

UNITED STATES OF AMERICA NUCLEAR REGULATORY COMMISSION

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ORGANIZATION AND MANAGEMENT

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UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

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BRIEFING ON PROGRESS OF RESEARCH IN THE AREA OF
ORGANIZATION AND MANAGEMENT

- - - -

PUBLIC MEETING

Nuclear Regulatory Commission
One White Flint North
Rockville, Maryland

Thursday, November 8, 1990

The Commission met in open session,
pursuant to notice, at 10:00 a.m., Kenneth M. Carr,
Chairman, presiding.

COMMISSIONERS PRESENT:

KENNETH M. CARR, Chairman of the Commission
KENNETH C. ROGERS, Commissioner
JAMES R. CURTISS, Commissioner
FORREST J. REMICK, Commissioner

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STAFF SEATED AT THE COMMISSION TABLE:

SAMUEL J. CHILK, Secretary

WILLIAM C. PARLER, General Counsel

JAMES TAYLOR, Executive Director for Operations

THOMAS RYAN, Section Leader, Human Factors Branch, RES

THEMIS SPEIS, RES

FRANKLIN COFFMAN, JR., Chief, Human Factors Branch,
RES

JACK ROE, Director, Division of Lic. Perf. & Qual.
Eval., NRR

DENWOOD ROSS, Deputy Director, AEOD

JOSEPH MURPHY, Deputy Director, Division of Systems
Research, RES

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

10:00 a.m.

CHAIRMAN CARR: Good morning, ladies and gentlemen.

The staff is here today to brief us on the progress made in organizational factors research since the last briefing on the subject in July of 1989. The staff's organizational factors research is part of the human factors programs and initiatives described in SECY-89-183 and later published in NUREG-1384.

The staff has stated that its focus for organizational factors research is at the plant level during normal and emergency operating conditions and the transition between the two. Its goals are to develop analytic tools and data for improving the technical database to support decision making regarding plant specific regulatory programs and to gain a better understanding of the factors that shape organizational performance as it pertains to safety. These are laudable goals and I look forward to the staff's briefing.

I understand that copies of the briefing slides will be available at the entrances to the meeting room. This is an information briefing and no Commission action is expected.

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1 Do any of my fellow Commissioners have any
2 opening remarks they wish to make?

3 If not, Mr. Taylor, please proceed.

4 MR. TAYLOR: Good morning. With me at the
5 table from the Office of Research, Joe Murphy, Frank
6 Coffman, Tom Ryan to my left. To the right, Themis
7 Speis, Jack Roe from NRR and Denny Ross from the
8 Office of AEOD.

9 This briefing was requested on the
10 progress of the staff's work in organizational factors
11 research. I believe it was, as the Commission noted,
12 to ensure that the research remains appropriately
13 focused, will provide useful tools to the NRC to
14 evaluate licensee organization and management issues.

15 The research role in this organizational
16 factors area is, first, to confirm that the Agency and
17 staff's evaluation of organizational effectiveness are
18 in a firm technical basis and to provide for
19 improvements in these programs. The research is
20 basically exploratory and is directed toward providing
21 regulatory insights into the organizational parameters
22 that influence safe operations. The research is not
23 to design organizational charts for imposition on
24 utilities, nor to analyze individual managers, nor to
25 develop specific regulations.

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1 With those opening thoughts, Doctor Speis,
2 would you like to add anything to that?

3 DOCTOR SPEIS: No, I think that's --

4 MR. TAYLOR: I will then as Doctor Tom
5 Ryan, who is responsible for this area in the Office
6 of Research to commence the formal briefing.

7 DOCTOR RYAN: Good morning. Mr. Chairman,
8 as Mr. Taylor indicated, my purpose here is to brief
9 the Commission on the status of our organizational
10 factors research activity, to apprise you of the
11 accomplishments that we've achieved to date, those we
12 anticipate by the end of the calendar year and those
13 that we expect to complete sometime in calendar 1991.

14 Organizational factors is the newest of
15 eight research activities that make up our Human
16 Factors Reliability Research Program. It's also a
17 direct descendant of research we did for short periods
18 in this area during 1982 and 1985 respectively. This
19 briefing is a follow-up to a presentation made to the
20 ACRS Subcommittee on Human Factors and later the full
21 ACRS on July 31st and August 10th respectively, and
22 subsequently to the various user offices during
23 September and October.

24 There is an August 16, 1990 letter
25 addressed from the ACRS to the Chairman that expresses

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1 general support for the research and makes a
2 recommendation that the Commission support it in the
3 future.

4 All of the reports, memoranda that are
5 cited in the Organizational Factors Status Report,
6 that is SECY-90-349, were provided to the Commission
7 or staff in mid-October.

8 (Slide) Could I have slide 2, please?
9 Could I have slide 2, please? Thank you.

10 This morning, I'd like to address my
11 remarks to four general topic areas, the first being
12 the background and rationale for our doing this
13 research in a regulatory setting. Secondly, those
14 accomplishments that we have achieved and anticipate
15 within the next several months, acquaint you with the
16 staff and the consultants that we are using to assist
17 us in managing, carrying out and reporting the
18 research, and finally some conclusions we've drawn
19 regarding the efficacy of the research after being in
20 this business now for about two years.

21 (Slide) Slide 3, please.

22 Regarding the background, traditionally
23 those of us who have been doing human factors research
24 in the Agency have normally focused on individual
25 operators or maintainers, and to some extent the

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1 performance of those people in small groups. If you
2 will sort of a bottom-up kind of perspective, although
3 limited. Organizational factors research is basically
4 top down.

5 We are interested in group performance,
6 as Mr. Taylor indicated, and the factors that
7 influence that performance. Currently we're focusing
8 on the plant organization. We're also interested in
9 the formal subelements, the divisions, departments,
10 sections, crews, teams within the context of the plant
11 organization. We're also interested in technical
12 support programs, maintenance, training and so on that
13 are believed to have a pervasive influence on the
14 overall plant safety performance.

15 Finally, we have an interest in certain
16 critical functions and roles within the organization
17 and one example is management.

18 There are two general goals of the
19 research. First, those are analytic methods that
20 allow us to characterize the structural and operating
21 characteristics of the organization in terms of
22 information flow paths, decision making strategies,
23 control mechanisms, coordinating mechanisms throughout
24 the plant. We are also interested in data gathering
25 tools that allow us to go out and to collect

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1 information on the organizational factors that are
2 identified as being important as part of that process.

3 A second general goal has to do with
4 leading indicators of performance. How can we take
5 that information and other information available to
6 the Agency and use it for the purpose of establishing
7 leading indicators of performance?

8 As Mr. Taylor indicated, this research is
9 currently at the plant level, primarily because that
10 is the basic unit of interest to the Agency. At the
11 end of fiscal year 1991, as suggested in the
12 Commission paper, we may try to go beyond that level
13 if, one, the research suggests that's where we should
14 go and, secondly, that we can identify any entities
15 beyond the plant that really demonstrate that some of
16 a systematic relationship between their influences and
17 what goes on at the plant.

18 With regard to the rationale for doing the
19 research, I think there are three basic rationales.
20 The first is that the staff has determined that many
21 of the licensing, inspection, evaluation, risk
22 assessment activities and the performance indicator
23 program can benefit from this kind of research.
24 Therefore, there have been eight initiatives that have
25 been identified which comprise the current

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1 organizational factors research activity, which I'll
2 get into a little bit later.

3 The second rationale has to do with past
4 experience. If you look at Three Mile Island,
5 Chernobyl, the various instant investigations the
6 Agency has done, usually one of the conclusions is
7 that at least one of the root causes were more
8 institutional factors that led to some of these events
9 that we have observed.

10 Finally, a number of outside respected
11 entities have reviewed what we are doing, namely the
12 National Academy of Sciences, the Human Factor
13 Society, the ACRS itself and some peer review groups,
14 for example the Nuclear Safety Research Review
15 Committee. All have recommended that as part of our
16 human factors program that we at least address this
17 issue.

18 I guess in summary, I guess there is an
19 emerging over the last few years, recognition that the
20 individuals don't operate the plants, they're operated
21 by groups of people. This becomes especially
22 significant during off normal conditions and therefore
23 any analysis or evaluation of that performance that
24 doesn't at least touch on these kind of factors is
25 probably at best incomplete.

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1 So that's basically the background and the
2 rationale for why we're doing the research.

3 (Slide) Could I have slide 4, please?

4 As I just mentioned, the staff has
5 identified eight initiatives for which we are pursuing
6 research. The activity is comprised of 11 research
7 projects that are addressing at least one or more of
8 those initiatives. On the overhead, as I mentioned
9 earlier, we have two general goals, analysis methods
10 and leading indicators of performance. I'll describe
11 those down the left-hand side of the overhead, the
12 slide and the next slide.

13 On the right-hand side you see some Xs
14 either alone or in parentheses. The Xs that stand
15 alone represent the primary user office. The Xs with
16 parentheses represent what Research feels are
17 activities offices that can benefit for the particular
18 things that are being done. With regard to what we
19 are doing under the analysis methods, one, we're
20 trying to develop those that will allow us to
21 integrate in some meaningful way organizational
22 factors in risk assessment studies.

23 A second area that we're working in is
24 support to the Agency's Accident Management Program.
25 I'll get into some of the details of this shortly.

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1 Under our leading performance indicator
2 goal, we have six initiatives, four of them directly
3 focusing on particular kinds of leading indicators.
4 The first area we're interested in organizational
5 indicators themselves. Secondly here we're interested
6 in control room team performance indicators during
7 off-normal operations.

8 (Slide) Could I have slide 5, please?

9 The third area we're interested in is
10 maintenance, the maintenance program. The fourth area
11 is the training area. These last two areas of
12 initiatives have sort of emerged out of some of the
13 earlier work. One of the things we're trying to do
14 is to capitalize on indicator work that's been done
15 in other organizations. So, we have work going on to
16 see if, in fact, we can identify some other
17 industries, if you will, that have developed
18 indicators, have validated them in some reasonable way
19 and are using them that we might be able to capitalize
20 on or transfer at least some of the ideas to this
21 industry.

22 Lastly, we recognize that people who are
23 trying to work with multiple indicators, that there
24 is a difficulty to try to step back from them and try
25 to sort of make some interpretation of them

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1 individually and in combination as they might relate
2 to overall plant safety. So, we are doing some
3 research attempting to develop a framework that will
4 allow users to plug these in and to basically address
5 three questions. One, to what degree do they
6 individually in combination allow statements about
7 overall plant safety to be made? Secondly, if one
8 does want to make some general statements about plant
9 safety, are there holes and where are they? Where do
10 we need some new indicators? Finally, where are the
11 redundancies, not necessarily to eliminate indicators
12 but to at least make the user aware that there may be
13 several, or more than one at least, that are measuring
14 the same thing.

15 So, those are basically the eight
16 initiatives that we're working on. As you can see on
17 the right-hand over the overheads or the slides, those
18 are the users.

19 (Slide) Slide 6, please.

20 If I could now, going through the two
21 research goals and the activities on them, talk to you
22 a little bit about what we're doing, what we've
23 accomplished and so on.

24 As I mentioned, we have two initiatives
25 in the analysis methods area, one directed toward

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1 supporting risk assessment studies, the second
2 directed toward supporting the accident management
3 program. As part of our support to risk assessment,
4 we have developed and conducted two field
5 evaluations/validations of a method designed to allow
6 us to integrate the influences of organizational
7 factors into plant risk.

8 The method is currently known as the
9 nuclear organization and management analysis concept,
10 or NOMAC. Thus far, as I mentioned, NOMAC has been
11 field tested on two occasions, once in a fossil fuel
12 plant, secondly in an NRC licensed facility, both in
13 the State of California. The results of those
14 evaluations have been documented in the draft NUREG/CR
15 that has been provided to the Commission staff, NUREG-
16 5538.

17 The field tests indicate that NOMAC can
18 be implemented in an NRC licensed facility without
19 unduly disrupting the operation of the facility. It
20 can achieve acceptance from the people who are
21 required to participate in that process, and here I'm
22 talking about primarily the plant management and
23 staff, and it can yield meaningful data for use in a
24 PRA kind of a setting.

25 Research on a second application to NOMAC,

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1 and this gets me to accident management, is to take
2 the NOMAC concept and extend it into emergency
3 configurations. Also, and maybe even more
4 importantly, to model the transition from a normal
5 organizational configuration to an emergency
6 configuration. Basically, we're interested in that
7 process, feeling that the transition period may be
8 very critical to success or failure in really
9 responding to the off normal event. We're also trying
10 to identify critical functions and roles in that
11 process both during transition and after the
12 configuration is stabilized. Finally, we're trying
13 to take a look and eventually develop some guidelines
14 for really assessing alternative strategies that might
15 be used to make decisions to respond to the accident
16 situation.

17 So, that is basically what we're involved
18 in under the analysis methods area.

19 In the second case with support to
20 accident management, we are preparing a report that
21 should be available at the end of January on this
22 work, a NUREG/CR-5570.

23 (Slide) What I would like to do, if I
24 could -- could I have slide 8, please?

25 What I'd like to do, if I could, is take

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1 a couple of minutes and sort of walk you through this
2 NOMAC concept. NOMAC is basically a framework. It
3 involves three iterative steps. The first doing some
4 modeling, the second doing data collection, and the
5 third involving actual quantification of the data for
6 support and PRA. The first step is something we call
7 a functional analysis. It's like --

8 MR. COFFMAN: Excuse me, Tom. I think we
9 need to have slide 7.

10 DOCTOR RYAN: Oh, slide 7. Okay.

11 As I was saying, the first step in this
12 process is what we call a function analysis. It's
13 like a task analysis and its intent is to describe the
14 structural and operating characteristics of the plant
15 organization. As I mentioned earlier, the information
16 flow paths, the decision making strategies, the
17 control mechanisms, the coordination mechanisms and
18 so on.

19 NOMAC proceeds from the assumption that
20 an American nuclear power plant can best be described
21 as a machine bureaucracy. The functional analysis
22 yields us three kinds of information. One, it
23 provides the human factors information that would
24 support the development of the plant models. It would
25 then be used to drive the risk assessment. Secondly,

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1 it identifies the critical functions and roles within
2 the plant, both at the managerial level and the worker
3 level that the subsequent data collection would focus
4 on. Thirdly, it provides us with information about
5 the degree to which the plant itself compares with
6 a pure machine bureaucracy. This has importance for
7 us later when we are trying to draw insights from the
8 quantification results.

9 The second step in NOMAC is the data
10 gathering. NOMAC allows for the use of any of four
11 techniques. One is survey, actually having people
12 fill out questionnaires. Secondly, directed or non-
13 directed interviews. Third, job sampling. That is
14 literally pieces of production, decisions made,
15 paperwork and that kind of thing. And finally, direct
16 observation.

17 For purposes of the evaluation of the
18 NOMAC concept at the two facilities in California, we
19 used a survey data collection instrument and a direct
20 observation collection instrument. The survey
21 instrument asked people, a cross section of the plant,
22 to rate some 205 items which then were collapsed into
23 18 scales of organizational culture and operability.
24 We also did direct observations over a period of time
25 where behavior was assessed using 37 categories, the

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1 amounts of time people spent doing these things,
2 making decisions, providing face-to-face instructions,
3 providing information from one person to another, and
4 again these were collapsed into five scales.

5 We chose those two instruments for some
6 particular reasons that have to do with especially the
7 research, one having to do with one end of the scale,
8 that is ease of administration. And at the other end
9 of the scale, we were interested in quality of
10 information. It is basically assumed, of course in
11 the kind of work we do, that certainly a survey is the
12 easiest vehicle to actually implement. But there are
13 questions about the quality of the data that you might
14 get because there are a lot of ways people might
15 manipulate this. But we wanted to try it because it
16 appeared to be probably one of the easiest ways to go.

17 We had a couple of reasons for going to
18 the other end of the scale in direct observation.
19 While direct observation presents some logistical
20 acceptability obtrusiveness issues, introduces them,
21 we find that it does provide the best characterization
22 of what's actually going. If you live with somebody
23 24 hours a day, it's pretty hard for them to put on
24 some kind of a facade.

25 The other reason that we chose the direct

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1 observation is because it's something that the NRC
2 does. Resident inspectors, licensing review people,
3 evaluators all engage in this kind of data gathering.
4 We felt that this was an opportunity for us to take
5 that process, maybe standardize it a little bit and
6 therefore be able to maximize to some extent the
7 amount of information that might be gathered.

8 The third step with NOMAC involves the
9 quantification procedures. In the tests in
10 California, we actually took the information and
11 treated it as, what we call in the risk assessment
12 community, performance shaping factors. That is those
13 influences that might change the likelihood that an
14 operator might or might not make an error.
15 Traditionally, we look at the quality of procedures
16 and training and experience and fatigue and stress.
17 What we did here was took the organizational factors
18 data and actually treated it as a performance
19 indicator. That's very exploratory. We feel that
20 there's a lot more work to be done and certain we're
21 pursuing that.

22 There's a second approach that NOMAC
23 allows in which we're also doing research on, and a
24 little different conceptualization regarding these
25 influences, and that is that these factors are so

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1 pervasive that they not only contribute to the changes
2 in error rates by humans, but also have a pervasive
3 effect on the reliability and the operability of the
4 equipment. So, there is a second approach and that
5 is to establish these factors as a term in the risk
6 equation that stands by itself. I simply bring this
7 up because these are the two areas that we are
8 focusing on and some of the research during the rest
9 of fiscal year 1991 is this issue of trying to take
10 the information and work in in a credible way into the
11 risk assessment.

12 (Slide) Slide 8, please.

13 COMMISSIONER REMICK: Before leaving that,
14 could I ask a couple of questions, Mr. Chairman?

15 The NOMAC method seems to require a large
16 amount of input from participating organization. In
17 a case where you have volunteers, as you did in this
18 case, and doing research, I can understand it. But
19 if this was utilized, how would we go about getting
20 all that information unless we use solely the
21 observation technique? Would we just seek volunteers
22 or --

23 DOCTOR RYAN: Are you talking about the
24 data collection?

25 COMMISSIONER REMICK: The data collection

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1 part of it, yes.

2 DOCTOR RYAN: I guess that would vary from
3 site to site. I was going to get into the next slide
4 here, Commissioner Remick, discussing where we kind
5 of go here, go with this here.

6 COMMISSIONER REMICK: Okay.

7 DOCTOR RYAN: Basically, that involves--
8 we're going to try to line up a second plan, to go in
9 and start exploring some of these issues. The
10 reaction that we got from the plant that we were
11 working with on the West Coast was an extremely
12 positive one. The original schedule that we had was
13 to try this at a fossil fuel plant and you may even
14 recall you were the one that originally suggested
15 this.

16 COMMISSIONER REMICK: I remember well.

17 DOCTOR RYAN: We felt that we would do
18 that and then sometime later maybe we would get a
19 chance to go into the NRC licensed facility. It
20 turned out we were only there a couple weeks and they
21 wanted to go ahead and do it right away. They became
22 fairly enthusiastic about it.

23 We have found out more recently that the
24 survey instrument, or a variation of the instrument
25 that we are using, we understand that INPO is talking

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1 to some of the utilities about the possibility of
2 using this across the industry as sort of a self-
3 assessment thing that could be used on a continuing
4 basis by management. So, I guess right now it would
5 be a voluntary kind of thing. Obviously observing
6 people is probably a little bit easier if you're
7 looking for volunteers than getting questionnaires
8 filled out or doing interviews.

9 COMMISSIONER REMICK: Would it be
10 difficult to train our residents to be able to do the
11 observation necessary?

12 DOCTOR RYAN: The whole purpose of this
13 was to remove from the person doing the observing all
14 of the responsibility of trying to make value
15 judgments. Basically, it takes us about eight hours
16 to train someone like a person who may not be a
17 behavioral scientist and basically what they do is
18 shadow an individual for some period of time and
19 simply record the amounts of time that are spent in
20 these various activities. The methodology takes it
21 for granted. The scaling, the interpretation and
22 everything is part of the method.

23 So, one of the things that we were trying
24 to do -- two things. One is to kind of standardize
25 this process, to sort of get everything out of it we

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1 could, if someone was going to go out and spend the
2 time to do it. And secondly to somewhat, at least to
3 some degree, take the onus away from the individual
4 doing the observing, of also trying to make a lot of
5 value judgments. So, yes, it is fairly simplistic.
6 People can be trained. At the NRC licensed facility,
7 they did use some of the people were not part of the
8 research team.

9 COMMISSIONER REMICK: And how -- go ahead,
10 Frank.

11 MR. COFFMAN: I was just going to mention
12 that at this stage of the research on the project
13 though, we still have so much more development to do
14 that it will offer some more opportunity to collect
15 data on the resource effectiveness of this kind of an
16 approach for broad application. But we're not at that
17 stage where we need to, I think, address how it could
18 be broadly applied.

19 COMMISSIONER REMICK: How much does this
20 indicate the organization versus the individual?
21 Let's hypothesize that they replace their vice
22 president, a former admiral, with a new vice president
23 who is an Army colonel. How dependent is the
24 results --

25 CHAIRMAN CARR: How big a mistake can you

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1 make?

2 COMMISSIONER REMICK: How dependent is it
3 on the styles of the individual versus the structure
4 of the organization?

5 DOCTOR RYAN: Well, in a case where you
6 had a large personnel turnover, and given the fact
7 that people have different styles of operating, if
8 we're assuming a machine bureaucracy, it isn't whether
9 that's good, bad or indifferent, it's how well do we
10 operate as a machine bureaucracy. If that individual
11 found it necessary to withhold information or to
12 somewhere the system break down in getting the
13 decisions down to the people that need to know about
14 them, information coming back up so that the
15 centralized decision making could take place, it could
16 have big or small. But the whole methodology is
17 designed to sort of pick some of those things up, not
18 by just looking at an individual or a particular
19 factor, but looking at a group of factors and looking
20 at the patterns.

21 So, the answer, I would think, is yes,
22 that certainly people could come in who had very
23 different styles but still operate very efficiently
24 as a machine bureaucracy. On the other hand, one
25 admiral could be replaced by a second admiral and we

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1 might get some different results because of the style
2 or whatever.

3 COMMISSIONER REMICK: Thank you.

4 COMMISSIONER ROGERS: If I could just ask
5 one. Going from the data collection to the
6 quantification, the second to the third step, how
7 sensitive are the results to that process? Is that
8 a big question? Does that introduce a new large area
9 of uncertainty in taking that step of what the data
10 is that's collected by the observers, either the
11 surveys or the -- the surveys may not be so much, but
12 the direct observation technique, the results, and
13 translating those into quantitative measures in the
14 third step here?

15 DOCTOR RYAN: How much uncertainty --

16 COMMISSIONER ROGERS: What uncertainties
17 does that introduce into your final conclusions? How
18 sensitive is the process to that step, taking the data
19 and translating it into quantitative numbers to plug
20 into the analysis model?

21 DOCTOR RYAN: Okay. The work that we've
22 done on the West Coast simply focused pretty much on
23 could you implement the method, could you get
24 information and could you come up with some numbers.
25 What we're going to do on the next go-round is have

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1 some -- what we're going to start to do is take a look
2 at the relationship between the information as
3 collected and some of the measures on our direct
4 performance indicators.

5 In other words, what I'm trying to say
6 here is that while we may not be able to do a
7 validation of the numbers that would go into the PRA,
8 what we're trying to do is to do what we might call
9 a validation of the information. Does this
10 information coming out of the direct observations of
11 the survey and so on bear some systematic relationship
12 with other things that we have some confidence in as
13 tapping plant safety performance?

14 So, my answer is that while we can't do
15 much about the voracity of the numbers that we come
16 up with in the PRA, we are going to at least be able
17 to get some sense of the completeness and the adequacy
18 of the information, vis-a-vis plant safety
19 performance.

20 MR. COFFMAN: I might add programatically
21 that this is the area that is most creative in this
22 whole process and the one that we feel the biggest
23 need to explore further. So, the uncertainty is
24 largest in this area and you'll see in the discussion
25 on future effort that's one of the places we're

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1 putting our emphasis.

2 COMMISSIONER ROGERS: Okay. Let's go on.

3 CHAIRMAN CARR: All right. Let's proceed.

4 DOCTOR RYAN: Okay. Could I have slide
5 8, please?

6 Slide 8 sort of represents three things
7 that we're trying to do to move this research to a
8 point -- maybe not necessarily the final products, but
9 to move it into the next phase. As I mentioned, we
10 are looking for a second site that will allow us to
11 go in, to implement NOMAC, to take again a look at
12 implementability, repeatability, the acceptability
13 aspect of it -- we have a second group of people. Are
14 they as enthusiastic about this as we experienced on
15 the West Coast -- and is there really internal
16 consistency and completeness in all of this thing?

17 As I mentioned a moment ago in response
18 to Commissioner Rogers' question, we're also going to
19 be interested in the value of some of the information
20 coming out of this. What we were going to try to do
21 is to do some kind of a statistical analysis of the
22 data using measures on the seven direct indicators
23 that we now use in the Agency, taking data from the
24 point in time that we go into the plant and moving
25 backwards, being careful to stop at a point where

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1 there might have been some major change made at that
2 plant. We don't want to confound the results by the
3 fact that an Army colonel replaced a Navy admiral or
4 something. So that's basically what we're going to
5 try to do as far as the method itself is concerned.

6 Secondly, we are doing research on
7 alternative ways to collect data. We have some
8 research ongoing into the possibility of using
9 directed and non-directed interviews. We're also
10 looking at job sampling approaches as alternatives to
11 the direct observation of the survey.

12 We are also doing something else that may
13 be of interest. There has been an interest shown in
14 the Agency of using sort of a risk basis for sort of
15 monitoring whether or not things are improving or
16 degrading at a plant in this particular area. We feel
17 that if a basic risk assessment study were done where
18 these factors were fully integrated to sort of give
19 us a benchmark, that we might be able to use data on
20 the performance indicators periodically to rerun the
21 analysis and let them serve as the input data to
22 these -- on some of these organizational factors, be
23 able to rerun the analysis and sort of watch whether
24 or not some of these changes that are taking place or
25 the performance as demonstrated by the indicators are

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1 suggesting to us that the organizational factors, if
2 you will, are improving or not improving from sort of
3 a risk perspective. So this is something we're going
4 to start taking a look at the feasibility of doing
5 something like that.

6 Finally, we mentioned the quantification
7 procedures. As I mentioned, we have tried or explored
8 the possibility of mapping this information as another
9 performance shaping factor on a task by task basis to
10 modify human error probabilities. We are proceeding
11 with that, trying to refine that further, explore it,
12 and we also have research ongoing pursuing the other
13 alternative, that the organizational factors are so
14 pervasive that they deserve a separate entry into the
15 overall risk equation. That work is ongoing.

16 This basically, Mr. Chairman, completes
17 my remarks concerning the analysis method segment of
18 the activity. Before I start discussing the leading
19 indicators of safety performance, are there further
20 questions?

21 COMMISSIONER ROGERS: Yes. Where does the
22 TALENT project fit into this activity? How do you
23 connect? Is that off on the side, or are you -- is
24 that part of your PRA effort in this regard?

25 DOCTOR RYAN: Okay. The TALENT, which

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1 stands for task analysis linked evaluation technique,
2 is part of our reliability assessment element, one of
3 the activities under that. It's part of the larger
4 human factors program. Certainly that is an attempt,
5 a process management concept for fully integrating
6 human factors into the PRA process.

7 We would expect that when NOMAC has gone
8 through sufficient research and development, it would
9 become part of that, the tool that the user of TALENT
10 would start using very early on during the period
11 where plant familiarization is taking place and some
12 of the systems analysis is being done to develop the
13 plant models. The function analysis part of this
14 would start. And later, as data were being collected
15 on other things, data would also be collected on
16 organizational factors. Certainly the final step when
17 we get to the point in TALENT, in that process where
18 we start quantification, this whatever is the third
19 step of NOMAC would be fit into that. But the TALENT
20 we see as a larger entity that would subsume NOMAC
21 into it, once we get to the point where we have
22 sufficient confidence in saying yes, this should be
23 offered as a tool to be used by --

24 COMMISSIONER ROGERS: That's very helpful.
25 It might be useful in some way to try to schematically

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1 show how some of these things relate. That's very
2 revealing. From what I read of the little bit on
3 TALENT and what I've heard here, I didn't see quite
4 how they fit together. Now I understand that much
5 better just on what you've said.

6 DOCTOR RYAN: We are preparing a draft
7 document on TALENT which does integrate all of these
8 methods into it. It also directs the user to where
9 these various methods might be considered for use
10 throughout the process. So, yes, we do plan to
11 incorporate this into it as soon as it's mature enough
12 that we think we would turn somebody --

13 COMMISSIONER ROGERS: Well, the test is
14 how they relate to each other. Not in detail, but in
15 general terms.

16 DOCTOR RYAN: Well, this would actually
17 become part of TALENT.

18 COMMISSIONER ROGERS: Thank you.

19 DOCTOR RYAN: (Slide) If we could then,
20 if we could turn to slide 9, please.

21 COMMISSIONER REMICK: Just a comment.

22 DOCTOR RYAN: Yes, sir.

23 COMMISSIONER REMICK: I found that NUREG-
24 5538, I see it's in the second draft, but I found it
25 quite difficult to read compared to some of the other

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1 reports that you provided. If there is another draft,
2 you might have people looking at the readability
3 question. It sounded fairly complex.

4 DOCTOR RYAN: We have some of the authors
5 here.

6 COMMISSIONER REMICK: Maybe it's because
7 I'm not a human factors specialist, but it was not as
8 readable as I found some of the other reports.

9 DOCTOR RYAN: Mr. Chairman, if I could
10 then, I'd like to turn to the work we've been doing
11 on leading indicators of safety performance. Before
12 I get into the individual indicators, what I'd like
13 to do is maybe discuss with you a little bit about the
14 concept and I think it then may be later a little
15 easier and more straightforward explanation of the
16 individual indicators.

17 As you see here on the bottom, we talked
18 about plant characteristics, the policies, the
19 procedures, the staffing and all the things that go
20 into representing the characteristics of a plant. We
21 would expect those moving to the right in this little
22 schematic that we would observe certain kinds of
23 performance. Some of that performance would have to
24 be with the generation of electrical power. Some of
25 it might have to do with the financial stability of

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1 the plant, and some of it might have to do with
2 compliance with regulatory requirements.

3 In turn, moving further to the right, we
4 might expect that some combinations of those
5 performances would lead to safe or non-safe
6 performance. What our job has been is to try to
7 identify some of these observed performances for which
8 we have data available and to see if we could
9 establish some kind of statistical relationships with
10 what we call safety performance. So, we are trying
11 to move to the left in the little diagram, even though
12 the flow would be from the left to the right.

13 In order to do this, obviously it's
14 necessary to have some statement of what we mean by
15 safety performance. What we have used are the seven
16 direct indicators that have been sanctioned by the
17 Agency as the criteria that we would use to try to
18 identify these leading indicators.

19 The next step in the process was to
20 acquire data on as many as 72 plants for throughout
21 the 1980s and to identify some of these observed
22 performances based on our understanding of the
23 relationships between the way the plant might be
24 organized and the kinds of things that we might
25 observe, and run some correlations. For the leading

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1 indicators to have any value, certainly we would like
2 to them to be preventive rather than explain something
3 that's already happened. So, we were interested in
4 a lag time.

5 So, what we did was we took observations
6 on this observed performance area and took FY '81
7 data, for example, on those and correlated it with '82
8 data on the direct indicator to see if, in fact, there
9 were relationships. We repeated the process using the
10 year lag time and we were able to identify a series
11 of the observed behaviors that appear to be leading
12 indicators of what we might expect at a later date on
13 the direct indicators.

14 Now, the other part of our task was to
15 label that observed performance. That is make some
16 inference about what it was we were talking about.
17 Were we talking about the organization, were we
18 talking really about the maintenance program and so
19 on. So, what this little schematic is intended -- is
20 to sort of lay out what the safety performance
21 measures were, indicate to you that we were interested
22 in the observed performance, the leading indicators,
23 establishing some kind of a systematic or statistical
24 relationship between the two with a lead time built
25 in and to make some inferences about what those

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1 observed performance measures really were telling us.

2 As I mentioned, these were carried out and
3 we have had some success, in which case these have
4 been documented and the reports have been provided to
5 the Commission.

6 (Slide) Could I have slide 10, please?

7 COMMISSIONER ROGERS: I think this is
8 really sort of the heart of a lot of what you're doing
9 here. Can you give me some idea of what the time
10 scales are that you're talking about here? The
11 observed performance, presumably at time zero,
12 produces a safety performance at time T later on.

13 DOCTOR RYAN: That's correct.

14 COMMISSIONER ROGERS: And what is that?
15 My understanding of one of the performance measures
16 is a lag itself in responding to something.

17 DOCTOR RYAN: I'm not sure I understand.

18 COMMISSIONER ROGERS: Well, how soon
19 management takes action after an LER or something of
20 that sort. My understanding is that was also part of
21 one of your performance measures. Is that right?

22 DOCTOR RYAN: Yes, and I --

23 COMMISSIONER ROGERS: Well, I mean, that's
24 a different time scale, so you've got to separate
25 these things clearly enough so that one is the

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1 antecedent to the other.

2 DOCTOR RYAN: Well, remember these were
3 correlational coefficients and we really can't say a
4 whole lot about cause and effect relationships, but
5 we are doing some things that I was going to talk
6 about here in a minute.

7 COMMISSIONER ROGERS: Well, of course, but
8 you have to have them separated enough in time so that
9 at least that makes some sense to think about that.

10 DOCTOR RYAN: What we did is we chose a
11 year. We had limited resources, so we used for
12 purposes of this research in all cases normally a year
13 lag time.

14 COMMISSIONER ROGERS: Between what and
15 what?

16 DOCTOR RYAN: Between the observed
17 performance on the candidate leading indicator and our
18 observations on the direct indicators.

19 COMMISSIONER ROGERS: Yes, but those
20 safety performance indicators represent an integration
21 over a period of time that's roughly a year anyhow.

22 DOCTOR RYAN: Well, what I'm saying here
23 is we took FY '81 data, for example, and computed the
24 indicator, then took FY '82 on the direct indicators
25 and recognizing, yes, that's an accumulation of the

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1 data through the year period.

2 We selected a year lag time because it
3 seemed most reasonable. We were unable to go and have
4 variable lag times because of some limitations on
5 resources, and at the time we were kind of trying out
6 the concept. Again, we were limited to data that we
7 normally collect in the Agency, either through our
8 mandatory or voluntary reporting systems, data that
9 might be collected on a regular basis during licensing
10 qualifications, and thirdly data that is kept and
11 readily available to the NRC from other agencies. For
12 example, in here we received a lot of data from DOE
13 and the University of Chicago on financial health of
14 the plants. But, a year was chosen.

15 One of the things that we're working on
16 now is lag time optimization, and after I go through
17 these I'll explain to you exactly --

18 COMMISSIONER ROGERS: Like to hear more
19 about that.

20 DOCTOR RYAN: -- the follow-up to what
21 we've already done.

22 MR. COFFMAN: If I could amplify just a
23 minute that there are really two steps and we were
24 going to take them in that order. First is you have
25 to establish that there is in fact a relationship

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1 between the observed performance and then a safety
2 measure like the performance indicators. First you
3 establish the relationship, then we may be able to
4 explore how would you grade the response time about
5 some norm or something. But first it was just to
6 establish the relationship, that there was a real
7 connection.

8 DOCTOR RYAN: (Slide) I believe we're on
9 slide number 10.

10 As I mentioned to you earlier, we're
11 working and have been working on these leading
12 indicators in four areas. In the organizational area,
13 we literally have developed and have done an initial
14 validation of basically two indicators. The first we
15 call organizational learning, and it involved major
16 violations and reportable events. The second area has
17 to do with financial health, made up of a debt equity
18 ratio and a return on assets part of the indicator.
19 We were able to track through the 1980s by looking at
20 these indicators and then looking at the direction
21 that the direct indicators were going.

22 Now, with a little explanation here, it
23 can be assumed that all complex organizations are
24 going to have things happen, the reportable events,
25 possible major violations. That isn't what's

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1 interesting. It's what they do about it. And what
2 we were able to do, tracking through the '80s, was
3 seeing that overall the utilities were very
4 responsive, that when these things would happen there
5 would be action taken and the scores, if you will, on
6 the direct indicators started going down in subsequent
7 years.

8 Another phenomenon that happens in life
9 is that we sort of rest on our laurels, that we pass
10 the crisis, every thing is going well and we sort of
11 to some extent go on automatic pilot and there's a
12 tendency for things -- so, we were able to walk
13 through the 1980s with this by looking at the
14 direction and the trending on these and looking a year
15 later at some of the direct indicators.

16 The same thing was possible with the
17 financial health data. I don't think it's terribly
18 new to say that the better the financial health of any
19 organization the more they might be likely to attend
20 to things like safety. I think we have a good example
21 with Eastern Airlines recently. They were running
22 into financial problems, ultimately were falsifying
23 maintenance records and everything else, cutting
24 corners on safety. So, this we were able to do also,
25 to watch these indicators and watch what happened the

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1 next year. So, the initial validation in that area
2 is being done, as far as the control, and that
3 material has been provided to the Commission in the
4 NUREG/CR-5437.

5 COMMISSIONER REMICK: Let me ask a
6 question on that point.

7 DOCTOR RYAN: Yes, sir.

8 COMMISSIONER REMICK: I was somewhat
9 surprised by that one, because I like to make the
10 argument that you can be very successful financially
11 by not investing in safety, at least for some period
12 of time before you get caught.

13 Did you look specifically at cases of
14 plants who have gotten in trouble and looked then if
15 this would have been an indicator in the years ahead
16 of getting into that trouble?

17 DOCTOR RYAN: Commissioner Remick,
18 remember we just grouped the data across 72 plants.
19 We are well aware that obviously everyone probably
20 didn't follow that path, if you go in on a plant by
21 plant basis.

22 We also had to make the assumption that
23 if in fact you had available capital that a certain
24 amount of that would go for this. I mean, that's an
25 assumption. What we're doing this year is we're going

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1 back behind the analysis, and again I was going to go
2 through the things we're doing with it to try to take
3 a look at some of those things. In fact, with some
4 more additional financial data, how much of that could
5 we really verify actually went into programs that
6 might be focusing on safety and so on?

7 What we have here are basically the
8 observed performance across all the plants, measures
9 on the direct indicators, and have the correlation.
10 And again this year we're trying to get behind that
11 and there are some things I was going to talk about
12 here.

13 COMMISSIONER REMICK: The 72 plants as a
14 group?

15 DOCTOR RYAN: Yes, right. Well, the
16 correlations that were done were across all of the
17 plants for all of the years. And certainly, as
18 grouped across all the plants, yes, these correlations
19 stood up. I have no doubt that the reason we didn't
20 get a .999 correlation was that there are some of the
21 plants that may not have responded or been -- followed
22 the theory very well.

23 With regard to the control room teams, we
24 have identified a series of candidate indicators and
25 we're in the process of evaluating those and we do

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1 expect the results of that early in calendar year
2 1991. And I've indicated we do have a Pacific
3 Northwest Laboratories report out that you do have.
4 It talks about the research up to the point of
5 actually doing the evaluation. We will have another
6 report out as soon as that's finished early in
7 calendar '91.

8 In the maintenance area, again, we have
9 actually developed and done an initial validation of
10 at least two indicators. The first, as indicated
11 here, has to do with ESF actuations due to tested
12 maintenance at power and a gross heat rate indicator.
13 We are in the process right now of evaluating a daily
14 power fluctuation indicator. Volumes 1 and 2 of the
15 NUREG there report our work on the first two
16 indicators and we will be producing a volume 3 to that
17 on the daily power fluctuation.

18 In the training area, we are taking a look
19 at a number of team-building indicators and time on
20 certain subjects, instructor/student ratios, resource
21 allocation, and we're in the process of trying to do
22 an initial validation of those.

23 As I mentioned earlier, we have an
24 interest in non-nuclear indicators. We have published
25 a report, which you have. It was done for us by a

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1 contractor who went out, started looking at the
2 military, civil aviation, chemical processing industry
3 and so on, and we have pretty much chosen to do
4 subsequent work in the chemical processing area. It
5 does offer a number of analogues with our industry.

6 We're in the process right now, having
7 published the feasibility study, of doing work with
8 Proctor and Gamble and DuPont to review some
9 indicators that they've developed, how they went about
10 validating them and how they've been using them, to
11 try to select a subset of these indicators to try out
12 in a nuclear setting. So, I guess the point here is
13 we're trying to take advantage of what's been done.

14 Finally, at the bottom of the page here,
15 we have developed a framework for taking individual
16 indicators, be they direct indicators, leading
17 indicators, whatever, individually and in combination
18 and making interpretations of them, looking for the
19 holes, looking for the redundancies. We're in the
20 process right now of taking that framework and taking
21 all seven of the current indicators along with a cause
22 code indicator that's being looked closely at and
23 seven of the leading indicators and working them
24 through this network or this framework to see the
25 degree to which it can actually be used to look at

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1 these combinations and make judgments.

2 We are in the process of doing that in a
3 report that you'll see, NUREG/CR-5610, that we hope
4 to have finished by around March of 1991. And, we see
5 this as very important, because obviously people
6 trying to use the indicators and trying to look at
7 them collectively and individually certainly might be
8 interested in this.

9 In fact, I should add, as a footnote here,
10 the stimulus for this was provided to some extent or
11 primarily by Commission Carr -- then Commissioner
12 Carr, now Chairman -- who was being briefed on the
13 performance indicator program and asked the question:
14 "I've got all these indicators in front of me. How
15 do I take a step back and really make an assessment
16 of what I can say about them?" And, that was sort of
17 one of the triggers that led us to try to see if we
18 couldn't come up with some method that could be used
19 for that purpose.

20 COMMISSIONER ROGERS: Are you doing this
21 quantitatively or -- I mean, when you say a pattern,
22 how literally --

23 DOCTOR RYAN: No. We are trying to stay
24 away from what might be considered composites of
25 things. Basically, what we have is something called

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1 a "hierarchical decomposition framework." We start
2 with plant safety up top, work our way down through
3 the functions, the systems and so on, and there are
4 certain rules allowing one to move horizontally and
5 vertically in this schema and the various indicators
6 get plugged in at various points. And by plugging
7 them in, abiding by the rules, it becomes fairly
8 apparent fairly quickly how much can I really say just
9 using measures on those indicators. How much can I
10 say, using them in combination, depending upon where
11 they fit in?

12 Also, there is an interest of how do I get
13 all the way up to the point where I can start really
14 making statements about overall plant safety. How
15 many of these do I need, what kinds? And, of course,
16 as I mentioned earlier, we're interested in some of
17 the redundancies.

18 MR. COFFMAN: It's obviously not
19 quantitative. We're just looking for patterns that
20 are in the potential outcomes that the indicators
21 could give you.

22 DOCTOR RYAN: (Slide) Could I have slide
23 11, please?

24 As I mentioned, there are two of these
25 areas where we've actually completed the initial

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1 validation of the indicators, namely in the
2 organizational learning and financial health area and
3 in the maintenance area having to do with the ESF
4 actuation indicator and the gross heat rate indicator.
5 The next steps in that process are represented by
6 these five bullets.

7 The first thing that we're in the process
8 of doing is doing what we call a qualitative
9 validation. Yes, we do have a statistical
10 relationship, but do the people who are supposed to
11 use the indicators or are going to be affected by the
12 indicators, do they believe that? Does it make sense
13 that, by looking at major violations and reportable
14 events, somebody is willing to say, "Yes, that's
15 organizational learning. I'm willing to do something
16 about that." So, we're really trying to now take the
17 step toward what we might call face validity.

18 The second thing, we recognize that we
19 need additional statistical validation of this. We
20 need to take more data from the same era and see if
21 we can replicate the statistical side of it. So,
22 that's the second thing we're doing.

23 Thirdly, we recognize that these are
24 simply outputs, that a major violation could accrue
25 from a lot of reasons; and if somebody is going to use

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1 these indicators, that when we get to the threshold
2 on them, certainly -- and they want to do something
3 about them, they need to have some kind of a shopping
4 list of things they might start looking at in the
5 plant. So, we're going back and doing a content
6 analysis of some of the event reports to see if we can
7 get some kind of a frequency count on some of these
8 causes so that we might be able to provide the typical
9 user with sort of maybe a little shopping list if he
10 or she wants to go back and start trying to say "What
11 do I have to change here?"

12 The fourth area gets me to the lag time
13 question. As I mentioned, because of limited
14 resources and the fact of where we were, we took a
15 year. Now, we have reason to believe in looking at
16 the data that in the case of organizational learning
17 the kinds of things that were done would probably show
18 up in less than a year. If you're trying to look out
19 there over some period of time, we have reason to
20 suspect that the onset of changes in the direct
21 indicators probably would start in less than a year.

22 On the other hand -- and this goes to the
23 financial data -- we have reason to believe that
24 improved financial condition or deteriorating
25 financial condition might take longer before you

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1 really started to see the cutting of corners and
2 additional scrams and things. So, what we are doing
3 is we're going back to the data and we're going to
4 take a look at where in time is the maximum
5 correlation and where in time prior to that does the
6 change really start, so that again the user who might
7 be trying to use the leading indicators can say, "Hey,
8 I've got six months, it appears," or "I've got nine
9 months or a year before, if I don't do something, that
10 other things are going to start to deteriorate."

11 The last thing we're doing we call --

12 CHAIRMAN CARR: Before you leave that --

13 DOCTOR RYAN: Yes, sir?

14 CHAIRMAN CARR: -- intuitively, the down-
15 time lag is less than the up-time. If you're on the
16 down side of that sort of cycle, it's faster than it
17 is if you're trying to get back up on the good side.

18 DOCTOR RYAN: Yes.

19 CHAIRMAN CARR: So, if you're -- I guess
20 what I'm concerned about, how are you going to take
21 care of the indicator that -- I can see where you can
22 say the indicator says you're going down. That's
23 faster. But then, if you want to know am I getting
24 well, it may have to take a different length of time.

25 DOCTOR RYAN: This last bullet gets into

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1 something we call indicator benchmarking and maybe
2 this -- I'll explain it to you and if this is
3 responsive, fine, or we can continue discussion.

4 We also realize that if someone is going
5 to use an indicator and they're watching a trending,
6 that there have to be points in time or scores on the
7 indicators or points where we need to pay more
8 attention just to have things sort of follow each
9 other. They may be in a zone that really doesn't make
10 much difference.

11 What we are doing is going back to all of
12 the data and doing something we call "curve fitting."
13 We're taking a look at all of the trend lines on the
14 leading indicators and taking a look at all of the
15 trend lines on the direct indicators and we're trying
16 to find if there are points on those direct indicators
17 where we have spikes. That is, everything is going
18 along, the leading indicator is trending up and, boy,
19 it gets to a certain point and things really start to
20 fall apart fast on the direct indicator or start to
21 get better or something.

22 Because, what we would like to be able to
23 do at least to some extent is to give the user some
24 kind of guidelines as to how to maybe use the
25 indicator and when we might move from a green to a

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1 yellow condition or to a red condition and so on.
2 Now, it may very well be that we have two of these
3 benchmarks, one for getting better, one for getting
4 poorer, because the shape of the curve is such that
5 it's very gradual at one end and maybe very sharp at
6 the other. So, we are going to attempt to try to do
7 some of that kind of work to see if we can provide the
8 ultimate user with something to guide in the use of
9 these.

10 Mr. Chairman, that completes my
11 presentation on the leading indicators work we've done
12 so far. Before I move on to the staff that's doing
13 the work and the consultants we have and some of our
14 conclusions, are there any further questions about the
15 indicators?

16 CHAIRMAN CARR: Let's proceed.

17 DOCTOR RYAN: Okay.

18 (Slide) Could I have slide 12, please?

19 As you can see from this slide, there are
20 three staff in the Agency who have primary
21 responsibility for the day to day management and
22 conduct of this research, myself and two of the staff
23 members.

24 As I mentioned earlier, we do have right
25 now 11 research projects ongoing, contracted out. The

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1 contractor assistance is from the array of entities
2 that you see. We have two of the labs, 11
3 universities, five commercial firms, three national
4 research institutes, and a whole series of
5 consultants.

6 I might make one point about this. With
7 the exception of maybe two or three of the projects,
8 we have multi-disciplinary teams working on these, in
9 most cases cutting across these entities. We
10 recognize in this area that certainly we need the
11 conceptual, the theoretical expertise that we can get
12 out of the university, but at the same time and on the
13 same team we recognize we need to have people that
14 know about nuclear power plants so that some reality
15 can be brought to the research itself, not when we go
16 out to try to go into the plant to do an evaluation,
17 but from the very beginning. So, on all of our
18 projects we do have multi-disciplinary teams ranging
19 from the university and the people that have a lot of
20 experience in the plants.

21 Are there any questions about any of the
22 consultants or any of that?

23 Okay. If there aren't -- yes, sir?

24 COMMISSIONER REMICK: I'd like to commend
25 you on the diversity of research providers. I think

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1 it's the best example in the Agency of this diversity
2 and interdisciplinarity and I applaud you for that.

3 COMMISSIONER ROGERS: That's a good point,
4 yes.

5 DOCTOR RYAN: (Slide) Slide 13, please.

6 In wrapping up, then, based on our two
7 years of experience in this area, I think there are
8 three things that we can say.

9 One, we do feel that we are focused on
10 specific researchable issues that have been raised
11 amongst the three offices: AEOD, NRR, and ourselves.

12 Secondly, we think we have put together
13 a program and a process that is pretty systematic and
14 certainly is directed toward products that the Agency
15 can use in one of its -- more of its capacities.

16 And lastly, I would just like to add as
17 a footnote that it does take a great deal of effort
18 to gain access to the plants. Obviously, or final
19 check on anything we do is certainly a reality check.
20 Can it be used at the plants? And certainly, this is
21 a factor in some of our scheduling.

22 Mr. Chairman, this pretty much completes
23 my presentation. We're open for further discussion.

24 CHAIRMAN CARR: Before you leave that one,
25 let's explore that last bullet. A great deal of

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1 effort on whose part?

2 DOCTOR RYAN: Basically, on the staff's
3 part and the contractor's part. We spent eight months
4 lining up the plant on the West Coast that allowed us
5 to go in and evaluate NOMAC.

6 CHAIRMAN CARR: Well, how much -- how many
7 people -- I mean, what kind of access do you need?
8 How many people, how long, and how much interference
9 does it cause at the plant?

10 DOCTOR RYAN: We found that on the West
11 Coast it really didn't interfere. And in fact, we
12 found that once the utility began to realize exactly
13 what we were doing, that the benefits that would
14 accrue to them from what we were doing were sufficient
15 to, as I mentioned earlier, wanting to go almost
16 immediately from the fossil plant to the NRC-licensed
17 facility. But, it was a lengthy process and we
18 estimated it was about a third of a year staff time
19 that was devoted by the contractor to do all the
20 meetings and make all the contacts and do the
21 briefings and explanations and all that associated
22 with it.

23 MR. COFFMAN: That was to gain access, to
24 actually --

25 DOCTOR RYAN: Yes, that was just for the

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1 access.

2 CHAIRMAN CARR: But, is that time fixed
3 no matter what plant you go to?

4 DOCTOR RYAN: We're now talking to some
5 other utilities. As I mentioned, we're going to try
6 to go into a second entity. How long it will take,
7 we're not sure.

8 MR. COFFMAN: I think the point is that
9 we've tried to be systematic, but in order to proceed
10 there are places that are outside our control.

11 CHAIRMAN CARR: Well, I'm trying to figure
12 out what's the problem. Getting permission from the
13 plant to come in?

14 DOCTOR RYAN: That's correct.

15 CHAIRMAN CARR: Nobody asked me to help.

16 MR. TAYLOR: It's not just getting
17 permission. You have to have the cooperation of the
18 plant.

19 CHAIRMAN CARR: Well, I know, but --

20 MR. TAYLOR: So, it does --

21 CHAIRMAN CARR: -- the CEOs and I talk all
22 the time and I've never asked them how about letting
23 us get in there --

24 MR. TAYLOR: We haven't come to you.

25 CHAIRMAN CARR: -- and do some research.

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1 DOCTOR SPEIS: We don't have big problems
2 right now. I think one of the points we're trying to
3 make is that progress is very slow in this area. It
4 just takes some effort and we haven't reached the
5 point that we'll have to come to you.

6 CHAIRMAN CARR: Well, you have if you've
7 wasted a lot of time.

8 MR. TAYLOR: I think that was the first
9 nuclear plant. We were very -- that's one of the
10 reasons they did a fossil plant to try it on, and we
11 knew or were concerned about the impact. We've talked
12 a lot about it. PG&E cooperated very nicely after a
13 lot of discussion and they also now apparently feel
14 there has been a net benefit or worth to the effort,
15 which I think will help us in gaining access to
16 others.

17 CHAIRMAN CARR: Well, how many people do
18 you put in the plant and how long are they there?

19 DOCTOR RYAN: The NOMAC team involves
20 about five people and I would have to go back and
21 resurrect the exact hours that were spent at the
22 fossil plant and the nuclear plant. I think it was
23 about, I guess, somewhere between two and three staff
24 weeks of each of those people. That seems to be it.

25 MR. COFFMAN: And we're proceeding

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1 carefully and conservatively in this, so --

2 CHAIRMAN CARR: Well, I don't mind how
3 slow you're going, but when you finger somebody and
4 say, "I can't get into his plant and that's holding
5 me up," you get my attention. You know?

6 MR. COFFMAN: No, we're not fingering
7 anybody. In fact, we wouldn't have made the progress
8 that we did if it weren't for the cooperation of --

9 CHAIRMAN CARR: Can we delete that bullet?

10 MR. COFFMAN: As long as we don't get held
11 to a schedule that -- yes, sir, we can --

12 CHAIRMAN CARR: You know, if you can't
13 meet your schedule, you've got to tell somebody.

14 MR. TAYLOR: I think you walked into this
15 one, Frank.

16 COMMISSIONER ROGERS: Well, he's trying
17 to back out.

18 DOCTOR RYAN: Well, I think it should be
19 said that we are moving ahead. We've had a lot of
20 success. And, one of the factors that are somewhat
21 beyond our control here is the time --

22 MR. TAYLOR: We'll let you know when we
23 have a problem.

24 CHAIRMAN CARR: Good.

25 MR. TAYLOR: Right?

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1 DOCTOR RYAN: Right.

2 COMMISSIONER ROGERS: Not on that itself,
3 but I take it that when you were first thinking about
4 trying to do a study there was some concern within
5 NRR, I guess, of doing it with any of our licensees
6 because of --

7 MR. TAYLOR: Right. How much interference
8 were you going to have.

9 COMMISSIONER ROGERS: Well, or is it
10 somehow or other going to give us some difficulties
11 with other things.

12 CHAIRMAN CARR: Well, there's going to be
13 a lot of concern out there on what's -- why and what
14 are the results and what are you going to use it for.

15 COMMISSIONER ROGERS: Right.

16 MR. TAYLOR: You'll have to understand
17 what you're doing when you do all this observation.

18 COMMISSIONER ROGERS: Well, do we feel
19 much more comfortable now than we did initially? Is
20 that --

21 CHAIRMAN CARR: I guess what we're really
22 saying is --

23 COMMISSIONER ROGERS: -- extending this
24 to more plants now.

25 CHAIRMAN CARR: -- can we use that plant

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1 as a reference?

2 DOCTOR RYAN: Certainly.

3 CHAIRMAN CARR: Okay. That's what we're
4 really saying is if Joe from plant B calls up Bill
5 from plant A and says, "Hey, are these guys any
6 problem and do you think it's a good idea?" is he
7 going to say, "Yes, I think it's a good idea and you
8 ought to let them in"?

9 DOCTOR RYAN: We would be fairly confident
10 that that's what would happen.

11 CHAIRMAN CARR: I'd hope you'd be real
12 confident, because that's what's going to happen.

13 DOCTOR RYAN: Yes. We are confident that
14 that's what will happen. We have reason to understand
15 that the management at the plant that we were in are
16 still using the data that were gathered to make
17 some --

18 CHAIRMAN CARR: Let me ask you one other
19 question in this area. You were talking about
20 operator stress level during off-normal situations,
21 and since I'm sensitive to stress levels and off-
22 normal situations by virtue of being beat on by some
23 of the utilities in requal exams, do you have a member
24 of the HF team at a requal exam to observe?

25 MR. ROE: Yes, sir. We have selected

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1 requalification exams they observe. Also, part of our
2 look at reducing the stress in requal is that after
3 it's over we will go to certain selected sites, those
4 who have done well, those who have not done well, and
5 interview them.

6 CHAIRMAN CARR: Is that an input into your
7 study?

8 MR. ROE: Not so far, because we have just
9 launched that particular program.

10 CHAIRMAN CARR: Couldn't it be?

11 DOCTOR RYAN: Possibly, yes.

12 MR. ROE: Yes.

13 CHAIRMAN CARR: That's about the only
14 place you're going to get that, because you'll spend
15 a lot of time at a plant, hopefully, waiting for a
16 stressful situation.

17 MR. TAYLOR: We'll get it at the
18 simulators.

19 CHAIRMAN CARR: Okay. Questions? Any
20 other comments from the staff?

21 MR. TAYLOR: No, I don't believe.

22 Anybody?

23 Denny or Joe, do you have any?

24 CHAIRMAN CARR: Commissioner Remick?

25 COMMISSIONER REMICK: A related question

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1 to what you asked. I'd like to look at Jack Roe and
2 ask are we still following the practice of -- I think
3 the word is "embargoing" people before they take a
4 requal exam or are we locking them up after they had
5 exam?

6 MR. ROE: No, we're not following that
7 particular practice. The only embargoes we put is--

8 CHAIRMAN CARR: Sequestering.

9 COMMISSIONER REMICK: That's a better
10 word. That's a better word.

11 MR. ROE: -- is that normally we request
12 the utility to provide us two subject matter experts
13 to assist the team to assure that the requalification
14 examination is on the mark as far as the technical
15 questions, the scenarios we run, and it represents
16 fidelity with the plant. Those are normally a senior
17 reactor operator from the operations department and
18 a similarly qualified person from the training
19 department. Those two people are asked not to divulge
20 any of the information they gain before the
21 examination to the members of the crew to keep it
22 basically --

23 COMMISSIONER REMICK: But how about -- my
24 understanding is we were taking people who yet had to
25 take the exam, locking them away so they could not

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1 talk to people who had taken the exam and they
2 indicated that was terribly stressful.

3 MR. ROE: We've changed that practice.

4 COMMISSIONER REMICK: Okay, good.

5 A couple other questions related to the
6 discussion we just had also. To what extent, if any
7 in this type of research, are you able to use our
8 simulator facilities at Chatanooga? I guess on
9 organizational factors, probably not, but how about
10 indicator?

11 DOCTOR RYAN: We have used the simulator
12 at Chatanooga. I mentioned to you that we have a
13 report the Pacific Northwest Laboratories did, this
14 report number 7250 that focuses on control room team
15 indicators. And, as a matter of fact, for the
16 purposes of developing those indicators we did collect
17 data on at least one of the simulators. Now, this did
18 involve instructor personnel. It was instructor
19 personnel that were involved.

20 So, the answer is yes. We have used it
21 and we intend to use it to the extent that we can in
22 the future.

23 COMMISSIONER REMICK: Good.

24 I think in the past both the ACRS and the
25 Commission cautioned that the type of work you're

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1 doing is very difficult and it's important that you
2 provide adequate oversight. You indicated you have
3 three people. Do you feel that you're able to provide
4 the oversight that's necessary on these projects so
5 there is some realism and practicality to hopefully
6 what comes out?

7 DOCTOR RYAN: Yes, sir, we believe we can.
8 We're in contact with the contractors almost
9 continually. We participate in the projects. Last
10 April, for example, we brought all of the contractors
11 together for three days at American University and
12 literally had an information exchange workshop so
13 that, not only were we involved in all the projects,
14 that each of the contractors knew exactly what
15 everybody else was doing, who they were, how they
16 might exchange information.

17 And more recently, we have started three
18 of our projects, one with UCLA, one with Penn State,
19 one with an organization called Accident Prevention
20 Group looking at these alternative data gathering
21 methods and the quantification issue, and we had a two
22 day meeting here in this very building about two weeks
23 ago where we brought people all together. And so, we
24 feel pretty comfortable that we got a fairly close
25 tight rein on this, not only between we on the staff

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1 and the contractors, but amongst them so that they not
2 only know what they're doing but what everybody else
3 is doing.

4 COMMISSIONER REMICK: I was very pleased
5 to see that DuPont, Proctor and Gamble, and Pacific
6 Gas and Electric apparently volunteered to participate
7 and I hope you pass on at least one Commissioner's
8 pleasure with the fact that they've done that. I was
9 somewhat surprised to see DuPont and Proctor and
10 Gamble, but I can understand the reasons and am very
11 pleased.

12 One final question. In a recent ACRS
13 letter, one of the members indicated that there's not
14 much need for research in this area. There's been a
15 lot of research done and what is really needed is to
16 take the results that already exist and apply them in
17 the nuclear industry. Do you have any specific
18 comment to that comment?

19 DOCTOR RYAN: Are you referring to Mr.
20 Lewis' comment at the tail end of the --

21 COMMISSIONER REMICK: Yes, I am.

22 DOCTOR RYAN: I would agree that there is
23 a real technical base, a lot of technical knowledge
24 out there on the subject. That is the reason that we
25 consider this very much an applied program. And what

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1 we attempt to do is to benefit from what other people
2 have done, the methods, the ideas and whatever, and
3 apply them in this industry.

4 I have been associated with maybe 50
5 research projects in the human factors area since
6 coming to the NRC about eight and a half years ago and
7 I do not know of one case where we were able to pick
8 something up from some other industry and as a piece
9 of whole cloth just introduce it.

10 In the cases of the two data collection
11 instruments that we've talked about today, one of
12 those is even copyrighted, but it was necessary for
13 us to change it dramatically to make it useful in a
14 nuclear power plant setting.

15 The direct observation approach is based
16 on work done at Purdue, another instrument that's on
17 the market that we had to change rather dramatically
18 to make it useful in our setting. And of course, once
19 you do that you introduce a requirement for validation
20 and evaluation of it and can this be done kind of
21 thing. So, while I think that certainly there is a
22 technology base out there in this particular area, I
23 think that in no way -- at least it's been the
24 experience here -- negates the necessity of going
25 through a research process.

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1 Additionally, I think hopefully we've
2 communicated to you this morning that in the area of
3 these quantification procedures, trying to take this
4 information and fold it into the risk assessment, I
5 wouldn't even consider that applied research. I think
6 we're -- I don't want to call it basic research, but
7 I think we're kind of on the cutting edge and there
8 really isn't much out there for us to sort of lean on.

9 So, in a sense I agree with the fact there
10 is a lot of information out there, but I certainly
11 don't think that negates doing the kinds of research
12 that we're really doing, admittedly more applied than
13 anything else.

14 COMMISSIONER REMICK: I remember several
15 years ago you had a project ongoing, not in this area,
16 I believe with I think George Mason University trying
17 to utilize industry experience. Is that still
18 ongoing?

19 DOCTOR RYAN: Yes, sir. We're wrapping
20 up. It was a three year grant. It is part of the
21 reliability assessment program that we mentioned,
22 TALENT, a little bit earlier. And the motivation
23 behind that was that we don't have a lot of data in
24 this industry and could we develop some criteria that
25 would allow us to equate a task performed in this

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1 industry with a task performed in, say, the military
2 or somewhere else for which there is a lot of data
3 available. And what we would like to do is use the
4 error probabilities that might come out of that other
5 area as bounding values or something to be used in our
6 analyses.

7 George Mason has published a NUREG/CR-
8 5438, which lays out the taxonomy for doing this.
9 They've completed that work. And what they're doing
10 for us now in this last year of the grant is they've
11 gained access to some databases from the Air Force and
12 other places and they're literally taking the data
13 from those databases, running them through this
14 taxonomy, and are generating for us a matrix of data
15 that we hope to publish and also put in what we call
16 the NUCLARR risk assessment database that we have
17 developed.

18 So, the answer to your question is, yes,
19 they have developed that and they are in the process
20 now of literally using this to provide us with a
21 matrix of data.

22 COMMISSIONER REMICK: Thank you for a very
23 clear and orderly presentation as usual, Tom.

24 DOCTOR RYAN: Thank you, sir.

25 CHAIRMAN CARR: Commissioner Curtiss?

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1 COMMISSIONER CURTISS: I just have two or
2 three questions, picking up on comments that were made
3 already. It looks like you're going to be completing
4 the bulk of your report here in the FY '91 year.
5 There are going to be some products and deliverables
6 coming up in that time period. When you've reached
7 that point, is it envisioned that the objective of
8 this program would be essentially to share the
9 information with the user, the licensee community, or
10 do you contemplate some sort of regulatory application
11 through NRC including, but not limited to, say, our
12 inspection program for the work that you're
13 undertaking?

14 DOCTOR RYAN: As was indicated at the
15 beginning of the presentation by Mr. Taylor, certainly
16 we are trying to develop a technical base to support
17 some of the regulatory activities that go on in the
18 Agency, ranging from reviewing risk assessments to
19 doing inspections and things like that. I think,
20 speaking from the research side, it probably remains
21 to be seen as to exactly how NRR, AEOD and others
22 might use some of the results of this. I think as an
23 Agency, I guess, maybe we'd have to decide exactly
24 how--

25 MR. TAYLOR: I think it's early.

1 COMMISSIONER CURTISS: Let me shift over
2 and ask NRR.

3 CHAIRMAN CARR: Before you leave that one,
4 let me jump in on it a second. When we originally put
5 it out, it was hopeful that NRR and AEOD were going
6 to be able to use the results of this research in
7 evaluating plant safety. Are AEOD and NRR involved
8 with you in evaluating what you're doing now?

9 DOCTOR RYAN: Yes, sir. We have a number
10 of vehicles for that.

11 First of all, we have points of contact
12 that are very much involved at a project level. In
13 fact, in almost all of our procurements, people from
14 the user office served on our source evaluation
15 panels, literally reviewed the proposals and
16 participated in that process.

17 We also have something called the Research
18 Program Review Group. These are groups of branch
19 chief level people that we go before periodically to
20 review the progress, the status, and sort of the
21 direction of each one of these projects. These are
22 branch chief level people from the user offices as
23 well as Research and they do give us guidance.

24 CHAIRMAN CARR: Well, I guess I'm more
25 interested, when you're testing your prototype

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1 product, to see whether there is correlation or not.
2 Are they involved in that?

3 DOCTOR RYAN: In the case of the leading
4 indicators of performance, since we were using data
5 on the direct indicators that AEOD is working with,
6 they were very much involved. We were working with
7 them with the data and so on.

8 CHAIRMAN CARR: Excuse me.

9 COMMISSIONER CURTISS: I guess that's the
10 area in particular that I had an interest in. I
11 understand the potential application of this work to
12 plug in a number in the PRA context and we've spoken
13 about that before. But in the area of the indicators,
14 for example, I guess I have a couple of questions, one
15 focused just on the maintenance indicator. Are we
16 coordinating the work that we're doing here with the
17 work that AEOD has done on the maintenance
18 effectiveness indicator and how do those two programs
19 relate to one another?

20 DOCTOR RYAN: Remember now, we're talking
21 about not direct indicators but leading indicators,
22 and I think that AEOD has sort of tried to direct
23 their activities to the direct indicators. We are
24 coordinating. There are discussions about how some
25 of these leading indicators might be used. In fact,

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1 one that we developed earlier, this cause code
2 indicator, is actually undergoing some tryout. So,
3 I guess that's what I can say to this.

4 COMMISSIONER CURTISS: Okay.

5 Jack, let me ask, from NRR's perspective
6 as you bring the work that's been described here down
7 to a local level, plant-specific level, and
8 recognizing as the staff has described over the years
9 that management has a significant potential impact on
10 plant safety, I guess I would ask you to expand on a
11 couple of things.

12 One, what do you see as the potential
13 applications of the Research and AEOD work on a day
14 to day basis at the plants?

15 And two, in this period of time that we're
16 in right now, what is the focus and what kind of
17 framework do the inspectors and the folks who are
18 responsible for day to day regulation have?

19 MR. ROE: The answer to the first part of
20 the question is that it's a little premature to give
21 you details about how we would implement it. We'd
22 have to see exactly how the product is in its final
23 form. We do have some ideas to utilize it in some of
24 the special evaluations that may be required.

25 And the second point, I think it's fairly

1 clear that our day to day involvement with the
2 organization and management of the facilities is based
3 on assuring that they meet their commitments they made
4 in the license, that the people are properly qualified
5 to the standards that they had committed to and that
6 they carry out the programs for review of those
7 qualifications of those positions. But, our
8 inspectors on a day to day basis do not get into
9 individual management issues or organizational issues.

10 MR. TAYLOR: I'd like to add to that too.
11 I don't believe we're there yet. I know Tom Murley's
12 not in the room, but I don't believe we -- that's a
13 major policy type decision where you would go out and
14 actually put this into service, so to speak.

15 The other thing is, if it's of value to
16 individual utilities, they may desire to set up
17 something based on this and of course that then is all
18 to the better, that is that they can observe their own
19 performance using these types of techniques and get
20 some indication, so to speak.

21 CHAIRMAN CARR: If it's good enough, we
22 might even use it ourselves.

23 COMMISSIONER CURTISS: I was going to ask
24 that question, but since you asked it --

25 MR. TAYLOR: I was afraid that question

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1 would come up too. It occurred to me early.

2 COMMISSIONER CURTISS: Just one final
3 question, really picking up on Jim's point. This
4 strikes me as the kind of work that the industry
5 itself logically has an interest in and may have
6 considerable effort underway. What is the nature--
7 I see we're spending a little over a million a year,
8 I think, for the next fiscal year. What is the nature
9 of the industry's interest and activity in this area?

10 DOCTOR RYAN: I do not personally know of
11 a specific activity that's ongoing within EPRI or INPO
12 directed at organizational factors the way we are.

13 We are working closely with people at
14 NUMARC. They attended some of the earlier
15 presentations. We've had meetings with them. As I
16 mentioned earlier, we have some information that
17 NUMARC may be exploring the possibility of taking the
18 survey instrument that we talked about a little bit
19 earlier and having the utilities look at it as a
20 possible way to do some kind of self-assessment.

21 CHAIRMAN CARR: But there is money being
22 spent on human performance evaluation.

23 DOCTOR RYAN: Yes. I thought you just
24 meant the organizational factors area. That's all I
25 was limiting my remarks to. Certainly EPRI has a

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1 fairly large human factors research program. We do
2 work with them. There is work that's going on down
3 at INPO, although no necessarily of a research nature.
4 And we also are aware that some of the utilities, and
5 this brings me full circle to the organizational
6 factors area, there are a couple of the utilities, and
7 one in particular that we're talking to about doing
8 the replication of the NOMAC study, that have a great
9 deal of interest in this kind of activity, are doing
10 work themselves, and we've had some meetings on
11 exchanging information on some of the things we're
12 doing and some of the things they're doing.

13 MR. ROSS: Commissioner Curtiss --

14 COMMISSIONER CURTISS: Denny?

15 MR. ROSS: I wanted to respond -- on the
16 two pieces that concern AEOD, it's sort of what Jim
17 Taylor was saying. Four years ago, the Commission
18 gave us some guidance on performance indicators
19 through an SRM. In developing new ones, we referred
20 some of the material to Office of Research. In
21 effect, that was one of the user needs and this is
22 part of the PI development. Like the Commission paper
23 says, there'll be some results next year, fiscal '91,
24 maybe into '92. Once we're satisfied, it will come
25 back through the same process as four years ago.

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1 We'll go back up to the EDO and to the Commission if
2 we so think it's a good idea and recommending your
3 approval, add these to the list. We wouldn't be
4 working in a vacuum.

5 Likewise in the diagnostic program, and
6 you can see this just from reading the recent letter
7 the Commission got a few days ago on Zion where
8 management effectiveness continues to show up in
9 diagnostic evaluations. If we think more needs to be
10 added to the diagnostic program, we've got a manual
11 chapter, we'd revise it, go back up to the EDO, I'm
12 sure, and come back to the Commission.

13 So, decisions to incorporate this research
14 aren't AEOD's unilaterally. The Commission would be
15 duly informed when we're ready to make an offer.

16 CHAIRMAN CARR: Commissioner Rogers?

17 COMMISSIONER ROGERS: Just a couple
18 questions.

19 Your analysis model, Mintzberg machine
20 bureaucracy model, how generally accepted is this in
21 the community as the best approach? Is this a
22 controversial issue? Are there different schools of
23 thought here that are at war with each other on this
24 kind of thing?

25 DOCTOR RYAN: Not really. When we started

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1 this research a couple of years ago, one of the first
2 things we did is to try to take a look out there to
3 see what was sort of the state of the art. After
4 talking to a variety of people in the universities,
5 in consulting firms and so on, we were pretty much
6 directed to Doctor Henry Mintzberg, who is with McGill
7 University up in Montreal as someone who has done an
8 excellent job of sort of synthesizing the state of
9 knowledge in a textbook from 1979 and there's a
10 revision of it, I believe, in 1983.

11 So, there was pretty much of a consensus
12 going in, that the state of the knowledge was pretty
13 much personified by this individual. We were able to
14 prevail upon him to participate in our research. It's
15 kind of humorous. He gets \$7,000.00 a day consulting
16 fee. Needless to say, he became willing to work for
17 considerably less than that on our project. Then it
18 became a matter of working with him and others to see
19 if, in fact, all of these ideas and concepts that had
20 been developed in a variety of environments could be
21 brought to bear on this particular area.

22 We followed that up with a two or three
23 day workshop down at the guest house in Bethesda and
24 some of the Commissioner staff attended that, where
25 we had some 50 some people representing the

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1 universities again, other projects, the utilities,
2 even a professional operators union, and as I
3 mentioned NRC staff to go back and rework all of this
4 information to see if, in fact, we could get some at
5 least general agreement that we were kind of on the
6 right track.

7 We took what came out of that workshop and
8 a couple of subsequent workshops and it was only on
9 that basis and through a review of a couple of white
10 papers, if you will, on this that were reviewed by a
11 much larger group of people than were indicated on
12 that overhead that we pretty much came to the point
13 where we sort of accepted this as probably a set of
14 ideas that we could work within. So far, we have no
15 reason to believe that we're on the wrong trail.

16 But I would say to you that it was -- we
17 got to Henry Mintzberg after a series of steps and
18 talking to an awful lot of people as to where could
19 we go to get the best.

20 COMMISSIONER ROGERS: Okay. I wonder if
21 you could say something a little bit to put into
22 perspective the qualitative versus quantitative
23 aspects of what you do here. I was a little concerned
24 about our trying -- or in any of these areas, trying
25 to overly quantify things, put numbers of things that

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1 maybe shouldn't have numbers on them and yet somehow
2 we are trying to develop some quantitative methods
3 that can go into a PRA. So, there you are. You're
4 between these competing concerns.

5 I wonder if you could say a little bit
6 about how you're trying to think about this issue.

7 DOCTOR RYAN: Okay. I guess I would say
8 one thing about the analysis methods and maybe
9 something a little different about the leading
10 indicators. With regard to the analysis methods, it
11 would be perfectly proper to do that first step, that
12 function analysis and say, "I'm not going to do
13 anything more. I understand sort of how things work."
14 And if I were doing, say, a study to make an overall
15 judgment on the industry and I wanted to know how many
16 plants do I have to look at, just performing that kind
17 of an exercise would give me some sense of how many
18 different kinds of plants, from an organizational
19 perspective, do we have.

20 We could do that plus just gather the
21 information using the various instruments and say,
22 "Okay, that's as far as we're going to go. We're
23 going to make some changes or we're going to index it
24 in some way that literally has nothing to do with
25 PRA." As a matter of fact, that's what we're doing

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1 in the accident management program. There's no real
2 interest in going in and trying to crank out numbers.
3 It's merely to give us enough insights that will allow
4 us to make a contribution to that program.

5 I think PRAs are a reality. There was a
6 decision many years ago to do them, to do
7 quantification in this industry. That is now being
8 picked up by the military, NASA and everyone else.
9 Somebody is going to make judgments about the
10 contributions of some of these factors, even if they
11 have to do it in isolation.

12 We recognize we're not going to be able
13 to immediately make a quantum leap from total
14 subjectivity to truth, but we think we're nudging that
15 way a little bit. Certainly people that go through
16 the first two steps are going to be in a better
17 position to make some judgments about quantification.
18 So, I think in that particular area it's sort of a
19 fact of life. And I think the real question is are
20 we going to be on board or not on board.

21 With regard to the leading indicators, I
22 think we're sort of stuck with some --

23 COMMISSIONER ROGERS: Well, just -- I mean
24 I'm concerned about accepting that too much. There
25 are fads that everybody gets caught up in and the best

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1 people and the best places very often are all on the
2 same wavelength on something and sometime later it
3 turns out that it wasn't such a smart thing.

4 DOCTOR RYAN: Well, I don't think --

5 COMMISSIONER ROGERS: So, I'm not knocking
6 PRA. I'm just saying that I think we should continue
7 to make our own independent judgments on this and the
8 fact that everybody else is on board doesn't mean
9 necessarily that we have to be on-board, unless we
10 think that it really is the right thing to do.

11 DOCTOR RYAN: Well, I would say that going
12 through this kind of process there is information
13 other than the numbers that can be used even as part
14 of the PRA to gain necessary insights and make some
15 kind of a qualitative assessment as to how much some
16 of these factors may be influencing what is going on.

17 With regard -- with the leading
18 indicators, I guess what I can say to you is they
19 simply take on their meaning based on their
20 statistical relationship with the direct indicators.
21 They certainly don't have a whole lot of value to us
22 unless there is some known relationship. Certainly
23 in addition to that, on the qualitative side,
24 obviously it has to be believable to people that in
25 fact these things we're observing really do relate in

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1 some way to organizational learning or maintenance or
2 whatever that we're going to have to act on.

3 So, I think that certainly quantification
4 is nice if you can get it. We really realize that in
5 the real world that we're working in that we have to
6 be very careful and that there may be some areas that
7 we cannot be terribly quantitative about and others
8 that we can go a little bit further. But I certainly
9 believe that these are areas that need to be pursued.
10 As I mentioned earlier, we're not leaping from
11 subjectivity to truth in one quantum leap, but
12 certainly we feel we're moving off the subjective
13 side.

14 COMMISSIONER ROGERS: A question in my own
15 mind in some of the studies that involve some of the
16 economic issues, financial and economic issues,
17 commitment of economic resources and things like this,
18 a little question of how ultimately we would use that
19 kind of information. What would we do with it?
20 Suppose we do find out something there. What do we
21 do with it? Do we go to a licensee and suggest that
22 maybe they are not allocating their resources in the
23 right way? You're starting to move into what are
24 management decisions.

25 DOCTOR RYAN: Well, I would guess again

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1 what we were trying to do was to take a look at
2 information that was available to us, either through
3 the NRC systems, the licensing exams or other entities
4 and working in this area, financial health tends to
5 be something that gets discussed fairly quickly
6 because there is really a literature trail that sort
7 of relates financial health to some of the emphasis
8 that various organizations might play a -- might focus
9 on safety.

10 I guess ultimately, once having
11 established that there is some relationship in our
12 domain, I guess the indicator would be of some use to
13 us, I guess in the same way it might have been to FAA
14 had they had one in maybe the Eastern Airlines
15 situation where before maintenance records were
16 getting falsified and some of these more overt things
17 were being done, that somebody may have -- it may have
18 been tipping somebody off that hey, the financial
19 stability of this organization has reached a point
20 where we may have reason to believe that a year
21 downstream or somewhere that this is really going to
22 manifest itself in an accident or some other unsafe
23 situation.

24 So, I would assume that certainly if this
25 turned out to be a very good indicator, a very good

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1 predictor of what might happen in the future, it would
2 be something that we could monitor and the information
3 is available. I guess I can't go beyond that.

4 COMMISSIONER ROGERS: Well, it's a
5 question we'll have to face when --

6 DOCTOR RYAN: Yes, sometime.

7 COMMISSIONER ROGERS: -- something turns
8 up that looks like it's useful.

9 I just wanted to say that I found this a
10 very useful and informative briefing because I've been
11 able to get a little better sense of how these things
12 fit together than I had just on the documents
13 themselves. Some of the documents do -- I've found
14 a little difficulty reading, as Commissioner Remick
15 has suggested. There is a little more clarity, I
16 think, in introducing some of the statements that I've
17 read a couple of times and still not quite sure what
18 they say. I don't think it has to do with my not
19 being an expert in the field. I think they just
20 weren't written very clearly. So, for some of your
21 contractors, they might pay a little more attention
22 to that sometimes.

23 But I think it's an interesting program
24 and it's something that some of these efforts just
25 have to be done. I quite agree with you. If we're

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1 ever going to use human factors in a PRA, some of this
2 kind of thing must be done. I think there's just no
3 way around it. I think it looks like a very
4 interesting, good program. I commend you.

5 CHAIRMAN CARR: The ACRS comment that said
6 that you should put more emphasis on communicating the
7 insights you're getting to the licensees, what are you
8 doing to take care of that problem and follow up on
9 it?

10 DOCTOR RYAN: Well, we make sure that all
11 of the publications go to all the utilities. As a
12 matter of fact, the relationship we've developed with
13 one of the utilities to possibly use one of their
14 plants sort of was triggered by that mechanism. We
15 are working with NUMARC. We are in the process of
16 almost all of our projects, and as I mentioned there
17 are 11 of them. We do require in most cases some
18 cooperation. So, we do literally on all of our
19 projects, we're trying to discuss the possibility of
20 using the plants. As part of that process, obviously,
21 we brief them on what we're doing, why it might be of
22 value to them as well as to us. And as part of that
23 process, certainly acquaint them with things that
24 might be of use to them.

25 CHAIRMAN CARR: Well, along that line, I

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1 guess my hope is that one of the results of this will
2 be some kind of a clue on how to reduce personnel
3 error. There's no doubt in my mind if you approach
4 any utility and say, "This may help to do that,"
5 they'll all buy in. Everybody's got that goal of
6 trying to figure out some way to reduce personnel
7 errors.

8 I guess that's the one thing that caused
9 me a little problem in the financial health of the
10 operation, trying to tie that back into a personnel
11 error. I can draw some remote connection maybe in the
12 guy's compensation or something, but it's -- I don't
13 see it as a problem. But I would hope we can -- I
14 mean if you're going to try to quantify for a PRA, I
15 think that's what we were looking for, how much
16 emphasis to put on personnel errors.

17 DOCTOR RYAN: Yes, sir. That's basically
18 in the draft NUREG that you have. But there is a
19 write-up of what was actually done and that approach
20 does focus on using this information as a shaping
21 factor, influencing each of the error probabilities
22 on a task by task basis.

23 CHAIRMAN CARR: I guess my comments are
24 all included in the comments you got from the Nuclear
25 Safety Research Review Committee. I would encourage

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1 you to get that piece of paper out every time you get
2 together with your people and review it because that's
3 a highly focused set of comments. It's, in my
4 opinion, thorough and it will keep you on track, I
5 think. It was pretty well done, I thought. As I say,
6 most of my concerns are at least stated in there.

7 Well, I wish to thank the staff for the
8 briefing on the progress in organization and
9 management research since we last met on this subject.
10 Because organizational and management factors have
11 such a profound influence on equipment and human
12 reliability, it's very important that we improve our
13 understanding of organizational influence on overall
14 plant safety.

15 You should be mindful, however, of the
16 continuing need for organization and management
17 research to remain appropriately focused on the needs
18 of the regulatory program. In this regard, I believe
19 it would be helpful on future briefings on this
20 subject to hear from NRR and AEOD on potential
21 applications of this research in quantifying
22 organization and management factors in risk and
23 reliability as well as other regulatory uses.

24 In addition, the staff should keep the
25 Commission informed of progress on solving any

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1 problems with access to the plants for testing or
2 whatever.

3 This is indeed a difficult area and it's
4 one that's outside the mainstream experience of the
5 NRC and the industry as noted by the ACRS. Therefore,
6 we must continue to do everything we can to assure
7 that the products can be affirmed by the potential
8 users as accurate, useful and based on sound science.

9 I commend the staff for the pioneering
10 efforts in this area.

11 Do any of my fellow Commissioners have any
12 further comments to make?

13 If not, again, thanks to the staff and we
14 stand adjourned.

15 (Whereupon, at 11:49 a.m., the above-
16 entitled matter was adjourned.)

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TITLE OF MEETING: BRIEFING ON PROGRESS OF RESEARCH IN THE AREA OF
ORGANIZATION AND MANAGEMENT

PLACE OF MEETING: ROCKVILLE, MARYLAND

DATE OF MEETING: NOVEMBER 8, 1990

were transcribed by me. I further certify that said transcription
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ORGANIZATIONAL FACTORS RESEARCH PROGRESS REPORT

**HUMAN FACTORS BRANCH
DIVISION OF SYSTEMS RESEARCH
OFFICE OF NUCLEAR REGULATORY RESEARCH**

NOVEMBER 1990

ORGANIZATIONAL FACTORS RESEARCH PROGRESS REPORT

BRIEFING AGENDA

- 1. BACKGROUND AND RATIONALE FOR RESEARCH**
- 2. ACCOMPLISHMENTS THRU DECEMBER 1990**
- 3. NRC RESEARCH STAFF AND CONSULTANTS**
- 4. CONCLUSIONS**

ORGANIZATIONAL FACTORS RESEARCH PROGRESS REPORT

1. BACKGROUND AND RATIONALE FOR RESEARCH

- 0 TOP-DOWN PERSPECTIVE ON GROUP PERFORMANCE AT THE PLANT LEVEL
- 0 RESEARCHABLE REGULATORY NEEDS, PAST EXPERIENCE, AND PRACTITIONER PERSPECTIVES

ORGANIZATIONAL FACTORS RESEARCH PROGRESS REPORT

1. BACKGROUND AND RATIONALE FOR RESEARCH

REGULATORY REQUESTS

RESEARCH INITIATIVES

NRR

AEOD

RES

ANALYSIS METHODS:

RISK ASSESSMENT

X

(X)

(X)

ACCIDENT MANAGEMENT

(X)

(X)

X

LEADING INDICATORS OF PERFORMANCE:

ORGANIZATIONAL

(X)

X

(X)

CONTROL ROOM TEAM

X

(X)

X REQUESTER

(X) OTHER POTENTIAL APPLICATIONS

ORGANIZATIONAL FACTORS RESEARCH PROGRESS REPORT

1. BACKGROUND AND RATIONALE FOR RESEARCH (CONT'D)

<u>RESEARCH INITIATIVES</u>	<u>RESEARCH REQUESTS</u>		
	<u>NRR</u>	<u>AEOD</u>	<u>RES</u>

LEADING INDICATORS OF PERFORMANCE:

MAINTENANCE	(X)	X
TRAINING	(X)	X
NON-NUCLEAR		X
PATTERNS		X

X REQUESTER (X) OTHER POTENTIAL APPLICATIONS

ORGANIZATIONAL FACTORS RESEARCH STATUS REPORT

2. ACCOMPLISHMENTS THRU DECEMBER 1990

ANALYSIS METHODS:

RISK ASSESSMENT

ACCIDENT MANAGEMENT

RESEARCH PHASE

**FOSSIL AND NRC
LICENSED FACILITY
IMPLEMENTATIONS**

(DRAFT NUREG/CR-5538)

**EMERGENCY PREPAREDNESS
EXERCISE OBSERVATIONS**

(DRAFT NUREG/CR-5570)

ORGANIZATIONAL FACTORS RESEARCH PROGRESS REPORT

2. ACCOMPLISHMENTS THRU DECEMBER 1990: ANALYSIS METHODS

NUCLEAR ORGANIZATION AND MANAGEMENT ANALYSIS CONCEPT (NOMAC) FOR RELIABILITY ASSESSMENT:

- 0 FUNCTION ANALYSIS FOR PLANT MODEL DEVELOPMENT AND IDENTIFICATION OF CRITICAL FUNCTION AND ROLES.
- 0 DATA COLLECTION ON THOSE FUNCTIONS AND ROLES USING SURVEY AND DIRECT OBSERVATION TECHNIQUES.
- 0 EXPLORATORY QUANTIFICATION OF ORGANIZATION AND MANAGEMENT INFLUENCES ON RELIABILITY.

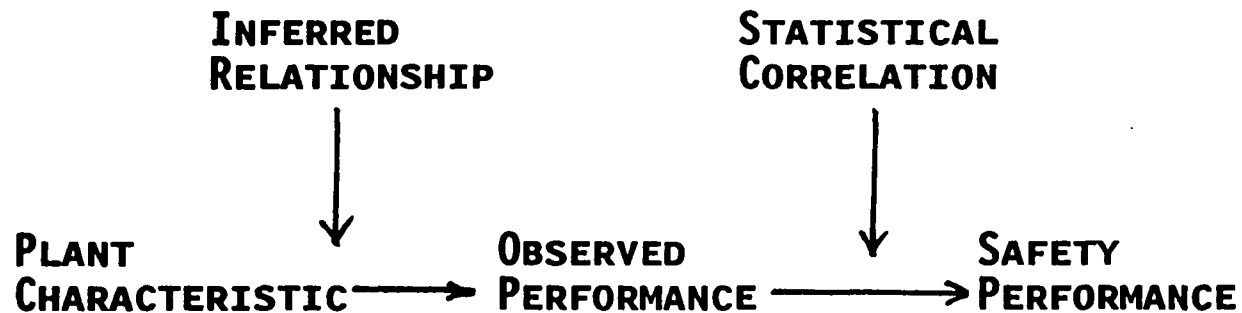
ORGANIZATIONAL FACTORS RESEARCH PROGRESS REPORT

2. ANALYSIS METHODS RESEARCH IN PROGRESS

- 0 TRIAL APPLICATIONS IN PRA AND OTHER EVALUATIONS**
- 0 ALTERNATIVE DATA GATHERING TECHNIQUES**
- 0 QUANTIFICATION PROCEDURES FOR PRA**

ORGANIZATIONAL FACTORS RESEARCH PROGRESS REPORT

2. ACCOMPLISHMENTS THRU DECEMBER 1990: LINEAR ANALYSIS CONCEPT FOR LEADING INDICATORS OF SAFETY PERFORMANCE



ORGANIZATIONAL FACTORS RESEARCH PROGRESS REPORT

2. ACCOMPLISHMENTS THRU DECEMBER 1990: LEADING INDICATORS

<u>PLANT CHARACTERISTIC</u>	<u>OBSERVED PERFORMANCE</u>
ORGANIZATIONAL - LEARNING - FINANCIAL HEALTH	MAJOR VIOLATIONS, REPORTABLE EVENTS DEBT/EQUITY RATIO, RETURN ON ASSETS (NUREG/CR-5437)
CONTROL ROOM TEAM	OBSERVABLE COLLEGIAL BEHAVIOR (PNL REPORT 7250)
MAINTENANCE	ESF ACTUATIONS, GROSS HEAT RATE, DAILY POWER FLUCTUATIONS (NUREG/CR-5436)
TRAINING	FOCUS, RESOURCE ALLOCATION (DRAFT NUREG/CR-5609)
NON-NUCLEAR	MECHANICAL INTEGRITY, TRAINING (NUREG/CR-5568)
PATTERNS	"INTERPRETATIONS OF DIRECT AND LEADING INDICATORS INDIVIDUALLY AND IN COMBINATIONS" (DRAFT NUREG/CR-5610)

ORGANIZATIONAL FACTORS RESEARCH PROGRESS REPORT

2. LEADING INDICATOR RESEARCH IN PROGRESS

- 0 QUALITATIVE VALIDATION**
- 0 CONTINUED STATISTICAL VALIDATION**
- 0 CAUSAL FACTOR ANALYSIS**
- 0 LAG TIME OPTIMIZATION**
- 0 INDICATOR BENCHMARKING**

ORGANIZATIONAL FACTORS RESEARCH PROGRESS REPORT

3. NRC PROGRAM STAFF AND CONSULTANTS

0 DAY TO DAY MANAGEMENT

-- THREE NRC STAFF

0 CONTRACTOR ASSISTANCE

**-- TWO DEPARTMENT OF ENERGY
LABORATORIES**

-- 11 UNIVERSITIES

-- FIVE COMMERCIAL FIRMS

-- THREE NATIONAL RESEARCH INSTITUTES

**-- 14 SUBJECT MATTER EXPERTS AS
CONSULTANTS**

ORGANIZATIONAL FACTORS RESEARCH PROGRESS REPORT

4. CONCLUSIONS

- 0 FOCUSED ON SPECIFIC RESEARCHABLE NRR, AEOD, AND RES NEEDS.
- 0 SYSTEMATIC AND DIRECTED TOWARD PRODUCTS TO ENHANCE NRC REGULATORY ANALYSIS AND DECISIONMAKING.
- 0 TAKES A GREAT DEAL OF EFFORT TO GAIN ACCESS TO PLANTS.