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ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

Subcommittee on Human Factors

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UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

Subcommittee on Human Factors

Room 1046
1717 H Street, NW
Washington, D.C.

Thursday, May 19, 1983

The Subcommittee on Human Factors convened at 8:45 a.m., pursuant to notice, David Ward, Chairman of the Subcommittee, presiding.

PRESENT FOR THE ACRS:

D. WARD, Member

H. LEWIS, Member

I. CATTON, Consultant

D. FISCHER, Designated Federal Employee

AUDIENCE PARTICIPANTS:

W. MINNERS

J. PITTMAN

G. SALVENDY

R. PEARSON

M. DEBONS

M. KEYSERLING

M. BUCK

M. NERTNEY

M. PEARSON

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P R O C E E D I N G S

MR. WARD: The meeting will now come to order. This is an Open Meeting of the Advisory Committee on Reactor Safeguards' Subcommittee on Human Factors.

I'm David Ward, the Subcommittee Chairman. The other ACRS member present today is Mr. Remick.

We also have ACRS consultants Mr. Buck, Mr. Catton, Mr. Debons, Mr. Keyserling, Mr. Pearson, and Mr. Salvendy and Mr. Nertney.

Regarding Professor Salvendy, I understand that he has received a distinguished award as the chief editor of a handbook in industrial engineering that was awarded the publishers' prize as the best engineering book of the year.

Is that correct?

MR. SALVENDY: Thank you. The information flows very fast. I appreciate it. Thank you.

MR. WARD: Congratulations. We are pleased to share your distinguished company.

MR. SALVENDY: I should add that I have distinguished contributors; Dr. Richard Pearson and Jim Buck are chapter contributors. Honor goes to them.

MR. WARD: Very good.

Other than that sort of discussion, the purpose of this meeting is four-fold.

First, we will discuss with NRR Safety Program

Branch the priorities assigned to humsn factors, related generic issues.

I understand that the Branch Chief, Mr. Warren Minners, will provide the Subcommittee with some opening remarks, and then Mr. Jim Pittman will walk the Subcommittee through the priorities assigned to a couple of the issues.

What I hope to hear from Mr. Minners and Mr. Pittman is, first, just sort of a brief description of the generic issue methodology for the benefit of the Subcommittee members who are unfamiliar with that.

And then, if you will describe how that methodology is applied to two or three issues, to reach a conclusion about priority -- just two or three I think is ample.

Then, if you can go over with us, in some sort of coarse way, the entire list and show us the priorities. And I understand there have been some changes in the priorities since the list that was sent to the consultants several weeks ago.

So, if you have something in particular there you might discuss and update us, we'd appreçiate that.

To the Subcommittee members, I would suggest that we not worry too much or argue too much about the methodology. This is an attempt by the Staff to bring some rationality to the whole issue or the whole problem of assigning priorities to generic issues.

I would like to welcome Dr. Lewis.

MR. LEWIS: Forgive me. I've been sitting in the back, but I decided to join the big boys.

(Laughter.)

MR. WARD: It's certainly an imperfect methodology, but the Committee, as a group, has reviewed it, accepted it as something that is helpful and workable.

Also, I would suggest that they not worry too much about the details of its application, but rather what I would like the Subcommittee to do is to look at the issues and, from your sometimes unique points of view, try to decide or develop some judgment about things that the methodology has missed with regard to the human factors issue.

Some of us think that it might be stretching this particular methodology to try to apply it to human factors issues. But something has to be done. I think the Staff has made a fine effort in doing this.

But from different perspectives, there may be some judgments reached which are different from the judgments made with the aid of application of methodology.

I think it is that sort of thing which the Subcommittee and the consultants can be particularly helpful to what we're trying to do.

So, by the end of this part of the meeting, part of the meeting on generic issues, we would like to be able to be able to agree or disagree with the priorities assigned to the full range of issues.

Then, during the Division of Human Factor Safety portion of this discussion, I would like to get some clarification from them on the relationship among the Human Factors Program Plan -- the Human Factors Program Plan expeditied schedule, the Human Factors Review Group and their perspective on NUREG 0933 for the generic issue priorities.

The second topic we plan on covering this morning is Dr. Salvendy's proposal to have NRC sponsor training of human factors experts at U.S. universities.

Before Drs. Salvendy and Pearson speak on this topic, I'd like the Staff to set the stage for their discussion, more or less telling us if the need exists, in their perception, for more human factors experts.

I'd like to point out that, in our discussion, the subject this morning will be general in nature. We should not get into what any specific university can or might do, especially since several of our consultants teach at universities which might be able to offer training programs of the type we'll be discussing.

I think it would be inappropriate to discuss anything more than the feasibility and the need for NRC-sponsored training of human factos experts.

After lunch, we plan to hear from I&E's Incident

Response and Development Branch. Mr. Ken Perkins, the Branch Chief, will provide the Subcommittee with some opening remarks. Then, Mr. Joe Himes will tell us about the Branch's work with the proposed Nuclear Data Link, their information management system, and several other systems.

Finally, the Subcommittee will discuss with the Office of Research, Human Factors Branch, the research budget for '85 and '86. This discussion will be used as a basis for the Full Committee's June letter report to the Commission on that subject.

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

Mr. David Fischer, to my right, is the designated federal employee for the meeting.

Rules for participation in today's meeting have been announced as part of the notice for this meeting previously published in the Federal Register on May 2, 1983.

A transcript of the meeting is being kept, and it's requested that each speaker first identify herself or himself and speak with sufficient clarity and volume so that she or he can be readily heard.

We have not received either written statements or requests for time to make oral statements from any members of the public.

At this time, I might ask if there is anyone who would like to make an oral statement at some time during the meeting. If so, we can arrange that. If there is, if you will make yourself known to Mr. Fischer at some time this morning, I would appreciate it.

Do any of the other Subcommittee members want to make any comment at this time?

Any consultants?

(No response.)

MR. WARD: Let's go ahead then.

Mr. Minners, will you lead off, please.

(Pause.)

MR. MINNERS: I'm Warren Minners, Chief of the Safety Program Evaluation Branch.

(Slide.)

And we started almost two years ago to prioritize generic safety issues, and we have progressed far enough along now that we've done the bulk of the backlog and we are starting to play catchup with some of the issues that are arising recently.

I would like to emphasize what this method is and what it is not --

(Slide.)

-- because there is sometimes some confusion.

It's purpose really is a means of allocating resources efficiently within mostly NRR. At the moment, this program has been directed towards NRR, although it does have some slop-over into what Research is doing and what I&E is doing. But it started out with an NRR focus, and it's still pretty much trying to allocate NRR resources to say which safety issues should be worked on and which should not.

Also, as part of that, it identifies which issues are not safety issues and what had to be assigned priorities on another basis.

A second purpose is to identify and maintain an accurate list of safety issues. I think that this is a thing the Commission has to do to the public, to represent what are our real safety concerns and what are not safety concerns, and we have not done a good job in that in the past. Everything has just been in one pot.

Now, what it is not, it is not a "regulatory analysis," which is the latest buzz word for "value impact analysis," which replaced "cost-benefit analysis." It is not that because it is not enough detail, it is just not intended as a tool for making final decisions. It's a tool for trying to take a guess at which things might be worthwhile if they were worked on.

It also does not prejudge what the resolution of an issue might be. Although out of necessity, you must make a guess at what the resolution might be in order to get some kind of a cost estimate that is not a prejudgment, that's "Hey, this is what we use to try to make a guess," and that's it. It is not a decision for a new requirement.

And in talking to some people, they sound, to me, like they think this is a decision for a new requirement, and these assessments are not that and are not intended to be.

Now, of course, if we are doing our job properly, our prioritizations are well done. Most of the high-priority things result in a requirement or else we're not doing a good job of guessing at it.

Still, they are not really the decisions yet.

(Slide.)

Prioritization is part of an overall program which starts with the identification of issues, and we have several means of identifying issues.

We have an office, AEOD, who will look at operating experience. Our regions pick up things and send them in. I&E picks up things and sends them in. Reviewers, when going for a review, they pick up -- we even take issues from the ACRS. So, we will do anything.

Then, we go through the prioritization process to try to rank these things. Then, we allocate resources to these things and proceed with resolution. We are now, really, up through the first three steps. Resolution on some of these issues has been an ongoing thing and some has just started.

But as far as this program goes, we have really got this step, and we're just starting with the resolution one.

The office has an office letter out which tells you the procedure for going through the first four steps.

The last step is a review and approval step, and that's covered by NRR Office Letter 039. In a lot of ways, the review and approval is like prioritization, because this now requires a regulatory analysis, which is similar, as I said, to prioritization, but much more detailed, much more thorough, and a good basis for recommending any changes.

The final action, of course, is implementation. We have a set of words that we use: "The resolution is" -- I reserve it for if Stan has taken an issue and has issued a new requirement, it's a new SRP, a new Reg Guide, a new Rule, that does not mean that it is yet installed in the plant. That's the resolution.

Implementation is taking those requirements and actually getting the necessary changes made in nuclear reactors.

(Slide.)

Now, the process by which we do prioritization, I think, is very important, because it gives some credibility to what we're doing.

Again, as I said, the first thing is to identify issues with the various sources. We then assign issues within the Branch. We have a contractor, Pacific Northwest Laboratories, who is helping us out; and we give them some, and keep some ourselves, et cetera, et cetera.

We are using the contractor basically as a fact-finder for us. They do not write up the assessments, as you see on 0933; although they do write their own reports, they don't make any conclusions. We take their input and my Branch makes a conclusion.

The hardest part of this -- one of the harder parts of this is to define the issues. We've run into this many times. People look at different prioritizations because we're talking about different issues. We have to be careful that the issues are defined, and that is not an easy job many times. We try to do that by going down to the Branch in R&R that is responsible for this area and getting with them and defining the issues.

Then, the next step is to get the nonsafety issues out. In the Commission, almost everything you do is related to safety in some way, but we are prioritizing only those issues which, as I say, are directly associated with safety, radiological safety. And the nonsafety issues we have broken down into licensing issues and environmental issues.

Environmental is fairly obvious. That's to go along with NEPA and that kind of stuff.

The licensing issues are what some people have what some people have called programmatic, training resident inspectors. That obviously has an effect on safety, but it's a second or third order effect. It's indirect, and it is really not very well -- not amenable to this kind of a prioritization process. And we identify those as licensing issues.

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Now, the next step is to identify resolved and nearly-resolved issues. We have a lot of those. Somebody has written a report which has recommendations in it or they have a draft Reg Guide or a draft SRP. We do not, in the strict sense, prioritize them. We don't try to get a ranking. These are so far along that the next steps are the review and approval steps, and those, basically, to do a regulatory analysis and as I said, a regulatory analysis is a much better prioritization so why do the duplicate effort of a prioritization and then do a regulatory analysis.

MR. CATTON: Do you consider it resolved when you find a path to its solution? Do you identify a problem?

MR. MINNERS: Yes.

MR. CATTON: One might then suggest a way to eliminate the problem. Is that when its considered resolved or is it considered resolved only when it truly is indeed put to bed?

MR. MINNERS: As you will note in the 0933, Table 2 has Note 1, Note 2, and Note 3. The purpose of that is to define what is a reality and that these things are in various stages of resolution. Going backwards with Note 3 would be an issue that is resolved, in a sense that there is a new improved requirement on the books, there is a new SRP which has been issued, a NUREG Guide has been issued, a generic letter has been sent out, whatever what form it might come out, it's approved and it's out there. It's not necessary implemented on plants, but it's an approved issue.

The next step is what we call Note 2, in which we have an issue which is almost approved, a NUREG report has been written in which there are recommendations for new requirements but they haven't been approved yet.

MR. CATTON: What about a second sense, where you might know what needs to be done, you might even recommend it, but you don't know how to do it. Would that be considered resolved? If it's a well-defined problem, you just don't know how to solve it yet, where would that fall?

MR. MINNERS: That would still be somewhere in the resolution process.

MR. CATTON: Okay, I'm going to bring this up again when you tell us what you're doing with simulators.

I notice in the chart they're all considered resolved. I really don't think that should be the case. When it comes up we can discuss that.

MR. MINNERS: It's a good thing to discuss. Part of this process is trying to impose a discipline upon the Staff to call things resolved and have them resolved. People want to have their cake and eat it, too. We'll go to people and say, is it resolved? And they'll look at it from one direction and say, yes, we need that being counted so we met our SES contract and it's resolved. Then we come back and say okay, you don't get any funds or people for that project and they say, no, no, we have carry-on effort. We haven't finished yet.

So, I think that's a natural tendancy. I'm sure I tend to do that myself. People say yes, its basically resolved, but gee, I still have a few more things. But this process is trying to impose a discipline that says, hey, when you say it's resolved, it's resolved and you're not doing any more work on it except to implement. That can get fuzzy, too, because in implementing some of these things to fit it to the different plants you really have to do more work. You kind of, sometimes, change the resolution a little bit. So resolution is really a little fuzzy around the edges but my criterion for the people who have been writing these up is that, to be resolved you have to reference a piece of paper which has an approved requirement on it.

MR. WARD: Would you go back to your previous chart, if you would. I thought I understood what you had there. You're talking about number four.

(Slide.)

Resolution. Resolution is completed when the Staff has developed the final proposal.

MR. MINNERS: And it has been approved by the approval process.

MR. WARD: That's step five, isn't it?

MR. MINNERS: Pardon me, yes. Resolution is when somebody -- this is a process and resolution is also an end-point. We call the thing resolved -- I see your confusion. We call something resolved when it has finished step five and we're calling this part of the process, where people are working on it and trying to find a resolution, resolution. Now I see your confusion.

MR. CATTON: So resolution is when you have figured out what to do. Resolved is when you have done it.

MR. MINNERS: Resolution is the process of figuring out what you're doing. That's when we hire contracts to do studies, find out what the error rate is, how you should fix up simulators, or what implementation plan you should use, which alternative plan you want. That's the task, the work the technical people are doing, to find out what is the resolution. The issue is not considered resolved, in my definition, until it has gone through this process.

MR. CATTON: What about our chart? Did you make up the chart?

MR. MINNERS: I don't think so. Which chart are you talking about?

(Mr. Catton indicated.)

MR. MINNERS: That made that up.

MR. CATTON: Does that "R" mean resolution or resolved?

MR. FISCHER: At the top there's a key. It says resolved.

MR. CATTON: Okay. That's what I thought.

MR. SALVENDY: Would it be appropriate now to raise some basic question about the presentation or would you prefer to have them delayed until the end? I have a question here about the generic safety issues. I'm really on your first slide. What do you, exactly, mean there? Now, do you mean there only radiation in-plant? Do you mean problem of transportation outside the plant? Do you mean other safety issues which has nothing to do with radiation but relate to the human interest? Do you mean safety or do you mean health? Safety is if somebody is injured, health when it affects your health. So, I'm not sure, I don't want to play words, but really the content, I'm not really sure. Are you talking about leg amp.tation or are you talking affecting the health of the person?

MR. MINNERS: Safety issues is a shorthand for what we are talking about. We are only addressing those generic issues which are things that the NRC regulates, which is off-site public risk and on-site occupation exposure and whether it's death or other health effects we include that, but it's only radiological things that the Commission regulates. There are other health -- there's OSHA, but we don't deal with those issues.

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MR. SALVENDY: The question is, who deals with the other, for instance, safety and health issues that affect the operation of a nuclear plant which you do not address here? Who addresses those issues?

MR. MINNERS: I don't really know the answer to that question. I think it's OSHA if you're talking about that --

MR. SALVENDY: I have a feeling OSHA has no jurisdiction over a nuclear plant, but maybe somebody knows it better.

MR. WARD: They do. The NRC regulates, primarily, the radiological threat to the health and safety of the public plus radiation exposure to organs but primarily what we're talking about here, with regard to generic issues, it's the issues that apply generally to all plants or to many plants which involve a radiological threat to the health and safety of the public.

MR. SALVENDY: Just the radiological ones.

MR. WARD: Right.

MR. SALVENDY: Do I understand you correctly that the issues you indicated OSHA covers them? Because I wasn't aware of it.

MR. CATTON: They certainly do. At least for research reactors OSHA is in there with both feet.

MR. SALVENDY: Very good. I appreciate that. I have one other question if I may, please. When you talk about

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identifying all isues, you're talking on your Slide four, number one, I wasn't sure whether the identification is based on past experiences where problems have occured, number one.

(Slide.)

Does that source provide you information on where problems have occured or do you, in effect, when you're talking generic, you have a way to analyze it to predict where problems may occur?

MR. MINNERS: Let me try to tell you what we have there. A NUREG report, 0933 as I said, is kind of catching up the backlog, that is, searching through the papers of reports that have been around and addressing those generic issues that have been written down in the past.

Office Letter 40 addresses itself to how this identification process will occur in the future and that is, as I said, people are looking at what is happening in plants, or what has happened in plants. AEOD is doing studies. IE is doing studies. The regions do studies. The ACRS may come up with something. We have not -- my branch has not started to do a systematic evaluation of overall safety of plants and said, hey, this is a place where we have a weak point and here's another place where we have a weak point. We do have programs going on in that area and I think the PR, Probabilistic Risk Analyses, that are being done in plants is a systematic way of searching out where there might be omissions

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in our safety requirements.

Human factors, I think, is now trying to do it the right way. Before TMI we didn't have very much human factors. After TMI we wrote down what we thought we knew was required, the human factors in the action plan. Recently people have stepped back. They say, we're now a little smarter, we've had a little more experience. Let's try to develop an integrated comprehensive plan for dealing with human factors issues and that's the human factors program.

We have not prioritized the issues of that plan. It's a rather new thing. We're working with the Division of Human Factors to, first of all, identify specific issues within the plan, work product, and we're going to prioritize those. Some of those will be identical to the TMI Action Plan, human factors issues that we have already worked on. But in answer to your question, in the human factors area, I think the human factors plan is an attempt to do a comprehensive, systematic study of where the missing requirements are.

MR. SALVENDY: So really, at this point, the sources identify only those places where problems have known to occur. I want to clarify.

MR. WARD: Let me try to answer your question. The whole issue of generic safety problems are, on the one hand, to treat safety questions and issues that have risen out of experience, but also to treat safety issues and questions that have only been hypothesized from analysis. I think you would have to say that the safety community in the NRC is almost preoccupied with the hypothetical accident, things that have never happened and probably never will happen. In fact, that's been a criticism so, certainly, both of those things are being considered.

MR. SALVENDY: Then is there, in effect, a systematic analysis of the whole operation of a nuclear power plant from a step-by-step process to identify which components of the total system can have --

MR. WARD: Absolutely. We're spending tens and hundreds of millions of dollars on that sort of thing.

MR. SALVENDY: Is it here in your sources. You see, I got the feeling that it isn't, so I don't know.

MR. WARD: I think it's very clear that --

MR. SALVENDY: In my opinion, it's very critical that the sources you utilize be of two types, both of places where problems have occured and that they would be a theoretical analysis of the system to predict where potential problems are.

MR. WARD: Emergency core cooling systems for reactors cost tens of millions of dollars per plant. They are to protect the reactor against an accident which has never occured anywhere, which is one of the hypothesizing exercises. So, I think the Reactor Safety Division of the NRC is unusually thorough in that regard. Perhaps over-thorough.

(Pause.)

MR. MINNERS: So after we have gone through this step we have winnowed out all the stuff which is not an active safety issue, stuff they're just starting up. We do our prioritization using a defined method, which we think is important because I have ten people in the Safety Program Evaluation Branch and we have maybe twenty or thirty people at PNL, obviously working part time, and you have to have some kind of defined method so everybody does it the same way.

The next step, I'm beginning to realize, is more and more important and that is a peer review of these things. Once again, we have a relatively small group making these assessments and they have a limited rep and depth of technical expertise and so, the peer review process is to try to get people who have a deeper knowledge on the particular subject to look at these issues and say, you did it wrong here, or it's not quite right here, or yes that's the right way. That's particularly true in Human Factors. We're trying to get as wide a peer review group as possible. We are not holding up the allocation of resources to get a peak peer review. We we do is, after an engineer and a Safety Program Evaluation Branch does it, we send it around to the assigned branch in NRR with copies to other people who would be interested in it and we require the Division Director of that assigned division

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to sign off that yes, he agrees with the analysis and agrees with the priority. If we don't get agreement we take it up, usually, to the Office Director. We have not had too many cases of that.

Then, after it gets approved and into the system, we begin allocating resources and doing the resolution process. But the peer review is still going on. We have made this draft report available in the PDR. We have gotten some industry comments and we are reviewing them with the ACRS, as we are today. If you have any particular comments, that's new information, we will go back and look at the issue and see if it has to be changed. If it does, fine, we'll change it and reallocate resources but we're not going to have a completely serial process with everybody reviewing it before we start out. That's not necessary.

So, we do get an Office Level approval on each issue and then we begin to schedule the resolution. We are now scheduling the resolution of high issues, in the next year or two, and the resolution of medium priorities, starting maybe not this year but maybe next year.

Now, another important feature of the process is to monitor the resolution. NRR has had a system for monitoring review of cases but we have not had a good system for monitoring the resolution of issues, and the Safety Program Evaluation Branch has that assignment. So for each issue that is approved,

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generic safety issue that is approved, and resources are allocated. We make people fill out a little form which has some high level milestones on it and we are going to check up that they meet those milestones. When they don't meet the milestones we're going to flag that to management and try to get corrective action, so maybe some of the things will get resolved.

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(Slide)

Jim is going to go down, and as he walks through, one of the two issues of how you do this in detail. I will discuss in broad outline our prioritization method.

We have defined a safety priority score which in the writeups is called the S-score. That is narrowly defined to be a ratio of the diverted public notes if you implemented the proposed requirement over the cost for the licensee to implement that requirement. That's his cost to design, procure, install, maintain, operate, train people, and it would include the cost of replacement power if the particular fix required the plant to shut down, extend the normal shutdown.

So that is really the kernel of safety and costs, and that's your starting point. If an issue has a very low safety significance, we will put it in the low drops category. So you have to have a kernel of safety significance before we really start to prioritize. Then after we have calculated that S-score, we compare it to a set of criteria which Jim will show you, which is based on this S-score ratio and the level of absolute risk that we think this issue has.

So after we have got what is kind of a preliminary ranking, we then look at the other considerations that an issue may involve, such as occupational exposure, averted plant damage, all of the other relevant significant considerations, which are looked at in a qualitative and sometimes semi-quantitative way included in this, and that may modify the original ranking criteria a little bit. We may move it up from a medium to a high or from a medium to a low. It's not going to -- it should not be something that drives the issue from a low to a high, but it does modify the ranking of it.

(Slide)

After we go through this process of assigning rankings, as I said, we have scheduled resolution, we have now scheduled resolution of high priority issues and also the nearly resolved issues, the ones that are identified as Note 1 and 2.

As I said, we scheduled these because the approval of work left to be done on these issues is a value-impact statement kind of thing, which is almost the same thing as a prioritization, so it would be a duplication if we did a prioritization. So we just go ahead and do it. Medium priority for later years. We started out with a low priority, but as we got through the program, we looked at it and decided they weren't very worthwhile issues either, so both things labeled as low and drop we do not intend to do any further work.

If there is new information that comes up or somebody says, hey, you did that issue a year ago but you did it wrong, we have significant information, we will go back and look at the issue again. It doesn't die, it doesn't just m3joy3

disappear, it's in 0933, which is an archive. So if you make any mistakes, it can be corrected, and if it warrants it, we can change the priority issue. And that would go from a high or medium also.

The last specification that we give is what I have termed "regulatory impact." Now, this is directly related to safety, but this is a derachet, and I am taking it out as a special category because I want to have a list of generic safety issues, and when I say generic safety issues, I mean deficiency in the radiological safety of nuclear power plants, and that will be an accurate list I can display to the public and say, here are the possible problems we have with this plants. This is not a possible problem for the public. But if we did this derachet, we would possibly change safety very little or not at all, but there would be a large cost saving.

These would be things that I think it would be well worth the time of the Staff to work on to be able to free up resources for doing things which are not very important, and we can put those on important things.

MR. WARD: So you see that category as something primarily that will save Staff time?

MR. MINNERS: It could if that might be a justification, but that usually isn't very much money in the big picture. It's primarily that it will save industry money.

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We are reviewing some issues. I think we are going back -- I guess I can't think of any human factors issues that fall in that category.

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At one time a few years ago, I guess two, three years ago, we completed the USI on A-2, which was asymmetric loading. We are really looking at that issue based on people now know fracture mechanics better and we may change our requirements in that area and not require people to put in restraints,which would be a large cost saving and also might have some secondary safety improvements by letting people inspect. So that is the kind of thing we mean by regulatory impact issue.

I don't want to represent it as a safety issue because the public would get the impression, then, that there is a deficiency in savings. It is that we are overconservative in those areas.

(Slide)

Now, I don't know if this is going to help you out or not, but I think Dr. Ward asked for a kind of overview of the results.

MR. BUCK: We don't have this slide, do we?

MR. MINNERS: No, you don't have that slide because I didn't know that you wanted it.

This is our matrix for deciding what the initial priorities . This is the value/impact score "S" that I

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talked about, which is the averted public risk in man-rem over the implementation cost in millions of dollars. So 1000 man-rem per million dollars is the same as $1000 per man-rem, which is right about here.

This axis is the absolute risk. For example, this is core melt from reactor year 10^{-5}, which is 10 percent of the original NUREG-0E80 numerical guideline of 10^{-4} on the basis that roughly each issue -- maybe there are ten issues that add up to the total core melt, so 10^{-5} for an issue should be the breakpoint for significance.

So if you are above this breakpoint, you are always a high priority. If you are below the breakpoint, then the value/impact score can affect your priority but not greatly. If you are at this point, just a little below 10 percent of the 10^{-4} number, if it is really cheap to do, you would get a high priority. Otherwise you would get a medium priority. If you are maybe a factor of 100 below the guideline and it is getting kind of expensive to do, you drop down into a low category, which, as I said, we would not work on.

So we use the cost/benefit of value/impact ratio to kind of move things a little bit up and down. Once again, once you pick one of these priorities, it may be modified again based on other considerations, and if it is, those other considerations are explicitly stated in the writeup, and the rationale for changing the priority is explained.

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This is kind of old now, but this is how the issues generally have come out in this kind of a correlation. We don't have any issues with large safety significance and large costs.

MR. WARD: These are all issues, now, not just human factors issues.

MR. MINNERS: These are all generic safety issues, right, so we don't have any down here. We also don't have any insignificant issues that have high costs, and this is probably an artifact of the potential screening process that the Staff does. If we see something significant down here but it's a big bucks item, we are not going to get excited about it.

This is here because I think this is the process that we have gone through. We have already gotten the big ticket items. People know what the big ticket items are. There are a few things up in here which are now coming out of PRAs and operating experience which may be high priority, like reactor core pump seals, molten degradation and things like that.

That is my run-through of the general process, and Jim will now take you through a couple of issues and show you how it is applied to specific issues.

MR. CATTON: Dave, this is a little bit unrelated, but he looks like the guy that I ought to ask the question.

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MR. WARD: Sure, go ahead.

MR. CATTON: In reading through some of the things that have been sent us, there was a report that had to do with the new procedures for BWRs. Right in the middle of it they discuss a decision-making process that leads them to stop cooling the core if the containment is jeopardized.

Where can I get some information on how that decision was made? I personally think it is a wrong decision. That's why I would like to read a little bit more about how they arrived at it.

MR. MINNERS: I'm trying to think. I guess Danny Ziemans' branch is writing up procedures. He would be the person. That is probably kind of a collegial decision. I'm sure the Reactor Systems Branch and other people are involved in that.

MR. CATTON: Who should I call?

MR. MINNERS: I would try Danny Ziemans first, and then I would call Bryan Sharon, who is the Branch Chief of the Reactor Systems Branch.

MR. CATTON: I will call Bryan. I know Bryan. Okay, thank you.

MR. MINNERS: Let me address that. I have been involved in that somewhat. I think those procedures are just prudent procedures. There might be better ways of doing it, but if you are in that situation, I think that is the best

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thing to try to do when you don't have much choice to do anything else.

MR. CATTON: You see, you are making that judgment based on what you think might happen if you let the core melt because you are making a conscious decision to let it melt rather than to depressurize or open up a hole in the containment to get rid of all the water.

MR. MINNERS: That is probably a problem with our requirements. We don't look at procedures themselves as requirements. We just have a general requirement that says you have to have procedues.

MR. CATTON: This was your review of the BWR procedures, and in essence the Staff was saying that's okay.

MR. MINNERS: I'm trying to explain the process. If we put out a new requirement, which in that case would be you have to have procedures, you have to have emergency operating procedures, okay, there might be some more detail about what has to be in it, but it is a general kind of procedure. The decision to put out that requirement goes through a rather lengthy and thorough review process. It goes up through the management chain in NRR. CRGR would review it, get approved and so on.

Now, what you are talking about is what I would call implementation. Somebody has now written a procedure for this, and the Staff is going to review it. That review

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does not go through the same thorough, comprehensive, widespread approval process, so it would just be the technical reviewers who are looking at that particular issue. I think that is a problem that is inherent in the system because you can't have every nut and bolt go through a huge review process.

MR. CATTON: That particular thing I really wouldn't consider a nut and bolt.

MR. WARD: This may be important, but I think it's for another meeting.

MR. CATTON: All I wanted was Bryan Sharon's name.

MR. WARD: I think where this will come up is in our review of emergency procedure guidelines and technical guidelines.

MR. KEYSERLING: I would like to ask one question before you leave. How many years has this prioritization process occurred? Is this something new or has this been going on for a while?

MR. MINNERS: We have been prioritizing things for a long time. I think the first set of priorities and rankings came out in '77 or '78, but that was done on a purely subjective basis and on a set of criteria that were completely different than what we are using now. Using a quantative method as we have been doing had its genesis in the TMI Action Plan, which I think had four -- I have forgotten what it was -- which said develop a method for early resolution of generic

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issues.

So starting in 1979, the idea of doing a quantitative analysis was there. People did not really start doing this until '81 in any real complete way.

MR. KEYSERLING: Has the list been fairly stable since '81 or has there been a lot of dynamics in terms of issues changing and in the, I guess, two years that has been in existence?

MR. MINNERS: Our process of going through the old backlog of issues has resulted in a combination of issues. There has been a lot of change. It has stabilized somewhat, but we have -- the AEOD is supposed to look at operating experiences and they write reports on the case studies, and we have been treating those reports as generic issues and applying this process to them.

The number of issues is now tapering off to some kind of a steady state level, which I don't perceive what the rate is yet but it is not going to be zero.

MR. WARD: Mr. Debons.

MR. DEBONS: I guess the question has been answered. The question I originally had in mind was something like this: How do you go about checking the validity of your methodology? It seems that it has a built-in non-validation check. It's a mathematical equation, and that is it. Are there ways of checking other than what Dr. Keyserling just said?

MR. MINNERS: I'm confused what you mean by methodology.

MR. DEBONS: The S-formula is a way of combining a number of the parameters of the experience of the issues, presumably.

MR. MINNERS: That is a policy decision of what decision criteria you are going to use. The S-score is a decision criteria, and that is a policy decision, and the Commissioners have not yet made up their minds about what kind of probabilistic decision criteria are going to be used in nuclear power plant regulations. In fact, the Staff has been directed not to use the one that is now in the Federal Register.

Our system is based, we say, on the principles, is the safety goal, but it is not the safety goal. In fact, it is quite different from the one that is on the street. So if you mean decision criteria, that's a policy decision. If you're talking about methodology, which is the write-ups of defining and trying to assess the safety significance and cost, the validation would come in two steps. After we do a prioritization, somebody goes through the resolution. They do a value/impact analysis, which is much more rigorous.

We have compared the results of our prioritization of that value/impact analysis and said did we come out to the same answer anywhere near. In one case that we have done so far, the value/impact analysis came out with a much higher value/impact ratio than we had, and we investigated that to see what it was.

The last step, which is not very well known in the Commission as a whole, is that these requirements do get implemented, and then, although maybe the risk side of the equation is not validated, but you should be getting some feedback on the cost side of the equation, but that feedback is a rather weak one.

MR. WARD: Doe that answer your question?

MR. DEBONS: Thank you.

MR. WARD: Anything else for Mr. Minners before he sits down?

(No response)

MR. WARD: Okay, thank you.

END T3

As Mr. Minner said, I am going to walk you through two issues that we looked at and we prioritized to give you an idea about what we do.

Now, this is going to get into a lot of nuts and bolts, and I'll try to keep it as simple and as straightforward as I can, without going into laborious detail. But I think we've got to get out some of the detail to give you an appreciation for what has been done.

The first thing is to make a definition of what the issue is that we're trying to prioritize.

(Slide.)

And it is important, also, to understand that the issues that we are looking at here are issues that were identified quite some time ago, and we are limiting ourselves to the identification of the issues, as was presented in NUREG 0660, which was the TMI Action Plan.

What has happened is situations are dynamic, and they change. Our prioritization only addresses itself to those things that were identified in the TMI Action Plan; and in the solution of those items, in the solution of those things, many other things have been identified, which we are going to address later.

But one of the items in the TMI Action Plan is what is known as 1.A.2.2, Training Qualifications of Operations and Personnel. I have sort of highlighted the key words here.

The first requirement is for the licensee to evaluate his training program, Important in that was the inclusion of the maintenance and technical personnel, along with the operation personnel. In his review, he's supposed to justify the acceptability of that training program. And where he identifies weaknesses, he is supposed and required to update that training.

And then, finally, as far as the Nuclear Regulatory Commission is concerned, our Inspection and Enforcment Branch or Group Office will assure that the training evaluations have been performed.

Now, I want you to note that one of the key words here is that evaluation has been performed.

MR. CATTON: How do they identify weaknesses? If you ask me is my program any good, I'm going to say it's great.

MR. PITTMAN: It's going to be based upon the evaluation that you perform, what was the depth of the evaluation, how did you evaluate it, what did you do.

MR. CATTON: I'll generate as much paper as you want.

How do I identify weakness?

MR. PITTMAN: Dan.

MR. JONES: I'm Dan Jones.

Basically, what we go out and do is atake a look at how the operators themselves pass the NRC examination. We take a look at their training programs, formally --

MR. CATTON: One minute. That brings up an interesting point. I was just reading somewhere, in all this paper, about what you're doing with the examinations. You're about to reduce the written part and increase -- I guess the other part must be oral. Some people are very glib and others are not. It takes a lot of skill to give an oral, and I frankly don't think that the people within NRC are trained that way. And yet you are reducing the one part that is reasonably quantitative.

MR. JONES: I'm not sure that that is what we're planning to do.

MR. CATTON: I just read it. It said that you're reducing the written part in order not tc have a -- I'm trying to think of the words -- a writing marathon.

MR. JONES: In that respect, yes, sir.

MR. CATTON: It sounds like there is a bit of a bad attitude with respect to being able to respond to written questions.

MR. JONES: I can only tell you, sir, that we are in the process of revising the whole examination process, that the oral part includes, also, a walk-through and simulator part that we're required to perform hands-on.

MR. CATTON: Unfortunately, I didn't write down the

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source of this. It's a reduction of the written portion of the exam to 25 percent. I think that's a step in the wrong direction; that's why I asked the question here about how do you identify weakness. If you identify it by examinations, you'd better be paying a lot of attention to your examination or you're not going to identify weaknesses.

MR. JONES: I couldn't agree with you more.

MR. MINNERS: Could I add a comment to that?

You are now criticizing the resolution of an issue.

MR. CATTON: This is not the place to do it.

MR. MINNERS: To a degree, correct. We're not prejudging what the resolution is going to be. We do have to guess at what the resolution could be, and I think that we have decided that a two-step process helps to do that.

In an issue such as this one, the first thing you try to decide is what's the potential in this reduction that I can get of it, which is kind of if I trained my people perfectly, they had the best qualifications I could get, how would that improve risk?

MR. CATTON: I agree that this particular one is very important, and that's why I'm concerned about how you're going to do it.

MR. MINNERS: The next step you have to do in assessing the risk reduction -- we've got a potential risk reduction -- how much of that risk reduction can be gained by

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a requirement issued by the NRC. That gets to be pretty much of a guess game.

You point out some of the weaknesses that you can -- it's hard to discover weaknesses.

Can we put out a Reg Guide or a NUREG or something that tells people, with enough clarity, that we are going to gain the potential risk reduction that we think we can?

So, I would say a lot of these issues, although the potential risk reduction is large, you have to multiply them by a rather small efficiency factor, which represents the ability of the Commission, as a regulator, to gain that potential.

The kind of questions you are asking have to be asked then. It's really somebody's judgment as to, well, okay, it's 50 percent of what's there or it's 25 percent or it's 75 percent.

MR. CATTON: I hear your answer, but I find it rather unsatisfactory.

MR. PITTMAN: I think going along with this is there is a lot of interrelationships among these human factors issues, as there are in many other issues. And one of the other things that we're not going to address here today in looking at this, but I think, to myself, is very important, concerns how we report human errors and whether our LER system is adequate, whether we have an adequate system so that we see what these human errors are in maintenance, operations, and personnel, and how do they come to the surface, and how can the utilities know what their proficiency is as far as the ability of their operators to operate and maintain a plant. So, it gets into a lot of other things.

But important is that this is an approach that was identified in the TMI Action Plan, and we're trying to assess that.

MR. OVERBY: Chuck Overby, Human Factors Research Branch.

To go back to your original question on how we're going to perform that evaluation, one of the things that we hope to tell you about this afternoon, when we discuss the Human Factors Research Program, will not answer your question but to describe the kind of research that will help us develop criteria for evaluating training effectiveness.

MR. CATTON: So, you're quite a ways from resolution of this issue. You haven't figured out how to do it yet.

MR. WARD: They're just trying to tell us how they are prioritizing this sort of thing.

MR. CATTON: I thought this was an example.

MR. WARD: It is.

MR. MINNERS: This is an example of how you prioritize. This is not an example of how you make a decision whether to impose or not impose this requirement. This is just a decision to decide should the NRC apply resources to try to figure out how to do this.

MR. REMICK: Mr. Pittman, on your slide, the first paragraph, where does that statement come from? Is that out of the Action Plan, or is that a post-part of Part 50?

MR. PITTMAN: That is part of a quote, verbatim, from the TMI Action Plan.

MR. REMICK: It is a quote. Thank you.

MR. LEWIS: Can I just, for one moment, follow up what Ivan was asking? I get more and more confused as we go on, instead of more and more enlightened.

You say you are revising the Operating License Exam. That, presumably, is to provide a better guarantee that operators -- operators and maintenance people will not only make fewer errors but actually will do more things constructively in the event of an accident.

We keep emphasizing human errors and keep trying to counterbalance it. Presumably there, in there, is the difference between training and education, because education leads to the capability to do things constructively, whereas training tends to reduce the probability of doing things destructively out of procedures.

Somewhere there has got to be a way, which is bound to be complex, of folding these things together in revising the examination. I don't quite see how you can decide that the examination needs to be revised without going through this kind of logical structure in advance, not later. Am I wrong?

MR. JONES: No. I think you're abolutely right, and that is one reason why we are emphasizing what we call the systematic approach to the training. It's a process starting from an analysis of the problem and of the training procedures, and we will get an effective, we hope, training program, with consistent and regular examinations -- evaluations of part of that total systematic process -- in other words, a feedback loop that evaluates the capability of the individual to reach a certain level of performance.

MR. LEWIS: I guess I didn't make myself entirely clear. The kind of depth that enables one to rise above his training level and do things constructively is not provided by establishing a minimum level of training; it's provided by establishing incentives for being better than you actually have to be.

And I just don't see any element -- I don't argue the way you're doing it, but I don't see any element of consideration of that kind of thing in the structure. I think I'm missing a point and probably talking out of line.

MR. WARD: It's probably a good point. I think it's out of line in that it's not the subject of today's meeting.

MR. LEWIS: I know, sir.

MR. CATTON: We certainly ought to, I think, address it in depth at some point. This examination business is really crucial. It's the base for the whole business. That's the incentive.

MR. WARD: Absolutely.

In this generic issue, evaluation has rea .d exactly this conclusion. It's given this issue an H, and now they're going to work on it. So, why don't we go ahead.

(Slide.)

MR. PITTMAN: This was an issue that the Pacific Northwest Labs did a quantitative evaluation for us, and they brought together a group of their people who had considerable experience in reactor operations, utility training programs -- and you can see the list here, I don't need to read it for you -- but who had a broad background in operations and licensing and training people.

And the results of their work is summarized as follows:

(Slide.)

They believe that the plants can be divided down into three groups.

There will be about 15 percent of the plants whose training program will be adequate. They're going to have very minimum impact on their training program.

They feel that about 60 percent of their plants, there'll be some intermediate effect felt.

Then, about 25 percent of our plants out there will have a maximum impact, their training programs are inadequate and that many changes can be made to improve their training programs.

The results were that -- there are a couple of strange numbers here -- they felt that there can be about a 17 percent improvement in operator proficiency and about a 28 percent in the maintenance and technical proficiency.

MR. CATTON: How do I interpret that?

Right now I think about half of the significant events that are associated with maintenance or operators and in effect, 17 percent of that -- does that say I would see an 8 percent improvement, 8 percent reduction in significant events?

MR. PITTMAN: Let me continue, and then you ask me that question.

MR. CATTON: That's 17 percent of what?

MR. PITTMAN: That's a 17 percent reduction in human error for the operators.

MR. CATTON: Okay.

MR. PITTMAN: I want to point out what I said originally, that this is looking at this issue just in isolation, not collectively with the others, because what we have is, if you would think of these as a group of intersections, there's a whole group in the middle that all of them will have some impact on. And we can have a 17 percent impact of this one and a 28 percent of something else, but it doesn't mean we're going to have a 45 percent reduction in human error.

MR. LEWIS: Right. We can alter the arithmetic.

But just for the record, you keep interchanging the terms "operator proficiency" and "human errort." And just to get back to that other point, there's a lot more to operator proficiency than reduction of error. They are not interchangeable terms.

And the other consideration seems to be completely absent from this analysis; is that right?

MR. PITTMAN: That's correct.

(Slide.)

I want to show you how those 17 and 28 percents were derived.

Looking at the potential for human error decrease, the 15 percent group -- this would be the minimally impacted -- this group of people came up with -- that about a 5 percent increase or decrease in human error would be possible by the licensed operators, the minimum impact of plants; and the maximally impacted plants, we can expect somewhere in the neighborhood of a 30 percent decrease in human error by those operators.

Now, for the other technical and maintenance staff, they believe that about a 10 percent decrease would be possible in human error for the groups with -- for those plants with good training programs and about a 45 percent decrease. for those which had poor programs.

So, that brought us the weighted averages of about 17 and 28 percent.

MR. CATTON: When you arrive at your weighted average -- I can see how you did it here -- were these human errors in any way weighted, some more serious than others? And if you just search LERs, you get a lot of trivia that really doesn't matter. Is all that trivia included here, or did you go through and say, "I'm only going to consider significant events"?

MR. PITTMAN: I think you've got to go back one step further than that. They didn't take a look at the actual number of events that they were looking at.

What this group of people were saying, that they believed that an improvement in training would reduce the operator's induced error, whether they were trivial errors or whether they were maximal errors.

MR. CATTON: So, this is speculation?

MR. PITTMAN: This is best judgment, strictly best judgment.

MR. CATTON: Has nothing to do with reality, or may have something to do with reality.

MR. PITTMAN: I wouldn't say it has nothing to do with reality.

MR. CATTON: I didn't mean that.

MR. PITTMAN: It's not an absolute measure, if you want to put it that way.

MR. WARD: It's kind of like Appendix K calculations?

MR. LEWIS: It's more like the Emperor of China document.

(Laughter.)

(Slide.)

MR. PITTMAN: What we were able -- what was able to be done with that reduction in human error, they went back to the Oconee RSSMAP Study. That's an acronym for Reactor Safety Study Methodology Application Program. They looked at four reactors, different types, based upon the WASH 1400 results of studies, and tried to take a look and see how this information that was derived from WASH 1400 could be applied to other reactors.

It turned out it's a pretty good tool, because they went back through there and they were able to identify the major sequences and the major events and the minimum cut sets that lead to accidents in the reactor.

And in those -- embedded in those was a number of human errors in which the human failed to take the proper action.

In going back through that and applying, then, this reduction that we identified as being possible, we found that in thie Oconee RSRAS Study and the Grand Gulf RSRAS Study, that we could have a result of 1.5 times 10 to the minus 5 formula per plant-year for the PWRs and 6.8 for the BWRs times 10 to the minus 5.

And putting that into the correct computer code and what the man-rem releases would be for each one of those plants and assuming an average population of 340 persons per square mile and from an exclusion zone of one-half mile around the reactor out to 50 miles, with a typical Midwest plain meteorology, this all comes out, then, that we will have a reduction in public risk of 38 man-rem per plant-rem for the PWRs and 46 for the BWRs.

Now, taking that, then, times -- when this was done, we used 95 PWRs and 48 BWRs, with an average plant life -- remaining plant life of 28 years. That came out to a total man-rem reduction of 120,000 man-rems.

MR. LEWIS: You didn't factor into this any risk aversion. That is, you didn't give any special weighting to avoiding large accidents, compared to small accidents?

MR. PITTMAN: No, we didn't.

MR. LEWIS: Just took an average?

MR. PITTMAN: Dr. Lewis, what we did do, it did apply to the various release categories. We kept the release

jl 15

categories the same as we had in WASH 1400. And so we got the change in probability of each one of those release categories.

MR. LEWIS: Then, you averaged them?

MR. PITTMAN: Then we averaged them, yes.

MR. LEWIS: Okay. Fine.

"Fine" doesn't mean I think it's a good idea, but I understand what you did, for the record.

MR. REMICK: That total risk reduction was for the remaining life of the plant; is that what you said?

MR. PITTMAN: That's correct, for the balance of 28 years.

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That's one part of the equation. The bottom line of the equation is cost.

(Slide.)

And this is what we estimated the cost to be. The implementation of this, the setting up into the utility, would be approximately $48 million and the maintenance, or the continuation, of this over a period of time would be $640 million. The total of that would be 688. The NRC cost we estimated would be $3 million, for a total estimated cost of $691 million.

(Slide.)

Now, to give you an idea that this wasn't exactly growing out of the air, the utility costs came, again, from our people that take a look at it. And going back to the various groups, for the highly proficient groups that had good training programs, we believe that the implementation cost would be about $100,000 for those groups, and for those groups which a large change would be required we estimate it would be somewhere in the neighborhood of $500,000, about a half a million dollars, to implement a good training program. Add the maintenance programs, as you see, or the continuation of those programs. These would be the annualized costs, so we come out with the weighted averages then for the utility costs and then taking those costs over the number of per plant times 143 plants gives us an initial implementation cost, and times the 143 plants for the cost per plant year of maintenance over the 28 years, give us some $640 million.

The NRC cost, you can see there, we estimated about one person year for the development and implementation and about one person year for the rest of the plants over 28 years for the total costs.

(Slide.)

Just looking at that, then, putting those two results together, we come up with a value/impact score, the S-score, and from those results that we had our best estimate is that the safety implementation of this is about 180 man-rem per million dollars. That's going to be the risk reduction. That's the value/impact.

MR. WARD: Jim, it might help the education process here if we could get Warren's plot, with the dots on it.

MR. PITTMAN: I'm going to come to that. I'm coming to it in just a minute.

MR. WARD: Show where this one fits on there.

MR. PITTMAN: Yes, you are getting to that. We're walking to it.

(Slide.)

I just want to bring up, before we get to there, that there are other considerations that Warren talked about that impact. Now, this is the raw score that we looked at. But for these other considerations, uncertainties, occupational

mm/t5/lb3

dose, and here we've got to look at two things. One is, we may make requirements that has a negative impact as far as occupational dose is concerned. We may, sometimes, we come out that we have inspection requirements that put people in too high a radiation zone so there is incurred doses. There are some of these actions that have averted dose because either we delete or change the frequency of operation and also involved in that is if we can reduce the accident frequency, if we get a way from the accident clean up and doses that's involved, and if we take a look at TMI we can get appreciation of what some of those dose levels are.

Also, we have averted costs. Others are defense in debt. There are political considerations that have to come in, what the public concept is, the Congressional concept, where the Commission is putting their effort, what the technical controversy involved, what's the effective delay, and, of course as Warren spoke of previously, the nearness to the resolution of the issue.

(Slide.)

In taking a look at these other considerations, one of the things that we believed to be important was the fact that an improved education will enhance the maintenance people's ability to be able to get in and perform an operation and perform it more quickly and more thoroughly the first time, with less requirement of going back in and redoing it, all cutting down the time of exposure. It was calculated that the occupational dose reduction has come out to be about 240 million man-rems over the lifetime of the plant.

So, putting together the public risk plus the occupational risk gave us then a total of 525 man-rem per million dollars and we believe this to be rated as a high priority item.

MR. LEWIS: Could I just ask, that's, of course, $2,000 per man-rem. Why is it a high priority item?

MR. PITTMAN: Very good, Dr. Lewis. We will come to that in just a moment.

(Slide.)

As Mr. Minners spoke, we plot -- we're going to take this issue. We're going to plot it out on a matrix on which on one side is the value/impact score and on the other side is the relative relationship to safety goal in the change of risk. Out here is 100%, or 10^{-4} core melt per reactor year probability. Here is the 1000 man-rem per million dollars line.

(Slide.)

If I take this issue, that we just described, and I put it on this matrix these are the two points that came out. Now, we discussed that there were 500 man-rem here per million dollars, and the other one was 180 man-rem per million dollars. But looking at the total risk involved, bring this out to the higher side of our matrix, and coming down, even though if the risk wasn't that high it would at least be a medium issue, a medium rated issue. So that gives you an idea, then, of plotting these on this matrix as to what the waiting factors of these two, as they go together.

MR. LEWIS: I must be the dumbest guy in the room because I didn't understand yet why it's a high priority. I know why you put it on the chart, but in that chart the boxes that say high priority extend a factor of ten below the safety goal, but I'm missing a point. It's high priority even though it's more than a $1,000 per man-rem and even though it has less than a 10^{-4} probability of core melt per year. But even so it's high priority.

MR. PITTMAN: That's correct.

MR. LEWIS: You simply revise the safety goal.

MR. WARD: I think they said, at the beginning, the weren't using the safety goal.

MR. MINNERS: This is based on NUREG 0880, Safety Goal Prescription, which had a 10^{-4} core melt probability and $1,000 per man-rem. The reason we're using 10^{-5} because we're only looking at individual issues. The safety goal was for the total core melt problem. As I said at the beginning, we said roughly well, maybe there are ten issues which are done when we're arriving at core melt probability recognizing that's a very rough approximation but sufficient to try to make decisions of whether you can allocate a few hundred thousand dollars of NRC effort towards resolving an issue. If you're going to be -- later on you're going to be talking about millions, or hundreds of millions, of dollars on industry. A better value/impact analysis has to be done than this is, but this is just to decide whether a couple of man-years of NRC effort is going to be applied. In the big picture that's trivial so you don't need a lot of accuracy.

MR. LEWIS: Okay. So by high priority you mean high priority for allocating NRC Staff time.

MR. PITTMAN: Absolutely.

MR. LEWIS: But you are using the Quantitative Safety Goals.

MR. MINNERS: No, we're not because the Commission switched the goals in the Federal Register notice, and these are not the same things as in the Federal Register notice.

MR. LEWIS: I see, you're using an earlier version of the Quantitative Safety Goals.

MR. PITTMAN: That's correct.

MR. MINNERS: So, as the Commission directed, we're not using the Safety Goals.

MR. LEWIS: I guess I understand.

MR. WARD: It's the earlier version.

MR. MINNERS: It's getting a little far off, I agree with you, but somebody has to have some decision criteria and we picked the ones we picked, which we think are reasonable, rational, and have a fairly good basis. At least there's some agreement on it. The problem is that the country, including the Commission, has not yet decided how safe is safe enough so we are kind of in limbo until that's decided.

MR. REMICK: Warren, I guess I have a problem with what you're saying. The safety goals, as promulgated, and they are promulgated now.

MR. MINNERS: No sir, they are not.

MR. REMICK: Let me correct you. They are. The evaluation plan is out for comment. The safety goal is promulgated for a two-year evaluation period.

MR. MINNERS: If that's what you mean by promulgated, yes, for evaluation. That's correct.

MR. REMICK: Yes, there's a policy statement on it, not a regulation but you're still $1,000 per man-rem in 1983 dollars. The core melt performance criteria is 10^{-4}. The Commission says the evaluation plan includes using it for establishing priorities on generic issues. That's one of the proposed uses of that, which is out for comment, I must admit. The evaluation plan is out for comment, the goal is out for a two-year trial period.

MR. MINNERS: The Commission has said maybe we would use it for something, including generic issues, but don't use it until the Commission tells you to use it, which is after the

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evaluation work.

MR. REMICK: Until they approve the evaluation plan that is correct.

MR. MINNERS: Maybe a minute or so on the difference between the old and the new safety goals would straighten things out. The old safety goal is as we showed it. You had a core melt probability and above that you did something, no matter what the cost. Below that you applied a value/impact analysis and if it came out better than $1,000 per man-rem you would do it and if it came out to worse than that you wouldn't do it. I think there was a third in that, although not clearly stated, that if you got down to trivial, insignificant issues, no matter what the value/impact ratio was, it was 00.1 over 000.1, you wouldn't do trivial things.

The present form of the goal as published in the Federal Register is quite different. The numbers are the same in that you have a 10^{-4} criterion but now it says if you're worse than that, if you have a worse probability of core melt, then you begin to apply value/impact. So, our graph would be changed at above 10^{-5}, we'd have low, medium, and high. Below the 10^{-4} safety goal on numerical guidelines, the President Register Notice Policy Statement says you would not do anything.

MR. LEWIS: Could I understand you very clearly, the factor of 10 between 10^{-5} and 10^{-4}, you picked 10^{-5} as your personal goal because you feel that any issue you identify will be part of a family of ten issues, which if they were all the same would drive you over 10^{-4}, so if I understand you that's what you did and that means you have, in effect, adopted 10^{-5} as a safety goal for your own personal use.

MR. MINNERS: 10^{-5} per issue, the safety goal is for all issues.

MR. LEWIS: That is certainly right.

MR. MINNERS: And we don't know how many issues there are.

MR. LEWIS: That's one of the classic problems of PRA but I don't know anything other than arbitraries that drives you to pick the number 10.

MR. MINNERS: You call it arbitrary, I call it judgment.

MR. LEWIS: And we're both right.

MR. WARD: Regulatory judgment.

MR. LEWIS: That's why we're both right, good regulatory judgment.

MR. MINNERS: Good regulatory judgment.

MR. LEWIS: Good is not a defined word.

MR. WARD: Let's go ahead.

MR. PEARSON: I noticed, in going through this material, a lot of the evaluations were carried out by PNL.

MR. PITTMAN: That's correct.

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MR. PEARSON: That's the Battelle group.

MR. PITTMAN: Yes.

MR. PEARSON: The people you identified as providing the evaluations of operating training error, were any of them Human Factors specialists or industrial psychologists? Do you happen to know that?

MR. PITTMAN: No, I do not know that. They identified them as people with this experience.

MR. PEARSON: Yes, well, just a point and I'll probably make it later when we get to discussing the generic priorities. One of the things that might be a problem there, and I am familiar with the fact that Battelle has been advertising rather heavily for the last year in the Human Factors Society Bulletin for Human Factors specialists, I don't know whether they have had any success in recruiting such people, but there is a distinction, in my mind, between say, evaluating the technical content of training programs and evaluating the methodologies that are used to conduct those programs and evaluate the effectiveness of the programs within a utility. By that I mean, certain talents are needed, people that are familiar with psycho-metrics, with statistics that can look at criteria in relationships, that is, between test scores, for example, and certain criteria measures, whether it's on the job, whether it's in the simulator, whether it's in the classroom, or whatever.

You know, it's one thing to look at lecture outlines and handbooks, training materials, and so forth, and it's another thing to evaluate the effectiveness of those programs. And I think that's a major deficiency in the utility business, that they don't have the personnel to perform the criterion evaluations and therefore I would hope that anybody that you can involve in this kind of exercise would have that kind of talent on board.

MR. MINNERS: May I address that? I'd like to go back to your original point. We are not trying to evaluate new requirement by the Commission that you have to have training plans and well-qualified people. All that PNL would have to be able to do, in this case, would be able to make a correct guess that if you got the right people writing the criteria and these were properly implemented in the plants, that the human error rate would be reduced, on the average 17%. Obviously, they have to have some background in Human Factors to be able to do that. I'm not so sure they have to have a very detailed one.

MR. PITTMAN: We have got to make a discernment here between -- here we're just trying to make an appraisal but we are not trying to judge the result, down the road, as to how efficient this program actually turns out to be. We are only saying that given that you would have a good program, this is what we can expect. You have got to look that this is a very short, not in great depth study, that we're looking here, trying to decide whether NRC should put its resources into this and that will have to come out in the detailed examination.

MR. MINNERS: It's a very judgmental process, first of all, in deciding what's the potential risk reduction. If you said that's pretty big and then we give the contract to Rinky-Dink Management Consultants, Incorporated and they did a very lousy job for us, and the utilities didn't implement it, the actual risk reduction might be a very small fraction of that. So, actually its largely a guessing process about what can be done. There are some limits in how big the guess can be because human error can not be total contributor to risk, it can only be some fraction of it. What this really is doing is trying to take some kind of very rough guess how much of a fraction of human risk due to human errors could you get through by such a requirement if it were put out, if it were done well by both the NRC and the utilities and those are very large ifs.

MR. WARD: Any other questions?

(No response.)

This is not a particularly good point on the agenda to take a break, but I think otherwise it might be. Let's take ten minutes.

(Recess.)

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MR. WARD: Jim, let me just say a word.

Before Jim starts again, I would like to make two points: first, sort of the premise for this part of the meeting, this item on the agenda; and the second, the sort of our strategy for finishing up.

Remember that what we are dealing with here is our evaluation of how the NRC staff has gone about a major problem they are having. And their major problem is that as a result of the Three Mile Island experience and many years of hypothesizing and conjecturing about reactor accidents, a number of different sources, including the staff itself, have identified a large number of what they call "safety issues."

They don't have infinite resources; they can't work on them all at once. And there are too many issues so that just raw judgment on the part of the managers has proven to be inadequate to deal with prioritizing the issues, some of the more traditional ways that you do it at your universities and your laboratories and plants.

So they came up with this analytical strategy for doing it. It isn't an analytical strategy that is used to resolve the issue but, as we said, only to decide which issues ought to be worked on first and which issues might even be dropped. And that's all it is. It isn't an attempt to develop a final resolution of the issue at all.

The second thing is the most important thing we have got to do, this subcommittee has to do, with regard to this issue is to decide at the end of this agenda item what we think about this list and the priorities assigned to it.

Now, this list was originally in the package which Mr. Fischer sent to you. There have been some modifications into it, so he has given you the list marked up. So after our education session is finished, after Mr. Pittman finishes and after the next speaker finishes, we will take another 10- or 15-minute break, and that will give you time to review this list. And then when we come back after that break, I would like you to, if you have any questions about the priority rankings, challenges to the priority rankings -- in particular, what we are looking for are any challenges that this subcommittee should come up with to the priority rankings, should some be higher, should some be lower, based on our perspective.

All this education process here is to give us the benefit of the perspective that the NRC staff has used to reach these. That is this priority methodology. You all have somewhat different perspectives, and we wanted to take advantage of that. So that is how we plan to do it.

With that, Jim, would you go ahead, please?

MR. PITTMAN: All right. The other item we are going to walk through real quickly is item I.A.25 of the

TMI Action Plan, which was entitled "Plant Drills" --

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-- in which it was envisioned that the operator training would be supplemented by the operating personnel walking through our doing drills during their normal shift work, in which they would simulate, if you will, going through an upset condition or something like that, to take a look at their procedures and say, well, I should be reading this and reading this and the result of these visual displays and what is being displayed to me and what's being brought to me by lighter enunciators, et cetera, would lead me to believe that this would be my upset conditions and these would be the actions I should take, go through on his control board and say, I should turn on this pump, close this valve, and these are the checks I should make.

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Operating from this group of assumptions that the coremelt frequency is about 5 x 10 to the -5 per plant-year frequency, that operator errors accounts for about 50 percent of these events. I don't like that number particularly; I think it's very conservative. I would say operator error is probably involved in much more than that. But I don't believe it accounts for 50 percent. But that's my observation.

But I think that's counterbalanced by the fact that the person who did this analysis assumed that the drills will reduce the operator errors by only 2 percent, may counterbalance out the conservative in the second section.

Again, this item was envisioned to affect 143 reactors, 95 PWRs and 48 BWRs, with an average life of 20 years, and that the average release between BWRs and PWRs is 2.5 million man-rems per coremelt. Those were the assumptions that started the analysis.

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This resulted in a reduction in coremelt frequency, considering a 2 percent reduction in human error and half of the accidents involved and a coremelt frequency. It would give us a reduction in coremelt of 5 x 10 to the -7 coremelts per plant-year. And taking that times 143 plants with 28 years and the average release will result in a lifetime reduction in risk of 4,800 man-rems.

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We estimated the costs of this change to be 76 -- say 77 million dollars, 80 million dollars, roughly, of which the utility costs would be 68.2 and the NRC cost would be 8.7.

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The basis for that quantification is shown here.

We believe that the implementation costs, it would take about 1 person-month per plant to originally set up the paperwork requirements and establish a procedure and a method of implementing this, and it would take about 2 person-months per plant year to keep the program going, to establishing what upsets they would walk through and the necessary guidance.

And even with those two very low implementation costs, we see that it's going to be about $70 million over the lifetime of the plant to keep a program like this going. We estimated the NRC cost as being about 3 man-years for implementation and about 3 man-years to continue the cost for evaluating the effectiveness of this for the lifetime of the plant.

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This results in a value-impact score. For the total man-rem risk reduction was 4,800 and $76.9 million cost to produce a risk reduction or an S-score of 62 man-rem per million dollars.

Our conclusion was it was probably a low-priority item.

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Putting it on our matrix, as we did the other one, given the 4,800 man-rem and a value impact of roughly 80 man-rem per million dollars, would bring us into the low-priority basis also on our matrix.

And with that chart there, that concludes my discussion. Are there any other questions?

MR. SALVENDY: May I have some clarification, please? I am sorry, I missed the first few minutes of the chairman's comment after the break.

When you are talking here about prioritization of the genetic safety issues, is the purpose here to identify which components should NRC spend funds on? Is that the idea? In fact, what is the main rationale for the prioritization?

MR. PITTMAN: Your assumption is correct. It is trying to make the best judgment of where within NRC we should put our resources.

MR. SALVENDY: Good. I wonder if I may follow through then. Does it in effect mean whether you have a low priority or a high priority, it just means the probability associated with a safety problem, whether it is a low or high, the probability of a safety problem exists? If it's a high-priority item, I assume the cost of recovery is more effective and is more beneficial for you, but the probability of, in effect, the safety occurring. So by virtue that you prioritize, you mean there is a certain type of safety issues and hazards that you in effect allow and don't really address? You address certainly only *?

Even an item that has the lowest priority has a probability of being a real safety problem, but yet if it is getting a very low score, meaning that it's being ignored and not being addressed at all, I would have thought that basically all safety issues need to be addressed.

I have no quarrel about the approach for prioritization. I find it very impressive. It's very good. I am sorry that efforts went into prioritizing rather than reducing the safety problems, or rather increasing the safety problems in nuclear power plants independently of the probability of their occurring. Even if it's one in a billion, it's bound to occur.

MR. PITTMAN: You have got to look at it this way. There is a political situation involved here. Congress gives us so many dollars to work with, and is it better to dilute your efforts and try to do everything, or is it more beneficial to take and maximize your return and to apply it to those issues which have the greatest safety benefit and has the highest probability of getting a satisfactory solution?

And I think that's a management decision that we have to face and we have to deal with. And in trying to do the prioritization, it's a very small effort but it's a management tool in which we can say it appears to us in this prioritization that here are the items that we should address first and here are the items that we should address second, and let us admit that it's not cast in concrete, there can always be changes and there will always be review of this.

MR. SALVENDY: It doesn't mean currently that you could have a number of items which definitely can pose safety and health hazards to the people that NRC is not addressing, because from a cost-benefit point of view, it doesn't become a very effective item. And the order that a certain problem of health and safety exist, we in effect completely ignore it. It makes me feel very cold. I don't want to be in a nuclear power plant if that's the way things are working.

MR. MINNERS: Can I address that? I have a slightly facetious story that I use because I have heard this criticism before. You have to draw the line somewhere at what risk level you are going to cut things off. My facetious example is: We don't protect nuclear power plants against meteors. There is obviously a hazard there, but the probability is very low, so we don't do it.

So I think you have to admit in concept that where some events whose probability and consequences, i.e., its risk is low, that we don't look at. I don't think the public expects us to look at.

The question has always been with the Commission: How safe is safe enough? And our matrix defines what we think is safe enough. I think you have to recognize at least in concept there have to be cutoff points, and ours are displayed.

MR. SALVENDY: But your safety matrix is based on cost-effectiveness, and you may have a very high risk factor which may cost a lot of money potentially to rectify it and it wouldn't be a high-priority item for you.

MR. MINNERS: I don't think that's correct. One element of the matrix is cost benefit, but as the matrix shows -- why don't you put your matrix up -- the matrix shows that if you get above a certain risk level, we are going to try to resolve that problem in the matter of what we think the cost is.

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MR. PITTMAN: Yes. The two elements of the matrix. One element is what the value impact is. The risk reduction per unit dollar per million-dollar cost. The other axis is what is the total risk involvement for the public? So, you know, it's possible. We saw when we took all the issues, they likely would expect them to be through the normal population, but it would be possible, I suppose, that there could be high-risk items here but the cost of fixing them is tremendously great, and they might still fall out here in the high category.

MR. MINNERS: You are focusing on the correct question: Are those decision criteria which should be adopted? That's the real question. The methodology of how we manipulate the numbers is not very important. You can change that around and manipulate in different ways. You can't really be against the assessment of issues. The question is: Are these the proper decisions?

MR. SALVENDY: Maybe what would be very helpful to me, would you be good enough to give an example of what you would consider to be in the categories of medium risk which typically wouldn't fall into your priority? What would be examples of medium risk that you consider?

MR. MINNERS: Medium risk?

MR. SALVENDY: Medium priority. You have high, medium, and low priority. What would you consider a typical item in your calculation that would fall in the medium category?

MR. MINNERS: How about I.A.264?

MR. CATTON: Operator workshops. I.A.26.

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MR. SALVENDY: Could you maybe say a couple of words on this means?

MR. MINNERS: I'll try to do it from memory. I think the concept was we were going to get the operators together in sort of a seminar situation, like professionals do, discuss the problems, exchange information and just try to make themselves better operators through an information exchange. Everybody else meets at meetings to learn things, but operators don't.

The suggest was that maybe it would be a good idea. I guess the judgment was made. I'd have to go look at 0933 to see the details, but I guess somebody thought that was very effective in reducing risk. I can imagine the cost would be quite high if every plant had to send their operators to a seminar every month or however often it's going to be.

MR. SALVENDY: Take, for example, just this one. I realize this is only an example. How could it be assessed what would be the impact of this in reducing risks of such an exercise of what you call here operator workshop? How could we assess the impact of this?

MR. MINNERS: That's not done very well if done the way people are doing it now. People who are hopefully knowledge on the subject make a decision on whatever factors they think are important. We don't do it that much better; we probably do it worse than the people in the business.

However, what we do do I don't think has been done before early on in the process -- is to make an estimate of what it would cost to do it.

I think in many situations, that's pretty easy to do. I think operator workshops are pretty easy to cost out. You say I'm going to have so many a year I'm going to send operators to. That's easy to calculate, you make an accurate estimate.

Once again, I have a facetious example. If my cost comes out to $400 billion for some issue, that's got to be a pretty good issue before you're going to do anything. And vice versa. If that cost comes out at $200,000 for a reactor to an issue and you think there's any reasonable amount of risk improvement, you probably would do it. So this gets the extremes of the issues identified.

Yes, there's a large grey area in the middle where it's mostly good regulatory judgment, and I don't see any way to change this.

However, our process does, I think, display the basis for coming to that judgment, which I don't think has been done very well in the past, at least not early on in the process. You can argue with it. As I said, defining the issue is very important. There's something to look at saying hey, you guys, that's not the issue I'm talking about; I'm talking about a different issue. So I think the biggest benefit of th human factors types thing in the risk a:ea is at least to display what you thought happened for other people to criticize, and that's why the peer review process is so important, especially in a judgmental area like human factors.

I hope by giving it a wide availability that some guy who really knows something about the issue will send me a letter or call me up and say boy, you've got it all wrong.

MR. KEYSERLING: This may be a follow-up on your comment but the biggest problem I have with the entire methodology is the area of assuming certain risk reductions. If we go back to the two examples which were presented, we have one case where it was assumed that drills would reduce the probability of an accident by 2 percent, which almost immediately condemns that to being a low priority solution.

My question, where do these numbers of 2 percent come from other than "it's expert opinion"? Is it truly expert opinion? Is it something that's kind of pulled out of the air? And is there any rating on the quality or accuracy of these numbers that we're getting in the assumptions? Because those assumptions which are probably based on very little data ultimately determine what the priority score is.

MR. MINNERS: That's what the peer review process is supposed to do. The peer review process is a QA for people to look at it and say hey, this group of people didn't do it right. I don't know any other way to do it. We're trying to develop better methods. I don't have much optimism that we're going to be doing much different than we do now.

I think everybody recognizes that in the area of human factors it isn't so much methodology that's involved as, is there any good data. If you have the data, you can apply this method.

This numerology may seem excessive, but one of the things we have to do is compare the human factors issues, which are very judgmental and subjective, to hardware issues and allocating resources. So that's why we go through the numbers game, so we can make a comparison between the human factors issues and hardware issues and allocating resources.

MR. KEYSERLINC: I agree with you totally. I guess the thing that I get a little bit worried about is you end up with the single number of probability that a certain type of human factors issue, such as training, such as drills, is going to give you that percentage with no idea of what the variability might be on that number. And whenever you talk about variability, then you start talking convolutions and you start coming up with multi-dimensional tables which are very difficult to interpret.

At the same time, I think that this analysis technique of using average numbers and average assumptions can be misleading and perhaps can result in certain things being characterized as low and other things high. I hope the peer review process works on this.

MR. PITTMAN: I think you have a good point. But I think by and large, if you would take a look at the results on this big table, you may say that some of these -- some of the mediums might go to a high, but I doubt very seriously if you'd say any of the lows would go from a low to a high.

And I think on a programmatic basis of taking a look at this in total, you know, I think you're going to pretty well agree that maybe the distribution is about right; maybe some of the mediums should be in a higher category. But I don't think the bottom ones are going to come up that much or be that much different.

Like I say, you've always got to remember, this is a dynamic analysis. If we can get better data, if we can get a better reasoning that says hey, there's more improvement in this than what you have given credit for, we'll take a look at it again. This is a --

MR. MINNERS: In fact, I have a standard offer. I can't defend my numbers very well, and if you criticize them I'll say I hear you, but if you provide me with another number I will probably accept it, unless it was absolutely out of line. And I think when people look at it, if they have another number they feel responsible -- just the lower half -- that they have a better opinion than I do. We've had cases like that with comments on the issues. In almost all cases I can think of, we adopted the other person's number. We thought he knew more about the issue than we did. That's one thing, I hope, in the peer review process which I think is going to be optimistic for people to do.

MR. KEYSERLING: I guess I'm not condemning any numbers. I'm just questioning how good you feel about them.

MR. CATTON: Two percent is almost zero. Five would push it too high, based on their previous scale.

MR. MINNERS: The proper question to ask is not whether this is perfect or even a semi-perfect method, but, is it better than what we were doing before. That's the question. If somebody can think of a better method,we'll use that. At the moment, we think this is better than we used before, and it should be continued.

MR. WARD: Any other questions? Yes, Jim?

MR. BUCK: Once you get your high, medium and low priorities, is that a fixed allocation, then, as far as the NRC is concerned? In other words, once it gets labeled into one box or the other, do you give it a certain manpower reading as a function of that?

MR. MINNERS: Yes. At the moment, we have scheduled all of the high priority issues. You used the word NRC. We are only prioritizing stuff or allocating resources for NRR at the moment, so within NRR, if it's got a high priority, a schedule is assigned to it. And that's based on the position director and his management staff to decide how much he's going to put on it or how soon he's going to get it done.

There are general directions. If it's a high priority issue, another decade is too long, and it's probably impractical to get it done in a month. So you know, somewhere in between there, people have to have a reasonable schedule but there are no hard and fast guidelines as to how much or how fast you have to do it.

MR. BUCK: I suppose the reason I asked the question was to come back to the next question. Once you're putting them in boxes and allocating on the basis of boxes there, when you close that boundary line it makes quite a difference. Is there any sensitivity types of thought put into the process? What about variability? Your point estimates on that side were points on this matrix rather than, in some cases, big envelopes of grey area.

MR. MINNERS: We try to deal -- I can't think of an example, but in many of the issues we'll discuss that very point. Even if you change the numbers this much, it can still be a medium priority, or whatever it is. So that's discussed.

We started out doing uncertainty calculations with each issue. A mathematical combination of the errors of the different elements, and we decided that was just a lot of number bunching because they all came out with large uncertainties. So now we only explicitly address uncertainty in which it has a unique or significant effect on the issue. You always have to look at these and say yes, this is at least a factor of 10, probably a factor of 100, error. And we are really less certain about the uncertainties than we are about the points, so we have to keep that in mind.

But you still have to make decisions. You don't have enough resources to do -- we have 464 issues. That's more than one issue per man in NRR. So there has to be some allocation of resources.

MR. WARD: Anything else?

(No response.)

Okay, thank you. I think Mr. Jones is next.

That's Item C on the agenda.

MR. JONES: What I have are really a few brief comments. As you have seen, the TMI issues are pretty well prioritized and we're working on them. Out of this has come the human factors program plan, which you all have reviewed, as I remember, last fall. That plan has gone through a number of iterations. It has gone through a considerable amount of review internally and by the Commission and by this group.

Out of it, we have come up with -- we originally had 24 major task areas. We then took a look at those 24 areas. Many of them were very closely related to the TMI Action Plan, tried to relate them to the TMI Action Plan, take a look at the prioritization that had been developed by Warren and his group, and arranged that plan to attack those issues and related items that had come up as we went on in our development of the human factors program.

As a result of this, as a result of a recommendation of this committee, I have now been appointed Program Manager for the NRC's human factors program plan, and this is all developmental activities that are attempting to resolve the human factors issues that have come up.

Another action that has been taken to help resolve this was the appointment of an NRC Human Factors Review Group. This group, of which I am the Chairman, has representatives in each of the major offices within NRR. The group's function is to review the program, the program plan, to make sure that we're accomplishing things in a reasonable and sensible manner within the limits of the resources that are available to us to make sure that any contract or other activities that are done in support of the plan receive group approval, and if they're properly funded, if they're effectively and reasonably oriented.

And we literally approve contracts for all of the developmental and research activities that are related to the

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human factors program.

That's not all human factors activities. There are some technical support and safety technology issues that are not part of the program but certainly all of the developmental activities.

MR. WARD: So then, are those both, I guess, then, well, research contracts and technical assistance contracts?

MR. JONES: Yes, that's true. Then our developmental activities. In essense, that's all research, and the majority of the NRR contract.

There are also some other activities. AEOD, for example, now has a small human factors activity related to the analysis of LER. That's part of that program.

MR. REMICK: Dan, who appointed the review group?

MR. JONES: The review group was appointed by the EDO. It consists of nine members from, as I said, each of the major NRC offices. We have had two meetings up to now. A third one is coming up in June.

The plan itself is being revised based upon several things. First, the Commission direction that they appoint a project manager, and I've been stuckee, as I said; that we eliminate all long-range research plan from the plan, which we have done; that we review and prioritize the major tasks within the plan and recommend the top 10 or 12. We've done that and I'd like to explain that process in a moment.

MR. WARD: Could I ask for a clarification? You say you've eliminated all long-range research from the plan. Does that mean all long-range research has been eliminated?

MR. JONES: No, sir. What it means is this plan is a short-term, three-year plan. Those parts of the plan that are current, 1983, 84, 85, that involve research are in the plan. Those párts of the research program that go beyond FY85, next year, FY86, are not included in the plan.

If you may remember the original plan, we had a section called Research. Since that section is also included in the NRC's Long-Range Research Plan, it seemed duplicative to have it in two places. That's an administrative change.

MR. WARD: But the review group reviews and improves even the long-range research contracts.

MR. JONES: That's true.

MR. JONES: The Review Group has just been getting started. We had two meetings -- an organziational meeting; we had a program review meeting, in which we reviewed the program plan, made some comments, some suggestions, some revisions, and then went back and looked at the detailed changes we made that had been suggested by the group. And the new plan has just gone to the Commission. It went down the 10th of May. It will be published in what I hope is final form for 1983 early -- at the end of this month or early in June.

The significant changes that occurred in that plan were the elimination of the long-range research, the addition of a new program element, which we have chosen to call human reliability and about which Tom Ryan is going to talk a little bit more as we move into the third item that was scheduled since we think it's important and it's related to what we have done here.

We also prioritize the major task. We had that problem, how do you prioritize. So, we chose a method of paired comparisons, which is dear to the heart of psychologists. We asked each member of the Human Factors Review Group, each manager in the Human Factors Division from NRR, and each senior manager from Research involved with human factors to compare each one of the prime elements, plans, sub-elements, tasks, in other words, with each other's sub-tasks. That comparison was made, and a ranking developed out of this.

Interestingly enough, while there was some difference between managers' concepts of what was important and the Review Group's concepts, the overall priorities did not change. They were essentially the same, a very high correlation, in other words, between the NRC wide view of what's important and managers' views of what's important.

The top 10 or 12 items came out. One item dropped out because, essentially, we had pretty much completed that, and the need for including it in the plan seemed to be unimportant. So, we dropped that out.

We now have 23 items that have been prioritized. Each one of those 23 items will then be handed off to Warren and his group, where they'll do the value impact score that goes along with it.

Within each one of those 23 major sub-tasks, that are a group of sub-tasks, sub-sub-tasks if you will. Those particular sub-tasks are then ranked as high, medium, or low based upon the best estimate of the people that had to implement them.

And we will then -- and we're moving out in that area.

Now, another item that occurred -- another action that occurred last December was the action of Congress on the Waste Management Bill of 1982, which directed us, the NRC, to develop programs for training simulators and examinations and development of "all personnel," all operating and maintenance personnel in nuclear power plants.

That has resulted in an expeditious action to meet the response that we have to be back to Congress the first week in January next year.

That particular group of five includes the business of licensing of SROs or second SRO in the control room. And that action was taken by the Commission just recently, early in the month of May or late April. And the decision has been made.

The second was the use of simulators in training should we require plant-referenced or plant-specific simulators versus generic simulator. That action is underway at this time.

A third was the requirement for degree personnel or not in nuclear power plants as operators, a requirement for the development of a training rule, or what the NRC should regulate in the way of training and training requirements.

And the last item was licensing of others -- in other words, licensing of other personnel, such as maintenance personnel perhaps, or plant managers -- perhaps other than operators themselves -- which are always reactor operators and senior operators.

As a result of this particular action, these expedited schedules are underway, and we would hope to be able to come to this group sometime in June to discuss each of those five actions and the whole impact of Section 306 of the Waste Management.

Because of the requirement to get to Congress by the end of January -- by the first of January of 1984, we are taking parallel actions. We're asking the ACRS, we're asking the Staff Review with NRC, the Cougar Committee within NRC to do this thing in a parallel action so that we can meet our requirements to get back to the Commission and the Congress, too, expeditiously by the end of the end of the year, end of 1983.

That's where we stand.

MR. REMICK: Dan, do you remember what the Secy document number is for that plan that you said went down on 10 May?

MR. JONES: I'm very sorry. We can get it for you, but I don't remember what it was.

MR. REMICK: Okay.

MR. OVERBY: I believe it was 83133.

MR. JONES: That sounds right. I regret that I had to make a transition this morning, wasn't able to pick it up on my way down.

MR. WARD: So that is the current update of the program on '82?

MR. JONES: As a result of the 1984 budget and as a result of the actions on 306, we are even changing that now to move some schedules around to meet some objectives.

We also anticipate, as these major sub-tasks are prioritized by Warren and his group, we may make some additional changes in priorities raised or drawn.

MR. OVERBY: I would like to correct a mistake I made on this number. It's actually Secy 83179.

MR. JONES: Any other comments?

MR. WARD: I didn't quite follow the string there, where you are talking about the ranking of the 22 items in the revised plan.

MR. JONES: There's a mathematical technique --

MR. WARD: I understand that.

But I don't understand -- how does that square with the generic issues ranking that has been done?

MR. JONES: Surprisingly close. You must understand that some of these generic issues cut across two or three tasks. Others of the tasks we've chosen aren't listed in those generic issues, because the issues we came up with at a later time -- maintenance, for example, is not.

MR. WARD: So, there isn't 100 percent congruency between the 23 items in the Program Plan in this list of about 40-some items?

MR. JONES: That's correct.

MR. WARD: Does that bother you?

MR. JONES: No, it doesn't bother me, because we figure that the plan is a much better, much more reasonable approach to the problem than this 1978-1979 action.

However, I should say that everything that is high there -- high and medium there is at least high or medium in our ranking.

MR. WARD: That's the bottom line.

MR. JONES: But there are some minor differences -- plant drills, for example. Some of us think that's pretty important, yet this had a low priority score. That's a subjective estimate.

MR. WARD: You will use this generic issue ranking as input to help the management decisions about what ought to go into the Human Factors Program?

MR. JONES: We have done so and will continue to do so.

MR. WARD: Any other questions?

MR. REMICK: Yes. You mentioned you want to come back to the Subcommittee, I believe, in June on these five items, one of which is "Operator Qualifications and Degree Requirement."

Do you have any feeling whether we'll get a chance to see the documents before that meeting? Or is it going to be one of those we'll walk in, and we'll first learn where the staff is --

MR. JONES: I hope Mr. Fischer may be able to give you a little better idea on that when you talk about action.

MR. FISCHER: As I was told, we have some of those documents hopefully early in June so that the Committee or the Subcommittee might look at them in mid-June sometime and then have the Full Committee comment on these documents probably at the August Full Committee meeting, which would mean another Subcommittee meeting sometime in late July.

MR. WARD: We have to talk about the scheduling.

MR. JONES: We understand the schedule problem. We ask you please to understand our legal requirement to get back to Congress.

MR. PEARSON: Dan, did you want to divulge some of the other areas where you disagree with this point? Or are you waiting to hear from the ACRS consultants?

MR. JONES: I don't have anything more to say. I'll be glad to hear any comments you might have.

MR. PEARSON: Somewhere along the line, I'm just curious as to if there were major divergencies, what they were and see if they agree with at least some of mine. But you might want to wait on that.

MR. JONES: Beyond just our own rankings internally, we compared this prioritization with the generic issues. The correlation there was good. We compared this prioritization with the Human Factor Society's recommendations. Those things matched exactly, which doesn't surprise me, but nonetheless has happened.

Meanwhile, DOE was asked to evaluate the Research Program. And, in fact, this action is going on right now, and the DOE's evaluation of the NRC's Research Program matched exactly the prioritization that we developed internally. So, we think we're fairly consistent, recognizing that DOE did not go into the Human Factors Program Plan in detail. However, they used that Program Plan, because the research was included in it as a guide as to what they thought was important or not.

So, all of us, from an expert or a reasoned judgment approach, essentially correlate very closely.

MR. PEARSON: DOE is Department of Energy?

MR. JONES: Yes.

Any other comments?

MR. WARD: Anything else?

(No response.)

MR. WARD: Okay. Unless there are some other questions, what I would like to do now is to take our 15-minute study break. Let's come back at 11:30. And at that time, I would like to get to the point we have been trying to get to all morning -- that is, what do you, Committee members and consultants, think about this list?

So, of course, we would like the Staff people to stay, because I'm sure there will be some questions.

MR. MINNERS: Do we get a vote?

(Laughter.)

MR. WARD: No.

In particular, I would like to know if you have any challenges or disagreements with the rankings on this list.

So, let's come back at 11:30. We'll reconvene at 11:30.

end t.8

(Recess.)

MR. WARD: Now we come to the most important period of the morning so far, before we can go to lunch.

(Laughter.)

What we really need now are your comments on what you think about the priorities that the staff has assigned by means of this methodology. And if you need some clarifications, we'll ask questions of the staff to help you do that. We will do that now. We could go around the table or we could just let the most eager start. So let's take the second, and who is most eager?

MR. CATTON: I can start it off. I think that the approach they took to obtain the priorities is weak. Mainly, because there are a large number of studies of plant operations, and none of these, it seems to me, have been brought to bear. With the ranking that they've given here, I'm not so much concerned, but rather, with the ranking of the human factors against other categories.

In other words, it's a high for human factors -- considered as a high enough category. Clearly, money is associated with this relative ranking.

As far as studies, there's a whole series of studies of operations that was done by Oak Ridge. All of the SEP plants, which are nine, I would think somehow those plants and what they discovered would be brought to bear in putting a high or a low on these categories. Clearly, all of these things play a role in the plant operation.

Specifically, when you look down this list, I find this I.A. 2.4.6.5 "development of" -- I guess this is "of inspection procedures and program training" has an "(R)" which means resolved. And I don't know how they can resolve it when they really don't know what they're looking for. We discussed that a little bit earlier this morning. I would disagree with the (R) that they have on that.

There's another one down here, I.A. 3.2, which is operator licensing program changes. I think that's what that PROG means. Here, I think that the question of how you give exams is part of the operator licensing, and I don't think that's fully resolved as yet. They don't really know what they're going to do with the licensees or with the examinations. At least, that's what I gathered from some discussion this morning. So I think that (R) is premature.

The other section I'd like to comment on is the simulators. I notice now they have changed a couple of the (R)'s to (H)'s, which I think is a step in the right direction. There are two parts, though. There is the upgrading of simulator standards -- they have that as resolved. I'm not sure we know what the standards should be. I don't understand how that can be resolved.

The Reg Guide on training simulators was written when it was thought that within six months you would have simulators that would meet the requirements. As a matter of fact, there were even dates associated with when these standards had to be met, yet it shows it resolved. I think that maybe there ought to be another look at that Reg Guide in light of the work that's been going on at Brookhaven.

I see that the I.A. 4.2 on this new one, which is the review of simulators and performance criteria, have been reset for high, which is good. I think that's basically the only comments I have. The rest of these seems reasonable.

MR. WARD: Let's see, I think it might be useful, before we go on, if anybody in the staff has any response to the questions or comments that have been made. I don't mean you have to try to answer every one of those, but if there's some particular thing that stands out, go ahead.

MR. MINNERS: I think the question is maybe you don't have the latest write-up. But the write-up of each issue that is designated as resolved -- there has to be a reference in there of a piece of paper that is the resolution of that issue, which is either a revised Reg Guide, SRP, something like that.

Resolved is really based on our discussions with the assigned review branch. If they say it's resolved and give us a reference, we agree with it.

MR. CATTON: I understand what you did. It's just that I disagree and I think the question that was posed to us by our subcommittee chairman was, do you agree. I agreed with the high that was on it before. I don't agree with the re-prioritizing it to R. I don't think you can resolve that question as yet.

MR. WARD: That's probably something Mr.Jones has to answer rather than Mr. Minners, I would expect.

MR. CATTON: I believe Mr. Jones would agree with me. As with inspection procedures or program training, I believe you have to know what you're looking for before you can fully resolve it.

MR. JONES: There are two things. One is a resolution of the TMI issue which is essentially, as Warren just pointed out, almost a paper exercise. We have done something about that particular TMI item.

Beyond that is the development of additional information, further considerations of the issue, particularly in view of the human factors program by other activities. So while we might have resolved a specific TMI issue by putting out a piece of paper that says you must do thus and so, that doesn't mean that the issue is still there. On the contrary, the lack of training is an excellent example where we are working like mad to meet the requirements of 306, for instance.

MR. CATTON: I guess I'm confused. I think -- if some of these things on this chart are just paper I don't know why we have to be bothered with them. I thought the issue was a little more meaty than that.

MR. MINNERS: I think you characterize paper as trivial, and I don't think that's the case. The Commission's product is paper, and it can't be anything else. We don't run nuclear power plants, we don't train operators. All we can do is send out a piece of paper that tells people to do it, and I don't think you can just say well, this is just a paper exercise, it's meaningless. That's the Commission's work.

If you want a different system of regulation, okay.

MR. CATTON: That's not the point. The point is that part of what you're doing here in developing inspection procedures for program training -- somehow, you have to set criteria for good, bad, weak or strong. I don't know where that's been done, so I don't know how you can put an "R" on it.

MR. MINNERS: I'm trying to find the write-up in here.

MR. CATTON: This was also the part of the example that was given us earlier by Jim. I don't think we need to --

MR. FISCHER: 31827.

MR. MINNERS: May I just point out there is a memorandum which is referenced in here which makes the statement that this issue was resolved. I think you haveto go back and look at that memo to see whether your agree that that is the resolution.

MR. CATTON: Not having seen the memo, the only thing I know is the answer to the questions that I asked earlier. That's what leads me to the conclusion that the "R" is inappropriate. If there's a memo, that would convince me. Otherwise, I'd be glad to read it.

MR. MINNERS: It's referenced in the write-up. That can be gotten. We're talking about 400 references here, so it's obviously impossible to supply all of them. Individual ones can be provided.

MR. CATTON: I understand.

MR. MINNERS: I'd suggest that people try to look at the specifics and see whether they agree with them. We're really dependent on the assigned office or division or branch to state that that piece of paper resolves the issue. It's difficult for us to make an independent judgment, but we do insist that there be a piece of paper. We're just not going to have someone tell us hey, it's resolved, without showing us the piece of paper. That has been reviewed and approved that there's a resolution.

MR. OVERBY: Chuck Overby, Human Factors Branch. With respect to the two safety issues on simulators that you pointed out that were a change from resolved to high --

MR. CATTON: That's very good. That took a lot of the steam out of what I was going to say.

MR. OVERBY: Thank you for that accolade there, because we are the office that's responsible for having that changed because we are an ongoing research program, which again, you'll be hearing more about this afternoon.

We have the lead for those two items, and when I reviewed that earlier, we recommended that the status reflect the fact that those issues are still being worked. It may, in fact, be that we should have the lead for the operator training, or that when we get a chance to look at this more clearly with regard to the Division of Human Factors issues; that is, the responsibility for resolution in terms of whether it's coming out in NRR, Dan's shop or our shop, that that one may well be changed from R to high again.

MR. CATTON: Good.

MR. OVERBY: It's a possibility. I think it's helpful that you point that out. We need to go back and talk about that one again because I have a research program that should provide some criteria for assisting in training effectiveness evaluation.

MR. WARD: Let's see, the one particular item here, development of inspection procedures for programs -- whatever that's supposed to be. I guess that's the one you've been talking about with the high.

MR. CATTON: Whatever it is we've been talking about.

MR. OVERBY: Yes, develop inspection procedures for program training.

MR. WARD: It's that -- Mr.Jones, is there an item-- there are 23 items in the Human Factors Program Plan. Is there an item that covers that area?

MR. JONES: Yes, there is. And one of the outputs of that plan is, in fact, inspection procedures for licensee evaluations.

MR. WARD: Okay. I guess I'm puzzled by the "R" also. It's being treated as if it's an "H", apparently.

MR. JONES: You must understand that TMI Action Plan said you must do certain things within a certain period of time; certain things were done. Training was evaluated. There were inspection procedures for evaluating that training.

As a result of that, we decided that we needed a better and improved approach. When you add to that the congressional actions incurred last December, tie it all together in one package, then it obviously becomes a much bigger, much larger item than just responding to the TMI Action Plan.

MR. WARD: So, I see, it's not just paper in some ways. Certain items in the TMI Action Plan are looked on as quasi-legal requirements, and they might be just a narrow slice of a given issue. Although the narrow slice is resolved, the entire issue is still being worked on.

MR. CATTON: I think prior to TMI-II, they didn't inspect training programs at all. They just wanted to be sure that they existed. The fact that they do inspect them is a step in the right direction.

Now, the concern is really that they know what they're inspecting.

MR. MINNERS: This illustrates a problem that we have run across. It's a natural desire of engineers to want to continue the program and develop it and optimize it. However, the regulatory process needs to make decisions and say that -- licensees, that's all you have to do. These two things are at odds. Sometimes you get both answers, depending on what time of day you ask them. One time, it's resolved, the next time they're still working on it; it's high priority.

I think one of the functions of this priority list is to try to get that stuff straightened out and get a consensus, or a decision, anyway, that this thing is resolved and we're not going to do anymore work on it, or it is not yet resolved and we are going to do work on it. That's an important functional decision.

MR. CATTON: Some of us have been sort of involved with this since TMI, and drew some rather strong conclusions as a result of it. One of them was that the training programs were weak in certain respects. When you look at the training programs going on now, I don't really see that those weaknesses are being taken care of. Yet, there's a valid inspection procedure that says they're fine. Something is wrong. Somehow, we have missed the beat.

MR. JONES: In training, for example, let me point out prior to TMI there was an NRC requirement on training. It was like 40 hours reactor theory. That sort of a requirement, we believe, is not appropriate. Well, 40 hours of reactor theory might be necessary. That isn't a training program. So out of this came some improved inspection modules for the licensing inspectors to use. Even those that were done rather quickly with the best judgment of the people concerned.

We're now trying to develop a real honest, technical basis, and I would refer you to generic letter 82-33, the requirement that came out for SPDS. Out of this is a requirement that the function of task analysis and integrated training program, and those items are being checked as part of the action necessary to evaluate the SPDS and other emergency response facilities. They're in generic letter 82-33.

We would hope this procedure we're trying at this particular time will become standard for all of NRC-regulated training.

MR. MINNERS: If this issue or the issues like it could be resurrected, that's fine, and part of the process. But then they're going to have to be redone again, re-prioritized and run through one more time. It doesn't automatically go from resolved back to a high priority.

MR. WARD: It seems to me that this one -- and there's probably others -- is a problem with the definition. If I go back to one of your earlier charts, Mr. Minners, where you talked about the processes, first, identifying and then defining the issue -- and this is perhaps one where the definition given in the Three Mile Island Action Plan isn't as complete a definition as you now believe you need. So that the definition issues have been resolved, but the broader one isn't. And the broader one isn't really on the list here.

MR. MINNERS: I think you have to go back to the reference memorandum that says this was complete, and see why that office director thought it was complete. And you can certainly disagree with that, but I'm certainly in a position where I have to give more weight to the office director's opinion on whether an issue in his area of responsibility is complete, than to anybody else's.

MR. CATTON: Maybe if some of these things -- including me. In particular, me.

(Laughter.)

MR. MINNERS: The issuers may never have reviewed that thing, that's an internal matter, that's for NRC inspectors to look for in a program. There isn't a Reg Guide, there's nothing that's required of licensees, so the ACRS wouldn't give it a Reg Guide review. That's really an internal matter.

I'm not sure how much of that gets reviewed in the ACRS.

MR. REMICK: There's something about this I don't fully understand. What was the Action Plan item? Does anybody on the staff know exactly what that is? Was this just to give I&E inspectors, when they did review the training program, some kind of guidance on what to look for? They were doing this before Three Mile Island.

The Operator Licensing Branch was evaluating the pre-qualification program.

MR. CATTON: It was an audit function.

MR. REMICK: An audit function, right.

MR. MINNERS: There's a description that's too long to go through. It's too convoluted. As I said, one of our problems was defining what the issues were. We tried to write down what we thought the issue was, and weight it on that basis. And there are times when we may have put down the wrong descriptions, but we did get other people, especially the assig ned officers, to look at that, and they didn't point out any big differences. But that's a big problem. I agree with you. What is the issue.

MR. REMICK: So, you don't have a precise action plan to state what the issue was at that time?

MR. MINNERS: The trouble is, it's a five part issue.

MR. REMICK: All right. I'll read it later.

MR. WARD: Ivan, the other points you raised, are there any other particular --

MR. CATTON: Under operator licensing, there is always the question of examinations and how you give them. As far as I could tell, that wasn't really resolved either, what their content should be, what kind of requirements should the people who are giving the examinations meet, there are a whole number of questions that one poses as soon as you're going to do examinations as a test of qualifications. In my mind, that's not yet resolved.

MR. REMICK: That has nothing to do with this item, I don't think. This said an inspection procedure.

MR. CATTON: No, no. You're jumping. He asked me about the next one, uhm, down now under Licensing and Requalification of Operating Personnel, the first item; as Operator Licensing Program changes. It's indicated here that it's resolved. It's not clear to me that it's resolved. Maybe, again, what the requirement was, to meet the TMI list, is different than the whole picture. It may be just a small piece of it.

MR. JONES: Once again, that's another one of those things. Now I'm not on firm ground to tell you about this one. I believe the requirement was there was several things. One was to eliminate the possibility of change. It was a problem in TMI. Another was --

MR. CATTON: That came after the accident.

MR. JONES: It came as a result. Another was to require significantly less reactor theory data and more hands-on practical experience. Another was to raise the requirement of a passing grade from some arbitrary 70 to an 80. All of those things were taken out. The fact that we are continuing to improve the -- develop the examination and examination process came out of this item.

But to respond to the specific item, I think we have done that already. In other words, the specific TMI requirement. Warren, do you have a copy of that one there?

MR. MINNERS: Yes.

MR. CATTON: The statement you made, as to what it is, I would have to agree that you have responded you tried to stop cheating and there has been a shift away from the reactor physics to a little bit more thermal hydraulics and other things. The examination, that I can see, really hasn't changed a whole lot yet. They now put in a couple of questions that even I could answer, which makes me suspect the operator's qualifications.

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MR. MINNERS: This was reviewed by the Operator Licensing Branch and they agreed this issue was revised based on our write-up, which says the administration of examinations and issuance renewal of operating licensing to transfer to divisions or regions will have operator licensing authority. NRR will provide oversight and guidance.

Second accomplishment was the study of Staff of the Operating Licensing Program. Qualifications and training of examiners were completed in November 1980 and documented in NUREG CR1750.

Third element was a plan for reporting operator errors and correcting operator errors with respect to continuation of licensing, was developed in NUREG CR1750. However, after review of this recommended plan, Divison of Human Factors Safety concluded no further action was required. The conclusion is, therefore, this item was resolved. We passed that under Operator Licensing Branch's nose, they looked at it and said okay, we agree, it's resolved.

MR. CATTON: I would like to make a comment, and I'll stop on this examination business. I've talked to people in the class, particularly some of those who are responsible for the training. One of them was the operator of the SRO, who was on deck and one of the appeals he made to the NRC Licensing, whoever takes care of issuing that license, is that they make good exams. He said the exams are not any good and the reason that he makes this appeal is because one of the biggest steps in an operators life is getting that license. He gets a huge chunk of money and no matter what anybody tells him, no matter what anybody says, he studies to pass that exam. If you don't give the right exam, you're not going to get the right kind of -- you're not going to be insuring that the right kind of training is being given. I don't see that anywhere. I consider that part of it unresolved.

Now, if you have met the stated requirements for TMI, it just moves the concern somewhere else.

MR. MINNERS: That may be. I think there are two alternatives. You can either resurrect this issue and continue to include your concerns and others or you can say that this particular is resolved then, maybe there's a long term improvement in the operator licensing exams and identify that as a separate issue but once again, I think it is a paper exercise and it should be a paper exercise because that's what we're producing. If we're going to have further requirements for operator licensing examinations we need a piece of paper which says these are going to be the new requirements.

MR. CATTON: Wait a minute. If NRC is giving that examination that is not a paper exercise that's a real exercise. That's the heart of this whole business.

MR. MINNERS: But the paper exercise is the exam and what the exam is going to contain. Somebody has to sit down and decide what that exam is going to contain. That's a paper exercise. I agree, giving the exam is what actually improves safety, or bolting the more --

MR. CATTON: Maybe I ought to define what I mean by a paper exercise. I think when a form is handed around and all I do is check yes, no, or give it back, that's a paper exercise. I don't consider giving the examination a paper exercise, even if it's done on paper.

MR. MINNERS: That's implementation, not resolution.

MR. WARD: Let me ask Mr. Jones a question. Is the present Human Factors Program Plan addressing the issue of a quality and content of exams?

MR. JONES: It certainly is. I might add, the number one priority item by the Human Factors Review group and everybody else was "licensing examination". That was the top priority item. And while it is resolved as a TMI action issue, in that list of 23 items that we're giving Mr. Minners and company to prioritize and do his evaluation on, that's the number one item.

MR. CATTON: Good.

MR. MINNERS: There's some problems here because I would guess, but I don't know in this particular instance, that this was originally rated medium. Then, when we went out to the responsible people if they said okay, we're now going to

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track the resolution, here's the form, fill in the milestones. We were told there were no more milestones, it is resolved. Once again, a paper exercise. But the purpose of the paper exercise is to see, has anybody scheduled work on this item. Based on what I see here, we must have been told no, there's no more work, resolved.

MR. CATTON: Now I'm confused again.

MR. PITTMAN: I think the confusion comes as where does the Three Mile Island issue cease, stop, and where does it continue over into a new issue? What we're dealing with is we're identifiying an issue, that the work was identified under the Three Mile Island Program Plan has been completed and that's been resolved, but in the resolution of that it was further recognized that further things needed to be done and that was going to be coming out of Dr. Jones' plan for new issues.

MR. JONES: That's exactly the point.

MR. WARD: The whole procedure isn't completely rational, but then what is?

MR. CATTON: That is.

MR. WARD: Cal, speaking of not completely rational.

MR. LEWIS: I think he's referring to me. He's seen me before.

(Laughter.)

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Since Ivan has kindly consented to drop the examination issue, let me take it up --

MR. CATTON: I just got tried.

MR. LEWIS: -- because I truly do not understand. First of all, I think the comment was made that you have decided to give less reactor theory and more hands-on testing. That comment was made. Now, that has got to be based on an analysis of accident sequences and that leads one to believe that the operators are more likely to put a plant into jeopardy by things which are contained in hands-on operation than they are by lack of understanding of the plant.

As I read recent large accidents, precisely the opposite is the case. It's lack of understanding at the plant that has led us very far down the line rather than inability to manipulate the controls. I just wonder where the analysis is that has led to this, on the face of it, crazy decision which somebody has made. Has there been a new analysis?

MR. CATTON: I would certainly like to see it.

MR. WARD: Mr. Jones, that's yours.

MR. JONES: We are trying to develop this analysis now.

MR. LEWIS: The decision has been made already?

MR. JONES: The decision was made as a result of the review of a lot of operators, these operator workshops that came about and other things that the operators felt that they didn't need all this reactor theory and they spent hours writing --

MR. CATTON: Wait. Maybe you understood what I told you earlier. The reduction was not just of reactor theory. It was a reduction of all written, which includes the other pieces.

MR. LEWIS: I understand. I'm using reactor theories as a talkie for this. We'll get to thermal hydraulics in a minute.

MR. JONES: Unfortunately, you're talking to the wrong guy. I'm sorry, the individual who is probably much more knowledgeable about this isn't here. I'm a Johnny come lately at this particular issue, but there has been a reasonably attempt to try to determine just exactly what the skills and knowledge that is required of operators are. This is largely due to the task analysis conducted by a research group and by INFO and both of the data of those task analyses are being looked by our examination people now to determine just exactly what skills, knowledge, and capabilities are required and we're trying to base our examination upon this analysis.

This is a much more rational approach than deciding you ought to have 40 hours of reactor theory.

MR. LEWIS: Right. I'm just reacting negatively to having made the decision to reduce the theory before getting

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the results of the analysis. I'm also a little bit concerned about, whereas it's very important to consult and observe operators, very often operators are poor judges of how much they need to know because their job is spent in routine operation of the plant. But what you want them to do is to be able to respond correctly in the event of an excursion that is perhaps unfamiliar to them and experience in other areas usually indicates that people under stress need more education than they think they need when they are not under stress.

MR. JONES: I couldn't agree with you more.

MR. LEWIS: Then do something about it.

MR. REMICK: I don't think you are saying that they would reduce the amount of theory. As I understand, what you are saying is the amount of examination that would be written would be altered?

MR. JONES: Yes.

MR. REMICK: It has nothing to do with theory versus practical training operation --

MR. CATTON: Certainly it does.

MR. REMICK: I'm just trying to find out here because I haven't even heard of this before, but as I understood it what you said earlier if they had decided to reduce the amount of the written examination. So, to me, that doesn't tell me anything really.

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MR. JONES: I'm not really familiar with it. I'm sorry. I'm sort of walking along and guessing as I go and remembering what I've heard from other people.

MR. CATTON: I'm just making the next step. The next step is these guys are going to work hard to pass that exam. That requires a lot of thinking. They're going to learn to think. If it doesn't, they're not.

MR. LEWIS: And in particular, you will get people through the sieve who will not have been tested under ability to do that.

MR. REMICK: I'm not sure, and I've conducted these exams for a number of years, that an oral question doesn't require thinking. I don't know written, oral is good or bad, but oral questions can be very thought provoking. You can do things orally that you --

MR. LEWIS: He said hands-on. He didn't say oral questions on the same subjects.

MR. JONES: I'm sorry. I should have used the term "walk-through" and oral examination.

MR. LEWIS: That can be very subjective, as I guess Ivan said much earlier.

MR. CATTON: You've been through a number of PhD exams. You know what it's all about.

MR. LEWIS: I've been through so many.

MR. WARD: That doesn't matter.

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(Laughter.)

MR. WARD: Did you want to pursue that more?

MR. LEWIS: No. I have, like the Chinese dinner, I feel a little bit hungry still, but I won't pursue it.

MR. WARD: Let's proceed this way. Let's go around the table. Maybe we can structure this a little bit. Can you make some general observations that you want to make and then pause after each specific problem or comment you have and if we can get a brief Staff response to that, let's get it at that time and then go on to the next one.

MR. KEYSERLING: Okay. I think my observations are very general and they may not require any response whatsoever, but I am concerned by two things. Number one is the general emphasis of most of the items that we see on this plan having to do with modifying the operator as opposed to modifying the control room. When you talk about Human Factors, you talk about trying to design a job to be consistent with a person's capabilities and training and whatever. However, you're talking about job design as opposed to person modification. I think the training is important, but I think it's something that cannot be ignored. I think there are some very good points that have been raised.

But I find it disturbing that if you get down to the point 1-C and 1-D, which are only the two points that really deal with what Human Factors is all about, that all of

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these are given moderate priority scores. I think if you put the best person in a lousily designed work station you are going to have mistakes made.

So, that's my general comment.

MR. SALVENDY: You saved me to say what I wanted to say.

MR. MINNERS: I would like to respond to that because in order to deal with it I think we have more specificity on this. 1.D. 4 says control room design standards, which I think this addresses your question, we'd have to go back to read more to see what the issue is, but is the issue as defined or resolved in a competent way. Would that satisfy your concern? Should there be, I don't know, some other work being done?

MR. KEYSERLING: If they were resolved in a competent way I'd be happy. I just want to make sure that that has as good a chance of being resolved as anything else and have equal priority with the high things. I think as long as we have defects in our hardware design we're going to have mistakes and those defects need to be eliminated as soon as possible. So I would like to see high priority on all of the items regarding design.

MR. MINNERS: I would suggest that it would be helpful to me if you would go back and read the assessment for 1.D. 4, and I'm sure that someone could guess at how the human error rate would be changed. We'd have better design control if we came up with some numbers. If you could point out where you think we have used an erroneous estimate to come up with it, that would be useful. I think the purpose of this exercise, what we're doing is to say control design standards is a medium priority relative to long term upgrading of training and qualifications. That's what we're trying to accomplish. You seem to be saying I've looked at the program design standards, so, nothing better has ever been invented and that kind of thing, we ought to do it. I don't think you can look at those things in isolation. It's a comparative relative ranking. You have to say the program design standards would accomplish this much at so much cost, operator training would accomplish this much at that much cost. Which one is better to do? The judgment that was made in this assessment was the operator training was more important than program design standards.

Without having the specifics of why you think that's the case, it's very difficult to deal with it.

MR. WARD: I think that one Monroe is saying, he's concerned that the methodology may have systematically underrated the importance of the machine side of the man-machine interface.

MR. KEYSERLING: Yes. It's almost a philosophical point that you should be looking at Human Factors from the

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standpoint of designing the job as opposed to modifying the person and even the number of items that have been listed on this sheet here almost indicate a reversal of that philosophy and since there are so few things listed, I'd at least like to see them get high priority.

MR. MINNERS: Maybe it might be suggested --

MR. WARD: Could I ask a question? Is there some chance that the methodology has done that because the cost is very high for 1.C and 1.D items and relatively low for 1.A. items?

MR. MINNERS: That's quite possible.

MR. NERTNEY: Do you think it's the methodology or the analyst used? The point raised earlier was how many Human Factors professionals have been involved in the estimates. I think the methodology seems sound to me.

MR. MINNERS: I think so, too. We may have had bad guessers. Maybe I did it. If I did it, it wouldn't be right.

MR. NERTNEY: You get a lot of traditionalists, traditional operators and trainers and naturally going bias towards the traditional approach to the problem in this institution.

MR. MINNERS: This happens to agree with my opinion of control design standards. Maybe it was done by somebody with as little knowledge as I have, but this kind of appeal

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review process should get that identified and say, hey, you guessed wrong, it should be this. But we need more specific comments then just that. I think you have to go back and read what the issue is, what you think is going to result from that issue and then say, hey, it should include this, that, and these extra things.

MR. NERTNEY: A review is a good mechanism, but I think first time right is a stronger right, if you can get the Human Factors people up front

MR. MINNERS: I think we did the best job we could. In my rather uneducated opinion, I think we've got the right answer. I think that the man interface is probably acceptable plans. I have not seen any data which shows us a high error rate in operator control rooms. That's a relatively uneducated opinon, but if somebody who knows more than I do can say, here's all the things you can do and include things --

MR. CATTON: I think almost anybody who knew about TMI could give you four or five examples of what they could do with their control room that would make a significant change. Now, maybe all other control rooms are better and it only deserves a medium. That, to me, would be a reasonable justification but there are many control rooms out there that are like TMI, too. I have to agree with you.

MR. MINNERS: You may be right and I may be wrong,

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but somewhere along the line the decision has to be made, who was right and who was wrong and whether resources are going to be allocated to this or not allocated to this.

MR. WARD: We have to estimate what hazardous means.

MR. MINNERS: That's right. It has to be done by professionals. We've had this reviewed by professionals and they've agreed with this. I think the professionals in this area have to argue it out and come to agreement or somebody make a decision. That's the purpose of this, to show that there is obvious disagreement but the decision, as of now, has been made that this is only medium priority and some action will have to be taken to have a different priority.

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(Pause.)

MR. WARD: All the talk about the human factors issues seem to be related to what we sometimes called "mobology" at that time.

There was a lot of criticism of that and a lot of discussion about "Well, you've really got to look at personnel and organization, training and procedures." But when I look at the list to reflect on what Monroe said, not only are the mobology items relatively low priority, but they're very few in number.

It almost seems -- the impression I have is somehow in the last two years this has flipped -- and maybe it's flipped too far, I don't know.

MR. MINNERS: That's the purpose of writing these things down and trying to get descriptions, so people like you, from the outside, who are supposed to be giving advice, can see what the programs are and where the emphasis is being placed.

If it's being placed in the wrong place, I think you've been asked to give your comments.

MR. CATTON: Could I make a brief comment? I think you're continually asking us to go read all this reference material. That's fine. But I'm not sure that the ACRS would support me for the next six months, reading all the material to sort of catch up with why you made your decisions.

I really would like to hear a clean, concise statement as to why the decision was made, not being told to go -- I started writing down the ones that were referred to. I got to four or five and I gave up.

MR. MINNERS: I don't think we can help you out on that. Unfortunately, these decisions you've been given the references in 0933 were just supposed to be the things that provide the justification, the rationale for taking the action that was taken.

Absent reading that, there's no way that I can, out of my brain, remember all that stuff and give it to you concisely. We tried to write down, in 933, as precisely as we could, the rationale for it being resolved.

If you look on page 3-1, A3-1, it has a concise description, which I will admit is not very helpful because it's concise. In other words, you cannot give a concise description of these issues; you have to be deeply involved and know what the details are.

I don't know the details. I depend very strongly on the side opinions of the professionals in this area to analyze the details.

MR. CATTON: I happen to know some of the details as to why the TMI control room was considered a bad one. And based on that, I just can't imagine this being a medium.

MR. JONES: Once again, I wasn't involved in the analysis, so I can say anything and feel free.

My guess is, personally, as an old practicing human engineer of some experience, I believe the control room designs in almost every nuclear power plant I've been in are so poor as to be almost horrendous.

I had the personal experience of working in a nuclear power plant in 1966 for about a month, and I came back and wrote the most horrible trip report you could ever imagine about how bad that particular control room was.

In 1983, I walked into a control room, and there it was, staring me in the face, with no change over all those years. It wasn't the same control room, but it was essentially a similar layout.

Yes, I think we can certainly reduce the error, human error, and improve the performance of control rooms by proper engineer design, proper human engineering design of the control room.

But I suspect that the cost of doing this over the values, where the improvement in man-rem was small enough and the cost high enough, it could have dropped down as a medium issue. I'm almost certain that's the case.

(Pause.)

MR. PEARSON: Could I interject a comment here? I was going to make this later, but I think it's appropriate.

Listening to all of this -- and Monroe used the word "philosphy" a while back -- to me, there is perhaps a conceptual difference between looking at engineering system components and human system components.

Perhaps if we looked at all the generic issues involved here and look at the engineering ones, you can probably break those down into systems, engineering systems, that can be looked at and examined and probabilities high -- and so forth and so on.

Conceptually, I find that a much easier task to do as an engineer.

Now, if I put on my other hat and become a psychologist and look at the human systems and the items that are on this generic list, I don't find it as easy to break them down into distinct components.

My point is that I think, in this whole discussion, we are failing to look at the interrelationships, the interaction among all the elements that involve the human aspects of the system.

We talk about selection, training procedures, the role of management and so foth and so on, the importance of the control room design. And I find it difficult to, you know, break these out and say, "Hey, this is really important. This is moderately important. This has low importance." I have to agree with Monroe, the control room is an important thing.

I think the problem, as I see it from a utilities' viewpoint -- and I don't perhaps have as much experiences as some people -- but the utilities that I have interacted with, the consulting firms, and so forth and so on, some of the vendors that I've worked with are dominated by what I would call the hard sciences, the engineers and the physicists, and sometimes chemists. They don't have much in the way of the soft sciences, the psychologists -- put the human factors engineers in that category, if you will.

And as a result, because of this absence or recognition of the soft sciences in the utilities, in the vendors, and perhaps within NRC, historically speaking, I think the human factors area, including the personnel side of the picture, the human resources side, if you will, gets the short end of the stick because of the fact that the hard scientists don't grasp this issue of the complex interaction of all the ingredients that make up the human side of the picture.

And, you know, I just can't -- I just have this problem with categorizing these things without talking about the interrelationships among them -- you know, we'll solve this problem this year, and we'll put this other one on the back burner for next year or two years from now or three years from now. It seems to me that all these things have to kind of flow along together. If you are going to redesign the control room, this has implications of the simulator, has implications of training for the rewriting of procedures and perhaps even the selection of operators. So, they are interrelated and can't be considered in a vacuum.

MR. MINNERS: But you do have to make a decision of whether you are or are not going to write new control and designs -- that's a guilty/not guilty decision. You're either going to write them or not going to write them, and that's the purpose of this exercise.

You are suggesting that you're going to write them, which says to me that you weight that equally with operator training, and it should have a high priority. That may be the proper opinion.

But I think I hear a little hint in your discussion that we have to work on everything. That cannot be done.

MR. PEARSON: I think what I'm saying is that I believe more of these items in the human factors area need to be rated with an H, versus the engineering side of the house.

MR. MINNERS: On design standards, our write-up says --

MR. PEARSON: Did you want me to repeat that last sentence? I thought it was an important observation.

MR. PITTMAN: I think an important observation is also to look how many issues really rated an H. And I think if you look through all of 933, there's very few -- number of issues that are real drivers that we have rated H. A majority of them are the medium-priority issues. And I think the human factors has been recognized as being an important issue.

MR. PEARSON: I think it's the most important issue, sir.

MR. MINNERS: Our rating scheme would say that's not true.

MR. PEARSON: I would disagree.

MR. MINNERS: That's right. I think when you read our analyses you will see why we came to the ratings. We think the facts are different, and what we ought to discuss is the right set of facts.

MR. CATTON: Could I comment on the facts? I dug up the analysis that led to this medium, and they show here 30 miles of cable, electric penetrations, cable transitional termination, intermediate logic panel, control alarms, and all sorts of things.

To me, going back to TMI-2 again, all they needed was a good process computer and a couple of those sets of instruments that they were using in a multiple way and move a few of the dials and they would have had a significant improvement. No way in hell is that $650,000.

MR. MINNERS: Then, the issue would not be control room design standards?

MR. CATTON: That's control room design standards. You issue design standards, "Thou shall not use the instruments three times to get 72 measurements out of a 24-measurement instrument. That, to me, is a design standard.

MR. MINNERS: You would already be prescriptive, saying, "Have a good process computer."

MR. CATTON: That's one thing. Process computer is only a part of it.

I would also state, "Thou shall not locate important instruments out of sight."

I just don't agree with this.

MR. MINNERS: Do you think the cost estimate is too high?

MR. CATTON: Too high --

MR. WARD: Yes. I think -- let's go ahead.

Monroe, were you finished?

MR. KEYSERLING: I want to say just one other thing. In the estimation --

MR. WARD: Is it going to be that big?

MR. KEYSERLING: I hope it doesn't create a reaction this big. But in terms of overall costs, I'm not sure that dollar cost savings was included in your estimates.

For example, if you have good control room design, you may be able to cut back on your training. You may not even need simulators, because if you have a good -- a well-designed work station, you may not need to spend as much time practicing in a poorly designed work station.

Was that cost savings at all?

MR. MINNERS: I don't think so in this issue, but it's our intent to do that. That just means we don't do all the issues. They are time-consuming; I'll readily admit that. The intent is to try to consider all of the significant factors -- if you can save money one way by doing this, that ought to be considered. And those are the kinds of things that should be pointed out in the assessment of the issues, that you forget the $10 million you're going to save in training or whatever.

MR. WARD: Gabe.

MR. SALVENDY: I think much of what I wanted to say has been said, but let me just kind of pick up a couple of the issues.

In effect -- I marked the notion I'm looking -- we want to increase, here, safety. To do that, the good human factors approach would suggest, first, what you do is you have a saver -- you have a design, a physical design of the work environment with which the human can effectively interact. Once I have that, then I must be sure I have a good methodology to select people and train people.

Now, the selection and training, I think, is very important. I think it has been downgraded by some. I think if you don't have the proper selection and training, you may have the best design room and operators will make errors.

What I am arguing for is that the variables associated with the control room design are as important as the selection and training.

I want to indicate there is overwhelming -- underline "overwhelming" -- amount of human factors data which indicate that poorly designed control rooms contribute to error, even in the most conventional aerospace area. Even for pilots -- designs contribute to error. In a chemical plant, poor control rooms contribute to error. A lot of human factors data, an overwhelming amount.

So, we know if you design it correctly, select the right person to be trained and can train them properly, you will have a safe design. If you select people properly and you train them properly and you put them into a situation which is such that it is inducive to creating errors, even the best-trained people will create errors. So, I'm arguing these should be increased to high.

Now, realizing the judgment here is a professional judgment, there is no objective way to assess, either for me or for the people that help you to assess, which one is more important, because thereis no way to quantify the effects exactly. But I think what we are doing is the same thing as you have done, use best professional judgment.

My best professional judgment is that the control room design variables are as important as selection and training. And degrading them to a medium one I think won't do.

MR. MINNERS: I would like to have these things to be a consensus of the best professional judgment. We've had some people review them, and to that point, this is their consensus. We're going to get another set of people, fine; I approve of that. Maybe we'll come to a different consensus.

MR. SALVENDY: I think the reason we're here, if I understand correctly, is to get another professional view. I think what we are expressing here is another professional view which disagrees with the professional view that you have received.

MR. MINNERS: There are two factors to look at. I think the professional view on the human factors is the proper way to do it. But the other side of the equation is the cost numbers. I think you ought to address yourself to those.

I have found, when I deal with the ACRS subcommittees, they tell me my costs are all overestimates, terrible, couldn't cost that much, no, no.

When I bring those same estimates out and have them reviewed by industry, they tell me "Oh, boy, have you overestimated. You're terrible. You're no good."

So, what is the right answer? I don't know. I try to make the best guess. But I think cost is an important factor.

And somebody on these issues says, "Hey, if you redesign control boards, you're going to have to move wires around." They came up with a cost estimate. If people think that cost estimate is wrong, they ought to say what they think the right cost estimate is. We'll factor it into the issue and reevaluate it.

MR. WARD: I have some advice. Ignore any cost estimates you get in this room.

(Laughter.)

MR. SALVENDY: I wonder if I may just go one step further? There are two issues:

One, what would it take the cost estimate to modify an existing system? But aren't you looking to plants and facilities that are being built, where you don't need to modify? Is it outside the jurisdictio of your area?

MR. MINNER: In this particular issue that's addressed, it says it was assumed only plants to be licensed beyond 1986 would be affected by this Cohen control room statement.

I told you his assumption. It sounds like a reasonable one to me.

MR. SALVENDY: Only those beyond --

MR. MINNERS: 1986.

You can go to the scheduling books --

MR. SALVENDY: What it means, this will have an impact on plants that will be built in the future.

MR. MINNERS: That was the assumption that was made.

MR. SALVENDY: If that's the case, there's no cost involved in building a control room correctly the first time.

MR. WARD: Wait a minute, a plant that's licensed in 1986 is already designed and almost built.

MR. SALVENDY: Past 1986, he mentioned.

MR. WARD: I didn't understand Warren's answer to your question.

MR. MINNERS: It was assumed only plants to be licensed beyond 1986 would be affected. I assume an operating license is what they're talking about.

All the operating licenses are all designed and most of them are half-built.

MR. SALVENDY: Couldn't it be, beyond '86, there'd be a situation that a plant may be built in 1995 and it hasn't been designed yet, and you may provide, here, guidelines for them, how they should be designed safely? Because beyond '86, the year 2000 is also beyond, and those, of course, haven't been designed yet.

MR. MINNERS: We have consciously derated the ranking of issues that would apply to new CPs in 1990 and the year 2000. That's too far in the future. We don't think the NRC should be directing their efforts to completely new designs at the expense of taking care of the present plants.

MR. SALVENDY: Then I have a problem, because if you take that approach, modifying control rooms always becomes expensive. If once you don't make the decision that you want to build correct control rooms, you'll have a vicious circle you never will modify, because it will always become too expensive to modify and they always will fall at the bottom of your priority.

MR. MINNERS: It's not at the bottom. It's on the medium. It's an issue to be worked at, and the time scale is 1990. So, we're okay.

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MR. SALVENDY: Not to me.

MR. WARD: I think the realities of today are that NRC isn't concerning itself with regulations for future plants. When the situation changes, I'm sure the NRC will respond. I mean, you can understand that --

MR. MINNERS: If Mr. Freeman has his way, there will be gas-cooled plants, so the design may not apply.

MR. SALVENDY: This is a very important issue because if you always address the issue --

MR. WARD: You have to look at the reality. We have a multi-billion dollar industry which the NRC is trying to regulate, and most of these concerns involve backfitting not -- nobody's building any. There aren't any construction permit applications. Zero.

So it's kind of a problem, an important one, but kind of theoretical at the present time.

MR. SALVENDY: You mean nobody applied for building nuclear power plants that are in the design change? There are none in the U.S.?

MR. WARD: That's right.

MR. SALVENDY: I find that quite astonishing. None?

MR. MINNERS: Some of the vendors are working on the standard design, yes, but no utility has signed up to buy them.

MR. SALVENDY: That's amazing.

MR. MINNERS: Maybe I'm beating a dead horse, but

I find this discussion very useful because I think it's illustrating to you the issues that I think are clearly defined in the write-ups. This particular issue of are there new plants or aren't there new plants, that has a great effect on whether we should do this. You had the opinion there were going to be new plants. I think you have the wrong set of facts.

So I think what we're doing is discussing what are the facts. Once you get what the facts are, all you have to do is plug that into the formula, and that gives you very good guidance of where this is going to drop out.

MR. SALVENDY: What happens if somebody tomorrow applies for a new plant? They will follow the old, incorrect regulations, they will build a plant from a design using out-dated control rooms?

MR. MINNERS: I don't think the Commission has a requirement out that requires you to design a bad control room. I think the vendors and utilities are competent people. If they need advice on how to design control rooms, I would hope they would go out and get it. You're suggesting that everything has to be controlled by requirements.

MR. SALVENDY: They haven't done it in the past. They could have gotten it, and the fact was that they were built incompetently.

MR. MINNERS: They're making a money decision so it's hard to say whether they're right or wrong.

MR. WARD: Let's go on. Gabe, did you have any other comments?

MR. SALVENDY: No, thank you.

MR. WARD: Tony?

MR. DEBONS: Perhaps my comments ought to come after Ken Perkins talks tonight -- this afternoon, rather.

(Laughter.)

MR. MINNERS: I think you were right the first time.

MR. DEBONS: I'm trying to make sense of this, and the only way I can make sense of this is to bring it within the focus of my own concept of what I think is the most important in the nuclear plant situation.

My view is not machinery, not human factors, but data flow, because data flow is the crucial factor that governs all information systems. And when you come down to look at safety, safety depends upon the adequate data that you're getting through to be able to act on. So that's a crucial bottom line.

We cannot design an information system to guide us in this particular environment. All of the other things are subsets. That's my immediate -- .

Let me just make a quick statement to support Dr. Pearson's comment. No machine has ever created information; man does. So consequently, if you don't put the human in front of the data processing aspect, you certainly will run into trouble. Let me just give you an idea of what I'm talking about in terms of information systems, and I rely chiefly on my experience in command and control, inasmuch as command and control systems are essentially the kind -- have objectives very similar to what we have right here in terms of this environment.

The thing that keeps a command and control system and information system alive is its transmission capability. And when you look at command and control systems and information system failures in the past, they have classically been transmission problems. That is, the inability of people to convey data from one source to another, which creates a poor response.

Nowhere do I see that emphasized as a high priority item. I could bring to bear to the situation at least 10 or 15 articles that have addressed the nuclear problem in which they stress the transmission problem within the context of management. That is that there were hints in the management structure which permitted, encouraged the aborting of data crucial to safety and decision making. Much of the problems we're having right here in judging whether a thing is right or wrong is based on an inability to see what an information system is structured on and how it should operate and where the failures are in its operation.

For example, in a command and control system, the most important aspect in a control system is the ability first to accurately cite and describe the event. Second, the ability of a census system to pick those critical aspects up from the event which are crucial to the processing function. The ability of the processing function, through its language structure, that is, the computer, to be particularly sensitive to the kinds of demands that are going to be made on the program through the decision makers. And finally, the ability of the system to provide the language which is comparable to the nature of the event and its ability to act upon that event.

All these factors are very crucial in an information system inorder to be able to insure safety. So what I'm really saying -- my major argument is that I could put all of these particular issues within a very circumscribed aspect of an information system and lease out three or four of the other major components, primarily, the transmission system, which is sc crucial to the safety factor.

End of statement.

MR. PEARSON: Here, here.

MR. DEBONS: Now, how do we deal with the transmission factors? All of the reports that I have read suggest --

MR. WARD: Which of these issues touch on the transmission problem?

MR. DEBONS: They're clouded. They're buried into all sorts of things -- operator process communications. There are not very many, but they are buried in there.

MR. BUCK: I.D. 5.3. is a good example.

MR. CATTON: And for process monitoring equipment.

MR. DEBONS: Which, it's obvious to me, is the most crucial. If you don't get the data transmitted, what are you going to do? If there's no data flow from your event to your control system, where is your safety? There's ample evidence of that.

Every war that has ever been created since Alexander the Great has been a transmission problem.

MR. BUCK: What happened before Alexander the Great?

MR. DEBONS: Transmission problem.

(Laughter.)

Even the Indians had transmission problems with their smoke. And the next mistake I probably can project will be a tranmission problem. Somebody didn't say, or somebody didn't do what they were supposed to have done. What research are we doing about that?

MR. WARD: Didn't do -- is that a transmission problem?

MR. DEBONS: That's a utilization problem actually -- well, it's a tranmission problem if you, in fact, do not communicate the data.

MR. SALVENDY: If you didn't do it because you didn't get the information.

MR. WARD: You said didn't say or didn't do.

MR. MINNERS: You're obviously an expert in transmission problems in industrial systems. I like to think I'm somewhat of an expert on information transmission from a regulatory agency to a regulator. That is an extremely difficult process.

Once again, maybe I'm beating it into the ground, but all the Commission can do basically is write a piece of paper and send it to the licensee. That's our information transmission mechanism. Not much more than that. And to buy that mechanism, we somehow have to control safety. That's the point here.

What do we do on these particular issues to produce the piece of paper that we send to the licensees?

MR. DEBONS: If I may say so, sir, you cannot do anything unless you have a conceptual framework of a system that you're dealing with. If this is an information system, you have to know what the components of that system are. And your judgments are going to be based upon the effectiveness of the components of that system.

In other words, if this was presented to me by some people in my university I'd say well, what is the conceptual structure of this.

MR. MINNERS: There is none.

MR. DEBONS: Then you can't make any judgments; you can't make any decisions if there are no conceptual structures.

MR. MINNERS: This is just constructed from the Action Plan, which was a bunch of rather uneducated people in human factors who put down some ideas. I think it's proper and prudent, three or four years later, to sit down and develop a human factors program plan which takes a philosophical conceptual approach such as you suggest and then do it.

But after you have done the concept of the philosophy you must break it down into individual issues and work products that somebody can work on. Then you must prioritize those individual items. I agree you won't have a conceptual base. I think the human factors program plan is supposed to do that.

MR. WARD: I think that's a good point. Tony, anything else?

MR. DEBONS: One quick question. What's the major thesis or theme of information management system? That's Mr. Perkins this afternoon. What is he going to talk about?

MR. WARD: We'll get that this afternoon.

MR. DEBONS: It seems to me the answer to the statement that was made rests on that.

MR. WARD: Okay, why don't we get to that this afternoon? Jim Buck?

MR. BUCK: First observation is there's damn few soapboxes left for me to stand on.

(Laughter.)

MR. WARD: Everybody else has found one.

MR. BUCK: That's right. As I look inside the categories, I don't necessarily disagree with the rankings within. I have some gut feelings for the rankings between.

Much has been talked about. The technology that was described here this morning seems to at least come up with one of three categories for each thing. I'm just a little bit concerned that when we deal with these in isolation, that we're not really confusing some issues here.

The one issue, for example, I.D.5.3, on-line surveillance, our surveillance system would be useless unless we got good training because in order to find out what's wrong with the system they've got to understand the thermodynamics and other aspects of it.

So as a first cut, it seems to me to be a reasonable approach to get started. But I still think you'll need far more judgment than just whether it's an R, M, H or whatever, and, of course, I'm not so sure resolved means resolved. That's what's bothering me.

MR. WARD: So you're saying one item on here might be an H or, say, an M if another item is an H.

MR. BUCK: That's right.

MR. WARD: But if they are both Ms or Ls, we're in trouble.

MR.BUCK: That's what I'm saying.

MR. WARD: Okay. Bob?

MR. NERTNEY: I'm agreeing, in principle, with all the things that the people on my right said. But it seems to me, eventually these people's problem has to boil down to acceptance and faith, or are we going to have to reduce our arguments down to the criteria that appear in the scaling matrices; namely, probability, consequence and cost.

So I guess really, I would have to ask if there were people involved in creating these numbers, that we are really including this type of consideration. That's the thing that I'm worried about. The challenge appears to be on the probabilistic basis.

And I have a feeling, my own intuitive feeling, not being able to work the numbers out in detail myself, that there probably was a little bit too much of the traditional approach here. We're really not "thinking modern."

The other thing that I felt also, was this business of isolating the item numbers here out of context. For example, I find out that drill comes out very low. The function of drills, to me I see it over and over again in accident investigation where we say train them, and then we check back and find out we're training them to do the same thing they did before. So really, the training -- the drills are serving two functions. One is keeping the training fresh, which may mean it will appear over in retraining programs but I'd have to be sure.

The other is in the sad state of the front end of our systems in terms of simulator fidelity,validity of training programs, all the things that have been challenged here. It really seems to me if we're going to rate those front end items high, at least during the interim period I would think that drills, actually working in the plant in context, would have a higher rating than low. In fact, that was the one that grated most on me, that that was a relatively low rating, and the probability numbers that went with that would probably fit a much better frontend on the system than we really have in terms of simulator fidelity and training.

The other thing is the interaction of the management system, and I would challenge some of the probabilistic numbers by an exercise we did on actual nuclear reactors. They were DOE-owned reactors. We were using monitoring of both operator errors as an index, and that was stated earlier as an index up here. We were running 300 to 330 per operator cycle, and we changed them so we didn't get balloon squeezing effects. If you squeeze on one type of error it will pop up in another. It was structured to avoid that.

We put in soft feedback, which was monitoring the errors, feeding them back to the shifts without a lot of table-pounding. That went down an order of magnitude. 300 to 30, no changes in training, no changes in hardware. Just managed and feedback.

Then we had some serious incidents in the plants. We got a lot of table-pounding on the part of management. Our monitors could hardly find errors. They were down another order of magnitude, on the order of 3.

What I would ask, then, is given that kind of contexst, the feedback loops on our gross informational basis, what plant are they talking about when they say they will reduce errors by a factor of 28 percent, if any? See, we're talking two orders of magnitude there, which again says I would really want to be sure that we have professional human factors people that see what these probabilistics statements -- that they see them in the broad context and really get the right variability on them. And really base them properly.

So I guess those would be my comments. I'm not in a position of really being intimately challenging individual probabilities, but it appears to me, and I think we all agree, that somehow the probability numbers we force into these things, along with the costs, have apparently distorted the systems, in our subjective judgment, professional judgment, when we get up to this top level here.

MR. MINNERS: I think the human factors issues have done comparatively well. There's only one here that's listed as a low priority, which is a throw-away. The rest are high and medium.

If you go through the hardware issues, you'll find a much higher frequency of throw-away issues. So people here seem to be saying that medium is a D. I think medium is more like a B. So I think getting a medium doesn't mean death; it just means you're going to get more attention.

MR. NERTNEY: That's true. It does make the input suspect. I don't think anybody here is prepared to challenge the probabilities of cost, but they are suspect in terms of the overall judgment of what needs to be done to upgrade the system.

They may turn out to be right, because we may exaggerate in our own minds the effects of hardware.

MR. MINNERS: I think this says human factors as a whole concept is getting a higher priority rating than hardware issues, which I think everybody thinks is the proper way to do it.

MR. NERTNEY: Yes, indeed, I would certainly agree with that, personally.

MR. WARD: Thank you, Bob. Dick?

MR. PEARSON: Yes. I've got some quibbles with a couple of ratings but I have some initial comments. I wasn't clear, Mr. Minners. You said something before about in this process you did not consult with the human factors people?

MR. MINNERS: We did consult with the human factors people. The people who wrote up the issue, if they were PNL, we did it by telephone. Or if we did it, we'd walk down and talk to the involved people and try to get a draft that was pretty much right.

After we had a draft, we circulated the draft around to the responsible branch and had them review that and make comments We incorporated all of their comments, or if we had a disagreement we specifically highlighted the disagreement. I don't think that's the case in any human factors issues.

So this is done through staff review of the most expert people that we have on the staff. Obviously, we're doing another step, as were reviewed by the human factors people.

MR. PEARSON: I was going to make an observation. You made some facetious comments a little earlier; I guess I will make one. And that is if you ask a Catholic what they thought of birth control, I'm sure you could predict what kind of answer you'd get. If you asked a poor person or a rich person what their attitude towards abortion would be, you probably could predict what kinds of answers you might get And I'm wondering here if there aren't a couple of factors involved in this whole exercise, one beginning with the Pacific Northwest Laboratory. Since we don't know who has made up that team, whether there were any human factors industrial psychologist types within that group. I wonder whether we got the right answers. That's point number one.

Point number two, which is a lead-in to my first criticism of the generic ratings, relates to the tendency for organizations to perpetuate themselves, and having been a government employee, I'm aware that government agencies like to perpetuate their jobs. People work like the devil to retain their own jobs and drum up things for the future.

I don't know whether you want to have this on the record or not, Mr. Chairman. You can rule one way or the other. But I wonder if there is, in fact, tendency --

MR. WARD: By all mean, go ahead.

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MR. PEARSON: I wonder if there is not that tendency within the Nuclear Regulatory Commission to generate things to keep their jobs going at the expense, say, of a new group in human factors which is struggling to gain visibility and do its job, that we happen to think is a very important job that needs to be done.

Anyway, this is a lead-in to my problem that I have with the utilities, that again my experience with the utilities, with the vendors, is, as I said earlier, they are dominated by physicists and engineers, physical scientists and what have you, and they have been very slow to accept human factors.

Some of the utilities are using consulting firms. I am very familiar with the human factors consulting firms around the country. I know who they have on board, and I know who they are trying to hire or have hired recently. Many of these people are unqualified to do the job for the utilities.

There are a few good consulting firms, and there are a few good people around. But some of the people that I have seen and some that have been hired are really terrible to do an adequate job for the utilities.

One utility in my own backyard has hired as their human factors specialist a B.S. psychology graduate who has no training whatsoever in industrial psychology or human factors. In fact, she didn't even have a 3.0 grade-point average. But she is working.

MR. CATTON: Probably anti-technology.

MR. PEARSON: As the human factors specialist for this utility.

Now, where this leads is my criticism of I.B.1.1, which is entitled "Organization and Management of Long-Term Improvements." I am really not sure what all that means, even having read the document, whether it includes what I am concerned with.

And what I am concerned with is the structure of management in the utilities and their philosophy of operation as it embraces the soft side of the house. The human factors people and the industrial psychologists, the people responsible for training, where do these people fit in, how much authority do they have, have they hired the right people to do the job.

My experience is that when you look and talk to some of the utilities and what they're doing in the training area, they know precious little about what they are doing in training in terms of whether it's paying off; namely, what is the relationship between their selection criteria, the grades they get on their exams, their instructor ratings, their on-the-job performance ratings, whether there are any correlations among these things.

Whether you want to do a multiple-regression analysis or what have you, you even mention the word to them, they don't know what the hell you're talking about. In short, they don't have any qualified personnel in this area to evaluate it. And that's because of the trouble that exists at top management in the utilties. They don't know who to hire and what job to give them. The need some people at the top in training that know what the hell they're doing.

I think, is it NUREG-835 that talked about the organization management structure we have looked at a year or a year and a half ago? But I think we need to go beyond that, and whatever isn't contained in I.B.1.1., I think we need to go beyond that. I think this pervades the whole issue.

If you don't have the right people working in there that have some authority, your bringing in a simulator, what the hell are you going to do with it? Who is going to run the training program, engineers who know something about nuclear engineering or some training specialist that knows something about training methodology and psychometrics? If it's the former, then gee whiz, I think we're going the wrong way. If it's the latter, fine. I think that should come out of this kind of exercise. I think that should be upgraded from medium to high.

The second one is a follow-on to Tony Debons' comments about information flow, and that's I.D.5.5, which deals with, I guess you would call it, disturbance analysis surveillance system.

Again, in my estimation, call it expert judgment if you will, the really weak link in the control room operations that may lead to a disaster, a coremelt or what have you, lies in the area of what a psychologist would call cognitive processes, either call it judgment, problem-solving, whatever, but it involves the symptom diagnosis with this myriad of displays and enunciators and so forth, all that information that Tony is talking about and what you do with it.

4 years ago I was talking to one of the vendors -- they didn't know what to do with it -- talking about a medical diagnostics model to them. They didn't understand what I was talking about. Some of them are beginning to grasp the concept. Some people are doing something about it.

It can be done. It can be done with a computer and the right instrumentation. And even with all the good selection and good training, you put that man on the job -- Tony's point is valid because if the fellow doesn't have the right information to take action and, you know, use his brain at that particular point and say, by God, we've got a problem, I want to do something about it, if he can't do it at that point, isn't that one of the big issues with Three Mile Island?

You know, we're going to be in trouble. Best instruments in the world, best training, if he doesn't have that information and can't make a proper decision, then we're going to be in trouble. And again, I think that particular item should be upgraded from medium to high.

I ready to eat lunch now.

MR. MINNERS: Could I take a minute to address your first two points on the process? I have no doubt that PNL has bias. I have bias. You have bias. Everybody has bias. You can't get rid of your biases. We try to establish a system to take that bias out as much as possible by having PNL, as I would call it, gather the facts, and then the NRC staff, the people in the Safety Program Evaluation Branch, drew the conclusions.

And while I will agree that if you give a guy a certain set of facts, you make him draw a certain conclusion. I understand that. But we try to -- we take some of the bias out of PNL. As far as job protection goes, that type of stuff, that's another bias. That's why we have a Safety Program Evaluation Branch doing these assessments, because hopefully we can be a little more objective about cutting out programs.

When we look at human factors systems integration, whatever we look at, hopefully we have a little more objectivity. I know that we have a broader view of the world because we see all of the issues that other people don't. And that is, I hope, part of the process which makes things a little more objective and cuts out some of the things like job protection that we were talking about.

The two issues you pick up are interesting. I.B.1.1. illustrates the point I am trying to make, which is what can the Commission do -- and the write-up lists some things that they thought the Commission could do -- to improve utility management; that is, issue Revised Reg Guide 1.33.1.8, require each utility to submit a new proposed organization and management plan, et cetera, et cetera.

I think you realize as well as I do it's very difficult to make people hire good people. You can certainly get them to put proper labels on them and all that kind of stuff. But you can lead the utilities to water and can't make them drink.

However, on I.D.5.5, which is quite hardware-related, I think the Commission could probably put out some requirements which would make people put good disturbance analysis systems in the plant, but I think I said before the potential improvement could be there, at times, the effectiveness in NRC regulation of gaining that protection.

In I.B.1., I think the effectiveness is much lower than I.D.5.5, and that's going to affect your priority rating, and I think it should.

MR. WARD: There was a specific point Dr. Pearson raised about the question of whether the PNL organization had participated in this, had qualified human factors experts included in it. I don't know.

Mr. Jones, I guess, do you know whether it did?

MR. JONES: No.

MR. WARD: Do you think by the end of the day we could get an answer to that?

Would that do you any good? Are you interested in that?

MR. PEARSON: I would be interested, sure.

MR. WARD: I think they may well have.

MR. MINNERS: Somewhere I think I have resumes, but not names. Would that be satisfactory?

MR. CATTON: They certainly didn't call it out on experience included.

MR. WARD: If a telephone call would do it, maybe you could check on it.

MR. MINNERS: I can find out if we have that information. I don't know whether I can get it down to you today.

MR. WARD: all right. By my calculation, if we come back at 2:00, we will be 2-1/2 hours behind the agenda. So let's plan on doing that.

Might I ask everybody at the table to give Mr. Fischer the time of day that they have to leave to catch their flight, and maybe we can organize the afternoon session differently.

MR. MINNERS: Are you going to discuss prioritization any more after lunch?

MR. WARD: I think we are finished. And we thank you very much. It's been very enlightening and helpful.

MR. MINNERS: Jim will stay here because he would like to listen to the rest of the presentation. So if something comes up on the priority issue, at least you will have somebody to get into it with you.

MR. WARD: Thank you. Let's break until 2:00.

(Whereupon, at 1:10 p.m., the Subcommittee was recessed, to reconvene at 2:00 p.m., this same day.)

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(2:00 p.m.)

MR. WARD: Let's reconvene.

The strategy for this afternoon is, we will plan to finish it about 5:30, no later then 5:30. I think we can do that by a little bit of speeding.

I would like to change the agenda, though, a little bit. The I&E presentation and Emergency Response Center might take only twenty minutes or half an hour. So, why don't we go ahead with that first and that will make it possible for those fellows to go back and then we will pick up the others.

MR. PERKINS: Good afternoon, my name is Ken Perkins. I'm the Chief of the Incidence Response Branch in the Office of Inspection and Enforcement, and I'm here to speak with you this afternoon regarding the upgrades of the Agency's Incidence Responce Program.

(Slide.)

The format I'd like to follow is talk about upgrades in the area of plans and procedures, personnel assignements and training, facilities upgrades on the supporting systems for the facilities. I had brought with me a package of handouts. I hope that you all have copies of the hand-out.

With respect to the plans and procedures upgrade we have recently, working with the Commission, gone through a revision of the Agency's Emergency Response Plan. We have recently republished Manual Chapter 0502, which is the same as NUREG 0728, which describes the Agency's Emergency Response Plan that is now out and available and the procedures for upgrading or for implementing, I should say, that plan are contained in NUREG 0845 and that has just recently been revised and published.

In going through the revisions to those two documents, we have gone through a process of clarifying and restating of the Agency's role in a manner that the Commission now endorses fully. We have presented that to the Commission and they have approved it and, as I mentioned before, have just recently been published.

With respect to personnel assignments and training, once we had an accurate statement of the Agency's role and statement of the Agency's plan and procedures for implementing its plan, we were able to formalize our organization in responding to emergencies and we have been in the process of conducting exercises at the Operation Center in conjunction with mobilizing regional response teams going to the sites.

In the process of getting ready for these exercises we have done work up drills. We have, in the course of doing those work up drills, identified areas where we needed to develop more detailed procedures for some of our team members and we have gone through the process of developing those detailed procedures.

In the area of facilities, we have done an interim upgrade within the space that we have in the East-West Towers, trying to go from office space used as emergency response space to a concept where the space is configured to responding to an emergency so that there is adequate area for people to lay out their resources and gather around tables and conference to discuss particular issues. We have also identified space in the Maryland National Bank Building for the operation center to be relocated. It will be a dedicated space for emergency response in the basement of the bank building. We have submitted a design to the General Services Administration. The General Services Administration has told us that the move to the Maryland National Bank Building could be anticipated about March of 1984.

With respect to supporting systems, we're moving forward on four fronts. The first of those is communications. If you have any exposure at all to the Agency's Emergency Response problems, communications is one of our foremost problems, reliable communications is one of our foremost problems at the Response Center. We have been instructed to stand back, take a look at communications, and come up with a systems approach that would be both cost effective, reliable, and user-friendly for the Operation Center. We'll be looking at long lines as well as the Operation Center's specific part of that communications system.

I'm going to speak a little more in detail in a

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few minutes about our data acquisition system. Right now, as you are probably familiar, our data acquisition system is individuals manning telephone lines to dedicated telephone lines within a site. Those dedicated telephone lines are the health physics network for all physics-type data and the emergency notification system telephone line, the ENS for reactor safety-type of data. We are hoping for a more automated data acquisition and transmission system.

The next system I would like to speak to is called the IMS and that's the Information Flow Integrator. It's the hub for information flow in the Emergency Response organization. It will be our system into which data acquired, regardless of the means, will be plugged. It will be the system into which our analytical tools will feed their products and it will be the mechanism we will use to move that information wherever it is needed in the response organization and that is what we refer to as IMS, Information Management System.

Two of the analytical tools that plug into the Information Management System, which feed their product into the Information Management System, are what we refer to as IDAS, that's the Intermediate Dose Assessment System, and that the tool of the Protective Measures Group, people who do our dose projections and come up with recommendations for protective actions. The second analytical tool that I'll speak to you of is the Reactor Safety Assessment System and that is the tool that is used by our reactor safety people in analyzing the situation at the facility.

MR. DEBONS: I wonder if we could have some questions, please. I'm going to be technical, not for the reason of being technical alone. I think there are some things that I would like to clear in my own mind. When you talk about communications, are you talking about transmissions or are you talking about something else, beyond transmissions? By transmissions I mean the physical property of transporting data from one place to another. Or, are you talking about something else?

MR. PERKINS: Right now we are speaking of -- it is very rudimentary, the system that we have. It's voice communication and we have a very unreliable voice communication system and that is both for transmission of data and exchange of ideas.

MR. DEBONS: There are two things, then. The exchange of ideas is one aspect and the physical transmission of the signal are the two. They are different. Are you planning to coordinate the concepts of these two concepts?

MR. PERKINS: Yes, that's our intent.

MR. DEBONS: How would you make a distinction between data acquisition, in your terminology, and internal information flow?

MR. PERKINS: I'm sorry.

MR. DEBONS: How would you make a distinction between data acquisition and internal information flow?

MR. PERKINS: Could I ask you to allow me to go to a couple of more viewgraphs and if I haven't answered that question, to bring it up again?

MR. DEBONS: In due justice to you, I see no distinction at all between information flow and analytical tools if, in fact, you consider it in certain ways. If you do not consider it in these ways there's wide difference.

MR. PERKINS: I'm not sure I'm understanding exactly --

MR. DEBONS: I'll let you go.

MR. PERKINS: All right. With regard to the plans and procedure upgrade. The first point that I would like to go to is the role, as described by the Commission.

(Slide.)

We have to look at that role in context with the role of a Licensee and the State. What has been recognized, now, is that your primary decision makers are the Licensee and the State. The Licensee has a primary and continuing responsibility for mitigating the consequences of an incident at his facility. That's both with respect to in-plant actions and with respect to off-site recommendations so he is one of the primary decision makers. The State or Local government is the other decision maker because it is the

State or Local authorities who have the ultimate responsibility for assuring the protection of the public from such consequences. They have the authority, or the responsibility, for deciding to act on the recommendation for off-site action made by a Licensee. So, recognizing that these two parties are the primary decision makers, let's look at the Agency's role.

(Slide.)

The Agency's role is, first, to monitor the Licensee to assure that appropriate protective action is being taken with respect to off-site recommendations.

Let me mention that when we made the presentation of this slide to the Commission that this also said with respect to in-plant actions, and that meant that the Agency might issue orders in an emergency. The Commission has said it is its intent not to issue orders to a Licensee during an emergency but that our focus should be on assuring that appropriate recommendations are being made for off-site. Next, we are to support the Licensee both with the expertise that we have within the Agency for doing analytical work and with our ability to call on other federal agencies to be able to provide assistance to the Licensee. This may be logistical assistance by obtaining lead bricks and getting them shipped to the sites or getting diesel generators brought to the site if that is the need, as has been the case in some of the exercises we have conducted, But it is to support the

Third, is to support off-site authorities and that support is a technical-type of support based on radiological assessments. Whether or not we confirm, for example, the Licensee's recommendation for protective action. Fourth is, we are to keep the other Federal Agencies informed of the status of the incident. This is because the other Federal Agencies have charters that give them responsibility in the area of responding to emergency -- radiological emergencies and we need to keep them informed. We have set ourselves up as the technical lead in responding to an incident at a licensed nuclear facility, so we have that responsibility. Fifth, is to keep the media informed of the NRC's knowledge of the status of the incident and let me underscore that last phrase, including coordination with other public affairs groups.

One thing that our executive team, of which the Chairman is the Director in emergency response, drove home to us is a very deep concern that any media releases coming out of the NRC should be coordinated with the State and the Licensee. The last thing we want is to cause or initiate -- be the reason for some spontaneous action by the public. That's contrary to the action intended by the Governor.

MR. DEBONS: Mr. Perkins, can I ask a question now? I assume that you certainly have different data requirements for each one of those. I think you have suggested this. What would you say are the information requirements?

MR. PERKINS: I'm not --

MR. DEBONS: I surmise you have data requirements for each one of those and you hinted at some of these. Now, what are the informatin requirements?

MR. PERKINS: I have an entire presentation on that area.

MR. DEBONS: On the information requirements? I'm sorry I'm preempting you all the time.

MR. PERKINS: No, I had not anticipated that was the area of your concern for this presentation and did not come prepared to give that. I have the slides with me. I can pull that out and give it if that's of interest to you.

The data requirements, we are in the process of defining as we are in the process of describing our reactor safety assessment system. The information requirements, I think the way you're using the terms I'm not as familiar with the distinction, as apparently you all recognize, are for us to be able to look at the big picture, look at the condition of core and containment, and to be able to project ahead where that situation is likely to lead so that we can assure that, if we are going to recommend protective action, it's realistic with respect to its ability to be able to taken and not to cause people to go into it blind.

MR. DEBONS: If I may just aid in the process.

Information requirements is what you do, intellectually, with the data.

MR. PERKINS: I see. You're talking about our analytical process.

MR. DEBONS: It can be analytical but it can also be you simply have to understand the data in the first place.

MR. PERKINS: Okay. Very good.

MR. DEBONS: Would the data organization differ for each one of those? Would the data organization have to be different for each of these or have you taken that into account?

MR. PERKINS: The data organization would not -- yes, the level of data that would be used in some areas, or the organization of it, would be different for some purposes than it would be for other purposes and we are recognizing that in the way we are designing our information management system.

MR. DEBONS: Thank you.

MR. PERKINS: One area, that I understood was of interest to the Subcommittee, was the changes that we have realized in our concept on nuclear data link from the concept that was proposed by Sandia a couple of years ago.

(Slide.)

And we have, by definition and clarification of the Agency's role, modified our concept of the nuclear data new backup

link in the following manner: first off, nuclear data link, as we now describe it, is an emergency monitoring system of the plant's conditions. Previously it had been described as a continuous monitoring system. If you will recall, back during the Carter administration, there was some concern about a continual Federal presence being at each of the facilities and it was considered, at that time, that nuclear data link might serve that function. We no longer believe that that is appropriate for us to pursue with nuclear data link. We need that for emergency monitoring plant conditions.

Second, the data link would be activated by the Licensee, just as the Licensee makes a report now on reportable events to the Operations Center, he can flip a switch and the data on the unusual event, or off-normal event, would be transmitted from the facility to headquarters. Previously, if you recall, there was a readout of pre-set -- readout triggered by pre-set alarms on plant parameters where there had been established thresholds, bells and whistles would go off if the plant exceeded spects. That's not in our concept. It's Licensee initiated when there is an off-normal event.

Next, in order to have the initiating event sequence, there would be a flight recorder at the site which, once activated, could rapidly dump the history so that we would have the initiating event record at the op center. We do not know, yet, how long that loop duration needs to be, whether it's a thirty minute, two hour, or twelve hour loop that should be put in that flight recorder. That would be something that we would hope to look at through a prototype study.

MR. KEYSERLING: Is this recorder going to be normally operational or will it only become operational upon being triggered?

MR. PERKINS: It would have to be continually operational. It would be a continually operating recorder at the facility, not connected to the Op Center until the Licensee flipped the switch.

MR. KEYSERLING: But the record would exist so that you could always go back.

MR. PERKINS: Exactly.

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MR. REMICK: Do you know if that would be connected to the SPDS system?

MR. PERKINS: I am getting there. Next -- this is the step -- next, there would be no connection to sensors. If you recall, in the Sandia concept some data had been anticipated to be acquired directly from the plant centers with isolation. All data would be provided from the existing plant computers. We're talking if there is an SPDS computer, it would come off of the SPDS computer. No interaction would be initiated by the operations center.

The earlier concept, it talked about a dedicated computer onsite which would allow the NRC to interact, so if there is an SPDS computer at the site, we would intend to come off of that.

Next, the data list would be developed with the licensee and State input in our current concept. Previously, we had talked about developing the data list ourselves without input of the licensees, and then requiring it of the licensees.

MR. WARD: Ken, I want to ask you a question. That's a data list, and then you say you're going to come of the SPDS computer, whatever that might be. What if the SPDS computer doesn't contain all the data on your list?

MR. PERKINS: We are taking a look at the SPDS. We are surveying the SPDSs. It is our intent, it is our expectation, that the list of parameters that we need for the -- for our role are very similar to the list of parameters that the licensees have for the SPDSs.

Remember, we are now big picture. We are not trying to turn valves and that kind of thing.

MR. WARD: Great. But even then, the SPDSs -- the last I heard, there were 70 different SPDS designs. How are you possibly going to get all of that together and have it compatible with one receiver up here somewhere?

MR. PERKINS: We are surveying all of the SPDSs for three purposes: one, to see the parameters that the licensees and vendors consider important for lessons that we can learn; see the analytical techniques that we consider to be important; to see the human factors techniques that they have used for presenting this information so that we are not reinventing the wheel, we are learning from what has already been done because we have gotten ourselves behind the curve.

Next, in the event -- we really believe that the parameters that the licensee needs to perform his functions from the SPDS are very similar to the ones that we need for the operations center. Where SPDSs do not exist, we intend to look at whether there are other plant process computers available from which to tap this information.

MR. WARD: How many SPDSs are actually designed to the point where you have something fixed to look at?

MR. PERKINS: I am not sure I can answer that right now. I know we have got four vendors lined up whose SPDSs we are looking at, and then we intend to do a site visit type of surveys of the facilities.

Joe Himes is here.

MR. HIMES: I am trying to remember. I think it's something in the neighborhood of a dozen that we could get pretty firm ideas on right now. We will have some problems of plants that have SPDSs. One I would like to show you where the SPDSs are, if that's the case, we would like to look at it.

MR. WARD: As I recall, the SECY, whatever it is, really doesn't require even a computer-based SPDS.

MR. PERKINS: That's true, it does not require a computer-based SPDS. That does not exist. We would look at coming off of the plant process computer if there is one available.

We recognize that there may be some sites where that may not be possible. Right now we are trying to focus on the majority, what we consider to be the majority of sites.

MR. WARD: Why don't you go ahead? I want to talk about the costs when you get done.

MR. PERKINS: I understand. Well, let me go ahead with this slide and then make that point.

The next bullet actually addresses the point that we were just discussing; and that is, the length of the data list will be limited, and it's expected to be comparable in size and content to the data set for the plant safety parameter and display systems.

This is, we have said, on the order of perhaps 60 to 80 parameters. In the earlier concepts it had been something like 400. It was later trimmed to 125.

The reason that it's even as high as 60 to 80 is that there may be some variability in parameters that are unique to plants that would need to be included.

The next bullet says the licensee will provide site-specific data in the licensee's own format and the burden will be the NRC's to have a software package for translating that into a standard format at headquarters.

Previously, if you recall, the licensee was to be required to meet NRC data needs in a standardized NRC format. As I mentioned, we are behind the power curve. It was unrealistic to cause licensees to backfit. We will take the data in the format the licensee has it and process it through a software package and put it in a standardized format.

Lastly, the estimated cost of the Sandia system was about $25 million 2 years ago. We estimate that the total system cost of the system we are describing is on the order of $9 million.

Now, you had a question about cost?

MR. WARD: That's the total cost? That includes the cost at each site?

MR. PERKINS: That is the total cost. That does not distinguish at this point between licensee cost and NRC cost. That is the total system cost.

MR. WARD: So, given 100 reactors, that is less than $100,000 per reactor?

MR. PERKINS: I do not recall the specific cost breakout between site and headquarters.

MR. HIMES: It's much less than $100,000 per reactor simply because they're putting in the SPDSs to meet other requirements. Where we have those, your cost is going to be something to get the data out and send it to us. Our biggest cost would be the software package and the equipment at our center. There are going to be certain sites where it's going to be over, but nearly all are going to be substantially under, I guess. That's the prototype program, of course, to determine how close we are and exactly problems we will run into.

MR. WARD: It strikes me that that is off very, very low. When I look at 100 plants that we have a package of data in some format there with some kind of computer which won't be compatible with whatever you've got up here, you know, the reason I think we ought to be interested in the cost -- I know you're going into a prototype program; that's what you are proposing -- but if the ultimate cost for the system is so high and if that's obvious out of hand before doing the prototype, it raises the question of whether the whole program should be continued at all.

I have sort of got a problem with the Nuclear Data Link. It raises a lot of emotion. 2 or 3 years ago when it first came up, the committee, the ACRS, at least informally had some rather strong objections or voiced some rather strong objections to it. And if the program is going to go ahead, it's been sort of up and down, back and forth, and we haven't understood exactly where the program was.

If it's going to go ahead, it may be that the committee will want to take a position on it one way or another. Maybe it is sliding right by us, the prototype part is sliding right by us, before we can take a position, for whatever that position would be worth.

So where are you in the decision process?

MR. PERKINS: Okay, let me speak to that. First, let me say that -- let me remind you of the slide with the agency's role described. Second, let me mention that the organization for implementing that agency role is headed by the chairman, who is the director of the executive team.

The chairman and the Commission have decided that they wish to proceed with the Nuclear Data Link prototype. The purpose for the Nuclear Data Link prototype is to allow them to eavluate the appropriateness and applicability of a data link in carrying out their role as they have described it.

The reason they are interested in proceeding with the Nuclear Data Link is that our current configuration has us hooked by telephone line to the licensee, who has a communicator on the other end of the phone who is asked a question by communicator at our end, who then goes and reads a dial or asks someone else to go and read a dial and bring that information back, transmit that by voice over the telephone, which is then received at our end by a human being who writes it down, all of which -- every one of those interfaces, and they are numerous -- has a high potential for introducing error.

MR. WARD: Could I comment on that? The way you describe it, that would obviously be a problem. But it presumes that it's necessary for someone in Bethesda to have the information. And that necessity is one of the questions that was raised about the need for the Nuclear Data Link, you know, a couple of years ago.

And what I question is whether the prototype system is really going to address the questions that were raised. The prototype system is going to help you decide how much it's going to cost, how the hardware will work, what sort of hardware-software compatibility, that sort of thing. But I am not sure that those were the principal questions.

MR. PERKINS: The prototype will also focus on the ability of the executive team headed by the chairman to perform its role using the data collected and provided by the Nuclear Data Link.

The Commission has decided that its role is to monitor the licensee -- recall the first function there, the first role described -- monitor the licensee to assure that appropriate protective actions are being taken. And we have backed off from the valves and thermocouple type of detail to a big picture assessment of what's going on at the facility, so that we are better able to understand where the condition is leading.

MR. WARD: I agree. The change in scope very much diffuses a lot of the objections. But I can see there are a lot of strong remaining objections to the concept.

MR. PERKINS: If I might just highlight a couple of things on this slide, concerns that I remember were: data acquired directly was one. Continuous monitoring triggerd by precept thresholds, we now have an emergency system, something that is crucial to our emergency response role that would be activated by the licensee just as he reports events to us now under 54.72.

MR. REMICK: You indicated the Commission has decided it's necessary to monitor. I assume that means monitor from Bethesda, because they have the choice of that site also.

MR. PERKINS: They have the choice from at the site, once someone arrives at the site, and there is a recognition that it will take 2 to 8 hours for the regional site team to arrive on site.

Our current concept of operation is that the Region is responsible for the incident. We go into what we call initial activation mode, which is the mode where the headquarters holds the ball while the Region is in transit to the site. The data link enables us to perform tha function while the site team is in transit to the site.

Don't let me leave you with the impression, though, that the only reason for the data link is for that 2 to 8 hours while the site team is in transit. Once the regional administrator arrives at the site and becomes designated the director of site operations -- that is, he becomes the focal point for the agency's response activities -- the headquarters then becomes a support agency of a support organ providing analysis to the director of site operations.

We have the expertise; we have resources back here. They need the data in order to be able to perform the analysis, to provide the product to the director of site operations. I thought that distinction was important.

MR. WARD: Has the NDL been programmed and subjected to the discipline of generic issues analysis?

MR. PERKINS: I am not certain I understand your term.

MR. WARD: Well, we heard this morning about a methodology and its application to what had been called the human factors issue in deciding what issues need to be addressed by the NRC on the basis of their relative benefits and costs. I just wonder if this has been analyzed from the standpoint of the ratio of benefits, possible benefits, to costs?

MR. CATTON: How you impact.

MR. HIMES: It has been. There was a brief generic issues paper prepared that measured the gain in lives saved and the risk of lives lost, I believe it was, versus cost. In fact, we just reviewed that again, I think it must be about 6 months ago.

MR. PERKINS: Are there any questions on this slide before I move on?

MR. CATTON: It assumes the NRC is always going to make the right decision or a better decision than the applicant.

MR. WARD: You haven't seen the paper. It might not say it.

MR. PERKINS: The assumption that is made is that the NRC has a breadth and depth of expertise that may not be available at the site, and given the proper and accurate, timely data, the NRC might be able to assist in addressing the situation at the site.

If there is a difference identified between the analysis of the licensee and the analysis of the NRC, the NRC's first course of action is to discuss that difference with the licensee, and the last course of action is to come up with an independent recommendation separate from the licensee's.

MR. WARD: Ken, do you have any idea of any of the large utilities, do they have anything like, or have plans for anything like, the Nuclear Data Link in either the United States or in Europe, for example, whether there is a large centralized utility?

MR. PERKINS: We have taken a look at KIT, which is the French version. That is not truly a Nuclear Data Link in the extent of providing real-time data.

MR. WARD: Is that something that CEA has or EDF has?

MR. PERKINS: I think it's EDF, if I recall correctly. We also -- I am sure you are all familiar with the TVA emergency response organization. In order for that to work, they have a means for moving data amongst their various facilities. Duke Power has a sort of data link. It has a human filter, I guess, is the best -- I am not sure of the right word, but it has a human reviewing the data prior to its release into the system to verify it.

Those are the ones that jump to my mind right now.

MR. WARD: I don't want to spend too much time on this, but could you tell me when commitments are going to be made or if they have been made regarding going ahead with the prototype program?

MR. PERKINS: Sure. We are in a hold right now. The Commission sent a letter to the Congress telling the Congress that they intended to proceed with the prototype study of the Nuclear Data Link. Interestingly, the Commission also had a supplemental budget request for salaries on the Hill at the same time. The exact amount of the Nuclear Data Link prototype study was cut from the salary supplemental with the comment that that was an appropriate source to use because that particular commitee had some question.

It's my understanding that the chairman has now met with the chairman of that committee or subcommittee and has arrived at an understanding and is preparing a letter to the Senate side, Senator Hatfield, which would ask to have that funding reinstated, because the agency believes that a prototype study should be performed.

We have also, I am told, this morning received a letter from Hart and Simpson saying that the Authorization Act instructed the agency to proceed with the prototype study, what are we waiting for?

(Slide)

Next I would like to talk about that hub that I spoke of a minute ago for receiving information and moving it within thhe response center. That's the information management system.

The purpose of the information management system is to manage the flow of information in the operations center. We are archaic right now in that we deal in very crude hard copy being hand-carried from one point to another, and we have a real problem in the operations center as far as getting information from one place to another.

Our operations center, as it is currently configured in East-West Towers, is a complex of rooms that are separated. We do have difficulty in moving information about.

The first phase of the information management system study is to evaluate what are the essential capabilities for responding to an emergency. That's our first priority.

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And we are working through a contractor now to try to develop a system that would allow us to implement Phase 1 by, I believe it's the 1st of July of this year, for making a first cut at being able to move the emergency type of information around the Ops Center. That will have to undergo refinement. We have given this phase, because of its pressing need, a very short fuse, so we'll have to do some refinement in subsequent months.

The second phase is -- or the second priority is to implement improvements on the system for functions that are Operations Center functions -- receiving information from licensees as they report those events to us. But those events are not ones that necessarily put us in an emergency response mode.

And the third is using this system to facilitate other inspection and enforcement mission tasks.

MR. DEBONS: Before we go off from that, I imagine you anticipated my interest. This is a very interesting data management system. Would you say your last slide on reactor safety analysis system is the true information system? That may seem like quibbling over terminology, but believe me, I have no interest in quibbling. I have an interest in showing the importance of these distinctions for the purposes of NRC.

You have a data management system here.

MM16,sy2

You don't have an information system.

MR. PERKINS: I think I'd better understand --

MR. DEBONS: An information system is what you do with the data.

MR. PERKINS: I apologize for not grasping your use of that term earlier on. I'm just not as familiar with it as you all are. Perhaps we do have a misnomer in this system.

What it is is an electronic system for being able to move data around the emergency -- around the Operations Center. I don't have a viewgraph to show you all this, but the kinds of things that IMS, the Information Management System, will be moving are -- would be useful would be monitoring access to the Ops Center. We would maintain a log of people. It's important for us to know who has responded, what kind of expertise we have available.

Two, it would contain within it data,the plant and site characteristics, a site file type of thing. Third, it would keep a record for us of the people we had notified. Fourth, it would allow us to move messages from one group in the Center to another. Fifth, it would allow us to log questions that we had passed to the site and the responses that we received back from them.

Next, it would be -- there would be a file for recording formatted data. We are advising the licensees that there are generic data requirements, so that's a formatted data. Next, it has what I call kind of a casual file, a temporary notes file, which is for pieces of information that we receive that are unverified. Next, is -- I think this probably borders on your information point -- what we call our safety assessment tools. It's the analytical ability to come up with a product in reactor safety, a projection of conditions, that then is -- it's the result of analysis that then is moved to the executive team for their consideration.

MR. DEBONS: I judge your judgment is right about the last point. Now, one of the things that we made very clear this m ning -- particularly, Dr. Pearson made clear this morning -- the importance to keep the cognitive aspects in mind.

Now, if we have a data transmission system here, which seems to be reasonable by virtue of what you, in fact, indicated to me just a moment ago, you have the last point in which you suggested that that would be an information system -- which is correct, the last point comes closest to an information system -- but certainly, that last point would not be sufficient to take care of all the contingencies that are likely to occur.

For example, let me just give you a very quick example, a very probably crude example. A person gets a lot of data concerning what's happening to a particular fuse, let's

MM16,sy4

say. Now, the first information requirement is that he understands what's going on. The information need is comprehension; what capabilities are we providing the individual to facilitate comprehension. That's the information requirement. The data requirement has already been met. What is the individual going to do with the data? If he obviously doesn't understand it, his information need has not been satisfied.

Now, have these considerations, which are not theoretical but very practical, been taken care of?

MR. PERKINS: Yes, I believe we have addressed those. Those are addressed -- I think I used a different term for that, and that is in our analytical tools, our intermediate dose assessment system is an information-generating system. And the product of that also has the reactor safety that I mentioned to you a minute ago, is moved to the executive team for their use in deciding whether or not to -- how to act on that on a given recommendation with respect to a licensee.

MR. DEBONS: I trust, then, that there's a clear conclusion that depending upon what level the executive team is operating, the information needs concerning these things are actually different.

MR. PERKINS: Yes.

MR. DEBONS: Thank you.

MM16,sy5

MR. PERKINS: Are there any other questions on that side?

(No response.)

(Slide.)

Let me speak very quickly to the protective measures tools. I may not use the right term here, but the protective measures tools that we have under development for our protective measures analytical team are at three levels. The first is a very quick and dirty method, and that's what we call IRDAM. That's the interactive rapid dose assessment model. It's meant to be used in the first hour before we have a full staff component in the Operations Center. It allows you to come up with a quick dose assessment. If you don't have data, it has built into it helps to keep you moving through it so you can come up with a rough cut type of dose assessment.

Next, we have the intermediate dose assessment system. This is longer-term. This is after we have our various experts present in the analyatical team protective measures. IDAS, or the intermediate dose assessment system, is made up of three models; one is for source term, one is for dispersion and one is for dosimetry, and the three together come out with a dose dispersion description.

The third is an extended effort. We are not pursuing that actively at this time. It will be a longer-term effort. I believe we're putting our effort appropriately right now in this intermediate dose assessment system and trying to refine its ability to track where the dose is likely to appear. Remember that the product of that model, the information it produces, the analyzed information, is then channeled into the executive team who will make a decision and act on it.

(Slide.)

I'm going to skip the last slide because I just realized -- I don't mean the last slide, I mean the next to the last slide. I believe I've pretty much covered that with you all in my describing the intermediate dose assessment system.

(Slide.)

And I'd like to go to the last slide, which is the reactor safety analysis system.

(Slide.)

Theoretically, you would like to take a look at your information needs at the outset and take a systems approach to developing it. Unfortunately, that did not get done. We're now trying to pull it together as a system. I would have been more comfortable if I could tell you that the reactor safety assessment system was being developed parallel to the intermediate dose assessment system, but that's not the case. The intermediate dose assessment system got out front. This is only now being developed.

The purpose of the reactor safety analysis system is to develop analytical tools for assessing the core and containment conditions. These are the conditions which can affect the need for off-site protective action. The concept is to determine our team needs, our analytical team needs, identify and evaluate existing resources of information, evaluate, as I described a moment ago, the existing SPDS like system to see what lessons we can learn from that, both with respect to analytical techniques and data that licensees consider important. And thirdly, the human factors handling of that.

Fourth, out of these three, to synthesize a reactor safety assessment system design, and to implement it. We are now in the process of describing a scope of work to do this effort.

MR. WARD: Will this have to have as input the nuclear data links, for example?

MR. PERKINS: Thank you for asking that. The nuclear data link would certainly help, but the nuclear data link is not crucial. We're not building it so that the nuclear data link is crucial for its implementation.

MR. WARD: So you could manually input data into this center?

MR. PERKINS: Correct. I know that trying to give a 20-minute presentation on Ops Center upgrades without the presentation of the agency's role and the organization and all is very much out of context for you. I would like to invite you to make the offer for any of you who are interested, to have you come to the Operations Center and see what we currently have there. See what we are trying to do to upgrade what we have there,to get a better understanding of how we are organized and the type of people that we have performing in the Operations Center.

I would be glad to spend a considerable amount of time with you in that regard. Are there any questions?

MR. BUCK: Just a couple here. In this prototype testing, what are you talking about numbers of plants in the prototype?

MR. PERKINS: Okay. If we get the $700,000 reinstated, we're talking about running a prototype study with one BWR and one PWR, and the complementary -- I'm sorry, and the simulators for each, and a simulator for each type. We'd like to have a chance to actually test the prototype using the simulator, for example, using the simulators, for example, and some exercises where we would fully staff the Operations Center and go through performing the agency's role.

MR. BUCK: Second question is if you have this nuclear data link there with your current planned system, then are you looking at that site recorder as going back to update your simulations, or are you going to look at this in the static type thing?

You had a flight recorder-like instrument that you're dealing with there. I'm trying to figure out how big the loop should be right now. If you had that with the full system, would you then anticipate doing an historical update on the plant in order to understand what the problems are?

MR. PERKINS: Yes.

MR. BUCK: So that's pretty crucial to anything that is kind of dynamic. And I mean this in a very slow dynamic sense. But it's hard to understand. Anything that's dynamic would have to have that flight center, I would think.

MR. PERKINS: The flight recorder.

MR. CATTON: That's a tough program to write for a complicated thing like a nuclear power plant.

MR. BUCK: That's what I was thinking, very complicated.

MR. CATTON: There's only one person who has ever recommended something like that, to do something that's this complex, and that was Richardson in 1917 in the trenches during the first World War. He recommended that for meteorology,but it's never been done for even that.

MR. BUCK: It looked rather complicated to me.

MR. PERKINS: I believe -- I may not be understanding the question.

MR. CATTON: Basically, what he's saying is that you have your calculational technique and it's running off. You have data coming in. Every once in a while you've got to drag your analysis back online.

MR. PERKINS: I'm sorry, I didn't understand your question correctly. The purpose of the flight recorder is only for initial history.

MR. BUCK: Oh, for initial history.

MR. PERKINS: For initial history. From then on, it's real time.

MR. CATTON: But you have the data coming in and you have analyses going on. Somehow, the two have to be compatible with one another. If you believe the data, you're going to be wanting to bring your solution back everytime it tends to wander away from what the data tells you truth is going. It's like a perturbation analysis. You can't get very far away from your data or you're in trouble.

MR. PERKINS: I understand, and I'm concerned that I have not accurately communicated our concept here. The concept that we had was as soon as the licensee would normally report to us that he has an incident, he would flip a switch which caused a rapid dump of data out of his flight recorder, a one-time dump, over the nuclear data link to the Operations Center. It would be received by the Operations Center and analyzed and presented.

In that short period of time, there will be nobody at the Operations Center other than the duty officer. We will not have our analytical teams present yet. From then on, we're in a real time data transmission mode.

MR. CATTON: I guess I still don't understand. I thought you were going to be using the data -- as soon as you are past the initial stages, you would be using the data and you would be making projections with respect to whether or not you thought a particular action was going to do any good.

MR. PERKINS: That's correct.

MR. CATTON: So what you're doing is, you're basically using the data as initial conditions for a projection.

MR. PERKINS: Correct.

MR. CATTON: Now they do something. Your projection is not going to match up with what the data that's coming in a little bit later tells you. So you need to re-initiate.

How one does that is what I think we're saying is kind of complicated. But you're saying you're not going to do that.

MR. PERKINS: I'm not sure I said.

MR. WARD: We're going to consult with Richardson.

(Laughter.)

MR. CATTON: Actually, what he recommended is kind of funny. My wife really gets upset. What he recommended is you get this great big roomful of little computers that you run by hand. You have a bunch of women that run outside and check the weather.

(Laughter.)

MR. PERKINS: The point that you're making, I believe, is that if there is a sudden change, the analysis that we may have done up to that sudden change is dated. I don't know that there's any way around that other than the mechanism that we currently have expressed, and that is as soon as we identify a difference with the licensee, our first course of action is to talk to the licensee.

MR. CATTON: Maybe we're still not communicating. You're going to be doing analysis to try to secondguess what's going to happen, to try to project, but all the while you have data coming in on a real time basis.

MR.PERKINS: Yes.

MR. CATTON: Somehow, the data coming in on a real time basis should be interacting with your analysis. You can't simulate that nuclear power plant absolutely during those circumstances.

MR. PERKINS: We don't intend to.

MR. CATTON: I understand you don't intend to, but what do you plan to do through the analysis to correct it when the small deviations begin to add up? Or maybe I'm still not getting through.

MR. HIMES: We have the same problem with reactor safety analysis, and with the IRDAS he's talking about. In protective measures analysis, it's true you make your projection and you figure out what's going to happen and then you get some real time data in that says your projection is wrong.

MR. CATTON: Then you have to change it.

MR. HIMES: So far you're right. Nobody is even thinking about how to efficiently take that difference, that delta, in the measurement versus what you get in, and feed it back to a modification in the model. They're not doing that.

They're simply going to recalculate and they're going to say hey, we were wrong; what's your best guess. The data has changed here, we think it's that. That's why we have experts on the team. They'll look at that and they'll say okay, let's do another quick calculation. These are not extensive calc lations. They're just not that big of a deal. They'll just recalculate it.

I wish we could fee d back. I proposed that.

MR. CATTON: You ought to read the last chapter of Richardson's book.

MR. HIMES: I should have talked to him.

MR. SALVENDY: May I ask a question? I'm not quite sure. Let's say all this information comes in. What happens in this control room? What do you do with that information?

MR. PERKINS: First,we don't have a control room. Second, it comes into the Operations Center and the data goes to the analytical teams. The analytical teams conduct an analysis of it, and remember it is data that will tell us about the potential impact on core containment, core containment conditions. And they try to first make an assessment of the current condition, and then project what the condition is likely to become.

Once that assessment is performed, if that assessment is different from the licensee's, the director of the analytical team or his deputy makes a call to the licensee and they discuss any difference.

MR. SALVENDY: I wonder if I may ask now, this analytical team,would they make their decision based on some expert system which may be available to supplement the human decisionmaking? Or would it be all a human decision calculation? Would you have an expert system in? Would you kind of link, in effect, computer intelligence with human intelligence to make a decision, or would it be all human intelligence?

MR. PERKINS: We intend to use this data beyond analytical capabilities available through computers as a tool for those judgment decisions, yes.

MR. CATTON: You'd almost have to have a large number of specific plant models done beforehand, if this is to be meaningful.

MR. PERKINS: From the reactor safety standpoint and from the protective measures standpoint, we need a site file available. Not necessarily models, but the results of analysis done beforehand to put into a site file.

MR. CATTON: But most of that beforehand analysis is done based on people's ideas about what's going to happen. All of a sudden, you're faced with the real thing. If you don't have available models like containment volume, pressure vessel volume, thickness of the annulus, dimensions of the core, all of these kinds of things characteristic of the secondary site, if you don't have all of that ready to go to plug that data into it, by the time you get it operational it's going to be over.

Is this part of the plan?

MR. PERKINS: That's exactly the kind of thing that we're looking at in the reactor safety assessment system.

Remember, though, that we're not trying to second-judge the licensee's manipulation of valves and reading of thermocouples; we're trying to stay with the big picture assessment of what's going on at the facility.

MR. CATTON: I understood you to say that you were going to try to project the future, the result of a given maneuver. Didn't you say that?

MR. PERKINS: I do have a problem with expressing my ideas.

The intent is to be able to assess the condition at the facility, how bad is it, and to be able to project, not what the licensee is going to be able to do, but how the facility -- what condition the facility is likely to go to.

MR. CATTON: Then we understand one another.

What you want to do is make a prediction of where it's going.

MR. PERKINS: Our reason for doing that is so that if there is likely to be core damage or a breach of containment and a need for taking protective action, that we have gained the most time that we can to implement that protective action -- for the off-site authorities to implement that protective action.

MR. CATTON: That means you really do need some kind of models of that plant to do that?

MR. PERKINS: Exactly. We do need models of the facility, and we do need to be able to perform calculations in order to make those kinds of projections.

MR. CATTON: You need to be able to feed the information coming off the Nuclear Data Link into your model.

You need to be able to stop your calculation and reset it to go forward.

MR. PERKINS: I wouldn't put that statement in the record, not off the Nuclear Data Link. We need the data from whatever source.

MR. CATTON: Whatever source.

MR. SALVENDY: I have problem -- back to the question I raised, it doesn't matter what data you have. It depends what you do with it.

I seem to be a little concerned. When you mentioned that you would be using the state-of-the-art analysis methodology, what type of a team do you have who actually puts these things together? What kind of qualifications? Do you have people like artificial intelligence? Do you have competent psychologists on the team so that the information that comes out from this data base can be most effectively analyzed and interpreted?

I had a feeling that you have on your team people with analytical background, which would imply applied mathematicians, operations research people, people in the computer simulation area. Or have I misunderstood you?

MR. PERKINS: I'm not sure that I understand your question.

MR. SALVENDY: My question is: Who are the people who make the data analysis? What is their qualification?

Are there nuclear engineers? Mathematicians? Who are they?

MR. PERKINS: On the reactor safety side, they are reactor engineers, project managers. They are a nuclear engineer or technical types on that side.

On the protective measures, it's meteorologists, health physicists, those kinds of inputs.

MR. SALVENDY: I would have thought that those people wouldn't have the required qualifications or knowledge to develop a good state-of-the-art expert system that would use the concepts of artificial intelligence and human decision-making in combination, in a hybrid way, to come out with an optimal decision --

MR. PERKINS: I'm sorry. I thought you were asking me who were the members of our analytical team, not who were the contractors who had developed the system for us.

MR. SALVENDY: I thought you mentioned an analytical team would be analyzing.

MR. PERKINS: They would be using the data that goes into the models. They would be using the models as tools. They are not the sole developers; they are certainly an input of the models.

MR. SALVENDY: If I may follow up, who are, in effect, the developers of the model? What is their qualification?

MR. PERKINS: With respect to IDAS, the Intermediate

Dose Assessment System, that has been developed with Pacific Northwest Laboratory as the lead organization, lead contractor. We have had involved in that Phoenix Associates, who are the software developers. And sitting in with that contract we have had Human Affairs Research Center, who are part of Pacific Northwest; and then we have also had the input from our analytical team members, who would be the users of the system.

MR. SALVENDY: If I would read, all these people bascially have one commonality, that they all are cognizant of the nuclear engineering field and they are all knowledgeable in computer programming and system development. But I wouldn't have thought that any of the group would have -- I would have identified any groups within those organizations who would have a specific competency in the area of the decisionmaking end of human factors and the artificial intelligence. I may be wrong. I just don't know any groups within those organizations --

MR. PERKINS: I believe Human Affairs Research Center has some of that expertise there. I can't say that I have been with the program since its inception, and I am not certain of the extent of their involvement along those lines in the early part.

MR. SALVENDY: I think it's very important, not what's coming in, but how the data is managed.

jl 5

MR. CATTON: Isn't there two parts of this?

MR. SALVENDY: Two parts for everytning.

MR. CATTON: There's the system he's talking about, which really is the area you're interested in. But what he's talking about now, when you say "model," "model" means one thing to me, another thing to you. When he talks about a "model," he's talking about a mathematical representation of the distribution of the radioactive things across the countryside. That's what he's talking about. That needs technical people. There's nothing in there that's human factors.

Maybe Howard's information is used. That's a different story. But the model itself --

MR. SALVENDY: I'm not addressing the issue. I'm addressing what data you collect, what model you have in hand. A decision has to be made what to do with it. That's the most critical end of it.

Now, you can do it a number of ways.

One, you can just have all this information thrown out on papers and have somebody sit there and make decisions, or you can use concepts of artificial intelligence, supplemented basically with human decisionmaking, and come up with a good expert system, where you provide decision aids to the human.

What I'm concerned with is not the collection of the data. You people have taken care of that. I'm concerned, once you have the right data collected, you have the right model, now the information comes up, how do I make a situation that the people can make a good decision with it most effectively. Because if you don't do it, I think you would be making a bad decision. You invested $9 million, and the decision won't be right when the emergency occurs. There'll be an overflow of information.

MR. DEBONS: Can I piggyback on that?

MR. WARD: Yes. I think we've got about one more minute on this subject. We have to go on.

MR. DEBONS: I'll take less than a minute.

Suppose you have A, B, C, and D. These are four different people. Suppose the information needed synthesis. Do you think these four different people will have the same ability to synthesize the data?

MR. PERKINS: No.

MR. DEBONS: How do you deal with the difference? That's the question that Dr. Salvendy was asking.

And should you account that in the design of the system? Of should you accoung for that in the training program or in the selection process? That's a crucial issue that Dr. Salvendy is asking.

MR. SALVENDY: That's the provision of decision-makers.

MR. DEBONS: Decisionmaking is the result of that.

MR. SALVENDY: This is the decision --

MR. DEBONS: That's essentially it. If the task requires synthesization and these four different people differ in their capabilities, how does the system compensate for the difference? That's the issue.

MR. PERKINS: Let me say that I believe --

MR. WARD: Don't say too much.

MR. PERKINS: Let me say we do recognize that there are limitations to different analysts' abilities, and we are trying to make our analysts sensitive to the need for conveying their competence in their analysis to the executive team when it is presented to the executive team.

I'm very much impressed with the interest that you have in our program. And I certainly hope that, rather than a quick overview like this, we will have an opportunity in the near future to give you a detailed presentation on the program.

MR. WARD: Thank you very much, Mr. Perkins.

We have two-and-a-quarter hours, and we absolutely have to cover the research, part of which Mr. Norberg will lead.

I suggest that we go ahead with the proposal for training human factors engineers, with the expectation that we'll take no more than an hour for the whole thing. Let's try to finish this by 4:15.

So -- Mr. Ryan.

(Slide.)

MR. RYAN: My name is Tom Ryan. I am with the Human Factors and Safeguards Branch of the Office of Research, NRC.

I have been asked to take about 15 minutes and make some comments on, first of all, the perceptions of the importance of human factors to nuclear power plant at risk, also some of the potential challenges posed by the commercial nuclear industries, a couple of comments on human factors as a discipline, and finally the tools required by the human factors specialist or practioner really to carry out the safety mission of the Commission.

Really, the objective here is, ultimately, to set the stage for a discussion of NRC's projected human factors staffing and information shortages, the NRC's plan to deal with these shortages and, finally, the ACRS' consultants' proposal for training human factors engineers.

(Slides.)

Turning quickly to the perceived importance of human factors to the nuclear power plant risk, really, there's no real good one answer to that question. I think the discussions this morning pretty much pointed that out, the differences of opinion as to what's important and what isn't.

However, there are a number of disparate sources of information, what kind of shape, our perceptions of the importance of the problem.

First of all, there are the reviews and study conclusions, operational data, and anecdotal information. And the review of study conclusions, of course, are based on summary of power plant accidents and the study that the Human Factors Society did through interviews with plant, industry, and NRC people. In the operational data area, of course, we do have some disparate actuarial data on and from nuclear power plants. Primarily this data comes from 14 of the PRAs, Probabilistic Risk Assessments, that have been published over the last few years, part of the RSSMAP and IRA programs, and a series of reporting systems that range all the way from the I&E surveys and data to, most prominently, the LERs and the maintenance records area.

A couple of comments about the anecdotal information. There's one school of thought that considers today's nuclear power plants to be basically extensions of their fossil fuel predecessors. Therefore, the human is required, to some extent -- not so much as a complement or a supplement to the system, but to overcome the current design deficiencies.

Therefore, for the human factors specialists, the question really is: How can the human be incorporated into the total system so as to take maximum advantage of his unique capabilities for planning, troubleshooting, decisionmaking, and recovering hardware failures.

I'd like to quickly also make a comment about the information we get from other industries. If you look at the human factor-related literature, pretty much you'll find out that across all industries we pretty much assume that the human is responsible for about 50 percent of the failure-type incidents. That number gets a whole lot higher in certain industries. For instance, in some aspects of the manufacturing industry, that number is 90 to 95 percent. But there are two other numbers -- kind of interesting -- between 1971 and 1978, 885 reported military-type aviation accidents. 686 of those, or 78 percent, it was determined that the cause or primary contributor was some kind of human error.

Between 1976 and '82, in the commercial aviation industry, there were over 30,000 reports to an aviation safety reporting system on safety-related-type incidents. 85 percent of them, or almost 26,000 of those 30,000, again cited some kind of human error as the primary cause or a very critical factor in that.

(Slide.)

Turning back quickly to the information from reviews and study conclusions, the quote I have here is from the Report of the President's Commission on the Three Mile Island accident. Of course, they pretty much concluded that the majority of these kinds of incidents, safety-related incidents, do involve, as a primary constituent, the human component in the system.

Certainly, the NRC ought to include human factors, research and engineering into the development and operation of the systems.

(Slide.)

Following behind that, of course, is the Human Factor Society Study that I am sure you are all familiar with.

Of course, after doing some observing and interviewing and so on, the Human Factor Society came up with, I think, 46 individual recommendations, pretty much that can be categorized under the six bullets I have here, the first one having to do with utility and NRC management of the programs. The revolves around the actual staffing, training, and carrying out of the research and engineering in this area. And this gets to some of the things the other speakers want to talk about. It also relates to human factors, data acquisition, and objective human factors evaluation criteria. I'm sure you can all appreciate some of the difficulties associated with this, especially within an industry that has sort of an adversarial relationship with NRC, human risk assessment having to do with both the likelihood of an error and what the consequence is and one that I feel is very important -- that is, system integration at all stages of the design and operation of the plant.

And that involves human factors considerations from the inception of the system, treating the system as an integrated entity, rather than a collection of disparate parts and, finally, recognizing the fact that the human doesn't operate in isolation, and finally a series of personnel allocation and support activities having to do with selection, training, testing procedures, and other performance.

(Slide.)

Turning to some operational data, first looking for a minute at the probabilistic risk assessment. We had a chance to look at seven of them -- at 12 of them, seven done on PWRs and five on BWRs. These involves ome 28 precursor events, sequences, involving human behavior, usually resulting from a small or medium-break LOCA, loss of off-site power, loss of power conversion system, various types of pipe ruptures.

Five of the 12 of those PRAs consider human error within the context of the precursor sequences of which they were a part -- is to be the most probable part of that kind of sequence, leading to that kind of an accident; one of the 12 considered to be second, two of the 12 third, and one of the 12 fourth.

So, as you can see, nine of the 12 PRAs reviewed, on an average, involved in considering sequences involving human behavior, the human error potential is considered to be very,

very high.

Most of these PRAs focus pretty much on operational-type tasks, rather than maintenance.

As you can see here, 83 percent of the human behavior sequences considered involved potential errors of omission, and 17 percent involved errors of commission.

These analyses range from very fine-grained types of things, Arkansas Nuclear 1, down at the component level, opening and closing valves and that kind of thing, all the way up to things like Grand Gulf -- we talked about the system level or some kind of generic term related to human error.

(Slide.)

There has also been a lot of work, as you may be well aware, done with LERs. I wanted to cite two studies that have been done here, one having to do with an Oak Ridge precursor study, and you can see the reference there.

These people took a look at LERs, a sampling of LERs that occurred between 1969 and 1980 and determined 38 percent of all of these involved some kind of human error, either at the component subsystem or system level.

A study by Brookhaven -- and by the way, a couple of you may have a handout that has the wrong NUREG number -- it's 2417 -- are looking at a large sample of LERs occuring between 1976 and '80. 12 percent of those involve human errors. By the way, they focused pretty much on valve-related activities.

MR. CATTON: When you take these numbers, human error frequency, that's 38 percent of the total number of LERs. If you do it in terms of significant events, I think that number gets bigger.

MR. RYAN: I would not be a bit surprised. Some of these studies don't get terribly fine-grained.

As a matter of fact, in the Oak Ridge precursor study, if you take the listing of LERs that are in the report, you cannot even make a determination whether they are errors of commission or omission.

MR. CATTON: You can kind of tell if you just categorize them by the number of hours until they report the event, and you can still run it through the computer to get this kind of information.

MR. RYAN: I'm relying pretty much on the report.

MR. CATTON: There are nine studies of reactor operations for the nine SEP plants, and it's there where the action is separated into significant events and so forth. When you look at a number like this, this number might almost double for some plants when you're focusing on significant events.

MR. RYAN: I would agree with you. This gets us into some of the problems with the LER system itself, as far as how it's reported --

MR. CATTON: The only point I'm trying to make is this number is a low number.

MR. RYAN: Conservative.

MR. CATTON: Not conservative. If you're trying to assess the impact of --

MR. RYAN: I'm saying it's low, underestimated.

The Brookhaven study, of course, they saw only 12 percent of the LERs they scanned involved human error, 51 percent omission. 49 percent commission. As I mentioned, they sort of focused on pumps and valves.

I believe someone asked earlier today about what kind of errors involved operations, which is maintenance. In this study, 40 percent of the errors were with operations people. 25 percent maintenance, 18 percent other technical people, and 17 percent occurred because somebody used their procedures and the procedures were wrong. So, consequently, something went bad.

Oak Ridge is also in the process of completing maintenance records analyses, the records from 1981, '82. They surveyed over 6,000 of these records to determine that approximately 16 percent of the total involved human error.

And one of the interesting things about this, when you look at these data versus PRA data, the thing is practically reverse, 73 percent of these involved in areas of commission and 27 in areas of omission.

Unlike the PRAs, who do very little with cognitive-type behavior in an explicit sort of way, these records were scanned for the operator-maintenance individuals, reading, interpreting, confirming, locating, manipulating, setting, attaching, removing, and recording. And 54 percent of all these had to do with attaching or putting back a piece of equipment correctly.

What I would like to say here, before I move on, very quickly, is that certainly we do have a sense that there is probably some serious human factor-related problems in the industry. There seems to be a lot of disparate evidence from a variety of sources that this is probably true.

However, as I mentioned earlier, there just really hasn't been a well-integrated systematic quantitative assessment of the issue itself.

(Slide.)

About some of the challenges for human factors in a commercial nuclear environment -- first of all, there's the government-industry attitudes and philosophies. As has been mentioned earlier, we basically have pretty much a hardware orientation. As missionaries like to say, "It's a lot easier to convert the heathens than it is those who believe something else, other than the missionary beliefs."

Certainly there's a tremendous problem of unlearning process here. If you look at a hardware approach to a system, a lot of the things you would do with hardware to make it operate efficiently run contrary to the kinds of things that you would do to make it easily operated and maintained by a human being.

So, there is sort of this adversarial kind of thing built in.

Quite frankly, having said that, I think that this industry is probably a little bit lucky, unlike the military aviation industry and so on. The NRC and the industry, fairly early on, when we were going through this tranmission phase from fossil to a nuclear age, has been forced to look at human factors. And hopefully that will, at least to some extend, ensure that a lot of human factor considerations went in to at least future power plants.

The next challenge, of course, is understanding the human factors discipline. And of course there's a great commonsense syndrome.

Also, we are all human factor specialists, and this seems to be something that pervades, not only in NRC but in the industry.

Another problem is the unpredicability of human behavior. Not only do we differ between us, but I perform different on Monday, versus Tuesday, Wednesday, and Thusday, and I'm involved in the development of Human Reliability Data Bank. And we're running around in circles just trying to design what a data cell should look like when you put in all of the modifiers that have to go with any statement -- in this case a human probability statement about an event, because there are so many performance-shaping variables that come into play and so on.

Another problem is human behavior analysis. Here, of course, we're talking about the data source problem, criterion problem. And again, we run into some problem here with the adversary relationship with the facility.

Of course, lastly, our observer biases -- one need only sit down, take a look at maintenance records and LERs to get and feel that everybody is not calling the same thing human error and they're not reporting it at the same time.

MR. WARD: Tom, you have used 15 minutes.

(Slide.)

MR. RYAN: I'd like to say a few quick words about human factors as a discipline. Of course, hopefully, we all recognize it's a multidisciplinary science; we are interested in all aspects of the human component of the system.

Those of us in the field tend to divide ourselves, eventually, up into three specialties. Some of us become personnel subsystem specialists, people interested in what is the system supposed to do -- Do we need people? Who are they? What do we need to have them do? What kind of experience do they have to bring to the situation? How do we have to train them? How do we have to support them? How do we organize them? And how do we permit them to communicate with one another?

Others get involved with what we refer to as human engineering, people interested in external-internal design of hardware, arrangement of hardware, so people can use it and also habitability issues, temperature and radiological issues.

t.17 Some of us get involved in human reliability. Human performance measurement.

Very quickly the processes we like to follow is a feasibility analysis, technology development, test and evaluation and technology transfer. And this first step is certainly to determine if and how a new or existing technique can be applied?

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How can we develop a testable representation of that? How do we test it to determine its practicality, acceptability, and usefulness. And finally, one that is very much that's overlooked is technology transfer creates a tremendous problem; that is, the communication between the producer and the user as to what the user's need is and what the product should look like. And also, a means for communicating utility of the product of the user, handing it off, supporting its implementation; and finally, a feedback system to the producer so it can be approved.

Lastly, and very quickly, tools.

(Slide)

Certainly, these are tools that are required of the specialist, be he researcher, regulator, or onsite engineer. As I mentioned earlier, a first thing is an understanding of what human factors is all about and what it's supposed to do.

Secondly, and contrary to a popular belief, you do have to have a background in the behavioral sciences. After all, we are measuring, analyzing, interpreting, and attempting to influence human behavior. Certainly, we need some familiarity with the existing human factors standards and guidelines. There is a plethora of them.

And certainly, we need some familiarity with the system of interest. And above all, as far as I am concerned, we need a systems perspective. People cross boundaries, and unless you take an organizational or a systems perspective on the thing, it's very difficult to do.

So in closing, I hope the comments stimulate discussions on the importance of human factors in the industry, the subcommittee's perception of the discipline, and particulary the tools that are required. Thank you.

MR. JONES: Here we go.

(Slide)

Here we go from an NRC point of view. Let's see what the requirements we think are for human factors and what kind of educational requirements. This is within us: human engineering training, testing, and examinations procedures, organization and management, personnel and staffing, all based on our knowledge of nuclear power plant operations.

And within the NRC we try to use a sort of multidisciplinary team for most of our investigations for our nuclear engineer, human factors engineer, training expert, whoever it happens to be, to work together to make this happen.

(Slide)

What kind of recourses do we think now? This is something of a wild guess. Within the NRC we have some 40 reasonably trained human factor-type specialists or nuclear engineers with human factors experience. Government labs, we can identify 20 with nuclear experience; in the universities, about 25. And if you look at the contractors out there, there are about 150 of them that say they have this kind of background and experience.

I won't guarantee the absolute value of these numbers, but they will give you a relative idea.

(Slide)

Talk about resources and requirements. The human factors support to the nuclear industry. Our technical assistance budget in the Division of Human Factors Safety is $4.7 million for 1984. Research is about $5.8 million. The analysis evaluation of operational data group has about $200,000. They are getting started, about 40 personnel in-house.

(Slide)

If you take a look at INPO and EPRI, EPRI has two human factors psychologists and about $1.4 million. INPO spends about $5.2 million in their budget, and about 46 personnel. However, most of those personnel are involved in training and personnel qualifications.

That's the orient, a little bit in management and organization.

MR. CATTON: Are either of the two at EPRI involved with the DAS program?

MR. JONES: Yes. John O'Brien, particularly.

MR. CATTON: Who else? I know Ron Duffy has a degree in psychology.

MR. JONES: The two that I nkow are Jack Paris and John O'Brien.

MR. CATTON: So there are three in EPRI.

MR. JONES: Okay, you got me. We had one-third increase in EPRI size.

(Slide)

As I say, these numbers are pretty rough. To give you an idea, if you look at industry requirements from a human factors point of view, if I take Generic Letter 82-33, in that we said each utility must have a human factors member of its review team for the design development of the SPDS and related emergency response facilities at $100,000 a man, 43 utilities, $4.3 million, about 43 personnel.

If I look at the nuclear steam suppliers, I have Westinghouse that has ten; General Electric has three that I know of; Combustion Engineering has two; and Babcock & Wilcox none. So I have 15 people at $100,000 apiece, a total of 55 personnel requirements within the nuclear industry and about $15.5 million.

(Slide)

Now, if I add that all up together, I find that government, NRC, and government laboratories, universities, contractors, nuclear industry, I have something like 336 personnel out there that I can have requirements for in the human factors business in this next year.

If I assume there is an annual attrition of about 10 percent, which the Labor Department says is about right, I have an annual requirement then, based on current levels at least, of a minimum of 34 personnel ever year that I have got to train and get ready to get onboard.

If you look at it also, the budget totals up for these activities of around $37 million that I can account for directly. The result of this is we think there is a significant shortfall in the human factors personnel that we think are needed to man the industry. And recognize also that that one human factors specialist per utility does not include training personnel; strictly human engineering at this point in time.

So it doesn't include trained experts, trained psychologists, behavioral scientists to conduct the training programs, the training operations, all the statistical evaluation and development that Dr. Pearson mentioned earlier this afternoon.

So that's a low number. And if I wanted to be real optimistic, I could probably double or triple that rather quickly by including a number of training personnel that the utilities should have.

MR. PEARSON: I am just curious. Why do you refer to all these psychologists?

MR. JONES: That's my shorthand. It shouldn't be psychologists. I really have a personal view. My personal view says they ought to start out as industrial engineers. But behavioral science, at least.

MR. WARD: Does that sound all right?

(Laughter)

MR. JONES: I might add, I didn't start as an industrial engineer.

MR. WARD: Thanks, Dan, that's just the sort of background we were looking for.

MR. JONES: Incidentally, we within the NRC would be very pleased if we could have several university-type interns that spent a year or 6 months at a time or a year with us as interns in training while they were going to a university, of course, coming back on a rotating basis. That would be just ideal.

MR. CATTON: We get good students. We keep them.

(Laughter)

MR. WARD: That's it. Gabe, can you two fellows do it in half an hour?

MR. PEARSON: I can.

MR. SALVENDY: I can do it in 20 minutes.

MR. WARD: You have got 12 minutes then, Dave.

MR. SALVENDY: What I would like to talk about is, very briefly, I will talk about four slides.

(Slide)

I would like to indicate what are the main problems, the way I see it.

(Slide)

The significant problem, one, we have a shortage of manpower to really deal with the issue in two ways. One way, we need to have people to implement what has to be done; and secondly, we need to have human factors people to germinate new basic generic information which the nuclear industry desperately needs in order to have a safe and effective operation.

Much of the research work up to now for NRC has been focused around contractors. Universities have been completely omitted from it. The reason why they have been omitted is because all the work that has been done waas predominantly project-oriented, which really hasn't addressed generic issues.

For example, if you come into the issues, such a simple one as task analysis, we to a great extent still use the same methodologies that have been developed for old technology, try to apply it to the new technology, and NRC doesn't have the ability by virtue of a mandate to carry out basic research to come up with a generic analysis that would be applicable to the technology of nuclear power plants.

So if you have a new design coming up, you don't have to reinvent the whole task analysis again, but you can apply your new methodology.

By most conservative estimate -- and we have seen more detailed results -- at least 50 percent of all critical incidents in nuclear power plants are assumed to be associated with the human side. So we have some degree of human problems here that we need to overcome.

(Slide)

My feeling is if there is a disbelief that there is a shortage, I recommend that a study be conducted. Of course, we already heard quite a good presentation this afternoon -- which I didn't expect -- that already indicated there is some degree of shortage. I indicated in case somebody wants to do it, they could confirm that such a shortage in effect exists.

Now, when we are talking about the development of training centers in universities, one has to bear in mind --

MR. WARD: Gabe, could I make one comment? I guess we really didn't hear that there was a shortage. Dan gave us an estimate that the nuclear industry needed about 34 people a year, but we didn't hear what the supply was.

MR. CATTON: His final statement was that there would be a significant shortfall in the number of people needed for a year to fill the industry's human factors needs.

MR. SALVENDY: Let me address that issue. I have only subjective data, and hence I suggest, number one, in case anybody doubts, my only doubt is I get about 15 inquiries per each student that I am graduating, which tells me something, that there are obviously more people that want them than we can supply them. And this is a very subjective one. This is only about 30 to a university.

But when I talk to colleagues in other universities, I find that they get a substantial number of requests for their students that they cannot fulfill the demand. This is not a systematic study, and I realize it's a very subjective one, and has, in case anybody doubts it, you know, I think NRC could undertake a study because, after all, research frequently is carried out because common sense or experience is not all that good and you need some hard data. So a study could be undertaken for the sake of proving the obvious.

In terms of a university, when you talk about a training center, you are really talking here about having your cake and eat it. Why? Because the majority of students who are going through a training program have to be engaged in research.

We have indicated now, and also in previous discussions, that NRC spends practically no money in the human factors area on basic research. Yet, in the other areas, NRC spends substantial amounts of money, I understand from my colleagues, on basic research.

Basic research is not research for the sake of basic research; it's to answer questions that currently we can't answer, such as human error in a very generic way. So we could in effect contribute to the basic research knowledge in the nuclear industry and at the same time train people who could apply that technology outside.

In terms of cost, it's my estimate that to train about ten master-level students in the human factors area will cost around $200,000, and that's a typical outfit per training center, maybe ten students a year.

MR. CATTON: That's a 1-year program?

MR. SALVENDY: 1-year program.

Let me table number 4 now for a moment, and let me proceed.

(Slide)

In terms of if one looks at what a typical program of this sort could look like, I don't want to go into details, I just thought I would present a quick example. And, of course, one can have a variety of different models.

One, I believe anybody who goes into the human factors area should know something about nuclear engineering. The majority of the people that have been referred to them know about the nuclear industry as human factors specialists; they don't know about the nuclear field at all.

So first, one would need a basic course that would introduce a student to the basic area of nuclear engineering, some of the items that I tossed out here.

(Slide)

Other types of courses that one would go through is the classical human factors course, the very basic typical McCormick-type course. One would have typically a course in the human computer communication area; one in the human information processing; decision and detection model area, one that I labeled functional analysis design and system documentation; one I labeled human quality assurance, which would include also the whole problem of human error causation and reduction; the issue of personnel selection and training, how you select people and hop you train them most effectively; and then the last one on what I call environmental health.

Of course, when you have such a program, there is always an issue of what to include and what to exclude. And one could argue on a different type of a program here. But that basically would give a framework.

Now, what one would really like to see happening here basically, we basically indicated there was a shortage of manpower on the one hand. We are indicating that we are really concerned that not only there is a snortage of manpower but it is also lack of basic research in the human factors section of NRC to answer some of the critical issues that affect safety.

Well, we currently have a budget. There is currently a budget which they have already difficulty to meet some of the application areas.

Well, you know, when you are poor, there is only so many things you can do. Usually, when you are poor, you can't do anything. You can't wear a good shoe, you can't wear good trousers, and you can't eat well.

Now, if we basically said that there is 50 percent of all human error causation as a result of the human aspects error causation. Yet when we go back to the budget -- and of course, the nucleat industry's lack of sufficient progress is attributed to the fact that people are concerned about incidents, which errors lead to incidents.

Now, if all this is true, then we look on the human factors budget and we see that the total human factors budget is only 5 percent of -- I see the fiugre "3."

MR. CATTON: 3 percent.

MR. SALVENDY: I like to be an optimist. Let me have the 5. That looks better. I get the figure of 2 or 3, whatever it is. I get a small figure, very small, minute.

Now, what happens? With that type of percentage, you obviously cannot do all that because if you try to do all tnat, you won't be able to do any of them. So what it means, I think -- I think to this committee I would like to recommend that basically the human factors group be asked -- and I don't know whether it is right to ask; maybe there is another word to use -- to prepare a document where by the document would indicate the following, because there are very good people there, first-class people there and they know exactly what is needed. They don't do things that need to be done because they don't have resources.

I think if we could have a document prepared based on their knowledge, what do they think are some of the basic generic research issues that need to be answered in order to decrease the occurrence of incidents and increase safety in nuclear power plants, which currently we cannot do with our current technology, what are some of those main issues, how much would it take to really embark on significant research programs in this area?

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Second, what they who are in the human factors -- they know the best, they're the closest in the industry. What do they think -- what size of training program would they like to see. How many do they really feel need to be trained, and in what mode of operation and management form would they like to see this working?

And I feel in this committee, in addition to doing nitpicking jobs on small lines, we have to address the main issue of how to raise more money for the human factors group to do the type of work that they really ought to be doing. And I think with a good document with a good argument and with the potential support from this committee, I think there is some possibility that the figures may be changed. If the figures are not changed, we can't do any of the things we're talking about, even what some of the clients are talking about would be done in a very mediocre way, not because the people aren't good, but because there are insufficient resources to do what needs to be done.

So my specific recommendation is to prepare a document, bring it in front of the committee, or whatever this group is called, the official title of it, have us discuss it and I would recommend that it go up and we do lobbying, like the chairman does, lobbying on it to increase the budget.

Thank you very much. I'm ahead of my time. I talk fast.

MR. WARD: Any questions for Gabe?

MR. REMICK: I guess I have one. I certainly agree with essentially everything you say. You know, the multiple benefits of the research you get out of the graduate education. Unquestionably, the support -- I wish more of the human factors-related research from the NRC would go to universities rather than to national labs or contractors and so forth, because it's easier to do that than through national laboratories.

I guess the thing I don't see is your overall proposal for the NRC to get into education and training -- I don't see that as an NRC function. I see it as more of a DOE INPO function. They're doing that type of thing in nuclear engineering and in other fields, helping out. I don't quite see NRC as a regulatory agency getting into that. I see it as kind of a developmental type activity, more appropriate for DOE and INPO.

I wonder if you had anticipated that type of response.

MR. SALVENDY: Yes, I surely anticipated that. If you look into the area of NIOSH and OSHA, there's a very similar setup, basically, only it's designed for industries, other type of industries. I understand it also applies to the nuclear one. But they predominantly are in other industries.

Well, when the 1970 OSHA Act came into law, there were not enough people around the country to be really implementing the safety rules and developing basic safety methodologies for industry to use. So what NIOSH did, they established training centers, in effect, -- Dr. Pearson will be talking about it. He had one for many, many years. And the purpose of this training centers by NIOSh was to train human factors with specific emphasis on safety and health to be used for two purposes. One, to develop research while they are trained, and once they have been trained only to the master level -- no training to the Ph.D., very few people trained for Ph.D. A few places offered Ph.D. I would say maybe 90 percent of NIOSH's money goes to training to Masters' level, and these people go out. There are a number of centers around now, the University of Michigan, North Carolina, New York University, specifically training in this area. It's a similar type setup to NRC.

MR. REMICK: The AEC did it, but I think they did it as part of their developmental function rather than the regulatory. As I say, DOE and INPO is doing it right now, supporting what I would call nuclear engineering education.

MR. CATTON: EPA does it.

MR. SALVENDY: But they don't train professional human factors people.

MR. CATTON: What I'm referring to -- I don't care who they train. EPA is a regulatory agency almost like NRC, and they have centers to do research in various areas. Students do the work. The students are being trained.

Unless you're talking about something different -- it sounds like the same thing. What you want to see is the money coming through to train the students. The government did that when they wanted a space program. They just poured the money into the universities and you have an excess.

MR. REMICK: You have to face the fact there's a DOE and an NRC. There is an EPA but there's not something else beside it.

MR. CATTON: So EPA has to take on that responsibility maybe.

MR. REMICK: AEC took it on at one time, but I think it was under the developmental program.

MR. SALVENDY: The way I was looking at this situation is that NRC's is a regulatory one. If you can't do what you need to do because you're short on manpower and you can't get the manpower to do it, you need must yourself develop a methodology so that you can be a regulatory -- you can do what's needed to be done. Currently, you can't do it because you don't have the manpower.

MR. REMICK: The thing I'm trying to get at is if DOE and INPO are doing it now, maybe they should be made aware of the fact that they should broaden that to human factors activities, too. I assume right now you can't get a traineeship and so forth with DOE and INPO probably, in the human factors area.

MR. CATTON: If you said it was dedicated -- if it's focused on nuclear,you could. The INPO fellowships don't designate that as nuclear engineering; therefore, it's like nuclear operations. The peripheral kind of discipline. As long as the student's goal is to go out into the nuclear industry, that's the only requirement.

Another one -- NRC and RES in the past have given out grants. They have a charter to give out grants. What Salvendy is talking about isn't a grant. It's just that for some reason, RES has chosen to trip off that kind of funding. It's not that any regulation has cut it off; it's been the choice of the head of RES to do that.

MR. WARD: But he's talking about something more organized and centralized than the individual grant program.

MR. CATTON: These are usually grants to do basic research.

MR. WARD: Yes, but they're one at a time. He's suggesting a center --

MR. CATTON: Typically, they are $100,000 a year for three years.

MR. WARD: But in his plan, there would be some continuity there.

MR. PEARSON: Maybe I'll answer some of those questions.

MR. WARD: Monroe had a question.

MR. KEYSERLING: It was just a comment. I'd hate to see this idea dropped because of some jurisdictional type thing. At the same time, I'd like to point out that in the OSHA-NIOSH area, OSHA is the regulatory arm. OSHA does not support training. NIOSH is the research and training arm, and the training centers are sponsored under NIOSH.

I would hope that a similar model or approach could be accomplished here that would have the same outcome, and that this subcommittee could do whatever is necessary to get such a program underway.

MR. PEARSON: Gabe has already stolen a little bit of my thunder. I think what I have to say, in some respects, may differ with what Gabriel had to present. So let me say a little bit about where I'm coming from.

Gabriel has already mentioned that I have had a NIOSH training grant. In fact, the grant was originally funded by Public Health Service in 1968. It's still in existence and funded by NIOSH as part of an education resource center. NIOSH funds research grants and training grants, and they are done by a study section. I served on that study section for four years, so I'm familiar with review of training grant programs, and their latest venture which is what they call the ERC, Educational Resource Centers, which focus on the training of physicians, nurses, industrial hygienists and occupational and safety specialists. That's a training grant program.

The other thing I did want to mention is that in the educational area, I have edited a directory of educational programs back in 1979, where I surveyed all the programs in the United States, as well as the rest of the world, and have been Chairman of the Education Committee of the Human Factors Society. I mention this because I think my statistics disagree with the gentleman and Dr. Ryan over here who spoke earlier. I'd guess he probably got his statistics from the American Psychological Association.

But anyway, commenting on that, the directories may list 50 or so programs in human factors in the United States, but a good many of those programs are not worth diddly. Many of them are run by people that are not human factors professionals. Many of them are run by people that are part-time faculty. There are really a few finite number of good human factors programs around the United States that teach the kind of courses that we're talking about in this room.

Now, what is our dilemma?

(Slide.)

The educational programs in our field, the good programs today are mostly based -- and somebody's going to start throwing eggs at me -- in industrial engineering. There are more programs located in industrial engineering departments today than there are in psychology. That's a fact.

The applicants for the programs, however, whether you're talking about psychology or industrial engineering, most of the applicants are undergraduate psychology majors.

In terms of marketplace factors, the industrial engineers pay more, they get more money, and this is probably one of the reasons that a lot of the psychologists come over to that side of the house. That is, they apply directly to industrial engineering programs. But Gabe has already said something about the demand for our graduates. I was going to quip to Gabe, Gabe, you must have one student if you got 15 letters -- that's a 15 to 1 ratio.

MR. SALVENDY: It may be just the quality of the program.

MR. PEARSON: I'm saying if you have one student and 15 letters, you have 15 letters to every one graduate.

Anyway, the problem here is the background of the applicant. Going back up to the marketplace factors, the industrial engineers get paid so well as undergraduates with their undergraduate degrees that it's difficult to attract them to graduate school. You know, why go to graduate school when you can start off at $24,000 a year?

So it's very difficult, and I think Gabe would agree, to try to get a good engineer to go to graduate school for a Master's degree on an assistanceship or fellowship or something that pays four or five, six thousand dollars an academic year.

The other problem is the prerequisite is that many of the students that apply do not have things like calculus, physics or computer science. Certainly, they're not going to have thermodynamics or differential equations unless they have an undergraduate engineering degree.

The program that I would foresee would involve admissions of students into a traineeship program of nuclear engineers, industrial engineers, other engineers and physicists, and people from psychology. The psychologists would have to make up their deficiencies which probably would take them maybe a year. I'm not saying they have to get right into a traineeship program, but they have to understand that they're going to have to maybe spend a year or so making up their deficiencies in the mathematics area, in courses like physics and thermodynamics.

The program that I see, which differs from Gabriel's, is something like this. I think it would take at least two years, but I'm talking about either an MS or a Ph.D.level program, one or the other but not both. Because I think we need both Master's level as well as doctorate level people.

It would involve a summer utility internship. There would be no NRC employment contract, and this is the issue that Forrest raises. There was an attempt to get the NRC to support the traineeship program for nuclear engineering, I believe about two years ago, through the Oak Ridge-associated universities. And I understand it failed because the legal counsel for NRC said we are not in the business of funding university traineeships.

So there are a couple of issues that have to be explored there. One is can NRC do it, A. And B, if they do do it, does this commit the person to spend some time working for NRC?

NIOSH doesn't work that way. NIOSH gets a gift.

The idea, of course, is that they would follow a program that's outlined in a grant proposal, and when they finish they can go to work anywhere they want to. Course work would involve nuclear engineering, human factors, ergonomics, safety, simulator experience at a local utility and a project for a Master's degree in a non-thesis project. Because with the program I'm going to show you, I don't think there's room to do a thesis.

So I think our views differ a little bit there.

The other thing I would point out is this program could be a minor for a nuclear engineer. That is, if there's a nuclear engineering program, the human factors side of the house could provide an effective liner for a student in nuclear engineering.

My view is in terms of the number of students that the universities could be expected to attract, I would say you'd be lucky to get six to eight students into a program for a year if you offered, you know, a reasonable fellowship stipend. You're just not going to get that many applicants because the engineers aren't going to want to go to graduate school. You're going to get most of them from psychology departments, and they're not going to have the prerequisites anyway.

So in terms of qualified applicants to programs around the country, if you had five programs you're going to be lucky to get six to eight good people that you would want to put into a program and say okay,they're in the program and we can turn them out in a couple of years.

So I don't see this as, you know, on the order of 10, 15 students at 10 or 12 universities. I don't think it could ever be that large. What would the program look like?

MR. REMICK: Let me ask a question. Should it be 10 to 12 at one university, if there was such a program, versus 6 at three? That's a touch decision for universities to make.

MR. SALVENDY: If I may respond to it, in my note that I sent out on page 2, which is in front of you, page 2, item (b), I recommended that my hunch was that half of the need for human factors could be met in the nuclear industry from other sources, from the current sources. My recommendations was to train -- on page 2 -- a total of 16 students, and 6 Ph.D.'s over a five-year period, in two to three universities.

So the idea would be basically that you had about 15 Masters a year, and about one Ph.D. coming out from the program, and that you'd have it in two -- you could have about five or six in any university.

MR. REMICK: My question is should it be one versus two or three?

MR. SALVENDY: You want a variety. You don't want

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them to go up with the same training.

MR. REMICK: I expected that answer.

MR. PEARSON: My answer there is, what I do is I look at all the nuclear engineering programs in the country, I looked at the human factors countries around the country, B, and C, I looked at where the NIOSH ERCs are located around the country. If you say that a program should embrace those three elements, there are only three universities in the country that would fulfill that requirement.

That is, specialization in nuclear engineering, human factors, ergonomics and occupational safety. There are 10 to 12 universities in the country that have both nuclear engineering and human factors ergonomics programs, but then they don't have occupational safety or health.

So it depends how wide you want to open the door. That would give you an idea of what the competition would be like.

MR. KEYSERLING: I'd like to make a comment on that. I think that number doesn't intend to necessarily beset ahead of time any specific numbers of schools, but I think a school that is giving this type of program should have a minimum of 10 students so that you have enough to make a program.

One thing that I would hope the NRC or whatever sponsoring agency does not do would be to follow the NIOSH mold of trying to establish this type of program where one does not necessarily exist, and the basic existence of a program would be nuclear engineering and human factors, and perhaps the capability or past record of working together.

One of the problems that NIOSH is facing 10 years after -- well, not 10 years -- 6 years after it established such a program is that the federal funding for the program has been cut back quite a bit, and places where programs were essentially created because funding was available are suddenly cutting back and they are not necessarily offering all four options.

And I think by only providing student support in terms of stipends and tuition and perhaps some research money and things like that, if we go with existing programs that it can be done on a competitive basis and things will probably fall out pretty well.

MR. PEARSON: I didn't know whether you wanted to get into the dynamics of that, but what NIOSH did was they set up some guidelines, essentially, when they wanted to establish ERC, saying what they should be like, solicited proposals, and then they sent site visit teams out in the field to take a look at these proposals, and not all of them were accepted, obviously. And I presume you would want to do the same thing, to evaluate them using certain criteria that were pre-established.

(Slide.)

Let me go on, then. In terms of the program that I'm recommending, this would be shorter if a person entered already with a Bachelor of Science degree in nuclear engineering. But the concentration -- I see some 39 hours in industrial engineering, human factors system design -- of course, system safety. That would get into things like fault analysis, failure modes and effects analysis, and so forth. Human performance theory, a course in occupational stress, course in environmental stress, a course in quality control and reliability. A seminar on human factors in nuclear power plant operations which would introduce the students to the control room environment, its problems and all the NUREGs and so forth, six hours of statistics, six hours of a summer internship at a utlity, and project work for the degree.

That's 39 hours in the major. The minor would have 9 hours in nuclear engineering -- I won't go into the details of those courses but there would be a fundamentals course, a reactor systems course, and a reactor and environmental safety course, and a minor in psychology of six hours, and a selection and training program. Total of 54 hours, and that's going to take two years plus the summer. Two academic years.

I've got a question here. Option is a psychology major. Some programs in the United States -- Dr. Salvendy's at Purdue, mine, Texas Tech -- have programs in both departments, psychology and industrial engineering. It would be possible to major in psychology. Some of these courses, for example, might be cross-listed. And a minor in industrial engineering. But they would still have to have those prerequisites that I mentioned earlier.

Another possibility is that a student might already have taken a Master of Science degree in human factors or ergonomics in either one of those departments and go on to a program like for the doctorate, and wouldn't have to take some of these courses because he's already had those.

Okay.

(Slide.)

The final viewgraph addresses the budget things. This is based on the NIOSH model.

Generally what you're looking for here is a ratio of where the stipend funds for the students is much greater -- certainly over half of the total budget. In this case, it's about three to one. In other words, the $75,000 going to the students and $24,000 to the program director and the things necessary to support the program.

I think this budget, which is based on six students -- by the way, to answer a point, I was talking about six students the first year. Since this takes two years, we're talking about having 12 students in the second year, so there would be 12 students in the program based on this model. So, this budget would probably double, not quite double the second year.

This figure would be the same.

This figure would be about the same, maybe a little bit more. This figure would be double.

So, 150,000 and 35 would be about 185,000. I figured roughly about 200,000 by the time the second year is rolling, and five centers would be about a million dollars.

This is compatible with the Oak Ridge Associated University model, which figures about $12,000 per student, plus $6,000 for the university, or a total of about $18,000 per student per year.

So, if you multiply 6 times 18, you get 108,000. So, that's probably a good figure.

The NIOSH centers -- there are 15 of them now in the United States, and while they were supposed to be funded at about a million dollars a year, they are funded now effectively somewhere in the neighborhood of 600,000 plus or minus 100 K. Some of them were funded at the $700,000 level.

I don't know what Harvard's his right now. Carolina is up in the 700,000. But I think there are a few funded down in the $500,000 range.

Does that sound about right, Monroe?

MR. KEYSERLING: I don't remember the numbers, but I think the total federal budget was 5.3 for everybody. So there were very significant cutbacks, across the board, and even moreso in selected schools in the past year.

MR. PEARSON: This figure doesn't include overhead.

MR. SALVENDY: I was thinking that figure is very close to the 200,000 I tossed out.

MR. PEARSON: About 200,000 for ultimately about 12 trainees.

MR. CATTON: $20,000 per student-year is about right everywhere.

MR. SALVENDY: That's fairly standard throughout the country.

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MR. WARD: Okay. Very good.

Thank you.

MR. SALVENDY: I have a question. Where do we go now? We had a presentation -- I gave a little presentation, and Dick gave a presentation. What do you see the next action regarding this matter? Where can we follow?

MR. WARD: That was what I just was going to say. It's not clear to me -- it may be that the NRC will be able to fund this sort of thing, but I think it looks very interesting.

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What I hope is -- I will attempt to get the committee as a whole interest in this, even if it's something that has to go outside the NRC. Perhaps we can serve as a catalyst for getting something going.

However, I do think I need some little harder data arguments or something on the needs -- you know, Dan Jones presented some number that he thinks the industry needs 34 a year. I'm not sure what is being supplied now. He said there was a shortage, but that was just an opinion.

I don't think we can take the time now, but if anybody has got any input on that or suggestion how we can get some input, I would like to hear it.

RM. SALVENDY: I think -- I don't want to take your time, but I suggested in my item there that the way you can do it, you can carry out a little study, basically survey the

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utilities and find out how difficult they find to get people.

MR. WARD: Maybe that's what needs to be done.

MR. SALVENDY: I think such a small study could be undertaken.

MR. PEARSON: May I add a couple of points there?

The value of a traineeship program is that it focuses the training in a special area. Without the traineeship program, you would rely on a cafeteria selection from the universities that have programs, and they're not going to turn out the kind of person that I have got listed there on that viewgraph.

The other thing is if we're going to do something like this, it takes time to set up the criteria to issue a call for a proposal. I'm not even thinking about getting it in the budget. But the proposal should probably be going out like in the fall, so that -- I mean the RFP -- early fall, so that the proposals could come in during the winter and be evaluated and awarded in the spring so universities can start recruiting.

So, I doubt seriously that could be done this year.

MR. WARD: I was wondering if you were talking about this year. There's a fall and spring every year.

MR. CATTON: The RFP process within NRC, if it worked in six months, would be a miracle. The RFP procedure is just terrible.

MR. SALVENDY: I think we are very far from the RFP. I have an idea a lot of groundwork is needed. What I really would be interested in is what type of procedure would you like to follow that we would reach the point where one may want even to consider to go through an RFP, and I think there's a lot of work to be done. And I am concerned that we spend about an hour here, that we just don't talk, the information goes in the minutes and nothing happens to it.

MR. WARD: At this point, you'll have to have a certain amount of faith that something will go on. I will try to make it go.

MR. DEBONS: I would like to ask Gabe a quick question.

MR. WARD: Could you do that during the break? Or do you think we all need to hear the answer?

MR. DEBONS: Very quickly. Have you considered the alternative in the nuclear people, the nuclear industry will support an educational institute in this regard?

MR. SALVENDY: I haven't.

MR. CATTON: You should probably talk to INPO. They would be the ones that --

MR. DEBONS: I just passed the question to him.

MR. SALVENDY: I personally am not specifically all that hot myself to get one at Purdue. I think the industry -- I'm up to here. I'm not looking for more work myself. I feel the industry needs it. I'm not lobbying for myself. I'm up to here. I feel we need it.

MR. WARD: Let's take a break until 4:30, and we'll get started then.

(Recess.)

MR. WARD: Mr. Norberg, if you would go ahead.

MR. NORBERG: I'm Jim Norberg, Chief of the Human Factors Safeguards Research Branch in the Office of Rsearch.

We are here to discuss our proposed FY '85 and '86 budget in the Human Factors area.

(Slide.)

I will try to go through this quickly since we are running pretty late.

These are the program areas that we are funding. We have broken them down into four areas: The licensing and qualifications area includes training and picks up that aspect of it, where the human factors program plan breaks this down a little bit more, into more areas. We are the same, except in the licensee personnel qualifications, which is lumped together. Our total budget is shown on this slide.

Now, to put this in perspective, in '83 we are spending 27 -- 2.7 million in human factors engineering. In '84, we're projecting to spend 2.1 million in this year. '85 -- what's on this slide. The licensee personnel qualifications, we're spending a little over 1 million in '83, 1.3 million in '84, and then it's projected to go up in '85 and '86.

Plant procedures, we are planning -- we're spending approximately 5 million in '83, 7 million in '84, a little bit more in '85 and '86.

MR. WARD: You mean 5 million or 500 K?

MR. NORBERG: Excuse me, 500,000 and 700,000.

MR. SALVENDY: May I ask for clarification? The figures you have here, are these the funds for outside funding, or does it include the in-house personnel?

MR. NORBERG: This is outside funding.

This does not include the staff salaries or our travel or any of that sort of thing. This is contract.

MR. SALVENDY: Human reliability is 1.3 million in '83 and 1.4 million in other years.

(Slide.)

In the human factors engineering area, again we are proposing 2.4 million in '85 and the same in '86. This is broken down into the following specific areas: Display design and control room auxiliary station standards and guidelines. We're spending approximately 600,000 in '84. This is actual funding. Our funding level only shows 75 because we forward-funded from '83 into that area.

We are looking at '85, at about 350,000; and '86, at about 150,000 -- in this area.

This is the work going on in IDAS that I think you're familiar with that we discussed several times.

The second area is the evaluation of computer-based diagnostic systems for aiding operating actions in accident management. This is a new program. We're really getting started.

In '84, we're looking at about 200 K. In '85, about 400 K. And '86, about 500 K.

Another new area is standards and guidelines for maintainability. This will be an adaption of industry -- EPRI, INPO design criteria for the engineering, human engineering aspects of maintainability. And in '84, we're looking at approximately 100 K; '85, 200 K; '86, 300 K.

In the advance control rool criteria development -- this is one that we are trying to get started this year -- in '84, it will be about 200 K; '85, 300 K; and '86, 300 K.

(Slide.)

Evaluation techniques for reducing severe stress effects on nuclear operating personnel -- this is getting started this year, and it is using the seismic event as the driver. In '84, we're looking at 100 K; '85, 200 K; and '86, 200 K.

Guidelines for function allocation, we've got 100 K in '84, 105 K in '85, and 100 K in '86 allocated for this.

Guidelines for application of automation tc

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man-machine system functions -- we have 100 K in '84, 150 K in '85, and 200 K in '86 in this area.

- The Halden Project is the project, the international project that we are funding, which also includes work in the fuels area. But the funding for this project comes out of the human factors budget, and it is 500 K in '84, '85, and '86.

And the Halden delegate, whom we keep over there for one of the laboratories, is 225 K in '84, and 150 K in '85 and '86. The reason for the higher number is these people are over there every two years, and when we c. ange delegates, it costs us more to bring them over and take them back. So, it's a little bit more. It's approximately 150 K a year to maintain a delegate at the Halden Project.

end 21

And then in 1984, we have quite a bit of money that we're spending in the task analysis data application that may carry over into 1985 if we don't finish up with it in 1984. But we were planning to finish that, and that was a set-aside this time at about $500,000 to apply the task analysis data. That doesn't show on this slide.

(Slide.)

In the licensee personnel qualifications area, we are spending in the personnel entry level qualifications, training guidelines, standards for training programs -- that should not be NRR; that should be NPP, I'm sure, at least my slide shows NRR. It's nuclear power plant training. We are spending $400,000 in 1984, $400,000 in 1985 and $300,000 in 1986 in this area, we're projecting to spend. And this is a program that's ongoing in 1983, we're trying to get it started in 1983.

Methods to scale human operator job performance is project to spend $400,000 in 1984, $400 in 1985 and $400 in 1986, [illegible] f funding program. Training simulator experiments is an ongoing program, and we're planning to spend $400,000 in 1984, $400 in 1985 and $400 in 1986 in this area.

Evaluation of operator training for severe accident management is a new program, and we're planning to spend $100,000 in 1984, $200 in 1985 and $250 in 1986 in this area.

Maintenance personnel qualifications and training is a new program. We're not spending anything in 1984; we're starting it in 1985. We have projected $200,000 in 1985 and $250,000 in 1986.

Staffing and manpower modeling is a new program that will start in 1985. We're projecting $250,000 in 1985, $400,000 in 1986.

(Slide.)

In the plant procedures area, the evaluation of alternative techniques and formats for preventive procedures is a program that is getting started in 1983. We are projecting $250,000 in 1984, $200,000 in 1985 and $200,000 in 1986 in this area.

Next is human factors evaluation of operator actions in severe accident sequence studies. This is a new program projecting to get started in 1984 at $200,000, in 1985 $300,000, and 1986, $300,000.

Evaluation of maintenance procedures effectiveness, guidelines and standards to support regulatory actions is a new program starting in 1984 at $150,000. 1985 is projected to be $250,000 and 1986 $300,000.

And a new program, feasbility study of applying artificial intelligence concepts to computer-based procedure prompting systems, we're projected to start in 1986 at about $100,000.

(Slide.)

In the area of human factors, human reliability, this is a program that was in direct support with the probability risk assessment effort. You heard some discussion of this from Dr. Tom Ryan a few minutes ago. Human errors data acquisition area, this is an ongoing program. In 1984 we are spending $930,000, 1985 $500,000, 1986 $400,000. That is involved in several different laboratories' programs.

Human error data base, again, is an ongoing program. We're spending -- we're projected to spend $245,000 in 1984, $150,000 in 1985, and right now, $350,000 in 1986.

Reliability specialist aids -- this is a program that we will get started in 1984, projecting at $225,000. $300,000 in 1985 and $200,000 in 1986.

MR. SALVENDY: Could you say a couple more words about this reliability specialist aids, since it can mean different things to different people? The last one, if you would care to say a couple more words about reliability specialist aids. What do you have in mind?

MR. NORBERG: Well, one of the first products -- and this will be a product that we'll have this year -- is the handbook by Allen Swain. That's a specialist aid. What we're talking about here are the aids to the human reliability specialists, the guy who does the PRA aspects for human reliability. It's those kinds of things. There are two or three different approaches that we are taking here, one of which is the Swain approach. There are some other approaches, expert judgment being another approach. The Swain approach, which we will try to consider, performance-shaping factors such as fatigue and stress. These are the things we're talking about.

MR. SALVENDY: Do you actually view this more as -- the reason I'm asking is because this could fall into a basic researcher, if you so wish, or it could be applied so much that basic research could be associated only with the dissemination of information. And using a booklet, for example, in the area of stress and fatigue, is a practical way that it would be useful for those people who would deal with reliability. Or you could address some basic research issues in the area of stress and fatigue.

And I wasn't sure which of the two you had in mind.

MR. NORBERG: I could let Tom Ryan discuss it directly if you'd like to hear from the project manager.

MR. RYAN: Basically, what we're talking about here are methods, techniques, models for the PRA specialist to actually do his unit reliability analysis with the PRA. How do you model a precursor sequence, take account of the performance-shaping factors? How do you deal with the inter-dependent conditional probabilities? How do you deal with cognition?

This also applies to work that we're doing concerning a better job of integrating the HRA process into the PRA process itself. I don't know how familiar you are with PRAs today, but the human reliability aspect; this is pretty much a peripheral activity. The specialist is not really involved in the initial human actions analysis to make a decision about which sequence involved human action, given these things, computer probability systems on THERP, techniques for human error rate predictions.

MR. SALVENDY: I don't want to take more time, but if I read it correctly, this, in effect, could be -- the product of this could be, in effect, just a collection of current body of knowledge and put it in a booklet form for a practical use.

MR. RYAN: No. More what we're getting at here is a procedure or a model for actually taking performance-shaping factor data and so on and actually introducing it in an event sequence.

On the other side of this, we're also talking about incorporation or integration of the human reliability part of the PRA into the reliability process. The earlier stuff is the actual data acquisition.

MR. SALVENDY: Thank you very much.

MR. NORBERG: All three of these programs are ongoing programs basically, and they are at more than one laboratory.

A couple of new programs in this area --

(Slide.)

-- we are projecting for 1985 and 1986 man-machine systems evaluation and we're projecting that at $225,000 in 1985 and $225,000 in 1986. Man-machine systems design guidelines is also projected to start in 1985 at $225,000 and continue on in 1986 at $225,000. Those are two new efforts.

That pretty much very quickly goes through the projected budget. We could have talked in more detail about each one, but I think in view of the time limitation, I will just drop it at this point unless there are specific questions that some of you would like to ask.

MR. WARD: That's good, Jim. What I don't see is anything in the area of management effectiveness research.

MR. NORBERG: That's correct.

MR. WARD: I didn't expect it. We agreed last week --

MR. NORBERG: You know the story of that. You don't see anything because there's nothing projected in this timeframe at this time.

MR. WARD: So we might take a few minutes to air that issue for this audience. If you remember, last fall or whenever it was, we heard a proposal for some work, research in this area by Dr. Ryan. And some of us were pleased to see that. The agency has decided to drop research in this area, or at least postpone it. One of the reasons they gave was that -- one of the reasons they gave early on last fall, I guess, was that it was expensive, they didn't know how to do it and they weren't sure they were going to get any useful results from it.

The committee had some objections to that sort of thing, but that stands. They ran the bat and they aren't funding any reearch in this area. They have told us that they expect to benefit from an INPO program in this area. INPO is going about its business of evaluating the organizational effectiveness, management effectiveness of the utility, that are part of the organization.

I think that's well and good. I guess my position is that it's not research. The INPO work would be something that I'd expect NRR to tell us they are doing. That, therefore, NRR doesn't have to do it. But there still doesn't seem to be any research in this area. So I'll just leave it at that.

MR. SALVENDY: I'd like to make one comment on the general budget, if I may, please. I don't know if you were here when I talked a few minutes ago, but I really expressed a concern about the budget in general, and, of course, the budget we see here is, again, in that line. I just wonder what's really being done by the human factors group in terms of trying to document to the people who are responsible to give you the budget that you really cannot do the job in a responsible way for the amount of money that you have. And that one really needs significantly more money to achieve the type of things one wants.

I remember way back many years ago, I was heading a management service department in the manufacturing industry. I spent significant amounts of time documenting to my boss that really, the number of people I had was insufficient to do the job I want to do. I was spending 25 percent of my time documenting my needs, trying to get more people.

I just wonder what's being done here, or what are your options, really. Do you have any options? I don't know, I'm very naive about it.

MR. NORBERG: Our options are somewhat limited, possibly. We do, we have projected, as you know, in our long-range research programs considerably more funding in the human factors area back earlier on. And this projection has been decreased, but this is because the overall agency's budget, as much as anything else, has been decreased.

Between 1984 and 85 our budget has remained fairly level, while other budgets are going down in research. So this is an indication that they consider the human factors program a high priority. But it's relative to everything else in the research program.

Our direction comes from the Commission to the Executive Director of Operations to the Office of Director of Research, and from him to each of the divisions, and then down to us. We have put together a budget within certain guidelines that we have had, and this budget is discussed with the office director and modified some. This, then, is reviewed through what they call a budget review committee for the whole agency, so there are several iterations within the agency, and there are many people who have input to this budget process.

I guess we tried to make our case for what we feel is needed, but we are pretty much living within guidelines that are given to us from our management.

MR. CATTON: Somehow, when I look at the overall budget for RES and the amount, the 3 percent that's going into the human factors area, that doesn't meet the requirements of cost-benefit, value impact or anything else. Fifty percent of the incidents that occur in nuclear power plants are associated with human error. It seems to me, you ought to have half the money. I wouldn't agree with that.

MR. SALVENDY: What I'm really thinking -- because, you know, I'm really concerned. Here in committee we're dealing with small issues. I think really, the main issue is if you would have twice as much money, I have a very high respect for your group. I know you folks would know what to do with this. And the question is really, that I don't think the type of monies that you have allocated you really can do a very decent job. I think you've done a very good job. I don't want to criticize what you have done. I'm saying the dollar amounts you allocated are really a joke.

I just wonder, shouldn't there be a document prepared to see if you would come to me and you say hey, I need $12 million, I wouldn't buy it. But I think if you can document to me why do you need $12 million and how those $12 million would increase the safety of nuclear power plants, I would listen very carefully and I may even give you half of it.

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MR. CATTON: It would have to be taken away from somebody else.

MR. SALVENDY: That's okay. That doesn't affect me.

MR. NORBERG: This sort of process does go on within the staff, but again there are pretty firm guidelines. Many times these decisions are made at a rather high level, based on the overall picture of the amount of funding available to the agency. Some of the programs in the Office of Research are programs that are committed programs; they have little option of whether they spend the money or not. And these are big programs in some cases. So they really are committed down the road, and there isn't much that the director or anybody else --

MR. SALVENDY: Let me ask the last question, if I may. How could this committee help you? Could this committee help you? How could we help if we believe -- at least I am a believer -- that you need significantly more money to be responsive to the needs that you really have? I don't think you can be responsive on what you have. What can this committee do for you?

MR. NORBERG: I believe the committee has in the past made comments of that sort in their letters and in their reports. This, of course, helps us in that we are maintaining at least a level budget in an era when everyone else is going down. So it has had -- it is helping. How much it can do towards what you are suggesting -- and that is doubling the budget or increasing it significantly -- then it certainly helps.

But I don't know. I have no control over its impact. I guess that's my answer to that. But it does help, there is no question about it.

The other side of the coin, if the committee says, what are you doing that kind of research for, that can really have the kiss of death. So recognize, we are in a situation where the money is very tight, and any type of comments that are on the negative side really is a strong comment for, don't work on that program because the committee such as yours says that we don't see the need for that. So it has significant influence, let me put it this way.

MR. CATTON: So you just feel damned lucky that you are maintaining your position.

MR. NORBERG: In this environment, that might be a good way to save it.

MR. WARD: Gabe, one of your comments was particularly interesting. Do you think these amounts for individual programs that Jim has been quoting, $250,000 a year for this, $150,000 a year --

MR. SALVENDY: I think it's a joke. Even if you would have Nobel Laureates addressed to each of them --

MR. WARD: As a researcher, would you say that is insufficient to get a critical mass of activity?

MR. SALVENDY: No question about it.

MR. CATTON: Some of them are $80,000. That's not even one man-year.

MR. NORBERG: The ones that are normally at the low level, I don't think we had any quite as low as 80. Well, we had one that was 75. That was a fictitious number you were seeing there because that was the actual funding level on that program for '84. It is more like a half a million because if you look at '83, it's like $1 million or something. It's really based on a 2-year funding.

This resulted from our cutting out the work in management and organization and putting it somewhere else where it was really into the '84 budget so that it didn't take quite a big a bath when the '84 cut came.

But in this listing that I think you have here, there is nothing under $100,000, and usually the $100,000 program is a new start type effort where you are really doing a survey of the area and formulating a program plan. And then we can, we feel, spend useful money, but it's usually in mind that this is leading to a larger area that will require more funding.

MR. SALVENDY: I want to correct something. I don't have quarrel about the allocation. The only quarrel I would have is such a minor one, I would bring artificial intelligence, instead of '86, I would put it into '84 to start. It's really a minor change. I am really concerned that all those areas are very important, yet I may have a couple of other areas I want to add. Yet the money is limited; there is no more money. I don't think the group can be responsive, and that's really my concern.

MR. DEBONS: I agree with Gabe. I am shocked beyond words when I see zero in '84 on artificial intelligence, zero in '85, and $100,000 in '86, when all of the discussions around here point to that as a major breakthrough that we need.

MR. NORBERG: I would like to turn this over to Dr. Overbey now. He will speak to that comment also. He will also speak to the rest of this agenda to be responsive to some of the questions that you asked us to discuss relative to your committee's recommendations.

MR. OVERBEY: Before responding to the specific comment, Dave, you have our copies of viewgraphs on our response to ACRS recommendation, and I will leave it to you as to whether you would like to actually take the time, the rest of the time, to go through those and discuss them or if this committee is willing to just receive those.

While you are thinking about that, you shouldn't be shocked because one of the problems I think that we had in the past in communicating about the exact nature of our research program, ongoing projects as reflected in your comments in the report to Congress on last year's presentation, is that some of our program titles in the past may have been too general and not included some information about specific tasks, subtasks in those research programs that did address and were responsive to previous ACRS comments as well as our own prioritization of issues in the human factors area.

In this particular case, it certainly is misleading if, by mentioning artificial intelligence only one time, we have given you the impression that none of our research programs are even involved in that area nor do we recognize it as priority until that year and at that level.

For example, the rather significant new start that is responsive to the ACRS comment in the evaluation of diagnostic, computer-based diagnostic systems. We certainly expect that to review and to incorporate the latest technology in terms of expert systems and the different approaches that may be based on artificial intelligence that one would normally find in a diagnostic aiding type system.

The program that you referred to noted that it is listed under plant procedures. And it may be that even there we will find a way to advance that. But it deals just specifically with a specific procedure prompting concept, and we think in the overall computer -- well, with the introduction of computers into the control room, the SPDS, with the added capability for doing more in the computer augmentation of the operator actions, a number of our programs that are organized in either the human factor engineering or in the training or in the procedures area will cut across those technologies that will aid us and that we should be focusing on.

As a matter of fact, in the display design criteria program, which is a fairly mature one at this time, we have a subtask this year which looks at artificial intelligence associated with the human factors evaluation of those kinds of systems, our advanced control room concepts program, which is starting this year and will by 1985 be 2-1/2, 3 years old, will cover that as well.

What do you think about our response to the recommendations?

MR. WARD: I don't think it's necessary to go over it. If any other consultants have questions about it, we could certainly entertain those.

This is the series of charts here. In the last report on the '84-'85 budget, the full ACRS made some recommendations on the research program. And in this area, those were boiled down -- those originally came from this group and got boiled down and distilled and modified a little bit.

My general impression is that the research staff has been quite responsive to those, with two exceptions. One is, as Gabe points out, perhaps there aren't very serious programs going on as far as the size of them in each area.

The other is this organization and management research is a bone of contention between us -- I think will continue to be until I guess they do what we want, which may be never.

(Laughter)

Okay, so if there are any questions on that?

MR. SALVENDY: Just to give you a feel, I believe any area where you mean to have a significant program to contribute to the reduction of error, anything less than about $400-500,000 activity per year, you are really not doing serious business, you are just really looking around.

MR. OVERBEY: In an attempt to respond to your earlier request to us, what should we be doing and what can the committee do perhaps to help the agency as a whole place human factors research in perspective with regard to the potential payoff or contribution in the reduction of risk, obviously concerns as accurate as they are that there isn't enough money or there should be twice as much effort in this area are not going to be very persuasive in the hard-nose budgetary environment where, as you pointed out, you have to fully document your request.

But if the committee, if the subcommittee would be willing or is available, my staff and I would certainly appreciate the opportunity to maybe meet with two or three individuals at a time on particular selected areas to help map out specific programs that there may be agreement that is underfunded.

And we on our side, as well as on the subcommittee side, could work out the details or at least have collectively reviewed whether that's as good an idea as it sounded at first or not.

We certainly would be very amenable and available for that kind of exchaage. And it might allow the committee, whose concern is genuine, to make more specific recommendations both with regard to the exact programs where you believe there are gaps as well as the level of effort.

MR. SALVENDY: Would it be helpful if your group would have prepared such a document, a draft copy, distribute it to the committee, and maybe if we could have down the road a meeting on it after we have seen a document, I personally would feel this is a very important one. And if the chairman would concur with it, I would like it very much personally to see such a document and have it discussed.

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MR. NORBERG: I think before we could prepare such a document we would have to go through our management with this type of thing. You're almost talking about going around management of the system here, it sounds like. We certainly have no intention -- we do not want to do that. And that kind of a suggestion or even that approach would certainly have to be cleared through our management system

We have no -- I guess I have no basic disagreement with the need to carefully look at the program to try to determine what the true dollar value -- dollar needs are to get the research in place that is needed. And I think this is what Dr. Overby is maybe alluding to a little bit. But we are in a position where we have to be quite selective to try to hit those things where we will get the biggest payoff for the limited amount of money that is truly available to us.

MR. WARD: Did you have anything else you wanted to state?

MR. OVERBY: I am prepared to respond to any of the other agenda items that were on your list, in terms of prioritization or guidance, as you like. I have no other slides prepared.

MR. PEARSON: I'd like to get one more word in here. I think I'm backing up.

I guess it was Tony or Gabe that made the point about artificial intelligence.

I'm looking at your long-range plan document. There's two numbers on the page. One says 9-3 and the other says page 105.

Anyway, it's the major products from human factors engineering and lists the alarm filtering systems, disturbance analysis systems, et cetera -- artificial intelligence for 1988.

I would just like to second -- I think that should be moved up.

And the second item there that is listed, "Effects of Function Allocation and Automation on Operator Motivation, Vigilance, and Attitudes," at least that portion is projected for '86.

Don't we know enough about vigilance and those kinds of things to answer some of the questions in that area? Maybe I misunderstand -- just a couple of sentences here -- but I certainly would reverse the priorities.

MR. OVERBEY: With regard to the first point, I believe that what that section is referring to is the products of research that would have been completed by that time frame. And in a regulatory environment and with the potential for regulatory action that comes with any research we undertake, it's very important to have validated any basic information or any guidelines or standards that may have been developed.

So, while we would all like to have these products in earlier, I think that's not an unreasonable time frame to talk about the delivery of some of those research fruits.

MR. PEARSON: Five years from now?

MR. SALVENDY: That's not delivery as I understand; that's allocation of money. When you talk about artificial intelligence, I think you indicated there would be no money allocated in '84 and '85. The first $100,000 will be allocated in '86, which means there would be no research done in '83, '84, '85 and that research could start only with the budget of '86. It's not the delivery of the product but allocation of funds to do those -- research.

MR. OVERBEY: Again, that particular project was not to start until '85 or '86 -- I forget the date on that. But other artificial intelligence, particularly with regard to the control room, our plan for the forthcoming year.

MR. NORBERG: I might make the comment here -- if you refer to the Human Factors Program Plan, which is a three-year-type planning document which is really aimed more at the licensing side of the issues, but also includes our research, when you look at their priority listing, there's a new SECY paper out -- have you got the SECY paper that transmitted the plan to the Commission on May 10th?

Well, if you have it, you can look at it later on. But you will see the kind of long-range, more advanced type of thing, such as artificial intelligence, is given a lower priority in the licensing arena, which very strongly drives our research program, because they are not anticipating seeing that sort of thing coming into the licensing arena for some time down the road.

So, although research -- and we are getting programs starting in advance control rooms and the computer diagnostics and other things that we anticipate will be coming in down the road -- and artificial intelligence is one of the more advanced -- our funding level there is not as high, because we are really driven and responding to, in the short term, the licensee needs which are listed out in this Human Factors Program Plan.

So, that's one of the reasons that you will see that you will see that these programs are lower funded and stretched out more, because there is not an immediate licensee need for this sort of thing.

MR. DEBONS: Where does the data link briefing that we get fit into your statement? Does it fit at all?

Remember?

MR. NORBERG: That is an effort that is going on within the I&E. We have, I guess, not been directly involved in the data link for the emergency preparedness.

MR. DEBONS: The reason I asked that is artificial intelligence is the heart of the whole operation.

MR. NORBERG: I recognize what you're saying. And for their specific application in the Emergency Response Center, they are taking the approach that you heard today. But our research program, we are not funded directly to assist in that. Indirectly we are, in some of the work that we're doing, and they will utilize that information, the data and information we generate.

But this is a separate I&E funded project for a specific purpose.

But the kind of thing I'm talking about is more in the NRR licensing side of the house, that you see in this program plan.

MR. OVERBEY: One thing that we -- we, even on the research side, have to constantly remind ourselves about is that we are not in the business of desiging systems for the industry.

The recommendation in this area by the ACRS, in fact, could have been read that we weren't doing enough to develop a system.

Our emphasis has to be on providing the agency with capability of evaluating for minimum standards such systems as may be proposed in the future.

MR. NERTNEY: Mr. Chairman, may I make a suggestion, at the beginning of the next meeting, that someone prepare a dissertation on the division of responsibilities between DOE, NRC, and INPO, because I think that we often get confused, because my understanding is that NRC is the function of the regulatory role, the development activities, government institutionalized developing activities are to be in DOE and industry-supported development are to be in INPO.

I think it would be very helpful to all of us if someone could structure a dissertation on this to orient us next time.

MR. WARD: Okay. Mr. Fischer will do that.

MR. DEBONS: One quick question I have, I see a whole battery of efforts here. What do we have in resources to support that? Ten people? Four people? What?

In other words, I see a substantial effort here. How many people do we have to manage this?

MR. OVERBEY: All of the dollar figures that we discussed there, the 64 -- 6.4 million in '85 and 6.7 million in '86 represent contract research dollars.

In-house, we have about eight people in the Human Factors Section to manage those efforts.

Are we overworked? Yes.

Are we doing the best job we can? Yes.

Do we have capable, qualified people? I think so.

The think that I think even the agency may not have recognized yet -- and perhaps the members of this Subcommittee are closer to it -- is that in the last year Mr. Norberg and the Office of Research have acquired four qualified human factors professionals, two at the senior level, two at the mid level. Jim Jenkins, who you all know, is a senior human factors professional. We have qualified people in our branch now. But just as we need more money for the overall effort, we could use more staff.

MR. DEBONS: I have no question about that. I'm sure your people are well qualified. I'm just trying to get a picture of the resource.

The second aspect of the resource problem, what support system do these people have, what support system do these very good people have? Do they have a library, for example? Do they have a budget for data base acquisition?

The reason I ask that is that in the several meetings that I have attended on this committee I find a very, very distinct lack of historical derivative to positions.

What I mean by "hisotrical derivative": Hey, this was studied by Alexander the Great. This was done by this fellow. What was his name? Richardson?

What kind of a support system do your good people have? Do they have a budget for library materials? Do they access to data bases, dialogue, whatever?

MR. OVERBEY: We do not have a specific support budget for building a library. We do the best we can, and this is not unusual in a government agency.

There is, of course, the NRC library, and it has --

it certainly doesn't compare with the university library in the human factors area, but we are able to order materials when we chose to.

We have a very strong support by the agency in our immediate management, getting these people out to meet both with the contractors and with industry representatives, INPO and EPRI, and meet subject matter experts. And that I would say -- I have worked in several government agencies in the human factors area, and we were much better off than the norm in this area.

MR. DEBONS: As a personal consultant, I feel a sense of responsibility in making judgments about a budget and about personnel resources. And consequently, I find I would need to have a much more objective estimattion as to what working environment these eight people have and for me to, in fact, make recommendations to support. Right now I find I don't have that, and I find that is a shortcoming.

Surely, as Dr. Salvendy said, we could increase this budget substantially by a factor of 2, 3, or whatever. But I couldn't make that judgment without realizing what are the capabilities of these people to respond to such a thing. And consequently, I find that to be a very, very distinct thing that I would like to find in the future discussions of this committee, Mr. Chairman.

MR. WARD: Okay. I think that is a good point in sort of a similar point that has been made.

We often get the Subcommittee and the Full Committee getting into a sort of an annual syndrome of hurriedly evaluating the research program so that we will respond to some specific needs for providing formal advice by some given date.

Usually we're in a small window, because the staff doesn't want to talk about it until they are ready, and then that doesn't provide much time.

I think maybe what we need to do is -- Chuck, you made an offer -- somehow develop, maybe, be this fall or something some sort of mechanism for perhaps a meeting of this Subcomittee kind of out in your shop, a more leisurely review of the research program, without attempting to nail down the specifics of this year and so forth, but a more informal review, familiarization.

MR. OVERBEY: If everyone could understand that such a meeting would have all the caveats attached to it, with regard to not having any official standing, until we had gone through our normal program review, approval process through our management --

MR. WARD: We've just come to help you.

MR. OVERBEY: A less formal kind of exchange of ideas would be very beneficial to us. I think it would certainly help the Committee's grasp. And although we have never considered you to be less than forthright in your constructive considerations, it may make them more effective by focusing better.

MR. SALVENDY: I would like that very much. I personally would like that idea. I think it would be a very effective one, very informative, education for me.

MR. WARD: Okay.

MR. PEARSON: Very quickly, I wanted to back up something that Bob Nertney said here a minute ago. That was the point about getting more information on INPO.

You may recall, a year, a year and a half ago, I suggested why don't we have our meeting sometimes in conjunction with some other groups. We have gone to Westinghouse; we have gone to Singer-Link. Why don't we meet down in Atlanta sometime and spend a half day with INPO, or even meet for two days?

MR. WARD: Okay. That's not unfeasible either.

MR. CATTON: It's easier than getting to Washington.

MR. WARD: Or even Raleigh.

MR. PEARSON: It's close for our Chairman.

MR. WARD: Okay. I think that wraps it up.

One thing, I don't think I need any comments, particularly on generic issues. We're kind of finished on that. I think I know what to report on.

If you have any comments on what you heard about the Emergency Response Center Nuclear Data Link, I'd appreciate it if you would write them down and tell me.

If -- after some more reflection on the research program and some of the issues you had raised, I would like to have a written report of your comments. It can be very informal. If I don't get it by the end of the month, it won't do me any good when I have to go and sort of do battle with the Full Committee.

So, if you can get something to Dave Fischer by then, it will help very much -- by the end of the month.

MR. PEARSON: You've been taking notes on our comments.

MR. WARD: I have, and we have the record. But I'm kind of lazy, and I would like something better focused, if it would be possible, in addition to that.

Thank you very much.

We will adjourn.

(Whereupon, at 5:30 p.m., the meeting was adjourned.)

CERTIFICATE OF PROCEEDINGS

This is to certify that the attached proceedings before the NRC COMMISSION

In the matter of: ACRS-Subcommittee on Human Factors

Date of Proceeding: May 19, 1983

Place of Proceeding: Washington, D. C.

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

Mimie Meltzer
Official Reporter - Typed

Mimie Meltzer
Official Reporter - Signature

ACRS RECOMMENDATION

- o DEVELOPMENT OF DIAGNOSTIC AIDS, PROBABLY COMPUTER BASED, TO ASSIST CONTROL ROOM OPERATORS IN UNDERSTANDING AND MANAGING COMPLEX TRANSIENTS

NRC RESPONSE

STAFF AGREES THAT RESEARCH ON DIAGNOSTIC AIDS SHOULD RECEIVE SPECIAL EMPHASIS IN THE HUMAN FACTORS AREA. RESEARCH UNDERWAY OR PLANNED IN THIS AREA INCLUDES:

1. NEW FY84-85 RESEARCH PROJECT SPECIFICALLY RESPONSIVE TO THIS ACRS RECOMMENDATION
2. PROGRAMMATIC INPUT FROM SEVERAL CURRENT ONGOING RESEARCH PROJECTS
3. JOINT SASA/HUMAN FACTORS STUDIES

ACRS Recommendation 2.7.2.d, Organization and Management Research

Over the longer term, research in the human factors area should emphasize the following:..... Development of criteria to assess the competence of a licensee's organization, including competence of the technical support staff.

NRC Response

- NRC management has determined research in this area to be a low priority.

- The nuclear utility industry (e.g., INPO, EPRI) is taking the lead role in this area of research.

ORGANIZATION AND MANAGEMENT ACTIVITIES

NRC Office of Nuclear Reactor Regulation (NRR):

- o Develop operating licensee assessment procedures.
- o Analyze need for regulatory action.
- o Monitor INPO corporate evaluation program.

Institute of Nuclear Power Operations (INPO):

- o Continue development of performance objectives and criteria for corporate evaluations.

Electric Power Research Institute (EPRI):

- o Conduct scoping study to determine research needs.

ACRS RECOMMENDATION

- o DEVELOPMENT OF STANDARDS FOR USE IN QUALIFYING BOTH MAINTENANCE PERSONNEL AND AUXILIARY OPERATORS.

NRC RESPONSE

RESEARCH HAS BEEN PLANNED IN THESE AREAS FOR:

MAINTENANCE PERSONNEL (INITIATE FY 85)

1) DEVELOP HUMAN PERFORMANCE DATA FOR NPP MAINTENANCE PERSONNEL (FIN NO. B0461, MAINTENANCE ERROR MODEL - JOB ANALYSIS)

2) APPLY METHODS TO IDENTIFY AND QUANTIFY MAINTENANCE PERSONNEL SKILLS, KNOWLEDGE AND ABILITIES (METHODS DEVELOPED IN FIN NO. B8118, "METHODS TO QUANTIFY HUMAN OPERATOR PERFORMANCE")

NRC RESPONSE (CONTINUED)

3) TRANSLATE SKILLS, KNOWLEDGE AND ABILITIES DATA INTO QUALIFICATIONS AND TRAINING GUIDELINES FOR NPP MAINTENANCE PERSONNEL (METHODS DEVELOPED IN FIN NO. B8118, "METHODS TO QUANTIFY HUMAN OPERATOR PERFORMANCE")

4) PROMULGATE NPP MAINTENANCE PERSONNEL QUALIFICATIONS AND TRAINING GUIDELINES.

5) EVALUATE THE EFFECTIVENESS OF THE NPP MAINTENANCE PERSONNEL QUALIFICATIONS AND TRAINING GUIDELINES AND THE EFFECTIVENESS OF THEIR IMPLEMENTATION (METHODS DEVELOPED IN FIN NO. B0466, "NPP PERSONNEL ENTRY LEVEL QUALIFICATIONS AND TRAINING")

ACRS RECOMMENDATION

- o DEVELOPMENT OF CRITERIA FOR QUALIFYING OPERATOR EXAMINERS

NRC RESPONSE

NRR PROGRAMS WITH IMPACT ON EXAMINERS:

1) IMPROVEMENTS TO EXAMINATION PROCESS TOWARD INCREASED STANDARDIZATION (E.G., AUTOMATED QUESTION BANK)

2) EXAMINER TRAINING AND GUIDELINES FOR CURRENT STAFF

3) REGIONALIZATION TO REDUCE THE BURDEN ON EACH EXAMINER

ESTABLISHMENT OF RESEARCH PROGRAM IS CONTINGENT UPON DEVELOPMENT OF A USER NEED FOR RESEARCH SUPPORT

ACRS RECOMMENDATION

- EVALUATION OF THE EFFECTIVENESS OF OPERATOR TRAINING AND LICENSING PROGRAMS.

NRC RESPONSE

LICENSEE PERSONNEL QUALIFICATIONS RESEARCH HAS BEEN FORMULATED TO (FIN NO. B0466, "NPP PERSONNEL ENTRY LEVEL QUALIFICATIONS AND TRAINING"):

1) DEVELOP CRITERIA AND METHODS TO EVALUATE THE EFFECTIVENESS OF NPP PERSONNEL TRAINING PROGRAMS BASED UPON THE SYSTEMS APPROACH TO TRAINING (SAT) METHODOLOGY (E.G., ISD - INSTRUCTIONAL SYSTEMS DEVELOPMENT)

2) DEVELOP VALID METHODS TO CONDUCT TRAINING EFFECTIVENESS EVALUATIONS OF FORMAL CLASSROOM TRAINING

3) DEVELOP VALID METHODS TO CONDUCT TRAINING EFFECTIVENESS EVALUATIONS OF NPP SIMULATOR TRAINING

NRC RESPONSE (CONTINUED)

4) DEVELOP VALID METHODS TO CONDUCT NPP PERSONNEL QUALIFICATIONS PROGRAMS EVALUATIONS.

5) RES SUPPORT TO NRR SAFETY TECHNOLOGY ASSISTANCE PROJECT TO DEVELOP AN IMPROVED OPERATOR LICENSING EXAMINATION (FIN 8118, "METHODS TO QUANTIFY HUMAN OPERATOR PERFORMANCE")

PROPOSED HUMAN FACTORS RESEARCH PROGRAM AND BUDGET

FOR FY85 AND FY86

PRESENTED TO

ACRS SUBCOMMITTEE ON HUMAN FACTORS

MAY 19, 1983

PROPOSED HUMAN FACTORS RESEARCH PROGRAM AND BUDGET FOR FY85-86

PROGRAM AREA	PROPOSED BUDGET FY85	PROPOSED BUDGET FY86
o HUMAN FACTORS ENGINEERING	2400K	2400K
o LICENSEE PERSONNEL QUALIFICATIONS	1850K	2000K
o PLANT PROCEDURES	750K	900K
o HUMAN RELIABILITY	1400K	1400K
TOTAL	6400K	6700K

HUMAN FACTORS ENGINEERING

($2400K PROPOSED FOR FY85; $2400K-FY 86)

- DISPLAY DESIGN AND CONTROL ROOM/AUXILIARY STATIONS STANDARDS AND GUIDELINES
  - HUMAN FACTORS CRITERIA AND STDS. TO SUPPORT NRC ASSESSMENT OF MAN-MACHINE INTERFACE DESIGN
- EVALUATION OF COMPUTER-BASED DIAGNOSTIC SYSTEMS FOR AIDING OPERATOR ACTIONS IN ACCIDENT MANAGEMENT
  - METHODS AND CRITERIA FOR REGULATORY ASSESSMENT OF COMPUTER AND HIGH TECHNOLOGY SYSTEMS
- STANDARDS AND GUIDELINES FOR MAINTAINABILITY
  - ADAPTATION OF INDUSTRY (EPRI, INPO) DESIGN CRITERIA FOR TOOLS, CLOTHING AND NPP DESIGN FOR MAINTAINABILITY
- ADVANCED CONTROL ROOM CRITERIA DEVELOPMENT
  - ASSESSMENT OF ADVANCED TECHNOLOGIES FOR CONTROL ROOM DESIGN TO DEFINE HUMAN FACTORS CRITERIA

HUMAN FACTORS ENGINEERING (CONTINUED)

- EVALUATION OF TECHNIQUES FOR REDUCING SEVERE STRESS EFFECTS ON NPP OPERATING PERSONNEL

  CRITICAL FOR MAN-MACHINE INTERFACES, TRAINING AND PERSONNEL QUALIFICATIONS FOR DEALING WITH STRESS
- GUIDELINES FOR FUNCTION ALLOCATION

  MODELS AND METHODS FOR ASSESSING ADEQUACY OF FUNCTION ALLOCATION.
- GUIDELINES FOR APPLICATION OF AUTOMATION TO MAN-MACHINE SYSTEM FUNCTION

  OPERATOR INFORMATION REQUIREMENTS AND HUMAN FACTORS FOR AUTOMATED NPP SYSTEMS.
- HALDEN PROJECT
- HALDEN DELEGATE

  NRC SUPPORT TO OECD HALDEN REACTOR PROJECT IN COMPUTER BASED SYSTEMS AND FUEL ANALYSIS. NRC DELEGATE PROVIDED.

LICENSEE PERSONNEL QUALIFICATIONS

(\$1850K PROPOSED FOR FY85; \$2000K-FY 86)

- o PERSONNEL ENTRY LEVEL QUALIFICATION AND TRAINING
  GUIDELINES AND STANDARDS FOR NRR TRAINING PROGRAMS
- o METHODS TO SCALE HUMAN OPERATOR JOB PERFORMANCE
  METHODS TO QUANTIFY RELATIONSHIP BETWEEN OPERATOR EDUCATION AND TRAINING AND SUBSEQUENT PERFORMANCE ON THE JOB
- o TRAINING SIMULATOR EXPERIMENTS
  OBTAIN OPERATOR PERFORMANCE DATA TO SUPPORT ACTIONS RELATIVE TO OPERATOR TRAINING, STAFFING, QUALIFICATIONS, & EXAMS.
- o EVALUATION OF OPERATOR TRAINING FOR SEVERE ACCIDENT MANAGEMENT
  PROVIDE A TECHNICAL BASIS FOR ASSESSING THE ROLE OF OPERATOR TRAINING IN SEVERE ACCIDENT MANAGEMENT
- o MAINTENANCE PERSONNEL QUALIFICATIONS AND TRAINING
  GUIDELINES AND STANDARDS TO SUPPORT REGULATORY ACTIONS ON QUALIFICATIONS AND TRAINING FOR MAINTENANCE PERSONNEL
- o STAFFING AND MANPOWER MODELING
  MODELS FOR ASSESSING THE VALUE AND IMPACT OF PROPOSED REGULATORY CHANGES IN MANPOWER AND STAFFING REQUIREMENTS.

PLANT PROCEDURES

($750K PROPOSED FOR FY85; $900K-FY 86)

- EVALUATION OF ALTERNATIVE TECHNIQUES AND FORMATS FOR PRESENTING PROCEDURES
  - CRITERIA FOR EVALUATING ALTERNATIVE METHODS/FORMATS FOR PRESENTING PROCEDURES FOR EFFECTIVE USE BY PLANT OPERATORS AND SUPPORT PERSONNEL

- HUMAN FACTORS EVALUATION OF OPERATOR ACTIONS IN SEVERE ACCIDENT SEQUENCE STUDIES
  - JOINT SASA/HUMAN FACTORS REVIEWS DESIGNED TO EVALUATE OPERATOR ACTIONS AND ERRORS IN DOMINANT RISK ACCIDENT SEQUENCES.

- EVALUATION OF MAINTENANCE PROCEDURES EFFECTIVENESS
  - GUIDELINES AND STANDARDS TO SUPPORT REGULATORY ACTIONS IN THE AREA OF MAINTENANCE PROCEDURES

- FEASIBILITY STUDY OF APPLYING ARTIFICAL INTELLIGENCE CONCEPTS TO A COMPUTER-BASED PROCEDURE PROMPTING SYSTEM

HUMAN FACTORS RESEARCH PROGRAM: HUMAN RELIABILITY AREA

($1400K PROPOSED FOR FY 85; $1400K-FY 86)

- HUMAN ERROR DATA ACQUISITION

  METHODS FOR ACQUIRING HUMAN ERROR DATA FROM EXPERT JUDGEMENT, FIELD, TRAINING SIMULATOR AND COMPUTER MODELING SOURCES

- HUMAN ERROR DATA BASE

  HUMAN RELIABILITY DATA BANK FOR STORING AND RETRIEVING HUMAN ERROR PROBABILITY (HEP) DATA FOR HUMAN RISK ANALYSIS (HRA) SEGMENTS OF PROBABILISTIC RISK ASSESSMENTS (PRAs)

- RELIABILITY SPECIALIST AIDS

  TECHNIQUES FOR MODELING PERFORMANCE SHAPING (E.G., STRESS, FATIGUE) AND COMMON MODE (INTERDEPENDENT) VARIABLES AS PART OF HRAS

HUMAN FACTORS RESEARCH PROGRAM: HUMAN RELIABILITY AREA (CONTINUED)

- MAN-MACHINE SYSTEMS EVALUATION

  METHODS FOR COMPILING AND UTILIZING HEP DATA AS BENCHMARK OR BASELINE MEASURES IN EVALUATIONS OF MAN-MACHINE SAFETY SYSTEMS.

- MAN-MACHINE SYSTEMS DESIGN GUIDELINES

  PROCEDURES FOR UTILIZING HUMAN ERROR AND RELATED PERFORMANCE SHAPING DATA TO SUPPORT DEVELOPMENT OF DESIGN GUIDELINES FOR ADVANCED MAN-MACHINE SAFETY SYSTEMS.

RGP: 5/19/83

TRAINEESHIP PROGRAM FOR
NPP/HUMAN FACTORS SPECIALISTS

- EDUCATION PROGRAMS IN H.F./ERGONOMICS
  - -- INDUSTRIAL ENGINEERING -- MORE PROGRAMS
  - -- PSYCHOLOGY -- MORE APPLICANTS
  - -- MARKETPLACE FACTORS
- PREQUISITES
  - -- CALCULUS, PHYSICS, COMPUTER SCIENCE
  - -- THERMODYNAMICS; DIFF. EQUATIONS
- ADMISSIONS
  - -- N. E. AND I. E.
  - -- OTHER ENGINEERING; PHYSICS
  - -- PSYCHOLOGY
- PROGRAM
  - -- TWO YEARS: M. S. AND PH. D.
  - -- SUMMER UTILITY INTERNSHIP
  - -- NO NRC EMPLOYMENT CONTRACT
  - -- COURSEWORK
    1. N. E.
    2. H. F./ERGONOMICS
    3. SAFETY
    4. SIMULATOR
    5. PROJECT (NON-THESIS)
  - -- MINOR FOR N. E.

RGP: 5/19/83

TRAINEESHIP: PLAN OF STUDY

- I. MAJOR: INDUSTRIAL ENGINEERING
    - A. HUMAN FACTORS IN SYSTEMS DESIGN
    - B. SYSTEMS SAFETY
    - C. HUMAN PERFORMANCE THEORY
    - D. OCCUPATIONAL STRESS
    - E. ENVIRONMENTAL STRESS
    - F. Q/C -- RELIABILITY
    - G. SEMINAR: H/F IN NPP
    - H. STATISTICS (6)
    - I. INTERNSHIP (6)
    - J. PROJECT (6)

  TOTAL: 39 HOURS

- II. MINOR: NUCLEAR ENGINEERING
    - A. FUNDAMENTALS OF N. E.
    - B. REACTOR SYSTEMS
    - C. REACTOR AND ENVIRONMENTAL SAFETY

  TOTAL: 9 HOURS

- III. MINOR: PSYCHOLOGY
    - A. SELECTION METHODS
    - B. TRAINING METHODS

  TOTAL: 6 HOURS

  GRAND TOTAL: 54 HOURS

- OPTION: PSYCHOLOGY MAJOR?

RGP: 5/19/83

TRAINEESHIP PROGRAM BUDGET

• **PERSONNEL**		
PROGRAM DIRECTOR		
-- ACADEMIC YEAR	$ 8,000	
-- SUMMER (1½ MOS.)	8,000	
SECRETARY (¼ TIME)	3,500	
FRINGE BENEFITS	4,500	
		$ 24,000
• **SUPPORT**		
TRAVEL	2,500	
HONORARIA	1,500	
EQUIPMENT	1,500	
SUPPLIES	1,000	
OTHER (PRINTING, BROCHURE, PHONE, POSTAGE, COMPUTER A/V, REFERENCE MATERIAL AND BOOKS, COPYING, AND SERVICES)	4,500	
		11,000
• **TRAINEES**		
STIPEND (8000 x 6)	48,000	
TUITION AND FEES: (3000x6)	18,000	
TRAVEL (500x6)	3,000	
SUMMER PER DIEM: (1000x6)	6,000	
		75,000
	GRAND TOTAL	$110.000

Memorandum

TO: D. Fischer, Staff Engineer, ACRS Subcommittee on Human Factors

FROM: Gavriel Salvendy, ACRS Consultant

DATE: 22 November, 1982

SUBJECT: A Proposal for Training Human Factor Engineers for Safe Design and Operation of Nuclear Power Plants

1. Background: During the ACRS subcommittee meeting of 7 September, 1982 I have urged the subcomittee to give serious considerations for developing an educational training program in human factors area which would overcome the current acute shortage. This notion was again re-emphasized in my 9 September, 1982 memorandum to ACRS (p. 2, item 5). D. Fischer has conveyed to me on 15 November, 1982, that D. Ward would like further information on this subject; hence this memorandum.

2. Significance of the Problem: It is my strong belief that there are two main reasons for the relatively slow progress regarding the development of critical new human factors knowledge for use in the safe design and operation of nuclear power plants and for the luck of implementation in nuclear power plant design of existing human factors data and knowledge. These reasons are as follows:

(A) The excellent human resources available at major American universities have not been adequately involved in human factors research which is critical for the safe design and operations of nuclear power plants. Much of these activities have been carried out, for the nuclear Repulatory Commission, by consulting companies. Yet, in other fields of science and technology these advances have been, frequently, most successfully carried out at major American universities, and

(B) Currently, there is an acute shortage of qualified human factors specialist who can cope with the many facets of the human factors aspects of safe design and operation of nuclear power plants. In effect, there is less than one human factors specialist for 350 engineers. Thus, urgently, additional human factors specialists are needed for: (1) Implementation of existing human factors knowledge into the safe design and operaion of power plants, and (2) generate more human factors knowledge, through creative research programs which is aimed at better understanding the cognitive, psychological and social aspects for the effective and safe design of nuclear power plants.

3. Proposed Method for Overcoming Current Limitations: The fact that the human factors proram receives only five percent of the total NRC yearly budget is a very poor reflection on the importance which the commission allocates to the safety of nuclear power plants. Since some estimates suggest that one-half of all nuclear accidents are the result of human considerations, and in view of the tremendous work to be be carried out in this area, it is recommended that a position paper be prepared which would request a 40 percent annual increase ($2 million) in the human factors budget for two purposes:

(A) Allocate annually one million dollars for basic research to be carried out at a number (6 to 12) of universities. This basic reserch would be aimed at providing input for the longer term design and operation of nuclear power plants. These research studies would address problems of interfacing both current and future technologies with humans in nuclear power plant operations, and

(B) Allocate annually one million dollars to establish three centers in universities. These training centers would be initially established for a five year period. Each training center would train, during the five year period, 60 masters degree and 6 doctorate level human factors professionals in the safe design and operation of nuclear power plants. These training programs would be specifically designed to deal with the human problems in nuclear power plants and as such it would be associated with both current and future nuclear power plant users.

In order to effectively develop and implement this program it is recommended that the practices of the National Institutes of Health in general and specifically the National Institute of Occupational Health and Safety training procedural guidelines be followed.

4. Action: It is recommended that at the next ACRS meeting this subject be included in the agenda. The agenda could be in four parts as follows: presentation by the ACRS human factors group; presentation by NIOSH training group; presentation by myself, and comments from ACRS consultants.

A PROPOSAL TO
ACRS SUBCOMMITTEE ON
HUMAN FACTORS

ON

ESTABLISHMENT OF TRAINING
CENTERS, AT SELECT UNIVERSITIES,
FOR SAFE DESIGN AND OPERATION OF
NUCLEAR POWER PLANTS

GAVRIEL SALVENDY
ACRS CONSULTANT
MAY 19, 1983

SIGNIFICANCE OF PROBLEM

1. SHORTAGE OF QUALIFIED MANPOWER

2. INVOLVE UNIVERSITIES IN HUMAN FACTORS NRC RESEARCH

3. ABOUT 50 PERCENT OF ALL CRITICAL INCIDENTS ARE THE RESULT OF HUMAN CONSIDERATIONS

METHOD FOR OVERCOMING CURRENT LIMITATIONS:

1. CONDUCT A STUDY TO DETERMINE CURRENT AND FUTURE (1985-1995) MANPOWER SUPPLY AND DEMANDS FOR HUMAN FACTOR PROFESSIONALS TO BE ENGAGED IN SAFE DESIGN AND OPERATION OF NUCLEAR POWER PLANTS.

2. BASED ON 1 ABOVE, PROVIDE FUNDING TO DEVELOP A NUMBER OF TRAINING CENTERS AT SELECT UNIVERSITIES.

3. ESTIMATED COST FOR TRAINING OF EACH 10 MASTER DEGREE STUDENTS IS ABOUT $200,000.

4. SOLICIT PROPOSAL FROM UNIVERSITIES.

5. A POSSIBLE PROGRAM OF STUDY WOULD CONSIST OF 24 CREDIT HOURS COURSE WORK AND 6 CREDIT HOURS RESEARCH FOR A TOTAL OF 12 MONTHS DURATION. THE EIGHTH COURSE OFFERING COULD CONSIST OF THE FOLLOWING:

NUCLEAR ENGINEERING

AN INTRODUCTION TO NUCLEAR REACTOR PRINCIPLES AND ENGINEERING APPLICATIONS. REACTOR THEORY; CONTROL; ENERGY REMOVAL; MATERIALS; POWER REACTOR SYSTEMS; PROPULSION AND OTHER APPLICATIONS.

HUMAN FACTORS ENGINEERING

HUMAN-COMPUTER COMMUNICATIONS

HUMAN INFORMATION PROCESSING, DECISION AND DETECTION MODELS

FUNCTIONAL ANALYSIS, DESIGN AND SYSTEM DOCUMENTATION

HUMAN QUALITY ASSURANCE

PERSONNEL SELECTION AND TRAINING

ENVIRONMENTAL HEALTH FACTORS

RGP: 5/19/83

TRAINEESHIP PROGRAM FOR NPP/HUMAN FACTORS SPECIALISTS

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  - -- PSYCHOLOGY -- MORE APPLICANTS
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  - -- N. E. AND I. E.
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RGP: 5/19/83

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  TOTAL: 39 HOURS

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GRAND TOTAL: 54 HOURS

- OPTION: PSYCHOLOGY MAJOR?

RGP: 5/19/83

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SUMMER PER DIEM: (1000x6)	6,000	
		75,000
	GRAND TOTAL	$110.000

HUMAN FACTORS PERSONNEL - EDUCATIONAL REQUIREMENTS (NRC VIEW)

- o HUMAN ENGINEERING
- o TRAINING
- o TESTING AND EXAMINATIONS
- o PROCEDURES
- o ORGANIZATION AND MANAGEMENT
- o PERSONNEL AND STAFFING

ALL WITH A KNOWLEDGE OF NUCLEAR POWER PLANTS AND OPERATIONS

CURRENT HUMAN FACTORS PERSONNEL RESOURCES
(WITH SOME NUCLEAR EXPERIENCE)

NRC	40
GOVERNMENT LABS	20
UNIVERSITIES	25
PRIVATE INDUSTRY (CONTRACTORS)	150
	235

HUMAN FACTORS STAFFING

PROJECTED RESOURCES/REQUIREMENTS

HUMAN FACTORS SUPPORT TO NUCLEAR INDUSTRY - FY 1984

NRC:	TECHNICAL ASSISTANCE (DHFS)	$ 4.7 M
	RESEARCH (HFSB)	$ 5.8 M
	AEOD	$ .2 M
	PERSONNEL (IN-HOUSE)	40

INPO/EPRI		RESOURCES/REQUIREMENTS
EPRI		$ 1.4 M
		2 PSY
INPO		$ 5.2 M
		46 PSY
	TOTALS	$ 6.6 M
		48 PSY

CURRENT INDUSTRY HUMAN FACTORS

HUMAN FACTORS UTILITY SUPPORT REQUIREMENTS:	\$ 4.3 M
(BASED ON GENERIC LTR 82-33)	43 PSY
NSSS HUMAN FACTORS SUPPORT:	\$ 1.5 M
	15 PSY
TOTALS	\$15.5 M
	55 PSY

TOTAL HUMAN FACTORS PERSONNEL REQUIREMENTS - FY 1984

GOVERNMENT	60
UNIVERSITY	25
CONTRACTOR	150
NUCLEAR INDUSTRY	101
TOTAL	336

ASSUME 10% ATTRITION PER YEAR - MINIMUM ANNUAL EDUCATIONAL REQUIREMENT: 34

ACRS SUBCOMMITTEE ON HUMAN FACTORS
U.S. NUCLEAR REGULATORY COMMISSION
MAY 19, 1983
WASHINGTON, D.C.

IMPORTANCE OF HUMAN FACTORS FOR REDUCING THE RISK ASSOCIATED WITH NUCLEAR POWER PLANTS

THOMAS G. RYAN, PH.D
HUMAN FACTORS BRANCH DFO-RES
U.S. NUCLEAR REGULATORY COMMISSION

IMPORTANCE OF HUMAN FACTORS FOR NPP RISK

- Perceptions of Importance

- Challenges Posed by the Commercial Nuclear Industry

- Human Factors as a Discipline

- Tools of the Human Factors Specialist

IMPORTANCE OF HUMAN FACTORS FOR NPP RISK

Perceptions of Importance

- o Review/Study Conclusions:
  - -- NPP Accidents
  - -- Human Factors Society Study
- o Operational Data:
  - -- NPP Probabilistic Risk Assessments
  - -- NPP Reporting Systems
- o Anecdotal Information:
  - -- Plant Visits
  - -- Press Reports
  - -- Other Industries

IMPORTANCE OF HUMAN FACTORS FOR NPP RISK

PRESIDENT'S COMMISSION ON THE ACCIDENT AT THREE MILE ISLAND:

".. THE MAJORITY OF SAFETY RELATED INCIDENTS CAN BE TRACED TO THE HUMAN COMPONENT OF THE SYSTEM, THEREFORE, HUMAN FACTORS RESEARCH AND ENGINEERING SHOULD BE INTEGRATED INTO THE DESIGN AND OPERATION OF U.S. NUCLEAR POWER PLANTS."

IMPORTANCE OF HUMAN FACTORS FOR NPP RISK

HUMAN FACTORS SOCIETY CONCLUDED THAT IMMEDIATE ATTENTION IS REQUIRED IN THE FOLLOWING HUMAN FACTORS RELATED AREAS:

- UTILITY/NRC MANAGEMENT OF PROGRAMS
- HUMAN FACTORS DATA ACQUISITION
- OBJECTIVE HUMAN FACTORS EVALUATION CRITERIA
- HUMAN RISK ASSESSMENT
- SYSTEMS INTEGRATION AT ALL STAGES OF NPP DESIGN AND OPERATION
- PERSONNEL ALLOCATION AND SUPPORT

IMPORTANCE OF HUMAN FACTORS FOR NPP RISK

Core melt/radiation release human factors precursors for PRAs

PRA Reviewed	Ranking of Human Error
5 of 12	Most Probable
1 of 12	2nd Most Probable
2 of 12	3rd Most Probable
1 of 12	4th Most Probable

Type Errors Analyzed	
Omission	83% of total involving component, and system level actions
Commission	17% of total involving component, and system level actions

IMPORTANCE OF HUMAN FACTORS FOR NPP RISK

PERCEPTIONS FROM ANALYSES OF NPP REPORTING SYSTEMS DATA:

LER ANALYSES	HUMAN ERROR FREQUENCY
ORNL PRECURSOR STUDY (NUREG/CR-2497, VOL 1)	38% OF TOTAL
BNL ERROR RATE ANALYSIS (NUREG/CR-241~~6~~) 7	12% OF TOTAL - 51% OMISSION - 49% COMMISSION

MAINTENANCE RECORDS ANALYSIS	HUMAN ERROR FREQUENCY
ORNL (NUREG/CR-XXXX)	16% OF TOTAL - 73% COMMISSION - 27% OMISSION

IMPORTANCE OF HUMAN FACTORS FOR NPP RISK

CHALLENGES FOR HUMAN FACTORS IN A COMMERCIAL NUCLEAR ENVIRONMENT

- GOVERNMENT/INDUSTRY ATTITUDES AND PHILOSOPHY
  (HARDWARE ORIENTATION)

- UNDERSTANDING OF HUMAN FACTORS DISCIPLINE
  (WHAT IS IT? WHAT CAN IT DO FOR ME?)

- UNPREDICTABILITY OF HUMAN BEHAVIOR
  (IMPACT OF COGNITION, PERFORMANCE SHAPING FACTORS, ETC.)

- HUMAN BEHAVIOR ANALYSIS
  (IDENTIFICATION, CAUSATION, RELATED FACTORS)

- OBSERVER BIASES

IMPORTANCE OF HUMAN FACTORS ROR NPP RISK

HUMAN FACTORS DISCIPLINE

- o DEFINITION (CONCERNED WITH HUMAN COMPONENT OF SYSTEM)
- o ELEMENTS
  - -- PERSONNEL SUBSYSTEM (PEOPLE CENTERED)
  - -- HUMAN ENGINEERING (FACILITIES CENTERED)
  - -- HUMAN RELIABILITY (PERFORMANCE MEASUREMENT CENTERED)
- o INTERRELATIONSHIP OF ELEMENTS
  - -- FEASIBILITY ANALYSIS (PERSONNEL SUBSYSTEM, HUMAN ENGINEERING, HUMAN RELIABILITY)
  - -- TECHNOLOGY DEVELOPMENT (PERSONNEL SUBSYSTEM, HUMAN ENGINEERING)
  - -- TEST AND EVALUATION (HUMAN RELIABILITY)
  - -- TECHNOLOGY TRANSFER (PERSONNEL SUBSYSTEM, HUMAN ENGINEERING)

IMPORTANCE OF HUMAN FACTORS FOR NPP RISK

Tools of the Human Factors Specialist

- Understanding of Human Factors as a Discipline
- Knowledge of Behavioral Sciences
- Familiarity with Existing Human Factors Standards and Guidelines
- Familiarity with System(s) of Interest
- Systems Perspective

GENERIC ITEMS ASSIGNED TO THE
HUMAN FACTORS SUBCOMMITTEE

- INFORMATION AVAILABILITY -

H = High
M = Medium
L = Low
D = Drop
LI = License Improvement
F = Future
R = Resolved

Item Number	Title	Priority	List of References Available	NUREG-0933: Description	Priority Determination: Assumptions	Frequency/Consequence Estim.	Cost Estimate	Value Impact Assessment	Conclusion	Issue Summary Worksheet: Summary of Problem and Proposed Resolution	Safety Issue Description	Safety Issue Benefit	Safety Issue Cost
I.A.	Operating Personnel												
I.A.1	Operating Personnel & Staffing			X									
I.A.1.4	Long-term upgrading		X	X					X				
I.A.2	Training & Qualifications of Oper. Personnel												
I.A.2.2	Operating Personnel	H		X	X	X	X	X	X				
I.A.2.4	NRR Particip. in Insp. Training	LI		X					X	X	X	X	X
I.A.2.5	Plant Drills	L		X	X	X	X	X	X				
I.A.2.6	Long-term Upgrading of Tng. & Qualifications	H	X	X	X	X	X	X	X				
I.A.2.6(1)	Revise Reg. Guide 1.8	H											
I.A.2.6(2)	Staff Review of NRR 80-117	~~H~~ R											
I.A.2.6(3)	Revise 10 CFR 55	~~H~~ Covered in I.A.2.2 workshops & priority [illegible] High											
I.A.2.6(4)	Operator Workshops	M		X	X	X	X	X	X	X	X	X	X
I.A.2.6(5)	Develop Insp. Proced. for Prog. Training	~~H~~ R											
I.A.2.6(6)	Nuc. PWR Fundamentals	D		X	X	X	X	X	X	X	X	X	X
I.A.2.7	Accrediation of Tng. Institutions	M	X	X	X	X	X	X	X	X	X	X	X
I.A.3	Licensing & Requal. of Operating Personnel												
I.A.3.2	Operator Licensing Prog. Changes	~~H~~ R		X	X	X	X	X	X				
I.A.3.3	Requirement for Operator Fitness	H	X	X	X	X	X	X	X				
I.A.3.4	Licensing of Add'l. Operations Personnel	M		X	X	X	X	X	X	X	X	X	X
I.A.3.5	Establish Statement of Understanding w/INPO	LI	X	X					X				
I.A.4	Simulator Use and Development			X									
I.A.4.1	Initial Simulator Improvements		X	X					X				
I.A.4.1(1)	Short-Term Study of Training Simulators	R								X	X	X	X
I.A.4.1(2)	Interim Changes in Training Simulators	R								X	X	X	X
I.A.4.2	Long-term Tng. Simulator Upgrade	H		X	X	X	X	X	X				
I.A.4.2(1)	Research on Training Simulators	R H											
I.A.4.2(2)	Upgrading Simulator Standards	R											
I.A.4.2(3)	Reg. Guide on Tng. Simulators	R											
I.A.4.2(4)	Review Simulators for Conformance to Criteria	R H											
I.A.4.3	Feasibility Study of Procurement of NRC Tng	NA		X					X				
I.A.4.4	Feasibility Study of NRC Engr. Computer	NA	X	X					X				
I.B.	Support Personnel												
I.B.1	Management for Operations			X									
I.B.1.1	Org. & Mgt. of Long-term Improvements	M	X	X	X	X	X	X	X	X	X	X	X
I.B.1.1(2)	Prepare Commission Paper	M											
I.B.1.1(3)	Issue Requirements for Upgrading of Manage. & Technical Resources	M											
I.B.1.1(4)	Review Responses to Determine Acceptability	M											
I.B.1.1(5)	Review Implementation of Upgrading Activities	M R											
I.B.1.1(6)	Revise Reg. Guides 1.33 and 1.8	M											
I.B.1.1(7)	Issue Reg. Guides 1.33 and 1.8	M											
I.C.	Operating Procedures			X									
I.C.9	Long-term Program Plan for Upgrading of Procedures	M	X	X		X	X	X	X	X	X	X	X
I.D.	Control Room Design			X									
I.D.3	Safety System Status Monitoring	M	X	X	X	X	X	X	X	X	X	X	X
I.D.4	Control Room Design Standards	M		X	X	X	X	X	X				
I.D.5	Improved CR Instrumentation Research												
I.D.5(1)	Operator-Process Communication	R		X					X				
I.D.5(2)	Plant Status and Post Accident Monitoring	R		X					X				
I.D.5(3)	On-Line Rx Surveillance System	M	X										
I.D.5(4)	Processing Monitoring Instrumentation	R	X	X	X	X	X	X	X				
I.D.5(5)	Disturbance Analysis System	M	X										
I.D.6	Technology Transfer Conference	R I											
II.J.3	Management for Design & Construction			X									
II.J.3.1	Organization & Staffing to Oversee Design and Construction	M	X	X					X	X	X	X	X
IV.D	NRC Staff Training												
IV.D.1	NRC Staff Training	R LI	X	X					X				

Possible R [illegible] [illegible] for [illegible]

[illegible]

PRIORITIZATION

OF

GENERIC SAFETY ISSUES

WHAT IT IS:

- A MEANS OF ALLOCATING NRR RESOURCES EFFICIENTLY
- A METHOD OF IDENTIFYING AND MAINTAINING AN ACCURATE LIST OF SAFETY ISSUES

WHAT IT IS NOT:

- A REGULATORY ANALYSIS
- A PREJUDGMENT OF RESOLUTIONS
- A DECISION TO ADD A NEW REQUIREMENT

NRR PROGRAM FOR MANAGEMENT OF GENERIC ISSUES

1. IDENTIFICATION
2. PRIORITIZATION
3. ALLOCATION OF NRR RESOURCES
4. RESOLUTION
5. REVIEW AND APPROVAL
6. IMPLEMENTATION

PROCESS
(NRR OFFICE LETTER NO. 40)

1. IDENTIFY ALL ISSUES
   - SOURCES - NRR, ACRS, AEOD, OIE, REGIONS

2. ASSIGN ISSUES
   - SPEB
   - CONTRACTOR ASSISTANCE FROM PNL (NUREG/CR-2800)

3. DEFINE ISSUES BY CONSULTING WITH LEAD NRC OFFICE/DIVISION/BRANCH

4. IDENTIFY NON-SAFETY ISSUES FOR SEPARATE PRIORITIZATION
   - LICENSING
   - ENVIRONMENTAL

5. IDENTIFY RESOLVED AND NEARLY-RESOLVED ISSUES

6. PRIORITIZE SAFETY ISSUES USING DEFINED METHOD

7. CIRCULATE PRODUCT FOR PEER-REVIEW

8. OFFICE LEVEL APPROVAL (ACRS REVIEW AND PUBLIC COMMENT IN PARALLEL)

9. SCHEDULE RESOLUTION OF HIGH AND MEDIUM PRIORITY ISSUES IDENTIFIED BY PROCESS

10. MONITOR RESOLUTION (INCLUDING REVIEW, APPROVAL, AND ISSUANCE) WITH THE GENERIC ISSUE MANAGEMENT CONTROL SYSTEM (GIMCS)

PRIORITIZATION METHOD

- SAFETY PRIORITY SCORE
- SAFETY PRIORITY RANKING CRITERIA
- OTHER CONSIDERATIONS
- SAFETY PRIORITY RANKING

SAFETY PRIORITY RANKINGS OF GENERIC ISSUES

1. NEARLY RESOLVED (NOTE 1 & NOTE 2)
   HIGH PRIORITY
   — SCHEDULE RESOLUTION

2. MEDIUM PRIORITY - SCHEDULE FOR FUTURE YEARS

3. LOW PRIORITY
   DROP
   — NO FURTHER WORK

4. REGULATORY IMPACT

ITEM I.A.2.2 TRAINING AND QUALIFICATIONS OF OPERATIONS PERSONNEL

EACH LICENSEE WILL BE REQUIRED TO REVIEW ITS TRAINING PROGRAM FOR ALL OPERATIONS PERSONNEL, INCLUDING MAINTENANCE AND TECHNICAL PERSONNEL, AND TO JUSTIFY THE ACCEPTABILITY OF TRAINING PROGRAMS ON THE BASIS THAT THESE PROGRAMS PROVIDE SUFFICIENT ASSURANCE THAT SAFETY-RELATED FUNCTIONS WILL BE CARRIED OUT.

⋮

LICENSEES WILL ALSO BE REQUIRED TO UPGRADE TRAINING AND QUALIFICATIONS OF PERSONNEL FOUND TO BE NECESSARY •••

⋮

I.E. WILL CHECK TO ASSURE THAT THE TRAINING EVALUATION HAS BEEN PERFORMED•••

APPROACH

GROUP OF EXPERTS FROM PNL

EXPERIENCE INCLUDED

- REACTOR OPERATIONS
- UTILITY TRAINING PROGRAMS
- REACTOR PLANT SYSTEMS
- UTILITY FIELD OPERATIONS
- REACTOR OPERATOR LICENSING EXAMINER

ASSUMPTIONS

LICENSEES CAN BE DIVIDED INTO THREE GROUPS

- 15% MINIMALLY AFFECTED
- 60% INTERMEDIATELY AFFECTED
- 25% MAXIMALLY AFFECTED

BEST ESTIMATE OF IMPROVEMENT IN H.E.

- OPERATORS 17%
- MAINTENANCE & TECHNICAL 28%

POTENTIAL H.E. DECREASE

% DECREASE FOR	GROUP 15%	60%	25%	WEIGHTED AVE.
LICENSED OPERATORS	5	15	30	17
OTHER STAFF (TECHNICIANS, MAINTENANCE, ETC.)	10	25	45	28

FREQUENCY/CONSEQUENCE REDUCTION

CORE-MELT FREQUENCY REDUCTION †

- PWR 1.5×10^{-5} C-M/PLT YR
- BWR 6.8×10^{-6} C-M/PLT YR

RISK REDUCTION

- PWR 38 MAN-REM/PLT YR
- BWR 46 MAN-REM/PLT YR

TOTAL RISK REDUCTION

1.2×10^{5} MAN-REM

† BASED UPON THE OCONEE AND GRAND GULF RSSMAP STUDIES

ESTIMATED COSTS

∘ UTILITY COSTS	
- IMPLEMENTATION	\$ 48 M
- MAINTENANCE	640 M
	\$ 688 M
∘ NRC COSTS	3 M
TOTAL COSTS	\$691 M

UTILITY COST BASIS

	GROUP			
	15%	60%	25%	WEIGHTED AVE.
IMPLEMENTATION COST ($\$10^3$/PLANT)	100	325	500	335
MAINTENANCE COST ($\$10^3$/PLT YR)	50	150	250	160

IMPLEMENTATION – ($\$335 \times 10^3$/PLT)(143 PLTS) = \$48 M
MAINTENANCE – ($\$160 \times 10^3$/PLT YR)(143 PLTS)(28 YR) = \$640 M

NRC COST BASIS

DEVELOPMENT AND IMPLEMENTATION

1 PY* = \$100 K

MAINTENANCE ~ REVIEW OF TRAINING AND DOCUMENTATION

1 PY*/ YR X 28 YR = \$2.8 M

* PY ~ PERSON YEAR

VALUE/IMPACT SCORE

$$S = \frac{1.2 \times 10^5 \text{ MAN-REM}}{\$691 \text{ M}} = 180 \ \frac{\text{MAN-REM}}{\$ \text{ M}}$$

OTHER CONSIDERATIONS

- UNCERTAINTIES
- OCCUPATIONAL DOSE
  - INCURRED (IMPLEMENTATION AND NORMAL OPERATIONS)
  - AVERTED (ACCIDENT CLEANUP AND NORMAL OPERATIONS)
- AVERTED COSTS
  - ACCIDENT CLEANUP (~\$400 M)
  - REPLACEMENT (~\$1000 M)
  - FORCED OUTAGE
  - NOT CONSIDERED - OFFSITE DAMAGE CORRELATED WITH MAN-REM (NO REAL DATA)
- DEFENSE-IN-DEPTH
- PUBLIC/CONGRESS/COMMISSION CONCERN
- TECHNICAL CONTROVERSY
- EFFECT OF DELAY
- NEARNESS TO RESOLUTION

OTHER CONSIDERATIONS

OCCUPATIONAL DOSE REDUCTION

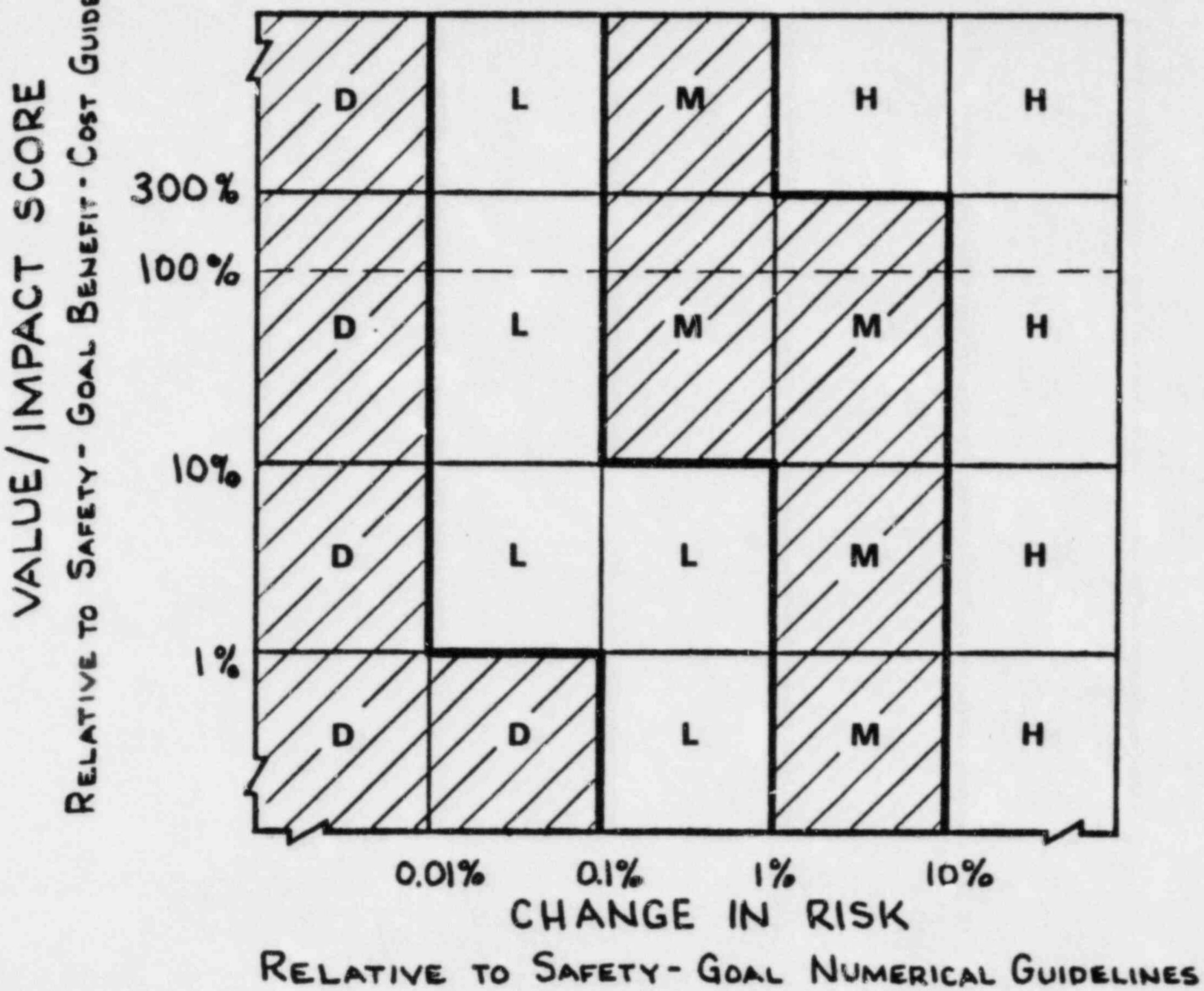
2.4×10^5 MAN-REM

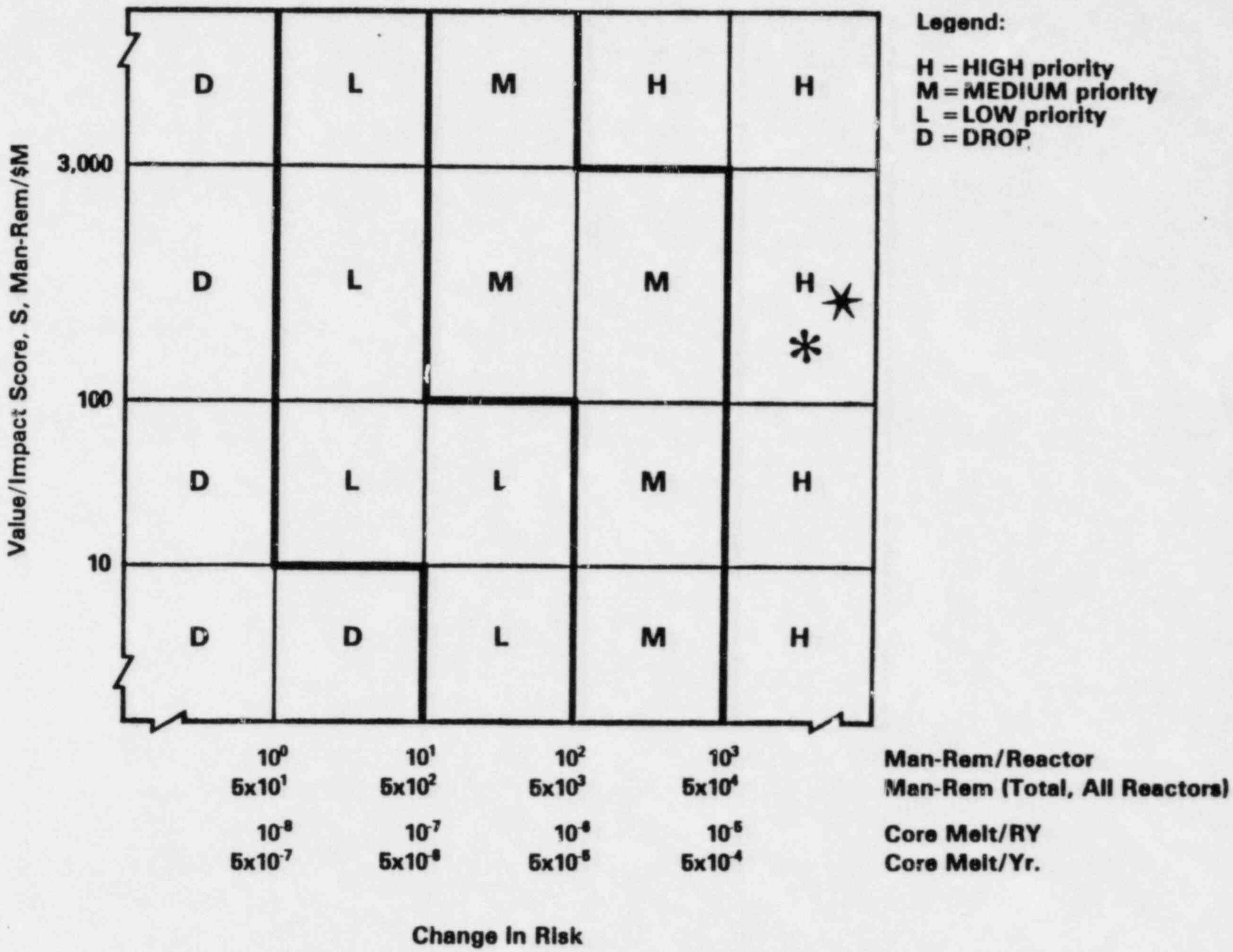
$$S_{p+o} = 525 \ \frac{\text{MAN-REM}}{\$\text{M}}$$

CONCLUSION

HIGH PRIORITY ITEM

POTENTIAL GENERIC ISSUES
SAFETY PRIORITY RANKING CRITERIA




Legend:
H = HIGH priority
M = MEDIUM priority
L = LOW priority
D = DROP
D L M H H
D L M M H
D L L M H
D D L M H
3,000
100
10
Value/Impact Score, S, Man-Rem/$M
10^0 10^1 10^2 10^3 Man-Rem/Reactor
$5x10^1$ $5x10^2$ $5x10^3$ $5x10^4$ Man-Rem (Total, All Reactors)
10^{-8} 10^{-7} 10^{-6} 10^{-5} Core Melt/RY
$5x10^{-7}$ $5x10^{-6}$ $5x10^{-5}$ $5x10^{-4}$ Core Melt/Yr.
Change in Risk

ITEM I.A.2.5 PLANT DRILLS

UPGRADE OPERATOR TRAINING BY REQUIRING OPERATING PERSONNEL TO CONDUCT PLANT DRILLS DURING SHIFTS. NORMAL AND OFF-NORMAL OPERATING MANEUVERS WOULD BE SIMULATED FOR WALK-THROUGH DRILLS ON A PLANT-WIDE BASIS. DRILLS WOULD ALSO BE REQUIRED TO TEST THE ADEQUACY OF REACTOR AND PLANT OPERATING PROCEDURES.

ASSUMPTIONS

- CORE MELT FREQUENCY IS 5×10^{-5} C-M/PLT YR
- OPERATOR ERROR ACCOUNTS FOR 50% OF THESE EVENTS
- DRILLS WILL REDUCE OPERATOR ERRORS BY 2%
- ITEM WILL AFFECT 95 PWRS & 48 BWRS WITH AN AVERAGE LIFE OF 28 YEARS
- AVERAGE RELEASE OF 2.4×10^{6} MAN-REM/C-M

FREQUENCY/CONSEQUENCES

CORE-MELT FREQUENCY REDUCTION

$(.02)(.50)(5 \times 10^{-5}) = 5 \times 10^{-7}$ C-M/ PLT YR

RISK REDUCTION

$(5 \times 10^{-7})(2.4 \times 10^{6})(143)(28) = 4800$ MAN-REM

ESTIMATED COSTS

∘ UTILITY COSTS	
- IMPLEMENTATION	$ 1.2 M
- MAINTENANCE	67 M
	$ 68.2 M
∘ NRC COSTS	8.7 M
TOTAL COSTS	$ 76.9 M

UTILITY COST BASIS

IMPLEMENTATION COSTS

1 PERSON MONTH / PLANT

(1 PM/PLT)(143 PLTS)($1 X 10^5/PY*/12 MO/YR) =

$1.2 M

MAINTENANCE COSTS

2 PERSON MONTHS/PLT YR

(2 PM/PLT YR)(143 PLT)($1 X 10^5/PY*/12 MO/YR)(28 YR) =

$67 M

* PY ~ PERSON YEAR

NRC COST BASIS

IMPLEMENTATION COST	$300 K
MAINTENANCE COST	
($300 K/YR)(28 YR)	$8.4 M

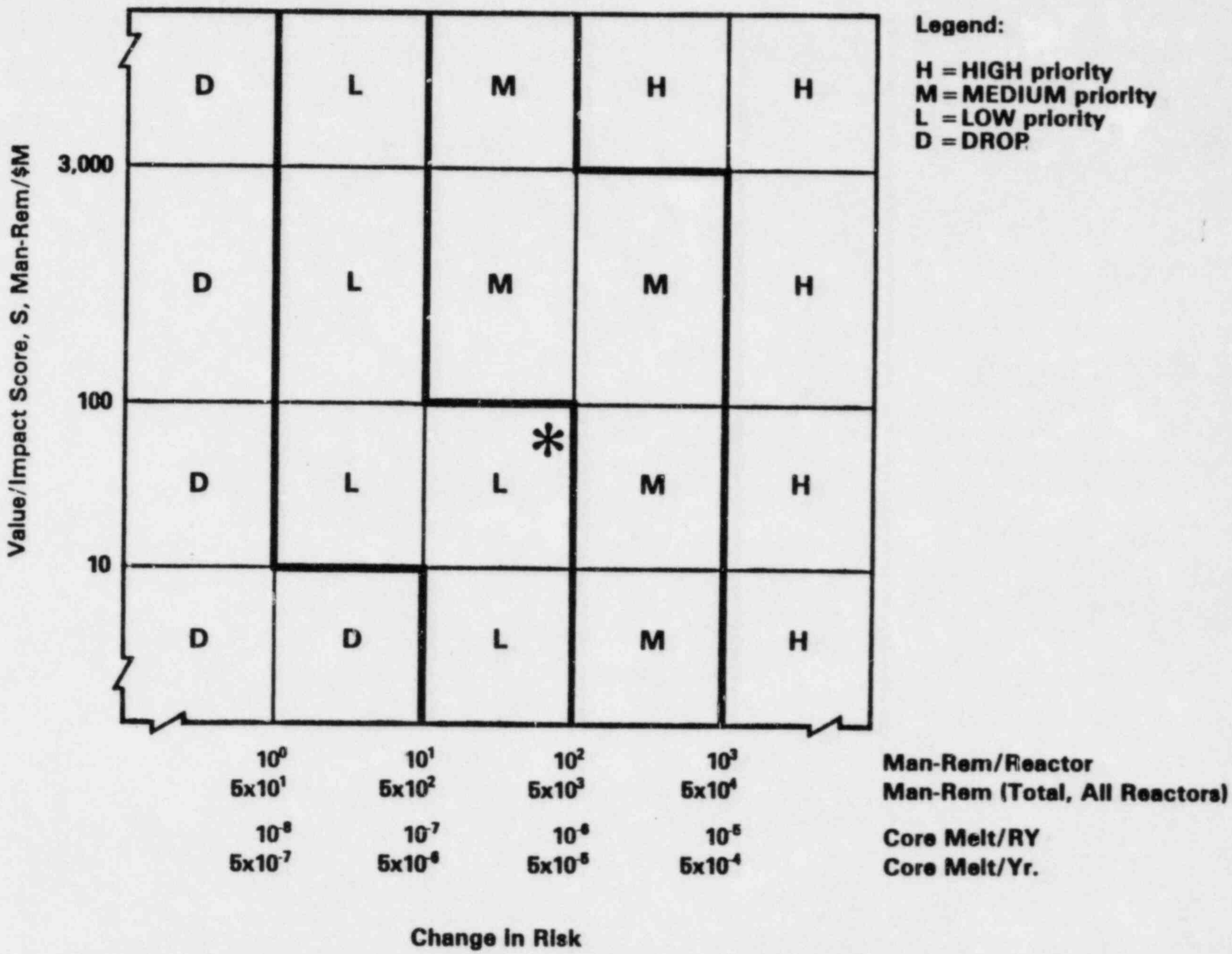
TOTAL $8.7 M

VALUE/IMPACT SCORE

$$S = \frac{4800 \text{ MAN-REM}}{\$76.9 \text{ M}} = 62 \frac{\text{MAN-REM}}{\$ \text{M}}$$

CONCLUSION

LOW PRIORITY ITEM


Legend:
H = HIGH priority
M = MEDIUM priority
L = LOW priority
D = DROP
D
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H
*
3,000
100
10
Value/Impact Score, S, Man-Rem/$M
10^0 10^1 10^2 10^3 Man-Rem/Reactor
$5x10^1$ $5x10^2$ $5x10^3$ $5x10^4$ Man-Rem (Total, All Reactors)
10^{-8} 10^{-7} 10^{-6} 10^{-5} Core Melt/RY
$5x10^{-7}$ $5x10^{-6}$ $5x10^{-5}$ $5x10^{-4}$ Core Melt/Yr.
Change in Risk

NRC INCIDENT RESPONSE UPGRADE

A COMPREHENSIVE PROGRAM OF INTEGRATED AND PHASED IMPROVEMENTS IN:

- PLANS AND PROCEDURES
  - REFINED STATEMENT OF NRC ROLE; REVISED NUREGs 0728, 0845
- PERSONNEL ASSIGNMENTS AND TRAINING
  - COMPLETED FIRST ROUND OF TRAINING FOR HEADQUARTERS AND THREE REGIONS
- FACILITIES
  - GSA SCHEDULED COMPLETION OF NEW OPERATIONS CENTER FOR 3/84
- SUPPORTING SYSTEMS
  - COMMUNICATIONS - COMPLETE SYSTEM EVALUATION BEING INITIATED
  - DATA ACQUISITION - NDL
  - INTERNAL INFORMATION FLOW - IMS
  - ANALYTICAL TOOLS - IDAS AND RSAS

ROLES

LICENSEE: THE LICENSEE HAS THE IMMEDIATE AND PRIMARY CONTINUING RESPONSIBILITY FOR LIMITING THE CONSEQUENCES OF AN INCIDENT AT A NUCLEAR POWER REACTOR.

STATE: WHILE THE LICENSEE HAS THE PRIMARY ROLE IN MITIGATING INCIDENT CONSEQUENCES, THE STATE AND LOCAL AUTHORITIES HAVE ULTIMATE RESPONSIBILITIES FOR ASSURING THE PROTECTION OF THE PUBLIC FROM SUCH CONSEQUENCES OFFSITE.

NRC: A REGULATORY AGENCY

AGENCY ROLE

1. MONITOR THE LICENSEE TO ASSURE APPROPRIATE PROTECTIVE ACTION IS BEING TAKEN WITH RESPECT TO OFFSITE RECOMMENDATIONS.

2. SUPPORT THE LICENSEE.

3. SUPPORT OFFSITE AUTHORITIES, INCLUDING CONFIRMING THE LICENSEE'S RECOMMENDATION TO OFFSITE AUTHORITIES.

4. KEEP OTHER FEDERAL AGENCIES AND ENTITIES INFORMED OF THE STATUS OF THE INCICENT.

5. KEEP THE MEDIA INFORMED OF THE NRC'S KNOWLEDGE OF THE STATUS OF THE INCIDENT, INCLUDING COORDINATION WITH OTHER PUBLIC AFFAIRS GROUPS.

NDL: ORIGINAL AND CURRENT CONCEPTS

ORIGINAL	CURRENT
PURPOSE: CONTINUOUS MONITORING OF PLANT CONDITIONS.	PURPOSE: EMERGENCY MONITORING OF PLANT CONDITIONS.
READ OUT TRIGGERED BY PRE-SET ALARMS ON PLANT PARAMETER THRESHOLDS.	LICENSEE ACTIVATED.
DATA CONTINUOUSLY RECORDED AT OPERATIONS CENTER.	"FLIGHT" RECORDER LOCATED ON-SITE STORES EARLY DATA FOR PREDETERMINED PERIOD.
SOME DATA ACQUIRED DIRECTLY FROM PLANT SENSORS (WITH ISOLATION).	NO CONNECTION TO SENSORS.
DEDICATED COMPUTER ON-SITE PERMITS NRC TO INTERACT.	ALL DATA TO BE PROVIDED FROM EXISTING PLANT COMPUTERS; NO INTERACTION INITIATED BY OPERATIONS CENTER.
DATA LIST DEVELOPED IN HOUSE, TO BE REQUIRED OF LICENSEES.	DATA LIST TO BE DEVELOPED WITH LICENSEE AND STATE INPUT.
INITIAL DATA LIST ABOUT 400 VARIABLES, LATER TRIMMED TO 125.	LENGTH OF DATA LIST LIMITED, AND EXPECTED TO BE COMPARABLE IN SIZE TO THE DATA SET FOR PLANT SAFETY PARAMETER DISPLAY SYSTEMS.
LICENSEE REQUIRED TO MEET NRC DATA NEEDS IN STANDARDIZED NRC FORMAT.	LICENSEE WILL PROVIDE SITE-SPECIFIC DATA IN OWN FORMAT. NRC WILL TRANSLATE FOR NRC USE.
ESTIMATED TOTAL SYSTEM COST ABOUT $25 MILLION.	ESTIMATED TOTAL SYSTEM COST ABOUT $9 MILLION.

INFORMATION MANAGEMENT SYSTEM (IMS)

PURPOSE

TO MANAGE THE FLOW OF INFORMATION IN THE OPERATIONS CENTER

CONCEPT

PHASE 1 - ESSENTIAL CAPABILITIES DURING EMERGENCIES

PHASE 2 - OTHER IMPROVEMENTS IN OPERATIONS CENTER AND RESPONSE FUNCTIONS

PHASE 3 - SUPPORT FOR RELATED IE NON-EMERGENCY, OPERATIONAL FUNCTIONS

PROTECTIVE MEASURES TOOLS

MULTITIERED CAPABILITY

1. RAPID - IRDAM - INTERACTIVE RAPID DOSE ASSESSMENT MODEL
2. INTERMEDIATE - INTERMEDIATE DOSE ASSESSMENT SYSTEM
3. EXTENDED - ABOVE SUPPLEMENTED BY THE FEDERAL COMMUNITY CAPABILITIES (E.G., ARAC)

INTERMEDIATE DOSE ASSESSMENT SYSTEM

1. ESTIMATES DOSE AND DOSE RATE USING REFINED SOURCE TERM, DOSIMETRY, AND DISPERSION MODELS.

2. INCORPORATES EFFLUENT AND ENVIRONMENTAL RADIOLOGICAL AND METEOROLOGICAL INFORMATION.

REACTOR SAFETY ANALYSIS SYSTEM

PURPOSE

TO DEVELOP ANALYTIC TOOLS FOR ASSESSING CORE AND CONTAINMENT CONDITIONS WHICH CAN AFFECT THE NEED FOR OFFSITE PROTECTIVE ACTIONS.

CONCEPT

- DETERMINE TEAM NEEDS FOR DATA AND TOOLS
- IDENTIFY AND EVALUATE EXISTING RESOURCES (SUCH AS TABLES AND CODES)
- EVALUATE EXISTING SPDS-LIKE SYSTEMS
- SYNTHESIZE RSAS DESIGN AND IMPLEMENT

19/11/7 Dennis Dougherty Contracts RAB
Ralph Avery - EIS RSD
Tom Carter Dep
Ralph Wilde
John Greeves
Wm Thompson

1- Serious matter - why NRC not notified of 75% level being exceeded
- mix of tasks + SE + Radon; response to tech matters, reg. for mod.
for adoption of mod. effects of rulemaking efforts
- never happened before

2- Will consider overrun + what will be req'd to complete but not for ~~those~~ costs currently in excess of contract limit
a- will not consider portion of overrun after notification 20 Sep
of part of current request for add'l funds -
Avg monthly - 57K

Work to be completed - WEThompson
3- a) Radon report - complete prep of final report. No further costs on Task XI
However do not destroy tapes -
RSD - offer to give fixed estimate accepted

b) - Carter lack of reporting - major concern

c - Cost to complete
separate Task XI to complete

d - Dose integration time paper ~~#~~ - no further costs on this

e - History - (1) varying Rn value - recognizing need for assurance scope change
(2) on completion of backend of S-3 proc - need to reflect change - scope SE +
(3) other subjects not identified as scope changes - disc w/ NW but no formal action from NUS to proceed w/ contract change

Carter f - address cost to complete specific milestones which will be provided by NRC

Problem in NUS PM not knowing what to NRC that costs were being exceeded + resources were being expended at a greater rate than planned

4- RAB - communications impact

5 Stop work, ~~write~~ effective close of business today

Tom Carter Dep
Ralph Wilde
John Greeves
Wm Thompson

1- Serious matter - why NRC not notified of 75% level being exceeded
- mix of tasks + SE + Radon / response to tech matters, reg to modif
time lapse of modif. effects of rule making efforts + ?
- never happened before

2- will consider overrun + what will be req'd to complete but not for
those costs currently in excess of contract limit
a- will not consider portion of overrun after notification 20 Sep
as part of current request for add'l funds —
approximately 572K

Work to be completed - WEThompson
3- a) Radon report - complete prep of final report No further costs on Task XI
however do not destroy tapes —
RW - offer to give fixed estimate accepted

b) - Carter lack of reporting - major concern

c - Cost to complete
separate Task XI to complete

d - Dose integration time paper - no further costs on this

e - History - ① vacating Rn value - recognizing need for scope change
② on completion of backward of S-7 proc - need to reflect change — scope SE +
③ other subjects not identified as scope changes - disc w/ NW but no formal action from NUS to proceed w/ contract change

Carter f - address cost to complete specific milestones which will be provided by NRC

Problem w NUS PM not bringing what to NRC that costs were being exceeded + resources were being exceeded at a greater rate than planned

4 - RAB - Commission impact

5 Stop work effective close of business today
until further notice —