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PUBLIC NOTICE
BY THE
UNITED STATES NUCLEAR REGULATORY COMMISSION'S
ADVISORY COMMITTEE ON REACTOR SAFEGUARDS
SUBCOMMITTEE ON HUMAN FACTORS

SEPTEMBER 20, 1996

The contents of this transcript of the proceedings of the United States Nuclear Regulatory Commission's Advisory Committee on Reactor Safeguards on SEPTEMBER 20, 1996, as reported herein, is a record of the discussions recorded at the meeting held on the above date.

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UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

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MEETING

ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

(ACRS)

HUMAN FACTORS SUBCOMMITTEE

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FRIDAY, SEPTEMBER 20, 1996

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ROCKVILLE, MARYLAND

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The Subcommittee met at the Nuclear Regulatory Commission, Two White Flint North, Room T-2B3, 11545 Rockville Pike at 8:30 a.m., Robert L. Seale, Chairman, presiding.

COMMITTEE MEMBERS:

ROBERT L. SEALE	Chairman
GEORGE E. APOSTOLAKIS	Member
JOHN J. BARTON	Member
IVAN CATTON	Member
THOMAS S. KRESS	Member
DANA A. POWERS	Member

ACRS STAFF PRESENT:

Noel Dudley

ALSO PRESENT:

Cecil O. Thomas

MaryAnn Biamonte

Clare Goodman

Jay Persensky

Franklin Coffman

Lee Spessard

Dolores Morisseau

Jerry Wachtel

Wayne Hodges

Isabelle Schoenfeld

INDEX

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

(8:33 a.m.)

INTRODUCTION

CHAIRMAN SEALE: The meeting will now come to order. This is a meeting of the ACRS Subcommittee on Human Factors. I am Robert Seale, Chairman of the Subcommittee for this meeting. The ACRS members in attendance are: George Apostolakis, John Barton, Ivan Carton, Tom Kress, Dana Powers.

The purpose of this meeting is to hold discussions with representatives of the staff to gather information concerning the NRC Human Performance Program Plan, the collection and use of human performance data, the development of the inspection guidelines, and the Human Factors Research Program. The Subcommittee will gather information, analyze relevant issues and facts, and formulate proposed positions and actions as appropriate for deliberation by the full Committee.

Noel Dudley is the cognizant ACRS staff engineer for this meeting.

The rules for participation in today's meeting have been announced as part of the notice of this meeting previously published in the Federal Register on August the 23rd this year.

A transcript of the meeting is being kept and

will be made available as stated in the Federal Register notice. It is requested that the speakers first identify themselves and speak with sufficient clarity and volume so that they can be readily heard.

We have received no written comments or requests for time to make oral statements from members of the public.

A few additional comments. The last ACRS letter on human factors was back in April of 1993. And at that time a recommendation was made to support research on organizational factors. One of our former members, Mr. Jay Carroll, was particularly helpful in bringing the need for these data to the attention of the Committee.

We heard then in 1994 from the AEOD that the staff had funded two active research programs and organizational factors. However, the Committee has not conducted an integrated review in the human factors area since 1993.

We heard some information earlier this year on the Human Factors Performance Program plan in February. The Subcommittee is now following up on that. And today we're going to hear from, this morning, people from NRR staff. And then this afternoon we'll hear further information from representatives from Research.

Now, we have an additional Subcommittee

meeting scheduled for November 6th. At that time it is expected that AEOD representatives will speak to us. And that's the day before the November full Committee meeting.

I would urge you to help us in anticipating or in identifying additional questions or clarifications that we might desire growing out of today's meeting. And we can ask for further clarification from those people or at least most of them if they don't have prior obligations along with the presentations from AEOD in early November.

MEMBER POWERS: Mr. Chairman?

CHAIRMAN SEALE: Yes?

MEMBER POWERS: In that regard, I have coming across my desk -- and I'm sure you do, too -- a continuing stream of incidents involving medical uses of isotopes where there's been human error. But when I look at this plan for human factors, I see that everything that NMSS is responsible for falls in the category of TBD, which I assume means to be determined.

I think it would be of interest to understand why they are so far behind everybody else in getting on board on this human factors plan, especially since they seem to have the bulk of the human errors that at least come across my desk.

CHAIRMAN SEALE: Okay. Well, perhaps we can hear something on that. Maybe I wouldn't think the people

from NRR are necessarily in a position to respond to that, but maybe the Research people this afternoon might be able to help us. We can look into that further, if necessary, if we don't get a satisfactory answer.

The other comment I would make is that in the recent identification of issues that might be included in our upcoming report to Congress we write each year that human factors was an area that was tentatively identified. If we're going to do that, we need to have some firm positions to base our comments on.

So I would urge us to be thinking in terms of those issues we'd like to identify and bring forward to the attention of the Commission. And while we probably won't have a letter coming out of this meeting, we may very well have a letter coming out of the results of this meeting and then the meeting early in November.

So with that, I think there are a couple of additional comments that other members of the Committee may like to make before we get started. Yes, Dr. Catton?

MEMBER CATTON: I'd like to pose a couple of questions. They came out of the meeting that we had over the past two days.

CHAIRMAN SEALE: Okay.

MEMBER CATTON: They have to do with the simulators and training. I'm not a human factors person.

So I don't really have a good feel for what it means. First, I'd like to -- maybe somebody could tell me how important good simulator fidelity and emergency operating procedure training -- how important is it?

Second, how well does plant process equipment represent the true symptoms of the state of the plant? And how necessary is it given the EOPs as they're written?

And, third, what will an operator do if he faces unexpected behavior during an accident? And by "unexpected" here I mean different than his simulator. I mean, these are physical processes. If you look at them properly, they shouldn't be unexpected.

The codes have been tuned. The simulators have been tuned to our big codes. And our big codes don't necessarily represent the behavior. But what I don't know is how well that behavior is represented by the plant process instrumentation.

It may not matter. But I think that these are questions that should be addressed at some point by somebody.

CHAIRMAN SEALE: Okay. Dr. Powers?

MEMBER POWERS: We've seen some of this Human Factors Program plan in a previous incarnation. I guess that was part of our February meeting. And I was perplexed by that previous presentation in that it did not

tell me what we were trying to achieve with our Human Factors Program, what nirvana was, the final state.

And I found that surprising. In the area of risk-informed regulation surely, we must have somewhere a measure of the risk worth of the human in this system. And we must have some reason to think that that risk measure or risk worth is too high and that we want to get it down. And this plan presumably is the vehicle for getting that down.

Each element should contribute to that, getting it down. And, quite frankly, the plan looks to me like a listing of everything that is going on in the agency that can vaguely be attributed to human factors.

And some of those things are profound, things like putting information into our human reliability analysis models. Others seem to amount to nothing more than saying that if you're a specialist in the area of human factors, remain current in your field. It's difficult for me to understand how each element is contributing to this goal of getting the risk measure of the human in the system down.

The prioritization of the activities and their funding status is, similarly, a bit mysterious to me. And I understand it's my fault. I just don't understand what we're trying to get, what the requirements are on the

system. But there are peculiarities in the prioritization that I hope we have a chance to explain today.

For instance, we're interested in developing guidance for hybrid control rooms. That's given very high priority. But to conduct reviews of hybrid control rooms and the modifications of control rooms to make them hybrids has a medium priority. Well, it seems to me that that's the data that you develop the guidance from.

I don't understand why they should have different priorities, one funded and one unfunded. Maybe it is the case that the guidance is not based on data, it's based on gut feel of social scientists of some sort. And that may be an appropriate way to do it. But it would surprise me if it were.

Similarly, I see that lots of the activities are going to use human reliability analysis models. And many of those activities have a high priority attached to them. But I find in the plan it says that the information needs for the human reliability analysis models has a medium priority. That strikes me as curious. It may be entirely appropriate. It would help if I could understand how the prioritization goes.

In that respect, it would help to have some quantitative measures. The planning is cast in relatively qualitative terms, which may not be surprising for a plan,

but I need to understand better what the term "effective" means. I need to know what the term "adequate" means because they appear in all of the goals and a great number of the options.

I hope we have a chance to explore those issues here because I think that this is the opportunity to get that kind of detail.

CHAIRMAN SEALE: Yes, George?

MEMBER APOSTOLAKIS: I have a related comment. In regarding this Human Performance Program plan, I tried to understand, just as Dana did, why these items and not something else. And then I came to the conclusion that what was missing that would have helped me was a model for human performance that would guide the researchers to say, "This is what the current thinking, the latest thinking, is as to how people take certain actions under certain circumstances."

These are the holes that we have right now in our arsenal of tools. And I think I'm stating the same thing that Dana stated in different words. But I think if such a model were presented up front with some statements to the effect that, you know, "This part we do well right now. On that part we have an ongoing activity. Here is where we have to do something else," then I think that would go a long way toward convincing the reader that

there is indeed a plan and that this is not just a listing of ongoing activities.

Now, in that context, for example -- and the model would have to be combined with experience because we have now some reports, NUREG reports, where experience with human errors has been investigated.

For example, if you look at the plan, there is an activity there on fatigue. I don't even know what it is. What is the impact of the operators being tired on their action, which in absolute terms is something you really have to understand, but the question is: How important is that in the overall scheme of things? Yes, that's 1.1.4, "Monitoring Events Caused by Fatigue."

CHAIRMAN SEALE: Very early.

MEMBER APOSTOLAKIS: And at the same time, at the same time, there are other items that are not there at all. There was a NUREG that was published -- I don't know -- a year or so ago by Research where they investigated some of the major incidents in nuclear power. And they found that circumventions or what Jim Reason calls violations were a major cause. That's related to the so-called informal structure that exists in the plant, where things don't quite happen the way they are supposed to.

Now, that seems to be a major issue these

days. How does one assess this informal structure and culture and evaluate it. And, yet, there is nothing on it here.

So it seems to me that a model of human behavior -- and there are models out there. Just to mention two, one is Jim Reason's, his book on human error that was published six years ago that is widely being used, even by some groups at the NRC. Another one is by Jens Rasmussen. And I'm sure there are others.

So a model like that I think would go a long way towards telling us: What is it that we need to do? And there was some work from Electricitie de France two-three years ago where they stressed the importance of this informal culture and, yet, will do nothing about it.

So I think this overall -- we would have a plan if we started with a model like that or a number of models combined with actual experience and say, "Here is where we want to go, which is Dana's point." At the end of this, we will have the model and the data perhaps and the tools to do this analysis. And right now we have A, B, C, but we don't have X, Y, Z. I think that really would be a nice plan.

A lot of that is here already, by the way. I'm not saying that everything here is not worth doing, but this structure is not there.

CHAIRMAN SEALE: It's not tied together.

MEMBER APOSTOLAKIS: Exactly.

CHAIRMAN SEALE: Thank you.

Any other comments?

(No response.)

CHAIRMAN SEALE: There is one other thing. I believe you are recusing yourself from decisions on the Subcommittee, Dr. Apostolakis.

MEMBER APOSTOLAKIS: For the time being, that's what I'm told, yes.

CHAIRMAN SEALE: Okay. Fine. As long as it's in the record. I understand.

Well, I think you can see that while the committee has been lying low, it hasn't exactly been a sleeping dog on this issue. We have some very real concerns. We also acknowledge, at least some of us, our naivete in this regard. And so we are looking forward to being enlightened.

To that end, Dr. Cecil Thomas will be our first presenter from NRR. He's Chief of the Human Factors Assessment Branch. And you have a handout on his presentation.

If you hear loud ticks during your performance, that is not a human factors problem. That happens to be the symptoms for a dead battery.

DR. THOMAS: Can you hear me okay?

CHAIRMAN SEALE: Yes.

HUMAN PERFORMANCE PROGRAM PLAN, REVISION I

DR. THOMAS: Good morning, gentlemen. With some of the comments that were made, all I can do is start out by saying I'm in trouble. I certainly appreciate the questions that were raised.

We face them every day, both in our different organizations within the agency and also in the Human Factors Coordinating Committee. I will attempt to talk to some of them as I go through my presentation. I'm not going to be able to answer all of them.

I would ask you to remember in going through my presentation and those that follow today and in November that one of the reasons that we formed a coordinating committee and have a plan is because there are a number of organizations within the agency that have different missions and different interests. And I hope to clarify at least what NRR's is this morning.

And I think it's important that you look for this aspect of the different organizations as they talk to you. It's extremely difficult to pull together all of our interests, activities, goals, objectives, especially with the budget situation being the way it is with resources and so on.

But, in any event, let me go through my presentation. And hopefully I can address some of your questions.

MEMBER CATTON: It would be really helpful to me as a non-human factors type if you could give sort of a concise statement as to what you view as the key human factors issues.

DR. THOMAS: I'll try that.

MEMBER CATTON: Thank you.

DR. THOMAS: I really will.

MEMBER CATTON: I think the customer is the one we'll hear from or the -- you're the customer. Research is your supplier.

DR. THOMAS: Yes.

MEMBER CATTON: I want in my own mind to be able to tie those two together.

DR. THOMAS: Yes. Let me attempt to do that.

MEMBER CATTON: Okay.

DR. THOMAS: I'll be happy to.

(Slide.)

DR. THOMAS: First of all, as Dr. Seale mentioned, I'm Cecil Thomas, Chief of the Human Factors Assessment Branch in NRR. With me today are two of my staff: Clare Goodman, who will later on be talking to you about some work we're doing in developing inspection

guidance to look into some of the human performance, different human performance, areas to try to give guidance to us and the regions and the inspectors as they go about looking into human performance issues; and MaryAnn Biamonte, who later on will be describing to you our human factors information system. Also we have representatives from Research and AEOD with us today.

(Slide.)

DR. THOMAS: As Dr. Seale mentioned, we met with the Subcommittee or we met with the Committee, I guess it was, in February and gave a brief overview of the Human Factors Coordinating Committee and the initial human performance program plan, which had just been issued.

Today what I am going to attempt to do is to just briefly go over the background for the Coordinating Committee, how it came about, and where it stands today to discuss with you changes that have taken place in the program plan, -- we have issued a new one fairly recently -- and to discuss the direction that we are going.

To put this in perspective and to try to address Dr. Catton's comments, I'd like to take just a moment and tell you a little bit about what we, the Human Factors Branch in NRR, do. We are end users. I don't want to say we are the end users. We're among them.

We do a lot of inspection work. We go out in

the field a lot. We supplement and complement the regions in their inspection work. So inspections are a large part of our work. So to that extent we certainly are end users. And also we do a lot of other things.

In inspections, one of our biggest I think efforts is we're responsible for the programmatic implementation of the training rule, 50.120, also the training requirements in Part 55 for licensed operators. To do that, we do a number of things, including for-cause training inspections. And we have been involved in three so far this year.

We also participate on call from request from the regions and also on our own initiative to look into events that involve human performance problems. We have a lot of expertise that we augment and participate in the inspections.

We also do a lot of what we call licensee self-assessment root cause inspections, investigations to look into see if their root cause program is working effectively and to see whether or not that they really understand what's going on.

MEMBER POWERS: This is going to be a little bit unfair, not that we have been particularly fair up until now, but at our last meeting the subject of root cause came up. And one of the members, I think Dr.

Apostolakis, pointed out that you can carry root cause on ad infinitum. You can go everywhere with it and erd up with some mouse twitching its nose sometimes during the birth process.

CHAIRMAN SEALE: A butterfly in the jungles of southeast Asia.

MEMBER POWERS: And what you have mentioned is not whether it's complete but whether the root cause is effective. And that's the kind of term that I have a little trouble with because I don't know what effective means in this context.

DR. THOMAS: Let me try to say we have the same problem. I'll mention in a moment we do some international work also with NEA and IAEA. And we run into the same problems when we're trying to assess what the root cause of an event is. And is it really what's immediate obvious or are there underlying reasons? Of course, theoretically you can go back to the mouse twitching his nose, like you said.

I think what we look for is something happened. Something really caused the event. And the root cause that we look for is: Did the licensee understand it enough to prevent it or at least to have some assurance that it won't happen again?

That's a very qualitative answer, but we're

looking for performance. Did the licensee understand what happened enough to modify his performance such that there's reasonable assurance that it won't happen again?

MEMBER POWERS: Actually, I think that's not such a bad answer. The situation I think is always the same, though, with respect to accidents. TMI probably will never occur exactly again. Everybody is attuned to that. But we still worry about small-break LOCAs.

So when you say "that accident," are you speaking in a class or that particular one?

DR. THOMAS: Actually, both as far as an individual licensee goes. If an individual licensee had had an event, hopefully what we look for is hopefully that the licensee has taken action that that licensee won't do it again. We look to see if it's something that happens frequently or involves a number of licensees, we'll look to see if we need to take some kind of generic action.

CHAIRMAN SEALE: You know, it seems to me that the bane, the ultimate salvation, and real interest in your discipline is the fact that you can get help from more people than you can ever imagine. Everybody has got an input on human factors.

I would imagine that Zach Pate's talk to the plant executives, chief executive officers, of a year ago probably has as good an answer to the kinds of questions

that Dana raised as any place. It defines a very practical bottom line on human behavior. And that may be a very good place to look to try to put that concept into words. Just a suggestion.

DR. THOMAS: Yes, we are certainly very familiar with it. We reviewed it. We did our own, by the way, evaluations. And AEOD did also with the NTSB study. We're familiar with his work and agree with it.

MEMBER APOSTOLAKIS: Again, I'll come back to my other point. It seems to me that when you say the licensee should understand the incident well enough so that they would take appropriate action so that it would not happen again, I think for a large number of incidents that's probably good enough. You need experienced people to tell you, "This is what happened. We're never going to do it again."

But I think if you want to go deeper and really identify the underlying root causes, it seems to me you have to have a model. You really can't -- it's like collecting data for hardware. I mean, you still have to go there having some model in your mind.

The model may be subject to change because it's not a one-way street. You have a model, and then you go and look for the data. Then the data may tell you that the model has to change a little bit to reflect reality.

So it's back and forth.

And the same thing for inspections. I mean, you have to have some mental model of what you are after. And I think in my opinion this is what's missing here.

Now, there may be a model in your minds, but you didn't bother to put it down on paper. But I think that it's important to have a model and say, "Yes. I will go to this level most of the time. And then if I see these triggers, I will go to a deeper level." And why? Because, you know, this is the current thinking. This is what I learned from experience. I put the two together and so on.

So I really would urge you to try to do that and show that there is some logic behind the plan, the inspections, and everything else.

DR. THOMAS: I'd like to address that. I would submit that we probably don't have a theoretical model with someone's name on it. We do have systematic investigation processes, protocols in place; human performance investigation protocol, HPIP; and a number of other tools that we do use to systematically ensure that the licensees have taken the steps that we think they should take in response to an event.

This may not be pretty. It may not have bells and whistles on it. And it may not have somebody's name

associated with it, but it works practically.

MEMBER APOSTOLAKIS: Well, I guess my comment is that part of my question is: Why not take advantage of other people's work and expand on the model and maybe look at things that you have not thought of?

DR. THOMAS: Perhaps we can hear more from Research this afternoon and some of the work they're doing.

Remember, too, when I started out, I tried to make the point -- and I don't mean it glibly. I think it's very important that you realize that we're really end users. We're the ones that are out trying to apply this stuff. Other organizations, like Research, have a different role. And they have a big role in exactly what you're saying.

We work with them. Hopefully this coordination effort is -- one of the outcomes is to make us work more closely together. I agree with what you're saying, but we each have our own rules, too. Ask that question again this afternoon also.

CHAIRMAN SEALE: Perhaps we ought to --

MEMBER CATTON: Are you going to address my question about the simulation and its importance?

DR. THOMAS: Simulation is very important. In fact, there's a regulation that requires that -- it

provides for some alternative methods for licensees to have an acceptable requalification programs, one that deals explicitly with fidelity of simulators. And there are a number of standards that the licensees have to commit to in order to have an acceptable ongoing requalification program.

It's extremely important that there are requirements in place and that there are problems. When we go out and do requal inspections or requal exams, if we find problems with simulator fidelity, we report them. And we take action on them, not us, but the Operator Licensing Branch.

MEMBER CATTON: Is there anywhere that there's a statement of the required fidelity? I mean, there must be some way that you assess that.

DR. THOMAS: MaryAnn, do you recall the standard number?

MS. BIAMONTE: I do not.

MR. PERSENSKY: It's ANS 3.5. I'm Jay Persensky and MaryAnn Biamonte. Oh, I'm sorry.

MEMBER CATTON: This meeting seems to be addressing a different topic. But I would like a copy of it, if I could. If you could get it to Noel? And, Noel, you could give that to me.

Again, the reason that I raise this question

is our yesterday's meeting, when we heard about the testing that was done at University of Maryland on the B and W scaled plant. The behavior is quite different than the codes predict. And these are our big codes, like RELAP5 and TRAC.

If that's the case, the first question that comes to mind is: Well, what the hell is the operator going to do if he sees that, instead of this? And nobody seemed to care. That's why I figured I'd come to today's meeting and ask you if you care.

DR. THOMAS: We sure do care.

MEMBER CATTON: Maybe you guys will start to follow that up.

DR. THOMAS: There are specific requirements in Part 55 of the regulations. And there are requirements that licensees commit to the various standards, one of which Jay mentioned.

Jay, will you get that to Noel, please? Thank you.

MEMBER CATTON: See, this is really more support for the need to do something about those codes.

DR. THOMAS: Other things quickly, we do a lot of plant-specific license reviews, amendment requests. We are involved with a lot of reviews of where licensees take human actions, especially in response to what may be

previously automated functions for interim use or whatever, where they propose some kind of human interaction. We look at staffing, working hours, personnel qualifications, and things like that.

I mentioned a little bit about training program oversight. That's an important aspect of our work. We every month attend National Nuclear Accrediting Board meetings in Atlanta. We observe accreditation team visits. And we do four class training inspections, like I mentioned earlier. And every year we assess how well licensees or the industry as a whole are meeting our training regulations.

MEMBER POWERS: Can you give us an idea of what a for cause would be? What do I have to do to --

DR. THOMAS: The main requirement of our regulations is that the licensees have what's called a systematic approach to training, SAT.

MEMBER POWERS: Right.

DR. THOMAS: If we have any indication from any source that the licensees are not meeting the elements of this systematic approach to training, that's sufficient cause for us to go out and look deeper.

MEMBER POWERS: Do you have an example?

DR. THOMAS: MaryAnn, I'm sure you have a bunch of them. MaryAnn is our training specialist.

MS. BIAMONTE: One of the main ways that we determine that is, for example, unsatisfactory results on a requalification or an initial exam, an operator licensing. We also look at what is the evolving trend in inspection reports as well.

MEMBER POWERS: If I found that the operators were -- there was an unsatisfactory requal rate, why would that trigger me under a clause of systematic training?

MS. BIAMONTE: I don't think it necessarily is an immediate reaction to go and do a training inspection. What we would do is take a look at the results, look at the possible causes for the results and, by looking at the results themselves, make a determination.

If after looking at all of the failures there seem to be some common causes to the failure that can be an indication of a poor training program or a poor training process, we would go and look.

MEMBER POWERS: So it's not only lack of systematics. It's also ineffectiveness that triggers this for cause?

MS. BIAMONTE: Well, the basic premise in looking at a systems approach to training is that if you use a systematic approach, you would be training specifically to job requirements and, therefore, should be guaranteeing success in exams.

So if you have a bad result on an examination, one of the possible causes is that the training that you used to prepare these people for this examination was not done systematically and, therefore, did not adequately prepare them to perform in a job test.

DR. THOMAS: Later on, when --

MEMBER BARTON: Excuse me. The licensees' programs are not reaccredited by the INPO Board. Does that automatically trigger you to do something special?

MS. BIAMONTE: I'm sorry? Could you repeat the question?

MEMBER BARTON: If the licensees' programs don't get reaccredited by INPO, does that automatically trigger you to do something?

MS. BIAMONTE: Well, there are two actions an accrediting board can take. One is to have some concerns about a training program and, as a result, place that program on probation.

In that case, what we do is to take a look to see if there are underlying safety considerations. If there are safety considerations, we would do a training inspection.

If there do not appear to be any safety considerations, we have a lot of confidence in the accreditation process and recognize that they have

standards of excellence versus standards of minimum compliance.

So we would not necessarily go and do a training inspection. If accreditation was withdrawn, however, we would be there shortly thereafter.

MEMBER BARTON: Thank you.

CHAIRMAN SEALE: For a lot of reasons.

MS. BIAMONTE: For a lot of reasons, yes.

DR. THOMAS: We're involved in a lot of generic activities, including some things I had mentioned, staffing overtime. We chaired the Human Factors Coordinating Committee. We're involved with work with NEA in the principal working group expanded task force on human factors.

We've also done some work on safety culture with IAEA. We're involved with some aspects of USIA 46 where operator action is assumed.

MEMBER APOSTOLAKIS: Excuse me. What work did you do with IAEA on there?

DR. THOMAS: I personally did some work on safety culture, taking NSAC 4 and developing the guidelines for ASCOT, for ASCOT evaluations, went out in the field and prepared member countries to do their own self-assessment under assessment of safety culture and operations.

MEMBER APOSTOLAKIS: Now, the IAEA has also published a report on performance indicators, safety culture, I guess, indicators. Are you using these in your inspection support, for instance?

Those would be -- unless they don't belong there, belong somewhere else. But they have a whole list of things, you know, on management, organization, and this and that.

DR. THOMAS: Yes, yes.

MEMBER APOSTOLAKIS: So they say: What is the concern? The concern is: Do they do it right? So what would be the indicators that tell you they are doing it right.

DR. THOMAS: Oh, absolutely, absolutely. Yes. I'm sorry. I didn't understand what you said, performance indicators.

MEMBER APOSTOLAKIS: I can see how that can be used when somebody is concerned about safety culture. The real use of that would be to take these insights and use them in your other programs, your other activities.

DR. THOMAS: We do. We do.

MEMBER APOSTOLAKIS: You do?

DR. THOMAS: And I think you'll hear a lot more from that from Clare later on this morning when we talk about what we're doing to our inspection programs.

One of the things that's really important I think from maybe as a constraint or whatever, but we do not regulate safety culture. That's very important. We have no underlying regulatory authority to review safety culture.

But what we do do is through our Inspection Program, through our Human Factors Program, we look to see what contributors to human performance are. And, for example, management is a good example.

We review management organizational structure to make sure it will do what the regulations require, but we don't offer an opinion on whether they have an effective management structure or whatever.

What we do is if management performance contributes to an event or contributes to some problems we're seeing, evolving problems, we make sure that the licensee understands that, that their self-assessment program is such that they see that, they understand it.

So that's the extent that we're involved in safety culture. And it's important. A lot of people think we ought to be regulating it. And we've had explicit directions that we are not regulators in safety culture.

MEMBER APOSTOLAKIS: I agree with that, but I think the whole notion of safety culture is really -- it's

a model, really. It's a model, which --

DR. THOMAS: It's pervasive, too.

MEMBER APOSTOLAKIS: So it contributes to the error forcing context that these are used.

DR. THOMAS: Sure, yes.

MEMBER APOSTOLAKIS: So in that sense you have to worry about it. But I agree with you. You don't have to go out and --

DR. THOMAS: It's very important. We would like to do more. And we don't do as much as some other countries do, but we do what we can with what we have.

MEMBER APOSTOLAKIS: Maybe that's the industry's job. Did you say that?

DR. THOMAS: It is. It fundamentally is. And that's why we want to make sure that the industry knows that that s a contributor. We give them that feedback. We're not experts.

CHAIRMAN SEALE: I think you'll find that INPO has a considerable interest in safety culture.

DR. THOMAS: Yes and a lot of guidance.

Last two things. Human factors information system. Maryann is going to review that in detail in a minute. Advanced reactor reviews. We're working on Chapters 18, "Human Factors," and 13 on AP600. So that --

MEMBER POWERS: Could I ask a question back to

your IAEA business?

DR. THOMAS: Sure.

MEMBER POWERS: The plan itself cites in several instances the words "state of the art." I'm not exactly sure what they do within the state of the art. But it posed a question to me.

In the area of human factors, does a regulator want to be at the state of the art?

DR. THOMAS: Yes. I think we need to understand what's going on as well as we can. I think we have that obligation. Now, do we want to get out ahead of industry? It's very expensive to get out ahead of industry, expensive in terms of staffing, in terms of what you have to give up to do that.

We need to reasonably keep up with what's going on I think in the whole context of human factors, both theoretically, practically, whatever. We need to keep up with what's going on, yes.

MEMBER POWERS: I think it's fine, and I probably agree that you do and the people who work for you need to know what the state of the art is. But in the matter of regulation, do you want to regulate to the state of the art or do you want to regulate to some more tried and true standard?

DR. THOMAS: When I answered your first

question, I was wearing my Chairman of the Human Factors Coordinating Committee hat. And I was answering for the agency as a whole.

As a practitioner in NRR, we just want to make sure that we're doing the best job we can to understand what's going on and to help ensure that the licensees understand what's going on and that they take advantage of experience and operate their plants as safety as possible.

CHAIRMAN SEALE: Yes, but clearly if some group has a -- and I hate to use the word, but I'll say it -- breakthrough and is able to meet their human factors requirements with greater effectiveness -- and I'll use a very qualitative kind of term now to characterize that, effectiveness than anyone else, you surely want to be able to understand and communicate that, both within the Commission and also to this culture out there which is omnipresent but not necessarily a part of your mission.

So to that extent you want to be on the leading edge as well. So it is more than just being aware. And I think the Commission has got to recognize that. You have to be in a position to seize the moment whenever that occurs.

DR. THOMAS: Just to comment on that, we all have a responsibility to keep up with what is going on. I think Research is probably the organization that probably

would pull all of that information together.

If we see something, you can be sure we're going to communicate it to everybody, including the licensees if there's a --

CHAIRMAN SEALE: Yes.

DR. THOMAS: One thing, I am not trained as a human factors part. I am a nuclear engineer who has been retreaded to human factors. Relative to a number of other areas, I think developments occur fairly slowly in human factors.

Nevertheless, you're exactly right. I totally agree with that.

MEMBER APOSTOLAKIS: You said it's a good idea to keep up with what's going on. As a practical matter, how do you do that?

DR. THOMAS: Okay. Several ways. First of all, as I'll get to hopefully in a minute, various organizations in NRC share information frequently. We have members of different societies and organizations that get input from their peers.

We get input. We read magazines. For example, the NTSB study was very important. And we have relationships. We have various agencies where we share information. We meet periodically. We attend meetings. We attend the IEEE meetings. We attend Human Factor

Society meetings. We're members of these societies, and we read their literature.

CHAIRMAN SEALE: I think we'd better let you get on with your presentation here or we're going to be in --

MEMBER CATTON: Now that his time is up.

CHAIRMAN SEALE: Yes. Now that your time is up, you may start your presentation.

DR. THOMAS: For many years -- this is a really important point. For many years three offices, NRR, Research, and AEOD, have had periodic coordination meetings, typically every quarter. We would get together at the branch chief level and division director level and discuss areas, topics of mutual interest, including, but not limited to, research user needs. That certainly was one common thread.

But we talked about all kinds of things that involved us. And this is important because later on I'm going to come back to it when I talk about what happened to the coordinating committee.

So this has been going on for as long as I've been in the division, which is like at least seven years and probably longer. Before that -- I'm sorry.

In 1994 the deputy EDO commissioned a task force called the Event Review Task Force. And one of the

findings of the task force was that there was potential for overlap and duplication in a number of areas.

One of them they identified was human factors. And they recommended a more formal coordinating committee be developed and that the coordinating committee, in turn, develop a human performance program plan.

(Slide.)

DR. THOMAS: The coordination committee was chartered in December of 1994. It consisted of branch chiefs from NRR, Research, AEOD, and added NMSS to the coordination that I had previously described. And also it consisted of a representative of all the regions, who communicated among the regions.

The coordination committee also was assisted in its work by a working group that consisted of one representative from each of our staffs. And Jay Persensky from Research and Clare Goodman from NRR were representatives on the working group.

The responsibilities of the coordination committee were to coordinate the activities; that is, sit down and read and discuss what was going on and try to eliminate duplication and overlap so we would most efficiently use our resources, and to develop this program plan.

The instructions in the charter were that the

committee would meet frequently, beginning in January of '95 and semiannually thereafter, that considered updating the program plan once it was issued.

(Slide.)

DR. THOMAS: The program plan that I described to the Committee in February I'll refer to as Rev. 0, the initial plan. It was developed by the coordinating committee And it was issued by me as chairman of the coordinating committee. I issued it to the office directors and the regional administrators in August of '95.

And the program plan was admittedly pretty rough. It was a first cut at it. But it was, quite honestly, about the best we could do in the time we had. It attempted to discuss the mission statement goals and objectives, activities, lead offices, target schedules, and priorities.

It was a first attempt. We have subsequently issued a second version of that. And hopefully we'll continue to get better as we go along. Admittedly, we received a number of comments on the plan, many of which were articulated by you then and also this morning.

Clearly the initial plan was a list of what was going on. That was really the first step to try to get our arms around what was going on. Maybe it certainly

is arguable. And I would not try to argue that it was probably more of a list than a plan, although it did attempt to pick up some -- identify holes, identify areas that needed further work. And it did indeed list not only what was going on but recommendations for further work.

Some of the comments that we received were that we needed more than just a line statement of the activities. We needed some kind of a more stand-alone description that provided the reader with more information. It didn't contain references to the activities. If the activities were being undertaken as a result of a commitment to somebody else, that needed to be shown. You needed elaboration on milestones to show intermediate milestones. And the status of the activities wasn't really articulated.

Also, there were a number of programmatic questions that were more important than the comments. Two of them, in particular, have led to some pretty substantial changes that I want to share with you. The first one was the ambiguous relationship of the coordinating committee to the line organization.

The charter was silent on who the coordinating committee reported to, what the involvement of the line organizations in each of the offices really was other than supplying a member, whose views were represented by the

program plan.

And it was truly the views -- and we tried to be explicit in there. It was truly the views of the coordinating committee. It was not necessarily the views of the offices. And I tried to address this back in February.

The other major policy question was the duplication and overlap of the coordinating committee's work with the coordination meetings that I talked to about earlier. You recall that three of the offices have met approximately quarterly to do this coordination. Well, in the coordinating committee, the same people did both of these. They were all branch chiefs largely. Except for NMSS and the regions, we were talking about the same thing.

So with the resource problems we've had in terms of people and money, the legitimate question was: Do we really need a separate standing committee that really duplicates the effort of what was going on, especially since now a program plan has been issued? And that was really one of the, perhaps the, most important objective of the committee to start with.

(Slide.)

DR. THOMAS: So hopefully we attempted to address some of these questions when we issued Revision 1

of the program plan in July. The program plan obviously was based on the original one. It does attempt to address the comments that were received. And I've listed here areas where we have hopefully done that.

When we issued the plan this time, it was not issued by the chairman of the coordinating committee to try to address the issue of line organization involvement. It was issued by the division directors of the organizations that include human factors in each of the offices. So we got line organization involvement.

In issuing it, we sent a letter, a memorandum. The division directors sent a memorandum to the deputy EDO, to whom the commitment for a coordinating committee was made originally, and posed some of the questions that I just described about duplication/overlap. Can we really justify a separate standing committee? And it was really an opportunity to reassess the need for the coordinating committee.

The deputy EDO agreed that the main objective had been accomplished. And that was to have a document that served as a focal point for coordination for continuations of the meetings and so on. And he agreed that so long as we continued the interoffice coordination meetings that we had had in the past and this time include NMSS in it, that there was no need for the separate

standing committee. So it removed that ambiguity.

(Slide.)

DR. THOMAS: So what was previously the Human Factors Coordinating Committee is now in the line organization. That solved that problem, too.

We did commit to continue the program plan. And it will continue. The product will be transparent to how it came about. You really won't see any difference in the future.

We do intend to continue to meet quarterly to consider the need to update it, to update it as appropriate, and will continue to issue it. And we'll certainly continue to try to be responsive to its users' comments, including the committee.

I'll just kind of stop there and ask if you have any more questions.

MEMBER POWERS: You seemed to indicate that NMSS is late in arriving at this party relative to the other organizations.

DR. THOMAS: NMSS participated in the coordinating committee, but they weren't big participators. And I'm not sure. It's not appropriate for me, even wearing my coordinating committee hat, to go into that. I think you should ask them.

It's not that they don't appreciate your

comment and I think appreciate the fact that there are many, many events involving human error. That came through loud and clear that they do appreciate that. I think they have a resource problem.

And I don't want to go beyond that. I think that's a question that is more appropriately posed to them.

CHAIRMAN SEALE: Dana, Noel tells me that we will request NMSS to talk to us at the November meeting.

MEMBER POWERS: Yes. I think it would be surprising if you have a resource problem addressing your biggest problem. That is a real serious problem.

CHAIRMAN SEALE: Yes. That is a real -- let me ask you this: In this morphing of the Committee back into the line organization, if you suddenly determined that there was a burning deficiency in your program plan, to wit: For reasons both internal and external, you decided that you really did need to find out or to define where nirvana was, where you're going, what your goal is and so forth, would the development of an amendment -- I won't say a revision, but amendment -- to the existing plan that would incorporate that kind of information be within the purview of this group of division directors who meet together with the blessing of their supervision? Is that within the realm of possibility?

DR. THOMAS: Oh, it's not within the realm. It's an absolute yes.

CHAIRMAN SEALE: Okay.

DR. THOMAS: There's no question that we would do that.

CHAIRMAN SEALE: Okay. So there is a mechanism to carry out these kinds of revisions?

DR. THOMAS: Absolutely.

MEMBER APOSTOLAKIS: Just out of curiosity, we are the Advisory Committee on Reactor Safeguards. Can we review what NMSS does?

MEMBER POWERS: Yes, yes.

MEMBER KRESS: The answer is yes.

MEMBER POWERS: And do.

MEMBER APOSTOLAKIS: So that's a generic reactor interpreted by a separate --

CHAIRMAN SEALE: Well, that jurisdictional issue has been solved to the extent that it needs to be solved. And we can go on.

That was all you have now?

DR. THOMAS: That was all I had, yes, sir. Any other questions?

MEMBER POWERS: I'd come back to the question of prioritization on these multiple tasks. I took it from your response that when I look at the priorities, that I

am looking at the priorities that the lead agency attaches to the task and not necessarily what the coordinating committee as an entity would attach to the task.

DR. THOMAS: No. It's really the other way around. The priorities that are in the program plan now are the consensus priorities, qualitative priorities, of the coordinating committee members.

That's not to say that does not consider some of the agency's priorities, but the committee felt that it had the license to go beyond what the agency -- for example, agency limitations on budget. If we felt something was important and should have been in there, we put that in there. And we changed the priorities. So you may see a disconnect between what the priority says and what's actually going on.

We tried to be quantitative. We really tried hard, spent a lot of time on it. We look at the various other similar plans, the PRA plan, for example, and how they tried to -- and how other people have attempted to do this.

I talked to Dave Morrison or we talked to him about it. We couldn't do it. It had to be an integrated vote from the various interests. And that's really the best we could do. You could --

MEMBER APOSTOLAKIS: It sounds like severe

accident analysis.

DR. THOMAS: You could polish this sucker to -- you could finally hone this. And I'm not sure you'd be any better off than you are now. We could spend days arguing whether the model was right.

MEMBER POWERS: How do I go about explaining what appears a perplexing situation or relative rankings? Like where I'm developing guidance or I don't want any data, I ascribe a lower priority to getting the data necessary to develop that guidance.

DR. THOMAS: I'm sorry. The example you used earlier was --

MEMBER POWERS: Well, I have just one in 1.2.6, "Develop Guidance for Hybrid Control Room."

DR. THOMAS: Right.

MEMBER POWERS: High priority. 1.2.2, "Conduct Reviews of Hybrid Control Rooms and the Human Digital Interface," and it has a nice statement of why that's important in there, medium priority; or, similarly, use the HRR models but determine model information needs gets a medium priority.

DR. THOMAS: In fact, in that situation it's probably not going to be a very satisfying answer. If there are problems out there -- and we have seen problems in hybrid control rooms where we react to them. If

they're contributor to some kind of event or human performance problems, man-machine interface problems, we go out. My group will go out and do something about it.

We see the need for more research in this area. Because research is a slower-moving animal and it takes longer to put a program in place and to define what you need, we certainly can use more tools.

And I think because it's a longer, more massive beast with more inertia, we thought it was a higher priority to get that i place, relatively speaking.

We still go out and deal with situations as they occur. We're not neglecting it waiting for a tool. In fact, it's not really the data. It's the tool.

We have the data through our human factors information system, through any numbers of sources, including feedback from operator license, the operator licensing program, when there are problems with the man-machine interface or analog to digital retrofits. And we'll go out and do something about that.

We see a need in the future for keeping up with what's going on, for maybe models, for better tools. And that's what we think is a high priority.

MEMBER POWERS: I think that's what's missing for me to understand the plan, these aspirations for the future. I've got my state now, and I have my state that I

want to get to. In order to get to that, I have these activities that I want to do. And to carry those out, I need these supporting activities.

I don't have that in the plan. The plan comes across as a list still. And some things that appear -- and, truthfully, it's just my perception in reading it -- appear to be incongruous. If you had that road map to how the Committee worked to get this, it wouldn't be so incongruous.

DR. THOMAS: I agree it's somewhere in the spectrum between a list and a plan, probably more so on the list side. How much effort do we devote to it to make a plan that satisfies that and to do the other work we need to do? It is a trade-off.

MEMBER POWERS: Well, a list is a valuable thing to have when you've got infinite resources. When you've got scarce resources, now you have to make hard choices.

DR. THOMAS: Yes.

MEMBER POWERS: And a good structured approach is at least appeals as a way of getting at it; whereas, list isn't help.

CHAIRMAN SEALE: A PERT chart, a P-E-R-T chart, may be very difficult to draw at this stage, but it sure would be helpful if you could.

MEMBER POWERS: Those who develop the PERT Program say that you need it, especially at this stage. That's what I mean.

CHAIRMAN SEALE: George, you have a comment?

MEMBER APOSTOLAKIS: Yes. I have two comments. One is we are meeting again November 6th. And then I suppose there will be a presentation to the full Committee.

CHAIRMAN SEALE: Yes, following that.

MEMBER APOSTOLAKIS: And we write a letter. I think that it would be very helpful to everyone if we came back in November with some specific responses to the comments we made today because that way the letter will be better, I think, when the letter is written and by whomever it is written because we met last February. And some concerns were raised, but I'm not sure that today you came back and said, "You guys said this. This is what we did in response to that."

So I'm wondering, Mr. Chairman, whether writing a list of concerns and questions at this time and giving it to them would help the staff in understanding what the concerns of the Subcommittee are. So there is a month and a half until November.

My second question is: Can I participate in that --

CHAIRMAN SEALE: Sure.

MEMBER APOSTOLAKIS: -- or do I recuse myself from that as well?

MEMBER KRESS: You can participate in that.

MEMBER APOSTOLAKIS: Okay. So I'll send you a list of --

CHAIRMAN SEALE: And I think that would be a much more helpful way to provide you with a better target, if you will, for what it is we're really driving at. And I think we owe that to you.

MEMBER APOSTOLAKIS: I would hate to come back in November and have to put the same concerns about models and Dr. Powers' concern in the letter.

CHAIRMAN SEALE: Noel tells me, reminds me, that I believe you already have a commitment on the 6th. So we may have to reschedule that meeting to a slightly different time, but it will be in that same --

MEMBER APOSTOLAKIS: I had a commitment, too, and I moved it.

CHAIRMAN SEALE: That will still be in the same general framework. Do you think we can arrange that?

DR. THOMAS: It's that week that's causing my problem.

CHAIRMAN SEALE: Okay. Fine. Well, we'll figure it out.

DR. THOMAS: I have to go out of town.

CHAIRMAN SEALE: Well, we'll work around that someway, then.

DR. THOMAS: Thank you very much.

MEMBER APOSTOLAKIS: And my next question is more technical. Coming back to these human system interface issues, which is 1.2.8 on Page 8, what exactly is that? What is human system interface issues, Page 8?

DR. THOMAS: I'd like to defer to Research on that since that's their program.

MEMBER APOSTOLAKIS: I mean, I don't want a big lecture, just a big --

DR. THOMAS: Perhaps we could address it this afternoon.

MEMBER APOSTOLAKIS: It has a high priority. It's continuing. So --

DR. THOMAS: I think basically it has to do with filling some gaps and holes that are in NUREG-0700 that's about to be issued.

MEMBER APOSTOLAKIS: Which dealt with what? I mean, I don't remember what --

DR. THOMAS: Jay?

MR. PERSENSKY: Jay Persensky, Office of Research.

That particular item had to do with the fact

that when we did NUREG/CR-5908, which was the draft guidelines, which became NUREG-0700, Rev. 1, there were a number of issues that we identified that there were not sufficient validated guidelines, to include N-0700. 0700 is the review guide for control rooms and control stations.

There were about 12 issues identified. Included were alarm systems, navigation among screens, soft controls, large screen displays. There were like 12 of those kinds of items that we felt there was a need or would be a need in the future for guidance but that there wasn't sufficient guidance for us to use and would require further research before we could do it.

This item here was really set in place in the plan for us to be able to determine which of those we should take in what order given limited resources. And you'll hear this afternoon about two of them, in fact, that we have already -- three of them. Hybrid, navigation, and alarm systems we are already taking some action on. But there are these additional gaps that have not yet been decided as to what order we might perform the research to develop the guidelines for.

MEMBER APOSTOLAKIS: So NUREG-0700 is where the length of the telephone cord was specified 27 inches?

CHAIRMAN SEALE: I believe that's correct.

MEMBER APOSTOLAKIS: Okay. So this is a good example of what I was trying to say earlier. It's not clear to me that this is an important issue. It may be, but I'm not convinced.

Why am I saying that? Well, if I look at the incidence from the past, I don't recall the cause being displayed in how they were arranged, what Dr. Catton said might be a major problem, namely the content of the information that is displayed.

But whether it is displayed in a small screen or a large screen or whether you have three red lights and two green lights versus two red and three green, I don't know why that is a high priority item, especially since we are interested, as it says here, in ensuring the adequate safety performance of nuclear facility personnel.

So this would be a good example in my mind to try to justify this as being a high priority item when things like, as I said earlier, informal culture, organizational learning, and other things that we have found have contributed to major incidents are not investigated. And I think that will be my --

CHAIRMAN SEALE: I think you made your point. Maybe you want to discuss that a little bit more this afternoon after we've had a chance to think about it.

MEMBER APOSTOLAKIS: Sure.

CHAIRMAN SEALE: I guess we're ready to go on to the next speaker; right? Our next speaker is Ms. MaryAnn Biamonte, who is going to tell us about the human factors information system. If anybody needs information on human factors, we're it.

MEMBER CATTON: We're going to communicate questions here.

CHAIRMAN SEALE: Excellent. Yes. As we go along and if you formulate any questions, any members of the Committee, the Subcommittee, I would appreciate if you could jot them down for us. And we can arm Noel with those.

(Slide.)

MS. BIAMONTE: You should have a copy of my handout for this presentation.

CHAIRMAN SEALE: Yes, we do. Thank you.

HUMAN FACTORS INFORMATION SYSTEM

MS. BIAMONTE: My name is MaryAnn Biamonte. I'm a training and assessment specialist in the Human Factors Branch in NRR. What I'm going to talk to you today about is the human factors information system.

(Slide.)

MS. BIAMONTE: The human factors information system started out post-TMI, when the Human Factors Branch was dealing with a lot of programs that were going across

all of the plants, like detailed control room design reviews.

We had a lot of information. They were submitting different evaluations and making commitments to do follow-up items. And we were tracking them. What we then did was allow it to grow. And I'm going to talk about that growth.

The entire system has been developed, is operated, and is maintained by our branch. We use it now a little bit differently than it was originally designed. We use it now as a way of compiling a profile on human performance at power plants. And I will talk in detail about how we do that.

In addition to the compilation of data on human performance, what we also do is use it to easily store and track some information on those long-term projects that were in existence after Three Mile Island.

MEMBER POWERS: Can I ask you --

MS. BIAMONTE: Certainly.

MEMBER POWERS: -- a literary question here. Is it used by the NRC in developing a dependable human or a dependable profile?

MS. BIAMONTE: We'd like to think it's a profile, but hopefully the profile will go to looking at a more dependable human. Yes, we use it to develop a

profile. It's a human environment profile.

MEMBER POWERS: Okay. It's a human profile, and I can depend on that profile. That is an accurate reflection of what the licensee is?

MS. BIAMONTE: Yes, that's correct.

MEMBER POWERS: That's not a reflection of the human?

MS. BIAMONTE: That's correct.

CHAIRMAN SEALE: "Human performance" is an adjective phrase.

MEMBER POWERS: Well, so is "dependable." It needs a comma there or something.

MS. BIAMONTE: Well, maybe what we need is a hyphen here, "dependable-human performance."

MEMBER POWERS: I think that's the --

MS. BIAMONTE: Will that help?

MEMBER POWERS: That's not going to help me.

MEMBER KRESS: That will make it worse.

MEMBER POWERS: It will make it worse, yes.

MS. BIAMONTE: Okay.

CHAIRMAN SEALE: As you can see, we really get hung up on profound issues occasionally.

MEMBER APOSTOLAKIS: Let me give you another profound issue.

MEMBER KRESS: More profound than the last

one?

CHAIRMAN SEALE: Go ahead, Dr. Apostolakis.

MEMBER APOSTOLAKIS: Tough competition.

What are we interested in in this agency: Human factors, human performance, or human error?

MS. BIAMONTE: I think all of those things. What our branch is most involved with is human performance, though, looking at the ways licensees perform in the day-to-day business of running a nuclear power plant.

What we do in terms of the inspection efforts, in terms of the program monitoring is look at end performance. So our emphasis is performance.

MEMBER APOSTOLAKIS: But do you have any performance measures, performance indicators? Now, is this consistent with a risk-informed, performance-based regulatory system we are trying to establish now or that's an unfair question to you?

MS. BIAMONTE: I think it may be an unfair question to me personally.

MEMBER APOSTOLAKIS: Okay. We'll ask somebody else.

MS. BIAMONTE: Okay.

MEMBER APOSTOLAKIS: Okay.

MS. BIAMONTE: I like that.

MEMBER APOSTOLAKIS: But human factors, again, what do you call it "human" --

CHAIRMAN SEALE: When we get the answer, tell you also. You'd like to know what it is.

MS. BIAMONTE: Well, I have to tell you that the name of this we think is probably well-intentioned but maybe not necessarily reflective of the data that's in it. This was something that was evolving when a lot of human factors information was being dealt with, such as detailed control room design reviews.

So I think that at the time when it was originally built and named, it was reflective of the information. But I think that our mission has grown with the completion of some of the DCRDR information. We're now looking at more performance and less programmatic issues like that.

(Slide.)

MS. BIAMONTE: We started out with several modules. One of them was when we first started going out to do reviews in power plants, we started bringing back sheets of information about any number of things, such as characteristics of their procedure upgrade programs, information about the design of their control rooms, information about the status of their EOP development effort.

This is how far back the system goes. We kept information about DCRDR steam generator tube rupture. We also started to keep information about LERs because we knew that was a ready source of information for us. We also started keeping by plant EOP inspection data as that effort got underway as the EOPs were put in place. We kept training information in there.

In the early days of accreditation, one of the main things that the NRC did was do some shadowing of INPO efforts. We would go back after accreditation visits and do NUREG-1220 inspections of the same training programs to get a feeling for the success and the rigor of the accreditation process. So we kept data like that in our system.

CHAIRMAN SEALE: For the record, to what extent do you have access to the INPO self-assessment reports, both with respect to training and also overall plant performance?

MS. BIAMONTE: We do not get copies of those reports. As Cecil mentioned, we do go and observe board meetings every month at INPO. And while there, in order to understand and make some meaning out of what's going on in that assessment meeting, we are allowed to read the reports on site so that we can get a feel for the discussion. But we don't take those reports away.

CHAIRMAN SEALE: Yes. Do you have a comparable limited access to the assessment reports from overall plant evaluation visits, as opposed to the training program?

MS. BIAMONTE: Well, the assessment reports are always available at the site, at the licensee's site. They're always able to be accessed by the resident inspectors.

CHAIRMAN SEALE: Okay.

MS. BIAMONTE: And as part of their normal responsibilities, they are required to go out and read those documents for safety-related concerns.

CHAIRMAN SEALE: Okay. And do you provide those resident inspectors, then, with, let's say, a set of goals or criteria that you would like to have them include in their assessment in order to get you the kind of information you would like?

MS. BIAMONTE: We do not, mainly because we see INPO's efforts as being totally independent from ours. And we're only interested in looking for safety-significant things that we may need to follow up on. So they are totally independent.

CHAIRMAN SEALE: All right.

MS. BIAMONTE: What has evolved after the initial development of this system is we added two new

modules: One on inspection report information and one to record the information on the human performance investigation process, HPIP. And I'll talk about those in a little bit more depth.

(Slide.)

MS. BIAMONTE: It's interesting to note that as we're evolving and as we're looking to build a better system that will suit our current needs, we are going to go into a next generation system.

This one happens to be DOS-based. If you know anything about codes, it uses a Clipper executable. And my understanding in computer te[illegible], that's equivalent to using a hammer and chisel on a piece of rock. So we're going to be going to a Windows-based relational database and transfer some of our information to that.

What we are not transferring is the information on regulatory programs because those have largely been completed and there's no need to continue to track those. We've closed those.

Our inspection, EOP inspection, data and training data is now being captured in our inspection reports. And so we're going to archive those modules as well. Our human factors programs, really, we found were a duplication of all of the other modules. And so we're going to archive that as well.

What we're going to take into the next evolution of this system is LER data, inspection reports, and the human performance investigation process data. When we were looking at this system initially to build, we were faced with the unenviable task of trying to come up with a way that we could answer the question: So what's happening in X and so plant in terms of their human performance record?

And although we had kept ourselves fairly well informed about what was going on, we found that every time someone asked that very specific question about a particular plant, we were always in a research mode then. We had to go back and pull out files. And so that was one of the main thrusts behind developing this program.

We were also faced, though, with the need not to create anything that would require additional documentation to be submitted by the licensees. So we were left with trying to come up with a system that would be useful to us given the kinds of information that was already available. So that's why we went to LERs.

LERs provided one source of information. It was submitted by the plant. So we got their perspective on activities, at least some activities, at their plant. What we current do is ever single LER is reviewed by a nuclear engineer who is on contract to us and is coded in

accordance with a predefined set of criteria that we have established.

Now, in your materials that you received prior to the meeting, you should have received an HFIS manual. That incorporates some of the information that the coder uses.

Clare is also going to hand out to you two documents, one of which is the LER coding scheme and one of which --

MEMBER CATTON: Doesn't AEOD do a lot of this kind of thing?

MS. BIAMONTE: AEOD does do some with the system sequence coding system. I've got those initials wrong, SCSS. What they do is look more at some of the hardware issues and the systems and components that are involved. They do take a little bit of a look at who was involved. We take a further look at the --

MEMBER CATTON: So does this add to what they do --

MS. BIAMONTE: That's correct.

MEMBER CATTON: -- or duplicate?

MS. BIAMONTE: Well, in some key areas, like LER number, plant number, the identifying information, certainly it has to overlap because we --

MEMBER CATTON: If one were interested in this

kind of information, you'd have to interrogate both databases.

MS. BIAMONTE: That's correct at this time. One of the main things that is driving us to go to a relational database is that the agency is trying to develop a system, an integrated system, that will allow all of these various computer databases to talk to each other.

So what will happen in the future -- at least this is the grand plan -- is that, for example, you could look at HFIS and be looking at the human performance aspects of an LER and then be interested enough to want to go and read the full text. And you'd be able to link to the full text out of this database, which actually the full text would be resident someplace else.

And if you wanted to then see what kind of event follow-up the event tracking system had on that; in other words, what did NRR staff do to follow up on this event, you could then go to yet another database kind of train of thought.

My understanding is that the databases will all be put into a relational format eventually -- I don't think I know the time frame for this -- so that you would be able to talk to them.

MEMBER CATTON: Thank you.

MS. BIAMONTE: Okay. The LER data entry sheet that Clare just passed out just gives you the information about the categories of people, the types of work. And in the user's guide that we did provide to you, it provides the characterization that we have for each one of those categories.

We then use that information to compile information on a semiannual basis to provide it to the senior management team to be used at the senior management meeting. And we'll talk about that shortly.

(Slide.)

MS. BIAMONTE: In the same vein, we recognize that looking at LERs provided us one view of a licensee. And that was the view of reportable events. So we were looking for a source of information of licensee activities, for instance, that was not related to a reportable event but, rather, was related to day-to-day operation.

So that information can be found in inspection reports. This also has value in that it provides us with a staff perspective to counterbalance the licensee perspective. And the information that we use is inspection reports. They come to us through the normal distribution system in the agency.

There are eight of us in the Human Factors

Branch. And there are four regions. So two of us are assigned to each region. And we read and code every single inspection report that is issued. Clare has also handed you the chart on the information about coding inspection reports.

Now, we look at who is involved, what were they doing, and get a little bit more detail on that information. We have found that as we are evolving this, we are honing our definitions for each of the different bits of information we put in. So it is evolving and changing.

This will also take on a somewhat new organization when we go into the relational database. But the idea here is to look at the same kinds of information in inspection reports as we look at LERs, namely people. What were they doing? What caused them to do it? That allows us to make some comparisons between the data in the two modules.

Of course, there would not be a useful bit of information in here if we did not have something to do with this. So what we do twice a year in preparation for the senior management meeting is provide graphs that look like this.

(Slide.)

MS. BIAMONTE: This is a sample. We provide

this on a regional basis for both LERs and inspection reports. What we do is generate a national average, share average, add them up and divide. And then we take that to two times the national average -- and that's what this line represents -- to identify the outliers that we feel are truly way past the performance of other plants in the nation.

What we then do for plants that would exceed two times the national average, we go into the data and inspection reports and LERs. And we provide a breakdown to the senior managers to kind of characterize that performance.

For example, we would provide information that said in this particular case, maintenance workers are the major contributors to performance errors in the last year.

We would talk about the kinds of errors they made. For example, they have a problem with -- these maintenance people also seem to have a great problem with following procedures or self-checking or whatever the data would indicate.

And we provide that write-up to the senior managers as a way of trying to either confirm their perceptions of the performance of a plant or to disprove it because we have found that human performance is one of those things that people have a hard time being very

specific about. And they will have some inclination based on what they have heard that the human performance record at a particular plant is very bad. But then we have some data here to say "Yes, you're right" or "No. You're wrong."

MEMBER KRESS: Is each one of those sets of numbers from the different plants developed by different individuals?

MS. BIAMONTE: What we do is we have for any one of these lines -- is that the one you're talking about?

MEMBER KRESS: Yes. The number, those 40 for that one you pointed to or 30, --

MS. BIAMONTE: Okay.

MEMBER KRESS: -- do they come out of a particular inspector for that region?

MS. BIAMONTE: No. The inspection reports are really a combination of resident inspector, normal cycle reports, special inspections out of headquarters, special inspections out of the region.

MEMBER KRESS: Most of them come from the regional inspector?

MS. BIAMONTE: I can't tell you. I know I do an awful lot of regional inspections. So I don't know how many of them --

MEMBER KRESS: What I was concerned about is this chart just may be a calibration of your regional inspectors, as opposed to the calibration in the plant.

MS. BIAMONTE: And we have taken that into consideration, I think, by using the two times the national average because what we do is just set the bar up high enough so that it's really the people who are significantly higher in the number of hits than any other.

MEMBER KRESS: Just may have a real dedicated regional inspector for that plant.

CHAIRMAN SEALE: Suddenly.

MS. BIAMONTE: You may. And we have no way of knowing that. We have done some swaps within our group to ensure that it's not a coding. You know, you can have --

CHAIRMAN SEALE: Yes, yes.

MS. BIAMONTE: -- really very dedicated coders as well. And we have tried to ensure that we don't do that either.

CHAIRMAN SEALE: Do you know if there are other criteria that are used by management to try to fish trends out of these kinds of data?

MS. BIAMONTE: Well, certainly this is a single data point that gets --

CHAIRMAN SEALE: For example --

MS. BIAMONTE: -- added to the senior

management mix.

CHAIRMAN SEALE: For example, -- and I haven't looked at all of them -- plant Number 15 strikes me as being one that I'd want to ask some questions about because, all of a sudden, the number of events has gone up by almost a decade. You know, they're not in the doghouse yet, but they're probably out of the living room for sure.

MS. BIAMONTE: Well, one of the main things that we do try and do if at all possible if we see something like that that we can explain, we try and do that.

CHAIRMAN SEALE: What I'm saying is I would ask you to explain it if I got that report as your customer.

MS. BIAMONTE: I agree. And what I'm saying to you is when we know things like that, we try and anticipate those questions. For example, if we know that they have had a particularly arduous or extended outage because outage times are particularly vulnerable for human performance errors, we do that. We would provide it.

CHAIRMAN SEALE: Yes.

MS. BIAMONTE: Cecil, did you want to add something?

DR. THOMAS: I was just going to add that yes, there certainly are a lot of factors and considerations in

this data.

CHAIRMAN SEALE: Or second derivative.

DR. THOMAS: What we use this for is an alarm system. It's not an indicator. It's just an alarm. In something sneaks above twice the national average, it just causes us to go look.

What we really wind up doing is -- you know, you could argue until Sunday about the statistics and all. And that's why I dictated twice the national average mainly because what it does is identify about the 10 or 12 plants with the greatest human performance concerns. And that seems to be about the right number to call to the attention of the senior managers, who use this not by itself, not in isolation, but use it to confirm other things they're seeing.

MEMBER BARTON: To help answer Dr. Kress' question, do you do a sanity check? His point was, well, maybe you've got a real aggressive inspector.

DR. THOMAS: Yes.

MEMBER BARTON: So your number goes up at a plant. But there is a way to do a sanity check. Every plant has a deviation reporting system, which basically uses the INPO criteria for identifying categories of errors.

If they are applying the INPO system, which

they should be because INPO looks at that when they come and do an evaluation, you can get a sanity check and check the plant's records for it. And the numbers ought to be similar to what you're seeing here.

So if you're doing the sanity check, your numbers ought to be pretty good.

DR. THOMAS: We do not compare them with those numbers.

MEMBER BARTON: You do not do that?

DR. THOMAS: But what we do is look, for example, like Dr. Seale pointed out, with trending and with other things that come to our attention and try to grossly explain them, at least to ourselves.

And, again, this is just a gross indicator indicating that we need to look more deeply at something. We don't use this information alone in isolation.

MS. BIAMONTE: In addition to this report, the system itself can produce reports that are used to develop this. And it provides the breakdown on an individual plant basis for the number human performance errors that have occurred in each department, in each category.

And we do use those and provide them on a regular basis when asked to resident inspectors or to other inspectors who are going to do an inspection in, for example, maintenance. We would provide them data on the

human performance history in the area of maintenance. So we do provide this as an input to help people guide inspection efforts in areas where there are known deficiencies.

In the new system that we're planning, hopefully all of this will automated and it will be more widely available because one of our charges has been to make this information available through a home page on the Internet. So we're still exploring how that can be accomplished.

CHAIRMAN SEALE: There is a whole host of indicators on plant performance, sort of the front-line indicators, that INPO and I guess WANO are putting together for the whole international nuclear complex. And then there are the more detailed indicators, second-order, if you will, some generated by the Commission, of course, some by the industry.

Do you do any kind of scan of those indicators as a starting point for or as the trip wire for looking back, then, into your information on that plant to see if there's something that you might not have picked up from your indicators but which is suggestive in theirs to generate a series of questions as to whether or not there is a particular problem beginning to show up?

DR. THOMAS: We don't look at the databases

that you talked about, but if, for some reason, there is -- if something comes up within NRC, the first thing we usually do is go back here and look and see if we can get some idea of what the problem is.

Each one of these bars is made up typically of six separate bars, including things like training procedures and four or five others. It's proven to be, especially for the more statistically significant ones, a pretty reliable confirmer of what's going on. But we mainly use our own information.

CHAIRMAN SEALE: Okay. Any other questions?

(No response.)

CHAIRMAN SEALE: Well, I'm sure we'll think of some if we think about it a little bit. And we are working on your list of things. But we'll have another presentation here shortly on the inspection guidelines. But for the moment we're going to take a short break. We'll be back at 10:30.

(Whereupon, the foregoing matter went off the record at 10:16 a.m. and went back on the record at 10:37 a.m.)

CHAIRMAN SEALE: Okay. It's later than it should be.

MS. GOODMAN: Only by three minutes.

CHAIRMAN SEALE: Yes, I know. But we always

fuss at whoever the subcommittee chairman may happen to be about dawdling if that happens, especially if it's Dr. Catton. And I don't want to be subject to the same kind of thing.

MEMBER POWERS: Same withering fire.

CHAIRMAN SEALE: Since I'm usually the abuser, I feel -- anyway, we will come back in session. And our next presentation is by Ms. Clare Goodman from NRR on human factors inspection guidelines. We look forward to hear what you have to tell us.

(Slide.)

HUMAN FACTORS INSPECTION GUIDELINE

MS. GOODMAN: Okay. Well, as you said, my name is Clare Goodman, and I am a human factors specialist in the Human Factors Assessment Branch.

My presentation this morning is going to be to brief you on human performance inspection guidelines. So sometimes I may leave out the word "human performance," but I am limiting my discussion to human performance inspection guidelines and not the whole inspection process.

(Slide.)

MS. GOODMAN: Just a real quick overview of what I am going to try to accomplish. I plan first to give you a feel for the breadth of the coverage of our

human performance inspection guidelines.

I'm then going to discuss a new human performance inspection manual chapter. Now, just for clarification, manual chapters are umbrellas over a number of different inspection procedures. I'll go into that a little bit later.

Then I'm going to give you some examples of specific areas of human performance guidance that we have now and some that we're going to be developing. And then, lastly, I'm going to try and summarize.

MEMBER POWERS: Would it be of use to our understanding to read this manual chapter?

MS. GOODMAN: First -- well, I'll get into the new human performance manual chapter. I'm sure you'll have future times where you'll want to discuss this. At the moment this is just an idea. It does not exist at the moment.

MEMBER POWERS: Then help me to read it.

MS. GOODMAN: Okay. In fact, what I hope to do is sort of show you all the different places human performance inspection guidance is now. Some of it's in the inspection procedures. Some of it's in NUREGs. Some of it's in branch positions. Some's in reg guides. It's all over the place.

And one of the things that not only for people

like yourselves but for the inspectors out in the field, the regional inspectors or the headquarters inspectors that are not in our branch, that go out is finding where all these different pieces are because on different inspections, you're not going to have it all in one place.

And so it's the hope of the manual chapter to be a road map, to be a path to follow so that you can sort of be led down a path as to where to get inspection guidance. But I will certainly get into that as we're going along.

CHAIRMAN SEALE: I have a question.

MS. GOODMAN: Certainly.

CHAIRMAN SEALE: I understand there is a whole array of human performance criteria or guidelines or whatever, which are in the form of standards, or are there, the equivalent of the national standards in --

MS. GOODMAN: You do have a human factors standard. That addresses mostly human-system interface materials.

CHAIRMAN SEALE: Okay. Now, to what extent --

MS. GOODMAN: Oh, okay. There are international standards.

CHAIRMAN SEALE: That's right.

MS. GOODMAN: There are U.S. standards.

CHAIRMAN SEALE: Right.

MS. GOODMAN: Yes, you've got multiples.

CHAIRMAN SEALE: Okay. Now, is there an agency position with respect to the extent to which you try to be consistent with those standards and build upon them or do you on occasion substitute for them?

MS. GOODMAN: The answer to that, first and foremost, is build upon them. I think that in our -- you have to remember that a standard may set a standard of excellence and that we regulate, particularly in NRR, to a set of regulations.

So the answer to your question depends upon the situation. It depends upon what particular area you're talking about.

CHAIRMAN SEALE: Yes, yes.

MS. GOODMAN: In each of these areas, there are going to be slightly different answers to that question.

CHAIRMAN SEALE: Okay. But do you anticipate when you get this final or, let's say, this revised version of your guidelines put together that you will, in fact, incorporate --

MS. GOODMAN: Oh, okay.

CHAIRMAN SEALE: -- the national standards or international standards into those guidelines by reference, like they do, for example, in I and C?

MS. GOODMAN: Generally there will be some reference. Most of the references will be to umbrella documents.

CHAIRMAN SEALE: Okay.

MS. GOODMAN: This slide lists a number of areas that we currently perform human performance inspections. It's a little bit of apples and oranges. For example, event follow-up covers a whole spectrum from small special inspections that may involve just one inspector from headquarters or even one inspector from the region, all the way through to very, very large inspections, like IITs or AITs, where you might have one individual on the team that's a human performance inspector from headquarters or you might not have anybody from headquarters but a number of regional folks but they're addressing human performance concerns. So it's a real spectrum of possible scenarios. We can't have a human performance person on every single event follow-up. It's just not feasible.

A number of these other areas we're getting particularly active in. For example, the second to the last one, corrective action programs, is a very popular area now. It involves going out and looking at a number of issues, some of which are human performance.

And generally again it's part of a team where

we look, "we" being a headquarters person from Human Factors, would look at human performance issues, but there would be other people on the team looking at other things.

We may, for example, focus on the root cause assessment program.

MEMBER CATTON: Don't take that away yet.

MS. GOODMAN: Okay.

MEMBER CATTON: On control room observations, what is that? What do you do?

MS. GOODMAN: Okay. That can mean several things. There is actually an inspection procedure. It's called sustained control room in-plant observation.

MEMBER CATTON: What are you observing?

MS. GOODMAN: Well, it is a procedure where you go into the control room. You observe the staff in the control room. Generally it's a procedure used by the residents and regional inspectors.

One of the regions has started to use this particular inspection procedure for special inspections. When they have other performance-based indicators that there are problems, they're using this procedure to go in and around the clock for, say, a 72-hour period observe things that are going on in the control room. And they have asked our branch to take a look at this procedure and develop additional guidance with respect to the human

performance pieces of what you might be observing in the control room.

MEMBER CATTON: That's not what I thought it was, then.

MS. GOODMAN: Oh, sorry.

MEMBER CATTON: During an event -- no. I understand what you were telling me. But during an event follow-up, is there any attempt made to try to tie what happens in a simulator to what the operator observes in the control room?

In other words, there's a condition in the plant somewhere. It's represented in the control room. The operator takes some kind of an action based on what he thinks this is all about.

Is there any attempt to take these events -- there are some interesting events that have occurred -- and try to relate these things to see whether or not the information is properly being conveyed to the operator? I mean, do you do that as a human factors person?

MS. GOODMAN: There's a two-level answer to that question. The second and more difficult answer involves some research, but the first answer because you mentioned event follow-up, I have been on event --

MEMBER CATTON: I don't know what the second --

MS. GOODMAN: Well, let me --

MEMBER CATTON: Tell me what the two parts are first --

MS. GOODMAN: Okay.

MEMBER CATTON: -- before you tell me what --

MS. GOODMAN: I've been out on event follow-ups where it's been an interesting event and we have taken that event to the simulator so that we can answer questions as to what happened on that event, specific to the event that you're evaluating, not in general for collecting data, but it's for the purpose of the team on site to get a stronger field for what happened on that event so that we can attempt to look for root causes for that specific event that we are investigating so we can then identify what actions will correct the problem. That's one level.

CHAIRMAN SEALE: Well, isn't the first level of criticism, if you will, in that process the question of the fidelity of the simulator in replicating what happened in the plant?

MEMBER BARTON: What simulator are you referring to?

MS. GOODMAN: The plant-specific full-scale simulator at the site that we're investigating the event.

CHAIRMAN SEALE: The one they use for operator

training.

MS. GOODMAN: Correct.

MEMBER CATTON: So are you looking to it for answers about the event or looking --

MS. GOODMAN: Yes, at that particular time. Yes.

DR. THOMAS: Let me, Clare --

MEMBER CATTON: -- or are you looking to it to tell you something about why the operator maybe did something strange because he didn't see what he should?

MS. GOODMAN: Yes.

MEMBER CATTON: Do you compare what the operator saw in the control room with what the simulator says?

MS. GOODMAN: Yes, yes.

CHAIRMAN SEALE: That's the first question.

MS. GOODMAN: Yes.

DR. THOMAS: Let me emphasize we don't do this routinely. Go back. Your first question, Dr. Catton, was control room observations, the components of that. We look for things like communications, use of procedure, procedural adherence, decorum, a whole list of things that we observe.

Now, only if the simulator is implicated by, for example, operators have difficulty in carrying out

their procedures, then we look more deeply into why. And this may take us to the simulator.

When we do a control room observation inspection, which is many times a part of a restart effort, where a plant has been down for a long time and the region has concerns that people have not had current operating practice, are not up to speed, and they want to make sure that everything proceeds normally, we don't do that. It's only if the simulator is somehow implicated. It is a result of an event or usage of EOPs or something like that will follow our nose.

And some of the procedures we have would take it back to that. We would look, for example, at licensed operator examination reports to see if there were any indication of simulator problems or fidelity problems or operators' problems in using the simulator.

But this is not a routine thing. Part of what Clare is talking about in terms of the manual chapter is a big road map that lets you follow your nose to the appropriate procedures to look at if you see a problem. It tells you where to go to sniff these things out. The individual procedures would then get into the specifics.

MEMBER CATTON: Why don't you continue?

MEMBER APOSTOLAKIS: I have a question.

MEMBER KRESS: Go ahead. You first.

MEMBER APOSTOLAKIS: Part of the reason why there is a move now in this agency toward risk-informed, performance-based regulation is to get away from overly prescriptive regulations and the burden that that entails for the licensees. Is this part of it?

I mean, would you say that this is overly prescriptive? I mean, worrying about staffing and --

MS. GOODMAN: This is just to give you a flavor for some of the areas that we have performed human performance inspections. These are components. For example, this is a slide that just has some inspection procedures on it.

(Slide.)

MS. GOODMAN: This is to give you a flavor for some of the types of existing inspection procedures. Forty-five hundred, the second one, for example, focuses at looking at corrective action programs. While you're looking at corrective action programs, you may be looking at some of the areas that were addressed in the first slide.

CHAIRMAN SEALE: Now, remember, this is an inspection module. It's not a licensee requirement. It's a lesson plan, if you will, for the inspector to use in inspecting the plant.

MS. GOODMAN: Okay. I assumed that, yes,

these are inspection procedures that are guidance for NRC inspectors, both the regional and headquarters. They use as references within them the regulations. They will cite reg guides. They will cite other types of regulatory guidance.

But they give guidance basically to the inspector how to conduct themselves while they're on site conducting inspections. They are not a tutorial on a particular human performance topic.

MEMBER APOSTOLAKIS: But let's say that ten years from now we have resolved all of the outstanding issues regarding implementation of a risk-informed, performance-based system. Would we still be doing this?

MEMBER KRESS: We'd probably be doing more of it because these are things you do to assess performance. And if you're in a performance-based system, you have to have some way to measure performance. I suspect you're going to do more of this.

MEMBER APOSTOLAKIS: Well, checking whether they have the right number of people --

MEMBER KRESS: That's an organizational performance.

MEMBER APOSTOLAKIS: Is that performance?

MEMBER KRESS: It's an organizational performance factor, I think.

MEMBER APOSTOLAKIS: It's an organizational factor, but it's not clear to me it's performance.

MEMBER CATTON: Shouldn't the organization be able to substitute training for equipment? Right?

MEMBER APOSTOLAKIS: See, I know that the issue of what constitutes performance is an open issue. That's why I said ten years from now. If we have performance indicators, would we really worry about whether they have the right number of people. I mean, theists not a performance measure.

CHAIRMAN SEALE: Clearly there's more than one way to skin a cat.

MEMBER APOSTOLAKIS: Yes.

CHAIRMAN SEALE: I mean, you can have mixes of people --

MEMBER APOSTOLAKIS: And you will.

CHAIRMAN SEALE: -- and equipment and processes and so forth. And you'll have that. But there is some minimal level of acceptable performance.

MEMBER APOSTOLAKIS: Yes.

CHAIRMAN SEALE: And if you have performance-based regulation, then you will have to have a vehicle for assessing whether or not you meet that minimal level.

MEMBER APOSTOLAKIS: And I agree, yes.

CHAIRMAN SEALE: So there's going to be something like this. You know, the words may not be the same. And then, of course, there's also just the general requirements of decorum and so on that the inspectors have to meet as we .. And those are among the things that are in some of these inspection manuals.

MEMBER CATTON: George, aren't you asking the question about whether or not it's performance in terms of meeting some kind of requirement, rather than the pieces?

MEMBER APOSTOLAKIS: Yes. I mean, again, let's not forget that the issue of what is performance has not been resolved. So it's very hard to really define indicators regarding these kinds of issues.

I'm just asking. I guess it's more of a philosophical question. I mean, is the fact that now we are moving towards that, RIPBR -- I prefer RIPR, but RIPBR -- affecting any of this? I mean, is this why the utilities complain that we are interfering too much?

MS. GOODMAN: No. I --

DR. THOMAS: Could I take a crack at this?

MS. GOODMAN: Go ahead.

DR. THOMAS: What we're doing, we're not prescribing performance here. Let's go to your staffing question. That's a good one. The regulations in 50.54(m) or in 50.54 provide minimum requirements for staffing in

the control room, on site, and so on.

We've had a number of occasions where we have had multi-plant trips simultaneously due to grid perturbations or causal one causes another to go off. In the back shift, you have a fire in the switchyard or whatever. It really taxes the licensees' ability to cope with two or three things at once. And in those cases we'll go in and take a look at, surely in every case they're meeting the requirements of the regulations.

What do the tech specs say? Have they considered all of this? Do their tech specs need to be augmented? Do they need more people? Have they looked at staffing? Is their staffing adequate? That's their responsibility.

Our inspection procedures guide the inspector into asking the kinds of questions we need to know the answers to to ensure that the licensee is acting responsibly in staffing. It's not to prescribe a particular number. It's based on performance to go in and let them take the next step.

MEMBER APOSTOLAKIS: So, in fact, I agree with your last statement. In that system ten years from now you would have, say, an indicator regarding the number of trips.

The way I understand it and I think NEI is

proposing that is that if you compare the number of trips, which is a performance indicator, against a standard, if you have too many of them, then you go deeper. And then you do what you said. So in the future I think that would be a good way to proceed. But routinely, though, it would not do that.

If the utility doesn't have a lot of these trips, then maybe it's none of our business whether they have enough people in the control room or not.

DR. THOMAS: Most of our inspection procedures and our guidance that Clare is talking about are reactive. It's reactive to something. They're not routine.

Maybe some of them, maybe control room observation would be routinely a core inspection module. You'd check on it. But most of these others are reactive in response to something. We look into it --

MS. GOODMAN: In fact, this whole list is an example of a reactive, there are many more reactive, --

CHAIRMAN SEALE: George?

MS. GOODMAN: -- inspections.

(Slide.)

MS. GOODMAN: These four are just four of the ones where you often have a multidisciplinary team, but they are definitely reactive. There are a number of reasons you might initiate these particular inspections,

but you just don't walk in and decide based on very little evidence that you are going to set up one of these inspections. They're based on numerous management inputs and numerous, as you say, performance-based indicators, plant indicators.

Generally there are three or four reasons why any one of these would be conducted.

CHAIRMAN SEALE: If I may, it's really more of a guideline or an instruction as to how an inspector judges the adequacy of the staffing of various functions. And it's my experience -- I believe I've heard at least as many criticisms of having too many people in the control room as I have of having not enough.

As a matter of fact, by far the more common criticism is that there are too many people underfoot in the control room.

MEMBER APOSTOLAKIS: I agree with that that this is how to do it. I guess my question was: Why would they do it?

CHAIRMAN SEALE: Because too many people in the control room put too many thumbs in the soup --

MEMBER APOSTOLAKIS: Right.

CHAIRMAN SEALE: -- and diffuse the focus of the internal communication process within the control room.

MEMBER APOSTOLAKIS: But in a performance-based system, you would ask the question: What are the consequences of that?

CHAIRMAN SEALE: Yes, yes.

MEMBER APOSTOLAKIS: Because, you know, maybe the --

MS. GOODMAN: But now --

MEMBER APOSTOLAKIS: The answer I got, though, is that this is not far from that, that that's the spirit of this, that it's really performance-based.

CHAIRMAN SEALE: Right.

MS. GOODMAN: Yes. For example, you would be looking at that issue if you went to investigate an event and during the event there were problems with too many people. So that would push you into investigating that particular issue. You wouldn't just investigate that unless there was evidence to indicate that it was a problem.

MEMBER POWERS: Okay. Let's see. I know you are probably --

CHAIRMAN SEALE: You are probably --

MEMBER POWERS: I know you are anxious to get off these slides.

MS. GOODMAN: Okay. That's all right. No. Go ahead.

MEMBER POWERS: But you've cited EOP several times here. And I noticed in the HPPP that the review of the EOPs as necessary is culled out. And then you spoke of reactive inspections.

Could you tell me what "as necessary" would mean in that context?

MS. GOODMAN: We have completed our EOP1 and 2, which is two separate rounds of EOP inspections, at all sites. So when we refer to "as necessary," that would be a plant specific problem that came up, could have come up as a result of an event where they used EOPs and it showed weaknesses in a specific EOP. So we would probably be reactive in nature.

EOPs are dynamic. There's always one or two sites out there that are changing their EOPs. So you might get in a situation where we haven't finished a review. But I'd say the vast majority of times we're talking -- when we say "as necessary," we mean reacting to a performance-based problem.

CHAIRMAN SEALE: A couple of years ago there was a quickie, as I recall, that you had to do because the floods in Missouri and so on cut off some of the access roads. And so now the EOPs didn't work any more.

MS. GOODMAN: Yes.

MEMBER POWERS: Well, I think she's answered.

What my concern was --

CHAIRMAN SEALE: Yes.

MEMBER POWERS: -- is that they have completed an inspection of these things as written --

CHAIRMAN SEALE: Yes.

MEMBER POWERS: -- and that in the future they only need to do it as necessary.

CHAIRMAN SEALE: As necessary.

MEMBER POWERS: That was my concern.

CHAIRMAN SEALE: Tom, you had a question you were going to raise.

MEMBER KRESS: It got answered.

CHAIRMAN SEALE: Okay.

MEMBER POWERS: And let me ask another one here. After that one on the EOPs, there's one on non-EOPs. And it says that you inspect them for useability.

MS. GOODMAN: Okay. There is an inspection procedure that, unlike most of these others, is part of the core program that looks at plant procedures, takes a small sample of plant procedures and looks at them.

That's done by the resident inspector. We took that inspection procedure module. It happens to be 42700. It's not listed in the slides here.

MEMBER POWERS: I noticed.

MS. GOODMAN: And we added an appendix. So while the inspector is reviewing the plant procedures, the sample -- it's a small sample if the plant doesn't have a problem. If there are problems with procedures at that plant, the sample gets larger. It gets larger not only as they get a problem but if they have a problem, say, in maintenance procedures, then it would get particularly large, the sample in that area.

The point that I'm trying to make is that we have added an appendix that looks at useability issues similar to the useability issues that we put in for EOPs, looks at readability, a number of human factors issues with regard to actually using those procedures. And it's an appendix. It's two check-off lists that essentially can be used by a resident inspector.

MEMBER POWERS: You recently had an incident involving cotter pins on a valve.

MS. GOODMAN: Yes, at an AIT at --

MEMBER BARTON: Arkansas.

MS. GOODMAN: ANO, yes.

MEMBER POWERS: Did you look at that procedure with a useability eye?

MS. GOODMAN: No, I didn't. Do you know if the team, Jesse Earlson did? I don't know.

DR. THOMAS: I don't know. Dana, typically

they wouldn't. That's a --

MS. GOODMAN: We did have a team member on that AIT. Probably the answer is yes.

MEMBER POWERS: I'd be interested in how that stood up on useability as a procedure.

MS. GOODMAN: Yes. I believe, although, again, I did not look at that procedure, I believe one of the issues was that there wasn't guidance on something. It was actually missing guidance. So it would not so much be a readability issue.

MEMBER POWERS: I think the --

MEMBER KRESS: It was actually conflicting guidance, as I remember.

MEMBER BARTON: Yes, yes. Right, right. I think the useability issue in EOPs is since this is not a typical procedure that operators are familiar with or use during the course of business, the useability inspection that I'm familiar with is the resident comes out and has the licensee bring the EOP out and then go and show that you can actually implement that EOP should you ever have to use it. At least that's what I'm familiar with.

MS. GOODMAN: Yes, that's exactly right.

DR. THOMAS: This one does got a little bit further than the EOPs, though.

MEMBER BARTON: Can you implement that

procedure if you have to use it? Show me that this works and an operator can actually go out and do this.

MEMBER CATTON: You're not reviewing it for effectiveness in accomplishing its purpose. You're reviewing it for useability, which is a human factors review. Somebody else makes that other decision, I guess, or does the other half of the review.

MS. GOODMAN: Yes, correct.

MEMBER CATTON: My concern is more basic than that, whether or not it's going to work.

MS. GOODMAN: What started this on procedures was useability. And the appendix that I was referring to just refers to the useability issue.

CHAIRMAN SEALE: Can you turn the pages? Can you read it?

MEMBER BARTON: Can you go out in the field and make the changes or can you take the actions in the field that you need to do to implement the procedures?

MEMBER CATTON: It has nothing to do, really, with the essence of: Will it work if you do it?

MEMBER BARTON: I know where you're coming from. I don't know that the NRC looks at that. I know utility management overviews that, but I don't know where the NRC looks at that from an adequacy perspective.

DR. THOMAS: As far as EOPs go, we really only

actually review EOPs -- and that was during the various phases of the EOP effort where we looked at writers' guides and so on.

When a procedural issue raises i head, there are two aspects. One is the technical aspect of: Does it really accomplish to the system what you expect?

And our branch does not do that. The cognizant technical branch would get involved as necessary; for example, Reactor Systems or Plant Systems. We look at the human factors aspect of it.

We only really do -- our primary emphasis is on EOPs, as was described. There is part of a core inspection module that requires some periodic sampling of other procedures.

And what we have done is take our human factors useability guidance from our EOP module and put it in the other one also to give practitioners some idea of what to look for, what are attributes of useability. And that's what Clare is describing.

(Slide.)

MS. GOODMAN: All this leads to the need for a manual chapter, a human performance manual chapter, that provides a road map that can direct inspectors to appropriate places or for human performance guidance.

For example, the list that you have just seen

of various inspection procedures, each of those have components that contain human performance guidance. There is also human performance guidance in standards, in NUREGs, in reg guides, a number of different places.

And we have started to develop the manual chapter that will basically establish performance-based thresholds for both initiating human performance inspections and when you're on a human performance inspection or a part of inspection that has a component that is human performance would allow you to get some guidance.

(Slide.)

MS. GOODMAN: This is a flow chart of what that manual chapter might look like. The first box, which is "Monitor Human Performance," involves a number of different items that --

MEMBER CATTON: What is A? Is that --

MS. GOODMAN: A you'll see comes out of here. We'll get that. What I'm going to do is go through this flow chart. I'll give you a little bit of a plan here. I'm going to go through the flow chart. And as I go through the flow chart, I'm going to put up pieces.

The first block is to "Monitor Human Performance." There are times in this where we're going to feed back to monitor. In other words, you're finished

your inspection. You go back to monitor.

(Slide.)

MS. GOODMAN: These are some of the ways that we monitor performance: HFIS, which you just heard about from MaryAnn. We certainly get input from regional inspectors, particularly resident inspectors. The PMs, or the program managers, are members of NRR, just one for each site. We get many management insights, both from regional and headquarters management.

We participate, we as a branch, in a monitoring call session, which is a multi-office review of what has happened in the last 24 hours except on Monday morning it goes over the weekend. It's a joint effort between AEOD and NRR. And "5072s" refers to those reports that come in.

In addition, there are LERs. They're later on. It's not quite as fast the reactive time since an LER doesn't hit the street until at least 30 days after the event.

And then another example would be operator licensing. We would get performance indicators from them as they go out and monitor the exam process. This is not an exclusive list. It's an example of some of the ways that we monitor performance.

(Slide.)

MS. GOODMAN: Two questions that we answer. One, if an event is involved, we look at: Do we need to conduct an on-site evaluation? Most cases we're requested by the region to assist them in looking at an event on site.

If we do that, we would be likely to follow our human performance investigation process. That's HPIP. And following HPIP, we would be determining the root causes of that event. And then the root causes that we find would then lead to corrective actions by the plant.

(Slide.)

MS. GOODMAN: While looking at HPIP, we may find specific areas that are problematic. In answering questions in HPIP, we may discover that there's a particular hangup in the area of procedures. That would lead us to a specific look at procedures or possibly to a future inspection that the region might pick up or that we might pick up with a special look at procedures in the future.

At the same time, if an event is not involved, we might be looking at if performance is declining. We may have input from management that there's a problem at a site. They may have been down for a great length of time and we are asked to go out and look at a particular problem at a site. And we would be asking, as indicated

here, some questions as to: Is HFIS also showing us that there is a problem?

In either way you may, say, come to the same conclusion that you need to look at procedures or some other specific area. These are five areas where we have some specific human performance guidance.

(Slide.)

MS. GOODMAN: In the area of procedures -- let me walk through a couple of these. I'll come back. In the area of procedures, that's one where we have a number of pieces of guidance already in place. Most of our procedural guidance is in place.

(Slide.)

MS. GOODMAN: In another area, the human factors engineering --

MEMBER CATTON: Which one of those guides you to comparison with your simulator, for example? I'm concerned --

MS. GOODMAN: I don't quite understand that.

MEMBER CATTON: Well, I'm concerned that when the operator receives simulator training for a class of accidents, it's not the same as what he's going to see in the plant.

CHAIRMAN SEALE: Ivan, I believe that's a simulator fidelity question. It's not a human factors

question.

MEMBER CATTON: I understand that. But if you have written procedures, they should accommodate it or, else, you should fix it.

CHAIRMAN SEALE: Yes.

MEMBER CATTON: And I'm just trying to sensitize everybody or trying to learn myself how this would happen if it would happen.

CHAIRMAN SEALE: Who would raise the issue?

MS. GOODMAN: Do you want to go ahead, Cecil? Then I --

DR. THOMAS: Yes. Let me take a crack at it. From our perspective, human performance, if we diagnose that it's a training issue, if it's a fidelity, discrepancy between the fidelity of the simulator and the actual plant, if we found out it was a training issue, it would come in in that aspect of it. We would probably look more deeply into it using Inspection Procedure 41,500, which is training.

Now, this is procedures. What I'm talking about are training.

MEMBER CATTON: Where is your human factors person given the guidance to look for that or are they?

DR. THOMAS: What Clare is describing is the manual chapter that's a big overview. It says there's a

human performance problem. It will direct you in this case to the training procedure, IP 41,500.

Forty-one five hundred would say go look in different elements of training. One of those could take you to the simulator and ask the question: Is there a disconnect between the simulator and the plant?

MEMBER CATTON: That's what I wanted to hear. Okay. Go ahead.

MS. GOODMAN: Do you want to go? Yes. I want to add one thing, too, but go ahead.

MR. SPESSARD: Hi. I'm Lee Spessard, Deputy Director, Division of Human Factors.

Your specific question, Cecil's branch does not look at operator licensing. The Operator Licensing Branch does that as do the regions. But we do requal inspections. Of course, we do exams. We also get every four years a simulator certification report from the utility.

We look at the discrepancies identified that way. So we do assess simulator fidelity issues but through a different mechanism, in addition to what Cecil was talking about.

MEMBER CATTON: See, the reason I got sensitized to this was yesterday we heard about some results from the B and W experimental simulator at

University of Maryland.

And the first thing that came up was the big codes that are used to assess the fidelity of the simulators don't predict observed behavior. Well, that means that when the operator is in the control room, he's going to see behavior that he's never seen before. And if he does something stupid as a result of that, it's really not his fault.

What I was trying to figure out is just: How would this surface if it happened? I'm a little bit afraid of an interface, where your responsibility is basically from the display to an action but out here somewhere there was a condition that maybe wasn't displayed quite right. As far as we know, the modern simulators have good fidelity, but, hey, that may not be the case.

Where would you pick this up?

DR. THOMAS: Well, if an event or something led us to look at it and we saw a performance problem, we would follow our nose. And it would take us back through the training inspection. And it would take us back to looking at the issue of simulator fidelity versus the actual plant. That's from that end of it.

CHAIRMAN SEALE: Ivan, I've just been told that the individual who developed the NUREG on simulator

fidelity will be here this afternoon.

MEMBER CATTON: Okay. I'll ask him the same question.

CHAIRMAN SEALE: Yes.

MS. GOODMAN: Okay. In the area of human factors engineering, that's another area where we don't have an inspection procedure. But we have a number of NUREGs that have guidance that inspectors both in our branch as well as inspectors out in the field can use when they're reviewing human-system interface issues.

(Slide.)

MS. GOODMAN: A third area that we've touched upon a number of times today is training. That's an area where we have conducted several inspections. This is usually a multidisciplinary team that pulls some people from the region, some people from human factors, as well as some people from the Operator Licensing Branch. And, again, it's an area where the guidance is fairly mature.

That's three examples where guidance is in various areas of maturity. Two areas where the guidance is new and we're working on it is one area in management processes and one area in communications. That's both under development.

The area of management development processes, the inspection procedure that we're working on there, you

have to remember, is not an evaluation of management. It is an evaluation of the processes that management utilizes.

For example, this inspection procedure would not be used to go out and evaluate a particular utility's management.

(Slide.)

MS. GOODMAN: On the other hand, if you had a site where you had a particular training issue and you kept hammering and it kept coming back and back again as a training issue and you looked at it and you really decided that management was hampering and the processes that they were using were hampering the corrective action on training, then this would be an inspection procedure to utilize.

CHAIRMAN SEALE: This is how to get up close without getting personal?

MS. GOODMAN: Okay. We can call it that.

MEMBER POWERS: In this particular area, you indicate a NUREG is under development. In the program plan, it also indicates there's a letter report titled "Guidelines for Evaluating Corrective Action Plans for Nuclear Power Plant Communication Related to NUREG."

MS. GOODMAN: This was a multi-office effort. Research did a research project. And that led to a

technical letter that I believe you're referring to right there.

That technical letter report came in. It was decided that it was appropriate to distill the parts of that technical letter that would be good information for inspectors. Inspectors generally don't have the time to go through a whole research report, but they can use pieces of it.

And so the NUREG that is under development pulls those pieces out. It references the technical report so any inspector could go back and read that technical report if they want the bases behind the guidelines.

MEMBER POWERS: I think you answered my question, which was: Who reads RES letter reports? I mean, George, you were --

MS. GOODMAN: In this case we most definitely read it. We liked it and decided to develop a NUREG.

MEMBER POWERS: If you complain, George, about NUREG reports as being an isolated method of communication, letter reports must really set you off because they truthfully are isolated. Nobody can get a hold of those.

(Slide.)

MS. GOODMAN: Okay. Just to summarize our

inspection efforts, we're going to continue to support regional requests. That's as Cecil said right at the beginning.

He said that our branch is heavily involved in inspection efforts. And that appears to be the direction we're going. You sort of have to keep in mind that that is to some degree our major focus. So when we don't immediately say that we've got lots of time to come up with in-detail models, it's partly because we are responding to the need to inspect.

We're currently developing a manual chapter that will provide a road map for not only our branch but for inspectors throughout the NRC. We're updating selected IPs similar to how we updated the procedures IP to add useability guidance. We're also updating other IPs. We're developing new IPs such as the management processes IPs. And we're always in the process of finalizing support documents that these IPs can reference.

Any other questions?

CHAIRMAN SEALE: I'm sure there are. Anybody?

(No response.)

CHAIRMAN SEALE: Goodness. Okay.

MS. GOODMAN: There can't be no questions.

CHAIRMAN SEALE: Well, I thank you very much. I have the impression that you have taken the Committee's

suggestion that we have plenty of time to discuss things to heart, probably better than most people do. Therefore, we're still on time. And I thank you for that. And we will supply you with a list of questions for the next meeting.

So now we'll recess for lunch. Be back at 12:30.

(Whereupon, a luncheon recess was taken at 11:27 a.m.)

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

(12:33 p.m.)

CHAIRMAN SEALE: We'll continue the meeting of the Human Factors Subcommittee. This afternoon we're going to hear about the human factors research programs, and our lead speaker will be Frank Coffman; correct?

MR. COFFMAN: Yes, sir.

CHAIRMAN SEALE: From Research. And I guess you're going to have a couple of your colleagues with you here a little later on; right?

MR. COFFMAN: That's right, Jerry Wachtel and Dolores Morisseau.

CHAIRMAN SEALE: Okay. I guess if there are no problems, we'll go ahead and get started.

(Slide.)

HUMAN FACTORS RESEARCH PROGRAMS

• OVERVIEW

MR. COFFMAN: Okay. Well, I appreciate this opportunity to briefly describe the RES plans and activities related to human factors because it definitely has been a while since we have gone over what's going on in RES.

And just a brief reminder, the RES goal is to ensure availability of sound technical bases for timely rulemaking and related decision --

MEMBER POWERS: If I could just interrupt you a bit, Frank, and say that, though I have been relatively critical of the plan to this point, I will point out that the plan has several items that are just really exciting, it strikes me, because they have the word "technical bases for" and fill in the blank. Those things just look really interesting, like technical bases for communications and things like that. It just looked like really exciting work.

CHAIRMAN SEALE: Certainly the intent is a laudable one. It may not be too easy to deliver, but you have --

MR. COFFMAN: You struck me as I said, boy, I've got to hear about these things because this looks like it's impossible to do.

So the control instrumentation/human factors part of the RES program is to provide the technical bases for things like guidance. We also do surveys. We develop methods, but they're specifically related to the human factors activities.

But also within the branch we deal with the rest of the I and C system, which includes software quality and environmental qualification. But we're not touching on that. I was going to focus totally on the human factors aspect of the branch program.

Within the branch we have six qualified human factors analysts. They are disciplined in such subjects as experimental psychology, industrial psychology, sociology. So there are six. And on the average they have 22 years' experience. There are 6 out of the total of 132 years' experience in working with human factors.

Then within the NRC, they have 14 years on the average of experience, or 84 years' total experience within the NRC. And about half, right about down the middle, of that experience from the staff in Research is experience in NRR. I think they're intimately familiar not only with human factors but also with the way the organization functions and the different roles that are played within the organization.

(Slide.)

MR. COFFMAN: What I was going to cover this afternoon is go over some recent human factors products and talk a bit about the ongoing projects and activities, talk about our plans and planning, some specific plans and some comments about the planning process. Then we were going to give some details about a couple of -- actually, three selected projects, two dealing with human-system interface and one dealing with staffing.

(Slide.)

MR. COFFMAN: By way of recent products -- and

I think this is a way to characterize the program, the first being NUREG-0700, Rev. 1, which, as we speak, is in the mail as far as being distributed.

That provides the human engineering guidelines or review guidelines for both design reviews -- I shouldn't say "both"; there are three elements -- for design reviews, for inspections, and for investigations.

And that work just recently being issued, there are some gaps, which we've mentioned this morning. And Jerry Wachtel is going to talk about those gaps.

To me the reason we call them gaps is because the technology is advancing, the technological capabilities are advancing, faster than experience is accruing on use of those systems and identification of some of the problems that can be or seem to be identified only through use through experience.

The guidelines that we tend to develop are based upon experience and feedback from experience. So it creates, as it were, a gap. And Jay earlier mentioned some of these gaps, like large screen overview, displays, computerized procedures, hybrid alarm systems, advanced alarm systems, some of those gaps. Jerry is going to talk about two of those. Jerry Wachtel is going to talk about two of those this afternoon.

The second bullet here is a reference to the

draft NUREG that NRR spoke about this morning. I apologize for leaving what could have been left as the wrong impression that it's not a total product out of our branch.

We participated in the development of this product. And that was at the completion of a project that it was decided explicitly to leave as a letter report. Rather than duplicate the effort, prepare a NUREG, and then -- prepare a NUREG contractor report and then prepare a NUREG, we just thought it was more efficient to join efforts across the office and prepare what was the final guidance.

Coming out of the research was the review criteria. Coming out of NRR was observation checklists and interview protocol. Those are all in that draft.

MEMBER POWERS: You know, if I get intensely interested in this subject like I'm going to be a licensee and I want to track the origin of some of these things so that I'm pursuing both the spirit and the letter of the regulation, can I track it? I mean, do I end up with a prescription without a basis if I can't see the letter report?

MR. COFFMAN: Let me ask Isabelle if the letter report is cited in the NUREG. This is Isabelle Schoenfeld, who was a research project manager on the

project and also participated in the development of the NUREG.

MS. SCHOENFELD: This is not prescriptive guidance in the NUREG-1545. It is a criterion to be used by NRC inspectors in evaluating licensee corrective action plans.

In terms of wanting to know what the basis documents are, there are a number of contributions to that NUREG. One of them was a result of a research project that his products were technical reports on communications errors.

The reason we undertook the project to begin with or that NRR had this user need was because in reviewing licensee event reports, they identified that in over 35 percent of licensee event reports that had personnel error as the major factor of the event, in over 35 percent, communications was a contributing factor. So NRR felt that that needed to have closer attention and needed to have information and guidance on reviewing communications as a contributing factor in events.

MR. COFFMAN: Isabelle, I think the thrust of the question was on the traceability of the bases. So I was trying just to establish that the letter report --

MS. SCHOENFELD: Well, the NUREG references all the appropriate reports and all the appropriate

regulatory documents.

MR. COFFMAN: So that it is traceable and --

MS. SCHOENFELD: It is traceable.

MR. COFFMAN: And documents that are referenced in NUREGs are typically put in the PDR. So that would be the --

MS. SCHOENFELD: Sorry for going over.

MR. COFFMAN: No. That was good background.

MEMBER POWERS: No. Your description of it was very useful information. I am really raising a point for other members of the Committee here that putting things in the PDR is one of the least pursuable options for tracing documents that I can think of.

Some of the gentlemen on that side of the table complain even about just laboratory reports as being unpursuable by them. I would think that they would be agitated in the extreme about letter reports that go into the PDR because that virtually excludes them from access to that kind of result.

And I raise the issue not so much just in this context. There's a lot of letter report going on in NRC right now. And I wonder how we decide what research is so meritorious that it should go into a report that's available out of, say, NTIS and what is so routine and unimaginative that we consign it to a letter report in the

PDR.

MR. COFFMAN: I'd like to split the comment up into two pieces. One is distribution of the NUREG contract reports. Those reports are put out on a standard distribution, which includes the ACRS.

And there is a list which we use for our branch. I think it's called the Rx list. It has over 200-250 people that have -- and it's kept current. So I think there's an attempt to make the information available.

As far as letter reports, the distinction between letter reports and contractor reports, that I think is a natural decision in the process of developing the plans, developing the statement of work for the preparation of the reports. In combination with the review process that it goes through, it has to be approved by the division director.

So if they think a letter report should be made a NUREG/CR, then that I think is part of the consideration.

MEMBER POWERS: So it's the division director we need to interrogate here?

MR. COFFMAN: No, I don't think --

MEMBER POWERS: I understand his --

MR. COFFMAN: What I'm saying is the process

of developing the plan for the work involves a decision about what the form of the final product should be by the project manager developing the work, probably interacting with the user office, and then the branch chief and deputy division director and division director.

CHAIRMAN SEALE: I think what Dr. Powers is suggesting is that if there is a communication that has substantial technical content that can be beneficial to the users of or the people that are involved in that regulatory process, that it would be a preferable situation to have that in a form that is retrievable from NTIS. And so if you got a letter report but it's really mostly technical content and so on, that's an unfortunate combination of circumstances.

MEMBER POWERS: One of the features of research is that you never know how the stuff is going to get used.

CHAIRMAN SEALE: Yes.

MEMBER POWERS: No matter how much you try to focus your research activity on some particular issue, it's amazing how things get used elsewhere. And your letter reports are simply denying lots of other people awareness that they even exist outside of the very narrow community that you work with.

MR. COFFMAN: There's no attempt to deny that.

And the publications of the results from research projects is emphasized. I think there was a paper written or planned on this project, just as an example. But typically publication is encouraged.

But I appreciate the difficulty. I think it needs to be balanced. The wide distribution of all of this information needs to be balanced with the cost in selecting the right information to distribute. I think we will take it as a comment.

MEMBER POWERS: Okay.

MR. COFFMAN: Just by way of characterizing the program with its products, this third item was a study that involved 38 cases and 10 or more operating crews from 2 different sites working on 2 simulations, 2 emergency scenarios, IS LOCA and loss of heat sink.

And the study was done to determine whether situation awareness and response planning or, in Rasmussen's terms, knowledge-based behavior continued even when the operators were following procedures. And the study concluded that yes, it did.

Coming out of this study was also a list of characteristics that make scenarios cognitively demanding. And that's being used in planning measures of situation awareness and some of the other projects, like the staffing study and the alarm study.

The next product, the 6398, was an evaluation. We wanted to get some firsthand experience with evaluating computerized procedures and what that might mean in terms of operator performance.

So the study was done using the computerized procedures manual. That's its title coming out of the Halden reactor project. And we did that study at North Carolina State University at their scaled PWR facility.

And the findings of the study were that the operators using the computerized procedures about half the errors that were made using paper procedures. But they were a little slower.

CHAIRMAN SEALE: That's interesting.

MR. COFFMAN: Yes, it's an interesting result. One of the considerations that may be part of it, though, is with a new system and experiment being conducted, they may have been more strict about following the procedures from that.

MEMBER POWERS: Multi-camera effect. Anything new gets more attention than the old and familiar.

CHAIRMAN SEALE: Yes, yes.

MR. COFFMAN: But it gave us an opportunity. It reports on an opportunity we had to do some firsthand experience looking into this issue of the effects of computerized procedures.

Then the last item there was a study on performance differences between those working night shifts 8 hours and those working night shifts 12 hours.

MEMBER POWERS: Can you give us a thumbnail sketch on that? I know that within the Department of Energy's nuclear facilities, there is a great deal of pressure from the operating staff to go to 12-hour shifts that's being vigorously resisted by the management staff appealing to the NRC to do so.

MR. COFFMAN: Let me give you the thumbnail. And if we need more details, then the project manager, Dolores Morisseau, can address it also. But I think the basic conclusions coming out of the project were that there was no degradation in performance accuracy for the tests that were run during the experiment.

And it did have some longevity to it. There were a couple of weeks', at least a couple of weeks', duration to the test. So there was no degradation in accuracy for the 12-hour shifts. There was some slowing down of response times but nothing that became critical. And there were lots of insights.

CHAIRMAN SEALE: That's the old Hal Lewis issue, isn't it?

MEMBER POWERS: It's a major issue --

CHAIRMAN SEALE: Yes, yes.

MEMBER POWERS: -- because the operating staff are attracted to the 12-hour shift for a lot of reasons. And there's always been a concern --

CHAIRMAN SEALE: Yes.

MEMBER POWERS: -- that performance will degrade --

CHAIRMAN SEALE: Yes.

MEMBER POWERS: -- because we believe that you can detect performance degradation even over an eight-hour shift. So you start adding four more hours on. You really start to worry about that.

CHAIRMAN SEALE: Yes.

MEMBER POWERS: So it's interesting to have some actual data.

MR. COFFMAN: Okay. That was to just briefly characterize the program from the standpoint of recent products.

(Slide.)

MR. COFFMAN: And I was going to touch on the ongoing activities, the first of which is the revision of Reg Guide 1.8 on qualifications training and training for personnel in nuclear power plants. This basically proposes to endorse ANSI/ANS-3.1-1983 with significant clarifications, additions, and modifications.

The next step in this project is to go out for

public comment. It will be imminent. I expect it will probably be issued in draft form for public comment this month. And then there will be the response to public comments and then putting the reg guide in final form. Then I would expect that the ACRS will have opportunity to see this in about the first quarter of 1997 calendar.

(Slide.)

MR. COFFMAN: Another reg guide we're working on is 1.164 and --

MEMBER APOSTOLAKIS: Excuse me.

MR. COFFMAN: Yes, sir?

MEMBER APOSTOLAKIS: Has the ACRS seen this at all, the previous one?

MR. COFFMAN: The 1.8? No. ACRS was offered the opportunity to look at it before it went out for comment. And the decision was made to not review it before.

This one the ACRS has seen. It, in fact, did go out for public comment. And the ACRS had some concerns. They expressed some concerns with the reg guide and the resolution of Generic Issue B-17.

The issue is what criteria should be used to determine whether credit can be given for operator actions when a safety-related function is required. And the approach that the staff was taking was to endorse ANS

58.8-1984 without exception.

The current status of this is that we are going back out for public comment specifically asking the commenters to address the ACRS concerns. And we're again trying to encourage or extract additional information if there is additional data if there is additional data.

And then after the public comment, the same process. And I estimate that this would be like in the Spring of '97 when the ACRS --

CHAIRMAN SEALE: Excuse me. George, is this the one where we had problems where the basic data were not available but the endorsement was hanging out there for God and everybody?

MEMBER APOSTOLAKIS: I was just restraining myself on making a comment on this third bullet, "ACRS expressed some concerns." I think it was a brutal rejection.

MEMBER POWERS: In no small part, that rejection came about because of the unavailability of the database that supported some of the decisions. And where data were available, the review standard appeared to be inconsistent with that data.

I will point out to the Committee that at our last meeting staff did share with me the existence of the data and showed me a stack of documents and offered me to

carry them back and study them carefully.

I suggested that I would do it after the thing came back. But I did look at the database enough to know that a large amount of it antedates 1979. That was distressing to me to see that because there have been a lot of changes within control rooms and in the interim.

And I guess I'm curious how you go about correcting data from one era to another era. You know, it struck me as a non-conservative kind of correction one had to think about because operators are now asked to do and think about a lot more than they were in the '78 to '79 time frame.

MR. COFFMAN: Yes. And the issue focused on how to substantiate the earlier conclusions on the time criteria. The only data that were available, although meaningful data but somewhat limited, was the EPRI operator reliability examination and evaluation and experimentation or ORE data. And the ANS Standards Committee looked at that.

We have subsequently made that data a little more available. And we're still looking for more of that substantive type data. It is limited. It merits a lot of discussion with the Committee. And I just wanted to identify it. I'm not here to resolve the issues but to just give the status.

MEMBER POWERS: It raises one of those questions, like about the program plan itself. You know, right now I can't say that the world hangs on the thread of availability of this data. But it might. And you would like to understand how the elements in the program plan get decided.

Why is it decided "We'll just go look for what EPRI has and not find that data collection effort on our own" or commission a data collection effort? That's one of the things I need to understand better about this program plan.

MR. COFFMAN: Yes. The generic issue was prioritized as medium.

MEMBER POWERS: Yes. I understand that.

MR. COFFMAN: So that influenced the degree to which we wanted to commit resources to --

MEMBER POWERS: And I think we all agreed this one probably medium is at worst a high-ranking --

MR. COFFMAN: Yes, sir.

MEMBER POWERS: I'm thinking more generically when I made my comment.

MR. COFFMAN: Okay.

(Slide.)

MR. COFFMAN: Hybrid control rooms are a user need that came from NRR looking for guidance on mixing

digital systems in with generally analog control rooms. And the comment was made earlier this morning about -- I think it was mixing the review, the regulatory review, of hybrid control rooms with the research project.

The research project is based upon information. In fact, so far we've collected information from the nuclear industry, including foreign plants and maritime industry and aerospace.

So we're trying to draw from these other industries to determine what insights they have on what are the issues that operators have to deal with when they mix digital and analog systems.

The stage of this project is that we have made an initial stab at defining these issues based upon the information collection. We've kind of prioritized them. And considerations there are more: Is there guidance available already? And it's just a matter of aggregating it and organizing it or is there something that has to be explored experimentally? So the resource considerations come into play in the prioritization process.

We expect to finish that this calendar year. We expect to have a report put together.

MEMBER APOSTOLAKIS: Does this look only at the human performance or does it look at the whole system? I remember when Idaho reviewed the AP600 control room, the

PRA actually, where they concluded that they couldn't find any significant problems with human performance unless something went wrong with the digital system because the operators by that time, they would rely on these systems. That's an advanced reactor. Maybe that's a different problem than what you have here. Anyway --

MR. COFFMAN: Yes, yes.

MEMBER APOSTOLAKIS: The question is really: Are you looking at what the operators might do if there was a faulty signal from the digital system?

MR. COFFMAN: Yes, but I think we're addressing that more from the total system than we are hybrid. This is more design. This is focused more on design.

MEMBER APOSTOLAKIS: This is design?

MR. COFFMAN: I think that's -- okay.

MEMBER POWERS: Well, the question that struck me this morning, actually a few days ago, got raised this morning, was this is a high priority activity in which to get data, you have had to go out to lots of allied industries. There is in the plan a medium priority activity to go out and collect what would be useful data for this program.

And it is that discontinuity between the data collection effort and this effort that was puzzling,

simply because I didn't know the prioritization. And it was explained that establishing this research program because of its long lead time meant that you had to get on with it or you weren't going to have this stuff. That was the rationale. We can only do so many things here.

It strikes me that one of the great services that this particular report that you're going to produce at the end of the year could serve is to tell people what kinds of data you would like them to be looking for when they do their inspections that would validate what you have had to assume and what you had to conclude from these allied data sources.

MR. COFFMAN: I think we're going to cover that from the standpoint of what would be necessary to move on with addressing specific topics. But the specific data that would be needed on that topic wouldn't come until we took the next step and developed the plan to address that topic.

MEMBER POWERS: And that strikes me as completely rational to do it that way. I mean, right now it seems to me the inspectors are out there. They're just looking for things.

And there may be things that by the time you're doing with this work, you say, "Well, don't look for all this wheat and chaff. I want this kind of stuff"

much more clearly than you probably can right now.

(Slide.)

MR. COFFMAN: Okay. I'll move on to the next project, which is almost a program in itself, but it's an ongoing activity that you probably have some familiarity with already. We participate in the OECD Halden Reactor Project, which gives us the opportunity to interact with 14 other signatory organizations, which cover the range in the industry, and some 7 associated members. And these come out of 19 countries.

We assess every three years whether we'll continue the participation. We have since 1958 continued to participate. And the decision has been documented in a SECY paper to participate for the 1997 through 1999 program.

Halden does work in basically two technical areas: The man-machine interface area and fuels and materials. The focus within our branch is both subaspects of the man-machine interface area, where we're looking at issues associated with developing guidance for software quality and then also human performance measures, tools to enhance human performance. Probably I should just go on because I think if that were unclear, it may become more clear as I indicate the benefits.

Coming out of the Halden reactor project, I

had already mentioned the computerized procedures manual. So there's software coming out of it. We also have PICASSO, which came out of it, that's being used at the TTC.

But there are technical reports, and there are data. These work their way into our projects that are developing guidance and thereby become part of the technical bases for regulatory guidance. So that's one benefit.

The second benefit is that we have access to the Halden man-machine laboratory, the HAMMLAB, and not only access to the laboratory but to test subjects and to experienced, qualified researchers to conduct studies on human factors or human performance, particularly as it's evaluating the effects of computerized operator support systems, like computerized procedures. So it's access to experimental facility. And I'll come back and touch on that later on in this overview.

It also provides us an opportunity to get early information on developing an emerging technology because Halden does development work. We normally in our interaction with organizations get involved later on, but this gives us an early insight into what are some of the issues.

In the other area where other aspects of the

division are interested, it provides data on fuel properties, especially at high burn-up. In another division it provides access to radiation facilities and information on materials degradation and for studies on materials degradation.

MEMBER POWERS: I believe Mr. Taylor came to talk to the Committee. And he characterized it as the most cost-effective research program the NRC has for return per dollar invested.

MR. COFFMAN: I think that's fair, which is an advantage, this leverage that it gives us. And then it also provides a forum.

MEMBER APOSTOLAKIS: Which perhaps is offset by the first bullet. I'm not sure that that's money wisely spent. I mean, I see your next slide also has ongoing projects. You listed ongoing projects on human-system interface. Here we have man-machine interface.

Why are we paying all of this attention to this? Does anybody have any evidence that this has been a safety problem or is it because it's the fashionable thing to do in a certain community?

MR. COFFMAN: Did you want to address that, Wayne?

MR. HODGES: Go ahead.

MEMBER APOSTOLAKIS: I'm getting a bit confused, by the way. It's just that I haven't seen any e idence that this is true.

MR. COFFMAN: You don't think that the indication, the display problems that occurred at Three Mile Island were safety problems in other industries? The mode, confusion on what mode they're in, confusion on the entry of data has led to air crashes.

MR. HODGES: The Airbus flying into the ground a number of times is one of the better examples.

MEMBER APOSTOLAKIS: Well, okay. These are examples from other industries. But was the problem the way the information was presented or was the problem with the information itself? This wasn't clear to me.

MR. COFFMAN: No. I think it's -- well, perhaps the Salem alarm problem indicates that it was the way the information was displayed.

MEMBER APOSTOLAKIS: Would you remind me what that was? I don't remember.

MR. COFFMAN: Can I --

MEMBER APOSTOLAKIS: I mean, briefly what happened with Salem?

MR. COFFMAN: Basically there was confusion on whether the operator should declare the alarm system inoperable, the alarm panels inoperable. We decided to

declare them inoperable when they were not.

MEMBER APOSTOLAKIS: Is that an issue that is studied under man-machine interface?

MR. PERSENSKY: Yes.

MR. HODGES: Well, actually at least one of the Salem events, it was a matter of the alarm panel was actually incapacitated for a period of hours because of the operators doing some things that they thought were for purposes that were legitimate and had been told that they couldn't screw the system up and they did. There are other examples, but that's one thing that happened at Salem.

MEMBER APOSTOLAKIS: Okay. As I say, I am not saying that this is an irrelevant problem. But I'm just questioning whether it deserves the attention it's getting or -- let me put it a different way -- coming back to the discussion this morning, it would really be useful, I think, to all of us to see a larger model of human performance where this, for example, man-machine interface would be placed in context. And then we would also have other things, cognitive things, organizational things and so on.

So we'll have the big picture in our mind and say, "Okay. Man-machine interface. These are the problems it creates. This is how it fits in the bigger

picture. This is how it can lead to human error" because this is really what the concern is.

But we have man-machine interface project at Halden. Your next slide says, "Human-system interface." And I'm just wondering whether it's an appropriate allocation of resources without doubting that there have been incidents, in fact, where maybe there was a problem.

By the way, Three Mile Island, I'm not sure that displays were the problem. There were more fundamental knowledge-related issues there in my opinion.

MEMBER BARTON: And since then there were a lot of human factors done in control rooms that were pointed out at TMI.

MR. COFFMAN: Yes, yes. The timing --

MEMBER BARTON: A lot of it has been fixed.

MEMBER APOSTOLAKIS: Yes.

MR. COFFMAN: The timing is --

MEMBER APOSTOLAKIS: So it comes back to what Dr. Powers said. It's really a matter of priorities, setting priorities and so on.

Now a related question. In all of these projects, is your group responsible for studying human error, not probability stuff? I know there is another project that is doing that. But there's all sorts of work that is being done and has been done internationally

trying to understand how humans think, how they act, what are the mechanisms, as you know, the types and whatever else, FENERGENs or something like that.

And this project from this branch on ATHENA is using some of that in their model for human error of commission. What strikes you when you look at this is the basic ideas really come from Europe.

So I was wondering whether your branch should have a project among all of these projects where you actually study human error, what is known now as human error, and how do people commit unsafe acts and so on.

Wouldn't that be very useful for us to have this kind of expertise?

MR. COFFMAN: I think we have it ongoing as part of the Halden Reactor Project. There's a separate effort --

MEMBER APOSTOLAKIS: On the Halden Reactor Project?

MR. PERSENSKY: Yes.

MR. COFFMAN: Yes, sir. There's a separate effort on human error and understanding human error. And it is an international effort. We're trying not to invent everything here.

MEMBER APOSTOLAKIS: Oh, no. I fully agree.

MR. COFFMAN: The key issues within human

error are measures, performance measures, which makes me wonder when you're asking your first question dealing with the safety significance if you're looking -- you must be looking for some measure other than experience.

That effort is being wrestled with. We're trying to wrestle with how to use other measures for the safety significance of human performance problems. I couldn't say that we have it solved. I think, in fact, the ATHENA project you're referring to, that's just their first phase.

MEMBER APOSTOLAKIS: Yes, that's true. But if you look at this, -- and there have been a number of reports from this project -- you see, for example, things about when they talk about mechanisms for human error, that the operators may glance at the control room. And they expect to see a certain pattern. And if they don't see it, then maybe they will do something wrong.

So what do we do about that? And I was looking at the list of projects that was given to use this morning. Is anybody concerned about it? Would that be important? And that's only an example.

MR. COFFMAN: Yes.

MEMBER APOSTOLAKIS: There are others as well, --

MR. COFFMAN: Yes. In that case --

MEMBER APOSTOLAKIS: -- what kind of human error analysis I'm talking about.

MR. COFFMAN: I think we're trying to wrestle with these issues because I think in that case if the operator sees a pattern that he's not expecting, then there could be a breakdown anywhere, in training. It could be in his vigilance. It could be in the design itself that the design consider it and it was really something that should have been considered in the design.

But this is the way the operators -- I'm not a licensed operator, but this is the way I understand the operators to think. They drive the plant. They drive it to within bounds.

And when it's outside the bounds, if they go to guidance, if that guidance is is missing, then you may have a design problem. But it's to realize that the operators are in a state of driving the plant. And it's the engineers. We can't expect the operators to be engineers.

I need to back away because I'm not licensed. Jay, do you want to --

MR. PERSENSKY: Yes, just briefly. This is Jay Persensky from the Office of Research.

That was a good example you brought up, as a matter of fact, with regard to the pattern recognition.

This has been an issue. And in the way we do research, we try to accommodate for that kind of problem.

For instance, one of the projects that we're going to discuss later on alarm systems, a lot of the problems that we have heard from other places, where they have changed alarm systems from the standard annunciator panels to alarm process lists, the operators had complained because of that problem because they're used to looking at a pattern.

So in the research that we're doing to develop a technical basis for new alarm systems, we're trying to make sure that that kind of situation isn't incorporated in the research so that we can build it into our technical basis.

So we are aware of those kinds of things. We're not a basic research organization. And the concept of just looking at human error is generally considered pretty much basic research.

We do stay aware of it. We're involved with the Human Error Analysis Project at the Halden Project, which right now is headed by Eric Holnagel and made up of a number of people who oversee it as well as the work that's being done at Halden. So we try to keep up.

The question came up: How do you stay up with the state of the art? Well, you try to be involved as

much as possible with projects like that and read and interact with the people that are doing that more basic state-of-the-art kind of research.

MEMBER APOSTOLAKIS: Well, I don't think it's a matter of doing basic research. I mean, first of all, that's an ill-defined term. I don't know what basic research is.

But you could do things such as if theoreticians have identified these things as being relatively important, maybe you can look at data and see whether they're important to our industry and talk to experienced operators and so on. So that's one of the things that you could be doing.

I mean, you don't necessarily have to advance the state of the art in human error, although I don't see why you shouldn't. I mean, human errors are supposed to be one of the major contributors to risk.

The other thing is, coming back to the alarms and the pattern recognition, I don't know the details, but I don't think the operators were surprised because the alarms were not designed properly. It's more it's a fact that in an accident situation, they see a new pattern that they're not familiar with. And that may confuse them for a while.

That's the impression I get from this. It's

not a matter of designing the alarms and making sure that right colors are there, although I'm sure that if you really look into the problem, you may come out with some design solutions, at least some of it.

MR. COFFMAN: "Design" is probably not the best word to choose because of the connotation of the activity of actually doing the design. It's more in the consideration of the total system and the requirements and expectations and possible configurations and permutations on the total system. So I agree with you in that sense. It's a broader question.

MR. PERSENSKY: Also, just to get back to that, we use the term "man-machine interface," "human-system interface." From what I'm hearing in your comments, you're taking it as a very narrow perspective in terms of the design of that piece of equipment.

When we do our research -- and our intent when we talk about it primarily includes the intent, what should be on there. Do they understand the information? It's just not do they see it, but do they understand it? Can they use that information, just as we talked earlier, NRR talked about, procedures? It's not just are they written in the right font, but can they also go out and use those procedures? That's part of the human-system interface type of review that we do, both from a research

perspective and a regulatory perspective.

For instance, the title here, "Man-Machine Interface," for one of the two broad areas of Halden includes the human error project. It includes software. It includes reliability of software, V and V software. So it's a whole broad perspective, not just the design of the interface.

MR. COFFMAN: Okay. What I'm going to do is skip over Viewgraph Number 8 because it just tells you what you're going to hear. I'll do that to allow more time for you to hear it.

MEMBER APOSTOLAKIS: One last comment from me.

MR. COFFMAN: Yes, sir.

MEMBER APOSTOLAKIS: Oh, that was different. Is it possible to have periodic meetings with the ACRS to discuss work in progress like we're doing with the PRA, SRP?

Then we will be in a better position to really judge and also to give you maybe our own opinion so you will have it in a timely manner. Then you can do whatever you like with it.

I get the impression that the way we're operating right now is you're telling us what you are doing and then there will be some final product that will be given to us for review. This is the way the ACRS has

traditionally functioned, but we are trying to change that.

Would that be something that you would be willing to do? In other words, okay. There is this Halden reactor project. They are doing work on human error, and they have a group of people.

At some point it would be useful, I think, at least to me, to have some of these people here and tell us, "Yes. This is what work we're doing." And then we ask again the questions we asked this morning and "Where are you going with this? Why are you doing it? Is this really reasonable in our opinion?" and so on so that you will have our input early on. And we will avoid unpleasant situations at the end if there is disagreement.

MR. HODGES: I think that --

CHAIRMAN SEALE: Wayne, do you want to make a comment?

MR. HODGES: Yes. This is Wayne Hodges with the NRC staff.

I would be perfectly willing to meet with you like that and talk about things that we have in mind and get the feedback. It's a little tougher to do with something like Halden because there are some things we do on a bilateral basis which we pretty well decide. And that we could do.

But, whereas, with the normal Halden program, we are just one voice to that. So it would be a little bit more difficult to --

MEMBER APOSTOLAKIS: I understand there are constraints.

MR. HODGES: But within those kinds of constraints, I have no problem coming and saying, "Okay. These are the kinds of things we're thinking about. Get your feedback and proceed."

MEMBER APOSTOLAKIS: I'm very curious, for example, about this Halden project, what they're planning to do, what they're doing, so on.

CHAIRMAN SEALE: And if you do have initiatives you want to present to them, --

MR. HODGES: Yes.

CHAIRMAN SEALE: -- maybe if we talk to you ahead of time, we might help you make your case.

MR. HODGES: Okay.

MEMBER APOSTOLAKIS: For example, it just came to my mind you mentioned earlier that Eric Holnagel is one of the principals there. Well, Eric is pushing his own model for human errors of commission. So what do we do now?

We have the ATHENA here and errors of commission there. Is there some effort to coordinate this

effort, not that I mind having two different people or groups trying to do the same thing because eventually you may find something useful in both approaches, but these are the kinds of things that I'm very curious about?

You don't have to answer now.

CHAIRMAN SEALE: Yes.

MR. HODGES: We're working cooperatively, not just in the PRA area, but we're trying to do it in the thermal hydraulics area as well. I have no problem in trying to do that.

MEMBER APOSTOLAKIS: Maybe this is not PRA. This is --

MR. HODGES: No, no.

MEMBER APOSTOLAKIS: This may be input to a PRA.

MR. HODGES: No. I'm saying you have a PRA Subcommittee. We're working cooperatively with you on a number of things there. I'm doing the same thing in the thermal hydraulics area.

MEMBER APOSTOLAKIS: Oh, I see. I misunderstood. Okay.

MR. HODGES: And so I don't have a major problem with doing the same thing here.

MEMBER APOSTOLAKIS: Good.

MEMBER POWERS: Do you have a staff member

assigned to the Halden project now?

MR. COFFMAN: The organization of the Halden project is that the project manager is Leo Beltracci. And he's a member of the Halden technical program group, which directs the technical program. But Wayne Hodges is also a member of the steering board which oversees it.

And then we have a lot of active participation in the Halden project. Probably one of the keynote things is Dolores Morisseau, whom you will be hearing from, just got back from a year at the Halden project.

(Slide.)

MR. COFFMAN: By the way of just mentioning plans, we heard about the role of the human performance program plan this morning. The only point here, to be brief, is that, instead of being totally user need-driven, we're making an effort to have the program be driven by experience feedback.

There's a lot to that, including looking at risk insights, continuing to coordinate with the regulatory offices in the regions, and maintaining our interaction with the directions that the industry is headed, and the experiences from other industries, and then adjust the program accordingly.

This last bullet kind of gets into more specific plans. You've heard that the human performance

investigation process is used by NRR, too, by the regions, and it's used by AEOD.

Out of that experience, there have been indications that there are some places where we might improve that human performance investigation process.

And so one of the efforts we plan in the next year is to survey the users to identify more specifically those needs and then also fold in some of the results from other completed research. Particularly we may need to upgrade the module in HPIP on communications based upon the work that was done on communications.

(Slide.)

MR. COFFMAN: Another area that we're looking at is organizational factors, which has a long background. This may merit a session in itself, but the effort has grown from -- it began in 1987 and grew and then was condensed. And selected projects were dropped.

There was a reevaluation. There are expressions of continued interest in this area. Basically the current objective being considered is what's stated there. And it's focused primarily on the non-quantitative aspects of it.

And trying to fit the human performance into risk assessments is being done by another branch in the division. And we're aware of what each other is doing.

(Slide.)

MR. COFFMAN: Let me just touch on the National Academy study. You've heard about it because you were very instrumental in the initiation of the study. That's what this Viewgraph Number 11 says.

(Slide.)

MR. COFFMAN: The important point that I wanted to make is that there are six technical issues that were identified in the Phase I report, which you received a briefing on. And then there are two strategic issues or that's what they were called, more programmatic issues.

But the fourth issue, even though the study was focused on instrumentation and control, man-machine interface, it additionally emphasizes -- okay. The English came out garbled, but the point is human factors is very much a part of the NAS study.

And the issue that they identified was they were looking at method, method and approach, to assure that the consideration of human factors has been properly taken into account. They were saying that currently a method is lacking to assess the overall impact.

I think that Professor Apostolakis is looking -- that's the way I read your anxiety, is that you're looking for a method to assess the overall impact. And certainly we're looking into that.

If I might take 30 seconds to just briefly state that if you focus on a model, a model can mean different things. It can mean a scheme, like Reason's slips, lapses, and mistakes or it can be Rasmussen's skill rule and knowledge-based behavior. That helps guide thinking and understanding.

But then there are more descriptive or operative models. And as part of these projects, we're looking into such things as task network modeling, which models behavior explicitly.

What these models help you do, -- and I agree with your point -- they help you incorporate the knowledge that you have and integrate the knowledge so that it's basically the corporate wisdom is contained within the model.

And we're trying to do that. We're doing it. We did it a bit with computerized procedures. We're doing it with staffing. And it's planned to be done with alarms.

We're chipping away at building up from research results these --

MEMBER APOSTOLAKIS: So I guess our suggestion this morning is to try to do the same thing for the plant itself.

MR. COFFMAN: Yes, sir, right. Yes. You

build up. The problem with human performance is that there are so many elements. So we're chipping away at taking them one at a time.

(Slide.)

MR. COFFMAN: I think there are some programmatic issues which will be influential in the way the program -- our plans for how the program will proceed. Certainly the outcome of the National Academy study and workshop is going to be influential.

Yes, we like to talk to try to get as much input from operating personnel as we can, but we recognize that operating personnel have limited time available and we start competing with other uses of their time. So that's a consideration in the degree to which we can involve operators.

And then human factors are -- there are many factors that influence human performance, some of which involve other disciplines. So team efforts are generally required, particularly when we get to looking at this National Academy issue, assessing the overall effects on performance that we will begin to have to work more interdisciplinary.

What I was ready to do at this point is to go to the next presentations, which give us a little more content of the research, rather than just an overview, and

ask -- I think Jerry Wachtel is scheduled next to talk about these human-system interface issues, but I can entertain a question or two.

Okay. Jerry, why don't --

MEMBER APOSTOLAKIS: So the subject is human systems?

MR. WACHTEL: Human-system interface.

MEMBER APOSTOLAKIS: That's not what the agenda says. "Human Systems."

MEMBER KRESS: That's the lymph system, the blood vessels, and the nervous system.

MEMBER POWERS: I thought maybe it was human systems as in Las Vegas systems, blackjack systems.

MEMBER KRESS: It could be.

MR. WACHTEL: This is my first experience with these fancy new slides. So I hope they work well for me.

(Slide.)

• HUMAN SYSTEMS

MR. WACHTEL: I'm going to talk about two projects in particular, both of them within the area that we call advanced human-system interface research. And I'm sure that most of you know that for the past five years we have been busy developing guidelines for the review of new technology in control rooms, both advanced control rooms and new technology that may be backfit into existing

control rooms.

(Slide.)

MR. WACHTEL: You may all be familiar with the now classic NUREG-0700 that was first issued in the wake of the TMI accident in 1981 and has been in use ever since.

We are in the very, very final stages of issuing the successor to NUREG-0700, which is called NUREG-0700, Revision 1. And I hoped to be able to wave a copy of it to you today. We expected it back from the printer yesterday, but we haven't seen it yet as of a few minutes ago.

In any event, that document will be issued within the next few days. It's a three-volume document known as the "Human-System Interface Design Review Guideline."

The three volumes are broken down as follows. Volume I is called "Process and Guidelines." It basically describes how the guidelines are to be used and contains the guidelines themselves.

Volume II is known as a reviewer's checklist. It's a hard copy of the guidelines themselves with some handy spaces for reviewers to take the document with them into the field to perform a review and make notes and keep score.

And Volume III is the computer-based version of that checklist, if you will. It's called "Review Software and User's Guide." It will be issued in a series of three computer diskettes and a user's manual. And we hope very soon it will also be posted on the World Wide Web so that anybody can access it and perform reviews electronically.

The reason for that background information is that during our development work on NUREG-0700 we identified several gaps in our knowledge. There are several technical areas in which we were not yet ready, if you will, to develop guidelines for reviewing certain technologies. And these occurred in several key technical areas.

Our customers in the Office of NRR have identified two of those areas, two of the gaps, as we call them: alarm systems and interface management or, as we refer to it, navigation as high priority user needs to provide a technical basis for their reviews of this technology when it's implemented.

(Slide.)

MR. WACHTEL: Just briefly, our NRR identified alarm reduction and prioritization techniques as a high priority user need in part because of research that has demonstrated that the quality of human performance when

using annunciator systems appears to change under stress.

And they identified navigation or the effects of advanced control interfaces on crew workload as a high priority need because of increasing evidence from aviation and the nuclear industry that advanced interfaces are correlated with an increase in crew workload.

MEMBER KRESS: I don't understand that. Would you interpret that last statement, please?

MEMBER BARTON: Explain that, please.

MR. WACHTEL: I'll tell you more when I get to it. But basically the discussion about interface management describes the tasks that the crew must use in order to obtain information from the computer-based display and control system.

In the old days, we had a single sensor and a single meter. When you needed to look at temperature or pressure, you looked at the appropriate meter face. And you could immediately read what you needed to know.

With the increasing complexity of computers and CRT display systems in the control rooms, there's much more information that's available to the crew much more quickly and more powerfully. That information can be analyzed in many more ways. So they have a much richer source to help them do their job.

Unfortunately, the very nature of the computer

interface with which they have to interact causes them to have to work very hard just to find the right information at the right time to do the job that they need.

They have to navigate through layers and layers of computer displays in order to call up the appropriate information at the appropriate time. And that's what we call the task of interface management or navigation, as you can understand now.

MEMBER KRESS: Okay. Thank you

(Slide.)

MR. WACHTEL: I want to put this in the context of the process that we have used over the past five years very successfully to develop new guidance for review of advanced technology.

This approach is one of great cost-effectiveness because there's no need for us to reinvent any existing wheels. It's also an approach that's very conservative in that we have great confidence that guidelines that we develop that come out of this process will be accepted for inclusion in our documents based upon the fact that they have already survived very rigorous prior reviews and independent validation.

The down side of this process is that our guidelines cannot always be right up to date with the latest technology because in some cases the research and

the testing that are needed to form a technical basis for guidelines haven't yet been done because the technologies are still evolving.

And in other cases there may have been a lot of research done for years and years but, for various reasons, the research is contradictory, the research results haven't given us a consensus. And so we don't feel comfortable basing guidelines on conflicting research results.

In the case of the two projects that I'm talking about today, we have a case of one of each of these situations. In the case of alarm systems, there has been research done in this country and in other countries for many years, but the research results are inconclusive.

Conversely, in the case of interface management, the techniques and the technologies used for interface management are so new that there's been relatively little research that's been done and certainly relatively little research that has been independently verified and validated sufficient to give us confidence that we can base guidelines on that research.

So, as you can see, the process is pretty simple to depict. It requires considerable attention to detail to carry it out successfully. And our first successful test case of that, as I mentioned, was the

imminent publication of NUREG-0700, Revision 1.

When guidelines are needed, the first thing we do is look to see what's already been done, look to see the quality of that work, look to see hcw well it has been independently verified, whether it's been published, tested by other folks, et cetera.

If that has been the case, then we feel comfortable in moving directly to the development of guidelines in that particular area, although we will still undertake our own independent peer review and validation process before we include them.

If we cannot find such primary sources in our guideline seeking, we then proceed down the list of these boxes on the left-hand side through secondary and tertiary sources of information, such as journal articles, handbooks, textbooks, presentations, industry experience, et cetera. At each level we have less and less confidence that the information we're getting has been proven by independent verification.

MEMBER POWERS: Don't you then have a cascade arrow that goes from, say, for instance, the industry experience to a research box that may not have the word "original" but perhaps has the term "confirmatory" in it?

MR. WACHTEL: I think that's a correct statement. That's really what we do do. We do undertake

confirmatory research when there is something out there. And, as I'll talk about in a minute, in the case of alarm systems, we have already done that.

We've gotten to that point. And now we are ready to move on to original research because there are still holes in our knowledge. But your point is well-taken.

MEMBER POWERS: It seems to me that you've given an eloquent speech here on why you really don't want to be at the state of the art in these areas when you're a regulator, that you need an experience base and testing base that's much greater than what the state of the art will typically have.

MR. WACHTEL: I agree with that. It's been expressed to me by my management for years that our job is not necessarily to drive the new technologies but to be able to determine whether those new technologies are safe and safely implemented.

In order to do that, I think we need a good degree of confidence that our review when we perform it will be a careful and conservative one.

MEMBER POWERS: So you might use the state of the art to ensure that in the face of doubt, you've taken a conservative approach, but you're using that as intellectual guidance?

MR. WACHTEL: Yes, that's right.

MEMBER POWERS: That strikes me as just very prudent.

MR. WACHTEL: Good. Thanks. And so --

MEMBER POWERS: It's different than the spin I get out of the plan. And it's different than the spin I was getting out of the presentations this morning, where there was a great deal of discussion of the state of the art.

And it strikes me personally that your view is where I want -- if I'm a licensee, I like your view. I like something that's nice and tested that I have some confidence in.

MR. WACHTEL: We do our best to keep up with the state of the art by our participation in professional societies and sitting in on international meetings where this is being discussed and pushed. But we, as you said, treat that as intellectual knowledge to inform our decision-making and our guidance development.

And so I was down at the last box here to indicate if we find nothing out there in the world in the form of existing guidelines that have been developed, validated, and proven or that we can go and perform some confirmatory research to develop and to validate, we will set out to do our own research when needed.

And, of course, as I'm sure you all know, performing original research is very expensive. It's very time-consuming. You've got to be very rigorous in your approach to it. And in dealing with the complex systems that we have in the nuclear environment, that's not always easy to do. So we think long and hard before setting out on the conduct of original research.

CHAIRMAN SEALE: Could I -- and I apologize. I may have missed this point. One of the things that has characterized our recent discussions with the staff in the area of PRA is becoming aware that there has been an awful lot of very interesting application of those methods to certain particular operations in plant space; that is, that the industry is actually applying PRA methods to make the case for various changes in the decision process about how they operate the plants and so on.

Now, I only mention that because that suggests that a lot of the industry experience may be out there in the nuclear industry. It's not somebody flying an airplane around. It's not somebody selling tickets on the Metro or anything like that. It's in the industry that we're involved with.

More than that, I've recently had an opportunity to see some things at one plant where people were doing some very interesting human factors kinds of

work.

As Research, how do you interact with the industry? I know that NRR is in there every day. Do they let you know if there is something going on in a plant that has got some interesting bells and whistles on it or interesting approaches? And do you then go out and try to really find out what they're doing?

MR. WACHTEL: Go ahead.

MR. HODGES: We sometimes learn of those types of things, but our contact is somewhat restricted just because there is an agency-wide incentive to try to not have too much of a regulatory impact on the licensees through NRC presence at the plant. And that is a sum total of the inspectors being there, the NRR folks being there, our being there, and also includes the INPO visits. And if you get too many people in there, they have trouble operating their plant.

CHAIRMAN SEALE: I am sure they don't want to have to do --

MR. HODGES: So, for those reasons, we have very restricted access to plant operators.

CHAIRMAN SEALE: Okay. But, now, what I'm suggesting is that you might get your NRR colleagues to be sensitive to the possibility that there may be somebody smart in the industry that's doing something that you

ought to know about. And then maybe you ask him to come here and tell you about it so you're not messing around in his plant and things like that.

MR. HODGES: Well, he's sitting right there in the audience. So hopefully he heard your statements.

CHAIRMAN SEALE: But, really, I think that, for one thing, a good part of the applicability question has already been resolved, maybe not the best way, but one way. And maybe they are smart enough to do some of these things.

MR. HODGES: Cecil, do you want to come --

DR. THOMAS: Yes.

MR. HODGES: -- since I took your name in vain?

DR. THOMAS: This may be not quite as bad as it sounds. I agree with Wayne. There is the agency concern of regulatory impact. But some of these smart people in the industry also publish papers. And there are lots of fora that we interact with them.

Research also has the opportunity to see the results of information we get from inspection reports. There's a lot of communication back and forth. And we strive to prove that every day, too. We're working on making the human factors system information available to everybody. It's available to the regions and I think

Research now.

So it's not quite that bad, but Wayne is right. There is a -- for all of us, not just Research, but even we're interested.

MR. WACHTEL: As a researcher, I want to agree with your point on two counts. Number one, I agree wholeheartedly that there is some excellent leading edge work going on in the human factors field in general and in some of this work with alarm systems and interface management in particular in the nuclear industry in this country, in the process control industry, which is closely related, in this country.

And we do try to keep up with that knowledge, as indicated by attending conferences, reading papers. The principal investigator for the work that I'm talking about today, Dr. John O'Hara from the Brookhaven National Laboratory, is at this very moment on his way home from an IAEA specialists' meeting on advanced alarm systems being sponsored by Atomic Energy of Canada Limited, at which a number of utility representatives are also present.

So we do have access to the information, not as well as I as a researcher would like because of some of these restrictions, but we do do our best to get that.

And the second way in which I agree with your point is that I have had my wrists slapped on more than

one occasion in this position while trying to work in conjunction with colleagues at the utilities who were interested in hosting us or having us see something new that they were developing, only to have our colleagues in NRR saying, for whatever reason, "It's not appropriate for you to visit that site at this time." And so we've kind of backed away.

MR. PERSENSKY: Let me take an opportunity here since it came up. The places, other places, that we interact with our industry collea[illegible] are through standards committees. Jerry sits on ANS-3.5. I sit on 3.1.

I also sit on IEEE SC-7, which is the Human Factors Subcommittee for IEEE. The reason I'm bringing that up is next June -- this is a little bit of advertisement -- there is a conference that occurs about every four or five years on human factors in nuclear power plants sponsored by SC-7 of IEEE. It will be in Orlando in early June. And I will be glad to send an announcement down to Noel so he can send it out to the Human Factors Subcommittee

CHAIRMAN SEALE: Well, more importantly, I think, though, is that interaction between you and the industry people who are doing some of these things.

MR. HODGES: Just another comment. Some of

the research we would like to do is somewhat intrusive. And that creates a problem in and of itself.

Some of the work that was done in Halden, there the operators had essentially special glasses with cameras mounted on them so you could follow where their eyes were looking when they were doing various things at the control panel. And then you stopped them in the process of dealing with the transient in the simulator and say, "Why did you do that?"

And so you've got the combination of seeing what they see, videotaping what they're doing, and interview them and getting their reactions. That gets to be relatively intrusive when you're doing that type of thing, and that's difficult to do when our crews are there trying to operate the plants.

MR. WACHTEL: I'm taking too much time. So I'm going to try to step through the rest of this a little bit more quickly. Feel free to stop me if there are more questions.

(Slide.)

MR. WACHTEL: The first project to address is the project on advanced alarm system review criteria. Our objective, as you might imagine, is to develop review criteria for the evaluation of advanced alarm systems. This criteria that we develop, the concept is that

ultimately we will feed this into the next revision of NUREG-0700.

The first thing we have to do, of course, is develop a technical basis to understand the safety significance criteria and then develop the guidelines themselves by following the process that I talked about on the preceding slide.

In the case of alarm systems, as I mentioned, there is a lot of literature already there, not only in the U.S., but in England, in Japan, in Norway, in Canada, and elsewhere. And the problem is that there's very little consensus on what is needed in the way of alarm system design and development characteristics.

MEMBER POWERS: Let me ask you a question on this. There are a lot of groups I know around the world where they do human factors-type research, including this particular type.

Is this an area where you've run into a culture problem doing leveraged research, joint research programs that Japanese people are culturally different than Norwegians and react to things differently?

MR. WACHTEL: That's a very interesting question. And maybe we shouldn't take much time here to talk about it, but, rather, talk about it offline.

At the last IEEE human factors conference that

Jay was just describing that occurred in Monterrey --

MR. PERSENSKY: '92.

MR. WACHTEL: -- in 1992, I chaired a session on cultural differences to address this very question. There's no doubt from anecdotal evidence from what we have seen in visiting plants in other countries that the culture is different.

The way operators operate is different. The way they use their procedures is different. There are very significant differences. And, as I have talked some more about this project, which we are doing with a bilateral agreement at the Halden plant at the Halden site in Norway using operators from the Loviisa Finnish plant, one of my concerns as we developed the research plan was the issue of the cultural differences and how well we would be able to generalize from the findings that we have to our own systems.

MR. HODGES: It might be worth getting Dolores Morisseau's opinion once she gets up here also. She's observed our operators in action here. She observed the Loviisa operators in action in Norway. And I think she has some interesting observations on that. So maybe when she gets up to give her presentation, you can ask her that question again.

CHAIRMAN SEALE: I have one other question.

The people over -- and maybe you can talk to these guys. I don't know. The guys in DOE have been concerned with alarm systems for nuclear material criticality in storage and things like that.

And that problem has become -- well, it always has been a potentially very expensive problem because of the instrumentation required and so on. It's become particularly acute with the fact that there seems to be an awful lot of fairly highly enriched material either floating around or potentially floating around. And there's also been the question of alarm systems which detect on multiple signals, mixed neutron, gamma, and that kind of thing.

Have you talked to any of them?

MR. WACHTEL: We are in touch with the DOE people who review our guidelines. And Jay sits with some of them on some committees. So we do talk about these things. We're not in cooperative research activities in any formal sense that I'm aware of, certainly not in this area.

CHAIRMAN SEALE: That's a particularly intriguing problem. I mean, it's kind of got some special burrs on it that might be of interest to you.

MR. WACHTEL: I suspect that the particular concerns of alarm systems in that kind of an environment

may be somewhat different than the highest priority concerns that we have.

CHAIRMAN SEALE: Sure, yes.

MR. WACHTEL: But, nonetheless, certainly sharing that information would be useful to us and hopefully to them.

MEMBER POWERS: Just a point of clarification, Bob. It is DOE's policy not to have special nuclear material floating around.

(Laughter.)

CHAIRMAN SEALE: I was articulating my deepest fears.

MR. WACHTEL: Well, I'm falling farther and farther behind. Let me just talk about the two high priority items that we have identified for this research, and that is alarm processing and alarm display characteristics. Very simply, by "alarm processing," we're referring to any of several different techniques that might be used to reduce what traditionally we think of as the avalanche of alarms that occurs in nuclear power plant control rooms during an upset.

By prioritizing these alarms for importance or for relevance to the particular situation or for timeliness and by the computer's power to filter these alarms or suppress certain alarms that are of lower

importance at any given moment, the capability exists, at least in theory, to help the operators cope with the situation and understand what needs their most urgent attention.

MEMBER POWERS: Very often that's a very real problem, alarm overload and things like that, but it always struck me. As soon as I invented a computer system to start suppressing alarms, I have in mind a particular way that I think accidents behave when I set my priority list.

The characteristic of accidents is almost by definition that they're not behaving the way we think they should behave. And isn't the biggest chore here to make sure that you're not removing diagnostic capability out of the system? I mean, it strikes me you have to have an extraordinarily accurate understanding of the progression of accidents to set these systems up.

MR. WACHTEL: That's right. I think you're right. And we have learned from some of the research and we have heard from operators that they are not comfortable with systems that make a choice for them to give them some information and withhold other information and make it difficult, if not impossible, for them to get the information that they think they need.

So there are different degrees or rigor, if

you will, of suppression systems. There are filtering systems that don't necessarily make alarms unavailable but may push some of them off to a lower level display that can be called up.

So there are many different ways to skin the cat. And I think the riskiest is the one in which you're talking about where you take information away if you don't have high confidence that you understand everything about the upset that's occurring. So that's part of the concern that we have.

The second high priority item for this research has to do with the way in which alarm information is presented or displayed to the operator. We're all familiar with a traditional plant in which alarms are on tiles above the control boards. There are now display devices, electronic CRTs that can simulate the look of the tiles.

You can present alarm information on CRT screens, on printed lists, on scrolls or scrolling lists on CRTs, and you can also increasingly embed alarm information into active process displays so that the alarm coming up shows right up on the computer screen along with the system that's affected.

(Slide.)

MR. WACHTEL: Very quickly I mention that

we're doing this work at the Halden Research Project under a bilateral agreement. We completed pilot testing in June. We just started our experimental trials at the beginning of this month. These rials are expected to run into the second week of November.

We'll then use the time to analyze the data and report on our findings next March and undergo the guidance development and peer review process thereafter. We hope to have some draft guidance available in the spring, May, of next year, which we will then subject to independent peer review, which we hope to accomplish in the summer; and then publish our final alarm system guidance in the form of a NUREG or a NUREG/CR in October of next year.

And the long-range plan is to incorporate that new guidance into a future revision to NUREG-0700, which we're calling Rev. 2 and contemplating will be issued in Fiscal Year '99.

(Slide.)

MR. WACHTEL: The other project I'll mention very quickly is a brand new one. So there's not much information to report here. This is officially called the "Effects of Advanced Control-Display Interface Management Tasks on Crew Workload and Performance."

I think I described what this issue is all

about in answering a question a few minutes ago. So I won't do it again. We are in the process of negotiating with Brookhaven National Laboratory. And we expect that this project will start within the next month. It's a 32-month anticipated effort.

And the user need for this is based not only on nuclear experience, particularly in France, where they have the advanced control room design, the S3C simulator for the N4 reactor, where the French human factors personnel have discovered in their training and testing that operators are spending inordinate amounts of time that they should be spending performing their principal tasks simply trying to get information out of the system.

And we have all been reading in newspapers and such the number of accidents and near misses that are occurring in the most advanced aircraft, both commercial and military, which use what are called glass cockpits, which are basically CRT screens and head up displays projected on the wind screen, replacing the old traditional analog instruments.

So there's a lot of data indicating the kinds of human errors that are occurring as a direct result of implementing advanced technology into the control room or the cockpit or the automobile or what have you. And this is what this project is all about.

(Slide.)

MR. WACHTEL: Again, quickly, the objective is to develop guidance to review these interface management tasks. In order to do that, we need to classify the tasks themselves and find out what effects they may have on human performance, the kinds of human factors measures we would be looking at to study the effects on human performance, include how long it takes the operator to perform a task, what the workload is like, how many errors and what types of errors are being made, and how or aware the operators are of the big picture, what we call Situation Awareness.

After we have identified these, we'll evaluate and prioritize the issues because it's possible that we simply will not have the time or the budget available to develop guidance for every single item that we identify.

So we'll look to see which are the most urgent. Then we will prepare and validate and review our design guidance and ultimately incorporate that into the next revision to 0700 as well.

(Slide.)

MR. WACHTEL: Just very quickly, these are some of the kinds of activities, the kinds of tasks that the crew might have to undertake that fit under the heading of "Interface Management," what we call navigation

between displays, different scales, different update rates, different sizes.

We all do it today when we're manipulating Windows on our computers. It's essentially the same concept, although this is information that is in real time and sometimes of critical importance, the way the user interacts with the computer, the use of a mouse or a touch pad or a keyboard or a joystick or what have you, the selection that the crew makes to display the right information at the right time and how easy that is to do, and then things we call preference tasks.

Some crew members prefer to see Windows larger. Some prefer them smaller. Some prefer different colors and background materials on their screens. Some like to see a different way of presenting a display than others. Some like to zoom in and scroll and so on.

So there are lots of tasks they do which are called secondary tasks because they're not the primary tasks needed to control the process but which, nonetheless, take up an enormous amount of time and have been known to be causing errors.

CHAIRMAN SEALE: It's very refreshing to not hear some crack about Macintosh as we go through the --

MEMBER POWERS: We don't have Shack here.

MR. WACHTEL: Any other questions?

CHAIRMAN SEALE: No.

MR. WACHTEL: Okay. Thank you.

CHAIRMAN SEALE: Thank you.

Well, Ms. Morisseau. Going to tell us about staffing levels, eh?

MS. MORISSEAU: I will.

MEMBER POWERS: She's going to explain to us about the cultural differences between the Finns and rednecks from Tennessee, I think.

MEMBER BARTON: Got some good old boys down there, too.

MEMBER POWERS: This is not an operator-friendly device.

MS. MORISSEAU: No. It never has been.

CHAIRMAN SEALE: It does empower you, though.

(Slide.)

• STAFFING STUDIES FOR ADVANCED REACTORS

MS. MORISSEAU: I'm going to tell you about the staffing study for advanced reactors that was done at the Halden Reactor Project, for which I was the project manager on.

I just saw something very interesting. As an aside, when I looked at Jerry's overheads, I saw that it said something in there about, there was a quote in there about that workload increases when people use advanced

interfaces. Our results came out the same way. I just realized it because I had those as an aside, different slides for backup in case somebody asked about graphs. Don't.

(Slide.)

MS. MORISSEAU: The background of this project is that, first of all, we know that the staffing for nuclear reactors in this country for licensed reactor operators and senior reactor operators is governed by regulation, as put forth in 10 CFR 50.54(m), which specifies minimum control room staff for various configurations of power plants.

The new power plants that are being produced by the vendors came to NRR, our human factors folks in NRR and other people in NRR, for review. And they needed to have some kind of guidance for their reviews.

Essentially those things that were submitted by the vendors had some task analyses that had no empirical bases underlying them. And so, whatever they were saying about staffing, there wasn't a lot to support it other than whatever they said their analysis was.

Some of the designs used a mixture of both proven technologies and passive system designs. And it's expected -- I mean, what you expect from new designs is that there's going to be some kind of an improvement in

the ease of performance and possibly safety.

But, in any case, out of all of this, there also is some sort of a need to think or rethink what the requirements are for minimum shift staffing because conceivably you could say that in an advanced reactor control room, perhaps you would not need as many people.

And part of that consideration is that maybe what we need to be looking at -- and I don't think there's too much doubt of this -- is performance-based regulation, rather than just talking about numbers.

It was decided to do this project at Halden. And we worked with the folks at Halden to come up with some of the objectives. And we worked also very closely with our NRR compatriots who presented us with this user need. So we worked quite a while to massage that work plan so it would come out so that NRR was going to get what they wanted from it.

(Slide.)

MS. MORISSEAU: The objectives were to evaluate the impact of the advanced passive plant designs on the staffing of the control room crews and the operator and team performance of those crews, also while we were doing that to identify and understand potential safety issues as we saw them while this work was in progress, and to provide information to support the development of the

design review guidance for the staffing that NRR needed.

The focus was on the control room crew configurations and the interaction with the control room automation and the passive plant performance.

MEMBER KRESS: On your first bullet there, --

MS. MORISSEAU: First bullet. Yes, sir.

MEMBER KRESS: Yes, when you talk about the impact of the advanced passive plant designs, are you referring just to their control room and monitoring design or the whole plant design?

MS. MORISSEAU: Well, it's got to be the whole plant. When you look at their performance, one of the things that I should mention is that this study -- and I'll get to that in the approach, but we made sure that when we looked at both the Loviisa plant simulator, which is what we used for our conventional design, and also at the simulator in HAMMLAB, or the Halden Man-Machine Lab, was that we had reviewed the submitted advanced designs. And we made some adjustments to both of those simulators so that the thermal hydraulic performance and other things would fit with the descriptions that were supplied to us by the vendor.

So it wasn't just that we were looking at the numbers of guys in the control room and the interface, the direct interface, itself. We adjusted the I and C of both

of those things to match, but we also looked at the thermal hydraulic performance.

(Slide.)

MS. MORISSEAU: The approach was to conduct a study of control room crew performance and include both conventional and advanced plant performance, as I've mentioned.

And, as I said, we made sure that we made whatever adjustments were necessary to the Loviisa simulator and to the HAMMLAB simulator as well so that I and C and thermal hydraulic performance would be appropriate to the vendor submittals.

We constructed five design basis scenarios with the assistance of several subject matter experts. And they were, as you see there: steam generator tube rupture, interfacing system LOCA, and loss of all feedwater, loss of off-site power, and a steam generator overfill.

These scenarios all require significant mitigation efforts to maintain the barriers. And so those were looked at, and they were task-analyzed to identify throughout all of those scenarios what the critical tasks were within them and where they should be performed. So that was all incorporated into the measures that we were taking as part of this approach.

The normal crew configurations were based on what the requirements are at present in U.S. federal regulation. The minimum crews were based on the minimum normals at Loviisa, which would also not violate ours, I don't believe, and the minimum from whatever the plant vendor said.

And, as I mentioned already, the conventional part of it was carried out at Loviisa's power station training simulator, and the non-conventional or advanced reactor was a HAMMLAB.

CHAIRMAN SEALE: Is the Loviisa simulator sort of, if you will, an Eastinghouse version of the Westinghouse simulator?

MS. MORISSEAU: It's a VVER Russian design.

CHAIRMAN SEALE: I recognize that.

MS. MORISSEAU: Yes. But we did adjust it, too, to be more like a Western plant. We were allowed to do that. That's --

CHAIRMAN SEALE: Yes. The 440, I believe, isn't it?

MS. MORISSEAU: Yes.

MEMBER APOSTOLAKIS: What does your last bullet meas, the "feasibility of crew simulation"?

MS. MORISSEAU: Okay. As part of this -- I think Frank mentioned this before. As part of a lot of

these studies we're doing now that have anything to do with staffing tasks, evaluating any kind of systems that require work on the part of crews or operators, we're looking at task network simulations. And so that was incorporated into this study as well.

We were looking at the feasibility of using task network simulations to find out some of the same kinds of things we were looking at using actual subjects.

MEMBER APOSTOLAKIS: This issue of how much we learn from simulation experiments was hotly debated when EPRI did its ORE, operator reliability, exercises on the simulator, trying to estimate human error rates. And a lot of people felt that those were not valid experiments for that purpose because, for example, when the crew is in the simulator, they always do the safe thing. But when they're in the real control room, we have evidence that they don't always do what safety requires but power production is also a major consideration in their minds.

So this decision-making process is very difficult to duplicate simulator exercise. So I thought you were going to address that issue as well.

I mean, how valid is the information we collect from these simulation exercises? What do we learn from them? We do learn something, but I don't think that it's a complete simulation of the crew's behavior in a

real situation.

MR. HODGES: Can I address that in part?

MEMBER APOSTOLAKIS: Sure.

MR. HODGES: I've had the opportunity to both observe our U.S. operators in the simulators and the same set of operators when they had to deal with events in the plant.

In one particular plant, we gave a set of requal exams. So we saw that behavior on a simulator approximately one year after one of the same crews that we tested had been through a fairly serious event in the plant.

Amazingly, their performance on the simulator was very, very similar to what they did in the plant. The mistakes they made were the same mistakes. So we saw similar behavior.

It is true that when you give an exam or even just normal training, you'd have some of what we refer to as simulator-itis, where they are kind of expecting certain things to happen and maybe even certain types of sequences. And so they know that certain kinds of things will happen.

You're right in that sense. But one thing we did observe is the same mistakes they made in operating a plant almost a year earlier they made on the simulator

when we tested them.

MEMBER APOSTOLAKIS: No. I have no doubt that there is a lot of value to this. But maybe this will be a good opportunity for you to think about what you think we learn from these and give examples such as this one because I think it was Davis-Bessey where the supervisor hesitated to go to bleed and feed until the very last moment waiting for that pump to be fixed.

I wonder whether in a simulation exercise he would do that. He would probably have gone to bleed and feed the moment his guys advised him to do so; right, because it doesn't cost him anything? But in a real life situation it costs a lot of money.

So there are some limitations, I think, to these exercises. And the funny thing was or the frustrating thing was that people were debating this issue without anybody sitting down to list what we learn and what perhaps we don't learn from these. And maybe this is a good opportunity to try to do that.

MR. HODGES: Clearly the simulator can never be quite the same as the real plant. But I was amazed that the same mistakes were showing up when you had the same crew.

MEMBER POWERS: My confidence that the same accident never happens twice is being shaken here.

MR. HODGES: No, no. It was not the same event. It was not the same event we gave them on the simulator as what we had observed in the plant with the same kind of mistakes; for example, the SRO going up into the control panel and taking over controls himself and not keeping the big picture like he's supposed to do.

Those kinds of mistakes were made in the simulator as well as in the real event.

MEMBER CATTON: That says something about their training, doesn't it?

MR. HODGES: It sure does.

MEMBER APOSTOLAKIS: But do you think it would be a good thing to do to actually try to -- I mean, this would be a good example, too. I mean, I'm not saying just to put down negative things. I mean, this is that we expect to learn from such exercises, but also there may be other areas that are not covered, instead of claiming incompleteness, --

MS. MORISSEAU: Except that I don't --

MEMBER APOSTOLAKIS: -- which you are not claiming. I realize that.

MS. MORISSEAU: I don't know whether I didn't say this right or not, but that's not what the last bullet means. The last bullet is talking about task network modeling. And I thought that I said that. Task network

modeling has nothing to do with humans except that we're trying to model their behavior with a computerized modeling system.

And what we were looking to do here was to see: Okay. We've run all of these crews through all of these scenarios in two different kinds of simulators. Now let's run it on a task network model and see what we get because we mentioned earlier the problem of accessibility.

We just have limited access to humans in plants because of this business of regulatory impact. And if task network modeling turns out to be a good approach, that would save us a lot of the hassle of always trying to have to worry about: Can we get access to human operators?

You can run task network models thousands of times through a scenario, for instance, to see what you get. I am not an expert at task network modeling, but it is something that we are applying in more than one project.

We've already applied it in the staffing project that was done a year and a half back that had to do with conventional reactors. And those results were pretty good, as I recall. I believe that these are, too.

That data, the task network modeling data, from the advanced reactor study is still in the process of

being analyzed. So I can't really speak to it too much, but it looks as though it's going to be pretty close to the same kinds of results we got using human beings in these scenarios.

MEMBER APOSTOLAKIS: It seems to me what I said is really very relevant to what you said. I mean, the way I understand it is by applying these network models for the simulator and also to real situations, you will see whether you can work with the simulator and using those networks, rather than going to the control room.

MS. MORISSEAU: It works both ways.

MEMBER APOSTOLAKIS: Yes.

MS. MORISSEAU: It works both ways, I think.

MEMBER APOSTOLAKIS: Well, I guess we'll have to wait until we understand better what that means.

MS. MORISSEAU: I will say that from my observations -- and, of course, as you know, I had the opportunity to stand back in the control room and watch things in process.

(Slide.)

MS. MORISSEAU: The data collection here, as I mentioned before, we had eight crews that were presented with five scenarios. There were four crews who served in the minimum and four in the normal staffing configurations.

We collected data as follows. We used a subjective workload index, which is a validated instrument that was developed by NASA called the NASA TLX, which is a task load index. We used a Situation Awareness instrument that was adapted from Micah Endsley's SAGAT, which -- and I cannot remember what that acronym stands for, but this one, SACRI, is Situation Awareness Control Room Inventory, which was developed at Halden and was made more specific to nuclear power plant control process, rather than SAGAT, which was more general, actually, and was used more in air crews.

MEMBER KRESS: Do you ask them what they think is going on?

MS. MORISSEAU: Yes. Actually, you stop and you ask them what went on before or their perception of what went on before. You ask them about what is going on right now. And you ask them about what they believe will happen in the future based on what actions they might take.

One of the conditions was that we insisted that they turn away from the screens or the interface, depending on which control. They were not allowed to be looking at that. You could see what a hard time they were having doing that. They kept wanting to do this, but we wouldn't let them do that because we didn't want them to

see.

As a matter of fact, for Jerry's alarm experiment at HAMMLAB, we figured out a way to blank the screen so they can't be tempted to do it without shutting down the whole simulator in the process. It's just a quick thing while they're filling these out. So yes, that's exactly what that is.

Rated crew performance. We had subject matter expert raters sitting in non-obtrusive places with rating forms that were what's called the behaviorally anchored rating scale rating these crews throughout the scenarios for each one of the scenarios for the whole time. they had to be --

MEMBER KRESS: Did you watch and see how much they sweat and --

MS. MORISSEAU: No, no, but it's interesting to see just how stressed they get, --

CHAIRMAN SEALE: Yes.

MS. MORISSEAU: -- even in a simulator when something is going on and they're having difficulty solving the problem. So watching them, it's hard to believe they don't think it's real.

Also, they were rated on specific task completion, critical tasks that had been previously analyzed as being -- these are the things that are

important in this scenario that they must be doing at particular times or at least within some range of time.

So that was a very objective performance measure as were the output from the plant logs, quote, "plant logs," that gave plant parameters. And from that output, you could see what they did.

In addition, this entire thing was videotaped. Those tapes were available for post hoc analysis so that after the whole study was over that the subject matter experts could sit once again and go through what these crews actually did.

Maybe I'll speak to that issue of cultural difference right now. This is my opinion. As I said, it's based on my observation. Frank mentioned that most of us in the human factors group came from NRR. We did a lot of inspections. I spent a lot of time in control rooms in the first seven years that I was in NRC. And I did not see substantial differences in the way the crews interacted.

Now, yes, they were speaking Finnish. I try to ignore that. I had to ignore that. It's a language that's totally unrelated to anything else except Hungarian, they tell me. And so my knowledge of Norwegian didn't help me at all. But to watch them, my favorite thing to do was just put my fingers in my ears to not hear

what they were saying but watch what they were doing.

And the one difference that is a cultural difference, if you will, is the way they use procedures. And that is because they simply do not have the stringent requirement on them in Finland to use procedures the way our operators do in the United States. I mean, that's just a -- it's a fact of life. What they would do if they had the same stringent, they would probably have to do it the way we do it.

But otherwise when you watch the way as a scenario unfolds and things begin to happen, you watch the way the shift supervisor acts, what he does in the two different configurations, what their operators do, it really does not look substantially different from anything that I have seen.

And, as I said, that's my point of view. I can only speak from mine.

MEMBER CATTON: What is Situation Awareness?

CHAIRMAN SEALE: They know what's going on.

MEMBER CATTON: It's me. I'm not a human factors person.

MS. MORISSEAU: I know. I guess you weren't --

MEMBER CATTON: Oh, you know? Okay.

MS. MORISSEAU: I guess you weren't here.

Situation Awareness is: Do you know what's going on? And it's simply put. You measure it by stopping the action every so often and asking them what happened five minutes or -- you put the time frame on it and say, "Five minutes prior did you know what was going -- what's your perception?"

MEMBER CATTON: In what sense? Do you mean --

MS. MORISSEAU: With the plant. What is going on with the plant? Then you ask them, "What's going on now?"

MEMBER CATTON: How important is it that they know this?

MS. MORISSEAU: I think it's important that they know this so that they know what they're going to do next because that's the other question you ask them when they stop.

MEMBER CATTON: Won't their EOPs guide them?

MS. MORISSEAU: Well, that's the other problem. Yes, their EOPs guide them, but not all scenarios can take you down that road. Some of these are so much knowledge-based that the procedures won't always help you.

MEMBER CATTON: The reason I ask -- and, again, I talked to people who were here earlier about this -- is that yesterday we found out that the simulators may

not be -- what they see for a particular circumstance may not be the same as what they've seen on the simulators.

And I'm just wondering: What would this do to the guy's head? Would he continue to follow his EOPs or would he get a little unsettled and maybe do something dumb?

MS. MORISSEAU: There's always the possibility that somebody is going to do something --

CHAIRMAN SEALE: The whole world here is the simulator.

MEMBER CATTON: But, see, you do all of these things on the simulator. And we saw yesterday that there are some cases where what they see in the plant process instrumentation may not be the same as what they've been seeing on the simulator.

CHAIRMAN SEALE: I know. I know what you're talking about.

MEMBER CATTON: Okay. So I was just asking: Situation Awareness, how important is it? And if it's very important, well, then maybe we ought to think about the simulators a little bit.

MR. HODGES: And, Ivan, I tried to answer it a little bit yesterday. Part of the answer is the operator looks at more than one piece of information to make his decision. That's part of his situation of assessment.

And so he's looking --

MEMBER CATTON: I understand that. I understand that.

MR. HODGES: For instance, you were talking about yesterday, I think, for example, just the subcooling meter might show he didn't have enough subcooling to do anything other than what we was already doing, even if his pressure indications were a little bit off, for example, in the pressurizer.

You have to look at a number of instruments. And that's true, whether he's operating the BWR or PWR or a Lovii..a.

MEMBER CATTON: We saw yesterday where you're going to have these oscillations that could continue for some period of time. Those are not on the simulator. If that happens, is the operator going to maintain the presence of mind to ignore them and continue to what he's doing?

That comes under this Situation Awareness. I'm just wondering: Where does it fit into the picture? I keep getting the feedback that it really doesn't matter. And if that's the case, that's fine, but I somehow don't believe it.

CHAIRMAN SEALE: Yes, sir?

MR. WACHTEL: I guess I'd like to say two

things about that.

MEMBER CATTON: Don't deviate too far from the question because I won't understand the answer.

MR. WACHTEL: Okay. I'm Jerry Wachtel. Before I worked in the Office of Research, I was with NRR and wrote the simulator requirements that are now in Part 55. First of all, we have requirements that if operational experience demonstrates that the plant is performing in a way different than the certified simulator would indicate it should perform, there are specific things that the licensee has to do in order to bring the simulator into conformance with the plant within a certain period of time.

MEMBER CATTON: I'm not talking about normal operations.

MR. WACHTEL: No. Neither am I.

MEMBER CATTON: I'm convinced that the simulator are fine for that. You have a lot of data --

MR. WACHTEL: I'm not talking about normal operation either. I'm talking about in abnormal or emergency --

MR. HODGES: I think the problem is that he would have seen this one in the plant but once.

MEMBER CATTON: That's right.

MR. HODGES: And that's when he's facing it.

So he wouldn't have an opportunity. But John Barton may actually be in a better position to answer this since he's --

MEMBER BARTON: We talked about this earlier. I told him they're trained to follow the procedures. And then when they see something that they can't follow the procedures and they're faced with a situation, a combination of plant parameters they have never seen before, they will try utilizing the expertise which they've got on shift, which is shift's technical adviser. They will try to figure out what actions to take to mitigate the situation. That's what they will do.

MR. HODGES: But generally what they're going to try to do is if there's a concern with whether the core is covered or not, they're going to put water in the pan.

MEMBER BARTON: They will take conservative action, sure.

MR. HODGES: They will take those kinds of actions. And so I think for the instance that came up yesterday, probably the answer is it doesn't matter. But I'm not sure that I want to say that across the board. That's one problem I'm having answering your question, Ivan.

MEMBER CATTON: Well, see, you keep hearing about errors of this kind or the other kind. And as long

as the system is behaving the way the simulator said it would behave. There's no question.

MEMBER BARTON: That's true.

MEMBER CATTON: But now there are circumstances where it's going to act in a different way. He probably should continue to do the same thing, but would these things that he is seeing lead him to do something he shouldn't?

MEMBER BARTON: Could because he's going to take some actions to try to mitigate.

MEMBER CATTON: Then should we be doing something to the simulators in order that that doesn't happen or do we just leave it? What do we do that with it? We have a piece of information that we didn't have before.

MEMBER BARTON: I'm not sure you could have the simulator simulate everything that may ever happen --

MEMBER CATTON: I think that even to suggest that I was recommending that is way off. I'm not. All I'm suggesting is, gee, somebody ought to take a look at it. And if it indeed doesn't matter, then you don't have to do anything.

And the question is gone. But right now I saw what looked to me to be some rather bizarre behavior that the simulators would never predict as a matter of fact,

some bizarre behavior that unless it would have been measured I wouldn't have believed. What do you do with this information? The operator has got to run the plant.

Anyway, that's enough. But I'll raise the issue at every opportunity. And I had an opportunity here when I saw "Situation Awareness."

MS. MORISSEAU: Well, as I said --

MEMBER CATTON: I think that's what it's all about.

MS. MORISSEAU: It is an important measure when you're trying to do this. What we were looking at was the difference, auspiciously in crew sizes, and also how that interacted with the type of plant.

So our concern here was what happens with Situation Awareness, for instance, if you change the size of the crew, if you change the type of plant and the interface. What are the effects there? And, of course, that was the key thing here that we were looking at.

MEMBER CATTON: So if you just add one sentence to that and what happens if you clobber the information he's receiving a little bit?

MS. MORISSEAU: One thing we did note, that at the end of each one of the crew runs; i.e., a week's worth, as it turned out, we had a very intensive debriefing session about a number of issues, but the most

important issue was things that they rely on, trying to find out what they rely on, when they are looking at an interface.

One of the most important things that these operators felt was essential to have, the trending. The Halden Man-Machine Lab has trending information that you can just click on with a mouse. You can go to a particular system in the icon on the street and say, "I want to see the trends in this system." And they can click that on and see.

When you were standing in the control room, you always knew exactly what those guys were looking at. Even if they weren't wearing an eye tracker, you knew by what they would turn on their own screen because they had absolute freedom to look at those systems in any way they felt was valuable to help them mitigate whatever was going on.

And so it seemed that the trending information was an extremely important thing to them, not just from what we observe but from what they told us at the end, which was consistent with what we were seeing.

MEMBER BARTON: Not only crew size. Did you look at different mixes of crew? You've got a crew that works together for a long period of time. And I think what I'm hearing is you've looked at maybe reducing that

by a couple of people and see what happens. Did you interject different people that weren't normally on that crew and then see the response?

MS. MORISSEAU: No. We couldn't do that. We had very predefined crews. But what we were doing was varying the size of those crews. Most of these people who were in the crews tended to be people who had worked together before. The Loviisa people don't stay with one crew.

MR. HODGES: Okay.

MS. MORISSEAU: See, that's a question we used to ask at plants all the time. Do your crews rotate with each other or do you just switch them around?

The Loviisa folks kind of move around, and they don't necessarily stick with one crew. So it would have been kind of an unnatural situation for using those operators to insist on that.

What was interesting was what would happen when you would vary the crew. And the other thing I noticed, at no big surprise, individuals vary. You couldn't say, "Every shift supervisor will do" so and so.

There were some shift supervisors who always stayed back at the shift supervisor's station and directed activities from back there. There were other shift supervisors who the minute something started to happen

would be out of his chair and up there at those boards between the turbine operator and the primary side operator.

MEMBER BARTON: That wasn't a surprise to you, though, was it?

MS. MORISSEAU: No, no.

MEMBER BARTON: Because if you look at some major events --

MS. MORISSEAU: I'm a psychologist.

MEMBER BARTON: -- that have happened in the industry, you will find the shift supervisor --

MS. MORISSEAU: Individual differences.

MEMBER BARTON: -- didn't even stay in the control room.

MS. MORISSEAU: Yes. Individual difference is something a psychologist comes to expect. But it's interesting to see given that this is a very defined set of activities that operators do on a normal basis. And so it is interesting to watch the style of individual people within a crew.

(Slide.)

MS. MORISSEAU: And this is very brief. The conclusions and the results from this study are enormous. We collected an enormous amount of data. It's going to take a long time to digest it all. The draft report has

been written, but there's a temptation when you have this much data to keep jumping back in and analyzing something from yet another point of view. And because of computers and statistical packages, you can do that a whole lot easier than you could 10 or 15 years ago even.

There were consistent trends in crew performance insofar as in the normal staffing configuration their workload was always lower. Understand workload is in this case a subjective workload. You're asking them, "How much work do you feel you have? Do you feel you're overloaded at this point?"

What did come out of this, too, is that -- and this is probably no surprise to anyone with operations experience -- as you reduce the size of the crew and you have fewer people in the control room, the largest burden over work falls on the shift supervisor because he tends to start taking over the activities of the person who is missing, the person that you would normally rely on for a lot of these little extra, maybe administrative tasks, falls on his shoulders because he's not at the boards. And so he's the natural one to pick it up. So that was not a surprising result.

The other things, like Situation Awareness and team interaction and performance and mitigation, those things tended to interact with which type of plant you

were in.

The smaller crews exhibited good performance in the advanced plant. They had been better than in the conventional plant. Their Situation Awareness was better. Their team interaction was better. And their objective performance was better.

And, of course, we don't know why this is specifically. This is where researchers have to -- that's where the last chapter of your NUREG comes in where you get to sit back and say, "Here are some possible reasons why this is true."

One of the things about the advanced plant configuration is that it is smaller. I mean, if you've been -- the smallest of conventional control rooms is big compared to what these advanced configurations would be.

MEMBER BARTON: I'm not surprised that smaller crews exhibit good performance at advanced plants. Advanced plants were designed so you should be able to operate them with the smaller crew. So to me the whole concept seems to be falling in place.

MS. MORISSEAU: It does, but in the world of human factors research, especially where it's something that's going to get applied to this wonderful real world of nuclear power, you can't say, "Well, anybody knows that. You've got to prove it."

So that's what we sort of set out to do, to see: Are the things that we might expect going to happen? And what about the ones that we don't expect?

(Slide.)

MS. MORISSEAU: The differences between the performance in the plant conditions; i.e., conventional, as opposed to advanced, are largely explained by the higher scores of the smaller crews in the advanced plant. What I mean by that is when you started to average performance measures across all of the crews, because the small crews did better in the advanced plant, they made that distribution look quite different between the two plants.

There was a lot of interaction depending on crew size, by scenario, by -- actually, the scenarios didn't seem to make much difference. They all performed well. They all seemed to mitigate at about the same rate. It didn't seem to matter where they were.

But, once again, here was a place where I saw individual differences. There were a couple of scenarios and there was one in particular that while I was watching this study that was in Loviisa, I had written down in shorthand on this one scenario "AHBL."

About five months later, I thought, "What does that mean? What was I thinking about when I wrote that

down?" What I meant was all hell breaks loose because this scenario was so bad and every time they did it, you could watch them and see differences in stress levels in people. And that was a very interesting thing.

This is the one where the steam generators go dry and if you fill them up too fast, you get a steam generator tube rupture. And that's not what you started out to do at all. And so you --

MEMBER BARTON: I wish you had said that when Ivan was here.

CHAIRMAN SEALE: Yes.

(Laughter.)

CHAIRMAN SEALE: I don't know. Maybe we're glad you didn't.

MS. MORISSEAU: And it was the only time I actually understood three words out of a Finnish operator. It was "Whew. Boy." He sat in his chair, and he saw what happening. And he just for about five minutes was -- he tried everything he could think of on his side of the plant. He was just frustrated by his inability to solve this problem. So it was very, very interesting for me to be able to watch this.

What the results out of all of this demonstrate without getting into the heavy details of every single one of these analyses is that the sensitivity

of crew performance measures in changes to the crew composition and the control room automation, those things clearly show up when you do these kinds of experiments and not only that, but it showed us that the measures are quite useful. I mean, they really show differences.

We saw differences in performance. We saw differences in the way people handled things depending on the interface they were using. And so we were pleased with that result because sometimes you think, "Well, you know, suppose we do all of this and we don't even see anything." That tells us it's a no, never mind.

Is it a no, never mind about the plant difference or is it a no, never mind about the measure? You know, you feel good about your measures when you see that they actually do show differences?

That's all I have to say about that.

CHAIRMAN SEALE: Very good.

MS. MORISSEAU: If you have any questions? Sorry.

CHAIRMAN SEALE: Are there any questions? Would any staff like to make any further comments?

(No response.)

CHAIRMAN SEALE: We would like to thank you very much for your preparations and your presentations. We thank you very much for your willingness to respond to

our questions as we've raised them. And we will be getting to you with a list of things along with scheduling our next meeting in the November-like time frame, whenever that turns out.

Does anyone on the Committee have anything else to say?

MEMBER APOSTOLAKIS: No.

CHAIRMAN SEALE: Well, I think we've given Noel quite a few comments. He's going to be synthesizing a list and checking back with us. Then we'll be getting it to you. So we thank you again very much.

And I'll adjourn the meeting.

MEMBER POWERS: Before you adjourn, I just note that the plan indicates that in the first quarter of '97, quite a few things are scheduled to be completed, a surprising number of them. While schedules tend to slip, that still suggests that this Subcommittee may have grist to chew on in abundance in the second and third quarters of '97. So we may be getting together more often.

CHAIRMAN SEALE: Okay. And if you could keep us informed as things go forward so we can schedule things in an appropriate way, we sure would be appreciative.

Okay. Well, we'll adjourn now.

(Whereupon, the foregoing matter was concluded at 2:54 p.m.)

C E R T I F I C A T E

This is to certify that the attached proceedings before the United States Nuclear Regulatory Commission in the matter of:

Name of Proceeding: ACRS SUBCOMMITTEE ON HUMAN FACTORS

Docket Number: N/A

Place of Proceeding: ROCKVILLE, MARYLAND

were held as herein appears, and that this is the original transcript thereof for the file of the United States Nuclear Regulatory Commission taken by me and, thereafter reduced to typewriting by me or under the direction of the court reporting company, and that the transcript is a true and accurate record of the foregoing proceedings.

Corbett Riner

CORBETT RINER
Official Reporter
Neal R. Gross and Co., Inc.

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INTRODUCTORY STATEMENT BY THE CHAIRMAN OF THE
HUMAN FACTORS SUBCOMMITTEE
11545 ROCKVILLE PIKE, ROOM T-2B3
ROCKVILLE, MARYLAND
SEPTEMBER 20, 1996

The meeting will now come to order. This is a meeting of the ACRS Subcommittee on Human Factors.

I am Robert Seale, Chairman of the Subcommittee.

The ACRS Members in attendance are:

George Apostolakis, John Barton, Ivan Catton, Thomas Kress, and Dana Powers.

The purpose of this meeting is to hold discussions with representatives of the staff to gather information concerning the NRC Human Performance Program Plan, the collection and use of human performance data, the development of inspection guidelines, and the human factors research program. The Subcommittee will gather information, analyze relevant issues and facts, and formulate proposed positions and actions as appropriate, for deliberation by the full Committee.

Noel Dudley is the Cognizant ACRS Staff Engineer for this meeting

The rules for participation in today's meeting have been announced as part of the notice of this meeting previously published in the Federal Register on August 23, 1996.

A transcript of the meeting is being kept and will be made available as stated in the Federal Register Notice. It is requested that the speakers first identify themselves and speak with sufficient clarity and volume so that they can be readily heard.

We have received no written comments or requests for time to make oral statements from members of the public.

(Chairman's Comments-if any)

We will proceed with the meeting and I call upon Dr. Cecil Thomas of the Human Factors Assessment Branch of NRR to begin.

HUMAN PERFORMANCE PROGRAM PLAN

A Presentation to the
Advisory Committee on Reactor Safeguards
Subcommittee on Human Factors

Cecil O. Thomas, Chief
Human Factors Assessment Branch

September 20, 1996

HUMAN FACTORS COORDINATION COMMITTEE

- Chartered in December 1994
- Consists of representatives of NRR, RES, AEOD, NMSS and the regions
- Responsibilities include:
  - coordination of human factors/performance activities
  - development of human factors/performance program plan
- Meet frequently beginning in January 1995 and semiannually following issuance of plan

HUMAN PERFORMANCE PROGRAM PLAN - REV. 0

- Developed by HFCC; issued by HFCC chairman in August 1995
- Contents:
  - mission statement, goals and objectives
  - ongoing, planned and recommended activities
  - lead offices, target schedules and priorities

HUMAN PERFORMANCE PROGRAM PLAN - REV. 1

- Developed by HFCC; issued by cognizant division directors in July 1996
- Contents similar to Rev. 1, but:
  - updates activities
  - expands descriptions of activities
  - references commitments made elsewhere
  - updates and expands schedules
  - reflects status of activities

FUTURE COORDINATION

- Opportunity to reassess need for continuation of HFCC
- Need for line organization involvement
- Overlap and duplication with interoffice coordination meetings
- Abolished HFCC; coordination will continue within line organizations
- Will continue to maintain HPPP; coordination changes will be transparent to end user

HUMAN FACTORS INFORMATION SYSTEM

A Presentation to the

Advisory Committee on Reactor Safeguards

Subcommittee on Human Factors

September 20, 1996

HUMAN FACTORS INFORMATION SYSTEM (HFIS)

- Developed, operated and maintained by the Human Factors Assessment Branch
- Tool for use by the NRC in developing a dependable human performance profile of a particular licensee
- Two main functions:

  1. Easy storage and retrieval of specific information on special projects
  2. Compilation of data on human performance based on existing information sources

HFIS MODULES

1. Human Factors Programs - general information collected on site visits

2. Regulatory Programs - SPDS, DCRDR, SGTR information

3. LER Data - extracted from LER information

4. EOP Data - EOP inspection information

5. Training Data - Accreditation and training inspection information

6. Inspection Reports - SALP and human performance information

7. Human Performance Investigation Process (HPIP) - investigation results

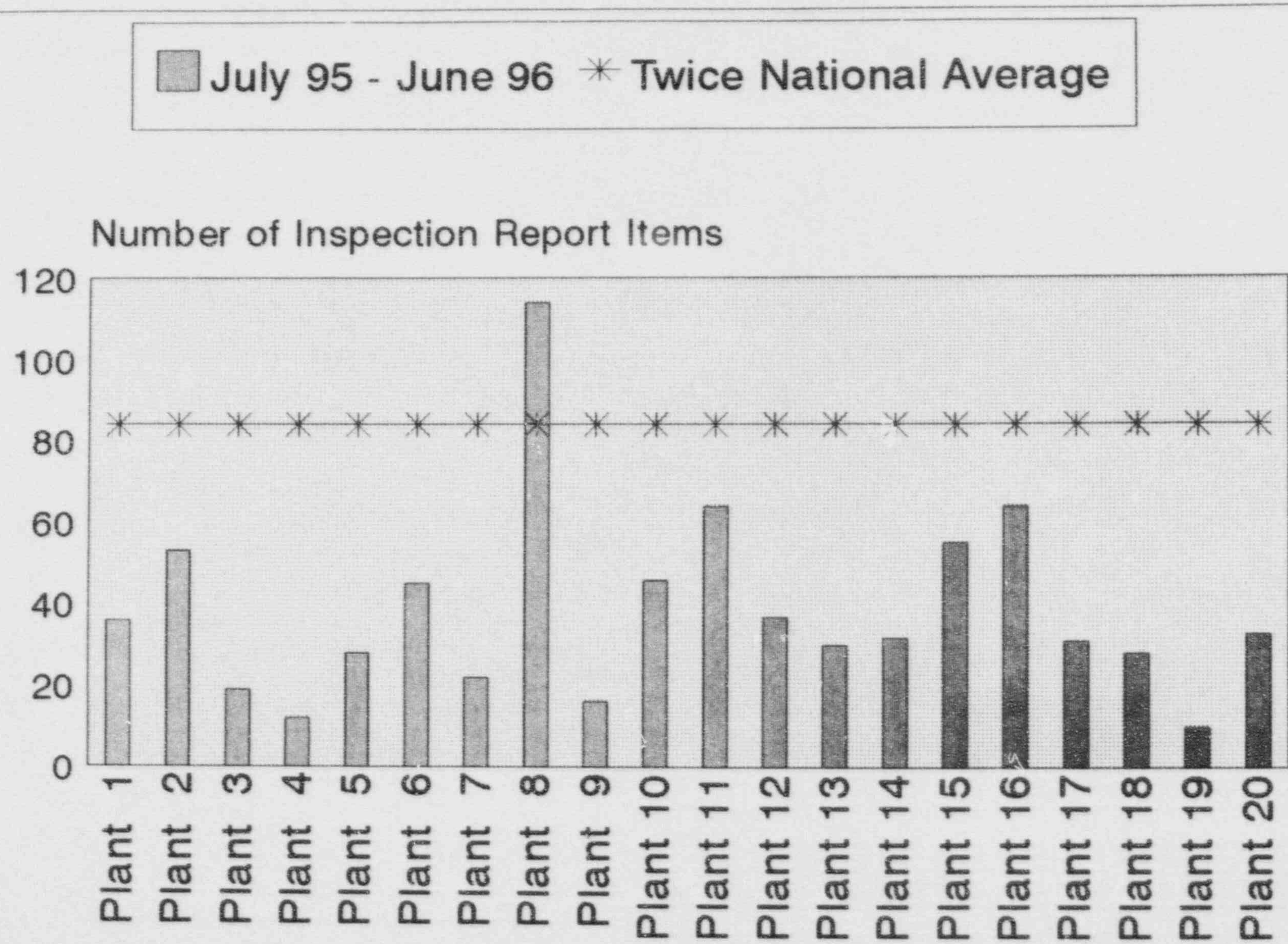
LER INFORMATION

• Information source:	LERs submitted by plants
• Reviewer:	Nuclear engineer on contract to NRC
• Information coded:	Personnel category
	Work type
	Contributing factors
	Plant identified root causes

INSPECTION REPORT INFORMATION

• Information source:	Inspection reports submitted by resident inspectors and special teams
• Reviewer:	HHFB staff
• Information coded:	Department Human performance category Category area Area details

Region HFIS Inspection Report Data



July 95 - June 96	36	53	19	12	28	45	22	114	16	46	64	37	30	32	55	64	31	28	10	33
July 94 - June 95	33	32	32	5	39	31	28	38	23	23	113	36	50	57	7	60	34	35	30	14
July 93 - June 94	17	16	2	3	15	11	7	31	44	2	29	8	10	12	5	13	9	17	8	7

HUMAN FACTORS ASSESSMENT BRANCH

MAJOR BRANCH ACTIVITIES

- Inspection Support
- Plant-Specific License Reviews
- Training Program Oversight
- Generic Activities
- Human Factors Information System
- Advanced Reactor Reviews

3A

Appendix D - HFIS Inspection Information Module Job Aid

DEPARTMENT	CATEGORY	AREA	DETAILS
A Operations B Instrument & Control C Electrical D Mechanical E Chemistry F Radiation Protection G Engineering H Contractor I Training J QA/QC K Plant Management L Planning & Scheduling	A Training	A Initial B Continuing/ requal C OJT D Simulator	01 No training 02 Inadequate training 03 Training process problem 04 Task qualification 05 Individual knowledge less than adequate
	B Procedures & Reference Documents	E Normal F Off-normal G Emergency H Surveillance and test I Administrative J Special	06 No procedure/reference document 07 Inadequate procedure/ reference document 08 Failure to follow procedure/reference document 09 Procedure/reference documents/development/ maintenance program LTA 10 Made an error using procedure/reference document
	C Organizational Issues	K Staffing	11 Inadequate staffing 12 Poor task allocation
		L Overtime	13 Inadequate controls 14 Excessive number of hours worked 15 Frequent use of overtime
	D Management and Supervision	M Attention and Oversight	16 No supervision 17 Inadequate supervision or involvement 18 Management expectations LTA
		N Work Control	19 Scheduling and planning 20 Worker Selection (unqualified worker)
		O Corrective actions	21 Individual corrective actions LTA 22 Action not yet started 23 No action planned 24 Corrective action programLTA

DEPARTMENT	CATEGORY	AREA	DETAILS
	D Management and Supervision (continued)	P Self-evaluation	25 Root cause LTA
	E Communication	Q Verbal R Written	26 Misunderstood information 27 Communication not timely 28 Communication LTA 29 No communication
	F Human - System	S Alarms T Controls U Displays V Panel/work station layout W Equipment X Tools and materials	30 Labels LTA 31 Information organization LTA 32 Size, shape or coding LTA 33 Placement or location LTA 34 Information format LTA
	G Work Factors	Y Work Practices	35 Work practices or skill of the craft LTA 36 Non-conservative decision-making/questioning attitude LTA 37 Tag outs 38 Pre-brief quality 39 Work package quality
		Z Work Environment	40 Temperature 41 Light 42 Noise 43 Radiation 44 Work Area/Layout
		AA Attention	45 Independent verification/plant tours LTA 46 Attention/self-checking LTA

LER DATA ENTRY SHEET

Plant name: (as marked on LER and selected from HFIS pick list)

Event date:(as marked on LER)

LER number:(as marked on LER)

Event time:

Power level:

Personnel category:
- licensed operator
- non-licensed operator
- instrument and control
- electrical
- mechanical
- engineer
- radiological protection
- chemistry
- security
- other

Work type:
- operating
- testing
- calibration
- troubleshooting
- maintenance
- engineering
- procedure development
- refueling
- modification
- other

Task behavior:
- skill
- rule
- knowledge

Action error:
- unavailable
- untimely action
- omission
- out of sequence
- wrong action
- extraneous action

Contributing factors:
- information unavailable
- inadequate training
- improper training
- no training
- procedure not followed
- procedure inadequate
- lack of procedure
- procedure wrong
- human system interface
- work environment
- verbal communication
- written communication
- work schedule
- work load
- management and planning
- shift turnover

Plant identified root cause:
(as marked on LER by coder)

Alternative root cause: (coder must specify here.)

Corrective Actions:
(as marked by coder)

Cognitive error:
- attention deficit
- misinterpreting information
- forgetting
- false assumption
- poor judgement
- boredom
- other

Reportability codes:
(as marked on LER)

HO
3 [redacted] A

HUMAN PERFORMANCE INSPECTION GUIDELINES

A Presentation to the
Advisory Committee on Reactor Safeguards
Subcommittee on Human Factors

Clare Goodman
Human Factors Assessment Branch

September 20,1996

OVERVIEW

- Human Performance Inspection Areas
- Inspection Manual Chapter
- Specific Areas of Human Performance Guidance
- Summary

HUMAN PERFORMANCE INSPECTION AREAS

- Event Follow-up
- Training
- EOPs
- Staffing
- Human Factors Engineering
- Management Processes
- Control Room Observations
- Corrective Action Programs
- Communications

INSPECTION PROCEDURES (IPS)
WITH HUMAN PERFORMANCE COMPONENTS

IP 93702	Prompt Onsite Response to Events at Operating Power Reactors
IP 40500	Effectiveness of Lic. Controls In Identifying, Resolving, and Preventing Problems
IP 41500	Training and Qualification Effectiveness
IP 42001	Emergency Operating Procedures
IP 71715	Sustained Control Room and Plant Observation

INSPECTION PROCEDURES
WITH HUMAN PERFORMANCE COMPONENTS (CONT.)

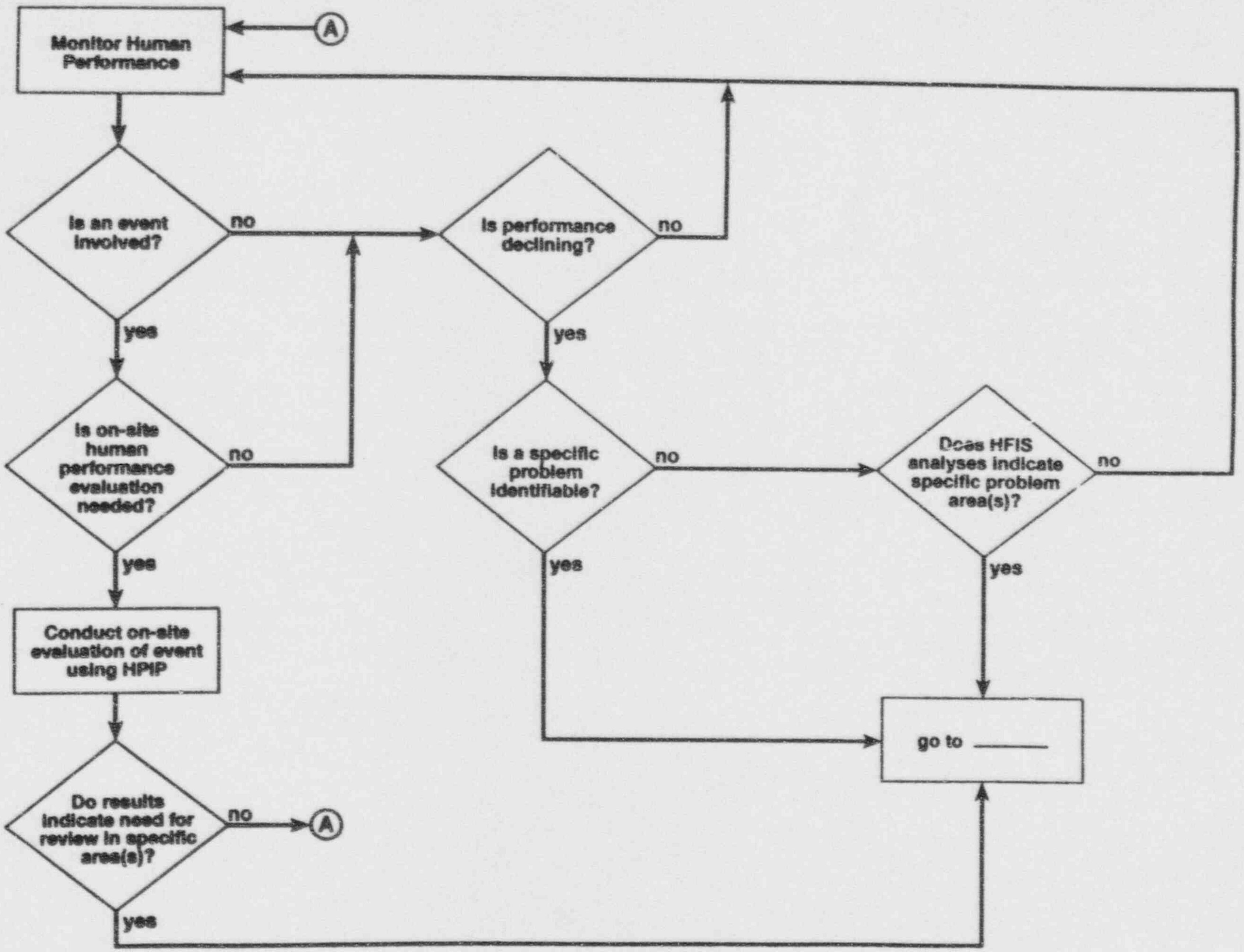
IP 93800	Augmented Inspection Team Implementing Procedure (AIT)
IP 93801	Safety System Functional Inspection (SSFI)
IP 93802	Operational Safety Team Inspection (OSTI)
IP 93806	Operational Readiness Assessment Team Inspection

DEVELOPING INSPECTION MANUAL CHAPTER ON HUMAN PERFORMANCE INSPECTIONS

- Establish Performance Based Thresholds for Initiation of Human Performance Related Inspections

- Direct Inspectors to the Appropriate IP or Guidance

Human Performance Review Inspection Manual Chapter



MONITOR PERFORMANCE

- HFIS
- Regional, Resident and PM Insights
- Management Insights
- Event Reports including 5072s
- Operator Licensing

EVENT FOLLOW-UP

- Evaluation of Human Performance Issues
- Use of the Human Performance Investigation Process (HPIP)
- Determine Potential Root Causes
- Component of Special Inspections, AITs, IITs, etc.

SPECIFIC AREAS OF HUMAN PERFORMANCE OF INSPECTION GUIDANCE

- Procedures
- Human Engineering
- Training
- Management Processes (IP Under Development)
- Communications (NUREG Under Development)

PROCEDURES

- IP 42001 for EOPs
- IP 42700 for Plant Procedures
  IP Revised to Include New Section on Procedure Usability
- NUREG-0899
- NUREG-1358, Supp. 1
- R.G. 1.33

HUMAN ENGINEERING

- NUREG-0711 (Program Review Model)
- NUREG-0700, Rev. 1
- NUREG/CR 6105 (Alarms)
- NUREG/CR-5680 (Environmental Factors)
- R.G. 1.97

TRAINING

- IP 41500 - Training and Qualification Effectiveness
- NUREG 1220, Revision 1 - Training Review Criteria and Procedures

"FOR CAUSE" TRAINING INSPECTION THRESHOLDS

Reasons for Conducting Training Inspections include but are not limited to:

- **An Indication of Declining Human Performance That Appears to have a Training-Related Cause**

- **Withdrawal of Training Program Accreditation by the National Nuclear Accrediting Board**

- **An Ineffective Initial or Requalification Licensed Operator Training Program**

SUMMARY

- Continue to Support Regional Requests
- Develop Manual Chapter on Human Performance
- Update Selected IPs
- Develop New IPs
- Finalize Support Documents

5

Human Factors Research

Presented to ACRS Subcommittee
on Human Factors
by Franklin Coffman

US NRC/RES/DST/CIHFB
September 20, 1996

1

Content of Presentation

- Recent Human Factors Products
- Ongoing Activities
- Plans
- Specific Ongoing Projects

2

Recent Human Factors Products

- NUREG-0700, Revision 1, Human-System Interface Design Review Guideline
- Draft NUREG-1545, Communications Corrective Action Plans: Review Criteria
- NUREG/CR-6208, An Empirical Investigation of Operator Performance in Cognitively Demanding Simulated Emergencies
- NUREG/CR-6398, Evaluation of the Computerized Procedures Manual II
- NUREG/CR-6046, Alertness, Performance and Off-duty Sleep on 8-Hour and 12-Hour Night Shifts in a Simulated Continuous Operations Control Room Setting

Ongoing: Revise Reg Guide 1.8, Qualifications & Training of Personnel for Nuclear Power Plants

- Proposes endorsing ANSI/ANS-3.1-1993 with several clarifications, additions, and exceptions
- ANSI/ANS-3.1 specifies experience, education, and training requirements
- Next step is to issue the draft for public comment
- ACRS will get the final Reg Guide for review after public comment

Ongoing: Reg Guide 1.164, Credit for Safety Related Operator Actions (DG-1052)

- Proposes endorsing ANSI/ANS-58.8-1994, Time Response Design Criteria for Safety-related Operator Actions
- ANSI/ANS-58.8-1994
  - Simplifies the calculation of time response intervals
  - Provides time criteria for safety-related operator actions
  - Reviewed related data and substantiated the time criteria developed from earlier data
- ACRS expressed some concerns
- Draft Reg Guide will go back for public comment requesting any supplemental data and specifically addressing the ACRS concerns
- ACRS will review the final Reg Guide after public comment

Ongoing: Hybrid control rooms- Operator Performance

- User need for guidance for reviews of modifications that mix digital I&C into generally analog control rooms
- Hybrid interfaces may impact human performance in different ways
- Initially identified potential human performance issues
- Issues & prioritization report and decision point this year

Ongoing: Halden Reactor Project

- Background
- Technical areas
  - Man-machine interface
    - software quality
    - human performance
  - Fuels and materials
- Benefits

7

Specific Ongoing Projects:

- Human-System Interface
  - Alarms systems
  - Navigation
- Staffing Studies
  - What are the appropriate staffing levels for advanced designs?
  - Technical basis report for advanced designs - FY 1997

8

Plans

- HPPP
- Experience Feedback
  - Performance data
  - Regulatory activities
  - Industry directions
  - Other industries
- Root-Causes Investigations
  - Update the Human Performance Investigation Process
  - Revisions prepared for field testing in FY 1998

Plans (Continued)

- Organizational Factors
  - Background
  - Issues
  - Motivation
  - Objective: To develop guidance to allow early identification of organizational influences using existing information
  - Considering new approach
  - Relationship to risk being investigated in a separate program

NAS Study & Workshop

- Phase I
  - Defined important safety & reliability issues including Human Factors
- Phase II
  - Identify criteria for review & acceptance of digital I&C for both upgrades to current plants and new designs
  - Evaluate alternative approaches to licensing digital technology
  - If basis exists, recommend guidelines for digital I&C
  - If basis not present, recommend means to acquire the needed data

NAS Study & Workshop Technical Issues

- Software quality assurance
- Common-mode software failure potential
- System aspects of digital I&C technology
- Human factors & human-machine interfaces
- Safety & reliability assessment methods
- Dedication of Commercial Off-the-Shelf hardware & software

Programmatic issues

- Outcome of NAS study & workshop
- Availability of operating personnel for research experiments and information visits
- Interactions among related topics requires team efforts among disciplines

6

Advanced Alarm Systems and Interface Management

ACRS Subcommittee on Human Factors

September 20, 1996

Jerry Wachtel

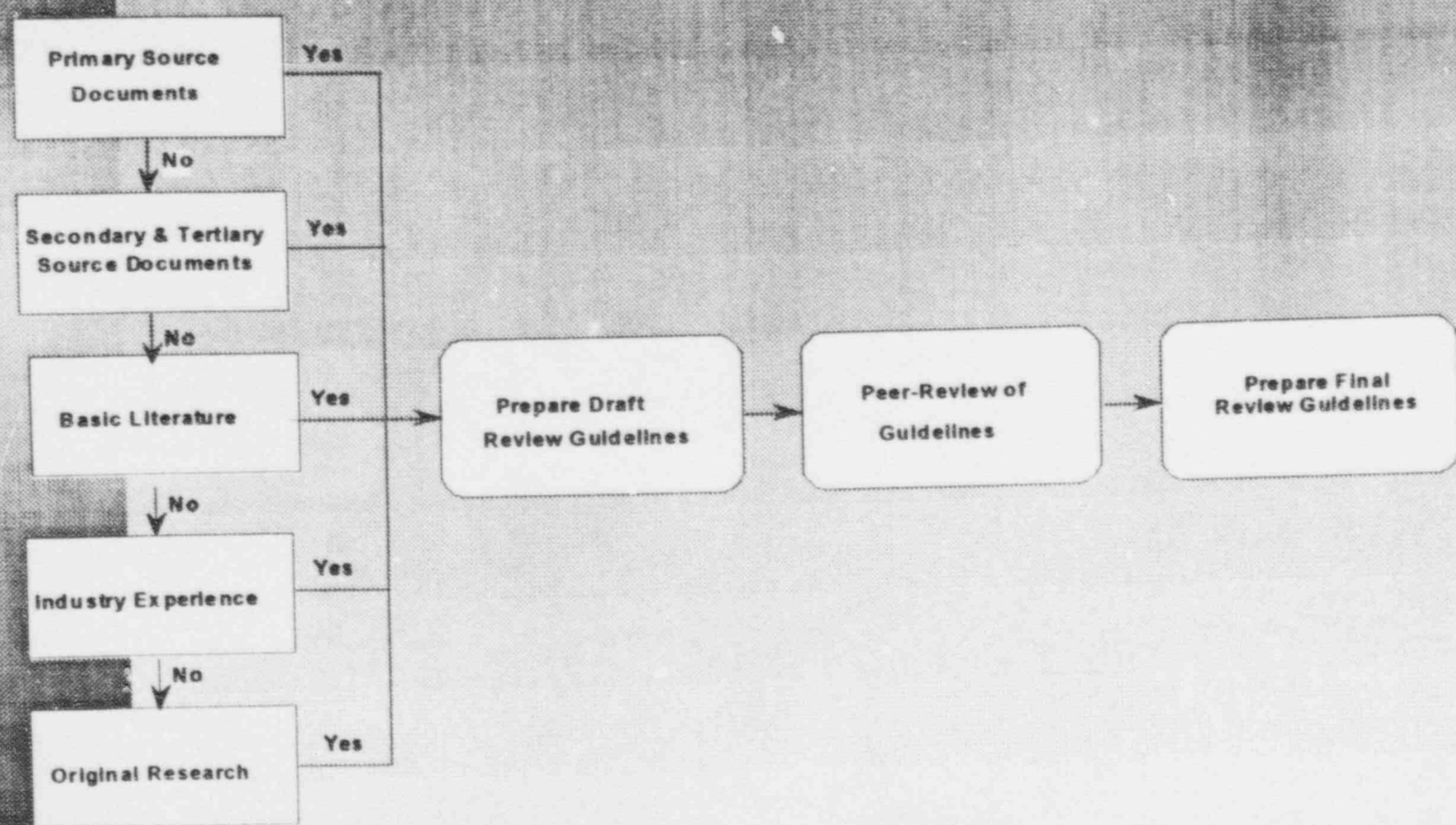
Background and Rationale

- NUREG-0700, Revision 1
  - "Human-System Interface Design Review Guideline"
- Gaps in our knowledge in key areas
- High priority user needs
  - Alarm systems
  - Navigation

User Needs

- Alarm reduction and prioritization techniques
  - "...quality of human performance when using annunciator systems appears to change under stress..." (3/93)
- Effects of advanced control-display interfaces on crew workload
  - "...increasing evidence from aviation and nuclear industries that...advanced interfaces...are correlated with an increase in crew workload..." (3/93)

NRC'S GUIDANCE DEVELOPMENT PROCESS



Advanced Alarm System Review Criteria

Objective

- To develop review criteria for the evaluation of advanced alarm systems
  - Develop technical basis for
    - alarm processing
    - display characteristics
  - Develop review guidelines and acceptance criteria

Advanced Alarm System Review Criteria

Approach and Status

- Experiments at Halden under Bilateral Agreement
  - Pilot testing completed 6/96
  - Experimental trials 9-11/96
  - Analyze data and report findings, 3/97
- Guidance development and peer review
  - Draft guidance, 5/97
  - Independent peer review, 7/97
- Final alarm system review guidance, 10/97
- Incorporate into NUREG-0700, Rev. 2, FY '99

Effects of Advanced Control-Display Interface Management Tasks on Crew Workload and Performance (Navigation)

- New project to begin 1Q FY'97
- User need based on
  - EdF, S3C/N4 simulator
  - "Glass cockpit" commercial aircraft
- Anticipated 32 month effort

"Navigation"
Objectives

- Principal objective
  - Develop guidance to review interface management of advanced HSIs
- Sub-objectives
  - Develop classification system for IM tasks
  - Identify effects of IM on crew performance
    - Task time; workload; errors; situation awareness
  - Evaluate and prioritize issues
  - Prepare and validate design review guidance for IM

"Navigation" Typical Interface Management Tasks

- Navigation between displays and within display hierarchies
- Dialog with the computer system
- Display selection for current conditions
- "Preference" tasks
  - Selecting and configuring functional modes
  - Window manipulation
  - Manipulating functions (pan, zoom, scroll)

Future Revision to HSI Guidelines

- Gaps in NUREG-0700, Rev. 1 in several areas due to
  - Conservative methodology
  - Rapidly changing technology
  - Unique characteristics of NPPs
- Some gaps are being addressed
  - Alarm systems
  - Navigation
  - Hybrid control rooms
- Participate in international and other industry forums; and monitor developments within the nuclear industry
- NUREG-0700, Rev. 2 anticipated in FY '99

7

Study of Staffing Levels for Advanced Reactors

Dolores S. Morisseau

Office of Nuclear Reactor Research

DST/CIHFB

Background

- Staffing of nuclear reactors by licensed reactor operators and senior reactor operators governed by 10 CFR 50.54 (m).
  - Specifies minimum licensed control room staff
- New plant designs being produced by vendors.
- NRC conducting Design Certification reviews.
- Some designs use a mixture of 'proven' technologies and passive system designs.
- Expect improvements in ease of performance and safety:
  - Passive systems, diversity, redundancy
  - Digital Instrumentation and Control Systems
- Need to reconsider requirements for minimum shift staffing

Project Objective

- Evaluate impact(s) of advanced passive plant design on:
  - Staffing of Control room crews;
  - Operator and team performance.
- Identify and understand potential safety issues
- Provide information to support the development of design review guidance for staffing of advanced, passive plants.
- Focus on:
  - Control room crew configurations
  - Interaction with control room automation and passive plant performance

Approach

- Conduct a study of control room crew performance.
  - Include both conventional and advanced plant performance features:
    - » Representative control room I&C;
    - » Representative T/H performance.
  - Use of 5 design basis scenarios;
    - » SGTR, ISLOCA, LOFW, LOOP, S/G overfill;
    - » All requiring significant mitigation efforts to maintain barriers.
  - Evaluate two different control room crew staffing configurations:
    - » normal (i.e., based on 10 CFR 50.54(m)).;
    - » minimum (minimum normal at Loviisa vs. minimum from advanced plant vendor).
- Carried out at Loviisa Nuclear Power Station training simulator (LOTS) and HAMMLAB.
- Evaluate the feasibility of crew simulation techniques.

Data Collection

- 8 Crews presented with 5 scenarios; 4 Crews served in minimum, 4 in normal staffing configurations.
- Data collected on:
  - Subjective Workload (NASA TLX)
  - Team Performance (BARS)
  - Situation Awareness (SACRI)
  - Rated Crew Performance
  - Task Completion
  - Plant Parameters
  - Onsite & Offsite Notifications
- First 4 measures collected 4-5 times during each scenario.

Conclusions

- Consistent trends in crew performance: normal staffing configuration - lower workload; SA, team interaction, performance in mitigating disturbances interacts with plant type
- Smaller crews exhibit good performance in advanced plant: better SA, team interaction, performance

Conclusions (cont'd)

- Differences between performance in plant conditions largely explained by higher scores of smaller crews in advanced plant
- Results demonstrate:
  - sensitivity of crew performance measures to changes in crew composition & plant/control room automation
  - usefulness of such measures

[illegible]EW[illegible]E	CO[illegible]	ADVANCED
[illegible]	N=2 4 persons SS, RO,BOP, CR Tech (lic)	N[illegible] 4 persons
Minimum	N=2 3 persons SS, RO, BOP	N=2 2 persons SS, RO