NRC code used in developing Appendix I to 10 CFR 50.

were assumed to have found their way to the radwaste system annually,* and 5 percent of the radioactive material in these two volumes is presumed to end up in the dry active waste (DAW).**

It is expected that the degree of correlation between the concentration of radionuclides would relate directly to their physical and chemical similarity. Nuclides having similar physical and chemical characteristics and produced and released to the reactor coolant system in a similar manner would show a strong correlation. A cited example of this is the result of the EPRI transuranic study*** where it was found that the Pu-239/240 in reactor waste varied directly with Ce-144 (Pu-239/240 = 1.8E-3 x Ce-144) which has a relatively long half-life and exhibits the similar chemical characteristic of being generally insoluble in reactor coolant systems. However, the characteristics of existing data in the literature and those obtained from other sources were such that verification of scaling factors developed was generally not possible. For example, the existing data did not relate the information on nuclide concentrations and quantities in wastes to the reactor's operational history. Thus the concentrations of nuclides in the reactor coolant, which is the source term for nuclides in the waste streams, could not be related to plant performance over the periods of time the various waste streams were accumulated. Accordingly, correlations between specific nuclides measured in reactor coolant and other nuclides of similar characteristics in waste streams were so variable as to be not useful. In addition, the representativeness of waste stream samples must be carefully considered. This is particularly true for spent resins where, in many plants, there is a single resin storage tank which receives spent resins from a number of different systems which vary greatly in radioactive material concentrations. In many cases resin samples can only be taken when the resins are transferred to a liner prior to shipment. Then, when only one or a few resin beads can be analyzed, because of handling and instrumentation limitations, the importance of representativeness of the sample becomes evident.

* This is consistent with the reactor coolant leakages assumed in the GALE code.

** Taken conservatively from the NUS study, ONWI-20, which found 1 to 2% of the total radioactivity in trash.

*** Ref EPRI Report NP-1494.

Consistent plant-specific data on nuclide concentrations in reactor coolant and waste streams are desirable, if not required, to validate the continuing application of the nuclide correlation methodology described. However, its provisional use is deemed reasonable and conservative for:

a) new plants going into operation where pertinent operating data are not yet available,
b) plants where physical limitations and/or potential exposure problems preclude adequate sampling, and
c) infrequently accumulated or discharged waste streams.

In cases where data exist to validate the model and methodology for the plant, its continuing application would appear justified and conservative. The details of the practical application of the correlation methodology as proposed for in-plant use are described in Appendix E.

It was known at the outset of this project that the nature of the work undertaken was directly related to that to be carried out under EPRI Project 1557-6--Radionuclide Correlation in Radioactive Waste. While no new data were to be acquired in this project, direct sampling and analysis of waste streams in operating plants were specifically included in the scope of the EPRI project also being carried out by EDS Nuclear Inc. (now Impell Corp). This AIF/NESP project emphasizes the importance of one objective of the EPRI project which is to validate the scaling factor methodology. The acquistion and analysis of plant-specific data, and the use of these data to verify the validity of the methodology developed in this project, would contribute significantly to the implementation of regulatory requirements for classification of low-level radioactive wastes from nuclear power plants.

In light of the classification requirements delineated in 10 CFR 61, the acknowledgements expressed in the Branch Technical Position (Classification) of "physical limitations" related to direct sampling and analysis for some waste streams and nuclides, and the need for flexibility regarding approaches to compliance, the methodology described in this report provides a reasonable approach to meeting the regulatory requirements for low-level waste classification. The rationale behind

the development of the scaling factors is logical and the approach is consistent with past related work (e.g., the Ce-144--TRU correlation). Although the plant-specific validation of the scaling factors through the acquisition and use of plant data is in order, the provisional application of this methodology should result in realistic yet conservative waste classification.

II SUMMARY AND CONCLUSIONS

A Classification Requirements

Specific NRC regulations identify the requirements for classification of radioactive wastes suitable for near-surface land disposal. Such classification is required in connection with the preparation of manifests which must accompany shipments or transfer of wastes destined for such disposal. The general requirements for such classification are given in 10 CFR 20.311 and the detailed requirements are delineated in 10 CFR 61.55. Classification into Class A, B, or C is determined by the concentrations of specific isotopes as listed in Section 61.55.

B Development of Classification Methodology

In this study, a methodology and procedures were developed for determining the concentrations of the specific isotopes listed in the regulation in essentially all of the radioactive waste streams associated with the operation of light water reactors. This methodology recognizes that the radioactive materials which ultimately find their way to various waste streams are contained in and transported by the reactor coolant. The rationale for the methodology is based essentially on radioactive material balances through each waste system or stream and takes into account the differing chemical behavior of the isotopes of interest. This involves the use of ratios of concentrations of readily measured key isotopes in the reactor coolant (for example, Cs-137 and Co-60) to the concentrations of other isotopes not so readily measured. The material balance calculations therefore must also take into account how these ratios change from the reactor coolant to the various waste streams.

The application of this methodology will generally overestimate the radionuclide levels of "scaled" isotopes in the waste streams. This is because "key" isotope decontamination factors were chosen conservatively so as to overstate changes in the scaling factors as material moves through the radwaste systems. The illustrations given in the report are clearly conservative since GALE code reactor coolant concentrations have been used. That code is based on higher fuel failure rates (0.12 percent

failed fuel for PWR, and 60,000 µCi/sec at 30 min for BWR) than current experience indicates. A plant operator, employing this methodology as explained in Appendix E, would use the key isotope concentration as actually measured in the plant reactor coolant over the time period associated with production of a particular waste. This is because the quantity of radioactive material accumulated in a particular waste system or component over the period of its operating cycle or the process run time is proportional to the quantity of radioactive material in the reactor coolant during that period.

The material balance equations include terms for correction of the scaling factor due to differences in decontamination factors (DF) and decay constants for the key isotope and others. Analysis shows that if the DF for the key isotope is greater than 1.5 the scaling factor will not change by more than a factor of three. Also, because the nuclides of concern have relatively long half-lives in comparison to process run times, correction for differences in decay constant can be neglected in most cases.

C Scaling Factor Development

The material balance approach was applied to reactor coolant system and radwaste system streams for both PWR and BWR. Eight possible waste streams plus contaminated trash or dry active waste (DAW) from a PWR radwaste system were examined. Since the radioactive material entering the radwaste system is that contained in reactor coolant leakage into the system, it is reasonable to expect the nuclide ratios in the radwaste system receiving tanks to be the same as those in the reactor coolant. In BWR the reactor coolant system waste includes both reactor coolant cleanup wastes and condensate polisher waste. Seven possible waste streams plus DAW were examined for BWR radwaste systems.

Since neither Tc-99 nor I-129 are included in the GALE code, the concentrations of these two isotopes in reactor coolant were calculated based on fission yields and escape coefficients from failed fuel. Tritium and Carbon-14 are treated as special cases. The tritium concentration in waste streams would be the same or less than in reactor coolant since there are no concentration mechanisms. Since essentially all of the C-14 in the primary coolant system is released in various

gaseous wastes, little is available for inclusion in solid wastes that would be disposed in a land disposal facility. TRU reactor coolant concentrations were determined from the correlation between Ce-144 and Pu-239/240 developed in an earlier study.*

D Waste Stream Classification and Comparison to Regulatory Limits

Using the material balance equations developed and Cs-137 as the key isotope, inventories, concentrations, and scaling factors for the isotopes of interest for each radwaste stream examined were calculated. These results, which represent a conservative characterization of wastes from both PWR and BWR, were then compared on a specific waste stream basis to the limits for Class A and Class C wastes as given in 10 CFR 61.55. A summary of this comparison is given in Table VI-19.

The following observations regarding the classification of LWR wastes appear reasonable and conservative. The conservatism results from the bases used for the material balance calculations, such as the high fuel failure rates selected.

- In PWR systems the two reactor coolant system wastes--cleanup filters and cleanup resins--are likely to exceed Class A limits due to Cs-137 concentrations, and may approach the Class C limit within a factor of 10 due primarily to TRU concentrations for Table 1 and to Cs-137 for Table 2 (10 CFR 61).

- Two other PWR waste streams--CVCS evaporator bottoms and dirty waste filters--approach, but are not likely to exceed, Class A limits. In these two cases Cs-137 is also the major contributor to the limit. All other PWR wastes are only a small percentage of the Class A limits. Two of the latter--steam generator blowdown filter and dry active waste (trash)--are three orders of magnitude below Class A limits. For both of these, Cs-137 is the major nuclide, with tritium a secondary contributor.

* Ref EPRI Report NP-1494

- In BWR systems only the reactor coolant cleanup filter/resin waste stream has a strong likelihood of exceeding Class A limits. The major isotopic contributor to the Table 1 limit is TRU; for Table 2 it is Sr-90 with some contribution from Cs-137.

- Three other BWR waste streams (condensate resin, high purity filter, chemical waste filter) are just about at Class A limits and may become Class B. In each case the major isotopic contributor to the limit is Sr-90, with Cs-137 contributing 10 to 40 percent to the limit. All other BWR wastes are Class A, low purity wastes are less than 10 percent of Class A limits, BWR trash is several orders of magnitude below the Class A limits.

E Generic Classification

The above observations lead to the following suggestions regarding generic classification of waste streams:

1) Dry Active Waste (trash) from both PWR and BWR can be generically classified as Class A.
2) All other LWR waste streams can be classified as Class A if external gamma readings are less than 100 mR/hr at 1 meter.

For reactor coolant system wastes, classification can be determined by measurement of Cs-137 and Co-60 and use of scaling factors shown in Section IV. If external gamma readings for other wastes noted in (2) above are exceeded, classification similarly can be determined on the basis of Cs-137 and Co-60 measurements and the use of the scaling factors developed in Section IV.

F Manifest Requirements and Recommendations

The regulations concerning manifesting of waste transfers or shipments require, among other things, that the total quantities of Tc-99, I-129, tritium and C-14 be reported. Analyses carried out using the classification methodology developed show that the contributions of I-129 and especially Tc-99 to Class A or Class C limits are small. Also,

Tc-99 pathway analysis indicates that, though it has a retardation factor of unity [i.e., moves with water], and even using very conservative assumptions, doses to man via a groundwater pathway would still be small. In the case of I-129, whose low limit is based on a thyroid dose, analysis indicates that because of inevitable dilution with stable I-127 the water migrational pathway would lead to only very small doses at the concentrations found in the waste streams.

With regard to tritium, even with conservative assumptions (viz, the waste is 50 percent undiluted reactor water), the contribution to Class A limit for PWR waste would be less than 1 percent, and even lower for BWR waste.

For C-14 about one third of that produced (from O-17 and N-14) is expected to be in the reactor coolant, and almost all of that would be released with various gaseous waste streams. Very little (<1 percent) remains available to end up in solid wastes. Further analysis indicates that even if all of the C-14 produced were released to the environment, radiation doses to people would be insignificant [See Appendix H].

In view of the foregoing, the following manifest preparation recommendations are proposed:

1) Manifest values for trash (DAW) can be derived from external gamma readings as described by procedures in Appendix E.
2) For all other LWR waste streams, if they are Class A based on external gamma readings, manifest values can also be derived as in (1) above. If they exceed the Class A limit based on external gamma readings, the manifest values can be determined from measured values of Cs-137 and Co-60 in the waste and the use of the scaling factors shown in Appendix E.
3) Manifest values for I-129 and others (including Tc-99) can be derived from scaling factors given in Table IV-25.
4) Manifest values for C-14 can be recorded as the concentration given on page V-8 of this report.
5) The tritium manifest value can be determined by the reactor coolant concentration of this isotope and the moisture content of the waste stream of concern.

6 Validation With Existing Data

The existing pertinent data base is limited. Although data do exist on gamma emitting nuclides, and, to a limited extent, certain beta and alpha emitters, data on other nuclides relevant to the classification requirements of 10 CFR 61 are only now beginning to become available. Therefore validation of the scaling factors developed in this study with existing data was not very satisfactory. The data were rather inconsistent and often anomalous. The difficulties with the data relate to the problem of getting representative samples from various waste streams and the lack of correlative information between plant performance, reactor coolant nuclide concentration data and the waste nuclide concentration data. This situation emphasizes the importance of acquisition of reliable data in other investigative efforts, particularly the on-going EPRI project on waste classification and the NRC/SAI work at Vermont Yankee and Maine Yankee. Sampling and analysis carried out in conjunction with waste classification requirements should also recognize the need to relate to plant operational performance.

III APPROACH

A Source of Waste Requiring Disposal

During the operation of a nuclear reactor, large quantitites of radioactive materials are formed in the fuel, coolant and structural components, and any reactor which has operated for any length of time at a high power level contains a large inventory of radioactive materials. Under ordinary operating conditions, most (>99.9 percent) of the fission products are maintained within the fuel itself and do not become available for potential shipment to a shallow land burial ground.* That small portion (<0.1 percent) which does escape into the reactor coolant, plus the activation products from the coolant and that portion of the structural materials which dissolve into the coolant, are free to circulate throughout the entire primary system, including those components of the reactor coolant system designed to remove them. Most of this circulating material is held within the reactor coolant system, and the major means of removal of radioactive material therefrom are the filters, resins and evaporator bottoms, waste streams designed to be the major sources of waste shipments from a reactor.

No known physical process is perfect, so some of the circulating material passes the reactor coolant system boundary into the reactor complex external to that system. Both gaseous and liquid wastes are generated from this escaping material. Reactors are provided with systems for treating gaseous and liquid wastes to reduce to appropriate levels the escape of these materials into the environment. To the extent these systems are successful, additional solid wastes will be produced which may also require shipment to a shallow land burial ground. These take the form of filters, filter aids, resins, evaporator bottoms, various non-compactible components and dry active waste (DAW or trash). Clearly these materials will nearly always be much lower in activity level than the waste streams from the reactor coolant system cleanup. In

* Spent fuel will either be shipped to a repository as high-level waste or reprocessed, at which point some of the fission products will become available in waste streams which may be suitable for shallow land disposal.

fact, the radioactive material content of some of them may be so low as to raise the question whether they should be considered radioactive at all.

In any event, the reactor coolant represents the basic source of all the radioactive materials which may need to be shipped from a reactor, with the exceptions of those associated with the operation of the fuel pool and of discarded irradiated structural or equipment components.

B Material Balances

Except for fuel pool and component wastes, the approach used in this report is to perform appropriate material balances over each reactor system taking the reactor coolant concentration as the source term for the calculation. Physical and chemical processes must be accounted for and the differences in behavior of the various chemical elements recognized. The calculations shown below are done for both a representative PWR and BWR. In practice, an operating reactor would use flow parameters specific to the particular site. The approach used in this study is essentially the reverse of that used in the GALE code calculation of Appendix I releases. The GALE code starts with an assumed failed fuel fraction and calculates the expected reactor coolant concentrations for the various isotopes. Then, for the parameters appropriate to a particular plant, the code uses a material balance approach to determine the amounts of radioactive materials which escape into gaseous and liquid wastes. We have applied the same technique but have started with the reactor coolant concentration and have calculated the amounts of the isotopes of interest which would accumulate on the various cleanup or waste stream components which would be prepared for shipment as solid waste to a shallow land burial ground.

The object of these calculations is to determine not only how much radioactive material gets to each of the component waste streams, but also to see whether the ratio of isotopes changes between the reactor coolant and the various waste streams. The latter point is of considerable importance. The reactor coolant is readily sampled and much data, at least for some isotopes, are taken on a routine basis. Many of the waste streams to be shipped, however, are sampled only with great

difficulty, often involving considerable personnel exposure, and some cannot be sampled accurately at all. Furthermore, while some isotopes (for example, Cs-137 and Co-60) are readily measured with little difficulty, others (such as Tc-99, I-129, Sr-90, C-14) are much more difficult and expensive to measure. Therefore, it would be highly desirable to develop an acceptable procedure by which readily measured "key" isotopes were analyzed in the reactor coolant, and the less readily measured isotopes ratioed to them. The ratios determined for the reactor coolant would be used throughout the system unless there is a good physical reason to do otherwise. Then the key isotopes would be measured in all waste streams and the other isotopes of concern would be calculated through the use of these ratios or scaling factors.

C Parametric Analyses of Nuclide Behavior

If all of the nuclides behaved the same physically and chemically the approach outlined above would be quite rigorous. However, all the elements involved do not behave the same. The ratios of isotopes which exist in the reactor coolant may change as materials move throughout the system. To evaluate such changes, parametric calculations have been made and the effects of these variations determined. This is of particular importance since one of the proposed key isotopes, Cs-137, is monovalent and highly soluble compared to some of the other isotopes. Consequently, some differences in their behavior in the reactor coolant cleanup and radwaste systems can be expected. The extent of this complication is discussed in some detail in Section IV of this report.

D Application

Throughout this report GALE code reactor coolant concentrations have been used to illustrate the method and to identify the activity levels which can be expected in the various waste streams. This represents an upper limit to the activity levels which should be expected in these wastes, since the GALE code calculations assume failed fuel fractions which are at the upper end of the present day fuel experience.