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UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

JOINT SUBCOMMITTEES ON SITE EVALUATION

AND REACTOR RADIOLOGICAL EFFECTS

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

Thursday, May 22, 1980

The Joint Subcommittee meeting was convened, pursuant to notice, at 8:30 a.m.

Present:

MR. DADE W. MOELLER, Subcommittee Chairman
MR. J. C. EBERSOLE, Member
MR. JEREMIAH J. RAY, Member
MR. PETER S. TAM, Designated Federal Employee
DR. RICHARD FOSTER, Consultant
MR. ALEX GRENDON, Consultant

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P R O C E E D I N G S 8:30 a.m.

CHAIRMAN MOELLER: The meeting will now come to order. This is the second day of a meeting of the Advisory Committee on Reactor Safeguards, Joint Subcommittees on Site Evaluation and Reactor Radiological Effects.

I'm Dade Moeller, the subcommittee chairman. The other ACRS members with us today are Jesse Ebersole and Jerry Ray. We also have with us two consultants, Richard Foster and Alex Grendon.

We have two purposes for the meeting. The first is to review and develop comments for submission to the full committee on the draft final rule on emergency planning, which has been prepared by the NRC staff. We met with them and discussed that yesterday and this afternoon we will be discussing and preparing our written comments on that rule.

The second item is to review the NRC safety research plans for FY 1982 with emphasis on the priorities assigned to the various research projects and the budgets that accompany them.

The meeting is being conducted in accordance with the provisions of the Federal Advisory Committee Act and the Government in the Sunshine Act.

We may find it necessary to hold one or more closed sessions for the purpose of exploring matters involving proprietary information. The vast majority of the meeting will be open, however.

Mr. Peter Tam, seated on my right, is the designated federal employee for this meeting.

The rules for participation in the meeting have been announced as part of the notice previousl. published in the Federal Register on May 6, 1980. A transc.ipt is being kept and it is requested that each speaker first identify himself or herself and speak with sufficient clarity and volume so that he or she can be readily heard.

We have a few minutes this morning for an Executive Session. Let me place in the record the fact that we do have a draft, the first draft of proposed comments on the file rule on emergency preparedness. These comments were prepared on the basis of the discussion we had yesterday afternoon.

We will immediately after lunch go over them and discuss and modify and refine them.

This morning we are meeting with the reactor radiological effects research group, R. Abbey and Frank Arsenault, and we have the discussions with them scheduled for the morning. As background to those discussions, you do have the hand-out which we distributed yesterday, which is the draft long-range research plan of the Office of Nuclear Regulatory Research dated May 2, 1980. And I'm fairly certain that you'll find that very useful as a guide in following the projects as we go along.

There will be, of course, and there is other hand-out

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material that will accompany the presentations.

Frank, what sort of -- you're ready then to proceed, and the floor is yours and whatever sequence you desire to take will be fine with us.

Are there any questions prior to Frank's presentation?

(No response.)

CHAIRMAN MOELLER: Okay, let's proceed. We welcome you here this morning and we look forward to having an in-depth discussion of your research. We would like to clearly understand, Frank, to have the material presented in units so we know precisely what subject area, what research we're talking about, and that we have some idea of the priority that you have assigned to it, and in the closed session a discussion of the budgetary recommendations for its support.

MR. ARSENAULT: Thank you.

I'd like to make two introductory comments or observations first. One is that there are two hand-outs that I brought with me this morning that I think have been distributed. One of these is a copy of the viewgraphs that I'll use. The other is a description in greater depth of the projects that are identified on the viewgraphs and contains budgetary information.

My discussion will deal with the substance of these discussions and the talk probably will be open. The second hand-out, however, containing budgetary proposals, should be dealt with as proprietary information for the time being.

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CHAIRMAN MOELLER: And we will close the session to do that, because we do indeed want to cover the budget.

MR. ARSENAULT: The second point is that the long-range plan draft that you have has one portion of it titled Occupational Exposure, which ultimately will be divided into two portions for the long-range plan, the reason being that we have within our organization two specific activities. One is to look at exposure and health effects and the other is to consider the sources of occupational exposures and protective mechanisms to reduce that exposure. That distinction will be made in subsequent drafts of the chapter.

I would like to describe to you the approach that we took in preparing this presentation and then get into the presentation itself.

The scope of the presentation is taken from Chapter X of last year's report, Reactor Radiological Effects. It covers all reactor radiological effects. It does not cover non-radiological effects. And it deals strictly with reactors. Again, the long-range plan chapters are broader in scope than Chapter X of the report.

We considered, taking some cues from observations and comments made by the subcommittee previously, that it would be useful to discuss the reactor radiological effects in four categories: the first, occupational exposure. The second is routine radiological effluents. The third is accidental

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radiological releases. The fourth category, closely associated with the third but distinct, is emergency response. The distinction between the third and the fourth lies largely in the fact that much research we do in the area of accidental releases is to develop a predictive capability, whereas in the case of emergency response we're dealing with an operational capability. That is the distinction you'll see in the presentation.

Another point is that you are not looking at any decision unit this morning. There is no decision unit corresponding to Chapter X. What you will be seeing instead are pieces of a number of different decision units in all of the organizational entities within the Office of Research. That is from the Safer Division, more than one branch, Probabilistic Analysis Section has an input to this, a big input, and RSR in more than one branch has a relationship to this topic. I'll make those relationships evident as we go along.

With that, I shall begin. Looking first at occupational radiation exposure, we looked at this in three areas. The question of source terms and how one goes about reducing exposure consistent with the ALARA principle, the question of dosimetry, how one measures the exposure, and finally, what the effects of those are.

In connection with the first area, source terms, if I may, and I think this will be the only time I do this, I want to put up slide 2 for just a moment and make a point. In slide 2, the first item is fin number A-605, which is a project that looks at the buildup of radionuclides in reactor systems and how they are distributed within the facility. From the point of view of determining the requirements for effluent treatment systems, the point is to learn what's in the plant so that you can describe the requirements and characteristics of treatment systems that will result in effluents from the plant that meet the EPA and NRC standards.

The point is that much of that work is related to the interest we have in determining what the sources are of occupational exposure. Much of the work in this project now related to how radionuclides are built up and distributed in the plant will be relevant to a project -- the first project on this list, which is as yet undesignated-- it's a plan to begin in earnest in fiscal '82, which is to determine where the sources of occupational exposure are within the plant. This will have a slightly different end point than the existing project, although much of the work in the existing project would be relevant to it.

The second project on this list -- I pointed out that each of these projects listed on the slides is dealt with a little more fully in the second hand-out. I'd be happy to interrupt at any point to discuss these in detail, or if I get through it we can go back and talk about any of the items.

CHAIRMAN MOELLER: Let's do that. That that UNDES means it's undesignated?



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MR. ARSENAULT: Undesignated merely means that the project is being formulated in the course of budgeting. It has not yet been issued a FIN number, that is an identification number. It means it is not yet entered into the RES or comptroller's listing of projects.

DR. FOSTER: How does that relate to the budget figures that we will see? Are there funds set aside for these undesignated projects?

MR. ARSENAULT: The figures you have on the sheets in front of you are the staff proposals for the '82 level.

DR. FOSTER: Including these.

MR. ARSENAULT: The second hand-out that you have is in fact a listing of these projects in the same order in which they appear on the slides, and in addition to a somewhat more detailed description of the projects I have here you will have a proposed funding level for fiscal year '82.

DR. FOSTER: Thank you.

MR. ARSENAULT: Now the ones with FIN numbers are all either under way now or they have been designated, funds allocated and they should be started either in the remainder of fiscal '80 or in fiscal '81. So those would be under way at the opening of fiscal '82.

MR. GRENDON: I'm not sure of the sequence of events. Is a contractor named in order to have a FIN number after it?

MR. ARSENAULT: No, not necessarily. It merely means that the project is planned to be started prior to the opening of fiscal '82. Most of these are in fact on-going projects and you can find the contractor listed in the program print-outs that we have. But there are a few of them that are not scheduled to begin until fiscal '81.

CHAIRMAN MOELLER: And all of the undesignated are beginning in FY '82?

MR. ARSENAULT: Correct.

CHAIRMAN MOELLER: Now let me, to help me on a question, this looks to me to be well organized and it directly addresses, as you've already said, what we had in Chapter X of our comments to you last year. So I'm very pleased with it.

Now did the same people prepare this viewgraph that prepared the write-up, this draft long-range research plan? Because I don't find the same crispness and focus in this May 2 document that I see here on the board or on the viewgraph.

MR. ARSENAULT: The reason for that -- well, there are two aspects to it. One is that the long-range plan draft was prepared prior to the development of this material. Secondly, the long-range plan draft covers this material as part of a much broader scope.

For example, the occupational exposure chapter deals with not only reactors but fuel cycle facilities and any other aspects of occupational exposure. So that the level of defined structure you will see in the presentation today is not built into the long-range plan.

CHAIRMAN MOELLER: And again, you have told us that here you're presenting a topic. You don't care, or you're not bothering us with who does it. You're telling us the total effect on that subject area.

MR. ARSENAULT: That's correct. Now the first slide, I believe also the second slide, the work listed is entirely within the SAFER Division, my division. I might be wrong on the second slide, but almost all of it. In any case, in the third slide you will see that most of the work is not in the SAFER Division but rather in other organizations, which I'll describe at that point.

And in the final slide on emergency planning it's scattered all over the place. I'll get to that.

People are here from the other organizational units and when we get to those points on the slides, they'll be happy to discuss the cued item in greater detail for you.

CHAIRMAN MOELLER: Jerry Ray?

MR. RAY: I'm just curious as to the scope and the amount of base information that's currently available in the area of source terms and ALARA as a result of the accumulated experience in the industry. It's not a new industry and we must have had some experience as to where the crud is accumulating and so on.

What is the status of such information?

MR. ARSENAULT: I indicated there's a close relationship between that and the study now going on to measure the distribution of radionuclides in plants. I'd ask Don Solberg to address the question of where we stand with regard to our knowledge on how those nuclides are developed and distributed.

MR. SOLBERG: My name's Don Solberg. In answer to your question, sir, we are aware that there's a lot of work going on related to crud buildups and decontamination.

We are currently determining what is available in the field in order to -- more definitive plans for 1982 and beyond. So I can't answer specifically your question at the present time what all is available, but certainly the beginning of our effort will be to make sure that we understand all that and then define what else we have to do in order to satisfy our needs.

MR. RAY: So you are acting with cognizance of the base information that is available and you give this consideration?

MR. SOLBERG: Absolutely. Certainly EPRI has done a great deal of work in this area. I'm familiar with some of it but not necessarily all of it.

MR. RAY: Thank you.

MR. ARSENAULT: The second two items under source terms deal with the need to determine how occupational exposure might be reduced by decontamination systems and components. The decontamination processes are fairly widely known but the question of just what they can do within an operating plant to reduce occupational exposure is not that well investigated. We're not quite yet what the details of such a project would be, but we have to get in and start doing enough studies to find out.

CHAIRMAN MOELLER: What is the -- and I know it's not your project, it's a DOE project, but what is the current schedule on Dresd n?

MR. ARSENAULT: I don't know.

CHAIRMAN MOELLER: Does anyone here know?

MR. SOLBERG: I believe they're supposed to start decontaminating some time very soon now. Just exactly what time scale, I'm not sure, but they're either under way at the present time or they will be shortly.

CHAIRMAN MOELLER: Jesse?

MR. EBERSOLE: Is there any work going on to effectively assess the degree to which you can control decontamination by continuous coolant polishing and cleanup? It's always an issue as to how much you should continuously clean up the coolant to optimize the overall operations, and I for one certainly don't know that that's ever really been methodically done.

Do you follow me?

MR. SOLBERG: Yes. There has been some work done at by the vendors to determine the degree to which transients in the system can result in cleanup.

MR. EBERSOLE: I'm talking about steady state polishing of the coolant, bypass cleanup, whatever other steps you take to maintain a stated activation level of the primary coolant.

MR. SOLBERG: And your question is?

MR. EBERSOLE: Has anyone struck an appropriate optimum balance on how to accomplish this?

MR. SOLBERG: Not so far as I know, but certainly housekeeping and cleanup are important aspects in crud buildup.

MR. EBERSOLE: My impression is that the boilers do not permit coolant activation level nearly as high as the pressure boiler reactors. It might be obvious because they have direct cycle functions. And then that brings the question, well, if PWR's permit a higher level, why do they, if they have similar problems?

MR. ARSENAULT: I think the term "decontamination" used in this context would include that type of activity --

MR. EBERSOLE: The on-stream steady state decontamination of the coolant?

MR. ARSENAULT: That's my understanding of the general scope, is how did one go about removing radionuclides from not only equipment components but also systems?

MR. EBERSOLE: I'm thinking about the preventative aspect, of keeping --

MR. SOLBERG: Prevention is a very key part of this whole thing. That's right. Either through material selection or process effluent. For example, EPRI does have a program

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going on at the present time for electromagnetic filtration, which they're testing and operating plants, another method for making sure that it keeps clean so that you don't have to periodically decontaminate.

MR. EBERSOLE: Well anyway, decontamination is supposed to include, I presume, some sort of optimization program for keeping the coolant clean?

MR. SOLBERG: We think that this whole thing covers the whole thing, starting with design and materials, operations and going to decontamination as well, yes, sir.

MR. ARSENAULT: There's another aspect that doesn't shine through the titles, and that is the question of maintenance regimes and the equipment reliability and so on, as it impacts upon occupational exposure, and that will be within the program, not necessarily within these projects.

With regard to the dosimetry, the three projects indicated are -- one that's just being formulated now I would expect to be started prior to the end of fiscal '80. It's a three-year project, I believe. It consists of the development of quality assurance and calibration techniques and procedures, as well as sources, to calibrate the dosimeters used by NRC inspectors in order to be able to trace their measurements back to national standards.

This project is part research, the development part of it, and part TA because we'll be actually in this project

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not only developing techniques but actually doirg calibration and testing for I&E.

Ultimately, I would expect them to take it over as a technical assistance service type project.

The second one is one that's been going on for some time, and that is to develop age-specific metabolic models to be able to -- this actually has broader application. I should make the point that many of the projects that we'll discuss here are assigned to the categories that we put them in but they have far broader application than merely solving the problem to which they've been assigned in this presentation.

MR. GLENDON: If I read that correctly, that belongs under health effects, doesn't it? How does it get under this entry at all?

MR. ARSENAULT: Well, the problem -- I'm going to take a stab at that but I'll call upon July Foulke if I get into trouble -- the problem here is to determine when exposed to inhalants and radionuclides, how they are taken up in the body, where they're distributed to, what their biological decay rate is, in order to determine exactly what the dose is.

Now that is a necessary precursor to then determining what the health effects are, but the aim of the project is largely toward the dosimetry aspect of it.

Does that answer your question? I'm relying on Judy Foulke, who's the project manager, to interrupt me if I stray too

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far from the truth.

DR. FOSTER: Frank, on that particular one, how far back in the research process are you going? Is this effort confined to looking at what other people have done in that area and what's published, in order to summarize it, to incorporate the information into your computer programs or does it go back to the bench or let's say --

MR. ARSENAULT: I understand the question and I think I know the answer but I'm sure we'll get a much more --

MS. FOULKE: This is work going on at Oak Ridge in the dosimetry group down there. The output is a computer program that we'll be able to use here and it's a multi-faceted endeavor. There is no bench work. The biomathematicians there get the metabolic information from the literature, from as many studies as they can find reported, and convert it into the mathematical parameters that are used in the INREM computer code for calculating interim of those as resulting from inhalation and ingestion. It's not a lab study.

DR. FOSTER: So it's kind of a continuous updating of the in-place system as further information comes in?

MS. FOULKE: Yes, that's right.

DR. FOSTER: Thank you.

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Tape 2



Finally, we are going to continue work on improving neutron dosimetry. We have work under way in this, and we expect this to continue into 1982. The papers you have indicate that Albedo and tract etch dosimeters would be evaluated for use as neutron dosimeters.

In the health effects, work, I question whether I should simply read from the handout you have been given. The question here is to look at biological factors as precursors and determine whether or not they can be used for dosimetric purposes.

CHAIRMAN MOELLER: Say that again. I am not sure I am with you.

MR. ARSENAULT: Judy, you might want to stay up in the front row.

CHAIRMAN MOELLER: Or come on up to the table here if you want to.

MR. ARSENAULT: If we pass the first level of review on these things, I need help.

MS. FOULKE: This is a project that is going on out at U.C. Davis, which has a large DOE-funded project looking at the mechanisms of radiation chemogenesis. The animal being studied is the beagle, and they are exposed basically continuously, 22 hours per day, to Cobalt 60.

Our project is sort of an add-on to look at dose rate effects. We have animals at comparatively low dose rates from the whole series of animals. They are developing sensitive blood tests, lymphocyte stimulation assays, colony-forming spleen assays, and the object is, of course -- one objective, and there are multiple objectives -- to see if something will show up at an early stage that can be correlated with the dose, since you have animals at different dose rates at the same time and you are looking at their blood cells at the same time.

We are also interested in seeing if you can predict the long-range effects -- namely, leukemia -- from these blood tests.

CHAIRMAN MOELLER: Thank you.

Go ahead.

MR. ARSENAULT: Finally is the work on neutron biological effectiveness factors, which --

CHAIRMAN MOELLER: Excuse me. Judy, did you cover the middle one?

MR. ARSENAULT: I am sorry, I skipped that.

CHAIRMAN MOELLER: Tell us about it.

MS. FOULKE: The second study right now is going on using mice, specifically the nude mouse, which has no thymus. The objective here is to see if there is a sensitive subpopulation that will develop leukemia at lower doses than the normal. So it is a separate study.

CHAIRMAN MOELLER: And where is that?

MS. FOULKE: That is also at U.C. Davis.

MR. FOSTER: Is that the genetic --

MS. FOULKE: The genetic factor is that the animals don't have a thymus. That is as far as we have gotten. It ha. just been funded last year, so we are not very far along on the second one.

MR. ARSENAULT: Why don't you go on and describe the last item on the list as well, Judy.

MS. FOULKE: The last item is something that is just in the planning phase now. We do have a research request letter from the Office of Standards Development concerning the proper value for the QF for neutrons. There, as you are aware, were studies performed by Rossi and Mays analyzing Nagasaki leukemia versus Hiroshima leukemia.

We decided that we should be funding some animal studies ourselves. Human studies have their advantages and their disadvantages. So this is a project that will be carried out at Argonne because there you have the Janus reactor which can give you an essentially pure fission neutron spectrum so you don't have gamma contamination.

Of course, the other side of the coin is you will have animals exposed to their pure Cobalt gamma rays, so you can develop the RBE. This will be a very expensive project. We expect it to last about three years. When I say expensive, that is about a half million per year because of the number of animals that will be involved.

Based on the long -- well, since the early sixties -- programs that Argonne has carried out, they have shown statistically that they expect to see an effect on mice exposed to what would correspond to our 5 rem per year dose limit.

CHAIRMAN MOELLER: Dick, and then Alex.

MR. FOSTER: Because of the nature of the work and its, let's say, relation to this health effects type work which has gone on under AEC/DOE/ERDA for many years and now into the NIH situation, do you have some overall criteria or plans as to what NRC's special interest role or niche is in this kind of work vis-a-vis the other radiation effects work in the country by other agencies?

The NRC is a member of the NIH Interagency Committee, and I am alternate member on that committee. The Committee has received a description of the research programs of all the various agencies involved, of which we are among the minor contributors.

The Committee then has the opportunity to review these programs to determine whether or not additional coordination, or whether there is any overlap or duplication, whether additional coordination is required. In this case, the technical coordination, I think, is effected largely at the contractor level by information exchange by the contractor.

I would point out that some of the work such as this might be done in another agency. It is not under way, to our knowledge. It is not budgeted for early initiation. We find ourselves in the position of starting work tht we would be happy to have someone else do if, in fact, they would do it on a time scale and at a level that would satisfy our requirements.

So I guess I was trying to explain to you why we are in a business which clearly might be done by other agencies if, in fact, they had budgeted for it.

I would ask Judy to address the question of technical coordination further, if you like.

MR. FOSTER: I guess my interest is more here in the coordination at the NIH level. Do you expect that the NIH's essentially new function here as a research coordinator for this sort of thing will be dictating or otherwise influencing the continuation of this work or where it is located in the government sytem?

MR. ARSENAULT: I think the NIH -- the Interagency Committee, really, I should point out, rather than NIH --

MR. FOSTER: Yes.

MR. ARSENAULT: I think the Interagency Committee will have an influence on where such work is done, how much of it is done, and so on. I think that influence is not likely to show up for another year or two. It is just getting its feet under it now. The NAS is reviewing the current Federal program of research in this area. The Interagency Committee, through a subcommittee, is developing a Federal strategy for research into the biological effects of ionizing radiation.

The strategy paper is due to go to the Congress late this year, I think maybe in January, but it might be as early as September. I have forgotten. I think that by the time the wheels turn in this high level, so far as I can see, quite well-coordinated activity, it will take a year or two before we see the effect.

But it seems to me to be on the right track and to be approaching its tasks effectively.

CHAIRMAN MOELLER: Alex.

MR. GRENDON: I can see that genetic factors among humans, the health effects of radiation would be of interest, but I don't see how any experiments on a peculiar strain of mice that is born without a thymus contributes any useful knowledge in that respect. That isn't a study of genetic factors in any sense that I can understand. It is just one peculiar strain.

We know there are strains of mice that are very susceptible to leukemia. If this is one of them, so what? I don't see that it bears on the human problem at all.

MS. FOULKE: That is always a consideration in radiobiology, extrapolation to man, but you have got to start where you have the most chance of success. And there are studies, I think, under NIH on humans specifically, those suffering from something called ataxia telangiectasia or some strange thing.

So there are human studies at the same time.

MR. GRENDON: But your project is only concerned with the --

MS. FOULKE: Oh, it will. That is what it is doing right now. It has just gotten started this last fiscal year. So we are not too far off.

MR. GRENDON: But do you envision some other work in the genetic area?

MS. FOULKE: That will be determined as we go on. If you have some particular suggestion?

MR. GRENDON: I wondered what your plan of action was. As I said, I don't see how this particular thing contributes very much too it, but if you have something, a further step in mind that might have more meaning, then I could understand why you are doing this. This in itself seems to me to add nothing to our knowledge.

MS. FOULKE: Well, we are starting with a system that something is know about and where we expect to have good results. It hasn't been looked at, so I think we should do it and then we will proceed from there.

MR. RAY: Maybe I deduced too much from your initial comment, but I had the impression from your first comment delineating the characteristics of this mouse that biological deficiencies of that breed that make it susceptible to ingestion or the effect of radiation is analogous, that particular characteristic, to some portion of the human population.

Did I read too much into your statement?

MS. FOULKE: We are not really sure what the human situation is, but the fact that leukemia is a disorder of the blood-forming organisms, blood-forming elements, and that the tests, the system that we are looking at also has to deal with cell immunity in the blood, then if we can establish a relationship it gives us a certain base of knowledge to formulate questions on.

MR. ARSENAULT: It is my understanding that the ultimate purpose is to try to set bounds on the degree to which genetic factors can influence dose-effect relationships. You will note that as we get into some of these topics, my understanding is paper thin.

You indicated, Judy, that what you are doing here is research that has a high probability of providing good results, of success. It might be helpful to describe what success means in this case and how it would be applied by NRC in formulating the next step. I think that is really the answer to the question that has been raised.

MS. FOULKE: The second part is not totally sure that just because we perform a series of experiments, the results will be directly applicable to NRC's standards and licensing. It is more basic research than some of our other things.

The question has been raised by outside intervenors concerning whether some portion of the population is more susceptible and therefore shouldn't be submitted to the same exposure limits of the other. Since nothing is known about it, we have got to start somewhere. This particular animal is one that we expect to be able to find some concrete evidence, and then we can formulate further questions to study. But it really is more basic research than a lot of our other projects.

MR. ARSENAULT: A starting point. The implication is, of course, that if some portion of the population is more susceptible than the average, we may end up with standards in view of the various factors involved, such as right to work laws, et cetera. We may end up with standards that are keyed to those more susceptible portions.

One question that arises, then, is what degree of conservatism should be entered in on this point. The fact is no one knows, but we feel impelled to start the process of discovery, and that is what this is about. If it isn't responsive to our needs, if there are more favorable avenues of approach, we would welcome being pointed in the right direction.

If we are finished with that slide, then --

CHAIRMAN MOELLER: I think we are.

MR. ARSENAULT: The second category that I mentioned was rou ·e radiological effluents. The Committee last year in its report indicated that it did not feel that very much priority should be assigned to further study of the atmospheric dispersion of routine radiological effluents. In fact, I think dispersion generally was the subject of the comment.

We might have conveyed to the Committee last year more emphasis on atmospheric dispersion than was intended or appropriate because the work being done at atmospheric dispersion and liquid pathways in connection with accidental releases is, of course, applicable also to routine, and there may have been a certain amount of confusion in the boundary conditions last year.

This year we have tried to separate these. The work we are doing, you can see, is with regard to source terms. We have the project I mentioned earlier on radionuclide buildup and the characteristics of the contaminated materials within the site. That formed the source terms for effluents.

The purpose of this study is to determine what the characteristics and capabilities of effluent treatment systems should be in order to meet the standards for effluents that are set by EPA and the NRC.

This project has been under way for a couple of years. It involves in-plant measurements of radionuclide buildup. The project is basically in a state of hiatus this year for lack of funds. We expect to revitalize it next year and, as I indicated earlier, begin to look forward to using the same capabilities and much of the same information and techniques as a basis for looking at sources of occupational exposure.

In the next projects, the B-2281 is looking at the effects of decontamination on radwaste systems, the question of what you do with the post-accident radwaste resulting from decontamination of the facility. As you know, that is a problem at TMI now. Don is the manager of this project, and I would call on him to extend my comments. I must admit that I don't know a great deal about this project.

Don, do you want to extend on this

MR. SOLBERG: Not too much. We have completed the first part of the study, which was decontamination radwaste treatment requirements for decontamination as a result of normal operations. The report has been issued. We are simply seeking in the next years to extend that to the requirements for waste treatment from post-accident decontamination.

MR. ARSENAULT: The next two projects. The improved gale code is simply what we have learned in the A-6075 to determine whether or not changes should be made to the gaseous and liquid effluent analytical code used by NRR. Finally, as we learn more about the characteristics of effluent treatment systems required characteristics, we will begin to evaluate and analyze alternative effluent treatment systemes not now used in reactors but used elsewhere in industry.

CHAIRMAN MOELLER: Is the gale code, for example, used in determining compliance with Appendix I?

MR. ARSENAULT: That is my understanding.

MR. SOLBERG: Yes, sir.

CHAIRMAN MOELLER: Do we have questions on this first group?

MR. GRENDON: What does assess advanced treatment mean?

CHAIRMAN ARSENAULT: It is what I refer to at the end. As we get into the final phases of the first project, which is to determine what effluent treatment is required, we expect that it will be desirable to assess alternative advanced effluent treatment systems not now used in the reactor systems.

MR. FOSTER: Relative to assessment of what treatment is required, can you tell us whether there is a feedback to that from the population dose? More specifically what I have in mind here is that it is often the case where a contaminated material, let's say effluent, is being cleaned up. The people who are working on that cleanup are interested dominantly in sort of a gross cleanup of all the dominant radionuclides, but it may very well turn out that they have done an excellent job of cleaning up most of the nuclides which contribute very little to population dose, and those which do contribute most to the dose of the population aren't worked on at all.

MR. ARSENAULT: I understand the question. I am going to make a stab at answering it, but here again, I am going to ask both Judy and Schlomo Yaniv to contribute.

It is my understanding that the standards set for effluents are set on the basis of a computation of the population dose resulting, and that it has been radionuclide specific. There is considerable conservatism built into the effuent standards that are then set by NRR in its technical specifications. But I believe that the standards set do result from a radionuclide-specific computation of the ultimate dose.

There is a considerable amount of conservatism built in so that although the effects you are speaking of may occur, that is, that the stuff that easy to get out gets out and other stuff doesn't, while one might wish for a better balance in the treatment process, the end result, in fact, is defensible and conservative.

If my brains back there would like to supplement that comment, I would appreciate it.

MR. RAY: Advanced treatments. Would the work on this project include benchwork to develop new treatments or would it be to survey industry such as the fuel processing and so on to borrow existing systems that haven't been used in reactors?

MR. ARSENAULT: It would be our inclination not to engage in development of new systems but rather to explore the possible application to reactors of existing systems. Generally we think of DOE in terms of developmental activities. What the actual balance and role of NRC will be by the time 1982 roles around, I am not able to foresee.

But we do see an increasing tendency to rely on the NRC for formulating solutions to the problems as well as assessing them.

MR. RAY: Does DOE have any ongoing projects for the development of new treatment systems?

MR. ARSENAULT: I seriously doubt it. I would ask Don whether he is aware of any.

MR. SOLBERG: I don't know. I can't answer that.

MR. ARSENAULT: I think EPRI is looking at it but I don't think DOE is.

MR. EBERSOLE: Mr. Chairman.

CHAIRMAN MOELLER: Yes.

MR. EBERSOLE: I feel compelled to mention a problem here which seems to never get any attention. You just mentioned the standard release criteria, or words relating to that. Presumably there is an emergency release set which is the opposing one.

There is also another category which is, in my view, given little if any attention, and that is the concept of allowing modest but not standard releases to guarantee or insure that worse releases will not occur. I will give you a case in point.

In the development of the Brown's Ferry plant, the question of maximum floods came up. The company was forced to, very expensively and with a great degradation in potential success, secure the plant against floodwaters, protect certain systems for cooling processes, under more or less normal emission standards.

Other plants -- I believe it is Quad Cities -- found it quite simple and highly reliable, and I think you will appreciate the fact it is not difficult at all, to cool the plant by simply simmering the primary coolant to atmosphere, a direct release off the fuel from a coolant, if it is clean enough.

This sort of represents a criterion which hasn't been mentioned, how clean you have to keep the coolant so that you can directly simmer to atmosphere, anticipating 100 percent success in cooling, which is very likely, due to the simplicity of the cooling process.

We are now coming up on a bleed/feed type of concept of emergency cooling for PWRs. That will certainly involve looking at the potential for deliberately bleed/feeding a reactor when it gets into an emergency, which is discharging the primary coolant to the containment deliberately, which is one step removed from discharing it to atmosphere.

Presumably the PWR, since it is normally a much dirtier coolant, could not be as practically cooled by direct evaporation to atmosphere as could a boiler. But I think these matters need to be considerd. To what extent does one strike a balance between the overall reliability of guaranteeing against a serious accident at the expense of modest releases above the standard release levels?

CHAIRMAN MOELLER: Such occurrences would be under an unusual situation.

MR. EBERSOLE: Yes, they would. It would be very infrequent; but the objective would be to guarantee against a catastrophic release at the expense of a modest release. I see no guidelines, no legal basis, no way for the operator to even invoke what would, in respect to risk to the community, be clearly the best action.

MR. ARSENAULT: I think it is an interesting point you have raised. I think it is more relevant to the next category of effluent, which would be accidental releases. It is possible, of course, to deal with that under either heading. I appreciate that.

MR. EBERSOLE: I am saying this is not accidental.

MR. ARSENAULT: Deliberate but not routine.

MR. EBERSOLE: Right.

MR. ARSENAULT: I understand that. And I think although one might be able to make a rational decision between this and the next category to deal with it, I personally would feel it more appropriate to deal with it in the next category, in the next slide.

MR. EBERSOLE: Well, as long as it is dealt with. My point is that in the zeal which I see all around to protect against any significant release, we frequently jeopardize plant operation by attempting to secure it, in such a tight fashion of operation that we may fail the whole process.

MR. ARSENAULT: I understand the point. In fact, I am not proposing that it is dealt with within the program. I think it may be at least partially. What I am suggesting is that I would like to return to the point when we get to the next slide and try to identify where it would more likely fit into the program, if I might.

MR. EBERSOLE: Sure.

MR. ARSENAULT: In connection with the dispersion pathways to man, we have actually no atmospheric dispersion research going on, which, I am pleased to note, is consistent with the priorities set by the Committee last year.

We do have an iodine pathway study, but that is not general dispersion; that is a rather specific question of where and how the iodine is transmitted through the environment to man. That has been going on for a few years and at a relatively modest level, as you can see by the handout.

In the liquid pathways, as I am sure you are familiar, the aquatic dispersion is a rather complex phenomenon, and we do have several studies going on looking at how sediments are involved in this transport. The first one looks specifically at the Susquehanna River and the Chesapeake Bay and has relevance to the TMI releases.

The next one, non-stream model, looks at the role of sediments in lakes, estuaries and essentially non-flowing bodies of water, non-stream bodies of water.

The next two projects are associated with streams. The first one is the collection of field data for the purpose of validating river transport models, and the next one is the use of that data in the exercise of the model for validation purposes.

Finally, the distribution coefficients is associated with questions of the characteristics of the water body, water quality, et cetera, and Mr. Reed would be happy to answer specific questions on that, much happier than I would, I am sure.

This research is relevant to the transport of routine effluents. I point out that it also has relevance to the aquatic transport of accidental releases, and there is on the next slide back to these. But the motivation, the genesis of these projects was actually by requests from NRR that were associated with routine effluents.

DR. FOSTER: Frank, I have a couple of questions there. The first one is relative to the sediment transport. Can you tell us if the focus of that is on the role of sediments in transporting the radionuclides back to man, as contrasted with the role of sediments in cleaning up the water and removing it into a sink?

Usually most of the focus has been on sediments as a part of the pathway to man. I have always kind of felt that perhaps the dominant role there of getting it out of the sytem has been somewhat neglected.

I have a second question.

MR. ARSENAULT: You might start moving down while I start the answer to this question. I am sure I am going to need help. I think both aspects are covered in the study. The question is exactly what is the role of sediments and how do they behave in the transport.

Now, to the extent they act as a sink and they collect and immobilize radionuclides, then that, of course, would be part of the data collected and part of the modeling to be done.

By and large, though, I think that the problem is one of being able to predict or model how sediments behave in transporting radionuclides. Generally, of course, they act as a slow migrational mode for the transport of the radionuclides in the stream beds after the materials suspended in the water are long gone. By and large -- and I am going to speak now from fairly general understanding and I would ask Phil then to direct his attention to these specific projects -- but by and large, sediments have a tendency to stretch out radionuclide contamination on a stream bed for a pulse release and to reach some form of equilibrium for continuous releases.

But there is a question as to whether or not they serve as a sink, in your terms, at some point in the stream bed and result in a higher level of deposition. From one point of view, that is a sink. From another point of view, it is a source. The real question, then, is how do they behave and how do we take into account the complex behavior.

Now, that is a rather superficial answer, but Dr. Reed will be happy to address any specific questions you have.

MR. ARSEN: You may wish to voluntarily add to my comments, Bill, if people have any specific questions.

MR. REED: Okay, in your first comment with regards to dose demand and uptake like that, this is not in this scope of work.

With regards to your second question on the distribution and the sediments and things like that, that is primarily the focus of this particular program. These particular programs are field programs to essentially collect the data. The data collected are the hydrodynamic data, as well as the distributions of the radionuclides on the suspended sediments and the bedload sediments. The sediments are broken down according to their size fraction, to silt, clay, sand, et cetera.

These essentially then are incorporated into the models. These are essentially physical transport models that go from Point A to Point B. That is the only thing that we were looking at at this time.

The models essentially are capable of predicting the sinks that you have been talking about, and in addition they are capable of handling resuspensions and items like that.

The models that we are using are essentially models that have been available for some time. We are essentially modifying the models to include the sediment and the transport phenomena and the radiological components in the sediments.

MR. FOSTER: But you end with the inventory of materials in the models ever ually in one or two places, either as material which is remaining in a, let's call it a soluble state in the water, or e e it is deposited someplace and may constitute ultimately a direct source of radiation on a beach or shoreline or something of that sort.

Well, the second question that I had was whether you have anywhere any work which is related to the actual transfer of contaminants from sediments to aquatic organisms. This is something which everybody talks about as a mechanism which undoubtedly is present, but to my knowledge there really exists very, very little positive information as to the real magnitude of that transfer.

MR. ARSEN: Before Phil rises to that, I will point out that my attention was called at a rather late hour to the fact that there was a small part of our program neglected in the presentation. And that was the effect of radiological effluence on fisheries and ecological, ecology. There is an ecological impact category in our program. That you will not find listed here. It is a rather small part of the program; that is, with respect to radiological effluence.

Now with that comment I would like Phil to address this business of ultimate transfer to biological effluence.

MR. REED: With regards to the biological question, these particular programs are not related to the biological



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component at this point. They are only designed to predict movements from one point, essentially the effluent down to the sediment.

The programs that regard transfer coefficients and essentially uptake by bottom feeders and young of the year within the streams and that are essentially either being discussed at this point or the people in the reactor licensing feel that there is sufficient information developed already.

CHAIRMAN MOELLER: Yes, Alex?

MR. GRINDON: Your mention of ecological effects, if by that you mean a matter that I have heard over the years and felt disturbed about, are we going to disturb fish population or something in a way that will hurt such population, I think it is a waste of effort to be studying that.

The transfer through the food chain to man is important, but changing fish isn't going to -- if you change them it makes no difference to man's interest in fish. You don't change enough of them to be a factor there. So I hope that you are not spending money on that kind of effort.

I have a little detail to point out. I was trying to identify that river sediment model, and I see it is 2295 in one place and 2294 in the other. And just as a detail it should be straightened out which it is. In your detailed one, that next set of papers.



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MR. ARSEN: Yes, I believe the correct figure --

MR. GRINDON: It is called 2294.

MR. ARSEN: I believe the correct figure is 2294.

MR. GRINDON: 94 you think is the right one?

MR. ARSEN: Right. Can you confirm that, Phil. That is the P & L study.

MR. GRINDON: It is a small point, but we might as well have it right.

MR. REED: That is correct, it should be 2294.

CHAIRMAN MOELLER: One other comment, let me put in the record, Frank has mentioned the recommendations of the ACRS on atmospheric transport, and several times we have heard of course that last year we did not support this type of research to a great degree, but I think it should be carefully pointed out that there were certain portions of it we did support and others that we did not.

These recommendations are in NUREG 9657. And just for the purposes of the subcommittee, so that we are all together and there is no misunderstanding, let me read. We said: "The ACRS does not believe there is an urgent need for emphasis on research to improve the models for describing low level airborne or liquid radionuclide releases from nuclear power plants under routine conditions. This is especially true relative to refinements in the calculations that support 10 CFR 50, Appendix I."



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Now we can go on to say with respect to mathematical models for the transport of radionuclides in water and sediments: "Portions of this work that should be emphasized include evaluations of the liquid pathway, particularly as it pertains to radionuclide releases from a nuclear power plant under conditions of a severe accident." And then development of mathematical models for the atmospheric transport of radionuclides, "although models for the transport of airborne radionuclides over short distances are reasonably adequate, there continues to be a need for an improved capability to assess the behavior of airborne releases at moderate, 5 to 15 kilometers, and greater distances, 16 to 80 kilometers from nuclear power plants. This is especially important relative to emergency planning where models are needed to provide projections on a real-time basis."

So I simply felt for purposes of the subcommittee members to remind ourselves to clarify the point that you are making, Frank. Routine releases we did not support the work. Emergency situations we definitely did support it.

MR. GRENDON: The critical point being the distance at which --

CHAIRMAN MOELLER: And the critical point being the distance.

MR. GRENDON: Of the estimate they made.

MR. ARSEN: Well, I would, if I may, repeat what I



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said a moment ago. Last year we described meteorological work in a somewhat lumpy context with routine effluence as well as accidental effluence.

MR. FOSTER: Right.

MR. ARSEN: But in fact, most of the meteorological work was being done in connection with accidental releases, and that is the way it is presented this year. And you will hear about that in a moment.

With regard to these liquid pathway projects that are in this current slide, the sediment projects, they were in fact generated on the basis of NRR requests associated with evaluation of routine releases, and I felt that it was only fair to present them in that context.

On the other hand, I have already noted their relevance for evaluations of liquid pathways for accidental releases as well. And we felt that it was important to point that out. And again, on the next slide I will make that reference one more time.

If there are no more questions on the pathways to man projects the health effects --

MR. FOSTER: Well, let me ask, Dick, can you give me a bottomline at this point in terms of your assessment of the proposed research on the liquid pathways?

MR. ARSEN: If I may interrupt, this is not all research related to liquid pathways.



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CHAIRMAN MOELLER: All right. Well, we will wait and hold it then until we hear the remainder.

MR. FOSTER: All right.

MR. ARSEN: It is merely that part of the SAFER program associated with transport of radionuclides in water bodies that we feel is relevant to the overall issue of aquatic pathways. But there is work going on in other offices which actually I will touch on in the next slide.

CHAIRMAN MOELLER: Fine.

MR. ARSEN: Then the health effects model, the health effects projects in fact deal with the models which are applicable to the question that was asked a short time ago in determining that in fact the effluence from nuclear power plants do not exceed population exposure rates that have been set as standards.

There are two projects dealing with models for this purpose. And again I cannot add actually much to what is written on the piece of paper. If you have any specific questions Judy will be happy to answer them.

MR. GRENDON: You can tell me what DEMPAK means. I have no idea.

CHAIRMAN MOELLER: Yes. And Judy, before you begin, I think I would like to offer a comment on this in a general way. I know that Congress has been pushing the NRC, and in fact, in several of the appropriation bills and other items they have



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specifically directed NRC to enter into the health effects research area, particularly in terms of epidemiological studies.

Here though I think I see something that maybe should be expressed in a different way. You call this health effects. Actually what Frank was saying is, I heard you, Frank, was you are talking about compliance with regulatory requirements.

In other words, this research will help you determine whether a plant is being operated in compliance with regulatory requirements as contrasted to an assessment of health effects. Now am I wrong?

MS. FOULKE: That is right. We are not looking at any biological studies here really. The first project at Argonne, DEMPAK is a computer code whose emphasis is on demography. That is where the DEM comes, demography package.

The second one is again dosimetry work at Oak Ridge and again the output is a computer code. And specifically, the work they are doing now is related to vital transport, pathways in the environment. Specifically, they are looking at the global models for Carbon 14 and Iodine 129, Technetium 99.

The first project at Argonne was developed based on a need and a decision, a regulatory decision in the Hartsville Appeals Board case that NRC should compare the health effects of a coal plant with the health effects of the nuclear plant that is under question.



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So what they are doing is taking dose-response information from the BEIR reports and the UNSCEAR and others and putting them into a model that will project cancers or lifeshortening for specific population groups, b ause it obviously, with the latency period, makes a difference, at what age you got an exposure, how long the exposure continues.

So the continuing work has to do with refining the dose-response functions that will be used in this model and getting a better air pollution model.

Right now they have one based on cigarette smoking that is not too great. But that is all they have. So they are both again paper studies. And they are just lumped under a category called health effects, because that is the end point of the considerations.

They are not looking at specific health effects.

MR. ARSEN: I think the point that you have made, Dr. Mueller, is a good one, and that is that we might be sensitive to the categorization of some of these studies so as to make much clearer the character of the work. It is true this is not health effects research in the sense that is frequently discussed. And we will give some thought to the question of how we might categorize our research to make that clear.

We are, however, stuck with the need not to have so many different categories that it becomes awkward for budgeting and discussion purposes.



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CHAIRMAN MOELLER: Alex.

MR. GRENDON: Your more detailed description, however, does start out by saying "advanced dose-response functions to be incorporated into this." And apparently dose-response functions is the heart of the thing. This certainly then refers to health effects there, and I am interested in the fact that it says a population exposed to radioactive and nonradioactive pollutants. Pollutants. Not just from nonradioactive material used as a test medium, but something that is regarded as having an adverse health effect, like cigarette smoke or fossil fuel burning.

Will some information be collected in this study on the adverse health effects, let's say, of the burning of coal?

MS. FOULKE: The people writing the program will depend upon other investigators for the input into this. They are not themselves looking at specific populations.

MR. EBERSOLE: Does this include the radiological emission aspects of burning coal?

MS. FOULKE: Could you repeat that, please?

MR. EBERSOLE: Yes. Does it include the radiological emission aspects of burning coal, which I understand --

MS. FOULKE: Yes, it will include all that, right.

MR. EBERSOLE: Thank you.

CHAIRMAN MOELLER: Certainly the second one, the biotransport models, I can see immediate applicability; for

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example, in terms of venting the krypton from TMI. That is one of the first questions, is where does it go and what does it do.

So this is very important.

Any other questions on this one?

Dick.

MR. FOSTER: In kind of a generic fashion, I wonder whether you still have anything going on on acceptable risk, which kind of ties in, has the related aspect of a de minimus level, de minimus dose sort of thing. This has an interaction with your health effects project here on global models and transport. It is one which is used in a number of the other NRC documents along the line.

It is not your problem alone, I recognize, but it is one that I think the NRC could continue to beat the drum for. And you did at one time have some work going on in that. I am wondering what the status is.

MR. ARSEN: Well, the work, to address the question of acceptable risk, is being handled in the probabilistic analysis section. And the question of de minimus of course is a policy matter. We do not have any research going on within the SAFER division that is directly in support of either of those two functions, for those two activities.

And while I recognize that it is certainly related to the subject of reactor radiological effects I think

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if it is in the RES presentation to the committee, it would probably show up in the risk assessment program. We don't have any work on it.

MR. FOSTER: The very evident place where this comes in is in your demograph. These codes which tend to calculate population dose in terms of man rems, and particularly if you are getting into global models, why, you are adding up extremely small doses with extremely large doses related to extremely large populations. And how you handle these things relative to your model building and what you plug into it is heavily influenced by whether or not you do put any cutoff level, whether this is distance, microrem or whatever.

MR. ARSEN: That is true, and it is not accommodated. I stand ready to --

MR. FOSTER: And you don't have anything going on in or even thinking about in that direction at this time?

MR. EBERSOLE: Do you have anything going on on more or less a differential basis, which you know my earlier question was. It would address the question, is it better to take a small dose, for a certain probability than to face a much larger one on a probabilistic basis? Do you follow me?

MR. ARSEN: I do. Once again that is a hard one to chew.

MR. EBERSOLE: But it is a necessary decision.

MR. ARSEN: I understand the question. I have to

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answer it in the following way.

The question can only be rigorously answered if one knows the shape of the dose effect curve at the low levels of exposure. We do not. We are operating on the basis of a no threshold linear response curve.

With that assumption of course the answer to your question is there is no difference between a large dose with a small number of people and a small dose with a large number of people. And I think that that is the answer that is consistent with the current operating hypothesis.

There is of course an implication in the way we do business that it is better to receive a higher dose for a small number of people because this implication is present in the way we deal with risk.

Probably, I don't have the figures to back up this statement, but I strongly suspect that occupational exposure in a nuclear power plant will far outweigh the accidental risk to the public. And yet look at the attention that we are giving to nuclear power plant accidents compared to the level of attention being given to occupational exposure.

I think there is a strong implication in that. I think I could find other examples. But the answer to your question is no, we are not giving any attention to that question. Beyond that aim, that rather intensive effort aims throughout the federal government to a better definition of the dose-response

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curve at the low level.

MR. EBERSOLE: Whether or not you are doing any work in that area, it was implicit in the decisions made of let's say Brown's Ferry versus Quad Cities that one method was better than another. And I think that might be examined more thoroughly.

I was a proponent of direct release of steam to atmosphere, but I got beat down.

MR. ARSEN: Well, many of the hypotheses of the NRC are evidenced only by the location.

CHAIRMAN MOELLER: But again, another aspect of what Jesse is saying, I am hearing him saying several things. The analogy, and correct me, Jesse, if I am using a bad analogy, but would be Three Mile Island venting. Jesse is saying that we could vent it with a probability of one that the population would get a certain dose, because he is going to vent it under control conditions. Or we could sit back and have it accidentally spring a leak and go out uncontrolled not at the best meteorological conditions or not under the best meteorological conditions.

MR. EBERSOLE: I will endorse that.

CHAIRMAN MOELLER: And so then the question is how much dose can you take with a probability of one to avoid a much worse situation with a lesser probability.

MR. EBERSOLE: Exactly. It is a good model.

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MR. ARSEN: The question and the answer of course is nontechnical. I mean, I am not being facetious. I think that the --

CHAIRMAN MOELLER: But there must be, like you are doing a lot of, or you are proposing in this long-range plan socioeconomic and political and so forth research. Well, I think what Jesse is naming would be to me one of the top priority items to place in this category.

MR. EBERSOLE: Right, I certainly do.

MR. ARSEN: The question of public acceptability of various modes of exposure.

MR. EBERSOLE: Well, they had an alternative of one over the other.

MR. ARSEN: I understand the point. I think it is a good point.

MR. EBERSOLE: So it is a choice you must often make, and I don't think we are helping it.

MR. ARSEN: I can only agree that we could do more in the area of socioeconomic studies to aid in that kind of decisionmaking. I would welcome the expansion of the subcommittee's interest into the area of socioeconomic studies. I think it is in fact an extremely important category of research being done in the SAFER decision, which has been excluded from the purview of the subcommittee in previous reviews.

We didn't bring any of our socioeconomic research with

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us to present today, for example. But I take your point. I think it is a very good one, and I welcome it.

MR. EBERSOLE: Thank you.

MR. ARSEN: The final category here is not really a category but rather an add-on.

Decommissioning has been an area of specific focus and attention. It represents rather than an element in the logical structure on the slide, rather a phase in the life of a facility to which all of the other radiological issues relate.

What we are doing so far in the area of decommissioning is to look at the various factors that affect the susceptibility to decommissioning, the modes and degrees of decontamination required to bring the site into a satisfactory state for decommissioning, the aspects of decommissioning decontamination that affect occupational exposure and effluence.

Generally, that is the scope of our current interest and concern with regard to decommissioning. It is reflected, at least in part, in the four projects that are described here. Again Don Solberg is the chief in charge of these and will be happy to answer any specific questions.

CHAIRMAN MOELLER: Questions on decommissioning.

MR. ARSEN: The titles are more or less descriptive. The second handout you have presents a greater detail. I can't really supplement what is said here. So if you want to look at it and present your questions to Don?



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CHAIRMAN MOELLER: Well, I hear none at the moment. There may be some that develop. This appears, Frank, to be a good point at which to take a break.

MR. ARSEN: Yes. We are ready to move on to the next one.

CHAIRMAN MOELLER: All right. Let's take ten minutes.



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CHAIRMAN MOELLER: The meeting will resume. Do we have any questions on the decommissioning portion? I guess I had sort of a thought on it. I wondered where it stands in your priorities now compared to a year or so ago, the subject of decommissioning?

MR. ARSENAULT: I think it's less a matter of priorities than budgeting. I think we're giving it far more attention in our plans for '82 than we did in our plans for '81. I think that's clear. We're giving it an expanded proposal.

The question of priorities would arise in the event that the proposed requested budget for '82 is reduced significantly and many of the decommissioning problems are still some off in the future while other problems we have to address are closer at hand. I would not want to prejudge what we would do in those cases, but I feel that I can anticipate a keener interest by NRR and our other clients on some of the more immediate problems.

CHAIRMAN MOELLER: Jesse?

MR. EBERSOLE: I'd like to see you, if you can, approach the decommissioning along two broad lines. That is old plants and new plants which have yet to be designed, and after a normal history versus after an accident, because these will present four different problem areas. In the new plants, I'm quite certain they can be designed to enhance the decommissioning operations whether it's after an accident or after a normal history.

MR. ARSENAULT: In a sense, we're covering the areas that you mentioned, perhaps not in an adequate or satisfactory sense, but the business of post-accident decontamination, we're thinking -- that was one of the projects that was addressed here -- we're thinking primarily in terms of post-accident decontamination for return to service. But it may also be simply not to return to service but rather to get it ready for decommissioning activity.

The other aspect of this is old plants and new plants. We're in the early days of collecting information and developing an understanding for the factors that will influence decommissioning at this point, but we appreciate the relevance that that data-gathering can have on materials of construction and design.

So we are cognizant of these things. To what degree we will be able to factor them productively into our on-going effect is another thing.

DR. FOSTER: Does NRC have anyone or group which is kind of watching what's going on at Hanford with the old plutonium production reactors and decommissioning there? There's a pretty elaborate study which has been made and to my -- well, I'm not fully up to speed on it, but a decision is about to be made on how, when and if to dismantle the old 100F reactor there. There are probably a lot of lessons to be learned associated with that.

MR. ARSENAULT: I want to respond to your question before I ask Don whether he can add anything. The lead office for the subject of decommissioning within the NRC is the Office of Standards Development. You're familiar with the PPPG and the cross-cut program areas, one of which is decommissioning.

Each of those cross-cut program areas has an assigned lead office. As I say, Standards is the assigned lead office for decommissioning.

I don't know the extent to which they are investigating the specific cases you mentioned. Don may and he can address that in a moment.

I would point out that the extent to which we can remain cognizant of all activities that are relevant to the sphere of research that we're engaged in is conditioned very sharply on the amount of available time and manpower that we have. I've raised this in the past. I hate to sound like I keep raising it as an excuse, but the factor is extremely important. Don recently doubled the size of his branch by hiring a man. That's the situation that he's in.

So I would ask him now if he's aware of any activities by Standards to coordinate with these DOE activities and if he can add anything else to this, but I think the answer is that we are not --we're not able to maintain a level of knowledge and awareness that we would consider acceptable.

MR. SOLBERG: We make every effort to coordinate with the Department of Energy. We know that most of the work in



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decommissioning is going through the Richland operations office of DOE. You'll notice from the program that we have that all our work is being currently done at Battelle Pacific Northwest Laboratories, as were the decommissioning studies done for the Office of Standards Development, which is the basis upon which the current rulemaking is taking place.

The most significant answer to your question I think is that the people that we have working for us are intimately familiar with all the basic plans at Battelle related to decommissioning research that they're doing and are reasonably familiar with the things that DOE is proposing.

Does that answer your question?

DR. FOSTER: Yes, partly. Underlying my comment here was the thought that perhaps a portion of the overall money here might well be spent not in a new direction but one of looking over the shoulders of,in this particular case the work is being done by United Nuclear out there, relative to the reactor, and particularly looking for situations which would have a tie-in back to commercial power reactors and the problem areas which were associated there, perhaps not so much techniques as with situations.

MR. ARSENAULT: You will note that the last item here, called in-plant evaluation, deals with the exploitation of opportunities to get in where decommissioning is actually going on and collect some information, so I think this is in line --

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DR. FOSTER: This is exactly in line with that, yes.

MR. ARSENAULT: I'm not sure that we have identified all possible opportunities for such activity.

MR. SOLBERG: Excuse me, Frank. This is precisely how we will do it. We're not planning to go in and decommission the site but piggyback on what somebody else is doing. We're doing it both in the fuel cycle area and the reactor area.

And pertinent to your question, certainly the decommissioning that will be going on at Shippingport will certainly be very interesting to us, and we would hope to follow that very closely, perhaps have a contractor that would be following all the decommissioning work at Shippingport, and provide us with specific information meeting our needs that may not be necessary from the DOE point of view.

MR. ARSENAULT: Shall we move on? The third category I had mentioned was accidental radiological releases. Now in connection with this, the principal activity dealing with this rests in the accident sequence analysis consequence assessment activities of the Probabilistic Analysis Section. And you are being -- perhaps have been -- briefed by that group on their program of research, which centers around this activity. So that we will restrict our comments today to those activities being carried on in Division of Reactor Safety Research and the SAFER Division that support or supplement the PAS activities.

These are principally, in connection with source term generation, within the Reactor Safety Research Division, there is an interconnection of body of research that leads to the accident environment within the containment. That is radionuclide release, transport within containment, deposition and so forth.

This research provides the basis for source term generation for accidental releases from containment. People from RSR are here to discuss in further detail that work. You are in fact, the ACRS in some subcommittee manifestation, will of course be briefed in detail and in toto on the RSR research, including this. But we have someone here who will be able to address that subject if you wish.

Beyond the source term, having postulated a release, the transport phenomena are both meteorological and liquid pathways. The liquid pathway -- this slide is incomplete because it does not indicate the rather extensive work being done within PAS on liquid pathways. The SAFER designation merely indicates that we're supplementing that to some degree by the product transport research that we're doing that we mentioned earlier.

The meteorological transport, the airborne transport of accidental releases, is done almost entirely within Jerry Harbour's branch, Site Safety Branch, by Bob Abbey, and Bob is here to address that in greater detail and extensively if you wish.

The work that he does is used directly then by PAS in its physical transport consequence assessment work.

Finally, with regard to health effects, much of the research that we do on biological models and health effects is relevant to the PAS consequence assessment, but two projects we have on are directly and specifically relevant, and in fact initiated for purposes of supporting that effort. They are two projects we have at Loveless and P&L, I believe, Loveless and P&L on the acute effects of accidental releases. This is a higher order of exposure than most of our subjects looked at.

MR. GRENDON: Each of these two projects is marked Phase 2. What was Phase 1? Is it just more of the same?

MS. FOULKE: I'll defer to Dr. Yaniv, who's the porject manager on these.

DR. YANIV: There is very little data available on the acute effects of inhaled radionuclides, and particular when the inhalation is combined with external exposure, and we're dealing with mixtures of radionuclides.

In Phase 1, paper work was performed, which consisted of collecting all available animal and some human data from therapy, and in the development of a predictive model. During that work, gaps in the knowledge had been identified, and Phase 2 is intended to fill those gaps by doing some animal research in this area.

Does that answer your question?

DR. FOSTER: What are the gaps?

DR. YANIV: Okay. The most important gaps are the combined effect of insults to multiple organs at the same time. What we're really talking about, if I illustrate it, is if an individual is exposed to an LD 50 metal dose and at the same time to an LD 50 lung dose, what is the combined effect? Is it additive, synergistic or what? And we do have no data. That's one example.

Another example is again inhalation let's say of a fairly non-soluble radionuclide, would you mainly irrigate the lung and this being combined with external exposure? How do you add this? This kind of thing. And animal experiments are designed to answer these questions.

CHAIRMAN MOELLER: And this will help you, then, or help the NRC in accident modeling of acute health effects?

DR. YANIV: Yes. It's basically designed for consequence analysis of a major accident.

MR. ARSENAULT: It will help to correct weaknesses that were identified in the WASH 1400.

DR. YANIV: Those weaknesses or strengths have been identified and we are fully aware of our deficiencies in our knowledge while doing the WASH 1400 work in this area.

CHAIRMAN MOELLER: What medical advice do you have in guiding -- does the NRC have in guiding the contractor on this? Do you have a team of -- do you have a consultants or review groups that have medical people on them?

DR. YANIV: First of all, no work is done on humans, obviously.

CHAIRMAN MOELLER: But certainly I would want -- you're the contractor or are you with NRC?

DR. YANIV: I'm with NRC.

CHAIRMAN MOELLER: Oh, you're with NRC. I'm sorry. I was thinking you represented the contractor. Okay, well who guides you? I can see you have WASH 1400 and it tells you there are certain problems and questions that need answers. But does your group in NRC -- are you a radiation biologist?

DR. YANIV: I'm a radiological physicist.

CHAIRMAN MOELLER: Okay, radiological physicist. Do you have radiation biologists? Do you have physicians who are helping to guide this work?

DR. YANIV: No, we have no physicians. There are no physicians on the NRC staff.

CHAIRMAN MOELLER: All right, who guides, who helps to advise you in planning this work?

DR. YANIV: There are the biologists, health physicists of the NRC staff.

CHAIRMAN MOELLER: I know some health physicists on the NRC staff. Who are some radiation biologists?

DR. YANIV: Judy is a radiation biologists and there are a number of radiation biologists in NRC, in all offices of NRC practically. In NRR, in OSD, I can mention names.

CHAIRMAN MOELLER: But you're assuring me there are plenty of these people?

DR. YANIV: And people who are performing the work in Boston, Lovelace and Battelle Northwest are the most eminent radiation biologists -- are among the most prominent radiation biologists in the country. Bill Bear, for instance, is intimately involved doing this work at P&L, and his work is coordinated between those two labs.

CHAIRMAN MOELLER: That's helpful. Jesse and then Alex.

MR. EBERSOLE: Is it within your sphere to consider this utilization of the potasium iodide method of reducing dose in emergency?

DR. YANIV: Well, first of all potassium iodide has to do only with radio-iodine in the thyroid. This work is mainly directed toward the effect on the lung and the bone marrow, as the critical organs which could lead -- the radiation of which could lead to mortality. It is very difficult to kill someone by irradiating his thyroid.

MR. ARSENAULT: If I may, a little more directly in connection with your question, it would be within the scope of our interest to do work along those lines. However, when the subject was raised following TMI, it appeared, for reasons unknown to me, to be more expeditious to have the work initiated by the Probablistic Analysis Section, and they have initiated efforts on that subject.

I do not know what precisely the nature of the project is nor what its objectives are.

MR. EBERSOLE: Well, as a competitive measure and one that might be more simple and practical, isn't it reasonable to think that maybe a modest design of face-nose masks using activated charcoal is a better alternative, a cheap thing? They're manufactured in great quantities and simply bought at the drug store and parked.

Do you follow me? I'm not talking about a World War II type of thing. A modest amount of --

MR. ARSENAULT: I understand. I think the options of potassium iodide versus evacuation versus mere sheltering have been considered. To my knowledge no one has raised the possibility of a mechanical solution equivalent to potassium iodide for this purpose. To my knowledge no one has.

Has anyone ever heard of PAS considering --

MR. EBERSOLE: Is that unreasonable, a cheap face mask?

MR. ARSENAULT: It's certainly not unreasonable to consider the effectiveness of such an option. PAS is using its consequence assessment techniques to evaluate the relative effectiveness, cost effectiveness of various options for interdictive measures. As a matter of fact, that's on my next slide. You seem to always manage to keep one step ahead of me.

MR. EBERSOLE: Well, it just seems a thing that to me

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that would be far more meaningful to the public to have it in their medicine chest.

MR. ARSENAULT: I certainly would be happy to pass on to PAS that this is one of the options that should be introduced into their evaluation program.

DR. YANIV: I might point out that the solution sounds very attractive but there are quite a number of difficulties associated with this kind of solution. For instance, at TMI during the accident one of the problems was that there is no such thing at this point as iodine approved cartridge for a face mask. And just think about the problems of starting those cartridges and their shelf life, and even activated charcoal would not be very helpful to an elemental icdine. There are compli:ations.

Obviously, all this kind of work in my opinion has to be done on the basis of cost benefit analysis and the best solution found.

CHAIRMAN MOELLER: Alex has been patiently waiting.

MR. GRENDON: I'm puzzled by the fact that your Lovelace experiment deals in a couple of points with the differences between alpha-emitters having different specific activities, effects on rats of inhalation of alpha-emitters having different specific activities, one such. I don't quite see what difference that makes if you have the same amount of activity inhaled, what difference in its specific activity?

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DR. YANIV: It can make a considerable difference in terms of the effect, but when we're talking about this kind of acute injury, there is a considerable amount of repair going on.

MR. GRENDON: Make sure that we're talking about the same thing. I'm saying you get the same amount of activity in, only in the one case the nuclide has a short enough halflife so its specific activity is high and in another case it's low, but here's a particle of the same size because in general these are deposits on some dust or something, particles the same size with the same amount of microcuries or whatever involved, but different specific --

DR. YANIV: Okay, to put it simply, it's not only the dose that effects the outcome, but also the dose rate.

MR. GRENDON: But the dose rate is the same. I'm saying the same number of microcuries.

DR. YANIV: The dose is the same but the --

MR. GRENDON: The dose rate --

MR. ARSENAULT: Isn't the relevant factor the biological uptake rate and the question is if you have a certain amount of some radionuclide, that you get a higher dose rate and potentially, given biological halflives of the larger dose?

MR. GRENDON: We're talking at cross purposes again.

DR. FOSTER: If I can stick my foot in here, I would visualize this in terms of the lung as the penetration. If you're dealing with alpha, why it's strict --

MR. GRENDON: They're both alpha. Alpha-emitters having different specific activities.

DR. FOSTER: But there's beta in here too.

MR. GRENDON: No, no. I'm saying of alpha-emitters having different specific activities. Now I say here's a particle of the same size, same number of microcuries. One has one microgram of some radioactive material on it and the other has 10 micrograms of some radioactive material on this particle, so --

DR. YANIV: So let's put it simple in terms. Let's call it by name. One microcurie of plutonium 239 and one microcurie of plutonium 238, 300 in specific activity. They have both more or less the same energy and let's assume that they'll have the same behavior, just for the sake of the argument, then the ultimate dose will be the same.

MR. GRENDON: The dose rate is still the same.

DR. YANIV: No, I'm sorry.

MR. GRENDON: If you have a microcurie, it is generating so many disintegrations per second.

MR. ARSENAULT: Didn't you mean micrograms?

MR. GRENDON: It generates so many disintegrations per second. The same for the 238 as the 239 if you have a microcurie of each. You have in the one case one microgram of plutonium 239 and 300 micrograms of plutonium 238, but they're on the same sized particle because in general they adhere to some dust particle.

Now what? Why is there a difference? Why do you expect a difference?

DR. YANIV: Well, for entirely different reason we expect a difference because the biological behavior of this example of plutonium 239 and plutonium 238, the transports from the lung and through the lung is different.

MR. GRENDON: Let's say they don't even transport, and generally they don't if you're talking about insoluble particles. These are plutonium oxide particles and in general they would be --

DR. YANIV: Animal experiments, not for acute effects but for long range --

MR. GRENDON: But you --

DR. YANIV: No, let me finish. Have shown that plutonium 238 is being much more readily transported from the lung into the bloodstream than plutonium 238.

MR. GRENDON: I know of no such experiment.

DR. YANIV: It was done in Hanford.

MR. GRENDON: With the chemical form?

DR. YANIV: With the same chemical form. The probable explanation of it is that because of the high specific activity, a concentration of energy, recoil particles are being removed. It is a well known fact --

MR. GRENDON: That high specific activity meant high rate of dose --

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DR. YANIV: No, I'm talking about high specific activity because then it's concentrated. It's a well known fact that if you take plutonium 210, which is probably the highest specific activity alpha-emitter that we have, and you put a piece right here it will be all over the room without an air movement.

MR. GRENDON: But what does the high specific activity to do with it? It means that one microgram has as much activity as 100 or 1,000 -- if you got to where it was milligrams I certainly think you've made a difference, but --

DR. YANIV: You have a tremendous concentration of energy within a very small particle.

MR. GRENDON: They're all very small particles in terms of cell size and such.

DR. YANIV: But the physical behavior of the material is different. The transport mechanism --

MR. GRENDON: We're gaining no ground, but I'm still puzzled as to why --

MR. ARSENAULT: It is my understanding that the basis for the distinction lies in the fact that the --

MR. GRENDON: It looks to me like it's a wild goose chase.

MR. ARSENAULT: The biological behavior of the material will be a function not of the number of curies but of the number of grams, micrograms, and that the higher specific



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activity does in fact provide, through the biological vehicle, provides a higher dose rate, potentially a higher dose. That has been my understanding. I would have to defer to the more detailed knowledge possessed by the project manager, but --

MR. GRENDON: Well, I've registered my point and belaboring it does no --

MR. ARSENAULT: I think it's a point that's important enough to deserve our attention following this briefing and we'll be happy to pass on what we've learned.

CHAIRMAN MOELLER: I would agree with Alex Grendon that it is confusing as presented.

Dick, did you have further questions?

DR. FOSTER: I forgot what my question was at this point. I will support the point here that it has been observed in animal lungs that there is a much enhanced effect of the plutonium 238 over the plutonium 239. That was observed to begin with and then the specific activity came into the picture as an explanation of something which was observed which was unexpected. And at this stage of the game it's a matter of searching for an explanation for an effect which has been observed, which seems to be associated with the specific activity.

So you're right, that the phenomenon is there and it probably results in having it included this way in the experiment.

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CHAIRMAN MOELLER: Another comment on a different aspect of your presention. You mentioned that PAS is doing work on a number of these subject areas. Yesterday we were told that and we heard some of the work that PAS is doing, but we were left with the troubled question in our minds that it seemed like when you -- not necessarily you but certain groups in NRC have a problem that they don't know what to do with, they just say well, PAS is taking care of it.

(Laughter.)

CHAIRMAN MOELLER: Further, we really wondered if PAS has all of this in-depth knowledge and intellect to do these things. For example, where they're helping you or doing something that's directly related to questions you want to have answered, do you have ample opportunity for technical input and review and working with them to be sure that they're coming along and approaching it the way you want to have it approached?

MR. ARSENAULT: That has not been the case in the past. There have been -- there is now activity under way within the Office of Research to approve the coordination among the various parts of the office, and I have some hope that more effective coordination will be the result of this effort.

I would point out that there are some cases where -- well, in the particular case in hand, the activity of PAS in performing accident sequence analyses and consequence

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assessments is a natural follow-on to the function they performed during the reactor safety study. This is in fact the central element of their PAS program and I see no reason to assume that will change.

With regard to some other areas of activity, I believe their involvement has been largely a matter of tradition rather than as a result of any inherent logic, and I suspect that there may be some adjustments made in that respect as a result of the improved coordination now being sought by the office.

The other part of your question of course is that it sometimes smacks a little bit of that's not my table, you'll have to get your glass of water somewhere else. But in fact the only way to carry on our business is to have reasonably clear assignments of responsibility. And it is impossible for one organizational unit to be as aware and fully cognizant of the activities of another.

So as a result, when there is an area which some other office is engaged in, we would tend to refer you to that office for more detailed information. We have brought with us altogether inputs to this area, but I would put that in the category of supportive, supplemental or ancillary research to the main thrust of this, which is to analyze sequences, accident sequences and physical transport consequence assessment in detail, which is still the function of PAS.

CHAIRMAN MOELLER: Alex?

MR. GRENDON: The point that I brought up yesterday is that my interpretation of the Probabilistic Analysis staff -- it isn't even a branch but a staff -- was exactly that, that it was an instrument that the various branches used when they had a problem of their type. Say will you help us solve this kind of problem; it's your kind of problem.

But that the basic physical and biological problem is the function of the branch that is asking for this kind of service from PAS, and that they should be prepared to say here's what we gave them and here's the answer that they gave us back, and not worry about how they got their answer and if you wanted to find out how they got it, you'd turn to PAS and ask them how they got it. But that you shouldn't be in the position of having to say, when you're asked about some phenomon, some issue, some problem, say well PAS is handling that.

They aren't handling it except in the sense, it seems to me, of doing a service. Isn't that right?

MR. ARSENAULT: I think the description you've just made is appropriate for the relationship between PAS and NRR. PAS performs services for NRR. They do not perform services in like manner for my division. I don't know whether RSR goes to PAS with services to be performed. They have the responsibility for performing accident sequence analysis and consequence assessments in the way that I have described. And my function relative to PAS is to perform the phenomenological research which is necessary for them to acquire sufficient understanding to do that competently.

I think you can see that with respect to service, although I don't like to put it precisely that way, that it is more likely that I would be asked by them to do research to support their activities, rather than the other way around.

I do of course derive some sense of priorities from the work that they do because it results in a clear understanding of where the principal contributors to risk are and where the principal uncertainties in risk assessment are, and that allows me to focus my program on the resolution of some of those problems more effectively.

I hope you appreciate also that I'm giving you an off-the-cuff response to the question that you posed, or the interest you've expressed, but the precise definition of the functions and responsibilities of the various parts of the offices, something that I'm sure Dr. Butness would prefer to address himself.

CHAIRMAN MOELLER: Okay, have we finished this?

MR. ARSENAULT: I would like to address your attention to one aspect of this slide. The RSR meteorological research done to support the consequence assessments resulting from accidents is done by Bob Abbey, who's with us, within the Site



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Safety Branch, Jerry Harbour's Site Safety Branch.

The program of that branch is reviewed by other subcommittees, but only with respect, to my knowledge, primarily with respect and possibly only with respect, to the extreme external phenomena aspects of the program. The meteorological dispersion research is of interest primarily I believe to this subcommittee, and is prepared to address it in greater depth and detail if you so desire.

I think the point I'm trying to make is that in connection with the review for budgetary purposes, if that part of Jerry's program is going to get reviewed, it's likely to be done here and not elsewhere.

CHAIRMAN MOELLER: Fine. Is it best to have him do that now?

MR. ARSENAULT: I would suggest, with Jerry's indulgence, that we continue and finish the last slide.

CHAIRMAN MOELLER: All right.

MR. ARSENAULT: As I indicated earlier, the question of accidental releases is one of analysis from a predictive point of view. The question of emergency response is one of looking at an accident and developing an operational capability.

The source term question here is not to identify or postulate source terms. The question here is in the event of an accident resulting in a significant release of radionuclides, what in fact is being released, how fast and how much?

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The committee drew our attention to this last year. There has been some activity to respond to this need. The activity has been in the Reactor Safety Research Division, rather than my own. The activity has two aspects.

There is an instrument qualification program going on. The need to address that program to the question of release -- qualifying instruments that could measure releases during an accident for the conditions that they would encounter during an accident, is being looked at. That program is considering how to go about addressing that question. They have no activity under way right now other than planning.

The other aspect of this is the question of not how can the instruments be qualified, but rather what instruments do you want and where? There is a new decision unit in making currently called -- well, the name changes so rapidly I'm not sure I have the right one, but I believe it's called Electrical and Instrumentation. And this will address the question of instrumentation systems, and within its purview would be the question of what instruments should be installed to measure releases at the time of an accident, or to get some indication of the quantities being released.

I believe that the formation of that decision unit suggests to me that there hasn't even been any planning yet of any kind of detail in that area. There's certainly no work under way.

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MR. GRENDON: May I ask a question? I'm sure you told us at some time in the past but I don't recall what the distinction between RSR does and your division does is. Some of these things sound as though they belong in your division.

MR. ARSENAULT: Well, I keep pointing that out, as a matter of fact.

(Laughter.)

MR. ARSENAULT: No, that's not quite true. On the subject of instrumentation, my division has the responsibility for environmental impacts, and environmental monitoring is a subject that falls into that category.

Last year Tom Murley and I found ourselves in the embarrassing position of doing this when the committee raised the subject of in-plant instrumentation to measure accidental releases. I sat there with blithe innocence and assumed that it was Murley's responsibility and he was doing the same with regard to me. It finally dawned on us that that was happening, and we addressed it explicitly. We discussed it with Bob Butness.

Because it is in-plant instrumentation, as distinct from environmental instrumentation, we felt that it more logically fell within the category of safety systems that Tom addresses, and that's how it fell into that category.

It really could have gone either way but I agree with the logic in this case.

In other areas my agreement is less pronounced, but this is the way the responsibilities have been defined.

MR. GRENDON: But a number of things you've described for our in-plant effects and plant phenomena that you are engaged in investigating, it isn't the question of in-plant or external that --

MR. ARSENAULT: Well, that is among the factors that are brought to bear. Another one is whether or not it has to do with accidental releases or routine releases. You will note that we have no significant role anywh e on this slide with regard to -- I'm sorry, on the previous slide -- with regard to accidental releases. The support that we provide in that category arises out of the work that we're doing on aquatic pathways associated with routine releases.

So that's another factor that's used to decide where the responsiblity is assigned.

For first of all, the SAFER division does not involve itself with accidents other than the downstream environmental effects from them, and we tend not to get involved in in-plant instrumentation unless it's associated with routine effluents, that specific category with regard to reactors.

Now on fuel cycles, the situation is somewhat different, at least for the time being. There we have the responsibility for safety system evaluation parallel to, comparable to Murley's responsibility for reactor safety



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system evaluation. It is of course a much simpler area to deal with.

I'll proceed. The issue in connection with a reactor accident, emergency response to reactor accident, is what's getting out, where's it going, what do we have to do about it? The first step in that is to determine what's getting out. The second step is where it's going.

The meteorological modeling work that Bob Abbey is working on with respect to reactor accidents is now being looked at with a view to developing site-specific models that could be used in the event of an accident in real time to track what was going on in a way that would be timely enough and informative enough to make response decisions.

I personally consider that a somewhat ambitious goal, but certainly one that is susceptible of resolution, given enough effort. So that's what the second line means, and when Bob addresses his work you can ask him about that.

CHAIRMAN MOELLER: Well, let me quickly ask, Bob, are you tied into ARAC or is ARAC using any of the products of your efforts?

MR. ABBEY: I prefer to answer that with my presentation.

CHAIRMAN MOELLER: Fine. We'll hold it. I just wanted to mention we heard about ARAC. We've heard about it many times but it was reviewed yesterday and I just wanted to be sure there is a tie here.

MR. ARSENAULT: Another element in this emergency response area would be having predicted what's happening or assessed what is happening, getting some confirmation from the field would be useful. This calls for instrumentation out in the environment.

Thereare two aspects to this, a real one and a fictitious one. We have this portable iodine measurement instrument which you heard about last year. It has been developed. It is currently undergoing testing at I&EL, I believe, and the instrument uses an activated charcoal -- Phil may be able to help me on this -- it uses in any case an iodine collector, which can be described in detail if you wish, and that is undergoing separate tests.

When will the tests be completed, Phil, to the point where the instrument would be available for field use?

DR. REED: The sampler collector evaluation should be completed midway into the next fiscal year. The actual testing with the specific Civil Defense and emergency instrumentation testing should be completed somewhere in mid 1982. We have several instruments and various types of probes and detectors that we are evaluating, along with the sampler collection system.

MR. GRENDON: I didn't understand whether this was supposed to distinguish iodine from other radionuclides.

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CHAIRMAN MOELLER: Yes, tell us or refresh us. We heard about it, but does the instrument give you a number or simply collect the sample?

DR. REED: Let me give you a little bit of background. First of all, there is a sampler collection system which is essentially an airborne collection system. It's essentially a filter which is composed of silica gel on which has been deposited approximately 8 percent silver.

Now the reason that we went to this mixture is that we're looking for all forms of iodine. We're looking for the organic iodine, the methyl iodine, the HOI forms of iodine, the I-2 iodines, and there is a filter.

This instrument is designed to be used with a Civil Defense-type instrument equipped with a small GM probe. This instrument is specifically designed for iodine 131. When it's used in combination with the specific probe for the CDV, we fit a shield to this which essentially screens out most of the exenans. So it is almost entirely for iodine 131 and this is what has been used at Three Mile Island.

Now associated with the particular instrument evaluations, it has been recognized by not only NRC but also by this Federal Interagency Task Force on Emergency Instrumentation which guides us in our evaluation and which an individual from FEMA is the task force chairman. So we are feeding into this and he is providing us with all of the



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guidance of his task force.

It was recognized that this instrument had not undergone tests under environmental conditions, for example under extreme temperatures -- coldness, heat. And in addition, at the Three Mile Island there was a problem with the water component. So we have to test this out under conditions of relative humidity, and in addition we also have to test it out under shock conditions and there are I think also a dusting type of testing.

So our purpose right now is to evaluate the testing of this instrument to determine its performance under these environmental conditions.

MR. GRENDON: Then it doesn't give real time measurements of iodine because you do have to collect the sample and then later measure; is that correct?

DR. REED: Right. Now the sampler is portable in the sense that it is operable in the field. It collects a sample and immediately, if you have a CDV system right there, you can read it out --

MR. GRENDON: How soon after you start collecting?

DR. REED: Immediately. The collection takes about 15 to 20 minutes. In reality I think at Three Mile Island they used it for longer than that. So you can get an instantaneous readout --

MR. GRENDON: Assume that the level at which the

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iodine appears in the air is just at the maximum concentration that might present a problem. You mean that within 15 or 20 minutes you collect enough under those conditions?

DR. REED: If the activities are high enough you should see --

MR. GRENDON: That's the reason I said, let's assume the activity is just barely at the point where you consider it beginning to generate a problem.

DR. REED: Right. It would be able to detect this and incidentally, with the testing that has been going up with Brookhaven, there has been a little chart developed by which one can essentially take the instrument reading in activity levels and just look at a chart and convert it into dose levels.

CHAIRMAN MOELLER: So you're telling us within a 15-minute sampling period, reading it in the field with a portable CD instrument, you could measure levels that would be important to take care of the situation?

DR. REED: That's right. Our specific designs were for 15-minute air flows.

CHAIRMAN MOELLER: And if you sampled 30 minutes, presumably it would be twice as sensitive?

DR. REED: RIght. We specified a maximum time of 15 minutes, but in reality up at Three Mile Island they used it for up to an hour and it worked very well.

CHAIRMAN MOELLER: And is it a portable little blower or pump?

DR. REED: Yes. Essentially it's like a vacuum cleaner. It's very small. The cartridge is essentially very small, like a vacuum cleaner cartridge.

CHAIRMAN MOELLER: Battery operated?

DR. REED: Yes, it is battery operated and it can also be used to operate off of the cigarette lighters of old automobiles.

MR. GRENDON: Just another small detail. On your chart there you have B numbers for those, on the detailed ones you have A numbers. What do the A and B signify and which one should be put on -- what do A and B stand for?

MR. ARSENAULT: It's simply part of the --

DR. REED: The A number for some reason is designated to those laboratories operated under I&EL and the Idaho operations office. The B numbers are designated for those laboratories that are all of the other places, the Oak Ridge, the P&L --

MR. GRENDON: So these really are A numbers, in other words?

DR. REED: The I&EL numbers should be A numbers.

CHAIRMAN MOELLER: Dick?

DR. FOSTER: Under that first one, the 6286, the language here says test and evaluate performance for an environmental response to radioiodines and other radionuclides. What do you mean by environmental response to the radionuclide?

DR. REED: Okay, which number were you referring to? Okay, under A-6286. What we're essentially looking for there is a minimum sensitivity level and precision and accuracy that we can determine with these other instruments that we have not yet evaluated and these other instruments that we're talking about, our portable CDV instruments and other systems that can be operated out in the field. For example, we have proposed tests for various CDV models with various GM tubes. We have an Eberline system we're going to use. We have a couple of Victorine systems that we want to use with various probes, including sodium iodide.

What we plan to do there is to test the sensitivities under various environmental conditions, again relative humidity, different temperatures and pressures to see how well they performed in the field such that we can recommend to the states they could use these instruments under emergency conditions.

DR. FOSTER: So it really should say the instrument responds to various -- under various environmental conditions. It was the "environmental response to radioiodines" that -- I didn't understand how the environment was responding.

CHAIRMAN MOELLER: Where are you reading that, Dave?

DR. FOSTER: This auxiliary, the one that describes the projects in somewhat more detail.

CHAIRMAN MOELLER: Thank you.

MR. EBERSOLE: I'm always impressed by what appears to be the agonizingly slow rate at which such things come into practical use. 1982, I believe, and I say to myself why so long, and what are we doing now and how much better is the new one?

I take it the older method of measurement involves discrimination by rate and energy, or does it use mechanical discrimination? How much better is the new one? Are we all right now, in other words, in our measurement techniques?

DR. REED: Well, yes, you're entirely right. The system of energy discrepancies and intensity and sensitivity are being evaluated as well as the collection system. Right now the big problem is in the collection system. The individual performances of these particular instruments have not been evaluated under the environmental conditions that we want them, so we still have to look at the responses, the responses to particular iodines and how we can separate out the particular iodines in the presence of other nuclides that would be deposited.

MR. ARSENAULT: Excuse me for interrupting. I think there are two parts to the question that I think we need to have addressed. One is, would there be any way, looking in reverse at them, the first is is there existing any way now to measure radioiodine concentration in the vicinity of a

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nuclear power plant following an accident?

DR. REED: Sure. All you have to do is collect a sample, take it back to the laboratory, do the extensive radiochemical tests, and you can get an answer.

MR. EBERSOLE: So the merit of this is that it's faster?

DR. REED: The merit of this is that we're using portable field instruments to get an answer right away, rather than having to wait an hour and a half, maybe three days to get the answer that you would normally get if you used laboratory type systems.

MR. EBERSOLE: There are no instruments whic in the field now can discriminate on the ground?

DR. REED: Yes, it's very difficult. Unless you have some type of an analyzer system that essentially gives energy discrimination --

MR. EBERSOLE: That's what I'm talking about. Those things are available.

DR. REED: Yes, they are, but you can't use these out in the field, though. Like jelly detectors and sodium iodide detectors, those are fine to be used in the laboratory, but these instruments are being designed to be handled by Civil Defense type people at the state level who do not essentially have the sophisticated background and training --

MR. EBERSOLE: You can now, if you take a real technician in the field, you can do a good job now, right?

DR. REED: Oh yes, no problem with that.

CHAIRMAN MOELLER: And cost, what do you anticipate is the cost of your system?

DR. REED: By the time we have completed evaluation, it would be something in the neighborhood of -- I'm giving ballpark numbers now. I have the value here that we listed about --

MR. GRENDON: No, the instrument itself.

DR. REED: With the simple collection system, I would say it would be in the neighborhood of something like $100 for just the instrument itself. The cartridges themselves would run maybe another $25. The detailed costs of this are detailed in one of our NUREG reports. I just don't have the numbers offhand, but we went through a complete breakdown of this instrument and cost and as a matter of fact, people have been calling us that they want to manufacture this and things like that. So it would be relatively inexpensive.

CHAIRMAN MOELLER: Now what is the shelf life of a cartridge? Do you break it open or something or is it -- tell me about it. In other words,it doesn't just last one day, you have to use it within three weeks or it spoils?

DR. REED: No, this cannister is essentially packed in a container with silica gel and it has been designed for extremely long shelf life.



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Now in reality, of course, what's going to happen is that the states themselves will implement testing proc< lres such that the sampler essentially will be evaluated periodically.

MR. ARSENAULT: There was another part to the question, if I may return to it, and that is the long time required to get from where we're at to the end, and is this one of those cases, Phil, where increased resources would speed up the test?

DR. REED: I'm not so sure if it's so much resour:es as it would be for people to go through the number of steps and the number of testing procedures that we essentially have. We are requiring a considerable number of tests to be done with several types of instruments. So these tests are somewhat lengthy and they require considerable effort of the people involved.

MR. ARSENAULT: Will they be done sequentially or concurrently?

DR. REED: The testing performance of the absorption instruments, or the air sampler, will be completed first. And then following that we will then evaluate the performance of the instruments, the specific ionization instruments.

MR. ARSENAULT: So the schedule is inherent.

CHAIRMAN MOELLER: Dic: Foster.

DR. FOSTER: I wonder if you can tell us a little bit more about where this information derived from this portable sampler enters into the scenario of the accident. More specifically here, if you have a release, you want to know where it went. You depend on the meteorological input to tell you generally. Then you have field monitors who are going out and trying to confirm did it in fact go in that particular direction. Some time later you're trying to identify what the dose to the population was that was particularly in the plume, or the hign area.

I guess my hang-up here is where you are going to spend even 15 minutes in the field with the portable instrument; how much territory are you going to be able to cover early in the game, or is that the wrong time in the accident scenario that you're using it? Whereabouts does this come in?

DR. REED: Well, let me give you -- the practical effect up at Three Mile Island was that it was used immediately and the scenario that has always been used by FEMA, by the Interagency Task Force, by the people in state programs, has always been concerned of course with the radioiodine, and this is where they want to get the initial measurements because of the iodine being concentrated through the milk, through the cows.

The present plans that will be incorporated into the action guides issued by state programs call, as I recall, it will be used immediately upon the indication that an event has occurred.

MR. ARSENAULT: If I can infer some of the content of your question, I point out that this is not an instrument whose



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primary purpose will be to map a plume or to do environmental monitoring per se. Its principal purpose is for use by Civil Defense type technicians, and they will likely be at population centers, so it's a device that is both a detection device and a confirming device, for emergency purposes.

DR. FOSTER: Well, I guess my problem goes back to a situation of whether this has its main function here relative to inhaled radioiodine by people or whether it is to provide some guidance as to where the milk contamination may be showing up a day or two later in the sequence, and if it's not for the plume, then I worry here about, particularly in the hands of the Civil Defense people, did they take the measurement in the right place at the right time, or were they two miles away from where the plume went?

There is an element here of an initial survey very rapidly, what sector and what points that got hit. At Hanford we used to do this not by taking samples but with a field crew just with a CP going out along the roadside, looking at grass or vegetation. This turned out to be a pretty good collector.

MR. ARSENAULT: You got mapping.

DR. FOSTER: Yes, you got very lousy information as far as quantitative, but from a qualitative point of view, whether I should be looking in this direction or five miles or twenty miles or here, it gave you a very rapid indication,



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which this wouldn't do because you've got to wait 15 minutes.

MR. ARSENAULT: I think you characterized the two applications very well when you said inhalation versus showing up in the milk. The latter is what I was trying to refer to when I said plume mapping.

I think the principal purpose of the instrument -- not its exclusive purpose, but the principal application of the instrument is for use by Civil Defense people to determine what the radioiodine concentration is where they are -- i.e., normally in the towns and population centers.

It could of course be used by roving teams to determine what the shape and location of the plume was. For this they would need to do a mapping exercise. So it could be applied for both purposes. I think the principal purpose is the former.

Does this answer your question?

DR. REED: Could I comment on that? First of all, the air sampler is only designed of course to measure concentrations in the atmosphere, and since we've already had the experience of Three Mile Island I think FEMA is pretty well sure how that will be used.

The other part of the program, the environmental part, does include the evaluation and the determinations of sensitivities, conditions, et cetera, for determining radioiodines and possibly other radionuclides, on pasture, in water, in milk samplers, and also some other things that we're looking at on down the road that FEMA has talked to us about.

So it's not just a simple air sampler. We are considering the actual nuclides that have been deposited on the pasture land itself.

DR. FOSTER: THat's a different kind of instrument.

DR. REED: Yes. The sampler of course, yes, will not be used for that, but these particular instruments that we are testing -- we have about seven or eight different types of instruments -- they will all be evaluated and then a decision will be made which recommendations will be used, et cetera. They will all go through this testing for the radioiodines in a centric on the pasture land and in the milk, et cetera.

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DR. FOSTER: Now, my perception is that the portable sampler here is not going to be in the hands of the roving health physicist, it's going to be in the hands of the Civil Defense people, and that you're going to have enough of these located in their hands so it's essentially going to be operated more or less as a fixed location kind of thing: "I'm here and what was the iodine content of the stuff that came past me," much like a fixed TLD, if you will, for ambient radiation.

CHAIRMAN MOELLER: Let's see, Jesse.

MR. EBERSOLE: Oh. Is the reliability and use of this instrument compatible with its possible use in triggering a mass exodus from an area?

DR. REED: I would -- I would believe that recommendations for evacuations would be based on numbers obtained from an instrument like this, especially if it could -- first team in received some high values and readings. And I'm sure that this is being considered by FEMA.

MR. EBERSOLE: So this is an instrument which may be used for that purpose?

DR. REED: Oh, yes, very definitely.

CHAIRMAN MOELLER: Any other questions on this item?

Well, thank you. That -- there was interest, and we do appreciate the in-depth review discussion.

MR. ARSENAULT: Relevant to some of the questions is the second line here: "Field installations with telemeter data."

You won't find that listed on the handouts, because the slide was prepared by me and the handouts were prepared by somebody else and this thing died while unbeknownst to me, while I wasn't looking. What happened with this is that following TMI and in connection with, we were asked to consider what research possibilities we felt were reasonable to address issues that were raised by the accident. The possibility of establishing some environmental monitoring-system that would provide, essentially, real-time information to help and guide -- help to guide decision-making during the emergency, was one that we felt had merit. And we added it to the list. It was in our fiscal '80 supplemental request, to be followed by a second year of effort in fiscal year '81.

A couple of things that happened along the way. One thing is that the fiscal year '80 supplement is no longer with us, at least, not for this purpose. The other is that the fiscal '81 budget is likely to be reduced. This suggests that the time for initiating this effort has been pushed off into the future. At the same time, NRR has been looking at the various requirements that it might establish relative to emergency response and accident monitoring and so on.

The question has existed from the first day as to whether or not there was, in fact, research involved here or whether it was merely technical assistance or -- or what it was. The further downstream we get, the more it looks like it's

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merely a matter of regulatory decision-making and that there isn't any instrument development or any other esoteric data gathering required in order to make that decision.

So it has slipped from our program until the needs and requirements for additional research are reestablished. So there it is, and it's not here and we do not have any plans for this.

CHAIRMAN MOELLER: Well, now, you are, though, NRC as an agency is, placing or installing your own environmental monitoring TLD system around all operating reactors --

MR. ARSENAULT: Yes. The distinction --

CHAIRMAN MOELLER: -- but it's not telemeters.

MR. ARSENAULT: Exactly.

CHAIRMAN MOELLER: All right.

MR. ARSENAULT: The distinction is one of real-time data to help in guiding decision-making. Now, this -- you can see the interface with the question on this portable instrument. If there are enough of them out there and if they are being used to map plumes, that is the kind of information we are talking about. But, again, I doubt that they will be used that way.

In any case, this is a defunct item in our planning horizons for now.

Countermeasures is an item that the subcommittee addressed last year. And two things are going on there. The PAS potassium iodide study -- which I've already admitted I know

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too little about to address -- and work that they are doing as a service to NRR to evaluate the effectiveness of various options, sheltering potassium iodide, evacuation, et cetera; another alternative they might wish to consider has been mentioned today. This is not research. This is simply the application of their existing capabilities for consequence assessment to consider what happens in the event of -- these options are adopted.

Now, in line with the suggestion that certain socio-economic studies might be done, this actually has been raised, by Bob Bernero, with me; and that had slipped my mind, but it's very closely associated with the suggestion we heard today. He points out that one can show the difference between potassium iodide and sheltering in terms of the ultimate dose to individuals, but the question comes up will people, in fact, take their pill and sit tight or will they, in fact, take their pill and get in their car and move or will they simply be too busy moving to bother taking their pill. And these are questions of psychology. They are not in the program now. They are the kind of thing that is continually being raised in the aftermath of TMI. I'm sure that the agency will have to address questions of this kind, whether in my -- the socioeconomic program or in some new human factors program or exactly where I think is unclear at the present time.

Finally, the report raised the question of

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post-accident recovery and re-entry, both with respect to on-site re-entry and off-site decontamination of contaminated areas. We have no specific research ongoing at present that's directed to these subjects. I believe that NRR has a task force that is addressing some of these questions; I'm not sure exactly what the content of their discussions are, but it's clear to us that we will have to await the results of their review and the formulation of NRR positions and policies before we would have any clear guidance as to what we might be required to do, if anything.

I beg your pardon -- in -- in -- post-accident decontamination is, of course, in our program earlier on. So that's one aspect that's covered.

That completes the material that I have here to present.

CHAIRMAN MOELLER: Yes, Jesse?

MR. EBERSOLE: In just the general spirit of getting the word around, I'd like to point out to you sort of a operational problem which we're dealing with elsewhere; I'm not sure whether you're involved in it or not. And that has to do with multi-unit sites. If we look at the degraded circumstances might have been worse at TMI, which was a two-unit station, and looked at the case where the first unit was still running but, because of circumstances, now the effective unit had to shut down, we have to conclude that the people in the working but undamaged unit may have -- will -- will, in fact -- have to stay there to effect a safe shutdown in a very long term. The control room designs have not been such that for degraded circumstances the entry of radionuclides into the atmosphere -- or, for that matter, the shielding design has been such as to be effective against gross accidents. They've been effective against design basis, which is much more limited. Therefore, we have to look at the problem of how well the occupants can withstand a degraded condition in a nearby unit in respect to staying there indefinitely and holding a shutdown configuration, if not an operating configuration, for the adjacent units. It's an effort, I think, that certainly interfaces with what you have here. It's kind of a occupational dose problem under unusual circumstances.

MR. ARSENAULT: Yes. Yes. I thank you. I think that's a good point. And it is, I believe, within the scope of my program to address that, that question.

CHAIRMAN MOELLER: Other questions or comments?

Well, thank you. Then we will go to Bob Abbey. Well, I think at this point we'll take ten minutes, and then we'll cover Bob's presentation.

How long will that take, Bob?

MR. ABBEY: Oh, I should think it would be about ten or fifteen minutes.

CHAIRMAN MOELLER: All right. Well, we can do that.

And that we'll do by noon.

Then I'm just wondering, though, for Frank's, thinking ahead on his schedule, I think the subcommittee should go over the budget material, so, Frank, would you want -- and that shouldn't take too long. So what we'll do, let me propose we take ten minutes, then we have Bob Abbey do his presentation, then we'll go into closed session and look at the budget, and then go to lunch.

MR. ARSENAULT: If I may. You have associated with the projects that we have described proposed funding levels. With regard to the budget per se, which is structured quite differently from this, we have three decision units within my division, I do not have that information with me today, that is, the total information for the decision units. That can be made available to you, I believe, shortly after the beginning of June. It's still undergoing a certain amount of restructuring. It should be ready by next week.

CHAIRMAN MOELLER: Well, we would like, though, say, in a closed session, to discuss certain -- you know, whatever we can --

MR. ARSENAULT: Fine.

CHAIRMAN MOELLER: -- about the budget with you.

Let's take ten minutes.

(A brief recess was taken.)

CHAIRMAN MOELLER: The meeting will resume. We will move on, then, and have the presentation by Bob Abbey on the meteorological program, to be specific, on the atmospheric dispersion research program.

Bob, it's a pleasure to have you with us again.

MR. ABBEY: Thank you. We appreciate the opportunity to come before the subcommittee again, as in years past. But even more we appreciate the support we received last year with regard to our program dealing with the dispersion of radioactive material under postulated accident conditions.

I have no handouts -- I mean, I have handouts, I have no Vu-graphs. Like to direct your attention to the package labeled "Atmospheric Dispersion Research Program," which provides for you, in capsulized form, the basic tenets of our dispersion program.

The program initially was conceived in 1972, at that time under the aegis of the Atomic Energy Commission, Division of Reactor Development and Technology, and, with the Energy Reorganization Act, came with the reactor safety program to the Nuclear Regulatory Commission.

The program began very modestly, looking at very short-term, short-distance type problems, to more adequately assess for site evaluation purposes, doses at site boundaries. The program has subsequently proceeded to more complex meteorological and topographical considerations, to longer durations of releases -- several hours -- and to longer distances downwind

-- nominally, 50 miles, or 80 kilometers.

The program began by outlining the concept of diffusion over various types of terrain. That in your handout page 1 is labled A. The program at that time was in its entirety an experimental, empirical program to obtain high-quality tracer concentration data bases, along with coincident meteorological measurements, to give the standards people and the licensing people bases for arriving at selections for site evaluation purposes and safety analysis decisions.

As the program has progressed, as problems have become identified, a theoretical component has been added, to try to address not only how the effluent gets dispersed but why, from a physical basis standpoint. It's not enough now, especially at the longer distances, to know how much effluent gets a certain distance downwind and the spread of the plume, but, precisely now because we cannot test at every reactor site to distances of 50 miles, just exactly what is the physical basis for evaluating the mathematical models to predict the plume's behavior at those distances.

The other two components -- or other three components to the program, then, deal with model evaluation. That's shown as item B in the handout. C and D are short-term programs designed for specific purposes. C deals with the assessment of vertical diffusion by measurement techniques. All models to date have relied on measuring only in the ground level horizontal and inferring what the vertical distribution must have been according to preconceived mathematical or analytical models. With the advent of lidar technology, primarily, we have attempted to try to quantify, then, the dispersion of effluents in the vertical during the same time that our field measurement programs are being conducted with our tracer gases in the horizontal.

Item D is merely on here for completeness. We have completed our building wakes effect research program, largely responsible for ascertaining the effect of increased turbulence due to building complexes on doses, then, at site boundaries. The last year of the program is this year -- as such, it will not affect the FY '81 or '82 considerations -- and is directed toward actually finding out concentrations within the site complex itself for control room-type assessments, vent intakes and so forth. And that one is a concluding program.

I direct your attention to the objective of the overall program, namely, the verification of current and proposed models used to predict the behavior of radioactive airborne effluents, primarily for two purposes: one, emergency planning, and, secondly, for site evaluation. The next two pages, then, consistent with Mr. Arsenault's handout material, gives the three basic, major programs currently being administered in the dispersion area. The first one is the -- these are in order of priority -- the first one is the evaluation of



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real-time --

MR. EBERSOLE: You say these are in order of priority?

MR. ABBEY: Yes. The evaluation of real-time dispersion models. As a result of Three Mile Island, in August the Nuclear Reactor Regulation Office sent to the Office of Research a request in which they identified a very real need to find out, one, what models are available, two, to find out what data are available by which to evaluate the models, three, to establish some sort of objective evaluation criteria by which the models can be judged as to their effective ability to predict plume behavior in a timely manner, and then, fourthly, of course, the result is then "Give me the range of models applicable during certain conditions for the range of sites on which nuclear power plants are currently sited."

Another dimension to this has recently been added with the concept of ARAC -- Atmospheric Release Advisory Capability. I apologize for not being here yesterday to hear the presentation and conversations with regard to ARAC. Due to the limited budget in FY '80, partly as a result of the late request factor into the current budget, the current emphasis in the evaluation of real-time dispersion model program is solely on the ARAC system and its suite of models. A further explanation of this particular program is on page 4 of your handout material and is entitled "The Approach to the Evaluation of Real-Time Atmospheric Dispersion Models."

We are not prepared at this time, either myself or -- or the staffs, or our consultants, to endorse the concept of ARAC and its suite of models. Data simply do not permit such a weighty decision to be made, with such far-ranging implications, at this time.

FEMA, despite the fact that they are planning to install the ARAC system at Indian Point, in the state of New York at Albany, at Zion, in the state of Illinois at Springfield, and perhaps Rancho Seco, in the state of California at Sacramento, asked the Office of Research to conduct a dispersion program involving field tests and evaluation models, preferably out to 50 miles, by which ARAC can be evaluated.

I would like to point out that when I say "ARAC" I'm talking the entire system, only part of which involves the meteorological dispersion and transport models. The other part of the ARAC system being evaluated as part of our program concerns the timeliness of response, the input data needed to make accurate calculations, and, more appropriately, the interpretation of the results arising from the ARAC suite of models and system.

That led us, then, to our second item on the sheet, namely, intermediate range atmospheric transport experiments. There's a direct correlation -- and if you look at the contractors you'll see a number of repeats -- a direct correlation, then, between our evaluation of model effort and our intermediate

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range atmospheric transport experiments. The ARAC system is a centrally located system, namely, at Lawrence Livermore facilities, whereby individual terminals cannot communicate with each other. Indian Point can only communicate with the state of New York at Albany or with the Incident Response Center in Bethesda, by first going through Lawrence Livermore in California and then back out again. The primary purpose in our model evaluation effort with regard to computer capabilities is to try to assess the state of the art, state of the knowledge, state of the technology right now to provide on-site personnel with a mini-computer, if you prefer, type facility with a model specifically adapted to their given site, to make quick, as accurate and as efficient on-site calculations of where the plume is going and how fast it's spreading.

Prior to the initiation of the study, the ARAC system was, to our knowledge, the only system available. Merely because the system is only -- is the only one of its kind does not a priori rule out consideration of other alternatives. The purpose of our research effort in this area is to provide those alternatives to the decision-makers, part of which for this particular program include FEMA. We also have been in consort with NRR because of their installation of the ARAC system into the Bethesda Incident Response Center. We are somewhat disturbed, both from a scientific as well as an administrative viewpoint, as to the objective evaluation being conducted to date on ARAC. I make reference to the Rogovin Report, for one, in which the assessment of ARAC is made and its performance at Three Mile Island. The assessment, however, was made by Lawrence Livermore Laboratories, the prime developers of the ARAC system. I call attention to some programs which I heard mentioned yesterday with regard to evaluation of the ARAC system and its potential applicability to nuclear power plant sites -- once again performed by Lawrence Livermore Laboratories.

Specifically for this purpose we formed a three-man committee, comprised of Dr. Steve Lewellan, from Aeronautical Research Associates of Princeton, one of the world's experts in modeling, Mr. Gene Stark, from Noah (phonetic) Air Resources Laboratory, Idaho, familiar with mini-computers, models, and data collection techniques, and Mr. Frank Carnegie, from Oak Ridge National Laboratory, who is familiar with the EPA-type models and has them all running on the Oak Ridge computer, to develop for us, then, an evaluation independent of any participation by Lawrence Livermore Laboratories or its proponents of the ARAC system and its suite of models.

We are disturbed, furthermore, in the evaluation of any models, that as more and more data become available, the models become, surprisingly, more and more accurate. We think this is not a peculiarity of the ARAC system at all but is true of all models. And merely because a large computer is necessary

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to run a large dispersion modeling program does not mean it may be, you know, the best or most efficient solution to the problem.

We are cooperating with FEMA right now in the conduct of a program at Indian Point -- which is the last page in your package. We just recently returned from a visit with Consolidated Edison at the Indian Point site to consider a joint program, simply because it's much too costly for either of us to fund it in its entirety, to outline the initial phase and test design of the dispersion program at Indian Point. By July 1st this test program will be available. It's our intention to publish it in our NUREG report series for critical review and examination prior to our target date in the field to commence the program, namely, May 1st of 1981.

The third --

CHAIRMAN MOELLER: Excuse me. You -- maybe I missed it -- but you mentioned this three independent -- this team consisting of three people unrelated to ARAC that you've asked to evaluate it. Is their report in? Or are they just in the midst of doing that?

MR. ABBEY: They just commenced about two months ago.

CHAIRMAN MOELLER: Oh. So there's no -- there are no results.

MR. ABBEY: That's correct.

CHAIRMAN MOELLER: Thank you.

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MR. ABBEY: We've asked for a Christmas present of that report.

CHAIRMAN MOELLER: Thank you.

Yes, Dick?

DR. FOSTER: Relative to that evaluation, the people on the team sound to me like they are all atmospheric modelers type of capability. I'm wondering, in your consideration of that, whether you're also evaluating the distance-time aspect. the -- let's say the point of view of a utility emergency personnel and what their particular attitude is on making such -- putting such tremendous responsibility, if you will, on the computer program which is quite distance and over which they have no, sort of, hands-on control. In other words, what I'm saying, I think there are some other considerations relative to the value of the system which are in addition to those of just the technical aspects of the model per se.

MR. ABBEY: I agree completely and will serve to elaborate on that point now. It may have sounded, in my cursory description of each of the experts involved in this task, that they were modelers. I think only one would take that as a compliment, namely, the modeler, which is Dr. Lewellan. Mr. Stark developed the entire emergency response plan, meteorologically speaking, involving network design, telemetry of the data, the mini-computer system, the models and so forth, for the Idaho National Engineering Laboratory site. He is

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intimately familiar with the capabilities of large and small computers, with the time delays necessary to input data to get a response back, and the sensitivities involved strictly from a computer system interactive type viewpoint. It's for that reason that Mr. Stark was selected, not for his modeling expertise. We tried to keep the number to a minimum, namely, to get the report out in a timely manner. Your point is well taken, and I assure not only that but the cost/benefit of various systems also will be considered in the report.

The third, and last, major program that I'll present to you this morning is entitled "Dispersion in Shoreline Environments" and will appear in the form page number 3 -- I think it's labeled number 2, but it's number 3 -- which was the program to have, if you recall from last year about this time, that was our number one priority program for the future, it's now relegated to number three in light, of course, of the previous two programs we've mentioned. We still consider it a high-priority, top program, due to the large number of nuclear plants located near large bodies of water.

The simple fact of inability to measure effluent spread over water, if, indeed, the initial accident has the wind blowing over the water, the eventual return to the shore, the complexities of fumigation or the downward transport from an elevated source to the land in coastal regimes has long been a problem recognized not only by the NRC but also by the

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Environmental Protection Agency. For this reason, and because of our particular interest in obtaining tracer concentration measurements, that we embarked on the design of this program last year, and we intended to be in the field, if not this year, certainly early next year. Once again, due to funding constraints and the introduction of other, higher-priority items, namely, the model evaluation and the intermediate range transport problem, we've had to push this one back another year.

I would like to also call your attention, although it's not shown here, to the interest of the American Petroleum Institute to cooperate with us in the conduct of our shoreline dispersion experiments. It turns out, with the outer continental shelf regulations promulgated by the USGS, that they're interested in diffusion over water as it impacts the land. I assure you, all of our releases will be from the shore itself, you know, on various, you know, dispersion meteorological regimes. But the acquisition and the opportunity provided by the oil industry for their offshore oil rigs, their data buoys, their sheer manpower, which is a large part of costs involved in any field program, are -- are quite welcomed on the part of research. However, we still have to bear the brunt of the expense to keep them interested.

It also turns out that the initial program probably will be conducted along the Gulf Coast in Texas, not because we've got a large number of plants there, but simply because

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TAPE 6

the oil companies own large fetches of controlled land area, which sure makes our sampling problem much easier and the design of our sampling and meteorological networks.

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There are a couple of minor programs which need not be presented here. When I say "minor," I'm talking, you know, a few tens of thousands of dollars which compared to these are simply insignificant.

I call your attention again to the fact that many of the contractors are mentioned in each of the three programs. We've established a network, interactive network, if you will, between steering committees and working groups.

What I've endeavored to do in this regard is to have the steering group composed of experimentalists when the problem is one of a theoretical nature, which the working group would be. The steering group for the experimentalists are the modelers, to indicate guidance as to what types of measurements they need or would like to see in the experimental field programs.

This not only provides a complex web as far as a view-graph is concerned, but the advantages of everyone knowing each other's responsibilities and literally interacting on a daily-type basis, the theoreticians as well as the empiricists, provide for a coherent program which would otherwise not be attainable.

So in the development of the reports, the development of the research, and the actual conduct of the experiments, all parties are involved at each stage along the way. This way we can achieve effective utilization of the results as they come out rather than waiting for them to be evaluated consecutively rather than concurrently.

I would like to briefly address some comments with regard to the viewgraph presented by Mr. Arsenault on the accidental radiological releases. Being a staff man I cannot go any lower, and as such I say more than I'm really entitled to do.

The ideal sequence of events, I'm sure, would involve us inputting our results into the PAS consequence model. In reality that is not done, and the programs are proceeding independently -- much to the chagrin not only of research but other offices as well.

I liken it to the PAS, probablistic analysis staff, phenomenology being a misnomer. In reality it acts as a division or an office. We do not ask them to input into our programs because we're not quite sure on the interface how they can best do that as far as the meteorological dispersion goes, not having any capability in that area.

On the other hand, they feel perhaps that our expertise in phenomenology characterization does not allow an adequate appreciation for consequence assessment. We're trying to break down these barriers, not only between SAFER, RSR, and PAS, but also with NRR and SD.

We have formed a few months ago what we have termed the meteorology information exchange group composed of staff members involved in meteorology. It's a great-sounding phrase in concept. In reality it involves only a handful of people, namely the meteorologists dispersed throughout the Commission.

The function of this meteorology information exchange group in a similar manner to that of the interactions between the steering committees and the working groups in the research program involves a rapid exchange of various types of information within the Commission. The information primarily consists of three parts.

One is identification of research and technical assistance programs and results to date. The second one is with regard to in-house staff review by other offices of regulatory guides and standards. NUREG-0654 in the emergency planning is a good example. And the third thing it does is that it promotes an exchange of information and ideas without the responsibility that may come back to haunt you on an organizational level. And we have found that staff input into the design of these programs at that level can be very effectively utilized by releasing the organizational administrative constraints and allowing the individuals to speak for themselves as experts in the area. The onus is then placed on them to go back within their respective divisions and offices and implement or inaugurate appropriate letters, staff papers, or whatever to achieve official office concurrence endorsement and support.

The third comment then comes back to ARAC and FEMA. In summary, there I would guess that we have achieved some resolution that the ARAC system at those three sites -- by the way, the only one that's receptive at this stage is Con Ed at Indian Point -- is that it is a pilot program, by no means implies that they will be installed at all nuclear power plant sites, nor that they should be installed, and that the results of our computer evaluation, meteorological modeling evaluation, which involves both the transport and the diffusion of airborne effluents, will be utilized then by FEMA as well as the NRC staff to arrive at an effective utilization of meteorological information for emergency planning purposes.

CHAIRMAN MOELLER: Questions?

Alex.

MR. GRENDON: I notice in your Indian Point description that you're using two gaseous traces, subhexachloride and an agent I don't recognize. It looks like a 72 or 12B2 --

MR. ABBEY: 12B2.

MR. GRENDON: 12B2, what is that?

MR. ABBEY: Oh, heavens. It's a freon. It's dibromo-dichloro --

MR. GRENDON: No, that's all right. It's a freon.

You know, you recall that when the military used a supposedly innocuous microorganism as a tracer in some atmospheric tests off the West Coast, now, 20 years later they're getting repercussions of people who are lodging claims for millions of dollars for damage to their health.

Have these been as thoroughly investigated as they should be to be sure that nobody is going to come back later with a claim that you've injured them? These tracers will be disseminated where there are people.

MR. ABBEY: These tracers are chemically inert, biologically inert, which is the precise reason they were developed, you know, for tracers, largely by Lovelock over in Great Britain. They represent only two of about seven or eight tracers available to us.

The highest degree of confidence we have now is in the SF6. It's readily available. It's not costly -- it's costly but not prohibitively so to use. And the background in most areas is sufficiently low to make it an easily amenable tracer.

I am not aware, to be quite honest, of any specific program directed toward the biological effects of these tracer gases.

MR. GRENDON: Well, the hexachloride somehow troubles me to begin with. I don't know what it does, but I'm a little uneasy about a high ratio of fluorine to other elements in a compound you're going to disperse widely, and whether or not there will be repercussions at some later date.

MR. ABBEY: Your concern is noted.

MR. FOSTER: Over the weekend Mt. St. Helens injected a very large amount of material which has resulted in an easily identifiable plumes and deposition patterns. Has anybody given any thought to using this as a test on some of these models to see how well the models behave relative to verification from that?

MR. ABBEY: The answer is a qualified yes. If we could be assured that in the event of a reactor accident we would have the initial plume height to be on the order of 60,000 feet, then the answer is yes, we can utilize the results of the volcano. In reality we don't think it's that high. We strictly deal with ground level sources.

The plume, as currently characterized, is pretty much gaussianly distributed. Satellite photos show this very beautifully. It's up in the layer of the stratosphere where there is not a great deal of turbulence. The air is thinner, such that there is not a lot of molecular particle interactions. And at fairly sufficient wind speeds, you know, to adequately theorize that a gaussian plume would indeed be the proper way to characterize the effluent, and indeed it has been so far in the preliminary nature.

It turns out, however, there are problems in the dispersion of radioactive material common to what we refer to as the planetary boundary layer or the ground boundary layer, which gets into several hundreds of feet to several thousands of feet. And therein all bets are off. Therein we look at non-isotropic effects. We look at turbulence. Profiles which simply are not matched in the upper atmosphere at all. We look at the density of the air, now becomes a factor whereas it had not up in the stratosphere. We look at the interaction now of terrain and water bodies and hills on the perturbing influence of the dispersion material.

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MR. FOSTER: Please be assured that there are a lot of lower atmosphere elements which are associated with Mt. St. Helens. It didn't all go up to 60,000 feet and stay there.

MR. ABBEY: That's true.

MR. FOSTER: And you've got a lot of lower area irregular terrain like Mt. Adams and a few other things which provide a very massive --

MR. ABBEY: Very much so.

MR. FOSTER: -- Pattern there for deposition.

MR. ABBEY: We liken the results of the Mt. St. Helens volcanic eruption to that of some of the earlier upper atmospheric weapons testing programs where we're talking now not in terms of hundreds of miles necessarily but in terms of global, you know, thousands of lives in their effects.

MR. FOSTER: Well, not necessarily in your general area here, but at the present time there are tremendous problems associated with, let's call it, re-entrainment.

MR. ABBEY: Yes.

MR. FOSTER: Which I think there are probably a lot of lessons that can be learned there, analogies for these sorts of things. As long as it's happened, I just hope that agencies will take full advantage of any opportunities that may be there.

MR. ABBEY: Please note in the model evaluation program, which would be the fourth sheet, we do have an identification of deposition models which is an all-encompassing term as we use it

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to also include resuspension. After we first identify the largest area of uncertainty and also the one having the highest importance, namely the transport -- where is the center line of the plume going -- then we address the second important factor, namely the dispersion of the spread about that center line. And the third thing then is the deposition and eventual resuspension perhaps.

That's why this program is presented as part of the FY 82 program, because in FY 82 the primary emphasis will be on those aspects. We hope to have already solved the transport and fusion aspects by FY 82.

CHAIRMAN MOELLER: Jessie.

MR. EBERSOLE: Yes. Concerning the matter of local dispersion, you went rather fast through the early part of your presentation, but I did hear you say something about your involvement or non-involvement in control designs and air intakes. Is this true? Is this within your scope?

MR. ABBEY: No. I apologize if that's the way I came across. In our building wake effects disperson program we initially had the test designed to measure the increased spread of the tracer gas as a result of the increased turbulence due to the building complex over and above the atmospheric meander and atmospheric turbulence.

As that program developed, the need was identified to us that it would sure be nice not only to characterize the effect at the site boundary, but also to ascertain any local peculiar effects within a reactor complex for such purposes as locating an operating room intake vent. We do not get involved at all with the actual design of the operating room or the intake vent system.

MR. EBERSOLE: But are you doing this work to help locate these intakes?

MR. ABBEY: We're doing work to characterize the wake, yes.

MR. EBERSOLE: Well, let me tell you why I mention this. A long time ago we were asking this question about the control room environment following the postulated accident. You know, the typical postulated accident, as in WASH-740 releases to the containment and then in essence cancels the results of that by assuming a near-perfect containment.

When we look at degraded accidents we have to look at higher leakage than this for whatever reason due to the hostility of the accident to the containment. And we got, as you mentioned and inferred -- this problem went to the PAS section and came back from it, and it went back and forth several times. And I don't think it's ever really been settled, but it's got to be settled.

I was interested to note that the model they use for dispersion and air uptake was the classical one they used in containment as though it were a single body, and it didn't account for the fact that most containments are tied to auxiliary buildings, and most of the penetrations directly interface the volume of the

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auxiliary buildings which in turn interface with the volume of the control room. Therefore, you don't have the benefit of the kind of dispersion model that they use. In fact, you have a concentration mechanism which takes the WASH-1400-740 releases through whatever leak there is and puts it undiluted into the building which interfaces with the control room. As a matter of fact, that's where the problem still stands. And I think we still have to address this in aspect to mitigating what would be an acceptable accident to the extent that operators can stand there and hold its consequence down, not to mention the fact that we have multi-unit stations which have the same problem.

Now, you don't get into that, do you?

MR. ABBEY: Well, may I take a couple of moments and discuss the building wake program?

Dr. Moeller?

CHAIRMAN MOELLER: Yes, go ahead.

MR. ABBEY: This was presented last year in its excruciating entirety. The design of the building wake program consisted essentially of isolating two factors -- one being terrain, the second one being building size. The first experiments were done at the experimental organic-cooled reactor located at I&EL, a building essentially square or cubicle, largely 90 percent complete -- of course, no one's there any longer -- flat terrain certainly, Idaho, and a series of about two dozen experiments were conducted out to 1600 meters using 300 samplers spaced every six

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degrees and so forth.

This was also modeled in the wind tunnel at Colorado State University by Professor Robert Moroni and John Peturka. The advantage to this was trying to obtain experience and insight from wind tunnel data applied directly to a field prototype experiment. There were, aside from a water tank, no ancillary, auxiliary buildings around in the flat terrain.

Recognizing that indeed a building complex was a significant factor in introducting increased turbulence into the atmosphere, we then conducted a field program and also wind tunnel simulation at the Rancho Seco facility just out of Sacramento. There not only do we have just one containment, but we've got two massive mechanical draft cooling towers which were found to have as large, if not larger effect than the containment building itself on perturbing the flow. Also because it was a real reactor complex, we were able to take advantage of the auxiliary buildings and the turbine buildings and so forth in the experiments.

This provided us then, because Rancho Seco is also located in fairly flat terrain, the comparison between a small singular building and a large reactor complex. And indeed, the results were a larger complex introduces more dispersive effects into the atmosphere than a small one. But it also enabled us to try to isolate in the wind tunnel then the various effects associated with increase in the complexity of the site, and this they

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were able to do effectively, and that report also is being published.

What they were unable to do, however, for modeling purposes in the field was to separate out the wind meander factor from the building-induced turbulence factor because all they're measuring at a given point is the concentration of a tracer gas. And unlike the wind tunnel, the wind meanders, even under barely moderate wind conditions. The wind still meanders around. And we're currently trying to isolate that phenomena in the wind tunnel, apply then the model thus developed to the field data to see if indeed it matches. Preliminary indications look pretty good that it does. Once this is accomplished then, the models can be extended to more sites in more types of terrain model-wise rather than experimentally. It's still being verified.

MR. EBERSOLE: Well, was your goal to look at the fence line dose as it was perturbed by these buildings?

MR. ABBEY: The goal was to obtain high quality tracer concentration data in a dense network by which eventually the dose-at-site boundaries would fall out. But because of the design of the experiment in what we felt was a comprehensive manner, it does more than just dose-at-site boundaries. It now is able to characterize the entire wake out to site boundaries.

MR. EBERSOLE: Was any finding made that might lead to a conclusion that control rooms in nucler power plants should have at least two air intake sources widely dispersed which could be selectively picked?

MR. ABBEY: It sounds like a good conclusion to me, but we can't take credit for it. What we were able to find, of course, is that you should always locate your vent upwind.

MR. EBERSOLE: Since you don't know which way the wind is blowing, of course that's what led to my suggestion.

MR. ABBEY: Exactly, exactly.

That's all I have.

CHAIRMAN MOELLER: All right. Any other questions for Mr. Abbey?

Well, thank you very much. I appreciate your being with us and particularly for summarizing your written material in such excellent fashion, not only giving us the projects but telling us the priorities. That's most helpful to us.

I think then following our earlier plan, if it's all right with the subcommittee, we'll continue on, because I think in very short order we can complete our closed session with Frank Arsenault to cover the budgetary details.

So we will then close out the open portion, and indeed the recorded portion of our subcommittee meeting. Let me repeat that we will be back into session this afternoon. I anticipate that we should be able to cover the budget by no later than 1:00. We'll recess from 1:00 to 2:00 for lunch. Then we'll go into open executive session this afternoon to prepare our written comments for the full committee. That will not be a recorded session, but it will be open to the public to the degree that it can be. If indeed we find we need to discuss budgetary details this afternoon, we'll simply close the meeting for a long enough period of time to do that.

And I would anticipate that we will complete the afternoon deliberations by no later than perhaps 3:30, to choose a time.

With those remarks then let me thank all of our people, the NRC staff and others who have taken time to come down and present their programs to us this morning.

The meeting is adjourned.

(Whereupon, at 12:25 p.m., the open portion of the meeting was adjourned, and the subcommittee went into closed session.)

NUCLEAR REGULATORY COMMISSION

This is to certify that the attached proceedings before the

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in the matter of: ACRS Joint Subcommittees on Site Evaluation and Reactor Radiological Effects

Date of Proceeding: May 22, 1980

Docket Number: ____________________

Place of Proceeding: Washington, D. C.

were held as herein appears, and that this is the original transcript thereof for the file of the Commission.

Suzanne Babineau

Official Reporter (Typed)

Suzanne Babineau

Official Reporter (Signature)

VIEWGRAPHS FOR PRESENTATION TO
THE ACRS SUBCOMMITTEE ON REACTOR RADIOLOGICAL EFFECTS

MAY 22, 1980

# OCCUPATIONAL RADIATION EXPOSURE

| | | |
|---|---|---|
| SOURCE TERMS & ALARA | UNDES | CRUD BUILDUP & REMOVAL |
| | UNDES | EQUIPMENT DECONTAMINATION |
| | UNDES | POST-ACCIDENT EXPOSURES |
| DOSIMETRY | B-7259 | QA & CALIBRATION TLDs |
| | B-0410 | AGE-SPECIFIC METABOLIC MODELS |
| | UNDES | IMPROVED NEUTRON DOSIMETRY |
| HEALTH EFFECTS | B-3029 | BIODOSIMETRY FOR DOSE RATE FACTORS |
| | B-3033 | GENETIC & ENVIRONMENTAL FACTORS |
| | UNDES | NEUTRON RBE |

# ROUTINE RADIOLOGICAL EFFLUENTS

| | | |
|---|---|---|
| SOURCE TERMS | A-6075 | TREATMENT SOURCE TERMS |
| | B-2281 | DECONTAMINATION RADWASTE |
| | UNDES | IMPROVED GALE CODE |
| | UNDES | ASSESS ADVANCED TREATMENT |
| PATHWAYS TO MAN | | |
| AIRBORNE | A-6288 | IODINE PATHWAYS |
| LIQUID | B-7260 | SUSQUEHANNA & CHESAPEAKE |
| | B-2271 | NON-STREAM MODEL |
| | B-2275 | RIVER FIELD DATA |
| | B-2295 | RIVER-SEDIMENT MODEL |
| | B-5749 | DISTRIBUTION COEFFICIENTS |
| HEALTH EFFECTS | A-2059 | DEMPAK MODEL |
| | B-0188 | BIOTRANSPORT MODELS |
| DECOMMISSIONING | B-2296 | ACTIVATION PRODUCTS |
| | B-2299 | CONTAMINATION FACTORS |
| | B-2303 | DECOMMISSIONING/DECONTAMINATION |
| | UNDES | IN PLANT EVALUATION |

# ACCIDENTAL RADIOLOGICAL RELEASES

ACCIDENT SEQUENCE ANALYSIS, INCLUDING SOURCE TERM DEFINITION, TRANSPORT MODELING, AND CONSEQUENCE ASSESSMENT DONE BY PAS AND BRIEFED SEPARATELY.

SUPPORTING RESEARCH BY RSR AND SAFER:

| | |
|---|---|
| SOURCE TERM | RSR IN PLANT PHENOMENA |
| TRANSPORT | |
| AIRBORNE | RSR METEOROLOGICAL |
| LIQUID | SAFER |
| HEALTH EFFECTS | SAFER B-2268 AND A1203<br>EARLY EFFECTS OF NUCLEAR ACCIDENTS |

## EMERGENCY RESPONSE

| | |
|---|---|
| RELEASE SOURCE TERMS | RSR QUALIFICATION TESTING & SYSTEMS ANALYSIS |
| METEOROLOGICAL MODELS | RSR REAL-TIME MODELS TO GUIDE DECISIONMAKING |
| ENVIRONMENTAL MONITORS | SAFER PORTABLE IODINE INSTRUMENTS (B-6286, B-6287) AND FIELD INSTALLATIONS WITH TELEMETERED DATA (UNDES) |
| COUNTER MEASURES | PAS KI STUDIES (ALSO ASSISTANCE TO NRR) |
| POST ACCIDENT RECOVERY | NRR FORMULATING POLICY AND NEEDS |

# OCCUPATIONAL RADIATION EXPOSURE

SOURCE TERMS AND ALARA

| FIN # CONTRACTOR | TITLE | DESCRIPTION | FY 1982 |
|---|---|---|---|
| Undesignated | In-Plant Measurement of Crud Buildup and Removal From Operating LWRs | System will be developed to make measurement at fixed location in operating LWRs to establish dose and radionuclide buildup and removal. Data collection will be initiated at operating plants, particularly those planning decontamination at some near future date. Data will also be collected on the coolant parameters, e.g., solids, radionuclide concentrations, chemistry, etc. All data will be correlated with plant operations and designs later in the project. | 600K |
| Undesignated | Decontamination Effectiveness | Contaminated equipment or components from operating plants will be obtained to evaluate the effectiveness of decontamination methods on radioactive deposits and their effect on the component itself. Simulated deposits will also be used. | 300K |
| Undesignated | Post-Accident Decontamination of Plant Sites | It is assumed that NRC will have some research needs following the interagency studies on TMI-2 contamination and decontamination. These studies are not defined at this time, but funds are being programmed to permit follow on research. | 300K |

# OCCUPATIONAL RADIATION EXPOSURE

## DOSIMETRY

| FIN # | CONTRACTOR | TITLE | DESCRIPTION | FY 1982 |
|---|---|---|---|---|
| B7259 | NBS | NBS Quality Assurance of Radiation Measurements in Licensed Facilities | Assess performance of Panasonic TLD's used in NRC TLD radiation monitoring network. Develop radiation fields, exposure chambers, etc. to calibrate radiation detection instruments and TLDs. Develop quality assurance program for laboratories that calibrate radiation survey instrumentation used by IE inspectors to relate measurements to NBS. | 200K |
| B0410 | ORNL | Methods in Dosimetry for Nuclear Regulations | Work will continue on the development of metabolic models for age-specific considerations. A computer program which estimates the absorbed dose commitment per unit intake as a function of age will be developed. | 175K |
| UNDES A | | Development of Improved Techniques for Neutron Dosimetry | Albedo and tract etch dosimeters will be calculated for use as personnel neutron dosimeters. Helium-3 proportional counters will be evaluated as neutron spectrometers. | 100K |
| **HEALTH EFFECTS** | | | | |
| B3029 | UCDavis | Biodosimetric Confirmation of Dose-Rate Amelioration Factors | Continuation of studies on dogs exposed to whole body gamma radiation will confirm the use of hematologic and immunologic end-points as biodosimeters. Predictions of late effects, e.g. leukemia, will be made using these end-points. | 150K |
| B3033 | UCDavis | The Influence of Genetic Immune Disorders and Anemia in Radiation Leukemogenesis | Continuation of studies in different species will examine whether genetic or environmental factors pre-dispose humans to radiation induced leukemia. | 190K |
| UNDES B | | Determination of the Relative Biological Effectiveness Value of Low Dose Neutrons | Mice will be exposed to pure fission neutrons at occupational exposure levels and to pure gamma rays. Tumor induction and life-shortening will be analyzed. | 425K |

# ROUTINE RADIOLOGICAL EFFLUENTS

ROUTINE RADIOLOGICAL EFFLUENTS

SOURCE TERMS

| FIN # | CONTRACTOR | TITLE | DESCRIPTION | FY 1982 |
|---|---|---|---|---|
| A6075 | EG&G | Source Term Measurements | Assemble data on the operating parameters in liquid, gaseous and solid systems of PWRs and on the performance of effluent treatment systems as a function of plant design and operation and to compare these data with predicted results from the PWR-GALE model and other available analysis models. The results of this comparison will be used to improve existing models. | 600K |
| B2281 | PNL | Decontamination Effects on Radwaste Systems | Determine the requirements for radwaste systems needed to handle post-accident decontamination wastes. Review plans for post-accident clean-up operations at TMI-2 and discuss these plans with TMI-2 personnel, their contractors and NRC staff as needed. Assess the adequacy of proposed measurements at TMI-2 related to decontamination effectiveness and decontamination waste treatment. Formulate recommendations and a plan for additional research on radwaste system requirements for post-accident decontamination and waste handling. | 60K |
| Undesignated | | Improved PWR Effluent Analysis Model | The data obtained from project A6075 will be reviewed and compared with the approach and assumptions used in the PWR-GALE code. If improvements to this code have potential to provide NRC with a more realistic, flexible model for effluent assessment, the basis and form of this development will be defined in FY 1982. | 100K |
| Undesignated | | Advanced Effluent Treatment Systems | Conduct a literature search for effluent treatment concepts not currently used in LWRs and assess their applicability to LWRs. For concepts offering potential improvements compared to systems currently used in LWRs, develop a plan and cost estimate for necessary development and demonstration and justify these expenditures as appropriate. | 100K |

## PATHWAYS TO MAN

| FIN # | CONTRACTOR | TITLE | DESCRIPTION | FY 1982 |
|---|---|---|---|---|
| AIRBORNE | | | | |
| A6288 | INEL | Iodine Pathway Study | Determine behavior of I-131 and other radionuclides in environment following releases from nuclear facilities | 80K |
| LIQUID | | | | |
| B7260 | CU | Determining Radionuclides in Susquehanna River and Chesapeake Sediments | Determine the seasonal radionuclide distributions in Susquehanna River and Chesapeake Bay suspended and bed sediments and establish mechanisms for environmental transport of radionuclides in these aquatic systems. | 120K |
| B2271 | PNL | Mathematical Simulation of Sediments and Radionuclide Transport in Surface Waters | Continue with development and validation of radionuclide transport models in lakes, oceans and estuarines to include effects due to adsorption/desorption of radionuclides on sediments, resuspension and sediment deposition. | 180K |
| B2275 | PNL | Sediment and Radionuclide Transport in Rivers | Collect field data for purposes of validating sediment/radionuclide transport models. | 120K |
| B2294 | PNL | Sediment and Radionuclide Transport in Rivers-Computer Simulations | Validate sediment and radionuclide transport in rivers using already collected field data. | 120K |
| B5749 | UW | Distribution Coefficients for Radionuclides in Aquatic Environments | Determine distribution coefficients for radionuclides in lakes and estuarine systems. Determine water quality parameters affecting sorption of radionuclides on sediments. Continue with determining distribution coefficients in Susquehanna River-Chesapeake Bay System. | 120K |

## HEALTH EFFECTS

| FIN # | CONTRACTOR | TITLE | DESCRIPTION | FY 1982 |
|---|---|---|---|---|
| A2059 | ANL | Projection Models for Health Effects Assessments in Populations Exposed to Radioactive and Non-Radioactive Pollutants | Advanced dose-response functions will be incorporated into the DEMPAK model which will take into account dose-rate effects and non-linear responses for ionizing radiation. Better models for exposure to air pollutants will be developed. | 150K |

Continue to Next Page

ROUTINE RADIOLOGICAL EFFLUENTS

HEALTH EFFECTS (Continued)

| | | | | |
|---|---|---|---|---|
| B0188 | ORNL | Dosimetry and Biotransport Models to Implement ALARA | Global models for environmental transport of selected radionuclides will be developed. Population doses resulting from multiple exposure pathways will be calculated. | 175K |

DECOMMISSIONING

| FIN # | CONTRACTOR | TITLE | DESCRIPTION | FY 1982 |
|---|---|---|---|---|
| B2296 | PNL | Long-Lived Activation Products in Reactor Materials | Determine the long-lived radionuclides which are produced in significant quantities in reactor construction materials and which will be of major concern in decommissioning in light water reactors. The project will determine the types of radionuclides produced, their location, chemical form and the non-radioactive isotopes from which they were generated. The project will also make recommendations of alternate construction materials to minimize decommissioning problems. | 100K |
| B2299 | PNL | Characterization of Radionuclide Contamination Throughout Light Water Reactor Power Stations | Aid NRC in formulating policies and strategies for decommissioning of nuclear power plants by determining the nature, distribution and inventory of residual radionuclide contamination in and around commercial light water nuclear power stations as a function of design and operating parameters. | 250K |
| B2303 | PNL | Decontamination as a Precursor to Decommissioning | Aid NRC in formulating policies and strategies for decommissioning of nuclear power plants by determining how effective decontamination methods are in reducing dose rates and waste volumes associated with LWR plant decommissioning. | 200K |
| Undesignated | | In-Plant Decommissioning Study | The plans for actual LWR decommissionings will be reviewed (especially Shippingport) and recommendations and plans prepared for an NRC-associated program. Funds will include additional NRC data needs, either performed by the organization decommissioning the site or by a separate NRC contractor. | 400K |

ACCIDENTAL RADIOLOGICAL RELEASES

EMERGENCY RESPONSE

## ACCIDENTAL RADIOLOGICAL RELEASES

HEALTH EFFECTS:

| FIN # | CONTRACTOR | TITLE | DESCRIPTION | FY 1982 |
|---|---|---|---|---|
| B2268 | PNL | Early Effects of Inhaled Radionuclides, Phase II | Continuation of studies initiated in FY 1981: Effects of inhaled alpha emitting radionuclides combined with external irradiation and effects of inhalation of mixtures of alpha and beta emitting radionuclides. | 200K |
| A1203 | LVLCE | Early Morbidity and Mortality Estimates for Different Nuclear Accidents, Phase II | Continuation of studies initiated in FY 1981: (1) mortality and morbidity of rats exposed to aerosols of mixture of beta emitters having different effective half-lives in the lung, (2) effects in rats of inhalation of alpha emitters having different specific activities and (3) effects in rats of inhaled beta emitters combined with external irradiation. Additional study will be initiated to examine the combined effect on early mortality of beta irradiation of the bone marrow and inhalation of a beta emitter, | 200K |

## EMERGENCY RESPONSE

ENVIRONMENTAL MONITORING:

| FIN # | CONTRACTOR | TITLE | DESCRIPTION | FY 1982 |
|---|---|---|---|---|
| A6286 | INEL | Air Sampler and Emergency Radiological Instruments | Test and evaluate performance of emergency radiological instrumentation for (a) environmental response to radioiodines and other radionuclides, (b) varying environmental conditions, (c) particulates and radioiodines in milk, food and water pathways, and (d) use in recovery and decontamination operations. | 180K |
| A6287 | INEL | Iodine Adsorber Evaluation | Complete evaluation of adsorber characteristics of filter cartridge used in portable air samplers and determine anion resin capability for concentrating I-131 from milk samples under emergency field conditions. | 70K |

# ATMOSPHERIC DISPERSION RESEARCH PROGRAM

-- DISTANCES (0 - 80 KM)

-- WIND SPEEDS (CALM - 10 MPS)

-- ALL STABILITY CONDITIONS

A. TERRAIN EFFECTS

1. FLAT, EVEN
2. ROUGH, HILLY
3. COASTAL SHORELINE ENVIRONMENT
4. CHANNELED FLOW
5. IMPINGEMENT

B. MODEL EVALUATION

1. TRANSPORT (TRAJECTORY)
2. DIFFUSION (TURBULENCE)
3. DEPOSITION
4. COMPUTER CAPABILITY FOR EMERGENCY RESPONSE

C. VERTICAL DISPERSION

D. BUILDING WAKE EFFECTS

OBJECTIVE: VERIFICATION OF CURRENT AND PROPOSED METHODS USED TO PREDICT THE TRANSPORT AND DIFFUSION OF AIRBORNE RADIOACTIVE EFFLUENTS FOR EMERGENCY RESPONSE AND SITE EVALUATION PURPOSES

SITE SAFETY RESEARCH BRANCH DIVISION OF REACTOR SAFETY RESEARCH

| FINs | CONTRACTORS | TITLE | DESCRIPTION | FY 1981 | FY 1982 |
|---|---|---|---|---|---|
| B5690<br>B6333<br><br>B5829<br>B6606<br><br>B6222<br>[illegible]<br><br>B0446 | NOAA/Air Resources Lab.<br>NOAA/ Atmospheric Turbulence and Diffusion Laboratory<br>Colorado State Univ.<br>Aeronautical Research Associates of Princeton<br>SRI International<br>Battelle - Pacific Northwest Laboratories<br>Oak Ridge National Lab. | Evaluation of Real-Time Dispersion Models | Utilizing known atmospheric transport, diffusion, and deposition models appropriate to estimate concentration patterns of effluents to 80 km and previously developed high quality tracer concentration data sets, an objective evaluation of selected models will be performed. This evaluation will demonstrate the range of models applicable to different meteorological/topographical regimes, identify needed input data, and quantify model uncertainties. Such an assessment will provide a basis for selecting a given model for use in emergency planning and environmental effects resulting from postulated accidental releases of radioactive effluents for site evaluation purposes. An evaluation of existing minicomputer capabilities for on-site dispersion modeling as well as the Atmospheric Release Advisory Capability (ARAC) centered at LLL is being made. | $ 400K | $ 300K |
| B5690<br>B6222<br>B6606<br><br>B0446 | NOAA/Air Resources Lab.<br>SRI International<br>Aeronautical Research Associates of Princeton<br>Oak Ridge National Lab. | Intermediate Range Atmospheric Transport Experiments | A continuous two week field program will be conducted at Indian Point, NY, to obtain high quality concentration measurements with 400 fixed point samples located in a 20 km x 5C km grid. Concurrent meteorological measurements will be made and used as data input to selected atmospheric transport and diffusion models. The model evaluation effort will be conducted independently in order to assess objectively the performance of each model in predicting the maximum concentration and spread of the tracer. Additional field programs are contemplated at Zion, IL and Rancho Seco, CA. | $ 500 | $ 700K |

| FINs | CONTRACTOR | TITLE | DESCRIPTION | FY 1981 | FY 1982 |
|---|---|---|---|---|---|
| B5690 | NOAA/Air Resources Lab. | Dispersion in Shoreline Environments | To quantify the spread of effluents from ground-level, point sources in shoreline environments during postulated accident conditions, a field program has been initiated to obtain high quality concentration measurements under controlled conditions. Tests are planned for the Texas Gulf Coast, Florida Atlantic Coast, and the shores of Lake Michigan. The measurements program will utilize state-of-the-art tracer technology and remote sensing techniques to determine the spread of the effluent in the horizontal and vertical, over water as well as over land. The data thus collected will be used to evaluate existing and proposed models of dispersion during accident conditions in coastal zones, both for emergency planning and site evaluation purposes. | $ 300K | $ 500K |
| B6222 | SRI International | | | | |
| B2081 | Battelle-Pacific Northwest Laboratories | | | | |
| B6240 | The Research Corporation of New England | | | | |

# APPROACH TO EVALUATION OF REAL-TIME ATMOSPHERIC DISPERSION MODELS

1. Identify atmospheric transport, diffusion, and deposition models appropriate to estimate concentration patterns of effluents to 80 k
   Model characteristics: a. Gaussian (statistical)
   b. K-theory
   c. 2nd-order closure

2. Identify tracer concentration data sets from point sources with simultaneous meteorological measurements taken out to 80 km.
   a. terrain and surface conditions
   b. atmospheric stability
   c. transition conditions
   d. wind fields

3. Determine evaluation criteria by which to assess models identified in 1 using data in 2.
   a. downwind 1 hr. surface concentration patterns to 80 km
   b. cost/benefit
   c. real time capability
   d. sensitivity of meteorological data input

4. Evaluate models using 3 and data in 2.
   a. Models (not more than 6)
   b. experiments (not more than 50)

5. In consultation with NRC determine performance criteria for meteorological data needed, model output, and compatibility at plants.

6. Perform 1, 2, 3, and 4 with precipitation scavenging models.

7. Evaluate minicomputer capabilities that currently exist which may be applicable or easily adaptable to on-site emergency planning and response functions.

# ATMOSPHERIC DISPERSION FIELD EXPERIMENT AT INDIAN POINT

PROJECT DIRECTOR: Robert F. Abbey, Jr., NRC/RES

FIELD DIRECTOR: C. Ray Dickson
Air Resources Laboratory, NOAA-ID

PARTICIPANTS: NOAA/ARL
SRI International
Battelle-Pacific Northwest Laboratories
Consolidated Edison
State of New York

OBJECTIVE: To obtain high quality tracer concentration and coincident meteorological data in order to verify and evaluate ARAC and other dispersion models.

TEST PERIOD: Two weeks commencing May 1, 1981

TEST CHARACTERISTICS:

1. Gaseous tracers released either concurrently from two different locations or consecutively to distinguish between day and night releases ($SF_6$, 12B2).
2. 50 km X 50 km square grid or 25 km X 70 km grid centered at Indian Point.
3. 200 portable samplers with four samples at each of 50 locations.
4. Continuous releases for two weeks with samplers changed every six hours.
5. Radiosondes released every six hours.
6. Tetroons tracked by radar, released every three hours for trajectory determination.
7. 6-8 150 ft instrumented towers.
8. Pibal stations and radar for wind field definition.
9. Mark IX mobile lidar system for concentration measurements in the vertical.
10. Acoustic sounder for stability and mixing height determinations.
11. Oil fog and plume photography.

OTHER OPTIONS:

1. ALPHA-1 airborne lidar.
2. Aircraft sampling.