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UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

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BRIEFING ON STATUS OF PERFORMANCE INDICATOR DEVELOPMENT

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PUBLIC MEETING

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Nuclear Regulatory Commission
One White Flint North
Rockville, Maryland

Wednesday, March 1, 1989

The Commission met in open session, pursuant to notice, at 9:30 a.m., the Honorable LANDO W. ZECH, JR., Chairman of the Commission, presiding.

COMMISSIONERS PRESENT:

LANDO W. ZECH, JR., Chairman of the Commission
THOMAS M. ROBERTS, Member of the Commission
KENNETH M. CARR, Member of the Commission
KENNETH C. ROGERS, Member of the Commission
JAMES R. CURTISS, Member of the Commission

STAFF AND PRESENTERS SEATED AT THE COMMISSION TABLE:

SAMUEL J. CHILK, Secretary

JOSEPH SCINTO, Assistant General Counsel

JAMES TAYLOR, Deputy Executive Director, Operations

ED JORDAN, Director, AEOD

MARK WILLIAMS, AEOD

TOM NOVAK, AEOD

CARL JOHNSON, RES

P R O C E E D I N G S

(9:35 a.m.)

CHAIRMAN ZECH: Good morning, ladies and gentlemen.

Today's meeting is for the NRC staff to brief the Commission concerning the status of development of the new performance indicators.

The Commission's Performance Indicator Program is an important component of NRC's overall capability to monitor licensee safety performance at nuclear power plants. The program, using seven approved indicators, provides an additional view of operational performance and enhances our ability to recognize areas of poor or declining safety performance.

This program provides the NRC a tool to be used in conjunction with other tools, such as the results of inspections and our systematic assessment of licensee performance program, for providing an input to NRC management and will help us make decisions regarding the need to adjust plant-specific regulatory programs.

Last year, the Commission approved a six-month trial period for development of cause codes and corrective actions from licensee event reports, as potential performance indicators.

The Commission also approved proceeding with the

validation of safety system function trend indicators and further developmental efforts focusing on indicators of maintenance performance.

Today's briefing will up-date the Commission concerning the status of the staff's actions in each of these significant areas related to the development of the new performance indicator program.

I understand that copies of the slides are available at the entrance to the room, and I should point out, too, there is no scheduled vote today, on this subject.

Do any of my fellow Commissioners have any comments to make before we begin?

(No response.)

If not, Mr. Taylor, you may proceed.

MR. TAYLOR: Thank you, Mr. Chairman. As you indicated, the staff has been using performance indicators as an important tool in its safety oversight responsibilities, and today the staff will be talking, as you indicated, about some of the efforts to improve those that we currently have, by adding potentially improvements or a new indicator particularly in regard to maintenance.

AEOD is the lead office on this, and I have at the table with me, starting from the left, my left, Mark Williams, Mr. Ed Jordan, Tom Novak, and Carl Johnson from

the Office of Research, the three previous gentlemen being from AEOD.

Ed will take the lead and start the briefing.

CHAIRMAN ZECH: Okay.

MR. JORDAN: Thank you very much. Mr. Chairman, we are pleased to be here today and bring you what we believe is good news regarding the development of performance indicators.

We have been, I think, rather successful in the past four months. We have made some break-throughs that we would like to share with you.

We previously briefed the Commission in April, on maintenance indicators, safety system availability and cause codes and, as you indicated, we proposed a trial program that we have been conducting since that time.

The Commission accelerated the development of maintenance indicators, and you requested further validation of the cause codes through your SRM in June of 1988.

We met with the Commission in October, on the maintenance rulemaking, in conjunction with the Office of Research and the Office of Reactor Regulation, and a part of that discussion was preliminary results of the maintenance performance indicator development.

At that time, we had done site visits at 23

units, and we came to the Commission with the view that the NPRDS component failure rate data showed the greatest potential, out of the information we had, for maintenance effectiveness measures, and we recommended some revisions to the draft rule at that time, to add that as a feature.

We found also, at that time, that process indicators, such as the ratio of preventive maintenance-to-total corrective action backlog, although it was useful for utility purposes, didn't really correlate well with our other data and was not useful for NRC purposes at that time.

Since October, the effort has continued very consistent, I believe, with the Commission directive to further develop and validate the maintenance, cause code and safety system availability.

The participants in this program have included the Office of Research, assistance from NRR and from the regional offices, and we've had very strong contractor support from Brookhaven, Pacific Northwest, Oak Ridge, Science Application International, and the AEOD staff itself.

Two of the areas, the maintenance and cause codes, have interacted. We've found data that was beneficial mutually between those two areas, through the close coordination of those activities.

We've looked at a great deal of data during this time frame, and it's summarized in the three reports that have been submitted to you in the last several weeks.

We've also continued discussions with INPO during this time frame, and we've maintained a joint awareness of activities with INPO. We've maintained coordination with the foreign performance indicator development through the IAEA. I, personally, participated in a workshop in September of this past year, in Vienna, and there is another workshop, a follow-on, scheduled for September of this year. And, so, the international community is aware of our actions, and we're quite aware of theirs.

As I indicated in opening, I believe that we're further along today than I expected four months ago. I think my only personal concern is that we adequately represent the tremendous amount of work that has been done by the staff and the contractors, in this discussion.

Mark and Carl are going to be making the presentation and, if we have detailed questions, we have additional staff that will be able to get down to the very lowest level of detail.

We also have representatives here from Oak Ridge, who were instrumental in developing the cause code database. And, with that, Mark, I'd like to turn it over

to you.

MR. WILLIAMS: Thank you, Ed.

CHAIRMAN ZECH: Thank you very much. You may proceed.

MR. WILLIAMS: Thank you.

I'd like to cover the areas in the order of maintenance and then cause codes, and then the candidate indicator of safety system function trends.

As Ed explained, there are two reports that have been submitted to you, one February 6th and the other February 7th, AEOD S804B, and then a report on the trial program on cause codes. And, in addition, we sent down a paper recently on safety system function trends.

(Slide) An overview of our accomplishments in the area of maintenance is, first of all, we have developed what we believe is a reasonable indicator, a useful indicator, of maintenance effectiveness performance, for use by the industry and, hopefully, by the staff in the future. This is based on NPRDS component failure information.

Our future work will be to develop simplified methods to acquire this indicator. Right now, it's fairly labor-intensive to obtain the indicator from the NPRDS system.

On the next slide -- (slide) -- in the area of

cause codes, right now, we have developed the LER information for cause codes to be a performance indicator. We've conducted a rather thorough analysis, which is documented in the Oak Ridge report, and we've resolved the questions, to our satisfaction, that were initially raised on cause codes.

We also found that the cause codes revealed problems in the areas of maintenance that correlated well with our proposed maintenance indicator. For future work, we hope to develop a performance indicator display method for cause codes, and we will present various options in May, at the senior manager meeting, and then we'll hope to have that indicator, with Commission approval, implemented into the program.

We will continue our trends and patterns analysis in the area of cause codes and corrective actions. We found some areas where, for certain sets of cause codes, a knowledge of the corrective actions provided additional interesting information that we'd like to pursue.

(Slide) In the area of safety system function trends, we've completed plant visits and the model development with actual plant data. We were encouraged that we could see differences between the plants in the magnitude and the variation of this indicator, and Carl

Johnson, from Research, will cover this later.

We're also recommending that we continue that program with more data, before we can make a decision on the indicator.

(Slide) First of all, on maintenance indicators, we thought it would be beneficial to briefly cover some of the earlier work from the October Commission briefing and the December report that we issued, and this was AEOD S804A, where Ed mentioned we made the plant visits.

In that work, we found that there were really two kinds of indicators that we wanted to describe, process indicators and effectiveness indicators. The process indicators were indicators such as corrective maintenance backlog, or the ratio of preventive maintenance to total maintenance at the plant.

We found the use of these indicators enhanced the management control of the maintenance process. We found some plants that made real gains in the use of these indicators.

We found that plant-specific flexibility in the implementation of the detailed definitions of these indicators was very important to the success of the program. We also found that during our statistical correlations, we were unable to correlate these process

indicators to output or results indicators of maintenance.

The maintenance effectiveness indicators were items such as failure rate, mean time return to service, or the number and duration of equipment out-of-service in the plant. These were based on actual component failure data, and we found these to be the most promising indicators to pursue.

The NPRDS had the best data, the best structure in the definition and the consistency of the data, to proceed to develop indicators. So, as a result, that was our line of pursuit and, consistent with our recommendations, the statement of consideration of a proposed rule emphasized and encouraged the use of NPRDS for maintenance indicator monitoring.

Our second report was a follow-on of the first report.

CHAIRMAN ZECH: Before you get into that, on your review of NPRDS data, you were obviously impressed with the capability it has to support an effectiveness indicator. How could you correlate the data to, and did you try to correlate the data to actual effectiveness performance at the plants?

MR. WILLIAMS: What we did was, we extracted data from the NPRDS on the mean time to return certain equipment to service and the equipment out-of-service

indicators, potential indicators, and then we correlated those with the equipment forced outage rates and the forced outage rate overall of the plant, plus the other indicators, and we conducted a program where we looked for some leading behavior of these indicators, quarter-by-quarter, as to whether they led the forced outage rate.

What we found was that all the analysis was mixed. There weren't any clear-cut findings, but the best consistency, the alignment of the data, was between the actual component failure data, the effectiveness indicators, and the forced outage rates, equipment forced outage rates, and the like.

CHAIRMAN ZECH: There was a correlation there?

MR. WILLIAMS: In some cases, there was a correlation, and it was consistent across a few plants, for some indicators. We weren't overly -- we weren't convinced, based on the strength of the statistics, that there was a correlation there, but it was promising, and I think that was our result. We said it was promising.

CHAIRMAN ZECH: Promising, and that's where we stand.

MR. JORDAN: No -- I'm sorry -- that was the December report. We have further work to report on today --

CHAIRMAN ZECH: Fine.

MR. JORDAN: -- so, things are better today.

MR. WILLIAMS: Yes.

MR. JORDAN: You're talking about the December report?

MR. WILLIAMS: Yes.

CHAIRMAN ZECH: Okay. Go ahead, then. Tell us about what happened today here, when you can get to it.

MR. WILLIAMS: The new report that we've submitted has worked since the December report, AEOD S804B. It provides information regarding some of the inspections conducted by the staff and the need for component trending. It also documents our development and validation of a maintenance indicator -- and this is the new work, and we'll get into this in great detail.

It provides a methodology to extract the indicator from the NPRDS and display the indicator such that it can be used by licensees today. It shows the benefits in monitoring, and it also continues the development in our program.

(Slide) The next slide gets right into the work we've done since the December report, and this is the concept of the indicator that we've developed.

There's quite a bit on here. First, on the X-axis, what we have is the failures extracted for one system. Now this slide, the line on this slide, is really

the cumulative number of failures in one system -- for example, the main steam system at a plant -- that are extracted from the NPRDS. The NPRDS has three different kinds of failures -- catastrophic or immediate failures, and degraded failures, and incipients. We only use the first two clear-cut failures to map this failure history within this system. The Y-axis, as I said, is the cumulative number of failures.

The indicator really scans this data and looks for an increase in the failure rate. The arrow on the curve indicates an up-turn in the failure rate, and our indicator is a mathematical model that checks for this increase in the failure rate and, as you see, conceptually on this picture -- and this is real plant data on an actual system -- when that failure rate turns up, we obtained an indicating mark.

COMMISSIONER CARR: That's a pretty -- there's another up-turn there that didn't indicate anything. You know, that's pretty -- it's not a sharp drop in the curve.

MR. JORDAN: It's not sharp. What was done was, an empirical determination was made from looking at lots of plant data, to see clustering of failures. And, so, the way I look at it is that we developed a methodology that is clearly empirical in nature, but identifies clustering as then a count, so when there are multiple

failures that occur in a short period of time, you get a count that then is registered in this system.

COMMISSIONER CARR: So, it's a monthly look then.

MR. JORDAN: That's correct.

MR. WILLIAMS: That's correct.

MR. JORDAN: Accumulated on a monthly basis, and we looked at considering just the slope itself, and decided that it was less confusing, in fact, to pick out the rate of change of slope, or a bump in the curve, and we have some interesting correlations. Why don't you proceed.

COMMISSIONER ROGERS: Before you move on, what is the solid curve? That's a fitted curve to those data?

MR. WILLIAMS: Yes.

COMMISSIONER ROGERS: And how did you fit that?

MR. WILLIAMS: The mathematical model that generates the indicator is actually based on taking the average of the latest three months, the count of the failures for the latest three months, and getting the average of that -- or the latest two months -- and then subtracting the average of the prior three months.

So, the indicator itself is based on the arithmetic of subtracting the points.

MR. JORDAN: The question was how do you fit

that curve?

MR. WILLIAMS: The curve was just a smooth-fit curve, with a standard personal computer-based package.

COMMISSIONER ROGERS: What kind of a function does it fit to it, to those points?

MR. JORDAN: You want Bob to answer that?

MR. WILLIAMS: Well, maybe so.

MR. JORDAN: Bob Dennig.

CHAIRMAN ZECH: Step to the microphone, please, and identify yourself for the Reporter.

MR. DENNIG: My name is Bob Dennig, AEOD.

That curve is -- actually, it's on there to aid the eye in following the points. The kind of function that's fit to draw that curve is not inherent in the machinery for generating the indicator.

As Mark indicated, it's based on a concept very similar to looking for trends in existing performance indicators, looking at the average of the two latest quarters, if you will, versus the three previous quarters. There's some kind of -- there's smoothing that's done in a very local way. That particular curve, for purposes of our discussion, is actually visual information or excess information. The curve, itself, there doesn't play a role in the indicator, itself.

COMMISSIONER ROGERS: Okay.

CHAIRMAN ZECH: All right. Let's proceed. Go ahead, Commissioner.

COMMISSIONER CARR: But if I understand this right, if the guy's consistently bad, it won't trigger an indicator.

MR. WILLIAMS: A consistently high failure rate for this system, that is absolutely correct, it will not trigger that indicator.

MR. JORDAN: But I would hasten to add that from the data we looked at, which was substantial, consistently bad -- that is, a rather steep slope -- has, frequently, greater numbers of clusterings than consistently good does, and so --

COMMISSIONER CARR: It might trigger something else, but --

MR. JORDAN: Right.

COMMISSIONER CARR: -- this system wouldn't be triggered unless the guy had a sudden jump.

MR. WILLIAMS: Well, this was designed not to be triggered on a constantly high failure rate because of reporting variations across the plants, and when we -- the way we got into this indicator, in fact, is by laying out, for all the boiling water reactors, this history for five systems, for 23 or 28 plants, and that's in Appendix A of the report.

CHAIRMAN ZECH: All right. Let's proceed.

MR. WILLIAMS: Given this indicator concept for one system, we applied it to five systems. We applied it to five systems, and the major components in the five systems that we called "outage dominating equipment". The equipment that we selected, was selected in order to obtain consistency across the plants, for reporting and off-set known reporting variations.

The next slide -- (slide) -- has the indicator for each of the systems -- the reactor recirculation, main steam, feedwater, neutron monitoring and control rod drive. This is a plot of the indicating marks that were shown on the prior page.

Basically, one could add up the indications at the bottom of the page for each month, for each quarter, and look at the overall performance of this particular plant, for this indicator of maintenance effectiveness.

That is revealed on the next slide -- (slide)-- and what we see is that the trend for this particular plant that we have looked at is overall improving. Again, this is just a best-fit line. Maybe it should turn up at the end, but it was just a resquare's best-fit line on the indications that we saw on the prior page. So, in this manner, one can obtain a trend from this indicator.

On the next slide -- (slide) -- we discuss some

of the key attributes, some of the important aspects of this indicator. The first, as Commissioner Carr mentioned, is that the indicator is really normalized to the plant, itself, to the plant's reporting practices. It's not sensitive to its total magnitude.

An indicator could be consistently high but, if it didn't have an increase, it would not trigger -- a plant could be consistently high, but it wouldn't trigger the indicator if it didn't have an increase in the failure rate within a system.

This was done to off-set known reporting variations. In fact, we have some systems that had consistently high failure rates, and that plant has improving trends in this indicator.

The reporting variations are due to things like resource allocation, conservatism in the definitions applied to failures which varies slightly across the plants.

Some other key aspects of this indicator is that it's generated on a system basis. There's a large variation in the number of components within a system. We must remain within a system and plot it on a monthly basis, to obtain an accurate indicator.

The systems and components selected for this particular indicator, were selected for consistency across

the plants, so that we could hope for some success in a validation program for this indicator. So, as a result, we limited our selection of systems and components, to ensure that.

A plant using an indicator like this would not be limited to this select set of systems and components. They could use it much more widely, and it certainly can be used on safety systems and other systems. Again, we limited ourselves primarily for the validation.

On slide 11 -- (slide) -- we discuss the methods that we used to validate this particular indicator, and there are three facets to it. The first thing that we did is, we looked at the root cause associated with the indicator.

We took about 500 failure records and about 40 indications, and we looked at the root cause as described in the written narrative statement of the failure by the NPRDS coordinator at the plant, and we analyzed that and binned them according to cause code definitions.

The next thing that we did was, we correlated it with other data, data that we obtained from LERs on maintenance problems. We also looked back at our technical studies on major components that we studied that are the same components that are constituting this indicator. And, in addition to that, for all the boilers,

we did a retrospective analysis, a retrospective look at their histories for a few years, for all these systems, at all the BWRs.

On the root cause area, on the next slide-- (slide) -- what we found is that the dominating cause for the indicator, the increase in the failure rate for the failures that constituted that indicator, was maintenance-associated. The definition of "maintenance" here is a fairly standard one. It includes up-keep, repair, surveillance testing, and errors of commission and omission.

The causes, again, were obtained from reading the narratives. The causes were not 100 percent maintenance, and it's a good point to make, that these failures are due to a number of reasons. Some of them are due to design, some of them due to random equipment failure but, overwhelmingly, we found that the main cause was maintenance errors.

For the correlation with other data, on slide 13 -- (slide) -- AEOD had performed studies in the past couple of years, on main steam isolation valves, feedwater reg valves and their bypass valves, and main feed pumps, turbine and motor driven, and the operators for the valves I mentioned.

These studies included plant visits, they

included a detailed analysis of the reasons for the component failures, and we looked at the manufacturer of the valve, the model, the size, the environment-- internal and external -- and what we found from these studies, overwhelmingly, was that the primary reason for differences in failure rates across the plants, was the differences in maintenance practices across the plants, and those results are documented in the studies.

CHAIRMAN ZECH: They are what, again?

MR. WILLIAMS: Those results are documented in our studies.

CHAIRMAN ZECH: Thank you.

MR. WILLIAMS: On the LER correlation, using cause codes, what we did is, we used the trial program cause codes and extracted the maintenance problems from those LERs, and then correlated that with the maintenance indicator that we extracted from a totally different database, the Nuclear Plant Reliability Data System. The plants correlated were the same plants, for the same period of time.

The next slide -- (slide) --

COMMISSIONER CARR: Let me go back to the previous slide for just a minute. When you say the root cause analysis, that's 77 percent of the failures reported to the NPRDS, right?

MR. WILLIAMS: Of the 500 that we analyzed for this set, yes, sir.

COMMISSIONER CARR: Are attributable to some maintenance-related subject.

MR. WILLIAMS: Yes, sir.

COMMISSIONER CARR: Okay.

COMMISSIONER ROBERTS: Well, on that same slide, you said the definition of "maintenance" you used is the standard one, and I understand "design", "random" and "unknown". Why isn't the "wearout" subsumed under "maintenance"?

MR. WILLIAMS: Well, it's in our construction of the definitions. In general, we didn't consider wearout, in this one, as maintenance.

MR. JORDAN: I think I would agree with you that --

COMMISSIONER ROBERTS: The purpose of maintenance failure is from wearing out?

MR. JORDAN: That's correct.

COMMISSIONER CARR: Failure to replace.

MR. JORDAN: And I think -- you make an argument that by seeing that most of the failures, the root cause was traceable to maintenance, then we were able to make the jump and say, well, we're going to assume that all of them are due to maintenance. And, so, the wearout is then

in the set, as we use them. So, we were trying to demonstrate that this particular indicator of failures of these systems and components were principally due to maintenance.

CHAIRMAN ZECH: So, you're saying wearout here was due to maintenance? Fourteen percent of the maintenance problems resulted in wearout, is that what you're saying?

MR. JORDAN: In binning the root cause, the staff binned wearout as a separate item but, in our use of this data, we're saying that since the majority of these failures are due to maintenance, then there was not a need for us to bin, for the purposes of analysis, the failures. We simply assumed --

COMMISSIONER CARR: You didn't separate those out.

MR. JORDAN: That's correct. We simply assumed then, based on this distribution, that the failures were due to maintenance.

COMMISSIONER CARR: So, you were really 91 percent or so correct.

MR. JORDAN: I think so.

COMMISSIONER CARR: But I am trying to figure out -- everything in the NPRDS database, you're saying, 91 percent of that stuff is due to lousy maintenance, and

that -- you know, I have a hard time with that.

MR. JORDAN: Of the sample that we used --

MR. WILLIAMS: Well, this is the indicator. This is only the failures that made up those increases in the failure rate, 40 of them --

COMMISSIONER CARR: Oh, okay.

MR. WILLIAMS: -- across those boilers. So, this is the constitution of the indicator.

COMMISSIONER CARR: This is the trigger.

MR. WILLIAMS: This is the trigger.

COMMISSIONER CARR: Ninety-one percent of those triggering items were --

MR. WILLIAMS: Yes, sir.

COMMISSIONER CARR: Okay.

MR. WILLIAMS: We did a root cause analysis only of the --

COMMISSIONER CARR: I was having trouble there seeing that database.

MR. WILLIAMS: -- only of the indicator. Right.

COMMISSIONER CARR: Okay. I'm all right.

CHAIRMAN ZECH: All right. Let's continue.

MR. WILLIAMS: The LER correlation with cause codes is on slide 14. (Slide) We portrayed it like this so we can see that the -- we can relay or describe the effect that it had on us.

Basically, what we found was the maintenance problems that we found from LERs, moved -- gave us the same picture as that we got from the NPRDS. Now, let me explain the graph.

On the abscissa of the graph is the plant name. The boilers -- this is actually ordered in increasing number of the candidate maintenance effectiveness indicator hits, so the plants at the bottom end at the left side would have the lowest number, and the plants at the top end would have the highest number.

The maintenance indicator is the crosses, and that is, again, a best-fit line through those. For those same plants -- in other words, if we draw a vertical line for the plant directly above the cross -- the asterisk directly above the cross is the same plant, for the same period of time.

We extracted from the LER database, the maintenance-related problems that we got from LERs. And we extracted that, plotted that on the right side, the NPRDS indicator on the left side, and got a correlation. Actually, we cross-correlated them, and the correlation was statistically significant, and this graph shows you, essentially, how they move in the same direction and by plant, and we felt this was very reinforcing to both the maintenance effectiveness indicator and to the LER-based

information that we extracted from the NPRDS.

On the next slide -- (slide) --

MR. JORDAN: It might be appropriate to say that when we first looked at this data, we did jump up and down because it was nice to see these two databases that are quite independent of one another, giving such good correlation, so we are restraining ourselves today, a bit.

CHAIRMAN ZECH: All right. Let's continue.

COMMISSIONER ROGERS: Don't be too restrained, we may miss the point.

CHAIRMAN ZECH: I understand your point. Let's continue.

MR. WILLIAMS: On slide 15 -- (slide) -- in the plant analysis, what we did is a retrospective look at the plant histories. This is, again, in Appendices A and B of the report.

We did this because there was a logical relationship between the outage dominating equipment that we had selected and the forced outage equipment. We did not expect to find a large correlation because of the redundancy within these systems, and also the magnitude of the failure is not catastrophic, so it would not necessarily take the system down, but we did look through all the boiling water reactors. We looked at about 3,000 failures and about 200 forced outages.

Basically, the results of this work were that in 10 of the 28 plants, at least once, we found the indicator occur in advance of a forced outage. Now, the time period in advance of a forced outage varied, and this is all described in the report.

During the analysis, the engineers found some very, very interesting things. They found very logical relationships within a plant. They could see an indicator occur once within a plant, twice within a plant. They would predict it would occur a third time, and it would occur. They saw some consistency within plant data that was very, very, very encouraging.

The results of this we don't believe are statistically significant, but they are what we expected to see, and the data analysis makes sense to us and it has convinced us that the indicator is a practical and useful one.

COMMISSIONER CARR: And that lead time, as I remember, was from zero to six months.

MR. WILLIAMS: It varied quite a bit, sir.

One of the things we then did is, we said, then we should see what this indicator tells us about the boiling water reactor industry, and that's on the next slide.

(Slide) We looked at the indicator overtime for

all the plants. We had talked about this indicator before we plotted it out. We expected that it would improve because, in general, we believe the industry is improving, and all of our indicators show general improvement.

This is a newly developed indicator and, lo and behold, it shows improvement in the industry over these years.

Within this trend, although the overall industry is improving, I think it is important to note that not all plants are improving. The majority of the plants were improving. There were some plants that had a trend upward but, overall, on the average, the overall industry trend is improving.

COMMISSIONER ROGERS: Excuse me -- what group of reactors was this? Was this all BWRs, or just those --

MR. WILLIAMS: BWRs in commercial operation before 1985.

COMMISSIONER ROGERS: How many were there in that -- was that 23?

MR. WILLIAMS: I want to say 23, but --

MR. JORDAN: I think that's right, 23.

MR. WILLIAMS: And the reason, Commissioner Rogers, we selected those is because the reactors don't put information into the Nuclear Plant Reliability Data System until they are commercial, and we wanted to have a

consistent set. So, we took all those commercial at the beginning, and used their data.

COMMISSIONER ROGERS: All right.

CHAIRMAN ZECH: All right. Fine. Let's continue.

MR. JORDAN: I believe that the conservative trend, or the improving trend, is conservative since utilities have done a better job of reporting to the NPRDS since 1985, that that level of reporting has improved and, so, if one were assuming that the greater number of reports would result in increased number of hits, then it would make this line look even more conservative in showing improvement.

CHAIRMAN ZECH: That's a very good point. All right. Let's continue.

MR. WILLIAMS: Slide 17 is the conclusions regarding the maintenance effectiveness considerations. I won't touch on all of them. We do believe, on item number 2 here, that the method is suitable for use in the regulatory guide by licensees. We think it's a key to improving self-assessment in the area of maintenance, that things like this be used, the results of maintenance be monitored. We haven't found it being done very widely, and we would really encourage it, and we think that this is a reasonable example of the kind of thing that people

could do.

The method is suitable for other designs. We found that we could minimize the effect of industry-wide variations in NPRDS reporting, by use of selected data set within the NPRDS.

One of the other major points that will lead us into the next slide is that the correlation with LER data was very encouraging, and we believe that we can also extract some maintenance-related information from the LER database.

MR. JORDAN: You did skip over one item that I think is important, and that is that this was labor-intensive. It was not easy to get the data out of the NPRDS system, and so to apply it on a wider use, we will have to come up with more automated ways of getting the data out and presenting it.

COMMISSIONER CARR: What was the resource impact?

MR. JORDAN: Sir?

COMMISSIONER CARR: What was the resource impact on doing this particular part of a job?

MR. WILLIAMS: I think this particular report, including the analysis and the data, was roughly 1.5 to 2 FTE over a four-month period.

COMMISSIONER CARR: So, we could put a couple of

guys permanently on it, they could hack it, for the industry?

MR. WILLIAMS: Yes.

MR. JORDAN: On a utility basis, it's something they should be doing anyway, but for us to extract it and try to put it on a national basis was difficult.

COMMISSIONER CARR: I predict if we start using it, they'll start using it.

MR. JORDAN: That may well be.

CHAIRMAN ZECH: All right. Let's continue, please.

MR. WILLIAMS: This led us into the discussion of cause codes -- this is slide 18. (Slide) This is the second area we wanted to cover. First of all, the trial program was completed, again, in response to the SRM from June 24th. The staff initiated a trial program to assess the benefits in the cost of cause codes. We also examined other issues relating to the accuracy of the information in the LERs and to the subjectivity of the coding of the information into our databases.

In this program, Oak Ridge National Laboratory supplied the major effort and major support. One of our AEOD people was in it full-time working with them. They used engineering judgment in the analysis of the LER data. They didn't just accept the cause codes -- the codes that

the licensee used or the cause codes on the front of the LER. They used independent judgment, and read the entire event description, and then assigned multiple cause codes to each of these events.

A major feature of this program is that the actual new coding was restricted to six months, but by use of different search strategies, with the sequence encoding search system database, which is our primary LER database, we were able to map the existing LER data for about two and a half years before that, into the new cause code areas, with a degree of confidence that allowed us to use that data for this cause code analysis.

So, rather than having only six months of cause code data, we have a few years of cause code data, and that was used for the trend analysis in the report that you have.

The corrective action data was only six months of new coding effort because we had not previously coded corrective actions into the sequence encoding search system.

On the next page is the cause codes -- and this is just a background from which we can continue to discuss it. This has the causal areas that we used. Let me say at the outset that the cause codes here are different than the cause codes we've seen before in maintenance. The

primary reason is that we started this program at an earlier time, and the cause codes were laid out in SECY 88-103 from May of 1988. We stuck with that structure in developing the cause code program.

The causal areas we used are maintenance, which we subdivided into two categories -- I'll discuss that in a second -- administrative control error, other personnel errors, licensed operator error, and random equipment, design/fabrication and construction.

We subdivided maintenance into two areas, really, because we had no other unknown category in this exercise, and many of the events that they coded were clearly associated with maintenance, 29 percent. Some events -- and we have some examples -- were not clearly associated with maintenance -- maybe an increase in downstream temperature of a check valve that caused a penetration to exceed some design value. Although they couldn't be clearly associated with maintenance, overall, the judgment of the evaluator was that a good, aggressive maintenance program could have caught that in a timely manner.

So, those items are coded in Maintenance-2, which constituted 11 percent of the total industry average cause code data.

COMMISSIONER CARR: Let me clear that up. When

I read the definitions in their study, I couldn't figure out how to code something Maintenance-2. It looked to me like you decided Maintenance-1 was okay and the other one was all-other.

MR. WILLIAMS: Well, we have some examples that might be the easiest way to show this.

COMMISSIONER CARR: I read those. That's what confused me a little bit.

(Laughter.)

MR. WILLIAMS: We tried to come up with a very simple explanation of those, Commissioner, and I think the -- we had the same trouble in reading the definitions in the report.

Oak Ridge is here, and they do have some examples of what became Maintenance-2. The only way I could come to grips with it after reading several events that were categorized as Maintenance-2 myself, was that, overall, one could see a strong maintenance implication in the event, that the conditions, the temperatures, or environmental temperatures, or the leaks in the valves, or whatever it was, were allowed to progress to a point where something else happened, which may have a design implication.

On an event that I'm thinking of, a downstream temperature of a valve -- there was back-leakage from the

steam generator in the aux feed system. The temperatures were increasing, but the only reason that the back-leakage was being driven was because of some leaky valves, embodied upon leaks from some valves. Those were allowed to get worse. They put some gum sealant into those, and the leaks continued, and the back-leakage continued.

The fix was to increase the DP across the check valve, which was really more of a design fix, but the problem had a very strong maintenance tone to it. That kind of thing got put in Maintenance-2. It was difficult --

COMMISSIONER CARR: Well, that one I would have thrown into Maintenance-1, but the one that was in Maintenance-2 that bothered me was the invertor transformer shorts to ground for an unknown reason -- you know? If a transformer shorts, it's pretty tough to blame it on maintenance, but I can clearly understand the Maintenance-1 problem, and I just assumed they threw everything else in all-other --

MR. JORDAN: Maintenance-2 as being an other bin is not too far off.

COMMISSIONER CARR: Yes, okay. Well, that's enough on that.

MR. JORDAN: I wouldn't argue.

CHAIRMAN ZECH: All right. Let's proceed.

MR. WILLIAMS: This is the industry average cause code distribution for the six months of data, about 1230 LERs. What we can see is that roughly 30 percent are clearly due to maintenance, with 11 percent in this second category that we've discussed, which is a fairly large portion.

One item on this slide is that across different designs, the vendor designs, we did not find a substantial variation in the causes. We found them fairly consistent across all the designs.

Another point that people would like to note is that across the NRC regions, the causes were found to be the same, in judging the LERs. So --

MR. JORDAN: They were remarkably consistent, cut by regions -- remarkably consistent.

MR. WILLIAMS: We found consistency there.

An interesting fact on the next slide is --

COMMISSIONER CARR: Well, Admin Control there, is that procedures?

MR. WILLIAMS: Communications procedures.

COMMISSIONER CARR: Okay.

MR. WILLIAMS: On the next slide -- (slide)-- the corrective action, this is the industry average corrective actions. What we can see is, it does help us focus our views on corrective actions. Over half are

procedure changes in training in the industry today, and equipment replacement-repair is a little under 20 percent.

So, this gives us a background from which we can understand the distribution of causes and corrective actions.

Slide 21 -- (slide) -- also, during the trial program, we looked at some issues associated with the accuracy of the information in the LER, whether the truth was in the LER, essentially, as the event occurred, and also the accuracy of our coding of the information in the LER.

On the first one, we compared LERs to one of our best estimations of the truth, which is the independent findings of an augmented inspection team, or an IIT finding. We looked at about 19 of these cases, and what we found is in about 80 percent of the cases, there was very good agreement between the causes assigned by the IIT and the causes in the LER, and this gave us a sense that the accuracy of the information in the LER was fairly good.

We also checked the enforcement history of about 30 licensees, from about 1985 up to-date, and we found none cited for inaccurate reporting of the causes in LERs. We did find some that were cited for not reporting at all.

We also looked at SALP assessments. We looked

into SALPs to determine if people were being mentioned for inaccurate reporting in the SALPs, and we did not find a major problem there. Overall, in the SALPs, many programs are very, very good. Just about all of them we looked at had the capability to identify the root cause and put it in the LERs.

AEOD also conducted LER quality reviews. For about three years, we had a program that very systematically looked at the LERs and evaluated them quantitatively -- gave them grades in each of several areas. One of the areas was root cause.

We found an overall improving trend in the LER quality and in the root causes and, as a result -- that was a continued improvement trend, so we stopped that program. We found, generally, all the plants that we were looking at for a second and third time, were improving in the quality of the LER. We think the program had a lot to do with it because we would mail our evaluation back to the plant and the people who write the LERs got it.

So, there has been an improvement in the LER quality, especially since the June, '84 -- January of 1984 rule, and since the implementation at that point in time, the quality of information has gone up.

We turned to look at the accuracy of the coding of the information in LERs. One of the ways we did this

is, we looked at the codes extracted by one of our contractors -- Idaho National Engineering Laboratory-- extracted essentially what the licensee said the cause of the event was.

Oak Ridge used independent judgment during the trial program, so we compared these two. We found the agreement rate -- and it was difficult because we had slightly different definitions, but the agreement rate was about 61-to-73 percent, or in that neighborhood -- it's in the report.

We also looked at the information in the SALPs, to see whether the regions were coming to the same conclusions that the Oak Ridge judgment was, regarding an overall plant, and we found agreement there.

The only problem we found across-- consistently, across some of the groups, was this personnel error. Sometimes there would be a sense of personnel error and it wasn't listed as a cause, but that wasn't a major problem.

The other thing we looked at is the overall controls on the program for coding and subjectivity. Oak Ridge has a very rigid quality assurance program for all of our information that we code into the database. It's a formal program, and they have an error rate that they report regularly to us. That program has very good

control of subjectivity, and the accuracy of the coding is excellent.

In addition to that, we had an independent check of the SCSS coding, by one of our contractors when we were evaluating the system just recently last year, and we had people in AEOD and people of the contractor independently code events and compare them to the coded information and the sequence encoding search system matrix, and we had very good agreement there.

So, we're satisfied that the coding efforts are okay, and that the information in the LER is fairly accurate and is good enough to use.

Now, the next slide discusses the benefits. Before we get into the next slide, I wanted to mention that the report does discuss the validation of the cause codes. We did find agreement between the cause code identification of plants and the existing performance indicator identification of plants, and the cause codes use a larger body of information than the existing indicators. The cause codes use all of the LERs.

The number of LERs has gone down slightly, but there's still roughly 2500 or so a year because the events have decreased and general improvement, but it's a large, a robust database from which we can extract the information.

We also compared the cause codes with the SALPs, and we got good agreement there, as far as validating the use of those cause codes.

On slide 22 -- (slide) -- there were two kinds of benefits we found from the cause codes, one was as performance monitor. We looked at a benchmark as being the senior management list, and it's described in the report from January of '87 to June of '88, and we found that the hit and the miss rate on the identification of plants by cause codes was just about as good as the indicators.

There were some plants that were identified by cause codes that were different than those identified by the indicators, that we felt added to the identification of plants by indicators.

The second value of the cause codes are that they are programmatic in nature, and they allow us to do a trending diagnosis so that we can see actual changes in operator error and we can trend these and give the information out to people, and it's good supplemental information to help them understand without too much work, what's changing in the events at the plant.

We did do an outlier analysis. The results of that are all documented in the report. The next --

COMMISSIONER CARR: I was certainly encouraged

because it looks like it's really an independent indicator, and it turns up something that nothing else turns up --

MR. WILLIAMS: Yes.

COMMISSIONER CARR: -- and what you've already got a subjective feeling for, you may get confirmed by this.

MR. WILLIAMS: That's right.

The next slide -- (slide) -- is one of the interesting features that we haven't fully explored, but we'd like to get into a little bit more. This shows the line-up of the corrective actions and the cause codes for one area. The report would show for maintenance or administrative controls, how each of the causes has a distribution of corrective actions associated with it.

For the licensed operator error here, procedure change is used as the corrective action 27 percent of the time. What we found in the exploratory program, the trial program, was that the -- if we look at the corrective actions for a given cause for different sets of plants-- inliers versus outliers, if you will -- we can see differences in the corrective actions that are used, and it's just another tool that we can use to analyze event causes and corrective actions, and what seems to be effective and what doesn't, and what the patterns are.

We haven't gotten into the work very much yet. We intend to pursue that area. And, with that, that brings us to our future plans --

COMMISSIONER CARR: Well, that tended to be, to me when I read it, a management indicator, really, more than anything else.

MR. WILLIAMS: There were some features that they could do that -- they looked at plants within a utility, and they --

COMMISSIONER CARR: And it was kind of interesting, the correlation between the goods and the bads and how they approached their corrective actions.

MR. JORDAN: Yes. There are patterns in the corrective actions for groups of plants that need a lot more work on our part. I think there is something there that will be beneficial to us.

CHAIRMAN ZECH: All right. Let's proceed.

MR. WILLIAMS: Our future plans are contingent on approval of SECY 89-046, which is the cause code paper that we submitted. We need to develop a new display format for the cause codes. We do have a number of candidate display methods we're looking at. They will all have different efficiencies and different people, like different displays.

What we were hoping to do was to send some

different displays to the management meeting, next senior management meeting coming up, and have people come to a consensus on what they thought they liked, and then we would go ahead and pursue that display for the next performance indicator report implementation, contingent on approval.

We would also begin corrective action coding for the 1989 LERs. We think that we'd like to code corrective actions because we feel it's an area we will get some benefit out of.

That brings us to the conclusion of the maintenance indicator and the cause codes. Carl Johnson and the Office of Research has provided primary support for the continued development of the safety system function trends indicator, and Carl is ready to proceed.

CHAIRMAN ZECH: You may proceed. Thank you.

MR. JOHNSON: Thank you.

The third indicator that we analyzed is safety system function trends. This is an indicator of the unavailability of selected risk significant systems. Unavailability we mean to be the fraction of time that a system is not operational, or it could be looked at as the probability that a stand-by safety system will not start up when called upon.

This candidate indicator is a potential

replacement for the existing indicator safety system failures. This indicator is calculated from two kinds of data, one is the duration that trains of safety system are taken out-of-service for maintenance and the second kind of data is the number of train level failures.

Next slide, please. (Slide) In response to the Commission meeting last April, we performed a retrospective analysis. We collected two or three years of data from five units at three sites. Brookhaven National Laboratory and Science Applications, Inc. analyzed the train level availability data in plant logs.

These logs say when a train of a safety system was removed from service for maintenance and when it was restored to service -- and this is one of the pieces of data we use in the indicator -- and the other is the number of failures. The indicator includes an estimate-- when a failure is found, it includes an estimate for how long the failure existed before it was discovered, so the sum of the two times then contribute to the unavailability, and this turned out to be -- did a system fail, or train fail, rather, turned out to be one of the problems in using the historical data.

Sometimes the logs did not clarify whether a train was taken out to perform maintenance because the train had failed already, or whether it was taken out for

maintenance before it failed.

The results of this work were promising, but not conclusive. They are promising in the sense that the indicator can -- we found that the indicator can evaluate the magnitude and trend of this unavailability versus time, and we found it is feasible to compare the indicator versus a benchmark of expected unavailability, to help flag indications of higher than expected unavailability of a safety system.

The results were not conclusive, in that for two of the five units that we analyzed, we did not get the indications that we expected to see. They didn't turn out the way we thought they would. One reason may be that we may not have a complete data set because of the historical nature of the data.

Next slide, please. (Slide) We propose to continue this validation with prospective data instead of historical data, from a few volunteer units. Where plants have good data on one or two systems, we would like to try out that data, to evaluate this performance indicator.

Also, we plan to examine existing data sources, such as NPRDS, the INPO safety system performance indicator, and LERs prior to 1984, which include train level failures, and we expect that this work will complete the validation of this indicator and will evaluate the

extent to which existing databases can indicate unavailability of important safety systems.

This completes our discussion on safety system function trends.

CHAIRMAN ZECH: Thank you very much.

MR. TAYLOR: That concludes our presentation.

CHAIRMAN ZECH: All right. Questions from my fellow Commissioners. Commissioner Roberts?

COMMISSIONER ROBERTS: I have no questions. I'm encouraged to hear that you are so encouraged that this seems to be giving you results you can use.

MR. JORDAN: Yes, sir.

CHAIRMAN ZECH: Commissioner Carr?

COMMISSIONER CARR: I agree. I think it's a good piece of work. I'm a little uncomfortable with the safety system function trends because if the guy's doing preventive maintenance, it's still going to show up in your trend as one of the indicators, but it lends itself to misinterpretation, I'm afraid, so you're going to have to be careful with that one.

MR. JOHNSON: The indicator is dominated by failures. About 75 percent of the unavailability is due to failures in the sample that we -- sample plants we looked at. And by including both halves, it allows us to look at a balance of -- if somebody is perhaps doing

excessive maintenance rather than letting things run.

COMMISSIONER CARR: The other thing I'd encourage you to do is to -- I understand you're considering balance-of-plant in some of these maintenance indicators, and I certainly encourage you to do that, continue that consideration. I don't know what your plans are in that area.

CHAIRMAN ZECH: Can you tell us, Mr. Jordan?

MR. JORDAN: The NPRDS database doesn't extend very far into the balance-of-plant --

CHAIRMAN ZECH: Does not?

MR. JORDAN: Does not. Industry is considering extension of that data and, so, our ability would be entirely dependent on whether or not industry does, in fact, extend that system. So, there is a lack of data that one can use.

COMMISSIONER CARR: Can the LERs come in on balance-of-plant?

MR. JORDAN: No, sir, not unless it causes a plant outage, a plant trip.

CHAIRMAN ZECH: Well, you're obviously focusing on the safety systems, but you know how the Commission feels about balance-of-plant, too. We all know that balance-of-plant does cause problems and, so, I'm that's, I'm sure, Commissioner Carr's question. I would certainly

--

COMMISSIONER CARR: Well, you've already analyzed, I thought, about 50 percent of their down-time comes out of balance-of-plant problems --

MR. JORDAN: It does.

COMMISSIONER CARR: -- so, we're overlooking a big bunch of data here.

MR. JORDAN: That's correct.

CHAIRMAN ZECH: Well, let's pursue that. Commissioner Rogers?

COMMISSIONER ROGERS: Yes. I think it's an excellent piece of work, and I'm really very encouraged by what you've done, and impressed by the high quality of the effort so far, and I really want to congratulate you on everything you've done.

What do you see as the false-positive aspect of this? What have you seen, in looking at these indicators, that would suggest that there really ought to have been a problem but there wasn't one? Have you been able to look at that at all, that aspect of this?

MR. WILLIAMS: We have looked at it. Regarding the false-positives, we would consider a false-positive something where the indicator hits and it's unrelated to maintenance.

I think there is a section of the causes that

are not due to maintenance, but it's a small section on this indicator. This particular indicator lends itself well to culling out some maintenance error.

So, I think it's a screening tool that we-- again, we would screen plants with it, and screen performance with it, but once we got indications, we really have to look underneath and look at the actual failures, what they were, what the corrective actions were, and do some straight engineering work. It's a screening tool.

It's very useful to systems engineers in plants. It's useful to us because we can get it to a point where it could provide good screening information in a very timely, efficient manner, if we continue to work on it.

That's the primary area of false-positives, I would think, where those areas were not due to maintenance, the causes were not associated with maintenance.

COMMISSIONER ROGERS: I suppose this question is also related to the extent to which there are conflicting messages coming back from the set of indicators that don't seem to be in agreement with each other. Have you seen instances of this?

MR. WILLIAMS: We have looked at the plants for consistency, with this indicator. We looked at the plants

that had a declining performance, in the maintenance indicator that we looked at for the boilers at least, because that's the only class of plants we've done.

We saw mixed results, but we did see some consistency with the maintenance indicator, with the other indicators. I think we were -- in looking at those results, we were very encouraged.

We saw plants -- in the development of this indicator, one of the things we did was, if a plant had a high reporting of failures and a high failure rate, we found that that was not that revealing, in the NPRDS failures, but the increase was.

We found plants that had that characteristic that were improving on this indicator, and their other trends were improving. We found plants that were declining and they were declining in this area.

So, this together with the other indicators as a set, does seem to help the picture. It does seem to add a piece of the picture, at least for that set of plants that we looked at.

Now, our experience is limited. We'd like to go ahead, and we are trying to go ahead and do the analysis for the PWRs, with one of our contractors in Idaho, to begin downloading the data and the labor-intensive job of laying out the data. So, we'll continue to look at that.

MR. JORDAN: I think you're entirely right. If we expand the numbers of indicators we use, then we're going to get some additional false-positives out of it and, so, we have to rely on looking behind it. If we only use it to nominate plants for review and then we look behind it and see whether there is or is not a problem.

COMMISSIONER ROGERS: Right. Well, on the other side of that question, were there any plants that had serious problems that, in retrospect, looking back at your indicators, none of the indicators suggested that they were getting into trouble?

MR. JORDAN: I don't think we've come to that view yet, but I think it's highly likely that --

COMMISSIONER ROGERS: I'd really be interested to know the answer to that one.

MR. JORDAN: We've clearly seen a number of anomalies, and the kind of anomalies that bother me are two unit or multi-unit facilities that have common management --

COMMISSIONER ROGERS: Yes.

MR. JORDAN: -- common practices, and where they show differences on different indicators, that always bothers me, and I think it's one of the more sensitive ways of seeing the limitations of the indicators, and that still occurs.

MR. TAYLOR: I think if we expanded the number of plants, that would be clearly a correlation we'd be looking for -- how does this stand up with what we believe to be the rest of the performance?

MR. JORDAN: But in looking, for instance, at cause codes with our other present methods of understanding plants, there's very strong correlation of the outliers of that, so that was the reinforcing side of it, but it does bring along a few false-positive plants that show up for cause codes that, otherwise, we don't really have a concern about and, in fact, still don't.

COMMISSIONER CARR: It was interesting the cause codes highlighted at one plant, that had an increasing SALP performance, but it'd be interesting to look at the next SALP on it.

MR. JORDAN: Yes. It bears watching.

COMMISSIONER ROGERS: What is the additional cost to the licensees, to fully implement the kinds of data -- putting the kinds of data that we need to really make this thing work, into --

MR. JORDAN: For the maintenance performance indicators, they put the data in already --

COMMISSIONER ROGERS: Full in and out, so there's nothing --

MR. JORDAN: -- so there's no additional data,

unless we expanded it to other than safety-related.

COMMISSIONER CARR: But we need them to be more consistent than they are, probably.

MR. JORDAN: That would be helpful, but there is useful data there now. We're really convinced that there's useful data now, so it's a matter of them applying it, in trying to measure their maintenance effectiveness, and the scheme that we came up with here is not, by any means, the only way of doing it. This is one we're confident works, but it may be that if you had consistent reporting within a plant, just looking at the slope, the rate of these failures, would be a very strong signal, but we couldn't use it across a number of plants. Comparing the slopes was not useful to us.

MR. WILLIAMS: This particular indicator is very helpful in balance-of-plant. We looked at the feedwater systems and other things in this particular exercise for the boilers. For the plants to implement it, they could use the failure information they send to NPRDS, but they have that information available for all of their systems.

The scope of NPRDS is not yet expanded to include the turbine, EHC condensate -- condenser, rather, some systems, but it shouldn't be very costly for them.

COMMISSIONER ROGERS: Just one final question. In interpreting any of these, or all of them together,

these performance indicators, in searching for a potential problem plant, how sophisticated does the observer have to be? Do you think that this is something that requires special training, to be able to spot? Obviously, digging below the performance indicators is another matter, but just looking at the collection of indicators, themselves, does that require a considerable degree of sophistication, to judge something from them, or not?

MR. JORDAN: From our method of using existing set is really, to me, like shuffling the cards and trying to find outlier sets. And, so, it's a visual look, and then after you've sorted and found the outliers, then you look behind that data. So, I find it to be -- if we have the right presentation, it should be a visual -- if, by going through it, you get a visual norm, and then you throw the outliers into the file.

COMMISSIONER CARR: User friendly, you'd class it, then?

MR. JORDAN: I'd like it to be, yes, sir.

COMMISSIONER ROGERS: Thank you very much.

MR. JORDAN: Thank you.

CHAIRMAN ZECH: Commissioner Curtiss?

COMMISSIONER CURTISS: No questions.

CHAIRMAN ZECH: Well, just a couple of comments. I noticed on your chart 7 -- we talked about it before--

but your failure rate change indicator. Commissioner Carr pointed out, too, and you acknowledge that if the trends are consistent, you don't get any indicator. Well, we recognize the limitations that brings. So, that, of course, would be useful information itself, but it requires additional evaluation and analysis, to see whether that steep slope that you referred to, Mr. Jordan, may be even more of a problem than a potential change of the slope.

MR. JORDAN: Yes.

CHAIRMAN ZECH: So, you recognize that, and I think that's important. I thought it was significant that you pointed out that the differences among maintenance practices drove the failure rates. I think that's quite an important conclusion to come to and, so, it seems to me that that would indicate that there we're certainly on the right track and at least the efforts have gone so far to develop this performance indicator.

We know how difficult it is, but I think -- I'm encouraged, as I think my colleagues are, by progress you've made, and I think it's a very significant undertaking. We've got a ways to go, obviously, but certainly you've made an awfully good effort so far, in my judgment.

Let me ask you just about a completely separate

subject. I know we're talking about maintenance here today, as performance indicators, but I'm interested in the radiation exposure performance indicator, and any progress you might have made in that regard. Can you give us a status report on that?

MR. JORDAN: This is in obtaining the data? I'll let Tom Novak answer that.

CHAIRMAN ZECH: All right.

MR. NOVAK: We did meet with INPO, and they will be submitting that information on a quarterly basis to us, so we'll be able to include radiation exposures in our --

CHAIRMAN ZECH: So, you'll have a performance indicator for radiation exposure, which I think is significant.

MR. NOVAK: We will, yes.

CHAIRMAN ZECH: You will be able to do that and you're working to get that information.

MR. NOVAK: That's correct.

MR. JORDAN: We will have a longer time delay in that data. It will be about a quarter behind the rest of the data, but --

CHAIRMAN ZECH: But you will have a performance indicator for radiation exposure, that's what you're planning on.

MR. JORDAN: Yes, sir. Right now, we're

providing that data only on an annual basis.

CHAIRMAN ZECH: Yes, I understand that. Okay, fine.

Well, let me just say, I think we've heard an excellent presentation this morning. I think all of us are encouraged by the work that's going on between AEOD and Research. I think it's a teamwork effort. We're really -- you know, the performance indicator program, as we've mentioned before -- it's been my experience, using it in the past, too -- is that it takes time to mature. So, I think we should not be discouraged by the fact that we don't have a complete solution to the problem now.

I think we should be encouraged by the fact that we are making progress, and you've come to some rather important, at least tentative, conclusions so far, it would seem to me.

So, I think it is an excellent effort, and I really do commend the staff for working to provide this very important tool which can be used with other inspections and management practices, to better evaluate the safety performance of our plants, and that's what we're trying to do.

So, I really do commend you for your efforts, and encourage you to continue to refine and develop and help mature this indicator program which I do think has

potential for helping us measure the safety and the safety parameters of the nuclear power plants in our country. So, again, thank you for an excellent presentation.

Are there any other comments from my colleagues?

(No response.)

If not, thank you very much. We stand adjourned.

(Whereupon, at 10:48 a.m., the meeting was adjourned.)

CERTIFICATE OF TRANSCRIBER

This is to certify that the attached events of a meeting of the United States Nuclear Regulatory Commission entitled:

TITLE OF MEETING: BRIEFING ON STATUS OF PERFORMANCE INDICATOR DEVELOPMENT

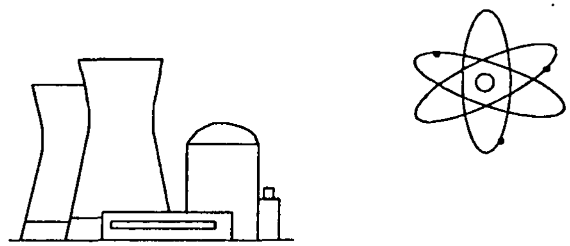
PLACE OF MEETING: ROCKVILLE, MARYLAND

DATE OF MEETING: MARCH 1, 1989

were transcribed by me. I further certify that said transcription is accurate and complete, to the best of my ability, and that the transcript is a true and accurate record of the foregoing events.

Phyllis Young

Reporter's name: Phyllis Young



STATUS OF PI DEVELOPMENT

BRIEFING DATE
MARCH 1, 1989

CURRENT PI CANDIDATES

- MAINTENANCE
- CAUSE CODES
- SAFETY SYSTEM FUNCTION TRENDS

MAINTENANCE
Status Summary

- ACCOMPLISHMENTS

  Increase in certain equipment failure rates based on NPRDS component failure data provides practical and useful MPI

- FUTURE WORK

  Develop simplified methods to acquire and display

CAUSE CODES
Status Summary

- ACCOMPLISHMENTS

  LER-based cause code PI developed, tested and ready for implementation

  Maintenance cause codes correlated with NPRDS-based MPI

- FUTURE WORK

  Develop PI data display methods

  Continue trends and patterns analyses of cause codes/corrective actions

SAFETY SYSTEM FUNCTION TRENDS

Status Summary

- ACCOMPLISHMENTS

  New insights provided

- FUTURE WORK

  Further trial program recommended

MAINTENANCE PI

Summary of December 1988 Report

- MAINTENANCE PROCESS INDICATORS

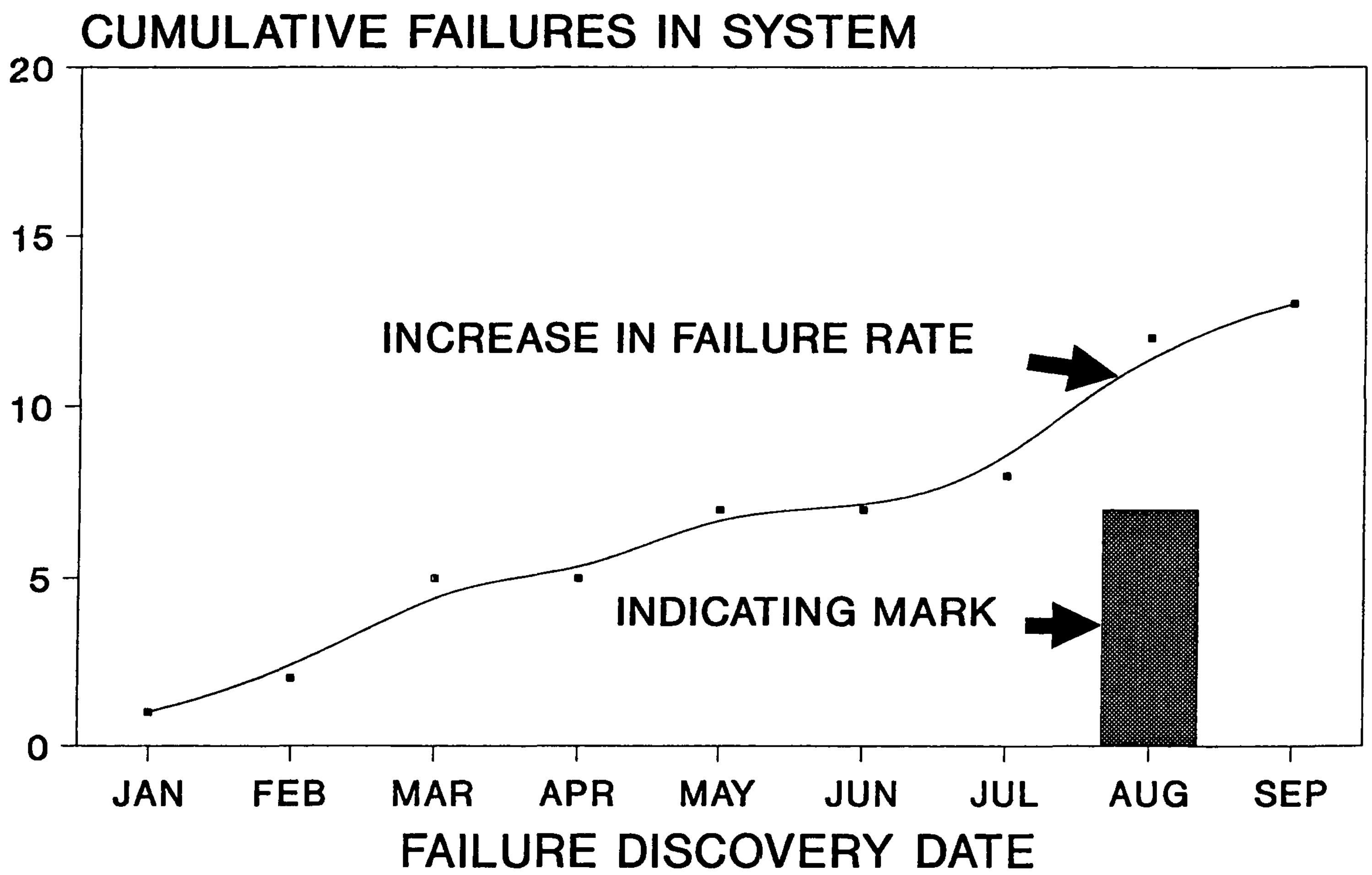
  Enhance management/control of process
  Plant-specific flexibility important
  Not reflective of maintenance results

- MAINTENANCE EFFECTIVENESS INDICATORS

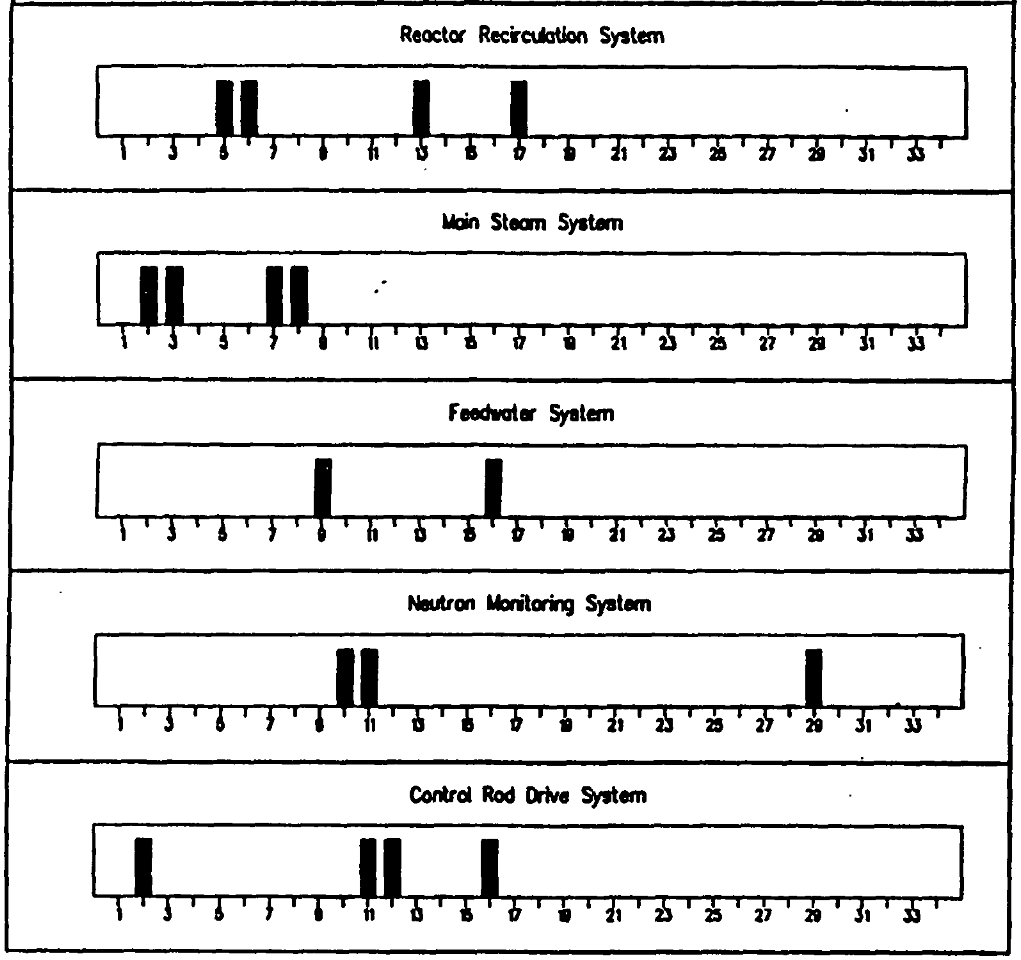
  Those based upon actual component failure history were the most promising
  NPRDS has capability to support NRC staff and industry in providing effectiveness indicators

- USE OF NPRDS ENCOURAGED IN PROPOSED RULE

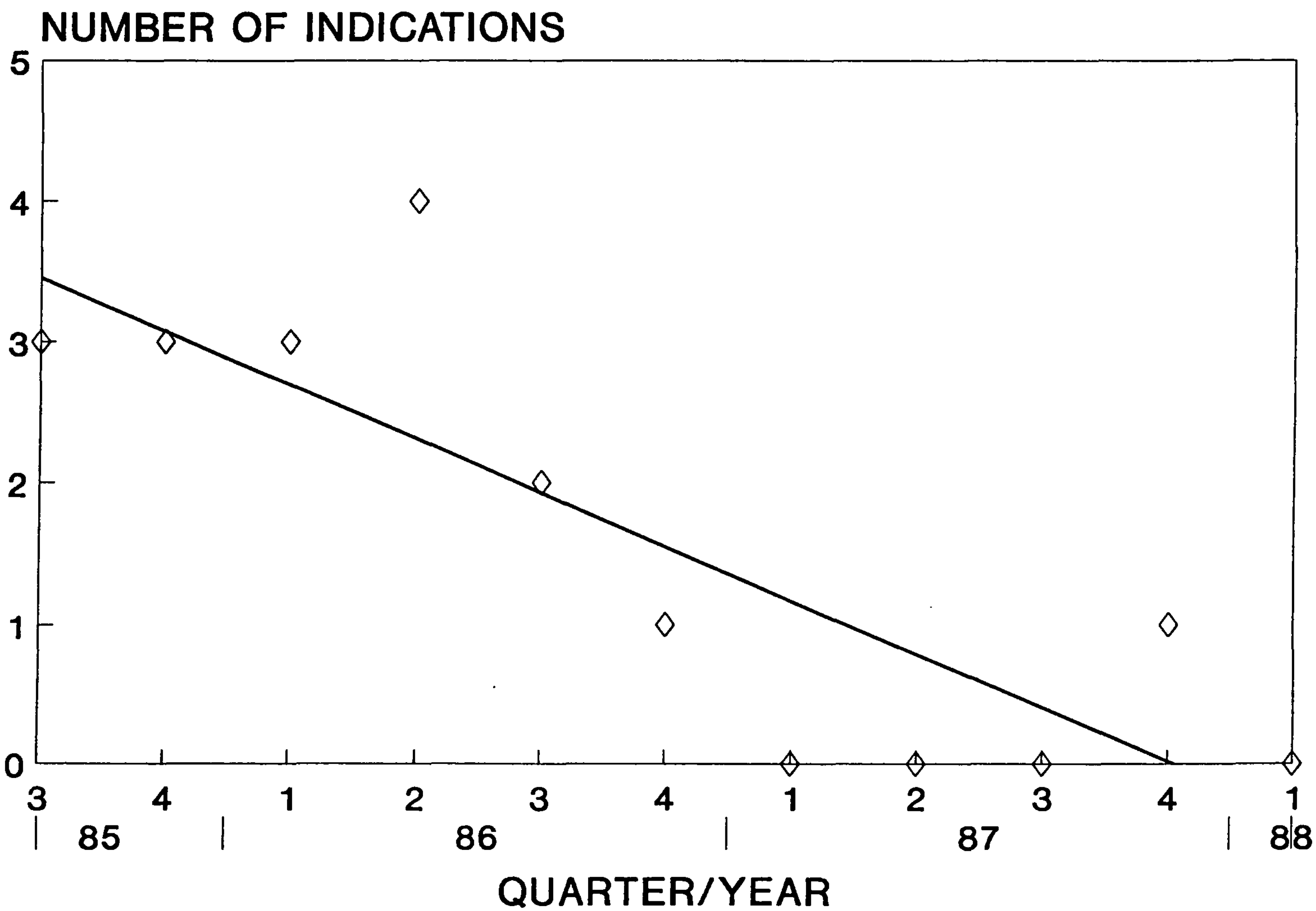
INDICATOR CONCEPT
FAILURE RATE CHANGE INDICATOR



Maintenance Effectiveness Indicator



MAINTENANCE EFFECTIVENESS TREND



INDICATOR ATTRIBUTES

- NORMALIZED TO PLANT REPORTING PRACTICES
- GENERATED ON SYSTEM/MONTHLY BASIS
- SYSTEMS AND COMPONENTS SELECTED FOR REPORTING CONSISTENCY FOR VALIDATION
- OTHER SYSTEMS AMENABLE TO SAME APPROACH

VALIDATION METHOD

- ROOT CAUSE ANALYSES

  500 failure records covering about 40 indications

- CORRELATION WITH OTHER DATA

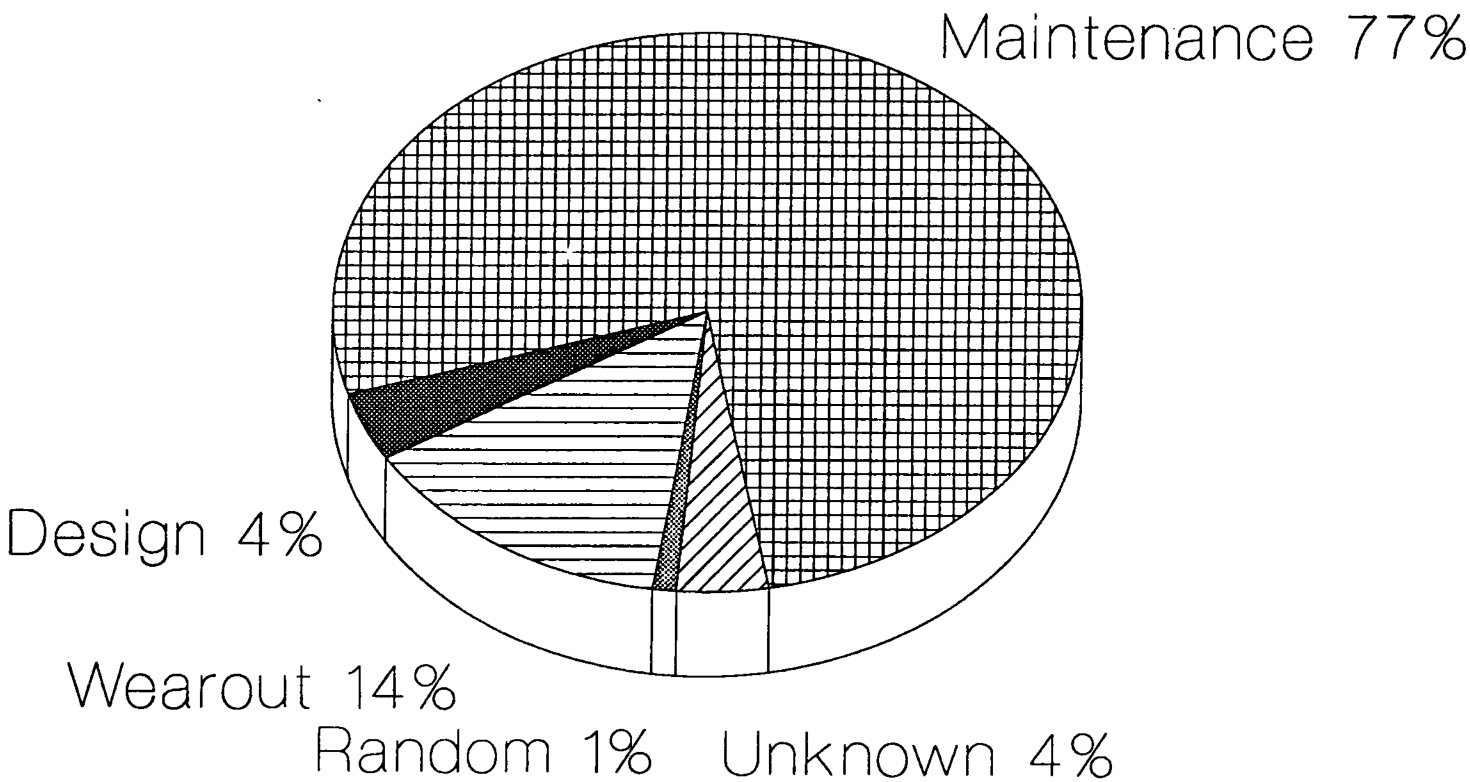
  LERs

  Technical studies

- PLANT ANALYSIS

  Period from 1/1/85 thru 3/31/88 for all commercial BWRs with adequate data

ROOT CAUSE ANALYSIS
(Indicator Constitution)



CORRELATION WITH OTHER DATA

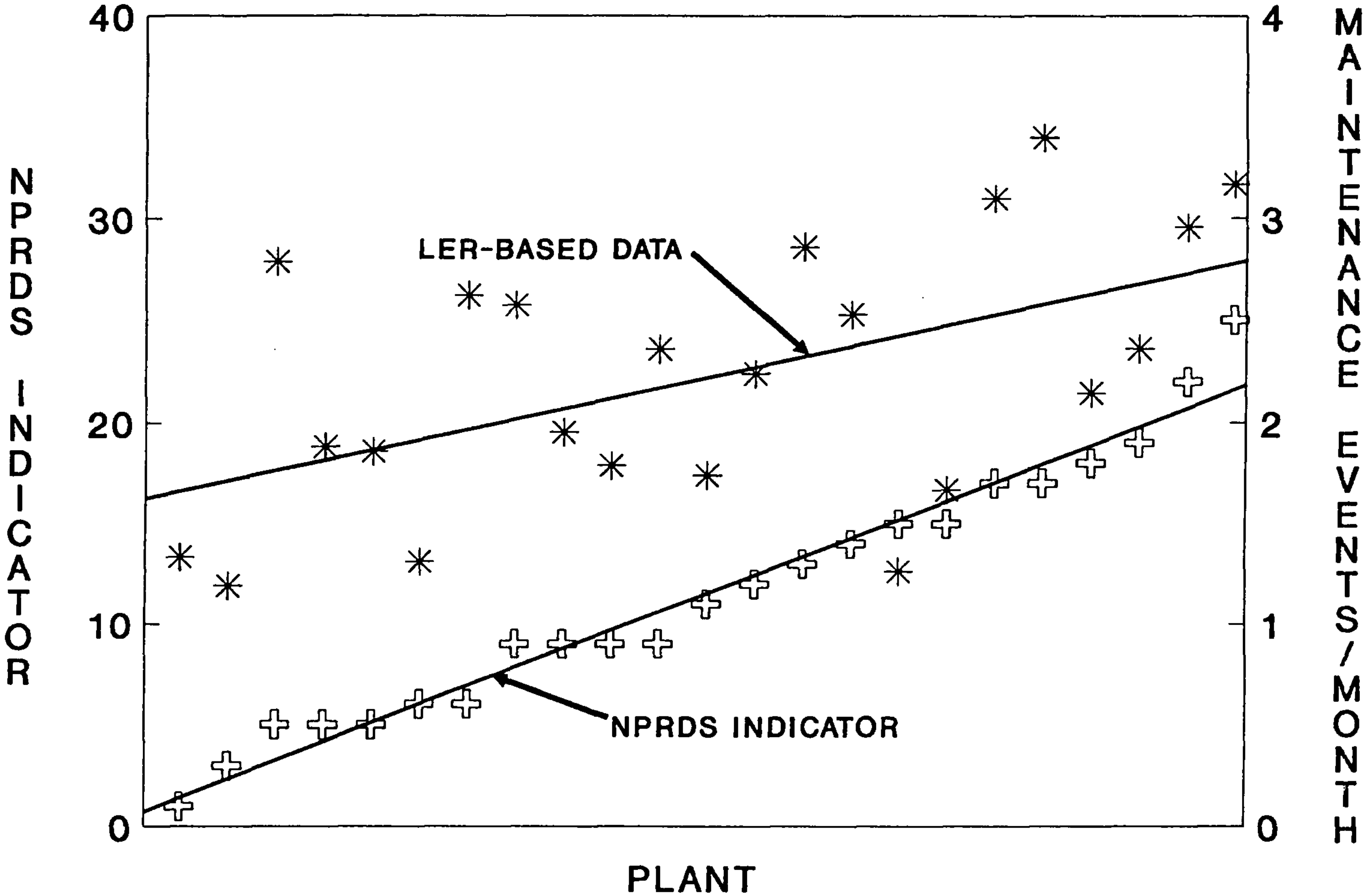
- COMPONENT FAILURE STUDIES

  Finding: Differences among maintenance practices drove the failure rates

- LER CORRELATION - CAUSE CODES

  Finding: Mutually reinforcing to MPI perspective

MPI VS. CAUSE CODE CORRELATION



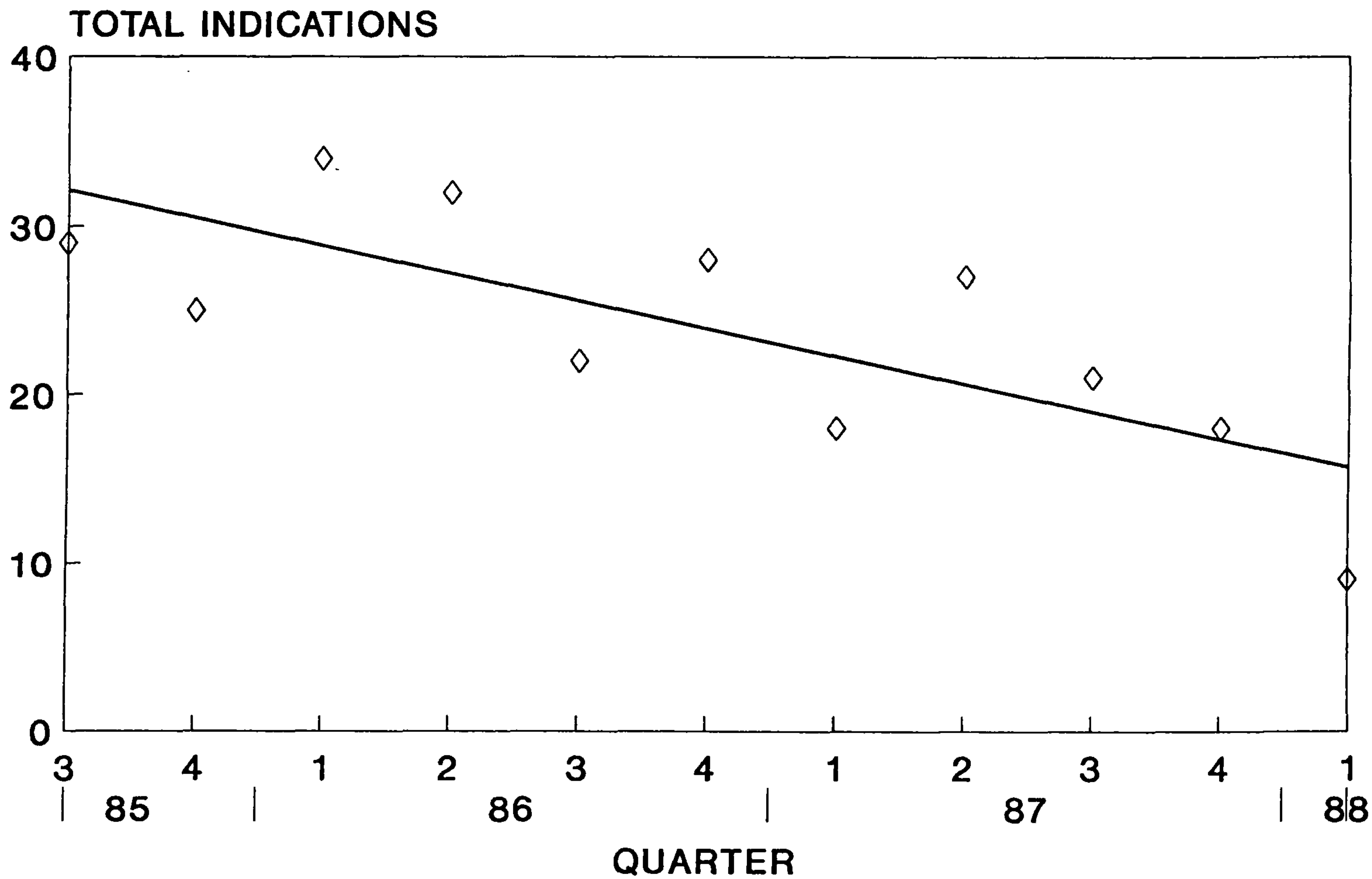
PLANT ANALYSES

- LOGICAL RELATIONSHIP BETWEEN OUTAGE DOMINATING EQUIPMENT AND EQUIPMENT FORCED OUTAGES
- REVIEWED OPERATING EXPERIENCE OF THE BWRs IN DETAIL (EXAMPLES IN PROPRIETARY APPENDIX A TO AEOD/S804B)
- 10 OF 28 PLANTS EXPERIENCED AT LEAST 1 OUTAGE THAT WAS PRECEDED BY AN MPI (LEAD TIME VARIED)

Maintenance Indicator Trend

Boiling Water Reactors

(COMMERCIAL OPERATION BEFORE 1985)



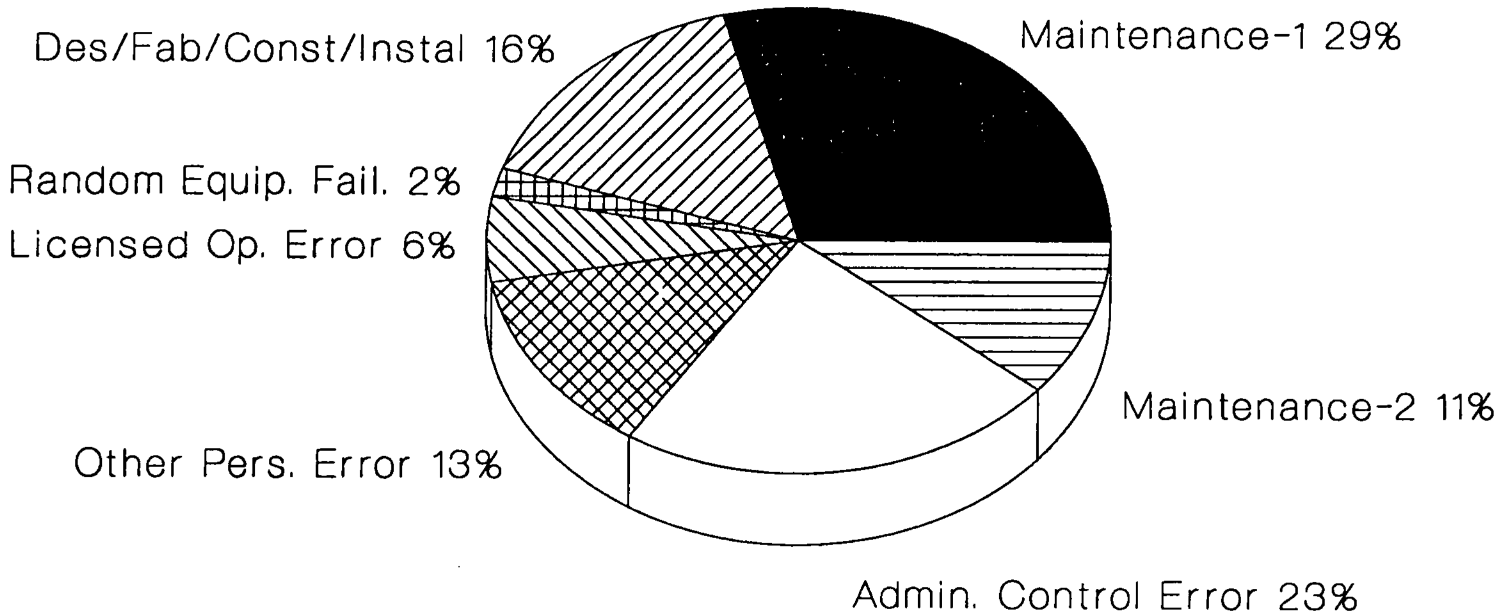
MAINTENANCE PI CONCLUSIONS

- CANDIDATE INDICATOR'S ABILITY TO REFLECT MAINTENANCE EFFECTIVENESS WAS CONFIRMED
- METHOD IS SUITABLE FOR REGULATORY GUIDE
- METHOD SHOULD BE VALID FOR OTHER DESIGNS
- FOR INDUSTRY-WIDE USE, EFFECT OF NPRDS REPORTING DIFFERENCES CAN BE MINIMIZED
- NRC USE REQUIRES IMPROVED EFFICIENCY TO MINIMIZE IMPACT ON RESOURCES
- CORRELATION WITH LER DATA REVEALS PROSPECT OF ADDITIONAL MAINTENANCE PIs

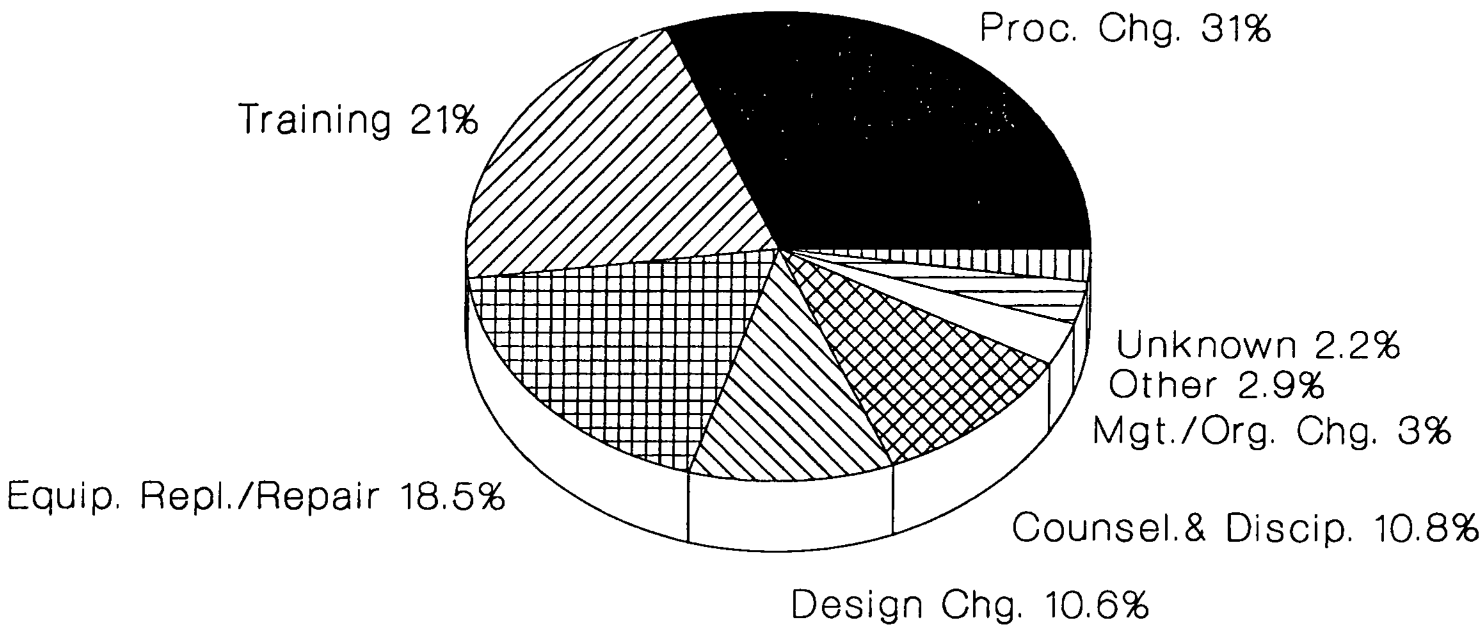
CAUSE CODES

- TRIAL PROGRAM COMPLETED
- CAUSE CODES USED LERs AND CODER ENGINEERING JUDGMENT
- CAUSE CODE DATA EXTENDED BY SCSS WITHOUT ADDITIONAL CODING
- CORRECTIVE ACTION DATA NECESSITATED SPECIAL CODING OF 6 MONTHS OF DATA

INDUSTRY AVERAGES
Cause Codes



INDUSTRY AVERAGES
Corrective Actions



VALIDITY OF LER DATA FOR CAUSE CODES

- ACCURACY OF INFORMATION IN LERs

  Compared LERs and AIT inspection report findings

  Enforcement history: reporting

  SALP assessments

  LER quality reviews

- ACCURACY OF LER CODING

  Trial program experience

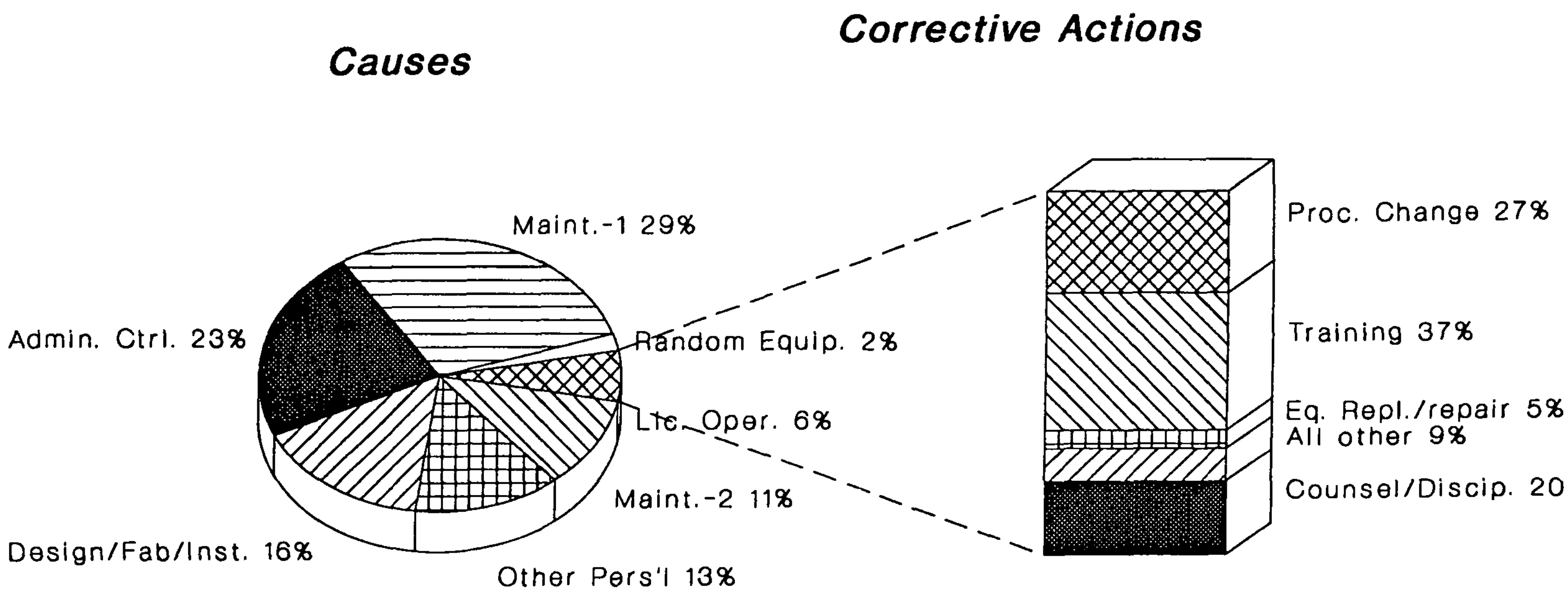
  SCSS quality assurance results

BENEFITS

- CAUSE CODE PIs PROVIDE ADDITIONAL PERFORMANCE INFORMATION
- CAUSE CODES ARE OF DIAGNOSTIC VALUE

  Trend causes and related corrective actions

CORRECTIVE ACTIONS
Events With Licensed Operator Errors



FUTURE PLANS

- CONTINGENT ON APPROVAL (SECY 89-046)
- DEVELOP DISPLAY FORMAT FOR NEW PI
- DISPLAY NEW PI WITH 2nd QTR 1989 PI REPORT
- BEGIN CORRECTIVE ACTION CODING FOR 1989 LERs

SAFETY SYSTEM FUNCTION TRENDS (SSFT)

- INDICATOR OF SAFETY TRAIN AVAILABILITY FOR SELECTED RISK-SIGNIFICANT SYSTEMS
- POTENTIAL REPLACEMENT FOR SAFETY SYSTEM FAILURE PERFORMANCE INDICATOR
- SSFT REQUIRES:

  Safety train out-of-service times

  Train failures

RETROSPECTIVE ANALYSIS

- HISTORIC DATA FROM 5 UNITS AT 3 SITES
- RECONSTRUCT TRAIN LEVEL AVAILABILITY FROM PLANT LOGS

  Component degradations vs. failures

- RESULTS

  Promising but not conclusive

SSFT FOLLOW ON ACTIVITIES

- VALIDATION WITH PROSPECTIVE DATA
- VOLUNTEER UNITS
- EXAMINE EXISTING DATA SOURCES

  NPRDS

  INPO safety system performance indicator

  Pre-1984 LERs